From: David Chain <david.chain@barmail.ch>
Sent: 8/19/2023 4:56:33 PM
To: Cristi Creegan <ccreegan@cityofslt.us>; Cody Bass <cbass@cityofslt.us>; John Friedrich <jfriedrich@cityofslt.us>; Scott Robbins <scott@scottforslt.com>; Cindy.Gustafson <cindygustafson@placer.ca.gov>; Hayley Williamson <hayley.a.williamson@gmail.com>; Shelly Aldean <shellyaldean@gmail.com>; Francisco Aguilar <cisco@sos.nv.gov>; Ashley Conrad-Saydah <ashleyc@alumni.princeton.edu>; Jessica Diss <jdiss.trpa@gmail.com>; Belinda Faustinos <belindafaustinos@gmail.com>; Meghan Hays <Meghan.hays9@gmail.com>; Alexis Hill <AHill@washoecounty.us>; Vince Hoenigman <vhoenigman@yahoo.com>; James Settelmeyer <JSettelmeyer@dcnr.nv.gov>; BOSFive@edcgov.us <BOSFive@edcgov.us>; Wesley Rice <wrice@douglasnv.us>; TRPA <trpa@trpa.gov>
Cc: Joe irvin <jirvin@cityofslt.us>; Lindsey Baker <lbaker@cityofslt.us>; Sheree Juarez <sjuarez@cityofslt.us>; sletton@cityofslt.us <sletton@cityofslt.us>; Heather Leyn Stroud <hstroud@cityofslt.us>; Daniel Bardzell <dbardzell@cityofslt.us>; nwieczorek@cityofslt.us <nwieczorek@cityofslt.us>; gfeiger@cityofslt.us <gfeiger@cityofslt.us>; showard@cityofslt.us <showard@cityofslt.us>; kroberts@cityofslt.us <kroberts@cityofslt.us>; nspeal@cityofslt.us <nspeal@cityofslt.us>; Marja Ambler <mambler@trpa.gov>; John Marshall <jmarshall@trpa.gov>; Katherine Huston <khuston@trpa.gov>; Wendy Jepson <wJepson@trpa.gov>; Jennifer Self <jself@trpa.gov>; Bridget Cornell <bcornell@trpa.gov>; Kenneth Kasman <kkasman@trpa.gov>; Devin Middlebrook <dmiddlebrook@trpa.gov>; Rep.KevinKiley@opencongress.org <Rep.KevinKiley@opencongress.org>; Daniel Cressy <daniel.cressy@usda.gov>; Vicki Lankford <Vicki.Lankford@usda.gov>; Danelle Harrison <danelle.harrison@usda.gov>; Erick Walker <erick.walker@usda.gov>; Charles Clark <charles.h.clark@usda.gov>; Kimberly Felton <Kimberly.felton@usda.gov>; Lisa Herron <lisa.herron@usda.gov>; FCC Litigation Notice <LitigationNotice@fcc.gov>; Dan P. Nubel <DNubel@ag.nv.gov>; California Attorney General <CEQA@doj.ca.gov>; AFord@ag.nv.gov <AFord@ag.nv.gov>; Susan Blankenship <sblankenship@cityofslt.us>; Julie Regan <jregan@trpa.gov>; Therssa Cody <theresa.cody@usda.gov>; lindsay.gusses@usda.gov <lindsay.gusses@usda.gov>; kimberly.felton@usda.gov <kimberly.felton@usda.gov>; joseph.keely@usda.gov <joseph.keely@usda.gov>; ashley.sibr@usda.gov <ashley.sibr@usda.gov>;
Subject: TRPA Governing Board Meeting — Aug. 23, 2023 — Public Comment
Attachments: 0fd10df4.jpeg , 0f790042.jpeg , f00f4926.jpeg , 22623a26.jpeg , 5e7daf99.jpeg , 4115f972.jpeg , ca9ca3b2.jpeg , 4dcb66e7.jpeg , dd32c5b3.jpeg , 18c57ba1.jpeg , 637dc2ce.jpeg , 610e1771.jpeg , 07028324.jpeg , 09871305.jpeg , ad1d00a6.jpeg , ebbf86ec.jpeg , f142a16e.jpeg , 34691532.png , e234dfaf.png , Environmental Procedures at the FCCA Case Study in Corporate Capture.pdf , Captured Agency—How the Federal Communications Commission is Dominated by the Industries it Pres.pdf , Scientific evidence invalidates health assumptions underlying the FCC and ICNIRP exposure limit .pdf , NRDC—FCC's Legal Duties to Inform and Protect the Public.pdf , The FCC Is Supposed to Protect the Environment. It Doesn't. (simplified).pdf

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Dear TRPA Governing Board,

Please read the attached PDF(s). The City and the TRPA have alleged to have exonerated themselves from environmental review for cell tower applications via transferring all responsibility to the Federal Communications Commission (FCC). It is clear the FCC has abandoned their own legal duties under the National Environmental Policy Act (NEPA). Below is a published explanation by a recently retired FCC environmental attorney of what happens when local governments such as the TRPA defer responsibility to the FCC. The TRPA staff ought to feel humiliated for having been the only line of defense against egregious environmental fraud yet they purposefully decided to actively aid and abet in such obvious deceit. Having actual or constructive knowledge of the undermentioned publication, you need to have command over the subject matter else be nakedly in the dark that **you are egregiously on the wrong side of history** (Erica Rosenberg. Environmental Procedures at the FCC: A Case Study in Corporate Capture, **Environment: Science and Policy for Sustainable Development** 64:5-6, 17-27, (2022) DOI: 10.1080/00139157.2022.2131190):

Environmental Procedures at the FCC: A Case Study in Corporate Capture

by Erica Rosenberg

With infrastructure including millions of miles of fiber optic cable and lines, thousands of towers, earth stations and satellites, and hundreds of thousands of small cells,[1] the telecommunications industry leaves a significant environmental footprint: wetlands filled, viewsheds marred, cultural resources damaged, and habitat destroyed. As the agency overseeing telecommunications, the Federal Communications Commission (FCC) regulates radio, TV, satellite, cable, and both wireline and wireless communications—and associated entities like Verizon, AT&T, and broadcast and radio corporations. It also plays a critical role in providing universal broadband and telecommunications access, and authorizing facilities associated with wireline and wireless build-outs. Yet the FCC fails to fulfill its mandatory duties under the National Environmental Policy Act (NEPA) in multiple and significant ways.[2]

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Towers have a breadth of individual and cumulative environmental impacts, many of which, such as visual impacts and tree removal, are not properly considered in the FCC's environmental review processes.

Like all federal agencies, the FCC must follow environmental laws, including NEPA, which requires it to assess potential environmental effects of its actions before it authorizes, funds, or licenses projects and communications infrastructure. These effects include visual and ecological impacts, and radio frequency emission exceedances, caused by the proliferation of wireless technology and the networks constructed to deploy it. The agency is supposed to follow legal requirements to assess such environmental impacts and, in doing so, to consider the concerns of communities and citizens.

It does neither. For most deployments it authorizes, the FCC rarely completes any environmental review or makes NEPA documents available to the public; instead, with little FCC oversight or enforcement, industry is delegated the task of determining how much environmental review is appropriate for its deployments and in most cases, is not required to submit documentation of those determinations.

In licensing and authorizing facilities associated with telecommunications, broadband, and broadcasting technologies, the FCC intentionally and routinely fails to meet its environmental obligations and epitomizes "regulatory capture." It treats environmental laws as obstacles to be circumvented or ignored, first by promulgating rules that fall short of what NEPA requires and then by failing to properly implement and enforce its own substandard rules. The chronic failure has cumulative, incalculable, and largely unknown environmental impacts.

Combined with statutory authority that curtails local government authority to regulate or block telecom deployment in their jurisdiction, public and local voices in what is deployed and where are further diminished.[3] Equally important, the agency suppresses and dismisses the voices of communities and citizens concerned about these encroachments. As wireless infrastructure proliferates under the auspices of an agency that flouts federal law, unabated and unaccounted for environmental impacts will only multiply.

NEPA: An Instrument of Democracy and Accountability

NEPA, a Nixon–era law and one emulated around the world, outlines a process for decision-making about "major federal actions, like dam-building, offshore drilling, and highway expansions.[4] Council on Environmental Quality implementing rules define major federal actions broadly to include "new and continuing activities, including programs entirely or partly financed, assisted, conducted or approved by federal agencies." They also include "approval of specific projects, such as construction or management activities located in a defined geographic area. Projects include actions approved by permit or other regulatory decision as well as federal and federally assisted activities."[5]

NEPA requires the government to disclose broadly defined environmental impacts of proposed actions—and to consider alternatives—including not undertaking the action.[6] It allows the public, from local governments to tribes to citizens, to participate in the decision.[7]

The greater the potential environmental impacts of a project, action, or policy, the more analysis and the more opportunities for public input and challenge. NEPA requires a full-scale environmental review (environmental impact statement) for major actions with potentially great environmental effects like a highway, a shorter assessment (environmental assessment) for actions that may have less significant impacts, and exemptions from analysis for categories of routine actions (categorical exclusions), like removing brush, that the agency has determined individually or cumulatively have no significant environmental effect. Although a categorical exclusion may exist for an action, in any given case, extraordinary circumstances such as the presence of environmentally sensitive resources can remove an action from a categorical exclusion and require either a documented categorical exclusion or more NEPA review. For example, even if the United States Forest Service categorically excludes brush removal on small tracts, brush removal in critical habitat for endangered species would require the agency to consider and document that its action would still not require an environmental assessment or conduct an environmental assessment.

As a procedural statute, NEPA cannot stop environmentally harmful projects, but it can substantially improve the imprint of an action by, for example, rerouting a power line to protect a stream, or bringing information about wildlife to light so that licensees can take mitigation measures. In short, NEPA, by mandating transparency and accountability, is an instrument of democracy and good governance. NEPA also requires that agencies promulgate policies or rules implementing NEPA in accordance with Council on Environmental Quality rules, and in consultation with the Council on Environmental Quality.

FCC's Failure to Consider Major Federal Actions

Council on Environmental Quality rules place many of the FCC's licensing and funding activities squarely within the definition of a major federal action. Yet the FCC has construed major federal actions narrowly or has simply not considered whether its actions are major federal actions. Consequently, the agency has not considered actions like providing financial assistance to carriers for deployment of small cells and build-outs with associated cable-laying and transmission lines as major federal actions.[8]

In 2018, the agency went as far as to deem all licensing of small cell facilities, which it authorizes as part of a license to carriers, as not requiring environmental review because they were not major federal actions.[9] Termed by industry as unobtrusive—"smaller than a pizza box or backpack"[10]—small cell facilities can be significantly larger and are placed on buildings or associated poles. In its order, the agency both eliminated federal environmental review of small cells and significantly limited local authority over small wireless infrastructure deployment.

In her dissent to the order, FCC Commissioner Jessica Rosenworcel noted that 5G would require millions of miles of fiber and up to 800,000 small

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The FCC is authorizing the deployment of hundreds of thousands of small cells with little public input or environmental review.

cells by 2026. The order thus "runs roughshod over the rights of our Tribal communities and gives short shrift to our most basic environmental and historic preservation values."[11] She noted that the Mobility Fund, which supports carriers in bringing wireless services to underserved areas, would support updated wireless service, to the tune of $4.53 billion. Yet in effect, she states, the FCC reads "projects carried out with financial assistance" (a requirement of the National Historic Preservation Act) as well as NEPA out of the law.[12] It also "removes many larger wireless facilities from environmental oversight."[13]

The FCC's efforts to eliminate small cell review were struck down by the D.C. Circuit in *United Keetoowah v. FCC*,[14] a case brought by the Natural Resources Defense Council and several tribes. The court found: "The scale of the deployment the FCC seeks to facilitate, particularly given its exemption of small cells that require new construction, makes it impossible on this record to credit the claim that small cell deregulation will 'leave little to no environmental footprint. *Order* ¶ 41.'"[15]

Appropriately, the FCC considers licensing spectrum and registering towers to be major federal actions that trigger NEPA. However, while the FCC recognizes that its grant of geographic licenses to carriers triggers NEPA, it issues the licenses without any knowledge of how the licensee will deploy infrastructure in its build-out. In most cases, it cannot know because the carrier may not have finalized its build-out plans for construction of towers, transmission lines, and small cell facilities over time. In fact, the agency does not prepare and never has prepared an environmental impact statement on a build out—or on any other major federal action; it has only prepared one programmatic environmental assessment, which was in response to a lawsuit.[16] Instead, it requires NEPA review only on a facility-by-facility basis, which also circumvents a NEPA requirement to consider cumulative effects.[17] Segmenting a project into smaller components is illegal, and the FCC's approach is another way it flouts the law.

FCC's Inadequate NEPA Rules

FCC NEPA rules undermine NEPA at every turn—they are inadequate both as written and as implemented. The rules' unusual structure and an agency that interprets its rules in favor of the carriers mean that most projects proceed without adequate environmental review and consideration.

Unlike other agencies' rules, FCC rules do not identify categories of actions that do not require further NEPA review; rather, the rules categorically exclude *all* actions the agency takes except for those that meet a limited set of itemized extraordinary circumstances.[18] In other

Wireless infrastructure is changing the character of historic buildings and neighborhoods.

instances, the FCC deems its actions categorically excluded. For example, construction of submarine cables, which indisputably has potentially significant environmental impacts to reefs, ocean floors, and marine life, is explicitly excluded from review following a 1974 FCC order asserting that the environmental consequences are negligible.[19]

In dismissing the petition brought by an environmental nongovernmental organization to require more environmental review for a number of FCC actions, including those involving submarine cables, the 1974 order acknowledged environmental damage from cables in Maine and the U.S. Virgin Islands but illogically found no need for environmental review because the projects violated state law and permits.[20]

By not considering FCC actions major federal actions and by relying on a broad and unsupported categorical exclusion, countless activities with potentially significant environmental impacts or actual impacts proceed with little or no NEPA review or public involvement. Unlike many agencies, FCC lacks a NEPA coordinating office and most bureaus within the agency have no NEPA expertise or even awareness of the obligations the statute confers on the agency.

Streamlined Effects: The NEPA Checklist

The agency also skirts its NEPA obligations through its procedures and practice around "effects" consideration. It defines effects narrowly and by doing so, removes actions from public notice and comment. Most egregiously, it delegates the initial consideration of effects to applicants and licensees—telecom companies, for the most part—to determine whether an environmental assessment is warranted or whether the project is categorically excluded, and because the review is not submitted to the FCC, it typically performs no subsequent review of the applicants' documentation.

Council on Environmental Quality regulations define effects broadly.[21] FCC rules and practices limit the consideration of environmental effects. They also limit the extraordinary circumstances that would warrant a higher level of environmental review (i.e., an environmental assessment) and public input for the action—through both its narrow list of circumstances and its narrow interpretation of those circumstances. Those limited circumstances are actions involving facilities that: may affect Indian cultural sites or historic resources (i.e., National Historical Preservation Act triggers); may affect threatened or endangered species or their habitat; may involve significant changes in surface features (such as to wetlands or forests); are in a floodplain if equipment is not raised; exceed radio frequency emissions limitations; involve high-intensity lights in residential areas; are in wilderness areas or wildlife

Tall, guyed towers kill millions of birds a year.

refuges; or are more than 450 feet tall in light of potential impacts to migratory birds.[22] These circumstances are referred to as "the NEPA checklist."

Even so, FCC has in effect gutted most elements of the checklist. For example, for the floodplain trigger,[23] as long as equipment is raised for a facility in a floodplain, no environmental assessment is required, although no evidence of raising the equipment or a local permit need be submitted. Although required by Council on Environmental Quality (which unfortunately approved the 2018 rule change), no cumulative effects of building in floodplains are considered. Similarly, applicants often fail to submit an environmental assessment when they have received a federal or state wetlands permit, so again, no evidence is submitted to the agency or for public review.

To eliminate another environmental assessment trigger, rule changes in 2020 allow projects that affect historic properties and cultural resources to proceed without an environmental assessment.[24] "Change in surface features" has in practice required consideration of wetlands impacts (i.e., whether a federal permit is needed), rather than considering large-scale vegetation or soil removal, or grading of sensitive habitats. Thus, even if several acres are bulldozed or dozens of trees cleared, an environmental assessment is not required.

A comprehensive NEPA review for telecommunications infrastructure is both possible and required by other agencies. For instance, the National Telecommunications and Information Administration, which also supports expanding broadband access and adoption, considers a breadth of effects under NEPA that the FCC's checklist fails to consider.[25] National Telecommunications and Information Administration, for example, requires consideration of cumulative effects.[26]

Delegation of Review: Fox Guarding the Hen House

Even more extraordinary than its failure to consider a breadth of environmental effects for most of its actions is the FCC's delegation of consideration of environmental effects to the applicant or licensee. In other words, self-interested parties conduct the NEPA checklist environmental review. Under Council on Environmental Quality rules, the federal agency is ultimately responsible for the environmental document, regardless of who prepares it.[27] Yet under FCC procedures, the agency never even sees the

initial environmental review documenting that a categorical exclusion, rather than a more extensive environmental review, is supported—except in the unlikely event it requests checklist documentation following a complaint.

No other agency allows the applicant to make the initial determination of whether a project is categorically excluded or requires an environmental assessment. Other agencies require submission of documentation of that determination or make the determination themselves. Instead, the FCC relies on applicants to be truthful in their dealings with the agency—yet rarely if ever has it enforced against applicants who make false statements on its forms. Applicants submit documentation only when checklist review triggers an environmental assessment. This approach to ensuring compliance with the NEPA rule is at best unrealistic and at worst, a license to deceive.

No FCC oversight ensures that applicants have done their due diligence to consider the checklist circumstances properly or to even review the circumstances at all. With no agency or public awareness, applicants can simply categorically exclude their projects that involve even larger scale impacts. In East Fishkill, New York, for example, more than 50 trees were cleared from a forested area along a highway known for its scenic views, with no environmental assessment.[28]

Incorrect, confusing, or inadequate filing instructions further ensure that the applicant's work will be incomplete.[29] The instructions themselves fail to even reflect the inadequate rules because they omit Endangered Species Act considerations, do not capture National Historical Preservation Association requirements, omit wetlands concerns, and include outdated floodplain requirements. Similarly, NEPA checklist guidance used until June 2022 did not even reflect the rules on environmental assessment triggers or environmental assessment content requirements.[30]

The checklist allows for only a very narrow set of environmental assessment triggers. In theory, FCC rules do allow for consideration of non-checklist effects or effects missed in the checklist review—those raised by members of the public and those raised by the FCC on its own motion.[31] In reality, this almost never happens. The FCC inevitably fails to consider some potentially significant effects outside of the checklist because it relies entirely on the public to identify them, it never initiates its own review, it relies on self-interested applicants to review projects, and it views its mission as facilitating deployment.

Lack of Notice and Public Availability of Documents

Limiting notice and public availability of documents is another way the agency fails to meet fundamental NEPA responsibilities. Council on Environmental Quality rules require both notice of

The effects of cell towers in sensitive areas like coastal zones and wetlands are not fully considered in the FCC's NEPA process.

actions and opportunities for public comment.[32] In fact, the rules require that agencies make "diligent efforts" to involve the public in implementing their NEPA procedures.[33] Instead, the FCC makes diligent efforts to exclude the public from raising concerns under NEPA.

Applicants and licensees submit no documentation of their determination that their project is categorically excluded, and the agency does not track categorically excluded actions. With the applicant conducting the initial environmental review of whether the project is categorically excluded by assessing the list of extraordinary circumstances (i.e., the NEPA checklist), as well as preparing the environmental assessment, the burden falls on the public to learn of the proposed action and to raise a potential effect.

But categorically excluded actions, including authorization of certain towers, do not receive public notice; only applications for towers that require registration (generally taller than 199 feet) are put on notice, and those may or may not have associated environmental assessments. In addition to towers under 200 feet not posing an air hazard, these stealth projects that the agency has no record of include small wireless facilities associated with 4G and 5G.

That the public has no access to this information is particularly problematic in the radio frequency context, where applicants are required to meet radio frequency emissions standards or submit an environmental assessment. If the applicants do analyze the checklist and radio frequency studies at all, they routinely categorically exclude small wireless facilities, despite growing public concern about radio frequency associated with such technologies. Without access to the documented checklist, the public has little to no basis on which to refute or comment on checklist conclusions on radio frequency. And given the streamlined process, citizens often find out about facilities only after they are built.

Lack of Transparency: Notice of EAs

While the public is completely disenfranchised on categorically excluded projects, the situation with environmental assessments is only slightly better. If an environmental assessment is required because the applicant identified a trigger on the NEPA checklist, the tower or other structure must be registered. But it is not the environmental assessment itself that is publicly noticed—it is the application for the tower registration or license modification. The notice serves only to notice for 30 days that an application for an antenna structure at a particular location has been submitted. Members of the public interested in that structure must track down the application in the antenna structure registration system and then see whether an environmental assessment is attached. To find environmental assessments that are "accessible," a member of the public would have to know that a proposed antenna structure registration included an environmental assessment.

Hence, notice is hardly "public." Rather than being posted on a readily accessible, centralized site for NEPA documents,[34] the registration application and the associated environmental assessment, if done, are buried in a hard-to-access, byzantine website.[35] Without project coordinates or an exact site location, it is difficult to get into the website and, once in, to find the environmental documents. To complicate matters further, environmental assessments associated with licensee towers that do not need to be registered (i.e., short towers) are noticed separately and are buried on a different webpage.[36]

Comments Deemed "Complaints"

Even if the public manages to overcome FCC hurdles and ascertain information about a proposed facility, it faces nearly insurmountable obstacles to get its concerns heard or addressed. Under NEPA, the burden of looking at effects is a federal obligation—it is not up to the public to establish a case but merely to apprise the agency of potential effects to consider; the comment period allows the agency to meet its NEPA obligations by giving the public an opportunity to raise effects or alternatives not considered in the environmental review process.

But rather than a standard, fair, or open comment process in which the agency considers and responds to concerns raised by the public, the FCC administers an adversarial complaints process that requires the public to meet a high burden of proof about a potential effect that may have been overlooked in the checklist or inaccurately documented.[37] With a process that unfairly shifts the burden of raising and establishing environmental concerns from the agency to the public, the outcome is always the same. The FCC virtually never finds that complaints are valid. To dismiss them or resolve them in the applicant's favor so that the project can proceed, it routinely finds that the complainant has not provided specific enough detail or an adequate scientific showing for the agency to consider an effect.

Compounding the unlikelihood that the public will learn about a project and be able to weigh in is a timing issue. When the public finds out about a project that the applicant has deemed categorically excluded (either by doing the checklist or failing to do the checklist), there is no timeline to comment on or complain about the project. With no notice and no timeline for these projects that proceed with no agency awareness, the public often learns about the projects when construction begins or, just as likely, when the facility is already built.

Because the applicant need not consider aesthetics, for example, a tower visible from a state park could be deemed categorically excluded and built before the public sees the impact to its viewshed. Rarely, if ever, will the FCC decide an environmental assessment is required under the circumstances because the applicant ostensibly did what was required of it by assessing the minimal checklist. Furthermore, in terms of failure to comply with NEPA, environmental assessments are submitted so late in the process that a meaningful alternatives analysis—a hallmark and requirement of NEPA[38]—is foreclosed.

Aesthetic Effects: The Greatest Impacts Never Addressed

Perhaps most egregious is the agency's approach to aesthetic impacts.

Applicants should be required to consider aesthetic impacts because, by the FCC's own account in its rulemaking, visual impacts are by far the most significant impact a tower could have.[39] As originally promulgated, FCC's NEPA regulations triggered an environmental assessment when facilities were to be located "in areas which are recognized either nationally or locally for their special scenic or recreational value."[40] Again and again in the rulemaking, visual effects were cited as the greatest impact, as well as an impact to be mitigated.[41] Yet in 1985, the FCC decided the standard was "unduly vague," and that it was unnecessary for applicants to submit environmental assessments in cases that "may raise aesthetic concerns."[42] It also noted that "aesthetic concerns may more appropriately be resolved by local, state, regional or local land use authorities"[43]—although NEPA is an independent federal obligation.

On the rare occasion when the FCC does consider aesthetics, its examination is generally limited to consideration of impacts to nationally designated scenic trails and historic sites (the latter falling under visual effects under National Historical Preservation Association) or to national parks, although nothing in NEPA or Council on Environmental Quality rules limits consideration of aesthetic impacts solely to those designated areas. This practice precludes consideration of impacts to, for example, scenic tourist areas or state or locally designated battlefields and parks. In 2014, AT&T built a tower in Fort Ransom, North Dakota, visible from a nearby National Scenic Tail and Scenic Byway, without having to consider aesthetic impacts.[44] Towers have been built in the viewsheds of, for example, a National Scenic Trail in Vergennes, Michigan, an iconic bridge in New York, a civil rights site in Selma, Alabama, and on Dewey Beach, Delaware's sand dunes, with little notice, consideration of visual impacts, or mitigation.

Little Compliance, Little Enforcement

With no oversight to ensure applicants have done the due diligence required to consider the checklist and no on-the-ground inspections, lack of compliance with the rules is rampant

Large-scale projects with multiple facilities built without NEPA review include hundreds of towers in Alaska built by GCI.[45] Between 2001 and 2015, T-Mobile built hundreds of towers in 22 states without environmental review.[46] In New Mexico and Texas, Plateau Telecommunications built 58 towers with no National Historical Preservation Association review.[47] Telalaska built 28 towers near and in sensitive areas in Alaska with no repercussions.[48] With no Enforcement Bureau action, the Wireless Telecommunications Bureau and Alliant Energy Corporation agreed in 2017 to a compliance plan after Alliant built 109 towers and 93 poles without NEPA review.[49] Railroad noncompliance was so widespread that the FCC entered into a settlement agreement with several railroads that created a $10 million cultural resources fund for 11,000 constructed poles that had not gone thru National Historical Preservation Association or NEPA review.[50]

Smaller-scale projects and individual towers also have significant impacts. For example, in 2019, licensees in Broward County, Florida, cleared 36 trees and built a driveway through a forested wetland before completing environmental review.[51] In Sabana Grande, Puerto Rico, a tower builder in 2014 bulldozed critical habitat for an endangered bird.[52] Dozens of sacred sites have been similarly destroyed or damaged across the country, as have multiple cultural resources and historic and archaeological sites.

Although towers can alter iconic views, the FCC does not require licensees to consider aesthetic impacts.

Cell towers are altering and marring views across the country.

Many of these failures to comply with environmental requirements come to light as National Historical Preservation Association violations, rather than as NEPA violations, because the National Historical Preservation Association process, as part of the checklist, requires photo documentation and official state and tribal review. Complaints from these officials or the public and self-reporting—often unintentionally with photos submitted through increasingly rare environmental assessment submissions[53]—are generally the sole bases for enforcement.

Conveniently for an agency intent on deployment, the FCC's Enforcement Bureau operates under a one-year statute of limitations—one year from the time the facility was built, not from when the agency learned of the violation. As a result, by the time the agency learns of the violation and decides to take action, it is often prohibited from levying fines against the violator.

When the agency does take action, it amounts, with few exceptions, to a slap on the wrist. In 2016, six licensees got admonishment letters with no penalties and little agency publicity.[54] For the past decade or so, Wireless Telecommunications Bureau admonishment letters, which number from zero to six per year, warn of the potential for increased fines and punishments if violators break rules again. But the agency could not fine the violators and does not track the letters. Fines are rare and if levied, de minimis.[55] At most, penalties are ordered once or twice a year, and tower removal, which would be a reasonable and authorized remedy for violations, is never ordered.

In one instance, clearing guy-wire areas for a 1,500-foot broadcast tower in Punta Gorda, Florida, destroyed 2.6 acres of treed habitat for bonneted bats, an endangered species. As mitigation, the applicant paid $28,000 to the U.S. Fish and Wildlife Service, while the FCC issued a Finding of No Significant Impact and imposed a fine of $28,000.[56]

Ex Post Facto NEPA: A Concept Not Contemplated by NEPA

To address instances of noncompliance, the agency has instead devised an ex post facto NEPA process under which the violators conduct and submit an after-the-fact checklist or environmental assessment. If an environmental assessment is required, these half-built or fully built projects then receive the FONSIs that are a prerequisite for construction. Enforcement action may, but more likely will not, follow; with no repercussions, a 485-foot broadcast tower in Chattanooga, Tennessee, was built and operating for months before it got its FONSI in 2021.[57]

Since 2002, the agency has used a clearance process for noncompliant towers (i.e., those that have not gone through the National Historical Preservation Association and NEPA process).[58] For example, on March 28, 2012, the FCC "cleared" with a post-construction review the 58 towers that Plateau Telecommunications had built in violation of historic preservation procedures.[59] Other elements of the requisite NEPA review were ignored—and are often ignored in this process.

Regardless, NEPA may not be done retroactively, and the substantive value of this follow-up exercise is unclear. It

Beyond visual impacts, cell towers built in pristine areas can affect sensitive species and ecosystems.

is hard to assess damage to a site never evaluated for the presence of, for example, wetlands, sensitive species, historic resources, or sacred sites before clearing took place. More importantly, given the dearth of documentation, little means for the agency to discover violations, and lack of oversight at the agency, it is unclear just how many projects that impact environmentally sensitive areas are constructed with improper or no checklist review, or get started without waiting for a FONSI to construct; most of the sites where environmental damage occurred and the degree of destruction will never be known.

By routinely clearing towers with post-construction checklist reviews, the agency creates incentives for tower companies and carriers to build their towers and, if necessary, do paperwork later. Given the lax enforcement and the statute of limitations issue, this approach from industry's perspective would be quite reasonable.

Conclusion: Prospects for a More Accountable FCC

Clearly, the FCC's NEPA process falls short of what NEPA and Council on Environmental Quality require.

- It ignores major federal actions requiring environmental review, such as its distribution to industry of billions of dollars that support build-outs for updated wireless service, or improperly deems certain major federal actions nonmajor federal actions to circumvent NEPA.
- Its NEPA rules create an unsupported and overbroad categorical exclusion so that, for example, satellite licensing and submarine cable licensing are excluded from review.
- With little oversight or tracking, it delegates environmental review of NEPA determinations to industry proponents of the project.
- It fails to vigorously enforce its rules so that industry noncompliance is rampant.
- It fails to provide adequate notice and opportunities for public comment.
- It fails to make environmental documents, including radio frequency emissions studies, publicly available or readily accessible.
- It routinely ignores or dismisses public comments and concerns and places an unfair burden of proof on the public when it raises concerns.

These practices serve to facilitate deployment for carriers while ignoring environmental rules and the public. Besides environmental costs, the FCC's approach bespeaks a lack of transparency

and accountability that undermines good governance and erodes democracy. It also bespeaks an agency completely captured by the entities it is tasked with regulating.

Recent Biden-era NEPA implementing rules[60] require agencies to revisit their NEPA rules and procedures by September 2023.[61] They also require that the agencies have the capacity to comply with NEPA,[62] something the FCC has to date lacked. Perhaps when Council on Environmental Quality reviews the FCC's procedures this time, it will scrutinize the rules more carefully and hold the agency to a higher standard for NEPA compliance.

An environmental and public lands policy attorney with over 30 years of experience, including in agencies, Congress, and academia, **Erica Rosenberg** worked at the FCC's Wireless Telecommunications Bureau from 2014 to 2021; for the last six of those years, she was Assistant Chief of the Competition and Infrastructure Policy Division.

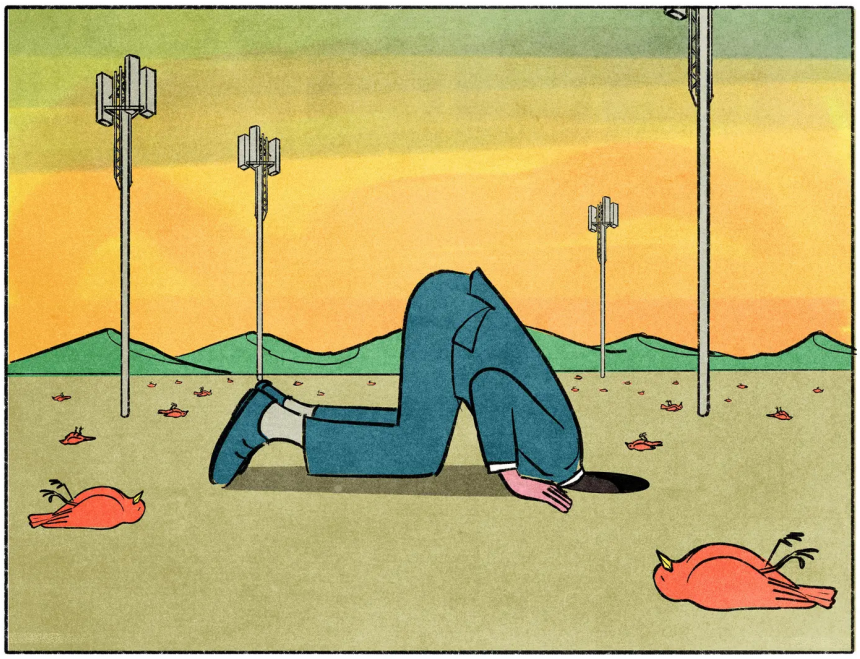
NOTES

1. Unlike macro-cells or wireless cell towers, a small cell installation consists of radio equipment and antennas placed every few meters on structures such as streetlights, buildings, or poles.
2. 42 U.S.C. §4371 *et seq.*
3. Telecommunications Act of 1996, Section 704, 47 U.S.C §332.
4. 40 CFR §1508.18 (1978). Note: Unless otherwise noted, NEPA regulations cited are 1978 regulations (i.e., pre-Trump and Biden-era regulations). The FCC was bound by those regulations until April 2022.
5. 40 CFR §1508.18.
6. 40 CFR §1508.8.
7. 40 CFR §§1501.2(d)2), 1.1501.7((a)(1), 1.1503.1, 1.1506.6.
8. Other agencies, such as the National Telecommunications and Information Administration (NTIA), do conduct NEPA reviews for such actions.
9. *See* Accelerating Wireless Broadband Deployment by Removing Barriers to Infrastructure Investment ("Infrastructure Order") (WT Docket 17-79, FCC 18-30), (March 22, 2018), 33 FCC Rcd 3102 (4).
10. *See* CTIA blog, March 27, 2018 ctia.org/news/what-is-a-small-cell.
11. 11. *See* Infrastructure Order, Rosenworcel dissenting statement.
12. 12. *Id.*
13. 13. *Id.*
14. *United Keetoowah Band of Cherokee Indians v. FCC,* 933 F. 3d 728 (D.C. Cir. 2019).
15. *Id*. at 741. Between the time the Order was issued and the decision handed down, however, countless small wireless facilities were deployed without NEPA review.
16. Final Programmatic Environmental Assessment for the Antenna Structure Registration Program, FCC (March 13, 2013).
17. *See* 40 CFR §1508.7(cumulative impacts); §1508.8 (b) (effects include cumulative).
18. 47 CFR §1.1306(a).
19. 49 FCC 2d 1313,para. 14(a) (1974); *see also* 47 CFR §1.1306 Note 1. (EA requirements do not "encompass the construction of new submarine cables systems.")
20. *See* In the matter of Public Employees for Environmental Responsibility, FCC 01-319, n. 46.
21. *See* §1501.3; §1508.1(g)(1) (definition of effects includes aesthetic, health, economic, etc.).
22. 47 CFR § 1.1307.
23. 47 CFR §1.1307(a)(6).
24. Declaratory Ruling and Notice of Proposed Rulemaking, In the Matter of Implementation of State and Local Governments' Obligation to Approve Certain Wireless Facility Modification Requests Under Section 6409(a) of the Spectrum Act of 2012, FCC 20-75A (June 9, 2020), paras. 45–50. 35 FCC Rcd 5977.
25. https://broadbandusa.ntia.doc.gov/sites/default/files/2021-07/July%202021%20BB%20Infra%20Webinar_FINAL%20Presentation_0.pdf, p. 23.
26. *See id.* at p. 50.
27. *See generally* 40 CFR §1506.5.
28. *See* letter from Michael S. Fishman, Conservation Biologist, Edgewood Environmental Consulting, to Noelle Rayman USFS biologist, Cortland, NY, November 13, 2020, Re: Determination of Adverse Effects from Wireless EDGE—WEC-NY-23 Cell Tower 90 Carpenter Road, East Fishkill, Dutchess County, NY 41°34'40.37"N, 73°47'03.84"W.
29. *See, e.g.*, Form 601 instructions (https://www.fcc.gov/sites/default/files/fcc-form-601.pdf): Item 22.
30. 30. *See* "FCC Environmental Assessment" (checklist) (undated).
31. *See* 47 CFR §§1.1307(c) and (d).
32. 40 CFR §1506.6 (provide public notice of availability of environmental documents).
33. 40 CFR §1506.6(a).
34. 40 CFR §1506.6 ("provide public notice of NEPA related-hearings … and the availability of environmental documents").
35. wireless2.fcc.gov/UlsApp/AsrSearch/asrApplicationSearch.jsp (application) and wireless2.fcc.gov/UlsApp/AsrSearch/asrApplicationSearch.jsp (environmental notice).
36. wireless2.fcc.gov/UlsApp/AsrSearch/asrApplicationLicense.jsp.
37. In *American Bird Conservancy, v. CTIA*, 516 F.3d 1027, 1033 (D.C. Cir. 2008). the court admonished the FCC for setting too high a standard.
38. *See* 40 CFR §1508.9 (EAs include consideration of alternatives).
39. *See, e.g.,* 49 FCC 2d 1313 (1974), para. 32 ("we have stressed the visual or aesthetic impacts of [such] facilities as their primary environmental effect").
40. *Id.* at para. 14.
41. *See, e.g., id.,* at paras. 18, 23, 27, 28, 32.
42. 986 WL 292182, 60 Rad. Reg. 2d, para. 11 (November 25, 1985).
43. *Id*. at para. 122.
44. AT&T Mobile Services, Inc. Construction of Tower Fort Ransom, North Dakota; Complaints of the Sheyenne River Valley National Scenic Byway, Don Busta, Judith L. Morris, and the North Country Trail Ass'n, Memorandum Opinion and Order, 30 FCC Rcd 11023, 11032, para. 28 (WTB/CIPD 2015).
45. *See* Consent Decree (DA 15-1179) (October 20, 2015).
46. Phoenix Towers International acquired the towers and in 2016, sought to bring them into compliance.
47. 27 FCC Rcd. 2972 (March 29, 2012) (letter to Gregory W. Whitaker from Dan Abeyta, WTB).
48. *See* email from Amy Summe, Shannon and Wilson, to Erica Rosenberg, Assistant Chief, Competition and Infrastructure Policy Division, Wireless Bureau, FCC re: Towers, after-the-fact NEPA compliance, February 14, 2020.
49. *See* email from Michelle Yun, Senior Attorney, Alliant to Jiaming Shang, Attorney Advisor, Wireless Telecommunications Bureau, FCC and attachment "Final Compliance Plan.pdf (May 23, 2017).
50. https://www.fcc.gov/document/fcc-announces-actions-facilitate-ptc-implementation; https://www.indianz.com/News/2014/06/04/tribes-take-role-in-major-rail.asp.
51. *See* ASR No. 1136027, Broward County, West Hollywood Telecommunications facility, filed November 2019 (attached EA).
52. See ASR No. A1062663, Wise Towers, filed December 29, 2016 (attached EA and filings).
53. *See., e.g.,* ASR No. A1179538 (attached EA, dated December 8, 2020, for a 610-foot tower in Weedville, PA indicates that the applicant cleared several acres of sensitive species habitat before completing environmental review). (Appendix III, pp. 17-18).
54. *See, e.g.,* letter to Kenneth Meyers, President and CEO, United States Cellular Corporation from Jeffrey Steinberg, Deputy Chief, CIPD, WTB, June, 16, 2016, re: Violation of FCC Environmental Rules.
55. *See, e.g.,* In re: Western Wireless Corp, FCC 03-109 (May 6, 2003) (tower built near several historic sites and operating in violation of environmental rules fined $200,000). The fine was ultimately rescinded on November 17, 2004.
56. *See* Consent Decree, In re: Fort Myers Broadcasting Company (DA21- 1365) (November 2, 2021).
57. *See* FONSI letter to Brian Fuqua, Greater Chattanooga Public TV Corp from Erica Rosenberg, Assistant Chief, Competition and Infrastructure Policy Division, Wireless Bureau, FCC (April 14, 2021).
58. In 2009, over 1,000 AT&T towers built pre-2001 without NEPA documentation were "cleared." Letter from Jeffrey Steinberg Deputy Chief, SPCD to Jeanine Poltronieri, AT&T (January 16, 2009).
59. 27 FCC Rcd 2972 (March 29, 2012) (letter to Gregory W. Whitaker from Dan Abeyta, WTB, FCC).
60. 40 CFR §100 et seq. (April 20, 2022).
61. *See* 40 CFR §1507.3 (2022).
62. *See id.*

You may also watch an video interview of the author:

FCC & NEPA: FCC Fails to Protect the Environment Interview With Former FCC Lawyer Erica Rosenberg

You may also read the attached ProPublica report with very similar findings: Peter Elkind "*The FCC Is Supposed to Protect the Environment. It Doesn't.*" ProPublica (May 2, 2023):



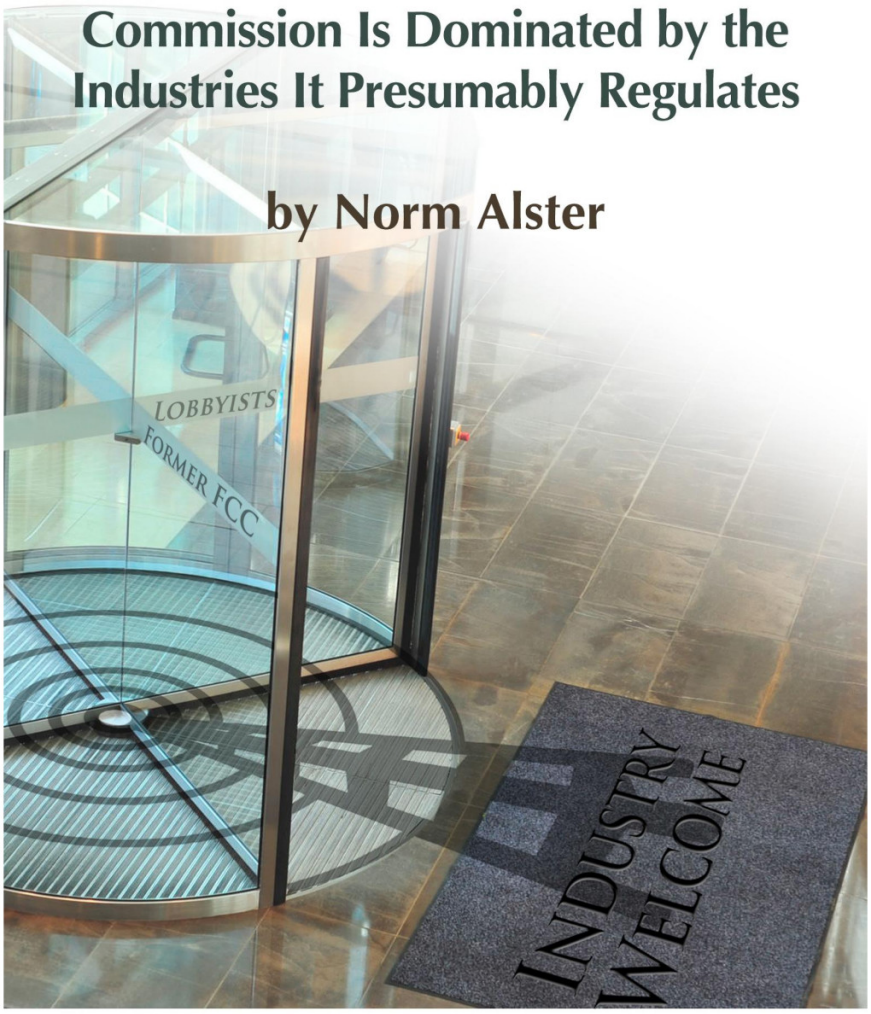
You may also read "*How the FCC Shields Cellphone Companies From Safety Concerns*" by the same author and reputable journal.

The FCC is a captured agency (Norm Alster. "*Captured Agency: How the Federal Communications Commission Is Dominated by the Industries It Presumably Regulates*," **Harvard University Edmond J. Safra Center for Ethics** (June 23, 2015)).

Captured Agency:

How the Federal Communications Commission Is Dominated by the Industries It Presumably Regulates

by Norm Alster



www.ethics.harvard.edu

There is also a strong argument that the TRPA itself has become a real estate developer captured agency...which explains why neither agency has done anything about the science:

International Commission on the Biological Effects of Electromagnetic Fields (ICBE-EMF)
Environmental Health (2022) 21:92
https://doi.org/10.1186/s12940-022-00900-9

Environmental Health

COMMENT Open Access

Scientific evidence invalidates health assumptions underlying the FCC and ICNIRP exposure limit determinations for radiofrequency radiation: implications for 5G

International Commission on the Biological Effects of Electromagnetic Fields (ICBE-EMF)*

Abstract

In the late-1990s, the FCC and ICNIRP adopted radiofrequency radiation (RFR) exposure limits to protect the public and workers from adverse effects of RFR. These limits were based on results from behavioral studies conducted in the 1980s involving 40–60-minute exposures in 5 monkeys and 8 rats, and then applying arbitrary safety factors to an apparent threshold specific absorption rate (SAR) of 4 W/kg. The limits were also based on two major assumptions: any biological effects were due to excessive tissue heating and no effects would occur below the putative threshold SAR, as well as twelve assumptions that were not specified by either the FCC or ICNIRP. In this paper, we show how the past 25 years of extensive research on RFR demonstrates that the assumptions underlying the FCC's and ICNIRP's exposure limits are invalid and continue to present a public health harm. Adverse effects observed at exposures below the assumed threshold SAR include non-thermal induction of reactive oxygen species, DNA damage, cardiomyopathy, carcinogenicity, sperm damage, and neurological effects, including electromagnetic hypersensitivity. Also, multiple human studies have found statistically significant associations between RFR exposure and increased brain and thyroid cancer risk. Yet, in 2020, and in light of the body of evidence reviewed in this article, the FCC and ICNIRP reaffirmed the same limits that were established in the 1990s. Consequently, these exposure limits, which are based on false suppositions, do not adequately protect workers, children, hypersensitive individuals, and the general population from short-term or long-term RFR exposures. Thus, urgently needed are health protective exposure limits for humans and the environment. These limits must be based on scientific evidence rather than on erroneous assumptions, especially given the increasing worldwide exposures of people and the environment to RFR, including novel forms of radiation from 5G telecommunications for which there are no adequate health effects studies.

Keywords: Federal Communications Commission (FCC), International commission on non-ionizing radiation protection (ICNIRP), Radiofrequency radiation (RFR), Exposure limits, Exposure assessment, Radiation health effects, Reactive oxygen species (ROS), DNA damage, 5G, Scientific integrity, Cell phone*, Mobile phone*

Introduction

In establishing exposure limits for toxic or carcinogenic agents, regulatory agencies generally set standards that take into account uncertainties of health risks for the general population [1] and for susceptible subgroups such as children [2]. That approach has not been applied in the same way to the setting of exposure limits for

*The terms cell phone and mobile phone are used interchangeably in this commentary; cell phone is the term used in the United States, while mobile phone is the term used in most of Europe.

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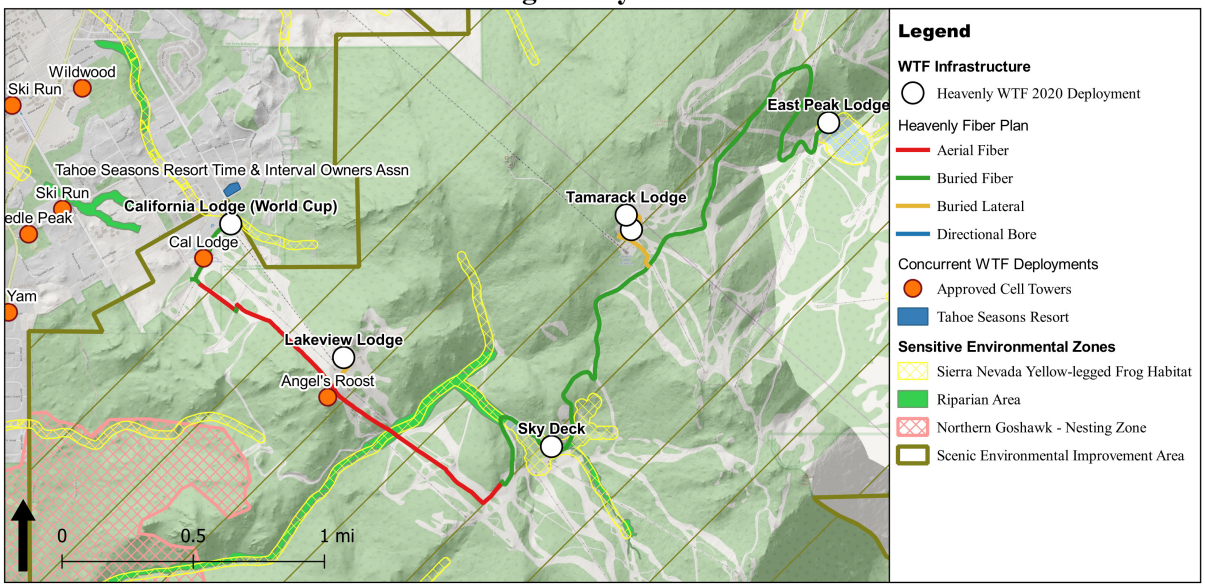
In summary, both the FCC and the TRPA allege they preempt our local governments over environmental regulation of radiofrequency radiation, and then they along with the USFS malfeasantly ignore this legal responsibility via deliberate indifference of known adverse environmental effects such as the undermentioned ones. The aforementioned article shows the FCC corruptively declines to extend any consideration of health effects beyond those thermal effects directly affecting humans despite federal courts a decade ago finding that NEPA requires a broad construction that encompasses wildlife (*Jaeger v. Cellco P'ship*, No. 3:09CV567, p. 18, 2010 U.S.Dist.LEXIS 24394, at *26 (D.Conn. Mar. 15, 2010) ("The plain meaning of the term 'environmental effects' incorporates adverse effects on all biological organisms"). This means the the FCC will almost certainly continue to ignore the degree to which radiofrequency radiation can harm frogs, trees including aspen, migratory birds, and birds of prey—which is contrary to their own regulations (47 CFR §§ 1.1307 & 1.1311) (Actions that may have a significant environmental effect, for which Environmental Assessments (EAs) must be prepared...Facilities that...May affect listed threatened or endangered species or designated critical habitats; or...are likely to jeopardize the continued existence of any proposed endangered or threatened species or likely to result in the destruction or adverse modification of...habitats...Facilities whose construction will involve significant change in surface features (e.g., wetland fill, deforestation or water diversion); The applicant shall submit an EA with each application that is subject to environmental processing...The EA shall contain the following information:...A statement as to whether construction of the facilities has been a source of controversy on environmental grounds in the local community....If endangered or threatened species or their critical habitats may be affected, the applicant's analysis must utilize the best scientific and commercial data available). This proposed cell tower may clearly have an effect on the environment (*see, e.g.*, *American Bird*

Conservancy, Inc. v. F.C.C., 516 F.3d 1027, 1033-1034 (2008) (a precondition of certainty before initiating NEPA procedures would jeopardize NEPA's purpose to ensure that agencies consider environmental impacts before they act rather than wait until it is too late); *Sierra Club v. Norton*, 207 F.Supp.2d 1310, 1336 (2002) (Under NEPA, an agency cannot use the lack of existing information as a basis for acting without preparing an EIS)). "Environment" includes ecological impacts, health impacts, social and economic impacts (40 CFR §1508.1(g)(1)&(m)). *See generally*, 42 U.S.C. §§ 4331-4332; 40 C.F.R. §§ 1500-1508. Presidential Executive Orders 13057 and 13186 add further protective duty to FCC actions in the Tahoe Basin as well as with all actions which may effect migratory birds. The FCC needed to obtain a U.S. Fish and Wildlife Service (FWS) biological opinion pursuant to 16 U.S.C. § 1536(a)(2); 50 CFR §§ 402.11, 402.14, & 402.15; Verizon itself was actually required to stop construction (47 CFR § 1.1312(d)). This fiasco could have been entirely prevented with transparency, adequate public notice, and otherwise substantive due process whereas these regulations further required that "environmental information is available to public officials and citizens before decisions are made and before actions are taken" (*see*, *Oglala Sioux Tribe v. Nuclear Regulatory Comm'n*, 896 F.3d 520 (D.C. Cir. 2018)). To the contrary, Verizon initially withheld and then continually dripped out novel environmental cell tower impact information up to the second 2022 TRPA Governing Board hearing on the Ski Run Cell Tower. The information provided to the public in the 2019 "public notice" pales in comparison to what Verizon ambushed the public with at the final TRPA hearing.

Heavenly Fiber Plan:
Regulatory Issues



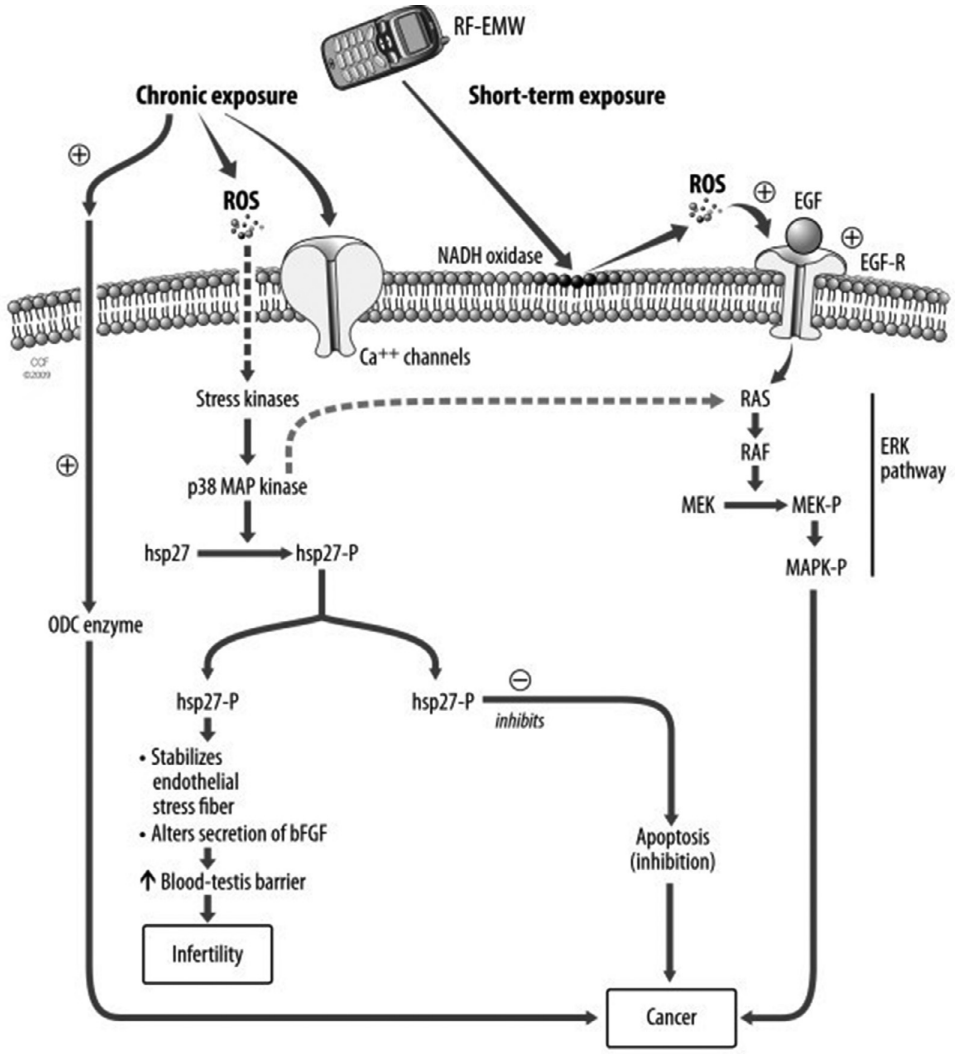
Project May Pose Significant Effect on the Environment

Numerous research studies have found that cell tower radiation causes mortality in frogs and amphibians [*e.g.,* Balmori, Alfonso. (2010). Mobile Phone Mast Effects on Common Frog (*Rana temporaria*) Tadpoles: The City Turned into a Laboratory. *Electromagnetic biology and medicine.* 29. 31-5. DOI: 10.3109/15368371003685363]. A NEPA "categorical exclusion" cannot be issued because there exists substantial evidence that the WTF's may have a significant effect on the environment, particularly an endangered frog and protected birds [36 CFR § 220.6(b)(1)(i),(iii); 50 CFR § 17.11(h); 79 FR 24255; *see also* 16 U.S.C. § 497b; 47 CFR § 1.1307(a)(3); 40 CFR § 1508.8]. The affected area contains substantive habitat for endangered, rare, or threatened species, and could result in significant effects relating to wetlands [50 CFR § 10.13; EO 13186; 16 U.S.C. § 700 et. seq.; *cf.* 14 CCR §§ 15192(d), 15097(c)(2), 15206(b)(4)(A),(b)(5)] or water quality [*cf.* 14 CCR § 15332]. The antennas would expose both nesting and migratory birds—including bald eagles—to radiofrequency radiation in excess of human exposure limits [47 CFR § 1.1310]. The miles of aerial fiber also blight the visual quality of the TRPA designated "Heavenly Valley Ski Resort" Scenic Recreation Environmental Improvement Area. This is an extraordinary Congressionally protected region warranting further analysis and documentation in an EA or an EIS [36 CFR § 220.6(b)(1)(iii); *see also* Public Law 96551; Public Law 96586; EO 13057].

It is incontrovertible that the USFS and TRPA have established Bijou Park Creek as qualifying habitat for Sierra Nevada Yellow-legged Frog. Under the Endangered Species Act, prohibited "harm" includes "significant habitat modification or degradation" (*Babbitt v. Sweet Home Chapter of, Communities for a Greater Ore.*, 515 U.S. 687, 702, 708 (1995)). Thus, this habitat as well as the endangered animal is protected from private action (*id.*). This is true regardless of whether the habitat is actually utilized, notwithstanding the fact that there is also compelling evidence that the habitat is in fact utilized (*e.g.* A, B, C, D, & E) / (*e.g.,* 1, 2, 3, 4 & 5, 6).

The prestigious National Institute of Health—National Toxicology Program (NIH—NTP) decade-long **Cell Phone study** has established that radiofrequency radiation used by cell phones cause DNA damage (Smith-Roe, Stephanie L et al. "*Evaluation of the genotoxicity of cell phone radiofrequency radiation in male and female rats and mice following subchronic exposure*." Environmental and Molecular Mutagenesis vol. 61,2 (2020): 276-290. doi:10.1002/em.22343) (results suggest that exposure to RFR is associated with an increase in DNA damage); Hardell, L., Carlberg, M. "*Comments on the US National Toxicology Program technical reports on toxicology and carcinogenesis study in rats exposed to whole-body radiofrequency radiation at 900 MHz and in mice exposed to whole-body radiofrequency radiation at 1,900 MHz*." International Journal of Oncology 54, no. 1 (2019): 111-127. https://doi.org/10.3892/ijo.2018.4606) (We conclude that there is clear evidence that RF radiation is a human carcinogen; RF radiation should be classified as carcinogenic to humans, Group 1). The peer-reviewed scientific studies such as the prestigious NIH study are not "bunk science" by armchair cranks. Similar findings been produced by other well-respected scientific studies (Ioniţă, E., Marcu, A., Temelie, M. *et al.* "*Radiofrequency EMF irradiation effects on pre-B lymphocytes undergoing somatic recombination*." NATURE Sci Rep 11, 12651 (2021). https://doi.org/10.1038/s41598-021-91790-3). RFR radiation causes DNA damage in plants as well (Dmitry S. Pesnya & Anton V. Romanovsky, *Comparison of cytotoxic and genotoxic effects of plutonium-239 alpha particles and mobile phone GSM 900 radiation in the Allium cepa test*, 750 Mutation Research, 27–33, (2013), http://dx.doi.org/10.1016/j.mrgentox.2012.08.010).

There is a "clear and convincing" body of scientific evidence showing that radiofrequency radiation really may cause DNA damage (Henry Lai. "*Genetic effects of non-ionizing electromagnetic fields*," Electromagnetic Biology and Medicine, (2021) 40:2, 264-273, DOI: 10.1080/15368378.2021.1881866) (of the 361 peer-reviewed scientific studies on the subject to date, "the majority of studies reported genetic effects of EMF (66% for RFR and 79% for static/ELF-EMF). Thus, it is safe to conclude that genotoxic effects of EMF have been reported. The most common effects found are: DNA strand breaks, micronucleus formation, and chromosomal structural changes")). This has particularly alarming implications for children (Devra Davis, Linda Birnbaum, Paul Ben-Ishai, Hugh Taylor, Meg Sears, Tom Butler, Theodora Scarato, "*Wireless technologies, non-ionizing electromagnetic fields and children: Identifying and reducing health risks*," Current Problems in Pediatric and Adolescent Health Care, Volume 53, Issue 2, (2023), https://doi.org/10.1016/j.cppeds.2023.101374).



DNA damage is merely one of a myriad of non-thermal environmental effects apparently caused by radiofrequency radiation. The FCC is not even concerned about the established thermal effects being applied to wildlife—or anything other than to humans. The precautionary principle requires us to at least assess the potential environmental impacts of radiofrequency radiation under the worst case scenario (*cf.*, Pearce, J M. "*Limiting liability with positioning to minimize negative health effects of cellular phone towers*." Environmental Research vol. 181 (2020): 108845. doi:10.1016/j.envres.2019.108845).

The FCC's radiofrequency radiation exposure limits have been outdated by modern science, yet the FCC arbitrary and capriciously refuses to update them (International Commission on the Biological Effects of Electromagnetic Fields (ICBE-EMF). *Scientific evidence invalidates health assumptions underlying the FCC and ICNIRP exposure limit determinations for radiofrequency radiation: implications for 5G*. Environ Health 21, 92 (2022). https://doi.org/10.1186/s12940-022-00900-9). *See also*, *Environmental Health Trust v. Federal Communications Commission*, No. 20-1025 (D.C. Cir. 2021)("we find the Commission's order arbitrary and capricious in its failure to respond to record evidence that exposure to RF radiation at levels below the Commission's current limits may cause negative health effects"). The FCC has blatantly ignored the public policy imperative updates which clearly arise from the current body of science (Levitt, B Blake et al. "*Effects of non-ionizing electromagnetic fields on flora and fauna, Part 3. Exposure standards, public policy, laws, and future directions*." Reviews on Environmental Health vol. 37,4 531-558. 27 Sep. 2021, doi:10.1515/reveh-2021-0083).

The FCC and TRPA may not use *"ex post facto"* environmental review which would be arbitrary and capricious *per se*. "[W]hen 'assessing the reasonableness of [an agency's action], [courts] look only to what the agency said at the time of the [action]—not to its lawyers' *post-hoc* rationalizations'" (*Environmental Health Trust v. Federal Communications Commission*, 9 F.4th 893, 910 (D.C. Cir. 2021) (quoting *Good Fortune Shipping SA v. Commissioner*, 897 F.3d 256, 263 (D.C. Cir. 2018)). "It is well-established that an agency's action must be upheld, if at all, on the basis articulated by the agency itself" (*Nat. Res. Def. Council v. U.S. Envtl. Prot. Agency*, No. 20-72794 *at* p. 9 (9th Cir. 2022) (quoting *Nat. Res. Def. Council v. U.S. EPA (NRDC 2013)*, 735 F.3d 873, 877 (9th Cir. 2013) (quoting *Motor Vehicle Mfrs. Ass'n of the U.S., Inc. v. State Farm Mut. Auto. Ins. Co.*, 463 U.S. 29, 50 (1983)))). "Courts do not "accept appellate counsel's *post-hoc* rationalizations for agency action" (*Id.* quoting *Nat. Res. Def. Council v. U.S. EPA (NRDC 2017)*, 857 F.3d 1030, 1040 (9th Cir. 2017) (quoting *Hernandez-Cruz v. Holder*, 651 F.3d 1094, 1109 (9th Cir. 2011))). "If the agency did not meet its burden, [courts] 'should not attempt…to make up for such deficiencies' and 'may not supply a reasoned basis for the agency's action that the agency itself has not given'" (*Id.* quoting *Ctr. for Biological Diversity v. Haaland*, 998 F.3d 1061, 1067 (9th Cir. 2021) (quoting *State Farm*, 463 U.S. *at* 43))). *See also*, *Kisor v. Wilkie*, 139 S. Ct. 2400, 2417 (2019) (noting a court should decline to defer to a *post-hoc* rationalization advanced to defend past agency action against attack); *San Luis & Delta-Mendota Water Authority v. Jewell*, 747 F.3d 581, 603 (9th Cir. 2014)). After all, it is "NEPA's purpose to ensure that agencies consider environmental impacts before they act rather than wait until it is too late" (*supra*, *American Bird Conservancy, Inc. v. F.C.C.*, at 1033-1034; *Oglala Sioux Tribe v. Nuclear Regulatory Comm'n*, at 520 (The National Environmental Policy Act...obligates every federal agency to prepare an adequate environmental impact statement before taking any major action...The statute does not permit an agency to act first and comply later); *Marsh, Secretary of the Army, et al. v. Oregon Natural Resources Council et al.*, 490 U.S. 360, 371 (1989) (NEPA is intended to "prevent or eliminate damage to the environment . . . by focusing government and public attention on the environmental effects of proposed agency action"); *City of Tenakee Springs v. Clough*, 915 F.2d 1308 (9th Cir. 1990) (National Environmental Policy Act (NEPA) requires consideration of potential impact of action before action takes place; where several actions have cumulative or synergistic environmental effect, that consequence must be considered in environmental impact statement (EIS)); *Neighbors of Cuddy Mountain v. U.S. Forest Service*, 137 F.3d 1372 (9th Cir., 1998) (It is inappropriate, under NEPA, for agency to defer consideration of cumulative impacts of actions to future date; NEPA requires consideration of potential impact of action before action takes place). *See also*, *Sierra Club v. Tahoe Regional Planning Agency*, 840 F.3d 1106 (9th Cir. 2016) (Decisions under NEPA are authoritative); *ForestKeeper v. Elliott*, 50 F.Supp.3d 1371 (E.D. CA. 2014) (NEPA procedures are substantive rules whose violation may invalidate an agency action).

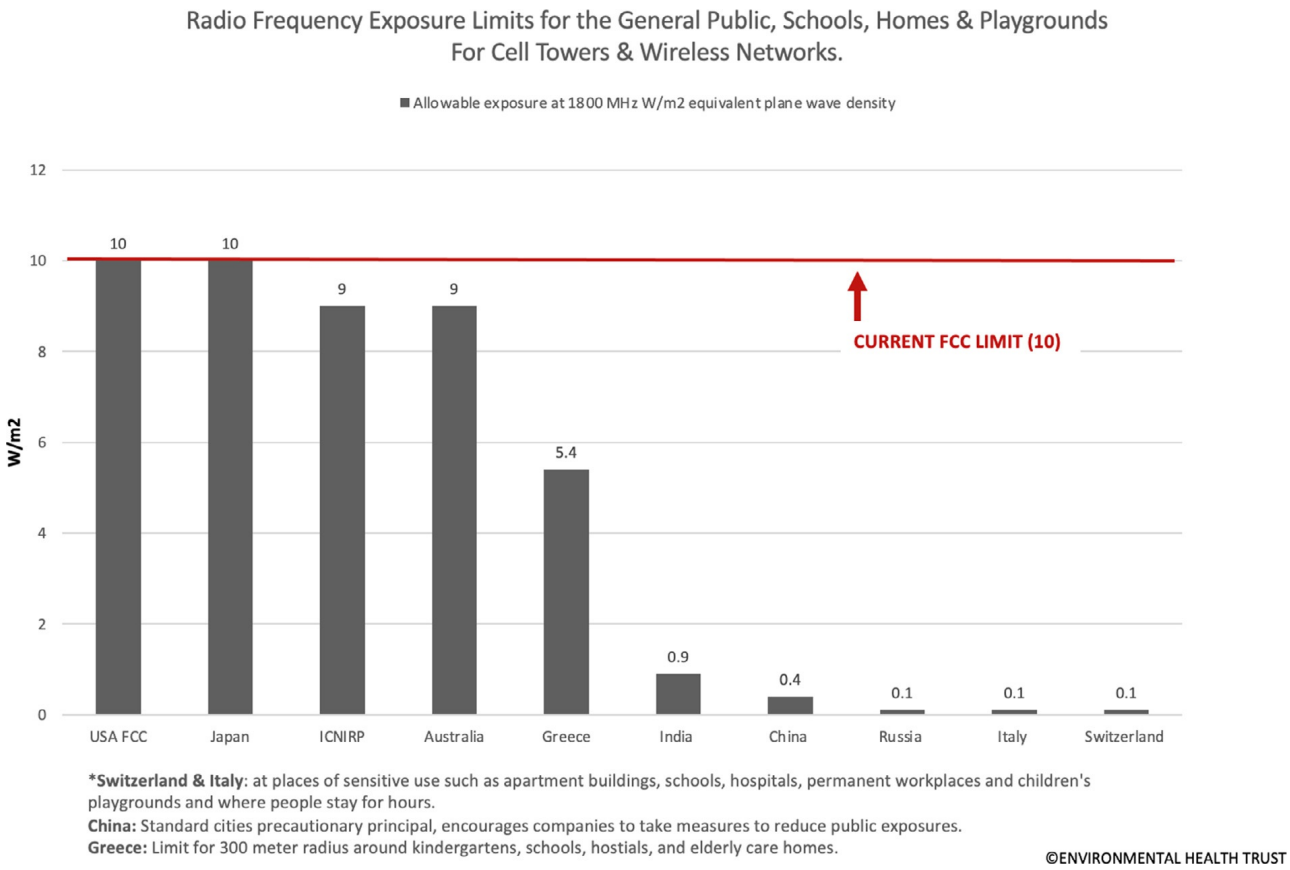
The evidence is compelling that the FCC and TRPA must act to prevent harm to the environment from radiofrequency radiation (Levitt, B Blake et al. "*Low-level EMF effects on wildlife and plants: What research tells us about an ecosystem approach*." Frontiers in Public Health vol. 10 1000840. 25 Nov. 2022, doi:10.3389/fpubh.2022.1000840) (There is enough evidence to indicate we may be damaging non-human species at ecosystem and biosphere levels across all taxa from rising background levels of anthropogenic non-ionizing electromagnetic fields (EMF) from 0 Hz to 300 GHz). "[A]n agency cannot simply ignore evidence suggesting that a major factual predicate of its position may no longer be accurate" (*supra*, *Environmental Health Trust v. Federal Communications Commission*, at 907). Notwithstanding whatever the probability that RFR causes DNA damage, because of the dire consequence of genetic damage and the vast number the cell tower deployments, the risk to the environment is extreme (*see*, *Kaplan, S.; Garrick, B.J. (1981). "On the Quantitative Definition of Risk." Risk Analysis. **1** (1): 11–27. doi:10.1111/j.1539-6924.1981.tb01350.x*). The FCC's and TRPA's legal duty—under the calculus of negligence—to protect the public and the environment has been breached (*United States v. Carroll Towing Co.*, 159 F.2d 169 (1947) (holding the duty to provide against resulting injuries is a function of three variables: (1) The probability that injury will occur; (2) the gravity of the resulting injury; (3) the burden of adequate precautions)). Thus, the arbitrary and capricious refusal of both the FCC and TRPA to reconsider and mitigate the environmental effects of radiofrequency radiation in light of the current science is unconscionable.

The only due process over RFR limits—the 1996 FCC "notice of proposed rulemaking (NPRM)" (61 FR 41006 (1996); 61 FR 42021 (1996); FCC 96-326 (1996)) for NEPA regulation promulgating the current radiofrequency exposure limits (47 CFR § 1.1310)—occurred nearly thirty years ago. Anyone who was legally an adult freely at liberty to submit written comment to the FCC would be at least forty-six years old today. According to the 2020 United States Census—Age and Sex Composition in the United States, 58 percent of the population today was not an adult in 1996 and therefore was never afforded their due process right—"an opportunity to be heard"—regarding the FCC's RFR exposure limits! Of the 42 percent of Americans who were adults during the NPRM, none of them were able to foresee the growing body of science which would later show adverse non-thermal environmental effects far below those exposure limits. Whereas today there is functionally no recourse to challenge the approval of new cell towers on the grounds of RFR levels which do not exceed the 1996 limits, and such exposure levels result in the "taking of life, liberty, or property," there is an egregious due process of law violation (*see*, *Mullane v. Central Hanover Tr. Co.*, 339 U.S. 306, 313, 314 (1950) (requisite of due process of law is the opportunity to be heard). Moreover, the FCC's giving license to the telecommunications companies to install cell towers which pervasively, systemically, and indiscriminately damage the DNA of living things—as to potentially amount to ecocide—concurrently encroaches on violating the "major questions doctrine" or the "non-delegation doctrine."

Let's be clear, Congress did not set the radiofrequency exposure limits, it delegated that responsibility to the FCC (Telecommunications Act of 1996, Pub. L. No. 104-104, § 704(b), 101 Stat. 56, 152 (directing Commission to "prescribe and make effective rules regarding the environmental effects of radio frequency emissions"); *see also*, 34 FCC Rcd 11687 (14) at 11689 n.5). The FCC must harmonize its responsibilities under Telecommunications Acts (TCA) with all other duties given by Congress under federal law. The FCC has never been given "clear congressional authorization" to violate the National Environmental Policy Act (NEPA), the Americans With Disability Act (ADA), the Endangered Species Act (ESA), or the Migratory Bird Treaty Act (MBTA). When the FCC promulgated regulation of radiofrequency exposure limits in 1996, it was not obvious that their regulation was in conflict those congressional acts. However, those limits are now invalidated by three decades of science which evidences that a substantive violations of these federal laws are actually occurring. The FCC and the courts are not in a "Hobson's choice" between violating the TCA or the ADA, because the TCA does not set radiofrequency exposure limits. That is a completely bogus argument. The FCC simply needs to regulate radiofrequency exposure limits in any manner of its choosing which does not violate its concurrent obligations under broader federal law. The FDA and the EPA are not delegated the responsibility to do this for the FCC (*e.g*, Senate Report 104-140, p. 91 (1996) ("EPA shall not engage in EMF activities"); Mouzaffar, Hala. (2021) "*The FCC Keeps Letting Me Be: Why Radiofrequency Radiation Standards Have Failed to Keep Up With Technology*". University of Pittsburgh Law Review 83 (1). https://doi.org/10.5195/lawreview.2021.826). The FCC arbitrarily and capriciously acts "contrary to law" and "without authority" when it violates NEPA, ESA, MBTA, ADA, or "inalienable" constitutional rights, which more broadly invokes the "major questions doctrine."

The FCC has been usurping local governments ability to protect the inalienable due process rights of their constituents. Their deliberate indifference has pervasively resulted in the taking of life, liberty, or property without any due process addressing the core issue of radiofrequency exposure. It has resulted in the installation of cell towers next to migratory bird and eagles nests, endangered animal habitat, children, and detrimentally adjacent to the homes of cancer patients! The substantive component of the Due Process Clause is violated by executive action when it "can properly be characterized as arbitrary, or conscience shocking, in a constitutional sense" (*see, County of Sacramento v. Lewis*, 523 U.S. 833, 846 (1998) (quoting *Collins v. Harker Heights*, 503 U.S. 115, 128 (1992); *Clark v. City of Hermosa Beach*, 48 Cal.App.4th 1152, 1183 (1996) (the due process clause precludes arbitrary and irrational decisionmaking)). The FCC and TRPA's actions have been egregiously both "arbitrary" and "conscience shocking."

Whereas TRPA claims the "TRPA could choose to regulate RF in the region should cellular facilities be proven to have a particular adverse effect on the unique environment of the Tahoe Region" it must act now (Governing Board Meeting, March 23, 2022, Agenda Item No. VIII.B, Staff Report). The United States has RF limits which are way higher than most European and other advancing countries:



Please act now and protect the Tahoe Basin.

Sincerely,

David Chain

The purpose of copyright law is "to Promote the Progress of Science and useful Arts" (U.S. Const. art. I, § 8, cl. 8). The House Committee on the Judiciary explicitly listed "reproduction of a work in legislative or judicial proceedings or reports" as an example of a fair use (H.R. Rep. No. 94-1476, 65 (1976)). Introducing entire copyrighted works in official governmental proceedings is generally fair use (*Sony Corp. of Am. v. Universal City Studios, Inc.*, 464 U.S. 417, 449-50 (1984) ("the fact that the entire work is reproduced…does not have its ordinary effect of militating against a finding of fair use"); *Jartech, Inc. v. Clancy*, 666 F.2d 403 (9th Cir. 1982) (holding that the city councils use of copyrighted material in the legal proceedings was not "the same intrinsic use to which the copyright holders expected protection from unauthorized use"); *Stern v. Does*, 978 F. Supp. 2d 1031, 1044-49 (C.D. Cal. 2011) (reproduction of copyrighted material for use in litigation or potential litigation is generally fair use, even if the material is copied in whole); *Ty, Inc. v. Publications Intern. Ltd.*, 292 F.3d 512 (7th Cir. 2002) (reproducing copyrighted works for litigation is an example of the fair use doctrine); *Healthcare Advocates, Inc. v. Harding, Earley, Follmer & Frailey*, 497 F.Supp. 2d 627, 638 (E.D. Pa. 2007) (holding that law firm's copying of an entire set of copyrighted web pages was justified where the web pages were relevant evidence in litigation); *Hollander v. Steinberg*, 419 Fed.Appx. 44 (2d Cir. 2011) (affirming dismissal of a copyright case by an attorney, where opposing counsel in an earlier civil action had appended that attorney's blog entries to a motion); *Religious Tech. v. Wollersheim*, 971 F.2d 364 (9th Cir. 1992) (holding that providing copies of the plaintiff's copyrighted documents to the defendant's expert witness was fair use); *Porter v. United States*, 473 F. 2d 1329 (5th Cir. 1973) (rejecting a claim by the widow of Lee Harvey Oswald that she was entitled to compensation because the publication of Oswald's writings in the Warren Commission Report diminished the value of the copyright in those works); *Kulik Photography v. Cochran*, 975 F. Supp. 812 (E.D. Va. 1997) (dismissing on jurisdictional grounds of a copyright infringement suit brought by the author of a photograph that was used without permission in the O.J. Simpson murder trial); *Levingston v. Earle*, No. 3:2012cv08165 (D. Ariz. 2014) (holding that appending a full copy of an author's book to a pleading, in a harassment proceeding against that author, was fair use); *Grundberg v. the Upjohn Co.*, 140 F.R.D. 459 (D. Utah 1991) (rejecting the defendant's attempt to register a copyright in its document production in order to restrict the plaintiff's use and public dissemination of those documents); *Shell v. City of Radford*, 351 F.Supp.2d 510 (W.D. Va. 2005) (dismissing a copyright infringement suit by a photographer whose photographs were copied and used by detectives investigating the murder of the photographer's assistant); *Denison v. Larkin*, 64 F. Supp. 3d 1127 (N.D. Ill. 2014) (dismissing with prejudice Plaintiff attorney's suit against defendants for using portions of her copyrighted Blog as evidence against her in an attorney disciplinary proceeding); *Carpenter v. Superior Court (Yamaha Motor Corp., USA)*, 141 Cal.App.4th 249 (2006) (holding the plaintiff in a personal injury action could gain access to certain standardized neurological tests over an objection that the tests were protected by, inter alia, copyright law)).

See also, DOJ Guidance on Copyrighted Materials and Public Records Acts (FOIA is designed to serve the public interest in access to information maintained by the government...disclosure of nonexempt copyrighted documents under the FOIA should be considered a "fair use"); *NLRB v. Robbins Tire & Rubber Co.*, 437 U.S. 214, 242 (1978) (The basic purpose of FOIA is to ensure an informed citizenry, vital to the functioning of a democratic society, needed to check against corruption and to hold the governors accountable to the governed).

FAILURE AT THE FCC: HOW THE AGENCY IGNORES THE ENVIRONMENT

Environment

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COVID Inequities in the U.S. Experience

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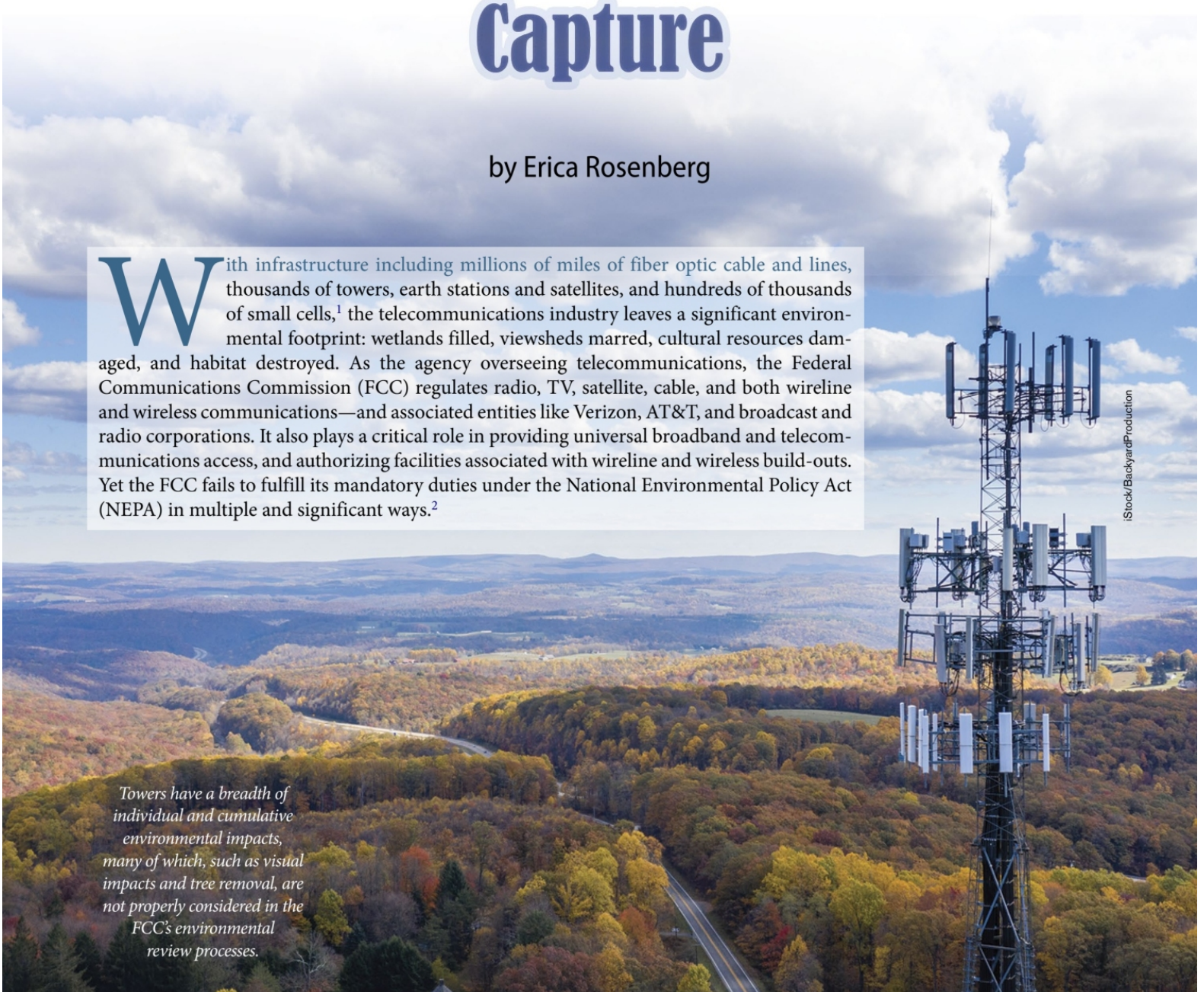
October/December 2022
Volume 64, Numbers 5-6
$9.95 U.S./Canada

Environmental Procedures at the FCC: A Case Study in Corporate Capture

by Erica Rosenberg

With infrastructure including millions of miles of fiber optic cable and lines, thousands of towers, earth stations and satellites, and hundreds of thousands of small cells,[1] the telecommunications industry leaves a significant environmental footprint: wetlands filled, viewsheds marred, cultural resources damaged, and habitat destroyed. As the agency overseeing telecommunications, the Federal Communications Commission (FCC) regulates radio, TV, satellite, cable, and both wireline and wireless communications—and associated entities like Verizon, AT&T, and broadcast and radio corporations. It also plays a critical role in providing universal broadband and telecommunications access, and authorizing facilities associated with wireline and wireless build-outs. Yet the FCC fails to fulfill its mandatory duties under the National Environmental Policy Act (NEPA) in multiple and significant ways.[2]



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Towers have a breadth of individual and cumulative environmental impacts, many of which, such as visual impacts and tree removal, are not properly considered in the FCC's environmental review processes.

Like all federal agencies, the FCC must follow environmental laws, including NEPA, which requires it to assess potential environmental effects of its actions before it authorizes, funds, or licenses projects and communications infrastructure. These effects include visual and ecological impacts, and radio frequency emission exceedances, caused by the proliferation of wireless technology and the networks constructed to deploy it. The agency is supposed to follow legal requirements to assess such environmental impacts and, in doing so, to consider the concerns of communities and citizens.

It does neither. For most deployments it authorizes, the FCC rarely completes any environmental review or makes NEPA documents available to the public; instead, with little FCC oversight or enforcement, industry is delegated the task of determining how much environmental review is appropriate for its deployments and in most cases, is not required to submit documentation of those determinations.

In licensing and authorizing facilities associated with telecommunications, broadband, and broadcasting technologies, the FCC intentionally and routinely fails to meet its environmental obligations and epitomizes "regulatory capture." It treats environmental laws as obstacles to be circumvented or ignored, first by promulgating rules that fall short of what NEPA requires and then by failing to properly implement and enforce its own substandard rules. The chronic failure has cumulative, incalculable, and largely unknown environmental impacts.

Combined with statutory authority that curtails local government authority to regulate or block telecom deployment in their jurisdiction, public and local voices in what is deployed and where are further diminished.[3] Equally important, the agency suppresses and dismisses the voices of communities and citizens concerned about these encroachments. As wireless infrastructure proliferates under the auspices of an agency that flouts federal law, unabated and unaccounted for environmental impacts will only multiply.

NEPA: An Instrument of Democracy and Accountability

NEPA, a Nixon–era law and one emulated around the world, outlines a process for decision-making about "major federal actions, like dam-building, offshore drilling, and highway expansions.[4] Council on Environmental Quality implementing rules define major federal actions broadly to include "new and continuing activities, including programs entirely or partly financed, assisted, conducted or approved by federal agencies." They also include "approval of specific projects, such as construction or management activities located in a defined geographic area. Projects include actions approved by permit or other regulatory decision as well as federal and federally assisted activities."[5]

NEPA requires the government to disclose broadly defined environmental impacts of proposed actions—and to consider alternatives—including not undertaking the action.[6] It allows the public, from local governments to tribes to citizens, to participate in the decision.[7]

The greater the potential environmental impacts of a project, action, or policy, the more analysis and the more opportunities for public input and challenge. NEPA requires a full-scale environmental review (environmental impact statement) for major actions with potentially great environmental effects like a highway, a shorter assessment (environmental assessment) for actions that may have less significant impacts, and exemptions from analysis for categories of routine actions (categorical exclusions), like removing brush, that the agency has determined individually or cumulatively have no significant environmental effect. Although a categorical exclusion may exist for an action, in any given case, extraordinary circumstances such as the presence of environmentally sensitive resources can remove an action from a categorical exclusion and require either a documented categorical exclusion or more NEPA review. For example, even if the United States Forest Service categorically excludes brush removal on small tracts, brush removal in critical habitat for endangered species would require the agency to consider and document that its action would still not require an environmental assessment or conduct an environmental assessment.

As a procedural statute, NEPA cannot stop environmentally harmful projects, but it can substantially improve the imprint of an action by, for example, rerouting a power line to protect a stream, or bringing information about wildlife to light so that licensees can take mitigation measures. In short, NEPA, by mandating transparency and accountability, is an instrument of democracy and good governance. NEPA also requires that agencies promulgate policies or rules implementing NEPA in accordance with Council on Environmental Quality rules, and in consultation with the Council on Environmental Quality.

FCC's Failure to Consider Major Federal Actions

Council on Environmental Quality rules place many of the FCC's licensing and funding activities squarely within the definition of a major federal action. Yet the FCC has construed major federal actions narrowly or has simply not considered whether its actions are major federal actions. Consequently, the agency has not considered actions like providing financial assistance to carriers for deployment of small cells and build-outs with associated cable-laying and transmission lines as major federal actions.[8]

In 2018, the agency went as far as to deem all licensing of small cell facilities, which it authorizes as part of a license to carriers, as not requiring environmental review because they were not major federal actions.[9] Termed by industry as unobtrusive—"smaller than a pizza box or backpack"[10]—small cell facilities can be significantly larger and are placed on buildings or associated poles. In its order, the agency both eliminated federal environmental review of small cells and significantly limited local authority over small wireless infrastructure deployment.

In her dissent to the order, FCC Commissioner Jessica Rosenworcel noted that 5G would require millions of miles of fiber and up to 800,000 small

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The FCC is authorizing the deployment of hundreds of thousands of small cells with little public input or environmental review.

cells by 2026. The order thus "runs roughshod over the rights of our Tribal communities and gives short shrift to our most basic environmental and historic preservation values."[11] She noted that the Mobility Fund, which supports carriers in bringing wireless services to underserved areas, would support updated wireless service, to the tune of $4.53 billion. Yet in effect, she states, the FCC reads "projects carried out with financial assistance" (a requirement of the National Historic Preservation Act) as well as NEPA out of the law.[12] It also "removes many larger wireless facilities from environmental oversight."[13]

The FCC's efforts to eliminate small cell review were struck down by the D.C. Circuit in *United Keetoowah v. FCC*,[14] a case brought by the Natural Resources Defense Council and several tribes. The court found: "The scale of the deployment the FCC seeks to facilitate, particularly given its exemption of small cells that require new construction, makes it impossible on this record to credit the claim that small cell deregulation will 'leave little to no environmental footprint. *Order* ¶ 41.'"[15]

Appropriately, the FCC considers licensing spectrum and registering towers to be major federal actions that trigger NEPA. However, while the FCC recognizes that its grant of geographic licenses to carriers triggers NEPA, it issues the licenses without any knowledge of how the licensee will deploy infrastructure in its build-out. In most cases, it cannot know because the carrier may not have finalized its build-out plans for construction of towers, transmission lines, and small cell facilities over time. In fact, the agency does not prepare and never has prepared an environmental impact statement on a build out—or on any other major federal action; it has only prepared one programmatic environmental assessment, which was in response to a lawsuit.[16] Instead, it requires NEPA review only on a facility-by-facility basis, which also circumvents a NEPA requirement to consider cumulative effects.[17] Segmenting a project into smaller components is illegal, and the FCC's approach is another way it flouts the law.

FCC's Inadequate NEPA Rules

FCC NEPA rules undermine NEPA at every turn—they are inadequate both as written and as implemented. The rules' unusual structure and an agency that interprets its rules in favor of the carriers mean that most projects proceed without adequate environmental review and consideration.

Unlike other agencies' rules, FCC rules do not identify categories of actions that do not require further NEPA review; rather, the rules categorically exclude *all* actions the agency takes except for those that meet a limited set of itemized extraordinary circumstances.[18] In other

Wireless infrastructure is changing the character of historic buildings and neighborhoods.

instances, the FCC deems its actions categorically excluded. For example, construction of submarine cables, which indisputably has potentially significant environmental impacts to reefs, ocean floors, and marine life, is explicitly excluded from review following a 1974 FCC order asserting that the environmental consequences are negligible.[19]

In dismissing the petition brought by an environmental nongovernmental organization to require more environmental review for a number of FCC actions, including those involving submarine cables, the 1974 order acknowledged environmental damage from cables in Maine and the U.S. Virgin Islands but illogically found no need for environmental review because the projects violated state law and permits.[20]

By not considering FCC actions major federal actions and by relying on a broad and unsupported categorical exclusion, countless activities with potentially significant environmental impacts or actual impacts proceed with little or no NEPA review or public involvement. Unlike many agencies, FCC lacks a NEPA coordinating office and most bureaus within the agency have no NEPA expertise or even awareness of the obligations the statute confers on the agency.

Streamlined Effects: The NEPA Checklist

The agency also skirts its NEPA obligations through its procedures and practice around "effects" consideration. It defines effects narrowly and by doing so, removes actions from public notice and comment. Most egregiously, it delegates the initial consideration of effects to applicants and licensees—telecom companies, for the most part—to determine whether an environmental assessment is warranted or whether the project is categorically excluded, and because the review is not submitted to the FCC, it typically performs no subsequent review of the applicants' documentation.

Council on Environmental Quality regulations define effects broadly.[21] FCC rules and practices limit the consideration of environmental effects. They also limit the extraordinary circumstances that would warrant a higher level of environmental review (i.e., an environmental assessment) and public input for the action—through both its narrow list of circumstances and its narrow interpretation of those circumstances. Those limited circumstances are actions involving facilities that: may affect Indian cultural sites or historic resources (i.e., National Historical Preservation Act triggers); may affect threatened or endangered species or their habitat; may involve significant changes in surface features (such as to wetlands or forests); are in a floodplain if equipment is not raised; exceed radio frequency emissions limitations; involve high-intensity lights in residential areas; are in wilderness areas or wildlife

Tall, guyed towers kill millions of birds a year.

refuges; or are more than 450 feet tall in light of potential impacts to migratory birds.[22] These circumstances are referred to as "the NEPA checklist."

Even so, FCC has in effect gutted most elements of the checklist. For example, for the floodplain trigger,[23] as long as equipment is raised for a facility in a floodplain, no environmental assessment is required, although no evidence of raising the equipment or a local permit need be submitted. Although required by Council on Environmental Quality (which unfortunately approved the 2018 rule change), no cumulative effects of building in floodplains are considered. Similarly, applicants often fail to submit an environmental assessment when they have received a federal or state wetlands permit, so again, no evidence is submitted to the agency or for public review.

To eliminate another environmental assessment trigger, rule changes in 2020 allow projects that affect historic properties and cultural resources to proceed without an environmental assessment.[24] "Change in surface features" has in practice required consideration of wetlands impacts (i.e., whether a federal permit is needed), rather than considering large-scale vegetation or soil removal, or grading of sensitive habitats. Thus, even if several acres are bulldozed or dozens of trees cleared, an environmental assessment is not required.

A comprehensive NEPA review for telecommunications infrastructure is both possible and required by other agencies. For instance, the National Telecommunications and Information Administration, which also supports expanding broadband access and adoption, considers a breadth of effects under NEPA that the FCC's checklist fails to consider.[25] National Telecommunications and Information Administration, for example, requires consideration of cumulative effects.[26]

Delegation of Review: Fox Guarding the Hen House

Even more extraordinary than its failure to consider a breadth of environmental effects for most of its actions is the FCC's delegation of consideration of environmental effects to the applicant or licensee. In other words, self-interested parties conduct the NEPA checklist environmental review. Under Council on Environmental Quality rules, the federal agency is ultimately responsible for the environmental document, regardless of who prepares it.[27] Yet under FCC procedures, the agency never even sees the

initial environmental review documenting that a categorical exclusion, rather than a more extensive environmental review, is supported—except in the unlikely event it requests checklist documentation following a complaint.

No other agency allows the applicant to make the initial determination of whether a project is categorically excluded or requires an environmental assessment. Other agencies require submission of documentation of that determination or make the determination themselves. Instead, the FCC relies on applicants to be truthful in their dealings with the agency—yet rarely if ever has it enforced against applicants who make false statements on its forms. Applicants submit documentation only when checklist review triggers an environmental assessment. This approach to ensuring compliance with the NEPA rule is at best unrealistic and at worst, a license to deceive.

No FCC oversight ensures that applicants have done their due diligence to consider the checklist circumstances properly or to even review the circumstances at all. With no agency or public awareness, applicants can simply categorically exclude their projects that involve even larger scale impacts. In East Fishkill, New York, for example, more than 50 trees were cleared from a forested area along a highway known for its scenic views, with no environmental assessment.[28]

Incorrect, confusing, or inadequate filing instructions further ensure that the applicant's work will be incomplete.[29] The instructions themselves fail to even reflect the inadequate rules because they omit Endangered Species Act considerations, do not capture National Historical Preservation Association requirements, omit wetlands concerns, and include outdated floodplain requirements. Similarly, NEPA checklist guidance used until June 2022 did not even reflect the rules on environmental assessment triggers or environmental assessment content requirements.[30]

The checklist allows for only a very narrow set of environmental assessment triggers. In theory, FCC rules do allow for consideration of non-checklist effects or effects missed in the checklist review—those raised by members of the public and those raised by the FCC on its own motion.[31] In reality, this almost never happens. The FCC inevitably fails to consider some potentially significant effects outside of the checklist because it relies entirely on the public to identify them, it never initiates its own review, it relies on self-interested applicants to review projects, and it views its mission as facilitating deployment.

Lack of Notice and Public Availability of Documents

Limiting notice and public availability of documents is another way the agency fails to meet fundamental NEPA responsibilities. Council on Environmental Quality rules require both notice of

The effects of cell towers in sensitive areas like coastal zones and wetlands are not fully considered in the FCC's NEPA process.

actions and opportunities for public comment.[32] In fact, the rules require that agencies make "diligent efforts" to involve the public in implementing their NEPA procedures.[33] Instead, the FCC makes diligent efforts to exclude the public from raising concerns under NEPA.

Applicants and licensees submit no documentation of their determination that their project is categorically excluded, and the agency does not track categorically excluded actions. With the applicant conducting the initial environmental review of whether the project is categorically excluded by assessing the list of extraordinary circumstances (i.e., the NEPA checklist), as well as preparing the environmental assessment, the burden falls on the public to learn of the proposed action and to raise a potential effect.

But categorically excluded actions, including authorization of certain towers, do not receive public notice; only applications for towers that require registration (generally taller than 199 feet) are put on notice, and those may or may not have associated environmental assessments. In addition to towers under 200 feet not posing an air hazard, these stealth projects that the agency has no record of include small wireless facilities associated with 4G and 5G.

That the public has no access to this information is particularly problematic in the radio frequency context, where applicants are required to meet radio frequency emissions standards or submit an environmental assessment. If the applicants do analyze the checklist and radio frequency studies at all, they routinely categorically exclude small wireless facilities, despite growing public concern about radio frequency associated with such technologies. Without access to the documented checklist, the public has little to no basis on which to refute or comment on checklist conclusions on radio frequency. And given the streamlined process, citizens often find out about facilities only after they are built.

Lack of Transparency: Notice of EAs

While the public is completely disenfranchised on categorically excluded projects, the situation with environmental assessments is only slightly better. If an environmental assessment is required because the applicant identified a trigger on the NEPA checklist, the tower or other structure must be registered. But it is not the environmental assessment itself that is publicly noticed—it is the application for the tower registration or license modification. The notice serves only to notice for 30 days that an application for an antenna structure at a particular location has been submitted. Members of the public interested in that structure must track down the application in the antenna structure registration system and then see whether an environmental assessment is attached. To find environmental assessments that are "accessible," a member of the public would have to know that a proposed antenna structure registration included an environmental assessment.

Hence, notice is hardly "public." Rather than being posted on a readily accessible, centralized site for NEPA documents,[34] the registration application and the associated environmental assessment, if done, are buried in a hard-to-access, byzantine website.[35] Without project coordinates or an exact site location, it is difficult to get into the website and, once in, to find the environmental documents. To complicate matters further, environmental assessments associated with licensee towers that do not need to be registered (i.e., short towers) are noticed separately and are buried on a different webpage.[36]

Comments Deemed "Complaints"

Even if the public manages to overcome FCC hurdles and ascertain information about a proposed facility, it faces nearly insurmountable obstacles to get its concerns heard or addressed. Under NEPA, the burden of looking at effects is a federal obligation—it is not up to the public to establish a case but merely to apprise the agency of potential effects to consider; the comment period allows the agency to meet its NEPA obligations by giving the public an opportunity to raise effects or alternatives not considered in the environmental review process.

But rather than a standard, fair, or open comment process in which the agency considers and responds to concerns raised by the public, the FCC administers an adversarial complaints process that requires the public to meet a high burden of proof about a potential effect that may have been overlooked in the checklist or inaccurately documented.[37] With a process that unfairly shifts the burden of raising and establishing environmental concerns from the agency to the public, the outcome is always the same. The FCC virtually never finds that complaints are valid. To dismiss them or resolve them in the applicant's favor so that the project can proceed, it routinely finds that the complainant has not provided specific enough detail or an adequate scientific showing for the agency to consider an effect.

Compounding the unlikelihood that the public will learn about a project and be able to weigh in is a timing issue. When the public finds out about a project that the applicant has deemed categorically excluded (either by doing the checklist or failing to do the checklist), there is no timeline to comment on or complain about the project. With no notice and no timeline for these projects that proceed with no agency awareness, the public often learns about the projects when construction begins or, just as likely, when the facility is already built.

Because the applicant need not consider aesthetics, for example, a tower visible from a state park could be deemed categorically excluded and built before the public sees the impact to its viewshed. Rarely, if ever, will the FCC decide an environmental assessment is required under the circumstances because the applicant ostensibly did what was required of it by assessing the minimal checklist. Furthermore, in terms of failure to comply with NEPA, environmental assessments are submitted so late in the process that a meaningful alternatives analysis—a hallmark and requirement of NEPA[38]—is foreclosed.

Aesthetic Effects: The Greatest Impacts Never Addressed

Perhaps most egregious is the agency's approach to aesthetic impacts.

Applicants should be required to consider aesthetic impacts because, by the FCC's own account in its rulemaking, visual impacts are by far the most significant impact a tower could have.[39] As originally promulgated, FCC's NEPA regulations triggered an environmental assessment when facilities were to be located "in areas which are recognized either nationally or locally for their special scenic or recreational value."[40] Again and again in the rulemaking, visual effects were cited as the greatest impact, as well as an impact to be mitigated.[41] Yet in 1985, the FCC decided the standard was "unduly vague," and that it was unnecessary for applicants to submit environmental assessments in cases that "may raise aesthetic concerns."[42] It also noted that "aesthetic concerns may more appropriately be resolved by local, state, regional or local land use authorities"[43]—although NEPA is an independent federal obligation.

On the rare occasion when the FCC does consider aesthetics, its examination is generally limited to consideration of impacts to nationally designated scenic trails and historic sites (the latter falling under visual effects under National Historical Preservation Association) or to national parks, although nothing in NEPA or Council on Environmental Quality rules limits consideration of aesthetic impacts solely to those designated areas. This practice precludes consideration of impacts to, for example, scenic tourist areas or state or locally designated battlefields and parks. In 2014, AT&T built a tower in Fort Ransom, North Dakota, visible from a nearby National Scenic Tail and Scenic Byway, without having to consider aesthetic impacts.[44] Towers have been built in the viewsheds of, for example, a National Scenic Trail in Vergennes, Michigan, an iconic bridge in New York, a civil rights site in Selma, Alabama, and on Dewey Beach, Delaware's sand dunes, with little notice, consideration of visual impacts, or mitigation.

Little Compliance, Little Enforcement

With no oversight to ensure applicants have done the due diligence required to consider the checklist and no on-the-ground inspections, lack of compliance with the rules is rampant

Large-scale projects with multiple facilities built without NEPA review include hundreds of towers in Alaska built by GCI.[45] Between 2001 and 2015, T-Mobile built hundreds of towers in 22 states without environmental review.[46] In New Mexico and Texas, Plateau Telecommunications built 58 towers with no National Historical Preservation Association review.[47] Telalaska built 28 towers near and in sensitive areas in Alaska with no repercussions.[48] With no Enforcement Bureau action, the Wireless Telecommunications Bureau and Alliant Energy Corporation agreed in 2017 to a compliance plan after Alliant built 109 towers and 93 poles without NEPA review.[49] Railroad noncompliance was so widespread that the FCC entered into a settlement agreement with several railroads that created a $10 million cultural resources fund for 11,000 constructed poles that had not gone thru National Historical Preservation Association or NEPA review.[50]

Smaller-scale projects and individual towers also have significant impacts. For example, in 2019, licensees in Broward County, Florida, cleared 36 trees and built a driveway through a forested wetland before completing environmental review.[51] In Sabana Grande, Puerto Rico, a tower builder in 2014 bulldozed critical habitat for an endangered bird.[52] Dozens of sacred sites have been similarly destroyed or damaged across the country, as have multiple cultural resources and historic and archaeological sites.

Although towers can alter iconic views, the FCC does not require licensees to consider aesthetic impacts.

Cell towers are altering and marring views across the country.

Many of these failures to comply with environmental requirements come to light as National Historical Preservation Association violations, rather than as NEPA violations, because the National Historical Preservation Association process, as part of the checklist, requires photo documentation and official state and tribal review. Complaints from these officials or the public and self-reporting—often unintentionally with photos submitted through increasingly rare environmental assessment submissions[53]—are generally the sole bases for enforcement.

Conveniently for an agency intent on deployment, the FCC's Enforcement Bureau operates under a one-year statute of limitations—one year from the time the facility was built, not from when the agency learned of the violation. As a result, by the time the agency learns of the violation and decides to take action, it is often prohibited from levying fines against the violator.

When the agency does take action, it amounts, with few exceptions, to a slap on the wrist. In 2016, six licensees got admonishment letters with no penalties and little agency publicity.[54] For the past decade or so, Wireless Telecommunications Bureau admonishment letters, which number from zero to six per year, warn of the potential for increased fines and punishments if violators break rules again. But the agency could not fine the violators and does not track the letters. Fines are rare and if levied, de minimis.[55] At most, penalties are ordered once or twice a year, and tower removal, which would be a reasonable and authorized remedy for violations, is never ordered.

In one instance, clearing guy-wire areas for a 1,500-foot broadcast tower in Punta Gorda, Florida, destroyed 2.6 acres of treed habitat for bonneted bats, an endangered species. As mitigation, the applicant paid $28,000 to the U.S. Fish and Wildlife Service, while the FCC issued a Finding of No Significant Impact and imposed a fine of $28,000.[56]

Ex Post Facto NEPA: A Concept Not Contemplated by NEPA

To address instances of noncompliance, the agency has instead devised an ex post facto NEPA process under which the violators conduct and submit an after-the-fact checklist or environmental assessment. If an environmental assessment is required, these half-built or fully built projects then receive the FONSIs that are a prerequisite for construction. Enforcement action may, but more likely will not, follow; with no repercussions, a 485-foot broadcast tower in Chattanooga, Tennessee, was built and operating for months before it got its FONSI in 2021.[57]

Since 2002, the agency has used a clearance process for noncompliant towers (i.e., those that have not gone through the National Historical Preservation Association and NEPA process).[58] For example, on March 28, 2012, the FCC "cleared" with a post-construction review the 58 towers that Plateau Telecommunications had built in violation of historic preservation procedures.[59] Other elements of the requisite NEPA review were ignored—and are often ignored in this process.

Regardless, NEPA may not be done retroactively, and the substantive value of this follow-up exercise is unclear. It

Beyond visual impacts, cell towers built in pristine areas can affect sensitive species and ecosystems.

is hard to assess damage to a site never evaluated for the presence of, for example, wetlands, sensitive species, historic resources, or sacred sites before clearing took place. More importantly, given the dearth of documentation, little means for the agency to discover violations, and lack of oversight at the agency, it is unclear just how many projects that impact environmentally sensitive areas are constructed with improper or no checklist review, or get started without waiting for a FONSI to construct; most of the sites where environmental damage occurred and the degree of destruction will never be known.

By routinely clearing towers with post-construction checklist reviews, the agency creates incentives for tower companies and carriers to build their towers and, if necessary, do paperwork later. Given the lax enforcement and the statute of limitations issue, this approach from industry's perspective would be quite reasonable.

Conclusion: Prospects for a More Accountable FCC

Clearly, the FCC's NEPA process falls short of what NEPA and Council on Environmental Quality require.

- It ignores major federal actions requiring environmental review, such as its distribution to industry of billions of dollars that support build-outs for updated wireless service, or improperly deems certain major federal actions nonmajor federal actions to circumvent NEPA.
- Its NEPA rules create an unsupported and overbroad categorical exclusion so that, for example, satellite licensing and submarine cable licensing are excluded from review.
- With little oversight or tracking, it delegates environmental review of NEPA determinations to industry proponents of the project.
- It fails to vigorously enforce its rules so that industry noncompliance is rampant.
- It fails to provide adequate notice and opportunities for public comment.
- It fails to make environmental documents, including radio frequency emissions studies, publicly available or readily accessible.
- It routinely ignores or dismisses public comments and concerns and places an unfair burden of proof on the public when it raises concerns.

These practices serve to facilitate deployment for carriers while ignoring environmental rules and the public. Besides environmental costs, the FCC's approach bespeaks a lack of transparency

and accountability that undermines good governance and erodes democracy. It also bespeaks an agency completely captured by the entities it is tasked with regulating.

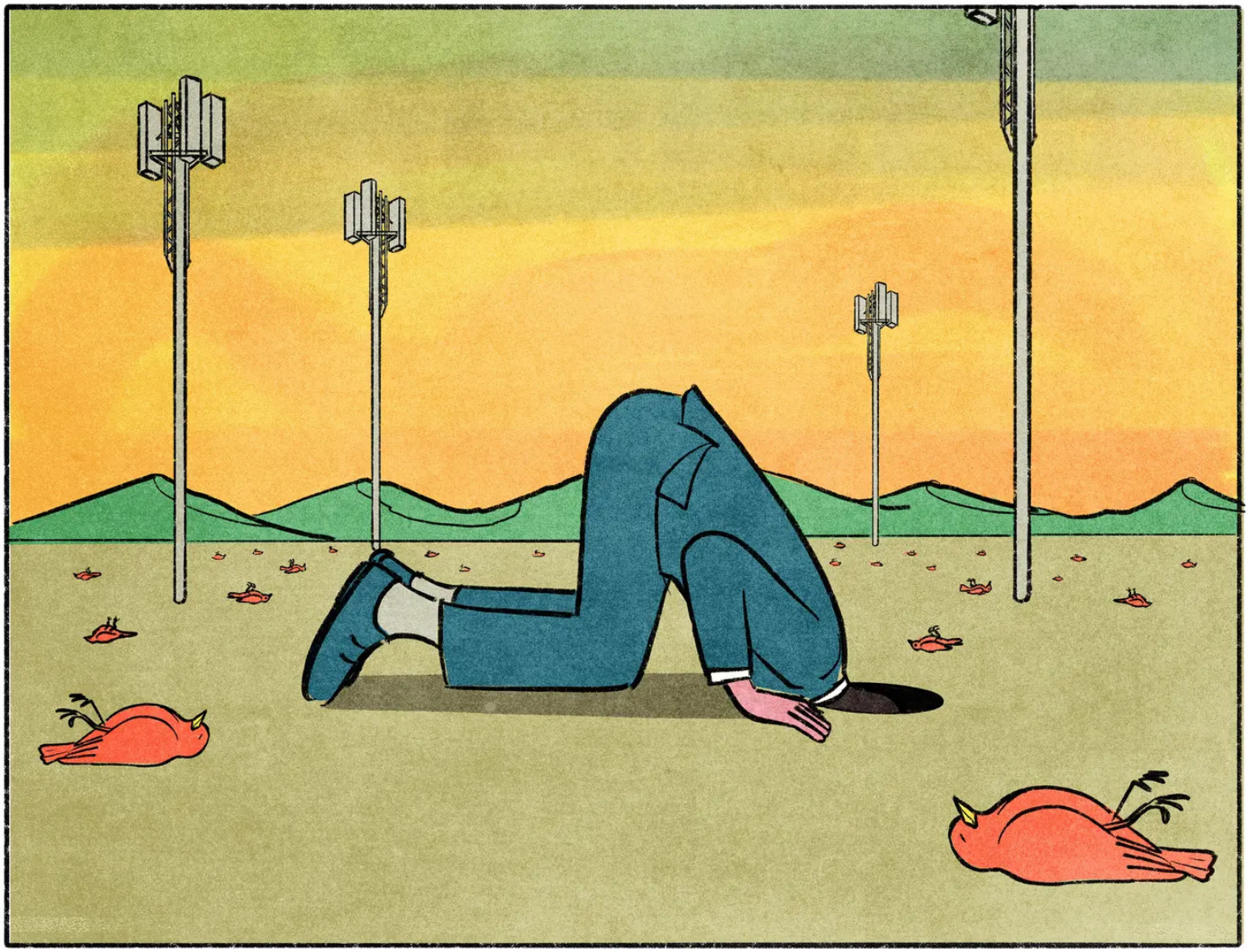
Recent Biden-era NEPA implementing rules[60] require agencies to revisit their NEPA rules and procedures by September 2023.[61] They also require that the agencies have the capacity to comply with NEPA,[62] something the FCC has to date lacked. Perhaps when Council on Environmental Quality reviews the FCC's procedures this time, it will scrutinize the rules more carefully and hold the agency to a higher standard for NEPA compliance.

An environmental and public lands policy attorney with over 30 years of experience, including in agencies, Congress, and academia, **Erica Rosenberg** worked at the FCC's Wireless Telecommunications Bureau from 2014 to 2021; for the last six of those years, she was Assistant Chief of the Competition and Infrastructure Policy Division.

NOTES

1. Unlike macro-cells or wireless cell towers, a small cell installation consists of radio equipment and antennas placed every few meters on structures such as streetlights, buildings, or poles.
2. 42 U.S.C. §4371 *et seq*.
3. Telecommunications Act of 1996, Section 704, 47 U.S.C §332.
4. 40 CFR §1508.18 (1978). Note: Unless otherwise noted, NEPA regulations cited are 1978 regulations (i.e., pre-Trump and Biden-era regulations). The FCC was bound by those regulations until April 2022.
5. 40 CFR §1508.18.
6. 40 CFR §1508.8.
7. 40 CFR §§1501.2(d)2), 1.1501.7((a)(1), 1.1503.1, 1.1506.6.
8. Other agencies, such as the National Telecommunications and Information Administration (NTIA), do conduct NEPA reviews for such actions.
9. *See* Accelerating Wireless Broadband Deployment by Removing Barriers to Infrastructure Investment ("Infrastructure Order") (WT Docket 17-79, FCC 18-30), (March 22, 2018), 33 FCC Rcd 3102 (4).
10. *See* CTIA blog, March 27, 2018 ctia.org/news/what-is-a-small-cell.
11. 11. *See* Infrastructure Order, Rosenworcel dissenting statement.
12. 12. *Id.*
13. 13. *Id.*
14. *United Keetoowah Band of Cherokee Indians v. FCC*, 933 F. 3d 728 (D.C. Cir. 2019).
15. *Id*. at 741. Between the time the Order was issued and the decision handed down, however, countless small wireless facilities were deployed without NEPA review.
16. Final Programmatic Environmental Assessment for the Antenna Structure Registration Program, FCC (March 13, 2013).
17. *See* 40 CFR §1508.7(cumulative impacts); §1508.8 (b) (effects include cumulative).
18. 47 CFR §1.1306(a).
19. 49 FCC 2d 1313,para. 14(a) (1974); *see also* 47 CFR §1.1306 Note 1. (EA requirements do not "encompass the construction of new submarine cables systems.")
20. *See* In the matter of Public Employees for Environmental Responsibility, FCC 01-319, n. 46.
21. *See* §1501.3; §1508.1(g)(1) (definition of effects includes aesthetic, health, economic, etc.).
22. 47 CFR § 1.1307.
23. 47 CFR §1.1307(a)(6).
24. Declaratory Ruling and Notice of Proposed Rulemaking, In the Matter of Implementation of State and Local Governments' Obligation to Approve Certain Wireless Facility Modification Requests Under Section 6409(a) of the Spectrum Act of 2012, FCC 20-75A (June 9, 2020), paras. 45–50. 35 FCC Rcd 5977.
25. https://broadbandusa.ntia.doc.gov/sites/default/files/2021-07/July%202021%20BB%20Infra%20Webinar_FINAL%20Presentation_0.pdf, p. 23.
26. *See id.* at p. 50.
27. *See generally* 40 CFR §1506.5.
28. *See* letter from Michael S. Fishman, Conservation Biologist, Edgewood Environmental Consulting, to Noelle Rayman USFS biologist, Cortland, NY, November 13, 2020, Re: Determination of Adverse Effects from Wireless EDGE—WEC-NY-23 Cell Tower 90 Carpenter Road, East Fishkill, Dutchess County, NY 41°34'40.37"N, 73°47'03.84"W.
29. *See, e.g.*, Form 601 instructions (https://www.fcc.gov/sites/default/files/fcc-form-601.pdf): Item 22.
30. 30. *See* "FCC Environmental Assessment" (checklist) (undated).
31. *See* 47 CFR §§1.1307(c) and (d).
32. 40 CFR §1506.6 (provide public notice of availability of environmental documents).
33. 40 CFR §1506.6(a).
34. 40 CFR §1506.6 ("provide public notice of NEPA related-hearings … and the availability of environmental documents").
35. wireless2.fcc.gov/UlsApp/AsrSearch/asrApplicationSearch.jsp (application) and wireless2.fcc.gov/UlsApp/AsrSearch/asrApplicationSearch.jsp (environmental notice).
36. wireless2.fcc.gov/UlsApp/AsrSearch/asrApplicationLicense.jsp.
37. In *American Bird Conservancy, v. CTIA*, 516 F.3d 1027, 1033 (D.C. Cir. 2008). the court admonished the FCC for setting too high a standard.
38. *See* 40 CFR §1508.9 (EAs include consideration of alternatives).
39. *See, e.g.,* 49 FCC 2d 1313 (1974), para. 32 ("we have stressed the visual or aesthetic impacts of [such] facilities as their primary environmental effect").
40. *Id.* at para. 14.
41. *See, e.g., id.,* at paras. 18, 23, 27, 28, 32.
42. 986 WL 292182, 60 Rad. Reg. 2d, para. 11 (November 25, 1985).
43. *Id*. at para. 122.
44. AT&T Mobile Services, Inc. Construction of Tower Fort Ransom, North Dakota; Complaints of the Sheyenne River Valley National Scenic Byway, Don Busta, Judith L. Morris, and the North Country Trail Ass'n, Memorandum Opinion and Order, 30 FCC Rcd 11023, 11032, para. 28 (WTB/CIPD 2015).
45. *See* Consent Decree (DA 15-1179) (October 20, 2015).
46. Phoenix Towers International acquired the towers and in 2016, sought to bring them into compliance.
47. 27 FCC Rcd. 2972 (March 29, 2012) (letter to Gregory W. Whitaker from Dan Abeyta, WTB).
48. *See* email from Amy Summe, Shannon and Wilson, to Erica Rosenberg, Assistant Chief, Competition and Infrastructure Policy Division, Wireless Bureau, FCC re: Towers, after-the-fact NEPA compliance, February 14, 2020.
49. *See* email from Michelle Yun, Senior Attorney, Alliant to Jiaming Shang, Attorney Advisor, Wireless Telecommunications Bureau, FCC and attachment "Final Compliance Plan.pdf (May 23, 2017).
50. https://www.fcc.gov/document/fcc-announces-actions-facilitate-ptc-implementation; https://www.indianz.com/News/2014/06/04/tribes-take-role-in-major-rail.asp.
51. *See* ASR No. 1136027, Broward County, West Hollywood Telecommunications facility, filed November 2019 (attached EA).
52. See ASR No. A1062663, Wise Towers, filed December 29, 2016 (attached EA and filings).
53. *See., e.g.,* ASR No. A1179538 (attached EA, dated December 8, 2020, for a 610-foot tower in Weedville, PA indicates that the applicant cleared several acres of sensitive species habitat before completing environmental review). (Appendix III, pp. 17-18).
54. *See, e.g.,* letter to Kenneth Meyers, President and CEO, United States Cellular Corporation from Jeffrey Steinberg, Deputy Chief, CIPD, WTB, June, 16, 2016, re: Violation of FCC Environmental Rules.
55. *See, e.g.,* In re: Western Wireless Corp, FCC 03-109 (May 6, 2003) (tower built near several historic sites and operating in violation of environmental rules fined $200,000). The fine was ultimately rescinded on November 17, 2004.
56. *See* Consent Decree, In re: Fort Myers Broadcasting Company (DA21- 1365) (November 2, 2021).
57. *See* FONSI letter to Brian Fuqua, Greater Chattanooga Public TV Corp from Erica Rosenberg, Assistant Chief, Competition and Infrastructure Policy Division, Wireless Bureau, FCC (April 14, 2021).
58. In 2009, over 1,000 AT&T towers built pre-2001 without NEPA documentation were "cleared." Letter from Jeffrey Steinberg Deputy Chief, SPCD to Jeanine Poltronieri, AT&T (January 16, 2009).
59. 27 FCC Rcd 2972 (March 29, 2012) (letter to Gregory W. Whitaker from Dan Abeyta, WTB, FCC).
60. 40 CFR §100 et seq. (April 20, 2022).
61. *See* 40 CFR §1507.3 (2022).
62. *See id.*

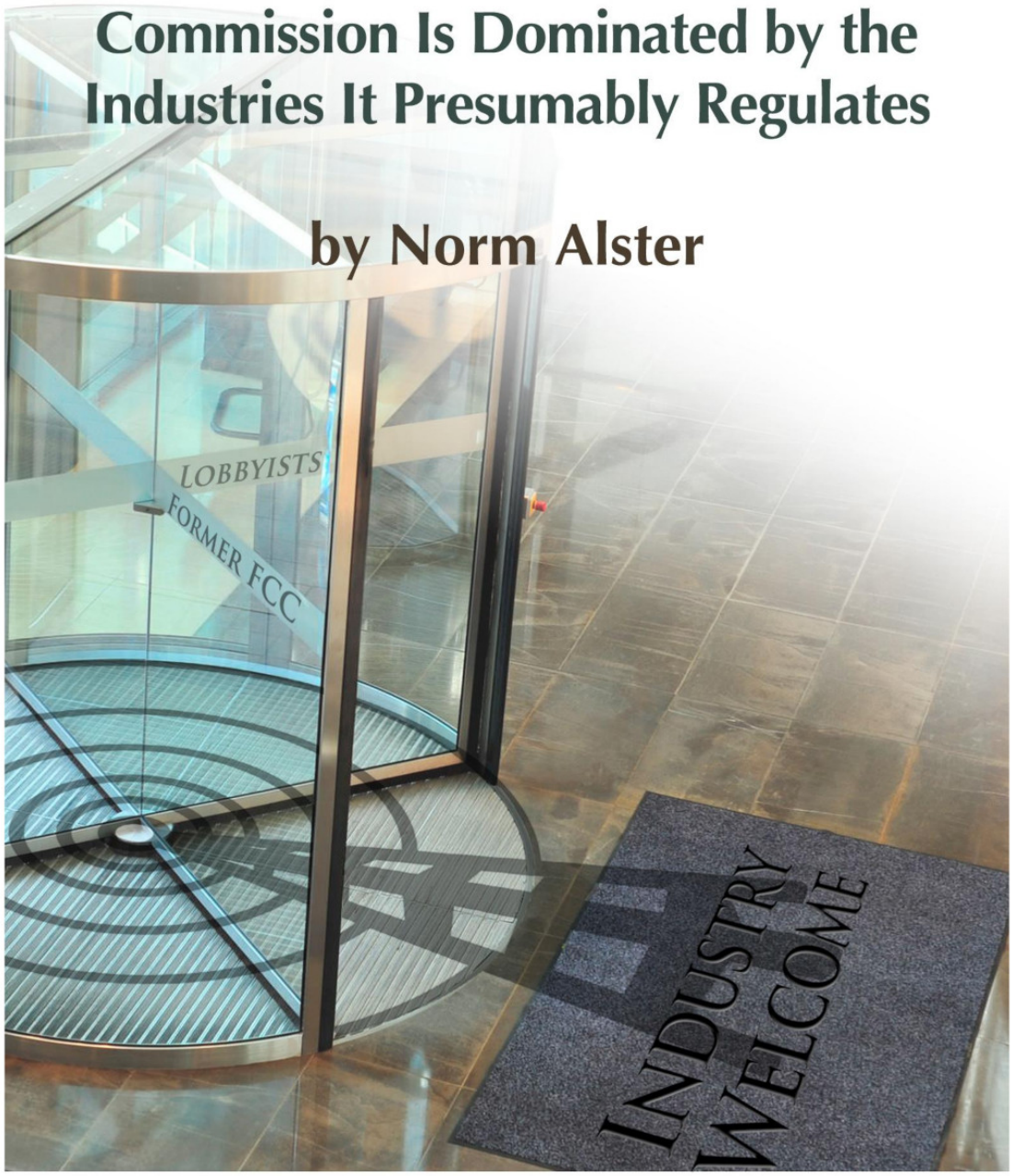
FCC & NEPA: FCC Fails to Protect the Environment Interview With Former FCC Lawyer Erica Rosenberg



Captured Agency:

How the Federal Communications Commission Is Dominated by the Industries It Presumably Regulates

by Norm Alster



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International Commission on the Biological Effects of Electromagnetic Fields (ICBE-EMF)
Environmental Health (2022) 21:92
https://doi.org/10.1186/s12940-022-00900-9

Environmental Health

COMMENT

Open Access

Scientific evidence invalidates health assumptions underlying the FCC and ICNIRP exposure limit determinations for radiofrequency radiation: implications for 5G

International Commission on the Biological Effects of Electromagnetic Fields (ICBE-EMF)*

Abstract

In the late-1990s, the FCC and ICNIRP adopted radiofrequency radiation (RFR) exposure limits to protect the public and workers from adverse effects of RFR. These limits were based on results from behavioral studies conducted in the 1980s involving 40–60-minute exposures in 5 monkeys and 8 rats, and then applying arbitrary safety factors to an apparent threshold specific absorption rate (SAR) of 4 W/kg. The limits were also based on two major assumptions: any biological effects were due to excessive tissue heating and no effects would occur below the putative threshold SAR, as well as twelve assumptions that were not specified by either the FCC or ICNIRP. In this paper, we show how the past 25 years of extensive research on RFR demonstrates that the assumptions underlying the FCC's and ICNIRP's exposure limits are invalid and continue to present a public health harm. Adverse effects observed at exposures below the assumed threshold SAR include non-thermal induction of reactive oxygen species, DNA damage, cardiomyopathy, carcinogenicity, sperm damage, and neurological effects, including electromagnetic hypersensitivity. Also, multiple human studies have found statistically significant associations between RFR exposure and increased brain and thyroid cancer risk. Yet, in 2020, and in light of the body of evidence reviewed in this article, the FCC and ICNIRP reaffirmed the same limits that were established in the 1990s. Consequently, these exposure limits, which are based on false suppositions, do not adequately protect workers, children, hypersensitive individuals, and the general population from short-term or long-term RFR exposures. Thus, urgently needed are health protective exposure limits for humans and the environment. These limits must be based on scientific evidence rather than on erroneous assumptions, especially given the increasing worldwide exposures of people and the environment to RFR, including novel forms of radiation from 5G telecommunications for which there are no adequate health effects studies.

Keywords: Federal Communications Commission (FCC), International commission on non-ionizing radiation protection (ICNIRP), Radiofrequency radiation (RFR), Exposure limits, Exposure assessment, Radiation health effects, Reactive oxygen species (ROS), DNA damage, 5G, Scientific integrity, Cell phone*, Mobile phone*

Introduction

In establishing exposure limits for toxic or carcinogenic agents, regulatory agencies generally set standards that take into account uncertainties of health risks for the general population [1] and for susceptible subgroups such as children [2]. That approach has not been applied in the same way to the setting of exposure limits for

*The terms cell phone and mobile phone are used interchangeably in this commentary; cell phone is the term used in the United States, while mobile phone is the term used in most of Europe.

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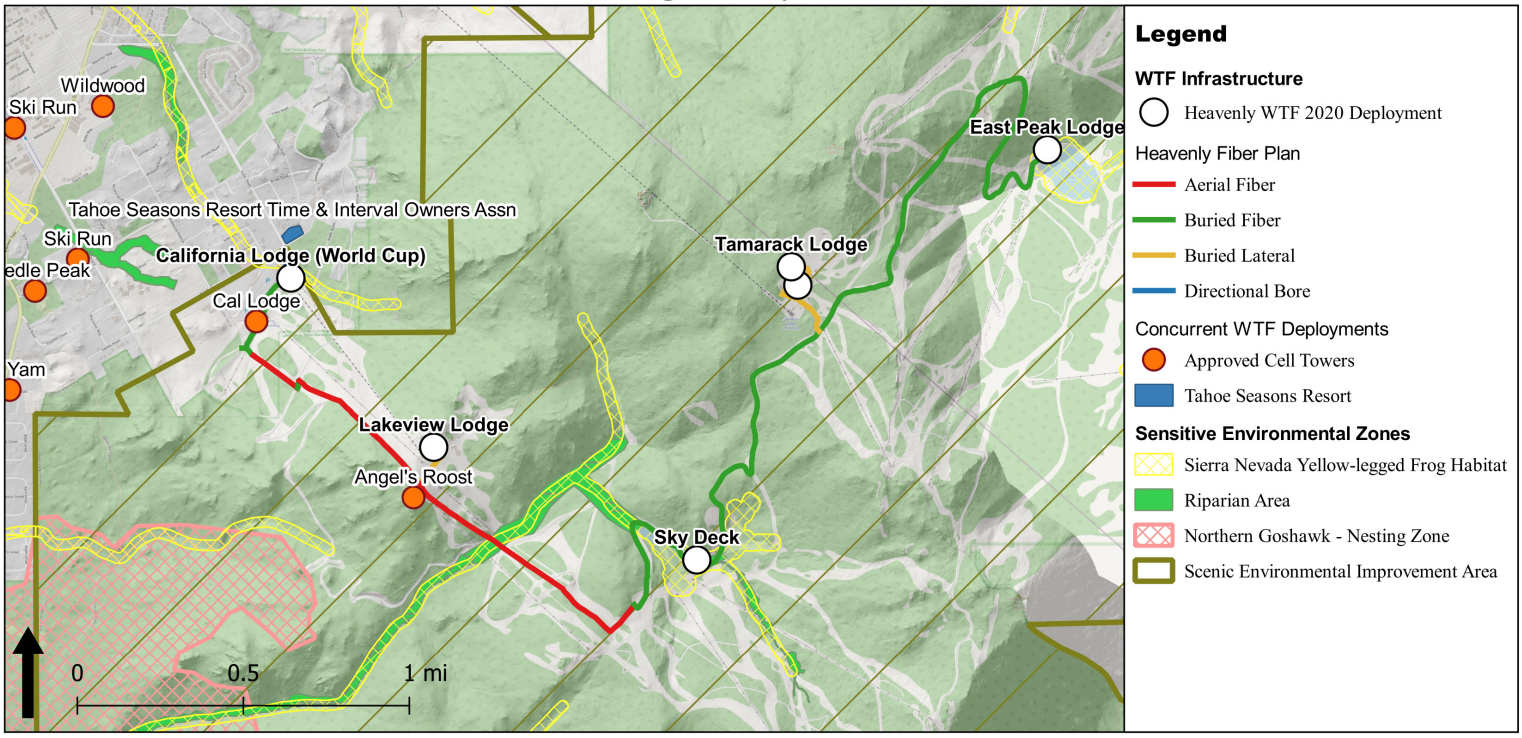
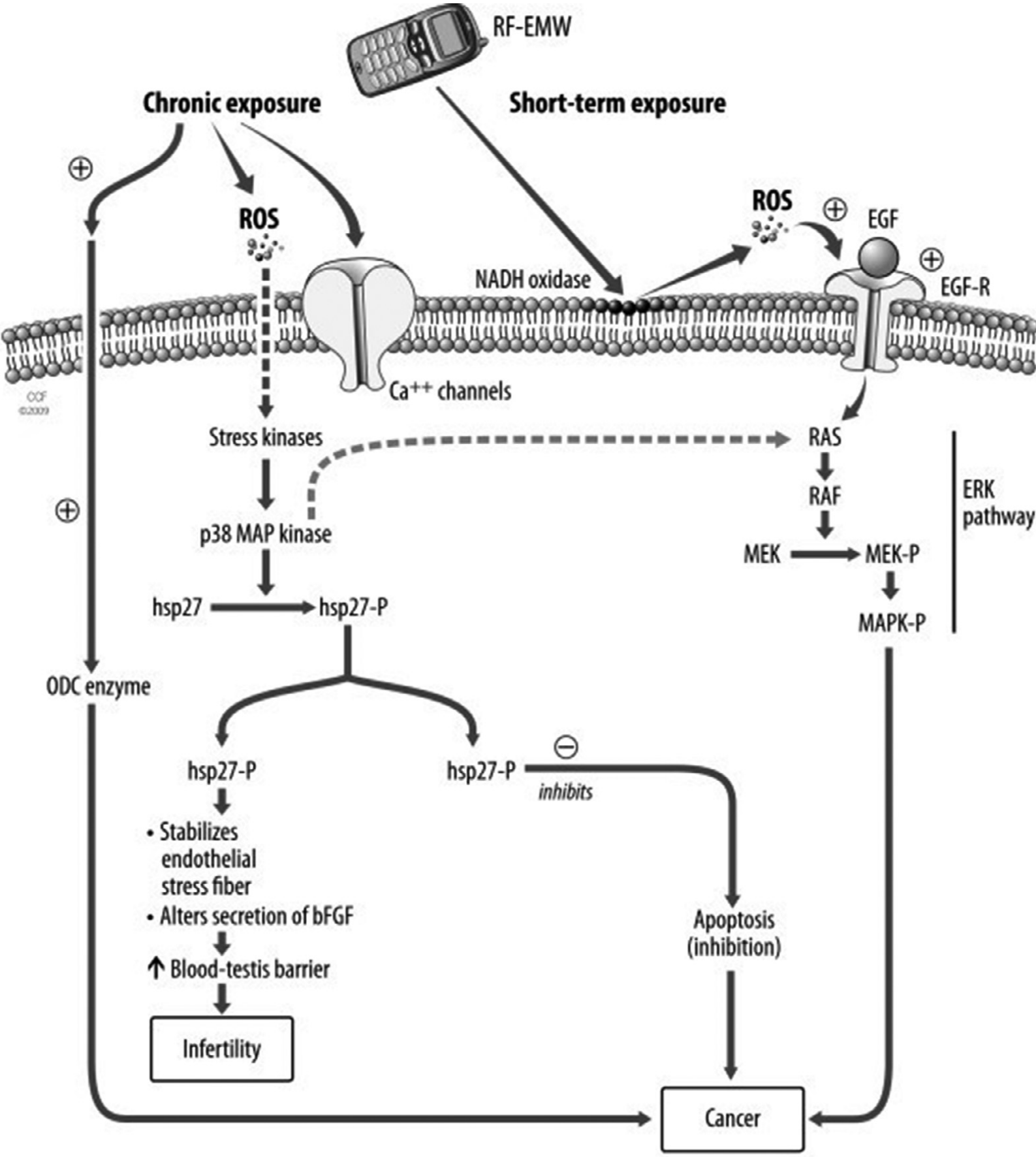
Heavenly Fiber Plan:
Regulatory Issues

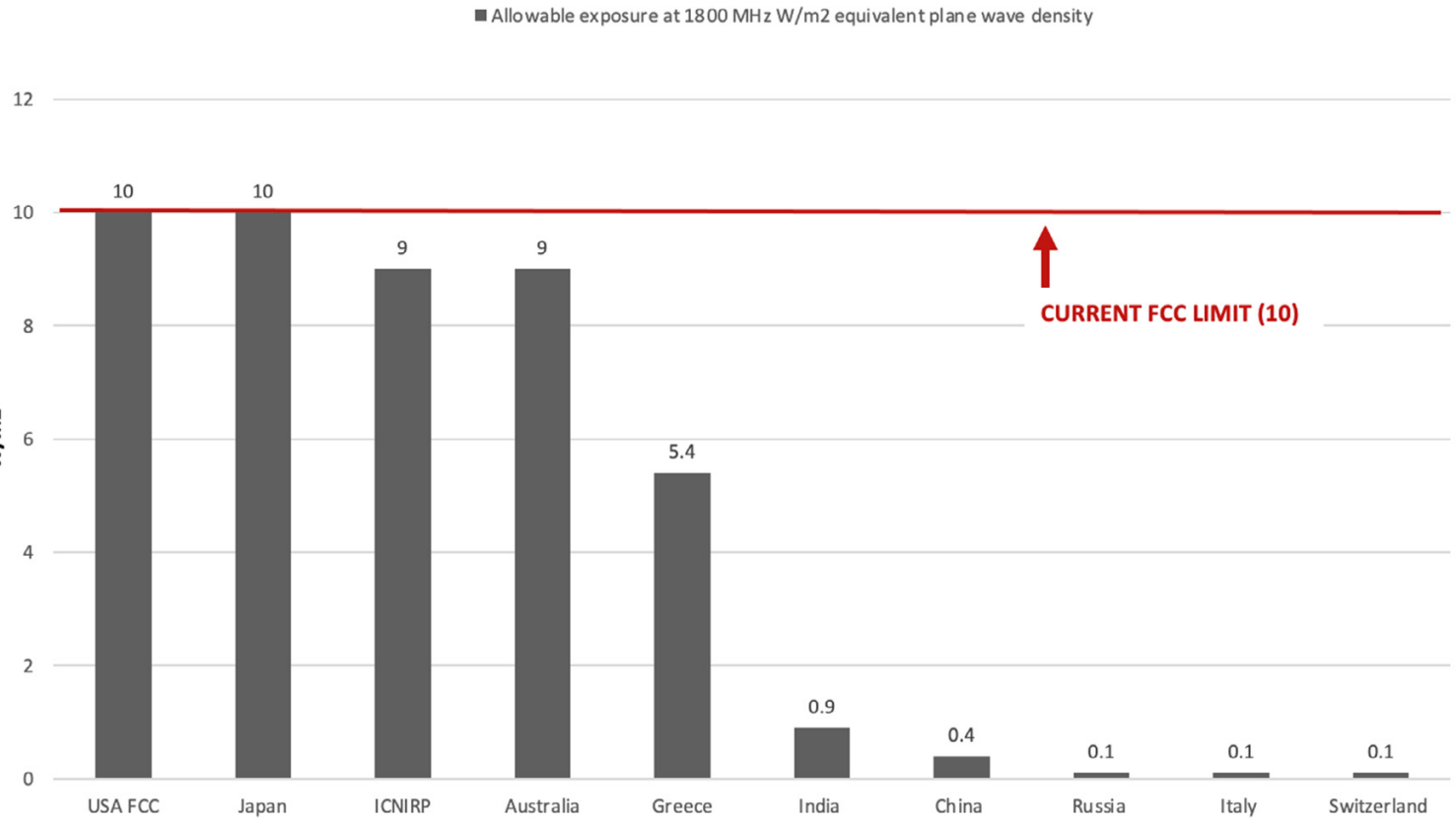


Project May Pose Significant Effect on the Environment

Numerous research studies have found that cell tower radiation causes mortality in frogs and amphibians [*e.g.,* Balmori, Alfonso. (2010). Mobile Phone Mast Effects on Common Frog (*Rana temporaria*) Tadpoles: The City Turned into a Laboratory. *Electromagnetic biology and medicine.* 29. 31-5. DOI: 10.3109/15368371003685363]. A NEPA "categorical exclusion" cannot be issued because there exists substantial evidence that the WTF's may have a significant effect on the environment, particularly an endangered frog and protected birds [36 CFR § 220.6(b)(1)(i),(iii); 50 CFR § 17.11(h); 79 FR 24255; *see also* 16 U.S.C. § 497b; 47 CFR § 1.1307(a)(3); 40 CFR § 1508.8]. The affected area contains substantive habitat for endangered, rare, or threatened species, and could result in significant effects relating to wetlands [50 CFR § 10.13; EO 13186; 16 U.S.C. § 700 et. seq.; *cf.* 14 CCR §§ 15192(d), 15097(c)(2), 15206(b)(4)(A),(b)(5)] or water quality [*cf.* 14 CCR § 15332]. The antennas would expose both nesting and migratory birds—including bald eagles—to radiofrequency radiation in excess of human exposure limits [47 CFR § 1.1310]. The miles of aerial fiber also blight the visual quality of the TRPA designated "Heavenly Valley Ski Resort" Scenic Recreation Environmental Improvement Area. This is an extraordinary Congressionally protected region warranting further analysis and documentation in an EA or an EIS [36 CFR § 220.6(b)(1)(iii); *see also* Public Law 96551; Public Law 96586; EO 13057].


RF-EMW
Chronic exposure
Short-term exposure
ROS
ROS
EGF
EGF-R
NADH oxidase
Ca++ channels
Stress kinases
RAS
RAF
MEK
MEK-P
MAPK-P
ERK pathway
p38 MAP kinase
hsp27
hsp27-P
ODC enzyme
hsp27-P
hsp27-P
inhibits
• Stabilizes endothelial stress fiber
• Alters secretion of bFGF
↑ Blood-testis barrier
Infertility
Apoptosis (inhibition)
Cancer

Radio Frequency Exposure Limits for the General Public, Schools, Homes & Playgrounds For Cell Towers & Wireless Networks.



***Switzerland & Italy**: at places of sensitive use such as apartment buildings, schools, hospitals, permanent workplaces and children's playgrounds and where people stay for hours.

China: Standard cities precautionary principal, encourages companies to take measures to reduce public exposures.

Greece: Limit for 300 meter radius around kindergartens, schools, hostials, and elderly care homes.

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ISSN: (Print) (Online) Journal homepage: https://www.tandfonline.com/loi/venv20

Environmental Procedures at the FCC: A Case Study in Corporate Capture

Erica Rosenberg

To cite this article: Erica Rosenberg (2022) Environmental Procedures at the FCC: A Case Study in Corporate Capture, Environment: Science and Policy for Sustainable Development, 64:5-6, 17-27, DOI: 10.1080/00139157.2022.2131190

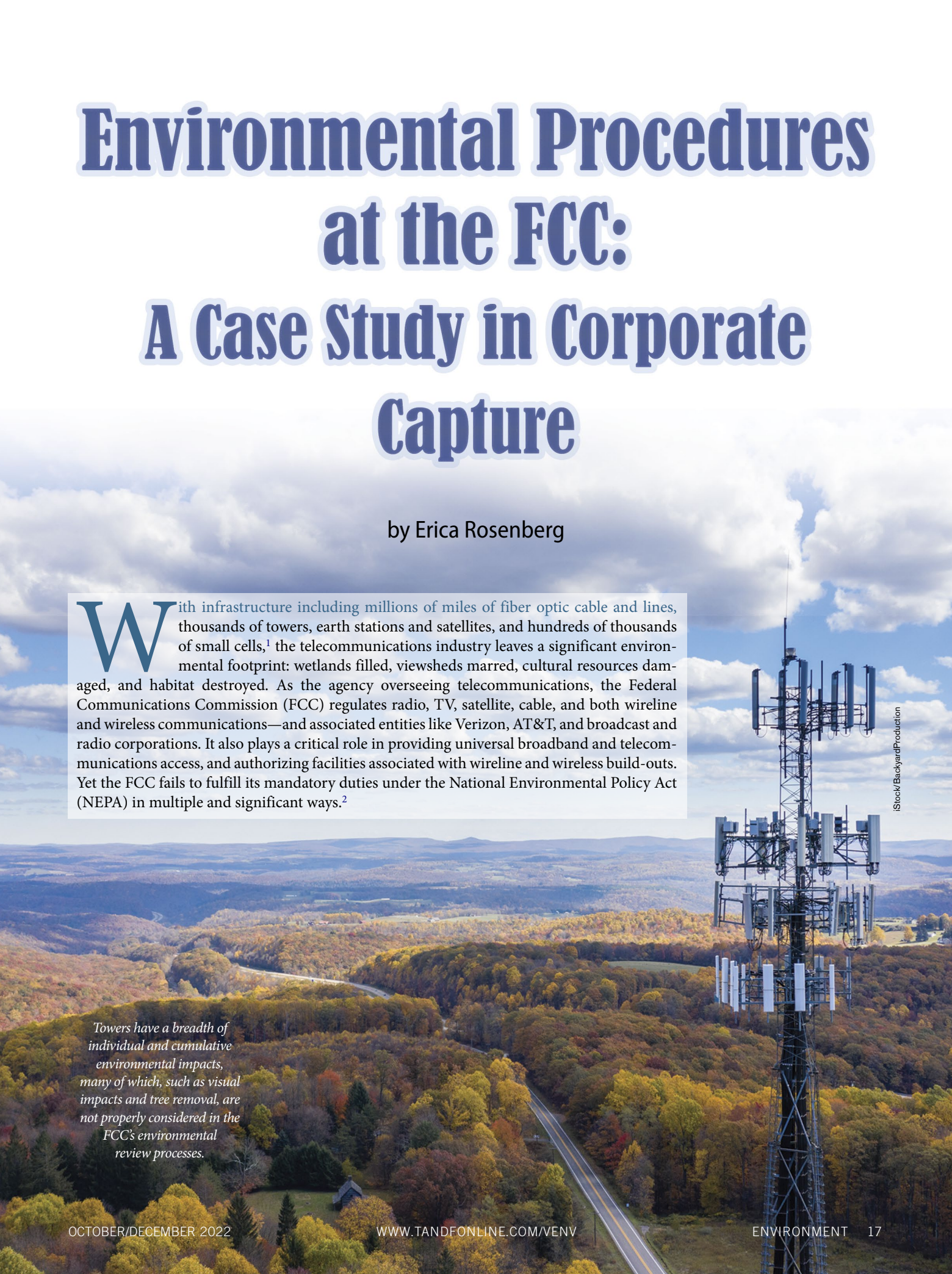
To link to this article: https://doi.org/10.1080/00139157.2022.2131190

Published online: 12 Dec 2022.

Environmental Procedures at the FCC: A Case Study in Corporate Capture

by Erica Rosenberg

With infrastructure including millions of miles of fiber optic cable and lines, thousands of towers, earth stations and satellites, and hundreds of thousands of small cells,[1] the telecommunications industry leaves a significant environmental footprint: wetlands filled, viewsheds marred, cultural resources damaged, and habitat destroyed. As the agency overseeing telecommunications, the Federal Communications Commission (FCC) regulates radio, TV, satellite, cable, and both wireline and wireless communications—and associated entities like Verizon, AT&T, and broadcast and radio corporations. It also plays a critical role in providing universal broadband and telecommunications access, and authorizing facilities associated with wireline and wireless build-outs. Yet the FCC fails to fulfill its mandatory duties under the National Environmental Policy Act (NEPA) in multiple and significant ways.[2]



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Towers have a breadth of individual and cumulative environmental impacts, many of which, such as visual impacts and tree removal, are not properly considered in the FCC's environmental review processes.

Like all federal agencies, the FCC must follow environmental laws, including NEPA, which requires it to assess potential environmental effects of its actions before it authorizes, funds, or licenses projects and communications infrastructure. These effects include visual and ecological impacts, and radio frequency emission exceedances, caused by the proliferation of wireless technology and the networks constructed to deploy it. The agency is supposed to follow legal requirements to assess such environmental impacts and, in doing so, to consider the concerns of communities and citizens.

It does neither. For most deployments it authorizes, the FCC rarely completes any environmental review or makes NEPA documents available to the public; instead, with little FCC oversight or enforcement, industry is delegated the task of determining how much environmental review is appropriate for its deployments and in most cases, is not required to submit documentation of those determinations.

In licensing and authorizing facilities associated with telecommunications, broadband, and broadcasting technologies, the FCC intentionally and routinely fails to meet its environmental obligations and epitomizes "regulatory capture." It treats environmental laws as obstacles to be circumvented or ignored, first by promulgating rules that fall short of what NEPA requires and then by failing to properly implement and enforce its own substandard rules. The chronic failure has cumulative, incalculable, and largely unknown environmental impacts.

Combined with statutory authority that curtails local government authority to regulate or block telecom deployment in their jurisdiction, public and local voices in what is deployed and where are further diminished.[3] Equally important, the agency suppresses and dismisses the voices of communities and citizens concerned about these encroachments. As wireless infrastructure proliferates under the auspices of an agency that flouts federal law, unabated and unaccounted for environmental impacts will only multiply.

NEPA: An Instrument of Democracy and Accountability

NEPA, a Nixon–era law and one emulated around the world, outlines a process for decision-making about "major federal actions, like dam-building, offshore drilling, and highway expansions.[4] Council on Environmental Quality implementing rules define major federal actions broadly to include "new and continuing activities, including programs entirely or partly financed, assisted, conducted or approved by federal agencies." They also include "approval of specific projects, such as construction or management activities located in a defined geographic area. Projects include actions approved by permit or other regulatory decision as well as federal and federally assisted activities."[5]

NEPA requires the government to disclose broadly defined environmental impacts of proposed actions—and to consider alternatives—including not undertaking the action.[6] It allows the public, from local governments to tribes to citizens, to participate in the decision.[7]

The greater the potential environmental impacts of a project, action, or policy, the more analysis and the more opportunities for public input and challenge. NEPA requires a full-scale environmental review (environmental impact statement) for major actions with potentially great environmental effects like a highway, a shorter assessment (environmental assessment) for actions that may have less significant impacts, and exemptions from analysis for categories of routine actions (categorical exclusions), like removing brush, that the agency has determined individually or cumulatively have no significant environmental effect. Although a categorical exclusion may exist for an action, in any given case, extraordinary circumstances such as the presence of environmentally sensitive resources can remove an action from a categorical exclusion and require either a documented categorical exclusion or more NEPA review. For example, even if the United States Forest Service categorically excludes brush removal on small tracts, brush removal in critical habitat for endangered species would require the agency to consider and document that its action would still not require an environmental assessment or conduct an environmental assessment.

As a procedural statute, NEPA cannot stop environmentally harmful projects, but it can substantially improve the imprint of an action by, for example, rerouting a power line to protect a stream, or bringing information about wildlife to light so that licensees can take mitigation measures. In short, NEPA, by mandating transparency and accountability, is an instrument of democracy and good governance. NEPA also requires that agencies promulgate policies or rules implementing NEPA in accordance with Council on Environmental Quality rules, and in consultation with the Council on Environmental Quality.

FCC's Failure to Consider Major Federal Actions

Council on Environmental Quality rules place many of the FCC's licensing and funding activities squarely within the definition of a major federal action. Yet the FCC has construed major federal actions narrowly or has simply not considered whether its actions are major federal actions. Consequently, the agency has not considered actions like providing financial assistance to carriers for deployment of small cells and build-outs with associated cable-laying and transmission lines as major federal actions.[8]

In 2018, the agency went as far as to deem all licensing of small cell facilities, which it authorizes as part of a license to carriers, as not requiring environmental review because they were not major federal actions.[9] Termed by industry as unobtrusive—"smaller than a pizza box or backpack"[10]—small cell facilities can be significantly larger and are placed on buildings or associated poles. In its order, the agency both eliminated federal environmental review of small cells and significantly limited local authority over small wireless infrastructure deployment.

In her dissent to the order, FCC Commissioner Jessica Rosenworcel noted that 5G would require millions of miles of fiber and up to 800,000 small

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The FCC is authorizing the deployment of hundreds of thousands of small cells with little public input or environmental review.

cells by 2026. The order thus "runs roughshod over the rights of our Tribal communities and gives short shrift to our most basic environmental and historic preservation values."[11] She noted that the Mobility Fund, which supports carriers in bringing wireless services to underserved areas, would support updated wireless service, to the tune of $4.53 billion. Yet in effect, she states, the FCC reads "projects carried out with financial assistance" (a requirement of the National Historic Preservation Act) as well as NEPA out of the law.[12] It also "removes many larger wireless facilities from environmental oversight."[13]

The FCC's efforts to eliminate small cell review were struck down by the D.C. Circuit in *United Keetoowah v. FCC*,[14] a case brought by the Natural Resources Defense Council and several tribes. The court found: "The scale of the deployment the FCC seeks to facilitate, particularly given its exemption of small cells that require new construction, makes it impossible on this record to credit the claim that small cell deregulation will 'leave little to no environmental footprint. *Order* ¶ 41.'"[15]

Appropriately, the FCC considers licensing spectrum and registering towers to be major federal actions that trigger NEPA. However, while the FCC recognizes that its grant of geographic licenses to carriers triggers NEPA, it issues the licenses without any knowledge of how the licensee will deploy infrastructure in its build-out. In most cases, it cannot know because the carrier may not have finalized its build-out plans for construction of towers, transmission lines, and small cell facilities over time. In fact, the agency does not prepare and never has prepared an environmental impact statement on a build out—or on any other major federal action; it has only prepared one programmatic environmental assessment, which was in response to a lawsuit.[16] Instead, it requires NEPA review only on a facility-by-facility basis, which also circumvents a NEPA requirement to consider cumulative effects.[17] Segmenting a project into smaller components is illegal, and the FCC's approach is another way it flouts the law.

FCC's Inadequate NEPA Rules

FCC NEPA rules undermine NEPA at every turn—they are inadequate both as written and as implemented. The rules' unusual structure and an agency that interprets its rules in favor of the carriers mean that most projects proceed without adequate environmental review and consideration.

Unlike other agencies' rules, FCC rules do not identify categories of actions that do not require further NEPA review; rather, the rules categorically exclude *all* actions the agency takes except for those that meet a limited set of itemized extraordinary circumstances.[18] In other

Wireless infrastructure is changing the character of historic buildings and neighborhoods.

instances, the FCC deems its actions categorically excluded. For example, construction of submarine cables, which indisputably has potentially significant environmental impacts to reefs, ocean floors, and marine life, is explicitly excluded from review following a 1974 FCC order asserting that the environmental consequences are negligible.[19]

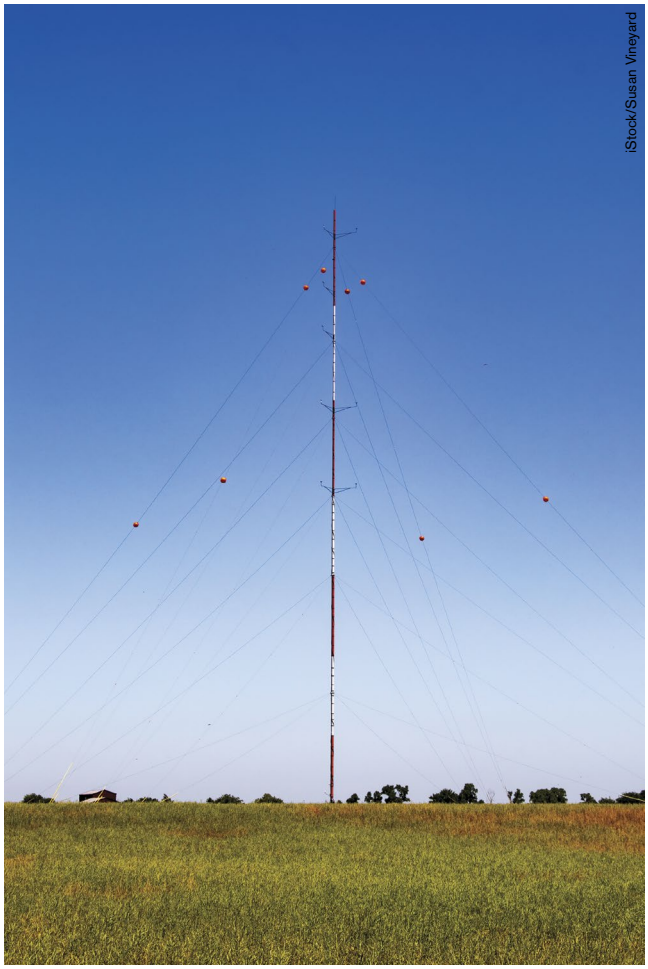
In dismissing the petition brought by an environmental nongovernmental organization to require more environmental review for a number of FCC actions, including those involving submarine cables, the 1974 order acknowledged environmental damage from cables in Maine and the U.S. Virgin Islands but illogically found no need for environmental review because the projects violated state law and permits.[20]

By not considering FCC actions major federal actions and by relying on a broad and unsupported categorical exclusion, countless activities with potentially significant environmental impacts or actual impacts proceed with little or no NEPA review or public involvement. Unlike many agencies, FCC lacks a NEPA coordinating office and most bureaus within the agency have no NEPA expertise or even awareness of the obligations the statute confers on the agency.

Streamlined Effects: The NEPA Checklist

The agency also skirts its NEPA obligations through its procedures and practice around "effects" consideration. It defines effects narrowly and by doing so, removes actions from public notice and comment. Most egregiously, it delegates the initial consideration of effects to applicants and licensees—telecom companies, for the most part—to determine whether an environmental assessment is warranted or whether the project is categorically excluded, and because the review is not submitted to the FCC, it typically performs no subsequent review of the applicants' documentation.

Council on Environmental Quality regulations define effects broadly.[21] FCC rules and practices limit the consideration of environmental effects. They also limit the extraordinary circumstances that would warrant a higher level of environmental review (i.e., an environmental assessment) and public input for the action—through both its narrow list of circumstances and its narrow interpretation of those circumstances. Those limited circumstances are actions involving facilities that: may affect Indian cultural sites or historic resources (i.e., National Historical Preservation Act triggers); may affect threatened or endangered species or their habitat; may involve significant changes in surface features (such as to wetlands or forests); are in a floodplain if equipment is not raised; exceed radio frequency emissions limitations; involve high-intensity lights in residential areas; are in wilderness areas or wildlife



Tall, guyed towers kill millions of birds a year.

refuges; or are more than 450 feet tall in light of potential impacts to migratory birds.[22] These circumstances are referred to as "the NEPA checklist."

Even so, FCC has in effect gutted most elements of the checklist. For example, for the floodplain trigger,[23] as long as equipment is raised for a facility in a floodplain, no environmental assessment is required, although no evidence of raising the equipment or a local permit need be submitted. Although required by Council on Environmental Quality (which unfortunately approved the 2018 rule change), no cumulative effects of building in floodplains are considered. Similarly, applicants often fail to submit an environmental assessment when they have received a federal or state wetlands permit, so again, no evidence is submitted to the agency or for public review.

To eliminate another environmental assessment trigger, rule changes in 2020 allow projects that affect historic properties and cultural resources to proceed without an environmental assessment.[24] "Change in surface features" has in practice required consideration of wetlands impacts (i.e., whether a federal permit is needed), rather than considering large-scale vegetation or soil removal, or grading of sensitive habitats. Thus, even if several acres are bulldozed or dozens of trees cleared, an environmental assessment is not required.

A comprehensive NEPA review for telecommunications infrastructure is both possible and required by other agencies. For instance, the National Telecommunications and Information Administration, which also supports expanding broadband access and adoption, considers a breadth of effects under NEPA that the FCC's checklist fails to consider.[25] National Telecommunications and Information Administration, for example, requires consideration of cumulative effects.[26]

Delegation of Review: Fox Guarding the Hen House

Even more extraordinary than its failure to consider a breadth of environmental effects for most of its actions is the FCC's delegation of consideration of environmental effects to the applicant or licensee. In other words, self-interested parties conduct the NEPA checklist environmental review. Under Council on Environmental Quality rules, the federal agency is ultimately responsible for the environmental document, regardless of who prepares it.[27] Yet under FCC procedures, the agency never even sees the

initial environmental review documenting that a categorical exclusion, rather than a more extensive environmental review, is supported—except in the unlikely event it requests checklist documentation following a complaint.

No other agency allows the applicant to make the initial determination of whether a project is categorically excluded or requires an environmental assessment. Other agencies require submission of documentation of that determination or make the determination themselves. Instead, the FCC relies on applicants to be truthful in their dealings with the agency—yet rarely if ever has it enforced against applicants who make false statements on its forms. Applicants submit documentation only when checklist review triggers an environmental assessment. This approach to ensuring compliance with the NEPA rule is at best unrealistic and at worst, a license to deceive.

No FCC oversight ensures that applicants have done their due diligence to consider the checklist circumstances properly or to even review the circumstances at all. With no agency or public awareness, applicants can simply categorically exclude their projects that involve even larger scale impacts. In East Fishkill, New York, for example, more than 50 trees were cleared from a forested area along a highway known for its scenic views, with no environmental assessment.[28]

Incorrect, confusing, or inadequate filing instructions further ensure that the applicant's work will be incomplete.[29] The instructions themselves fail to even reflect the inadequate rules because they omit Endangered Species Act considerations, do not capture National Historical Preservation Association requirements, omit wetlands concerns, and include outdated floodplain requirements. Similarly, NEPA checklist guidance used until June 2022 did not even reflect the rules on environmental assessment triggers or environmental assessment content requirements.[30]

The checklist allows for only a very narrow set of environmental assessment triggers. In theory, FCC rules do allow for consideration of non-checklist effects or effects missed in the checklist review—those raised by members of the public and those raised by the FCC on its own motion.[31] In reality, this almost never happens. The FCC inevitably fails to consider some potentially significant effects outside of the checklist because it relies entirely on the public to identify them, it never initiates its own review, it relies on self-interested applicants to review projects, and it views its mission as facilitating deployment.

Lack of Notice and Public Availability of Documents

Limiting notice and public availability of documents is another way the agency fails to meet fundamental NEPA responsibilities. Council on Environmental Quality rules require both notice of

The effects of cell towers in sensitive areas like coastal zones and wetlands are not fully considered in the FCC's NEPA process.

actions and opportunities for public comment.[32] In fact, the rules require that agencies make "diligent efforts" to involve the public in implementing their NEPA procedures.[33] Instead, the FCC makes diligent efforts to exclude the public from raising concerns under NEPA.

Applicants and licensees submit no documentation of their determination that their project is categorically excluded, and the agency does not track categorically excluded actions. With the applicant conducting the initial environmental review of whether the project is categorically excluded by assessing the list of extraordinary circumstances (i.e., the NEPA checklist), as well as preparing the environmental assessment, the burden falls on the public to learn of the proposed action and to raise a potential effect.

But categorically excluded actions, including authorization of certain towers, do not receive public notice; only applications for towers that require registration (generally taller than 199 feet) are put on notice, and those may or may not have associated environmental assessments. In addition to towers under 200 feet not posing an air hazard, these stealth projects that the agency has no record of include small wireless facilities associated with 4G and 5G.

That the public has no access to this information is particularly problematic in the radio frequency context, where applicants are required to meet radio frequency emissions standards or submit an environmental assessment. If the applicants do analyze the checklist and radio frequency studies at all, they routinely categorically exclude small wireless facilities, despite growing public concern about radio frequency associated with such technologies. Without access to the documented checklist, the public has little to no basis on which to refute or comment on checklist conclusions on radio frequency. And given the streamlined process, citizens often find out about facilities only after they are built.

Lack of Transparency: Notice of EAs

While the public is completely disenfranchised on categorically excluded projects, the situation with environmental assessments is only slightly better. If an environmental assessment is required because the applicant identified a trigger on the NEPA checklist, the tower or other structure must be registered. But it is not the environmental assessment itself that is publicly noticed—it is the application for the tower registration or license modification. The notice serves only to notice for 30 days that an application for an antenna structure at a particular location has been submitted. Members of the public interested in that structure must track down the application in the antenna structure registration system and then see whether an environmental assessment is attached. To find environmental assessments that are "accessible," a member of the public would have to know that a proposed antenna structure registration included an environmental assessment.

Hence, notice is hardly "public." Rather than being posted on a readily accessible, centralized site for NEPA documents,[34] the registration application and the associated environmental assessment, if done, are buried in a hard-to-access, byzantine website.[35] Without project coordinates or an exact site location, it is difficult to get into the website and, once in, to find the environmental documents. To complicate matters further, environmental assessments associated with licensee towers that do not need to be registered (i.e., short towers) are noticed separately and are buried on a different webpage.[36]

Comments Deemed "Complaints"

Even if the public manages to overcome FCC hurdles and ascertain information about a proposed facility, it faces nearly insurmountable obstacles to get its concerns heard or addressed. Under NEPA, the burden of looking at effects is a federal obligation—it is not up to the public to establish a case but merely to apprise the agency of potential effects to consider; the comment period allows the agency to meet its NEPA obligations by giving the public an opportunity to raise effects or alternatives not considered in the environmental review process.

But rather than a standard, fair, or open comment process in which the agency considers and responds to concerns raised by the public, the FCC administers an adversarial complaints process that requires the public to meet a high burden of proof about a potential effect that may have been overlooked in the checklist or inaccurately documented.[37] With a process that unfairly shifts the burden of raising and establishing environmental concerns from the agency to the public, the outcome is always the same. The FCC virtually never finds that complaints are valid. To dismiss them or resolve them in the applicant's favor so that the project can proceed, it routinely finds that the complainant has not provided specific enough detail or an adequate scientific showing for the agency to consider an effect.

Compounding the unlikelihood that the public will learn about a project and be able to weigh in is a timing issue. When the public finds out about a project that the applicant has deemed categorically excluded (either by doing the checklist or failing to do the checklist), there is no timeline to comment on or complain about the project. With no notice and no timeline for these projects that proceed with no agency awareness, the public often learns about the projects when construction begins or, just as likely, when the facility is already built.

Because the applicant need not consider aesthetics, for example, a tower visible from a state park could be deemed categorically excluded and built before the public sees the impact to its viewshed. Rarely, if ever, will the FCC decide an environmental assessment is required under the circumstances because the applicant ostensibly did what was required of it by assessing the minimal checklist. Furthermore, in terms of failure to comply with NEPA, environmental assessments are submitted so late in the process that a meaningful alternatives analysis—a hallmark and requirement of NEPA[38]—is foreclosed.

Aesthetic Effects: The Greatest Impacts Never Addressed

Perhaps most egregious is the agency's approach to aesthetic impacts.

Applicants should be required to consider aesthetic impacts because, by the FCC's own account in its rulemaking, visual impacts are by far the most significant impact a tower could have.[39] As originally promulgated, FCC's NEPA regulations triggered an environmental assessment when facilities were to be located "in areas which are recognized either nationally or locally for their special scenic or recreational value."[40] Again and again in the rulemaking, visual effects were cited as the greatest impact, as well as an impact to be mitigated.[41] Yet in 1985, the FCC decided the standard was "unduly vague," and that it was unnecessary for applicants to submit environmental assessments in cases that "may raise aesthetic concerns."[42] It also noted that "aesthetic concerns may more appropriately be resolved by local, state, regional or local land use authorities"[43]—although NEPA is an independent federal obligation.

On the rare occasion when the FCC does consider aesthetics, its examination is generally limited to consideration of impacts to nationally designated scenic trails and historic sites (the latter falling under visual effects under National Historical Preservation Association) or to national parks, although nothing in NEPA or Council on Environmental Quality rules limits consideration of aesthetic impacts solely to those designated areas. This practice precludes consideration of impacts to, for example, scenic tourist areas or state or locally designated battlefields and parks. In 2014, AT&T built a tower in Fort Ransom, North Dakota, visible from a nearby National Scenic Tail and Scenic Byway, without having to consider aesthetic impacts.[44] Towers have been built in the viewsheds of, for example, a National Scenic Trail in Vergennes, Michigan, an iconic bridge in New York, a civil rights site in Selma, Alabama, and on Dewey Beach, Delaware's sand dunes, with little notice, consideration of visual impacts, or mitigation.

Little Compliance, Little Enforcement

With no oversight to ensure applicants have done the due diligence required to consider the checklist and no on-the-ground inspections, lack of compliance with the rules is rampant

Large-scale projects with multiple facilities built without NEPA review include hundreds of towers in Alaska built by GCI.[45] Between 2001 and 2015, T-Mobile built hundreds of towers in 22 states without environmental review.[46] In New Mexico and Texas, Plateau Telecommunications built 58 towers with no National Historical Preservation Association review.[47] Telalaska built 28 towers near and in sensitive areas in Alaska with no repercussions.[48] With no Enforcement Bureau action, the Wireless Telecommunications Bureau and Alliant Energy Corporation agreed in 2017 to a compliance plan after Alliant built 109 towers and 93 poles without NEPA review.[49] Railroad noncompliance was so widespread that the FCC entered into a settlement agreement with several railroads that created a $10 million cultural resources fund for 11,000 constructed poles that had not gone thru National Historical Preservation Association or NEPA review.[50]

Smaller-scale projects and individual towers also have significant impacts. For example, in 2019, licensees in Broward County, Florida, cleared 36 trees and built a driveway through a forested wetland before completing environmental review.[51] In Sabana Grande, Puerto Rico, a tower builder in 2014 bulldozed critical habitat for an endangered bird.[52] Dozens of sacred sites have been similarly destroyed or damaged across the country, as have multiple cultural resources and historic and archaeological sites.

Although towers can alter iconic views, the FCC does not require licensees to consider aesthetic impacts.

Cell towers are altering and marring views across the country.

Many of these failures to comply with environmental requirements come to light as National Historical Preservation Association violations, rather than as NEPA violations, because the National Historical Preservation Association process, as part of the checklist, requires photo documentation and official state and tribal review. Complaints from these officials or the public and self-reporting—often unintentionally with photos submitted through increasingly rare environmental assessment submissions[53]—are generally the sole bases for enforcement.

Conveniently for an agency intent on deployment, the FCC's Enforcement Bureau operates under a one-year statute of limitations—one year from the time the facility was built, not from when the agency learned of the violation. As a result, by the time the agency learns of the violation and decides to take action, it is often prohibited from levying fines against the violator.

When the agency does take action, it amounts, with few exceptions, to a slap on the wrist. In 2016, six licensees got admonishment letters with no penalties and little agency publicity.[54] For the past decade or so, Wireless Telecommunications Bureau admonishment letters, which number from zero to six per year, warn of the potential for increased fines and punishments if violators break rules again. But the agency could not fine the violators and does not track the letters. Fines are rare and if levied, de minimis.[55] At most, penalties are ordered once or twice a year, and tower removal, which would be a reasonable and authorized remedy for violations, is never ordered.

In one instance, clearing guy-wire areas for a 1,500-foot broadcast tower in Punta Gorda, Florida, destroyed 2.6 acres of treed habitat for bonneted bats, an endangered species. As mitigation, the applicant paid $28,000 to the U.S. Fish and Wildlife Service, while the FCC issued a Finding of No Significant Impact and imposed a fine of $28,000.[56]

Ex Post Facto NEPA: A Concept Not Contemplated by NEPA

To address instances of noncompliance, the agency has instead devised an ex post facto NEPA process under which the violators conduct and submit an after-the-fact checklist or environmental assessment. If an environmental assessment is required, these half-built or fully built projects then receive the FONSIs that are a prerequisite for construction. Enforcement action may, but more likely will not, follow; with no repercussions, a 485-foot broadcast tower in Chattanooga, Tennessee, was built and operating for months before it got its FONSI in 2021.[57]

Since 2002, the agency has used a clearance process for noncompliant towers (i.e., those that have not gone through the National Historical Preservation Association and NEPA process).[58] For example, on March 28, 2012, the FCC "cleared" with a post-construction review the 58 towers that Plateau Telecommunications had built in violation of historic preservation procedures.[59] Other elements of the requisite NEPA review were ignored—and are often ignored in this process.

Regardless, NEPA may not be done retroactively, and the substantive value of this follow-up exercise is unclear. It

Beyond visual impacts, cell towers built in pristine areas can affect sensitive species and ecosystems.

is hard to assess damage to a site never evaluated for the presence of, for example, wetlands, sensitive species, historic resources, or sacred sites before clearing took place. More importantly, given the dearth of documentation, little means for the agency to discover violations, and lack of oversight at the agency, it is unclear just how many projects that impact environmentally sensitive areas are constructed with improper or no checklist review, or get started without waiting for a FONSI to construct; most of the sites where environmental damage occurred and the degree of destruction will never be known.

By routinely clearing towers with post-construction checklist reviews, the agency creates incentives for tower companies and carriers to build their towers and, if necessary, do paperwork later. Given the lax enforcement and the statute of limitations issue, this approach from industry's perspective would be quite reasonable.

Conclusion: Prospects for a More Accountable FCC

Clearly, the FCC's NEPA process falls short of what NEPA and Council on Environmental Quality require.

- It ignores major federal actions requiring environmental review, such as its distribution to industry of billions of dollars that support build-outs for updated wireless service, or improperly deems certain major federal actions nonmajor federal actions to circumvent NEPA.
- Its NEPA rules create an unsupported and overbroad categorical exclusion so that, for example, satellite licensing and submarine cable licensing are excluded from review.
- With little oversight or tracking, it delegates environmental review of NEPA determinations to industry proponents of the project.
- It fails to vigorously enforce its rules so that industry noncompliance is rampant.
- It fails to provide adequate notice and opportunities for public comment.
- It fails to make environmental documents, including radio frequency emissions studies, publicly available or readily accessible.
- It routinely ignores or dismisses public comments and concerns and places an unfair burden of proof on the public when it raises concerns.

These practices serve to facilitate deployment for carriers while ignoring environmental rules and the public. Besides environmental costs, the FCC's approach bespeaks a lack of transparency

and accountability that undermines good governance and erodes democracy. It also bespeaks an agency completely captured by the entities it is tasked with regulating.

Recent Biden-era NEPA implementing rules[60] require agencies to revisit their NEPA rules and procedures by September 2023.[61] They also require that the agencies have the capacity to comply with NEPA,[62] something the FCC has to date lacked. Perhaps when Council on Environmental Quality reviews the FCC's procedures this time, it will scrutinize the rules more carefully and hold the agency to a higher standard for NEPA compliance.

An environmental and public lands policy attorney with over 30 years of experience, including in agencies, Congress, and academia, **Erica Rosenberg** worked at the FCC's Wireless Telecommunications Bureau from 2014 to 2021; for the last six of those years, she was Assistant Chief of the Competition and Infrastructure Policy Division.

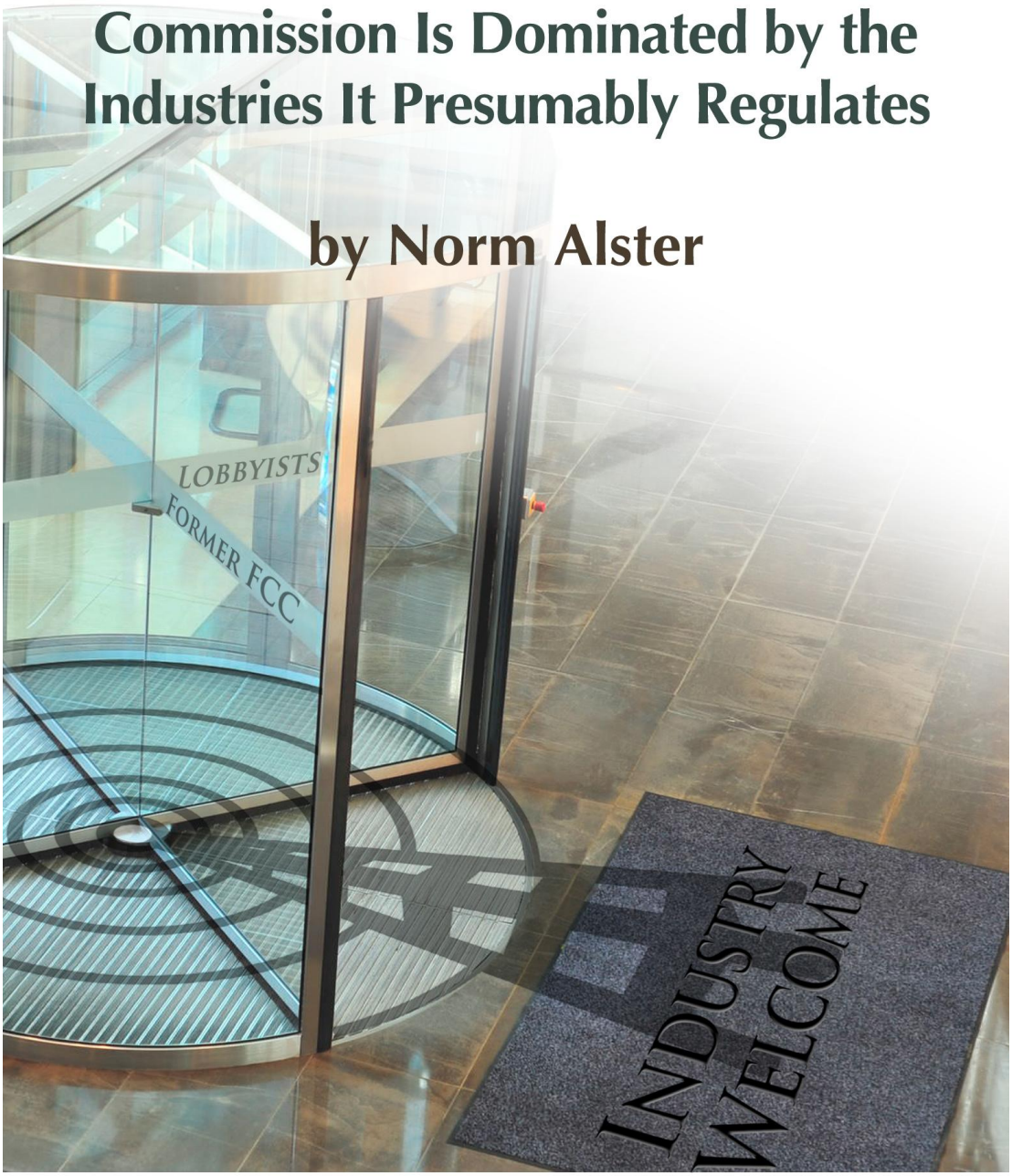
NOTES

1. Unlike macro-cells or wireless cell towers, a small cell installation consists of radio equipment and antennas placed every few meters on structures such as streetlights, buildings, or poles.
2. 42 U.S.C. §4371 *et seq*.
3. Telecommunications Act of 1996, Section 704, 47 U.S.C §332.
4. 40 CFR §1508.18 (1978). Note: Unless otherwise noted, NEPA regulations cited are 1978 regulations (i.e., pre-Trump and Biden-era regulations). The FCC was bound by those regulations until April 2022.
5. 40 CFR §1508.18.
6. 40 CFR §1508.8.
7. 40 CFR §§1501.2(d)2), 1.1501.7((a)(1), 1.1503.1, 1.1506.6.
8. Other agencies, such as the National Telecommunications and Information Administration (NTIA), do conduct NEPA reviews for such actions.
9. *See* Accelerating Wireless Broadband Deployment by Removing Barriers to Infrastructure Investment ("Infrastructure Order") (WT Docket 17-79, FCC 18-30), (March 22, 2018), 33 FCC Rcd 3102 (4).
10. *See* CTIA blog, March 27, 2018 ctia.org/news/what-is-a-small-cell.
11. 11. *See* Infrastructure Order, Rosenworcel dissenting statement.
12. 12. *Id.*
13. 13. *Id.*
14. *United Keetoowah Band of Cherokee Indians v. FCC,* 933 F. 3d 728 (D.C. Cir. 2019).
15. *Id.* at 741. Between the time the Order was issued and the decision handed down, however, countless small wireless facilities were deployed without NEPA review.
16. Final Programmatic Environmental Assessment for the Antenna Structure Registration Program, FCC (March 13, 2013).
17. *See* 40 CFR §1508.7(cumulative impacts); §1508.8 (b) (effects include cumulative).
18. 47 CFR §1.1306(a).
19. 49 FCC 2d 1313,para. 14(a) (1974); *see also* 47 CFR §1.1306 Note 1. (EA requirements do not "encompass the construction of new submarine cables systems.")
20. *See* In the matter of Public Employees for Environmental Responsibility, FCC 01-319, n. 46.
21. *See* §1501.3; §1508.1(g)(1) (definition of effects includes aesthetic, health, economic, etc.).
22. 47 CFR § 1.1307.
23. 47 CFR §1.1307(a)(6).
24. Declaratory Ruling and Notice of Proposed Rulemaking, In the Matter of Implementation of State and Local Governments' Obligation to Approve Certain Wireless Facility Modification Requests Under Section 6409(a) of the Spectrum Act of 2012, FCC 20-75A (June 9, 2020), paras. 45–50. 35 FCC Rcd 5977.
25. https://broadbandusa.ntia.doc.gov/sites/default/files/2021-07/July%202021%20BB%20Infra%20Webinar_FINAL%20Presentation_0.pdf, p. 23.
26. *See id.* at p. 50.
27. *See generally* 40 CFR §1506.5.
28. *See* letter from Michael S. Fishman, Conservation Biologist, Edgewood Environmental Consulting, to Noelle Rayman USFS biologist, Cortland, NY, November 13, 2020, Re: Determination of Adverse Effects from Wireless EDGE—WEC-NY-23 Cell Tower 90 Carpenter Road, East Fishkill, Dutchess County, NY 41°34'40.37"N, 73°47'03.84"W.
29. *See, e.g.*, Form 601 instructions (https://www.fcc.gov/sites/default/files/fcc-form-601.pdf): Item 22.
30. 30. *See* "FCC Environmental Assessment" (checklist) (undated).
31. *See* 47 CFR §§1.1307(c) and (d).
32. 40 CFR §1506.6 (provide public notice of availability of environmental documents).
33. 40 CFR §1506.6(a).
34. 40 CFR §1506.6 ("provide public notice of NEPA related-hearings … and the availability of environmental documents").
35. wireless2.fcc.gov/UlsApp/AsrSearch/asrApplicationSearch.jsp (application) and wireless2.fcc.gov/UlsApp/AsrSearch/asrApplicationSearch.jsp (environmental notice).
36. wireless2.fcc.gov/UlsApp/AsrSearch/asrApplicationLicense.jsp.
37. In *American Bird Conservancy, v. CTIA*, 516 F.3d 1027, 1033 (D.C. Cir. 2008). the court admonished the FCC for setting too high a standard.
38. *See* 40 CFR §1508.9 (EAs include consideration of alternatives).
39. *See, e.g.,* 49 FCC 2d 1313 (1974), para. 32 ("we have stressed the visual or aesthetic impacts of [such] facilities as their primary environmental effect").
40. *Id.* at para. 14.
41. *See, e.g., id.,* at paras. 18, 23, 27, 28, 32.
42. 986 WL 292182, 60 Rad. Reg. 2d, para. 11 (November 25, 1985).
43. *Id*. at para. 122.
44. AT&T Mobile Services, Inc. Construction of Tower Fort Ransom, North Dakota; Complaints of the Sheyenne River Valley National Scenic Byway, Don Busta, Judith L. Morris, and the North Country Trail Ass'n, Memorandum Opinion and Order, 30 FCC Rcd 11023, 11032, para. 28 (WTB/CIPD 2015).
45. *See* Consent Decree (DA 15-1179) (October 20, 2015).
46. Phoenix Towers International acquired the towers and in 2016, sought to bring them into compliance.
47. 27 FCC Rcd. 2972 (March 29, 2012) (letter to Gregory W. Whitaker from Dan Abeyta, WTB).
48. *See* email from Amy Summe, Shannon and Wilson, to Erica Rosenberg, Assistant Chief, Competition and Infrastructure Policy Division, Wireless Bureau, FCC re: Towers, after-the-fact NEPA compliance, February 14, 2020.
49. *See* email from Michelle Yun, Senior Attorney, Alliant to Jiaming Shang, Attorney Advisor, Wireless Telecommunications Bureau, FCC and attachment "Final Compliance Plan.pdf (May 23, 2017).
50. https://www.fcc.gov/document/fcc-announces-actions-facilitate-ptc-implementation; https://www.indianz.com/News/2014/06/04/tribes-take-role-in-major-rail.asp.
51. *See* ASR No. 1136027, Broward County, West Hollywood Telecommunications facility, filed November 2019 (attached EA).
52. See ASR No. A1062663, Wise Towers, filed December 29, 2016 (attached EA and filings).
53. *See., e.g.,* ASR No. A1179538 (attached EA, dated December 8, 2020, for a 610-foot tower in Weedville, PA indicates that the applicant cleared several acres of sensitive species habitat before completing environmental review). (Appendix III, pp. 17-18).
54. *See, e.g.,* letter to Kenneth Meyers, President and CEO, United States Cellular Corporation from Jeffrey Steinberg, Deputy Chief, CIPD, WTB, June, 16, 2016, re: Violation of FCC Environmental Rules.
55. *See, e.g.,* In re: Western Wireless Corp, FCC 03-109 (May 6, 2003) (tower built near several historic sites and operating in violation of environmental rules fined $200,000). The fine was ultimately rescinded on November 17, 2004.
56. *See* Consent Decree, In re: Fort Myers Broadcasting Company (DA21- 1365) (November 2, 2021).
57. *See* FONSI letter to Brian Fuqua, Greater Chattanooga Public TV Corp from Erica Rosenberg, Assistant Chief, Competition and Infrastructure Policy Division, Wireless Bureau, FCC (April 14, 2021).
58. In 2009, over 1,000 AT&T towers built pre-2001 without NEPA documentation were "cleared." Letter from Jeffrey Steinberg Deputy Chief, SPCD to Jeanine Poltronieri, AT&T (January 16, 2009).
59. 27 FCC Rcd 2972 (March 29, 2012) (letter to Gregory W. Whitaker from Dan Abeyta, WTB, FCC).
60. 40 CFR §100 et seq. (April 20, 2022).
61. *See* 40 CFR §1507.3 (2022).
62. *See id.*

Captured Agency:

How the Federal Communications Commission Is Dominated by the Industries It Presumably Regulates

by Norm Alster



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How the Federal Communications Commission Is Dominated by the Industries It Presumably Regulates

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Published by:
Edmond J. Safra Center for Ethics
Harvard University
124 Mount Auburn Street, Suite 520N
Cambridge, MA 02138 USA
http://www.ethics.harvard.edu/

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Chapter One: The Corrupted Network

Renee Sharp seemed proud to discuss her spring 2014 meeting with the Federal Communications Commission.

As research director for the non-profit Environmental Working Group, Sharp doesn't get many chances to visit with the FCC. But on this occasion she was able to express her concerns that lax FCC standards on radiation from wireless technologies were especially hazardous for children.

The FCC, however, should have little trouble dismissing those concerns.

Arguing that current standards are more than sufficient and that children are at no elevated risk from microwave radiation, wireless industry lobbyists don't generally have to set up appointments months in advance. They are at the FCC's door night and day.

Indeed, a former executive with the Cellular Telecommunications Industry Association (CTIA), the industry's main lobbying group, has boasted that the CTIA meets with FCC officials "500 times a year."[1]

Sharp does not seem surprised. "There's no question that the government has been under the influence of industry. The FCC is a captured agency," she said.[2]

Captured agency.

That's a term that comes up time and time again with the FCC. Captured agencies are essentially controlled by the industries they are supposed to regulate. A detailed look at FCC actions—and non-actions—shows that over the years the FCC has granted the wireless industry pretty much what it has wanted. Until very recently it has also granted cable what it wants. More broadly, the FCC has again and again echoed the lobbying points of major technology interests.

Money—and lots of it—has played a part. The National Cable and Telecommunications Association (NCTA) and CTIA have annually been among Washington's top lobbying spenders. CTIA alone lobbied on at least 35 different Congressional bills through the first half of 2014. Wireless market leaders AT&T and Verizon work through CTIA. But they also do their own lobbying, spending nearly $15 million through June of 2014, according to data from the Center for Responsive Politics (CRP). In all, CTIA, Verizon, AT&T, T-Mobile USA, and Sprint spent roughly $45 million lobbying in 2013. Overall, the Communications/Electronics sector is one of Washington's super heavyweight lobbyists, spending nearly $800 million in 2013-2014, according to CRP data.

But direct lobbying by industry is just one of many worms in a rotting apple. The FCC sits at the core of a network that has allowed powerful moneyed interests with limitless access a variety of ways to shape its policies, often at the expense of fundamental public interests.

As a result, consumer safety, health, and privacy, along with consumer wallets, have all been overlooked, sacrificed, or raided due to unchecked industry influence. The cable industry has consolidated into giant local monopolies that control pricing while leaving consumers little choice over content selection. Though the FCC has only partial responsibility, federal regulators have allowed the Internet to grow into a vast hunting grounds for criminals and commercial interests: the go-to destination for the surrender of personal information, privacy and identity. Most insidious of all, the wireless industry has been allowed to grow unchecked and virtually unregulated, with fundamental questions on public health impact routinely ignored.

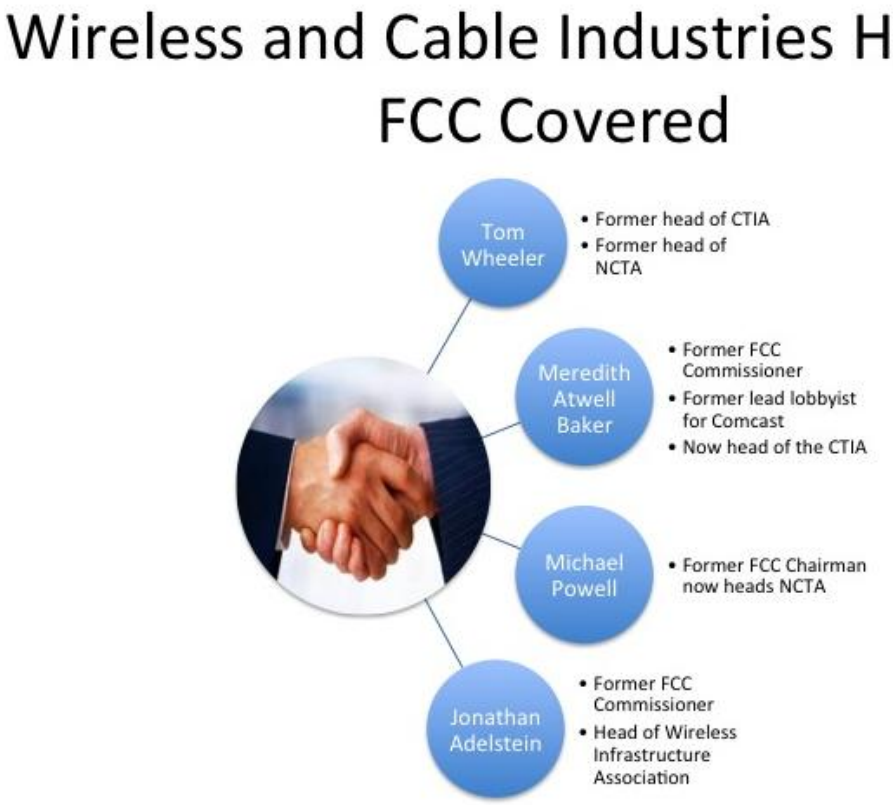
Industry controls the FCC through a soup-to-nuts stranglehold that extends from its well-placed campaign spending in Congress through its control of the FCC's Congressional oversight committees to its persistent agency lobbying. "If you're on a committee that regulates industry you'll be a major target for industry," said Twaun Samuel, chief of staff for Congresswoman Maxine Waters.[3] Samuel several years ago helped write a bill aimed at slowing the revolving door. But with Congress getting its marching orders from industry, the bill never gained any traction.

Industry control, in the case of wireless health issues, extends beyond Congress and regulators to basic scientific research. And in an obvious echo of the hardball tactics of the tobacco industry, the wireless industry has backed up its economic and political power by stonewalling on public relations and bullying potential threats into submission with its huge standing army of lawyers. In this way, a coddled wireless industry intimidated and silenced the City of San Francisco, while running roughshod over local opponents of its expansionary infrastructure.

On a personal level, the entire system is greased by the free flow of executive leadership between the FCC and the industries it presumably oversees. Currently presiding over the FCC is Tom Wheeler, a man who has led the two most powerful industry lobbying groups: CTIA and NCTA. It is Wheeler who once supervised a $25 million industry-funded research effort on wireless health effects. But when handpicked research leader George Carlo concluded that wireless radiation did raise the risk of brain tumors, Wheeler's CTIA allegedly rushed to muffle the message. "You do the science. I'll take care of the politics," Carlo recalls Wheeler saying.[4]

Wheeler over time has proved a masterful politician. President Obama overlooked Wheeler's lobbyist past to nominate him as FCC chairman in 2013. He had, after all, raised more than $700,000 for Obama's presidential campaigns. Wheeler had little trouble earning confirmation from a Senate whose Democrats toed the Presidential line and whose Republicans understood Wheeler was as industry-friendly a nominee as they could get. And while Wheeler, at the behest of his Presidential sponsor, has taken on cable giants with his plans for net neutrality and shown some openness on other issues, he has dug in his heels on wireless.

Newly ensconced as chairman of the agency he once blitzed with partisan pitches, Wheeler sees familiar faces heading the industry lobbying groups that ceaselessly petition the FCC. At CTIA, which now calls itself CTIA - The Wireless Association, former FCC commissioner Meredith Atwell Baker is in charge.



And while cell phone manufacturers like Apple and Samsung, along with wireless service behemoths like Verizon and AT&T, are prominent CTIA members, the infrastructure of 300,000 or more cellular base stations and antenna sites has its own lobbying group: PCIA, the Wireless Infrastructure Association. The President and CEO of PCIA is Jonathan Adelstein, another former FCC commissioner. Meanwhile, the cable industry's NCTA employs former FCC chairman Michael Powell as its president and CEO. Cozy, isn't it?

FCC commissioners in 2014 received invitations to the Wireless Foundation's May 19th Achievement Awards Dinner. Sounds harmless, but for the fact that the chief honoree at the dinner was none other than former wireless lobbyist but current FCC Chairman Tom Wheeler. Is this the man who will act to look impartially at the growing body of evidence pointing to health and safety issues?

The revolving door also reinforces the clout at another node on the industry-controlled influence network. Members of congressional oversight committees are prime targets of

industry. The cable industry, for example, knows that key legislation must move through the Communications and Technology Subcommittee of the House Energy and Commerce Committee. Little wonder then that subcommittee chairman Greg Walden was the second leading recipient (after Speaker John Boehner) of cable industry contributions in the last six years (through June 30, 2014). In all, Walden, an Oregon Republican, has taken over $108,000 from cable and satellite production and distribution companies.[5] But he is not alone. Six of the top ten recipients of cable and satellite contributions sit on the industry's House oversight committee. The same is true of senators on the cable oversight committee. Committee members were six of the ten top recipients of campaign cash from the industry.[6]

Cable & Satellite Campaign Contributions

Top House Recipients Funded

Recipient	Amount
John A. Boehner	$135,425
Greg Walden	$108,750
Bob Goodlatte	$93,200
John Conyers Jr.	$84,000
Mike Coffman	$82,137
Fred Upton	**$73,500**
Lee Terry	**$65,916**
Henry A. Waxman	**$65,000**
Cory Gardner	**$64,500**
Anna G. Eshoo	**$60,500**

Cellular Industry Campaign Contributions

Top House Recipients Funded

Recipient	Amount
Henry A. Waxman	**$41,500**
Scott H. Peters	$40,300
Greg Walden	**$35,750**
Fred Upton	**$32,250**
Bob Goodlatte	$31,250
Lee Terry	**$29,600**
Anna G. Eshoo	**$27,000**
Doris O. Matsui	**$25,500**
John Shimkus	**$24,000**
Peter J. Roskam	$21,100

Cable & Satellite Campaign Contributions

Top Senate Recipients Funded

Recipient	Amount
Edward J. Markey	**$320,500**
Kirsten E. Gillibrand	$194,125
Mitch McConnell	$177,125
Harry Reid	$175,600
Charles E. Schumer	$175,450
Mark L. Pryor	**$172,950**
Michael F. Bennet	$159,000
Richard Blumenthal	**$148,800**
Claire McCaskill	**$138,185**
Mark Udall	$136,625

Cellular Industry Campaign Contributions

Top Senate Recipients Funded

Recipient	Amount
Edward J. Markey	**$155,150**
Mark R. Warner	$74,800
Harry Reid	$73,600
Mark L. Pryor	**$71,900**
Roy Blunt	**$57,400**
John McCain	$56,261
Charles E. Schumer	$53,300
Roger F. Wicker	$51,300
Barbara Boxer	$49,578
Kelly Ayotte	$43,333

The compromised FCC network goes well beyond the revolving door and congressional oversight committees. The Washington social scene is one where money sets the tone and throws the parties. A look at the recent calendar of one current FCC commissioner shows it would take very disciplined and almost saintly behavior on the part of government officials to resist the lure of lavishly catered dinners and cocktail events. To paraphrase iconic investigative journalist I.F. Stone, if you're going to work in Washington, bring your chastity belt.

All that free liquor, food and conviviality translates into the lobbyist's ultimate goal: access. "They have disproportionate access," notes former FCC commissioner Michael Copps. "When you are in a town where most people you see socially are in industry, you don't have to ascribe malevolent behavior to it," he added.[7]

Not malevolent in motive. But the results can be toxic. And blame does not lie solely at the feet of current commissioners. The FCC's problems predate Tom Wheeler and go back a long way.

Indeed, former Chairman Newton Minow, enduringly famous for his 1961 description of television as a "vast wasteland," recalls that industry manipulation of regulators was an issue even back then. "When I arrived, the FCC and the communications industry were both regarded as cesspools. Part of my job was to try to clean it up."[8]

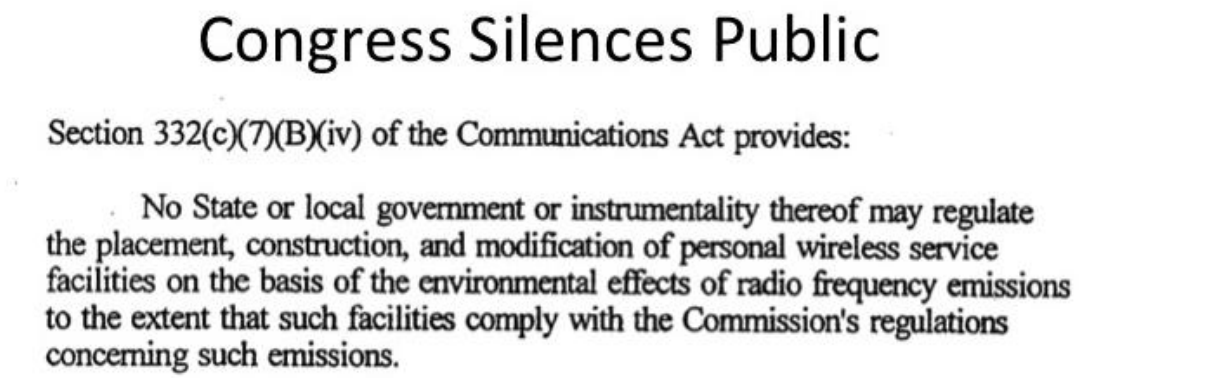
More than 50 years later, the mess continues to pile up.

Chapter Two: Just Don't Bring Up Health

Perhaps the best example of how the FCC is tangled in a chain of corruption is the cell tower and antenna infrastructure that lies at the heart of the phenomenally successful wireless industry.

It all begins with passage of the Telecommunications Act of 1996, legislation once described by South Dakota Republican senator Larry Pressler as "the most lobbied bill in history." Late lobbying won the wireless industry enormous concessions from lawmakers, many of them major recipients of industry hard and soft dollar contributions. Congressional staffers who helped lobbyists write the new law did not go unrewarded. Thirteen of fifteen staffers later became lobbyists themselves.[9]

Section 332(c)(7)(B)(iv) of the Act remarkably—and that adverb seems inescapably best here—wrests zoning authority from local governments. Specifically, they cannot cite health concerns about the effects of tower radiation to deny tower licenses so long as the towers comply with FCC regulations.



In preempting local zoning authority—along with the public's right to guard its own safety and health— Congress unleashed an orgy of infrastructure build-out. Emboldened by the government green light and the vast consumer appetite for wireless technology, industry has had a free hand in installing more than 300,000 sites. Church steeples, schoolyards, school rooftops, even trees can house these facilities.

Is there any reason to believe that the relatively low level radiofrequency emissions of these facilities constitute a public health threat? Certainly, cell phones themselves, held close to the head, have been the focus of most concern on RF emissions. Since the impact of RF diminishes with distance, industry advocates and many scientists dismiss the possibility that such structures pose health risks.

But it's not really that simple. A troubling body of evidence suggests exposure to even low emission levels at typical cellular frequencies between 300 MHz and 3 GHz can have a wide range of negative effects.

In a 2010 review of research on the biological effects of exposure to radiation from cell tower base stations, B. Blake Levitt and Henry Lai found that "some research does exist to warrant caution in infrastructure siting."[10] They summarized the results on one 2002 study that compared the health of 530 people living at various distances within 300 meters of cell towers with a control group living more than 300 meters away. "Results indicated increased symptoms and complaints the closer a person lived to a tower. At <10 m, symptoms included nausea, loss of appetite, visual disruptions, and difficulties in moving. Significant differences were observed up through 100 m for irritability, depressive tendencies, concentration difficulties, memory loss, dizziness, and lower libido."[11]

A 2007 study conducted in Egypt found similar results. Levitt and Lai report, "Headaches, memory changes, dizziness, tremors, depressive symptoms, and sleep disturbance were significantly higher among exposed inhabitants than controls."[12]

Beyond epidemiological studies, research on a wide range of living things raises further red flags. A 2013 study by the Indian scientists S. Sivani and D. Sudarsanam reports: "Based on current available literature, it is justified to conclude that RF-EMF [electro magnetic fields] radiation exposure can change neurotransmitter functions, blood-brain barrier, morphology, electrophysiology, cellular metabolism, calcium efflux, and gene and protein expression in certain types of cells even at lower intensities."[13]

The article goes on to detail the effects of mobile tower emissions on a wide range of living organisms: "Tops of trees tend to dry up when they directly face the cell tower antennas. . . . A study by the Centre for Environment and Vocational Studies of Punjab University noted that embryos of 50 eggs of house sparrows were damaged after being exposed to mobile tower radiation for 5-30 minutes. . . . In a study on cows and calves on the effects of exposure from mobile phone base stations, it was noted that 32% of calves developed nuclear cataracts, 3.6% severely."[14]

Does any of this constitute the conclusive evidence that would mandate much tighter control of the wireless infrastructure? Not in the estimation of industry and its captured agency. Citing other studies—often industry-funded—that fail to establish health effects, the wireless industry has dismissed such concerns. The FCC has typically echoed that position.

Keep in mind that light regulation has been one factor in the extraordinary growth of wireless—CTIA says exactly that in a Web post that credits the Clinton Administrations light regulatory touch.

July 25, 2013

CTIA BLOG

CTIA is an international nonprofit trade association that has represented the wireless communications industry since 1984.

But our position as the world's leader was no accident. It started with the Clinton Administration that had the foresight to place a "light regulatory touch" on the wireless industry, which was in its infancy at the time. That light touch has continued through multiple Administrations.

Obviously, cellular technology is wildly popular because it offers many benefits to consumers. But even allowing for that popularity and for the incomplete state of science, don't some of these findings raise enough concern to warrant some backtracking on the ham-fisted federal preemption of local zoning rights?

In reality, since the passage of the 1996 law, the very opposite has occurred. Again and again both Congress and the FCC have opted to stiffen—rather than loosen—federal preemption over local zoning authority. In 2009, for example, the wireless industry convinced the FCC to impose a "shot clock" that requires action within 90 days on many zoning applications. "My sense is that it was an industry request," said Robert Weller, who headed up the FCC's Office of Engineering and Technology when the shot clock was considered and imposed.[15]

And just last November, the FCC voted to further curb the rights of local zoning officials to control the expansion of antenna sites Again and again, Congress and the FCC have extended the wireless industry carte blanche to build out infrastructure no matter the consequences to local communities.

The question that hangs over all this: would consumers' embrace of cell phones and Wi-Fi be quite so ardent if the wireless industry, enabled by its Washington errand boys, hadn't so consistently stonewalled on evidence and substituted legal intimidation for honest inquiry? (See Appendix for online study of consumer attitudes on wireless health and safety.)

Document searches under the Freedom of Information Act reveal the central role of Tom Wheeler and the FCC in the tower siting issue. As both lobbyist and FCC chairman, Wheeler has proved himself a good friend of the wireless industry.

In January of 1997, CTIA chieftain Wheeler wrote FCC Wireless Telecommunications Bureau Chief Michele C. Farquhar citing several municipal efforts to assert control over siting. Wheeler, for example, asserted that one New England state had enacted a law requiring its Public Service Commissioner to issue a report on health risks posed by wireless facilities.[16] He

questions whether such a study—and regulations based on its results—would infringe on FCC preemption authority.

FCC bureau chief Farquhar hastily reassured Wheeler that no such study could be consulted in zoning decisions. "Therefore, based on the facts as you have presented them, that portion of the statute that directs the State Commissioner to recommend regulations based upon the study's findings would appear to be preempted,"[17] the FCC official wrote to Wheeler. She emphasized that the state had the right to do the study. It just couldn't deny a siting application based on anything it might learn.

The FCC in 1997 sent the message it has implicitly endorsed and conveyed ever since: study health effects all you want. It doesn't matter what you find. The build-out of wireless cannot be blocked or slowed by health issues.

Now let's fast forward to see Wheeler on the other side of the revolving door, interacting as FCC chairman with a former FCC commissioner who is now an industry lobbyist.

A March 14, 2014 letter[18] reveals the chummy relationship between Wheeler and former commissioner Jonathan Adelstein, now head of PCIA, the cellular infrastructure lobbying group. It also references FCC Chairman Wheeler seeking policy counsel from lobbyist Adelstein:

Wheeler Still Willing to Help

From: Jonathan Adelstein [mailto:adelstein@pcia.com]
Sent: Friday, March 14, 2014 12:24 PM
To: [redacted]
Cc: Renee Gregory; Jonathan Campbell
Subject: How to Spur Wireless Broadband Deployment

Tom – It was great to see you the other night at the FCBA event, and wonderful to see how much fun you're having (if that's the right word). I know I enjoyed my time there (thanks to your help with Daschle in getting me that role in the first place!).

Thanks for asking how we think the FCC can help spur wireless broadband deployment. The infrastructure proceeding perfectly tees up many of the top issues the FCC needs to address. As you requested, I've summarized briefly in the attached letter some of the key steps you can take now.

"Tom – It was great to see you the other night at the FCBA event, and wonderful to see how much fun you're having (if that's the right word). I know I enjoyed my time there (thanks to your help with Daschle in getting me that role in the first place!)."

"Thanks for asking how we think the FCC can help spur wireless broadband deployment," the wireless lobbyist writes to the ex-wireless lobbyist, now running the FCC.

Adelstein's first recommendation for FCC action: *"Amend its rules to categorically exclude DAS and small deployments* [Ed. note: these are compact tower add-ons currently being widely deployed] *from environmental and historic review."* Adelstein outlined other suggestions for further limiting local antenna zoning authority and the FCC soon did its part. Late last year, the agency proposed new rules that largely (though not entirely) complied with the antenna industry's wish list.

James R. Hobson is an attorney who has represented municipalities in zoning issues involving the FCC. He is also a former FCC official, who is now of counsel at Best, Best and Krieger, a Washington-based municipal law practice. "The FCC has been the ally of industry," says Hobson. Lobbyist pressure at the FCC was intense even back in the 70s, when he was a bureau chief there. "When I was at the FCC, a lot of my day was taken up with appointments with industry lobbyists." He says of the CTIA that Wheeler once headed: "Their reason for being is promoting the wireless industry. And they've been successful at it."[19]

The FCC's deferential compliance has allowed industry to regularly bypass and if necessary steamroll local authorities. Violation of the FCC-imposed "shot clock," for example, allows the wireless license applicant to sue.

The FCC's service to the industry it is supposed to regulate is evidently appreciated. The CTIA web site, typically overflowing with self-congratulation, spreads the praise around in acknowledging the enabling contributions of a cooperative FCC. In one brief summation of its own glorious accomplishments, CTIA twice uses the word "thankfully" in describing favorable FCC actions.

In advancing the industry agenda, the FCC can claim that it is merely reflecting the will of Congress. But the agency may not be doing even that.

Remember the key clause in the 96 Telecom Act that disallowed denial of zoning permits based on health concerns? Well, federal preemption is granted to pretty much any wireless outfit on just one simple condition: its installations must comply with FCC radiation emission standards. In view of this generous carte blanche to move radiation equipment into neighborhoods, schoolyards and home rooftops, one would think the FCC would at the very least diligently enforce its own emission standards. But that does not appear to be the case.

Indeed, one RF engineer who has worked on more than 3,000 rooftop sites found vast evidence of non-compliance. Marvin Wessel estimates that "10 to 20% exceed allowed radiation standards."[20] With 30,000 rooftop antenna sites across the U.S. that would mean that as many as 6,000 are emitting radiation in violation of FCC standards. Often, these emissions can be 600% or more of allowed exposure levels, according to Wessel.

Antenna standards allow for higher exposure to workers. In the case of rooftop sites, such workers could be roofers, painters, testers and installers of heating and air conditioning

equipment, to cite just a few examples. But many sites, according to Wessel, emit radiation at much higher levels than those permitted in occupational standards. This is especially true of sites where service providers keep adding new antenna units to expand their coverage. "Some of these new sites will exceed ten times the allowable occupational radiation level," said Wessel.[21] Essentially, he adds, this means that nobody should be stepping on the roof.

"The FCC is not enforcing its own standard," noted Janet Newton, who runs the EMF Policy Institute, a Vermont-based non-profit. That group several years ago filed 101 complaints on specific rooftop sites where radiation emissions exceeded allowable levels. "We did this as an exercise to hold the FCC's feet to the fire," she said. But the 101 complaints resulted in few responsive actions, according to Newton.[22]

Former FCC official Bob Weller confirms the lax—perhaps negligible is the more appropriate word—FCC activity in enforcing antenna standards. "To my knowledge, the enforcement bureau has never done a targeted inspection effort around RF exposure," he said.[23] Budget cuts at the agency have hurt, limiting the FCC's ability to perform field inspections, he added. But enforcement, he adds, would do wonders to insure industry compliance with its limited regulatory compliance requirements. "If there were targeted enforcement and fines issued the industry would pay greater attention to ensuring compliance and self-regulation," he allowed.

Insurance is where the rubber hits the road on risk. So it is interesting to note that the rating agency A.M. Best, which advises insurers on risk, in 2013 topped its list of "emerging technology-based risks" with RF Radiation:

> *"The risks associated with long-term use of cell phones, although much studied over the past 10 years, remain unclear. Dangers to the estimated 250,000 workers per year who come in close contact with cell phone antennas, however, are now more clearly established. Thermal effects of the cellular antennas, which act at close range essentially as open microwave ovens can include eye damage, sterility and cognitive impairments. While workers of cellular companies are well trained on the potential dangers, other workers exposed to the antennas are often unaware of the health risks. The continued exponential growth of cellular towers will significantly increase exposure of these workers and others coming into close contact with high-energy cell phone antenna radiation,"* A.M. Best wrote.[24]

So what has the FCC done to tighten enforcement? Apparently, not very much. Though it does follow up on many of the complaints filed against sites alleged to be in violation of standards it takes punitive actions very rarely. (The FCC did not provide answers to written questions on details of its tower enforcement policies.)

The best ally of industry and the FCC on this (and other) issues may be public ignorance.

An online poll conducted for this project asked 202 respondents to rate the likelihood of a series of statements.[25] Most of the statements were subject to dispute. Cell phones raise the risk of certain health effects and brain cancer, two said. There is no proof that cell phones are harmful, another declared. But among the six statements there was one statement of indisputable fact: "The U.S. Congress forbids local communities from considering health effects when deciding whether to issue zoning permits for wireless antennae," the statement said.

Though this is a stone cold fact that the wireless industry, the FCC and the courts have all turned into hard and inescapable reality for local authorities, just 1.5% of all poll respondents replied that it was "definitely true."

Public ignorance didn't take much cultivation by the wireless industry on the issue of local zoning. And maybe it doesn't matter much, considering the enormous popularity of wireless devices. But let's see how public ignorance has been cultivated and secured—with the FCC's passive support—on the potentially more disruptive issue of mobile phone health effects.

Chapter Three: Wireless Bullies and the Tobacco Analogy

Issues of cable and net neutrality have recently attracted wide public attention (more on that in Chapter Six). Still, the bet here remains that future judgment of the FCC will hinge on its handling of wireless health and safety issues.

And while the tower siting issue is an egregious example of an industry-dominated political process run amuck, the stronger health risks appear to reside in the phones themselves. This is an issue that has flared up several times in recent years. Each time, industry has managed to beat back such concerns. But it's worth noting that the scientific roots of concern have not disappeared. If anything, they've thickened as new research substantiates older concerns.

The story of an FCC passively echoing an industry determined to play hardball with its critics is worth a further look. The CTIA's own website acknowledges the helpful hand of government's "light regulatory touch" in allowing the industry to grow.[26]

Former congressman Dennis Kucinich ventures one explanation for the wireless industry's success in dodging regulation: "The industry has grown so fast its growth has overtaken any health concerns that may have gained attention in a slow growth environment. The proliferation of technology has overwhelmed all institutions that would have attempted safety testing and standards," Kucinich said.[27]

But the core questions remain: Is there really credible evidence that cell phones emit harmful radiation that can cause human health problems and disease? Has the FCC done an adequate job in protecting consumers from health risks? Or has it simply aped industry stonewalling on health and safety issues?

Before wading into these questions, some perspective is in order.

First, there's simply no denying the usefulness and immense popularity of wireless technology. People depend on it for safety, information, entertainment and communication. It doesn't take a keen social observer to know that wireless has thoroughly insinuated itself into daily life and culture.

The unanswered question, though, is whether consumers would embrace the technology quite so fervently if health and safety information was not spun, filtered and clouded by a variety of industry tactics.

To gain some insight into this question, we conducted an online survey of 202 respondents, nearly all of whom own cell phones, on Amazon's Mechanical Turk Web platform (see Appendix). One striking set of findings: many respondents claim they would change behavior—reduce wireless use, restore landline service, protect their children—if claims on health dangers of wireless are true.

It is not the purpose of this reporter to establish that heavy cell phone usage is dangerous. This remains an extremely controversial scientific issue with new findings and revised scientific conclusions repeatedly popping up. Just months ago, a German scientist who had been outspoken in denouncing the view that cell phones pose health risks reversed course. In an April 2015 publication, Alexander Lerchl reported results confirming previous research on the tumor-promoting effects of electromagnetic fields well below human exposure limits for mobile phones. "Our findings may help to understand the repeatedly reported increased incidences of brain tumors in heavy users of mobile phones," the Lerchl team concluded.[28] And in May 2015, more than 200 scientists boasting over 2,000 publications on wireless effects called on global institutions to address the health risks posed by this technology.

But the National Cancer Institute still contends that no cell phone dangers have been established. A representative of NCI was the sole known dissenter among the 30 members of the World Health Organization's International Agency for Research on Cancer (IARC) when it voted to declare wireless RF "possibly carcinogenic."[29] If leading scientists still can't agree, I will not presume to reach a scientific conclusion on my own.

IARC RF working group: Official press release

International Agency for Research on Cancer

World Health Organization

PRESS RELEASE
N° 208

31 May 2011

IARC CLASSIFIES RADIOFREQUENCY ELECTROMAGNETIC FIELDS AS POSSIBLY CARCINOGENIC TO HUMANS

Lyon, France, May 31, 2011 -- The WHO/International Agency for Research on Cancer (IARC) has classified radiofrequency electromagnetic fields as **possibly carcinogenic to humans (Group 2B)**, based on an increased risk for **glioma**, a malignant type of brain cancer, associated with wireless phone use.

But let's at least look at some of the incriminating clues that health and biology research has revealed to date. And let's look at the responses of both industry and the FCC.

The most widely cited evidence implicating wireless phones concerns gliomas, a very serious type of brain tumor. The evidence of elevated risk for such tumors among heavy cell phone users comes from several sources.

Gliomas account for roughly half of all malignant brain tumors, which are relatively rare. The annual incidence of primary malignant brain tumors in the U.S. is only 8.2 per 100,000 people, according to the International Radio Surgery Association.

Still, when projected over the entire U.S. population, the public health impact is potentially very significant.

Assuming roughly four new glioma cases annually in the U.S. per 100,000 people, yields over 13,000 new cases per year over a total U.S. population of 330 million. Even a doubling of that rate would mean 13,000 new gliomas, often deadly, per year. A tripling, as some studies have found, could mean as many as 26,000 more new cases annually. Indeed, the respected online site Medscape in January 2015 reported results of Swedish research under the headline: *Risk for Glioma Triples With Long-Term Cell Phone Use*.[30]

And here's some eye-opening quantitative perspective: the wars in Iraq and Afghanistan, waged now for more than a decade each, have together resulted in roughly 7,000 U.S. deaths.

Preliminary—though still inconclusive—research has suggested other potential negative health effects. Swedish, Danish and Israeli scientists have all found elevated risk of salivary gland tumors. One Israeli studied suggested elevated thyroid cancer risk. Some research has found that men who carry their phones in their pockets may suffer sperm count damage. One small study even suggests that young women who carry wireless devices in their bras are unusually vulnerable to breast cancer.

And while industry and government have never accepted that some portion of the population is unusually sensitive to electromagnetic fields, many people continue to complain of a broad range of symptoms that include general weakness, headaches, nausea and dizziness from exposure to wireless.

Some have suggested that the health situation with wireless is analogous to that of tobacco before court decisions finally forced Big Tobacco to admit guilt and pay up. In some ways, the analogy is unfair. Wireless research is not as conclusively incriminating as tobacco research was. And the identified health risks with wireless, significant as they are, still pale compared with those of tobacco.

But let's not dismiss the analogy outright. There is actually a very significant sense in which the tobacco-wireless analogy is uncannily valid.

People tend to forget that the tobacco industry—like the wireless industry—also adopted a policy of tone-deaf denial. As recently as 1998, even as evidence of tobacco toxicity grew overwhelming, cigarette maker Phillip Morris was writing newspaper advertorials insisting there was no proof smoking caused cancer.

It seems significant that the responses of wireless and its captured agency—the FCC—feature the same obtuse refusal to examine the evidence. The wireless industry reaction features stonewalling public relations and hyper aggressive legal action. It can also involve undermining the credibility and cutting off the funding for researchers who do not endorse cellular safety. It is these hardball tactics that look a lot like 20th century Big Tobacco tactics. It is these hardball tactics—along with consistently supportive FCC policies—that heighten suspicion the wireless industry does indeed have something to hide.

Begin with some simple facts issuing from meta-analysis of cellular research. Dr. Henry Lai, emeritus professor of bioengineering at the University of Washington, has reviewed hundreds of published scientific papers on the subject. He wanted to see how many studies demonstrated that non-ionizing radiation produces biological effects beyond the heating of tissue. This is critical since the FCC emission standards protect only against heating. The assumption behind these standards is that there are no biological effects beyond heating.

But Dr. Lai found that just over half—actually 56%—of 326 studies identified biological effects. And the results were far more striking when Dr. Lai divided the studies between those that were industry-funded and those that were independently funded. Industry-funded research identified biological effects in just 28% of studies. But fully 67% of non-industry funded studies found biological effects (Insert Slide—Cell Phone Biological Studies).

A study conducted by Swiss and British scientists also looked at how funding sources affected scientific conclusions on the possible health effects of cell phone usage. They found that of studies privately funded, publicly funded and funded with mixed sponsorship, industry-funded studies were "least likely to report a statistically significant result."[31] "The interpretation of results from studies of health effects of radiofrequency radiation should take sponsorship into account," the scientists concluded.[32]

So how does the FCC handle a scientific split that seems to suggest bias in industry-sponsored research?

In a posting on its Web site that reads like it was written by wireless lobbyists, the FCC chooses strikingly patronizing language to slight and trivialize the many scientists and health and safety experts who've found cause for concern. In a two page Web post titled "Wireless Devices and Health Concerns," the FCC four times refers to either "some health and safety interest groups," "some parties," or "some consumers" before in each case rebutting their presumably groundless concerns about wireless risk.[33] Additionally, the FCC site references the World Health Organization as among those organizations who've found that "the weight of scientific

evidence" has not linked exposure to radiofrequency from mobile devices with "any known health problems."

Yes, it's true that the World Health organization remains bitterly divided on the subject. But it's also true that a 30 member unit of the WHO called the International Agency for Research on Cancer (IARC) was near unanimous in pronouncing cell phones "possibly carcinogenic" in 2011. How can the FCC omit any reference to such a pronouncement? Even if it finds reason to side with pro-industry scientists, shouldn't this government agency also mention that cell phones are currently in the same potential carcinogen class as lead paint?

Now let's look a bit more closely at the troublesome but presumably clueless crowd of "some parties" that the FCC so cavalierly hastens to dismiss? Let's begin with **Lennart Hardell**, professor of Oncology and Cancer Epidemiology at the University Hospital in Oreboro, Sweden.

Until recently it was impossible to gain any real sense of brain tumor risk from wireless since brain tumors often take 20 or more years to develop. But the cohort of long-term users has been growing. In a study published in the International Journal of Oncology in 2013, Dr. Hardell and Dr. Michael Carlberg found that the risk of glioma—the most deadly type of brain cancer—rose with cell phone usage. The risk was highest among heavy cell phone users and those who began to use cell phones before the age of 20.[34]

Indeed, those who used their phones at least 1640 hours (which would be roughly 30 minutes a day for nine years) had nearly three times the glioma incidence. Drs. Hardell and Carlberg also found that gliomas tend to be more deadly among heavy wireless callers.[35]

Perhaps of greatest long-term relevance, glioma risk was found to be four times higher among those who began to use mobile phones as teenagers or earlier. These findings, along with the established fact that it generally takes decades for tumors induced by environmental agents to appear, suggest that the worst consequences of omnipresent wireless devices have yet to be seen.

In a 2013 paper published in *Reviews on Environmental Health*, Drs. Hardell and Carlberg argued that the 2011 finding of the IARC that identified cell phones as a "possibly carcinogenic" needs to be revised. The conclusion on radiofrequency electromagnetic fields from cell phones should now be "cell phones are not just a possible carcinogen." They can now be "regarded as carcinogenic to humans" and the direct cause of gliomas (as well as acoustic neuromas, a less serious type of tumor).[36] Of course, these views are not universally accepted.

The usual spin among industry supporters when presented with research that produces troubling results is along the lines of: "We might pay attention if the results are duplicated." In fact, the Hardell results were echoed in the French CERENAT study, reported in May of 2014. The CERENAT study also found higher risk among heavy users, defined as those using their phones at least 896 hours (just 30 minutes a day for five years). "These additional data support

previous findings concerning a possible association between heavy mobile phone use and brain tumors," the study concluded.[37]

Cell phones are not the only wireless suspects. Asked what he would do if he had policy-making authority, Dr. Hardell swiftly replied that he would "ban wireless use in schools and pre-schools. You don't need Wi-Fi," he noted.[38] This is especially interesting in view of the FCC's sharply hiked spending to promote and extend Wi-Fi usage, as well as its consistent refusal to set more stringent standards for children (more on all this later). But for now let's further fill out the roster of the FCC's unnamed "some parties."

Martin Blank is a Special Lecturer in Physiology and Cellular Biophysics at Columbia University. Unlike Dr. Hardell, who looks at broad epidemiological effects over time, Dr. Blank sees cause for concern in research showing there is biological response at the cellular level to the type of radiation emitted by wireless devices. "The biology tells you unequivocally that the cell treats radiation as a potentially damaging influence," Dr. Blank said in a late 2014 interview.[39]

"The biology tells you it's dangerous at a low level," he added. Though some results have been difficult to replicate, researchers have identified a wide range of cellular responses including genetic damage and penetration of the blood brain barrier. Dr. Blank specifically cited the "cellular stress response" in which cells exposed to radiation start to make proteins.

It is still not clear whether biological responses at the cellular level translate into human health effects. But the research seems to invalidate the basic premise of FCC standards that the only biological effect of the type of radiation produced by wireless devices is tissue heating at very high power levels. But the standards-setting agencies "ignore the biology," according to Dr. Blank. He describes the FCC as being "in industry's pocket."[40]

Sweden's Lund University is annually ranked among the top 100 universities in the world. **Leif Salford** has been chairman of the Department of Neurosurgery at Lund since 1996. He is also a former president of the European Association for Neuro-Oncology. In the spring of 2000, Professor Salford told me that wireless usage constituted "the world's largest biological experiment ever."[41]

He has conducted numerous experiments exposing rats to cellular-type radiation. Individual experiments have shown the radiation to penetrate the blood-brain barrier, essential to protecting the brain from bloodstream toxins. Professor Salford also found that rats exposed to radiation suffered loss of brain cells. "A rat's brain is very much the same as a human's. They have the same blood-brain barrier and neurons. We have good reason to believe that what happens in rat's brains also happens in humans," he told the BBC in 2003. Dr. Salford has also speculated that mobile radiation could trigger Alzheimer's disease in some cases but emphasized that much more research would be needed to establish any such causal relationship. Does this man deserve to be dismissed as one of a nameless and discredited group of "some parties?"

And what about the **American Academy of Pediatrics (AAP),** which represents 60,000 American doctors who care for children? In a December 12, 2012 letter to former Ohio Congressman Dennis Kucinich, AAP President Dr. Thomas McInerny writes: "Children are disproportionately affected by environmental exposures, including cell phone radiation. The differences in bone density and the amount of fluid in a child's brain compared to an adult's brain could allow children to absorb greater quantities of RF energy deeper into their brains than adults."[42]

In a subsequent letter to FCC officials dated August 29, 2013, Dr. McInerny points out that "children, however, are not little adults and are disproportionately impacted by all environmental exposures, including cell phone radiation." Current FCC exposure standards, set back in 1996, "do not account for the unique vulnerability and use patterns specific to pregnant women and children," he wrote. (Insert slide: A Plea from Pediatricians). Does an organization representing 60,000 practitioners who care for children deserve to be brushed off along with "some health and safety interest groups?"

So what is the FCC doing in response to what at the very least is a troubling chain of clues to cellular danger? As it has done with wireless infrastructure, the FCC has to this point largely relied on industry "self-regulation." Though it set standards for device radiation emissions back in 1996, the agency doesn't generally test devices itself. Despite its responsibility for the safety of cell phones, the FCC relies on manufacturers' good-faith efforts to test them. Critics contend that this has allowed manufacturers undue latitude in testing their devices.

Critics further contend that current standards, in place since cell phones were barely in use, are far too lax and do not reflect the heavy usage patterns that have evolved. Worse still, industry is allowed to test its own devices using an imprecise system that makes no special provision for protecting children and pregnant women. One 2012 study noted that the procedure widely used by manufacturers to test their phones "substantially underestimates" the amount of RF energy absorbed by 97% of the population, "especially children." A child's head can absorb over two times as much RF energy. Other persons with smaller heads, including women, are also more vulnerable. The authors recommend an alternative computer simulation technique that would provide greater insight into the impact of cellular radiation on children and on to the specific RF absorption rates of different tissues, which vary greatly.[43]

Acting on recommendations of the General Accounting Office, the FCC is now reconsidering its standards for wireless testing and allowed emissions. On the surface, this may seem to represent an effort to tighten standards to promote consumer health and safety. But many believe the FCC's eventual new standard will actually be weaker, intensifying any health risk from industry's self-reported emission levels. "They're under great pressure from industry to loosen the criteria," notes Joel Moskowitz, director of the Center for Family and Community Health at UC Berkeley's School of Public Health.[44] One fear is that the FCC could measure the allowed radiation absorption level (SAR) over a wider sample of tissue, effectively loosening the

standard allowable energy absorption. One FCC official, who asked that his name not be used, contended that a decision had not yet been made to loosen the standard.

But to this point, there is little evidence the FCC is listening to anyone beyond its familiar friends in the wireless industry. Carl Blackman, a scientist at the Environmental Protection agency until retiring in 2014, notes that the FCC does rely to some degree on an inter-agency governmental group for advice on health matters. The group includes, for example, representatives from the EPA and the FDA.

Blackman served on that advisory group and he says that it has been divided. Though some government advisers to the FCC find evidence of wireless health risks convincing, others remain skeptical, said Blackman. Root of the skepticism: even though numerous researchers have found biological and health effects, the mechanism for action by non-ionizing radiation on the human body has still not been identified. "I don't think there's enough of a consensus within the Radio Frequency Inter-agency Working Group for them to come out with stricter standards," he says.[45]

But political pressures also figure mightily in all this. The EPA, notably, was once a hub of research on RF effects, employing as many as 35 scientists. However, the research program was cut off in the late 80s during the Regan presidency. Blackman says he was personally "forbidden" to study health effects by his "supervisory structure."[46] He termed it "a political decision" but recognized that if he wanted to continue to work at the EPA he would have to do research in another area.

Blackman is cautious in imputing motives to the high government officials who wanted his work at EPA stopped. But he does say that political pressure has been a factor at both the EPA and FCC: "The FCC people were quite responsive to the biological point of view. But there are also pressures on the FCC from industry." The FCC, he suggests, may not just be looking at the scientific evidence "The FCC's position—like the EPA's—is influenced by political considerations as well."[47]

Still, the FCC has ultimate regulatory responsibility and cannot indefinitely pass the buck on an issue of fundamental public health. Remarkably, it has not changed course despite the IARC classification of cell phones as possibly carcinogenic, despite the recent studies showing triple the glioma risk for heavy users, despite the floodtide of research showing biological effects, and despite even the recent defection of core industry booster Alex Lerchl. It is the refusal of both industry and the FCC to even acknowledge this cascade of warning signs that seems most incriminating.

Of course, industry behavior goes well beyond pushing for the FCC's willful ignorance and inaction. Industry behavior also includes self-serving public relations and hyper aggressive legal action. It can also involve undermining the credibility of and cutting off the funding for researchers who do not endorse cellular safety. It is these hardball tactics that recall 20th century Big Tobacco tactics. It is these tactics that heighten suspicion that the wireless industry does

indeed have a dirty secret. And it is those tactics that intensify the spotlight on an FCC that so timidly follows the script of the fabulously wealthy, bullying, billion-dollar beneficiaries of wireless.

Chapter Four: You Don't Need Wires To Tie People Up

So let's look a little more deeply at some of the actions of an industry group that boasts of 500 meetings a year with the FCC. Lobbying is one thing. Intimidation is another. CTIA has shown its skill at—and willingness to use—both.

Outright legal bullying is a favored tactic. The City of San Francisco passed an ordinance in 2010 that required cell phone manufacturers to display more prominently information on the emissions from their devices. This information was already disclosed—but often buried—in operator manuals and on manufacturer websites. The idea was to ensure that consumers saw information already mandated and provided.

Seeing this as a threat to its floodtide of business, the industry sued the City of San Francisco. The City, fearing a prolonged legal fight with an industry that generates hundreds of billions of dollars in annual revenue, backed down.

On May 12, 2015, Berkeley, California's City Council unanimously passed a similar ordinance. Joel Moskowitz, director of the Center for Family and Community Health at the University of California-Berkeley's School of Public Health, has been involved in the effort. Berkeley, he says, didn't want to run into the same legal threats that paralyzed San Francisco. So it tried to draft the most inoffensive and mild language possible. The proposed Cell Phone Right to Know ordinance: "To assure safety, the Federal Government requires that cell phones meet radio frequency (RF) exposure guidelines. If you carry or use your phone in a pants or shirt pocket or tucked into a bra when the phone is ON and connected to a wireless network, you may exceed the federal guidelines for exposure to RF radiation. This potential risk is greater for children. Refer to the instructions in your phone or user manual for information about how to use your phone safely."[48]

Sounds pretty inoffensive, no? Not to the CTIA, which indicated that it was prepared to sue, according to Berkeley City Attorney Zach Cowan.[49] (On June 8th, CTIA did indeed sue the City of Berkeley.)

Well, from the industry point of view, why not throw around your weight? Smash mouth legal tactics have been highly successful thus far as industry has managed to throttle several efforts to implicate manufacturers in cases where heavy users suffered brain tumors.

But one current case has advanced in district court in Washington to the point where the judge allowed plaintiffs to present expert witness testimony. The industry response: file a legal action seeking to invalidate long-held court methods for qualifying expert witnesses.

This is a very rich industry that does not hesitate to outspend and bully challengers into submission. Meanwhile, amidst the legal smoke and medical confusion, the industry has

managed to make the entire world dependent on its products. Even tobacco never had so many hooked users.

Such sustained success in the face of medical doubt has required industry to keep a lid on critics and detractors. Many scientists who've found real or potential risk from the sort of microwave radiation emanating from wireless devices have learned there is a price to be paid for standing up to the industry juggernaut. A few prominent examples:

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In 1994, University of Washington researchers Henry Lai and N.P. Singh found that rats exposed to microwave radiation suffered DNA damage to their brain cells. This was a scary finding since DNA damage can lead to mutations and possibly cancer.

The reaction from industry was swift. Motorola was at that time the U.S. market leader in cell phones. In a memorandum obtained by the journal Microwave News, Motorola PR honcho Norm Sandler outlined how the company could "downplay the significance of the Lai study." One step: "We have developed a list of independent experts in this field and are in the process of recruiting individuals willing and able to reassure the public on these matters," Sandler wrote. After outlining such measures, he concluded that Motorola had "sufficiently war-gamed" the issue. The practices of lining up industry-friendly testimony and "war-gaming" researchers who come up with unfavorable results have been persistent themes with this industry.

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After Lai's results were published, Motorola decided to sponsor further research on microwaves and DNA damage. Oftentimes, lab results cannot be reproduced by other

researchers, particularly if experiments are tweaked and performed a bit differently. Non-confirming studies raise doubt, of course, on the original work.

Motorola lined up Jerry Phillips, a scientist at the Veteran's Administration Medical Center in Loma Linda, California, and Phillips tested the effect of radiation at different frequencies from those tested by Lai and Singh. Nevertheless, Phillips found that at some levels of exposure, DNA damage increased, while at other levels it decreased. Such findings were "consistent" with the sorts of effects produced by chemical agents, Phillips said in an interview.[50] In some cases, the radiation may have activated DNA repair mechanisms, reducing the overall microwave effect. But what was important, Phillips explained, is that there were *any* biological effects at all. The wireless industry has long contended—and the FCC has agreed—that there is no evidence that non-ionizing radiation at the frequencies and power levels used by cell phones is biologically active.

Understanding the potential impact of "biological effect" findings, Motorola again turned to damage control, said Phillips. He recalls receiving a phone call from a Motorola R&D executive. "I don't think you've done enough research,'" Phillips recalls being told. The study wasn't ready for publication, according to the Motorola executive. Phillips was offered more money to do further research without publishing the results of what he'd done.

But Phillips felt he'd done enough. Despite warnings for his own boss to "give Motorola what it wants," Phillips went ahead and published his findings in 1998. Since then, Phillips' industry funding has dried up. Meanwhile, as many other researchers report, government funding to do independent research on microwave radiation has dried up, leaving the field at least in the U.S. to industry-funded scientists. "There is no money to do the research," Said Phillips. "It's not going to come from government because government is controlled by industry."[51]

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Om P. Gandhi is Professor of Electrical and Computer Engineering at the University of Utah and a leading expert in dosimetry—measurement of non-ionizing radiation absorbed by the human body. Even before cell phones were in wide use, Professor Gandhi had concluded that children absorb more emitted microwave radiation. "The concentration of absorbed energy is 50 to 80% greater," he explained.[52]

These conclusions were not acceptable to Professor Gandhi's industrial sponsors. In 1998, he recalls, an executive from a cell phone manufacturer—which he did not want to identify—told him directly that if he did not discontinue his research on children his funding would be cut off. Professor Gandhi recalled replying: "I will not stop. I am a tenured professor at the University of Utah and I will not reject my academic freedom." Professor Gandhi also recalled some of his thought process: "I wasn't going to order my students to alter their results so that I can get funding." His industry sponsors cancelled his contract and asked for a return of funds.

Professor Gandhi believes that some cell phone users require extra protection because their heads are smaller and more absorptive. “Children, as well as women and other individuals with smaller heads absorb more concentrated energy because of the proximity of the radiating antenna to the brain tissue,” he said. And yet the FCC has not acted to provide special protection for these groups. Asked why not, Professor Gandhi conceded that he doesn’t know. He does note, however, that recent standards-setting has been dominated by industry representatives.[53]

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While the mobile industry refuses to admit to even the possibility that there is danger in RF radiation, giant insurance companies see things differently. Several insurers have in recent years issued reports highlighting product liability risk with cell phones. This is important because it is evidence that where money is on the line professionals outside the industry see the risk of legal liability.

Legal exposure could be one reason—perhaps the central one—the industry continues to stonewall. Should legal liability be established, one key question will be how much wireless executives knew—and at what point in time. Meanwhile, the combination of public relations denials, legal intimidation and the selective application of pressure on research follows a familiar pattern. “The industry is basically using the tobacco industry playbook,” UC Berkeley’s Moskowitz said in a recent radio interview.[54]

That playbook has thus far been highly successful in warding off attention, regulation and legal incrimination.

Chapter Five: $270 Billion . . . and Looking for Handouts

The FCC's network of corruption doesn't just shield industry from needed scrutiny and regulation on matters of public health and safety. Sometimes it just puts its hand directly into the public pocket and redistributes that cash to industry supplicants.

Such is arguably the case with the Universal Service Fund. Originally established to extend telephone service to rural and urban areas that industry would find difficult or uneconomical to wire, the USF is now shifting from subsidizing landline phone service to subsidizing the extension of broadband Internet. USF monies also support the Lifeline program, which subsidizes cell phone service to low-income consumers, and the E-Rate program, which subsidizes Internet infrastructure and service to schools and libraries.

Since 1998, more than $110 billion has been allocated to Universal Service programs, notes Charles Davidson, director of the Advanced Communications Law & Policy Institute at New York Law School. The FCC has allocated over $40 billion to the E-Rate program alone.

Who pays the freight for these high-cost programs? You do.

Technically, landline and wireless phone companies are assessed for the Universal Service fund's expenditures. But the FCC also allows those companies to pass on such charges to their subscribers, which they do. Both landline and wireless subscribers pay a monthly Universal Service charge that is tacked on to their phone bills. That charge has been rising and recently amounted to a 16% surcharge on interstate calls.

Consumers who pay for these programs might be interested to learn that both the E-Rate and Lifeline programs have been riddled with fraud. Government watchdogs have repeatedly found the programs to be inefficient and prone to inflated and fraudulent claims. But the programs have been a windfall for tech and telecom industry beneficiaries. Wherever the FCC presides, it seems, these industries reap a windfall.

The General Accounting Office (GAO) has issued several reports citing fraud, waste and mismanagement, along with inadequate FCC oversight of the subsidy program. Bribery, kickbacks and false documentation can perhaps be expected in a handout program mandated by Congress and only indirectly supervised by the FCC.

But the scope of fraud has been impressive. The most striking corruption has marred the E-Rate program, which subsidizes Internet hardware, software and service for schools and libraries, and the Lifeline cell phone subsidies.

In recent years, several school districts have paid fines to settle fraud cases involving bribery, kickbacks, non-competitive bidding of contracts and false documentation in the E-Rate

program. More eye opening perhaps are the settlements of fraud claims by tech giants like IBM, Hewlett Packard and AT&T. The HP case, for example, involved some colorful bribery allegations, including gifts of yachts and Super Bowl tickets. HP settled for $16 million. An HP official and a Dallas Independent School District official both received jail sentences.

The Lifeline program has also been riddled with fraud. A Wall Street Journal investigation of the five top corporate beneficiaries of Lifeline showed that 41% of more than 6 million subsidy claimants "couldn't demonstrate their eligibility or didn't respond to requests for certification."[55] AT&T, Verizon, and Sprint Nextel were three of the major Lifeline beneficiaries.

The FCC has initiated several efforts to clean up USF programs and seems honestly determined to bring greater accountability and efficiency to its subsidy efforts. Nevertheless, problems with fraud persist, as reported recently by the FCC's own top investigator.

Congress established the FCC's Office of Inspector General in 1989 to "provide objective and independent investigations, audits and reviews of the FCC's programs and operations." Here's what the FCC's internal investigative unit said in a September 30, 2014 report to Congress about its Office of Investigation (OI): "*The bulk of the work of OI involves investigating and supporting civil and criminal investigations/prosecutions of fraud in the FCC's federal universal service program*."[56]

Fraud—as pervasive and troubling as it has been—is just one of the problems with the programs of universal service. It may not even be the fundamental problem. More fundamental issues concern the very aim, logic and efficiency of programs to extend broadband and wireless technology at public expense. Though the aims of extending service to distant impoverished areas seem worthy on the surface, there are many reasons to think the major beneficiaries of these programs are the technology companies that win the contracts.

Lobbyists have long swarmed over the FCC looking to get an ever-growing piece of the USF honeypot. An FCC report on meetings with registered lobbyists details a 2010 meeting with representatives of the International Society for Technology in Education and other education lobbyists. Topics discussed, according to the FCC report, included "the need to raise the E-Rate's annual cap."[57]

The CTIA, leaving no stone unturned in its efforts to pump up member revenues, last year responded to a House hearing on the USF by grousing that "current USF-supported programs skew heavily toward support of wireline services. . . . The concentration of USF monies to support wireline services is inconsistent with technological neutrality principles and demonstrated consumer preferences," CTIA wrote..[58] An industry that generates hundreds of billions of dollars in equipment and service revenues annually bellies up for a bigger slice of the $8 billion a year USF.

The grousing has paid off. The FCC recently announced that it will raise spending on E-Rate from what had been a cap of $2.4 billion a year to $3.9 billion. A significant portion of new outlays will go to Wi-Fi—yet another wireless industry victory at the FCC. But the CTIA is by no means the only industry group pressing the FCC.

Leading the roster of active lobbyists on E-Rate issues is the Software and Information Industry Association. Beginning in 2006, SIAA led all lobbyists with 54 mentions of E-Rate in its filings, according to the Center for Responsive Politics. SIAA board members include executives from tech heavyweights Google, Oracle and Adobe Systems.

Tech business leaders—many of them direct beneficiaries of FCC programs—made a direct pitch to FCC Chairman Wheeler last year to hike E-Rate funding. "The FCC must act boldly to modernize the E-Rate program to provide the capital needed to upgrade our K-12 broadband connectivity and Wi-Fi infrastructure within the next five years," the executives wrote.[59]

There were dozens of corporate executive signees to this letter, including the CEOs of many Fortune 500 giants. But let's just consider the participation of three: top executives of Microsoft, Google and HP all joined the call to expand E-Rate subsidies. Consider the simple fact that these three tech giants alone had revenues of $270 billion—more than a quarter of a trillion dollars—in a recent four-quarter period. Together, they produced nearly $40 billion in net income. And yet their top executives still thought it necessary to dun the FCC—and really, they were surreptitiously hitting up the public—for ramped-up spending on what was then a $2.4 billion a year program.

Is that greed? Arrogance? Or is it simply behavior conditioned by success in repeatedly getting what they want at the public trough? Almost never mentioned in these pleas for higher subsidies is the fact that ordinary American phone subscribers are the ones footing the bill for the E-Rate program—not the FCC or the telecom industry.

Much of the added spending, as noted, will go towards the installation of wireless networks. And yet Wi-Fi does not have a clean bill of health. When Lennart Hardell, professor of Oncology and Cancer Epidemiology at the University Hospital in Orebro, Sweden, was asked what he would do if given policy authority over wireless health issues, he replied swiftly that he would "ban wireless use in schools and pre-school." Noting that there are wired alternatives, Professor Hardell flatly stated: "You don't need Wi-Fi."[60] And yet the FCC, prodded by an industry ever on the lookout for incremental growth opportunities, is ignoring the health of youngsters to promote expanded Wi-Fi subsidies in schools across the U.S.

And what about the merit of the program itself? Overlooking the fraud and lobbying and Wi-Fi safety issues for a moment, shouldn't schools and libraries across the country be equipped with the best electronic gear, accessing the Internet at the fastest speeds? Doesn't the government owe that to its younger citizens, especially those disadvantaged by the long-referenced digital divide?

Well, maybe. But answers to these questions hinge on even more fundamental question: Do students actually learn more or better with access to the latest high-speed electronic gadgetry?

It would be foolish to argue that nobody benefits from access to high-speed Internet. But the benefits are nowhere near as broad or rich as corporate beneficiaries claim. Some researchers, for example, have concluded that computers don't seem to have positive educational impact—they may even have negative impact—when introduced into the home or freely distributed to kids from low income backgrounds.

Duke University researchers Jacob Vigdor and Helen Ladd studied the introduction of computers into North Carolina homes. They found that the academic performance of youngsters given computers actually declined. *"The introduction of home computer technology is associated with modest but statistically significant and persistent negative impacts on student math and reading test scores,"* the authors wrote in a National Bureau of Economic Research Working Paper.[61] The impact was actually most negative on the poorer students.

A study in the Journal of International Affairs examined the impact of the global One Laptop Per Child Program (OLPC), which has distributed millions of computers to children around the world. Researchers Mark Warschauer and Morgan Ames conclude: *"The analysis reveals that provision of individual laptops is a utopian vision for the children in the poorest countries, whose educational and social futures could be more effectively improved if the same investments were instead made on more proven and sustainable interventions. Middle- and high-income countries may have a stronger rationale for providing individual laptops to children, but will still want to eschew OLPC's technocratic vision. In summary, OLPC represents the latest in a long line of technologically utopian schemes that have unsuccessfully attempted to solve complex social problems with overly simplistic solutions*."[62]

Access to computers in the home may not work educational magic. But what about computers in the classroom? Don't they have educational value there?

The anecdotal evidence is mixed at best. Consider how students in Los Angeles, newly equipped with flashy iPads at a mind-boggling taxpayer cost of more than $1 billion, went about using the new tools to improve their educational performance. "Instead of solving math problems or doing English homework, as administrators envisioned, more than 300 Los Angeles Unified School District students promptly cracked the security setting and started tweeting, posting to Facebook and playing video games."[63]

But let's cut through the self-serving corporate claims and the troubling anecdotes to hear from someone who actually has had extensive and unique field experience. Kentaro Toyama was co-founder of Microsoft's research lab in India. Over more than five years he oversaw at least a dozen projects that sought to address educational problems with the introduction of computer technology. His conclusion: "The value of technology has been over-hyped and over-sold."

The most important factor in improving schools, says Toyama, now the W.K Kellogg Associate Professor of Community Information at the University of Michigan, is good teachers. Without good, well-trained teachers, adequate budgets and solid school administration, technology does little good. "Technology by itself never has any kind of positive impact," he said.[64]

The only schools in his experience that benefited from increased technology investment were those where "the teachers were very good, the budgets adequate." The richer schools, in essence. But as both Vigdor and Warschauer found, the introduction of technology has by itself little if any positive effect. For a public conditioned to believe in the virtues of new technology, such testimony is a bracing dose of cold reality.

But what about cost? Doesn't technology in the schools more efficiently replace alternative investments? Cost reductions are often the most persuasive argument for technology, Toyama agrees. But even these have been overstated. The costs of introducing new technology run far beyond initial hardware and software investments, said Toyama. In reality, the total costs of ownership—including maintenance, training, and repair—typically run to five or ten times the initial cost, according to Toyama. He said of the investment in technology for cost benefits: "I would say that in the long run—and even in the medium run and the short-run—that's probably the worst and most misguided conclusion to come to."[65]

He adds: "The inescapable conclusion is that significant investments in computers, mobile phones and other electronic gadgets in education are neither necessary nor warranted for most school systems. In particular, the attempt to use technology to fix underperforming class rooms . . . is futile. And for all but wealthy, well-run schools, one-to-one computer programs cannot be recommended in good conscience."[66]

But that doesn't keep industry lobbyists from recommending them. And it hasn't kept the FCC for spending scores of billions subsidizing technology to the very groups least likely to benefit from it.

Unmoved by the arguments of researchers and educators like Vigdor, Warschauer, and Toyama, the FCC keeps moving to increase technology subsidies. Ignoring research that disputes the value of technology in closing the so-called "digital divide," the FCC has even pioneered a new slogan: "the Wi-Fi gap."

In announcing that it was lifting E-Rate's annual budget from $2.4 billion to $3.9 billion and stepping up investment in wireless networking, FCC chairman Wheeler exulted that "10 million students are going to experience new and better opportunities."[67] The impact on consumer pocketbooks (and potentially on youngsters' health from daily Wi-Fi exposure) were not mentioned.

The two Republican members of the FCC did at least recognize the pocketbook impact. "It always seems easier for some people to take more money from the American people via higher taxes and fees rather than do the hard work," said Commissioner Michael O'Reilly.[68]

The subsidized provision of high-speed Internet service is yet another pet project of the FCC. Julius Genachowski, chairman from 2009 to 2013, championed the transition of the USF from landline phone service to broadband. Universal broadband Internet connections would begin to absorb the monies collected from consumers to extend basic phone service.

As with government subsidies for cell phone service, classroom technology, and Wi-Fi, there are basic questions about the wisdom of subsidizing broadband. Charles Davidson and Michael Santorelli of the New York Law School found that spending billions to extend broadband is a flawed approach since there are many largely ignored reasons people choose not to adopt

broadband. “Everybody is pushing broadband non-stop,” noted Davidson, director of the Law School’s Advanced Communications Law and Policy Institute. “I think the FCC is focused on the wrong set of issues,” he said.[69]

Already, he explained, over 98% of Americans have access to wired or wireless broadband. The issue is not one of supply. It’s one of demand. Many people—for a variety of reasons—don’t really care about broadband, he contends. Price is one issue. Also powerful factors—but given almost no attention—are privacy and security concerns. “In our view, they should be focused on barriers to meaningful broadband utilization: privacy and security,” said Davidson.[70]

But consumer privacy (more on this subject in Chapter Seven) has no well-funded lobby with limitless access to the FCC.

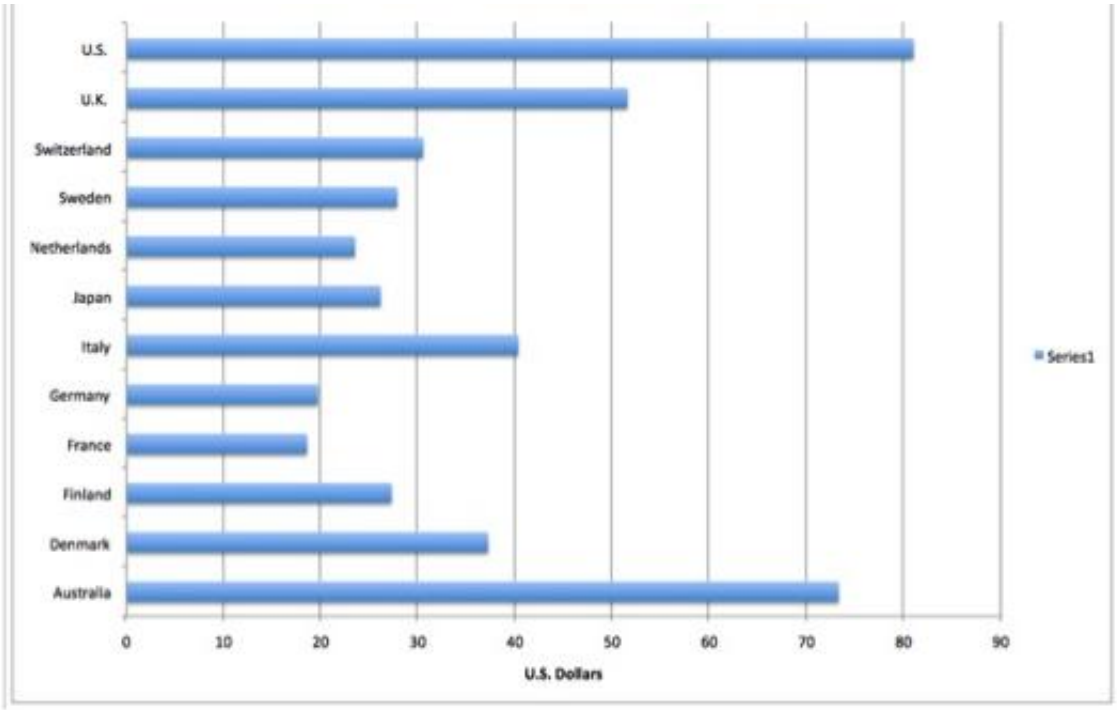
Chapter Six: The Cable Connection

The network has also been active in diluting FCC control of the cable television industry. Over the years, cable has devolved into major de facto local monopolies. Comcast and Time Warner Cable, whose merger proposal was dropped in April, are dominant forces in both cable television and broadband Internet subscriptions. Somehow, though, they have managed to steer clear of one another in specific markets, giving each pricing power where it faces little local competition.

It's interesting that cable companies annually rank in consumer polls among the "most hated" or "most disliked" American corporations. Indeed, Comcast and Time Warner Cable often top the "most hated" list.[71] Why would these companies—providers of the TV programming that has so expanded consumer options in recent decades—be so widely scorned? After all, the U.S. has been a leader in developing both cable technology and diverse television programming.

The problem is that it hasn't been anything close to a leader in bringing down subscriber prices. Industry consultants typically measure pricing by the metric of average revenue per subscriber. Industry trackers at IHS compared the price of U.S. pay television (which includes satellite services) to those in more than 60 other countries. U.S. prices were the highest, with only Australia even coming close. The average revenue per subscriber in the U.S. in 2013 was $81. But in France it was just $18.55. In Germany it was $19.68. In Japan it was just over $26.

Pay TV Monthly Revenue Per Person:



And U.S. cable prices have risen in recent years at rates three or more times the rate of inflation. This has been going on for some time. From 1995 to 2013 cable rates increased at a 6.1% annual clip. The Consumer Price Index, by contrast, rose by just 2.4% annually. Former FCC commissioner Michael Copps says the FCC shares a major part of the blame. "The FCC is as culpable for allowing that as much as the companies for imposing it," he said.[72]

One area where the FCC has contributed to the problem is in its traditional rubber-stamping of merger agreements. The proposed Comcast/Time Warner Cable deal has been shelved, largely because of Justice Department reservations. But a long run of earlier FCC-sanctioned deals allowed Comcast and Time Warner Cable to grow to the market dominance—and attendant pricing power—they currently command.

Lofty monthly cable bills pinch consumers. But it's more than that. Subscribers paying $80 a month are often paying for a lot of channels they don't watch and don't want. The FCC has never required cable operators to charge for what consumers actually want to watch. Kevin Martin, who chaired the FCC from 2005 to 2009, pushed to "debundle" programming in hopes of lowering bills. But the issue was never resolved. Only recently have viable competitive alternatives to cable's "bundled" packages become available. The satellite service Dish, for example, months ago introduced its Sling offering that enables consumers to opt for smaller and cheaper packages.

In fairness to cable operators, it should be pointed that programmers often require operators to take unwanted or fledgling channels along with their stars. New York cable operator Cablevision Systems filed suit against Viacom in 2013, charging that in order to get popular channels like MTV and Nickelodeon it was also forced to take low-rated channels like Nicktoons and VH1 Soul. But the simple truth is that no matter who is to blame, the cable consumer pays high prices, typically for some programming he doesn't want. As it often does when powerful interests pursue dubious practices, the FCC has for the most part idly stood by.

Still, the FCC isn't entirely to blame. Some factors in the growth of the cable giants cannot be laid at its doorstep. Local municipalities often granted monopoly or duopoly status in granting franchises to cable network builders. With the huge capital investments required to cable metropolitan areas, this once seemed to make sense.

And over the years, the cable giants have used a variety of tactics to weaken what little local competition they may have had. Active lobbyists on the local level, the cable giants have managed to convince a growing number of states to outlaw municipal systems that could threaten private corporate incumbents. The FCC for many years declined to tangle with the states in this matter, partly due to the opposition of Republican commissioners. But the Wheeler-led Commission did vote recently to override state laws that limit the build-out of municipal cable systems.

Still, many years of industry subservience will be difficult to swiftly undo. One linchpin merger shows how FCC decision-making has been thoroughly undermined by the revolving door, lobbying, and carefully targeted campaign contributions. All conspired in Comcast's pivotal 2011 buyout of NBC Universal, a deal which reinforced Comcast's domination of both cable and broadband access. This deal also set the stage for the recent headline-grabbing acrimony over the issue of net neutrality.

In 2011, mighty Comcast proposed to acquire NBC Universal. A series of mergers including the 1986 acquisition of Group W assets and the 2002 acquisition of AT&T's cable assets had already vaulted Comcast into cable market leadership. In bidding for NBC Universal, a huge step towards vertical integration, Comcast was once again raising the stakes. NBC Universal would give Comcast a treasure trove of programming, including valued sports content like NFL football and the Olympics.

Suddenly, the issue was not just cable subscriber base size—where Comcast had already bought its way to dominance. NBC Universal would also allow Comcast to consolidate its growing power as a broadband Internet provider. And with NBC Universal's programming assets, Comcast would gain new leverage when negotiating prices to carry the competing programming content of rivals. This would prompt a new round of debate over net neutrality. Couldn't a programming-rich Comcast slow down rival services—or charge them more to carry their programming?

To short-circuit any potential opposition to the merger, Comcast assembled a superstar cast of lobbyists. As Susan Crawford reports in her 2013 book, "Comcast hired almost eighty former government employees to help lobby for approval of the merger, including several former chiefs of staff for key legislators on congressional antitrust committees, former FCC staffers and Antitrust Division lawyers, and at least four former members of Congress.[73] Such "profligate hiring," Crawford observes, pretty much silenced the opposition to the deal. If Comcast had already retained one member of a lobbying firm, the firm could not under conflict of interest rules object to the deal. And Comcast had locked up key lobbying shops. Money was both weapon and silencer.

Of course, Comcast had always been a big spender on lobbying, with outlays exceeding $12 million every year since 2008. Lobbying costs peaked in 2011 at $19.6 million, according to the Center for Responsive Politics.

For its part, the FCC had a long history of approving most media mergers. So it was hardly a great surprise when the agency, after exacting some relatively minor concessions from Comcast, rubber-stamped the deal. Comcast would thus broaden its footprint as local monopoly distributor of cable. And with its new programming assets, it would enhance its leverage in negotiating deals to carry its rivals' programming. It would also fortify its position of growing strength as broadband Internet gatekeeper.

The most telling footnote to the deal would come just four months later. FCC Commissioner Meredith Atwell Baker, who voted to approve the merger in January 2011, left the FCC to become a top-tier Comcast lobbyist in May. It was the ultimate—and perhaps most telling—glide of the revolving door.

Baker's was a high-profile defection. But it was neither the first nor the last. Comcast had successfully convinced other FCC officials to take their expertise and government contacts to the cable giant. Comcast has long been a master at spinning the revolving door to its own advantage. "Comcast has been very good at hiring everyone who is very smart," said Crawford.[74]

Approval of the NBC Universal deal was another in the long string of FCC merger approvals that made Comcast a nationwide monopolist that could dictate both pricing and viewer programming choice.

But the deal may have had another unintended consequence. It set the stage for Comcast's subsequent battles on net neutrality. "Those mergers gave additional oomph to the issue of net neutrality," noted former commissioner Copps. Speaking specifically of Comcast's buyout of NBC Universal, IHS senior analyst Eric Brannon agreed. "That merger laid the grounds for net neutrality."

In allowing Comcast to acquire major programming assets, the deal would sharpen questions about the power of gatekeepers like Comcast to control the flow of traffic from rival Web services. So in bowing to lobbyist pressure, the FCC would bring on itself a whole new set of pressures by focusing public attention on the issue of net neutrality.

With activists rounding up comments from the public and hip TV personalities like HBO's John Oliver also beating the drums, net neutrality quickly grew into a popular issue that won the support of President Obama, and by proxy, his hand-picked appointee Tom Wheeler. When the FCC ruled in February of 2015 that it would seek Title II authority to regulate the Internet and presumably block any favoritism by broadband gatekeepers, it seemed to finally cast its lot with the public against steamrolling corporate interests

The issue had simmered for years but reached full boil when movie purveyor Netflix, which had argued that its service was slowed down by Comcast, signed a side deal ensuring better download speeds for its wares. This triggered an outburst of public concern that Comcast was now in position to operate "fast" and "slow" lanes, depending on whether a rival programmer could afford to ensure that Comcast provide adequate download speed.

With nearly 4 million comments—many supplied or encouraged by public interest groups—filed to the FCC, net neutrality was a bankable political issue. And there's no question, net neutrality attracted public interest because it gave cable viewers—long furious at the treatment by the monopolists who send them monthly bills—issues of both viewing pleasure and economics.

But it also fed into the longstanding sentimental but increasingly unrealistic view of the Internet as the last bastion of intellectual freedom. Internet romanticists have long seen the Web as a place that somehow deserves special rules for breaking the stranglehold of traditional media and offering exciting new communications, information retrieval and shopping efficiencies.

Yes, the Internet is a modern marvel. This is beyond dispute. But some of the favors it has won from government over the years have had unfortunate unintended consequences.

In the 1990s, for example, net access providers were repeatedly exempted as an "infant industry" from paying access charges to the Baby Bells even though they had to connect users through local phone networks. The long distance companies were then paying as much as $30 billion a year for the privilege. But the Internet was exempted.

As the late 90s approached, the Internet was no longer an infant industry. Still, the exemption from access charges was extended. That exemption essentially allowed AOL in the late 90s to offer unlimited unmetered online time, a key factor in boosting usage and siphoning advertisers from print media. Why buy an ad in print that might get viewed with the transitory flip of a page when you can get round-the-clock attention online?[75] FCC decisions to grant the Internet access-charge exemptions arguably accelerated the decline of print media and much of the quality journalism print advertising could once support.

Meanwhile, retailers on the Internet were making inroads into brick and mortar retail business with the help of a Supreme Court-sanctioned exemption from collecting sales tax.[76] This judicial coddling of the Internet was the death knell for many smaller mom and pop local businesses, already challenged to match online pricing. And that's not all. The special favors continue virtually every year, as Congress proposes and/or passes legislation to extend special tax exemptions to Internet services.

Well, maybe tax breaks aren't such a bad idea for such an innovative and transformational emerging technology. For all its faults, the Internet—gateway to all goods, repository of all things, wizardly guide to all knowledge, enabler of universal self-expression—is undeniably cool.

But let's not deny that the combination of tax advantages and deregulation was toxic. Allow an industry to emerge with advantages over useful existing industries that largely play by the rules—well, maybe that can be rationalized. But then fail to hold the upstart industry to the same rules, allowing it more leeway to trample fundamental rights because it has the technical capacity to do so. Well, then you have a cruel Faustian bargain.

With the see-no-evil deregulatory gospel loosing all constraints, the Web would devolve into a playground for corporate snoops and criminals. For all its wonders, the Internet comes at a cost: the loss of control over personal data, the surrender of personal privacy, sometimes even the confiscation of identity.

Perhaps the most favorable consequence of net neutrality—and one that has gotten surprisingly little attention—is that it could set the stage for privacy reform. (More on this in Chapter Seven). The FCC can now choose to exercise its Title II powers to enforce privacy standards over broadband Internet. Privacy is one area where the FCC has done a pretty good job in the past.

Worth remembering, though, is that the hard-fought public victory over Net Neutrality may be transitory. AT&T and others have threatened to go to court to upend the FCC rules. And there's a fair chance a Republican Congress will legislate against Title II.

Meanwhile, though, one supreme irony has begun to unfold in the marketplace.

Modern-day laissez fair ideologues love to invoke the wisdom of markets as represented by the "mysterious hand" of Adam Smith. Unfortunately, in the absence of effective regulation, the putatively wise "mysterious hand" generally seems to work its magic for those with huge financial resources and the political access it buys.

In the current cable situation, however, the mysterious hand may actually be working in consumer-friendly ways. Years of regulation that favored the cable companies have now backfired as the market reacts to monopolistic pricing and content control.

Whereas cable giants have commanded premium monthly subscriber prices to deliver packages of largely unwatched channels, the market is now beginning to burst with new "debundled" options that are whittling away at cable's vast subscriber base.

Satellite service Direct TV, as noted, now offers its streaming video Sling TV package of popular networks that includes live sports and news. Amazon, Apple, CBS, HBO, Netflix, Sony, and others offer a variety of streaming video options that allow viewers to cut the cable cord. Suddenly, consumers have the cherry-picking capability that bundled—and expensive—cable packages have never allowed.

In this case, at least, the unintended consequences of the FCC's pro-industry policies may be producing an unexpected pro-consumer twist.

Chapter Seven: What about Privacy?

Has any issue gotten as much lip service—and as little meaningful action?

For all the various congressional bills, corporate self-regulatory schemes and presidential Privacy Bill of Rights proposals, the simple truth remains that no personal information is safe on the Internet. Data brokers have built a multi-billion dollar business exchanging information used to build profiles of Net users. Your shopping and surfing habits, your health history, your banking data, your network of social ties, perhaps even your tax filings are all potentially exposed online. Both legal and criminal enterprises amass this information. And it doesn't go away.

At any given moment people you don't know somehow know where you are. They may very well know when you made your last bank deposit, when you had your last asthma attack or menstrual period. Corporations encourage and pay for every bit of information they can use or sell. Creepy? Perhaps, but as Jeff Chester, president of the Center for Digital Democracy points out: "The basic business model that drives online is advertising."[77]

The FCC largely escapes blame on this one. It is the Federal Trade Commission that has had primary responsibility for protecting Internet privacy. The FCC does have some limited authority, which, some critics say, could have been exercised more vigorously. But for the most part the FCC is not to blame for the rampant online abuse of personal privacy and identity.

The FCC does however have privacy authority over the phone, cable and satellite industries. Until recently, at least, the FCC has kept privacy issues at bay among the companies in these industries. "The FCC has generally taken privacy very seriously," noted Harold Feld, a senior vice president at the non-profit Public Knowledge.[78]

But dynamics now in place suggest that privacy may be the next great testing ground for the FCC. A new chance, perhaps, to champion public interest. Even before the opportunity for privacy enforcement under Title II regulatory powers, the FCC faces new challenges from phone companies, now itching to monetize their vast consumer data stashes the way Net companies have. The commonly used term is "Google envy."

"Until now, ISPs (Internet Service Providers) have mostly not gotten into hot water on privacy—but that's changing," observed Jonathan Mayer, a fellow at the Center for Internet and Society.[79] Verizon and AT&T, major providers of mobile Internet access, have each introduced "super cookies" that track consumer behavior even if they try to delete older, less powerful, forms of cookies. AT&T is actually charging its customers an extra $30 a month *not* to be tracked.

Showdowns loom.

In adopting Title II to enforce net neutrality, the FCC has made broadband Internet access a telecom service subject to regulation as a "common carrier." This reclassification means that the FCC could choose to invoke privacy authority under Title II's Section 222. That section, previously applied to phone and cable companies, mandates the protection of consumer information. Such information—called CPNI for Customer Proprietary Network Information—has kept phone companies from selling data on whom you call, from where you call and how long you spend on the phone. Consumers may have taken such protection for granted on their phone calls. But they have no such protection on their Internet activity—which, as noted, has been a multi-billion dollar safe house hideaway for corporate and criminal abusers of personal privacy.

Now, though, the FCC could put broadband Internet communications under Section 222 protection. To Scott Cleland, a telecom industry consultant who has often been ahead of the analytic pack, this would be a momentous decision.

When the smoke clears—and it hasn't yet—the FCC could make consumer identifiers like IP addresses the equivalent of phone numbers. Suddenly, the Internet companies that have trafficked in all that personal data would be subject to the same controls as the phone and cable companies.

Cleland argues that the risk for privacy abuses extends beyond broadband access providers like Comcast and Verizon to Internet giants like Google and Facebook that have until now flourished with all that personal data. "They are at risk and they are going to live under the uncertainty their business model could be ruled illegal by the FCC," Cleland said.[80]

Much has been written about the legal challenges broadband access providers intend to mount against the FCC's new rules. But Cleland argues that a very different type of legal action could engulf companies that have benefited from the use and sale of private data. Trial lawyers, he argues, will see opportunity in rounding up massive class action suits of Internet users whose privacy has been violated. What sorts of privacy abusers face legal action? Anyone who has "collected CPNI via some type of cookie," according to Cleland.

"Right now, edge providers like Google, Facebook and Twitter are at risk of being sued by trial lawyers," he said.[81]

Sounds great for consumers who care about privacy on the Internet and how it has been abused. But the FCC, Cleland was reminded, has never been a consumer advocate. "Bingo," replied Cleland. That's what makes the FCC's potential move into privacy protection so important and so surprising, he suggests.

There are other signs that the FCC under Tom Wheeler might actually become more consumer-friendly on the issue of data privacy. While Wheeler has brought some former associates from lobbying groups to the FCC, he has also peppered his staff with respected

privacy advocates. Indeed, he named Gigi Sohn, longtime president of the non-profit Public Knowledge, as Counsellor to the Chairman in April.

Another appointee with a privacy background is Travis LeBlanc, head of the FCC's Enforcement Bureau. In previous employment in California's Office of the Attorney General, LeBlanc was active in enforcing online privacy. LeBlanc has stated an interest in privacy and has already taken action against two firms that exposed personal information—including social security numbers—on unprotected Internet servers.

But many aspects of LeBlanc's approach to regulating Internet privacy under Title II remain unclear. Unfortunately, the FCC declined repeated requests to make LeBlanc available for an interview. (It also declined to answer written questions on its enforcement intentions in both privacy and cell tower infrastructure emissions.)

It remains to be seen if LeBlanc and his superiors at the FCC are really willing to take on privacy enforcement. Such a stance would require great courage as the entire Internet infrastructure is built around privacy abuse. It is also questionable whether the FCC would have the courage to challenge Google—a rare corporate ally in the battles over Net Neutrality.

Chapter Eight: Dependencies Power the Network of Corruption

As a captured agency, the FCC is a prime example of institutional corruption. Officials in such institutions do not need to receive envelopes bulging with cash. But even their most well-intentioned efforts are often overwhelmed by a system that favors powerful private influences, typically at the expense of public interest.

Where there is institutional corruption, there are often underlying dependencies that undermine the autonomy and integrity of that institution. Such is the case with the FCC and its broader network of institutional corruption.

As noted earlier, the FCC is a single node on a corrupt network that embraces Congress, congressional oversight committees and Washington social life. The network ties the public sector to the private through a frictionless revolving door—really no door at all.

Temptation is everywhere in Washington, where moneyed lobbyists and industry representatives throw the best parties and dinners. Money also allows industry to control other important factors, like the research agenda. All of this works together to industry's advantage because—as with other instances of institutional corruption—there are compromising dependencies. Policy makers, political candidates and legislators, as well as scientific researchers are all compromised by their dependence on industry money.

Dependency #1 – So much of the trouble here comes back to the core issue of campaign finance. Cable, cellular and educational tech interests know where to target their funds for maximum policy impact. And the contributions work, seemingly buying the silence of key committee congressmen—even those with past records as progressives. Key recipients of industry dollars include Massachusetts Senator Ed Markey and, until he retired, California Democrat Henry Waxman. Though they have intermittently raised their voices on such issues as data privacy and cellular health and safety, neither has shown any great inclination to follow through and take up what would have to be a long and tough fight on these issues.

Dependency #2 – Democrats might be expected to challenge industry now and then. They traditionally have done so, after all. But this is the post-*Citizens United* era where the Supreme Court has turned government into a giant auction house.

Bid the highest price and you walk home with the prize—your personal congressman, legislative loophole, even an entire political party.

Such is the case with technology industries and the Democrats. The communications/electronics industry is the third largest industry group in both lobbying and campaign contributions, according to the Center for Responsive Politics. In just 2013 and 2014, this industry sector spent well over $750 million on lobbying.[82]

Only the finance/insurance/real estate and health industries outspend the tech sector on lobbying. But those industry groups lean Republican. Over 62% of the finance/insurance/real estate campaign contributions go to the GOP. Health contributions lean Republican 57% to 43%. But the technology group leans sharply to Democrats, who got 60% of contributions in the 2013-2014 election cycle.[83] The two next largest industry groups—energy/natural resources and agribusiness—also lean heavily Republican. So of the top five industry groups whose money fuels and often tilts elections four are strongly Republican. The Democrats need the tech industry—and they show that dependence with consistent support, rarely raising such public interest issues as wireless health and safety and Internet privacy.

Dependency #3 – Spectrum auctions give the wireless industry a money-making aura. In recent Congressional testimony, an FCC official reminded legislators that the FCC has over the years been a budget-balancing revenue-making force.[84] Indeed, the auctions of electromagnetic spectrum, used by all wireless communications companies to send their signals, have yielded nearly $100 billion in recent years. The most recent auction to wireless providers produced the unexpectedly high total of $43 billion. No matter that the sale of spectrum is contributing to a pea soup of electromagnetic "smog" whose health consequences are largely unknown. The government needs money and Congress shows its appreciation with consistently pro-wireless policies.

Dependency #4 – Science is often the catalyst for meaningful regulation. But what happens when scientists are dependent on industry for research funding? Under pressure from budget cutters and deregulators, government funding for research on RF health effects has dried up. The EPA, which once had 35 investigators in the area, has long since abandoned its efforts.[85] Numerous scientists have told me there's simply no independent research funding in the U.S. They are left with a simple choice: work on industry-sponsored research or abandon the field.

Chapter Nine: A Modest Agenda for the FCC

Nobody is proposing that cell phones be banned. Nor does anyone propose the elimination of the Universal Service program or other radical reforms. But there are some steps—and most are modest—that the FCC can take now to right some of the wrongs that result from long years of inordinate industry access and influence:

1. Acknowledge that there may be health risks in wireless communications. Take down the dismissive language. Maturely and independently discuss the research and ongoing debate on the safety of this technology.

2. In recognition of this scientific uncertainty, adopt a precautionary view on use of wireless technology. Require prominent point-of-sale notices suggesting that users who want to reduce health risks can adopt a variety of measures, including headphones, more limited usage and storage away from at-risk body parts.

3. Back off the promotion of Wi-Fi. As Professor Lennart Hardell has noted, there are wired alternatives that do not expose children to wireless risk.

4. Petition Congress for the budgetary additions needed to expand testing of emissions on antenna sites. It was Congress after all that gave industry carte blanche for tower expansion so long as they comply with FCC standards. But there is evidence of vast non-compliance and Congress needs to ensure that tower infrastructure is operating within the law.

5. Acknowledge that children and pregnant women may be more vulnerable to the effects of RF emissions and require special protection.

6. Promote cable debundling as a way to lighten consumer cable bills, especially for those customers who don’t care about high-cost sports programming.

7. Apply more rigorous analysis to properly assess the value of technology in education. Evidence continues to pile up that technology in education is not as valuable as tech companies claim. Pay less attention to tech CEOs—pay more attention to the researchers who’ve actually studied the impact of trendy technology fixes on learning

8. Take over enforcement of personal privacy rights on the Internet. Of all the basic suggestions here, this would require the most courage as it would involve challenging many of the entrenched powers of the Internet.

Chapter Ten: Stray Thoughts

Some concluding thoughts:

Why do so many of the most dubious FCC policies involve technology?

In large part, of course, because the FCC has authority over communications and that is a sector that has been radically transformed—along with so many others—by technology.

Let's be clear, though. The problem is not technology, which unarguably brings countless benefits to modern life. The problem is with the over-extension of claims for technology's usefulness and the worshipful adulation of technology even where it has fearful consequences. Most fundamentally, the problem is the willingness in Washington—for reasons of both venality and naïveté—to give technology a free pass.

Personally, I don't believe that just because something can be done it should heedlessly be allowed. Murder, rape and Ponzi schemes are all doable—but subject to prohibition and regulation. Government regulators have the responsibility to examine the consequences of new technologies and act to at least contain some of the worst. Beyond legislators and regulators, public outrage and the courts can also play a role—but these can be muffled indefinitely by misinformation and bullying.

There are precedents for industries (belatedly perhaps) acting to offset the most onerous consequences of their products. In responding to a mix of litigation, public demand and regulatory requirement, the auto industry, for example, has in the last 50 years substantially improved the safety and environmental footprint of its products.

Padded instrument panels, seat belts, air bags, and crumple zones have all addressed safety issues. Environmental concerns have been addressed with tightened emissions and fuel consumption standards. The response to new safety challenges is ongoing. Before side air bags were widely deployed, sedan drivers side-swiped by much larger SUVs were at vastly disproportionate risk of death and dismemberment.[86] But the deployment of side air bags has "substantially" reduced the risk of collision deaths.[87] Overall, auto fatality rates per 100,000 persons have dropped by nearly 60% in the U.S. since 1966.[88] Today, automakers continue to work on advanced safety features like collision avoidance.

It can be argued that most of these safety improvements came decades after autos were in wide usage and only in response to outrage at Ralph Nader's 1965 revelations on the auto industry.[89] No matter the catalysts. The simple truth remains that the auto industry—and its regulators—have for the last half-century been addressing safety and environmental issues.

But with the overwhelming application of money and influence, information and communications technologies have almost totally escaped political scrutiny, regulatory control, and legal discipline.

Should the Internet have been allowed to develop into an ultra-efficient tool for lifting personal information that includes financial records, health histories and social security numbers? Should wireless communications be blindly promoted even as new clues keep suggesting there may be toxic effects? Should local zoning authorities and American citizens be stripped of the right to protect their own health? Should education be digitized and imposed just because technology companies want to develop a new market and lock in a younger customer base?

All these questions can perhaps be rolled up in one: do we all just play dead for the corporate lobbyists and spinners who promote the unexamined and unregulated application of their products?

Finally, a word about the structure of the FCC. With five commissioners—no more than three from the same party—the structure seems to make some kind of sense.

But in practice, it works out poorly. The identification of commissioners by party tends to bring out the worst in both Republicans and Democrats. Instead of examining issues with clear-sighted independence, the commissioners seem to retreat into the worst caricatures of their parties. The Republicans spout free market and deregulatory ideology that is most often a transparent cover for support of business interests. The Democrats seems satisfied if they can implement their pet spending programs—extension of broadband wireless to depressed urban and rural schools, cell phone subsidies for low income clients. The result is a Commission that fulminates about ideology and spends heavily to subsidize powerful interests.

Perhaps one solution would be to expand the Commission to seven by adding two public interest Commissioners. The public interest only rarely prevails at the FCC. So it would represent vast improvement if both Republican and Democrat commissioners had to vie for support of public interest representatives in order to forge a majority. The public interest, in other words, would sometimes carry the swing votes.

It's very hard to believe, though, that Congress would ever approve such a plan. It simply represents too much of a threat to the entrenched political power of the two parties. Why would they ever agree to a plan that dilutes that power?

It's also worth noting that the public interest is not always easy to define. Sometimes there are arguably conflicting definitions. Still, an FCC with public interest commissioners is an idea worth consideration. It would at least require party apologists to defend how they so consistently champion the moneyed interests that have purchased disproportionate access and power in Washington.

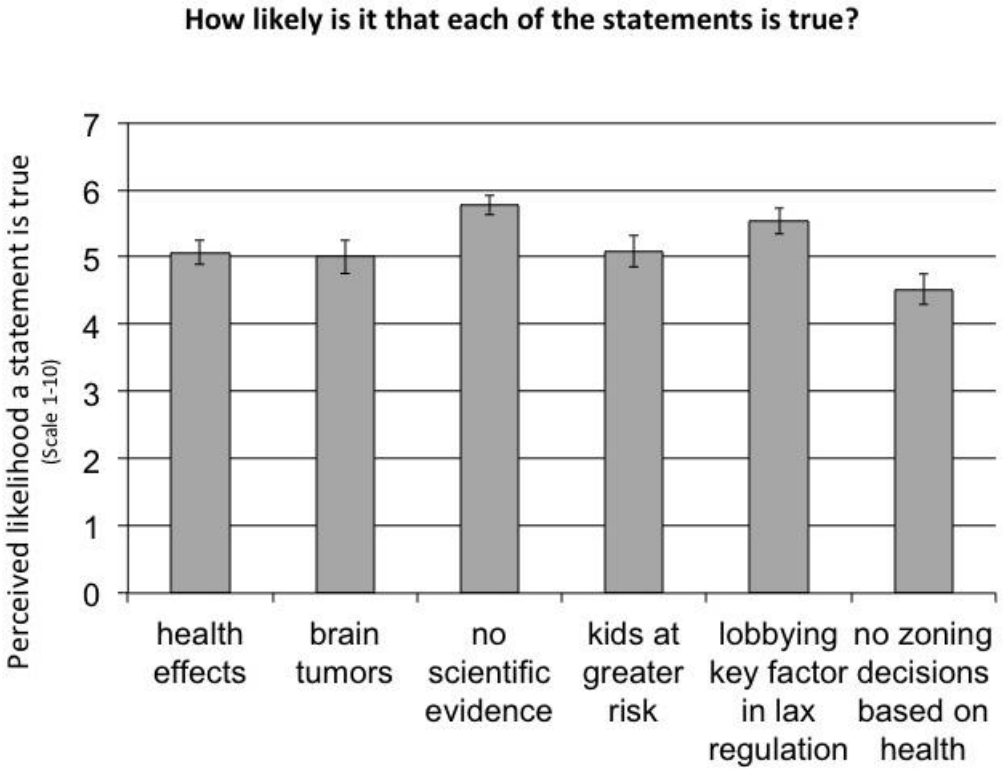
Appendix—Survey of Consumer Attitudes

What does the public believe about the science and politics of wireless health research? Under what conditions would people change wireless usage patterns? Is the FCC currently trusted to protect public health? How would confirmation of health risks affect trust in the FCC?

These are some of the questions Ann-Christin Posten[90] and Norm Alster[91] hoped to answer with an April 2015 online survey of 202 respondents. Participants were recruited through Amazon's Mechanical Turk online platform. All were U.S. residents and had achieved qualifying approval rates in prior Mechanical Turk surveys.

Participants were asked how likely they believed the following statements to be true:

> Statement 1. Prolonged and heavy cell phone use can have a variety of damaging effects on health.
>
> Statement 2. Prolonged and heavy cell phone use triples the risk of brain tumors.
>
> Statement 3. There is no scientific evidence that proves that wireless phone usage can lead to cancer or a variety of other problems.
>
> Statement 4. Children and pregnant women are especially vulnerable to radiation from wireless phones, cell towers and Wi-Fi
>
> Statement 5. Lobbying and campaign contributions have been key factors in keeping the government from acknowledging wireless hazards and adopting more stringent regulation.
>
> Statement 6. The U.S. Congress forbids local communities from considering health concerns when deciding whether to issue zoning permits for wireless antennae.

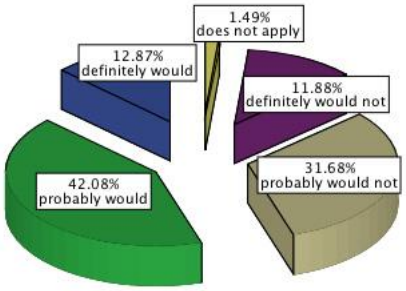


Two findings seem especially interesting:

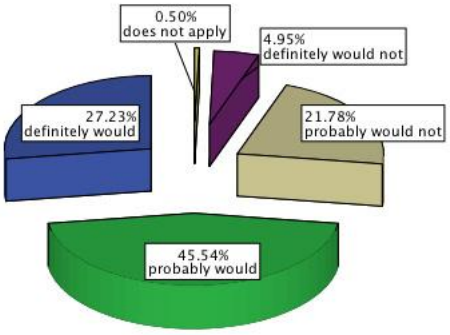
1. Statement 3 received a higher credibility rating than Statements 1 and 2. The different credibility levels are statistically significant. Respondents are more likely to trust in wireless safety than to believe there are general or specific health risks.

2. The only statement that is a matter of uncontested fact is Statement 6 on the outlawing of opposition to antenna sites on health grounds. (All other statements have been both proclaimed and denied.) And yet Statement 6 was least likely to be believed. Just 1.5% of respondents recognized this as an "absolutely true" statement. Over 14% thought this statement was "not true at all." Answers to this question would seem to reflect public ignorance on the political background to wireless health issues.

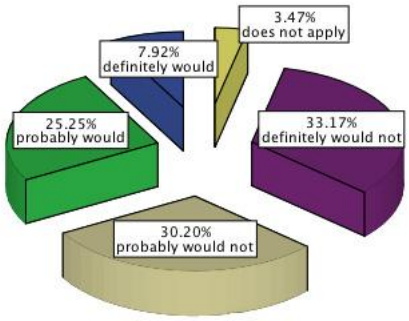
Participants were also asked how they would change behavior if claims of wireless health risks were established as true:



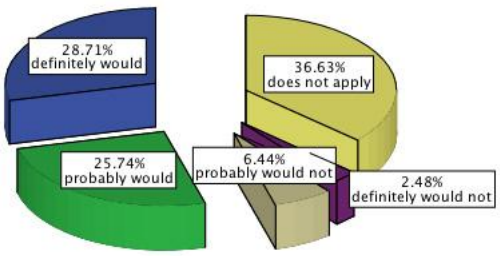
**If statement 1 was true,
I would start using headphones.**



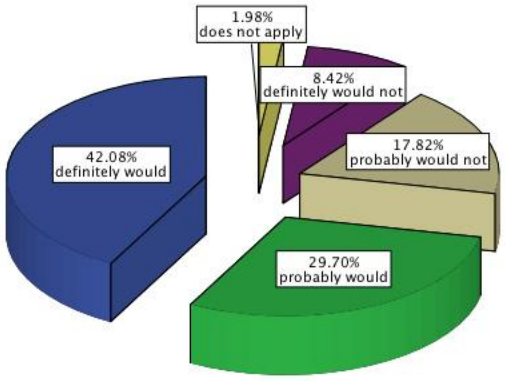
**If statement 1 was true,
I would restrict the amount of time
I spend on the phone.**



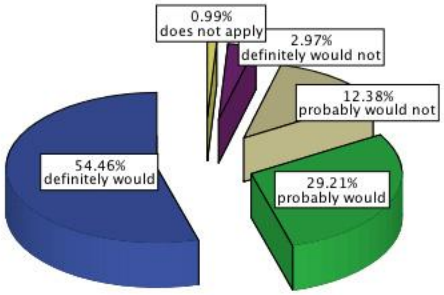
**If statement 1 was true,
I would start up a new land line
account for home use.**



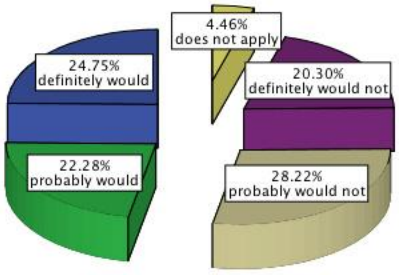
**If statement 1 was true,
I would restrict my children's cell phone use.**



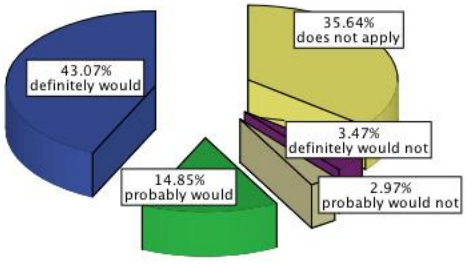
If statement 2 was true,
I would start using headphones.



If statement 2 was true,
I would restrict the amount of time
I spend on the phone.



If statement 2 was true,
I would start up a new land line
account for home use.



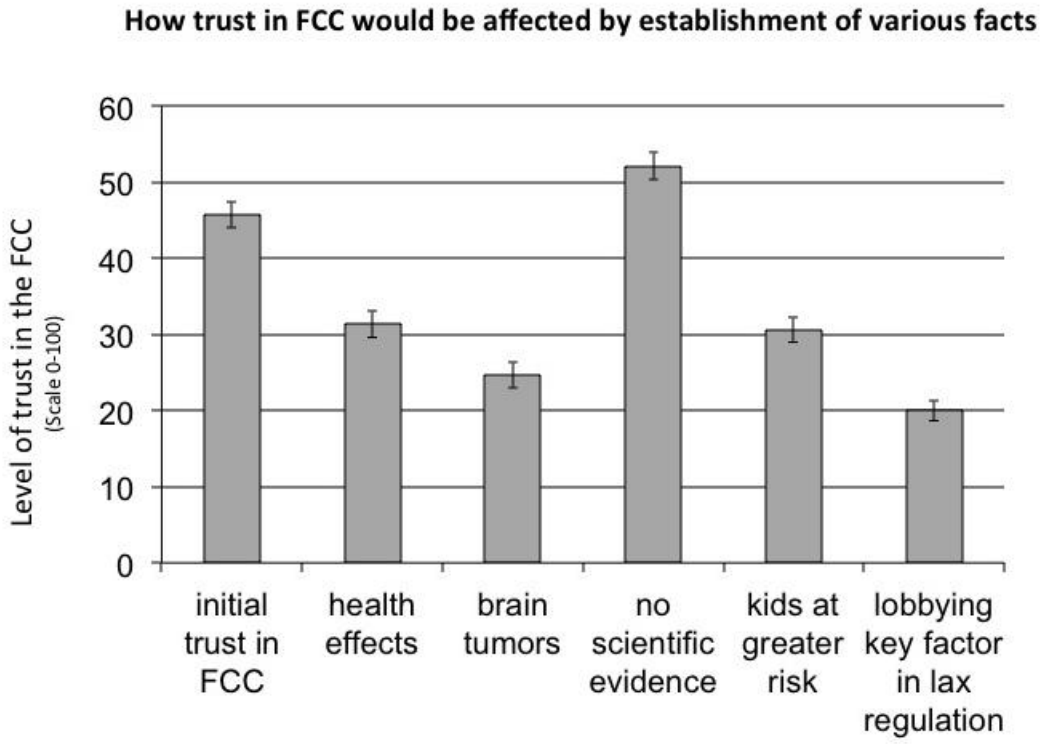
If statement 2 was true,
I would restrict my children's cell phone use.

The greatest impact on behavior came when respondents were asked to assume it is true that prolonged and heavy cell phone use triples the risk of brain tumors. More than half said they would "definitely" restrict the amount of time spent on the phone. Just over 43% would "definitely" restrict their children's phone use. Perhaps most surprisingly, close to 25% would "definitely" start up a new landline phone account. (This last response suggests it may be foolishly premature for the phone giants to exit the landline business just yet.)

The inclination of consumers to change behavior should negative health effects be confirmed suggests the stakes are enormous for all companies that derive revenue from wireless usage.

This survey points to—but cannot answer—some critical questions: Do wireless companies better protect themselves legally by continuing to deny the validity of all troublesome research? Or should they instead be positioning themselves to maintain consumer trust? Perhaps there is greater financial wisdom in listening to the lawyers right now and denying all chance of harm. If so, however, why would anyone seriously concerned about health listen to the industry—or to its captured agency? That's a question the FCC will eventually need to answer.

Trust could eventually become a central issue. Respondents were initially asked to describe their level of trust in the wireless industry and in the FCC as its regulator. Not surprisingly, establishment of any of the presumed health risks—or confirmation of inordinate industry pressure—resulted in statistically significant diminution of trust in both the industry and the FCC.



On a scale of 1 to 100, the FCC had a mean baseline trust level of 45.66. But if the tripling of brain tumor risk is established as definitely true, that number falls all the way to 24.68. If "lobbying and campaign contributions" have been "key factors" in keeping the government from acknowledging wireless hazards, the trust level in the FCC plummets to 20.02. All results were statistically significant.

It's clear that at this point confirmation of health dangers—or even of behind-the-scenes political pressures—from wireless will substantially diminish public trust in the FCC. Skeptics might argue that this gives the FCC motive to continue to downplay and dismiss further evidence of biological and human health effects. Those of a more optimistic bent might see in these findings reason to encourage an FCC concerned about public trust to shake itself loose from special interests.

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International Commission on the Biological Effects of Electromagnetic Fields (ICBE-EMF)
Environmental Health (2022) 21:92
https://doi.org/10.1186/s12940-022-00900-9

Environmental Health

COMMENT

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Scientific evidence invalidates health assumptions underlying the FCC and ICNIRP exposure limit determinations for radiofrequency radiation: implications for 5G

International Commission on the Biological Effects of Electromagnetic Fields (ICBE-EMF)*

Abstract

In the late-1990s, the FCC and ICNIRP adopted radiofrequency radiation (RFR) exposure limits to protect the public and workers from adverse effects of RFR. These limits were based on results from behavioral studies conducted in the 1980s involving 40–60-minute exposures in 5 monkeys and 8 rats, and then applying arbitrary safety factors to an apparent threshold specific absorption rate (SAR) of 4 W/kg. The limits were also based on two major assumptions: any biological effects were due to excessive tissue heating and no effects would occur below the putative threshold SAR, as well as twelve assumptions that were not specified by either the FCC or ICNIRP. In this paper, we show how the past 25 years of extensive research on RFR demonstrates that the assumptions underlying the FCC's and ICNIRP's exposure limits are invalid and continue to present a public health harm. Adverse effects observed at exposures below the assumed threshold SAR include non-thermal induction of reactive oxygen species, DNA damage, cardiomyopathy, carcinogenicity, sperm damage, and neurological effects, including electromagnetic hypersensitivity. Also, multiple human studies have found statistically significant associations between RFR exposure and increased brain and thyroid cancer risk. Yet, in 2020, and in light of the body of evidence reviewed in this article, the FCC and ICNIRP reaffirmed the same limits that were established in the 1990s. Consequently, these exposure limits, which are based on false suppositions, do not adequately protect workers, children, hypersensitive individuals, and the general population from short-term or long-term RFR exposures. Thus, urgently needed are health protective exposure limits for humans and the environment. These limits must be based on scientific evidence rather than on erroneous assumptions, especially given the increasing worldwide exposures of people and the environment to RFR, including novel forms of radiation from 5G telecommunications for which there are no adequate health effects studies.

Keywords: Federal Communications Commission (FCC), International commission on non-ionizing radiation protection (ICNIRP), Radiofrequency radiation (RFR), Exposure limits, Exposure assessment, Radiation health effects, Reactive oxygen species (ROS), DNA damage, 5G, Scientific integrity, Cell phone*, Mobile phone*

Introduction

In establishing exposure limits for toxic or carcinogenic agents, regulatory agencies generally set standards that take into account uncertainties of health risks for the general population [1] and for susceptible subgroups such as children [2]. That approach has not been applied in the same way to the setting of exposure limits for

*The terms cell phone and mobile phone are used interchangeably in this commentary; cell phone is the term used in the United States, while mobile phone is the term used in most of Europe.

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radiofrequency radiation (RFR) (frequency range: 3 kHz to 300 GHz). Moreover, assumptions underlying the current RFR exposure limits are flawed; hence, the limits that are currently applied do not adequately protect human and environmental health. This issue is discussed in greater detail under Assumption #9.

The Federal Communications Commission's (FCC) limits for maximum permissible exposure to RF electromagnetic fields (EMF) [3] were established in 1996 [4], and currently include many recommendations from the International Commission on Non-Ionizing Radiation Protection [5]. These exposure limits were expected to protect against adverse health effects in humans that might occur from short-term (i.e., acute) exposures to RFR and have been maintained by the FCC for the past 26 years. The exposure limits that were established by the FCC in 1996 relied on criteria recommended by the National Council on Radiation Protection & Measurements (NCRP) [6] and the Institute of Electrical and Electronics Engineers (ANSI/IEEE) [7, 8]. The limits were "based on a determination that potentially harmful biological effects can occur at a SAR (specific absorption rate) level of 4.0 W/kg as averaged over the whole-body." The SAR is a measure of the rate of RF energy absorbed per unit mass.

The threshold for a behavioral response and for acute thermal damage in sensitive tissues was considered to be an exposure that produced a whole-body SAR greater than 4 W/kg. In parallel with the development of the FCC's RFR exposure limits, ICNIRP's guidelines for limiting exposure to RF-EMF were also based on behavioral studies conducted in rats and monkeys in the 1980s [9].

The harmful effects that served as the basis for the exposure criteria were changes in behavior observed in small numbers of rats and monkeys when exposed to RFR for up to 60 minutes to power densities at which the whole-body SAR was approximately 4 W/kg or higher [10, 11]. Those studies were conducted in the early 1980s (1980 and 1984, respectively) by investigators of the US Navy Department. Consequently, 4 W/kg was identified as the threshold SAR for adverse health effects induced by RFR. In food-deprived monkeys that were exposed to three different frequencies (225 MHz, 1.3 GHz, and 5.8 GHz) during 60-min sessions, lever-pressing response rates for the delivery of food pellets were reduced compared to sham exposure sessions. The threshold SAR for this decreased response was reported to range from 3.2 to 8.4 W/kg [11]. Similarly, in food-deprived rats exposed to 40-min sessions at 1.28 or 5.62 GHz radiation, the threshold SAR for a decrease in response rate was reported to range from approximately 3.8 to 4.9 W/kg [10]. In experimental studies in which monkeys were exposed in an anechoic chamber for 4 hours to 1.29 GHz radiation at various power densities, an increase in mean body temperature of 0.7 °C was associated with a whole-body SAR of 4 W/kg [12]. Behavior disruption associated with an increase in body temperature of approximately 1.0 °C was assumed to be the most sensitive measure of harmful effects from RF-EMF exposure.

After establishing 4 W/kg as the threshold dose for acute harmful effects, both the FCC [3, 4] and ICNIRP [5, 9] set exposure limits for controlled occupational exposures to 0.4 W/kg SAR averaged over the whole body (based on applying a 10-fold safety/uncertainty factor). For the general population, the FCC's and ICNIRP's exposure limits were set at 0.08 W/kg SAR averaged over the whole body (by applying an additional 5-fold safety/uncertainty factor) for frequencies between 3 MHz and 3 GHz. The exposure limits established by the FCC and ICNIRP do not account for any impact of differing signal characteristics, such as carrier wave modulations or pulsing of the signal. Whole-body exposures for the general population are based simply on power levels averaged over 30-minute periods [3, 5].

Based on SAR distributions from whole-body exposures in which local (i.e., partial body) SARs were estimated to be 10 to 20 times the average value, local exposure limits were set 20 times higher than the average whole-body exposure limit [4–7]. For occupational exposures, local peak exposure limits were permitted up to 8 W/kg averaged over any 1-g cube of tissue [4] or 10 W/kg averaged over any 10 g of contiguous tissue [9] by the FCC and ICNIRP, respectively. For the general population, local peak SARs for partial-body exposures were not to exceed 1.6 W/kg averaged over any 1 g of cube-shaped tissue [3], or not to exceed 2.0 W/kg averaged over any 10 g of cube-shaped tissue [5]. Higher limit values are permissible for extremities. Extremities include the hands, wrists, feet, ankles, and pinnae (the external part of the ear), despite the close proximity of the ear to the brain. These adjustments were made long before the widespread use of wireless communication devices in which the emitting antenna is typically held close to local body organs such as the brain. The NCRP document [6] acknowledges that exposures could be greater than the recommended safety limit values when people are in close proximity to emitters of RFR.

The setting of exposure limits for the prevention of excessive tissue heating was based on the following assumptions: 1) electromagnetic waves at frequencies used in wireless communications do not have sufficient energy to break chemical bonds or ionize molecules [13]; 2) RFR could not damage DNA; and 3) tissue heating was the only possible biological effect of nonionizing radiation [5, 9, 14–16]. For potential environmental and human health issues that are not addressed in the

A) Effects of RF radiation at exposures below the putative threshold SAR of 4 W/kg

Assumption 1) There is a threshold exposure for any adverse health effect caused by RF radiation; in the frequency range of 100 kHz to 6 GHz it is a whole-body exposure that exceeds an SAR of 4 W/kg. Any biological effect of RF radiation above the threshold exposure is due to tissue heating.

Assumption 2) RF radiation is incapable of causing DNA damage other than by heating; there is no mechanism for non-thermal DNA damage.

Assumption 3) Two to seven exposures to RF radiation for up to one hour duration are sufficient to exclude adverse effects for any duration of exposure including chronic exposures.

Assumption 4) No additional effects would occur from RF radiation with co-exposure to other environmental agents.

B) Factors affecting dosimetry

Assumption 5) Health effects are dependent only on the SAR value; carrier wave modulations, frequency, or pulsing do not matter except as they influence the SAR.

C) Human brain cancer risk

Assumption 6) The multiple human studies that find associations between exposure to cell phone RF radiation and increases in brain cancer risk are flawed because of biases in the published case-control studies, and because brain cancer rates have remained steady since the time that use of wireless communication devices became widespread.

D) Individual variations in exposure and sensitivity to RF-EMF

Assumption 7) There are no differences among individuals, including children, in the absorption of RF-EMF and susceptibility to this radiation.

Assumption 8) There are no differences among individuals in their sensitivity to RF radiation-induced health effects.

E) Applied safety factors for EMF-RF workers and the general population

Assumption 9) A 50-fold safety factor for whole body exposure to RF radiation is adequate for protecting the general population to any health risks from RF radiation.

Assumption 10) A 10-fold safety factor for whole body exposure to RF radiation is adequate for protecting workers to any health risks from RF radiation.

Assumption 11) Exposure of any gram of cube-shaped tissue up to 1.6 W/kg, or 10 grams of cube-shaped tissue up to 2 W/kg, (duration not specified) will not increase the risk of that tissue to any toxic or carcinogenic effects in the general population.

Assumption 12) Exposure of any gram of cube-shaped tissue up to 8 W/kg, or 10 grams of cube-shaped tissue up to 10 W/kg, (duration not specified) will not increase the risk of that tissue to any toxic or carcinogenic effects in workers.

F) Environmental exposure to RF radiation

Assumption 13) There is no concern for environmental effects of RF radiation or for effects on wildlife or household pets.

G) 5G (5^{th} generation wireless)

Assumption 14) No health effects data are needed for exposures to 5G; safety is assumed because penetration is limited to the skin ("minimal body penetration").

Fig. 1 Assumptions Underlying the FCC/ICNIRP Exposure Limits for RF Radiation

setting of exposure limits (for example effects of chronic exposures, or effects of co-exposure of skin to RFR and other environmental agents, such as would occur with 5G exposure in combination with sunlight), the implicit assumption is that such effects do not matter, or that the arbitrarily selected safety/uncertainty factor is sufficient to deal with those concerns. In any case, it is expected that underlying assumptions applied to health risk assessments would be clearly described [1].

Exposure limits for RF radiation are based on numerous assumptions; however, research studies published over the past 25 years show that most of those assumptions are not supported by scientific evidence. In the NCRP report [6], the authors noted that when further understanding of biological effects of RF radiation becomes available, exposure guidelines will need to be evaluated and possibly revised. The ANSI/IEEE document [7] also notes that effects of chronic exposure or evidence of non-thermal interactions could result in revising exposure standards. Unfortunately, these recommendations were never implemented. Assumptions of safety from exposures that could adversely affect human or environmental health should be tested and validated *before* widespread exposures occur, not afterwards, by agencies responsible for protecting public health.

In this paper, we highlight studies that demonstrate the fallacy of inherent assumptions in the FCC/ICNIRP guidelines for RF radiation exposure limits, and we find that the limits fail to protect human and environmental health. Fourteen assumptions that underlie the RFR exposure limits established in the 1990s and reaffirmed in 2020 by the FCC [4, 5] and ICNIRP [5, 9] are addressed in this paper and are shown in Fig. 1.

Assumptions underlying exposure limits for RF radiation and the scientific evidence demonstrating that these assumptions are not valid

A. Effects of RF radiation at exposures below the putative threshold SAR of 4 W/kg

Assumption 1) *There is a threshold exposure for any adverse health effect caused by RF radiation; in the*

frequency range of 100 kHz to 6 GHz it is a whole-body exposure that exceeds an SAR of 4 W/kg. Any biological effect of RF radiation above the threshold exposure is due to tissue heating.

Cardiomyopathy and carcinogenicity

In response to a request from the Food and Drug Administration's (FDA) Center for Devices and Radiological Health [17], the National Toxicology Program (NTP) conducted toxicity and carcinogenicity studies of cell phone (CDMA- or GSM-modulated) radiation in rats and mice exposed to RFR at frequencies of 900 MHz and 1800 MHz, respectively [18, 19]. Exposures to RFR for up to 2 years occurred in reverberation chambers over 18 hours/day on a continuous cycle of 10 minutes on and 10 minutes off. In rats, the whole-body SAR levels during the 10-minute on cycles were 0, 1.5, 3, or 6 W/kg.

The major histopathological findings from the NTP study in male rats [18] included dose-related increases in cardiomyopathy, increased incidence of cancers and preneoplastic lesions in the heart (schwannoma and Schwann cell hyperplasia) and brain (glioma and glial cell hyperplasia), increases in prostate gland tumors and hyperplasias, significant increases in adrenal gland tumors, and significant increases in the overall incidence of benign or malignant neoplasms in all organs in the 3 W/kg groups. The incidence of cardiomyopathy was also increased in GSM-exposed female rats, and significant increases in DNA damage were found in rats and mice [18, 19]. Similarly, an earlier study by Chou et al. [20] found a significant (3.6-fold) increase in the incidence of primary malignant neoplasms in male rats exposed to 2450 MHz pulsed RFR for 25 months (21.5 hr./day) at an SAR that ranged from 0.15 to 0.4 W/kg.

A 3-day external peer-review of the NTP studies confirmed there was "clear evidence of carcinogenic activity" in male rats for heart schwannomas, and "some evidence of carcinogenic activity" for brain gliomas and adrenal gland tumors with exposure to either GSM- or CDMA-modulated RF radiation [21]. In addition, a lifetime study by the Ramazzini Institute reported a significant increase in heart schwannomas in male rats exposed 19 hour/day to 1800 MHz GSM-modulated RFR at a field strength of 50 V/m, equivalent to a whole-body SAR of 0.1 W/kg [22]. The incidence of heart Schwann cell hyperplasia was also increased in that exposure group. These findings are consistent with results from the NTP study and demonstrate that the proliferative effect of modulated RFR in heart Schwann cells is a reproducible finding that can occur at doses far below the assumed whole-body threshold SAR of 4 W/kg.

ICNIRP [23] dismissed the evidence of carcinogenicity for RFR that was provided in the studies by the NTP [18] and the Ramazzini Institute [22] based on their earlier critique of those studies [24]. However, that critique demonstrated an unfortunate lack of understanding together with a misrepresentation of the design, conduct, and interpretation of experimental carcinogenicity studies in animal models [25], as well as a lack of appreciation for the remarkable concordance between the tumor responses observed in experimental animals with those identified in cancer epidemiology studies of mobile phone users described under Assumption #6.

Neither heating effects nor thermal stress was likely causal of the adverse health effects observed in the NTP [18] study, since there was no tissue damage observed in a 28-day study at the same SARs, there was no significant effect on body weight during the 2-year study, and there were no exposure-related clinical observations that would indicate thermal or metabolic stress. Furthermore, a preliminary thermal pilot study demonstrated that body temperatures did not increase by more than 1^{O} C at the exposure levels used in the chronic studies [26], and there is no evidence that a small change in body temperature associated with the RFR exposures in the NTP study can cause the types of carcinogenic effects that were observed. The similar findings of GSM-modulated RFR on Schwann cells by the Ramazzini Institute [22] at much lower whole-body SARs confirm these effects to be independent of tissue heating.

Neurological effects

Though the FCC and ICNIRP exposure limits are based on a putative threshold dose of 4 W/kg due to behavioral disruption observed at higher doses in rats and monkeys [10, 11] numerous studies have shown consistent and reproducible deficits in spatial learning and memory in laboratory animals exposed to RF radiation at SARs below 4 W/kg. Examples of study exposures that demonstrated these neurological effects included 900 MHz GSM at 0.41–0.98 W/kg, 2 hr./day for 4 days in mice [27]; 900 MHz GSM at 0.52–1.08 W/kg, 2 hr./day for 1 month in rats [28]; 900 MHz GSM at 1.15 W/kg, 1 hr./day for 28 days in rats [29]; 900 MHz pulsed RFR at 0.3–0.9 W/kg for 6 hr./day in rats from conception to birth and tested at 30 days of age [30]; 900 MHz GSM and 1966 MHz UMTS at 0.4 W/kg for 6 months in rats [31]; and 900 MHz continuous wave EMF at 0.016 W/kg 3 hr./day for 28 days in rats [32]. The studies cited above are not the only studies showing these effects, but they clearly demonstrate that exposure to RFR at an SAR of 4 W/kg is not a threshold dose for neurological effects in rodents. The effects of RF radiation on spatial learning and memory indicate

the hippocampus as a target site of these exposures. For a more complete listing of neurological effects of RFR reported between 2007 and 2017 see Lai [33].

In addition, many studies have reported changes in brain electrical activities in human subjects, measured by electroencephalography (EEG), including sleep disturbance from single exposures to cell phone RF radiation. This is not surprising since the nervous system transmits messages based on electrical signals generated by nerve cells. Decreased β-trace protein, which is a key enzyme in the synthesis of a sleep-promoting neurohormone, has been seen in young adults with high-cumulative amounts of hours of mobile phone use [34]. Another frequently reported effect of RF radiation is increased blood-brain barrier permeability in rats at SARs much lower than 4 W/kg, e.g. [32, 35–41]. Oxidative stress induced in the brain of animals exposed to RF-EMF has been associated with observed neurological effects [42]. Although many studies did not observe significant changes in neurological effects in humans and several studies did not observe increased permeability in the blood-brain barrier in animal models [33], differences in EMF frequency, modulation, duration of exposure, and direction of incident waves to the exposed subject, as well as difference in dielectric properties and the size and shape of the exposed subject likely account for differences in observed effects [43, 44].

Sperm damage

The effect of non-ionizing microwave radiation on the testis (testicular degeneration in mice) was first reported 60 years ago [45]. Since then, and with the rapid increase in use of RF-EMF emitting devices, numerous studies have investigated testicular effects of RFR and potential associations with male infertility [46–50]. Human and animal studies have shown that the testis is one of the most sensitive organs to RF-EMF exposures, and that keeping a mobile phone in trouser pockets in talk mode can affect fertility parameters e.g., sperm motility, sperm count, sperm morphology, and apoptosis [48, 51]. Meta-analyses of published epidemiologic studies on the impact of mobile phone radiation on sperm quality in adult men have found significant decreases in sperm motility, sperm viability and/or sperm concentrations that were associated with mobile phone usage [52–55]. Several physical factors associated with exposure conditions can affect the outcome of human studies, including depth of energy penetration, duration of call, type of transmission technology, distance of the device to the body or testis, and power density with defined SAR. For example, Zilberlicht et al. [56] observed higher rates of abnormal sperm concentrations among men who held their phones less than 50 cm from their groin.

The effects of RFR on reproductive parameters in humans are consistent with results from experimental studies in animals and in vitro studies. For example, exposure of human semen to 850 MHz radiation from mobile phones for 1 hour at an SAR of 1.46 W/kg caused a significant decrease in sperm viability that was associated with an increase in reactive oxygen species (ROS) [50] or an increase in sperm DNA fragmentation [57]. Exposure of isolated human spermatozoa to 1.8 GHz RF-EMF significantly reduced sperm motility and induced ROS generation at an SAR of 1.0 W/kg, and significantly increased oxidative DNA damage and DNA fragmentation at an SAR of 2.8 W/kg [58].

Some examples of effects of RFR on male fertility factors in studies with experimental animals at SARs below 4 W/kg include: a decrease in sperm count and an increase in ROS in rats exposed to mobile phone frequencies 2 hr./day, for 35 days (SAR = 0.9 W/kg) [59]; increases in oxidative stress, 8-hydroxy-deoxyguanosine (8-OHdG), and DNA strand breaks in the testes of rats exposed to 900 MHz (SAR = 0.166 W/kg), 1800 MHz (0.166 W/kg), or 2100 MHz (0.174 W/kg) 2 hr./day for 6 months [60]; an increase in ROS, a decrease in sperm count, and altered sperm morphology in rats exposed to 900 MHz 3G mobile phone radiation (SAR = 0.26 W/kg) 2 hr./day for 45 days [61]; decreased sperm quality in rats in which local exposure of the scrotum to 2575–2635 MHz 4G smartphone time division LTE radiation occurred for 1 min over 10 min intervals 6 hr./day for 150 days [62]; impaired testicular development at 35 days of age in male offspring of pregnant rats that were exposed to 2.45 GHz RFR (SAR = 1.75 W/kg) 2 hr./day throughout pregnancy [63]; decreased sperm motility in mice exposed to 905 MHz RFR (SAR = 2.2 W/kg) 12 hr./day for 5 weeks, and increased ROS formation and DNA fragmentation after 1 week of exposure [64]. Although negative studies have also been reported, it is important to remember that the outcome of experimental studies can be affected by differences in exposure conditions, including the frequency, modulation, polarization, stray electromagnetic fields, local SAR, duration of exposure, and analytical methods [43, 44].

Although the mechanism of testicular effects from exposure to non-thermal levels of RFR is not fully known, numerous studies in rats and mice, and in human sperm have found associations between negative effects on fertility parameters and increases in ROS and/or DNA damage [48, 51, 57, 58, 60, 61, 64–68]. Thus, the adverse effects of RFR on sperm quality are likely due in large part to induced generation of ROS.

Assumption 2) *RF radiation is incapable of causing DNA damage other than by heating; there is no mechanism for non-thermal DNA damage.*

In 2009, ICNIRP [16] claimed that "low energy photons of RF radiation are too weak to affect ionization or cause significant damage to biological molecules such as DNA, under ordinary circumstances." However, DNA damage and other genotoxic effects have been observed in numerous studies of low intensity RFR in animal models and in humans. For example, the NTP study found statistically significant increases in DNA damage in brain cells of exposed rats and mice compared to sham controls [18, 19, 69], and Akdag et al. [70] found statistically significant increases in DNA damage in hair cells in the ear canal among 30 to 60 year-old men who used mobile phones for 10 years for 0–30 min/day, 30–60 min/day, or greater than 60/min/day compared to people who did not use mobile phones. In the latter study, the extent of DNA damage increased with increasing daily exposure duration. In a review of published studies on genetic effects of ELF- and RF-EMF, Lai [71] listed more than 150 studies in which non-thermal exposures to RFR produced increases in DNA damage, chromosome aberrations, or micronuclei formation.

In addition, it is well established that DNA damage can also be caused by indirect processes, such as by the generation of reactive oxygen species (ROS), and numerous studies have demonstrated DNA damage at exposures below the putative threshold SAR of 4 W/kg. More than 120 published studies have demonstrated oxidative effects associated with exposure to low intensity RFR (Additional file 1: Appendix 1). An analysis of experimental studies on molecular effects of low intensity RF radiation (RFR) in biological systems found that the majority (93 of 100 studies) demonstrated the induction of oxidative effects [72]. More recent studies (from 2017) revealed that all 30 relevant publications (100%) detected significant oxidative effects under low intensity RFR exposures, and most of these studies used modulated RFR from wireless communication devices.

Increased production of ROS in living cells may be caused by weak magnetic fields altering recombination rates of short-lived radical pairs generated by normal metabolic processes leading to changes in free radical concentrations [73], or by low intensity extremely low frequency (ELF) EMFs resulting in alterations in voltage-gated ion channels in cell membranes causing changes in cation flow across membranes [74]. These mechanisms apply to both ELF-EMFs and to RFR modulated by pulsed fields at extremely low frequencies. Other biophysical mechanisms by which non-thermal RF-EMF can cause biological effects through interactions with normal cellular processes have been described [75].

Increasing NADH oxidase activity is another mechanism by which RFR can increase ROS production. NADH oxidases, which are membrane-associated enzymes that catalyze one-electron reduction of oxygen to superoxide radical using NADH as the electron donor, have been identified as primary mediators of RFR interactions in cellular systems [76]. A significant (3-fold) increase in the activity of NADH oxidase was measured in purified plasma membranes from HeLa cells exposed to 875 MHz for 5 or 10 min at a power density of 200 μW/cm^2. This exposure intensity is significantly lower than the ICNIRP [5] safety limit.

The major source of ROS in living cells is the mitochondrial electron transport chain, where leakage of electrons generates superoxide radicals due to the partial reduction of oxygen [77]. A dose-dependent effect of 1.8 GHz modulated RFR exposure (SAR = 0.15 and 1.5 W/kg) on mitochondrial ROS production was detected in mouse spermatogonial germ cells [65]. Exposure of quail embryos to extremely low intensity modulated RFR (GSM 900 or 1800 MHz, 0.25 or 0.32 μW/cm^2) during the initial days of embryogenesis resulted in a robust overproduction of superoxide radical and nitrogen oxide in mitochondria of embryonic cells [78, 79]. Thus, multiple mechanisms for the increased production of ROS by low intensity RF radiation have been demonstrated.

Numerous studies have been published on mutagenic effects of low intensity RF-EMFs, especially studies that identified increases in levels of a specific marker of oxidative DNA damage and a risk factor for cancer, 8-hydroxy-2′-deoxyguanosine (8-OHdG) [58, 60, 78–84]. For example, the level of 8-OHdG in human spermatozoa was increased significantly after in vitro exposure for 16 hr. to 1.8 GHz at a power level of 2.8 W/kg and correlated with levels of ROS generation [58]. Likewise, exposure of quail embryos *in ovo* to GSM-modulated 900 MHz of 0.25 μW/cm^2 for 1.5, 5, or 10 days was sufficient to produce a significant, two-threefold, increase in 8-OHdG levels in embryonic cells [79]. Umbilical cord blood and placenta tissue samples obtained after delivery from women who used mobile phones during pregnancy had significantly higher levels of oxidative stress parameters, including 8-OHdG and malondialdehyde, compared to cord blood and placental tissue from women who did not use mobile phones during pregnancy [85]. In addition, DNA damage, analyzed by the comet assay, was increased significantly in cord blood lymphocytes obtained from women who used mobile phones during pregnancy compared to cord blood lymphocytes obtained from women who did not use mobile phones.

As low intensity RF radiation does not have sufficient energy to ionize DNA molecules, and as increased production of ROS in living cells due to RF-EMF exposures has been reliably documented, an indirect effect of this type of radiation is the formation of oxidative damage to DNA. The most aggressive form of ROS that can cause oxidative DNA damage is the hydroxyl radical; this reactive oxygen species can be generated from superoxide radical and hydrogen peroxide [86], which may be produced in living cells exposed to low intensity RF radiation. Ultraviolet radiation (UVR, encompassing UVA, UVB, and UVC), which is classified by IARC as "carcinogenic to humans"), can also cause indirect DNA damage by generating ROS [87]. Thus, both RFR and UVR, which can similarly induce oxidative DNA damage, can increase cancer risk by a similar mechanism.

Increased production of ROS and depletion of antioxidant capacity in living cells exposed to low intensity RF radiation can result in oxidative DNA damage. Induction of oxidative stress, which is a key characteristic of many human carcinogens [88], including UVR and asbestos, can also lead to genotoxicity and carcinogenicity of non-ionizing RF radiation without causing direct DNA damage.

> **Assumption 3**) *Two to seven exposures to RF radiation for up to 1 hour duration are sufficient to exclude adverse effects for any duration of exposure including chronic exposures.*

The behavioral studies in 8 male rats and 5 male monkeys that served as the basis for the exposure limits to RF radiation adopted by the FCC and ICNIRP involved 2 to 7 exposure sessions of 40-minute duration for rats [10] and 3 exposure sessions of 60-minute duration for monkeys at each power density [11]. Additional support for the threshold SAR of 4 W/kg in the frequency range of 100 kHz to 6 GHz came from behavioral studies conducted in rats and monkeys by D'Andrea et al. [89, 90]. However, D'Andrea et al. [91, 92] also reported that exposure of rats to continuous wave 2450 MHz RFR for 14 or 16 weeks caused significant differences in behavioral activity between sham-exposed rats and RFR-exposed rats at mean SARs of 0.7 W/kg and at 1.23 W/kg, indicating that 4 W/kg is not a threshold SAR with extended exposure durations. Since that time many studies have shown that responses to non-thermal RFR depend on both exposure intensity and exposure duration [93]. Importantly, the same response was observed with lower exposure intensity but prolonged exposure duration as at higher exposure intensity and shorter duration [94].

Recognizing that the exposure limits do not address potential health effects after long-term exposures to RF radiation emitted from wireless devices that people are experiencing, the FDA [17] nominated RF radiation to the NTP for chronic toxicology and carcinogenicity studies out of concern that "existing exposure guidelines are based on protection from acute injury from thermal effects of RFR exposure, and may not be protective against any non-thermal effects of chronic exposures." Adverse health effects noted in Assumption #1, including cardiomyopathy, carcinogenicity, sperm damage, and neurological effects, as well as the human epidemiology studies to be described in Assumption #6, occurred with much longer exposures to RF radiation than the exposure durations used in the acute studies in rats [10] and monkeys [11]. Consequently, the acute behavioral exposure studies that served as the basis for exposure limits to RF radiation established by the FCC and ICNIRP are inadequate to identify and characterize adverse effects of RF radiation after longer exposure durations. Neither the exposure limits established in the 1990s by the FCC [4] or by ICNIRP [9], nor those reaffirmed more recently by these groups [3, 5] address health risks associated with long-term exposure to RF radiation.

> **Assumption 4**) *No additional effects would occur from RF radiation with co-exposure to other environmental agents.*

The current FCC/ICNIRP exposure limits do not take into consideration interactive effects of RF radiation with other environmental agents even though such effects have been documented. Interactions of RF radiation with other agents may result in antagonistic or synergistic effects, i.e., effects that are greater than the sum of each agent alone.

In the International Agency for Research on Cancer (IARC) evaluation of the carcinogenicity of RF-EMF [44], the expert working group noted that 4 of 6 co-carcinogenesis studies available at that time showed increased responses with exposure to RF-EMF. One of those studies reported co-carcinogenic effects of UMTS-modulated RF radiation at 4.8 W/m^2 in the liver and lung of mice that had been treated with the carcinogen ethylnitrosourea (ENU) in utero [95]; the incidence of liver and lung cancers were increased in mice exposed to ENU plus RF radiation compared to cage controls, sham controls and ENU alone. After the IARC evaluation, Lerchl et al. [96] replicated the experimental design of Tillmann et al. [95] by exposing mice to RF-EMF at whole-body SAR levels of 0 (sham), 0.04, 0.4, and 2 W/kg. Significant increases in lung adenomas and/or liver carcinomas were observed at all exposure levels. Lerchl et al. [96] concluded that their "findings are a very clear indication that tumor-promoting effects

of life-long RF-EMF exposure may occur at levels supposedly too low to cause thermal effects." Thus, the reproducibility of the tumor-promoting effects of RFR at non-thermal exposure levels has been demonstrated.

Other examples of reported synergistic effects include the following study results. Synergistic effects on damage to human lymphocytes were observed with co-exposure to RFR (1.8 GHz RFR, SAR 3 W/kg) and 2 different mutagens, namely, mitomycin C or 4-nitroquinoline-1-oxide [97], or with co-exposure to ultralight (UVC) light [98]. A synergistic effect was found on DNA damage in human blood cells exposed to 2450 MHz radiation (5 mW/cm^2) and then exposed to mitomycin C [99]. A potentiation effect on DNA damage was observed in cultured mammalian cells exposed to CDMA-modulated 835 MHz RF-EMF (SAR = 4 W/kg) and the clastogens cyclophosphamide or 4-nitroquinoline-1-oxide [100]. Gene expression was altered in neuronal and glial cells of rats pre-treated with lipopolysaccharide, a neuroinflammatory agent, and then exposed to 1800 MHz GSM modulated radiation (SAR = 3.22 W/kg) for 2 hr. [101]. In rats pre-treated with picrotoxin, a chemical that induces seizures, exposure to pulse-modulated 900 MHz GSM-modulated RF radiation of mobile phones increased regional changes in brain activity and c-Fos expression [102, 103].

Exposure limits based on exposure to only RF radiation will result in an underestimation of the true risk and inadequate protection of human health under conditions in which co-exposures to other toxic agents lead to synergistic adverse effects [104].

B. Factors affecting dosimetry

Assumption 5) *Health effects are dependent only on the time-averaged SAR value; carrier wave modulations, frequency, or pulsing do not matter except as they influence the SAR.*

The FCC's and ICNIRP's exposure limits to RFR are based on SARs for frequencies up to 6 GHz and on power densities for frequencies between 6 GHz and 300 GHz averaged over 6-minute or 30-minute intervals for local areas and whole-body exposures [3, 5]. However, time-averaged dosimetry does not capture the unique characteristics of modulated or pulsed RFR. For example, GSM modulation may involve as many as 8 voice channels with a duration of 0.577 msec for each channel. Thus, the exposure from GSM modulation can be 8-times higher during each time slot pulse compared to exposure to a continuous wave at equivalent time-averaged SARs. Also, as noted under assumption #14, repetitive pulses of data in bursts with short exposures to 5G can cause localized temperature spikes in the skin [105]. The impact of pulsed radiation on biological activities at the molecular or cellular levels is not taken into consideration with time-averaged dosimetry.

Another issue not addressed by time-averaged dosimetry is the importance of low frequency modulations on biological systems. As discussed under assumption #2, increased production of ROS in living cells and DNA damage have been demonstrated with exposure to low frequency modulations of radiofrequency carrier waves [106]. Exposure limits based on time-averaged SAR dosimetry or power density, without consideration of the impact of amplitude or frequency modulations, do not adequately address potential health effects of real-world exposures to RFR. There is ample evidence that various effects of RFR exposure depend on carrier wave modulations, frequency, or pulsing [43, 107, 108]. In contrast to ICNIRP/FCC, the IARC monograph on RFR carcinogenicity noted that RFR effects may be influenced by such exposure characteristics as duration of exposure, carrier frequency, type of modulation, polarization, exposure intermittence, and background electromagnetic fields [44].

C. Human brain tumor risk

Assumption 6) *The multiple human studies that find associations between exposure to cell phone RF radiation and increases in brain tumor risk are flawed because of biases in the published case-control studies, and because brain cancer rates have remained steady since the time that use of wireless communication devices became widespread.*

Although claims have been made that "current limits for cell phones are acceptable for protecting the public health" because "even with frequent daily use by the vast majority of adults, we have not seen an increase in events like brain tumors" [109], the SEER (Surveillance, Epidemiology, and End Results Program) database shows an annual decrease of 0.3% for all brain tumors, but an increase of 0.3% per year for glioblastoma in the US between 2000 and 2018 (https://seer.cancer.gov/explorer/). Most concerning was that the annual increase for glioblastoma was 2.7% per year for people under 20 years of age. In addition, Zada et al. [110] reported that the incidence of glioblastoma multiforme (GBM) in the frontal lobe, temporal lobe, and cerebellum increased in the US between 1992 and 2006, and Philips et al. [111] likewise reported a statistically significant increasing incidence of GBM in the frontal and temporal lobes of the brain in the UK during 1995–2015. In Sweden, rates of brain tumors in the Swedish National Inpatient Register and the Swedish Cancer Register increased from 1998 to

2015 [112]. In addition, it should be realized that cumulative exposure, side-of-head use, and latency for tumor formation from RFR are not fully captured in national cancer registries. Thus, the claim that trends in brain cancer incidence rates have not increased since mobile phones were introduced is both wrong and misleading. The specificity of effect needs to be factored into such trend analyses.

Case-control studies, using sound scientific methods, have consistently found increased risks with long-term, heavy mobile phone use for brain tumors of the glioma type and acoustic neuroma. This association was evaluated at IARC in 2011 by 30 expert participants who concluded that radiofrequency (RF) radiation is a "possible" human carcinogen [44]. In contrast, the much-cited Danish cohort study on 'mobile phone users' [113] was disregarded by IARC due to serious methodological shortcomings in the study design, including exposure misclassifications [44, 114].

Results of meta-analyses of glioma risk and acoustic neuroma from Swedish case-control studies conducted by Hardell and coworkers [115, 116], the 13-nation Interphone study [117], and the French study by Coureau et al. [118] are shown in Table 1 as odds ratios (OR) with 95% confidence intervals. For glioma on any location in the head, a statistically significant increase of nearly two-fold was found, while for ipsilateral mobile phone use (tumor and phone use on the same side of the head) the risk was increased by 2.5-fold. These ORs are based on the groups in each study with the highest category of cumulative call time, which were ≥ 1640 hr. in the Interphone study [117, 119] and the Swedish studies [115, 116], and ≥ 896 hr. in the study by Coureau et al. [118]. Decreased survival among glioma cases, especially astrocytoma grade IV, was associated with long-term and high cumulative use of wireless phones [120]. Increased risk for the mutant type of *p53* gene expression in the peripheral zone of astrocytoma grade IV was associated with use of mobile phones for ≥3 hours a day. Increase in this mutation was significantly correlated with shorter overall survival time [121].

For acoustic neuroma, risk was significantly increased with cumulative exposure and ipsilateral use by 2.7-fold. A random effects model, which was based on a test for heterogeneity, was used for the meta-analyses of these published studies. Tumor volume of acoustic neuroma increased per 100 hr. of cumulative use of wireless phones in the Swedish study and years of latency, indicating tumor promotion [115].

Other case-control studies of mobile phone use also reported increased risk of acoustic neuroma [122–124]. Those studies were not included in the meta-analysis because data on cumulative mobile phone use with numbers of cases and controls were not given or there were other shortcomings. It is also noteworthy that tumor risks were increased in subsets of the Interphone study; for example, there was nearly a 2-fold increase in the risk of acoustic neuroma for ≥10 y and ipsilateral use among the North European countries that participated in the Interphone study [125].

Claims have been made that associations between increases in brain cancer risk and exposure to cell phone RF radiation in the published case-control studies may be attributable to recall and/or selection biases [5, 109]. However, a re-analysis of the Canadian data that was included in the Interphone study showed that there was no effect on the risk of glioma after adjustments were made for selection and recall biases [126]. Odds ratios (OR) for glioma were increased significantly and to a similar extent when comparing the highest quartile of use to those who were not regular users whether or not adjustments for biases were made. In addition, Hardell

Table 1 Odds ratios (OR) with 95% confidence interval (CI) for glioma and acoustic neuroma in case-control studies in the highest category for cumulative mobile phone use in hours[a]

	Glioma				Acoustic neuroma			
	All		Ipsilateral		All		Ipsilateral	
	OR	95% CI	OR	95% CI	OR	95% CI	OR	95% CI
Interphone [117, 119] Cumulative use ≥1640 hr	1.40	1.03–1.89	1.96	1.22–3.16	1.32	0.88–1.97	2.33	1.23–4.40
Coureau et al. [118] Cum use ≥896 hr	2.89	1.41–5.93	2.11	0.73–6.08				
Hardell et al. [115, 116] Cumulative use ≥1640 hr	2.13	1.61–2.82	3.11	2.18–4.44	2.40	1.39–4.16	3.18	1.65–6.12
Meta-analysis longest cumulative use	**1.90**	**1.31–2.76**	**2.54**	**1.83–3.52**	**1.73**	**0.96–3.09**	**2.71**	**1.72–4.28**

[a] Note Hardell et al. [115, 116] also assessed use of cordless phones

and Carlberg [116] showed that the risk for glioma with mobile phone use was increased significantly even when compared to the risk for meningioma. Because risk of meningioma was not increased significantly, this tumor response could not be attributed to recall bias. Clearly, selection and recall biases do not explain the elevated brain tumor risk associated with the use of mobile phones. Thus, epidemiological evidence contradicts the opinions of the FCC and ICNIRP on brain tumor risk from RF radiation.

It should also be noted that the thyroid gland is a target organ for RFR from smartphones. A case-control study on mobile phone use suggested an increased risk for thyroid microcarcinoma associated with long-term cell phone use [127]. Peripheral lymphocyte DNA obtained from cases and controls was used to study genotype-environment interactions. The study showed that several genetic variants based on single nucleotide polymorphisms (SNPs) increased the risk of thyroid cancer with mobile phone use [128]. Increasing incidence of thyroid cancer in the Nordic countries, especially over the last two decades, has also been reported [129, 130]. In addition, a recent case-control study found significant increases in breast cancer risk among Taiwanese women based on their use of smartphones and distance between the breast and placement of their smartphone [131].

D. Individual variations in exposure and sensitivity to RF-EMF

Assumption 7) *There are no differences among individuals, including children, in the absorption of RF-EMF and susceptibility to this radiation.*

Differences between children and adults regarding the absorption of radiofrequency electromagnetic fields when mobile phones are operated close to the head have been demonstrated and widely documented [132–137]. The main factors accounting for these dissimilar absorption rates include differences in anatomy, tissue dielectric properties, and physiology. Through finite-difference time-domain (FDTD) simulations, employing detailed computational anthropomorphic models, it is possible to find differences relating to anatomy and to dimensions of the head.

Since EMF penetration into human tissues can be in the order of a few centimeters, depending on the wavelength, the inner tissues in the brain clearly will receive a significantly higher dose in the smaller heads of children compared to adults, despite the total absorption and the peak spatial SAR (psSAR) calculated across the whole head varying by smaller amounts [132, 133, 138]. Fernández et al. [136] estimated that the cell phone radiation psSAR in the hippocampus was 30-fold higher in children compared to adults, while the psSAR in the eyes was 5-fold higher in children; these differences were due largely to closer proximity to the cell phone antennas. The thinner dimensions of children's skulls also contribute to this difference [135], resulting in a psSAR around 2-fold higher in children's brains [134–137, 139] compared to adults.

Additionally, tissues of young mammals have higher conductivity and electrical permittivity than those of mature animals [140]. This also contributes to greater EMF penetration and absorption, resulting in further increases in the psSAR. The psSAR in the skull bone marrow of children was estimated to increase by 10-fold due to higher conductivity in this tissue [137]. Distance between the mobile device and the body tissues is important in characterizing tissue dosimetry. The National Agency ANFR of France recently released cell phone SAR test data for 450 cell phones. Ten gram psSARs increased by 10–30% for each millimeter of proximal placement of the cell phone to the planar body phantom (http://data.anfr.fr/explore/dataset/das-telephonie-mobile/?disjunctive.marque&disjunctive.modele&sort=marque).

Finally, it is important to note that simulations of tissue dosimetry consider only the physical parameters of the tissues; they do not consider biological processes occurring in living tissues. While children are growing, developing organs and multi-organ systems are more susceptible to adverse effects of environmental agents; finite-difference time-domain (FDTD) simulations do not address differences in organ or system susceptibility for exposures occurring during child development.

Assumption 8) *There are no differences among individuals in their sensitivity to RF radiation-induced health effects.*

All life is "electrosensitive" to some degree as physiological processes are dependent on both subtle and substantial electromagnetic interactions at every level, from the molecular to the systemic. Responses to multiple types of electromagnetic exposure reveal that there is a far broader range of EMF sensitivity than previously assumed, and subgroups of extremely hypersensitive subjects exist [141–151]. Given the adverse health effects noted in Assumption #1, including cardiomyopathy, carcinogenicity and neurological effects, the acute, conscious symptoms manifesting in some individuals should not be unexpected. The term currently and most frequently used within the medical profession to describe those who are acutely, symptomatically sensitive to non-ionizing radiation exposures is Electromagnetic Hypersensitivity (EHS).

EHS is a multisystem, physical response characterized by awareness and/or symptoms triggered by EMF exposures. Common symptoms include (but are not limited to) headaches, dizziness, sleep disturbance, heart palpitations, tinnitus, skin rashes, visual disturbance, sensory disturbance, and mood disturbance [152, 153]. These symptoms are reported in response to even extremely low intensity (orders of magnitude below current safety levels) EMFs of multiple types (in terms of frequency, intensity and waveforms). Commonly noticed triggers of frequent and persistent EHS symptoms are pulse-modulated RF emissions, modulated at extremely low frequencies. Common triggering sources include mobile phones, DECT cordless landlines, Wi-Fi/Bluetooth-enabled computers, Wi-Fi routers, smart meters, base station antennas, and household electrical items. EMF avoidance/mitigation is found to be the most effective way to reduce symptoms [154].

Guidelines for EHS diagnosis and management have also been peer-reviewed and concur that the mainstay of medical management is avoidance of anthropogenic electromagnetic fields [152, 155, 156]. Case histories detailing clinical presentations, EMF measurements and mitigation are also published [157], and biomarkers including elevated markers of oxidative stress, inflammatory markers and changes in cerebral blood flow continue to be explored [152].

EHS has been proven to be a physical response under blinded conditions [145, 151, 158, 159] and, in addition to these studies, acute EMF-induced changes in cognition, behavior, and physiology reactions have been observed in studies involving animals [27, 30, 160–172]; plus further references under Assumption 13), which cannot be biased by media-cultivated fears. These studies provide further evidence which invalidates the nocebo response (physical symptoms induced by fear) as causal regarding symptoms.

It should not be expected that all provocation studies will reliably demonstrate adverse reactions; however, suggestions that the nocebo response may cause EHS symptoms were claimed from provocation studies which failed to show a relationship between the EMF exposure and the reported symptoms [173]. The failures of these studies are explainable given the very poor methodology in the majority of them. There were failures to account for a multitude of essential factors that must be tailored to the individual, such as variable symptom onset and offset, the necessity for adequate washout periods, specificity of trigger frequencies and intensities, requirement for complete EMF hygiene during sham exposures, requirement for life-like exposures (e.g., pulse-modulated information-carrying waves), etc. For example, it has been shown that various frequency channels from GSM/UMTS mobile phones affect the same human cells differently [174–177]. Similarly, EHS has been shown to be frequency dependent [151]. As noted above, meaningful provocation studies need to take into consideration multiple physical parameters of exposure, including frequency, modulation, duration of exposure, and time after exposure [155]; however, most provocation studies that have failed to establish causative connection between RFR exposure and EHS symptoms [173] used only one or two conditions with short-term exposures.

There are many issues with the nocebo response as a cause of EHS, not least of which is also the absence of the required temporal link. For the nocebo response to be the cause of EHS, awareness and concern of negative health impacts from EMFs must precede symptoms. But, in the majority of EHS persons this is not the case [178]. As public risk communication improves, this will no longer be verifiable; however, this has been importantly observed at the only point in time when it could have been – prior to generalized awareness of health detriments from non-ionizing radiation (NIR).

While recognizing that some vulnerable groups may be more susceptible to effects of NIR exposure, ICNIRP [179] acknowledged that their guidelines may not safely accommodate these sensitive subgroups:

> *"Different groups in a population may have differences in their ability to tolerate a particular NIR [Non-Ionizing Radiation] exposure. For example, children, the elderly, and some chronically ill people might have a lower tolerance for one or more forms of NIR exposure than the rest of the population. Under such circumstances, it may be useful or necessary to develop separate guideline levels for different groups within the general population, but it may be more effective to adjust the guidelines for the general population to include such groups. Some guidelines may still not provide adequate protection for certain sensitive individuals nor for normal individuals exposed concomitantly to other agents, which may exacerbate the effect of the NIR exposure, an example being individuals with photosensitivity".*

In 2020, ICNIRP [23] also noted that biological effects are not easily discernible from adverse health effects, and that their guidelines:

> *"…are not intended to protect against biological effects as such (when compensatory mechanisms are overwhelmed or exhausted), unless there is also an associated adverse health effect. However, it is not always easy to draw a clear distinction between biological and adverse health effects, and indeed this can vary depending on individual susceptibility*

to specific situations. An example is sensory effects from nonionizing radiation exposures under certain circumstances, such as a tingling sensation resulting from peripheral nerve stimulation by electric or magnetic fields; magnetophosphenes (light flickering sensations in the periphery of the visual field) resulting from stimulation of the retina by electric fields induced by exposure to low-frequency magnetic fields; and microwave hearing resulting from thermoelastic waves due to expansion of soft tissues in the head which travel via bone conduction to the inner ear. Such perceptions may sometimes lead to discomfort and annoyance. ICNIRP does not consider discomfort and annoyance to be adverse health effects by themselves, but, in some cases, annoyance may lead to adverse health effects by compromising well-being. The exposure circumstances under which discomfort and annoyance occur vary between individuals".

Trivializing "discomfort" which is the pre-cursor to pain is not in keeping with WHO recommendations quoted by the same ICNIRP [23] document: "Health is a state of complete physical, mental and social well-being and not merely the absence of disease or infirmity."

Discomfort is a sign that an organism is experiencing something which is compromising optimal health and although in some cases this can be trivial and reversible, in other cases it may not be reversed. There is an extremely broad range of both pain tolerance and also of pain perception among humans, and to achieve meaningful preventative health care, "discomfort" must be taken seriously and mitigated whenever possible. This is especially true in this case where symptoms such as headaches are being reported in response to mobile phone exposures at the same time as increased brain tumor risk is noted from those same exposures (see Assumption 6).

In reality, people with EHS are reporting far more serious health disruption than "discomfort" or "annoyance" and in some cases these symptoms are disabling [180, 181]. Increasingly, EHS is being recognized as a disability by national courts in France, Sweden, and Spain, which amplifies the requirement for safety guidelines that are deliberately accommodating to this more susceptible group [180].

E. Applied safety factors for RF-EMF-RF workers and the general population

Assumption 9) *A 50-fold safety factor for whole body exposure to RF radiation is adequate for protecting the general population to any health risks from RF radiation.*

Public health agencies in the US and worldwide apply multiple uncertainty factors to health effects data to establish exposure levels that are considered safe for the great majority of exposed populations [182–184]. Although guidelines for the use of uncertainty factors were developed for chemicals, they are also pertinent to other toxic agents, such as RFR. The uncertainty factors needed for toxic effects of RFR based on studies that demonstrate a no-observed-adverse-effect level (NOAEL) in experimental animals include:

1) Animal-to-human extrapolation. When data are based on studies in experimental animals, a factor of 3–10 is applied (for potential species differences in tissue dosimetry and response) unless there are convincing data demonstrating equivalent sensitivity in animals and humans. However, there is no evidence showing that humans are equally or less sensitive to RFR than animals that were used in studies from which exposure limits were established by the FCC and ICNIRP.
2) Adjustment for human variability. A second factor of 10 is used to account for interindividual variability in susceptibility (for instance, due to differences in age, sex, genetic variation, pre-existing diseases) to the toxic agent among the general population. It has been recognized that a factor of 10 for human variability is likely inadequate for sensitive subpopulations and may require an additional adjustment.
3) Extrapolation from short-term studies to lifetime exposure. An additional factor of 10 is applied for short-term studies, such as those used to establish exposure limits to RF radiation, to provide lifetime protection from chronic exposure. This is of particular importance considering the remarkably short periods over which RFR toxicity was originally assessed [10, 11].
4) Database insufficiencies. Finally, an uncertainty factor of 3-to-10 is applied for database inadequacy, i.e., for incomplete characterization of an agent's toxicity. The behavioral studies [10, 11] that were used to establish the FCC and ICNIRP exposure limits to RFR do not provide a full characterization of the effects of this type of radiation nor did they identify the most sensitive adverse effect of RFR exposures.

Basing exposure limits to RFR on the behavioral studies in rats and monkeys [10, 11, 90, 91] would require the application of a composite uncertainty factor of about 900 to 10,000 to be consistent with approaches used by public health agencies to establish protective exposure limits for workers and the general population. Based on the size of the needed uncertainty/safety factor, the

data sets used by the FCC and ICNIRP are clearly inadequate to establish RF exposure limits with reasonable confidence. The arbitrarily selected safety factors of 10 for workers and 50 for the general population by the FCC and ICNIRP are woefully inadequate for protecting exposed populations.

When uncertainty/safety factors are applied to a misrepresented threshold exposure value for adverse effects, the resulting level does not provide assurance of health protection for the general population exposed to that agent. Studies cited above [18, 22, 91, 92, 96] show that the whole-body SAR of 4 W/kg is not a threshold level for adverse effects caused by RFR. In a recent quantitative analysis of various adverse health effects from the NTP study, Uche and Naidenko [185] showed that the permissible whole-body SAR of 0.08 W/kg (based on a 50-fold reduction of the assumed threshold SAR of 4 W/kg) was 20–40-fold higher than health protective SAR values derived by benchmark dose modelling of NTP data for cardiomyopathy (following application of 10-fold safety factors for interspecies and intraspecies variability). The approaches used by these authors are consistent with methodologies recommended by the US Environmental Protection Agency for quantifying health risks for toxic and carcinogenic environmental agents [1, 182]. Thus, a 50-fold reduction of the assumed threshold whole-body SAR of 4 W/kg is inadequate to protect the health of the general population from exposure to RF radiation.

> **Assumption 10)** *A 10-fold safety factor for whole body exposure to RF radiation is adequate for protecting workers to any health risks from RF radiation.*

When RFR exposure limits were implemented in 1997, the rationale given for the difference in safety factors for the general population (50-fold) and for workers (10-fold) was "based on the exposure periods of the two populations, rounded to one digit (40 work hours per week/168 hours per week = ~0.2)" [6]. In addition to differences in exposure periods between workers and the general population, ICNIRP rationalizes the appropriateness of the lower safety factor for workers because "occupationally-exposed individuals can be considered a more homogeneous group than the general population," they are, "in general, relatively healthy adults within a limited age range," and "occupationally-exposed individuals should be operating under controlled conditions and be informed about the risks associated with non-ionizing radiation exposure for their specific situation and how to reduce these risks" [23]. In contrast, "the general public are, in most cases, unaware of their exposure to non-ionizing radiation and, without education, cannot reasonably be expected to take precautions to minimize or avoid any adverse effects of exposure."

The assumption that workers are trained in understanding health risks associated with exposure to RFR and in mitigating those risks to the greatest possible degree is not correct because neither the FCC nor the ICNIRP guidelines recognize any health effects from RFR at SARs below 4 W/kg, and the exposure limits authorized by the FCC and ICNIRP do not consider health effects from long-term exposures [3, 5]. The only health effect addressed by the FCC and ICNIRP is tissue damage due to excessive heating from acute exposures. Thus, the 10-fold reduction from the threshold whole-body SAR calculated from acute behavioral studies in rats and monkeys is inadequate for protecting the health of workers exposed long-term to RFR (see comments under assumption #9). There are no data demonstrating the adequacy of this arbitrarily chosen safety/uncertainty factor for occupationally-exposed workers, while on the contrary, excess cancer risks have been associated with exposure to RFR workers who operate radar and communication systems in military and occupational settings [186].

> **Assumption 11)** *Exposure of any gram of cube-shaped tissue up to 1.6 W/kg, or 10 g of cube-shaped tissue up to 2 W/kg, (duration not specified) will not increase the risk of that tissue to any toxic or carcinogenic effects in the general population.*

Tissue dosimetry was analysed in the NTP study of cell phone RF radiation in rats and mice [187]. In rats, whole body exposures during the 10-minute on cycles were 1.5, 3.0, or 6.0 W/kg, and the brain and heart SARs varied from the whole-body SARs by about 7% to under 2-fold for the brain and heart, respectively. A quantitative risk assessment of the NTP tumor incidence data is needed to evaluate organ-specific cancer risk. The FDA [19] nomination to the NTP recognized the need for "large well-planned animal experiments …. to provide the basis to assess the risk to human health of wireless communications devices." However, more than 3 years after an external peer-review of the NTP studies found "clear evidence of carcinogenic activity," the FDA [109] has continued to downplay the importance of these findings and avoid conducting a quantitative risk assessment of the tumor data that they (the FDA) originally requested. In contrast to the FDA, Uche and Naidenko [185] analysed the NTP data on cardiomyopathy by a benchmark dose approach and found that the 10% extra risk level for this effect was in the range of a whole-body SAR of 0.2 to 0.4 W/kg. Thus, there is an increased risk (greater than 10%) of developing cardiomyopathy at local tissue SARs below 1.6 or 2.0 W/kg.

The peak spatial specific absorption rate (psSAR), as used by ICNIRP and the FCC, is an inadequate dosimetric of RF radiation at frequencies above 1 GHz. The psSAR is calculated by averaging fixed cubic volumes containing a given amount of mass, and assumes a homogeneous material with a given mass density. The ICNIRP recommendation is to average cubic volumes containing 10 g of tissue (10 g-psSAR), while the FCC recommendation is to average cubic volumes containing 1 g of tissue (1 g-psSAR). Current recommendations limit the use of psSAR to frequencies up to 6 GHz [3, 5].

An evaluation of the utility of using psSAR as a dosimetric parameter at different frequencies ranging from 100 MHz to 26 GHz and with cube sizes ranging from 10 mg to 10 g is shown in Additional file 2: Appendix 2. For the smaller cubes and lower frequencies, averaging in the cube does not underestimate the maximum value on the cube surface, but at higher frequencies the psSAR averaged on larger cubes can be several-fold lower than the psSAR averaged on smaller cubes. For example, at 2.45 GHz, averaging over a 10-g cube underestimates by 4 dB (approximately 2.5-fold) the psSAR averaged in smaller cubes, while for 5.8 GHz, averaging over a 10-g cube underestimates the psSAR by 12 dB (approximately 16-fold) compared with averaging in a 10-mg cube, and by 6 dB (approximately 4-fold) compared with averaging over a 1-g cube. When the frequency is increased, the underestimation of the psSAR averaged in larger cubes (e.g. 10 g or 1 g) compared to smaller cubes (e.g. 100 mg and 10 mg) becomes more pronounced. Considering the 10-g cube, the difference between the psSAR for 5.8 GHz EMF compared to 0.9 GHz EMF is around 7 dB (or approximately 5-fold underestimation). These large differences are due to reduced penetration of EMFs at higher frequencies. Therefore, the ICNIRP's 10 g-psSAR and FCC's 1 g-psSAR recommendations do not provide reliable dosimetric parameters to evaluate EMF absorption above 1 GHz.

The SAR averaging over a 10-g cube is also flawed for assessing carcinogenicity because it is too large a volume to focus on stem cells and their important role in carcinogenesis. Human stem cells were more sensitive to RFR exposures from GSM and UMTS mobile phones than lymphocytes and fibroblasts [175]. Instead of a random distribution of targets for carcinogenesis, localized distribution of SAR in smaller volumes is needed to more accurately characterize relationships between SAR and tumor induction. From the point of view of stem cell organization, the volume of SAR determinations may be especially important for setting safety limits for children, because most stem cells and their niches are spatially and temporally transient during brain development [188].

Assumption 12) *Exposure of any gram of cube-shaped tissue up to 8 W/kg, or 10 g of cube-shaped tissue up to 10 W/kg, (duration not specified) will not increase the risk of that tissue to any toxic or carcinogenic effects in workers.*

Based on the analyses of tissue dosimetry in the NTP study [187], organ-specific toxic and carcinogenic effects were observed in rats at local tissue SARs that were much lower than 8 or 10 W/kg [18]. The tissue dosimetry in the NTP study and the inadequacy of the local SAR as specified by ICNIRP and the FCC is described in assumption #9.

F. Environmental exposure to RF radiation

Assumption 13) *There is no concern for environmental effects of RF radiation or for effects on wildlife or household pets.*

While background levels of RF-EMF are increasing in the environment, including rural remote areas [189], neither the FCC nor the ICNIRP take into consideration effects of this radiation on wildlife. The constant movement of most wildlife species in and out of varying artificial EMF can result in high exposures near communication structures, especially for flying species such as birds and insects. There is a substantial amount of scientific literature on the disrupting effects of RFR on wildlife (e.g., [190–206]).

Many nonhuman species use Earth's geomagnetic fields for activities such as orientation and seasonal migration, food finding, mating, nest and den building [190]. For example, migratory bird species [191, 192], honeybees [193], bats [194], fish [195–197], and numerous other species sense Earth's magnetic fields with specialized sensory receptors. Mechanisms likely involved in magneto-reception include magnetic induction of weak electric signals in specialized sensory receptors [198], magneto-mechanical interactions with the iron-based crystal magnetite [194], and/or free-radical interactions with cryptochrome photoreceptors [191, 192]. Each of these sensing processes shows extreme sensitivity to low intensity changes in electromagnetic fields. For a fuller description of the mechanisms by which non-human species use magneto-reception to perform essential life activities see Levitt et al. [190].

The following studies represent a few of the many examples of the disrupting effects of low-level exposures to RF-EMF on magneto-reception and the natural behavior of wildlife. Oscillating magnetic fields have been reported to disrupt the ability of migratory birds to orient and navigate in Earth's geomagnetic field [199–202].

Garden warblers became disoriented by exposure to a weak oscillating magnetic field of 1.403 MHz at an intensity as low as 2–3 nT [200]. The orientation of European robins that use Earth's magnetic field for compass orientation was completely disrupted by exposure to electromagnetic noise in the frequency range of 50 kHz to 5 MHz or a broadband noise-modulated ELF covering the range ~ 2 kHz to ~ 9 MHz [199, 201]. RFR in the low MHz range (7.0 MHz of 480 nT or 1.315 MHz of 15 nT) has been shown to disable the magneto-reception avian compass as long as the exposure was present [202].

In addition to effects on migratory birds, Landler et al. [203] found that exposure to a low-level magnetic field (1.43 MHz at an intensity of 30–52 nT) disrupted the natural orientation of juvenile turtles hatched on land. GSM-modulated 900 MHz RF radiation caused ants to lose their visual and olfactory memory for finding food [166]. Navigational abilities of trout were reduced when reared under conditions in which magnetic fields were spatially distorted [204].

Activities of honeybees are also disrupted by exposure to RF radiation. GSM-modulated cell phone radiation (900 MHz) caused a reduction in egg laying by queen bees and depletion of beehive pollen and honey counts [205]. GSM-modulated cell phone radiation (900 MHz) reduced hatching and altered pupal development of honey queen bee larvae [206].

The lack of consideration of chronic low-level RF radiation exposure on wildlife could result in dangerously disruptive effects on fragile ecosystems and on the behavior and survival of species that have long existed in Earth's natural environment.

G. 5G (5th generation wireless)

Assumption 14) *No health effects data are needed for exposures to 5G; safety is assumed because penetration is limited to the skin ("minimal body penetration").*

Fifth generation (5G) wireless communication systems are being deployed worldwide to provide higher data transfer rates with shorter lag times between massive numbers of connected wireless devices. To provide faster transfer of large amounts of data (up to 20 gigabits per second peak data rates), the frequency range for 5G includes millimeter waves (30 to 300 GHz), in addition to carrier frequencies as low as 600 MHz. Extremely high frequency millimeter waves (MMW) that transmit large amounts of data to user devices are directed into narrow beams by line-of-sight transmission with beamforming antennas. Because millimeter waves do not penetrate solid structures such as building materials, hills, foliage, etc., and travel only short distances (a few hundred meters), denser networks of base-stations with massive Multiple Input/Multiple Output (MIMO) transmitters and receivers in millions of small cell towers are being installed on structures such as utility poles. These features can lead to much closer proximity between humans and radiation-emitting antennas, and thereby change individual peak and average exposures to RFR.

For a 5G frequency of 26 GHz, EMF absorption is very superficial, which means that for typical human skin, more than 86% of the incident power is absorbed within the first millimeter. The skin penetration depth was computed as 1 mm based on the electrical conductivity of the skin and its electrical permittivity [5, 207]. This is expected to bring the SAR in this tissue well above the recommended limits ([208], and Additional file 2: Appendix 2). This is also expected to be harmful to very small species, such as birds and other small animals (e.g., insects) [209]. It is often claimed that because of its shallow penetration, exposure to high frequency 5G radiation is safe, and that the only effect is tissue heating [210]. However, this view ignores the deeper penetration of the ELF components of modulated RF signals, which are rated on the basis of heat alone, as well as the effects of short bursts of heat from pulsed signals [211, 212]. Within the first 1 mm of skin, cells divide to renew the stratum corneum (a consideration for skin cancer), and nerve endings in the dermis are situated within 0.6 mm (eyelids) to 3 mm (feet) of the surface (a consideration for neurological effects). Ultraviolet light, which exerts its action at a penetration depth of less than 0.1 mm [213, 214] is a recognized cause of skin cancer [87].

The higher the frequency of electromagnetic waves, the shorter the wavelength and the shallower the penetration of energy into exposed people or animals. For example, penetration depth in the human body is about 8 mm at 6 GHz and 0.92 mm at 30 GHz [5]. Because of the minimal depth of energy absorption at frequencies above 6 GHz, the FCC and ICNIRP have based exposure limits on power density instead of on SAR levels. The FCC [3] proposed a general localized power density exposure limit of 4 mW/cm^2 averaged over 1 cm^2 and not to exceed 30 minutes for 5G services up to 3000 GHz for the general population, claiming that this exposure is consistent with the peak spatial-average SAR of 1.6 W/kg averaged over any 1 g of tissue at 6 GHz. ICNIRP's [5] exposure limits for 5G are an absorbed power density of 200 W/m^2 (0.2 W/cm^2) averaged over 4 cm^2 and a 6-minute interval for frequencies up to 30 GHz, and 400 W/m^2 (0.4 mW/cm^2) averaged over 1 cm^2 and a 6-minute interval for frequencies of 30 GHz to 300 GHz.

Because of its minimal penetration, exposure to 5G radiation results in higher energy intensity on the skin and other directly-exposed body parts, such as the eye

cornea or lens. However, the skin, which is the largest organ in the human body, provides important functions such as acting as a protective physical and immunological barrier against mechanical injury, infection by pathogenic microorganisms, and entry of toxic substances. In addition, skin cancers, including basal cell carcinomas and squamous cell carcinomas, are the most prevalent human cancers, while melanomas are highly metastatic and increasing in prevalence. Although the high incidence of skin cancers are largely attributed to exposure to ultraviolet light, no studies have been reported on the effects of 5G radiation on (i) the skin's ability to provide protection from pathogenic microorganisms, (ii) the possible exacerbation of other skin diseases, (iii) promotion of sunlight-induced skin cancers, or (iv) initiation of skin cancer by itself. Information is also lacking on the effects of 5G radiation on nervous and immune systems which are also exposed even by the shallower penetration of MMW.

Another important factor is the maximum bandwidth with 5G radiation, which is up to 100 MHz in the frequency range of 450 MHz to 6 GHz, and up to 400 MHz in the ranges from 24 GHz to 52 GHz, compared to previous types of mobile communication where bandwidth is limited to 20 MHz. Because many studies indicated frequency-dependent, non-thermal RF effects from mobile communication RFR [43, 177] and for MMW effects [215, 216], the possibility of effective frequency windows for biological effects would increase with the increased bandwidth of 5G radiation.

Another consideration for effects of 5G exposures on human health is that radiation pulses created by extremely fast data transmission rates have the potential to generate bursts of energy that can travel much deeper than predicted by conventional models [217, 218]. Neufeld and Kuster [105] showed that repetitive pulses of data in bursts with short exposures to 5G can cause localized temperature spikes in the skin leading to permanent tissue damage even when the average power density values were within ICNIRP's acceptable safety limits. The authors urged the setting of new thermal safety standards to address the kind of health risks possible with 5G technology:

> *"The FIFTH generation of wireless communication technology (5G) promises to facilitate transmission at data rates up to a factor of 100 times higher than 4G. For that purpose, higher frequencies (including millimetre-wave bands), broadband modulation schemes, and thus faster signals with steeper rise and fall times will be employed, potentially in combination with pulsed operation for time domain multiple access…The thresholds for frequencies above 10 MHz set in current exposure guidelines (ICNIRP 1998, IEEE 2005, 2010) are intended to limit tissue heating. However, short pulses can lead to important temperature oscillations, which may be further exacerbated at high frequencies (>10 GHz, fundamental to 5G), where the shallow penetration depth leads to intense surface heating and a steep, rapid rise in temperature…"*

Areas of uncertainty and health concerns with 5G radiation include potential increase in skin cancer rates with (or possibly without) co-exposure to sunlight, exacerbation of skin diseases, greater susceptibility to pathogenic microorganisms, corneal damage or early development of cataracts, testicular effects, and possible resonant-enhanced absorption due to skin structures [219]. One of the complex technical challenges in relation to human exposure to 5G millimeter waves is that the unpredictable propagation patterns that could result in unacceptable levels of human exposure to electromagnetic radiation are not well understood [220]. Although MMW are almost completely absorbed within 1–2 mm in biologically-equivalent tissues, their effects may penetrate deeper in a live human body possibly by affecting signal transduction pathways. Thus, there are too many uncertainties with exposure to 5G to support an assumption of safety without adequate health effects data. There are no adequate studies on health effects from short-term or long-term exposures to 5G radiation in animal models or in humans.

Discussion

To develop health-based exposure limits for toxic and carcinogenic substances, regulatory agencies typically rely on available scientific evidence about the agent under review. In the mid- and late-1990s when the FCC [4] and the ICNIRP [9] initially established exposure limits for RFR, the prevailing assumptions were that any adverse effects from exposure to RFR were due to excessive heating because non-ionizing radiation did not have sufficient energy to break chemical bonds or damage DNA. However, non-thermal effects of RFR are demonstrated from studies that find different effects with exposure to continuous waves versus pulsed or modulated waves at the same frequency and the same SAR or power density, e.g., [221–226], and from studies that show adverse effects at very low exposure intensities, e.g., [78, 96].

Acute exposure studies conducted in rats and monkeys in the 1980s [10, 11] suggested that an SAR of 4 W/kg could be a threshold dose for behavioral effects. Because this SAR was associated with an approximate increase in body temperature of 1 °C, it was again assumed that no adverse health effects would occur if increases in core

body temperature were less than 1 °C. From this putative threshold dose a "safety factor" of 10 was applied for occupational exposures and an additional factor of 5 (50x total) was applied for the general population, resulting in exposure limits in which the whole-body SAR was less than 0.4 W/kg for workers and 0.08 W/kg for the general population. However, realizing that local parts of the body could receive doses of RFR that were 10 to 20 times higher than the whole-body SARs, local peak exposure limits were set by the FCC at SARs 20-times higher than the whole-body SARs, i.e., 8 W/kg averaged over any 1-g of tissue for localized exposures for workers and 1.6 W/kg averaged over any 1-g for the general population [3, 4]. ICNIRP opted for partial body exposures that would not exceed 2.0 W/kg averaged over any 10 g of cube-shaped tissue for the general population [5, 9]. To rationalize the smaller safety factor for workers (10-fold) versus the general population (50-fold), one claim made by ICNIRP [24] is that workers are informed about risks associated with non-ionizing radiation exposure and how to reduce these risks, whereas "the general public are, in most cases, unaware of their exposure to non-ionizing radiation and, without education, cannot reasonably be expected to take precautions to minimize or avoid any adverse effects of exposure." From a public health perspective, the FCC and ICNIRP should make the public aware of their exposures to RFR and promote precautionary measures to minimize potential adverse effects, especially for children and pregnant women. Eight practical recommendations by the International EMF Scientist Appeal aimed at protecting and educating the public about potential adverse health effects from exposures to non-ionizing EMFs [227] are shown in Table 2.

The acute behavioral studies that provide the basis for the FCC's and ICNIRP's exposure limits lacked any information on potential effects of RF radiation that can occur after longer durations of exposure, and they did not address effects of carrier wave modulations used in wireless communications. Research on RFR conducted over the past 25 years has produced thousands of scientific papers, with many demonstrating that acute behavioral studies are inadequate for developing health protective exposure limits for humans and wildlife, and that inherent assumptions underlying the FCC's and ICNIRP's exposure limits are not valid. First, 4 W/kg is not a threshold SAR for health effects caused by RFR exposures; experimental studies at lower doses and for longer durations of exposure demonstrated cardiomyopathy, carcinogenicity, DNA damage, neurological effects, increased permeability of the blood brain barrier, and sperm damage (see Assumptions 1–3). Multiple robust epidemiologic studies on cell phone radiation have found increased risks for brain tumors (Assumption 6), and these are supported by clear evidence of carcinogenicity of the same cell types (glial cell and Schwann cell) from animal studies. Even studies conducted by D'Andrea et al. [89, 90] before the limits were adopted found behavioral disruption in rats exposed to RFR for 14 or 16 weeks at mean SARs of 0.7 W/kg and at 1.23 W/kg. A combination of exposure duration and exposure intensity would be more appropriate for setting safety standards for exposure to RFR from mobile communication systems including mobile phones, base stations, and WiFi.

More than 120 studies have demonstrated oxidative effects associated with exposure to low intensity RFR (Additional file 1: Appendix 1). DNA damage that has been reported in studies of RFR was most likely caused by induction of oxidative stress, which is a key characteristic of human carcinogens [88], rather than by direct ionization (Assumption 2). The generation of reactive oxygen species has also been linked to DNA damage and the carcinogenicity of UVA radiation [87] and asbestos [228]. Despite the enormous amount of scientific evidence of low-dose effects of RFR, the IEEE [229] maintains that behavioral disruption is still the most sensitive and reproducible effect of RFR. It is this opinion that contributed to the FCC [3] and ICNIRP [5] reaffirming their previous exposure limits to RFR.

Table 2 Precautionary Measures Recommended by the International EMF Scientist Appeal

1) Priority should be given to protect children and pregnant women
2) Guidelines and regulatory standards should be strengthened
3) Manufacturers should be encouraged to develop safer technologies
4) The public should be fully informed about the potential health risks from electromagnetic energy and taught harm reduction strategies
5) Medical professionals need to be educated about the biological effects of electromagnetic energy and be provided training on treatment of patients with electromagnetic sensitivity
6) Governments need to fund training and research on electromagnetic fields and health that is independent of industry
7) The media should disclose experts' financial relationships with industry when citing their opinions regarding health and safety aspects of EMF-emitting technologies
8) Radiation-free areas need to be established, especially for individuals with EHS

Other concerns about the current exposure limits for RFR are that they do not consider potential synergistic effects due to co-exposure to other toxic or carcinogenic agents, the impact of pulsed radiation or frequency modulations, multiple frequencies, differences in levels of absorption or of susceptibility by children, or differences among individuals in their sensitivity to RFR (see Assumptions 4, 5, 7, 8). Currently, children's cumulative exposures are much higher than previous generations and they continue to increase [230]. ICNIRP [23, 179] acknowledged that their guidelines do not accommodate sensitive subgroups and admit to difficulties separating "biological effects" from "health effects." Neurological symptoms, some of which are acknowledged by ICNIRP and currently being experienced by persons with EHS, are most certainly non-thermal "health effects" that need to be mitigated by providing environments with reduced exposures to anthropogenic EMF for hypersensitive individuals.

The debilitating effects and restrictions suffered by adults and children with EHS constitutes a contravention of the 2010 Equalities Act, Human Rights Act and other ethical and legal frameworks. Failure to respond and appropriately safeguard this group is already causing preventable morbidity, mortality and economic deficit due to lost workdays, compensations for health damages and increased healthcare costs. Conversely, accommodating this group by, as suggested by ICNIRP [179], acting to 'adjust the guidelines for the general population to include such groups' would not only lessen the negative impacts for people with EHS, but would also improve public health more broadly, given the other NIR-related health concerns that are highlighted in this paper.

Basing local tissue exposure limits on 1-g [3] or 10-g [5] cubes substantially underestimates the peak spatial SAR compared to basing local tissue exposure limits on smaller cubes (e.g., 100 mg or 10 mg), and therefore are not reliable dosimetric parameters to evaluate EMF absorption at frequencies above 1 GHz (Assumptions 11, 12). The volumes specified by the FCC and ICNIRP for local tissue SAR limits are too large to focus on stem cells which are important targets for carcinogenesis. To reduce health risks from exposures to RFR, limits for localized distribution of the SAR should be based on 100 mg, or preferably 10 mg cubes.

Another important deficiency raised in this paper is that neither the FCC nor ICNIRP addresses concerns for environmental effects of RFR on wildlife, even though there is extensive literature demonstrating the disrupting effects of RFR on wildlife behavior (Assumption 13).

The arbitrarily selected uncertainty/safety factors applied to the putative threshold SAR for RFR are woefully inadequate for protecting public health (Assumptions 9, 10). Based on the way the US Environmental Protection Agency, the International Council for Harmonization, and the National Institute for Occupational Safety and Health (US NIOSH) apply uncertainty/safety factors to a no-observed-adverse-effect level (NOAEL) in experimental animals [182–184], the safety factor for RFR would be at least 900 to 10,000, which is 18 to 200 times larger than the safety factor recommended by the FCC and ICNIRP for the general population. This large safety factor is based on adjustments for human variability, lifetime exposure from short-term studies, and database insufficiencies that include incomplete characterization of the toxicity of RFR. Clearly, the acute behavioral studies that served as the basis for the current exposure limits for RFR are not suitable for characterizing human health risks associated with long-term exposure to this type of radiation. The NCRP report from 1986 [6] and the ANSI/IEEE document from 1992 [7] recognized that when future studies on biological effects of RFR become available including effects of chronic exposures or evidence of non-thermal interactions there will be a need to evaluate and possibly revise exposure standards. When the FCC [3] and ICNIRP [5] reaffirmed their exposure limits from the 1990s, they dismissed the scientific evidence that invalidated the assumptions that underlie the basis for those exposure limits. An independent re-evaluation of RFR exposure limits based on the scientific knowledge gained over the past 25 years is needed and is long overdue. This evaluation should be performed by scientists and medical doctors who have no conflicting interests and who have expertise in RF-EMF exposure and dosimetry, toxicology, epidemiology, clinical assessment, and risk assessment. Special precautions should be taken to ensure that interpretations of health effects data and the setting of exposure limits for RFR are not influenced by the military or the telecommunications industry. In the meantime, manufacturers should be obliged to develop safer technologies [227].

Finally, we note our concern about the worldwide deployment of 5G communication networks for faster transfer of large amounts of data, but with no adequate health effects studies demonstrating the safety of high frequency millimeter waves. Because of limitations of the penetration and distance of travel of millimeter waves, dense networks of base stations are being mounted on structures such as utility poles in highly populated cities. Also, because the absorption of EMF at frequencies above 6 GHz is minimal, ICNIRP [5] has specified absorbed power density (S_{ab}) as the dosimetric parameter for "heating effects" at the higher frequencies. S_{ab} is a function of the incident power density (S_{inc}) and the input reflection coefficient (Γ). In near field scenarios, the S_{inc} does not have a singular value; this is largely due

to the heterogeneous nature of human body tissues and their relevant parameters (such as the permittivity, equivalent conductivity, mass density), which vary in different body regions and with frequency. Therefore, unless a powerful EMF simulation method together with realistic human models are used, the S_{inc} and the reflection coefficient values would be difficult to accurately estimate, making the resulting S_{ab} unreliable.

The assumption that 5G is safe at the power density limits recommended by ICNIRP (50 W/m^2 and 10 W/m^2 averaged over 6 min for occupational and 30 min for public exposures, respectively) because of its minimal penetration into the body does not justify the dismissal of the need for health effects studies prior to implementing 5G networks. The new communication networks will result in exposures to a form of radiation that has not been previously experienced by the public at large (Assumption 14). The implementation of 5G technology without adequate health effects information raises many questions, such as: Will exposure to 5G radiation: (i) compromise the skin's ability to provide protection from pathogenic microorganisms? (ii) will it exacerbate the development of skin diseases? (iii) will it increase the risk of sunlight-induced skin cancers? (iv) will it increase the risk of damage to the lens or cornea? (v) will it increase the risk of testicular damage? (vi) will it exert deeper tissue effects either indirectly following effects on superficial structures or more directly due to deeper penetration of the ELF components of modulated RF signals? (vii) will it adversely affect wildlife populations? Answers to these questions and others that are relevant to human and wildlife health should be provided *before* widespread exposures to 5G radiation occur, not afterwards. Based on lessons that should have been learned from studies on RFR at frequencies below 6 GHz, we should no longer rely on the untested assumption that current or future wireless technology, including 5G, is safe without adequate testing. To do otherwise is not in the best interest of either public or environmental health.

Abbreviations

ANSI: American National Standards Institute; CDMA: Code-division multiple access; dB: Decibel; DECT: Digital enhanced cordless technology; EHS: Electromagnetic hypersensitivity; ELF: Extremely low frequency; EMF: Electromagnetic field; FCC: Federal Communications Commission; FDA: Food and Drug Administration; GHz: Gigahertz; GBM: Glioblastoma multiforme brain cancer; GSM: Global system for mobile communication; IARC: International Agency for Research on Cancer; ICNIRP: International Commission on Non-Ionizing Radiation Protection; IEEE: Institute of Electrical and Electronics Engineers; LTE: Long Term Evolution (4G); MMW: Millimeter wave; NCRP: National Council on Radiation Protection and Measurements; NIR: Non-ionizing radiation; nT: Nanotesla; NTP: National Toxicology Program; 8-OHdG: 8-hydroxy-2'deoxyguanosine; psSAR: Peak spatial specific absorption rate; RFR: Radiofrequency radiation; ROS: Reactive oxygen species; SAR: Specific absorption rate; UMTS: Universal mobile telecommunications service (3G); UVR: Ultraviolet radiation; 5G: 5th generation wireless.

Supplementary Information

The online version contains supplementary material available at https://doi.org/10.1186/s12940-022-00900-9.

Additional file 1: Appendix 1 Table 1. Studies demonstrating increased oxidative DNA damage and other indicators of oxidative stress at SAR < 4 W/kg.

Additional file 2: Appendix 2. On the Inadequacy of the psSAR Dosimetric Parameter at Frequencies above 1 GHz. **Table 1.** Electric permittivity and electric conductivity of the gray matter. **Figure 1.** A block of gray matter radiated by different frequencies. The highlighted cubes are of 10 g, 1 g, 100 mg and 10 mg. **Fig. 2.** A block of gray matter radiated by different frequencies. The highlighted cubes are of 10 g, 1 g, 100 mg and 10 mg. **Fig. 3.** Electric field intensity averaged in each cube for different frequencies: in the left axis, the electric field is in dB and in the right axis the electric field is in V/m normalized to 100 V/m.

Acknowledgements

Igor Belyaev: Cancer Research Institute, Biomedical Research Center, Slovak Academy of Sciences, Slovakia
Carl Blackman: US Environmental Protection Agency (retired), North Carolina, USA
Kent Chamberlin: Department of Electrical and Computer Engineering, University of New Hampshire, USA
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Authors' contributions

IB, AD, CF, LH, PH, KK, DM, EMB, RLM, and IY drafted the initial sections of this manuscript: by IB (factors affecting dosimetry), AD and CF (absorption in children versus adults, peak spatial specific absorption rate), LH (human brain cancer risk), KK (sperm damage), DM and DM (5G), EMB (electromagnetic hypersensitivity), RLM (cardiomyopathy, carcinogenicity, neurologic effects, safety factors), and IY (oxidative stress and DNA damage). IY prepared Appendix 1, and AD and CF prepared Appendix 2. The authors who drafted sections of the manuscript, as well as CB, KC, SD, EK, AM, JMM, and WS reviewed multiple manuscript drafts and made revisions. All authors reviewed and approved the final manuscript.

Funding
The Electromagnetic Safety Alliance provided funding for publication costs.

Availability of data and materials
All literature citations are available online.

Declarations

Ethics approval and consent to participate
Not Applicable.

Consent for publication
Not Applicable.

Competing interests
IB, EMB, and AM have served as plaintiff's expert witnesses in cases involving radiofrequency radiation. All other authors declare they have no competing interests.

Received: 14 July 2022 Accepted: 8 September 2022
Published online: 18 October 2022

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Publisher's Note

The FCC Is Supposed to Protect the Environment. It Doesn't.

by Peter Elkind

In a mountainous forest in southwest Puerto Rico, workers cleared a patch to make room for a 120-foot cellphone tower intended for use by AT&T and T-Mobile. The site, as the tower company later acknowledged, destroyed some of the nesting habitat of the Puerto Rican nightjar, a tiny endangered songbird. Fewer than 2,000 are believed to be alive today.

In the northwestern New Mexico desert, a company called Sacred Wind Communications, promising to bring broadband to remote Navajo communities, planted a cell tower near the legally protected Pictured Cliffs archaeological site, which contains thousands of centuries-old tribal rock carvings.

And in Silicon Valley, a space startup pursued plans to equip thousands of satellites to use mercury fuel in orbit, even as an Air Force official at one of the possible launch sites voiced "extreme concern" that the toxic element could rain back down to earth.

You may be surprised to learn that these potential harms fall under the jurisdiction of the Federal Communications Commission. Few people think of the FCC as an environmental cop. It's known for regulating television and radio and overseeing the deployment of communications technology. But the agency also has a broad mandate to ensure that technology doesn't damage the environment. The task includes everything from protecting wildlife and human health to preserving historic sites and even preventing aesthetic blight.

This role is particularly critical now, as the FCC presides over a nationwide buildout for 5G service, which will require 800,000 new "small cell" transmitters, those perched on street poles and rooftops, often near schools, apartments and homes. But even with this massive effort underway, as ProPublica previously reported, the FCC has refused to revise its radiation-exposure limits, which date back to the era of flip phones. In addition, the agency has cut back on the environmental reviews that it requires while also restricting local governments' control over wireless sites.

And as the satellite-fuel example reflects, the FCC's ambit extends even into space. The agency is licensing thousands of commercial satellites at a moment when the profusion of objects circling the planet is raising concerns about collisions in space, impediments to astronomy, pollution, and debris falling back to earth.

To call the FCC's environmental approach hands-off would be an understatement. The agency operates on the honor system, delegating much of its responsibility to the industries that it regulates. It allows companies to decide for themselves whether their projects require environmental study. And if the companies break the rules, they're expected to report their own transgression. Few do. In the rare instances in which the FCC investigates, even brazen illegality is often met with a minor fine, a scolding "admonishment" or no action at all. (The FCC declined to make officials available for interviews for this article or to respond to questions sent in writing.)

The FCC's inaction can have dire consequences. For years, the agency refused to take action even as millions of birds died by flying into communications towers. Only after a federal appeals court castigated the agency for its "apparent misunderstanding" of its environmental obligations did the FCC take steps that addressed some, but not all, of the problem.

In most instances, the scale of damages is relatively small: a half-acre of demolished habitat, a mound of damaged Native American artifacts, an ugly tower looming over a national scenic trail. But the FCC authorizes thousands of projects each year, and the effects add up.

These days, the FCC's laissez-faire approach is sparking resistance. Hundreds of conflicts have erupted across the country, triggered by citizens fearing risks to their health from wireless radiation, harm to their property values, damage to the environment and the destruction of treasured views. Fights are raging from rural Puerto Rico, where protesters have been arrested for blocking roads used by cell-tower-construction crews, to New York City, where a dozen community boards protested the appearance of visually jarring three-story 5G poles on neighborhood sidewalks. In New York, state officials got involved, then a local congressman. Finally, in late April, the furor grew intense enough that the FCC was forced to act; it belatedly ordered a company to halt construction — after more than a hundred poles had been built — and begin the type of reviews that are supposed to be completed before breaking ground.

A 5G tower in New York City Credit: Amir Hamja/The New York Times/Redux

Environmentalists are routinely infuriated by the FCC's stance. The telecommunications industry, which is eager to avoid the costs and delays of reviews, is considerably happier. In 2014, the FCC hired its first full-time environmental lawyer, Erica Rosenberg. Her mission was an afterthought at the agency, she told ProPublica: "Everybody was set on deployment. These environmental laws just got in the way." Rosenberg finally quit in frustration in 2021. "It was just the culture of the place," she said. "Nobody cared."

The FCC's ecological role originated in the National Environmental Policy Act, passed in 1969 at a moment of fervor for protecting the earth. The law requires federal agencies to assess whether projects they've authorized will cause harm. The goal is to "assure for all Americans safe, healthful, productive and aesthetically and culturally pleasing surroundings."

The law mandates an exhaustive environmental impact statement for big federal projects, such as a new dam or highway. Smaller agency actions that are judged to pose a risk of significant harm, either individually or cumulatively, require a less detailed environmental assessment. Any finding of significant impact is supposed to trigger an effort to avoid or minimize the damage.

Since the anti-regulatory era under President Ronald Reagan, the FCC has largely abandoned direct environmental oversight. Using a provision of the law that allows agencies to grant themselves "categorical exclusions" — exemptions from any review — for actions they deem risk-free, the FCC removed review requirements for the vast majority of its actions. The only FCC actions still requiring review are those that fall into one of eight categories, including construction in protected habitat or wilderness areas, building in or near historic or Native American sites, projects that would significantly alter a site's "surface features" and towers taller than 450 feet. Aesthetic harms were dropped from routine consideration, even though NEPA required federal agencies to consider them.

Stricter rules were a "waste of time," according to comments cited by the FCC. In the decades since, the agency has never required a single environmental impact statement.

The FCC's blanket exemption for its actions went unchallenged by a White House office, called the Council on Environmental Quality, that was set up to review agency NEPA rules. Dinah Bear, who

joined the council under Reagan and served as general counsel there for 23 years, told ProPublica that "never should have happened. … It's completely abysmal."

By the time Republican Michael Powell took office as FCC chairman in 2001, the agency had yet to fine a single company for violating environmental rules. (At the FCC, he told ProPublica, environmental regulation is "chronically unattended to.") Powell vowed to get "serious" about enforcement, telling a congressional committee, "When you cheat, I'm going to hurt you and hurt you hard."

Powell took aim at a major obstacle to punishing violators, urging Congress to extend the FCC's unusually short one-year statute of limitations for prosecuting misconduct, which starts running from the date of an alleged offense, not when the violation is discovered. Congress refused; the rule remains in place today. Powell, who now heads NCTA, a Washington trade association representing the cable industry, calls the rule "ridiculous. You don't have a real statute if the offense can hide in the woods and by the time you know about it, it's too late."

Under Powell, the FCC proposed its first environmental fine against a company, citing a 180-foot cell tower built without approval near five historic sites in North Dakota, including a cabin where Teddy Roosevelt lived while hunting bison. The agency promptly dropped the matter after the company fought back.

Of the technologies the FCC oversees, broadcast and cell towers have long generated the most environmental controversy. They're mammoth eyesores. They emit wireless radiation. Their construction requires clearing the ground of trees and vegetation, pouring concrete and building fences, access roads and support structures.

Yet for decades, the FCC refused to address their most gruesome impact: dead birds. Drawn by red nighttime lights intended to warn aircraft, migrating birds were slamming into communications towers, crashing into their support wires or tumbling to the ground in exhaustion after circling the lights for hours. As far back as 1974, the agency had identified this as "a matter of concern."

Experts would later estimate the annual toll from North American towers at around seven million birds. In one much-cited tale of carnage, a researcher reported in 1996 that a 1,000-foot TV tower in Eau Claire, Wisconsin, had claimed more than 12,000 birds on a single stormy night.

"We don't have the resources to investigate or monitor sites," FCC attorney Ava Berland said at a 1999 workshop convened to discuss the bird issue. "What the FCC does is delegate our environmental responsibilities to our licensees and our applicants." Consideration of bird mortality, she noted, wasn't required.

The FCC resisted pleas to require environmental assessments of new towers as industry groups insisted that the bird-mortality estimates were grossly overstated. ("Not one member has witnessed

more than a few dead birds at one time," wrote the National Association of Tower Erectors.) In 2008, following a lawsuit by the American Bird Conservancy, a U.S. Court of Appeals panel scolded the agency's "refusal to take action," noting that the environmental law required agencies to assess the risks of their actions up front, "rather than wait until it is too late." It ordered the FCC to examine the problem.

As the agency slowly moved to do so, Joelle Gehring, then a biologist at Michigan State University, published a study suggesting that switching from steadily burning to flashing lights could cut bird mortality by as much as 70%. In January 2013, she joined the FCC as its first staff biologist, focused on reducing the toll.

In December 2015, the agency, with the FAA's concurrence, finally approved a requirement for all new towers over 150 feet to use flashing lights. But the FCC rejected pleas to mandate that the tens of thousands of existing towers be retrofitted. Gehring quietly launched a personal persuasion campaign, emailing tower operators individually with a plea to voluntarily make the shift. Just a third of the tallest towers, the ones most lethal to birds, have been switched over to date.

Erica Rosenberg was shocked by the FCC's approach to environmental oversight when she arrived at the agency in 2014. Then 53, Rosenberg had spent most of her career doing environmental work, with stints at the EPA, on the staff of congressional committees, as a consultant for nonprofits and as director of a public policy program at Arizona State University.

Part of her new job involved reviewing submissions involving broadcast and cell towers. Most could be built without any notice to the FCC. Environmental assessments were required only when companies volunteered that their project would be built on a sensitive site, one that fell into any of the eight categories on the FCC checklist. Projects near historic or Native American sites also required prior reviews by state and tribal officials to avoid or minimize any "adverse impacts."

But as Rosenberg and Gehring, the FCC's biologist, reviewed the reports, which were supposed to be submitted for FCC approval before construction started, they sometimes discovered photos revealing that the tower had already been built or trees and vegetation removed in preparation for building. It happened frequently enough that they even coined a term for it: "premature construction."

Such rule-breaking was rarely penalized. Companies were simply instructed to perform their own after-the-fact reviews; unless the companies confessed that they expected to cause harm, they were granted permission to build their tower.

In one rare instance in which a tower was blocked, it happened only because of the FCC's inaction — and only after the tower's developer had already damaged a sensitive site. In that episode in Puerto Rico, a developer had cleared scarce habitat of the endangered nightjar in 2014 before completing any environmental review. An uproar ensued, including a hearing in Puerto Rico's Senate. In 2017, FCC

officials finally drafted an order denying the developer the usual no-impact finding, citing the habitat destruction. But the denial was never issued, leaving the project on terminal hold. Even in this case, Rosenberg said, the FCC simply didn't want to set a precedent of formally rejecting a tower approval.

Much has escaped the FCC's notice. In 2020, Alabama's historic preservation office alerted the FCC about a 160-foot TV tower in downtown Montgomery, which had already been built and was operating within blocks of the state Capitol and the Selma to Montgomery civil rights trail, in violation of requirements to assess harm (including aesthetic impact) to any national historic site within a half-mile. Because the structure had been built more than a year earlier, the company was immune from any enforcement action.

Self-reporting is rare, according to FCC officials speaking on condition of anonymity. As one put it, "It's a game that gets played. A very small percentage of actual violations come to our attention." Industry executives seemed to confirm that indirectly in a 2017 Government Accountability Office report on FCC enforcement (which addressed all forms of agency enforcement, not just environmental). Nine stakeholders offered the seemingly improbable explanation that they had "lost the incentive to self-report potential violations" because they felt they'd be treated too harshly.

There was little evidence of harsh consequences in that same GAO report: Just 10% of FCC enforcement cases between 2014 and 2016 resulted in a monetary penalty, while 40% ended with a warning and the rest resulted in no action. In a 2018 email, the agency's federal preservation officer commented, "Industry treats our environmental rules like a joke."

A year into her time at the FCC, Rosenberg started keeping a color-coded enforcement cheat sheet listing the status of apparent violations crossing her desk, which was then happening at a pace of about one a week. Among them was the case of Sacred Wind Communications, the New Mexico company that had built a 199-foot cellphone tower without undergoing any cultural review near a site containing Native American rock carvings. (In an interview with ProPublica, Sacred Wind co-founder John Badal blamed the violations on an outside consultant and the company's failure to properly oversee him.)

Frustrated to see that the FCC's enforcement team wasn't pursuing many of these cases, Rosenberg began promoting the idea of sending violators public "admonishment letters" to deter future violations. After months of internal debate, a half-dozen letters finally went out in June 2016. But the agency declined to issue a press release publicly shaming the offenders, and it abandoned the effort months later.

The arrival of the 5G era stirred the FCC to make things even easier for the telecom industry. In September 2016, five senior agency officials met with 20 representatives from wireless and cell tower companies, including AT&T, Verizon and T-Mobile, who were eager to press their agenda. Jon

Wilkins, chief of the FCC's wireless telecommunications bureau, began by stating that "there is bipartisan support among the Commissioners for doing all that they can to help the industry with infrastructure deployment," according to a summary of the session obtained through a public records request.

The industry delegation laid out a wish list of changes aimed at making the 5G rollout cheaper and faster. After Trump appointees assumed majority control of the agency in 2017, the FCC would seek to give the industry virtually everything it wanted. The agency passed new rules limiting what local governments could charge for access to utility poles and restricting the aesthetic requirements they could put in place. In 2018, with one commissioner blaming "outdated NEPA procedures" for slowing 5G deployment, the FCC exempted most small cell sites from environmental, historic-preservation and tribal reviews. In 2019, the commission shut down reconsideration of whether its wireless-radiation limits adequately protect people and the environment.

Federal appeals court challenges overturned most of these actions. Citing the vast scale of the 5G deployment, one court rejected the FCC's claim that deregulating small cell sites would have "little to no environmental footprint." It wrote that the FCC had "dismissed the benefits of historic-preservation and environmental review in a two-sentence paragraph." A second appeals court later ordered the FCC to revisit the adequacy of its wireless-radiation safeguards, excoriating the agency for its "cursory analysis" of human health and environmental risks.

The FCC doesn't release the totals, but, according to current and former agency employees, companies overseen by the FCC now submit just a few dozen environmental assessments a year, down from several hundred in 2016.

The FCC's biggest environmental penalty ever — $10 million imposed on Sprint Corp. — stemmed from an investigation prompted not by the FCC, but by a wireless industry website called Event Driven. In May 2017, it published an internal Sprint memo detailing a "trial" aimed at speeding small cell deployment. The memo authorized Mobilitie, a Sprint infrastructure contractor, to start construction on scores of sites "without fully completing regulatory compliance." The FCC's consent decree in the Sprint case, made public in April 2018, noted that ignoring review requirements displayed "contempt" for regulatory authority. A spokesperson for T-Mobile, which purchased Sprint in 2020, said the violations occurred "long before" T-Mobile acquired it and "Sprint took steps to address their procedures at the time." Mobilitie, which paid $1.6 million in a separate consent decree, said the episode involved "less than 1%" of the small cell sites it has constructed and that the company has subsequently developed "a robust compliance program."

The latest environmental threat that falls under the FCC's jurisdiction is in the heavens. Because the agency has broad authority over communications, it also licenses commercial satellites. And under the FCC's watch, space is rapidly becoming a far more crowded place. Five years ago, there were fewer

than two thousand satellites in orbit. Last December, the FCC approved the deployment of 7,500 satellites by a single company, Elon Musk's SpaceX, that is building an extraterrestrial broadband network called Starlink. By 2030, experts project that as many as 60,000 satellites will be orbiting the Earth. In January the FCC approved the creation of a new Space Bureau to "better support the needs of the growing satellite industry."

The FCC has approved Musk's space armada, and many other satellite constellations, without requiring an environmental assessment, on the premise that, even cumulatively, they present no serious risk. (Musk has also argued that NEPA rules don't apply to space.)

The agency has rejected fears from multiple quarters that tens of thousands of satellites pose worrisome threats. These include toxic emissions from rocket fuels that could pollute the earth, deplete the ozone layer and worsen global warming; increased radio congestion and space traffic that could destroy other satellites and impede critical astronomy used for weather tracking, national security and science; and a growing threat of human casualties and property damage from falling bits of satellite debris. The GAO inventoried the concerns in a September 2022 report.

For more than a year, the FCC did nothing to stop a more imminent environmental threat that emerged in 2018. It involved a Silicon Valley startup called Apollo Fusion, which was developing a low-cost satellite thruster system that uses a secret, proprietary fuel: liquid mercury. Mercury has big advantages as a fuel, but it's also a toxic heavy metal that causes an array of harms to humans and the environment. NASA discarded it as a fuel option decades earlier. Ten years ago, the U.S. was among more than 140 countries that signed a United Nations treaty aimed at cutting global mercury emissions. But the restrictions didn't apply to space.

Apollo was engaging in discussions with multiple big companies interested in purchasing its mercury-fueled thruster for their satellites. Its website claimed the company had a signed contract with at least one customer, with plans for a trial launch by the end of 2018.

That November, Public Employees for Environmental Responsibility, a nonprofit that had been tipped off by a whistleblower, revealed Apollo's plans, warning that they could create an "eco-catastrophe." The group accused the FCC of abdicating its responsibility to protect the public and petitioned the agency to halt the use of mercury. Two experts voiced concern in a Bloomberg Businessweek article that much of the toxic mercury emitted in space would descend back to earth.

At least two companies in 2019 sought FCC approval to launch satellites using Apollo's mercury-fueled thrusters, FCC documents show. One later withdrew its request. The second, Astro Digital, applied in April for an experimental satellite license.

At what was then known as Vandenberg Air Force Base, a California site for the planned launches, an environmental reviewer in 2019 voiced "extreme concern" about flight "anomalies" that could allow

mercury “to enter the terrestrial or ocean environment,” according to documents obtained from a public records request.

In August, Astro Digital and Apollo executives insisted to FCC officials that the mercury they’d release in space would remain there and cause no harm. They pressed to move forward with the planned launch.

In mid-September, the FCC finally ordered Astro Digital to submit an environmental assessment covering Apollo’s thruster system. Astro Digital agreed to comply, but asked the FCC to reconsider whether it had the authority to order such an assessment, noting that it was “not aware that the FCC has ever requested such information from other satellite operators.”

The FCC never responded, either to grant Astro Digital’s request or to deny it, according to Apollo co-founder Mike Cassidy. “We spent a year and a half waiting,” he said. (Cassidy defended his company’s fuel while acknowledging that “you obviously have to be really careful with mercury from an environmental perspective.”) Astro Digital eventually withdrew its application and Apollo switched to another propellant.

In March 2022, a United Nations conference in Indonesia did what the FCC wouldn’t: It banned the use of mercury to propel spacecraft.

Doris Burke contributed research.

From:	skitumbleweed
To:	Alexis Hill; Ann Nichols; Marja Ambler; Jeff Cowen; bos@placer.ca.gov; Sara Schmitz; Jacob Stock; dent_trustee@ivgid.org; tonking_trustee@ivgid.org; tulloch_trustee@ivgid.org; noble_trustee@ivgid.org
Subject:	Money is the root of all evil---Tim Delaney
Date:	Thursday, August 17, 2023 10:52:19 AM

With all the difficulty of my guardianship and the evil nonsense hurled at me with my parents moving out of this world should I be surprised that money is the root of evil?

If a fire happens in Incline like what we have seen in Maui do you think we are going to just allow a bunch of developers and lawyers to do a land grab on us??

And what's up with the $25 million or whatever left on the table for that center for kids in IV? Really?

Seems to me that folks with money cannot even be allowed to attempt to do good. Billions in construction and a few million for kids is scuttled? Really? I had free skiing at the Olympic Hill and an ice rink and night skiing....All sorts of things all year. Nowadays I am not sure what kids in Tahoe do. The rich guy actually thought about the kids. Cannot even be wealthy and help people. Nobody cares about anyone or anything!!!

It's all about cash and stuffing as many tourists as possible onto a beach. Is that fun? Who wants that for a vacation?

Carson Tahoe Hospital could not handle my mother. I was shocked that they were talking of unsafe discharge of an elderly memory care facility woman like that. What's up with that garbage? This is the USA??? This is Nevada??? I had no idea things are like this??? This is what folks do???

How will healthcare handle IV/CB after a disaster or any other Tahoe town??

Answer----They'll kick us to the curb and kill us efficiently. Just like what happened to my father. We will be treated terribly in the event of a fire. Just like my mother being handled at Carson Tahoe Hospital!!! Yep....That's how.

And you dummies think Maui cannot happen on the North Shore or East Shore or anywhere in Tahoe???? I know our hospitals and politics is total garbage.

What about the kids you fools??? What about them???

Yeah...Sure....Burn our houses down and kill our town and then go for the land grab to build giant hotels on all our land!!! Nice concept!!! All while you stack horrendous crowds in our towns to assure a total disaster.

Meanwhile kids in Tahoe get a crummy deal as big money corporations take over the ski resorts and wall us all out. Skiing will not be for the Tahoe kid. It will be for the special people.

And our elderly are shuttled to killing zones. What a load of BS!!!!

Lawyers, PMC, Private prisons, insurance companies, outsourced government for things like

Social Security and Medicare.

Whatever TRPA!!!! Bunch of crooks!!!

Today's lawyers.....Rats scurrying for a crumb of cheese!!! All are epic scum!!! This bunk enables a guy like Putin!!!

Tim Delaney

From:	skitumbleweed
To:	Ann Nichols; Jeff Cowen; Jacob Stock; Alexis Hill; Marja Ambler; bos@placer.ca.gov; Sara Schmitz; dent_trustee@ivgid.org; tonking_trustee@ivgid.org; tulloch_trustee@ivgid.org; noble_trustee@ivgid.org
Subject:	Evacuation is Plan F!!! Not Plan A or B!!
Date:	Wednesday, August 16, 2023 2:27:51 PM

See all that death in Hawaii? Being burned to death is mighty lame. Their hospitals are struggling with burn patients.

Evacuation means you screwed up super hard. That's called evacuation. You do that when a fire department can't maneuver and is losing the war against the fire. Now folks panic and pray to get out of the way.

Clint Eastwood and Bruce Willis are good with words here. Figure it out folks!!

Don't mean to burst more bubbles here!!! Nevada hospitals are junk and are not prepared at all to handle hundreds of severely burned people and kids. Think kids. **Anyone out there want to talk to a kid that is severely burned and in enormous pain???**

Nevada can hardly handle taking care of my mother in a Carson City secure memory care unit. And Carson Tahoe hospital wanted to **unsafe discharge my mother** who was transported from the secure memory care facility to the hospital by the Carson City Fire department and law enforcement after her treatment in the middle of a cold night. **Unsafe discharge of an elderly lady that has severe brain issues is enormously stupid. And illegal.**

So northern Nevada hospitals are epic junk in just handling the people of Nevada or old ladies like my mother on a normal day. Garbage hospitals!!

And you bozos think these facilities are anywhere near being able to handle a disaster like Hawaii???

I am floored by the lack of ethics and evil hatched on my community and I!!!

The ignorance of TRPA is astounding!!!

Take your focus groups and consultants and shove it!! Bunch of scummy creeps!! Working our politicians and communities for a fast buck!!

If my family or property is damaged henceforth I will demand criminal charges!!! We don't want an apology for burned family members or greedy developers looking for opportunity after a fire so they can build a 1000 room unit on my land!!!

We will demand a huge damage payout and double to compensate the insurance company!! If my insurance costs goes up I say TRPA pays!!!

TRPA can pay the insurance bill for all of IV/CB!!!

Bunch of crooks!!! We know what you are!!

Stuff all those folks onto our roads and endanger all of us!! Nice!!

You folks need to rethink a great many things. It's so obvious!!! You don't need a Physics Degree. But yes government combat engineers and environmental engineer specialists should be reviewing this with engineers that specialize in risk and logistics!!! Not a bunch of focus group clowns with no credentials to back up anything!!!

Lawyers and politicians do not do these jobs!!! Guys like I do these jobs!!! Or individuals that have real military heavy society industrial experience. Not politicians. Not focus groups mucky mucks. Not lawyers!!!

Lawyers and politicians don't fight fires or wars. They sit there and hope to live!!! That's what they do.

Can't help but rant.....No shortage of idiots in this era that's for sure. God save me from these stupid people!!!! They cannot understand the obvious. Or they are immensely evil!!! One or the other.

Tim

From:	skitumbleweed
To:	Ann Nichols; Sara Schmitz; dent_trustee@ivgid.org; noble_trustee@ivgid.org; tulloch_trustee@ivgid.org; tonking_trustee@ivgid.org; Alexis Hill; Jeff Cowen; Jacob Stock; Marja Ambler; bos@placer.ca.gov
Subject:	Moral High Ground and Mentorship---Tim Delaney
Date:	Tuesday, August 15, 2023 12:29:56 PM

Keep in mind....I really don't like to win my arguments. Typically when I left an engineering company they struggled or went bankrupt. Often folks would suffer job loss and in the end they struggled money wise over a lifetime.

Checkmate!!!! Who has the moral high ground? Tim Delaney. That's who.

The words for the day. Risk management. Logistics. Room to maneuver. Leadership.

The risk situation is outrageous. Law enforcement and fire officials have no room to maneuver. Leadership is ignorant. In war I would not allow your leadership TRPA. TRPA leadership is terrible. And all that know me would not follow any of you at TRPA in a war. Leadership would fall squarely upon me.

I am worn on telling folks what to do. I worked too much and I prefer to just play. Do understand.

In my case I just made more money when leaving bogus jobs. Slowly. Does not matter if it's minimum wage or triple digit. Hyatt or Lockheed, folks would be quick to point out to you folks that I cared not a bit about title, management, or money even with kids in tow. **The kids I enrolled in my agenda. They are all science and athletics too.** In fact my bosses were in a state of panic every single time I went surfing or skiing. They never liked an extreme sports guy that has many near death experiences who was at the center of billions of dollars of their programs. And paying me more would do nothing to change my behavior.

I tell companies to make carbon copies of me so I can be free. That's how I operated back then.

My life experiences are more important than a buck. A bigger home or fancy car is a bigger mess or another thing to fix. I have fixed enough things over a life. I am done fixing things.

More.....A boss is nothing more to me then someone I hire or put in place to keep everyone out of my agenda. That's what a boss is to me. I tell them what to do. They don't tell me what to do.

So you folks at TRPA and some politicians now have choices. And same goes for politicians. You can keep your jobs maybe by risk management. Risk engineering. Logistics engineering. Or, you can lose your jobs and reputations. Or perhaps risk losing your jobs and reputations in the near future? You better look real hard at Hawaii and this upcoming September holiday in Tahoe!!! Better punt the crowds folks! Better do it in a stealth way. And create real human population control from here on.

Worse. If death trap by fire occurs now there absolutely could be criminal charges. My advice is to mitigate that risk. Common sense from here forward.

Think many dead bodies!!!! Rich or poor!! What is a life worth!!! Who goes against an angry 40 year old dad on Lakeshore or by the Elementary school that is asking why his family died??? Think about that!!! You think those folks in Maui are happy??? You want to be confronted with that situation? I sure would not. That's garbage. Clint Eastwood would have a great phrase for that!!!

Jacob Stock----One day you will be the 40 year old dad. I doubt very much you want your own kid stuck on a bus roasted by fire while you are at work. This is one dad to another dad trying to help you in life. Your kid is worth a whole lot. All dads typically do not like to be confronted by such things. Everyone knows this.

This is where you Jacob see that Maui fire and you alone pull the plug on this nonsense. You have the power. I give that power to you right now. Do it!! Do it for your kid and any friend of your kid in life.

Risk management says TRPA screwed up super hard. Yes, I see those news articles about parking all around the lake. Jeff Cowen, you are in a bit of trouble.

With all that death in Hawaii and the very fact that I made so many comparisons to what is wrong in Hawaii and what is wrong in Tahoe over decades my sound advice to you folks at TRPA is to do a rush pivot to my agenda to chop that human population visiting the lake. I am the guy with the UNR Engineering Physics Degree and you folks are not. My class was a class of two. Only two graduated in 1994 from UNR. They did not care about GPA folks. There is a reason for that.

So I worked so hard in life for that from poverty only to have a bunch of unqualified clowns walk all over my humanity. Maybe God is telling you folks to cut the nonsense after Maui. And yes I loved surfing in Maui and have friends there.

As an engineer I always punted risk very hard. Every single time. I never allowed anyone to put my reputation at risk ever. I never allowed group think and never cared a bit about bosses and their agendas. I looked at things straight forward and would handle the risk and big picture long term.

My only mistake was not investing in myself I suppose. If I was so darn good then why did I not invest in Lockheed? And I should have looked at my spacecraft prior to launch. My buddies wanted me to look at these things one last time. I was too busy with other projects and did not review the spacecraft. I should have. The success of those projects was huge. Also look at Lockheed stock. Yes I should have invested in myself. After all my
work was rather awesome.

So there you have it. I won the debate on the matter. TRPA has a hard stop on a great many things. TRPA will create awesome room to maneuver for fire officials and law enforcement. An evacuation plan is good but is a pin drop in what is needed. If you ever have to evacuate that means you failed your mission!!! **Evacuation is not the plan A that you depend on!!!**

The plan you depend on is the plan to chop human population back to 90s levels and to give law enforcement and fire officials room to maneuver to mitigate risk!!! That's the plan. That is what you do.

So all those cars parked on H28 from IV to Spooner on the east side of the road will not be allowed!!! And if you can't tow them and ticket them to stop this then you will swiftly put in place toll roads just like Pebble Beach and other communities to stop injection of vehicles and human beings into the IV/CB and IV to Spooner region.

The focus is law enforcement and fire officials having room to maneuver to at least attempt to put out a fire or stop a disaster. Currently with all the people and bogus parking there is no room to maneuver and this region is a death trap in Tahoe.

Whether you folks believe me or not is moot at this point. Risk management says an engineer will not allow this because it's grade school common sense!!

Checkmate TRPA!!!! I own you now. All developers, banks, politicians and rich or poor will appreciate that very fact!!!

Maybe you can live instead of dying in a terrible fire. Or being confronted by an angry population wishing this was not so.

Be real appreciative that I have spoken on the matter.

Tim Delaney---One fabulous engineer

From: Ann Nichols
To: Marja Ambler
Subject: [BULK] Tahoe Prosperity Center"s False Narrative by Brett Tibbetts
Date: Sunday, August 13, 2023 8:23:18 PM
Attachments: image001.png

Marja, Please distribute to Governing Board and APC.
Thank you,
Ann Nichol

North Tahoe Preservation Alliance
P.O. Box 4
Crystal Bay, Nv. 89402
preserve@ntpac.org
775-831-0625
www,ntpac.org
"Helping preserve the natural beauty and rural character of North Lake Tahoe"

Preserve Lake Tahoe (Video): https://youtu.be/WKzPL-EwEUw

TikTok Video: https://www.tiktok.com/@northtahoepreservation?_t=8XCELbNFbSt&_r=1

Instagram Video: https://www.instagram.com/northtahoepreservation/

View this email in your browser

Tahoe Prosperity Center's False Narrative

Hats off to Brett Tibbits. His August Moonshine Ink article below articulates a lot of the things many of us have wanted to say but wouldn't have been able to say as well.
Step back and look at what is happening today. The origins of the Tahoe Regional Planning Agency (TRPA) came from environmental consciousness. At that time those in favor of regulating Tahoe development were accused of being a vocal minority. There are parallels between the past and present, where those concerned about pro-growth policies are once again being accused of being stuck in time. The debate and attitudes around environmental consciousness and development have persisted over the years. Today those of us concerned with TRPA's, the County's and Special Interest's pro-growth policies are being accused again.

Tahoe Prosperity Center's False Narrative

By
Special to Moonshine Ink
-
August 10, 2023

By Brett Tibbitts
I was very much struck by Heidi Hill Drum's July 13, 2023 opinion piece in your paper, titled ***Tahoe's Ted Lasso Lessons***.
As I read this article, I thought to myself, "Who does this woman think she is?" Her article is filled with judgment, disdain, and condemnation of those who dare to disagree with her and her view of what Tahoe should be. How can this woman be head of a nonprofit agency? Her article is mean-spirited. She clearly has zero interest in working with those who disagree with her. Rather, she appears to want to demolish them so she can get her way. The Tahoe Prosperity Center is not about unification as its website proclaims; it is all about divide and conquer.
Heidi says every one of Tahoe Prosperity Center's goals is focused exclusively on how to add housing for low and middle-income people. I have read Heidi's *Envision Tahoe Prosperity Playbook*. Her statement about it being 100% focused on low and middle-income workers is just plain wrong. Indeed, her opinion article belies this statement. The Tahoe Prosperity Center is very much focused on bringing thousands of high paying jobs into Tahoe and increasing Tahoe's population by 10,000 to 25,000 people. One of the businesses that Heidi supports and whose owner is on the board of the center is the owner of the GearLab, a tech lab that wants to develop a large tech center in Tahoe (see Heidi's My Shot.) Heidi and her cohorts want to build cities around Lake Tahoe that thrive independently of the lake. A very bad idea.

Sorry, I don't buy that vision of Tahoe. To me, all of our visions and efforts should be about preserving Tahoe for future generations, not ruining it by bringing thousands more residents and visitors as the Tahoe Prosperity Center and many others are trying to do. This is not about NIMBYism, as Heidi will try to protest; it is all about preserving the lake and stopping over-tourism and over-development. Heidi and her group want higher buildings than currently exist around much of the Basin, with $2.5 million to $5 million condos. Just look at the Tahoe Beach Club, Latitude 39, and Nine 47 Tahoe projects approved by the TRPA in recent months. Where is the low to moderate income housing? Look at what TRPA and the Tahoe Prosperity Center actually do, not at what they profess to be doing.
Heidi also says Lake Tahoe had fewer visitors in 2022 than 2019. I am sorry, Heidi, but I will use my own eyes and experiences to judge that statement. Statistics are constantly used to mislead, in my opinion. There is no doubt in my mind as a resident of the East Shore that there are far

more visitors today than in 2019, and that the lake simply cannot support all of these visitors. Look at the tons of trash left on Tahoe beaches after the Fourth of July.

Finally, one of my biggest exasperations with people like Heidi and her organization is that the same small group of people is attempting to ramrod through their vision of the lake on all of us, and it is not about preserving the lake. The Tahoe Prosperity Center is largely funded by other governmental organizations like the TRPA, Placer County, El Dorado County, Douglas County, and Washoe County, a circle of continual bloviating and bad ideas. This funding to Tahoe Prosperity Center goes on year after year with no board member of these county governments questioning it. Once again, follow the money. The money is traded between the same small group of people trying to enforce the same vision. I say vote them all out.

I recommend that Heidi turn her organization into a group that preserves the lake, like picking up trash and micro-plastics, as opposed to trying to overdevelop the lake.

~ Brett Tibbitts was a lawyer for 40 years and is a leader in the fight to keep Highway 50 four lanes and to designate it as a major evacuation route. He and his wife reside in Glenbrook, Nevada.

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Katherine Huston

From: David Chain <david.chain@barmail.ch>
Sent: Tuesday, August 8, 2023 12:57 PM
To: Cristi Creegan; Cody Bass; John Friedrich; Scott Robbins; CSLT Public Comment
Cc: Joe irvin; Lindsey Baker; Sheree Juarez; sletton@cityofslt.us; Heather Leyn Stroud; Daniel Bardzell; nwieczorek@cityofslt.us; gfeiger@cityofslt.us; showard@cityofslt.us; kroberts@cityofslt.us; nspeal@cityofslt.us; Marja Ambler; John Marshall; Katherine Huston; Wendy Jepson; Jennifer Self; Bridget Cornell; Kenneth Kasman; Devin Middlebrook; Rep.KevinKiley@opencongress.org; Daniel Cressy; Vicki Lankford; Danelle Harrison; Erick Walker; Charles Clark; Kimberly Felton; Lisa Herron; FCC Litigation Notice; Dan P. Nubel; California Attorney General; AFord@ag.nv.gov; Susan Blankenship; Julie Regan
Subject: City Council Public Comment
Attachments: Environmental Procedures at the FCCA Case Study in Corporate Capture.pdf; Captured Agency—How the Federal Communications Commission is Dominated by the Industries it Presumably Regulates.pdf; Scientific evidence invalidates health assumptions underlying the FCC and ICNIRP exposure limit determinations for radiofrequency radiation.pdf; NRDC—FCC's Legal Duties to Inform and Protect the Public.pdf; The FCC Is Supposed to Protect the Environment. It Doesn't. (simplified).pdf

Dear City Council,

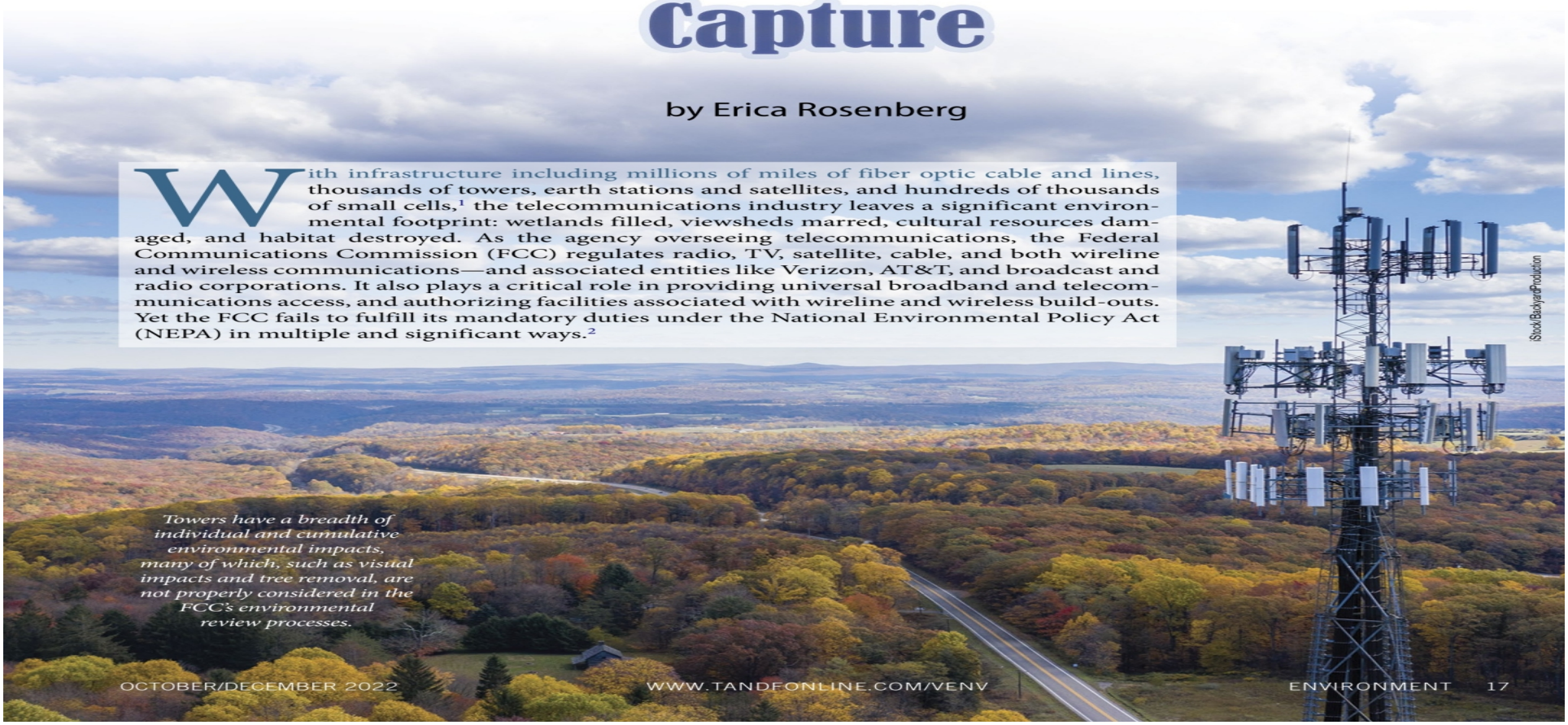
Please read the attached PDF(s). The City and the TRPA have alleged to have exonerated themselves from environmental review for cell tower applications via transferring all responsibility to the Federal Communications Commission (FCC). It is clear the FCC has abandoned their own legal duties under the National Environmental Policy Act (NEPA). Below is a published explanation by a recently retired FCC environmental attorney of what happens when local governments such as the TRPA defer responsibility to the FCC. The TRPA staff ought to feel humiliated for having been the only line of defense against egregious environmental fraud yet they purposefully decided to actively aid and abet in such obvious deceit. Having actual or constructive knowledge of the undermentioned publication, you need to have command over the subject matter else be nakedly in the dark that **you are egregiously on the wrong side of history** (Erica Rosenberg. Environmental Procedures at the FCC: A Case Study in Corporate Capture, **Environment: Science and Policy for Sustainable Development** 64:5-6, 17-27, (2022) DOI: 10.1080/00139157.2022.2131190):


Environment
COVID Inequities in the U.S. Experience
INTERVIEW: JOSEPH HEATHCOTT, CHAIR OF URBAN AND ENVIRONMENTAL STUDIES, THE NEW SCHOOL

Environmental Procedures at the FCC: A Case Study in Corporate Capture

by Erica Rosenberg

With infrastructure including millions of miles of fiber optic cable and lines, thousands of towers, earth stations and satellites, and hundreds of thousands of small cells,[1] the telecommunications industry leaves a significant environmental footprint: wetlands filled, viewsheds marred, cultural resources damaged, and habitat destroyed. As the agency overseeing telecommunications, the Federal Communications Commission (FCC) regulates radio, TV, satellite, cable, and both wireline and wireless communications—and associated entities like Verizon, AT&T, and broadcast and radio corporations. It also plays a critical role in providing universal broadband and telecommunications access, and authorizing facilities associated with wireline and wireless build-outs. Yet the FCC fails to fulfill its mandatory duties under the National Environmental Policy Act (NEPA) in multiple and significant ways.[2]



Towers have a breadth of individual and cumulative environmental impacts, many of which, such as visual impacts and tree removal, are not properly considered in the FCC's environmental review processes.

iStock/BackyardProduction

Like all federal agencies, the FCC must follow environmental laws, including NEPA, which requires it to assess potential environmental effects of its actions before it authorizes, funds, or licenses projects and communications infrastructure. These effects include visual and ecological impacts, and radio frequency emission exceedances, caused by the proliferation of wireless technology and the networks constructed to deploy it. The agency is supposed to follow legal requirements to assess such environmental impacts and, in doing so, to consider the concerns of communities and citizens.

It does neither. For most deployments it authorizes, the FCC rarely completes any environmental review or makes NEPA documents available to the public; instead, with little FCC oversight or enforcement, industry is delegated the task of determining how much environmental review is appropriate for its deployments and in most cases, is not required to submit documentation of those determinations.

In licensing and authorizing facilities associated with telecommunications, broadband, and broadcasting technologies, the FCC intentionally and routinely fails to meet its environmental obligations and epitomizes "regulatory capture." It treats environmental laws as obstacles to be circumvented or ignored, first by promulgating rules that fall short of what NEPA requires and then by failing to properly implement and enforce its own substandard rules. The chronic failure has cumulative, incalculable, and largely unknown environmental impacts.

Combined with statutory authority that curtails local government authority to regulate or block telecom deployment in their jurisdiction, public and local voices in what is deployed and where are further diminished.[3] Equally important, the agency suppresses and dismisses the voices of communities and citizens concerned about these encroachments. As wireless infrastructure proliferates under the auspices of an agency that flouts federal law, unabated and unaccounted for environmental impacts will only multiply.

NEPA: An Instrument of Democracy and Accountability

NEPA, a Nixon–era law and one emulated around the world, outlines a process for decision-making about "major federal actions, like dam-building, offshore drilling, and highway expansions.[4] Council on Environmental Quality implementing rules define major federal actions broadly to include "new and continuing activities, including programs entirely or partly financed, assisted, conducted or approved by federal agencies." They also include "approval of specific projects, such as construction or management activities located in a defined geographic area. Projects include actions approved by permit or other regulatory decision as well as federal and federally assisted activities."[5]

NEPA requires the government to disclose broadly defined environmental impacts of proposed actions—and to consider alternatives—including not undertaking the action.[6] It allows the public, from local governments to tribes to citizens, to participate in the decision.[7]

The greater the potential environmental impacts of a project, action, or policy, the more analysis and the more opportunities for public input and challenge. NEPA requires a full-scale environmental review (environmental impact statement) for major actions with potentially great environmental effects like a highway, a shorter assessment (environmental assessment) for actions that may have less significant impacts, and exemptions from analysis for categories of routine actions (categorical exclusions), like removing brush, that the agency has determined individually or cumulatively have no significant environmental effect. Although a categorical exclusion may exist for an action, in any given case, extraordinary circumstances such as the presence of environmentally sensitive resources can remove an action from a categorical exclusion and require either a documented categorical exclusion or more NEPA review. For example, even if the United States Forest Service categorically excludes brush removal on small tracts, brush removal in critical habitat for endangered species would require the agency to consider and document that its action would still not require an environmental assessment or conduct an environmental assessment.

As a procedural statute, NEPA cannot stop environmentally harmful projects, but it can substantially improve the imprint of an action by, for example, rerouting a power line to protect a stream, or bringing information about wildlife to light so that licensees can take mitigation measures. In short, NEPA, by mandating transparency and accountability, is an instrument of democracy and good governance. NEPA also requires that agencies promulgate policies or rules implementing NEPA in accordance with Council on Environmental Quality rules, and in consultation with the Council on Environmental Quality.

FCC's Failure to Consider Major Federal Actions

Council on Environmental Quality rules place many of the FCC's licensing and funding activities squarely within the definition of a major federal action. Yet the FCC has construed major federal actions narrowly or has simply not considered whether its actions are major federal actions. Consequently, the agency has not considered actions like providing financial assistance to carriers for deployment of small cells and build-outs with associated cable-laying and transmission lines as major federal actions.[8]

In 2018, the agency went as far as to deem all licensing of small cell facilities, which it authorizes as part of a license to carriers, as not requiring environmental review because they were not major federal actions.[9] Termed by industry as unobtrusive—"smaller than a pizza box or backpack"[10]—small cell facilities can be significantly larger and are placed on buildings or associated poles. In its order, the agency both eliminated federal environmental review of small cells and significantly limited local authority over small wireless infrastructure deployment.

In her dissent to the order, FCC Commissioner Jessica Rosenworcel noted that 5G would require millions of miles of fiber and up to 800,000 small

The FCC is authorizing the deployment of hundreds of thousands of small cells with little public input or environmental review.

cells by 2026. The order thus "runs roughshod over the rights of our Tribal communities and gives short shrift to our most basic environmental and historic preservation values."[11] She noted that the Mobility Fund, which supports carriers in bringing wireless services to underserved areas, would support updated wireless service, to the tune of $4.53 billion. Yet in effect, she states, the FCC reads "projects carried out with financial assistance" (a requirement of the National Historic Preservation Act) as well as NEPA out of the law.[12] It also "removes many larger wireless facilities from environmental oversight."[13]

The FCC's efforts to eliminate small cell review were struck down by the D.C. Circuit in *United Keetoowah v. FCC*,[14] a case brought by the Natural Resources Defense Council and several tribes. The court found: "The scale of the deployment the FCC seeks to facilitate, particularly given its exemption of small cells that require new construction, makes it impossible on this record to credit the claim that small cell deregulation will 'leave little to no environmental footprint. *Order* ¶ 41.'"[15]

Appropriately, the FCC considers licensing spectrum and registering towers to be major federal actions that trigger NEPA. However, while the FCC recognizes that its grant of geographic licenses to carriers triggers NEPA, it issues the licenses without any knowledge of how the licensee will deploy infrastructure in its build-out. In most cases, it cannot know because the carrier may not have finalized its build-out plans for construction of towers, transmission lines, and small cell facilities over time. In fact, the agency does not prepare and never has prepared an environmental impact statement on a build out—or on any other major federal action; it has only prepared one programmatic environmental assessment, which was in response to a lawsuit.[16] Instead, it requires NEPA review only on a facility-by-facility basis, which also circumvents a NEPA requirement to consider cumulative effects.[17] Segmenting a project into smaller components is illegal, and the FCC's approach is another way it flouts the law.

FCC's Inadequate NEPA Rules

FCC NEPA rules undermine NEPA at every turn—they are inadequate both as written and as implemented. The rules' unusual structure and an agency that interprets its rules in favor of the carriers mean that most projects proceed without adequate environmental review and consideration.

Unlike other agencies' rules, FCC rules do not identify categories of actions that do not require further NEPA review; rather, the rules categorically exclude *all* actions the agency takes except for those that meet a limited set of itemized extraordinary circumstances.[18] In other

Wireless infrastructure is changing the character of historic buildings and neighborhoods.

instances, the FCC deems its actions categorically excluded. For example, construction of submarine cables, which indisputably has potentially significant environmental impacts to reefs, ocean floors, and marine life, is explicitly excluded from review following a 1974 FCC order asserting that the environmental consequences are negligible.[19]

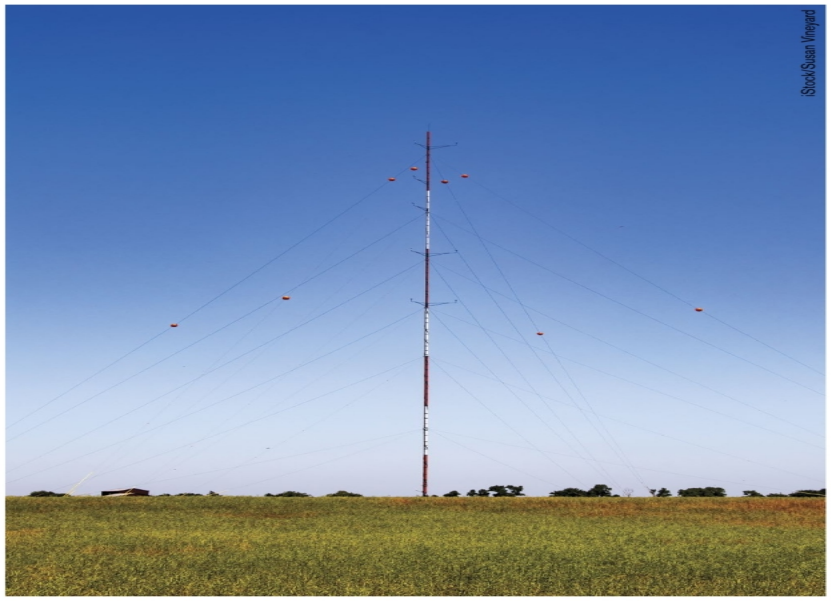
In dismissing the petition brought by an environmental nongovernmental organization to require more environmental review for a number of FCC actions, including those involving submarine cables, the 1974 order acknowledged environmental damage from cables in Maine and the U.S. Virgin Islands but illogically found no need for environmental review because the projects violated state law and permits.[20]

By not considering FCC actions major federal actions and by relying on a broad and unsupported categorical exclusion, countless activities with potentially significant environmental impacts or actual impacts proceed with little or no NEPA review or public involvement. Unlike many agencies, FCC lacks a NEPA coordinating office and most bureaus within the agency have no NEPA expertise or even awareness of the obligations the statute confers on the agency.

Streamlined Effects: The NEPA Checklist

The agency also skirts its NEPA obligations through its procedures and practice around "effects" consideration. It defines effects narrowly and by doing so, removes actions from public notice and comment. Most egregiously, it delegates the initial consideration of effects to applicants and licensees—telecom companies, for the most part—to determine whether an environmental assessment is warranted or whether the project is categorically excluded, and because the review is not submitted to the FCC, it typically performs no subsequent review of the applicants' documentation.

Council on Environmental Quality regulations define effects broadly.[21] FCC rules and practices limit the consideration of environmental effects. They also limit the extraordinary circumstances that would warrant a higher level of environmental review (i.e., an environmental assessment) and public input for the action—through both its narrow list of circumstances and its narrow interpretation of those circumstances. Those limited circumstances are actions involving facilities that: may affect Indian cultural sites or historic resources (i.e., National Historical Preservation Act triggers); may affect threatened or endangered species or their habitat; may involve significant changes in surface features (such as to wetlands or forests); are in a floodplain if equipment is not raised; exceed radio frequency emissions limitations; involve high-intensity lights in residential areas; are in wilderness areas or wildlife



Tall, guyed towers kill millions of birds a year.

refuges; or are more than 450 feet tall in light of potential impacts to migratory birds.[22] These circumstances are referred to as "the NEPA checklist."

Even so, FCC has in effect gutted most elements of the checklist. For example, for the floodplain trigger,[23] as long as equipment is raised for a facility in a floodplain, no environmental assessment is required, although no evidence of raising the equipment or a local permit need be submitted. Although required by Council on Environmental Quality (which unfortunately approved the 2018 rule change), no cumulative effects of building in floodplains are considered. Similarly, applicants often fail to submit an environmental assessment when they have received a federal or state wetlands permit, so again, no evidence is submitted to the agency or for public review.

To eliminate another environmental assessment trigger, rule changes in 2020 allow projects that affect historic properties and cultural resources to proceed without an environmental assessment.[24] "Change in surface features" has in practice required consideration of wetlands impacts (i.e., whether a federal permit is needed), rather than considering large-scale vegetation or soil removal, or grading of sensitive habitats. Thus, even if several acres are bulldozed or dozens of trees cleared, an environmental assessment is not required.

A comprehensive NEPA review for telecommunications infrastructure is both possible and required by other agencies. For instance, the National Telecommunications and Information Administration, which also supports expanding broadband access and adoption, considers a breadth of effects under NEPA that the FCC's checklist fails to consider.[25] National Telecommunications and Information Administration, for example, requires consideration of cumulative effects.[26]

Delegation of Review: Fox Guarding the Hen House

Even more extraordinary than its failure to consider a breadth of environmental effects for most of its actions is the FCC's delegation of consideration of environmental effects to the applicant or licensee. In other words, self-interested parties conduct the NEPA checklist environmental review. Under Council on Environmental Quality rules, the federal agency is ultimately responsible for the environmental document, regardless of who prepares it.[27] Yet under FCC procedures, the agency never even sees the

initial environmental review documenting that a categorical exclusion, rather than a more extensive environmental review, is supported—except in the unlikely event it requests checklist documentation following a complaint.

No other agency allows the applicant to make the initial determination of whether a project is categorically excluded or requires an environmental assessment. Other agencies require submission of documentation of that determination or make the determination themselves. Instead, the FCC relies on applicants to be truthful in their dealings with the agency—yet rarely if ever has it enforced against applicants who make false statements on its forms. Applicants submit documentation only when checklist review triggers an environmental assessment. This approach to ensuring compliance with the NEPA rule is at best unrealistic and at worst, a license to deceive.

No FCC oversight ensures that applicants have done their due diligence to consider the checklist circumstances properly or to even review the circumstances at all. With no agency or public awareness, applicants can simply categorically exclude their projects that involve even larger scale impacts. In East Fishkill, New York, for example, more than 50 trees were cleared from a forested area along a highway known for its scenic views, with no environmental assessment.[28]

Incorrect, confusing, or inadequate filing instructions further ensure that the applicant's work will be incomplete.[29] The instructions themselves fail to even reflect the inadequate rules because they omit Endangered Species Act considerations, do not capture National Historical Preservation Association requirements, omit wetlands concerns, and include outdated floodplain requirements. Similarly, NEPA checklist guidance used until June 2022 did not even reflect the rules on environmental assessment triggers or environmental assessment content requirements.[30]

The checklist allows for only a very narrow set of environmental assessment triggers. In theory, FCC rules do allow for consideration of non-checklist effects or effects missed in the checklist review—those raised by members of the public and those raised by the FCC on its own motion.[31] In reality, this almost never happens. The FCC inevitably fails to consider some potentially significant effects outside of the checklist because it relies entirely on the public to identify them, it never initiates its own review, it relies on self-interested applicants to review projects, and it views its mission as facilitating deployment.

Lack of Notice and Public Availability of Documents

Limiting notice and public availability of documents is another way the agency fails to meet fundamental NEPA responsibilities. Council on Environmental Quality rules require both notice of

The effects of cell towers in sensitive areas like coastal zones and wetlands are not fully considered in the FCC's NEPA process.

actions and opportunities for public comment.[32] In fact, the rules require that agencies make "diligent efforts" to involve the public in implementing their NEPA procedures.[33] Instead, the FCC makes diligent efforts to exclude the public from raising concerns under NEPA.

Applicants and licensees submit no documentation of their determination that their project is categorically excluded, and the agency does not track categorically excluded actions. With the applicant conducting the initial environmental review of whether the project is categorically excluded by assessing the list of extraordinary circumstances (i.e., the NEPA checklist), as well as preparing the environmental assessment, the burden falls on the public to learn of the proposed action and to raise a potential effect.

But categorically excluded actions, including authorization of certain towers, do not receive public notice; only applications for towers that require registration (generally taller than 199 feet) are put on notice, and those may or may not have associated environmental assessments. In addition to towers under 200 feet not posing an air hazard, these stealth projects that the agency has no record of include small wireless facilities associated with 4G and 5G.

That the public has no access to this information is particularly problematic in the radio frequency context, where applicants are required to meet radio frequency emissions standards or submit an environmental assessment. If the applicants do analyze the checklist and radio frequency studies at all, they routinely categorically exclude small wireless facilities, despite growing public concern about radio frequency associated with such technologies. Without access to the documented checklist, the public has little to no basis on which to refute or comment on checklist conclusions on radio frequency. And given the streamlined process, citizens often find out about facilities only after they are built.

Lack of Transparency: Notice of EAs

While the public is completely disenfranchised on categorically excluded projects, the situation with environmental assessments is only slightly better. If an environmental assessment is required because the applicant identified a trigger on the NEPA checklist, the tower or other structure must be registered. But it is not the environmental assessment itself that is publicly noticed—it is the application for the tower registration or license modification. The notice serves only to notice for 30 days that an application for an antenna structure at a particular location has been submitted. Members of the public interested in that structure must track down the application in the antenna structure registration system and then see whether an environmental assessment is attached. To find environmental assessments that are "accessible," a member of the public would have to know that a proposed antenna structure registration included an environmental assessment.

Hence, notice is hardly "public." Rather than being posted on a readily accessible, centralized site for NEPA documents,[34] the registration application and the associated environmental assessment, if done, are buried in a hard-to-access, byzantine website.[35] Without project coordinates or an exact site location, it is difficult to get into the website and, once in, to find the environmental documents. To complicate matters further, environmental assessments associated with licensee towers that do not need to be registered (i.e., short towers) are noticed separately and are buried on a different webpage.[36]

Comments Deemed "Complaints"

Even if the public manages to overcome FCC hurdles and ascertain information about a proposed facility, it faces nearly insurmountable obstacles to get its concerns heard or addressed. Under NEPA, the burden of looking at effects is a federal obligation—it is not up to the public to establish a case but merely to apprise the agency of potential effects to consider; the comment period allows the agency to meet its NEPA obligations by giving the public an opportunity to raise effects or alternatives not considered in the environmental review process.

But rather than a standard, fair, or open comment process in which the agency considers and responds to concerns raised by the public, the FCC administers an adversarial complaints process that requires the public to meet a high burden of proof about a potential effect that may have been overlooked in the checklist or inaccurately documented.[37] With a process that unfairly shifts the burden of raising and establishing environmental concerns from the agency to the public, the outcome is always the same. The FCC virtually never finds that complaints are valid. To dismiss them or resolve them in the applicant's favor so that the project can proceed, it routinely finds that the complainant has not provided specific enough detail or an adequate scientific showing for the agency to consider an effect.

Compounding the unlikelihood that the public will learn about a project and be able to weigh in is a timing issue. When the public finds out about a project that the applicant has deemed categorically excluded (either by doing the checklist or failing to do the checklist), there is no timeline to comment on or complain about the project. With no notice and no timeline for these projects that proceed with no agency awareness, the public often learns about the projects when construction begins or, just as likely, when the facility is already built.

Because the applicant need not consider aesthetics, for example, a tower visible from a state park could be deemed categorically excluded and built before the public sees the impact to its viewshed. Rarely, if ever, will the FCC decide an environmental assessment is required under the circumstances because the applicant ostensibly did what was required of it by assessing the minimal checklist. Furthermore, in terms of failure to comply with NEPA, environmental assessments are submitted so late in the process that a meaningful alternatives analysis—a hallmark and requirement of NEPA[38]—is foreclosed.

Aesthetic Effects: The Greatest Impacts Never Addressed

Perhaps most egregious is the agency's approach to aesthetic impacts.

Applicants should be required to consider aesthetic impacts because, by the FCC's own account in its rulemaking, visual impacts are by far the most significant impact a tower could have.[39] As originally promulgated, FCC's NEPA regulations triggered an environmental assessment when facilities were to be located "in areas which are recognized either nationally or locally for their special scenic or recreational value."[40] Again and again in the rulemaking, visual effects were cited as the greatest impact, as well as an impact to be mitigated.[41] Yet in 1985, the FCC decided the standard was "unduly vague," and that it was unnecessary for applicants to submit environmental assessments in cases that "may raise aesthetic concerns."[42] It also noted that "aesthetic concerns may more appropriately be resolved by local, state, regional or local land use authorities"[43]—although NEPA is an independent federal obligation.

On the rare occasion when the FCC does consider aesthetics, its examination is generally limited to consideration of impacts to nationally designated scenic trails and historic sites (the latter falling under visual effects under National Historical Preservation Association) or to national parks, although nothing in NEPA or Council on Environmental Quality rules limits consideration of aesthetic impacts solely to those designated areas. This practice precludes consideration of impacts to, for example, scenic tourist areas or state or locally designated battlefields and parks. In 2014, AT&T built a tower in Fort Ransom, North Dakota, visible from a nearby National Scenic Tail and Scenic Byway, without having to consider aesthetic impacts.[44] Towers have been built in the viewsheds of, for example, a National Scenic Trail in Vergennes, Michigan, an iconic bridge in New York, a civil rights site in Selma, Alabama, and on Dewey Beach, Delaware's sand dunes, with little notice, consideration of visual impacts, or mitigation.

Little Compliance, Little Enforcement

With no oversight to ensure applicants have done the due diligence required to consider the checklist and no on-the-ground inspections, lack of compliance with the rules is rampant

Large-scale projects with multiple facilities built without NEPA review include hundreds of towers in Alaska built by GCI.[45] Between 2001 and 2015, T-Mobile built hundreds of towers in 22 states without environmental review.[46] In New Mexico and Texas, Plateau Telecommunications built 58 towers with no National Historical Preservation Association review.[47] Telalaska built 28 towers near and in sensitive areas in Alaska with no repercussions.[48] With no Enforcement Bureau action, the Wireless Telecommunications Bureau and Alliant Energy Corporation agreed in 2017 to a compliance plan after Alliant built 109 towers and 93 poles without NEPA review.[49] Railroad noncompliance was so widespread that the FCC entered into a settlement agreement with several railroads that created a $10 million cultural resources fund for 11,000 constructed poles that had not gone thru National Historical Preservation Association or NEPA review.[50]

Smaller-scale projects and individual towers also have significant impacts. For example, in 2019, licensees in Broward County, Florida, cleared 36 trees and built a driveway through a forested wetland before completing environmental review.[51] In Sabana Grande, Puerto Rico, a tower builder in 2014 bulldozed critical habitat for an endangered bird.[52] Dozens of sacred sites have been similarly destroyed or damaged across the country, as have multiple cultural resources and historic and archaeological sites.

Although towers can alter iconic views, the FCC does not require licensees to consider aesthetic impacts.

Cell towers are altering and marring views across the country.

Many of these failures to comply with environmental requirements come to light as National Historical Preservation Association violations, rather than as NEPA violations, because the National Historical Preservation Association process, as part of the checklist, requires photo documentation and official state and tribal review. Complaints from these officials or the public and self-reporting—often unintentionally with photos submitted through increasingly rare environmental assessment submissions[53]—are generally the sole bases for enforcement.

Conveniently for an agency intent on deployment, the FCC's Enforcement Bureau operates under a one-year statute of limitations—one year from the time the facility was built, not from when the agency learned of the violation. As a result, by the time the agency learns of the violation and decides to take action, it is often prohibited from levying fines against the violator.

When the agency does take action, it amounts, with few exceptions, to a slap on the wrist. In 2016, six licensees got admonishment letters with no penalties and little agency publicity.[54] For the past decade or so, Wireless Telecommunications Bureau admonishment letters, which number from zero to six per year, warn of the potential for increased fines and punishments if violators break rules again. But the agency could not fine the violators and does not track the letters. Fines are rare and if levied, de minimis.[55] At most, penalties are ordered once or twice a year, and tower removal, which would be a reasonable and authorized remedy for violations, is never ordered.

In one instance, clearing guy-wire areas for a 1,500-foot broadcast tower in Punta Gorda, Florida, destroyed 2.6 acres of treed habitat for bonneted bats, an endangered species. As mitigation, the applicant paid $28,000 to the U.S. Fish and Wildlife Service, while the FCC issued a Finding of No Significant Impact and imposed a fine of $28,000.[56]

Ex Post Facto NEPA: A Concept Not Contemplated by NEPA

To address instances of noncompliance, the agency has instead devised an ex post facto NEPA process under which the violators conduct and submit an after-the-fact checklist or environmental assessment. If an environmental assessment is required, these half-built or fully built projects then receive the FONSIs that are a prerequisite for construction. Enforcement action may, but more likely will not, follow; with no repercussions, a 485-foot broadcast tower in Chattanooga, Tennessee, was built and operating for months before it got its FONSI in 2021.[57]

Since 2002, the agency has used a clearance process for noncompliant towers (i.e., those that have not gone through the National Historical Preservation Association and NEPA process).[58] For example, on March 28, 2012, the FCC "cleared" with a post-construction review the 58 towers that Plateau Telecommunications had built in violation of historic preservation procedures.[59] Other elements of the requisite NEPA review were ignored—and are often ignored in this process.

Regardless, NEPA may not be done retroactively, and the substantive value of this follow-up exercise is unclear. It

Beyond visual impacts, cell towers built in pristine areas can affect sensitive species and ecosystems.

is hard to assess damage to a site never evaluated for the presence of, for example, wetlands, sensitive species, historic resources, or sacred sites before clearing took place. More importantly, given the dearth of documentation, little means for the agency to discover violations, and lack of oversight at the agency, it is unclear just how many projects that impact environmentally sensitive areas are constructed with improper or no checklist review, or get started without waiting for a FONSI to construct; most of the sites where environmental damage occurred and the degree of destruction will never be known.

By routinely clearing towers with post-construction checklist reviews, the agency creates incentives for tower companies and carriers to build their towers and, if necessary, do paperwork later. Given the lax enforcement and the statute of limitations issue, this approach from industry's perspective would be quite reasonable.

Conclusion: Prospects for a More Accountable FCC

Clearly, the FCC's NEPA process falls short of what NEPA and Council on Environmental Quality require.

- It ignores major federal actions requiring environmental review, such as its distribution to industry of billions of dollars that support build-outs for updated wireless service, or improperly deems certain major federal actions nonmajor federal actions to circumvent NEPA.
- Its NEPA rules create an unsupported and overbroad categorical exclusion so that, for example, satellite licensing and submarine cable licensing are excluded from review.
- With little oversight or tracking, it delegates environmental review of NEPA determinations to industry proponents of the project.
- It fails to vigorously enforce its rules so that industry noncompliance is rampant.
- It fails to provide adequate notice and opportunities for public comment.
- It fails to make environmental documents, including radio frequency emissions studies, publicly available or readily accessible.
- It routinely ignores or dismisses public comments and concerns and places an unfair burden of proof on the public when it raises concerns.

These practices serve to facilitate deployment for carriers while ignoring environmental rules and the public. Besides environmental costs, the FCC's approach bespeaks a lack of transparency

and accountability that undermines good governance and erodes democracy. It also bespeaks an agency completely captured by the entities it is tasked with regulating.

Recent Biden-era NEPA implementing rules[60] require agencies to revisit their NEPA rules and procedures by September 2023.[61] They also require that the agencies have the capacity to comply with NEPA,[62] something the FCC has to date lacked. Perhaps when Council on Environmental Quality reviews the FCC's procedures this time, it will scrutinize the rules more carefully and hold the agency to a higher standard for NEPA compliance.

An environmental and public lands policy attorney with over 30 years of experience, including in agencies, Congress, and academia, **Erica Rosenberg** worked at the FCC's Wireless Telecommunications Bureau from 2014 to 2021; for the last six of those years, she was Assistant Chief of the Competition and Infrastructure Policy Division.

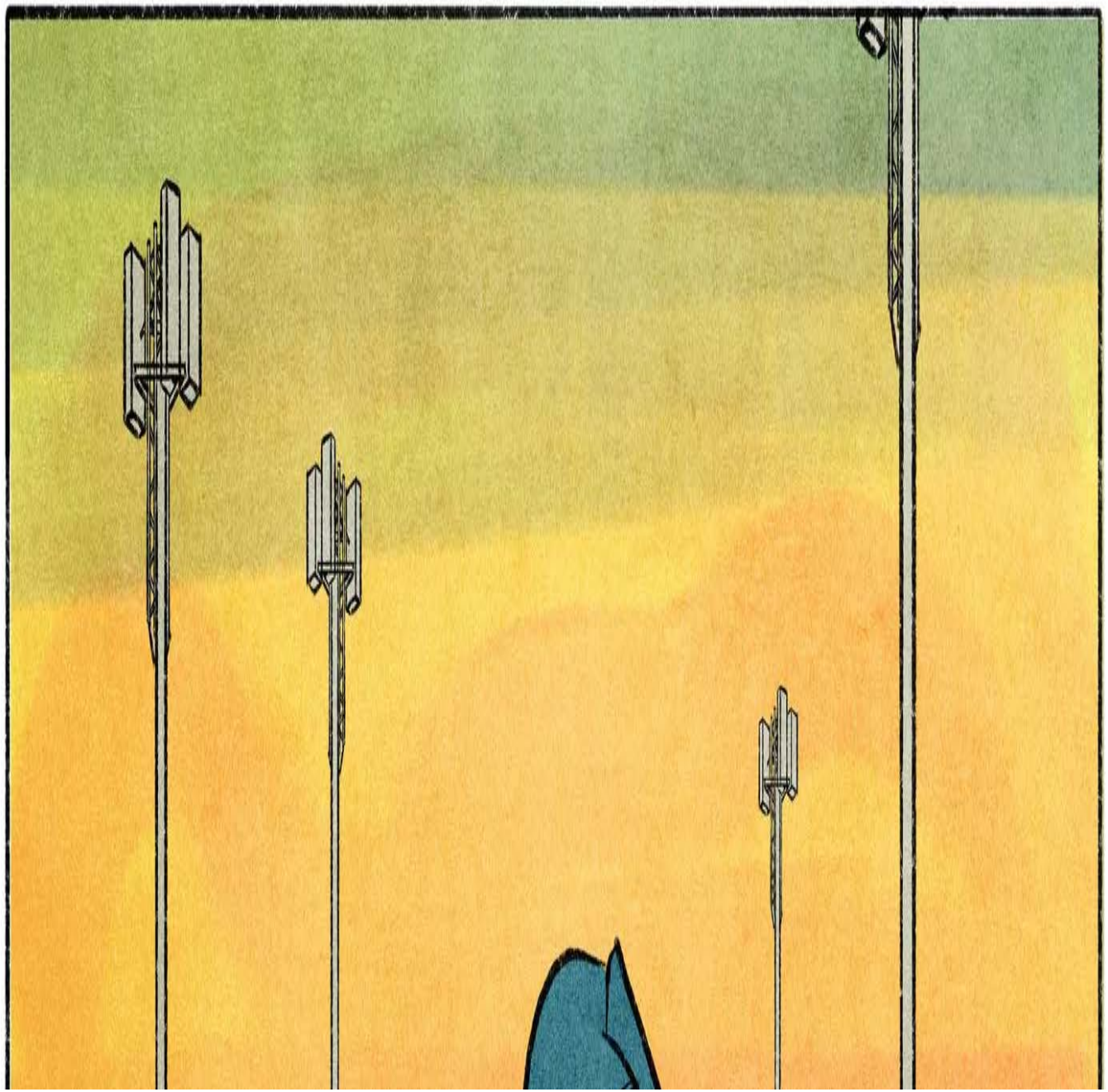
NOTES

1. Unlike macro-cells or wireless cell towers, a small cell installation consists of radio equipment and antennas placed every few meters on structures such as streetlights, buildings, or poles.
2. 42 U.S.C. §4371 *et seq*.
3. Telecommunications Act of 1996, Section 704, 47 U.S.C §332.
4. 40 CFR §1508.18 (1978). Note: Unless otherwise noted, NEPA regulations cited are 1978 regulations (i.e., pre-Trump and Biden-era regulations). The FCC was bound by those regulations until April 2022.
5. 40 CFR §1508.18.
6. 40 CFR §1508.8.
7. 40 CFR §§1501.2(d)2), 1.1501.7((a)(1), 1.1503.1, 1.1506.6.
8. Other agencies, such as the National Telecommunications and Information Administration (NTIA), do conduct NEPA reviews for such actions.
9. *See* Accelerating Wireless Broadband Deployment by Removing Barriers to Infrastructure Investment ("Infrastructure Order") (WT Docket 17-79, FCC 18-30), (March 22, 2018), 33 FCC Rcd 3102 (4).
10. *See* CTIA blog, March 27, 2018 ctia.org/news/what-is-a-small-cell.
11. 11. *See* Infrastructure Order, Rosenworcel dissenting statement.
12. 12. *Id.*
13. 13. *Id.*
14. *United Keetoowah Band of Cherokee Indians v. FCC*, 933 F. 3d 728 (D.C. Cir. 2019).
15. *Id*. at 741. Between the time the Order was issued and the decision handed down, however, countless small wireless facilities were deployed without NEPA review.
16. Final Programmatic Environmental Assessment for the Antenna Structure Registration Program, FCC (March 13, 2013).
17. *See* 40 CFR §1508.7(cumulative impacts); §1508.8 (b) (effects include cumulative).
18. 47 CFR §1.1306(a).
19. 49 FCC 2d 1313,para. 14(a) (1974); *see also* 47 CFR §1.1306 Note 1. (EA requirements do not "encompass the construction of new submarine cables systems.")
20. *See* In the matter of Public Employees for Environmental Responsibility, FCC 01-319, n. 46.
21. *See* §1501.3; §1508.1(g)(1) (definition of effects includes aesthetic, health, economic, etc.).
22. 47 CFR § 1.1307.
23. 47 CFR §1.1307(a)(6).
24. Declaratory Ruling and Notice of Proposed Rulemaking, In the Matter of Implementation of State and Local Governments' Obligation to Approve Certain Wireless Facility Modification Requests Under Section 6409(a) of the Spectrum Act of 2012, FCC 20-75A (June 9, 2020), paras. 45—50. 35 FCC Rcd 5977.
25. https://broadbandusa.ntia.doc.gov/sites/default/files/2021-07/July%202021%20BB%20Infra%20Webinar_FINAL%20Presentation_0.pdf, p. 23.
26. *See id.* at p. 50.
27. *See generally* 40 CFR §1506.5.
28. *See* letter from Michael S. Fishman, Conservation Biologist, Edgewood Environmental Consulting, to Noelle Rayman USFS biologist, Cortland, NY, November 13, 2020, Re: Determination of Adverse Effects from Wireless EDGE—WEC-NY-23 Cell Tower 90 Carpenter Road, East Fishkill, Dutchess County, NY 41°34'40.37"N, 73°47'03.84"W.
29. *See, e.g.*, Form 601 instructions (https://www.fcc.gov/sites/default/files/fcc-form-601.pdf): Item 22.
30. 30. *See* "FCC Environmental Assessment" (checklist) (undated).
31. *See* 47 CFR §§1.1307(c) and (d).
32. 40 CFR §1506.6 (provide public notice of availability of environmental documents).
33. 40 CFR §1506.6(a).
34. 40 CFR §1506.6 ("provide public notice of NEPA related-hearings … and the availability of environmental documents").
35. wireless2.fcc.gov/UlsApp/AsrSearch/asrApplicationSearch.jsp (application) and wireless2.fcc.gov/UlsApp/AsrSearch/asrApplicationSearch.jsp (environmental notice).
36. wireless2.fcc.gov/UlsApp/AsrSearch/asrApplicationLicense.jsp.
37. In *American Bird Conservancy, v. CTIA*, 516 F.3d 1027, 1033 (D.C. Cir. 2008). the court admonished the FCC for setting too high a standard.
38. *See* 40 CFR §1508.9 (EAs include consideration of alternatives).
39. *See, e.g.,* 49 FCC 2d 1313 (1974), para. 32 ("we have stressed the visual or aesthetic impacts of [such] facilities as their primary environmental effect").
40. *Id.* at para. 14.
41. *See, e.g., id.*, at paras. 18, 23, 27, 28, 32.
42. 986 WL 292182, 60 Rad. Reg. 2d, para. 11 (November 25, 1985).
43. *Id*. at para. 122.
44. AT&T Mobile Services, Inc. Construction of Tower Fort Ransom, North Dakota; Complaints of the Sheyenne River Valley National Scenic Byway, Don Busta, Judith L. Morris, and the North Country Trail Ass'n, Memorandum Opinion and Order, 30 FCC Rcd 11023, 11032, para. 28 (WTB/CIPD 2015).
45. *See* Consent Decree (DA 15-1179) (October 20, 2015).
46. Phoenix Towers International acquired the towers and in 2016, sought to bring them into compliance.
47. 27 FCC Rcd. 2972 (March 29, 2012) (letter to Gregory W. Whitaker from Dan Abeyta, WTB).
48. *See* email from Amy Summe, Shannon and Wilson, to Erica Rosenberg, Assistant Chief, Competition and Infrastructure Policy Division, Wireless Bureau, FCC re: Towers, after-the-fact NEPA compliance, February 14, 2020.
49. *See* email from Michelle Yun, Senior Attorney, Alliant to Jiaming Shang, Attorney Advisor, Wireless Telecommunications Bureau, FCC and attachment "Final Compliance Plan.pdf (May 23, 2017).
50. https://www.fcc.gov/document/fcc-announces-actions-facilitate-ptc-implementation; https://www.indianz.com/News/2014/06/04/tribes-take-role-in-major-rail.asp.
51. *See* ASR No. 1136027, Broward County, West Hollywood Telecommunications facility, filed November 2019 (attached EA).
52. See ASR No. A1062663, Wise Towers, filed December 29, 2016 (attached EA and filings).
53. *See., e.g.,* ASR No. A1179538 (attached EA, dated December 8, 2020, for a 610-foot tower in Weedville, PA indicates that the applicant cleared several acres of sensitive species habitat before completing environmental review). (Appendix III, pp. 17-18).
54. *See, e.g.,* letter to Kenneth Meyers, President and CEO, United States Cellular Corporation from Jeffrey Steinberg, Deputy Chief, CIPD, WTB, June, 16, 2016, re: Violation of FCC Environmental Rules.
55. *See, e.g.,* In re: Western Wireless Corp, FCC 03-109 (May 6, 2003) (tower built near several historic sites and operating in violation of environmental rules fined $200,000). The fine was ultimately rescinded on November 17, 2004.
56. *See* Consent Decree, In re: Fort Myers Broadcasting Company (DA21- 1365) (November 2, 2021).
57. *See* FONSI letter to Brian Fuqua, Greater Chattanooga Public TV Corp from Erica Rosenberg, Assistant Chief, Competition and Infrastructure Policy Division, Wireless Bureau, FCC (April 14, 2021).
58. In 2009, over 1,000 AT&T towers built pre-2001 without NEPA documentation were "cleared." Letter from Jeffrey Steinberg Deputy Chief, SPCD to Jeanine Poltronieri, AT&T (January 16, 2009).
59. 27 FCC Rcd 2972 (March 29, 2012) (letter to Gregory W. Whitaker from Dan Abeyta, WTB, FCC).
60. 40 CFR §100 et seq. (April 20, 2022).
61. *See* 40 CFR §1507.3 (2022).
62. *See id.*

You may also watch an video interview of the author:

FCC & NEPA: FCC Fails to Protect the Environment Interview With Former FCC Lawyer Erica Rosenberg

You may also read the attached ProPublica report with very similar findings: Peter Elkind "*The FCC Is Supposed to Protect the Environment. It Doesn't.*" ProPublica (May 2, 2023):



You may also read "*How the FCC Shields Cellphone Companies From Safety Concerns*" by the same author and reputable journal.

The FCC is a captured agency (Norm Alster. "*Captured Agency: How the Federal Communications Commission Is Dominated by the Industries It Presumably Regulates*," **Harvard University Edmond J. Safra Center for Ethics** (June 23, 2015)).

There is also a strong argument that the TRPA itself has become a real estate developer captured agency...which explains why neither agency has done anything about the science:

International Commission on the Biological Effects of Electromagnetic Fields (ICBE-EMF)
Environmental Health (2022) 21:92
https://doi.org/10.1186/s12940-022-00900-9

Environmental Health

COMMENT Open Access

Scientific evidence invalidates health assumptions underlying the FCC and ICNIRP exposure limit determinations for radiofrequency radiation: implications for 5G

International Commission on the Biological Effects of Electromagnetic Fields (ICBE-EMF)*

Abstract

In the late-1990s, the FCC and ICNIRP adopted radiofrequency radiation (RFR) exposure limits to protect the public and workers from adverse effects of RFR. These limits were based on results from behavioral studies conducted in the 1980s involving 40–60-minute exposures in 5 monkeys and 8 rats, and then applying arbitrary safety factors to an apparent threshold specific absorption rate (SAR) of 4 W/kg. The limits were also based on two major assumptions: any biological effects were due to excessive tissue heating and no effects would occur below the putative threshold SAR, as well as twelve assumptions that were not specified by either the FCC or ICNIRP. In this paper, we show how the past 25 years of extensive research on RFR demonstrates that the assumptions underlying the FCC's and ICNIRP's exposure limits are invalid and continue to present a public health harm. Adverse effects observed at exposures below the assumed threshold SAR include non-thermal induction of reactive oxygen species, DNA damage, cardiomyopathy, carcinogenicity, sperm damage, and neurological effects, including electromagnetic hypersensitivity. Also, multiple human studies have found statistically significant associations between RFR exposure and increased brain and thyroid cancer risk. Yet, in 2020, and in light of the body of evidence reviewed in this article, the FCC and ICNIRP reaffirmed the same limits that were established in the 1990s. Consequently, these exposure limits, which are based on false suppositions, do not adequately protect workers, children, hypersensitive individuals, and the general population from short-term or long-term RFR exposures. Thus, urgently needed are health protective exposure limits for humans and the environment. These limits must be based on scientific evidence rather than on erroneous assumptions, especially given the increasing worldwide exposures of people and the environment to RFR, including novel forms of radiation from 5G telecommunications for which there are no adequate health effects studies.

Keywords: Federal Communications Commission (FCC), International commission on non-ionizing radiation protection (ICNIRP), Radiofrequency radiation (RFR), Exposure limits, Exposure assessment, Radiation health effects, Reactive oxygen species (ROS), DNA damage, 5G, Scientific integrity, Cell phone*, Mobile phone*

*The terms cell phone and mobile phone are used interchangeably in this commentary; cell phone is the term used in the United States, while mobile phone is the term used in most of Europe.

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Introduction

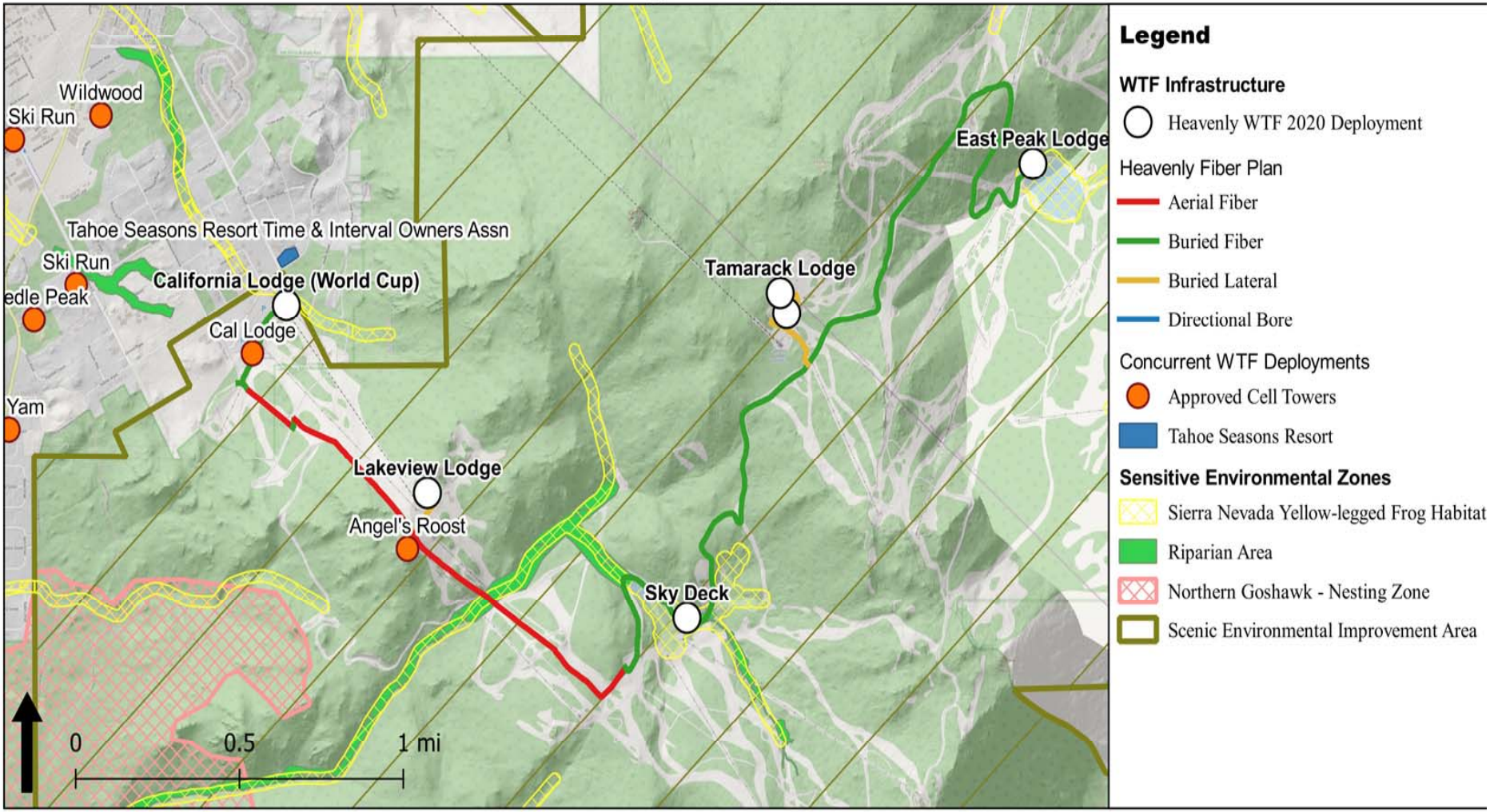
In establishing exposure limits for toxic or carcinogenic agents, regulatory agencies generally set standards that take into account uncertainties of health risks for the general population [1] and for susceptible subgroups such as children [2]. That approach has not been applied in the same way to the setting of exposure limits for

In summary, both the FCC and the TRPA allege they preempt our local governments over environmental regulation of radiofrequency radiation, and then they along with the USFS malfeasantly ignore this legal responsibility via

deliberate indifference of known adverse environmental effects such as the undermentioned ones. The aforementioned article shows the FCC corruptively declines to extend any consideration of health effects beyond those thermal effects directly affecting humans despite federal courts a decade ago finding that NEPA requires a broad construction that encompasses wildlife (*Jaeger v. Cellco P'ship*, No. 3:09CV567, p. 18, 2010 U.S.Dist.LEXIS 24394, at *26 (D.Conn. Mar. 15, 2010) ("The plain meaning of the term 'environmental effects' incorporates adverse effects on all biological organisms"). This means the the FCC will almost certainly continue to ignore the degree to which radiofrequency radiation can harm frogs, trees including aspen, migratory birds, and birds of prey—which is contrary to their own regulations (47 CFR §§ 1.1307 & 1.1311) (Actions that may have a significant environmental effect, for which Environmental Assessments (EAs) must be prepared...Facilities that...May affect listed threatened or endangered species or designated critical habitats; or...are likely to jeopardize the continued existence of any proposed endangered or threatened species or likely to result in the destruction or adverse modification of...habitats...Facilities whose construction will involve significant change in surface features (e.g., wetland fill, deforestation or water diversion); The applicant shall submit an EA with each application that is subject to environmental processing...The EA shall contain the following information:...A statement as to whether construction of the facilities has been a source of controversy on environmental grounds in the local community....If endangered or threatened species or their critical habitats may be affected, the applicant's analysis must utilize the best scientific and commercial data available). This proposed cell tower may clearly have an effect on the environment (*see, e.g.*, *American Bird Conservancy, Inc. v. F.C.C.*, 516 F.3d 1027, 1033-1034 (2008) (a precondition of certainty before initiating NEPA procedures would jeopardize NEPA's purpose to ensure that agencies consider environmental impacts before they act rather than wait until it is too late); *Sierra Club v. Norton*, 207 F.Supp.2d 1310, 1336 (2002) (Under NEPA, an agency cannot use the lack of existing information as a basis for acting without preparing an EIS)). "Environment" includes ecological impacts, health impacts, social and economic impacts (40 CFR §1508.1(g)(1)&(m)). *See generally*, 42 U.S.C. §§ 4331-4332; 40 C.F.R. §§ 1500-1508. Presidential Executive Orders 13057 and 13186 add further protective duty to FCC actions in the Tahoe Basin as well as with all actions which may effect migratory birds. The FCC needed to obtain a U.S. Fish and Wildlife Service (FWS) biological opinion pursuant to 16 U.S.C. § 1536(a)(2); 50 CFR §§ 402.11, 402.14, & 402.15; Verizon itself was actually required to stop construction (47 CFR § 1.1312(d)). This fiasco could have been entirely prevented with transparency, adequate public notice, and otherwise substantive due process whereas these regulations further required that "environmental information is available to public officials and citizens before decisions are made and before actions are taken" (*see*, *Oglala Sioux Tribe v. Nuclear Regulatory Comm'n*, 896 F.3d 520 (D.C. Cir. 2018)). To the contrary,

Verizon initially withheld and then continually dripped out novel environmental cell tower impact information up to the second 2022 TRPA Governing Board hearing on the Ski Run Cell Tower. The information provided to the public in the 2019 "public notice" pales in comparison to what Verizon ambushed the public with at the final TRPA hearing.

Heavenly Fiber Plan:
Regulatory Issues



Project May Pose Significant Effect on the Environment

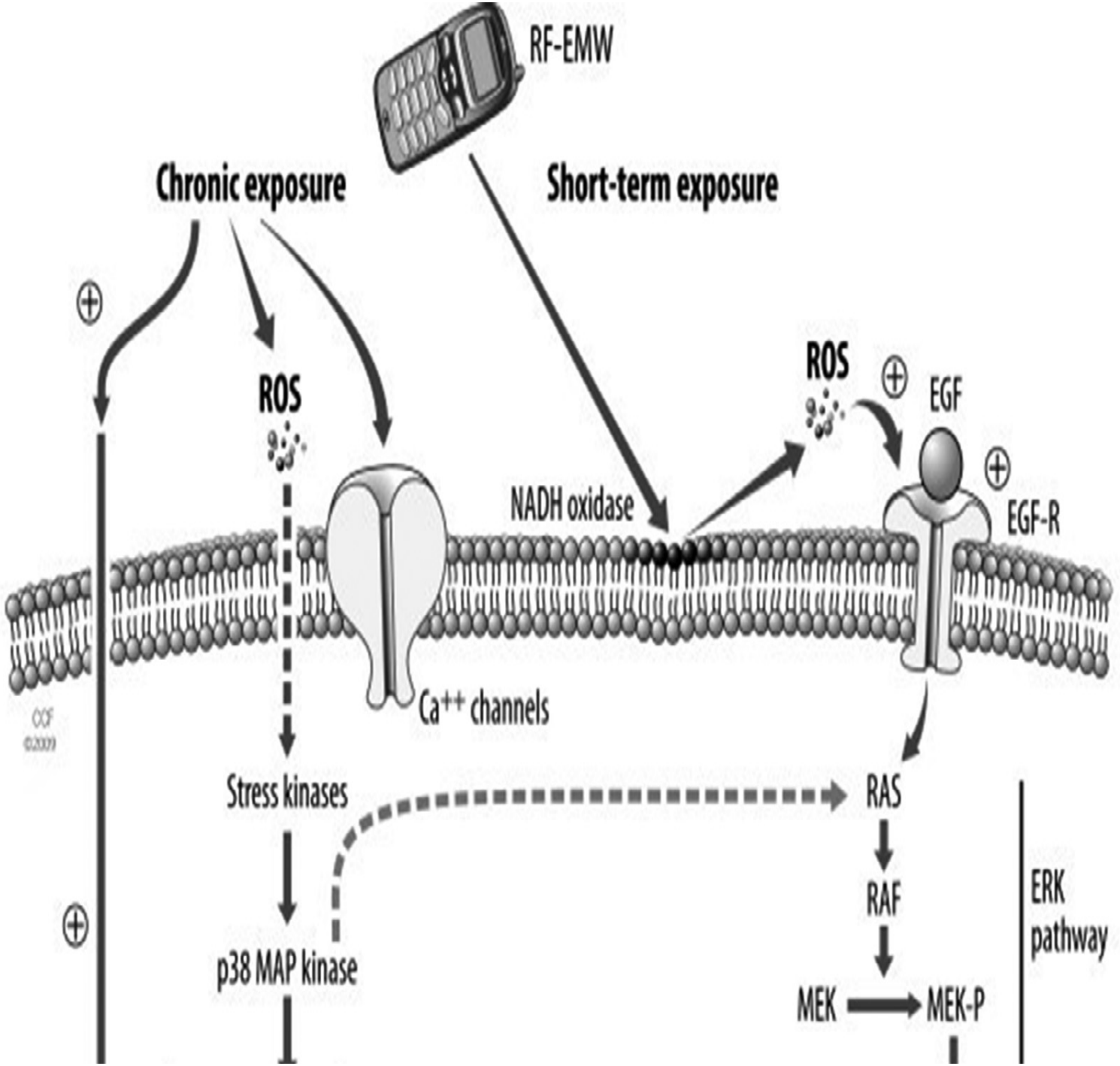
Numerous research studies have found that cell tower radiation causes mortality in frogs and amphibians [*e.g.,* Balmori, Alfonso. (2010). Mobile Phone Mas Effects on Common Frog (*Rana temporaria*) Tadpoles: The City Turned into a Laboratory. *Electromagnetic biology and medicine.* 29. 31-5. DOI 10.3109/15368371003685363]. A NEPA "categorical exclusion" cannot be issued because there exists substantial evidence that the WTF's may have a significar effect on the environment, particularly an endangered frog and protected birds [36 CFR § 220.6(b)(1)(i),(iii); 50 CFR § 17.11(h); 79 FR 24255; *see also* 16 U.S.C § 497b; 47 CFR § 1.1307(a)(3); 40 CFR § 1508.8]. The affected area contains substantive habitat for endangered, rare, or threatened species, and could result i significant effects relating to wetlands [50 CFR § 10.13; EO 13186; 16 U.S.C. § 700 et. seq.; *cf.* 14 CCR §§ 15192(d), 15097(c)(2), 15206(b)(4)(A),(b)(5)] or wate

It is incontrovertible that the USFS and TRPA have established Bijou Park Creek as qualifying habitat for Sierra Nevada Yellow-legged Frog. Under the Endangered Species Act, prohibited "harm" includes "significant habitat modification or degradation" (*Babbitt v. Sweet Home Chapter of, Communities for a Greater Ore.*, 515 U.S. 687, 702, 708 (1995)). Thus, this habitat as well as the endangered animal is protected from private action (*id.*). This is true regardless of whether the habitat is actually utilized, notwithstanding the fact that there is also compelling evidence that the habitat is in fact utilized (*e.g.* A, B, C, D, & E) / (*e.g.*, 1, 2, 3, 4 & 5, 6).

The prestigious National Institute of Health—National Toxicology Program (NIH—NTP) decade-long **Cell Phone study** has established that radiofrequency radiation used by cell phones cause DNA damage (Smith-Roe, Stephanie L et al. "*Evaluation of the genotoxicity of cell phone radiofrequency radiation in male and female rats and mice following subchronic exposure*." Environmental and Molecular Mutagenesis vol. 61,2 (2020): 276-290. doi:10.1002/em.22343) (results suggest that exposure to RFR is associated with an increase in DNA damage); Hardell, L., Carlberg, M. "*Comments on the US National Toxicology Program technical reports on toxicology and carcinogenesis study in rats exposed to whole-body radiofrequency radiation at 900 MHz and in mice exposed to whole-body radiofrequency radiation at 1,900 MHz*." International Journal of Oncology 54, no. 1 (2019): 111-127. https://doi.org/10.3892/ijo.2018.4606) (We conclude that there is clear evidence that RF radiation is a human carcinogen; RF radiation should be classified as carcinogenic to humans, Group 1). The peer-reviewed scientific studies such as the prestigious NIH study are not "bunk science" by armchair cranks. Similar findings been produced by other well-respected scientific studies (Ioniță, E., Marcu, A., Temelie, M. *et al*. "*Radiofrequency EMF irradiation effects on pre-B lymphocytes undergoing somatic recombination*." NATURE Sci Rep 11, 12651 (2021). https://doi.org/10.1038/s41598-021-91790-3). RFR radiation causes DNA damage in plants as well (Dmitry S. Pesnya & Anton V. Romanovsky, *Comparison of cytotoxic and genotoxic effects of plutonium-239 alpha particles and mobile phone GSM 900 radiation in the Allium cepa test*, 750 Mutation Research, 27–33, (2013), http://dx.doi.org/10.1016/j.mrgentox.2012.08.010).

There is a "clear and convincing" body of scientific evidence showing that radiofrequency radiation really may cause DNA damage (Henry Lai. "*Genetic effects of non-ionizing electromagnetic fields*," Electromagnetic Biology and Medicine, (2021) 40:2, 264-273, DOI: 10.1080/15368378.2021.1881866) (of the 361 peer-reviewed scientific studies on the subject to date, "the majority of studies reported genetic effects of EMF (66% for RFR and 79% for static/ELF-EMF). Thus, it is safe to conclude that genotoxic effects of EMF have been reported. The most common effects found are: DNA strand breaks, micronucleus formation, and chromosomal structural changes")). This has particularly

alarming implications for children (Devra Davis, Linda Birnbaum, Paul Ben-Ishai, Hugh Taylor, Meg Sears, Tom Butler, Theodora Scarato, "*Wireless technologies, non-ionizing electromagnetic fields and children: Identifying and reducing health risks*," Current Problems in Pediatric and Adolescent Health Care, Volume 53, Issue 2, (2023), https://doi.org/10.1016/j.cppeds.2023.101374).


RF-EMW
Chronic exposure
Short-term exposure
ROS
ROS
EGF
EGF-R
NADH oxidase
Ca++ channels
Stress kinases
RAS
RAF
ERK pathway
p38 MAP kinase
MEK
MEK-P

DNA damage is merely one of a myriad of non-thermal environmental effects apparently caused by radiofrequency radiation. The FCC is not even concerned about the established thermal effects being applied to wildlife—or anything other than to humans. The precautionary principle requires us to at least assess the potential environmental impacts of radiofrequency radiation under the worst case scenario (*cf.*, Pearce, J M. "*Limiting liability with positioning to minimize negative health effects of cellular phone towers*." Environmental Research vol. 181 (2020): 108845. doi:10.1016/j.envres.2019.108845).

The FCC's radiofrequency radiation exposure limits have been outdated by modern science, yet the FCC arbitrary and capriciously refuses to update them (International Commission on the Biological Effects of Electromagnetic Fields (ICBE-EMF). *Scientific evidence invalidates health assumptions underlying the FCC and ICNIRP exposure limit determinations for radiofrequency radiation: implications for 5G*. Environ Health 21, 92 (2022). https://doi.org/10.1186/s12940-022-00900-9). *See also*, *Environmental Health Trust v. Federal Communications Commission*, No. 20-1025 (D.C. Cir. 2021)("we find the Commission's order arbitrary and capricious in its failure to respond to record evidence that exposure to RF radiation at levels below the Commission's current limits may cause negative health effects"). The FCC has blatantly ignored the public policy imperative updates which clearly arise from the current body of science (Levitt, B Blake et al. "*Effects of non-ionizing electromagnetic fields on flora and fauna, Part 3. Exposure standards, public policy, laws, and future directions*." Reviews on Environmental Health vol. 37,4 531-558. 27 Sep. 2021, doi:10.1515/reveh-2021-0083).

The FCC and TRPA may not use "*ex post facto*" environmental review which would be arbitrary and capricious *per se*. "[W]hen 'assessing the reasonableness of [an agency's action], [courts] look only to what the agency said at the time of the [action]—not to its lawyers' *post-hoc* rationalizations'" (*Environmental Health Trust v. Federal Communications Commission*, 9 F.4th 893, 910 (D.C. Cir. 2021) (quoting *Good Fortune Shipping SA v. Commissioner*, 897 F.3d 256, 263 (D.C. Cir. 2018)). "It is well-established that an agency's action must be upheld, if at all, on the basis articulated by the agency itself" (*Nat. Res. Def. Council v. U.S. Envtl. Prot. Agency*, No. 20-72794 *at* p. 9 (9th Cir. 2022) (quoting *Nat. Res. Def. Council v. U.S. EPA (NRDC 2013)*, 735 F.3d 873, 877 (9th Cir. 2013) (quoting *Motor Vehicle Mfrs. Ass'n of the U.S., Inc. v. State Farm Mut. Auto. Ins. Co.*, 463 U.S. 29, 50 (1983))))). "Courts do not "accept appellate counsel's *post-hoc* rationalizations for agency action" (*Id.* quoting *Nat. Res. Def. Council v. U.S. EPA (NRDC 2017)*, 857 F.3d 1030, 1040 (9th Cir. 2017) (quoting *Hernandez-Cruz v. Holder*, 651 F.3d 1094, 1109 (9th Cir. 2011))). "If the agency did not meet its burden, [courts] 'should not attempt…to make up for such deficiencies' and 'may not supply a

reasoned basis for the agency's action that the agency itself has not given'" (*Id.* quoting *Ctr. for Biological Diversity v. Haaland*, 998 F.3d 1061, 1067 (9th Cir. 2021) (quoting *State Farm*, 463 U.S. *at* 43))). *See also*, *Kisor v. Wilkie*, 139 S. Ct. 2400, 2417 (2019) (noting a court should decline to defer to a *post-hoc* rationalization advanced to defend past agency action against attack); *San Luis & Delta-Mendota Water Authority v. Jewell*, 747 F.3d 581, 603 (9th Cir. 2014)). After all, it is "NEPA's purpose to ensure that agencies consider environmental impacts before they act rather than wait until it is too late" (*supra*, *American Bird Conservancy, Inc. v. F.C.C.*, at 1033-1034; *Oglala Sioux Tribe v. Nuclear Regulatory Comm'n*, at 520 (The National Environmental Policy Act...obligates every federal agency to prepare an adequate environmental impact statement before taking any major action...The statute does not permit an agency to act first and comply later); *Marsh, Secretary of the Army, et al. v. Oregon Natural Resources Council et al.*, 490 U.S. 360, 371 (1989) (NEPA is intended to "prevent or eliminate damage to the environment . . . by focusing government and public attention on the environmental effects of proposed agency action").

The evidence is compelling that the FCC and TRPA must act to prevent harm to the environment from radiofrequency radiation (Levitt, B Blake et al. "*Low-level EMF effects on wildlife and plants: What research tells us about an ecosystem approach*." Frontiers in Public Health vol. 10 1000840. 25 Nov. 2022, doi:10.3389/fpubh.2022.1000840) (There is enough evidence to indicate we may be damaging non-human species at ecosystem and biosphere levels across all taxa from rising background levels of anthropogenic non-ionizing electromagnetic fields (EMF) from 0 Hz to 300 GHz). "[A]n agency cannot simply ignore evidence suggesting that a major factual predicate of its position may no longer be accurate" (*supra*, *Environmental Health Trust v. Federal Communications Commission*, at 907). Notwithstanding whatever the probability that RFR causes DNA damage, because of the dire consequence of genetic damage and the vast number the cell tower deployments, the risk to the environment is extreme (*see*, *Kaplan, S.; Garrick, B.J. (1981). "On the Quantitative Definition of Risk."* *Risk Analysis*. ***1*** *(1): 11–27. doi:10.1111/j.1539-6924.1981.tb01350.x*). The FCC's and TRPA's legal duty—under the calculus of negligence—to protect the public and the environment has been breached (*United States v. Carroll Towing Co.*, 159 F.2d 169 (1947) (holding the duty to provide against resulting injuries is a function of three variables: (1) The probability that injury will occur; (2) the gravity of the resulting injury; (3) the burden of adequate precautions)). Thus, the arbitrary and capricious refusal of both the FCC and TRPA to reconsider and mitigate the environmental effects of radiofrequency radiation in light of the current science is unconscionable.

The only due process over RFR limits—the 1996 FCC "notice of proposed rulemaking (NPRM)" (61 FR 41006 (1996); 61 FR 42021 (1996); FCC 96-326 (1996)) for NEPA regulation promulgating the current radiofrequency

exposure limits (47 CFR § 1.1310)—occurred nearly thirty years ago. Anyone who was legally an adult freely at liberty to submit written comment to the FCC would be at least forty-six years old today. According to the 2020 United States Census—Age and Sex Composition in the United States, 58 percent of the population today was not an adult in 1996 and therefore was never afforded their due process right—"an opportunity to be heard"—regarding the FCC's RFR exposure limits! Of the 42 percent of Americans who were adults during the NPRM, none of them were able to foresee the growing body of science which would later show adverse non-thermal environmental effects far below those exposure limits. Whereas today there is functionally no recourse to challenge the approval of new cell towers on the grounds of RFR levels which do not exceed the 1996 limits, and such exposure levels result in the "taking of life, liberty, or property," there is an egregious due process of law violation (*see*, *Mullane v. Central Hanover Tr. Co.*, 339 U.S. 306, 313, 314 (1950) (requisite of due process of law is the opportunity to be heard). Moreover, the FCC's giving license to the telecommunications companies to install cell towers which pervasively, systemically, and indiscriminately damage the DNA of living things—as to potentially amount to ecocide—concurrently encroaches on violating the "major questions doctrine" or the "non-delegation doctrine."

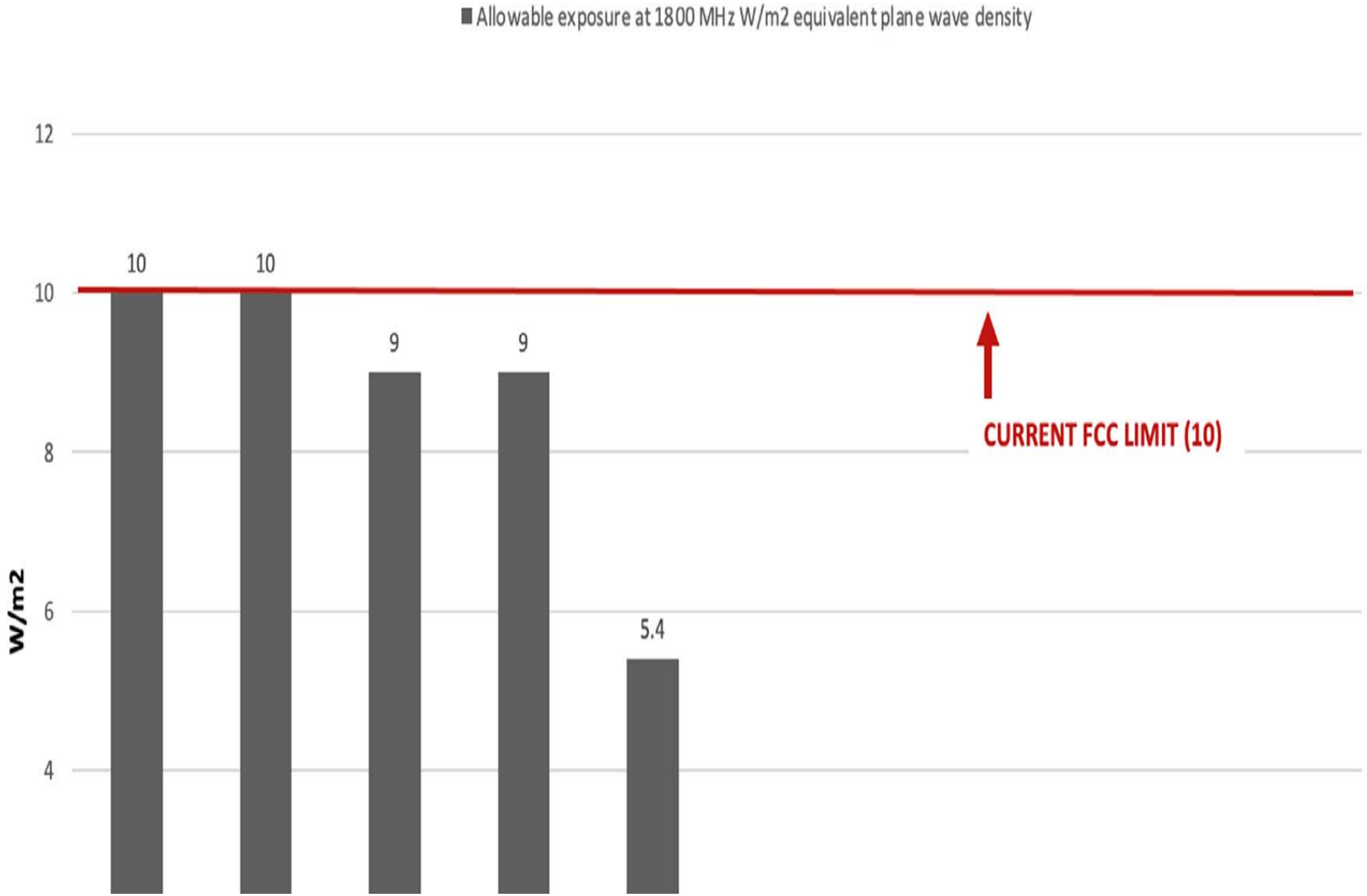
Let's be clear, Congress did not set the radiofrequency exposure limits, it delegated that responsibility to the FCC (Telecommunications Act of 1996, Pub. L. No. 104-104, § 704(b), 101 Stat. 56, 152 (directing Commission to "prescribe and make effective rules regarding the environmental effects of radio frequency emissions"); *see also*, 34 FCC Rcd 11687 (14) at 11689 n.5). The FCC must harmonize its responsibilities under Telecommunications Acts (TCA) with all other duties given by Congress under federal law. The FCC has never been given "clear congressional authorization" to violate the National Environmental Policy Act (NEPA), the Americans With Disability Act (ADA), the Endangered Species Act (ESA), or the Migratory Bird Treaty Act (MBTA). When the FCC promulgated regulation of radiofrequency exposure limits in 1996, it was not obvious that their regulation was in conflict those congressional acts. However, those limits are now invalidated by three decades of science which evidences that a substantive violations of these federal laws are actually occurring. The FCC and the courts are not in a "Hobson's choice" between violating the TCA or the ADA, because the TCA does not set radiofrequency exposure limits. That is a completely bogus argument. The FCC simply needs to regulate radiofrequency exposure limits in any manner of its choosing which does not violate its concurrent obligations under broader federal law. The FDA and the EPA are not delegated the responsibility to do this for the FCC (*e.g*, Senate Report 104-140, p. 91 (1996) ("EPA shall not engage in EMF activities"); Mouzaffar, Hala. (2021) "*The FCC Keeps Letting Me Be: Why Radiofrequency Radiation Standards Have Failed to Keep Up With Technology*". University of Pittsburgh Law Review 83

(1). https://doi.org/10.5195/lawreview.2021.826). The FCC arbitrarily and capriciously acts "contrary to law" and "without authority" when it violates NEPA, ESA, MBTA, ADA, or "inalienable" constitutional rights, which more broadly invokes the "major questions doctrine."

The FCC has been usurping local governments ability to protect the inalienable due process rights of their constituents. Their deliberate indifference has pervasively resulted in the taking of life, liberty, or property without any due process addressing the core issue of radiofrequency exposure. It has resulted in the installation of cell towers next to migratory bird and eagles nests, endangered animal habitat, children, and detrimentally adjacent to the homes of cancer patients! The substantive component of the Due Process Clause is violated by executive action when it "can properly be characterized as arbitrary, or conscience shocking, in a constitutional sense" (*see, County of Sacramento v. Lewis*, 523 U.S. 833, 846 (1998) (quoting *Collins v. Harker Heights*, 503 U.S. 115, 128 (1992); *Clark v. City of Hermosa Beach*, 48 Cal.App.4th 1152, 1183 (1996) (the due process clause precludes arbitrary and irrational decisionmaking)). The FCC and TRPA's actions have been egregiously both "arbitrary" and "conscience shocking."

Whereas TRPA claims the "TRPA could choose to regulate RF in the region should cellular facilities be proven to have a particular adverse effect on the unique environment of the Tahoe Region" it must act now (Governing Board Meeting, March 23, 2022, Agenda Item No. VIII.B, Staff Report). The United States has RF limits which are way higher than most European and other advancing countries:

Radio Frequency Exposure Limits for the General Public, Schools, Homes & Playgrounds For Cell Towers & Wireless Networks.



Please act now and protect the Tahoe Basin.

Sincerely,

David Chain

The purpose of copyright law is “to Promote the Progress of Science and useful Arts” (U.S. Const. art. I, § 8, cl. 8). The House Committee on the Judiciary explicitly listed “reproduction of a work in legislative or judicial proceedings or reports” as an example of a fair use (H.R. Rep. No. 94-1476, 65 (1976)). Introducing entire copyrighted works in official governmental proceedings is generally fair use (*Sony Corp. of Am. v. Universal City Studios, Inc.*, 464 U.S. 417, 449-50 (1984) (“the fact that the entire work is reproduced…does not have its ordinary effect of militating against a finding of fair use”); *Jartech, Inc. v. Clancy*, 666 F.2d 403 (9th Cir. 1982) (holding that the city councils use of copyrighted material in the legal proceedings was not “the same intrinsic use to which the copyright holders expected protection from unauthorized use”); *Stern v. Does*, 978 F. Supp. 2d 1031, 1044-49 (C.D. Cal. 2011) (reproduction of copyrighted material for use in litigation or potential litigation is generally fair use, even if the material is copied in whole); *Ty, Inc. v. Publications Intern. Ltd.*, 292 F.3d 512 (7th Cir. 2002) (reproducing copyrighted works for litigation is an example of the fair use doctrine); *Healthcare Advocates, Inc. v. Harding, Earley, Follmer & Frailey*, 497 F.Supp. 2d 627, 638 (E.D. Pa. 2007) (holding that law firm's copying of an entire set of copyrighted web pages was justified where the web pages were relevant evidence in litigation); *Hollander v. Steinberg*, 419 Fed.Appx. 44 (2d Cir. 2011) (affirming dismissal of a copyright case by an attorney, where opposing counsel in an earlier civil action had appended that attorney’s blog entries to a motion); *Religious Tech. v. Wollersheim*, 971 F.2d 364 (9th Cir. 1992) (holding that providing copies of the plaintiff’s copyrighted documents to the defendant’s expert witness was fair use); *Porter v. United States*, 473 F. 2d 1329 (5th Cir. 1973) (rejecting a claim by the widow of Lee Harvey Oswald that she was entitled to compensation because the publication of Oswald’s writings in the Warren Commission Report diminished the value of the copyright in those works); *Kulik Photography v. Cochran*, 975 F. Supp. 812 (E.D. Va. 1997) (dismissing on jurisdictional grounds of a copyright infringement suit brought by the author of a photograph that was used without permission in the O.J. Simpson murder trial); *Levingston v. Earle*, No. 3:2012cv08165 (D. Ariz. 2014) (holding that appending a full copy of an author’s book to a pleading, in a harassment proceeding against that author, was fair use); *Grundberg v. the Upjohn Co.*, 140 F.R.D. 459 (D. Utah 1991) (rejecting the defendant’s attempt to register a copyright in its document production in order to restrict the plaintiff’s use and public dissemination of those documents); *Shell v. City of Radford*, 351 F.Supp.2d 510 (W.D. Va. 2005) (dismissing a copyright infringement suit by a photographer whose photographs were copied and used by detectives investigating the murder of the photographer’s assistant); *Denison v. Larkin*, 64 F. Supp. 3d 1127 (N.D. Ill. 2014) (dismissing with prejudice Plaintiff attorney's suit against defendants for using portions of her copyrighted Blog as evidence against her in an attorney disciplinary proceeding); *Carpenter v. Superior Court (Yamaha Motor Corp., USA)*, 141 Cal.App.4th 249 (2006) (holding the plaintiff in a personal injury action could gain access to certain standardized neurological tests over an objection that the tests were protected by, inter alia, copyright law)).

See also, DOJ Guidance on Copyrighted Materials and Public Records Acts (FOIA is designed to serve the public interest in access to information maintained by the government...disclosure of nonexempt copyrighted documents under the FOIA should be considered a "fair use"); *NLRB v. Robbins Tire & Rubber Co.*, 437 U.S. 214, 242 (1978) (The basic purpose of FOIA is to ensure an informed citizenry, vital to the functioning of a democratic society, needed to check against corruption and to hold the governors accountable to the governed).

Routledge
Taylor & Francis Group

Environment: Science and Policy for Sustainable Development

ISSN: (Print) (Online) Journal homepage: https://www.tandfonline.com/loi/venv20

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To cite this article: Erica Rosenberg (2022) Environmental Procedures at the FCC: A Case Study in Corporate Capture, Environment: Science and Policy for Sustainable Development, 64:5-6, 17-27, DOI: 10.1080/00139157.2022.2131190

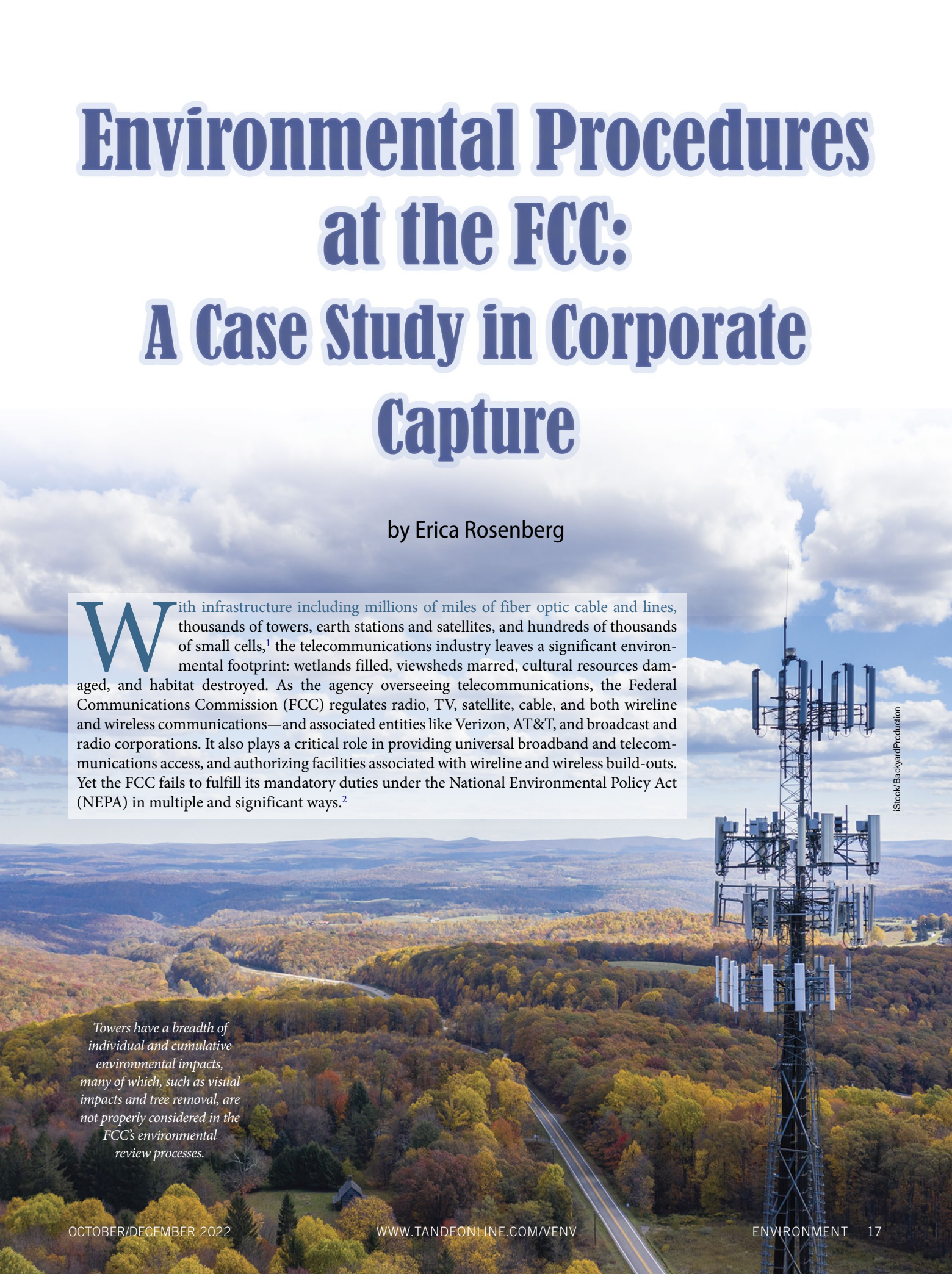
To link to this article: https://doi.org/10.1080/00139157.2022.2131190

Published online: 12 Dec 2022.

Environmental Procedures at the FCC: A Case Study in Corporate Capture

by Erica Rosenberg

With infrastructure including millions of miles of fiber optic cable and lines, thousands of towers, earth stations and satellites, and hundreds of thousands of small cells,[1] the telecommunications industry leaves a significant environmental footprint: wetlands filled, viewsheds marred, cultural resources damaged, and habitat destroyed. As the agency overseeing telecommunications, the Federal Communications Commission (FCC) regulates radio, TV, satellite, cable, and both wireline and wireless communications—and associated entities like Verizon, AT&T, and broadcast and radio corporations. It also plays a critical role in providing universal broadband and telecommunications access, and authorizing facilities associated with wireline and wireless build-outs. Yet the FCC fails to fulfill its mandatory duties under the National Environmental Policy Act (NEPA) in multiple and significant ways.[2]



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Towers have a breadth of individual and cumulative environmental impacts, many of which, such as visual impacts and tree removal, are not properly considered in the FCC's environmental review processes.

Like all federal agencies, the FCC must follow environmental laws, including NEPA, which requires it to assess potential environmental effects of its actions before it authorizes, funds, or licenses projects and communications infrastructure. These effects include visual and ecological impacts, and radio frequency emission exceedances, caused by the proliferation of wireless technology and the networks constructed to deploy it. The agency is supposed to follow legal requirements to assess such environmental impacts and, in doing so, to consider the concerns of communities and citizens.

It does neither. For most deployments it authorizes, the FCC rarely completes any environmental review or makes NEPA documents available to the public; instead, with little FCC oversight or enforcement, industry is delegated the task of determining how much environmental review is appropriate for its deployments and in most cases, is not required to submit documentation of those determinations.

In licensing and authorizing facilities associated with telecommunications, broadband, and broadcasting technologies, the FCC intentionally and routinely fails to meet its environmental obligations and epitomizes "regulatory capture." It treats environmental laws as obstacles to be circumvented or ignored, first by promulgating rules that fall short of what NEPA requires and then by failing to properly implement and enforce its own substandard rules. The chronic failure has cumulative, incalculable, and largely unknown environmental impacts.

Combined with statutory authority that curtails local government authority to regulate or block telecom deployment in their jurisdiction, public and local voices in what is deployed and where are further diminished.[3] Equally important, the agency suppresses and dismisses the voices of communities and citizens concerned about these encroachments. As wireless infrastructure proliferates under the auspices of an agency that flouts federal law, unabated and unaccounted for environmental impacts will only multiply.

NEPA: An Instrument of Democracy and Accountability

NEPA, a Nixon–era law and one emulated around the world, outlines a process for decision-making about "major federal actions, like dam-building, offshore drilling, and highway expansions.[4] Council on Environmental Quality implementing rules define major federal actions broadly to include "new and continuing activities, including programs entirely or partly financed, assisted, conducted or approved by federal agencies." They also include "approval of specific projects, such as construction or management activities located in a defined geographic area. Projects include actions approved by permit or other regulatory decision as well as federal and federally assisted activities."[5]

NEPA requires the government to disclose broadly defined environmental impacts of proposed actions—and to consider alternatives—including not undertaking the action.[6] It allows the public, from local governments to tribes to citizens, to participate in the decision.[7]

The greater the potential environmental impacts of a project, action, or policy, the more analysis and the more opportunities for public input and challenge. NEPA requires a full-scale environmental review (environmental impact statement) for major actions with potentially great environmental effects like a highway, a shorter assessment (environmental assessment) for actions that may have less significant impacts, and exemptions from analysis for categories of routine actions (categorical exclusions), like removing brush, that the agency has determined individually or cumulatively have no significant environmental effect. Although a categorical exclusion may exist for an action, in any given case, extraordinary circumstances such as the presence of environmentally sensitive resources can remove an action from a categorical exclusion and require either a documented categorical exclusion or more NEPA review. For example, even if the United States Forest Service categorically excludes brush removal on small tracts, brush removal in critical habitat for endangered species would require the agency to consider and document that its action would still not require an environmental assessment or conduct an environmental assessment.

As a procedural statute, NEPA cannot stop environmentally harmful projects, but it can substantially improve the imprint of an action by, for example, rerouting a power line to protect a stream, or bringing information about wildlife to light so that licensees can take mitigation measures. In short, NEPA, by mandating transparency and accountability, is an instrument of democracy and good governance. NEPA also requires that agencies promulgate policies or rules implementing NEPA in accordance with Council on Environmental Quality rules, and in consultation with the Council on Environmental Quality.

FCC's Failure to Consider Major Federal Actions

Council on Environmental Quality rules place many of the FCC's licensing and funding activities squarely within the definition of a major federal action. Yet the FCC has construed major federal actions narrowly or has simply not considered whether its actions are major federal actions. Consequently, the agency has not considered actions like providing financial assistance to carriers for deployment of small cells and build-outs with associated cable-laying and transmission lines as major federal actions.[8]

In 2018, the agency went as far as to deem all licensing of small cell facilities, which it authorizes as part of a license to carriers, as not requiring environmental review because they were not major federal actions.[9] Termed by industry as unobtrusive—"smaller than a pizza box or backpack"[10]—small cell facilities can be significantly larger and are placed on buildings or associated poles. In its order, the agency both eliminated federal environmental review of small cells and significantly limited local authority over small wireless infrastructure deployment.

In her dissent to the order, FCC Commissioner Jessica Rosenworcel noted that 5G would require millions of miles of fiber and up to 800,000 small

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The FCC is authorizing the deployment of hundreds of thousands of small cells with little public input or environmental review.

cells by 2026. The order thus "runs roughshod over the rights of our Tribal communities and gives short shrift to our most basic environmental and historic preservation values."[11] She noted that the Mobility Fund, which supports carriers in bringing wireless services to underserved areas, would support updated wireless service, to the tune of $4.53 billion. Yet in effect, she states, the FCC reads "projects carried out with financial assistance" (a requirement of the National Historic Preservation Act) as well as NEPA out of the law.[12] It also "removes many larger wireless facilities from environmental oversight."[13]

The FCC's efforts to eliminate small cell review were struck down by the D.C. Circuit in *United Keetoowah v. FCC*,[14] a case brought by the Natural Resources Defense Council and several tribes. The court found: "The scale of the deployment the FCC seeks to facilitate, particularly given its exemption of small cells that require new construction, makes it impossible on this record to credit the claim that small cell deregulation will 'leave little to no environmental footprint. *Order* ¶ 41.'"[15]

Appropriately, the FCC considers licensing spectrum and registering towers to be major federal actions that trigger NEPA. However, while the FCC recognizes that its grant of geographic licenses to carriers triggers NEPA, it issues the licenses without any knowledge of how the licensee will deploy infrastructure in its build-out. In most cases, it cannot know because the carrier may not have finalized its build-out plans for construction of towers, transmission lines, and small cell facilities over time. In fact, the agency does not prepare and never has prepared an environmental impact statement on a build out—or on any other major federal action; it has only prepared one programmatic environmental assessment, which was in response to a lawsuit.[16] Instead, it requires NEPA review only on a facility-by-facility basis, which also circumvents a NEPA requirement to consider cumulative effects.[17] Segmenting a project into smaller components is illegal, and the FCC's approach is another way it flouts the law.

FCC's Inadequate NEPA Rules

FCC NEPA rules undermine NEPA at every turn—they are inadequate both as written and as implemented. The rules' unusual structure and an agency that interprets its rules in favor of the carriers mean that most projects proceed without adequate environmental review and consideration.

Unlike other agencies' rules, FCC rules do not identify categories of actions that do not require further NEPA review; rather, the rules categorically exclude *all* actions the agency takes except for those that meet a limited set of itemized extraordinary circumstances.[18] In other

Wireless infrastructure is changing the character of historic buildings and neighborhoods.

instances, the FCC deems its actions categorically excluded. For example, construction of submarine cables, which indisputably has potentially significant environmental impacts to reefs, ocean floors, and marine life, is explicitly excluded from review following a 1974 FCC order asserting that the environmental consequences are negligible.[19]

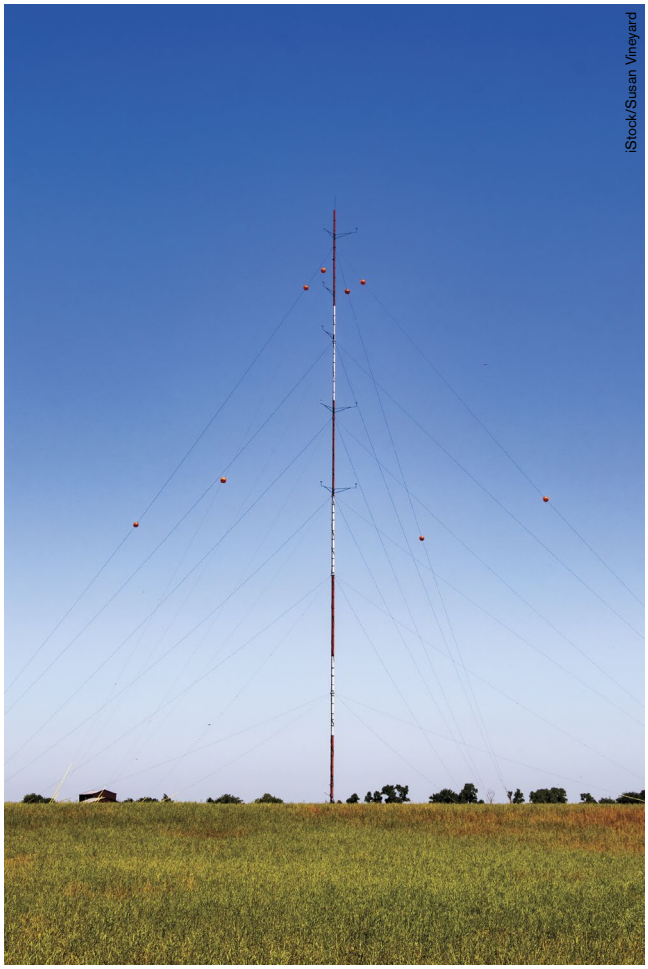
In dismissing the petition brought by an environmental nongovernmental organization to require more environmental review for a number of FCC actions, including those involving submarine cables, the 1974 order acknowledged environmental damage from cables in Maine and the U.S. Virgin Islands but illogically found no need for environmental review because the projects violated state law and permits.[20]

By not considering FCC actions major federal actions and by relying on a broad and unsupported categorical exclusion, countless activities with potentially significant environmental impacts or actual impacts proceed with little or no NEPA review or public involvement. Unlike many agencies, FCC lacks a NEPA coordinating office and most bureaus within the agency have no NEPA expertise or even awareness of the obligations the statute confers on the agency.

Streamlined Effects: The NEPA Checklist

The agency also skirts its NEPA obligations through its procedures and practice around "effects" consideration. It defines effects narrowly and by doing so, removes actions from public notice and comment. Most egregiously, it delegates the initial consideration of effects to applicants and licensees—telecom companies, for the most part—to determine whether an environmental assessment is warranted or whether the project is categorically excluded, and because the review is not submitted to the FCC, it typically performs no subsequent review of the applicants' documentation.

Council on Environmental Quality regulations define effects broadly.[21] FCC rules and practices limit the consideration of environmental effects. They also limit the extraordinary circumstances that would warrant a higher level of environmental review (i.e., an environmental assessment) and public input for the action—through both its narrow list of circumstances and its narrow interpretation of those circumstances. Those limited circumstances are actions involving facilities that: may affect Indian cultural sites or historic resources (i.e., National Historical Preservation Act triggers); may affect threatened or endangered species or their habitat; may involve significant changes in surface features (such as to wetlands or forests); are in a floodplain if equipment is not raised; exceed radio frequency emissions limitations; involve high-intensity lights in residential areas; are in wilderness areas or wildlife



Tall, guyed towers kill millions of birds a year.

refuges; or are more than 450 feet tall in light of potential impacts to migratory birds.[22] These circumstances are referred to as "the NEPA checklist."

Even so, FCC has in effect gutted most elements of the checklist. For example, for the floodplain trigger,[23] as long as equipment is raised for a facility in a floodplain, no environmental assessment is required, although no evidence of raising the equipment or a local permit need be submitted. Although required by Council on Environmental Quality (which unfortunately approved the 2018 rule change), no cumulative effects of building in floodplains are considered. Similarly, applicants often fail to submit an environmental assessment when they have received a federal or state wetlands permit, so again, no evidence is submitted to the agency or for public review.

To eliminate another environmental assessment trigger, rule changes in 2020 allow projects that affect historic properties and cultural resources to proceed without an environmental assessment.[24] "Change in surface features" has in practice required consideration of wetlands impacts (i.e., whether a federal permit is needed), rather than considering large-scale vegetation or soil removal, or grading of sensitive habitats. Thus, even if several acres are bulldozed or dozens of trees cleared, an environmental assessment is not required.

A comprehensive NEPA review for telecommunications infrastructure is both possible and required by other agencies. For instance, the National Telecommunications and Information Administration, which also supports expanding broadband access and adoption, considers a breadth of effects under NEPA that the FCC's checklist fails to consider.[25] National Telecommunications and Information Administration, for example, requires consideration of cumulative effects.[26]

Delegation of Review: Fox Guarding the Hen House

Even more extraordinary than its failure to consider a breadth of environmental effects for most of its actions is the FCC's delegation of consideration of environmental effects to the applicant or licensee. In other words, self-interested parties conduct the NEPA checklist environmental review. Under Council on Environmental Quality rules, the federal agency is ultimately responsible for the environmental document, regardless of who prepares it.[27] Yet under FCC procedures, the agency never even sees the

initial environmental review documenting that a categorical exclusion, rather than a more extensive environmental review, is supported—except in the unlikely event it requests checklist documentation following a complaint.

No other agency allows the applicant to make the initial determination of whether a project is categorically excluded or requires an environmental assessment. Other agencies require submission of documentation of that determination or make the determination themselves. Instead, the FCC relies on applicants to be truthful in their dealings with the agency—yet rarely if ever has it enforced against applicants who make false statements on its forms. Applicants submit documentation only when checklist review triggers an environmental assessment. This approach to ensuring compliance with the NEPA rule is at best unrealistic and at worst, a license to deceive.

No FCC oversight ensures that applicants have done their due diligence to consider the checklist circumstances properly or to even review the circumstances at all. With no agency or public awareness, applicants can simply categorically exclude their projects that involve even larger scale impacts. In East Fishkill, New York, for example, more than 50 trees were cleared from a forested area along a highway known for its scenic views, with no environmental assessment.[28]

Incorrect, confusing, or inadequate filing instructions further ensure that the applicant's work will be incomplete.[29] The instructions themselves fail to even reflect the inadequate rules because they omit Endangered Species Act considerations, do not capture National Historical Preservation Association requirements, omit wetlands concerns, and include outdated floodplain requirements. Similarly, NEPA checklist guidance used until June 2022 did not even reflect the rules on environmental assessment triggers or environmental assessment content requirements.[30]

The checklist allows for only a very narrow set of environmental assessment triggers. In theory, FCC rules do allow for consideration of non-checklist effects or effects missed in the checklist review—those raised by members of the public and those raised by the FCC on its own motion.[31] In reality, this almost never happens. The FCC inevitably fails to consider some potentially significant effects outside of the checklist because it relies entirely on the public to identify them, it never initiates its own review, it relies on self-interested applicants to review projects, and it views its mission as facilitating deployment.

Lack of Notice and Public Availability of Documents

Limiting notice and public availability of documents is another way the agency fails to meet fundamental NEPA responsibilities. Council on Environmental Quality rules require both notice of

The effects of cell towers in sensitive areas like coastal zones and wetlands are not fully considered in the FCC's NEPA process.

actions and opportunities for public comment.[32] In fact, the rules require that agencies make "diligent efforts" to involve the public in implementing their NEPA procedures.[33] Instead, the FCC makes diligent efforts to exclude the public from raising concerns under NEPA.

Applicants and licensees submit no documentation of their determination that their project is categorically excluded, and the agency does not track categorically excluded actions. With the applicant conducting the initial environmental review of whether the project is categorically excluded by assessing the list of extraordinary circumstances (i.e., the NEPA checklist), as well as preparing the environmental assessment, the burden falls on the public to learn of the proposed action and to raise a potential effect.

But categorically excluded actions, including authorization of certain towers, do not receive public notice; only applications for towers that require registration (generally taller than 199 feet) are put on notice, and those may or may not have associated environmental assessments. In addition to towers under 200 feet not posing an air hazard, these stealth projects that the agency has no record of include small wireless facilities associated with 4G and 5G.

That the public has no access to this information is particularly problematic in the radio frequency context, where applicants are required to meet radio frequency emissions standards or submit an environmental assessment. If the applicants do analyze the checklist and radio frequency studies at all, they routinely categorically exclude small wireless facilities, despite growing public concern about radio frequency associated with such technologies. Without access to the documented checklist, the public has little to no basis on which to refute or comment on checklist conclusions on radio frequency. And given the streamlined process, citizens often find out about facilities only after they are built.

Lack of Transparency: Notice of EAs

While the public is completely disenfranchised on categorically excluded projects, the situation with environmental assessments is only slightly better. If an environmental assessment is required because the applicant identified a trigger on the NEPA checklist, the tower or other structure must be registered. But it is not the environmental assessment itself that is publicly noticed—it is the application for the tower registration or license modification. The notice serves only to notice for 30 days that an application for an antenna structure at a particular location has been submitted. Members of the public interested in that structure must track down the application in the antenna structure registration system and then see whether an environmental assessment is attached. To find environmental assessments that are "accessible," a member of the public would have to know that a proposed antenna structure registration included an environmental assessment.

Hence, notice is hardly "public." Rather than being posted on a readily accessible, centralized site for NEPA documents,[34] the registration application and the associated environmental assessment, if done, are buried in a hard-to-access, byzantine website.[35] Without project coordinates or an exact site location, it is difficult to get into the website and, once in, to find the environmental documents. To complicate matters further, environmental assessments associated with licensee towers that do not need to be registered (i.e., short towers) are noticed separately and are buried on a different webpage.[36]

Comments Deemed "Complaints"

Even if the public manages to overcome FCC hurdles and ascertain information about a proposed facility, it faces nearly insurmountable obstacles to get its concerns heard or addressed. Under NEPA, the burden of looking at effects is a federal obligation—it is not up to the public to establish a case but merely to apprise the agency of potential effects to consider; the comment period allows the agency to meet its NEPA obligations by giving the public an opportunity to raise effects or alternatives not considered in the environmental review process.

But rather than a standard, fair, or open comment process in which the agency considers and responds to concerns raised by the public, the FCC administers an adversarial complaints process that requires the public to meet a high burden of proof about a potential effect that may have been overlooked in the checklist or inaccurately documented.[37] With a process that unfairly shifts the burden of raising and establishing environmental concerns from the agency to the public, the outcome is always the same. The FCC virtually never finds that complaints are valid. To dismiss them or resolve them in the applicant's favor so that the project can proceed, it routinely finds that the complainant has not provided specific enough detail or an adequate scientific showing for the agency to consider an effect.

Compounding the unlikelihood that the public will learn about a project and be able to weigh in is a timing issue. When the public finds out about a project that the applicant has deemed categorically excluded (either by doing the checklist or failing to do the checklist), there is no timeline to comment on or complain about the project. With no notice and no timeline for these projects that proceed with no agency awareness, the public often learns about the projects when construction begins or, just as likely, when the facility is already built.

Because the applicant need not consider aesthetics, for example, a tower visible from a state park could be deemed categorically excluded and built before the public sees the impact to its viewshed. Rarely, if ever, will the FCC decide an environmental assessment is required under the circumstances because the applicant ostensibly did what was required of it by assessing the minimal checklist. Furthermore, in terms of failure to comply with NEPA, environmental assessments are submitted so late in the process that a meaningful alternatives analysis—a hallmark and requirement of NEPA[38]—is foreclosed.

Aesthetic Effects: The Greatest Impacts Never Addressed

Perhaps most egregious is the agency's approach to aesthetic impacts.

Applicants should be required to consider aesthetic impacts because, by the FCC's own account in its rulemaking, visual impacts are by far the most significant impact a tower could have.[39] As originally promulgated, FCC's NEPA regulations triggered an environmental assessment when facilities were to be located "in areas which are recognized either nationally or locally for their special scenic or recreational value."[40] Again and again in the rulemaking, visual effects were cited as the greatest impact, as well as an impact to be mitigated.[41] Yet in 1985, the FCC decided the standard was "unduly vague," and that it was unnecessary for applicants to submit environmental assessments in cases that "may raise aesthetic concerns."[42] It also noted that "aesthetic concerns may more appropriately be resolved by local, state, regional or local land use authorities"[43]—although NEPA is an independent federal obligation.

On the rare occasion when the FCC does consider aesthetics, its examination is generally limited to consideration of impacts to nationally designated scenic trails and historic sites (the latter falling under visual effects under National Historical Preservation Association) or to national parks, although nothing in NEPA or Council on Environmental Quality rules limits consideration of aesthetic impacts solely to those designated areas. This practice precludes consideration of impacts to, for example, scenic tourist areas or state or locally designated battlefields and parks. In 2014, AT&T built a tower in Fort Ransom, North Dakota, visible from a nearby National Scenic Tail and Scenic Byway, without having to consider aesthetic impacts.[44] Towers have been built in the viewsheds of, for example, a National Scenic Trail in Vergennes, Michigan, an iconic bridge in New York, a civil rights site in Selma, Alabama, and on Dewey Beach, Delaware's sand dunes, with little notice, consideration of visual impacts, or mitigation.

Little Compliance, Little Enforcement

With no oversight to ensure applicants have done the due diligence required to consider the checklist and no on-the-ground inspections, lack of compliance with the rules is rampant

Large-scale projects with multiple facilities built without NEPA review include hundreds of towers in Alaska built by GCI.[45] Between 2001 and 2015, T-Mobile built hundreds of towers in 22 states without environmental review.[46] In New Mexico and Texas, Plateau Telecommunications built 58 towers with no National Historical Preservation Association review.[47] Telalaska built 28 towers near and in sensitive areas in Alaska with no repercussions.[48] With no Enforcement Bureau action, the Wireless Telecommunications Bureau and Alliant Energy Corporation agreed in 2017 to a compliance plan after Alliant built 109 towers and 93 poles without NEPA review.[49] Railroad noncompliance was so widespread that the FCC entered into a settlement agreement with several railroads that created a $10 million cultural resources fund for 11,000 constructed poles that had not gone thru National Historical Preservation Association or NEPA review.[50]

Smaller-scale projects and individual towers also have significant impacts. For example, in 2019, licensees in Broward County, Florida, cleared 36 trees and built a driveway through a forested wetland before completing environmental review.[51] In Sabana Grande, Puerto Rico, a tower builder in 2014 bulldozed critical habitat for an endangered bird.[52] Dozens of sacred sites have been similarly destroyed or damaged across the country, as have multiple cultural resources and historic and archaeological sites.

Although towers can alter iconic views, the FCC does not require licensees to consider aesthetic impacts.

Cell towers are altering and marring views across the country.

Many of these failures to comply with environmental requirements come to light as National Historical Preservation Association violations, rather than as NEPA violations, because the National Historical Preservation Association process, as part of the checklist, requires photo documentation and official state and tribal review. Complaints from these officials or the public and self-reporting—often unintentionally with photos submitted through increasingly rare environmental assessment submissions[53]—are generally the sole bases for enforcement.

Conveniently for an agency intent on deployment, the FCC's Enforcement Bureau operates under a one-year statute of limitations—one year from the time the facility was built, not from when the agency learned of the violation. As a result, by the time the agency learns of the violation and decides to take action, it is often prohibited from levying fines against the violator.

When the agency does take action, it amounts, with few exceptions, to a slap on the wrist. In 2016, six licensees got admonishment letters with no penalties and little agency publicity.[54] For the past decade or so, Wireless Telecommunications Bureau admonishment letters, which number from zero to six per year, warn of the potential for increased fines and punishments if violators break rules again. But the agency could not fine the violators and does not track the letters. Fines are rare and if levied, de minimis.[55] At most, penalties are ordered once or twice a year, and tower removal, which would be a reasonable and authorized remedy for violations, is never ordered.

In one instance, clearing guy-wire areas for a 1,500-foot broadcast tower in Punta Gorda, Florida, destroyed 2.6 acres of treed habitat for bonneted bats, an endangered species. As mitigation, the applicant paid $28,000 to the U.S. Fish and Wildlife Service, while the FCC issued a Finding of No Significant Impact and imposed a fine of $28,000.[56]

Ex Post Facto NEPA: A Concept Not Contemplated by NEPA

To address instances of noncompliance, the agency has instead devised an ex post facto NEPA process under which the violators conduct and submit an after-the-fact checklist or environmental assessment. If an environmental assessment is required, these half-built or fully built projects then receive the FONSIs that are a prerequisite for construction. Enforcement action may, but more likely will not, follow; with no repercussions, a 485-foot broadcast tower in Chattanooga, Tennessee, was built and operating for months before it got its FONSI in 2021.[57]

Since 2002, the agency has used a clearance process for noncompliant towers (i.e., those that have not gone through the National Historical Preservation Association and NEPA process).[58] For example, on March 28, 2012, the FCC "cleared" with a post-construction review the 58 towers that Plateau Telecommunications had built in violation of historic preservation procedures.[59] Other elements of the requisite NEPA review were ignored—and are often ignored in this process.

Regardless, NEPA may not be done retroactively, and the substantive value of this follow-up exercise is unclear. It

Beyond visual impacts, cell towers built in pristine areas can affect sensitive species and ecosystems.

is hard to assess damage to a site never evaluated for the presence of, for example, wetlands, sensitive species, historic resources, or sacred sites before clearing took place. More importantly, given the dearth of documentation, little means for the agency to discover violations, and lack of oversight at the agency, it is unclear just how many projects that impact environmentally sensitive areas are constructed with improper or no checklist review, or get started without waiting for a FONSI to construct; most of the sites where environmental damage occurred and the degree of destruction will never be known.

By routinely clearing towers with post-construction checklist reviews, the agency creates incentives for tower companies and carriers to build their towers and, if necessary, do paperwork later. Given the lax enforcement and the statute of limitations issue, this approach from industry's perspective would be quite reasonable.

Conclusion: Prospects for a More Accountable FCC

Clearly, the FCC's NEPA process falls short of what NEPA and Council on Environmental Quality require.

- It ignores major federal actions requiring environmental review, such as its distribution to industry of billions of dollars that support build-outs for updated wireless service, or improperly deems certain major federal actions nonmajor federal actions to circumvent NEPA.
- Its NEPA rules create an unsupported and overbroad categorical exclusion so that, for example, satellite licensing and submarine cable licensing are excluded from review.
- With little oversight or tracking, it delegates environmental review of NEPA determinations to industry proponents of the project.
- It fails to vigorously enforce its rules so that industry noncompliance is rampant.
- It fails to provide adequate notice and opportunities for public comment.
- It fails to make environmental documents, including radio frequency emissions studies, publicly available or readily accessible.
- It routinely ignores or dismisses public comments and concerns and places an unfair burden of proof on the public when it raises concerns.

These practices serve to facilitate deployment for carriers while ignoring environmental rules and the public. Besides environmental costs, the FCC's approach bespeaks a lack of transparency

and accountability that undermines good governance and erodes democracy. It also bespeaks an agency completely captured by the entities it is tasked with regulating.

Recent Biden-era NEPA implementing rules[60] require agencies to revisit their NEPA rules and procedures by September 2023.[61] They also require that the agencies have the capacity to comply with NEPA,[62] something the FCC has to date lacked. Perhaps when Council on Environmental Quality reviews the FCC's procedures this time, it will scrutinize the rules more carefully and hold the agency to a higher standard for NEPA compliance.

An environmental and public lands policy attorney with over 30 years of experience, including in agencies, Congress, and academia, **Erica Rosenberg** worked at the FCC's Wireless Telecommunications Bureau from 2014 to 2021; for the last six of those years, she was Assistant Chief of the Competition and Infrastructure Policy Division.

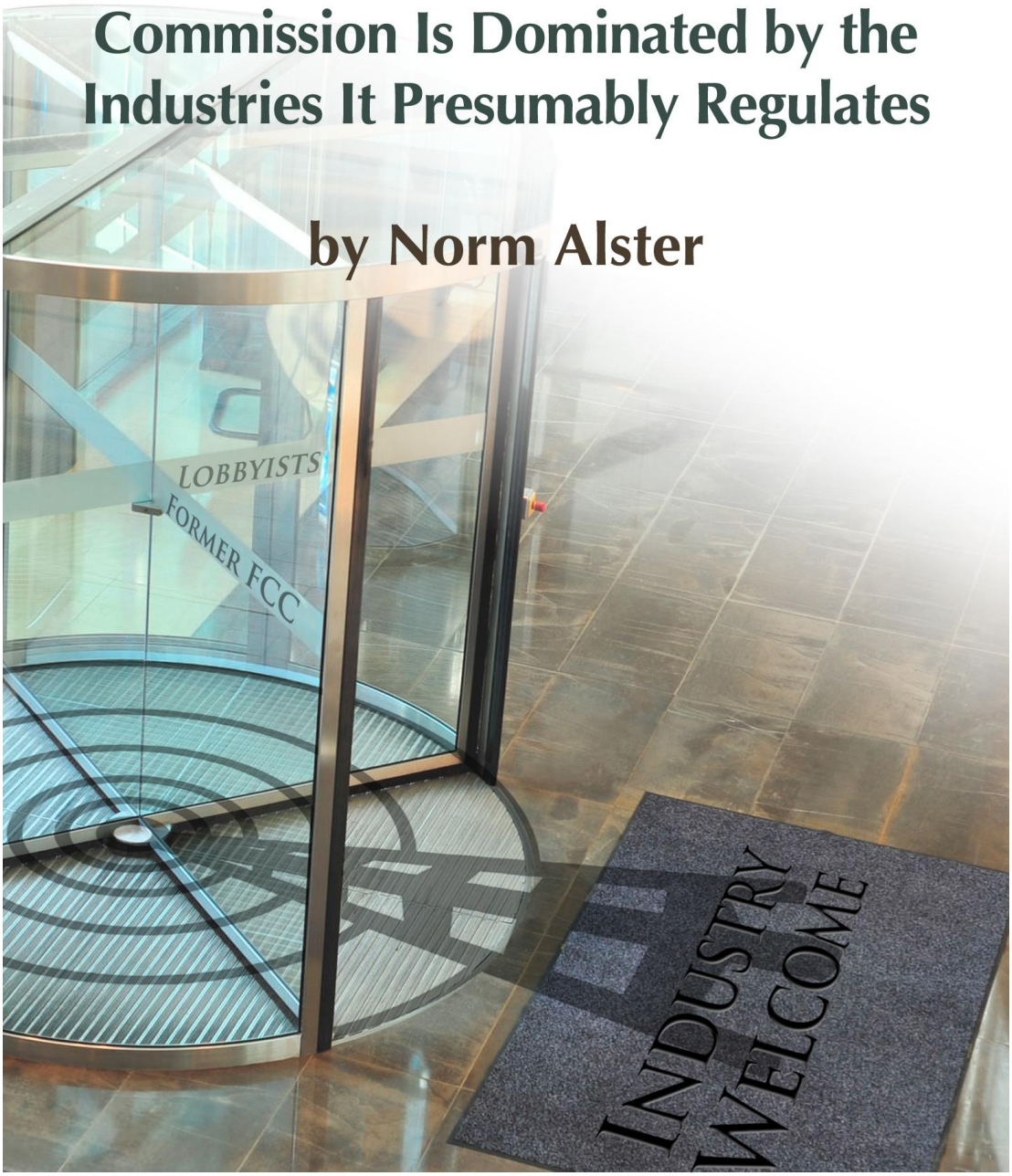
NOTES

1. Unlike macro-cells or wireless cell towers, a small cell installation consists of radio equipment and antennas placed every few meters on structures such as streetlights, buildings, or poles.
2. 42 U.S.C. §4371 *et seq*.
3. Telecommunications Act of 1996, Section 704, 47 U.S.C §332.
4. 40 CFR §1508.18 (1978). Note: Unless otherwise noted, NEPA regulations cited are 1978 regulations (i.e., pre-Trump and Biden-era regulations). The FCC was bound by those regulations until April 2022.
5. 40 CFR §1508.18.
6. 40 CFR §1508.8.
7. 40 CFR §§1501.2(d)2), 1.1501.7((a)(1), 1.1503.1, 1.1506.6.
8. Other agencies, such as the National Telecommunications and Information Administration (NTIA), do conduct NEPA reviews for such actions.
9. *See* Accelerating Wireless Broadband Deployment by Removing Barriers to Infrastructure Investment ("Infrastructure Order") (WT Docket 17-79, FCC 18-30), (March 22, 2018), 33 FCC Rcd 3102 (4).
10. *See* CTIA blog, March 27, 2018 ctia.org/news/what-is-a-small-cell.
11. 11. *See* Infrastructure Order, Rosenworcel dissenting statement.
12. 12. *Id.*
13. 13. *Id.*
14. *United Keetoowah Band of Cherokee Indians v. FCC,* 933 F. 3d 728 (D.C. Cir. 2019).
15. *Id.* at 741. Between the time the Order was issued and the decision handed down, however, countless small wireless facilities were deployed without NEPA review.
16. Final Programmatic Environmental Assessment for the Antenna Structure Registration Program, FCC (March 13, 2013).
17. *See* 40 CFR §1508.7(cumulative impacts); §1508.8 (b) (effects include cumulative).
18. 47 CFR §1.1306(a).
19. 49 FCC 2d 1313,para. 14(a) (1974); *see also* 47 CFR §1.1306 Note 1. (EA requirements do not "encompass the construction of new submarine cables systems.")
20. *See* In the matter of Public Employees for Environmental Responsibility, FCC 01-319, n. 46.
21. *See* §1501.3; §1508.1(g)(1) (definition of effects includes aesthetic, health, economic, etc.).
22. 47 CFR § 1.1307.
23. 47 CFR §1.1307(a)(6).
24. Declaratory Ruling and Notice of Proposed Rulemaking, In the Matter of Implementation of State and Local Governments' Obligation to Approve Certain Wireless Facility Modification Requests Under Section 6409(a) of the Spectrum Act of 2012, FCC 20-75A (June 9, 2020), paras. 45–50. 35 FCC Rcd 5977.
25. https://broadbandusa.ntia.doc.gov/sites/default/files/2021-07/July%202021%20BB%20Infra%20Webinar_FINAL%20Presentation_0.pdf, p. 23.
26. *See id.* at p. 50.
27. *See generally* 40 CFR §1506.5.
28. *See* letter from Michael S. Fishman, Conservation Biologist, Edgewood Environmental Consulting, to Noelle Rayman USFS biologist, Cortland, NY, November 13, 2020, Re: Determination of Adverse Effects from Wireless EDGE—WEC-NY-23 Cell Tower 90 Carpenter Road, East Fishkill, Dutchess County, NY 41°34'40.37"N, 73°47'03.84"W.
29. *See, e.g.*, Form 601 instructions (https://www.fcc.gov/sites/default/files/fcc-form-601.pdf): Item 22.
30. 30. *See* "FCC Environmental Assessment" (checklist) (undated).
31. *See* 47 CFR §§1.1307(c) and (d).
32. 40 CFR §1506.6 (provide public notice of availability of environmental documents).
33. 40 CFR §1506.6(a).
34. 40 CFR §1506.6 ("provide public notice of NEPA related-hearings … and the availability of environmental documents").
35. wireless2.fcc.gov/UlsApp/AsrSearch/asrApplicationSearch.jsp (application) and wireless2.fcc.gov/UlsApp/AsrSearch/asrApplicationSearch.jsp (environmental notice).
36. wireless2.fcc.gov/UlsApp/AsrSearch/asrApplicationLicense.jsp.
37. In *American Bird Conservancy, v. CTIA*, 516 F.3d 1027, 1033 (D.C. Cir. 2008). the court admonished the FCC for setting too high a standard.
38. *See* 40 CFR §1508.9 (EAs include consideration of alternatives).
39. *See, e.g.,* 49 FCC 2d 1313 (1974), para. 32 ("we have stressed the visual or aesthetic impacts of [such] facilities as their primary environmental effect").
40. *Id.* at para. 14.
41. *See, e.g., id.,* at paras. 18, 23, 27, 28, 32.
42. 986 WL 292182, 60 Rad. Reg. 2d, para. 11 (November 25, 1985).
43. *Id*. at para. 122.
44. AT&T Mobile Services, Inc. Construction of Tower Fort Ransom, North Dakota; Complaints of the Sheyenne River Valley National Scenic Byway, Don Busta, Judith L. Morris, and the North Country Trail Ass'n, Memorandum Opinion and Order, 30 FCC Rcd 11023, 11032, para. 28 (WTB/CIPD 2015).
45. *See* Consent Decree (DA 15-1179) (October 20, 2015).
46. Phoenix Towers International acquired the towers and in 2016, sought to bring them into compliance.
47. 27 FCC Rcd. 2972 (March 29, 2012) (letter to Gregory W. Whitaker from Dan Abeyta, WTB).
48. *See* email from Amy Summe, Shannon and Wilson, to Erica Rosenberg, Assistant Chief, Competition and Infrastructure Policy Division, Wireless Bureau, FCC re: Towers, after-the-fact NEPA compliance, February 14, 2020.
49. *See* email from Michelle Yun, Senior Attorney, Alliant to Jiaming Shang, Attorney Advisor, Wireless Telecommunications Bureau, FCC and attachment "Final Compliance Plan.pdf (May 23, 2017).
50. https://www.fcc.gov/document/fcc-announces-actions-facilitate-ptc-implementation; https://www.indianz.com/News/2014/06/04/tribes-take-role-in-major-rail.asp.
51. *See* ASR No. 1136027, Broward County, West Hollywood Telecommunications facility, filed November 2019 (attached EA).
52. See ASR No. A1062663, Wise Towers, filed December 29, 2016 (attached EA and filings).
53. *See., e.g.,* ASR No. A1179538 (attached EA, dated December 8, 2020, for a 610-foot tower in Weedville, PA indicates that the applicant cleared several acres of sensitive species habitat before completing environmental review). (Appendix III, pp. 17-18).
54. *See, e.g.,* letter to Kenneth Meyers, President and CEO, United States Cellular Corporation from Jeffrey Steinberg, Deputy Chief, CIPD, WTB, June, 16, 2016, re: Violation of FCC Environmental Rules.
55. *See, e.g.,* In re: Western Wireless Corp, FCC 03-109 (May 6, 2003) (tower built near several historic sites and operating in violation of environmental rules fined $200,000). The fine was ultimately rescinded on November 17, 2004.
56. *See* Consent Decree, In re: Fort Myers Broadcasting Company (DA21- 1365) (November 2, 2021).
57. *See* FONSI letter to Brian Fuqua, Greater Chattanooga Public TV Corp from Erica Rosenberg, Assistant Chief, Competition and Infrastructure Policy Division, Wireless Bureau, FCC (April 14, 2021).
58. In 2009, over 1,000 AT&T towers built pre-2001 without NEPA documentation were "cleared." Letter from Jeffrey Steinberg Deputy Chief, SPCD to Jeanine Poltronieri, AT&T (January 16, 2009).
59. 27 FCC Rcd 2972 (March 29, 2012) (letter to Gregory W. Whitaker from Dan Abeyta, WTB, FCC).
60. 40 CFR §100 et seq. (April 20, 2022).
61. *See* 40 CFR §1507.3 (2022).
62. *See id.*

Captured Agency:

How the Federal Communications Commission Is Dominated by the Industries It Presumably Regulates

by Norm Alster



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Published by:
Edmond J. Safra Center for Ethics
Harvard University
124 Mount Auburn Street, Suite 520N
Cambridge, MA 02138 USA
http://www.ethics.harvard.edu/

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Chapter One: The Corrupted Network

Renee Sharp seemed proud to discuss her spring 2014 meeting with the Federal Communications Commission.

As research director for the non-profit Environmental Working Group, Sharp doesn't get many chances to visit with the FCC. But on this occasion she was able to express her concerns that lax FCC standards on radiation from wireless technologies were especially hazardous for children.

The FCC, however, should have little trouble dismissing those concerns.

Arguing that current standards are more than sufficient and that children are at no elevated risk from microwave radiation, wireless industry lobbyists don't generally have to set up appointments months in advance. They are at the FCC's door night and day.

Indeed, a former executive with the Cellular Telecommunications Industry Association (CTIA), the industry's main lobbying group, has boasted that the CTIA meets with FCC officials "500 times a year."[1]

Sharp does not seem surprised. "There's no question that the government has been under the influence of industry. The FCC is a captured agency," she said.[2]

Captured agency.

That's a term that comes up time and time again with the FCC. Captured agencies are essentially controlled by the industries they are supposed to regulate. A detailed look at FCC actions—and non-actions—shows that over the years the FCC has granted the wireless industry pretty much what it has wanted. Until very recently it has also granted cable what it wants. More broadly, the FCC has again and again echoed the lobbying points of major technology interests.

Money—and lots of it—has played a part. The National Cable and Telecommunications Association (NCTA) and CTIA have annually been among Washington's top lobbying spenders. CTIA alone lobbied on at least 35 different Congressional bills through the first half of 2014. Wireless market leaders AT&T and Verizon work through CTIA. But they also do their own lobbying, spending nearly $15 million through June of 2014, according to data from the Center for Responsive Politics (CRP). In all, CTIA, Verizon, AT&T, T-Mobile USA, and Sprint spent roughly $45 million lobbying in 2013. Overall, the Communications/Electronics sector is one of Washington's super heavyweight lobbyists, spending nearly $800 million in 2013-2014, according to CRP data.

But direct lobbying by industry is just one of many worms in a rotting apple. The FCC sits at the core of a network that has allowed powerful moneyed interests with limitless access a variety of ways to shape its policies, often at the expense of fundamental public interests.

As a result, consumer safety, health, and privacy, along with consumer wallets, have all been overlooked, sacrificed, or raided due to unchecked industry influence. The cable industry has consolidated into giant local monopolies that control pricing while leaving consumers little choice over content selection. Though the FCC has only partial responsibility, federal regulators have allowed the Internet to grow into a vast hunting grounds for criminals and commercial interests: the go-to destination for the surrender of personal information, privacy and identity. Most insidious of all, the wireless industry has been allowed to grow unchecked and virtually unregulated, with fundamental questions on public health impact routinely ignored.

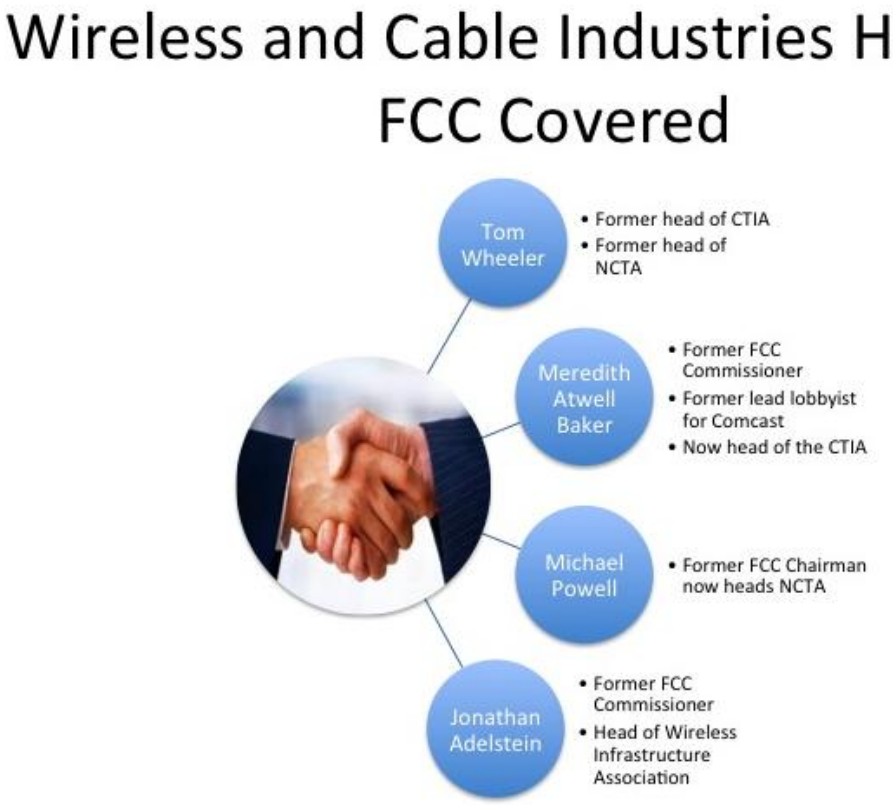
Industry controls the FCC through a soup-to-nuts stranglehold that extends from its well-placed campaign spending in Congress through its control of the FCC's Congressional oversight committees to its persistent agency lobbying. "If you're on a committee that regulates industry you'll be a major target for industry," said Twaun Samuel, chief of staff for Congresswoman Maxine Waters.[3] Samuel several years ago helped write a bill aimed at slowing the revolving door. But with Congress getting its marching orders from industry, the bill never gained any traction.

Industry control, in the case of wireless health issues, extends beyond Congress and regulators to basic scientific research. And in an obvious echo of the hardball tactics of the tobacco industry, the wireless industry has backed up its economic and political power by stonewalling on public relations and bullying potential threats into submission with its huge standing army of lawyers. In this way, a coddled wireless industry intimidated and silenced the City of San Francisco, while running roughshod over local opponents of its expansionary infrastructure.

On a personal level, the entire system is greased by the free flow of executive leadership between the FCC and the industries it presumably oversees. Currently presiding over the FCC is Tom Wheeler, a man who has led the two most powerful industry lobbying groups: CTIA and NCTA. It is Wheeler who once supervised a $25 million industry-funded research effort on wireless health effects. But when handpicked research leader George Carlo concluded that wireless radiation did raise the risk of brain tumors, Wheeler's CTIA allegedly rushed to muffle the message. "You do the science. I'll take care of the politics," Carlo recalls Wheeler saying.[4]

Wheeler over time has proved a masterful politician. President Obama overlooked Wheeler's lobbyist past to nominate him as FCC chairman in 2013. He had, after all, raised more than $700,000 for Obama's presidential campaigns. Wheeler had little trouble earning confirmation from a Senate whose Democrats toed the Presidential line and whose Republicans understood Wheeler was as industry-friendly a nominee as they could get. And while Wheeler, at the behest of his Presidential sponsor, has taken on cable giants with his plans for net neutrality and shown some openness on other issues, he has dug in his heels on wireless.

Newly ensconced as chairman of the agency he once blitzed with partisan pitches, Wheeler sees familiar faces heading the industry lobbying groups that ceaselessly petition the FCC. At CTIA, which now calls itself CTIA - The Wireless Association, former FCC commissioner Meredith Atwell Baker is in charge.



And while cell phone manufacturers like Apple and Samsung, along with wireless service behemoths like Verizon and AT&T, are prominent CTIA members, the infrastructure of 300,000 or more cellular base stations and antenna sites has its own lobbying group: PCIA, the Wireless Infrastructure Association. The President and CEO of PCIA is Jonathan Adelstein, another former FCC commissioner. Meanwhile, the cable industry's NCTA employs former FCC chairman Michael Powell as its president and CEO. Cozy, isn't it?

FCC commissioners in 2014 received invitations to the Wireless Foundation's May 19th Achievement Awards Dinner. Sounds harmless, but for the fact that the chief honoree at the dinner was none other than former wireless lobbyist but current FCC Chairman Tom Wheeler. Is this the man who will act to look impartially at the growing body of evidence pointing to health and safety issues?

The revolving door also reinforces the clout at another node on the industry-controlled influence network. Members of congressional oversight committees are prime targets of

industry. The cable industry, for example, knows that key legislation must move through the Communications and Technology Subcommittee of the House Energy and Commerce Committee. Little wonder then that subcommittee chairman Greg Walden was the second leading recipient (after Speaker John Boehner) of cable industry contributions in the last six years (through June 30, 2014). In all, Walden, an Oregon Republican, has taken over $108,000 from cable and satellite production and distribution companies.[5] But he is not alone. Six of the top ten recipients of cable and satellite contributions sit on the industry's House oversight committee. The same is true of senators on the cable oversight committee. Committee members were six of the ten top recipients of campaign cash from the industry.[6]

Cable & Satellite Campaign Contributions

Top House Recipients Funded

Recipient	Amount
John A. Boehner	$135,425
Greg Walden	$108,750
Bob Goodlatte	$93,200
John Conyers Jr.	$84,000
Mike Coffman	$82,137
Fred Upton	**$73,500**
Lee Terry	**$65,916**
Henry A. Waxman	**$65,000**
Cory Gardner	**$64,500**
Anna G. Eshoo	**$60,500**

Cellular Industry Campaign Contributions

Top House Recipients Funded

Recipient	Amount
Henry A. Waxman	**$41,500**
Scott H. Peters	$40,300
Greg Walden	**$35,750**
Fred Upton	**$32,250**
Bob Goodlatte	$31,250
Lee Terry	**$29,600**
Anna G. Eshoo	**$27,000**
Doris O. Matsui	**$25,500**
John Shimkus	**$24,000**
Peter J. Roskam	$21,100

Cable & Satellite Campaign Contributions

Top Senate Recipients Funded

Recipient	Amount
Edward J. Markey	**$320,500**
Kirsten E. Gillibrand	$194,125
Mitch McConnell	$177,125
Harry Reid	$175,600
Charles E. Schumer	$175,450
Mark L. Pryor	**$172,950**
Michael F. Bennet	$159,000
Richard Blumenthal	**$148,800**
Claire McCaskill	**$138,185**
Mark Udall	$136,625

Cellular Industry Campaign Contributions

Top Senate Recipients Funded

Recipient	Amount
Edward J. Markey	**$155,150**
Mark R. Warner	$74,800
Harry Reid	$73,600
Mark L. Pryor	**$71,900**
Roy Blunt	**$57,400**
John McCain	$56,261
Charles E. Schumer	$53,300
Roger F. Wicker	$51,300
Barbara Boxer	$49,578
Kelly Ayotte	$43,333

The compromised FCC network goes well beyond the revolving door and congressional oversight committees. The Washington social scene is one where money sets the tone and throws the parties. A look at the recent calendar of one current FCC commissioner shows it would take very disciplined and almost saintly behavior on the part of government officials to resist the lure of lavishly catered dinners and cocktail events. To paraphrase iconic investigative journalist I.F. Stone, if you're going to work in Washington, bring your chastity belt.

All that free liquor, food and conviviality translates into the lobbyist's ultimate goal: access. "They have disproportionate access," notes former FCC commissioner Michael Copps. "When you are in a town where most people you see socially are in industry, you don't have to ascribe malevolent behavior to it," he added.[7]

Not malevolent in motive. But the results can be toxic. And blame does not lie solely at the feet of current commissioners. The FCC's problems predate Tom Wheeler and go back a long way.

Indeed, former Chairman Newton Minow, enduringly famous for his 1961 description of television as a "vast wasteland," recalls that industry manipulation of regulators was an issue even back then. "When I arrived, the FCC and the communications industry were both regarded as cesspools. Part of my job was to try to clean it up."[8]

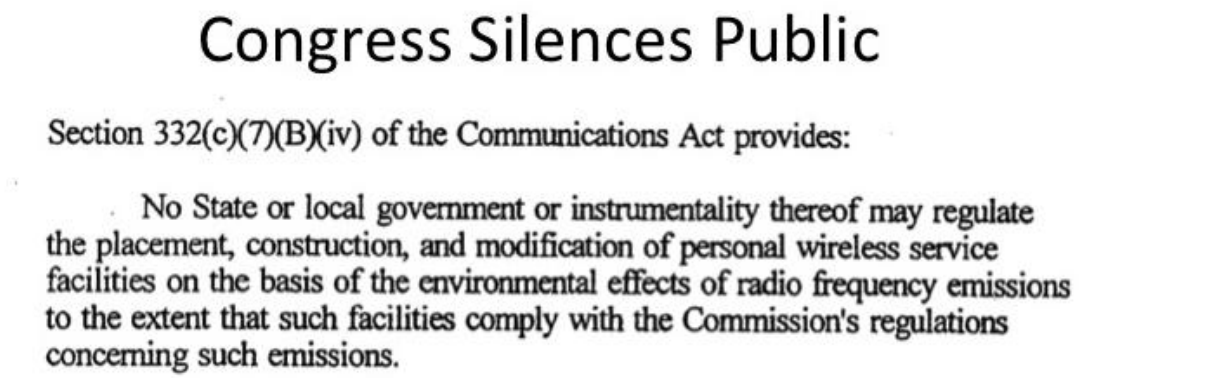
More than 50 years later, the mess continues to pile up.

Chapter Two: Just Don't Bring Up Health

Perhaps the best example of how the FCC is tangled in a chain of corruption is the cell tower and antenna infrastructure that lies at the heart of the phenomenally successful wireless industry.

It all begins with passage of the Telecommunications Act of 1996, legislation once described by South Dakota Republican senator Larry Pressler as "the most lobbied bill in history." Late lobbying won the wireless industry enormous concessions from lawmakers, many of them major recipients of industry hard and soft dollar contributions. Congressional staffers who helped lobbyists write the new law did not go unrewarded. Thirteen of fifteen staffers later became lobbyists themselves.[9]

Section 332(c)(7)(B)(iv) of the Act remarkably—and that adverb seems inescapably best here—wrests zoning authority from local governments. Specifically, they cannot cite health concerns about the effects of tower radiation to deny tower licenses so long as the towers comply with FCC regulations.



In preempting local zoning authority—along with the public's right to guard its own safety and health— Congress unleashed an orgy of infrastructure build-out. Emboldened by the government green light and the vast consumer appetite for wireless technology, industry has had a free hand in installing more than 300,000 sites. Church steeples, schoolyards, school rooftops, even trees can house these facilities.

Is there any reason to believe that the relatively low level radiofrequency emissions of these facilities constitute a public health threat? Certainly, cell phones themselves, held close to the head, have been the focus of most concern on RF emissions. Since the impact of RF diminishes with distance, industry advocates and many scientists dismiss the possibility that such structures pose health risks.

But it's not really that simple. A troubling body of evidence suggests exposure to even low emission levels at typical cellular frequencies between 300 MHz and 3 GHz can have a wide range of negative effects.

In a 2010 review of research on the biological effects of exposure to radiation from cell tower base stations, B. Blake Levitt and Henry Lai found that "some research does exist to warrant caution in infrastructure siting."[10] They summarized the results on one 2002 study that compared the health of 530 people living at various distances within 300 meters of cell towers with a control group living more than 300 meters away. "Results indicated increased symptoms and complaints the closer a person lived to a tower. At <10 m, symptoms included nausea, loss of appetite, visual disruptions, and difficulties in moving. Significant differences were observed up through 100 m for irritability, depressive tendencies, concentration difficulties, memory loss, dizziness, and lower libido."[11]

A 2007 study conducted in Egypt found similar results. Levitt and Lai report, "Headaches, memory changes, dizziness, tremors, depressive symptoms, and sleep disturbance were significantly higher among exposed inhabitants than controls."[12]

Beyond epidemiological studies, research on a wide range of living things raises further red flags. A 2013 study by the Indian scientists S. Sivani and D. Sudarsanam reports: "Based on current available literature, it is justified to conclude that RF-EMF [electro magnetic fields] radiation exposure can change neurotransmitter functions, blood-brain barrier, morphology, electrophysiology, cellular metabolism, calcium efflux, and gene and protein expression in certain types of cells even at lower intensities."[13]

The article goes on to detail the effects of mobile tower emissions on a wide range of living organisms: "Tops of trees tend to dry up when they directly face the cell tower antennas. . . . A study by the Centre for Environment and Vocational Studies of Punjab University noted that embryos of 50 eggs of house sparrows were damaged after being exposed to mobile tower radiation for 5-30 minutes. . . . In a study on cows and calves on the effects of exposure from mobile phone base stations, it was noted that 32% of calves developed nuclear cataracts, 3.6% severely."[14]

Does any of this constitute the conclusive evidence that would mandate much tighter control of the wireless infrastructure? Not in the estimation of industry and its captured agency. Citing other studies—often industry-funded—that fail to establish health effects, the wireless industry has dismissed such concerns. The FCC has typically echoed that position.

Keep in mind that light regulation has been one factor in the extraordinary growth of wireless—CTIA says exactly that in a Web post that credits the Clinton Administrations light regulatory touch.

July 25, 2013

CTIA BLOG

CTIA is an international nonprofit trade association that has represented the wireless communications industry since 1984.

But our position as the world's leader was no accident. It started with the Clinton Administration that had the foresight to place a "light regulatory touch" on the wireless industry, which was in its infancy at the time. That light touch has continued through multiple Administrations.

Obviously, cellular technology is wildly popular because it offers many benefits to consumers. But even allowing for that popularity and for the incomplete state of science, don't some of these findings raise enough concern to warrant some backtracking on the ham-fisted federal preemption of local zoning rights?

In reality, since the passage of the 1996 law, the very opposite has occurred. Again and again both Congress and the FCC have opted to stiffen—rather than loosen—federal preemption over local zoning authority. In 2009, for example, the wireless industry convinced the FCC to impose a "shot clock" that requires action within 90 days on many zoning applications. "My sense is that it was an industry request," said Robert Weller, who headed up the FCC's Office of Engineering and Technology when the shot clock was considered and imposed.[15]

And just last November, the FCC voted to further curb the rights of local zoning officials to control the expansion of antenna sites Again and again, Congress and the FCC have extended the wireless industry carte blanche to build out infrastructure no matter the consequences to local communities.

The question that hangs over all this: would consumers' embrace of cell phones and Wi-Fi be quite so ardent if the wireless industry, enabled by its Washington errand boys, hadn't so consistently stonewalled on evidence and substituted legal intimidation for honest inquiry? (See Appendix for online study of consumer attitudes on wireless health and safety.)

Document searches under the Freedom of Information Act reveal the central role of Tom Wheeler and the FCC in the tower siting issue. As both lobbyist and FCC chairman, Wheeler has proved himself a good friend of the wireless industry.

In January of 1997, CTIA chieftain Wheeler wrote FCC Wireless Telecommunications Bureau Chief Michele C. Farquhar citing several municipal efforts to assert control over siting. Wheeler, for example, asserted that one New England state had enacted a law requiring its Public Service Commissioner to issue a report on health risks posed by wireless facilities.[16] He

questions whether such a study—and regulations based on its results—would infringe on FCC preemption authority.

FCC bureau chief Farquhar hastily reassured Wheeler that no such study could be consulted in zoning decisions. "Therefore, based on the facts as you have presented them, that portion of the statute that directs the State Commissioner to recommend regulations based upon the study's findings would appear to be preempted,"[17] the FCC official wrote to Wheeler. She emphasized that the state had the right to do the study. It just couldn't deny a siting application based on anything it might learn.

The FCC in 1997 sent the message it has implicitly endorsed and conveyed ever since: study health effects all you want. It doesn't matter what you find. The build-out of wireless cannot be blocked or slowed by health issues.

Now let's fast forward to see Wheeler on the other side of the revolving door, interacting as FCC chairman with a former FCC commissioner who is now an industry lobbyist.

A March 14, 2014 letter[18] reveals the chummy relationship between Wheeler and former commissioner Jonathan Adelstein, now head of PCIA, the cellular infrastructure lobbying group. It also references FCC Chairman Wheeler seeking policy counsel from lobbyist Adelstein:

Wheeler Still Willing to Help

From: Jonathan Adelstein [mailto:adelstein@pcia.com]
Sent: Friday, March 14, 2014 12:24 PM
To: [redacted]
Cc: Renee Gregory; Jonathan Campbell
Subject: How to Spur Wireless Broadband Deployment

Tom – It was great to see you the other night at the FCBA event, and wonderful to see how much fun you're having (if that's the right word). I know I enjoyed my time there (thanks to your help with Daschle in getting me that role in the first place!).

Thanks for asking how we think the FCC can help spur wireless broadband deployment. The infrastructure proceeding perfectly tees up many of the top issues the FCC needs to address. As you requested, I've summarized briefly in the attached letter some of the key steps you can take now.

"Tom – It was great to see you the other night at the FCBA event, and wonderful to see how much fun you're having (if that's the right word). I know I enjoyed my time there (thanks to your help with Daschle in getting me that role in the first place!)."

"Thanks for asking how we think the FCC can help spur wireless broadband deployment," the wireless lobbyist writes to the ex-wireless lobbyist, now running the FCC.

Adelstein's first recommendation for FCC action: *"Amend its rules to categorically exclude DAS and small deployments* [Ed. note: these are compact tower add-ons currently being widely deployed] *from environmental and historic review."* Adelstein outlined other suggestions for further limiting local antenna zoning authority and the FCC soon did its part. Late last year, the agency proposed new rules that largely (though not entirely) complied with the antenna industry's wish list.

James R. Hobson is an attorney who has represented municipalities in zoning issues involving the FCC. He is also a former FCC official, who is now of counsel at Best, Best and Krieger, a Washington-based municipal law practice. "The FCC has been the ally of industry," says Hobson. Lobbyist pressure at the FCC was intense even back in the 70s, when he was a bureau chief there. "When I was at the FCC, a lot of my day was taken up with appointments with industry lobbyists." He says of the CTIA that Wheeler once headed: "Their reason for being is promoting the wireless industry. And they've been successful at it."[19]

The FCC's deferential compliance has allowed industry to regularly bypass and if necessary steamroll local authorities. Violation of the FCC-imposed "shot clock," for example, allows the wireless license applicant to sue.

The FCC's service to the industry it is supposed to regulate is evidently appreciated. The CTIA web site, typically overflowing with self-congratulation, spreads the praise around in acknowledging the enabling contributions of a cooperative FCC. In one brief summation of its own glorious accomplishments, CTIA twice uses the word "thankfully" in describing favorable FCC actions.

In advancing the industry agenda, the FCC can claim that it is merely reflecting the will of Congress. But the agency may not be doing even that.

Remember the key clause in the 96 Telecom Act that disallowed denial of zoning permits based on health concerns? Well, federal preemption is granted to pretty much any wireless outfit on just one simple condition: its installations must comply with FCC radiation emission standards. In view of this generous carte blanche to move radiation equipment into neighborhoods, schoolyards and home rooftops, one would think the FCC would at the very least diligently enforce its own emission standards. But that does not appear to be the case.

Indeed, one RF engineer who has worked on more than 3,000 rooftop sites found vast evidence of non-compliance. Marvin Wessel estimates that "10 to 20% exceed allowed radiation standards."[20] With 30,000 rooftop antenna sites across the U.S. that would mean that as many as 6,000 are emitting radiation in violation of FCC standards. Often, these emissions can be 600% or more of allowed exposure levels, according to Wessel.

Antenna standards allow for higher exposure to workers. In the case of rooftop sites, such workers could be roofers, painters, testers and installers of heating and air conditioning

equipment, to cite just a few examples. But many sites, according to Wessel, emit radiation at much higher levels than those permitted in occupational standards. This is especially true of sites where service providers keep adding new antenna units to expand their coverage. "Some of these new sites will exceed ten times the allowable occupational radiation level," said Wessel.[21] Essentially, he adds, this means that nobody should be stepping on the roof.

"The FCC is not enforcing its own standard," noted Janet Newton, who runs the EMF Policy Institute, a Vermont-based non-profit. That group several years ago filed 101 complaints on specific rooftop sites where radiation emissions exceeded allowable levels. "We did this as an exercise to hold the FCC's feet to the fire," she said. But the 101 complaints resulted in few responsive actions, according to Newton.[22]

Former FCC official Bob Weller confirms the lax—perhaps negligible is the more appropriate word—FCC activity in enforcing antenna standards. "To my knowledge, the enforcement bureau has never done a targeted inspection effort around RF exposure," he said.[23] Budget cuts at the agency have hurt, limiting the FCC's ability to perform field inspections, he added. But enforcement, he adds, would do wonders to insure industry compliance with its limited regulatory compliance requirements. "If there were targeted enforcement and fines issued the industry would pay greater attention to ensuring compliance and self-regulation," he allowed.

Insurance is where the rubber hits the road on risk. So it is interesting to note that the rating agency A.M. Best, which advises insurers on risk, in 2013 topped its list of "emerging technology-based risks" with RF Radiation:

> *"The risks associated with long-term use of cell phones, although much studied over the past 10 years, remain unclear. Dangers to the estimated 250,000 workers per year who come in close contact with cell phone antennas, however, are now more clearly established. Thermal effects of the cellular antennas, which act at close range essentially as open microwave ovens can include eye damage, sterility and cognitive impairments. While workers of cellular companies are well trained on the potential dangers, other workers exposed to the antennas are often unaware of the health risks. The continued exponential growth of cellular towers will significantly increase exposure of these workers and others coming into close contact with high-energy cell phone antenna radiation,"* A.M. Best wrote.[24]

So what has the FCC done to tighten enforcement? Apparently, not very much. Though it does follow up on many of the complaints filed against sites alleged to be in violation of standards it takes punitive actions very rarely. (The FCC did not provide answers to written questions on details of its tower enforcement policies.)

The best ally of industry and the FCC on this (and other) issues may be public ignorance.

An online poll conducted for this project asked 202 respondents to rate the likelihood of a series of statements.[25] Most of the statements were subject to dispute. Cell phones raise the risk of certain health effects and brain cancer, two said. There is no proof that cell phones are harmful, another declared. But among the six statements there was one statement of indisputable fact: "The U.S. Congress forbids local communities from considering health effects when deciding whether to issue zoning permits for wireless antennae," the statement said.

Though this is a stone cold fact that the wireless industry, the FCC and the courts have all turned into hard and inescapable reality for local authorities, just 1.5% of all poll respondents replied that it was "definitely true."

Public ignorance didn't take much cultivation by the wireless industry on the issue of local zoning. And maybe it doesn't matter much, considering the enormous popularity of wireless devices. But let's see how public ignorance has been cultivated and secured—with the FCC's passive support—on the potentially more disruptive issue of mobile phone health effects.

Chapter Three: Wireless Bullies and the Tobacco Analogy

Issues of cable and net neutrality have recently attracted wide public attention (more on that in Chapter Six). Still, the bet here remains that future judgment of the FCC will hinge on its handling of wireless health and safety issues.

And while the tower siting issue is an egregious example of an industry-dominated political process run amuck, the stronger health risks appear to reside in the phones themselves. This is an issue that has flared up several times in recent years. Each time, industry has managed to beat back such concerns. But it's worth noting that the scientific roots of concern have not disappeared. If anything, they've thickened as new research substantiates older concerns.

The story of an FCC passively echoing an industry determined to play hardball with its critics is worth a further look. The CTIA's own website acknowledges the helpful hand of government's "light regulatory touch" in allowing the industry to grow.[26]

Former congressman Dennis Kucinich ventures one explanation for the wireless industry's success in dodging regulation: "The industry has grown so fast its growth has overtaken any health concerns that may have gained attention in a slow growth environment. The proliferation of technology has overwhelmed all institutions that would have attempted safety testing and standards," Kucinich said.[27]

But the core questions remain: Is there really credible evidence that cell phones emit harmful radiation that can cause human health problems and disease? Has the FCC done an adequate job in protecting consumers from health risks? Or has it simply aped industry stonewalling on health and safety issues?

Before wading into these questions, some perspective is in order.

First, there's simply no denying the usefulness and immense popularity of wireless technology. People depend on it for safety, information, entertainment and communication. It doesn't take a keen social observer to know that wireless has thoroughly insinuated itself into daily life and culture.

The unanswered question, though, is whether consumers would embrace the technology quite so fervently if health and safety information was not spun, filtered and clouded by a variety of industry tactics.

To gain some insight into this question, we conducted an online survey of 202 respondents, nearly all of whom own cell phones, on Amazon's Mechanical Turk Web platform (see Appendix). One striking set of findings: many respondents claim they would change behavior—reduce wireless use, restore landline service, protect their children—if claims on health dangers of wireless are true.

It is not the purpose of this reporter to establish that heavy cell phone usage is dangerous. This remains an extremely controversial scientific issue with new findings and revised scientific conclusions repeatedly popping up. Just months ago, a German scientist who had been outspoken in denouncing the view that cell phones pose health risks reversed course. In an April 2015 publication, Alexander Lerchl reported results confirming previous research on the tumor-promoting effects of electromagnetic fields well below human exposure limits for mobile phones. "Our findings may help to understand the repeatedly reported increased incidences of brain tumors in heavy users of mobile phones," the Lerchl team concluded.[28] And in May 2015, more than 200 scientists boasting over 2,000 publications on wireless effects called on global institutions to address the health risks posed by this technology.

But the National Cancer Institute still contends that no cell phone dangers have been established. A representative of NCI was the sole known dissenter among the 30 members of the World Health Organization's International Agency for Research on Cancer (IARC) when it voted to declare wireless RF "possibly carcinogenic."[29] If leading scientists still can't agree, I will not presume to reach a scientific conclusion on my own.

IARC RF working group: Official press release

International Agency for Research on Cancer

World Health Organization

PRESS RELEASE
N° 208

31 May 2011

IARC CLASSIFIES RADIOFREQUENCY ELECTROMAGNETIC FIELDS AS POSSIBLY CARCINOGENIC TO HUMANS

Lyon, France, May 31, 2011 -- The WHO/International Agency for Research on Cancer (IARC) has classified radiofrequency electromagnetic fields as **possibly carcinogenic to humans (Group 2B)**, based on an increased risk for **glioma**, a malignant type of brain cancer, associated with wireless phone use.

But let's at least look at some of the incriminating clues that health and biology research has revealed to date. And let's look at the responses of both industry and the FCC.

The most widely cited evidence implicating wireless phones concerns gliomas, a very serious type of brain tumor. The evidence of elevated risk for such tumors among heavy cell phone users comes from several sources.

Gliomas account for roughly half of all malignant brain tumors, which are relatively rare. The annual incidence of primary malignant brain tumors in the U.S. is only 8.2 per 100,000 people, according to the International Radio Surgery Association.

Still, when projected over the entire U.S. population, the public health impact is potentially very significant.

Assuming roughly four new glioma cases annually in the U.S. per 100,000 people, yields over 13,000 new cases per year over a total U.S. population of 330 million. Even a doubling of that rate would mean 13,000 new gliomas, often deadly, per year. A tripling, as some studies have found, could mean as many as 26,000 more new cases annually. Indeed, the respected online site Medscape in January 2015 reported results of Swedish research under the headline: *Risk for Glioma Triples With Long-Term Cell Phone Use*.[30]

And here's some eye-opening quantitative perspective: the wars in Iraq and Afghanistan, waged now for more than a decade each, have together resulted in roughly 7,000 U.S. deaths.

Preliminary—though still inconclusive—research has suggested other potential negative health effects. Swedish, Danish and Israeli scientists have all found elevated risk of salivary gland tumors. One Israeli studied suggested elevated thyroid cancer risk. Some research has found that men who carry their phones in their pockets may suffer sperm count damage. One small study even suggests that young women who carry wireless devices in their bras are unusually vulnerable to breast cancer.

And while industry and government have never accepted that some portion of the population is unusually sensitive to electromagnetic fields, many people continue to complain of a broad range of symptoms that include general weakness, headaches, nausea and dizziness from exposure to wireless.

Some have suggested that the health situation with wireless is analogous to that of tobacco before court decisions finally forced Big Tobacco to admit guilt and pay up. In some ways, the analogy is unfair. Wireless research is not as conclusively incriminating as tobacco research was. And the identified health risks with wireless, significant as they are, still pale compared with those of tobacco.

But let's not dismiss the analogy outright. There is actually a very significant sense in which the tobacco-wireless analogy is uncannily valid.

People tend to forget that the tobacco industry—like the wireless industry—also adopted a policy of tone-deaf denial. As recently as 1998, even as evidence of tobacco toxicity grew overwhelming, cigarette maker Phillip Morris was writing newspaper advertorials insisting there was no proof smoking caused cancer.

It seems significant that the responses of wireless and its captured agency—the FCC—feature the same obtuse refusal to examine the evidence. The wireless industry reaction features stonewalling public relations and hyper aggressive legal action. It can also involve undermining the credibility and cutting off the funding for researchers who do not endorse cellular safety. It is these hardball tactics that look a lot like 20th century Big Tobacco tactics. It is these hardball tactics—along with consistently supportive FCC policies—that heighten suspicion the wireless industry does indeed have something to hide.

Begin with some simple facts issuing from meta-analysis of cellular research. Dr. Henry Lai, emeritus professor of bioengineering at the University of Washington, has reviewed hundreds of published scientific papers on the subject. He wanted to see how many studies demonstrated that non-ionizing radiation produces biological effects beyond the heating of tissue. This is critical since the FCC emission standards protect only against heating. The assumption behind these standards is that there are no biological effects beyond heating.

But Dr. Lai found that just over half—actually 56%—of 326 studies identified biological effects. And the results were far more striking when Dr. Lai divided the studies between those that were industry-funded and those that were independently funded. Industry-funded research identified biological effects in just 28% of studies. But fully 67% of non-industry funded studies found biological effects (Insert Slide—Cell Phone Biological Studies).

A study conducted by Swiss and British scientists also looked at how funding sources affected scientific conclusions on the possible health effects of cell phone usage. They found that of studies privately funded, publicly funded and funded with mixed sponsorship, industry-funded studies were "least likely to report a statistically significant result."[31] "The interpretation of results from studies of health effects of radiofrequency radiation should take sponsorship into account," the scientists concluded.[32]

So how does the FCC handle a scientific split that seems to suggest bias in industry-sponsored research?

In a posting on its Web site that reads like it was written by wireless lobbyists, the FCC chooses strikingly patronizing language to slight and trivialize the many scientists and health and safety experts who've found cause for concern. In a two page Web post titled "Wireless Devices and Health Concerns," the FCC four times refers to either "some health and safety interest groups," "some parties," or "some consumers" before in each case rebutting their presumably groundless concerns about wireless risk.[33] Additionally, the FCC site references the World Health Organization as among those organizations who've found that "the weight of scientific

evidence" has not linked exposure to radiofrequency from mobile devices with "any known health problems."

Yes, it's true that the World Health organization remains bitterly divided on the subject. But it's also true that a 30 member unit of the WHO called the International Agency for Research on Cancer (IARC) was near unanimous in pronouncing cell phones "possibly carcinogenic" in 2011. How can the FCC omit any reference to such a pronouncement? Even if it finds reason to side with pro-industry scientists, shouldn't this government agency also mention that cell phones are currently in the same potential carcinogen class as lead paint?

Now let's look a bit more closely at the troublesome but presumably clueless crowd of "some parties" that the FCC so cavalierly hastens to dismiss? Let's begin with **Lennart Hardell**, professor of Oncology and Cancer Epidemiology at the University Hospital in Oreboro, Sweden.

Until recently it was impossible to gain any real sense of brain tumor risk from wireless since brain tumors often take 20 or more years to develop. But the cohort of long-term users has been growing. In a study published in the International Journal of Oncology in 2013, Dr. Hardell and Dr. Michael Carlberg found that the risk of glioma—the most deadly type of brain cancer—rose with cell phone usage. The risk was highest among heavy cell phone users and those who began to use cell phones before the age of 20.[34]

Indeed, those who used their phones at least 1640 hours (which would be roughly 30 minutes a day for nine years) had nearly three times the glioma incidence. Drs. Hardell and Carlberg also found that gliomas tend to be more deadly among heavy wireless callers.[35]

Perhaps of greatest long-term relevance, glioma risk was found to be four times higher among those who began to use mobile phones as teenagers or earlier. These findings, along with the established fact that it generally takes decades for tumors induced by environmental agents to appear, suggest that the worst consequences of omnipresent wireless devices have yet to be seen.

In a 2013 paper published in *Reviews on Environmental Health*, Drs. Hardell and Carlberg argued that the 2011 finding of the IARC that identified cell phones as a "possibly carcinogenic" needs to be revised. The conclusion on radiofrequency electromagnetic fields from cell phones should now be "cell phones are not just a possible carcinogen." They can now be "regarded as carcinogenic to humans" and the direct cause of gliomas (as well as acoustic neuromas, a less serious type of tumor).[36] Of course, these views are not universally accepted.

The usual spin among industry supporters when presented with research that produces troubling results is along the lines of: "We might pay attention if the results are duplicated." In fact, the Hardell results were echoed in the French CERENAT study, reported in May of 2014. The CERENAT study also found higher risk among heavy users, defined as those using their phones at least 896 hours (just 30 minutes a day for five years). "These additional data support

previous findings concerning a possible association between heavy mobile phone use and brain tumors," the study concluded.[37]

Cell phones are not the only wireless suspects. Asked what he would do if he had policy-making authority, Dr. Hardell swiftly replied that he would "ban wireless use in schools and pre-schools. You don't need Wi-Fi," he noted.[38] This is especially interesting in view of the FCC's sharply hiked spending to promote and extend Wi-Fi usage, as well as its consistent refusal to set more stringent standards for children (more on all this later). But for now let's further fill out the roster of the FCC's unnamed "some parties."

Martin Blank is a Special Lecturer in Physiology and Cellular Biophysics at Columbia University. Unlike Dr. Hardell, who looks at broad epidemiological effects over time, Dr. Blank sees cause for concern in research showing there is biological response at the cellular level to the type of radiation emitted by wireless devices. "The biology tells you unequivocally that the cell treats radiation as a potentially damaging influence," Dr. Blank said in a late 2014 interview.[39]

"The biology tells you it's dangerous at a low level," he added. Though some results have been difficult to replicate, researchers have identified a wide range of cellular responses including genetic damage and penetration of the blood brain barrier. Dr. Blank specifically cited the "cellular stress response" in which cells exposed to radiation start to make proteins.

It is still not clear whether biological responses at the cellular level translate into human health effects. But the research seems to invalidate the basic premise of FCC standards that the only biological effect of the type of radiation produced by wireless devices is tissue heating at very high power levels. But the standards-setting agencies "ignore the biology," according to Dr. Blank. He describes the FCC as being "in industry's pocket."[40]

Sweden's Lund University is annually ranked among the top 100 universities in the world. **Leif Salford** has been chairman of the Department of Neurosurgery at Lund since 1996. He is also a former president of the European Association for Neuro-Oncology. In the spring of 2000, Professor Salford told me that wireless usage constituted "the world's largest biological experiment ever."[41]

He has conducted numerous experiments exposing rats to cellular-type radiation. Individual experiments have shown the radiation to penetrate the blood-brain barrier, essential to protecting the brain from bloodstream toxins. Professor Salford also found that rats exposed to radiation suffered loss of brain cells. "A rat's brain is very much the same as a human's. They have the same blood-brain barrier and neurons. We have good reason to believe that what happens in rat's brains also happens in humans," he told the BBC in 2003. Dr. Salford has also speculated that mobile radiation could trigger Alzheimer's disease in some cases but emphasized that much more research would be needed to establish any such causal relationship. Does this man deserve to be dismissed as one of a nameless and discredited group of "some parties?"

And what about the **American Academy of Pediatrics (AAP),** which represents 60,000 American doctors who care for children? In a December 12, 2012 letter to former Ohio Congressman Dennis Kucinich, AAP President Dr. Thomas McInerny writes: "Children are disproportionately affected by environmental exposures, including cell phone radiation. The differences in bone density and the amount of fluid in a child's brain compared to an adult's brain could allow children to absorb greater quantities of RF energy deeper into their brains than adults."[42]

In a subsequent letter to FCC officials dated August 29, 2013, Dr. McInerny points out that "children, however, are not little adults and are disproportionately impacted by all environmental exposures, including cell phone radiation." Current FCC exposure standards, set back in 1996, "do not account for the unique vulnerability and use patterns specific to pregnant women and children," he wrote. (Insert slide: A Plea from Pediatricians). Does an organization representing 60,000 practitioners who care for children deserve to be brushed off along with "some health and safety interest groups?"

So what is the FCC doing in response to what at the very least is a troubling chain of clues to cellular danger? As it has done with wireless infrastructure, the FCC has to this point largely relied on industry "self-regulation." Though it set standards for device radiation emissions back in 1996, the agency doesn't generally test devices itself. Despite its responsibility for the safety of cell phones, the FCC relies on manufacturers' good-faith efforts to test them. Critics contend that this has allowed manufacturers undue latitude in testing their devices.

Critics further contend that current standards, in place since cell phones were barely in use, are far too lax and do not reflect the heavy usage patterns that have evolved. Worse still, industry is allowed to test its own devices using an imprecise system that makes no special provision for protecting children and pregnant women. One 2012 study noted that the procedure widely used by manufacturers to test their phones "substantially underestimates" the amount of RF energy absorbed by 97% of the population, "especially children." A child's head can absorb over two times as much RF energy. Other persons with smaller heads, including women, are also more vulnerable. The authors recommend an alternative computer simulation technique that would provide greater insight into the impact of cellular radiation on children and on to the specific RF absorption rates of different tissues, which vary greatly.[43]

Acting on recommendations of the General Accounting Office, the FCC is now reconsidering its standards for wireless testing and allowed emissions. On the surface, this may seem to represent an effort to tighten standards to promote consumer health and safety. But many believe the FCC's eventual new standard will actually be weaker, intensifying any health risk from industry's self-reported emission levels. "They're under great pressure from industry to loosen the criteria," notes Joel Moskowitz, director of the Center for Family and Community Health at UC Berkeley's School of Public Health.[44] One fear is that the FCC could measure the allowed radiation absorption level (SAR) over a wider sample of tissue, effectively loosening the

standard allowable energy absorption. One FCC official, who asked that his name not be used, contended that a decision had not yet been made to loosen the standard.

But to this point, there is little evidence the FCC is listening to anyone beyond its familiar friends in the wireless industry. Carl Blackman, a scientist at the Environmental Protection agency until retiring in 2014, notes that the FCC does rely to some degree on an inter-agency governmental group for advice on health matters. The group includes, for example, representatives from the EPA and the FDA.

Blackman served on that advisory group and he says that it has been divided. Though some government advisers to the FCC find evidence of wireless health risks convincing, others remain skeptical, said Blackman. Root of the skepticism: even though numerous researchers have found biological and health effects, the mechanism for action by non-ionizing radiation on the human body has still not been identified. "I don't think there's enough of a consensus within the Radio Frequency Inter-agency Working Group for them to come out with stricter standards," he says.[45]

But political pressures also figure mightily in all this. The EPA, notably, was once a hub of research on RF effects, employing as many as 35 scientists. However, the research program was cut off in the late 80s during the Regan presidency. Blackman says he was personally "forbidden" to study health effects by his "supervisory structure."[46] He termed it "a political decision" but recognized that if he wanted to continue to work at the EPA he would have to do research in another area.

Blackman is cautious in imputing motives to the high government officials who wanted his work at EPA stopped. But he does say that political pressure has been a factor at both the EPA and FCC: "The FCC people were quite responsive to the biological point of view. But there are also pressures on the FCC from industry." The FCC, he suggests, may not just be looking at the scientific evidence "The FCC's position—like the EPA's—is influenced by political considerations as well."[47]

Still, the FCC has ultimate regulatory responsibility and cannot indefinitely pass the buck on an issue of fundamental public health. Remarkably, it has not changed course despite the IARC classification of cell phones as possibly carcinogenic, despite the recent studies showing triple the glioma risk for heavy users, despite the floodtide of research showing biological effects, and despite even the recent defection of core industry booster Alex Lerchl. It is the refusal of both industry and the FCC to even acknowledge this cascade of warning signs that seems most incriminating.

Of course, industry behavior goes well beyond pushing for the FCC's willful ignorance and inaction. Industry behavior also includes self-serving public relations and hyper aggressive legal action. It can also involve undermining the credibility of and cutting off the funding for researchers who do not endorse cellular safety. It is these hardball tactics that recall 20th century Big Tobacco tactics. It is these tactics that heighten suspicion that the wireless industry does

indeed have a dirty secret. And it is those tactics that intensify the spotlight on an FCC that so timidly follows the script of the fabulously wealthy, bullying, billion-dollar beneficiaries of wireless.

Chapter Four: You Don't Need Wires To Tie People Up

So let's look a little more deeply at some of the actions of an industry group that boasts of 500 meetings a year with the FCC. Lobbying is one thing. Intimidation is another. CTIA has shown its skill at—and willingness to use—both.

Outright legal bullying is a favored tactic. The City of San Francisco passed an ordinance in 2010 that required cell phone manufacturers to display more prominently information on the emissions from their devices. This information was already disclosed—but often buried—in operator manuals and on manufacturer websites. The idea was to ensure that consumers saw information already mandated and provided.

Seeing this as a threat to its floodtide of business, the industry sued the City of San Francisco. The City, fearing a prolonged legal fight with an industry that generates hundreds of billions of dollars in annual revenue, backed down.

On May 12, 2015, Berkeley, California's City Council unanimously passed a similar ordinance. Joel Moskowitz, director of the Center for Family and Community Health at the University of California-Berkeley's School of Public Health, has been involved in the effort. Berkeley, he says, didn't want to run into the same legal threats that paralyzed San Francisco. So it tried to draft the most inoffensive and mild language possible. The proposed Cell Phone Right to Know ordinance: "To assure safety, the Federal Government requires that cell phones meet radio frequency (RF) exposure guidelines. If you carry or use your phone in a pants or shirt pocket or tucked into a bra when the phone is ON and connected to a wireless network, you may exceed the federal guidelines for exposure to RF radiation. This potential risk is greater for children. Refer to the instructions in your phone or user manual for information about how to use your phone safely."[48]

Sounds pretty inoffensive, no? Not to the CTIA, which indicated that it was prepared to sue, according to Berkeley City Attorney Zach Cowan.[49] (On June 8th, CTIA did indeed sue the City of Berkeley.)

Well, from the industry point of view, why not throw around your weight? Smash mouth legal tactics have been highly successful thus far as industry has managed to throttle several efforts to implicate manufacturers in cases where heavy users suffered brain tumors.

But one current case has advanced in district court in Washington to the point where the judge allowed plaintiffs to present expert witness testimony. The industry response: file a legal action seeking to invalidate long-held court methods for qualifying expert witnesses.

This is a very rich industry that does not hesitate to outspend and bully challengers into submission. Meanwhile, amidst the legal smoke and medical confusion, the industry has

managed to make the entire world dependent on its products. Even tobacco never had so many hooked users.

Such sustained success in the face of medical doubt has required industry to keep a lid on critics and detractors. Many scientists who've found real or potential risk from the sort of microwave radiation emanating from wireless devices have learned there is a price to be paid for standing up to the industry juggernaut. A few prominent examples:

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In 1994, University of Washington researchers Henry Lai and N.P. Singh found that rats exposed to microwave radiation suffered DNA damage to their brain cells. This was a scary finding since DNA damage can lead to mutations and possibly cancer.

The reaction from industry was swift. Motorola was at that time the U.S. market leader in cell phones. In a memorandum obtained by the journal Microwave News, Motorola PR honcho Norm Sandler outlined how the company could "downplay the significance of the Lai study." One step: "We have developed a list of independent experts in this field and are in the process of recruiting individuals willing and able to reassure the public on these matters," Sandler wrote. After outlining such measures, he concluded that Motorola had "sufficiently war-gamed" the issue. The practices of lining up industry-friendly testimony and "war-gaming" researchers who come up with unfavorable results have been persistent themes with this industry.

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After Lai's results were published, Motorola decided to sponsor further research on microwaves and DNA damage. Oftentimes, lab results cannot be reproduced by other

researchers, particularly if experiments are tweaked and performed a bit differently. Non-confirming studies raise doubt, of course, on the original work.

Motorola lined up Jerry Phillips, a scientist at the Veteran's Administration Medical Center in Loma Linda, California, and Phillips tested the effect of radiation at different frequencies from those tested by Lai and Singh. Nevertheless, Phillips found that at some levels of exposure, DNA damage increased, while at other levels it decreased. Such findings were "consistent" with the sorts of effects produced by chemical agents, Phillips said in an interview.[50] In some cases, the radiation may have activated DNA repair mechanisms, reducing the overall microwave effect. But what was important, Phillips explained, is that there were *any* biological effects at all. The wireless industry has long contended—and the FCC has agreed—that there is no evidence that non-ionizing radiation at the frequencies and power levels used by cell phones is biologically active.

Understanding the potential impact of "biological effect" findings, Motorola again turned to damage control, said Phillips. He recalls receiving a phone call from a Motorola R&D executive. "I don't think you've done enough research,'" Phillips recalls being told. The study wasn't ready for publication, according to the Motorola executive. Phillips was offered more money to do further research without publishing the results of what he'd done.

But Phillips felt he'd done enough. Despite warnings for his own boss to "give Motorola what it wants," Phillips went ahead and published his findings in 1998. Since then, Phillips' industry funding has dried up. Meanwhile, as many other researchers report, government funding to do independent research on microwave radiation has dried up, leaving the field at least in the U.S. to industry-funded scientists. "There is no money to do the research," Said Phillips. "It's not going to come from government because government is controlled by industry."[51]

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Om P. Gandhi is Professor of Electrical and Computer Engineering at the University of Utah and a leading expert in dosimetry—measurement of non-ionizing radiation absorbed by the human body. Even before cell phones were in wide use, Professor Gandhi had concluded that children absorb more emitted microwave radiation. "The concentration of absorbed energy is 50 to 80% greater," he explained.[52]

These conclusions were not acceptable to Professor Gandhi's industrial sponsors. In 1998, he recalls, an executive from a cell phone manufacturer—which he did not want to identify—told him directly that if he did not discontinue his research on children his funding would be cut off. Professor Gandhi recalled replying: "I will not stop. I am a tenured professor at the University of Utah and I will not reject my academic freedom." Professor Gandhi also recalled some of his thought process: "I wasn't going to order my students to alter their results so that I can get funding." His industry sponsors cancelled his contract and asked for a return of funds.

Professor Gandhi believes that some cell phone users require extra protection because their heads are smaller and more absorptive. “Children, as well as women and other individuals with smaller heads absorb more concentrated energy because of the proximity of the radiating antenna to the brain tissue,” he said. And yet the FCC has not acted to provide special protection for these groups. Asked why not, Professor Gandhi conceded that he doesn’t know. He does note, however, that recent standards-setting has been dominated by industry representatives.[53]

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While the mobile industry refuses to admit to even the possibility that there is danger in RF radiation, giant insurance companies see things differently. Several insurers have in recent years issued reports highlighting product liability risk with cell phones. This is important because it is evidence that where money is on the line professionals outside the industry see the risk of legal liability.

Legal exposure could be one reason—perhaps the central one—the industry continues to stonewall. Should legal liability be established, one key question will be how much wireless executives knew—and at what point in time. Meanwhile, the combination of public relations denials, legal intimidation and the selective application of pressure on research follows a familiar pattern. “The industry is basically using the tobacco industry playbook,” UC Berkeley’s Moskowitz said in a recent radio interview.[54]

That playbook has thus far been highly successful in warding off attention, regulation and legal incrimination.

Chapter Five: $270 Billion . . . and Looking for Handouts

The FCC's network of corruption doesn't just shield industry from needed scrutiny and regulation on matters of public health and safety. Sometimes it just puts its hand directly into the public pocket and redistributes that cash to industry supplicants.

Such is arguably the case with the Universal Service Fund. Originally established to extend telephone service to rural and urban areas that industry would find difficult or uneconomical to wire, the USF is now shifting from subsidizing landline phone service to subsidizing the extension of broadband Internet. USF monies also support the Lifeline program, which subsidizes cell phone service to low-income consumers, and the E-Rate program, which subsidizes Internet infrastructure and service to schools and libraries.

Since 1998, more than $110 billion has been allocated to Universal Service programs, notes Charles Davidson, director of the Advanced Communications Law & Policy Institute at New York Law School. The FCC has allocated over $40 billion to the E-Rate program alone.

Who pays the freight for these high-cost programs? You do.

Technically, landline and wireless phone companies are assessed for the Universal Service fund's expenditures. But the FCC also allows those companies to pass on such charges to their subscribers, which they do. Both landline and wireless subscribers pay a monthly Universal Service charge that is tacked on to their phone bills. That charge has been rising and recently amounted to a 16% surcharge on interstate calls.

Consumers who pay for these programs might be interested to learn that both the E-Rate and Lifeline programs have been riddled with fraud. Government watchdogs have repeatedly found the programs to be inefficient and prone to inflated and fraudulent claims. But the programs have been a windfall for tech and telecom industry beneficiaries. Wherever the FCC presides, it seems, these industries reap a windfall.

The General Accounting Office (GAO) has issued several reports citing fraud, waste and mismanagement, along with inadequate FCC oversight of the subsidy program. Bribery, kickbacks and false documentation can perhaps be expected in a handout program mandated by Congress and only indirectly supervised by the FCC.

But the scope of fraud has been impressive. The most striking corruption has marred the E-Rate program, which subsidizes Internet hardware, software and service for schools and libraries, and the Lifeline cell phone subsidies.

In recent years, several school districts have paid fines to settle fraud cases involving bribery, kickbacks, non-competitive bidding of contracts and false documentation in the E-Rate

program. More eye opening perhaps are the settlements of fraud claims by tech giants like IBM, Hewlett Packard and AT&T. The HP case, for example, involved some colorful bribery allegations, including gifts of yachts and Super Bowl tickets. HP settled for $16 million. An HP official and a Dallas Independent School District official both received jail sentences.

The Lifeline program has also been riddled with fraud. A Wall Street Journal investigation of the five top corporate beneficiaries of Lifeline showed that 41% of more than 6 million subsidy claimants "couldn't demonstrate their eligibility or didn't respond to requests for certification."[55] AT&T, Verizon, and Sprint Nextel were three of the major Lifeline beneficiaries.

The FCC has initiated several efforts to clean up USF programs and seems honestly determined to bring greater accountability and efficiency to its subsidy efforts. Nevertheless, problems with fraud persist, as reported recently by the FCC's own top investigator.

Congress established the FCC's Office of Inspector General in 1989 to "provide objective and independent investigations, audits and reviews of the FCC's programs and operations." Here's what the FCC's internal investigative unit said in a September 30, 2014 report to Congress about its Office of Investigation (OI): "*The bulk of the work of OI involves investigating and supporting civil and criminal investigations/prosecutions of fraud in the FCC's federal universal service program*."[56]

Fraud—as pervasive and troubling as it has been—is just one of the problems with the programs of universal service. It may not even be the fundamental problem. More fundamental issues concern the very aim, logic and efficiency of programs to extend broadband and wireless technology at public expense. Though the aims of extending service to distant impoverished areas seem worthy on the surface, there are many reasons to think the major beneficiaries of these programs are the technology companies that win the contracts.

Lobbyists have long swarmed over the FCC looking to get an ever-growing piece of the USF honeypot. An FCC report on meetings with registered lobbyists details a 2010 meeting with representatives of the International Society for Technology in Education and other education lobbyists. Topics discussed, according to the FCC report, included "the need to raise the E-Rate's annual cap."[57]

The CTIA, leaving no stone unturned in its efforts to pump up member revenues, last year responded to a House hearing on the USF by grousing that "current USF-supported programs skew heavily toward support of wireline services. . . . The concentration of USF monies to support wireline services is inconsistent with technological neutrality principles and demonstrated consumer preferences," CTIA wrote..[58] An industry that generates hundreds of billions of dollars in equipment and service revenues annually bellies up for a bigger slice of the $8 billion a year USF.

The grousing has paid off. The FCC recently announced that it will raise spending on E-Rate from what had been a cap of $2.4 billion a year to $3.9 billion. A significant portion of new outlays will go to Wi-Fi—yet another wireless industry victory at the FCC. But the CTIA is by no means the only industry group pressing the FCC.

Leading the roster of active lobbyists on E-Rate issues is the Software and Information Industry Association. Beginning in 2006, SIAA led all lobbyists with 54 mentions of E-Rate in its filings, according to the Center for Responsive Politics. SIAA board members include executives from tech heavyweights Google, Oracle and Adobe Systems.

Tech business leaders—many of them direct beneficiaries of FCC programs—made a direct pitch to FCC Chairman Wheeler last year to hike E-Rate funding. "The FCC must act boldly to modernize the E-Rate program to provide the capital needed to upgrade our K-12 broadband connectivity and Wi-Fi infrastructure within the next five years," the executives wrote.[59]

There were dozens of corporate executive signees to this letter, including the CEOs of many Fortune 500 giants. But let's just consider the participation of three: top executives of Microsoft, Google and HP all joined the call to expand E-Rate subsidies. Consider the simple fact that these three tech giants alone had revenues of $270 billion—more than a quarter of a trillion dollars—in a recent four-quarter period. Together, they produced nearly $40 billion in net income. And yet their top executives still thought it necessary to dun the FCC—and really, they were surreptitiously hitting up the public—for ramped-up spending on what was then a $2.4 billion a year program.

Is that greed? Arrogance? Or is it simply behavior conditioned by success in repeatedly getting what they want at the public trough? Almost never mentioned in these pleas for higher subsidies is the fact that ordinary American phone subscribers are the ones footing the bill for the E-Rate program—not the FCC or the telecom industry.

Much of the added spending, as noted, will go towards the installation of wireless networks. And yet Wi-Fi does not have a clean bill of health. When Lennart Hardell, professor of Oncology and Cancer Epidemiology at the University Hospital in Orebro, Sweden, was asked what he would do if given policy authority over wireless health issues, he replied swiftly that he would "ban wireless use in schools and pre-school." Noting that there are wired alternatives, Professor Hardell flatly stated: "You don't need Wi-Fi."[60] And yet the FCC, prodded by an industry ever on the lookout for incremental growth opportunities, is ignoring the health of youngsters to promote expanded Wi-Fi subsidies in schools across the U.S.

And what about the merit of the program itself? Overlooking the fraud and lobbying and Wi-Fi safety issues for a moment, shouldn't schools and libraries across the country be equipped with the best electronic gear, accessing the Internet at the fastest speeds? Doesn't the government owe that to its younger citizens, especially those disadvantaged by the long-referenced digital divide?

Well, maybe. But answers to these questions hinge on even more fundamental question: Do students actually learn more or better with access to the latest high-speed electronic gadgetry?

It would be foolish to argue that nobody benefits from access to high-speed Internet. But the benefits are nowhere near as broad or rich as corporate beneficiaries claim. Some researchers, for example, have concluded that computers don't seem to have positive educational impact—they may even have negative impact—when introduced into the home or freely distributed to kids from low income backgrounds.

Duke University researchers Jacob Vigdor and Helen Ladd studied the introduction of computers into North Carolina homes. They found that the academic performance of youngsters given computers actually declined. *"The introduction of home computer technology is associated with modest but statistically significant and persistent negative impacts on student math and reading test scores,"* the authors wrote in a National Bureau of Economic Research Working Paper.[61] The impact was actually most negative on the poorer students.

A study in the Journal of International Affairs examined the impact of the global One Laptop Per Child Program (OLPC), which has distributed millions of computers to children around the world. Researchers Mark Warschauer and Morgan Ames conclude: *"The analysis reveals that provision of individual laptops is a utopian vision for the children in the poorest countries, whose educational and social futures could be more effectively improved if the same investments were instead made on more proven and sustainable interventions. Middle- and high-income countries may have a stronger rationale for providing individual laptops to children, but will still want to eschew OLPC's technocratic vision. In summary, OLPC represents the latest in a long line of technologically utopian schemes that have unsuccessfully attempted to solve complex social problems with overly simplistic solutions*."[62]

Access to computers in the home may not work educational magic. But what about computers in the classroom? Don't they have educational value there?

The anecdotal evidence is mixed at best. Consider how students in Los Angeles, newly equipped with flashy iPads at a mind-boggling taxpayer cost of more than $1 billion, went about using the new tools to improve their educational performance. "Instead of solving math problems or doing English homework, as administrators envisioned, more than 300 Los Angeles Unified School District students promptly cracked the security setting and started tweeting, posting to Facebook and playing video games."[63]

But let's cut through the self-serving corporate claims and the troubling anecdotes to hear from someone who actually has had extensive and unique field experience. Kentaro Toyama was co-founder of Microsoft's research lab in India. Over more than five years he oversaw at least a dozen projects that sought to address educational problems with the introduction of computer technology. His conclusion: "The value of technology has been over-hyped and over-sold."

The most important factor in improving schools, says Toyama, now the W.K Kellogg Associate Professor of Community Information at the University of Michigan, is good teachers. Without good, well-trained teachers, adequate budgets and solid school administration, technology does little good. "Technology by itself never has any kind of positive impact," he said.[64]

The only schools in his experience that benefited from increased technology investment were those where "the teachers were very good, the budgets adequate." The richer schools, in essence. But as both Vigdor and Warschauer found, the introduction of technology has by itself little if any positive effect. For a public conditioned to believe in the virtues of new technology, such testimony is a bracing dose of cold reality.

But what about cost? Doesn't technology in the schools more efficiently replace alternative investments? Cost reductions are often the most persuasive argument for technology, Toyama agrees. But even these have been overstated. The costs of introducing new technology run far beyond initial hardware and software investments, said Toyama. In reality, the total costs of ownership—including maintenance, training, and repair—typically run to five or ten times the initial cost, according to Toyama. He said of the investment in technology for cost benefits: "I would say that in the long run—and even in the medium run and the short-run—that's probably the worst and most misguided conclusion to come to."[65]

He adds: "The inescapable conclusion is that significant investments in computers, mobile phones and other electronic gadgets in education are neither necessary nor warranted for most school systems. In particular, the attempt to use technology to fix underperforming class rooms . . . is futile. And for all but wealthy, well-run schools, one-to-one computer programs cannot be recommended in good conscience."[66]

But that doesn't keep industry lobbyists from recommending them. And it hasn't kept the FCC for spending scores of billions subsidizing technology to the very groups least likely to benefit from it.

Unmoved by the arguments of researchers and educators like Vigdor, Warschauer, and Toyama, the FCC keeps moving to increase technology subsidies. Ignoring research that disputes the value of technology in closing the so-called "digital divide," the FCC has even pioneered a new slogan: "the Wi-Fi gap."

In announcing that it was lifting E-Rate's annual budget from $2.4 billion to $3.9 billion and stepping up investment in wireless networking, FCC chairman Wheeler exulted that "10 million students are going to experience new and better opportunities."[67] The impact on consumer pocketbooks (and potentially on youngsters' health from daily Wi-Fi exposure) were not mentioned.

The two Republican members of the FCC did at least recognize the pocketbook impact. "It always seems easier for some people to take more money from the American people via higher taxes and fees rather than do the hard work," said Commissioner Michael O'Reilly.[68]

The subsidized provision of high-speed Internet service is yet another pet project of the FCC. Julius Genachowski, chairman from 2009 to 2013, championed the transition of the USF from landline phone service to broadband. Universal broadband Internet connections would begin to absorb the monies collected from consumers to extend basic phone service.

As with government subsidies for cell phone service, classroom technology, and Wi-Fi, there are basic questions about the wisdom of subsidizing broadband. Charles Davidson and Michael Santorelli of the New York Law School found that spending billions to extend broadband is a flawed approach since there are many largely ignored reasons people choose not to adopt

broadband. “Everybody is pushing broadband non-stop,” noted Davidson, director of the Law School’s Advanced Communications Law and Policy Institute. “I think the FCC is focused on the wrong set of issues,” he said.[69]

Already, he explained, over 98% of Americans have access to wired or wireless broadband. The issue is not one of supply. It’s one of demand. Many people—for a variety of reasons—don’t really care about broadband, he contends. Price is one issue. Also powerful factors—but given almost no attention—are privacy and security concerns. “In our view, they should be focused on barriers to meaningful broadband utilization: privacy and security,” said Davidson.[70]

But consumer privacy (more on this subject in Chapter Seven) has no well-funded lobby with limitless access to the FCC.

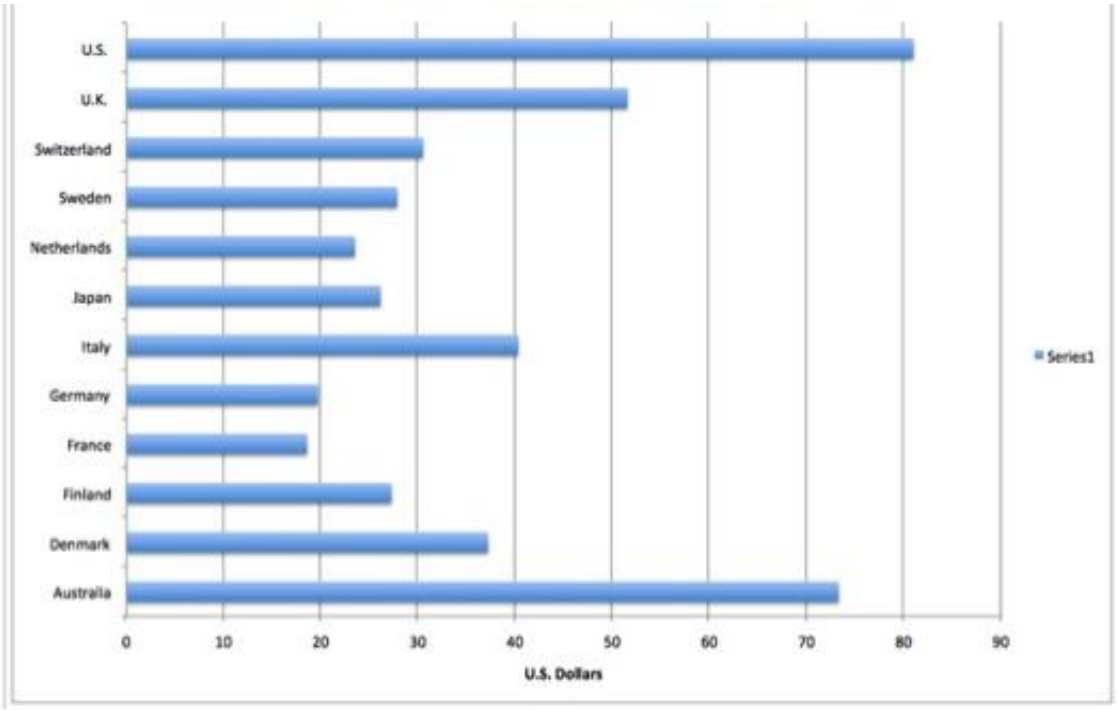
Chapter Six: The Cable Connection

The network has also been active in diluting FCC control of the cable television industry. Over the years, cable has devolved into major de facto local monopolies. Comcast and Time Warner Cable, whose merger proposal was dropped in April, are dominant forces in both cable television and broadband Internet subscriptions. Somehow, though, they have managed to steer clear of one another in specific markets, giving each pricing power where it faces little local competition.

It's interesting that cable companies annually rank in consumer polls among the "most hated" or "most disliked" American corporations. Indeed, Comcast and Time Warner Cable often top the "most hated" list.[71] Why would these companies—providers of the TV programming that has so expanded consumer options in recent decades—be so widely scorned? After all, the U.S. has been a leader in developing both cable technology and diverse television programming.

The problem is that it hasn't been anything close to a leader in bringing down subscriber prices. Industry consultants typically measure pricing by the metric of average revenue per subscriber. Industry trackers at IHS compared the price of U.S. pay television (which includes satellite services) to those in more than 60 other countries. U.S. prices were the highest, with only Australia even coming close. The average revenue per subscriber in the U.S. in 2013 was $81. But in France it was just $18.55. In Germany it was $19.68. In Japan it was just over $26.

Pay TV Monthly Revenue Per Person:



And U.S. cable prices have risen in recent years at rates three or more times the rate of inflation. This has been going on for some time. From 1995 to 2013 cable rates increased at a 6.1% annual clip. The Consumer Price Index, by contrast, rose by just 2.4% annually. Former FCC commissioner Michael Copps says the FCC shares a major part of the blame. "The FCC is as culpable for allowing that as much as the companies for imposing it," he said.[72]

One area where the FCC has contributed to the problem is in its traditional rubber-stamping of merger agreements. The proposed Comcast/Time Warner Cable deal has been shelved, largely because of Justice Department reservations. But a long run of earlier FCC-sanctioned deals allowed Comcast and Time Warner Cable to grow to the market dominance—and attendant pricing power—they currently command.

Lofty monthly cable bills pinch consumers. But it's more than that. Subscribers paying $80 a month are often paying for a lot of channels they don't watch and don't want. The FCC has never required cable operators to charge for what consumers actually want to watch. Kevin Martin, who chaired the FCC from 2005 to 2009, pushed to "debundle" programming in hopes of lowering bills. But the issue was never resolved. Only recently have viable competitive alternatives to cable's "bundled" packages become available. The satellite service Dish, for example, months ago introduced its Sling offering that enables consumers to opt for smaller and cheaper packages.

In fairness to cable operators, it should be pointed that programmers often require operators to take unwanted or fledgling channels along with their stars. New York cable operator Cablevision Systems filed suit against Viacom in 2013, charging that in order to get popular channels like MTV and Nickelodeon it was also forced to take low-rated channels like Nicktoons and VH1 Soul. But the simple truth is that no matter who is to blame, the cable consumer pays high prices, typically for some programming he doesn't want. As it often does when powerful interests pursue dubious practices, the FCC has for the most part idly stood by.

Still, the FCC isn't entirely to blame. Some factors in the growth of the cable giants cannot be laid at its doorstep. Local municipalities often granted monopoly or duopoly status in granting franchises to cable network builders. With the huge capital investments required to cable metropolitan areas, this once seemed to make sense.

And over the years, the cable giants have used a variety of tactics to weaken what little local competition they may have had. Active lobbyists on the local level, the cable giants have managed to convince a growing number of states to outlaw municipal systems that could threaten private corporate incumbents. The FCC for many years declined to tangle with the states in this matter, partly due to the opposition of Republican commissioners. But the Wheeler-led Commission did vote recently to override state laws that limit the build-out of municipal cable systems.

Still, many years of industry subservience will be difficult to swiftly undo. One linchpin merger shows how FCC decision-making has been thoroughly undermined by the revolving door, lobbying, and carefully targeted campaign contributions. All conspired in Comcast's pivotal 2011 buyout of NBC Universal, a deal which reinforced Comcast's domination of both cable and broadband access. This deal also set the stage for the recent headline-grabbing acrimony over the issue of net neutrality.

In 2011, mighty Comcast proposed to acquire NBC Universal. A series of mergers including the 1986 acquisition of Group W assets and the 2002 acquisition of AT&T's cable assets had already vaulted Comcast into cable market leadership. In bidding for NBC Universal, a huge step towards vertical integration, Comcast was once again raising the stakes. NBC Universal would give Comcast a treasure trove of programming, including valued sports content like NFL football and the Olympics.

Suddenly, the issue was not just cable subscriber base size—where Comcast had already bought its way to dominance. NBC Universal would also allow Comcast to consolidate its growing power as a broadband Internet provider. And with NBC Universal's programming assets, Comcast would gain new leverage when negotiating prices to carry the competing programming content of rivals. This would prompt a new round of debate over net neutrality. Couldn't a programming-rich Comcast slow down rival services—or charge them more to carry their programming?

To short-circuit any potential opposition to the merger, Comcast assembled a superstar cast of lobbyists. As Susan Crawford reports in her 2013 book, "Comcast hired almost eighty former government employees to help lobby for approval of the merger, including several former chiefs of staff for key legislators on congressional antitrust committees, former FCC staffers and Antitrust Division lawyers, and at least four former members of Congress.[73] Such "profligate hiring," Crawford observes, pretty much silenced the opposition to the deal. If Comcast had already retained one member of a lobbying firm, the firm could not under conflict of interest rules object to the deal. And Comcast had locked up key lobbying shops. Money was both weapon and silencer.

Of course, Comcast had always been a big spender on lobbying, with outlays exceeding $12 million every year since 2008. Lobbying costs peaked in 2011 at $19.6 million, according to the Center for Responsive Politics.

For its part, the FCC had a long history of approving most media mergers. So it was hardly a great surprise when the agency, after exacting some relatively minor concessions from Comcast, rubber-stamped the deal. Comcast would thus broaden its footprint as local monopoly distributor of cable. And with its new programming assets, it would enhance its leverage in negotiating deals to carry its rivals' programming. It would also fortify its position of growing strength as broadband Internet gatekeeper.

The most telling footnote to the deal would come just four months later. FCC Commissioner Meredith Atwell Baker, who voted to approve the merger in January 2011, left the FCC to become a top-tier Comcast lobbyist in May. It was the ultimate—and perhaps most telling—glide of the revolving door.

Baker's was a high-profile defection. But it was neither the first nor the last. Comcast had successfully convinced other FCC officials to take their expertise and government contacts to the cable giant. Comcast has long been a master at spinning the revolving door to its own advantage. "Comcast has been very good at hiring everyone who is very smart," said Crawford.[74]

Approval of the NBC Universal deal was another in the long string of FCC merger approvals that made Comcast a nationwide monopolist that could dictate both pricing and viewer programming choice.

But the deal may have had another unintended consequence. It set the stage for Comcast's subsequent battles on net neutrality. "Those mergers gave additional oomph to the issue of net neutrality," noted former commissioner Copps. Speaking specifically of Comcast's buyout of NBC Universal, IHS senior analyst Eric Brannon agreed. "That merger laid the grounds for net neutrality."

In allowing Comcast to acquire major programming assets, the deal would sharpen questions about the power of gatekeepers like Comcast to control the flow of traffic from rival Web services. So in bowing to lobbyist pressure, the FCC would bring on itself a whole new set of pressures by focusing public attention on the issue of net neutrality.

With activists rounding up comments from the public and hip TV personalities like HBO's John Oliver also beating the drums, net neutrality quickly grew into a popular issue that won the support of President Obama, and by proxy, his hand-picked appointee Tom Wheeler. When the FCC ruled in February of 2015 that it would seek Title II authority to regulate the Internet and presumably block any favoritism by broadband gatekeepers, it seemed to finally cast its lot with the public against steamrolling corporate interests

The issue had simmered for years but reached full boil when movie purveyor Netflix, which had argued that its service was slowed down by Comcast, signed a side deal ensuring better download speeds for its wares. This triggered an outburst of public concern that Comcast was now in position to operate "fast" and "slow" lanes, depending on whether a rival programmer could afford to ensure that Comcast provide adequate download speed.

With nearly 4 million comments—many supplied or encouraged by public interest groups—filed to the FCC, net neutrality was a bankable political issue. And there's no question, net neutrality attracted public interest because it gave cable viewers—long furious at the treatment by the monopolists who send them monthly bills—issues of both viewing pleasure and economics.

But it also fed into the longstanding sentimental but increasingly unrealistic view of the Internet as the last bastion of intellectual freedom. Internet romanticists have long seen the Web as a place that somehow deserves special rules for breaking the stranglehold of traditional media and offering exciting new communications, information retrieval and shopping efficiencies.

Yes, the Internet is a modern marvel. This is beyond dispute. But some of the favors it has won from government over the years have had unfortunate unintended consequences.

In the 1990s, for example, net access providers were repeatedly exempted as an "infant industry" from paying access charges to the Baby Bells even though they had to connect users through local phone networks. The long distance companies were then paying as much as $30 billion a year for the privilege. But the Internet was exempted.

As the late 90s approached, the Internet was no longer an infant industry. Still, the exemption from access charges was extended. That exemption essentially allowed AOL in the late 90s to offer unlimited unmetered online time, a key factor in boosting usage and siphoning advertisers from print media. Why buy an ad in print that might get viewed with the transitory flip of a page when you can get round-the-clock attention online?[75] FCC decisions to grant the Internet access-charge exemptions arguably accelerated the decline of print media and much of the quality journalism print advertising could once support.

Meanwhile, retailers on the Internet were making inroads into brick and mortar retail business with the help of a Supreme Court-sanctioned exemption from collecting sales tax.[76] This judicial coddling of the Internet was the death knell for many smaller mom and pop local businesses, already challenged to match online pricing. And that's not all. The special favors continue virtually every year, as Congress proposes and/or passes legislation to extend special tax exemptions to Internet services.

Well, maybe tax breaks aren't such a bad idea for such an innovative and transformational emerging technology. For all its faults, the Internet—gateway to all goods, repository of all things, wizardly guide to all knowledge, enabler of universal self-expression—is undeniably cool.

But let's not deny that the combination of tax advantages and deregulation was toxic. Allow an industry to emerge with advantages over useful existing industries that largely play by the rules—well, maybe that can be rationalized. But then fail to hold the upstart industry to the same rules, allowing it more leeway to trample fundamental rights because it has the technical capacity to do so. Well, then you have a cruel Faustian bargain.

With the see-no-evil deregulatory gospel loosing all constraints, the Web would devolve into a playground for corporate snoops and criminals. For all its wonders, the Internet comes at a cost: the loss of control over personal data, the surrender of personal privacy, sometimes even the confiscation of identity.

Perhaps the most favorable consequence of net neutrality—and one that has gotten surprisingly little attention—is that it could set the stage for privacy reform. (More on this in Chapter Seven). The FCC can now choose to exercise its Title II powers to enforce privacy standards over broadband Internet. Privacy is one area where the FCC has done a pretty good job in the past.

Worth remembering, though, is that the hard-fought public victory over Net Neutrality may be transitory. AT&T and others have threatened to go to court to upend the FCC rules. And there's a fair chance a Republican Congress will legislate against Title II.

Meanwhile, though, one supreme irony has begun to unfold in the marketplace.

Modern-day laissez fair ideologues love to invoke the wisdom of markets as represented by the "mysterious hand" of Adam Smith. Unfortunately, in the absence of effective regulation, the putatively wise "mysterious hand" generally seems to work its magic for those with huge financial resources and the political access it buys.

In the current cable situation, however, the mysterious hand may actually be working in consumer-friendly ways. Years of regulation that favored the cable companies have now backfired as the market reacts to monopolistic pricing and content control.

Whereas cable giants have commanded premium monthly subscriber prices to deliver packages of largely unwatched channels, the market is now beginning to burst with new "debundled" options that are whittling away at cable's vast subscriber base.

Satellite service Direct TV, as noted, now offers its streaming video Sling TV package of popular networks that includes live sports and news. Amazon, Apple, CBS, HBO, Netflix, Sony, and others offer a variety of streaming video options that allow viewers to cut the cable cord. Suddenly, consumers have the cherry-picking capability that bundled—and expensive—cable packages have never allowed.

In this case, at least, the unintended consequences of the FCC's pro-industry policies may be producing an unexpected pro-consumer twist.

Chapter Seven: What about Privacy?

Has any issue gotten as much lip service—and as little meaningful action?

For all the various congressional bills, corporate self-regulatory schemes and presidential Privacy Bill of Rights proposals, the simple truth remains that no personal information is safe on the Internet. Data brokers have built a multi-billion dollar business exchanging information used to build profiles of Net users. Your shopping and surfing habits, your health history, your banking data, your network of social ties, perhaps even your tax filings are all potentially exposed online. Both legal and criminal enterprises amass this information. And it doesn't go away.

At any given moment people you don't know somehow know where you are. They may very well know when you made your last bank deposit, when you had your last asthma attack or menstrual period. Corporations encourage and pay for every bit of information they can use or sell. Creepy? Perhaps, but as Jeff Chester, president of the Center for Digital Democracy points out: "The basic business model that drives online is advertising."[77]

The FCC largely escapes blame on this one. It is the Federal Trade Commission that has had primary responsibility for protecting Internet privacy. The FCC does have some limited authority, which, some critics say, could have been exercised more vigorously. But for the most part the FCC is not to blame for the rampant online abuse of personal privacy and identity.

The FCC does however have privacy authority over the phone, cable and satellite industries. Until recently, at least, the FCC has kept privacy issues at bay among the companies in these industries. "The FCC has generally taken privacy very seriously," noted Harold Feld, a senior vice president at the non-profit Public Knowledge.[78]

But dynamics now in place suggest that privacy may be the next great testing ground for the FCC. A new chance, perhaps, to champion public interest. Even before the opportunity for privacy enforcement under Title II regulatory powers, the FCC faces new challenges from phone companies, now itching to monetize their vast consumer data stashes the way Net companies have. The commonly used term is "Google envy."

"Until now, ISPs (Internet Service Providers) have mostly not gotten into hot water on privacy—but that's changing," observed Jonathan Mayer, a fellow at the Center for Internet and Society.[79] Verizon and AT&T, major providers of mobile Internet access, have each introduced "super cookies" that track consumer behavior even if they try to delete older, less powerful, forms of cookies. AT&T is actually charging its customers an extra $30 a month *not* to be tracked.

Showdowns loom.

In adopting Title II to enforce net neutrality, the FCC has made broadband Internet access a telecom service subject to regulation as a "common carrier." This reclassification means that the FCC could choose to invoke privacy authority under Title II's Section 222. That section, previously applied to phone and cable companies, mandates the protection of consumer information. Such information—called CPNI for Customer Proprietary Network Information—has kept phone companies from selling data on whom you call, from where you call and how long you spend on the phone. Consumers may have taken such protection for granted on their phone calls. But they have no such protection on their Internet activity—which, as noted, has been a multi-billion dollar safe house hideaway for corporate and criminal abusers of personal privacy.

Now, though, the FCC could put broadband Internet communications under Section 222 protection. To Scott Cleland, a telecom industry consultant who has often been ahead of the analytic pack, this would be a momentous decision.

When the smoke clears—and it hasn't yet—the FCC could make consumer identifiers like IP addresses the equivalent of phone numbers. Suddenly, the Internet companies that have trafficked in all that personal data would be subject to the same controls as the phone and cable companies.

Cleland argues that the risk for privacy abuses extends beyond broadband access providers like Comcast and Verizon to Internet giants like Google and Facebook that have until now flourished with all that personal data. "They are at risk and they are going to live under the uncertainty their business model could be ruled illegal by the FCC," Cleland said.[80]

Much has been written about the legal challenges broadband access providers intend to mount against the FCC's new rules. But Cleland argues that a very different type of legal action could engulf companies that have benefited from the use and sale of private data. Trial lawyers, he argues, will see opportunity in rounding up massive class action suits of Internet users whose privacy has been violated. What sorts of privacy abusers face legal action? Anyone who has "collected CPNI via some type of cookie," according to Cleland.

"Right now, edge providers like Google, Facebook and Twitter are at risk of being sued by trial lawyers," he said.[81]

Sounds great for consumers who care about privacy on the Internet and how it has been abused. But the FCC, Cleland was reminded, has never been a consumer advocate. "Bingo," replied Cleland. That's what makes the FCC's potential move into privacy protection so important and so surprising, he suggests.

There are other signs that the FCC under Tom Wheeler might actually become more consumer-friendly on the issue of data privacy. While Wheeler has brought some former associates from lobbying groups to the FCC, he has also peppered his staff with respected

privacy advocates. Indeed, he named Gigi Sohn, longtime president of the non-profit Public Knowledge, as Counsellor to the Chairman in April.

Another appointee with a privacy background is Travis LeBlanc, head of the FCC's Enforcement Bureau. In previous employment in California's Office of the Attorney General, LeBlanc was active in enforcing online privacy. LeBlanc has stated an interest in privacy and has already taken action against two firms that exposed personal information—including social security numbers—on unprotected Internet servers.

But many aspects of LeBlanc's approach to regulating Internet privacy under Title II remain unclear. Unfortunately, the FCC declined repeated requests to make LeBlanc available for an interview. (It also declined to answer written questions on its enforcement intentions in both privacy and cell tower infrastructure emissions.)

It remains to be seen if LeBlanc and his superiors at the FCC are really willing to take on privacy enforcement. Such a stance would require great courage as the entire Internet infrastructure is built around privacy abuse. It is also questionable whether the FCC would have the courage to challenge Google—a rare corporate ally in the battles over Net Neutrality.

Chapter Eight: Dependencies Power the Network of Corruption

As a captured agency, the FCC is a prime example of institutional corruption. Officials in such institutions do not need to receive envelopes bulging with cash. But even their most well-intentioned efforts are often overwhelmed by a system that favors powerful private influences, typically at the expense of public interest.

Where there is institutional corruption, there are often underlying dependencies that undermine the autonomy and integrity of that institution. Such is the case with the FCC and its broader network of institutional corruption.

As noted earlier, the FCC is a single node on a corrupt network that embraces Congress, congressional oversight committees and Washington social life. The network ties the public sector to the private through a frictionless revolving door—really no door at all.

Temptation is everywhere in Washington, where moneyed lobbyists and industry representatives throw the best parties and dinners. Money also allows industry to control other important factors, like the research agenda. All of this works together to industry's advantage because—as with other instances of institutional corruption—there are compromising dependencies. Policy makers, political candidates and legislators, as well as scientific researchers are all compromised by their dependence on industry money.

Dependency #1 – So much of the trouble here comes back to the core issue of campaign finance. Cable, cellular and educational tech interests know where to target their funds for maximum policy impact. And the contributions work, seemingly buying the silence of key committee congressmen—even those with past records as progressives. Key recipients of industry dollars include Massachusetts Senator Ed Markey and, until he retired, California Democrat Henry Waxman. Though they have intermittently raised their voices on such issues as data privacy and cellular health and safety, neither has shown any great inclination to follow through and take up what would have to be a long and tough fight on these issues.

Dependency #2 – Democrats might be expected to challenge industry now and then. They traditionally have done so, after all. But this is the post-*Citizens United* era where the Supreme Court has turned government into a giant auction house.

Bid the highest price and you walk home with the prize—your personal congressman, legislative loophole, even an entire political party.

Such is the case with technology industries and the Democrats. The communications/electronics industry is the third largest industry group in both lobbying and campaign contributions, according to the Center for Responsive Politics. In just 2013 and 2014, this industry sector spent well over $750 million on lobbying.[82]

Only the finance/insurance/real estate and health industries outspend the tech sector on lobbying. But those industry groups lean Republican. Over 62% of the finance/insurance/real estate campaign contributions go to the GOP. Health contributions lean Republican 57% to 43%. But the technology group leans sharply to Democrats, who got 60% of contributions in the 2013-2014 election cycle.[83] The two next largest industry groups—energy/natural resources and agribusiness—also lean heavily Republican. So of the top five industry groups whose money fuels and often tilts elections four are strongly Republican. The Democrats need the tech industry—and they show that dependence with consistent support, rarely raising such public interest issues as wireless health and safety and Internet privacy.

Dependency #3 – Spectrum auctions give the wireless industry a money-making aura. In recent Congressional testimony, an FCC official reminded legislators that the FCC has over the years been a budget-balancing revenue-making force.[84] Indeed, the auctions of electromagnetic spectrum, used by all wireless communications companies to send their signals, have yielded nearly $100 billion in recent years. The most recent auction to wireless providers produced the unexpectedly high total of $43 billion. No matter that the sale of spectrum is contributing to a pea soup of electromagnetic "smog" whose health consequences are largely unknown. The government needs money and Congress shows its appreciation with consistently pro-wireless policies.

Dependency #4 – Science is often the catalyst for meaningful regulation. But what happens when scientists are dependent on industry for research funding? Under pressure from budget cutters and deregulators, government funding for research on RF health effects has dried up. The EPA, which once had 35 investigators in the area, has long since abandoned its efforts.[85] Numerous scientists have told me there's simply no independent research funding in the U.S. They are left with a simple choice: work on industry-sponsored research or abandon the field.

Chapter Nine: A Modest Agenda for the FCC

Nobody is proposing that cell phones be banned. Nor does anyone propose the elimination of the Universal Service program or other radical reforms. But there are some steps—and most are modest—that the FCC can take now to right some of the wrongs that result from long years of inordinate industry access and influence:

1. Acknowledge that there may be health risks in wireless communications. Take down the dismissive language. Maturely and independently discuss the research and ongoing debate on the safety of this technology.

2. In recognition of this scientific uncertainty, adopt a precautionary view on use of wireless technology. Require prominent point-of-sale notices suggesting that users who want to reduce health risks can adopt a variety of measures, including headphones, more limited usage and storage away from at-risk body parts.

3. Back off the promotion of Wi-Fi. As Professor Lennart Hardell has noted, there are wired alternatives that do not expose children to wireless risk.

4. Petition Congress for the budgetary additions needed to expand testing of emissions on antenna sites. It was Congress after all that gave industry carte blanche for tower expansion so long as they comply with FCC standards. But there is evidence of vast non-compliance and Congress needs to ensure that tower infrastructure is operating within the law.

5. Acknowledge that children and pregnant women may be more vulnerable to the effects of RF emissions and require special protection.

6. Promote cable debundling as a way to lighten consumer cable bills, especially for those customers who don’t care about high-cost sports programming.

7. Apply more rigorous analysis to properly assess the value of technology in education. Evidence continues to pile up that technology in education is not as valuable as tech companies claim. Pay less attention to tech CEOs—pay more attention to the researchers who’ve actually studied the impact of trendy technology fixes on learning

8. Take over enforcement of personal privacy rights on the Internet. Of all the basic suggestions here, this would require the most courage as it would involve challenging many of the entrenched powers of the Internet.

Chapter Ten: Stray Thoughts

Some concluding thoughts:

Why do so many of the most dubious FCC policies involve technology?

In large part, of course, because the FCC has authority over communications and that is a sector that has been radically transformed—along with so many others—by technology.

Let's be clear, though. The problem is not technology, which unarguably brings countless benefits to modern life. The problem is with the over-extension of claims for technology's usefulness and the worshipful adulation of technology even where it has fearful consequences. Most fundamentally, the problem is the willingness in Washington—for reasons of both venality and naïveté—to give technology a free pass.

Personally, I don't believe that just because something can be done it should heedlessly be allowed. Murder, rape and Ponzi schemes are all doable—but subject to prohibition and regulation. Government regulators have the responsibility to examine the consequences of new technologies and act to at least contain some of the worst. Beyond legislators and regulators, public outrage and the courts can also play a role—but these can be muffled indefinitely by misinformation and bullying.

There are precedents for industries (belatedly perhaps) acting to offset the most onerous consequences of their products. In responding to a mix of litigation, public demand and regulatory requirement, the auto industry, for example, has in the last 50 years substantially improved the safety and environmental footprint of its products.

Padded instrument panels, seat belts, air bags, and crumple zones have all addressed safety issues. Environmental concerns have been addressed with tightened emissions and fuel consumption standards. The response to new safety challenges is ongoing. Before side air bags were widely deployed, sedan drivers side-swiped by much larger SUVs were at vastly disproportionate risk of death and dismemberment.[86] But the deployment of side air bags has "substantially" reduced the risk of collision deaths.[87] Overall, auto fatality rates per 100,000 persons have dropped by nearly 60% in the U.S. since 1966.[88] Today, automakers continue to work on advanced safety features like collision avoidance.

It can be argued that most of these safety improvements came decades after autos were in wide usage and only in response to outrage at Ralph Nader's 1965 revelations on the auto industry.[89] No matter the catalysts. The simple truth remains that the auto industry—and its regulators—have for the last half-century been addressing safety and environmental issues.

But with the overwhelming application of money and influence, information and communications technologies have almost totally escaped political scrutiny, regulatory control, and legal discipline.

Should the Internet have been allowed to develop into an ultra-efficient tool for lifting personal information that includes financial records, health histories and social security numbers? Should wireless communications be blindly promoted even as new clues keep suggesting there may be toxic effects? Should local zoning authorities and American citizens be stripped of the right to protect their own health? Should education be digitized and imposed just because technology companies want to develop a new market and lock in a younger customer base?

All these questions can perhaps be rolled up in one: do we all just play dead for the corporate lobbyists and spinners who promote the unexamined and unregulated application of their products?

Finally, a word about the structure of the FCC. With five commissioners—no more than three from the same party—the structure seems to make some kind of sense.

But in practice, it works out poorly. The identification of commissioners by party tends to bring out the worst in both Republicans and Democrats. Instead of examining issues with clear-sighted independence, the commissioners seem to retreat into the worst caricatures of their parties. The Republicans spout free market and deregulatory ideology that is most often a transparent cover for support of business interests. The Democrats seems satisfied if they can implement their pet spending programs—extension of broadband wireless to depressed urban and rural schools, cell phone subsidies for low income clients. The result is a Commission that fulminates about ideology and spends heavily to subsidize powerful interests.

Perhaps one solution would be to expand the Commission to seven by adding two public interest Commissioners. The public interest only rarely prevails at the FCC. So it would represent vast improvement if both Republican and Democrat commissioners had to vie for support of public interest representatives in order to forge a majority. The public interest, in other words, would sometimes carry the swing votes.

It's very hard to believe, though, that Congress would ever approve such a plan. It simply represents too much of a threat to the entrenched political power of the two parties. Why would they ever agree to a plan that dilutes that power?

It's also worth noting that the public interest is not always easy to define. Sometimes there are arguably conflicting definitions. Still, an FCC with public interest commissioners is an idea worth consideration. It would at least require party apologists to defend how they so consistently champion the moneyed interests that have purchased disproportionate access and power in Washington.

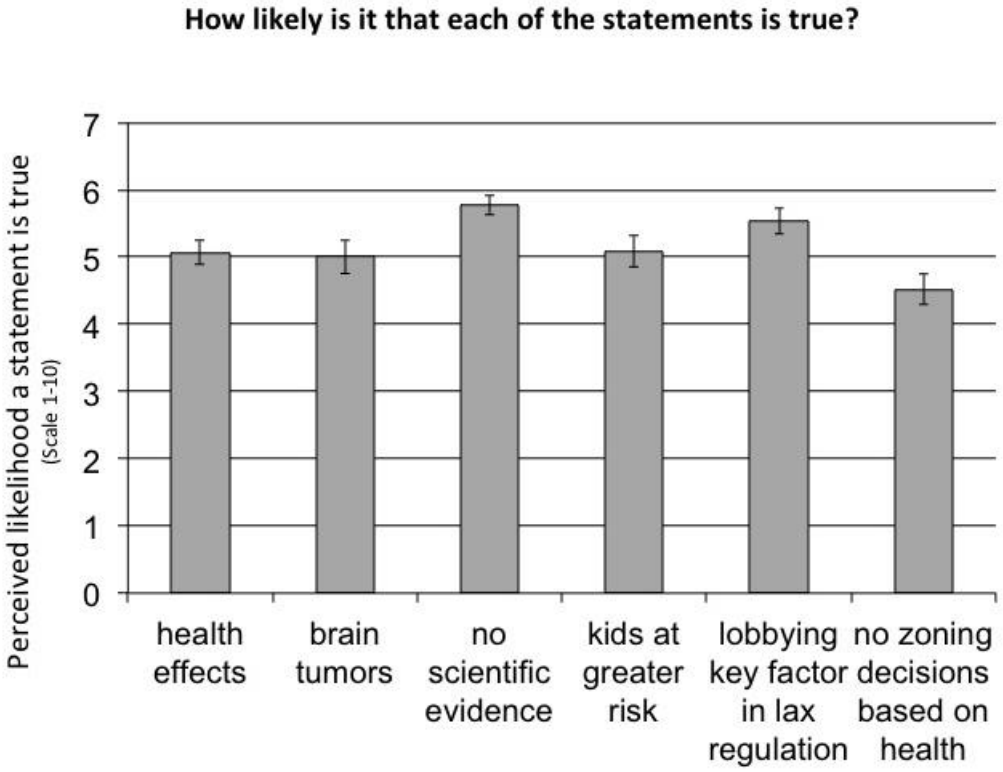
Appendix—Survey of Consumer Attitudes

What does the public believe about the science and politics of wireless health research? Under what conditions would people change wireless usage patterns? Is the FCC currently trusted to protect public health? How would confirmation of health risks affect trust in the FCC?

These are some of the questions Ann-Christin Posten[90] and Norm Alster[91] hoped to answer with an April 2015 online survey of 202 respondents. Participants were recruited through Amazon's Mechanical Turk online platform. All were U.S. residents and had achieved qualifying approval rates in prior Mechanical Turk surveys.

Participants were asked how likely they believed the following statements to be true:

> Statement 1. Prolonged and heavy cell phone use can have a variety of damaging effects on health.
>
> Statement 2. Prolonged and heavy cell phone use triples the risk of brain tumors.
>
> Statement 3. There is no scientific evidence that proves that wireless phone usage can lead to cancer or a variety of other problems.
>
> Statement 4. Children and pregnant women are especially vulnerable to radiation from wireless phones, cell towers and Wi-Fi
>
> Statement 5. Lobbying and campaign contributions have been key factors in keeping the government from acknowledging wireless hazards and adopting more stringent regulation.
>
> Statement 6. The U.S. Congress forbids local communities from considering health concerns when deciding whether to issue zoning permits for wireless antennae.

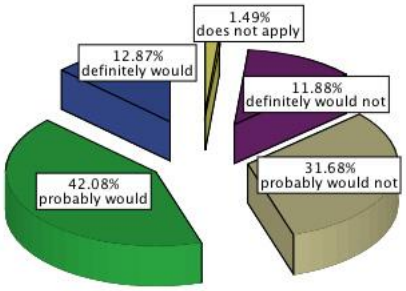


Two findings seem especially interesting:

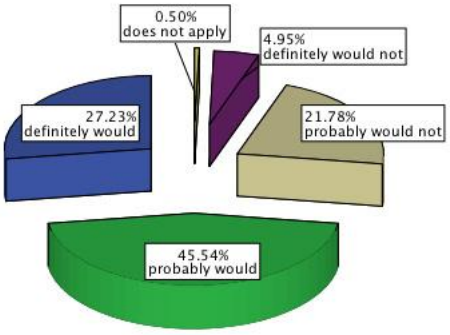
1. Statement 3 received a higher credibility rating than Statements 1 and 2. The different credibility levels are statistically significant. Respondents are more likely to trust in wireless safety than to believe there are general or specific health risks.

2. The only statement that is a matter of uncontested fact is Statement 6 on the outlawing of opposition to antenna sites on health grounds. (All other statements have been both proclaimed and denied.) And yet Statement 6 was least likely to be believed. Just 1.5% of respondents recognized this as an "absolutely true" statement. Over 14% thought this statement was "not true at all." Answers to this question would seem to reflect public ignorance on the political background to wireless health issues.

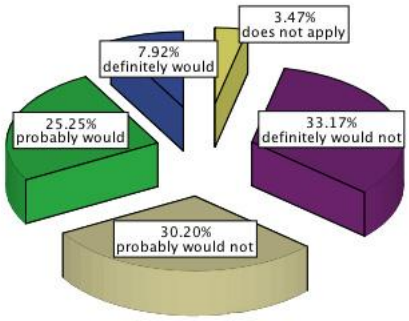
Participants were also asked how they would change behavior if claims of wireless health risks were established as true:



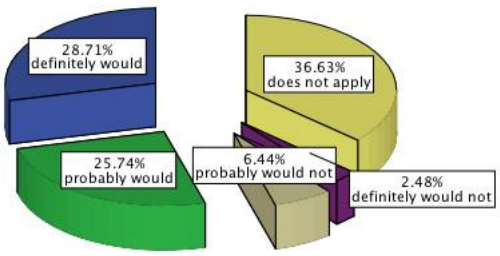
**If statement 1 was true,
I would start using headphones.**



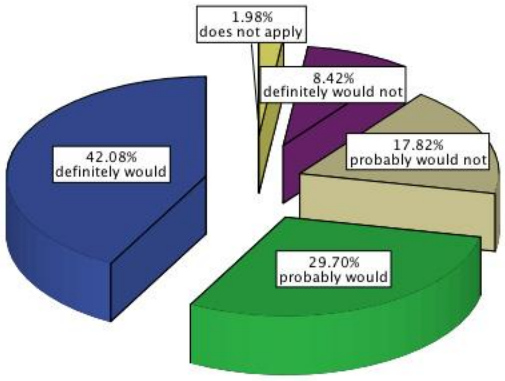
**If statement 1 was true,
I would restrict the amount of time
I spend on the phone.**



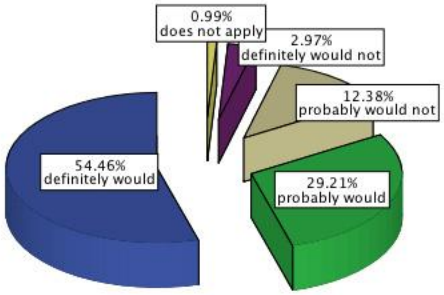
**If statement 1 was true,
I would start up a new land line
account for home use.**



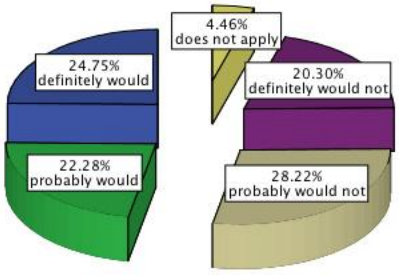
**If statement 1 was true,
I would restrict my children's cell phone use.**



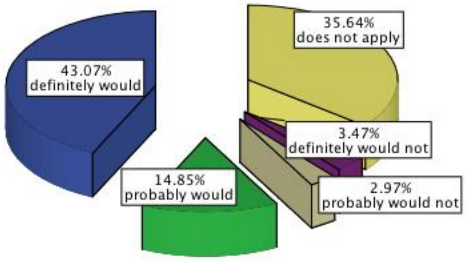
If statement 2 was true,
I would start using headphones.



If statement 2 was true,
I would restrict the amount of time
I spend on the phone.



If statement 2 was true,
I would start up a new land line
account for home use.



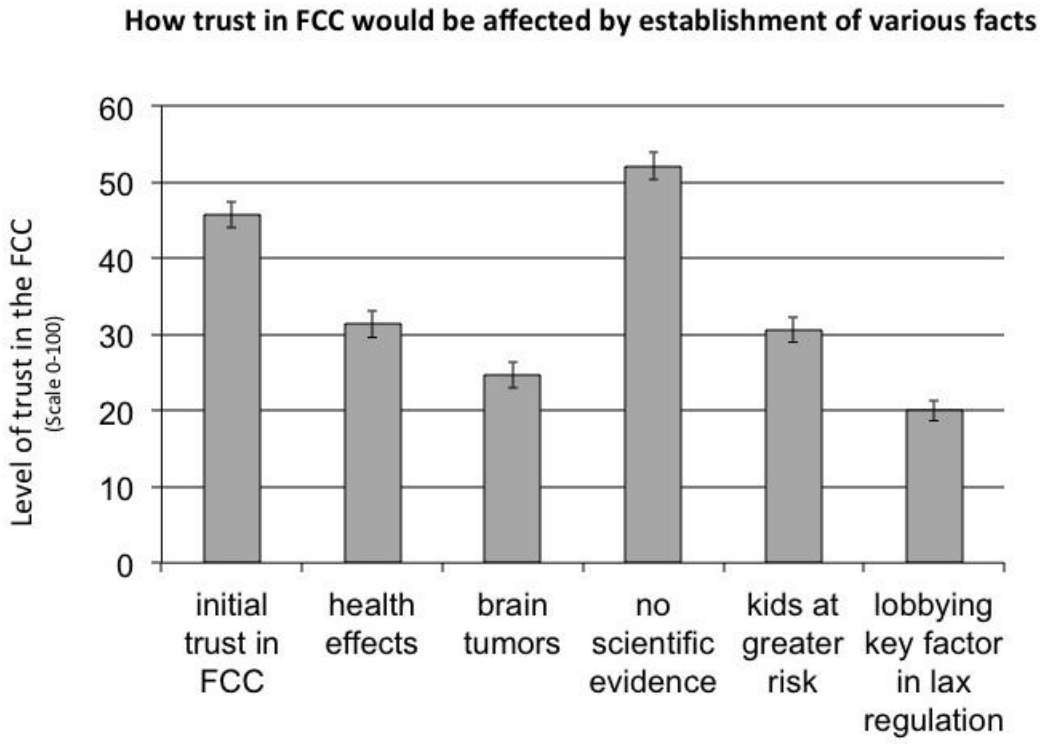
If statement 2 was true,
I would restrict my children's cell phone use.

The greatest impact on behavior came when respondents were asked to assume it is true that prolonged and heavy cell phone use triples the risk of brain tumors. More than half said they would "definitely" restrict the amount of time spent on the phone. Just over 43% would "definitely" restrict their children's phone use. Perhaps most surprisingly, close to 25% would "definitely" start up a new landline phone account. (This last response suggests it may be foolishly premature for the phone giants to exit the landline business just yet.)

The inclination of consumers to change behavior should negative health effects be confirmed suggests the stakes are enormous for all companies that derive revenue from wireless usage.

This survey points to—but cannot answer—some critical questions: Do wireless companies better protect themselves legally by continuing to deny the validity of all troublesome research? Or should they instead be positioning themselves to maintain consumer trust? Perhaps there is greater financial wisdom in listening to the lawyers right now and denying all chance of harm. If so, however, why would anyone seriously concerned about health listen to the industry—or to its captured agency? That's a question the FCC will eventually need to answer.

Trust could eventually become a central issue. Respondents were initially asked to describe their level of trust in the wireless industry and in the FCC as its regulator. Not surprisingly, establishment of any of the presumed health risks—or confirmation of inordinate industry pressure—resulted in statistically significant diminution of trust in both the industry and the FCC.



On a scale of 1 to 100, the FCC had a mean baseline trust level of 45.66. But if the tripling of brain tumor risk is established as definitely true, that number falls all the way to 24.68. If "lobbying and campaign contributions" have been "key factors" in keeping the government from acknowledging wireless hazards, the trust level in the FCC plummets to 20.02. All results were statistically significant.

It's clear that at this point confirmation of health dangers—or even of behind-the-scenes political pressures—from wireless will substantially diminish public trust in the FCC. Skeptics might argue that this gives the FCC motive to continue to downplay and dismiss further evidence of biological and human health effects. Those of a more optimistic bent might see in these findings reason to encourage an FCC concerned about public trust to shake itself loose from special interests.

Endnotes

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[18] Letter from FCC Chairman Thomas Wheeler to former FCC Commissioner Jonathan Adelstein, President and CEO, PCIA-The Wireless Infrastructure Association, March 14, 2014.

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[30] Medscape, "Brain Cancer CME Learning Center," http://www.medscape.org/resource/brain-cancer/cme.

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International Commission on the Biological Effects of Electromagnetic Fields (ICBE-EMF)
Environmental Health (2022) 21:92
https://doi.org/10.1186/s12940-022-00900-9

Environmental Health

COMMENT

Open Access

Scientific evidence invalidates health assumptions underlying the FCC and ICNIRP exposure limit determinations for radiofrequency radiation: implications for 5G

International Commission on the Biological Effects of Electromagnetic Fields (ICBE-EMF)*

Abstract

In the late-1990s, the FCC and ICNIRP adopted radiofrequency radiation (RFR) exposure limits to protect the public and workers from adverse effects of RFR. These limits were based on results from behavioral studies conducted in the 1980s involving 40–60-minute exposures in 5 monkeys and 8 rats, and then applying arbitrary safety factors to an apparent threshold specific absorption rate (SAR) of 4 W/kg. The limits were also based on two major assumptions: any biological effects were due to excessive tissue heating and no effects would occur below the putative threshold SAR, as well as twelve assumptions that were not specified by either the FCC or ICNIRP. In this paper, we show how the past 25 years of extensive research on RFR demonstrates that the assumptions underlying the FCC's and ICNIRP's exposure limits are invalid and continue to present a public health harm. Adverse effects observed at exposures below the assumed threshold SAR include non-thermal induction of reactive oxygen species, DNA damage, cardiomyopathy, carcinogenicity, sperm damage, and neurological effects, including electromagnetic hypersensitivity. Also, multiple human studies have found statistically significant associations between RFR exposure and increased brain and thyroid cancer risk. Yet, in 2020, and in light of the body of evidence reviewed in this article, the FCC and ICNIRP reaffirmed the same limits that were established in the 1990s. Consequently, these exposure limits, which are based on false suppositions, do not adequately protect workers, children, hypersensitive individuals, and the general population from short-term or long-term RFR exposures. Thus, urgently needed are health protective exposure limits for humans and the environment. These limits must be based on scientific evidence rather than on erroneous assumptions, especially given the increasing worldwide exposures of people and the environment to RFR, including novel forms of radiation from 5G telecommunications for which there are no adequate health effects studies.

Keywords: Federal Communications Commission (FCC), International commission on non-ionizing radiation protection (ICNIRP), Radiofrequency radiation (RFR), Exposure limits, Exposure assessment, Radiation health effects, Reactive oxygen species (ROS), DNA damage, 5G, Scientific integrity, Cell phone*, Mobile phone*

Introduction

In establishing exposure limits for toxic or carcinogenic agents, regulatory agencies generally set standards that take into account uncertainties of health risks for the general population [1] and for susceptible subgroups such as children [2]. That approach has not been applied in the same way to the setting of exposure limits for

*The terms cell phone and mobile phone are used interchangeably in this commentary; cell phone is the term used in the United States, while mobile phone is the term used in most of Europe.

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radiofrequency radiation (RFR) (frequency range: 3 kHz to 300 GHz). Moreover, assumptions underlying the current RFR exposure limits are flawed; hence, the limits that are currently applied do not adequately protect human and environmental health. This issue is discussed in greater detail under Assumption #9.

The Federal Communications Commission's (FCC) limits for maximum permissible exposure to RF electromagnetic fields (EMF) [3] were established in 1996 [4], and currently include many recommendations from the International Commission on Non-Ionizing Radiation Protection [5]. These exposure limits were expected to protect against adverse health effects in humans that might occur from short-term (i.e., acute) exposures to RFR and have been maintained by the FCC for the past 26 years. The exposure limits that were established by the FCC in 1996 relied on criteria recommended by the National Council on Radiation Protection & Measurements (NCRP) [6] and the Institute of Electrical and Electronics Engineers (ANSI/IEEE) [7, 8]. The limits were "based on a determination that potentially harmful biological effects can occur at a SAR (specific absorption rate) level of 4.0 W/kg as averaged over the whole-body." The SAR is a measure of the rate of RF energy absorbed per unit mass.

The threshold for a behavioral response and for acute thermal damage in sensitive tissues was considered to be an exposure that produced a whole-body SAR greater than 4 W/kg. In parallel with the development of the FCC's RFR exposure limits, ICNIRP's guidelines for limiting exposure to RF-EMF were also based on behavioral studies conducted in rats and monkeys in the 1980s [9].

The harmful effects that served as the basis for the exposure criteria were changes in behavior observed in small numbers of rats and monkeys when exposed to RFR for up to 60 minutes to power densities at which the whole-body SAR was approximately 4 W/kg or higher [10, 11]. Those studies were conducted in the early 1980s (1980 and 1984, respectively) by investigators of the US Navy Department. Consequently, 4 W/kg was identified as the threshold SAR for adverse health effects induced by RFR. In food-deprived monkeys that were exposed to three different frequencies (225 MHz, 1.3 GHz, and 5.8 GHz) during 60-min sessions, lever-pressing response rates for the delivery of food pellets were reduced compared to sham exposure sessions. The threshold SAR for this decreased response was reported to range from 3.2 to 8.4 W/kg [11]. Similarly, in food-deprived rats exposed to 40-min sessions at 1.28 or 5.62 GHz radiation, the threshold SAR for a decrease in response rate was reported to range from approximately 3.8 to 4.9 W/kg [10]. In experimental studies in which monkeys were exposed in an anechoic chamber for 4 hours to 1.29 GHz radiation at various power densities, an increase in mean body temperature of 0.7 °C was associated with a whole-body SAR of 4 W/kg [12]. Behavior disruption associated with an increase in body temperature of approximately 1.0 °C was assumed to be the most sensitive measure of harmful effects from RF-EMF exposure.

After establishing 4 W/kg as the threshold dose for acute harmful effects, both the FCC [3, 4] and ICNIRP [5, 9] set exposure limits for controlled occupational exposures to 0.4 W/kg SAR averaged over the whole body (based on applying a 10-fold safety/uncertainty factor). For the general population, the FCC's and ICNIRP's exposure limits were set at 0.08 W/kg SAR averaged over the whole body (by applying an additional 5-fold safety/uncertainty factor) for frequencies between 3 MHz and 3 GHz. The exposure limits established by the FCC and ICNIRP do not account for any impact of differing signal characteristics, such as carrier wave modulations or pulsing of the signal. Whole-body exposures for the general population are based simply on power levels averaged over 30-minute periods [3, 5].

Based on SAR distributions from whole-body exposures in which local (i.e., partial body) SARs were estimated to be 10 to 20 times the average value, local exposure limits were set 20 times higher than the average whole-body exposure limit [4–7]. For occupational exposures, local peak exposure limits were permitted up to 8 W/kg averaged over any 1-g cube of tissue [4] or 10 W/kg averaged over any 10 g of contiguous tissue [9] by the FCC and ICNIRP, respectively. For the general population, local peak SARs for partial-body exposures were not to exceed 1.6 W/kg averaged over any 1 g of cube-shaped tissue [3], or not to exceed 2.0 W/kg averaged over any 10 g of cube-shaped tissue [5]. Higher limit values are permissible for extremities. Extremities include the hands, wrists, feet, ankles, and pinnae (the external part of the ear), despite the close proximity of the ear to the brain. These adjustments were made long before the widespread use of wireless communication devices in which the emitting antenna is typically held close to local body organs such as the brain. The NCRP document [6] acknowledges that exposures could be greater than the recommended safety limit values when people are in close proximity to emitters of RFR.

The setting of exposure limits for the prevention of excessive tissue heating was based on the following assumptions: 1) electromagnetic waves at frequencies used in wireless communications do not have sufficient energy to break chemical bonds or ionize molecules [13]; 2) RFR could not damage DNA; and 3) tissue heating was the only possible biological effect of nonionizing radiation [5, 9, 14–16]. For potential environmental and human health issues that are not addressed in the

A) Effects of RF radiation at exposures below the putative threshold SAR of 4 W/kg

Assumption 1) There is a threshold exposure for any adverse health effect caused by RF radiation; in the frequency range of 100 kHz to 6 GHz it is a whole-body exposure that exceeds an SAR of 4 W/kg. Any biological effect of RF radiation above the threshold exposure is due to tissue heating.

Assumption 2) RF radiation is incapable of causing DNA damage other than by heating; there is no mechanism for non-thermal DNA damage.

Assumption 3) Two to seven exposures to RF radiation for up to one hour duration are sufficient to exclude adverse effects for any duration of exposure including chronic exposures.

Assumption 4) No additional effects would occur from RF radiation with co-exposure to other environmental agents.

B) Factors affecting dosimetry

Assumption 5) Health effects are dependent only on the SAR value; carrier wave modulations, frequency, or pulsing do not matter except as they influence the SAR.

C) Human brain cancer risk

Assumption 6) The multiple human studies that find associations between exposure to cell phone RF radiation and increases in brain cancer risk are flawed because of biases in the published case-control studies, and because brain cancer rates have remained steady since the time that use of wireless communication devices became widespread.

D) Individual variations in exposure and sensitivity to RF-EMF

Assumption 7) There are no differences among individuals, including children, in the absorption of RF-EMF and susceptibility to this radiation.

Assumption 8) There are no differences among individuals in their sensitivity to RF radiation-induced health effects.

E) Applied safety factors for EMF-RF workers and the general population

Assumption 9) A 50-fold safety factor for whole body exposure to RF radiation is adequate for protecting the general population to any health risks from RF radiation.

Assumption 10) A 10-fold safety factor for whole body exposure to RF radiation is adequate for protecting workers to any health risks from RF radiation.

Assumption 11) Exposure of any gram of cube-shaped tissue up to 1.6 W/kg, or 10 grams of cube-shaped tissue up to 2 W/kg, (duration not specified) will not increase the risk of that tissue to any toxic or carcinogenic effects in the general population.

Assumption 12) Exposure of any gram of cube-shaped tissue up to 8 W/kg, or 10 grams of cube-shaped tissue up to 10 W/kg, (duration not specified) will not increase the risk of that tissue to any toxic or carcinogenic effects in workers.

F) Environmental exposure to RF radiation

Assumption 13) There is no concern for environmental effects of RF radiation or for effects on wildlife or household pets.

G) 5G (5^{th} generation wireless)

Assumption 14) No health effects data are needed for exposures to 5G; safety is assumed because penetration is limited to the skin ("minimal body penetration").

Fig. 1 Assumptions Underlying the FCC/ICNIRP Exposure Limits for RF Radiation

setting of exposure limits (for example effects of chronic exposures, or effects of co-exposure of skin to RFR and other environmental agents, such as would occur with 5G exposure in combination with sunlight), the implicit assumption is that such effects do not matter, or that the arbitrarily selected safety/uncertainty factor is sufficient to deal with those concerns. In any case, it is expected that underlying assumptions applied to health risk assessments would be clearly described [1].

Exposure limits for RF radiation are based on numerous assumptions; however, research studies published over the past 25 years show that most of those assumptions are not supported by scientific evidence. In the NCRP report [6], the authors noted that when further understanding of biological effects of RF radiation becomes available, exposure guidelines will need to be evaluated and possibly revised. The ANSI/IEEE document [7] also notes that effects of chronic exposure or evidence of non-thermal interactions could result in revising exposure standards. Unfortunately, these recommendations were never implemented. Assumptions of safety from exposures that could adversely affect human or environmental health should be tested and validated *before* widespread exposures occur, not afterwards, by agencies responsible for protecting public health.

In this paper, we highlight studies that demonstrate the fallacy of inherent assumptions in the FCC/ICNIRP guidelines for RF radiation exposure limits, and we find that the limits fail to protect human and environmental health. Fourteen assumptions that underlie the RFR exposure limits established in the 1990s and reaffirmed in 2020 by the FCC [4, 5] and ICNIRP [5, 9] are addressed in this paper and are shown in Fig. 1.

Assumptions underlying exposure limits for RF radiation and the scientific evidence demonstrating that these assumptions are not valid

A. Effects of RF radiation at exposures below the putative threshold SAR of 4 W/kg

Assumption 1) *There is a threshold exposure for any adverse health effect caused by RF radiation; in the*

frequency range of 100 kHz to 6 GHz it is a whole-body exposure that exceeds an SAR of 4 W/kg. Any biological effect of RF radiation above the threshold exposure is due to tissue heating.

Cardiomyopathy and carcinogenicity

In response to a request from the Food and Drug Administration's (FDA) Center for Devices and Radiological Health [17], the National Toxicology Program (NTP) conducted toxicity and carcinogenicity studies of cell phone (CDMA- or GSM-modulated) radiation in rats and mice exposed to RFR at frequencies of 900 MHz and 1800 MHz, respectively [18, 19]. Exposures to RFR for up to 2 years occurred in reverberation chambers over 18 hours/day on a continuous cycle of 10 minutes on and 10 minutes off. In rats, the whole-body SAR levels during the 10-minute on cycles were 0, 1.5, 3, or 6 W/kg.

The major histopathological findings from the NTP study in male rats [18] included dose-related increases in cardiomyopathy, increased incidence of cancers and preneoplastic lesions in the heart (schwannoma and Schwann cell hyperplasia) and brain (glioma and glial cell hyperplasia), increases in prostate gland tumors and hyperplasias, significant increases in adrenal gland tumors, and significant increases in the overall incidence of benign or malignant neoplasms in all organs in the 3 W/kg groups. The incidence of cardiomyopathy was also increased in GSM-exposed female rats, and significant increases in DNA damage were found in rats and mice [18, 19]. Similarly, an earlier study by Chou et al. [20] found a significant (3.6-fold) increase in the incidence of primary malignant neoplasms in male rats exposed to 2450 MHz pulsed RFR for 25 months (21.5 hr./day) at an SAR that ranged from 0.15 to 0.4 W/kg.

A 3-day external peer-review of the NTP studies confirmed there was "clear evidence of carcinogenic activity" in male rats for heart schwannomas, and "some evidence of carcinogenic activity" for brain gliomas and adrenal gland tumors with exposure to either GSM- or CDMA-modulated RF radiation [21]. In addition, a lifetime study by the Ramazzini Institute reported a significant increase in heart schwannomas in male rats exposed 19 hour/day to 1800 MHz GSM-modulated RFR at a field strength of 50 V/m, equivalent to a whole-body SAR of 0.1 W/kg [22]. The incidence of heart Schwann cell hyperplasia was also increased in that exposure group. These findings are consistent with results from the NTP study and demonstrate that the proliferative effect of modulated RFR in heart Schwann cells is a reproducible finding that can occur at doses far below the assumed whole-body threshold SAR of 4 W/kg.

ICNIRP [23] dismissed the evidence of carcinogenicity for RFR that was provided in the studies by the NTP [18] and the Ramazzini Institute [22] based on their earlier critique of those studies [24]. However, that critique demonstrated an unfortunate lack of understanding together with a misrepresentation of the design, conduct, and interpretation of experimental carcinogenicity studies in animal models [25], as well as a lack of appreciation for the remarkable concordance between the tumor responses observed in experimental animals with those identified in cancer epidemiology studies of mobile phone users described under Assumption #6.

Neither heating effects nor thermal stress was likely causal of the adverse health effects observed in the NTP [18] study, since there was no tissue damage observed in a 28-day study at the same SARs, there was no significant effect on body weight during the 2-year study, and there were no exposure-related clinical observations that would indicate thermal or metabolic stress. Furthermore, a preliminary thermal pilot study demonstrated that body temperatures did not increase by more than 1^{O} C at the exposure levels used in the chronic studies [26], and there is no evidence that a small change in body temperature associated with the RFR exposures in the NTP study can cause the types of carcinogenic effects that were observed. The similar findings of GSM-modulated RFR on Schwann cells by the Ramazzini Institute [22] at much lower whole-body SARs confirm these effects to be independent of tissue heating.

Neurological effects

Though the FCC and ICNIRP exposure limits are based on a putative threshold dose of 4 W/kg due to behavioral disruption observed at higher doses in rats and monkeys [10, 11] numerous studies have shown consistent and reproducible deficits in spatial learning and memory in laboratory animals exposed to RF radiation at SARs below 4 W/kg. Examples of study exposures that demonstrated these neurological effects included 900 MHz GSM at 0.41–0.98 W/kg, 2 hr./day for 4 days in mice [27]; 900 MHz GSM at 0.52–1.08 W/kg, 2 hr./day for 1 month in rats [28]; 900 MHz GSM at 1.15 W/kg, 1 hr./day for 28 days in rats [29]; 900 MHz pulsed RFR at 0.3–0.9 W/kg for 6 hr./day in rats from conception to birth and tested at 30 days of age [30]; 900 MHz GSM and 1966 MHz UMTS at 0.4 W/kg for 6 months in rats [31]; and 900 MHz continuous wave EMF at 0.016 W/kg 3 hr./day for 28 days in rats [32]. The studies cited above are not the only studies showing these effects, but they clearly demonstrate that exposure to RFR at an SAR of 4 W/kg is not a threshold dose for neurological effects in rodents. The effects of RF radiation on spatial learning and memory indicate

the hippocampus as a target site of these exposures. For a more complete listing of neurological effects of RFR reported between 2007 and 2017 see Lai [33].

In addition, many studies have reported changes in brain electrical activities in human subjects, measured by electroencephalography (EEG), including sleep disturbance from single exposures to cell phone RF radiation. This is not surprising since the nervous system transmits messages based on electrical signals generated by nerve cells. Decreased β-trace protein, which is a key enzyme in the synthesis of a sleep-promoting neurohormone, has been seen in young adults with high-cumulative amounts of hours of mobile phone use [34]. Another frequently reported effect of RF radiation is increased blood-brain barrier permeability in rats at SARs much lower than 4 W/kg, e.g. [32, 35–41]. Oxidative stress induced in the brain of animals exposed to RF-EMF has been associated with observed neurological effects [42]. Although many studies did not observe significant changes in neurological effects in humans and several studies did not observe increased permeability in the blood-brain barrier in animal models [33], differences in EMF frequency, modulation, duration of exposure, and direction of incident waves to the exposed subject, as well as difference in dielectric properties and the size and shape of the exposed subject likely account for differences in observed effects [43, 44].

Sperm damage

The effect of non-ionizing microwave radiation on the testis (testicular degeneration in mice) was first reported 60 years ago [45]. Since then, and with the rapid increase in use of RF-EMF emitting devices, numerous studies have investigated testicular effects of RFR and potential associations with male infertility [46–50]. Human and animal studies have shown that the testis is one of the most sensitive organs to RF-EMF exposures, and that keeping a mobile phone in trouser pockets in talk mode can affect fertility parameters e.g., sperm motility, sperm count, sperm morphology, and apoptosis [48, 51]. Meta-analyses of published epidemiologic studies on the impact of mobile phone radiation on sperm quality in adult men have found significant decreases in sperm motility, sperm viability and/or sperm concentrations that were associated with mobile phone usage [52–55]. Several physical factors associated with exposure conditions can affect the outcome of human studies, including depth of energy penetration, duration of call, type of transmission technology, distance of the device to the body or testis, and power density with defined SAR. For example, Zilberlicht et al. [56] observed higher rates of abnormal sperm concentrations among men who held their phones less than 50 cm from their groin.

The effects of RFR on reproductive parameters in humans are consistent with results from experimental studies in animals and in vitro studies. For example, exposure of human semen to 850 MHz radiation from mobile phones for 1 hour at an SAR of 1.46 W/kg caused a significant decrease in sperm viability that was associated with an increase in reactive oxygen species (ROS) [50] or an increase in sperm DNA fragmentation [57]. Exposure of isolated human spermatozoa to 1.8 GHz RF-EMF significantly reduced sperm motility and induced ROS generation at an SAR of 1.0 W/kg, and significantly increased oxidative DNA damage and DNA fragmentation at an SAR of 2.8 W/kg [58].

Some examples of effects of RFR on male fertility factors in studies with experimental animals at SARs below 4 W/kg include: a decrease in sperm count and an increase in ROS in rats exposed to mobile phone frequencies 2 hr./day, for 35 days (SAR = 0.9 W/kg) [59]; increases in oxidative stress, 8-hydroxy-deoxyguanosine (8-OHdG), and DNA strand breaks in the testes of rats exposed to 900 MHz (SAR = 0.166 W/kg), 1800 MHz (0.166 W/kg), or 2100 MHz (0.174 W/kg) 2 hr./day for 6 months [60]; an increase in ROS, a decrease in sperm count, and altered sperm morphology in rats exposed to 900 MHz 3G mobile phone radiation (SAR = 0.26 W/kg) 2 hr./day for 45 days [61]; decreased sperm quality in rats in which local exposure of the scrotum to 2575–2635 MHz 4G smartphone time division LTE radiation occurred for 1 min over 10 min intervals 6 hr./day for 150 days [62]; impaired testicular development at 35 days of age in male offspring of pregnant rats that were exposed to 2.45 GHz RFR (SAR = 1.75 W/kg) 2 hr./day throughout pregnancy [63]; decreased sperm motility in mice exposed to 905 MHz RFR (SAR = 2.2 W/kg) 12 hr./day for 5 weeks, and increased ROS formation and DNA fragmentation after 1 week of exposure [64]. Although negative studies have also been reported, it is important to remember that the outcome of experimental studies can be affected by differences in exposure conditions, including the frequency, modulation, polarization, stray electromagnetic fields, local SAR, duration of exposure, and analytical methods [43, 44].

Although the mechanism of testicular effects from exposure to non-thermal levels of RFR is not fully known, numerous studies in rats and mice, and in human sperm have found associations between negative effects on fertility parameters and increases in ROS and/or DNA damage [48, 51, 57, 58, 60, 61, 64–68]. Thus, the adverse effects of RFR on sperm quality are likely due in large part to induced generation of ROS.

Assumption 2) *RF radiation is incapable of causing DNA damage other than by heating; there is no mechanism for non-thermal DNA damage.*

In 2009, ICNIRP [16] claimed that "low energy photons of RF radiation are too weak to affect ionization or cause significant damage to biological molecules such as DNA, under ordinary circumstances." However, DNA damage and other genotoxic effects have been observed in numerous studies of low intensity RFR in animal models and in humans. For example, the NTP study found statistically significant increases in DNA damage in brain cells of exposed rats and mice compared to sham controls [18, 19, 69], and Akdag et al. [70] found statistically significant increases in DNA damage in hair cells in the ear canal among 30 to 60 year-old men who used mobile phones for 10 years for 0–30 min/day, 30–60 min/day, or greater than 60/min/day compared to people who did not use mobile phones. In the latter study, the extent of DNA damage increased with increasing daily exposure duration. In a review of published studies on genetic effects of ELF- and RF-EMF, Lai [71] listed more than 150 studies in which non-thermal exposures to RFR produced increases in DNA damage, chromosome aberrations, or micronuclei formation.

In addition, it is well established that DNA damage can also be caused by indirect processes, such as by the generation of reactive oxygen species (ROS), and numerous studies have demonstrated DNA damage at exposures below the putative threshold SAR of 4 W/kg. More than 120 published studies have demonstrated oxidative effects associated with exposure to low intensity RFR (Additional file 1: Appendix 1). An analysis of experimental studies on molecular effects of low intensity RF radiation (RFR) in biological systems found that the majority (93 of 100 studies) demonstrated the induction of oxidative effects [72]. More recent studies (from 2017) revealed that all 30 relevant publications (100%) detected significant oxidative effects under low intensity RFR exposures, and most of these studies used modulated RFR from wireless communication devices.

Increased production of ROS in living cells may be caused by weak magnetic fields altering recombination rates of short-lived radical pairs generated by normal metabolic processes leading to changes in free radical concentrations [73], or by low intensity extremely low frequency (ELF) EMFs resulting in alterations in voltage-gated ion channels in cell membranes causing changes in cation flow across membranes [74]. These mechanisms apply to both ELF-EMFs and to RFR modulated by pulsed fields at extremely low frequencies. Other biophysical mechanisms by which non-thermal RF-EMF can cause biological effects through interactions with normal cellular processes have been described [75].

Increasing NADH oxidase activity is another mechanism by which RFR can increase ROS production. NADH oxidases, which are membrane-associated enzymes that catalyze one-electron reduction of oxygen to superoxide radical using NADH as the electron donor, have been identified as primary mediators of RFR interactions in cellular systems [76]. A significant (3-fold) increase in the activity of NADH oxidase was measured in purified plasma membranes from HeLa cells exposed to 875 MHz for 5 or 10 min at a power density of 200 μW/cm^2. This exposure intensity is significantly lower than the ICNIRP [5] safety limit.

The major source of ROS in living cells is the mitochondrial electron transport chain, where leakage of electrons generates superoxide radicals due to the partial reduction of oxygen [77]. A dose-dependent effect of 1.8 GHz modulated RFR exposure (SAR = 0.15 and 1.5 W/kg) on mitochondrial ROS production was detected in mouse spermatogonial germ cells [65]. Exposure of quail embryos to extremely low intensity modulated RFR (GSM 900 or 1800 MHz, 0.25 or 0.32 μW/cm^2) during the initial days of embryogenesis resulted in a robust overproduction of superoxide radical and nitrogen oxide in mitochondria of embryonic cells [78, 79]. Thus, multiple mechanisms for the increased production of ROS by low intensity RF radiation have been demonstrated.

Numerous studies have been published on mutagenic effects of low intensity RF-EMFs, especially studies that identified increases in levels of a specific marker of oxidative DNA damage and a risk factor for cancer, 8-hydroxy-2′-deoxyguanosine (8-OHdG) [58, 60, 78–84]. For example, the level of 8-OHdG in human spermatozoa was increased significantly after in vitro exposure for 16 hr. to 1.8 GHz at a power level of 2.8 W/kg and correlated with levels of ROS generation [58]. Likewise, exposure of quail embryos *in ovo* to GSM-modulated 900 MHz of 0.25 μW/cm^2 for 1.5, 5, or 10 days was sufficient to produce a significant, two-threefold, increase in 8-OHdG levels in embryonic cells [79]. Umbilical cord blood and placenta tissue samples obtained after delivery from women who used mobile phones during pregnancy had significantly higher levels of oxidative stress parameters, including 8-OHdG and malondialdehyde, compared to cord blood and placental tissue from women who did not use mobile phones during pregnancy [85]. In addition, DNA damage, analyzed by the comet assay, was increased significantly in cord blood lymphocytes obtained from women who used mobile phones during pregnancy compared to cord blood lymphocytes obtained from women who did not use mobile phones.

As low intensity RF radiation does not have sufficient energy to ionize DNA molecules, and as increased production of ROS in living cells due to RF-EMF exposures has been reliably documented, an indirect effect of this type of radiation is the formation of oxidative damage to DNA. The most aggressive form of ROS that can cause oxidative DNA damage is the hydroxyl radical; this reactive oxygen species can be generated from superoxide radical and hydrogen peroxide [86], which may be produced in living cells exposed to low intensity RF radiation. Ultraviolet radiation (UVR, encompassing UVA, UVB, and UVC), which is classified by IARC as "carcinogenic to humans"), can also cause indirect DNA damage by generating ROS [87]. Thus, both RFR and UVR, which can similarly induce oxidative DNA damage, can increase cancer risk by a similar mechanism.

Increased production of ROS and depletion of antioxidant capacity in living cells exposed to low intensity RF radiation can result in oxidative DNA damage. Induction of oxidative stress, which is a key characteristic of many human carcinogens [88], including UVR and asbestos, can also lead to genotoxicity and carcinogenicity of non-ionizing RF radiation without causing direct DNA damage.

> **Assumption 3**) *Two to seven exposures to RF radiation for up to 1 hour duration are sufficient to exclude adverse effects for any duration of exposure including chronic exposures.*

The behavioral studies in 8 male rats and 5 male monkeys that served as the basis for the exposure limits to RF radiation adopted by the FCC and ICNIRP involved 2 to 7 exposure sessions of 40-minute duration for rats [10] and 3 exposure sessions of 60-minute duration for monkeys at each power density [11]. Additional support for the threshold SAR of 4 W/kg in the frequency range of 100 kHz to 6 GHz came from behavioral studies conducted in rats and monkeys by D'Andrea et al. [89, 90]. However, D'Andrea et al. [91, 92] also reported that exposure of rats to continuous wave 2450 MHz RFR for 14 or 16 weeks caused significant differences in behavioral activity between sham-exposed rats and RFR-exposed rats at mean SARs of 0.7 W/kg and at 1.23 W/kg, indicating that 4 W/kg is not a threshold SAR with extended exposure durations. Since that time many studies have shown that responses to non-thermal RFR depend on both exposure intensity and exposure duration [93]. Importantly, the same response was observed with lower exposure intensity but prolonged exposure duration as at higher exposure intensity and shorter duration [94].

Recognizing that the exposure limits do not address potential health effects after long-term exposures to RF radiation emitted from wireless devices that people are experiencing, the FDA [17] nominated RF radiation to the NTP for chronic toxicology and carcinogenicity studies out of concern that "existing exposure guidelines are based on protection from acute injury from thermal effects of RFR exposure, and may not be protective against any non-thermal effects of chronic exposures." Adverse health effects noted in Assumption #1, including cardiomyopathy, carcinogenicity, sperm damage, and neurological effects, as well as the human epidemiology studies to be described in Assumption #6, occurred with much longer exposures to RF radiation than the exposure durations used in the acute studies in rats [10] and monkeys [11]. Consequently, the acute behavioral exposure studies that served as the basis for exposure limits to RF radiation established by the FCC and ICNIRP are inadequate to identify and characterize adverse effects of RF radiation after longer exposure durations. Neither the exposure limits established in the 1990s by the FCC [4] or by ICNIRP [9], nor those reaffirmed more recently by these groups [3, 5] address health risks associated with long-term exposure to RF radiation.

> **Assumption 4**) *No additional effects would occur from RF radiation with co-exposure to other environmental agents.*

The current FCC/ICNIRP exposure limits do not take into consideration interactive effects of RF radiation with other environmental agents even though such effects have been documented. Interactions of RF radiation with other agents may result in antagonistic or synergistic effects, i.e., effects that are greater than the sum of each agent alone.

In the International Agency for Research on Cancer (IARC) evaluation of the carcinogenicity of RF-EMF [44], the expert working group noted that 4 of 6 co-carcinogenesis studies available at that time showed increased responses with exposure to RF-EMF. One of those studies reported co-carcinogenic effects of UMTS-modulated RF radiation at 4.8 W/m^2 in the liver and lung of mice that had been treated with the carcinogen ethylnitrosourea (ENU) in utero [95]; the incidence of liver and lung cancers were increased in mice exposed to ENU plus RF radiation compared to cage controls, sham controls and ENU alone. After the IARC evaluation, Lerchl et al. [96] replicated the experimental design of Tillmann et al. [95] by exposing mice to RF-EMF at whole-body SAR levels of 0 (sham), 0.04, 0.4, and 2 W/kg. Significant increases in lung adenomas and/or liver carcinomas were observed at all exposure levels. Lerchl et al. [96] concluded that their "findings are a very clear indication that tumor-promoting effects

of life-long RF-EMF exposure may occur at levels supposedly too low to cause thermal effects." Thus, the reproducibility of the tumor-promoting effects of RFR at non-thermal exposure levels has been demonstrated.

Other examples of reported synergistic effects include the following study results. Synergistic effects on damage to human lymphocytes were observed with co-exposure to RFR (1.8 GHz RFR, SAR 3 W/kg) and 2 different mutagens, namely, mitomycin C or 4-nitroquinoline-1-oxide [97], or with co-exposure to ultralight (UVC) light [98]. A synergistic effect was found on DNA damage in human blood cells exposed to 2450 MHz radiation (5 mW/cm^2) and then exposed to mitomycin C [99]. A potentiation effect on DNA damage was observed in cultured mammalian cells exposed to CDMA-modulated 835 MHz RF-EMF (SAR = 4 W/kg) and the clastogens cyclophosphamide or 4-nitroquinoline-1-oxide [100]. Gene expression was altered in neuronal and glial cells of rats pre-treated with lipopolysaccharide, a neuroinflammatory agent, and then exposed to 1800 MHz GSM modulated radiation (SAR = 3.22 W/kg) for 2 hr. [101]. In rats pre-treated with picrotoxin, a chemical that induces seizures, exposure to pulse-modulated 900 MHz GSM-modulated RF radiation of mobile phones increased regional changes in brain activity and c-Fos expression [102, 103].

Exposure limits based on exposure to only RF radiation will result in an underestimation of the true risk and inadequate protection of human health under conditions in which co-exposures to other toxic agents lead to synergistic adverse effects [104].

B. Factors affecting dosimetry

Assumption 5) *Health effects are dependent only on the time-averaged SAR value; carrier wave modulations, frequency, or pulsing do not matter except as they influence the SAR.*

The FCC's and ICNIRP's exposure limits to RFR are based on SARs for frequencies up to 6 GHz and on power densities for frequencies between 6 GHz and 300 GHz averaged over 6-minute or 30-minute intervals for local areas and whole-body exposures [3, 5]. However, time-averaged dosimetry does not capture the unique characteristics of modulated or pulsed RFR. For example, GSM modulation may involve as many as 8 voice channels with a duration of 0.577 msec for each channel. Thus, the exposure from GSM modulation can be 8-times higher during each time slot pulse compared to exposure to a continuous wave at equivalent time-averaged SARs. Also, as noted under assumption #14, repetitive pulses of data in bursts with short exposures to 5G can cause localized temperature spikes in the skin [105]. The impact of pulsed radiation on biological activities at the molecular or cellular levels is not taken into consideration with time-averaged dosimetry.

Another issue not addressed by time-averaged dosimetry is the importance of low frequency modulations on biological systems. As discussed under assumption #2, increased production of ROS in living cells and DNA damage have been demonstrated with exposure to low frequency modulations of radiofrequency carrier waves [106]. Exposure limits based on time-averaged SAR dosimetry or power density, without consideration of the impact of amplitude or frequency modulations, do not adequately address potential health effects of real-world exposures to RFR. There is ample evidence that various effects of RFR exposure depend on carrier wave modulations, frequency, or pulsing [43, 107, 108]. In contrast to ICNIRP/FCC, the IARC monograph on RFR carcinogenicity noted that RFR effects may be influenced by such exposure characteristics as duration of exposure, carrier frequency, type of modulation, polarization, exposure intermittence, and background electromagnetic fields [44].

C. Human brain tumor risk

Assumption 6) *The multiple human studies that find associations between exposure to cell phone RF radiation and increases in brain tumor risk are flawed because of biases in the published case-control studies, and because brain cancer rates have remained steady since the time that use of wireless communication devices became widespread.*

Although claims have been made that "current limits for cell phones are acceptable for protecting the public health" because "even with frequent daily use by the vast majority of adults, we have not seen an increase in events like brain tumors" [109], the SEER (Surveillance, Epidemiology, and End Results Program) database shows an annual decrease of 0.3% for all brain tumors, but an increase of 0.3% per year for glioblastoma in the US between 2000 and 2018 (https://seer.cancer.gov/explorer/). Most concerning was that the annual increase for glioblastoma was 2.7% per year for people under 20 years of age. In addition, Zada et al. [110] reported that the incidence of glioblastoma multiforme (GBM) in the frontal lobe, temporal lobe, and cerebellum increased in the US between 1992 and 2006, and Philips et al. [111] likewise reported a statistically significant increasing incidence of GBM in the frontal and temporal lobes of the brain in the UK during 1995–2015. In Sweden, rates of brain tumors in the Swedish National Inpatient Register and the Swedish Cancer Register increased from 1998 to

2015 [112]. In addition, it should be realized that cumulative exposure, side-of-head use, and latency for tumor formation from RFR are not fully captured in national cancer registries. Thus, the claim that trends in brain cancer incidence rates have not increased since mobile phones were introduced is both wrong and misleading. The specificity of effect needs to be factored into such trend analyses.

Case-control studies, using sound scientific methods, have consistently found increased risks with long-term, heavy mobile phone use for brain tumors of the glioma type and acoustic neuroma. This association was evaluated at IARC in 2011 by 30 expert participants who concluded that radiofrequency (RF) radiation is a "possible" human carcinogen [44]. In contrast, the much-cited Danish cohort study on 'mobile phone users' [113] was disregarded by IARC due to serious methodological shortcomings in the study design, including exposure misclassifications [44, 114].

Results of meta-analyses of glioma risk and acoustic neuroma from Swedish case-control studies conducted by Hardell and coworkers [115, 116], the 13-nation Interphone study [117], and the French study by Coureau et al. [118] are shown in Table 1 as odds ratios (OR) with 95% confidence intervals. For glioma on any location in the head, a statistically significant increase of nearly two-fold was found, while for ipsilateral mobile phone use (tumor and phone use on the same side of the head) the risk was increased by 2.5-fold. These ORs are based on the groups in each study with the highest category of cumulative call time, which were ≥ 1640 hr. in the Interphone study [117, 119] and the Swedish studies [115, 116], and ≥ 896 hr. in the study by Coureau et al. [118]. Decreased survival among glioma cases, especially astrocytoma grade IV, was associated with long-term and high cumulative use of wireless phones [120]. Increased risk for the mutant type of *p53* gene expression in the peripheral zone of astrocytoma grade IV was associated with use of mobile phones for ≥3 hours a day. Increase in this mutation was significantly correlated with shorter overall survival time [121].

For acoustic neuroma, risk was significantly increased with cumulative exposure and ipsilateral use by 2.7-fold. A random effects model, which was based on a test for heterogeneity, was used for the meta-analyses of these published studies. Tumor volume of acoustic neuroma increased per 100 hr. of cumulative use of wireless phones in the Swedish study and years of latency, indicating tumor promotion [115].

Other case-control studies of mobile phone use also reported increased risk of acoustic neuroma [122–124]. Those studies were not included in the meta-analysis because data on cumulative mobile phone use with numbers of cases and controls were not given or there were other shortcomings. It is also noteworthy that tumor risks were increased in subsets of the Interphone study; for example, there was nearly a 2-fold increase in the risk of acoustic neuroma for ≥10 y and ipsilateral use among the North European countries that participated in the Interphone study [125].

Claims have been made that associations between increases in brain cancer risk and exposure to cell phone RF radiation in the published case-control studies may be attributable to recall and/or selection biases [5, 109]. However, a re-analysis of the Canadian data that was included in the Interphone study showed that there was no effect on the risk of glioma after adjustments were made for selection and recall biases [126]. Odds ratios (OR) for glioma were increased significantly and to a similar extent when comparing the highest quartile of use to those who were not regular users whether or not adjustments for biases were made. In addition, Hardell

Table 1 Odds ratios (OR) with 95% confidence interval (CI) for glioma and acoustic neuroma in case-control studies in the highest category for cumulative mobile phone use in hours[a]

	Glioma				Acoustic neuroma			
	All		Ipsilateral		All		Ipsilateral	
	OR	95% CI	OR	95% CI	OR	95% CI	OR	95% CI
Interphone [117, 119] Cumulative use ≥1640 hr	1.40	1.03–1.89	1.96	1.22–3.16	1.32	0.88–1.97	2.33	1.23–4.40
Coureau et al. [118] Cum use ≥896 hr	2.89	1.41–5.93	2.11	0.73–6.08				
Hardell et al. [115, 116] Cumulative use ≥1640 hr	2.13	1.61–2.82	3.11	2.18–4.44	2.40	1.39–4.16	3.18	1.65–6.12
Meta-analysis longest cumulative use	**1.90**	**1.31–2.76**	**2.54**	**1.83–3.52**	**1.73**	**0.96–3.09**	**2.71**	**1.72–4.28**

[a] Note Hardell et al. [115, 116] also assessed use of cordless phones

and Carlberg [116] showed that the risk for glioma with mobile phone use was increased significantly even when compared to the risk for meningioma. Because risk of meningioma was not increased significantly, this tumor response could not be attributed to recall bias. Clearly, selection and recall biases do not explain the elevated brain tumor risk associated with the use of mobile phones. Thus, epidemiological evidence contradicts the opinions of the FCC and ICNIRP on brain tumor risk from RF radiation.

It should also be noted that the thyroid gland is a target organ for RFR from smartphones. A case-control study on mobile phone use suggested an increased risk for thyroid microcarcinoma associated with long-term cell phone use [127]. Peripheral lymphocyte DNA obtained from cases and controls was used to study genotype-environment interactions. The study showed that several genetic variants based on single nucleotide polymorphisms (SNPs) increased the risk of thyroid cancer with mobile phone use [128]. Increasing incidence of thyroid cancer in the Nordic countries, especially over the last two decades, has also been reported [129, 130]. In addition, a recent case-control study found significant increases in breast cancer risk among Taiwanese women based on their use of smartphones and distance between the breast and placement of their smartphone [131].

D. Individual variations in exposure and sensitivity to RF-EMF

Assumption 7) *There are no differences among individuals, including children, in the absorption of RF-EMF and susceptibility to this radiation.*

Differences between children and adults regarding the absorption of radiofrequency electromagnetic fields when mobile phones are operated close to the head have been demonstrated and widely documented [132–137]. The main factors accounting for these dissimilar absorption rates include differences in anatomy, tissue dielectric properties, and physiology. Through finite-difference time-domain (FDTD) simulations, employing detailed computational anthropomorphic models, it is possible to find differences relating to anatomy and to dimensions of the head.

Since EMF penetration into human tissues can be in the order of a few centimeters, depending on the wavelength, the inner tissues in the brain clearly will receive a significantly higher dose in the smaller heads of children compared to adults, despite the total absorption and the peak spatial SAR (psSAR) calculated across the whole head varying by smaller amounts [132, 133, 138]. Fernández et al. [136] estimated that the cell phone radiation psSAR in the hippocampus was 30-fold higher in children compared to adults, while the psSAR in the eyes was 5-fold higher in children; these differences were due largely to closer proximity to the cell phone antennas. The thinner dimensions of children's skulls also contribute to this difference [135], resulting in a psSAR around 2-fold higher in children's brains [134–137, 139] compared to adults.

Additionally, tissues of young mammals have higher conductivity and electrical permittivity than those of mature animals [140]. This also contributes to greater EMF penetration and absorption, resulting in further increases in the psSAR. The psSAR in the skull bone marrow of children was estimated to increase by 10-fold due to higher conductivity in this tissue [137]. Distance between the mobile device and the body tissues is important in characterizing tissue dosimetry. The National Agency ANFR of France recently released cell phone SAR test data for 450 cell phones. Ten gram psSARs increased by 10–30% for each millimeter of proximal placement of the cell phone to the planar body phantom (http://data.anfr.fr/explore/dataset/das-telephonie-mobile/?disjunctive.marque&disjunctive.modele&sort=marque).

Finally, it is important to note that simulations of tissue dosimetry consider only the physical parameters of the tissues; they do not consider biological processes occurring in living tissues. While children are growing, developing organs and multi-organ systems are more susceptible to adverse effects of environmental agents; finite-difference time-domain (FDTD) simulations do not address differences in organ or system susceptibility for exposures occurring during child development.

Assumption 8) *There are no differences among individuals in their sensitivity to RF radiation-induced health effects.*

All life is "electrosensitive" to some degree as physiological processes are dependent on both subtle and substantial electromagnetic interactions at every level, from the molecular to the systemic. Responses to multiple types of electromagnetic exposure reveal that there is a far broader range of EMF sensitivity than previously assumed, and subgroups of extremely hypersensitive subjects exist [141–151]. Given the adverse health effects noted in Assumption #1, including cardiomyopathy, carcinogenicity and neurological effects, the acute, conscious symptoms manifesting in some individuals should not be unexpected. The term currently and most frequently used within the medical profession to describe those who are acutely, symptomatically sensitive to non-ionizing radiation exposures is Electromagnetic Hypersensitivity (EHS).

EHS is a multisystem, physical response characterized by awareness and/or symptoms triggered by EMF exposures. Common symptoms include (but are not limited to) headaches, dizziness, sleep disturbance, heart palpitations, tinnitus, skin rashes, visual disturbance, sensory disturbance, and mood disturbance [152, 153]. These symptoms are reported in response to even extremely low intensity (orders of magnitude below current safety levels) EMFs of multiple types (in terms of frequency, intensity and waveforms). Commonly noticed triggers of frequent and persistent EHS symptoms are pulse-modulated RF emissions, modulated at extremely low frequencies. Common triggering sources include mobile phones, DECT cordless landlines, Wi-Fi/Bluetooth-enabled computers, Wi-Fi routers, smart meters, base station antennas, and household electrical items. EMF avoidance/mitigation is found to be the most effective way to reduce symptoms [154].

Guidelines for EHS diagnosis and management have also been peer-reviewed and concur that the mainstay of medical management is avoidance of anthropogenic electromagnetic fields [152, 155, 156]. Case histories detailing clinical presentations, EMF measurements and mitigation are also published [157], and biomarkers including elevated markers of oxidative stress, inflammatory markers and changes in cerebral blood flow continue to be explored [152].

EHS has been proven to be a physical response under blinded conditions [145, 151, 158, 159] and, in addition to these studies, acute EMF-induced changes in cognition, behavior, and physiology reactions have been observed in studies involving animals [27, 30, 160–172]; plus further references under Assumption 13), which cannot be biased by media-cultivated fears. These studies provide further evidence which invalidates the nocebo response (physical symptoms induced by fear) as causal regarding symptoms.

It should not be expected that all provocation studies will reliably demonstrate adverse reactions; however, suggestions that the nocebo response may cause EHS symptoms were claimed from provocation studies which failed to show a relationship between the EMF exposure and the reported symptoms [173]. The failures of these studies are explainable given the very poor methodology in the majority of them. There were failures to account for a multitude of essential factors that must be tailored to the individual, such as variable symptom onset and offset, the necessity for adequate washout periods, specificity of trigger frequencies and intensities, requirement for complete EMF hygiene during sham exposures, requirement for life-like exposures (e.g., pulse-modulated information-carrying waves), etc. For example, it has been shown that various frequency channels from GSM/UMTS mobile phones affect the same human cells differently [174–177]. Similarly, EHS has been shown to be frequency dependent [151]. As noted above, meaningful provocation studies need to take into consideration multiple physical parameters of exposure, including frequency, modulation, duration of exposure, and time after exposure [155]; however, most provocation studies that have failed to establish causative connection between RFR exposure and EHS symptoms [173] used only one or two conditions with short-term exposures.

There are many issues with the nocebo response as a cause of EHS, not least of which is also the absence of the required temporal link. For the nocebo response to be the cause of EHS, awareness and concern of negative health impacts from EMFs must precede symptoms. But, in the majority of EHS persons this is not the case [178]. As public risk communication improves, this will no longer be verifiable; however, this has been importantly observed at the only point in time when it could have been – prior to generalized awareness of health detriments from non-ionizing radiation (NIR).

While recognizing that some vulnerable groups may be more susceptible to effects of NIR exposure, ICNIRP [179] acknowledged that their guidelines may not safely accommodate these sensitive subgroups:

> *"Different groups in a population may have differences in their ability to tolerate a particular NIR [Non-Ionizing Radiation] exposure. For example, children, the elderly, and some chronically ill people might have a lower tolerance for one or more forms of NIR exposure than the rest of the population. Under such circumstances, it may be useful or necessary to develop separate guideline levels for different groups within the general population, but it may be more effective to adjust the guidelines for the general population to include such groups. Some guidelines may still not provide adequate protection for certain sensitive individuals nor for normal individuals exposed concomitantly to other agents, which may exacerbate the effect of the NIR exposure, an example being individuals with photosensitivity".*

In 2020, ICNIRP [23] also noted that biological effects are not easily discernible from adverse health effects, and that their guidelines:

> *"…are not intended to protect against biological effects as such (when compensatory mechanisms are overwhelmed or exhausted), unless there is also an associated adverse health effect. However, it is not always easy to draw a clear distinction between biological and adverse health effects, and indeed this can vary depending on individual susceptibility*

to specific situations. An example is sensory effects from nonionizing radiation exposures under certain circumstances, such as a tingling sensation resulting from peripheral nerve stimulation by electric or magnetic fields; magnetophosphenes (light flickering sensations in the periphery of the visual field) resulting from stimulation of the retina by electric fields induced by exposure to low-frequency magnetic fields; and microwave hearing resulting from thermoelastic waves due to expansion of soft tissues in the head which travel via bone conduction to the inner ear. Such perceptions may sometimes lead to discomfort and annoyance. ICNIRP does not consider discomfort and annoyance to be adverse health effects by themselves, but, in some cases, annoyance may lead to adverse health effects by compromising well-being. The exposure circumstances under which discomfort and annoyance occur vary between individuals".

Trivializing "discomfort" which is the pre-cursor to pain is not in keeping with WHO recommendations quoted by the same ICNIRP [23] document: "Health is a state of complete physical, mental and social well-being and not merely the absence of disease or infirmity."

Discomfort is a sign that an organism is experiencing something which is compromising optimal health and although in some cases this can be trivial and reversible, in other cases it may not be reversed. There is an extremely broad range of both pain tolerance and also of pain perception among humans, and to achieve meaningful preventative health care, "discomfort" must be taken seriously and mitigated whenever possible. This is especially true in this case where symptoms such as headaches are being reported in response to mobile phone exposures at the same time as increased brain tumor risk is noted from those same exposures (see Assumption 6).

In reality, people with EHS are reporting far more serious health disruption than "discomfort" or "annoyance" and in some cases these symptoms are disabling [180, 181]. Increasingly, EHS is being recognized as a disability by national courts in France, Sweden, and Spain, which amplifies the requirement for safety guidelines that are deliberately accommodating to this more susceptible group [180].

E. Applied safety factors for RF-EMF-RF workers and the general population

Assumption 9) *A 50-fold safety factor for whole body exposure to RF radiation is adequate for protecting the general population to any health risks from RF radiation.*

Public health agencies in the US and worldwide apply multiple uncertainty factors to health effects data to establish exposure levels that are considered safe for the great majority of exposed populations [182–184]. Although guidelines for the use of uncertainty factors were developed for chemicals, they are also pertinent to other toxic agents, such as RFR. The uncertainty factors needed for toxic effects of RFR based on studies that demonstrate a no-observed-adverse-effect level (NOAEL) in experimental animals include:

1) Animal-to-human extrapolation. When data are based on studies in experimental animals, a factor of 3–10 is applied (for potential species differences in tissue dosimetry and response) unless there are convincing data demonstrating equivalent sensitivity in animals and humans. However, there is no evidence showing that humans are equally or less sensitive to RFR than animals that were used in studies from which exposure limits were established by the FCC and ICNIRP.
2) Adjustment for human variability. A second factor of 10 is used to account for interindividual variability in susceptibility (for instance, due to differences in age, sex, genetic variation, pre-existing diseases) to the toxic agent among the general population. It has been recognized that a factor of 10 for human variability is likely inadequate for sensitive subpopulations and may require an additional adjustment.
3) Extrapolation from short-term studies to lifetime exposure. An additional factor of 10 is applied for short-term studies, such as those used to establish exposure limits to RF radiation, to provide lifetime protection from chronic exposure. This is of particular importance considering the remarkably short periods over which RFR toxicity was originally assessed [10, 11].
4) Database insufficiencies. Finally, an uncertainty factor of 3-to-10 is applied for database inadequacy, i.e., for incomplete characterization of an agent's toxicity. The behavioral studies [10, 11] that were used to establish the FCC and ICNIRP exposure limits to RFR do not provide a full characterization of the effects of this type of radiation nor did they identify the most sensitive adverse effect of RFR exposures.

Basing exposure limits to RFR on the behavioral studies in rats and monkeys [10, 11, 90, 91] would require the application of a composite uncertainty factor of about 900 to 10,000 to be consistent with approaches used by public health agencies to establish protective exposure limits for workers and the general population. Based on the size of the needed uncertainty/safety factor, the

data sets used by the FCC and ICNIRP are clearly inadequate to establish RF exposure limits with reasonable confidence. The arbitrarily selected safety factors of 10 for workers and 50 for the general population by the FCC and ICNIRP are woefully inadequate for protecting exposed populations.

When uncertainty/safety factors are applied to a misrepresented threshold exposure value for adverse effects, the resulting level does not provide assurance of health protection for the general population exposed to that agent. Studies cited above [18, 22, 91, 92, 96] show that the whole-body SAR of 4 W/kg is not a threshold level for adverse effects caused by RFR. In a recent quantitative analysis of various adverse health effects from the NTP study, Uche and Naidenko [185] showed that the permissible whole-body SAR of 0.08 W/kg (based on a 50-fold reduction of the assumed threshold SAR of 4 W/kg) was 20–40-fold higher than health protective SAR values derived by benchmark dose modelling of NTP data for cardiomyopathy (following application of 10-fold safety factors for interspecies and intraspecies variability). The approaches used by these authors are consistent with methodologies recommended by the US Environmental Protection Agency for quantifying health risks for toxic and carcinogenic environmental agents [1, 182]. Thus, a 50-fold reduction of the assumed threshold whole-body SAR of 4 W/kg is inadequate to protect the health of the general population from exposure to RF radiation.

> **Assumption 10)** *A 10-fold safety factor for whole body exposure to RF radiation is adequate for protecting workers to any health risks from RF radiation.*

When RFR exposure limits were implemented in 1997, the rationale given for the difference in safety factors for the general population (50-fold) and for workers (10-fold) was "based on the exposure periods of the two populations, rounded to one digit (40 work hours per week/168 hours per week = ~0.2)" [6]. In addition to differences in exposure periods between workers and the general population, ICNIRP rationalizes the appropriateness of the lower safety factor for workers because "occupationally-exposed individuals can be considered a more homogeneous group than the general population," they are, "in general, relatively healthy adults within a limited age range," and "occupationally-exposed individuals should be operating under controlled conditions and be informed about the risks associated with non-ionizing radiation exposure for their specific situation and how to reduce these risks" [23]. In contrast, "the general public are, in most cases, unaware of their exposure to non-ionizing radiation and, without education, cannot reasonably be expected to take precautions to minimize or avoid any adverse effects of exposure."

The assumption that workers are trained in understanding health risks associated with exposure to RFR and in mitigating those risks to the greatest possible degree is not correct because neither the FCC nor the ICNIRP guidelines recognize any health effects from RFR at SARs below 4 W/kg, and the exposure limits authorized by the FCC and ICNIRP do not consider health effects from long-term exposures [3, 5]. The only health effect addressed by the FCC and ICNIRP is tissue damage due to excessive heating from acute exposures. Thus, the 10-fold reduction from the threshold whole-body SAR calculated from acute behavioral studies in rats and monkeys is inadequate for protecting the health of workers exposed long-term to RFR (see comments under assumption #9). There are no data demonstrating the adequacy of this arbitrarily chosen safety/uncertainty factor for occupationally-exposed workers, while on the contrary, excess cancer risks have been associated with exposure to RFR workers who operate radar and communication systems in military and occupational settings [186].

> **Assumption 11)** *Exposure of any gram of cube-shaped tissue up to 1.6 W/kg, or 10 g of cube-shaped tissue up to 2 W/kg, (duration not specified) will not increase the risk of that tissue to any toxic or carcinogenic effects in the general population.*

Tissue dosimetry was analysed in the NTP study of cell phone RF radiation in rats and mice [187]. In rats, whole body exposures during the 10-minute on cycles were 1.5, 3.0, or 6.0 W/kg, and the brain and heart SARs varied from the whole-body SARs by about 7% to under 2-fold for the brain and heart, respectively. A quantitative risk assessment of the NTP tumor incidence data is needed to evaluate organ-specific cancer risk. The FDA [19] nomination to the NTP recognized the need for "large well-planned animal experiments …. to provide the basis to assess the risk to human health of wireless communications devices." However, more than 3 years after an external peer-review of the NTP studies found "clear evidence of carcinogenic activity," the FDA [109] has continued to downplay the importance of these findings and avoid conducting a quantitative risk assessment of the tumor data that they (the FDA) originally requested. In contrast to the FDA, Uche and Naidenko [185] analysed the NTP data on cardiomyopathy by a benchmark dose approach and found that the 10% extra risk level for this effect was in the range of a whole-body SAR of 0.2 to 0.4 W/kg. Thus, there is an increased risk (greater than 10%) of developing cardiomyopathy at local tissue SARs below 1.6 or 2.0 W/kg.

The peak spatial specific absorption rate (psSAR), as used by ICNIRP and the FCC, is an inadequate dosimetric of RF radiation at frequencies above 1 GHz. The psSAR is calculated by averaging fixed cubic volumes containing a given amount of mass, and assumes a homogeneous material with a given mass density. The ICNIRP recommendation is to average cubic volumes containing 10 g of tissue (10 g-psSAR), while the FCC recommendation is to average cubic volumes containing 1 g of tissue (1 g-psSAR). Current recommendations limit the use of psSAR to frequencies up to 6 GHz [3, 5].

An evaluation of the utility of using psSAR as a dosimetric parameter at different frequencies ranging from 100 MHz to 26 GHz and with cube sizes ranging from 10 mg to 10 g is shown in Additional file 2: Appendix 2. For the smaller cubes and lower frequencies, averaging in the cube does not underestimate the maximum value on the cube surface, but at higher frequencies the psSAR averaged on larger cubes can be several-fold lower than the psSAR averaged on smaller cubes. For example, at 2.45 GHz, averaging over a 10-g cube underestimates by 4 dB (approximately 2.5-fold) the psSAR averaged in smaller cubes, while for 5.8 GHz, averaging over a 10-g cube underestimates the psSAR by 12 dB (approximately 16-fold) compared with averaging in a 10-mg cube, and by 6 dB (approximately 4-fold) compared with averaging over a 1-g cube. When the frequency is increased, the underestimation of the psSAR averaged in larger cubes (e.g. 10 g or 1 g) compared to smaller cubes (e.g. 100 mg and 10 mg) becomes more pronounced. Considering the 10-g cube, the difference between the psSAR for 5.8 GHz EMF compared to 0.9 GHz EMF is around 7 dB (or approximately 5-fold underestimation). These large differences are due to reduced penetration of EMFs at higher frequencies. Therefore, the ICNIRP's 10 g-psSAR and FCC's 1 g-psSAR recommendations do not provide reliable dosimetric parameters to evaluate EMF absorption above 1 GHz.

The SAR averaging over a 10-g cube is also flawed for assessing carcinogenicity because it is too large a volume to focus on stem cells and their important role in carcinogenesis. Human stem cells were more sensitive to RFR exposures from GSM and UMTS mobile phones than lymphocytes and fibroblasts [175]. Instead of a random distribution of targets for carcinogenesis, localized distribution of SAR in smaller volumes is needed to more accurately characterize relationships between SAR and tumor induction. From the point of view of stem cell organization, the volume of SAR determinations may be especially important for setting safety limits for children, because most stem cells and their niches are spatially and temporally transient during brain development [188].

Assumption 12) *Exposure of any gram of cube-shaped tissue up to 8 W/kg, or 10 g of cube-shaped tissue up to 10 W/kg, (duration not specified) will not increase the risk of that tissue to any toxic or carcinogenic effects in workers.*

Based on the analyses of tissue dosimetry in the NTP study [187], organ-specific toxic and carcinogenic effects were observed in rats at local tissue SARs that were much lower than 8 or 10 W/kg [18]. The tissue dosimetry in the NTP study and the inadequacy of the local SAR as specified by ICNIRP and the FCC is described in assumption #9.

F. Environmental exposure to RF radiation

Assumption 13) *There is no concern for environmental effects of RF radiation or for effects on wildlife or household pets.*

While background levels of RF-EMF are increasing in the environment, including rural remote areas [189], neither the FCC nor the ICNIRP take into consideration effects of this radiation on wildlife. The constant movement of most wildlife species in and out of varying artificial EMF can result in high exposures near communication structures, especially for flying species such as birds and insects. There is a substantial amount of scientific literature on the disrupting effects of RFR on wildlife (e.g., [190–206]).

Many nonhuman species use Earth's geomagnetic fields for activities such as orientation and seasonal migration, food finding, mating, nest and den building [190]. For example, migratory bird species [191, 192], honeybees [193], bats [194], fish [195–197], and numerous other species sense Earth's magnetic fields with specialized sensory receptors. Mechanisms likely involved in magneto-reception include magnetic induction of weak electric signals in specialized sensory receptors [198], magneto-mechanical interactions with the iron-based crystal magnetite [194], and/or free-radical interactions with cryptochrome photoreceptors [191, 192]. Each of these sensing processes shows extreme sensitivity to low intensity changes in electromagnetic fields. For a fuller description of the mechanisms by which non-human species use magneto-reception to perform essential life activities see Levitt et al. [190].

The following studies represent a few of the many examples of the disrupting effects of low-level exposures to RF-EMF on magneto-reception and the natural behavior of wildlife. Oscillating magnetic fields have been reported to disrupt the ability of migratory birds to orient and navigate in Earth's geomagnetic field [199–202].

Garden warblers became disoriented by exposure to a weak oscillating magnetic field of 1.403 MHz at an intensity as low as 2–3 nT [200]. The orientation of European robins that use Earth's magnetic field for compass orientation was completely disrupted by exposure to electromagnetic noise in the frequency range of 50 kHz to 5 MHz or a broadband noise-modulated ELF covering the range ~ 2 kHz to ~ 9 MHz [199, 201]. RFR in the low MHz range (7.0 MHz of 480 nT or 1.315 MHz of 15 nT) has been shown to disable the magneto-reception avian compass as long as the exposure was present [202].

In addition to effects on migratory birds, Landler et al. [203] found that exposure to a low-level magnetic field (1.43 MHz at an intensity of 30–52 nT) disrupted the natural orientation of juvenile turtles hatched on land. GSM-modulated 900 MHz RF radiation caused ants to lose their visual and olfactory memory for finding food [166]. Navigational abilities of trout were reduced when reared under conditions in which magnetic fields were spatially distorted [204].

Activities of honeybees are also disrupted by exposure to RF radiation. GSM-modulated cell phone radiation (900 MHz) caused a reduction in egg laying by queen bees and depletion of beehive pollen and honey counts [205]. GSM-modulated cell phone radiation (900 MHz) reduced hatching and altered pupal development of honey queen bee larvae [206].

The lack of consideration of chronic low-level RF radiation exposure on wildlife could result in dangerously disruptive effects on fragile ecosystems and on the behavior and survival of species that have long existed in Earth's natural environment.

G. 5G (5th generation wireless)

Assumption 14) *No health effects data are needed for exposures to 5G; safety is assumed because penetration is limited to the skin ("minimal body penetration").*

Fifth generation (5G) wireless communication systems are being deployed worldwide to provide higher data transfer rates with shorter lag times between massive numbers of connected wireless devices. To provide faster transfer of large amounts of data (up to 20 gigabits per second peak data rates), the frequency range for 5G includes millimeter waves (30 to 300 GHz), in addition to carrier frequencies as low as 600 MHz. Extremely high frequency millimeter waves (MMW) that transmit large amounts of data to user devices are directed into narrow beams by line-of-sight transmission with beamforming antennas. Because millimeter waves do not penetrate solid structures such as building materials, hills, foliage, etc., and travel only short distances (a few hundred meters), denser networks of base-stations with massive Multiple Input/Multiple Output (MIMO) transmitters and receivers in millions of small cell towers are being installed on structures such as utility poles. These features can lead to much closer proximity between humans and radiation-emitting antennas, and thereby change individual peak and average exposures to RFR.

For a 5G frequency of 26 GHz, EMF absorption is very superficial, which means that for typical human skin, more than 86% of the incident power is absorbed within the first millimeter. The skin penetration depth was computed as 1 mm based on the electrical conductivity of the skin and its electrical permittivity [5, 207]. This is expected to bring the SAR in this tissue well above the recommended limits ([208], and Additional file 2: Appendix 2). This is also expected to be harmful to very small species, such as birds and other small animals (e.g., insects) [209]. It is often claimed that because of its shallow penetration, exposure to high frequency 5G radiation is safe, and that the only effect is tissue heating [210]. However, this view ignores the deeper penetration of the ELF components of modulated RF signals, which are rated on the basis of heat alone, as well as the effects of short bursts of heat from pulsed signals [211, 212]. Within the first 1 mm of skin, cells divide to renew the stratum corneum (a consideration for skin cancer), and nerve endings in the dermis are situated within 0.6 mm (eyelids) to 3 mm (feet) of the surface (a consideration for neurological effects). Ultraviolet light, which exerts its action at a penetration depth of less than 0.1 mm [213, 214] is a recognized cause of skin cancer [87].

The higher the frequency of electromagnetic waves, the shorter the wavelength and the shallower the penetration of energy into exposed people or animals. For example, penetration depth in the human body is about 8 mm at 6 GHz and 0.92 mm at 30 GHz [5]. Because of the minimal depth of energy absorption at frequencies above 6 GHz, the FCC and ICNIRP have based exposure limits on power density instead of on SAR levels. The FCC [3] proposed a general localized power density exposure limit of 4 mW/cm^2 averaged over 1 cm^2 and not to exceed 30 minutes for 5G services up to 3000 GHz for the general population, claiming that this exposure is consistent with the peak spatial-average SAR of 1.6 W/kg averaged over any 1 g of tissue at 6 GHz. ICNIRP's [5] exposure limits for 5G are an absorbed power density of 200 W/m^2 (0.2 W/cm^2) averaged over 4 cm^2 and a 6-minute interval for frequencies up to 30 GHz, and 400 W/m^2 (0.4 mW/cm^2) averaged over 1 cm^2 and a 6-minute interval for frequencies of 30 GHz to 300 GHz.

Because of its minimal penetration, exposure to 5G radiation results in higher energy intensity on the skin and other directly-exposed body parts, such as the eye

cornea or lens. However, the skin, which is the largest organ in the human body, provides important functions such as acting as a protective physical and immunological barrier against mechanical injury, infection by pathogenic microorganisms, and entry of toxic substances. In addition, skin cancers, including basal cell carcinomas and squamous cell carcinomas, are the most prevalent human cancers, while melanomas are highly metastatic and increasing in prevalence. Although the high incidence of skin cancers are largely attributed to exposure to ultraviolet light, no studies have been reported on the effects of 5G radiation on (i) the skin's ability to provide protection from pathogenic microorganisms, (ii) the possible exacerbation of other skin diseases, (iii) promotion of sunlight-induced skin cancers, or (iv) initiation of skin cancer by itself. Information is also lacking on the effects of 5G radiation on nervous and immune systems which are also exposed even by the shallower penetration of MMW.

Another important factor is the maximum bandwidth with 5G radiation, which is up to 100 MHz in the frequency range of 450 MHz to 6 GHz, and up to 400 MHz in the ranges from 24 GHz to 52 GHz, compared to previous types of mobile communication where bandwidth is limited to 20 MHz. Because many studies indicated frequency-dependent, non-thermal RF effects from mobile communication RFR [43, 177] and for MMW effects [215, 216], the possibility of effective frequency windows for biological effects would increase with the increased bandwidth of 5G radiation.

Another consideration for effects of 5G exposures on human health is that radiation pulses created by extremely fast data transmission rates have the potential to generate bursts of energy that can travel much deeper than predicted by conventional models [217, 218]. Neufeld and Kuster [105] showed that repetitive pulses of data in bursts with short exposures to 5G can cause localized temperature spikes in the skin leading to permanent tissue damage even when the average power density values were within ICNIRP's acceptable safety limits. The authors urged the setting of new thermal safety standards to address the kind of health risks possible with 5G technology:

> *"The FIFTH generation of wireless communication technology (5G) promises to facilitate transmission at data rates up to a factor of 100 times higher than 4G. For that purpose, higher frequencies (including millimetre-wave bands), broadband modulation schemes, and thus faster signals with steeper rise and fall times will be employed, potentially in combination with pulsed operation for time domain multiple access…The thresholds for frequencies above 10 MHz set in current exposure guidelines (ICNIRP 1998, IEEE 2005, 2010) are intended to limit tissue heating. However, short pulses can lead to important temperature oscillations, which may be further exacerbated at high frequencies (>10 GHz, fundamental to 5G), where the shallow penetration depth leads to intense surface heating and a steep, rapid rise in temperature…"*

Areas of uncertainty and health concerns with 5G radiation include potential increase in skin cancer rates with (or possibly without) co-exposure to sunlight, exacerbation of skin diseases, greater susceptibility to pathogenic microorganisms, corneal damage or early development of cataracts, testicular effects, and possible resonant-enhanced absorption due to skin structures [219]. One of the complex technical challenges in relation to human exposure to 5G millimeter waves is that the unpredictable propagation patterns that could result in unacceptable levels of human exposure to electromagnetic radiation are not well understood [220]. Although MMW are almost completely absorbed within 1–2 mm in biologically-equivalent tissues, their effects may penetrate deeper in a live human body possibly by affecting signal transduction pathways. Thus, there are too many uncertainties with exposure to 5G to support an assumption of safety without adequate health effects data. There are no adequate studies on health effects from short-term or long-term exposures to 5G radiation in animal models or in humans.

Discussion

To develop health-based exposure limits for toxic and carcinogenic substances, regulatory agencies typically rely on available scientific evidence about the agent under review. In the mid- and late-1990s when the FCC [4] and the ICNIRP [9] initially established exposure limits for RFR, the prevailing assumptions were that any adverse effects from exposure to RFR were due to excessive heating because non-ionizing radiation did not have sufficient energy to break chemical bonds or damage DNA. However, non-thermal effects of RFR are demonstrated from studies that find different effects with exposure to continuous waves versus pulsed or modulated waves at the same frequency and the same SAR or power density, e.g., [221–226], and from studies that show adverse effects at very low exposure intensities, e.g., [78, 96].

Acute exposure studies conducted in rats and monkeys in the 1980s [10, 11] suggested that an SAR of 4 W/kg could be a threshold dose for behavioral effects. Because this SAR was associated with an approximate increase in body temperature of 1 °C, it was again assumed that no adverse health effects would occur if increases in core

body temperature were less than 1 °C. From this putative threshold dose a "safety factor" of 10 was applied for occupational exposures and an additional factor of 5 (50x total) was applied for the general population, resulting in exposure limits in which the whole-body SAR was less than 0.4 W/kg for workers and 0.08 W/kg for the general population. However, realizing that local parts of the body could receive doses of RFR that were 10 to 20 times higher than the whole-body SARs, local peak exposure limits were set by the FCC at SARs 20-times higher than the whole-body SARs, i.e., 8 W/kg averaged over any 1-g of tissue for localized exposures for workers and 1.6 W/kg averaged over any 1-g for the general population [3, 4]. ICNIRP opted for partial body exposures that would not exceed 2.0 W/kg averaged over any 10 g of cube-shaped tissue for the general population [5, 9]. To rationalize the smaller safety factor for workers (10-fold) versus the general population (50-fold), one claim made by ICNIRP [24] is that workers are informed about risks associated with non-ionizing radiation exposure and how to reduce these risks, whereas "the general public are, in most cases, unaware of their exposure to non-ionizing radiation and, without education, cannot reasonably be expected to take precautions to minimize or avoid any adverse effects of exposure." From a public health perspective, the FCC and ICNIRP should make the public aware of their exposures to RFR and promote precautionary measures to minimize potential adverse effects, especially for children and pregnant women. Eight practical recommendations by the International EMF Scientist Appeal aimed at protecting and educating the public about potential adverse health effects from exposures to non-ionizing EMFs [227] are shown in Table 2.

The acute behavioral studies that provide the basis for the FCC's and ICNIRP's exposure limits lacked any information on potential effects of RF radiation that can occur after longer durations of exposure, and they did not address effects of carrier wave modulations used in wireless communications. Research on RFR conducted over the past 25 years has produced thousands of scientific papers, with many demonstrating that acute behavioral studies are inadequate for developing health protective exposure limits for humans and wildlife, and that inherent assumptions underlying the FCC's and ICNIRP's exposure limits are not valid. First, 4 W/kg is not a threshold SAR for health effects caused by RFR exposures; experimental studies at lower doses and for longer durations of exposure demonstrated cardiomyopathy, carcinogenicity, DNA damage, neurological effects, increased permeability of the blood brain barrier, and sperm damage (see Assumptions 1–3). Multiple robust epidemiologic studies on cell phone radiation have found increased risks for brain tumors (Assumption 6), and these are supported by clear evidence of carcinogenicity of the same cell types (glial cell and Schwann cell) from animal studies. Even studies conducted by D'Andrea et al. [89, 90] before the limits were adopted found behavioral disruption in rats exposed to RFR for 14 or 16 weeks at mean SARs of 0.7 W/kg and at 1.23 W/kg. A combination of exposure duration and exposure intensity would be more appropriate for setting safety standards for exposure to RFR from mobile communication systems including mobile phones, base stations, and WiFi.

More than 120 studies have demonstrated oxidative effects associated with exposure to low intensity RFR (Additional file 1: Appendix 1). DNA damage that has been reported in studies of RFR was most likely caused by induction of oxidative stress, which is a key characteristic of human carcinogens [88], rather than by direct ionization (Assumption 2). The generation of reactive oxygen species has also been linked to DNA damage and the carcinogenicity of UVA radiation [87] and asbestos [228]. Despite the enormous amount of scientific evidence of low-dose effects of RFR, the IEEE [229] maintains that behavioral disruption is still the most sensitive and reproducible effect of RFR. It is this opinion that contributed to the FCC [3] and ICNIRP [5] reaffirming their previous exposure limits to RFR.

Table 2 Precautionary Measures Recommended by the International EMF Scientist Appeal

1) Priority should be given to protect children and pregnant women
2) Guidelines and regulatory standards should be strengthened
3) Manufacturers should be encouraged to develop safer technologies
4) The public should be fully informed about the potential health risks from electromagnetic energy and taught harm reduction strategies
5) Medical professionals need to be educated about the biological effects of electromagnetic energy and be provided training on treatment of patients with electromagnetic sensitivity
6) Governments need to fund training and research on electromagnetic fields and health that is independent of industry
7) The media should disclose experts' financial relationships with industry when citing their opinions regarding health and safety aspects of EMF-emitting technologies
8) Radiation-free areas need to be established, especially for individuals with EHS

Other concerns about the current exposure limits for RFR are that they do not consider potential synergistic effects due to co-exposure to other toxic or carcinogenic agents, the impact of pulsed radiation or frequency modulations, multiple frequencies, differences in levels of absorption or of susceptibility by children, or differences among individuals in their sensitivity to RFR (see Assumptions 4, 5, 7, 8). Currently, children's cumulative exposures are much higher than previous generations and they continue to increase [230]. ICNIRP [23, 179] acknowledged that their guidelines do not accommodate sensitive subgroups and admit to difficulties separating "biological effects" from "health effects." Neurological symptoms, some of which are acknowledged by ICNIRP and currently being experienced by persons with EHS, are most certainly non-thermal "health effects" that need to be mitigated by providing environments with reduced exposures to anthropogenic EMF for hypersensitive individuals.

The debilitating effects and restrictions suffered by adults and children with EHS constitutes a contravention of the 2010 Equalities Act, Human Rights Act and other ethical and legal frameworks. Failure to respond and appropriately safeguard this group is already causing preventable morbidity, mortality and economic deficit due to lost workdays, compensations for health damages and increased healthcare costs. Conversely, accommodating this group by, as suggested by ICNIRP [179], acting to 'adjust the guidelines for the general population to include such groups' would not only lessen the negative impacts for people with EHS, but would also improve public health more broadly, given the other NIR-related health concerns that are highlighted in this paper.

Basing local tissue exposure limits on 1-g [3] or 10-g [5] cubes substantially underestimates the peak spatial SAR compared to basing local tissue exposure limits on smaller cubes (e.g., 100 mg or 10 mg), and therefore are not reliable dosimetric parameters to evaluate EMF absorption at frequencies above 1 GHz (Assumptions 11, 12). The volumes specified by the FCC and ICNIRP for local tissue SAR limits are too large to focus on stem cells which are important targets for carcinogenesis. To reduce health risks from exposures to RFR, limits for localized distribution of the SAR should be based on 100 mg, or preferably 10 mg cubes.

Another important deficiency raised in this paper is that neither the FCC nor ICNIRP addresses concerns for environmental effects of RFR on wildlife, even though there is extensive literature demonstrating the disrupting effects of RFR on wildlife behavior (Assumption 13).

The arbitrarily selected uncertainty/safety factors applied to the putative threshold SAR for RFR are woefully inadequate for protecting public health (Assumptions 9, 10). Based on the way the US Environmental Protection Agency, the International Council for Harmonization, and the National Institute for Occupational Safety and Health (US NIOSH) apply uncertainty/safety factors to a no-observed-adverse-effect level (NOAEL) in experimental animals [182–184], the safety factor for RFR would be at least 900 to 10,000, which is 18 to 200 times larger than the safety factor recommended by the FCC and ICNIRP for the general population. This large safety factor is based on adjustments for human variability, lifetime exposure from short-term studies, and database insufficiencies that include incomplete characterization of the toxicity of RFR. Clearly, the acute behavioral studies that served as the basis for the current exposure limits for RFR are not suitable for characterizing human health risks associated with long-term exposure to this type of radiation. The NCRP report from 1986 [6] and the ANSI/IEEE document from 1992 [7] recognized that when future studies on biological effects of RFR become available including effects of chronic exposures or evidence of non-thermal interactions there will be a need to evaluate and possibly revise exposure standards. When the FCC [3] and ICNIRP [5] reaffirmed their exposure limits from the 1990s, they dismissed the scientific evidence that invalidated the assumptions that underlie the basis for those exposure limits. An independent re-evaluation of RFR exposure limits based on the scientific knowledge gained over the past 25 years is needed and is long overdue. This evaluation should be performed by scientists and medical doctors who have no conflicting interests and who have expertise in RF-EMF exposure and dosimetry, toxicology, epidemiology, clinical assessment, and risk assessment. Special precautions should be taken to ensure that interpretations of health effects data and the setting of exposure limits for RFR are not influenced by the military or the telecommunications industry. In the meantime, manufacturers should be obliged to develop safer technologies [227].

Finally, we note our concern about the worldwide deployment of 5G communication networks for faster transfer of large amounts of data, but with no adequate health effects studies demonstrating the safety of high frequency millimeter waves. Because of limitations of the penetration and distance of travel of millimeter waves, dense networks of base stations are being mounted on structures such as utility poles in highly populated cities. Also, because the absorption of EMF at frequencies above 6 GHz is minimal, ICNIRP [5] has specified absorbed power density (S_{ab}) as the dosimetric parameter for "heating effects" at the higher frequencies. S_{ab} is a function of the incident power density (S_{inc}) and the input reflection coefficient (Γ). In near field scenarios, the S_{inc} does not have a singular value; this is largely due

to the heterogeneous nature of human body tissues and their relevant parameters (such as the permittivity, equivalent conductivity, mass density), which vary in different body regions and with frequency. Therefore, unless a powerful EMF simulation method together with realistic human models are used, the S_{inc} and the reflection coefficient values would be difficult to accurately estimate, making the resulting S_{ab} unreliable.

The assumption that 5G is safe at the power density limits recommended by ICNIRP (50 W/m^2 and 10 W/m^2 averaged over 6 min for occupational and 30 min for public exposures, respectively) because of its minimal penetration into the body does not justify the dismissal of the need for health effects studies prior to implementing 5G networks. The new communication networks will result in exposures to a form of radiation that has not been previously experienced by the public at large (Assumption 14). The implementation of 5G technology without adequate health effects information raises many questions, such as: Will exposure to 5G radiation: (i) compromise the skin's ability to provide protection from pathogenic microorganisms? (ii) will it exacerbate the development of skin diseases? (iii) will it increase the risk of sunlight-induced skin cancers? (iv) will it increase the risk of damage to the lens or cornea? (v) will it increase the risk of testicular damage? (vi) will it exert deeper tissue effects either indirectly following effects on superficial structures or more directly due to deeper penetration of the ELF components of modulated RF signals? (vii) will it adversely affect wildlife populations? Answers to these questions and others that are relevant to human and wildlife health should be provided *before* widespread exposures to 5G radiation occur, not afterwards. Based on lessons that should have been learned from studies on RFR at frequencies below 6 GHz, we should no longer rely on the untested assumption that current or future wireless technology, including 5G, is safe without adequate testing. To do otherwise is not in the best interest of either public or environmental health.

Abbreviations

ANSI: American National Standards Institute; CDMA: Code-division multiple access; dB: Decibel; DECT: Digital enhanced cordless technology; EHS: Electromagnetic hypersensitivity; ELF: Extremely low frequency; EMF: Electromagnetic field; FCC: Federal Communications Commission; FDA: Food and Drug Administration; GHz: Gigahertz; GBM: Glioblastoma multiforme brain cancer; GSM: Global system for mobile communication; IARC: International Agency for Research on Cancer; ICNIRP: International Commission on Non-Ionizing Radiation Protection; IEEE: Institute of Electrical and Electronics Engineers; LTE: Long Term Evolution (4G); MMW: Millimeter wave; NCRP: National Council on Radiation Protection and Measurements; NIR: Non-ionizing radiation; nT: Nanotesla; NTP: National Toxicology Program; 8-OHdG: 8-hydroxy-2'deoxyguanosine; psSAR: Peak spatial specific absorption rate; RFR: Radiofrequency radiation; ROS: Reactive oxygen species; SAR: Specific absorption rate; UMTS: Universal mobile telecommunications service (3G); UVR: Ultraviolet radiation; 5G: 5th generation wireless.

Supplementary Information

The online version contains supplementary material available at https://doi.org/10.1186/s12940-022-00900-9.

Additional file 1: Appendix 1 Table 1. Studies demonstrating increased oxidative DNA damage and other indicators of oxidative stress at SAR < 4 W/kg.

Additional file 2: Appendix 2. On the Inadequacy of the psSAR Dosimetric Parameter at Frequencies above 1 GHz. **Table 1.** Electric permittivity and electric conductivity of the gray matter. **Figure 1.** A block of gray matter radiated by different frequencies. The highlighted cubes are of 10 g, 1 g, 100 mg and 10 mg. **Fig. 2.** A block of gray matter radiated by different frequencies. The highlighted cubes are of 10 g, 1 g, 100 mg and 10 mg. **Fig. 3.** Electric field intensity averaged in each cube for different frequencies: in the left axis, the electric field is in dB and in the right axis the electric field is in V/m normalized to 100 V/m.

Acknowledgements

Igor Belyaev: Cancer Research Institute, Biomedical Research Center, Slovak Academy of Sciences, Slovakia
Carl Blackman: US Environmental Protection Agency (retired), North Carolina, USA
Kent Chamberlin: Department of Electrical and Computer Engineering, University of New Hampshire, USA
Alvaro DeSalles: Graduate Program on Electrical Engineering (PPGEE), Federal University of Rio Grande do Sul (UFRGS). Porto Alegre, Brazil
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Authors' contributions

IB, AD, CF, LH, PH, KK, DM, EMB, RLM, and IY drafted the initial sections of this manuscript: by IB (factors affecting dosimetry), AD and CF (absorption in children versus adults, peak spatial specific absorption rate), LH (human brain cancer risk), KK (sperm damage), DM and DM (5G), EMB (electromagnetic hypersensitivity), RLM (cardiomyopathy, carcinogenicity, neurologic effects, safety factors), and IY (oxidative stress and DNA damage). IY prepared Appendix 1, and AD and CF prepared Appendix 2. The authors who drafted sections of the manuscript, as well as CB, KC, SD, EK, AM, JMM, and WS reviewed multiple manuscript drafts and made revisions. All authors reviewed and approved the final manuscript.

Funding
The Electromagnetic Safety Alliance provided funding for publication costs.

Availability of data and materials
All literature citations are available online.

Declarations

Ethics approval and consent to participate
Not Applicable.

Consent for publication
Not Applicable.

Competing interests
IB, EMB, and AM have served as plaintiff's expert witnesses in cases involving radiofrequency radiation. All other authors declare they have no competing interests.

Received: 14 July 2022 Accepted: 8 September 2022
Published online: 18 October 2022

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Publisher's Note

The FCC Is Supposed to Protect the Environment. It Doesn't.

by Peter Elkind

In a mountainous forest in southwest Puerto Rico, workers cleared a patch to make room for a 120-foot cellphone tower intended for use by AT&T and T-Mobile. The site, as the tower company later acknowledged, destroyed some of the nesting habitat of the Puerto Rican nightjar, a tiny endangered songbird. Fewer than 2,000 are believed to be alive today.

In the northwestern New Mexico desert, a company called Sacred Wind Communications, promising to bring broadband to remote Navajo communities, planted a cell tower near the legally protected Pictured Cliffs archaeological site, which contains thousands of centuries-old tribal rock carvings.

And in Silicon Valley, a space startup pursued plans to equip thousands of satellites to use mercury fuel in orbit, even as an Air Force official at one of the possible launch sites voiced "extreme concern" that the toxic element could rain back down to earth.

You may be surprised to learn that these potential harms fall under the jurisdiction of the Federal Communications Commission. Few people think of the FCC as an environmental cop. It's known for regulating television and radio and overseeing the deployment of communications technology. But the agency also has a broad mandate to ensure that technology doesn't damage the environment. The task includes everything from protecting wildlife and human health to preserving historic sites and even preventing aesthetic blight.

This role is particularly critical now, as the FCC presides over a nationwide buildout for 5G service, which will require 800,000 new "small cell" transmitters, those perched on street poles and rooftops, often near schools, apartments and homes. But even with this massive effort underway, as ProPublica previously reported, the FCC has refused to revise its radiation-exposure limits, which date back to the era of flip phones. In addition, the agency has cut back on the environmental reviews that it requires while also restricting local governments' control over wireless sites.

And as the satellite-fuel example reflects, the FCC's ambit extends even into space. The agency is licensing thousands of commercial satellites at a moment when the profusion of objects circling the planet is raising concerns about collisions in space, impediments to astronomy, pollution, and debris falling back to earth.

To call the FCC's environmental approach hands-off would be an understatement. The agency operates on the honor system, delegating much of its responsibility to the industries that it regulates. It allows companies to decide for themselves whether their projects require environmental study. And if the companies break the rules, they're expected to report their own transgression. Few do. In the rare instances in which the FCC investigates, even brazen illegality is often met with a minor fine, a scolding "admonishment" or no action at all. (The FCC declined to make officials available for interviews for this article or to respond to questions sent in writing.)

The FCC's inaction can have dire consequences. For years, the agency refused to take action even as millions of birds died by flying into communications towers. Only after a federal appeals court castigated the agency for its "apparent misunderstanding" of its environmental obligations did the FCC take steps that addressed some, but not all, of the problem.

In most instances, the scale of damages is relatively small: a half-acre of demolished habitat, a mound of damaged Native American artifacts, an ugly tower looming over a national scenic trail. But the FCC authorizes thousands of projects each year, and the effects add up.

These days, the FCC's laissez-faire approach is sparking resistance. Hundreds of conflicts have erupted across the country, triggered by citizens fearing risks to their health from wireless radiation, harm to their property values, damage to the environment and the destruction of treasured views. Fights are raging from rural Puerto Rico, where protesters have been arrested for blocking roads used by cell-tower-construction crews, to New York City, where a dozen community boards protested the appearance of visually jarring three-story 5G poles on neighborhood sidewalks. In New York, state officials got involved, then a local congressman. Finally, in late April, the furor grew intense enough that the FCC was forced to act; it belatedly ordered a company to halt construction — after more than a hundred poles had been built — and begin the type of reviews that are supposed to be completed before breaking ground.

A 5G tower in New York City Credit: Amir Hamja/The New York Times/Redux

Environmentalists are routinely infuriated by the FCC's stance. The telecommunications industry, which is eager to avoid the costs and delays of reviews, is considerably happier. In 2014, the FCC hired its first full-time environmental lawyer, Erica Rosenberg. Her mission was an afterthought at the agency, she told ProPublica: "Everybody was set on deployment. These environmental laws just got in the way." Rosenberg finally quit in frustration in 2021. "It was just the culture of the place," she said. "Nobody cared."

The FCC's ecological role originated in the National Environmental Policy Act, passed in 1969 at a moment of fervor for protecting the earth. The law requires federal agencies to assess whether projects they've authorized will cause harm. The goal is to "assure for all Americans safe, healthful, productive and aesthetically and culturally pleasing surroundings."

The law mandates an exhaustive environmental impact statement for big federal projects, such as a new dam or highway. Smaller agency actions that are judged to pose a risk of significant harm, either individually or cumulatively, require a less detailed environmental assessment. Any finding of significant impact is supposed to trigger an effort to avoid or minimize the damage.

Since the anti-regulatory era under President Ronald Reagan, the FCC has largely abandoned direct environmental oversight. Using a provision of the law that allows agencies to grant themselves "categorical exclusions" — exemptions from any review — for actions they deem risk-free, the FCC removed review requirements for the vast majority of its actions. The only FCC actions still requiring review are those that fall into one of eight categories, including construction in protected habitat or wilderness areas, building in or near historic or Native American sites, projects that would significantly alter a site's "surface features" and towers taller than 450 feet. Aesthetic harms were dropped from routine consideration, even though NEPA required federal agencies to consider them.

Stricter rules were a "waste of time," according to comments cited by the FCC. In the decades since, the agency has never required a single environmental impact statement.

The FCC's blanket exemption for its actions went unchallenged by a White House office, called the Council on Environmental Quality, that was set up to review agency NEPA rules. Dinah Bear, who

joined the council under Reagan and served as general counsel there for 23 years, told ProPublica that "never should have happened. … It's completely abysmal."

By the time Republican Michael Powell took office as FCC chairman in 2001, the agency had yet to fine a single company for violating environmental rules. (At the FCC, he told ProPublica, environmental regulation is "chronically unattended to.") Powell vowed to get "serious" about enforcement, telling a congressional committee, "When you cheat, I'm going to hurt you and hurt you hard."

Powell took aim at a major obstacle to punishing violators, urging Congress to extend the FCC's unusually short one-year statute of limitations for prosecuting misconduct, which starts running from the date of an alleged offense, not when the violation is discovered. Congress refused; the rule remains in place today. Powell, who now heads NCTA, a Washington trade association representing the cable industry, calls the rule "ridiculous. You don't have a real statute if the offense can hide in the woods and by the time you know about it, it's too late."

Under Powell, the FCC proposed its first environmental fine against a company, citing a 180-foot cell tower built without approval near five historic sites in North Dakota, including a cabin where Teddy Roosevelt lived while hunting bison. The agency promptly dropped the matter after the company fought back.

Of the technologies the FCC oversees, broadcast and cell towers have long generated the most environmental controversy. They're mammoth eyesores. They emit wireless radiation. Their construction requires clearing the ground of trees and vegetation, pouring concrete and building fences, access roads and support structures.

Yet for decades, the FCC refused to address their most gruesome impact: dead birds. Drawn by red nighttime lights intended to warn aircraft, migrating birds were slamming into communications towers, crashing into their support wires or tumbling to the ground in exhaustion after circling the lights for hours. As far back as 1974, the agency had identified this as "a matter of concern."

Experts would later estimate the annual toll from North American towers at around seven million birds. In one much-cited tale of carnage, a researcher reported in 1996 that a 1,000-foot TV tower in Eau Claire, Wisconsin, had claimed more than 12,000 birds on a single stormy night.

"We don't have the resources to investigate or monitor sites," FCC attorney Ava Berland said at a 1999 workshop convened to discuss the bird issue. "What the FCC does is delegate our environmental responsibilities to our licensees and our applicants." Consideration of bird mortality, she noted, wasn't required.

The FCC resisted pleas to require environmental assessments of new towers as industry groups insisted that the bird-mortality estimates were grossly overstated. ("Not one member has witnessed

more than a few dead birds at one time," wrote the National Association of Tower Erectors.) In 2008, following a lawsuit by the American Bird Conservancy, a U.S. Court of Appeals panel scolded the agency's "refusal to take action," noting that the environmental law required agencies to assess the risks of their actions up front, "rather than wait until it is too late." It ordered the FCC to examine the problem.

As the agency slowly moved to do so, Joelle Gehring, then a biologist at Michigan State University, published a study suggesting that switching from steadily burning to flashing lights could cut bird mortality by as much as 70%. In January 2013, she joined the FCC as its first staff biologist, focused on reducing the toll.

In December 2015, the agency, with the FAA's concurrence, finally approved a requirement for all new towers over 150 feet to use flashing lights. But the FCC rejected pleas to mandate that the tens of thousands of existing towers be retrofitted. Gehring quietly launched a personal persuasion campaign, emailing tower operators individually with a plea to voluntarily make the shift. Just a third of the tallest towers, the ones most lethal to birds, have been switched over to date.

Erica Rosenberg was shocked by the FCC's approach to environmental oversight when she arrived at the agency in 2014. Then 53, Rosenberg had spent most of her career doing environmental work, with stints at the EPA, on the staff of congressional committees, as a consultant for nonprofits and as director of a public policy program at Arizona State University.

Part of her new job involved reviewing submissions involving broadcast and cell towers. Most could be built without any notice to the FCC. Environmental assessments were required only when companies volunteered that their project would be built on a sensitive site, one that fell into any of the eight categories on the FCC checklist. Projects near historic or Native American sites also required prior reviews by state and tribal officials to avoid or minimize any "adverse impacts."

But as Rosenberg and Gehring, the FCC's biologist, reviewed the reports, which were supposed to be submitted for FCC approval before construction started, they sometimes discovered photos revealing that the tower had already been built or trees and vegetation removed in preparation for building. It happened frequently enough that they even coined a term for it: "premature construction."

Such rule-breaking was rarely penalized. Companies were simply instructed to perform their own after-the-fact reviews; unless the companies confessed that they expected to cause harm, they were granted permission to build their tower.

In one rare instance in which a tower was blocked, it happened only because of the FCC's inaction — and only after the tower's developer had already damaged a sensitive site. In that episode in Puerto Rico, a developer had cleared scarce habitat of the endangered nightjar in 2014 before completing any environmental review. An uproar ensued, including a hearing in Puerto Rico's Senate. In 2017, FCC

officials finally drafted an order denying the developer the usual no-impact finding, citing the habitat destruction. But the denial was never issued, leaving the project on terminal hold. Even in this case, Rosenberg said, the FCC simply didn't want to set a precedent of formally rejecting a tower approval.

Much has escaped the FCC's notice. In 2020, Alabama's historic preservation office alerted the FCC about a 160-foot TV tower in downtown Montgomery, which had already been built and was operating within blocks of the state Capitol and the Selma to Montgomery civil rights trail, in violation of requirements to assess harm (including aesthetic impact) to any national historic site within a half-mile. Because the structure had been built more than a year earlier, the company was immune from any enforcement action.

Self-reporting is rare, according to FCC officials speaking on condition of anonymity. As one put it, "It's a game that gets played. A very small percentage of actual violations come to our attention." Industry executives seemed to confirm that indirectly in a 2017 Government Accountability Office report on FCC enforcement (which addressed all forms of agency enforcement, not just environmental). Nine stakeholders offered the seemingly improbable explanation that they had "lost the incentive to self-report potential violations" because they felt they'd be treated too harshly.

There was little evidence of harsh consequences in that same GAO report: Just 10% of FCC enforcement cases between 2014 and 2016 resulted in a monetary penalty, while 40% ended with a warning and the rest resulted in no action. In a 2018 email, the agency's federal preservation officer commented, "Industry treats our environmental rules like a joke."

A year into her time at the FCC, Rosenberg started keeping a color-coded enforcement cheat sheet listing the status of apparent violations crossing her desk, which was then happening at a pace of about one a week. Among them was the case of Sacred Wind Communications, the New Mexico company that had built a 199-foot cellphone tower without undergoing any cultural review near a site containing Native American rock carvings. (In an interview with ProPublica, Sacred Wind co-founder John Badal blamed the violations on an outside consultant and the company's failure to properly oversee him.)

Frustrated to see that the FCC's enforcement team wasn't pursuing many of these cases, Rosenberg began promoting the idea of sending violators public "admonishment letters" to deter future violations. After months of internal debate, a half-dozen letters finally went out in June 2016. But the agency declined to issue a press release publicly shaming the offenders, and it abandoned the effort months later.

The arrival of the 5G era stirred the FCC to make things even easier for the telecom industry. In September 2016, five senior agency officials met with 20 representatives from wireless and cell tower companies, including AT&T, Verizon and T-Mobile, who were eager to press their agenda. Jon

Wilkins, chief of the FCC's wireless telecommunications bureau, began by stating that "there is bipartisan support among the Commissioners for doing all that they can to help the industry with infrastructure deployment," according to a summary of the session obtained through a public records request.

The industry delegation laid out a wish list of changes aimed at making the 5G rollout cheaper and faster. After Trump appointees assumed majority control of the agency in 2017, the FCC would seek to give the industry virtually everything it wanted. The agency passed new rules limiting what local governments could charge for access to utility poles and restricting the aesthetic requirements they could put in place. In 2018, with one commissioner blaming "outdated NEPA procedures" for slowing 5G deployment, the FCC exempted most small cell sites from environmental, historic-preservation and tribal reviews. In 2019, the commission shut down reconsideration of whether its wireless-radiation limits adequately protect people and the environment.

Federal appeals court challenges overturned most of these actions. Citing the vast scale of the 5G deployment, one court rejected the FCC's claim that deregulating small cell sites would have "little to no environmental footprint." It wrote that the FCC had "dismissed the benefits of historic-preservation and environmental review in a two-sentence paragraph." A second appeals court later ordered the FCC to revisit the adequacy of its wireless-radiation safeguards, excoriating the agency for its "cursory analysis" of human health and environmental risks.

The FCC doesn't release the totals, but, according to current and former agency employees, companies overseen by the FCC now submit just a few dozen environmental assessments a year, down from several hundred in 2016.

The FCC's biggest environmental penalty ever — $10 million imposed on Sprint Corp. — stemmed from an investigation prompted not by the FCC, but by a wireless industry website called Event Driven. In May 2017, it published an internal Sprint memo detailing a "trial" aimed at speeding small cell deployment. The memo authorized Mobilitie, a Sprint infrastructure contractor, to start construction on scores of sites "without fully completing regulatory compliance." The FCC's consent decree in the Sprint case, made public in April 2018, noted that ignoring review requirements displayed "contempt" for regulatory authority. A spokesperson for T-Mobile, which purchased Sprint in 2020, said the violations occurred "long before" T-Mobile acquired it and "Sprint took steps to address their procedures at the time." Mobilitie, which paid $1.6 million in a separate consent decree, said the episode involved "less than 1%" of the small cell sites it has constructed and that the company has subsequently developed "a robust compliance program."

The latest environmental threat that falls under the FCC's jurisdiction is in the heavens. Because the agency has broad authority over communications, it also licenses commercial satellites. And under the FCC's watch, space is rapidly becoming a far more crowded place. Five years ago, there were fewer

than two thousand satellites in orbit. Last December, the FCC approved the deployment of 7,500 satellites by a single company, Elon Musk's SpaceX, that is building an extraterrestrial broadband network called Starlink. By 2030, experts project that as many as 60,000 satellites will be orbiting the Earth. In January the FCC approved the creation of a new Space Bureau to "better support the needs of the growing satellite industry."

The FCC has approved Musk's space armada, and many other satellite constellations, without requiring an environmental assessment, on the premise that, even cumulatively, they present no serious risk. (Musk has also argued that NEPA rules don't apply to space.)

The agency has rejected fears from multiple quarters that tens of thousands of satellites pose worrisome threats. These include toxic emissions from rocket fuels that could pollute the earth, deplete the ozone layer and worsen global warming; increased radio congestion and space traffic that could destroy other satellites and impede critical astronomy used for weather tracking, national security and science; and a growing threat of human casualties and property damage from falling bits of satellite debris. The GAO inventoried the concerns in a September 2022 report.

For more than a year, the FCC did nothing to stop a more imminent environmental threat that emerged in 2018. It involved a Silicon Valley startup called Apollo Fusion, which was developing a low-cost satellite thruster system that uses a secret, proprietary fuel: liquid mercury. Mercury has big advantages as a fuel, but it's also a toxic heavy metal that causes an array of harms to humans and the environment. NASA discarded it as a fuel option decades earlier. Ten years ago, the U.S. was among more than 140 countries that signed a United Nations treaty aimed at cutting global mercury emissions. But the restrictions didn't apply to space.

Apollo was engaging in discussions with multiple big companies interested in purchasing its mercury-fueled thruster for their satellites. Its website claimed the company had a signed contract with at least one customer, with plans for a trial launch by the end of 2018.

That November, Public Employees for Environmental Responsibility, a nonprofit that had been tipped off by a whistleblower, revealed Apollo's plans, warning that they could create an "eco-catastrophe." The group accused the FCC of abdicating its responsibility to protect the public and petitioned the agency to halt the use of mercury. Two experts voiced concern in a Bloomberg Businessweek article that much of the toxic mercury emitted in space would descend back to earth.

At least two companies in 2019 sought FCC approval to launch satellites using Apollo's mercury-fueled thrusters, FCC documents show. One later withdrew its request. The second, Astro Digital, applied in April for an experimental satellite license.

At what was then known as Vandenberg Air Force Base, a California site for the planned launches, an environmental reviewer in 2019 voiced "extreme concern" about flight "anomalies" that could allow

mercury “to enter the terrestrial or ocean environment,” according to documents obtained from a public records request.

In August, Astro Digital and Apollo executives insisted to FCC officials that the mercury they’d release in space would remain there and cause no harm. They pressed to move forward with the planned launch.

In mid-September, the FCC finally ordered Astro Digital to submit an environmental assessment covering Apollo’s thruster system. Astro Digital agreed to comply, but asked the FCC to reconsider whether it had the authority to order such an assessment, noting that it was “not aware that the FCC has ever requested such information from other satellite operators.”

The FCC never responded, either to grant Astro Digital’s request or to deny it, according to Apollo co-founder Mike Cassidy. “We spent a year and a half waiting,” he said. (Cassidy defended his company’s fuel while acknowledging that “you obviously have to be really careful with mercury from an environmental perspective.”) Astro Digital eventually withdrew its application and Apollo switched to another propellant.

In March 2022, a United Nations conference in Indonesia did what the FCC wouldn’t: It banned the use of mercury to propel spacecraft.

Doris Burke contributed research.

Marja Ambler

From: Aaron <renotahoesky@gmail.com>
Sent: Tuesday, August 1, 2023 5:11 AM
To: Marja Ambler; jhester@trpa.go; John Marshall
Subject: [BULK] NOISE COMPLAINT

Follow Up Flag: Follow up
Flag Status: Flagged

I don't know who to submit this too but if it wasn't already enough in my neighborhood of Oriole and Southwood next to this Old Elementary School East Shore Express garbage, now I am awoken from a deep sleep every night around 4 am from the road work on highway 28 half a mile away.
I can't sleep so I just drove the half mile over there to see what the hell is going on.
If it comes down to putting out millions of commuters or a few thousand working class trying to sleep, I say stop traffic for the millions.
The noise in this neighborhood is intolerable. Living in Lake Tahoe is becoming intolerable.
You need to uphold your thresholds! There are illegally loud vehicles all throughout every day and night, explosions coming from the construction stating at the old elementary school, and now this construction noise. They shouldn't running that much noise at this hour!
I AM SO TIRED!!!!

Marja Ambler

From: Ann Nichols <preserve@ntpac.org>
Sent: Monday, July 31, 2023 1:40 PM
To: Julie Regan; Marja Ambler
Subject: [BULK] FW: Washoe Commissioner Hill Proposes User Tax For Tahoe Basin

Marja, Please distribute to Governing Board and APC.
Thanks,
Ann

North Tahoe Preservation Alliance
P.O. Box 4
Crystal Bay, Nv. 89402
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www,ntpac.org
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Preserve Lake Tahoe (Video): https://youtu.be/WKzPL-EwEUw

TikTok Video: https://www.tiktok.com/@northtahoepreservation?_t=8XCELbNFbSt&_r=1

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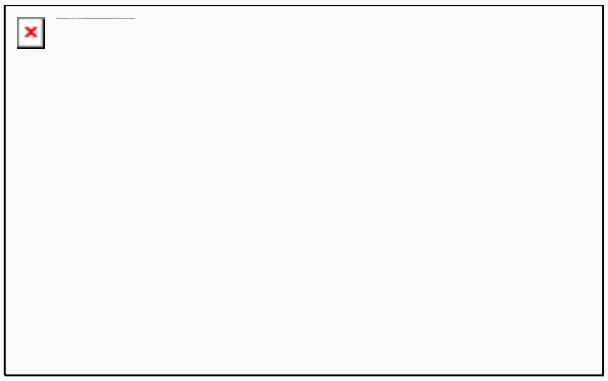

mmissioner Alexis Hill Proposes User Tax on Tahoe Basin Driv

ommissioner-alexis-hill-proposes-user-tax-on-tahoe-basin-drivers/

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d local government agencies build a billion dollar, concrete tourist attraction in North Lake Tahoe, without adequate parking, and that

n, you must have been graced with a little common sense–or, you're unfortunate enough to have been ensnared in the mile-long bac
ollar bike/walk path.

e of Lake Tahoe for nearly a decade, I watched (in horror) for years as the excavation of the billion dollar path was carved into the sid

vely easy in-and-out of the basin, or an enjoyable hike up Tunnel Creek, has devolved into a California-esque Sigalert of epic and da

y Rock is now scarred with bright red bus lanes and out-of-state cars parked on residential sidewalks of Lakeshore Blvd. Hidden and

or by locals, are now littered with trash from weekend warriors.

s told to stay home to protect grandma from catching a virus, not many people stayed home. In fact, many came to Lake Tahoe to es

ondary residence, which drove up rental and housing prices to astronomical and unaffordable levels for our local workforce.

tourists have created so much traffic that Fodor's recently listed Lake Tahoe as a "No Go Zone" due to congestion and ecological co

ant contributor to climate change."

contributor to revenue–an estimated $5 billion in revenue for the CalNeva basin.

as "natural attractions that could use a break" and proclaimed that "Lake Tahoe has a people problem."

estion?

the "people problem," their solution is to tax the people who live, work, and visit the basin and force people into electric buses, bikes,

e is referred to as "micro mobility."

sion Chair Alexis Hill (she/her/hers) took to Twitter to announce "user or roadway pricing to limit the vehicles in the basin and incenti

l such a critical point that it's time to adopt "user or roadway pricing to limit the vehicles in the basin and incentivize the use of public

airwoman Alexis Hillhttps://t.co/yD0khJ1Ryz

Hill (@VoteAlexisHill) July 22, 2023

Journal, Hill recognizes that the road to sustainability is marred with the consequences of the decisions of the numerous elected and

and once-manageable) section of Lake Tahoe:

l such a critical point that it's time to adopt "user or roadway pricing to limit the vehicles in the basin and incentivize the use of public

airwoman Alexis Hill in Reno, Nevada, the closest major city, about 20 miles northeast of the lake.

mber of people to take that view, Hill knows the idea that would have been dismissed out of hand a decade ago by hotels, casinos, s

osed to anything that might discourage visitors.

won't be easy, especially because of the multiple jurisdictions involved, including five counties in two states, individual towns, regulat

vice.

ople may have recognized we may already be getting to the point of unsustainability," Hill said.

ke Fodor's say, Don't go to Lake Tahoe,′ that's not good for us as a region. We need folks to visit here, but we need a system to man

stem doesn't sound so nice…or sustainable.

f residents have at monthly and quarterly community meetings— led by consultants and bureaucrats— that a tourist attraction will, in

ination.

ere were plenty of tourists who sustained our local economy without being "managed by a system."

likely rent a car for the duration of their stay.

boring California, they will take an easy 90-minute drive to the basin which can result in traffic jams that stretch to Sacramento.

npopular "mobility hubs" are in locations in the basin **that tourists have to drive to** to catch an ecologically-friendly bus.

n is made up of laborers who tend to the uber-wealthy along the lake and the small businesses who make the community stronger a

ctric bikes, scooters, or buses to carry their equipment or supplies to their job sites.

d efficient gas guzzling trucks or cars to haul their equipment, and soon it looks like they will be charged a fee for commuting to, or liv

l tourism official who reiterated the concerns held by a variety of local workers and residents of the basin:

sustainability logic related to micro-mobility or bussing people around the lake. The Casinos in the basin rely on cars for their busine
South Lake Tahoe will rely on cars for their business. This whole idea to eliminate cars from the basin doesn't make sense. The area
and want to drive to in order to tour the area. They aren't going to be forced into public transit, especially when there is no infrastructu

e Tahoe Transportation authority can be found here.

in 2019, they are now outdated due to rising energy costs, transportation costs, and inflation.

Commuter and Tourist pricing for Tahoe Basin (Photo: Tahoe Transportation Authority)

ommissioner Hill and Andy Chapman, CEO of Travel North Tahoe Nevada, in order to receive clarification on current travel pricing/fe
and government entities involved in “sustainability planning” for the basin.

eir comments if and when received.

on the billion dollar bike path in the summer due to the temperature of the materials used in parts of the trail. Dog booties or wagons

---

North Tahoe Preservation Alliance
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775-831-0625
preserve@ntpac.org

Marja Ambler

From: Ann Nichols <preserve@ntpac.org>
Sent: Friday, July 28, 2023 10:45 AM
To: Rinnn; Gavin Feiger; Julie Regan; Kristina Hill; leah kaufman; Vince Hoenigman; Cindy.Gustafson; Alexis Hill; Alexis Ollar; Tobi Tyler; carolyn willette; jmtornese@aol.com; Ron Grassi; somis5@cs.com; Marja Ambler; kathiejulian@gmail.com; rondatycer@aol.com; Carole Black
Cc: Doug Flaherty; Ellie
Subject: Re: height question and affordable housing definition.

Follow Up Flag: Follow up
Flag Status: Flagged

Marja- please distribute to GB and APC.

With the current supposedly improved achievable definition, Larry Ellison could comply with achievable housing, (a TRPA /mt housing made up term) All he would have to do is buy a local business license and claim to work 30 hours a week. There is no maximum income cap. No sales price cap. No rental cap. Billionaires can qualify. Retirees can qualify if they get a business license locally. No need to have lived here seven years. The new definition is worse than it was before. at least before you couldn't make more than $450,000 and washoe or $350k and Placer. Which was rediculous. It appears that TRPA is not capable of dealing with deed restricted housing definitions, unless they just keep it to affordable housing-120% or less of average median income. Forget, achievable housing period.
Thanks
Ann

Sent from my iPhone

> On Jul 27, 2023, at 6:20 PM, Rinnn <rinnn@aol.com> wrote:
>
> did he show up?
>
> On Wednesday, July 26, 2023 at 11:12:30 AM PDT, Ann Nichols <preserve@ntpac.org> wrote:
>
> There are holes to drive a truck through…it's worse than before. Hopefully I'll see you at the meeting tonight.
>
> Ann

North Tahoe Preservation Alliance

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"Helping preserve the natural beauty and rural character of North Lake Tahoe"

Preserve Lake Tahoe (Video): https://youtu.be/WKzPL-EwEUw

TikTok Video:
https://www.tiktok.com/@northtahoepreservation?_t=8XCELbNFbSt&_r=1

Instagram Video: https://www.instagram.com/northtahoepreservation/

From: Gavin Feiger <gavin@keeptahoeblue.org>
Sent: Tuesday, July 25, 2023 3:20 PM
To: Ann Nichols <preserve@ntpac.org>; 'Karen Fink' <kfink@trpa.gov>
Cc: 'Alyssa Bettinger' <abettinger@trpa.gov>; 'Rinnn' <rinnn@aol.com>; 'Alexis Ollar' <alexis@mapf.org>; 'Jeff Cowen' <jcowen@trpa.gov>; 'Chris Egger' <christopher.j.egger@gmail.com>
Subject: RE: height question and affordable housing definition.

There are some interesting edge cases like this. Joining most if not all of the public meetings where this was discussed, there may be some loopholes but it makes it more possible for the "missing middle" to be able to buy and stay in Tahoe. Part of the goal was to make it so remote workers making, for example, Bay Area salaries, couldn't qualify. Deed restricted housing is generally not what high income earners want to live in.

As with everything, monitoring and adaptive management is the best way to develop effective policies over time.

Ann – I'm interested to hear your thoughts on what a more effective definition or process for qualifying for deed restricted housing might be.

Gavin Feiger

Senior Land Use Policy Analyst, League to Save Lake Tahoe
Subscribe | Instagram | Facebook | Twitter | Donate

2608 Lake Tahoe Boulevard, South Lake Tahoe, CA 96150 | 530.541.5388 | keeptahoeblue.org

---

From: Ann Nichols <preserve@ntpac.org>
Sent: Tuesday, July 25, 2023 8:03 AM
To: 'Karen Fink' <kfink@trpa.gov>
Cc: 'Alyssa Bettinger' <abettinger@trpa.gov>; 'Rinnn' <rinnn@aol.com>; Gavin Feiger <gavin@keeptahoeblue.org>; 'Alexis Ollar' <alexis@mapf.org>; 'Jeff Cowen' <jcowen@trpa.gov>; 'Chris Egger' <christopher.j.egger@gmail.com>
Subject: RE: height question and affordable housing definition.

I have a business license in Placer Tahoe. So I qualify for deed restricted housing? No other limitations?

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https://www.tiktok.com/@northtahoepreservation?_t=8XCELbNFbSt&_r=1

Instagram Video: https://www.instagram.com/northtahoepreservation/

From: Karen Fink <kfink@trpa.gov>
Sent: Tuesday, July 25, 2023 7:50 AM
To: Ann Nichols <preserve@ntpac.org>
Cc: Alyssa Bettinger <abettinger@trpa.gov>; 'Rinnn' <rinnn@aol.com>; Gavin Feiger <gavin@keeptahoeblue.org>; 'Alexis Ollar' <alexis@mapf.org>; Jeff Cowen <jcowen@trpa.gov>; 'Chris Egger' <christopher.j.egger@gmail.com>
Subject: RE: height question and affordable housing definition.

Hi Ann,

That's correct. You need to have a business license or tax address within the Tahoe-Truckee region. Otherwise your household income needs to be below 120% of AMI.

-Karen

From: Ann Nichols <preserve@ntpac.org>
Sent: Monday, July 24, 2023 11:48 AM
To: Karen Fink <kfink@trpa.gov>
Cc: Alyssa Bettinger <abettinger@trpa.gov>; 'Rinnn' <rinnn@aol.com>; Gavin Feiger <gavin@keeptahoeblue.org>; 'Alexis Ollar' <alexis@mapf.org>; Jeff Cowen <jcowen@trpa.gov>; 'Chris Egger' <christopher.j.egger@gmail.com>
Subject: RE: height question and affordable housing definition.

65’ is completely inappropriate for North Shore, but you’ve heard that nonstop.

Your achievable housing definition has no income cap. Correct?

So if you work 30 hours per week in the basin and are self employed and have a business license. Do you qualify?

Thank you,

Ann Nichols

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Instagram Video: https://www.instagram.com/northtahoepreservation/

From: Karen Fink <kfink@trpa.gov>
Sent: Monday, July 24, 2023 8:48 AM
To: Ann Nichols <preserve@ntpac.org>
Cc: Alyssa Bettinger <abettinger@trpa.gov>; 'Rinnn' <rinnn@aol.com>; Gavin Feiger <gavin@keeptahoeblue.org>; 'Alexis Ollar' <alexis@mapf.org>; Jeff Cowen <jcowen@trpa.gov>
Subject: RE: height question and affordable housing definition.

Hi Ann,

We haven't specified a max height yet for the 5 stories but our research indicates 5 stories would be between 59 and 65 feet. In our next iteration we will specify a specific height and welcome feedback on that.

The affordable and achievable housing definitions are in Chapter 90 of the code, starting on page 630 of the .pdf.

Karen Fink, AICP

Housing and Community Revitalization Program Manager

Office: 775-589-5258

kfink@trpa.gov

TAHOE REGIONAL PLANNING AGENCY
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From: Ann Nichols <preserve@ntpac.org>
Sent: Tuesday, July 18, 2023 9:54 AM
To: Karen Fink <kfink@trpa.gov>
Cc: Alyssa Bettinger <abettinger@trpa.gov>; 'Rinnn' <rinnn@aol.com>; Gavin Feiger <gavin@keeptahoeblue.org>; 'Alexis Ollar' <alexis@mapf.org>
Subject: height question and affordable housing definition.

Karen,

In TRPA's proposals to update height, density and coverage, in town centers you talk about 5 stories, but multi-family no more than 48'. What is the maximum feet for 5 stories? According to my calculations it could be as much as 60'. 15' main floor and four 12' floors. What is the latest iteration of what TRPA is considering?

What is the latest iteration of achievable or affordable housing definitions? We are trying to compare Placer to TRPA to Washoe.

Thank you,

Ann Nichols

Marja Ambler

From: leah kaufman <leah.lkplanning@sbcglobal.net>
Sent: Sunday, July 30, 2023 10:53 PM
To: Marja Ambler; Crystal Jacobsen; Stacy Wydra
Cc: leah kaufman
Subject: Fw: Comments March 23 TBAP

Follow Up Flag: Follow up
Flag Status: Flagged

(Marja please distribute to the board members)

Dear Governing Board Members

I have forwarded for you the comments from the March 23, 2023, public workshop regarding amendments to height and length as part of proposed TBAP amendments that the County and TRPA staff presented to the public. Renderings were presented showing varying lengths for buildings and heights to 62 feet plus more height for mechanical equipment, roof top decks etc.

The TRPA and Placer County staff facilitated this workshop as well as over a hundred community members or more. Placer County probably has exact numbers for this info.

As you can see, there is not one supportive comment for increased height and Ski Run type village lengths for our Northshore Town Centers.

In 2017 the County and TRPA approved building heights to 56 feet on the mountainside and 48 feet on the lakeside in Town Centers as part of our area plan approval.
(The public wanted even less height on both the lake and mountainside, but this was a huge compromise).

Now the TRPA would like to approve 65 feet of height and five stories for "achievable housing" in the Town Centers, 100 percent land coverage and unlimited density. The tallest current building is under 48 feet and is affordable housing (Domus). It did receive a density override increase. Any larger buildings would look completely out of scope and scale with what currently exists and what was a community vision after 2 years and 35 developers, community members and business owners working together to craft the Area Plans.

As a 40-year Tahoe Basin land planner I don't understand how the public is treated with such disdain and am disappointed in both the TRPA and the County who seem to have lost touch with the "endangered species" the locals have become. How can one compete with 15,000,000 tourists and a billion-dollar tourist driven economy, yet we are the better Stewards of the Lake treating it with the respect it deserves and cleaning up after the tourists who leave their trash, microplastics and now lead. Is it not fair for a community to craft their own vision? We want infill redevelopment and housing that is fair for all, but we need to fix the existing problems first before we continue to build even more.

The problems of (too many STR's, placement of the STR's, Luxury condos with no workforce component, a fair policy for housing between the two states, not allowing McMansions, define community character and work harder to fix and incentivize the owners of the boarded buildings such as the Garni for workforce, work with the hotels and ski areas and other larger employers to place J-1's on site, make the ADU's and JADU's easy to obtain), then maybe there would not be so much resistance. The architects and designers should be able with good design to make projects work within the 56 feet that other ski communities don't exceed.
I will continue to research and learn as much as possible about other areas with problems similar to ours and hope that the board members also engage in hearty debate and maybe listen to the people who do not want the excessive heights and massive village style development.
Thank you.

Leah Kaufman - Land Use Planner

.

https://www.placer.ca.gov/DocumentCenter/View/71747/TBAP-Workshop-032323-Comments

Marja Ambler

From: skitumbleweed <skitumbleweed@gmail.com>
Sent: Wednesday, July 26, 2023 9:26 PM
To: Alexis Hill; Jacob Stock; Jeff Cowen; Sara Schmitz; Ann Nichols; Marja Ambler
Subject: A rock concert gone wrong---TRPA style--Firestorms, terrorism, and no exit!!!

Follow Up Flag: Follow up
Flag Status: Flagged

Well Alexis, you along with TRPA have successfully destroyed my community of Incline Village.

What part of immensely stupid is it that you folks don't understand, Alexis? You don't need to have a high education or language ability or math ability or whatever to understand the danger presented to IV/CB and all the folks that visit our East Shore beaches.

Alexis, you allowed this nonsense to happen to IV and the East Shore beaches??? Really? What were you thinking??? God almighty!! What is this nonsense???

When you keep building and keep packing people in, something bad will happen sooner or later.

Think bump stocks, Ariana Grande concert, Vegas, Paradise, and on and on. What you have done is create a logistics and environmental hell scape of the East and North Shore of Tahoe. Waves of people like goats descending on our forest floors and destroying all life. All these people and cars and boats are sitting in a perfect death trap that firemen, medical folks, and law enforcement are unable to get to or help. It's perfect for evil.

The forest soil is totally ruined. Trails all over and a sick unhealthy trampled forest. It's lame!!!

Never mind the environmental destruction and bogus economics of allowing all these people to show up on our beaches and in my community to freely destroy it all free of charge!! Who runs a business like that? Who? It's like if you folks ran Costco folks would come in and steal everything and burn the building down. All free. And the kids are left to cower in the cold rain or to bake in the hot sun!!! What's up with that?

It's like an epic rock concert with no metal detectors and terrified law enforcement and fire officials. That's the east shore beaches of Tahoe and Incline Village!!!!

If I were a bank or insurance company I'd pull the rug out from under TRPA.

With all the horrible things in this world you folks threaten my community and make my community terribly unsafe with all these people. Any nut job would see the perfect opportunity. They could drop in with weapons and light fires on a windy day and my community would suffer a mass casualty event that would make Paradise or 9/11 look tame. It is horribly terrible. Awful. Zero chance of firemen or law enforcement being able to help. They might flat out run for their lives if things go wrong.

Elbow to elbow. Elbow to elbow. Elbow to elbow people walking all over you. That is jacked up stupid Alexis!!!

I don't see rock concerts operated this way. Typically they screen and have ample security and many exits for people to run. I don't see that with this Highway 28 situation in Incline Village or from IV to Spooner on H28. It's all danger and way way too many people. Elbow to elbow just waiting for the inevitable with nowhere to run or hide. The car is pointless. You'll die for sure trying to drive away.

That entire east side stretch of H28 should be closed to parking. You need to flat out half the human numbers and 2/3rd reduce the number of watercraft. It's a $hit show all around on the East and North Shore.

And how do Native American people feel? Shucks those folks despise seeing their once sacred grounds wrecked like this. It's shameful and disgusting.

If any member of my family is killed by fire or domestic or international terrorism or my property damaged politicians and TRPA will be criminally liable. I will be enormously bitter over the matter and fight it out in court and win a multi billion dollar settlement over the matter. One billion U.S. dollars for every family member killed and one billion for any damage to my property.

You folks should be liable for a trillion dollars in damage if my community suffers a mass casualty event. A trillion U.S. dollars paid in full. All of it. Every penny. And jail time for criminal liability.

With all the war around the world you greedy dirty scoundrels allow this and do this evil to my community. You know this is wrong. You know that!!!! You know the risk with all these people and development in my community and you know this is wrong and you know there is no chance fire and law enforcement officials can handle this. Zero. Time and time again massive waves of people and parking violations and not one ticket or tow. Officers hate this and fear this scenario!!!

Your hospital systems would suffer unbelievably in such an event!!! They can never handle a massive flow of dead and dying and injured people if such a thing happens. Never!!! They are nowhere near even being capable.

A nut can come in and start fires on a windy day and pull out a machine gun. It's bogus.

You all get a full throttle F grade on public safety!!!

Does not matter for a ski resort or beach. It's way too many people and a massive public hazzard and every terror organization in the USA and world is looking at it now. Especially seeing the traffic jams and publicity. Everyone knows what the threat is.

It's an easy kill zone now!!! Real easy!!!

I don't like it!!!! And if I don't like it then that is bad for all that supported this bull$hit!!!

I suppose it is maybe a register my opinion day and when folks die you can look at this opinion and feel like an a$$ in life!!!

A bunch of darn fools!!!

Tim Delaney.....I stand by my words on this matter....What TRPA has done is very wrong!!! Nevada should pull out and protect their citizenry from this!!!

Marja Ambler

From: skitumbleweed <skitumbleweed@gmail.com>
Sent: Monday, July 31, 2023 8:10 PM
To: Alexis Hill; Ann Nichols; Sara Schmitz; Marja Ambler; Jeff Cowen; Jacob Stock
Subject: Day trip human population limit topic

Follow Up Flag: Follow up
Flag Status: Flagged

It is not true that toll roads cannot be put in place. These statements are totally false.

Public safety always wins in court at the Fed and State level.

Hence, flood the place with people and kill residents will without a doubt incur huge criminal and civil liability going forward.

No engineer places themselves in front of that.

Tim Delaney

Marja Ambler

From: skitumbleweed <skitumbleweed@gmail.com>
Sent: Monday, July 31, 2023 11:35 PM
To: Ann Nichols; Alexis Hill; Sara Schmitz; Marja Ambler; Jacob Stock; Jeff Cowen
Subject: The Honorable Judge Kickbacks, Payoffs, and Bribes

Follow Up Flag: Follow up
Flag Status: Flagged

Well the Judge comments are a concern. The whole concept that growing up in Incline the judicial system did not always let us off easy. And that includes some officers too. Some officers I grew up with as a kid and those officers and I suffered tickets and sometimes a county jail incident. So. I paid my way. Paid for my college. And supported my family when I was a teen. And more. Same goes for my law enforcement friend. They are just people after all. Even law officers are not perfect.

I am sure law enforcement and fire officials feel just like I do. These individuals risk their lives by simply patrolling H28. And I risk my life too to check on my Mom in a Carson City memory care facility. Yep. And Guardianship was rough all around for me. And POA was rough too. And the other Grandmother was roughed up when her husband died.

So I think about all that. And I risk death with my family on H28 driving back from Carson and you have all these tourists from inside Nevada or from all over the world violating our laws clearly and parking over the white line in the road. This is a physical obstruction on a highway that can kill me and my friends and even kill law and fire officials or even Alexis Hill or the Carson County commissioner.

Yep. We can all easily die in a fire or terror episode. And this Judge that is not backing up the tickets is another enabler of our doom.

And you folks at the mobility hub meeting told me that this judge tosses the tickets??? Is this a joke?

So we all risk our lives and our entire community is endangered and this judge tosses these tickets and creates conditions where officers cannot even uphold basic traffic law in the interests of the safety of the general public? I have never heard of such a thing in my life!!? Yep. This is odd for sure. This Judge impedes a local Carson or Washoe county officer or even Nevada State Highway officer that is trying to do his job to ensure my safety when I travel on H28 with my family. Nice.

So this is going on and I am being tortured with guardianship legal documentation and working myself to death worrying about my Mom. Meanwhile this other Judge is sticking it to my entire community while I struggle in life. Nice.

And you folks think it's ok to entertain this mobility hub with this going on? And also having our community endangered with all this overcrowding of people and cars? Is this a joke or a bad dream here?

Yep. You need to put in toll roads that tax tourism and count tourists specifically. Do not tax the local homeowners and workers or anyone living in IV/CB. You can have a small tax maybe. Residents might accept that if it improves their situation massively and helps fund keeping down the human numbers. Not sure how they'll react. Do understand they don't want you attempting to gouge them tax wise in the future. So solid understandings must be developed that have real teeth to protect IV/CB.

Aside from that, the tourist numbers must be controlled. And it's time to make them pay for the damage to our community and environment. Homeowners did not ask for this. And folks working in the community should not be

paying punishing taxes. But the tourists need to be charged and numbers controlled. Once the place is full tourism must be routed back out. Locals that own property and workers in IV/CB can come into the area.

However it's done. You need to implement it and flush out the details. And tax wise you'll have to be open with the community on that one. It may be that the community does not pay. Or maybe Washoe and Carson county as a whole pay to create it and any tax for IV/CB is minimal?

Whatever the case our community cannot be destroyed by these outrageous acts perpetrated against it.

Certainly law enforcement and removal of the east side of H28 parking will help. West side of H28 can be fine as long as it's reasonable in spots with minimal potential for road erosion or damage to the road bed. But the enforcement and denial of parking on H28 and in Incline Village must be real. Human levels must be brought back to early 90s levels. 90s levels is about all the region can handle human wise. So there really is no option other than removing that human footprint and chopping the watercraft impact by 2/3rds. Then the Bald Eagle and general environment can thrive just a little bit. Currently the environment is being totally destroyed. So I am shocked by all this nonsense.

So this Judge Honorable Kickback, Payoffs, and Bribes needs a talking to or this Judge needs to be removed or recused from the bench. Whatever the case the behavior may not even be legal. Maybe he is the Judge Honorable Crack Pipe or something. Whatever the case, this Judge is bogus. It's Nevada folks!!!! Not surprised. Unphased!! At least we are not in the deep south!!

Also are the Federal Law Violations in not upholding fundamental public safety concerns? The Judge can be liable for my death and that of my community in the event of fire or terrorism too.

If anything bad happens someone must pay!! Someone is liable. So who is it???? The Judge?

Who sticks their neck out for this?? Who?? Do realize the community will demand that. After all this thought our community is not going to just sit here and be abused.

Nice to know all is crooked. A bit bummed about the world I and my kids are in. It's pretty darn lame I'd say.

You good with this Jacob? What about you Jeff at TRPA?

What if say Jacob's family died in a car accident on H28? Is that a good thing??? You now have a kid in this world. Just like me. You folks at TRPA better start wondering a lot about this. It's stupid all around folks. You TRPA folks cannot realistically be OK with all of this. No way.

Who is the engineer to execute on these concepts? Who? And the Judge tosses tickets and cops run scared. Hmmmmmm. No wonder I saw no tickets and doom and lot's of chaos on H28. Hmmmmm.

Tim Delaney

Marja Ambler

From: skitumbleweed <skitumbleweed@gmail.com>
Sent: Monday, July 31, 2023 8:40 PM
To: Alexis Hill; Ann Nichols; Sara Schmitz; Marja Ambler; Jeff Cowen; Jacob Stock
Subject: The Officer Jon Weber Memorial Toll Road System

Follow Up Flag: Follow up
Flag Status: Flagged

So.

Criminal and Civil liability risk says checkmate and I win at the Federal and State level. And yes, if any IV/CB resident in state or out of state homeowner dies from a fire or terror incident whereby law enforcement and fire officials and hospitals are overwhelmed those residents can indeed collect for each resident billions of US dollars in a settlement. That is a fair ball. More so when folks present the obvious danger.

Not to mention this great idea of a mobility hub could even kill the fireman and police officer. And that is bogus junk in my book. It's an emphatic NO. Just like telling the kid NO to candy.

As an engineer or politician I would never allow my reputation to be tarnished in such a way. And that is why I told you folks that as an engineer I never took my marching orders from any of my bosses. I owned my situations to protect my interests.

No responsible engineer will bless this knowing the environmental and community hazards. There are too many ways for a lawsuit including the endangered species act regarding the bald eagles.

I'd ditch the idea and put in the toll roads. The toll roads are a better legal battle to get in front of. Much better than a bunch of dead people and melted asphalt from a fire.

Oh by the way----Some Judges are fools. I remember my buddy in the Bay Area had to go to court for a traffic ticket....The Judge was chained to his desk. He had to do community service for a DUI. So just because one Judge makes a problem does not mean that others will rise up and defend a community against evil. Remember that. Civil and Criminal liability for a killed community is sometimes very real.

You would be wise to go along with my engineering guidance on this one. Fighting a few dumb Judges and Politicians is soooooo much better than an angry community with burned homes and killed family.

I am a no bull$hit engineer. Better than Elon Musk. Think about it.

How much was Paradise money wise??? IV/CB may be a trillion dollar lawsuit and ruined careers. And folks will not want to even show their faces after such an event.

So yep. You folks are soooo wrong that you cannot limit these people. Very wrong. The property owners have the upper hand.

I have the Gold. I rule.

Tim Delaney

Marja Ambler

From: skitumbleweed <skitumbleweed@gmail.com>
Sent: Wednesday, August 2, 2023 11:01 AM
To: Ann Nichols; Jacob Stock; Jeff Cowen; Marja Ambler; Alexis Hill; Sara Schmitz
Subject: TRPA cannot legally change any code

Honestly Ann,

Considering what we now know about the Judge that would not enforce tickets on H28 and officers not ticketing when public safety is clearly endangered, TRPA cannot change any of these codes without violating laws on public safety.

To change codes you have to have engineers willing to go to prison for it. Engineers are the holders of power and they are the ones that say yes or no. Engineers are the ones that assume liability on these things.

It's not like who is the CEO or CFO or politician when a building comes down and kills a thousand people. It's who is the engineer that gave the green light to this? Who? Who do we send to prison when an entire town is burned to the ground and people die? Who?

So if there is no engineer willing to sign off and risk a prison stint when people die then what TRPA is doing is against the law!!

I purchased my home full knowing what is allowed. I read the documents. Politicians and focus groups and political consultants cannot just come along and change building codes and laws. They must ask engineers to put their career and lives on the line. That's how it works.

Some business groups cannot just ask a politician to change a code so some idiot can build a plutonium mine in my backyard!!!

That is why engineers are not always friendly. Do you think I allow a boss or politician to run the show and tell me what to do? NO!! I don't allow anyone to tell me what to do. I tell everyone else what to do. I am the boss on every job!! I hire bosses to keep people out of my engineering work. That's how it works. Every engineer knows this.

This is how engineers behave. They all know that if people are injured then everyone comes for them. Who is the engineer that did this.

Where are the logistics and public safety engineers?? Where? Big number engineers looking at risk and traffic flow? Where are they? All militaries have these engineers too.

So....TRPA folks. You better hear me. If you folks kill or injure my community or financially damage my community or even harm my way of life it's possible that you folks could land in prison. Remember that.

Get Incline people or any tourists killed with your death trap congested roadway nonsense and folks can absolutely file very expensive and damaging lawsuits to recover what they lost.

What's a life worth Jacob?? Is Jacob an engineer? Is Jeff an engineer? Who are the engineers? We engineers jump all these hoops and pay for all this education. Who are the engineers that allowed this? Where are they?

I don't give a $hit about a consultant!!! I want credentialed engineers and engineers making the decisions that are willing to go to jail for it!!!

And now we have Labor Day and our beaches will be demolished again with Burning Man.

You folks at TRPA better rethink. Better stop it all. Us folks in Incline Village may indeed file a massive multi billion dollar lawsuit against you folks!!! We do have a case and the upper hand.

Anytime the public is endangered we have the upper hand!! When a cop does not ticket an obstruction in the road and a judge does not uphold that law??? Really? And if someone dies on H28? Really? Show me the engineer at TRPA or anywhere that wants to get in front of that lawsuit or potential prison time for that? Show me.

Get my family killed and you can count on a massive lawsuit!!! So you better change that attitude at TRPA buddy!!!

These folks are fools Ann. Never seen such a junk show like this.

Tim Delaney

Marja Ambler

From: skitumbleweed <skitumbleweed@gmail.com>
Sent: Thursday, July 27, 2023 2:19 PM
To: Jacob Stock; Jeff Cowen; Ann Nichols; Sara Schmitz; Alexis Hill; Marja Ambler
Subject: TRPA---Terrorsim---Fire---Garbage

Follow Up Flag: Follow up
Flag Status: Flagged

Well it all sort of goes together. When folks don't care the worst will happen sooner or later.

Whether fire by accident or arson does it matter? If arson is it a Bernie Bro or a MAGA Bro that starts it?

Bump stocks and machine guns anyone? Unbelievable. A perfect killing zone created in my community by these arrogant and insensitive politicians and TRPA.

In all my life I have never witnessed so much ignorance on the topic of public safety and environment. You'd think these fools would wake up to the situation and seriously think about what they have done thus far?

And then there is the Native American angle? How do you think Native American people feel as they full know that Tahoe's East Shore Beaches are being stormed by all these people with all this environmental damage occurring. Geesh....That's a kick in the gut isn't it.

So you care about people Jacob Stock? Really?

What about Northern Nevada Native Americans and their new born kid? Do you think these fine people appreciate seeing the East Shore Beaches stormed and trashed? Do you think they like the forest floor and soils ripped to shreds by all those tourists?

I am darn serious that the numbers of people must be cut in half for the environment, law enforcement, and fire officials. Public safety is horribly threatened by the current situation. It's not OK at all!!!

DO UNDERSTAND JACOB THAT YOU ARE NO FRIEND OF MINE. ONLY MEN OF EVIL WOULD WRECK MY COMMUNITY AND BEACHES LIKE THIS!!!

You folks at TRPA and the politicians that are allowing this calamity to happen on the East Shore and Incline Village are mighty rotten. No doubt about it!!!

I am not happy with you. Not at all.

Jacob, you folks at TRPA with your developers and the local politicians are no better than all the other Europeans that killed Native American people. Same ole same ole junk. Just greed and anything for a dollar. You don't care who you harm. I doubt very much after seeing this damage and all those folks on H28 that if you were born in the 1800s you'd take the path of ethics. Nope. You'd fit right in with all the Europeans destroying Native people for money and land. Anything for a buck.

I see zero ethics and morality here. Zero.

How can I be happy watching these beaches be destroyed and nobody stopping it.

Tim Delaney

Marja Ambler

From: skitumbleweed <skitumbleweed@gmail.com>
Sent: Thursday, July 27, 2023 2:30 PM
To: Jacob Stock; Jeff Cowen; Marja Ambler; Ann Nichols; Alexis Hill; Sara Schmitz
Subject: The Whale Beach portable toilets!!!! Overflowing and in disrepair

Follow Up Flag: Follow up
Flag Status: Flagged

Shucks....These politicians and TRPA don't even fix the toilets.

When I mentioned to Santa Cruz politicians that the bathrooms were in disrepair at one of my surfing breaks those folks got serious and fixed it right away.

The bathrooms were filthy and the lights were out. I was worried about being stabbed by a local gang after getting out of my wetsuit and using the bathroom.

Tell me Jacob, do you think women appreciate a filthy portable toilet at Whale Beach???? I always thought women hated dirty bathrooms. Maybe out of respect for women and all people you'd high tail it out there to clean up those toilets?

You will learn Jacob. Yep. With a kid to struggle with you will learn if you intend to be a good father.

A dirty beach with garbage and broken glass in the water and broken portable toilets is highly uncool.

Sometimes Men need mentorship from older Men...You young men need to get out there and clean up my beaches!!!

And you do that for women. Assuming you actually care about the lady that brought your child into this world. That's fair ball.

TRPA and Alexis you need to get out to those beaches and clean them up. Fix the toilets and fix the human being number problem on H28!!!

That's the priority!!! Not some developer guy shoving 1000+ people into my community!!

What a bunch of bozos!!! Wrecked my town and wrecked my beaches!!! TRPA??? Yeah whatever. A pack of fools.

Tim Delaney

From:	skitumbleweed
To:	dent_trustee@ivgid.org; noble_trustee@ivgid.org; tulloch_trustee@ivgid.org; Sara Schmitz; tonking_trustee@ivgid.org; Ann Nichols; Alexis Hill; Marja Ambler; Jeff Cowen; Jacob Stock; bos@placer.ca.gov
Subject:	IVGID"s Jurisdiction
Date:	Friday, August 11, 2023 5:23:06 PM

I'll be clear on jurisdiction here.

Golden Rule. I have the gold and I rule.

That's right. I own the property. I worked my butt off for it. The property is my property. Folks cannot just run around and change codes all around me. I bought my property fully knowing the codes. And so did my neighbors. A politician cannot just come around with an agenda and a kickback, payoff, and bribe in their pockets and build a plutonium mine next door to me.

My expectations are that I have representation and politicians that represent **my interests**. IVGID facilities and all things IVGID that are in my community and against my land are my interests. So you bet IVGID has jurisdiction. Yep. IVGID absolutely has jurisdiction just like our beach fight that was won at the higher court level.

Don't even think about it that a fire can damage any part of our community and those that contributed to these conditions namely TRPA and the surrounding counties and state of Nevada and California along with the Fed will be able to avoid liability. More so in light of all the fires we have seen over the last couple of years and the fire in Maui that we all know about.

Should fire occur, will fire officials prioritize community safety, our property or IVGID? Do they run over to an IVGID facility before they come to our homes or to help people escape? What's the order of precedence? And who pays?? Oh you think we the residents are going to pay for the damage to golf courses, beaches, and the ski resort? Really? Is that what you think? You think that residents will pay for the horrible destruction after such a fire to our water quality and the pollution that results from burning cars and all sorts of plastics and buildings and toxic chemicals flowing in culverts and our creeks???

You might want to stop smoking your crack pipe right about now folks!!

You bet you have jurisdiction. And you folks at IVGID will defend Incline Village and Crystal Bay assets and the entirety of our towns like a starved pit bull. That is your #1 job. You folks should have been front and center talking to the county and TRPA in telling them that creating a huge death trap for all residents within our community and H28 jammed with people is not in the interests of IVGID or the community of Incline Village and Crystal Bay. And you should have been telling TRPA and the county what they can and cannot do all around our homes and IVGID property. You bet.

You should have told them to shove it with the transportation hub ideas. Yes, you folks should be speaking to them. You bet!!!

You bet you'll be joining lawsuits and filing lawsuits for injury to Incline assets and the placing of our community in grave danger.

Any damage to our facilities of which all us IV residents pay for cannot be tolerated and will not be tolerated. In fact that cave rock Kayak tour guy you can go after too. He should not be sending tour groups up to Sand Harbor and back or even further. That guy attempts to unload his 100 patrons at Sand Harbor for the bathrooms. And if all these old people can't find a bathroom where do they urinate? The lake? Right off our beaches?

IVGID should be defending the entirety of our community and our water and our public safety. No entity should be allowed to damage our assets, our water, our private home, bank accounts and on and on. No entity should be allowed to create conditions that threaten our lives!!!

Now if you board members cannot do your jobs and defend our community from things like policy changes that threaten our lives and assets then yep I am in agreement with other residents that perhaps you folks are not suited for the job.

Incline Village residents and residents of Crystal Bay want real representation. We always had that before. If we cannot get representation then either the board needs to be replaced or we need to dissolve IVGID and create towns and our own county. Whatever the case we all demand representation.

In the past I told IVGID no transportation hubs. They relayed the message and folks steered clear of the community and my neighborhood.

So I am a bit shocked things have come this far and blown away at the damage on East Shore beaches.

If a fire hits Incline Village the damages will be upwards of $1 trillion US dollars. Every homeowner will be getting multiple tens of millions of dollars.

With all this information there will be massive liability. And Incline Village and Crystal Bay residents will be compensated in a massive way. That is money separate from the damages done to our facilities of IVGID.

I prefer that my community is not burned down and harmed. This is why I am mentioning this. You folks (board members) at IVGID better clean up your act and start having some real talks with Washoe County, TRPA, Nevada, and California.

I can assure you that if I am damaged by a destructive fire and people die in my community or if my family dies I will be furious and the lawsuit will be horrendous and paid in full swiftly. Not years. Paid within months.

I see the human impact and outrageous traffic and damage. It's obvious and many of us have been complaining. We will win any lawsuit if it comes to that and at this point criminal and civil liability seems very reasonable. That's how I feel about the matter.

You cannot destroy my community and my life free of charge.

Public Safety comes first always, always, always!!! A politician that does not defend public safety is epic junk as a human being! Remember that. That is rule # uno!!

Tim Delaney

From:	skitumbleweed
To:	Ann Nichols; Sara Schmitz; Jacob Stock; Alexis Hill; Marja Ambler; Jeff Cowen; bos@placer.ca.gov
Subject:	MCI/WorldCom ENRON TRPA Tahoe Death Trap!!
Date:	Thursday, August 10, 2023 7:53:25 PM

The stupidity and total lack of common sense is impressive indeed!!!

My UNR Engineering Physics Degree and all my fabulous real life work success is useless against this junk.

You folks at TRPA and Placer county are still playing this game with our lives.

If Incline Village or Crystal Bay burns the payout and criminal penalties should be swift in light of Hawaii!!!

Even the insurance companies should collect $1 trillion!! Insurance company business models will be horribly damaged!!!!

The people of Incline Village and Crystal Bay will not suffer these losses. We will make you pay like never before!!!! MCI/WorldCom, Enron and all financial crisis will be small compared to what will be paid to the people of Incline Village in full!!!!

We will be very upset if any of our homes burn!!!! We will be furious if our families die like this!!!! It's no different than war!!!

Tim Delaney

From:	skitumbleweed
To:	Ann Nichols; Alexis Hill; Sara Schmitz; Jacob Stock; Marja Ambler; Jeff Cowen
Subject:	The Cost of a lawsuit---1 trillion dollar minimum for Incline Village
Date:	Thursday, August 10, 2023 7:43:54 PM

$50 million for each of say the 20,000 residents that are IVGID passholders showing property ownership.

Same applies to all that own Crystal Bay property.

You folks at TRPA and the state of Nevada, California, and the Federal government can chew on that. Payout will be swift and harsh. Specifically to make a point that this evil will not happen in the United State of America anymore.

Public Safety comes first!!! We are no longer safe and we know that and TRPA continues this nonsense!!!

What is the cost of extreme mental duress and anguish over melted and burned family members. Just like war. Just like a melted body in a tank.

We do not expect a bunch of bankers, developers, and politicians to wage a war on our communities. With all the information coming out of Hawaii if you folks don't do a hard stop and swiftly chop in half the human population parking on highway 28 from IV to Spooner you folks should endure criminal and civil penalties should Incline Village burn and any of its residents harmed.

What is the value of lost priceless items and property now? What is the cost of lost family members? What is the mental health cost on our community?

All these meetings is a mental health hit!!!! We are being abused at this point.

Up to $2 trillion in U.S. dollar damages should be paid out to Incline Village and Crystal Bay residents in full to all of us even if only a small percentage of buildings burn.

What is the cost of life!!!??

What about the low income renting workers??!!! How much is their lives worth??? We will all file the largest lawsuit in history and flat out win swiftly!!!

Tim Delaney

From:	skitumbleweed
To:	Ann Nichols; Sara Schmitz; Jacob Stock; Jeff Cowen; Alexis Hill; Marja Ambler; bos@placer.ca.gov
Subject:	What about Insurance companies and their business?---Tahoe Death Trap
Date:	Thursday, August 10, 2023 8:21:48 PM

Last I checked insurance companies like State Farm run a business too.

I say their businesses should not be ruined because of a couple of crooked banks, developers, and politicians, and of course TRPA!!! What about their business models!!!

You folks with all the government should pay $1 trillion to IVGID residents, $1 trillion to Crystal Bay residents, and $1 trillion to all insurance companies of Crystal Bay and Incline Village. $4 trillion total!!!

The damages should be harsh at this point.

It's all about the money your dirty jackals you!!! The $$$$$$!!!!!! And our lives too!!! Being melted sucks!!!

Tim Delaney

From:	Robert Aaron
To:	Sue Blankenship; Marja Ambler; Katrina.Fleshman
Subject:	Fwd: City Council Public Comment
Date:	Wednesday, August 9, 2023 8:48:31 AM
Attachments:	Environmental Procedures at the FCCA Case Study in Corporate Capture.pdf Captured Agency—How the Federal Communications Commission is Dominated by the Industries it Presumably Regulates.pdf Scientific evidence invalidates health assumptions underlying the FCC and ICNIRP exposure limit determinations for radiofrequency radiation.pdf NRDC—FCC"s Legal Duties to Inform and Protect the Public.pdf The FCC Is Supposed to Protect the Environment. It Doesn't. (simplified).pdf

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Please add this to the Records!
And share with all of your Boards!
Thank you!

Sent from my iPhone

Begin forwarded message:

From: David Chain <david.chain@barmail.ch>
Date: August 8, 2023 at 12:59:47 PM PDT
To: Cristi Creegan <ccreegan@cityofslt.us>, Cody Bass <cbass@cityofslt.us>, John Friedrich <jfriedrich@cityofslt.us>, Scott Robbins <scott@scottforslt.com>, CSLT Public Comment <PublicComment@cityofslt.us>
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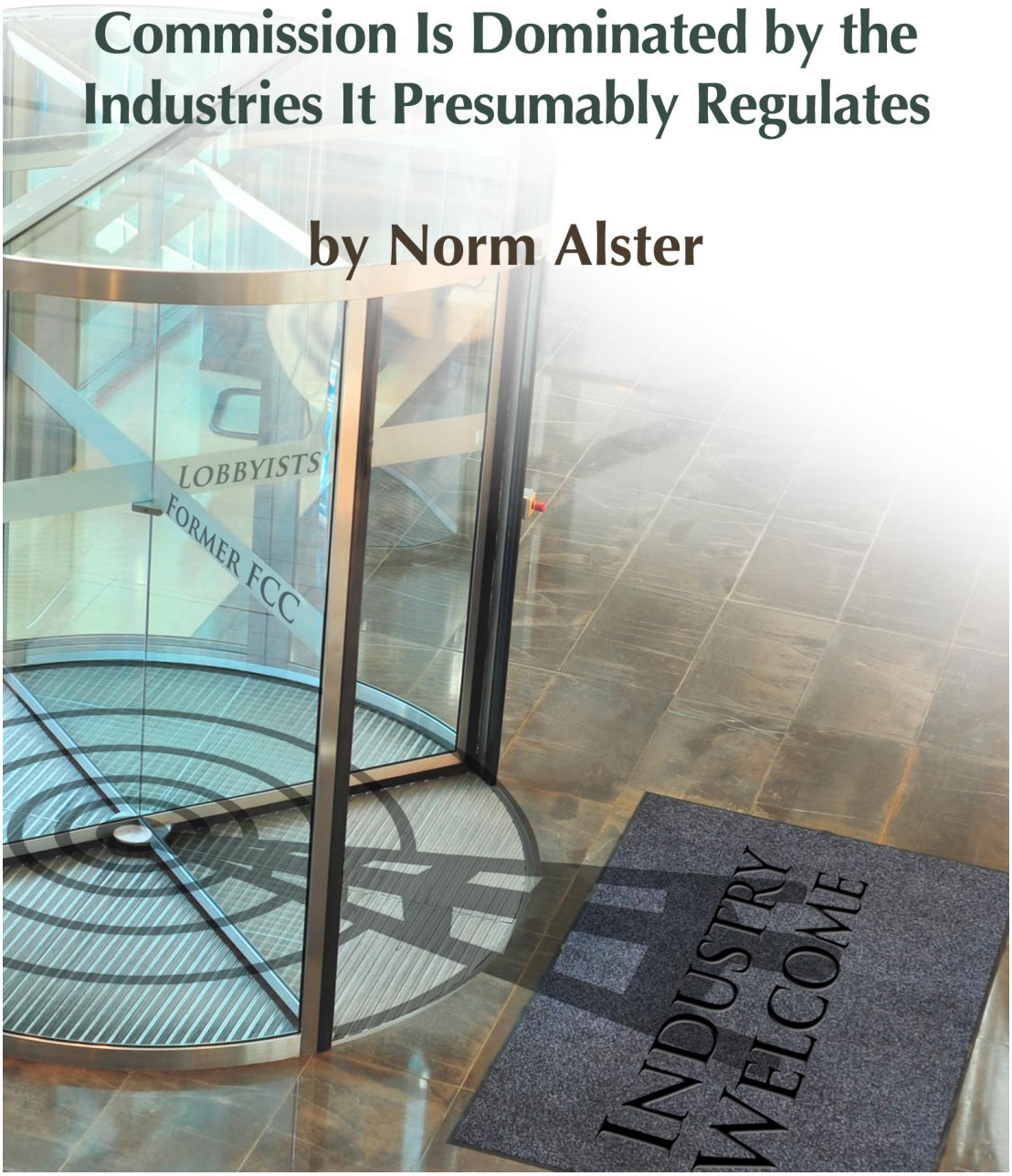
Subject: City Council Public Comment

Captured Agency:

How the Federal Communications Commission Is Dominated by the Industries It Presumably Regulates

by Norm Alster



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Published by:
Edmond J. Safra Center for Ethics
Harvard University
124 Mount Auburn Street, Suite 520N
Cambridge, MA 02138 USA
http://www.ethics.harvard.edu/

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Chapter One: The Corrupted Network

Renee Sharp seemed proud to discuss her spring 2014 meeting with the Federal Communications Commission.

As research director for the non-profit Environmental Working Group, Sharp doesn't get many chances to visit with the FCC. But on this occasion she was able to express her concerns that lax FCC standards on radiation from wireless technologies were especially hazardous for children.

The FCC, however, should have little trouble dismissing those concerns.

Arguing that current standards are more than sufficient and that children are at no elevated risk from microwave radiation, wireless industry lobbyists don't generally have to set up appointments months in advance. They are at the FCC's door night and day.

Indeed, a former executive with the Cellular Telecommunications Industry Association (CTIA), the industry's main lobbying group, has boasted that the CTIA meets with FCC officials "500 times a year."[1]

Sharp does not seem surprised. "There's no question that the government has been under the influence of industry. The FCC is a captured agency," she said.[2]

Captured agency.

That's a term that comes up time and time again with the FCC. Captured agencies are essentially controlled by the industries they are supposed to regulate. A detailed look at FCC actions—and non-actions—shows that over the years the FCC has granted the wireless industry pretty much what it has wanted. Until very recently it has also granted cable what it wants. More broadly, the FCC has again and again echoed the lobbying points of major technology interests.

Money—and lots of it—has played a part. The National Cable and Telecommunications Association (NCTA) and CTIA have annually been among Washington's top lobbying spenders. CTIA alone lobbied on at least 35 different Congressional bills through the first half of 2014. Wireless market leaders AT&T and Verizon work through CTIA. But they also do their own lobbying, spending nearly $15 million through June of 2014, according to data from the Center for Responsive Politics (CRP). In all, CTIA, Verizon, AT&T, T-Mobile USA, and Sprint spent roughly $45 million lobbying in 2013. Overall, the Communications/Electronics sector is one of Washington's super heavyweight lobbyists, spending nearly $800 million in 2013-2014, according to CRP data.

But direct lobbying by industry is just one of many worms in a rotting apple. The FCC sits at the core of a network that has allowed powerful moneyed interests with limitless access a variety of ways to shape its policies, often at the expense of fundamental public interests.

As a result, consumer safety, health, and privacy, along with consumer wallets, have all been overlooked, sacrificed, or raided due to unchecked industry influence. The cable industry has consolidated into giant local monopolies that control pricing while leaving consumers little choice over content selection. Though the FCC has only partial responsibility, federal regulators have allowed the Internet to grow into a vast hunting grounds for criminals and commercial interests: the go-to destination for the surrender of personal information, privacy and identity. Most insidious of all, the wireless industry has been allowed to grow unchecked and virtually unregulated, with fundamental questions on public health impact routinely ignored.

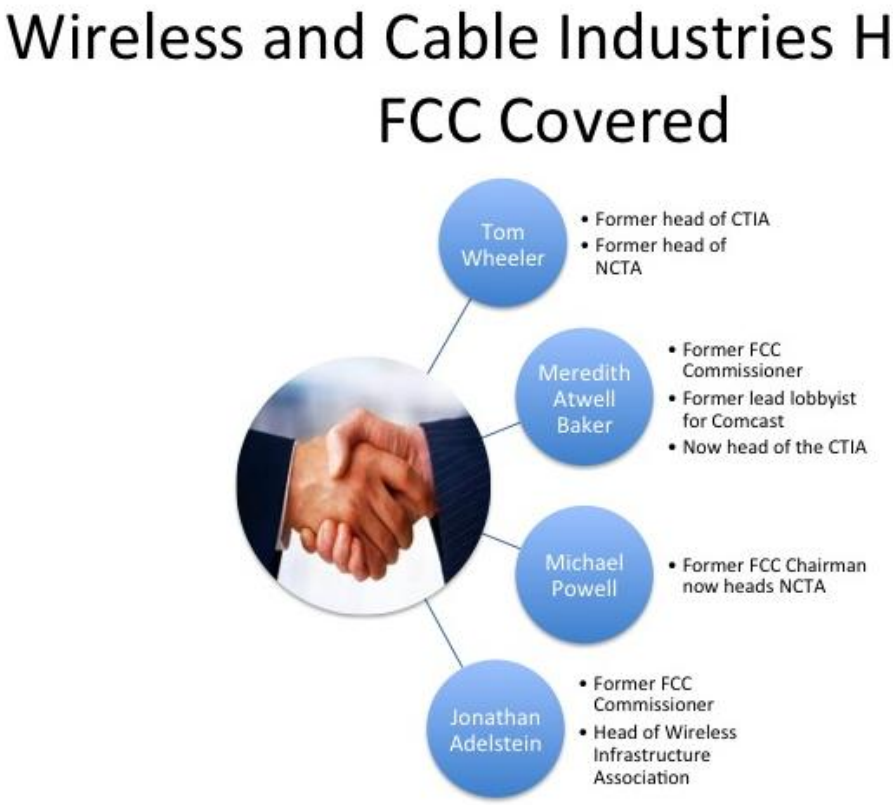
Industry controls the FCC through a soup-to-nuts stranglehold that extends from its well-placed campaign spending in Congress through its control of the FCC's Congressional oversight committees to its persistent agency lobbying. "If you're on a committee that regulates industry you'll be a major target for industry," said Twaun Samuel, chief of staff for Congresswoman Maxine Waters.[3] Samuel several years ago helped write a bill aimed at slowing the revolving door. But with Congress getting its marching orders from industry, the bill never gained any traction.

Industry control, in the case of wireless health issues, extends beyond Congress and regulators to basic scientific research. And in an obvious echo of the hardball tactics of the tobacco industry, the wireless industry has backed up its economic and political power by stonewalling on public relations and bullying potential threats into submission with its huge standing army of lawyers. In this way, a coddled wireless industry intimidated and silenced the City of San Francisco, while running roughshod over local opponents of its expansionary infrastructure.

On a personal level, the entire system is greased by the free flow of executive leadership between the FCC and the industries it presumably oversees. Currently presiding over the FCC is Tom Wheeler, a man who has led the two most powerful industry lobbying groups: CTIA and NCTA. It is Wheeler who once supervised a $25 million industry-funded research effort on wireless health effects. But when handpicked research leader George Carlo concluded that wireless radiation did raise the risk of brain tumors, Wheeler's CTIA allegedly rushed to muffle the message. "You do the science. I'll take care of the politics," Carlo recalls Wheeler saying.[4]

Wheeler over time has proved a masterful politician. President Obama overlooked Wheeler's lobbyist past to nominate him as FCC chairman in 2013. He had, after all, raised more than $700,000 for Obama's presidential campaigns. Wheeler had little trouble earning confirmation from a Senate whose Democrats toed the Presidential line and whose Republicans understood Wheeler was as industry-friendly a nominee as they could get. And while Wheeler, at the behest of his Presidential sponsor, has taken on cable giants with his plans for net neutrality and shown some openness on other issues, he has dug in his heels on wireless.

Newly ensconced as chairman of the agency he once blitzed with partisan pitches, Wheeler sees familiar faces heading the industry lobbying groups that ceaselessly petition the FCC. At CTIA, which now calls itself CTIA - The Wireless Association, former FCC commissioner Meredith Atwell Baker is in charge.



And while cell phone manufacturers like Apple and Samsung, along with wireless service behemoths like Verizon and AT&T, are prominent CTIA members, the infrastructure of 300,000 or more cellular base stations and antenna sites has its own lobbying group: PCIA, the Wireless Infrastructure Association. The President and CEO of PCIA is Jonathan Adelstein, another former FCC commissioner. Meanwhile, the cable industry's NCTA employs former FCC chairman Michael Powell as its president and CEO. Cozy, isn't it?

FCC commissioners in 2014 received invitations to the Wireless Foundation's May 19th Achievement Awards Dinner. Sounds harmless, but for the fact that the chief honoree at the dinner was none other than former wireless lobbyist but current FCC Chairman Tom Wheeler. Is this the man who will act to look impartially at the growing body of evidence pointing to health and safety issues?

The revolving door also reinforces the clout at another node on the industry-controlled influence network. Members of congressional oversight committees are prime targets of

industry. The cable industry, for example, knows that key legislation must move through the Communications and Technology Subcommittee of the House Energy and Commerce Committee. Little wonder then that subcommittee chairman Greg Walden was the second leading recipient (after Speaker John Boehner) of cable industry contributions in the last six years (through June 30, 2014). In all, Walden, an Oregon Republican, has taken over $108,000 from cable and satellite production and distribution companies.[5] But he is not alone. Six of the top ten recipients of cable and satellite contributions sit on the industry's House oversight committee. The same is true of senators on the cable oversight committee. Committee members were six of the ten top recipients of campaign cash from the industry.[6]

Cable & Satellite Campaign Contributions

Top House Recipients Funded

Recipient	Amount
John A. Boehner	$135,425
Greg Walden	$108,750
Bob Goodlatte	$93,200
John Conyers Jr.	$84,000
Mike Coffman	$82,137
Fred Upton	**$73,500**
Lee Terry	**$65,916**
Henry A. Waxman	**$65,000**
Cory Gardner	**$64,500**
Anna G. Eshoo	**$60,500**

Cellular Industry Campaign Contributions

Top House Recipients Funded

Recipient	Amount
Henry A. Waxman	**$41,500**
Scott H. Peters	$40,300
Greg Walden	**$35,750**
Fred Upton	**$32,250**
Bob Goodlatte	$31,250
Lee Terry	**$29,600**
Anna G. Eshoo	**$27,000**
Doris O. Matsui	**$25,500**
John Shimkus	**$24,000**
Peter J. Roskam	$21,100

Cable & Satellite Campaign Contributions

Top Senate Recipients Funded

Recipient	Amount
Edward J. Markey	**$320,500**
Kirsten E. Gillibrand	$194,125
Mitch McConnell	$177,125
Harry Reid	$175,600
Charles E. Schumer	$175,450
Mark L. Pryor	**$172,950**
Michael F. Bennet	$159,000
Richard Blumenthal	**$148,800**
Claire McCaskill	**$138,185**
Mark Udall	$136,625

Cellular Industry Campaign Contributions

Top Senate Recipients Funded

Recipient	Amount
Edward J. Markey	**$155,150**
Mark R. Warner	$74,800
Harry Reid	$73,600
Mark L. Pryor	**$71,900**
Roy Blunt	**$57,400**
John McCain	$56,261
Charles E. Schumer	$53,300
Roger F. Wicker	$51,300
Barbara Boxer	$49,578
Kelly Ayotte	$43,333

The compromised FCC network goes well beyond the revolving door and congressional oversight committees. The Washington social scene is one where money sets the tone and throws the parties. A look at the recent calendar of one current FCC commissioner shows it would take very disciplined and almost saintly behavior on the part of government officials to resist the lure of lavishly catered dinners and cocktail events. To paraphrase iconic investigative journalist I.F. Stone, if you're going to work in Washington, bring your chastity belt.

All that free liquor, food and conviviality translates into the lobbyist's ultimate goal: access. "They have disproportionate access," notes former FCC commissioner Michael Copps. "When you are in a town where most people you see socially are in industry, you don't have to ascribe malevolent behavior to it," he added.[7]

Not malevolent in motive. But the results can be toxic. And blame does not lie solely at the feet of current commissioners. The FCC's problems predate Tom Wheeler and go back a long way.

Indeed, former Chairman Newton Minow, enduringly famous for his 1961 description of television as a "vast wasteland," recalls that industry manipulation of regulators was an issue even back then. "When I arrived, the FCC and the communications industry were both regarded as cesspools. Part of my job was to try to clean it up."[8]

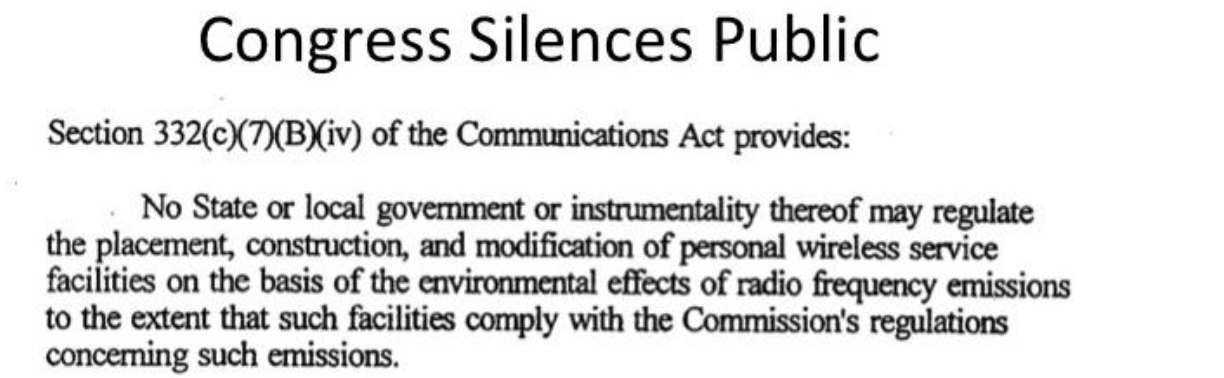
More than 50 years later, the mess continues to pile up.

Chapter Two: Just Don't Bring Up Health

Perhaps the best example of how the FCC is tangled in a chain of corruption is the cell tower and antenna infrastructure that lies at the heart of the phenomenally successful wireless industry.

It all begins with passage of the Telecommunications Act of 1996, legislation once described by South Dakota Republican senator Larry Pressler as "the most lobbied bill in history." Late lobbying won the wireless industry enormous concessions from lawmakers, many of them major recipients of industry hard and soft dollar contributions. Congressional staffers who helped lobbyists write the new law did not go unrewarded. Thirteen of fifteen staffers later became lobbyists themselves.[9]

Section 332(c)(7)(B)(iv) of the Act remarkably—and that adverb seems inescapably best here—wrests zoning authority from local governments. Specifically, they cannot cite health concerns about the effects of tower radiation to deny tower licenses so long as the towers comply with FCC regulations.



In preempting local zoning authority—along with the public's right to guard its own safety and health— Congress unleashed an orgy of infrastructure build-out. Emboldened by the government green light and the vast consumer appetite for wireless technology, industry has had a free hand in installing more than 300,000 sites. Church steeples, schoolyards, school rooftops, even trees can house these facilities.

Is there any reason to believe that the relatively low level radiofrequency emissions of these facilities constitute a public health threat? Certainly, cell phones themselves, held close to the head, have been the focus of most concern on RF emissions. Since the impact of RF diminishes with distance, industry advocates and many scientists dismiss the possibility that such structures pose health risks.

But it's not really that simple. A troubling body of evidence suggests exposure to even low emission levels at typical cellular frequencies between 300 MHz and 3 GHz can have a wide range of negative effects.

In a 2010 review of research on the biological effects of exposure to radiation from cell tower base stations, B. Blake Levitt and Henry Lai found that "some research does exist to warrant caution in infrastructure siting."[10] They summarized the results on one 2002 study that compared the health of 530 people living at various distances within 300 meters of cell towers with a control group living more than 300 meters away. "Results indicated increased symptoms and complaints the closer a person lived to a tower. At <10 m, symptoms included nausea, loss of appetite, visual disruptions, and difficulties in moving. Significant differences were observed up through 100 m for irritability, depressive tendencies, concentration difficulties, memory loss, dizziness, and lower libido."[11]

A 2007 study conducted in Egypt found similar results. Levitt and Lai report, "Headaches, memory changes, dizziness, tremors, depressive symptoms, and sleep disturbance were significantly higher among exposed inhabitants than controls."[12]

Beyond epidemiological studies, research on a wide range of living things raises further red flags. A 2013 study by the Indian scientists S. Sivani and D. Sudarsanam reports: "Based on current available literature, it is justified to conclude that RF-EMF [electro magnetic fields] radiation exposure can change neurotransmitter functions, blood-brain barrier, morphology, electrophysiology, cellular metabolism, calcium efflux, and gene and protein expression in certain types of cells even at lower intensities."[13]

The article goes on to detail the effects of mobile tower emissions on a wide range of living organisms: "Tops of trees tend to dry up when they directly face the cell tower antennas. . . . A study by the Centre for Environment and Vocational Studies of Punjab University noted that embryos of 50 eggs of house sparrows were damaged after being exposed to mobile tower radiation for 5-30 minutes. . . . In a study on cows and calves on the effects of exposure from mobile phone base stations, it was noted that 32% of calves developed nuclear cataracts, 3.6% severely."[14]

Does any of this constitute the conclusive evidence that would mandate much tighter control of the wireless infrastructure? Not in the estimation of industry and its captured agency. Citing other studies—often industry-funded—that fail to establish health effects, the wireless industry has dismissed such concerns. The FCC has typically echoed that position.

Keep in mind that light regulation has been one factor in the extraordinary growth of wireless—CTIA says exactly that in a Web post that credits the Clinton Administrations light regulatory touch.

July 25, 2013

CTIA BLOG

CTIA is an international nonprofit trade association that has represented the wireless communications industry since 1984.

But our position as the world's leader was no accident. It started with the Clinton Administration that had the foresight to place a "light regulatory touch" on the wireless industry, which was in its infancy at the time. That light touch has continued through multiple Administrations.

Obviously, cellular technology is wildly popular because it offers many benefits to consumers. But even allowing for that popularity and for the incomplete state of science, don't some of these findings raise enough concern to warrant some backtracking on the ham-fisted federal preemption of local zoning rights?

In reality, since the passage of the 1996 law, the very opposite has occurred. Again and again both Congress and the FCC have opted to stiffen—rather than loosen—federal preemption over local zoning authority. In 2009, for example, the wireless industry convinced the FCC to impose a "shot clock" that requires action within 90 days on many zoning applications. "My sense is that it was an industry request," said Robert Weller, who headed up the FCC's Office of Engineering and Technology when the shot clock was considered and imposed.[15]

And just last November, the FCC voted to further curb the rights of local zoning officials to control the expansion of antenna sites Again and again, Congress and the FCC have extended the wireless industry carte blanche to build out infrastructure no matter the consequences to local communities.

The question that hangs over all this: would consumers' embrace of cell phones and Wi-Fi be quite so ardent if the wireless industry, enabled by its Washington errand boys, hadn't so consistently stonewalled on evidence and substituted legal intimidation for honest inquiry? (See Appendix for online study of consumer attitudes on wireless health and safety.)

Document searches under the Freedom of Information Act reveal the central role of Tom Wheeler and the FCC in the tower siting issue. As both lobbyist and FCC chairman, Wheeler has proved himself a good friend of the wireless industry.

In January of 1997, CTIA chieftain Wheeler wrote FCC Wireless Telecommunications Bureau Chief Michele C. Farquhar citing several municipal efforts to assert control over siting. Wheeler, for example, asserted that one New England state had enacted a law requiring its Public Service Commissioner to issue a report on health risks posed by wireless facilities.[16] He

questions whether such a study—and regulations based on its results—would infringe on FCC preemption authority.

FCC bureau chief Farquhar hastily reassured Wheeler that no such study could be consulted in zoning decisions. "Therefore, based on the facts as you have presented them, that portion of the statute that directs the State Commissioner to recommend regulations based upon the study's findings would appear to be preempted,"[17] the FCC official wrote to Wheeler. She emphasized that the state had the right to do the study. It just couldn't deny a siting application based on anything it might learn.

The FCC in 1997 sent the message it has implicitly endorsed and conveyed ever since: study health effects all you want. It doesn't matter what you find. The build-out of wireless cannot be blocked or slowed by health issues.

Now let's fast forward to see Wheeler on the other side of the revolving door, interacting as FCC chairman with a former FCC commissioner who is now an industry lobbyist.

A March 14, 2014 letter[18] reveals the chummy relationship between Wheeler and former commissioner Jonathan Adelstein, now head of PCIA, the cellular infrastructure lobbying group. It also references FCC Chairman Wheeler seeking policy counsel from lobbyist Adelstein:

Wheeler Still Willing to Help

From: Jonathan Adelstein [mailto:adelstein@pcia.com]
Sent: Friday, March 14, 2014 12:24 PM
To: [redacted]
Cc: Renee Gregory; Jonathan Campbell
Subject: How to Spur Wireless Broadband Deployment

Tom – It was great to see you the other night at the FCBA event, and wonderful to see how much fun you're having (if that's the right word). I know I enjoyed my time there (thanks to your help with Daschle in getting me that role in the first place!).

Thanks for asking how we think the FCC can help spur wireless broadband deployment. The infrastructure proceeding perfectly tees up many of the top issues the FCC needs to address. As you requested, I've summarized briefly in the attached letter some of the key steps you can take now.

"Tom – It was great to see you the other night at the FCBA event, and wonderful to see how much fun you're having (if that's the right word). I know I enjoyed my time there (thanks to your help with Daschle in getting me that role in the first place!)."

"Thanks for asking how we think the FCC can help spur wireless broadband deployment," the wireless lobbyist writes to the ex-wireless lobbyist, now running the FCC.

Adelstein's first recommendation for FCC action: *"Amend its rules to categorically exclude DAS and small deployments* [Ed. note: these are compact tower add-ons currently being widely deployed] *from environmental and historic review."* Adelstein outlined other suggestions for further limiting local antenna zoning authority and the FCC soon did its part. Late last year, the agency proposed new rules that largely (though not entirely) complied with the antenna industry's wish list.

James R. Hobson is an attorney who has represented municipalities in zoning issues involving the FCC. He is also a former FCC official, who is now of counsel at Best, Best and Krieger, a Washington-based municipal law practice. "The FCC has been the ally of industry," says Hobson. Lobbyist pressure at the FCC was intense even back in the 70s, when he was a bureau chief there. "When I was at the FCC, a lot of my day was taken up with appointments with industry lobbyists." He says of the CTIA that Wheeler once headed: "Their reason for being is promoting the wireless industry. And they've been successful at it."[19]

The FCC's deferential compliance has allowed industry to regularly bypass and if necessary steamroll local authorities. Violation of the FCC-imposed "shot clock," for example, allows the wireless license applicant to sue.

The FCC's service to the industry it is supposed to regulate is evidently appreciated. The CTIA web site, typically overflowing with self-congratulation, spreads the praise around in acknowledging the enabling contributions of a cooperative FCC. In one brief summation of its own glorious accomplishments, CTIA twice uses the word "thankfully" in describing favorable FCC actions.

In advancing the industry agenda, the FCC can claim that it is merely reflecting the will of Congress. But the agency may not be doing even that.

Remember the key clause in the 96 Telecom Act that disallowed denial of zoning permits based on health concerns? Well, federal preemption is granted to pretty much any wireless outfit on just one simple condition: its installations must comply with FCC radiation emission standards. In view of this generous carte blanche to move radiation equipment into neighborhoods, schoolyards and home rooftops, one would think the FCC would at the very least diligently enforce its own emission standards. But that does not appear to be the case.

Indeed, one RF engineer who has worked on more than 3,000 rooftop sites found vast evidence of non-compliance. Marvin Wessel estimates that "10 to 20% exceed allowed radiation standards."[20] With 30,000 rooftop antenna sites across the U.S. that would mean that as many as 6,000 are emitting radiation in violation of FCC standards. Often, these emissions can be 600% or more of allowed exposure levels, according to Wessel.

Antenna standards allow for higher exposure to workers. In the case of rooftop sites, such workers could be roofers, painters, testers and installers of heating and air conditioning

equipment, to cite just a few examples. But many sites, according to Wessel, emit radiation at much higher levels than those permitted in occupational standards. This is especially true of sites where service providers keep adding new antenna units to expand their coverage. "Some of these new sites will exceed ten times the allowable occupational radiation level," said Wessel.[21] Essentially, he adds, this means that nobody should be stepping on the roof.

"The FCC is not enforcing its own standard," noted Janet Newton, who runs the EMF Policy Institute, a Vermont-based non-profit. That group several years ago filed 101 complaints on specific rooftop sites where radiation emissions exceeded allowable levels. "We did this as an exercise to hold the FCC's feet to the fire," she said. But the 101 complaints resulted in few responsive actions, according to Newton.[22]

Former FCC official Bob Weller confirms the lax—perhaps negligible is the more appropriate word—FCC activity in enforcing antenna standards. "To my knowledge, the enforcement bureau has never done a targeted inspection effort around RF exposure," he said.[23] Budget cuts at the agency have hurt, limiting the FCC's ability to perform field inspections, he added. But enforcement, he adds, would do wonders to insure industry compliance with its limited regulatory compliance requirements. "If there were targeted enforcement and fines issued the industry would pay greater attention to ensuring compliance and self-regulation," he allowed.

Insurance is where the rubber hits the road on risk. So it is interesting to note that the rating agency A.M. Best, which advises insurers on risk, in 2013 topped its list of "emerging technology-based risks" with RF Radiation:

> *"The risks associated with long-term use of cell phones, although much studied over the past 10 years, remain unclear. Dangers to the estimated 250,000 workers per year who come in close contact with cell phone antennas, however, are now more clearly established. Thermal effects of the cellular antennas, which act at close range essentially as open microwave ovens can include eye damage, sterility and cognitive impairments. While workers of cellular companies are well trained on the potential dangers, other workers exposed to the antennas are often unaware of the health risks. The continued exponential growth of cellular towers will significantly increase exposure of these workers and others coming into close contact with high-energy cell phone antenna radiation,"* A.M. Best wrote.[24]

So what has the FCC done to tighten enforcement? Apparently, not very much. Though it does follow up on many of the complaints filed against sites alleged to be in violation of standards it takes punitive actions very rarely. (The FCC did not provide answers to written questions on details of its tower enforcement policies.)

The best ally of industry and the FCC on this (and other) issues may be public ignorance.

An online poll conducted for this project asked 202 respondents to rate the likelihood of a series of statements.[25] Most of the statements were subject to dispute. Cell phones raise the risk of certain health effects and brain cancer, two said. There is no proof that cell phones are harmful, another declared. But among the six statements there was one statement of indisputable fact: "The U.S. Congress forbids local communities from considering health effects when deciding whether to issue zoning permits for wireless antennae," the statement said.

Though this is a stone cold fact that the wireless industry, the FCC and the courts have all turned into hard and inescapable reality for local authorities, just 1.5% of all poll respondents replied that it was "definitely true."

Public ignorance didn't take much cultivation by the wireless industry on the issue of local zoning. And maybe it doesn't matter much, considering the enormous popularity of wireless devices. But let's see how public ignorance has been cultivated and secured—with the FCC's passive support—on the potentially more disruptive issue of mobile phone health effects.

Chapter Three: Wireless Bullies and the Tobacco Analogy

Issues of cable and net neutrality have recently attracted wide public attention (more on that in Chapter Six). Still, the bet here remains that future judgment of the FCC will hinge on its handling of wireless health and safety issues.

And while the tower siting issue is an egregious example of an industry-dominated political process run amuck, the stronger health risks appear to reside in the phones themselves. This is an issue that has flared up several times in recent years. Each time, industry has managed to beat back such concerns. But it's worth noting that the scientific roots of concern have not disappeared. If anything, they've thickened as new research substantiates older concerns.

The story of an FCC passively echoing an industry determined to play hardball with its critics is worth a further look. The CTIA's own website acknowledges the helpful hand of government's "light regulatory touch" in allowing the industry to grow.[26]

Former congressman Dennis Kucinich ventures one explanation for the wireless industry's success in dodging regulation: "The industry has grown so fast its growth has overtaken any health concerns that may have gained attention in a slow growth environment. The proliferation of technology has overwhelmed all institutions that would have attempted safety testing and standards," Kucinich said.[27]

But the core questions remain: Is there really credible evidence that cell phones emit harmful radiation that can cause human health problems and disease? Has the FCC done an adequate job in protecting consumers from health risks? Or has it simply aped industry stonewalling on health and safety issues?

Before wading into these questions, some perspective is in order.

First, there's simply no denying the usefulness and immense popularity of wireless technology. People depend on it for safety, information, entertainment and communication. It doesn't take a keen social observer to know that wireless has thoroughly insinuated itself into daily life and culture.

The unanswered question, though, is whether consumers would embrace the technology quite so fervently if health and safety information was not spun, filtered and clouded by a variety of industry tactics.

To gain some insight into this question, we conducted an online survey of 202 respondents, nearly all of whom own cell phones, on Amazon's Mechanical Turk Web platform (see Appendix). One striking set of findings: many respondents claim they would change behavior—reduce wireless use, restore landline service, protect their children—if claims on health dangers of wireless are true.

It is not the purpose of this reporter to establish that heavy cell phone usage is dangerous. This remains an extremely controversial scientific issue with new findings and revised scientific conclusions repeatedly popping up. Just months ago, a German scientist who had been outspoken in denouncing the view that cell phones pose health risks reversed course. In an April 2015 publication, Alexander Lerchl reported results confirming previous research on the tumor-promoting effects of electromagnetic fields well below human exposure limits for mobile phones. "Our findings may help to understand the repeatedly reported increased incidences of brain tumors in heavy users of mobile phones," the Lerchl team concluded.[28] And in May 2015, more than 200 scientists boasting over 2,000 publications on wireless effects called on global institutions to address the health risks posed by this technology.

But the National Cancer Institute still contends that no cell phone dangers have been established. A representative of NCI was the sole known dissenter among the 30 members of the World Health Organization's International Agency for Research on Cancer (IARC) when it voted to declare wireless RF "possibly carcinogenic."[29] If leading scientists still can't agree, I will not presume to reach a scientific conclusion on my own.

IARC RF working group: Official press release

International Agency for Research on Cancer

World Health Organization

PRESS RELEASE
N° 208

31 May 2011

IARC CLASSIFIES RADIOFREQUENCY ELECTROMAGNETIC FIELDS AS POSSIBLY CARCINOGENIC TO HUMANS

Lyon, France, May 31, 2011 -- The WHO/International Agency for Research on Cancer (IARC) has classified radiofrequency electromagnetic fields as **possibly carcinogenic to humans (Group 2B)**, based on an increased risk for **glioma**, a malignant type of brain cancer, associated with wireless phone use.

But let's at least look at some of the incriminating clues that health and biology research has revealed to date. And let's look at the responses of both industry and the FCC.

The most widely cited evidence implicating wireless phones concerns gliomas, a very serious type of brain tumor. The evidence of elevated risk for such tumors among heavy cell phone users comes from several sources.

Gliomas account for roughly half of all malignant brain tumors, which are relatively rare. The annual incidence of primary malignant brain tumors in the U.S. is only 8.2 per 100,000 people, according to the International Radio Surgery Association.

Still, when projected over the entire U.S. population, the public health impact is potentially very significant.

Assuming roughly four new glioma cases annually in the U.S. per 100,000 people, yields over 13,000 new cases per year over a total U.S. population of 330 million. Even a doubling of that rate would mean 13,000 new gliomas, often deadly, per year. A tripling, as some studies have found, could mean as many as 26,000 more new cases annually. Indeed, the respected online site Medscape in January 2015 reported results of Swedish research under the headline: *Risk for Glioma Triples With Long-Term Cell Phone Use*.[30]

And here's some eye-opening quantitative perspective: the wars in Iraq and Afghanistan, waged now for more than a decade each, have together resulted in roughly 7,000 U.S. deaths.

Preliminary—though still inconclusive—research has suggested other potential negative health effects. Swedish, Danish and Israeli scientists have all found elevated risk of salivary gland tumors. One Israeli studied suggested elevated thyroid cancer risk. Some research has found that men who carry their phones in their pockets may suffer sperm count damage. One small study even suggests that young women who carry wireless devices in their bras are unusually vulnerable to breast cancer.

And while industry and government have never accepted that some portion of the population is unusually sensitive to electromagnetic fields, many people continue to complain of a broad range of symptoms that include general weakness, headaches, nausea and dizziness from exposure to wireless.

Some have suggested that the health situation with wireless is analogous to that of tobacco before court decisions finally forced Big Tobacco to admit guilt and pay up. In some ways, the analogy is unfair. Wireless research is not as conclusively incriminating as tobacco research was. And the identified health risks with wireless, significant as they are, still pale compared with those of tobacco.

But let's not dismiss the analogy outright. There is actually a very significant sense in which the tobacco-wireless analogy is uncannily valid.

People tend to forget that the tobacco industry—like the wireless industry—also adopted a policy of tone-deaf denial. As recently as 1998, even as evidence of tobacco toxicity grew overwhelming, cigarette maker Phillip Morris was writing newspaper advertorials insisting there was no proof smoking caused cancer.

It seems significant that the responses of wireless and its captured agency—the FCC—feature the same obtuse refusal to examine the evidence. The wireless industry reaction features stonewalling public relations and hyper aggressive legal action. It can also involve undermining the credibility and cutting off the funding for researchers who do not endorse cellular safety. It is these hardball tactics that look a lot like 20th century Big Tobacco tactics. It is these hardball tactics—along with consistently supportive FCC policies—that heighten suspicion the wireless industry does indeed have something to hide.

Begin with some simple facts issuing from meta-analysis of cellular research. Dr. Henry Lai, emeritus professor of bioengineering at the University of Washington, has reviewed hundreds of published scientific papers on the subject. He wanted to see how many studies demonstrated that non-ionizing radiation produces biological effects beyond the heating of tissue. This is critical since the FCC emission standards protect only against heating. The assumption behind these standards is that there are no biological effects beyond heating.

But Dr. Lai found that just over half—actually 56%—of 326 studies identified biological effects. And the results were far more striking when Dr. Lai divided the studies between those that were industry-funded and those that were independently funded. Industry-funded research identified biological effects in just 28% of studies. But fully 67% of non-industry funded studies found biological effects (Insert Slide—Cell Phone Biological Studies).

A study conducted by Swiss and British scientists also looked at how funding sources affected scientific conclusions on the possible health effects of cell phone usage. They found that of studies privately funded, publicly funded and funded with mixed sponsorship, industry-funded studies were "least likely to report a statistically significant result."[31] "The interpretation of results from studies of health effects of radiofrequency radiation should take sponsorship into account," the scientists concluded.[32]

So how does the FCC handle a scientific split that seems to suggest bias in industry-sponsored research?

In a posting on its Web site that reads like it was written by wireless lobbyists, the FCC chooses strikingly patronizing language to slight and trivialize the many scientists and health and safety experts who've found cause for concern. In a two page Web post titled "Wireless Devices and Health Concerns," the FCC four times refers to either "some health and safety interest groups," "some parties," or "some consumers" before in each case rebutting their presumably groundless concerns about wireless risk.[33] Additionally, the FCC site references the World Health Organization as among those organizations who've found that "the weight of scientific

evidence" has not linked exposure to radiofrequency from mobile devices with "any known health problems."

Yes, it's true that the World Health organization remains bitterly divided on the subject. But it's also true that a 30 member unit of the WHO called the International Agency for Research on Cancer (IARC) was near unanimous in pronouncing cell phones "possibly carcinogenic" in 2011. How can the FCC omit any reference to such a pronouncement? Even if it finds reason to side with pro-industry scientists, shouldn't this government agency also mention that cell phones are currently in the same potential carcinogen class as lead paint?

Now let's look a bit more closely at the troublesome but presumably clueless crowd of "some parties" that the FCC so cavalierly hastens to dismiss? Let's begin with **Lennart Hardell**, professor of Oncology and Cancer Epidemiology at the University Hospital in Oreboro, Sweden.

Until recently it was impossible to gain any real sense of brain tumor risk from wireless since brain tumors often take 20 or more years to develop. But the cohort of long-term users has been growing. In a study published in the International Journal of Oncology in 2013, Dr. Hardell and Dr. Michael Carlberg found that the risk of glioma—the most deadly type of brain cancer—rose with cell phone usage. The risk was highest among heavy cell phone users and those who began to use cell phones before the age of 20.[34]

Indeed, those who used their phones at least 1640 hours (which would be roughly 30 minutes a day for nine years) had nearly three times the glioma incidence. Drs. Hardell and Carlberg also found that gliomas tend to be more deadly among heavy wireless callers.[35]

Perhaps of greatest long-term relevance, glioma risk was found to be four times higher among those who began to use mobile phones as teenagers or earlier. These findings, along with the established fact that it generally takes decades for tumors induced by environmental agents to appear, suggest that the worst consequences of omnipresent wireless devices have yet to be seen.

In a 2013 paper published in *Reviews on Environmental Health*, Drs. Hardell and Carlberg argued that the 2011 finding of the IARC that identified cell phones as a "possibly carcinogenic" needs to be revised. The conclusion on radiofrequency electromagnetic fields from cell phones should now be "cell phones are not just a possible carcinogen." They can now be "regarded as carcinogenic to humans" and the direct cause of gliomas (as well as acoustic neuromas, a less serious type of tumor).[36] Of course, these views are not universally accepted.

The usual spin among industry supporters when presented with research that produces troubling results is along the lines of: "We might pay attention if the results are duplicated." In fact, the Hardell results were echoed in the French CERENAT study, reported in May of 2014. The CERENAT study also found higher risk among heavy users, defined as those using their phones at least 896 hours (just 30 minutes a day for five years). "These additional data support

previous findings concerning a possible association between heavy mobile phone use and brain tumors," the study concluded.[37]

Cell phones are not the only wireless suspects. Asked what he would do if he had policy-making authority, Dr. Hardell swiftly replied that he would "ban wireless use in schools and pre-schools. You don't need Wi-Fi," he noted.[38] This is especially interesting in view of the FCC's sharply hiked spending to promote and extend Wi-Fi usage, as well as its consistent refusal to set more stringent standards for children (more on all this later). But for now let's further fill out the roster of the FCC's unnamed "some parties."

Martin Blank is a Special Lecturer in Physiology and Cellular Biophysics at Columbia University. Unlike Dr. Hardell, who looks at broad epidemiological effects over time, Dr. Blank sees cause for concern in research showing there is biological response at the cellular level to the type of radiation emitted by wireless devices. "The biology tells you unequivocally that the cell treats radiation as a potentially damaging influence," Dr. Blank said in a late 2014 interview.[39]

"The biology tells you it's dangerous at a low level," he added. Though some results have been difficult to replicate, researchers have identified a wide range of cellular responses including genetic damage and penetration of the blood brain barrier. Dr. Blank specifically cited the "cellular stress response" in which cells exposed to radiation start to make proteins.

It is still not clear whether biological responses at the cellular level translate into human health effects. But the research seems to invalidate the basic premise of FCC standards that the only biological effect of the type of radiation produced by wireless devices is tissue heating at very high power levels. But the standards-setting agencies "ignore the biology," according to Dr. Blank. He describes the FCC as being "in industry's pocket."[40]

Sweden's Lund University is annually ranked among the top 100 universities in the world. **Leif Salford** has been chairman of the Department of Neurosurgery at Lund since 1996. He is also a former president of the European Association for Neuro-Oncology. In the spring of 2000, Professor Salford told me that wireless usage constituted "the world's largest biological experiment ever."[41]

He has conducted numerous experiments exposing rats to cellular-type radiation. Individual experiments have shown the radiation to penetrate the blood-brain barrier, essential to protecting the brain from bloodstream toxins. Professor Salford also found that rats exposed to radiation suffered loss of brain cells. "A rat's brain is very much the same as a human's. They have the same blood-brain barrier and neurons. We have good reason to believe that what happens in rat's brains also happens in humans," he told the BBC in 2003. Dr. Salford has also speculated that mobile radiation could trigger Alzheimer's disease in some cases but emphasized that much more research would be needed to establish any such causal relationship. Does this man deserve to be dismissed as one of a nameless and discredited group of "some parties?"

And what about the **American Academy of Pediatrics (AAP),** which represents 60,000 American doctors who care for children? In a December 12, 2012 letter to former Ohio Congressman Dennis Kucinich, AAP President Dr. Thomas McInerny writes: "Children are disproportionately affected by environmental exposures, including cell phone radiation. The differences in bone density and the amount of fluid in a child's brain compared to an adult's brain could allow children to absorb greater quantities of RF energy deeper into their brains than adults."[42]

In a subsequent letter to FCC officials dated August 29, 2013, Dr. McInerny points out that "children, however, are not little adults and are disproportionately impacted by all environmental exposures, including cell phone radiation." Current FCC exposure standards, set back in 1996, "do not account for the unique vulnerability and use patterns specific to pregnant women and children," he wrote. (Insert slide: A Plea from Pediatricians). Does an organization representing 60,000 practitioners who care for children deserve to be brushed off along with "some health and safety interest groups?"

So what is the FCC doing in response to what at the very least is a troubling chain of clues to cellular danger? As it has done with wireless infrastructure, the FCC has to this point largely relied on industry "self-regulation." Though it set standards for device radiation emissions back in 1996, the agency doesn't generally test devices itself. Despite its responsibility for the safety of cell phones, the FCC relies on manufacturers' good-faith efforts to test them. Critics contend that this has allowed manufacturers undue latitude in testing their devices.

Critics further contend that current standards, in place since cell phones were barely in use, are far too lax and do not reflect the heavy usage patterns that have evolved. Worse still, industry is allowed to test its own devices using an imprecise system that makes no special provision for protecting children and pregnant women. One 2012 study noted that the procedure widely used by manufacturers to test their phones "substantially underestimates" the amount of RF energy absorbed by 97% of the population, "especially children." A child's head can absorb over two times as much RF energy. Other persons with smaller heads, including women, are also more vulnerable. The authors recommend an alternative computer simulation technique that would provide greater insight into the impact of cellular radiation on children and on to the specific RF absorption rates of different tissues, which vary greatly.[43]

Acting on recommendations of the General Accounting Office, the FCC is now reconsidering its standards for wireless testing and allowed emissions. On the surface, this may seem to represent an effort to tighten standards to promote consumer health and safety. But many believe the FCC's eventual new standard will actually be weaker, intensifying any health risk from industry's self-reported emission levels. "They're under great pressure from industry to loosen the criteria," notes Joel Moskowitz, director of the Center for Family and Community Health at UC Berkeley's School of Public Health.[44] One fear is that the FCC could measure the allowed radiation absorption level (SAR) over a wider sample of tissue, effectively loosening the

standard allowable energy absorption. One FCC official, who asked that his name not be used, contended that a decision had not yet been made to loosen the standard.

But to this point, there is little evidence the FCC is listening to anyone beyond its familiar friends in the wireless industry. Carl Blackman, a scientist at the Environmental Protection agency until retiring in 2014, notes that the FCC does rely to some degree on an inter-agency governmental group for advice on health matters. The group includes, for example, representatives from the EPA and the FDA.

Blackman served on that advisory group and he says that it has been divided. Though some government advisers to the FCC find evidence of wireless health risks convincing, others remain skeptical, said Blackman. Root of the skepticism: even though numerous researchers have found biological and health effects, the mechanism for action by non-ionizing radiation on the human body has still not been identified. "I don't think there's enough of a consensus within the Radio Frequency Inter-agency Working Group for them to come out with stricter standards," he says.[45]

But political pressures also figure mightily in all this. The EPA, notably, was once a hub of research on RF effects, employing as many as 35 scientists. However, the research program was cut off in the late 80s during the Regan presidency. Blackman says he was personally "forbidden" to study health effects by his "supervisory structure."[46] He termed it "a political decision" but recognized that if he wanted to continue to work at the EPA he would have to do research in another area.

Blackman is cautious in imputing motives to the high government officials who wanted his work at EPA stopped. But he does say that political pressure has been a factor at both the EPA and FCC: "The FCC people were quite responsive to the biological point of view. But there are also pressures on the FCC from industry." The FCC, he suggests, may not just be looking at the scientific evidence "The FCC's position—like the EPA's—is influenced by political considerations as well."[47]

Still, the FCC has ultimate regulatory responsibility and cannot indefinitely pass the buck on an issue of fundamental public health. Remarkably, it has not changed course despite the IARC classification of cell phones as possibly carcinogenic, despite the recent studies showing triple the glioma risk for heavy users, despite the floodtide of research showing biological effects, and despite even the recent defection of core industry booster Alex Lerchl. It is the refusal of both industry and the FCC to even acknowledge this cascade of warning signs that seems most incriminating.

Of course, industry behavior goes well beyond pushing for the FCC's willful ignorance and inaction. Industry behavior also includes self-serving public relations and hyper aggressive legal action. It can also involve undermining the credibility of and cutting off the funding for researchers who do not endorse cellular safety. It is these hardball tactics that recall 20th century Big Tobacco tactics. It is these tactics that heighten suspicion that the wireless industry does

indeed have a dirty secret. And it is those tactics that intensify the spotlight on an FCC that so timidly follows the script of the fabulously wealthy, bullying, billion-dollar beneficiaries of wireless.

Chapter Four: You Don't Need Wires To Tie People Up

So let's look a little more deeply at some of the actions of an industry group that boasts of 500 meetings a year with the FCC. Lobbying is one thing. Intimidation is another. CTIA has shown its skill at—and willingness to use—both.

Outright legal bullying is a favored tactic. The City of San Francisco passed an ordinance in 2010 that required cell phone manufacturers to display more prominently information on the emissions from their devices. This information was already disclosed—but often buried—in operator manuals and on manufacturer websites. The idea was to ensure that consumers saw information already mandated and provided.

Seeing this as a threat to its floodtide of business, the industry sued the City of San Francisco. The City, fearing a prolonged legal fight with an industry that generates hundreds of billions of dollars in annual revenue, backed down.

On May 12, 2015, Berkeley, California's City Council unanimously passed a similar ordinance. Joel Moskowitz, director of the Center for Family and Community Health at the University of California-Berkeley's School of Public Health, has been involved in the effort. Berkeley, he says, didn't want to run into the same legal threats that paralyzed San Francisco. So it tried to draft the most inoffensive and mild language possible. The proposed Cell Phone Right to Know ordinance: "To assure safety, the Federal Government requires that cell phones meet radio frequency (RF) exposure guidelines. If you carry or use your phone in a pants or shirt pocket or tucked into a bra when the phone is ON and connected to a wireless network, you may exceed the federal guidelines for exposure to RF radiation. This potential risk is greater for children. Refer to the instructions in your phone or user manual for information about how to use your phone safely."[48]

Sounds pretty inoffensive, no? Not to the CTIA, which indicated that it was prepared to sue, according to Berkeley City Attorney Zach Cowan.[49] (On June 8th, CTIA did indeed sue the City of Berkeley.)

Well, from the industry point of view, why not throw around your weight? Smash mouth legal tactics have been highly successful thus far as industry has managed to throttle several efforts to implicate manufacturers in cases where heavy users suffered brain tumors.

But one current case has advanced in district court in Washington to the point where the judge allowed plaintiffs to present expert witness testimony. The industry response: file a legal action seeking to invalidate long-held court methods for qualifying expert witnesses.

This is a very rich industry that does not hesitate to outspend and bully challengers into submission. Meanwhile, amidst the legal smoke and medical confusion, the industry has

managed to make the entire world dependent on its products. Even tobacco never had so many hooked users.

Such sustained success in the face of medical doubt has required industry to keep a lid on critics and detractors. Many scientists who've found real or potential risk from the sort of microwave radiation emanating from wireless devices have learned there is a price to be paid for standing up to the industry juggernaut. A few prominent examples:

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In 1994, University of Washington researchers Henry Lai and N.P. Singh found that rats exposed to microwave radiation suffered DNA damage to their brain cells. This was a scary finding since DNA damage can lead to mutations and possibly cancer.

The reaction from industry was swift. Motorola was at that time the U.S. market leader in cell phones. In a memorandum obtained by the journal Microwave News, Motorola PR honcho Norm Sandler outlined how the company could "downplay the significance of the Lai study." One step: "We have developed a list of independent experts in this field and are in the process of recruiting individuals willing and able to reassure the public on these matters," Sandler wrote. After outlining such measures, he concluded that Motorola had "sufficiently war-gamed" the issue. The practices of lining up industry-friendly testimony and "war-gaming" researchers who come up with unfavorable results have been persistent themes with this industry.

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After Lai's results were published, Motorola decided to sponsor further research on microwaves and DNA damage. Oftentimes, lab results cannot be reproduced by other

researchers, particularly if experiments are tweaked and performed a bit differently. Non-confirming studies raise doubt, of course, on the original work.

Motorola lined up Jerry Phillips, a scientist at the Veteran's Administration Medical Center in Loma Linda, California, and Phillips tested the effect of radiation at different frequencies from those tested by Lai and Singh. Nevertheless, Phillips found that at some levels of exposure, DNA damage increased, while at other levels it decreased. Such findings were "consistent" with the sorts of effects produced by chemical agents, Phillips said in an interview.[50] In some cases, the radiation may have activated DNA repair mechanisms, reducing the overall microwave effect. But what was important, Phillips explained, is that there were *any* biological effects at all. The wireless industry has long contended—and the FCC has agreed—that there is no evidence that non-ionizing radiation at the frequencies and power levels used by cell phones is biologically active.

Understanding the potential impact of "biological effect" findings, Motorola again turned to damage control, said Phillips. He recalls receiving a phone call from a Motorola R&D executive. "I don't think you've done enough research,'" Phillips recalls being told. The study wasn't ready for publication, according to the Motorola executive. Phillips was offered more money to do further research without publishing the results of what he'd done.

But Phillips felt he'd done enough. Despite warnings for his own boss to "give Motorola what it wants," Phillips went ahead and published his findings in 1998. Since then, Phillips' industry funding has dried up. Meanwhile, as many other researchers report, government funding to do independent research on microwave radiation has dried up, leaving the field at least in the U.S. to industry-funded scientists. "There is no money to do the research," Said Phillips. "It's not going to come from government because government is controlled by industry."[51]

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Om P. Gandhi is Professor of Electrical and Computer Engineering at the University of Utah and a leading expert in dosimetry—measurement of non-ionizing radiation absorbed by the human body. Even before cell phones were in wide use, Professor Gandhi had concluded that children absorb more emitted microwave radiation. "The concentration of absorbed energy is 50 to 80% greater," he explained.[52]

These conclusions were not acceptable to Professor Gandhi's industrial sponsors. In 1998, he recalls, an executive from a cell phone manufacturer—which he did not want to identify—told him directly that if he did not discontinue his research on children his funding would be cut off. Professor Gandhi recalled replying: "I will not stop. I am a tenured professor at the University of Utah and I will not reject my academic freedom." Professor Gandhi also recalled some of his thought process: "I wasn't going to order my students to alter their results so that I can get funding." His industry sponsors cancelled his contract and asked for a return of funds.

Professor Gandhi believes that some cell phone users require extra protection because their heads are smaller and more absorptive. “Children, as well as women and other individuals with smaller heads absorb more concentrated energy because of the proximity of the radiating antenna to the brain tissue,” he said. And yet the FCC has not acted to provide special protection for these groups. Asked why not, Professor Gandhi conceded that he doesn’t know. He does note, however, that recent standards-setting has been dominated by industry representatives.[53]

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While the mobile industry refuses to admit to even the possibility that there is danger in RF radiation, giant insurance companies see things differently. Several insurers have in recent years issued reports highlighting product liability risk with cell phones. This is important because it is evidence that where money is on the line professionals outside the industry see the risk of legal liability.

Legal exposure could be one reason—perhaps the central one—the industry continues to stonewall. Should legal liability be established, one key question will be how much wireless executives knew—and at what point in time. Meanwhile, the combination of public relations denials, legal intimidation and the selective application of pressure on research follows a familiar pattern. “The industry is basically using the tobacco industry playbook,” UC Berkeley’s Moskowitz said in a recent radio interview.[54]

That playbook has thus far been highly successful in warding off attention, regulation and legal incrimination.

Chapter Five: $270 Billion . . . and Looking for Handouts

The FCC's network of corruption doesn't just shield industry from needed scrutiny and regulation on matters of public health and safety. Sometimes it just puts its hand directly into the public pocket and redistributes that cash to industry supplicants.

Such is arguably the case with the Universal Service Fund. Originally established to extend telephone service to rural and urban areas that industry would find difficult or uneconomical to wire, the USF is now shifting from subsidizing landline phone service to subsidizing the extension of broadband Internet. USF monies also support the Lifeline program, which subsidizes cell phone service to low-income consumers, and the E-Rate program, which subsidizes Internet infrastructure and service to schools and libraries.

Since 1998, more than $110 billion has been allocated to Universal Service programs, notes Charles Davidson, director of the Advanced Communications Law & Policy Institute at New York Law School. The FCC has allocated over $40 billion to the E-Rate program alone.

Who pays the freight for these high-cost programs? You do.

Technically, landline and wireless phone companies are assessed for the Universal Service fund's expenditures. But the FCC also allows those companies to pass on such charges to their subscribers, which they do. Both landline and wireless subscribers pay a monthly Universal Service charge that is tacked on to their phone bills. That charge has been rising and recently amounted to a 16% surcharge on interstate calls.

Consumers who pay for these programs might be interested to learn that both the E-Rate and Lifeline programs have been riddled with fraud. Government watchdogs have repeatedly found the programs to be inefficient and prone to inflated and fraudulent claims. But the programs have been a windfall for tech and telecom industry beneficiaries. Wherever the FCC presides, it seems, these industries reap a windfall.

The General Accounting Office (GAO) has issued several reports citing fraud, waste and mismanagement, along with inadequate FCC oversight of the subsidy program. Bribery, kickbacks and false documentation can perhaps be expected in a handout program mandated by Congress and only indirectly supervised by the FCC.

But the scope of fraud has been impressive. The most striking corruption has marred the E-Rate program, which subsidizes Internet hardware, software and service for schools and libraries, and the Lifeline cell phone subsidies.

In recent years, several school districts have paid fines to settle fraud cases involving bribery, kickbacks, non-competitive bidding of contracts and false documentation in the E-Rate

program. More eye opening perhaps are the settlements of fraud claims by tech giants like IBM, Hewlett Packard and AT&T. The HP case, for example, involved some colorful bribery allegations, including gifts of yachts and Super Bowl tickets. HP settled for $16 million. An HP official and a Dallas Independent School District official both received jail sentences.

The Lifeline program has also been riddled with fraud. A Wall Street Journal investigation of the five top corporate beneficiaries of Lifeline showed that 41% of more than 6 million subsidy claimants "couldn't demonstrate their eligibility or didn't respond to requests for certification."[55] AT&T, Verizon, and Sprint Nextel were three of the major Lifeline beneficiaries.

The FCC has initiated several efforts to clean up USF programs and seems honestly determined to bring greater accountability and efficiency to its subsidy efforts. Nevertheless, problems with fraud persist, as reported recently by the FCC's own top investigator.

Congress established the FCC's Office of Inspector General in 1989 to "provide objective and independent investigations, audits and reviews of the FCC's programs and operations." Here's what the FCC's internal investigative unit said in a September 30, 2014 report to Congress about its Office of Investigation (OI): "*The bulk of the work of OI involves investigating and supporting civil and criminal investigations/prosecutions of fraud in the FCC's federal universal service program*."[56]

Fraud—as pervasive and troubling as it has been—is just one of the problems with the programs of universal service. It may not even be the fundamental problem. More fundamental issues concern the very aim, logic and efficiency of programs to extend broadband and wireless technology at public expense. Though the aims of extending service to distant impoverished areas seem worthy on the surface, there are many reasons to think the major beneficiaries of these programs are the technology companies that win the contracts.

Lobbyists have long swarmed over the FCC looking to get an ever-growing piece of the USF honeypot. An FCC report on meetings with registered lobbyists details a 2010 meeting with representatives of the International Society for Technology in Education and other education lobbyists. Topics discussed, according to the FCC report, included "the need to raise the E-Rate's annual cap."[57]

The CTIA, leaving no stone unturned in its efforts to pump up member revenues, last year responded to a House hearing on the USF by grousing that "current USF-supported programs skew heavily toward support of wireline services. . . . The concentration of USF monies to support wireline services is inconsistent with technological neutrality principles and demonstrated consumer preferences," CTIA wrote..[58] An industry that generates hundreds of billions of dollars in equipment and service revenues annually bellies up for a bigger slice of the $8 billion a year USF.

The grousing has paid off. The FCC recently announced that it will raise spending on E-Rate from what had been a cap of $2.4 billion a year to $3.9 billion. A significant portion of new outlays will go to Wi-Fi—yet another wireless industry victory at the FCC. But the CTIA is by no means the only industry group pressing the FCC.

Leading the roster of active lobbyists on E-Rate issues is the Software and Information Industry Association. Beginning in 2006, SIAA led all lobbyists with 54 mentions of E-Rate in its filings, according to the Center for Responsive Politics. SIAA board members include executives from tech heavyweights Google, Oracle and Adobe Systems.

Tech business leaders—many of them direct beneficiaries of FCC programs—made a direct pitch to FCC Chairman Wheeler last year to hike E-Rate funding. "The FCC must act boldly to modernize the E-Rate program to provide the capital needed to upgrade our K-12 broadband connectivity and Wi-Fi infrastructure within the next five years," the executives wrote.[59]

There were dozens of corporate executive signees to this letter, including the CEOs of many Fortune 500 giants. But let's just consider the participation of three: top executives of Microsoft, Google and HP all joined the call to expand E-Rate subsidies. Consider the simple fact that these three tech giants alone had revenues of $270 billion—more than a quarter of a trillion dollars—in a recent four-quarter period. Together, they produced nearly $40 billion in net income. And yet their top executives still thought it necessary to dun the FCC—and really, they were surreptitiously hitting up the public—for ramped-up spending on what was then a $2.4 billion a year program.

Is that greed? Arrogance? Or is it simply behavior conditioned by success in repeatedly getting what they want at the public trough? Almost never mentioned in these pleas for higher subsidies is the fact that ordinary American phone subscribers are the ones footing the bill for the E-Rate program—not the FCC or the telecom industry.

Much of the added spending, as noted, will go towards the installation of wireless networks. And yet Wi-Fi does not have a clean bill of health. When Lennart Hardell, professor of Oncology and Cancer Epidemiology at the University Hospital in Orebro, Sweden, was asked what he would do if given policy authority over wireless health issues, he replied swiftly that he would "ban wireless use in schools and pre-school." Noting that there are wired alternatives, Professor Hardell flatly stated: "You don't need Wi-Fi."[60] And yet the FCC, prodded by an industry ever on the lookout for incremental growth opportunities, is ignoring the health of youngsters to promote expanded Wi-Fi subsidies in schools across the U.S.

And what about the merit of the program itself? Overlooking the fraud and lobbying and Wi-Fi safety issues for a moment, shouldn't schools and libraries across the country be equipped with the best electronic gear, accessing the Internet at the fastest speeds? Doesn't the government owe that to its younger citizens, especially those disadvantaged by the long-referenced digital divide?

Well, maybe. But answers to these questions hinge on even more fundamental question: Do students actually learn more or better with access to the latest high-speed electronic gadgetry?

It would be foolish to argue that nobody benefits from access to high-speed Internet. But the benefits are nowhere near as broad or rich as corporate beneficiaries claim. Some researchers, for example, have concluded that computers don't seem to have positive educational impact—they may even have negative impact—when introduced into the home or freely distributed to kids from low income backgrounds.

Duke University researchers Jacob Vigdor and Helen Ladd studied the introduction of computers into North Carolina homes. They found that the academic performance of youngsters given computers actually declined. *"The introduction of home computer technology is associated with modest but statistically significant and persistent negative impacts on student math and reading test scores,"* the authors wrote in a National Bureau of Economic Research Working Paper.[61] The impact was actually most negative on the poorer students.

A study in the Journal of International Affairs examined the impact of the global One Laptop Per Child Program (OLPC), which has distributed millions of computers to children around the world. Researchers Mark Warschauer and Morgan Ames conclude: *"The analysis reveals that provision of individual laptops is a utopian vision for the children in the poorest countries, whose educational and social futures could be more effectively improved if the same investments were instead made on more proven and sustainable interventions. Middle- and high-income countries may have a stronger rationale for providing individual laptops to children, but will still want to eschew OLPC's technocratic vision. In summary, OLPC represents the latest in a long line of technologically utopian schemes that have unsuccessfully attempted to solve complex social problems with overly simplistic solutions*."[62]

Access to computers in the home may not work educational magic. But what about computers in the classroom? Don't they have educational value there?

The anecdotal evidence is mixed at best. Consider how students in Los Angeles, newly equipped with flashy iPads at a mind-boggling taxpayer cost of more than $1 billion, went about using the new tools to improve their educational performance. "Instead of solving math problems or doing English homework, as administrators envisioned, more than 300 Los Angeles Unified School District students promptly cracked the security setting and started tweeting, posting to Facebook and playing video games."[63]

But let's cut through the self-serving corporate claims and the troubling anecdotes to hear from someone who actually has had extensive and unique field experience. Kentaro Toyama was co-founder of Microsoft's research lab in India. Over more than five years he oversaw at least a dozen projects that sought to address educational problems with the introduction of computer technology. His conclusion: "The value of technology has been over-hyped and over-sold."

The most important factor in improving schools, says Toyama, now the W.K Kellogg Associate Professor of Community Information at the University of Michigan, is good teachers. Without good, well-trained teachers, adequate budgets and solid school administration, technology does little good. "Technology by itself never has any kind of positive impact," he said.[64]

The only schools in his experience that benefited from increased technology investment were those where "the teachers were very good, the budgets adequate." The richer schools, in essence. But as both Vigdor and Warschauer found, the introduction of technology has by itself little if any positive effect. For a public conditioned to believe in the virtues of new technology, such testimony is a bracing dose of cold reality.

But what about cost? Doesn't technology in the schools more efficiently replace alternative investments? Cost reductions are often the most persuasive argument for technology, Toyama agrees. But even these have been overstated. The costs of introducing new technology run far beyond initial hardware and software investments, said Toyama. In reality, the total costs of ownership—including maintenance, training, and repair—typically run to five or ten times the initial cost, according to Toyama. He said of the investment in technology for cost benefits: "I would say that in the long run—and even in the medium run and the short-run—that's probably the worst and most misguided conclusion to come to."[65]

He adds: "The inescapable conclusion is that significant investments in computers, mobile phones and other electronic gadgets in education are neither necessary nor warranted for most school systems. In particular, the attempt to use technology to fix underperforming class rooms . . . is futile. And for all but wealthy, well-run schools, one-to-one computer programs cannot be recommended in good conscience."[66]

But that doesn't keep industry lobbyists from recommending them. And it hasn't kept the FCC for spending scores of billions subsidizing technology to the very groups least likely to benefit from it.

Unmoved by the arguments of researchers and educators like Vigdor, Warschauer, and Toyama, the FCC keeps moving to increase technology subsidies. Ignoring research that disputes the value of technology in closing the so-called "digital divide," the FCC has even pioneered a new slogan: "the Wi-Fi gap."

In announcing that it was lifting E-Rate's annual budget from $2.4 billion to $3.9 billion and stepping up investment in wireless networking, FCC chairman Wheeler exulted that "10 million students are going to experience new and better opportunities."[67] The impact on consumer pocketbooks (and potentially on youngsters' health from daily Wi-Fi exposure) were not mentioned.

The two Republican members of the FCC did at least recognize the pocketbook impact. "It always seems easier for some people to take more money from the American people via higher taxes and fees rather than do the hard work," said Commissioner Michael O'Reilly.[68]

The subsidized provision of high-speed Internet service is yet another pet project of the FCC. Julius Genachowski, chairman from 2009 to 2013, championed the transition of the USF from landline phone service to broadband. Universal broadband Internet connections would begin to absorb the monies collected from consumers to extend basic phone service.

As with government subsidies for cell phone service, classroom technology, and Wi-Fi, there are basic questions about the wisdom of subsidizing broadband. Charles Davidson and Michael Santorelli of the New York Law School found that spending billions to extend broadband is a flawed approach since there are many largely ignored reasons people choose not to adopt

broadband. “Everybody is pushing broadband non-stop,” noted Davidson, director of the Law School’s Advanced Communications Law and Policy Institute. “I think the FCC is focused on the wrong set of issues,” he said.[69]

Already, he explained, over 98% of Americans have access to wired or wireless broadband. The issue is not one of supply. It’s one of demand. Many people—for a variety of reasons—don’t really care about broadband, he contends. Price is one issue. Also powerful factors—but given almost no attention—are privacy and security concerns. “In our view, they should be focused on barriers to meaningful broadband utilization: privacy and security,” said Davidson.[70]

But consumer privacy (more on this subject in Chapter Seven) has no well-funded lobby with limitless access to the FCC.

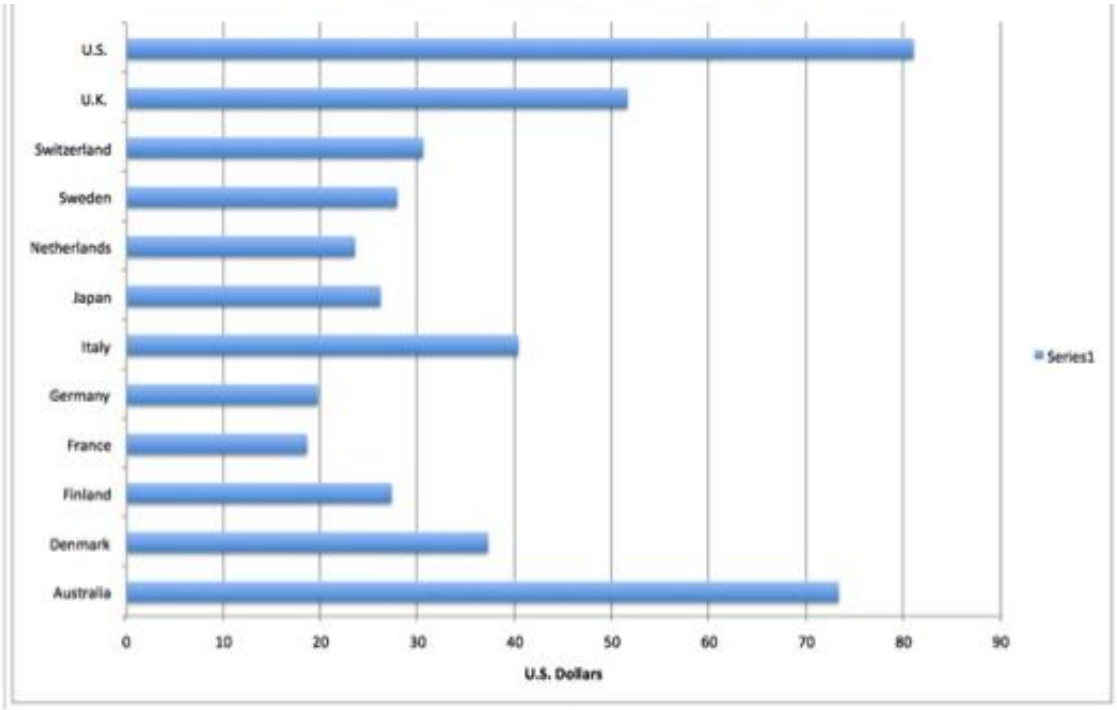
Chapter Six: The Cable Connection

The network has also been active in diluting FCC control of the cable television industry. Over the years, cable has devolved into major de facto local monopolies. Comcast and Time Warner Cable, whose merger proposal was dropped in April, are dominant forces in both cable television and broadband Internet subscriptions. Somehow, though, they have managed to steer clear of one another in specific markets, giving each pricing power where it faces little local competition.

It's interesting that cable companies annually rank in consumer polls among the "most hated" or "most disliked" American corporations. Indeed, Comcast and Time Warner Cable often top the "most hated" list.[71] Why would these companies—providers of the TV programming that has so expanded consumer options in recent decades—be so widely scorned? After all, the U.S. has been a leader in developing both cable technology and diverse television programming.

The problem is that it hasn't been anything close to a leader in bringing down subscriber prices. Industry consultants typically measure pricing by the metric of average revenue per subscriber. Industry trackers at IHS compared the price of U.S. pay television (which includes satellite services) to those in more than 60 other countries. U.S. prices were the highest, with only Australia even coming close. The average revenue per subscriber in the U.S. in 2013 was $81. But in France it was just $18.55. In Germany it was $19.68. In Japan it was just over $26.

Pay TV Monthly Revenue Per Person:



And U.S. cable prices have risen in recent years at rates three or more times the rate of inflation. This has been going on for some time. From 1995 to 2013 cable rates increased at a 6.1% annual clip. The Consumer Price Index, by contrast, rose by just 2.4% annually. Former FCC commissioner Michael Copps says the FCC shares a major part of the blame. "The FCC is as culpable for allowing that as much as the companies for imposing it," he said.[72]

One area where the FCC has contributed to the problem is in its traditional rubber-stamping of merger agreements. The proposed Comcast/Time Warner Cable deal has been shelved, largely because of Justice Department reservations. But a long run of earlier FCC-sanctioned deals allowed Comcast and Time Warner Cable to grow to the market dominance—and attendant pricing power—they currently command.

Lofty monthly cable bills pinch consumers. But it's more than that. Subscribers paying $80 a month are often paying for a lot of channels they don't watch and don't want. The FCC has never required cable operators to charge for what consumers actually want to watch. Kevin Martin, who chaired the FCC from 2005 to 2009, pushed to "debundle" programming in hopes of lowering bills. But the issue was never resolved. Only recently have viable competitive alternatives to cable's "bundled" packages become available. The satellite service Dish, for example, months ago introduced its Sling offering that enables consumers to opt for smaller and cheaper packages.

In fairness to cable operators, it should be pointed that programmers often require operators to take unwanted or fledgling channels along with their stars. New York cable operator Cablevision Systems filed suit against Viacom in 2013, charging that in order to get popular channels like MTV and Nickelodeon it was also forced to take low-rated channels like Nicktoons and VH1 Soul. But the simple truth is that no matter who is to blame, the cable consumer pays high prices, typically for some programming he doesn't want. As it often does when powerful interests pursue dubious practices, the FCC has for the most part idly stood by.

Still, the FCC isn't entirely to blame. Some factors in the growth of the cable giants cannot be laid at its doorstep. Local municipalities often granted monopoly or duopoly status in granting franchises to cable network builders. With the huge capital investments required to cable metropolitan areas, this once seemed to make sense.

And over the years, the cable giants have used a variety of tactics to weaken what little local competition they may have had. Active lobbyists on the local level, the cable giants have managed to convince a growing number of states to outlaw municipal systems that could threaten private corporate incumbents. The FCC for many years declined to tangle with the states in this matter, partly due to the opposition of Republican commissioners. But the Wheeler-led Commission did vote recently to override state laws that limit the build-out of municipal cable systems.

Still, many years of industry subservience will be difficult to swiftly undo. One linchpin merger shows how FCC decision-making has been thoroughly undermined by the revolving door, lobbying, and carefully targeted campaign contributions. All conspired in Comcast's pivotal 2011 buyout of NBC Universal, a deal which reinforced Comcast's domination of both cable and broadband access. This deal also set the stage for the recent headline-grabbing acrimony over the issue of net neutrality.

In 2011, mighty Comcast proposed to acquire NBC Universal. A series of mergers including the 1986 acquisition of Group W assets and the 2002 acquisition of AT&T's cable assets had already vaulted Comcast into cable market leadership. In bidding for NBC Universal, a huge step towards vertical integration, Comcast was once again raising the stakes. NBC Universal would give Comcast a treasure trove of programming, including valued sports content like NFL football and the Olympics.

Suddenly, the issue was not just cable subscriber base size—where Comcast had already bought its way to dominance. NBC Universal would also allow Comcast to consolidate its growing power as a broadband Internet provider. And with NBC Universal's programming assets, Comcast would gain new leverage when negotiating prices to carry the competing programming content of rivals. This would prompt a new round of debate over net neutrality. Couldn't a programming-rich Comcast slow down rival services—or charge them more to carry their programming?

To short-circuit any potential opposition to the merger, Comcast assembled a superstar cast of lobbyists. As Susan Crawford reports in her 2013 book, "Comcast hired almost eighty former government employees to help lobby for approval of the merger, including several former chiefs of staff for key legislators on congressional antitrust committees, former FCC staffers and Antitrust Division lawyers, and at least four former members of Congress.[73] Such "profligate hiring," Crawford observes, pretty much silenced the opposition to the deal. If Comcast had already retained one member of a lobbying firm, the firm could not under conflict of interest rules object to the deal. And Comcast had locked up key lobbying shops. Money was both weapon and silencer.

Of course, Comcast had always been a big spender on lobbying, with outlays exceeding $12 million every year since 2008. Lobbying costs peaked in 2011 at $19.6 million, according to the Center for Responsive Politics.

For its part, the FCC had a long history of approving most media mergers. So it was hardly a great surprise when the agency, after exacting some relatively minor concessions from Comcast, rubber-stamped the deal. Comcast would thus broaden its footprint as local monopoly distributor of cable. And with its new programming assets, it would enhance its leverage in negotiating deals to carry its rivals' programming. It would also fortify its position of growing strength as broadband Internet gatekeeper.

The most telling footnote to the deal would come just four months later. FCC Commissioner Meredith Atwell Baker, who voted to approve the merger in January 2011, left the FCC to become a top-tier Comcast lobbyist in May. It was the ultimate—and perhaps most telling—glide of the revolving door.

Baker's was a high-profile defection. But it was neither the first nor the last. Comcast had successfully convinced other FCC officials to take their expertise and government contacts to the cable giant. Comcast has long been a master at spinning the revolving door to its own advantage. "Comcast has been very good at hiring everyone who is very smart," said Crawford.[74]

Approval of the NBC Universal deal was another in the long string of FCC merger approvals that made Comcast a nationwide monopolist that could dictate both pricing and viewer programming choice.

But the deal may have had another unintended consequence. It set the stage for Comcast's subsequent battles on net neutrality. "Those mergers gave additional oomph to the issue of net neutrality," noted former commissioner Copps. Speaking specifically of Comcast's buyout of NBC Universal, IHS senior analyst Eric Brannon agreed. "That merger laid the grounds for net neutrality."

In allowing Comcast to acquire major programming assets, the deal would sharpen questions about the power of gatekeepers like Comcast to control the flow of traffic from rival Web services. So in bowing to lobbyist pressure, the FCC would bring on itself a whole new set of pressures by focusing public attention on the issue of net neutrality.

With activists rounding up comments from the public and hip TV personalities like HBO's John Oliver also beating the drums, net neutrality quickly grew into a popular issue that won the support of President Obama, and by proxy, his hand-picked appointee Tom Wheeler. When the FCC ruled in February of 2015 that it would seek Title II authority to regulate the Internet and presumably block any favoritism by broadband gatekeepers, it seemed to finally cast its lot with the public against steamrolling corporate interests

The issue had simmered for years but reached full boil when movie purveyor Netflix, which had argued that its service was slowed down by Comcast, signed a side deal ensuring better download speeds for its wares. This triggered an outburst of public concern that Comcast was now in position to operate "fast" and "slow" lanes, depending on whether a rival programmer could afford to ensure that Comcast provide adequate download speed.

With nearly 4 million comments—many supplied or encouraged by public interest groups—filed to the FCC, net neutrality was a bankable political issue. And there's no question, net neutrality attracted public interest because it gave cable viewers—long furious at the treatment by the monopolists who send them monthly bills—issues of both viewing pleasure and economics.

But it also fed into the longstanding sentimental but increasingly unrealistic view of the Internet as the last bastion of intellectual freedom. Internet romanticists have long seen the Web as a place that somehow deserves special rules for breaking the stranglehold of traditional media and offering exciting new communications, information retrieval and shopping efficiencies.

Yes, the Internet is a modern marvel. This is beyond dispute. But some of the favors it has won from government over the years have had unfortunate unintended consequences.

In the 1990s, for example, net access providers were repeatedly exempted as an "infant industry" from paying access charges to the Baby Bells even though they had to connect users through local phone networks. The long distance companies were then paying as much as $30 billion a year for the privilege. But the Internet was exempted.

As the late 90s approached, the Internet was no longer an infant industry. Still, the exemption from access charges was extended. That exemption essentially allowed AOL in the late 90s to offer unlimited unmetered online time, a key factor in boosting usage and siphoning advertisers from print media. Why buy an ad in print that might get viewed with the transitory flip of a page when you can get round-the-clock attention online?[75] FCC decisions to grant the Internet access-charge exemptions arguably accelerated the decline of print media and much of the quality journalism print advertising could once support.

Meanwhile, retailers on the Internet were making inroads into brick and mortar retail business with the help of a Supreme Court-sanctioned exemption from collecting sales tax.[76] This judicial coddling of the Internet was the death knell for many smaller mom and pop local businesses, already challenged to match online pricing. And that's not all. The special favors continue virtually every year, as Congress proposes and/or passes legislation to extend special tax exemptions to Internet services.

Well, maybe tax breaks aren't such a bad idea for such an innovative and transformational emerging technology. For all its faults, the Internet—gateway to all goods, repository of all things, wizardly guide to all knowledge, enabler of universal self-expression—is undeniably cool.

But let's not deny that the combination of tax advantages and deregulation was toxic. Allow an industry to emerge with advantages over useful existing industries that largely play by the rules—well, maybe that can be rationalized. But then fail to hold the upstart industry to the same rules, allowing it more leeway to trample fundamental rights because it has the technical capacity to do so. Well, then you have a cruel Faustian bargain.

With the see-no-evil deregulatory gospel loosing all constraints, the Web would devolve into a playground for corporate snoops and criminals. For all its wonders, the Internet comes at a cost: the loss of control over personal data, the surrender of personal privacy, sometimes even the confiscation of identity.

Perhaps the most favorable consequence of net neutrality—and one that has gotten surprisingly little attention—is that it could set the stage for privacy reform. (More on this in Chapter Seven). The FCC can now choose to exercise its Title II powers to enforce privacy standards over broadband Internet. Privacy is one area where the FCC has done a pretty good job in the past.

Worth remembering, though, is that the hard-fought public victory over Net Neutrality may be transitory. AT&T and others have threatened to go to court to upend the FCC rules. And there's a fair chance a Republican Congress will legislate against Title II.

Meanwhile, though, one supreme irony has begun to unfold in the marketplace.

Modern-day laissez fair ideologues love to invoke the wisdom of markets as represented by the "mysterious hand" of Adam Smith. Unfortunately, in the absence of effective regulation, the putatively wise "mysterious hand" generally seems to work its magic for those with huge financial resources and the political access it buys.

In the current cable situation, however, the mysterious hand may actually be working in consumer-friendly ways. Years of regulation that favored the cable companies have now backfired as the market reacts to monopolistic pricing and content control.

Whereas cable giants have commanded premium monthly subscriber prices to deliver packages of largely unwatched channels, the market is now beginning to burst with new "debundled" options that are whittling away at cable's vast subscriber base.

Satellite service Direct TV, as noted, now offers its streaming video Sling TV package of popular networks that includes live sports and news. Amazon, Apple, CBS, HBO, Netflix, Sony, and others offer a variety of streaming video options that allow viewers to cut the cable cord. Suddenly, consumers have the cherry-picking capability that bundled—and expensive—cable packages have never allowed.

In this case, at least, the unintended consequences of the FCC's pro-industry policies may be producing an unexpected pro-consumer twist.

Chapter Seven: What about Privacy?

Has any issue gotten as much lip service—and as little meaningful action?

For all the various congressional bills, corporate self-regulatory schemes and presidential Privacy Bill of Rights proposals, the simple truth remains that no personal information is safe on the Internet. Data brokers have built a multi-billion dollar business exchanging information used to build profiles of Net users. Your shopping and surfing habits, your health history, your banking data, your network of social ties, perhaps even your tax filings are all potentially exposed online. Both legal and criminal enterprises amass this information. And it doesn't go away.

At any given moment people you don't know somehow know where you are. They may very well know when you made your last bank deposit, when you had your last asthma attack or menstrual period. Corporations encourage and pay for every bit of information they can use or sell. Creepy? Perhaps, but as Jeff Chester, president of the Center for Digital Democracy points out: "The basic business model that drives online is advertising."[77]

The FCC largely escapes blame on this one. It is the Federal Trade Commission that has had primary responsibility for protecting Internet privacy. The FCC does have some limited authority, which, some critics say, could have been exercised more vigorously. But for the most part the FCC is not to blame for the rampant online abuse of personal privacy and identity.

The FCC does however have privacy authority over the phone, cable and satellite industries. Until recently, at least, the FCC has kept privacy issues at bay among the companies in these industries. "The FCC has generally taken privacy very seriously," noted Harold Feld, a senior vice president at the non-profit Public Knowledge.[78]

But dynamics now in place suggest that privacy may be the next great testing ground for the FCC. A new chance, perhaps, to champion public interest. Even before the opportunity for privacy enforcement under Title II regulatory powers, the FCC faces new challenges from phone companies, now itching to monetize their vast consumer data stashes the way Net companies have. The commonly used term is "Google envy."

"Until now, ISPs (Internet Service Providers) have mostly not gotten into hot water on privacy—but that's changing," observed Jonathan Mayer, a fellow at the Center for Internet and Society.[79] Verizon and AT&T, major providers of mobile Internet access, have each introduced "super cookies" that track consumer behavior even if they try to delete older, less powerful, forms of cookies. AT&T is actually charging its customers an extra $30 a month *not* to be tracked.

Showdowns loom.

In adopting Title II to enforce net neutrality, the FCC has made broadband Internet access a telecom service subject to regulation as a "common carrier." This reclassification means that the FCC could choose to invoke privacy authority under Title II's Section 222. That section, previously applied to phone and cable companies, mandates the protection of consumer information. Such information—called CPNI for Customer Proprietary Network Information—has kept phone companies from selling data on whom you call, from where you call and how long you spend on the phone. Consumers may have taken such protection for granted on their phone calls. But they have no such protection on their Internet activity—which, as noted, has been a multi-billion dollar safe house hideaway for corporate and criminal abusers of personal privacy.

Now, though, the FCC could put broadband Internet communications under Section 222 protection. To Scott Cleland, a telecom industry consultant who has often been ahead of the analytic pack, this would be a momentous decision.

When the smoke clears—and it hasn't yet—the FCC could make consumer identifiers like IP addresses the equivalent of phone numbers. Suddenly, the Internet companies that have trafficked in all that personal data would be subject to the same controls as the phone and cable companies.

Cleland argues that the risk for privacy abuses extends beyond broadband access providers like Comcast and Verizon to Internet giants like Google and Facebook that have until now flourished with all that personal data. "They are at risk and they are going to live under the uncertainty their business model could be ruled illegal by the FCC," Cleland said.[80]

Much has been written about the legal challenges broadband access providers intend to mount against the FCC's new rules. But Cleland argues that a very different type of legal action could engulf companies that have benefited from the use and sale of private data. Trial lawyers, he argues, will see opportunity in rounding up massive class action suits of Internet users whose privacy has been violated. What sorts of privacy abusers face legal action? Anyone who has "collected CPNI via some type of cookie," according to Cleland.

"Right now, edge providers like Google, Facebook and Twitter are at risk of being sued by trial lawyers," he said.[81]

Sounds great for consumers who care about privacy on the Internet and how it has been abused. But the FCC, Cleland was reminded, has never been a consumer advocate. "Bingo," replied Cleland. That's what makes the FCC's potential move into privacy protection so important and so surprising, he suggests.

There are other signs that the FCC under Tom Wheeler might actually become more consumer-friendly on the issue of data privacy. While Wheeler has brought some former associates from lobbying groups to the FCC, he has also peppered his staff with respected

privacy advocates. Indeed, he named Gigi Sohn, longtime president of the non-profit Public Knowledge, as Counsellor to the Chairman in April.

Another appointee with a privacy background is Travis LeBlanc, head of the FCC's Enforcement Bureau. In previous employment in California's Office of the Attorney General, LeBlanc was active in enforcing online privacy. LeBlanc has stated an interest in privacy and has already taken action against two firms that exposed personal information—including social security numbers—on unprotected Internet servers.

But many aspects of LeBlanc's approach to regulating Internet privacy under Title II remain unclear. Unfortunately, the FCC declined repeated requests to make LeBlanc available for an interview. (It also declined to answer written questions on its enforcement intentions in both privacy and cell tower infrastructure emissions.)

It remains to be seen if LeBlanc and his superiors at the FCC are really willing to take on privacy enforcement. Such a stance would require great courage as the entire Internet infrastructure is built around privacy abuse. It is also questionable whether the FCC would have the courage to challenge Google—a rare corporate ally in the battles over Net Neutrality.

Chapter Eight: Dependencies Power the Network of Corruption

As a captured agency, the FCC is a prime example of institutional corruption. Officials in such institutions do not need to receive envelopes bulging with cash. But even their most well-intentioned efforts are often overwhelmed by a system that favors powerful private influences, typically at the expense of public interest.

Where there is institutional corruption, there are often underlying dependencies that undermine the autonomy and integrity of that institution. Such is the case with the FCC and its broader network of institutional corruption.

As noted earlier, the FCC is a single node on a corrupt network that embraces Congress, congressional oversight committees and Washington social life. The network ties the public sector to the private through a frictionless revolving door—really no door at all.

Temptation is everywhere in Washington, where moneyed lobbyists and industry representatives throw the best parties and dinners. Money also allows industry to control other important factors, like the research agenda. All of this works together to industry's advantage because—as with other instances of institutional corruption—there are compromising dependencies. Policy makers, political candidates and legislators, as well as scientific researchers are all compromised by their dependence on industry money.

Dependency #1 – So much of the trouble here comes back to the core issue of campaign finance. Cable, cellular and educational tech interests know where to target their funds for maximum policy impact. And the contributions work, seemingly buying the silence of key committee congressmen—even those with past records as progressives. Key recipients of industry dollars include Massachusetts Senator Ed Markey and, until he retired, California Democrat Henry Waxman. Though they have intermittently raised their voices on such issues as data privacy and cellular health and safety, neither has shown any great inclination to follow through and take up what would have to be a long and tough fight on these issues.

Dependency #2 – Democrats might be expected to challenge industry now and then. They traditionally have done so, after all. But this is the post-*Citizens United* era where the Supreme Court has turned government into a giant auction house.

Bid the highest price and you walk home with the prize—your personal congressman, legislative loophole, even an entire political party.

Such is the case with technology industries and the Democrats. The communications/electronics industry is the third largest industry group in both lobbying and campaign contributions, according to the Center for Responsive Politics. In just 2013 and 2014, this industry sector spent well over $750 million on lobbying.[82]

Only the finance/insurance/real estate and health industries outspend the tech sector on lobbying. But those industry groups lean Republican. Over 62% of the finance/insurance/real estate campaign contributions go to the GOP. Health contributions lean Republican 57% to 43%. But the technology group leans sharply to Democrats, who got 60% of contributions in the 2013-2014 election cycle.[83] The two next largest industry groups—energy/natural resources and agribusiness—also lean heavily Republican. So of the top five industry groups whose money fuels and often tilts elections four are strongly Republican. The Democrats need the tech industry—and they show that dependence with consistent support, rarely raising such public interest issues as wireless health and safety and Internet privacy.

Dependency #3 – Spectrum auctions give the wireless industry a money-making aura. In recent Congressional testimony, an FCC official reminded legislators that the FCC has over the years been a budget-balancing revenue-making force.[84] Indeed, the auctions of electromagnetic spectrum, used by all wireless communications companies to send their signals, have yielded nearly $100 billion in recent years. The most recent auction to wireless providers produced the unexpectedly high total of $43 billion. No matter that the sale of spectrum is contributing to a pea soup of electromagnetic "smog" whose health consequences are largely unknown. The government needs money and Congress shows its appreciation with consistently pro-wireless policies.

Dependency #4 – Science is often the catalyst for meaningful regulation. But what happens when scientists are dependent on industry for research funding? Under pressure from budget cutters and deregulators, government funding for research on RF health effects has dried up. The EPA, which once had 35 investigators in the area, has long since abandoned its efforts.[85] Numerous scientists have told me there's simply no independent research funding in the U.S. They are left with a simple choice: work on industry-sponsored research or abandon the field.

Chapter Nine: A Modest Agenda for the FCC

Nobody is proposing that cell phones be banned. Nor does anyone propose the elimination of the Universal Service program or other radical reforms. But there are some steps—and most are modest—that the FCC can take now to right some of the wrongs that result from long years of inordinate industry access and influence:

1. Acknowledge that there may be health risks in wireless communications. Take down the dismissive language. Maturely and independently discuss the research and ongoing debate on the safety of this technology.

2. In recognition of this scientific uncertainty, adopt a precautionary view on use of wireless technology. Require prominent point-of-sale notices suggesting that users who want to reduce health risks can adopt a variety of measures, including headphones, more limited usage and storage away from at-risk body parts.

3. Back off the promotion of Wi-Fi. As Professor Lennart Hardell has noted, there are wired alternatives that do not expose children to wireless risk.

4. Petition Congress for the budgetary additions needed to expand testing of emissions on antenna sites. It was Congress after all that gave industry carte blanche for tower expansion so long as they comply with FCC standards. But there is evidence of vast non-compliance and Congress needs to ensure that tower infrastructure is operating within the law.

5. Acknowledge that children and pregnant women may be more vulnerable to the effects of RF emissions and require special protection.

6. Promote cable debundling as a way to lighten consumer cable bills, especially for those customers who don’t care about high-cost sports programming.

7. Apply more rigorous analysis to properly assess the value of technology in education. Evidence continues to pile up that technology in education is not as valuable as tech companies claim. Pay less attention to tech CEOs—pay more attention to the researchers who’ve actually studied the impact of trendy technology fixes on learning

8. Take over enforcement of personal privacy rights on the Internet. Of all the basic suggestions here, this would require the most courage as it would involve challenging many of the entrenched powers of the Internet.

Chapter Ten: Stray Thoughts

Some concluding thoughts:

Why do so many of the most dubious FCC policies involve technology?

In large part, of course, because the FCC has authority over communications and that is a sector that has been radically transformed—along with so many others—by technology.

Let's be clear, though. The problem is not technology, which unarguably brings countless benefits to modern life. The problem is with the over-extension of claims for technology's usefulness and the worshipful adulation of technology even where it has fearful consequences. Most fundamentally, the problem is the willingness in Washington—for reasons of both venality and naïveté—to give technology a free pass.

Personally, I don't believe that just because something can be done it should heedlessly be allowed. Murder, rape and Ponzi schemes are all doable—but subject to prohibition and regulation. Government regulators have the responsibility to examine the consequences of new technologies and act to at least contain some of the worst. Beyond legislators and regulators, public outrage and the courts can also play a role—but these can be muffled indefinitely by misinformation and bullying.

There are precedents for industries (belatedly perhaps) acting to offset the most onerous consequences of their products. In responding to a mix of litigation, public demand and regulatory requirement, the auto industry, for example, has in the last 50 years substantially improved the safety and environmental footprint of its products.

Padded instrument panels, seat belts, air bags, and crumple zones have all addressed safety issues. Environmental concerns have been addressed with tightened emissions and fuel consumption standards. The response to new safety challenges is ongoing. Before side air bags were widely deployed, sedan drivers side-swiped by much larger SUVs were at vastly disproportionate risk of death and dismemberment.[86] But the deployment of side air bags has "substantially" reduced the risk of collision deaths.[87] Overall, auto fatality rates per 100,000 persons have dropped by nearly 60% in the U.S. since 1966.[88] Today, automakers continue to work on advanced safety features like collision avoidance.

It can be argued that most of these safety improvements came decades after autos were in wide usage and only in response to outrage at Ralph Nader's 1965 revelations on the auto industry.[89] No matter the catalysts. The simple truth remains that the auto industry—and its regulators—have for the last half-century been addressing safety and environmental issues.

But with the overwhelming application of money and influence, information and communications technologies have almost totally escaped political scrutiny, regulatory control, and legal discipline.

Should the Internet have been allowed to develop into an ultra-efficient tool for lifting personal information that includes financial records, health histories and social security numbers? Should wireless communications be blindly promoted even as new clues keep suggesting there may be toxic effects? Should local zoning authorities and American citizens be stripped of the right to protect their own health? Should education be digitized and imposed just because technology companies want to develop a new market and lock in a younger customer base?

All these questions can perhaps be rolled up in one: do we all just play dead for the corporate lobbyists and spinners who promote the unexamined and unregulated application of their products?

Finally, a word about the structure of the FCC. With five commissioners—no more than three from the same party—the structure seems to make some kind of sense.

But in practice, it works out poorly. The identification of commissioners by party tends to bring out the worst in both Republicans and Democrats. Instead of examining issues with clear-sighted independence, the commissioners seem to retreat into the worst caricatures of their parties. The Republicans spout free market and deregulatory ideology that is most often a transparent cover for support of business interests. The Democrats seems satisfied if they can implement their pet spending programs—extension of broadband wireless to depressed urban and rural schools, cell phone subsidies for low income clients. The result is a Commission that fulminates about ideology and spends heavily to subsidize powerful interests.

Perhaps one solution would be to expand the Commission to seven by adding two public interest Commissioners. The public interest only rarely prevails at the FCC. So it would represent vast improvement if both Republican and Democrat commissioners had to vie for support of public interest representatives in order to forge a majority. The public interest, in other words, would sometimes carry the swing votes.

It's very hard to believe, though, that Congress would ever approve such a plan. It simply represents too much of a threat to the entrenched political power of the two parties. Why would they ever agree to a plan that dilutes that power?

It's also worth noting that the public interest is not always easy to define. Sometimes there are arguably conflicting definitions. Still, an FCC with public interest commissioners is an idea worth consideration. It would at least require party apologists to defend how they so consistently champion the moneyed interests that have purchased disproportionate access and power in Washington.

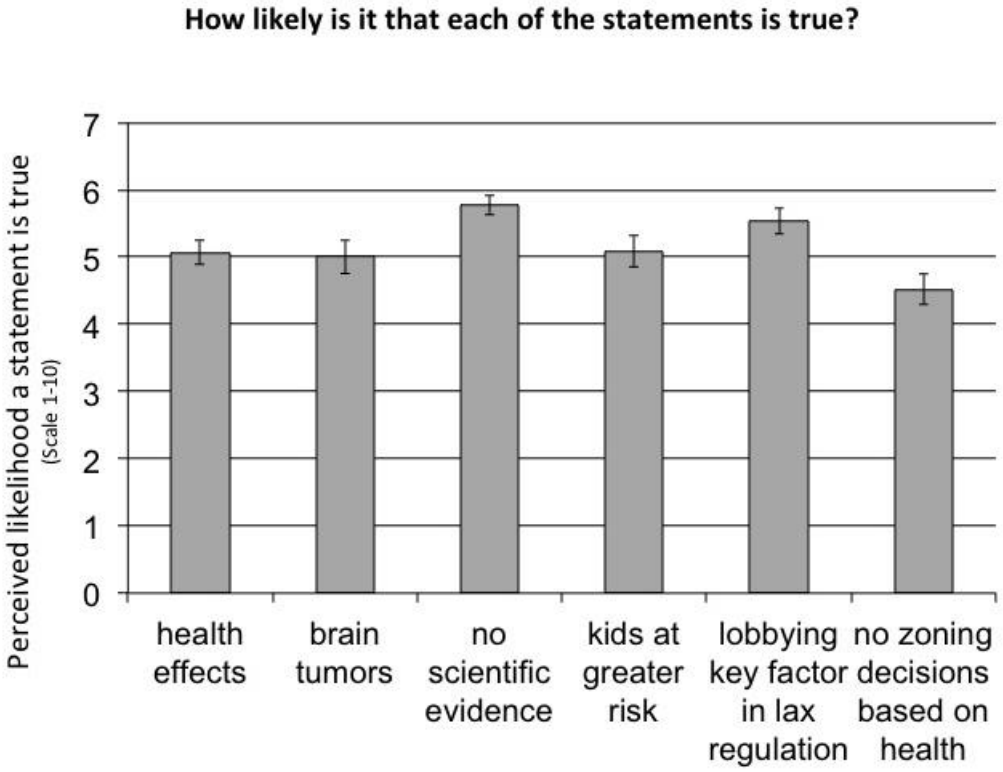
Appendix—Survey of Consumer Attitudes

What does the public believe about the science and politics of wireless health research? Under what conditions would people change wireless usage patterns? Is the FCC currently trusted to protect public health? How would confirmation of health risks affect trust in the FCC?

These are some of the questions Ann-Christin Posten[90] and Norm Alster[91] hoped to answer with an April 2015 online survey of 202 respondents. Participants were recruited through Amazon's Mechanical Turk online platform. All were U.S. residents and had achieved qualifying approval rates in prior Mechanical Turk surveys.

Participants were asked how likely they believed the following statements to be true:

> Statement 1. Prolonged and heavy cell phone use can have a variety of damaging effects on health.
>
> Statement 2. Prolonged and heavy cell phone use triples the risk of brain tumors.
>
> Statement 3. There is no scientific evidence that proves that wireless phone usage can lead to cancer or a variety of other problems.
>
> Statement 4. Children and pregnant women are especially vulnerable to radiation from wireless phones, cell towers and Wi-Fi
>
> Statement 5. Lobbying and campaign contributions have been key factors in keeping the government from acknowledging wireless hazards and adopting more stringent regulation.
>
> Statement 6. The U.S. Congress forbids local communities from considering health concerns when deciding whether to issue zoning permits for wireless antennae.

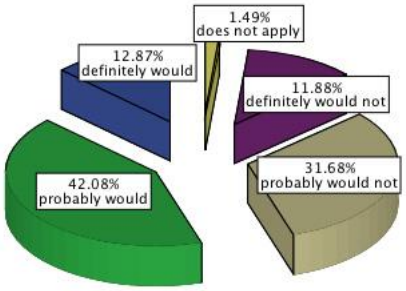


Two findings seem especially interesting:

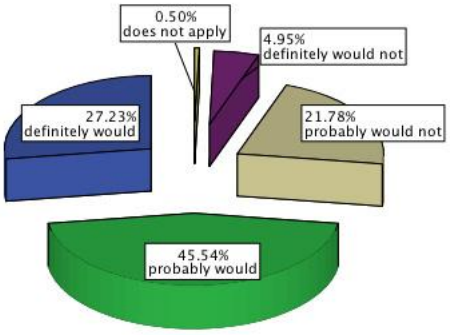
1. Statement 3 received a higher credibility rating than Statements 1 and 2. The different credibility levels are statistically significant. Respondents are more likely to trust in wireless safety than to believe there are general or specific health risks.

2. The only statement that is a matter of uncontested fact is Statement 6 on the outlawing of opposition to antenna sites on health grounds. (All other statements have been both proclaimed and denied.) And yet Statement 6 was least likely to be believed. Just 1.5% of respondents recognized this as an "absolutely true" statement. Over 14% thought this statement was "not true at all." Answers to this question would seem to reflect public ignorance on the political background to wireless health issues.

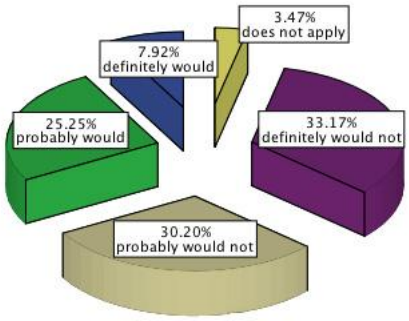
Participants were also asked how they would change behavior if claims of wireless health risks were established as true:



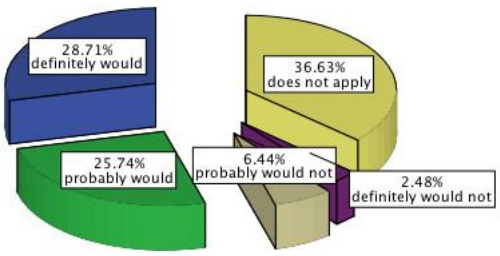
**If statement 1 was true,
I would start using headphones.**



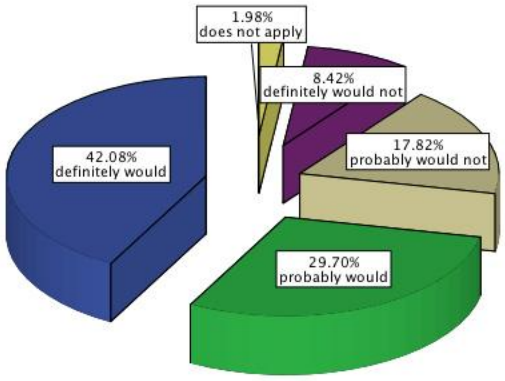
**If statement 1 was true,
I would restrict the amount of time
I spend on the phone.**



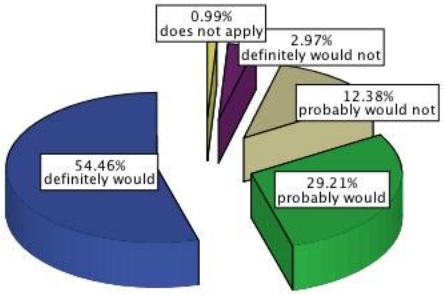
**If statement 1 was true,
I would start up a new land line
account for home use.**



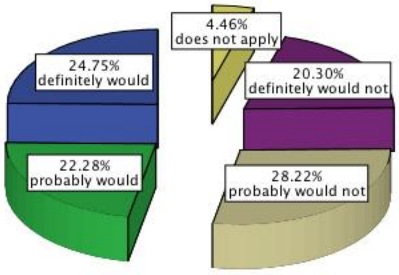
**If statement 1 was true,
I would restrict my children's cell phone use.**



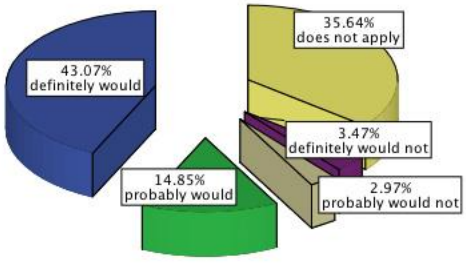
If statement 2 was true,
I would start using headphones.



If statement 2 was true,
I would restrict the amount of time
I spend on the phone.



If statement 2 was true,
I would start up a new land line
account for home use.



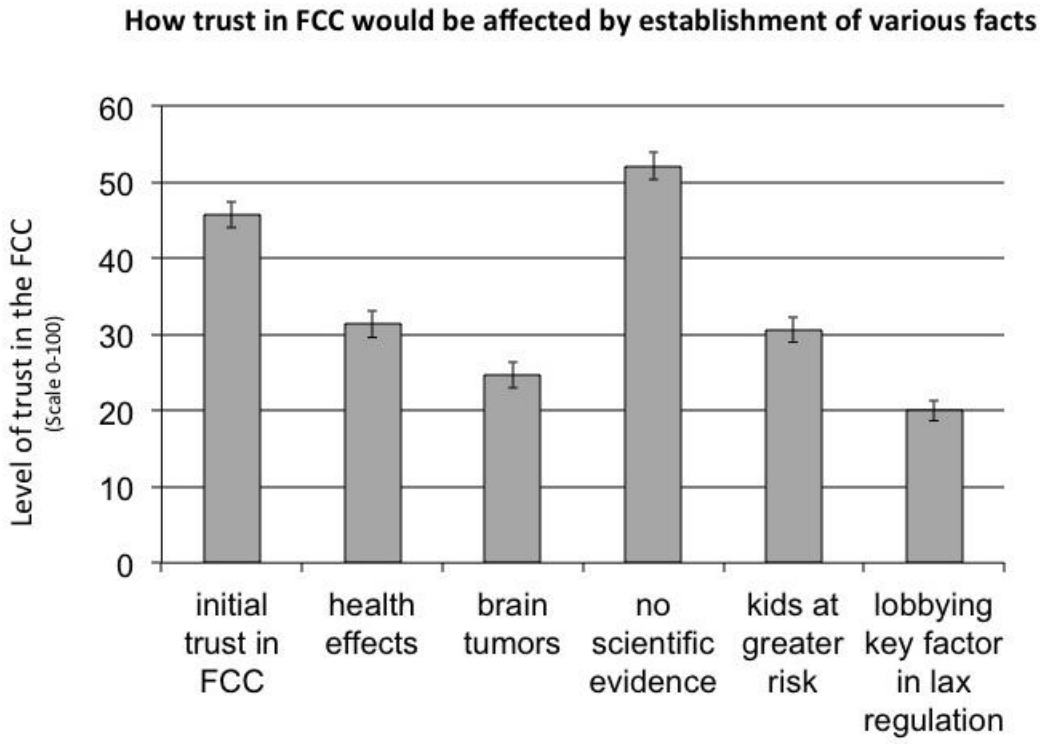
If statement 2 was true,
I would restrict my children's cell phone use.

The greatest impact on behavior came when respondents were asked to assume it is true that prolonged and heavy cell phone use triples the risk of brain tumors. More than half said they would "definitely" restrict the amount of time spent on the phone. Just over 43% would "definitely" restrict their children's phone use. Perhaps most surprisingly, close to 25% would "definitely" start up a new landline phone account. (This last response suggests it may be foolishly premature for the phone giants to exit the landline business just yet.)

The inclination of consumers to change behavior should negative health effects be confirmed suggests the stakes are enormous for all companies that derive revenue from wireless usage.

This survey points to—but cannot answer—some critical questions: Do wireless companies better protect themselves legally by continuing to deny the validity of all troublesome research? Or should they instead be positioning themselves to maintain consumer trust? Perhaps there is greater financial wisdom in listening to the lawyers right now and denying all chance of harm. If so, however, why would anyone seriously concerned about health listen to the industry—or to its captured agency? That's a question the FCC will eventually need to answer.

Trust could eventually become a central issue. Respondents were initially asked to describe their level of trust in the wireless industry and in the FCC as its regulator. Not surprisingly, establishment of any of the presumed health risks—or confirmation of inordinate industry pressure—resulted in statistically significant diminution of trust in both the industry and the FCC.



On a scale of 1 to 100, the FCC had a mean baseline trust level of 45.66. But if the tripling of brain tumor risk is established as definitely true, that number falls all the way to 24.68. If "lobbying and campaign contributions" have been "key factors" in keeping the government from acknowledging wireless hazards, the trust level in the FCC plummets to 20.02. All results were statistically significant.

It's clear that at this point confirmation of health dangers—or even of behind-the-scenes political pressures—from wireless will substantially diminish public trust in the FCC. Skeptics might argue that this gives the FCC motive to continue to downplay and dismiss further evidence of biological and human health effects. Those of a more optimistic bent might see in these findings reason to encourage an FCC concerned about public trust to shake itself loose from special interests.

Endnotes

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ISSN: (Print) (Online) Journal homepage: https://www.tandfonline.com/loi/venv20

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To cite this article: Erica Rosenberg (2022) Environmental Procedures at the FCC: A Case Study in Corporate Capture, Environment: Science and Policy for Sustainable Development, 64:5-6, 17-27, DOI: 10.1080/00139157.2022.2131190

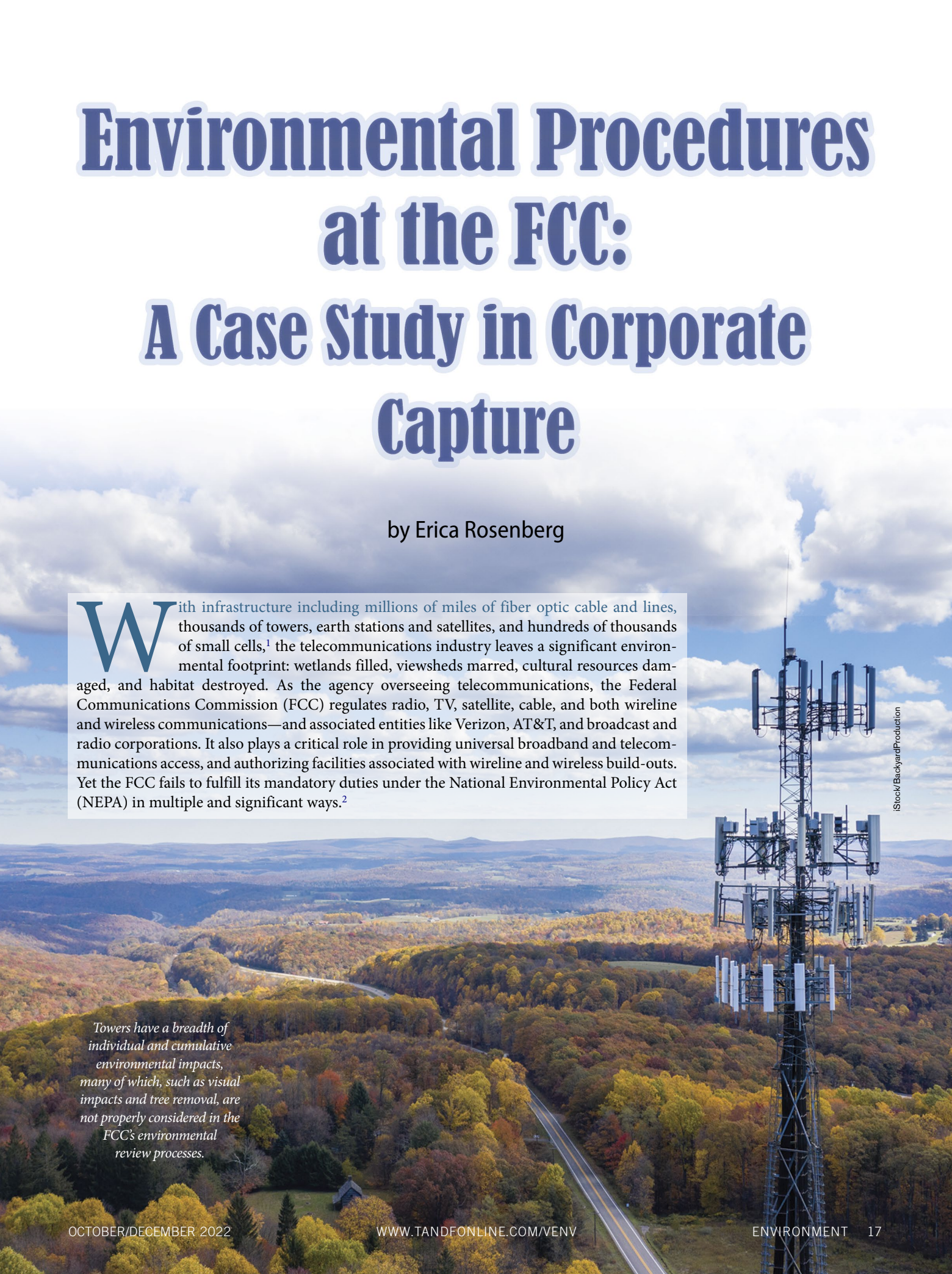
To link to this article: https://doi.org/10.1080/00139157.2022.2131190

Published online: 12 Dec 2022.

Environmental Procedures at the FCC: A Case Study in Corporate Capture

by Erica Rosenberg

With infrastructure including millions of miles of fiber optic cable and lines, thousands of towers, earth stations and satellites, and hundreds of thousands of small cells,[1] the telecommunications industry leaves a significant environmental footprint: wetlands filled, viewsheds marred, cultural resources damaged, and habitat destroyed. As the agency overseeing telecommunications, the Federal Communications Commission (FCC) regulates radio, TV, satellite, cable, and both wireline and wireless communications—and associated entities like Verizon, AT&T, and broadcast and radio corporations. It also plays a critical role in providing universal broadband and telecommunications access, and authorizing facilities associated with wireline and wireless build-outs. Yet the FCC fails to fulfill its mandatory duties under the National Environmental Policy Act (NEPA) in multiple and significant ways.[2]



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Towers have a breadth of individual and cumulative environmental impacts, many of which, such as visual impacts and tree removal, are not properly considered in the FCC's environmental review processes.

Like all federal agencies, the FCC must follow environmental laws, including NEPA, which requires it to assess potential environmental effects of its actions before it authorizes, funds, or licenses projects and communications infrastructure. These effects include visual and ecological impacts, and radio frequency emission exceedances, caused by the proliferation of wireless technology and the networks constructed to deploy it. The agency is supposed to follow legal requirements to assess such environmental impacts and, in doing so, to consider the concerns of communities and citizens.

It does neither. For most deployments it authorizes, the FCC rarely completes any environmental review or makes NEPA documents available to the public; instead, with little FCC oversight or enforcement, industry is delegated the task of determining how much environmental review is appropriate for its deployments and in most cases, is not required to submit documentation of those determinations.

In licensing and authorizing facilities associated with telecommunications, broadband, and broadcasting technologies, the FCC intentionally and routinely fails to meet its environmental obligations and epitomizes "regulatory capture." It treats environmental laws as obstacles to be circumvented or ignored, first by promulgating rules that fall short of what NEPA requires and then by failing to properly implement and enforce its own substandard rules. The chronic failure has cumulative, incalculable, and largely unknown environmental impacts.

Combined with statutory authority that curtails local government authority to regulate or block telecom deployment in their jurisdiction, public and local voices in what is deployed and where are further diminished.[3] Equally important, the agency suppresses and dismisses the voices of communities and citizens concerned about these encroachments. As wireless infrastructure proliferates under the auspices of an agency that flouts federal law, unabated and unaccounted for environmental impacts will only multiply.

NEPA: An Instrument of Democracy and Accountability

NEPA, a Nixon–era law and one emulated around the world, outlines a process for decision-making about "major federal actions, like dam-building, offshore drilling, and highway expansions.[4] Council on Environmental Quality implementing rules define major federal actions broadly to include "new and continuing activities, including programs entirely or partly financed, assisted, conducted or approved by federal agencies." They also include "approval of specific projects, such as construction or management activities located in a defined geographic area. Projects include actions approved by permit or other regulatory decision as well as federal and federally assisted activities."[5]

NEPA requires the government to disclose broadly defined environmental impacts of proposed actions—and to consider alternatives—including not undertaking the action.[6] It allows the public, from local governments to tribes to citizens, to participate in the decision.[7]

The greater the potential environmental impacts of a project, action, or policy, the more analysis and the more opportunities for public input and challenge. NEPA requires a full-scale environmental review (environmental impact statement) for major actions with potentially great environmental effects like a highway, a shorter assessment (environmental assessment) for actions that may have less significant impacts, and exemptions from analysis for categories of routine actions (categorical exclusions), like removing brush, that the agency has determined individually or cumulatively have no significant environmental effect. Although a categorical exclusion may exist for an action, in any given case, extraordinary circumstances such as the presence of environmentally sensitive resources can remove an action from a categorical exclusion and require either a documented categorical exclusion or more NEPA review. For example, even if the United States Forest Service categorically excludes brush removal on small tracts, brush removal in critical habitat for endangered species would require the agency to consider and document that its action would still not require an environmental assessment or conduct an environmental assessment.

As a procedural statute, NEPA cannot stop environmentally harmful projects, but it can substantially improve the imprint of an action by, for example, rerouting a power line to protect a stream, or bringing information about wildlife to light so that licensees can take mitigation measures. In short, NEPA, by mandating transparency and accountability, is an instrument of democracy and good governance. NEPA also requires that agencies promulgate policies or rules implementing NEPA in accordance with Council on Environmental Quality rules, and in consultation with the Council on Environmental Quality.

FCC's Failure to Consider Major Federal Actions

Council on Environmental Quality rules place many of the FCC's licensing and funding activities squarely within the definition of a major federal action. Yet the FCC has construed major federal actions narrowly or has simply not considered whether its actions are major federal actions. Consequently, the agency has not considered actions like providing financial assistance to carriers for deployment of small cells and build-outs with associated cable-laying and transmission lines as major federal actions.[8]

In 2018, the agency went as far as to deem all licensing of small cell facilities, which it authorizes as part of a license to carriers, as not requiring environmental review because they were not major federal actions.[9] Termed by industry as unobtrusive—"smaller than a pizza box or backpack"[10]—small cell facilities can be significantly larger and are placed on buildings or associated poles. In its order, the agency both eliminated federal environmental review of small cells and significantly limited local authority over small wireless infrastructure deployment.

In her dissent to the order, FCC Commissioner Jessica Rosenworcel noted that 5G would require millions of miles of fiber and up to 800,000 small

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The FCC is authorizing the deployment of hundreds of thousands of small cells with little public input or environmental review.

cells by 2026. The order thus "runs roughshod over the rights of our Tribal communities and gives short shrift to our most basic environmental and historic preservation values."[11] She noted that the Mobility Fund, which supports carriers in bringing wireless services to underserved areas, would support updated wireless service, to the tune of $4.53 billion. Yet in effect, she states, the FCC reads "projects carried out with financial assistance" (a requirement of the National Historic Preservation Act) as well as NEPA out of the law.[12] It also "removes many larger wireless facilities from environmental oversight."[13]

The FCC's efforts to eliminate small cell review were struck down by the D.C. Circuit in *United Keetoowah v. FCC*,[14] a case brought by the Natural Resources Defense Council and several tribes. The court found: "The scale of the deployment the FCC seeks to facilitate, particularly given its exemption of small cells that require new construction, makes it impossible on this record to credit the claim that small cell deregulation will 'leave little to no environmental footprint. *Order* ¶ 41.'"[15]

Appropriately, the FCC considers licensing spectrum and registering towers to be major federal actions that trigger NEPA. However, while the FCC recognizes that its grant of geographic licenses to carriers triggers NEPA, it issues the licenses without any knowledge of how the licensee will deploy infrastructure in its build-out. In most cases, it cannot know because the carrier may not have finalized its build-out plans for construction of towers, transmission lines, and small cell facilities over time. In fact, the agency does not prepare and never has prepared an environmental impact statement on a build out—or on any other major federal action; it has only prepared one programmatic environmental assessment, which was in response to a lawsuit.[16] Instead, it requires NEPA review only on a facility-by-facility basis, which also circumvents a NEPA requirement to consider cumulative effects.[17] Segmenting a project into smaller components is illegal, and the FCC's approach is another way it flouts the law.

FCC's Inadequate NEPA Rules

FCC NEPA rules undermine NEPA at every turn—they are inadequate both as written and as implemented. The rules' unusual structure and an agency that interprets its rules in favor of the carriers mean that most projects proceed without adequate environmental review and consideration.

Unlike other agencies' rules, FCC rules do not identify categories of actions that do not require further NEPA review; rather, the rules categorically exclude *all* actions the agency takes except for those that meet a limited set of itemized extraordinary circumstances.[18] In other

Wireless infrastructure is changing the character of historic buildings and neighborhoods.

instances, the FCC deems its actions categorically excluded. For example, construction of submarine cables, which indisputably has potentially significant environmental impacts to reefs, ocean floors, and marine life, is explicitly excluded from review following a 1974 FCC order asserting that the environmental consequences are negligible.[19]

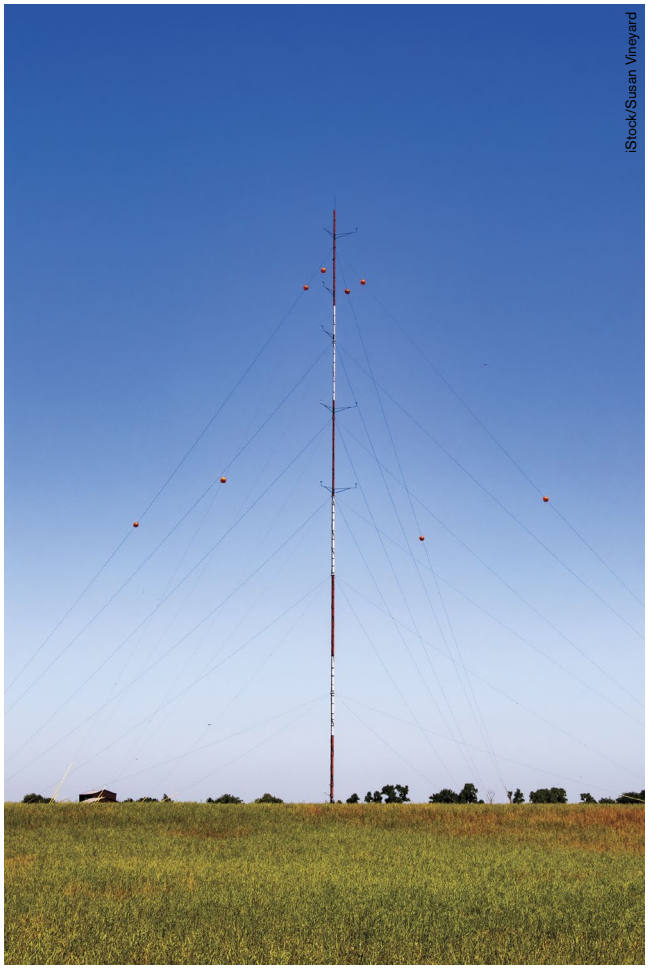
In dismissing the petition brought by an environmental nongovernmental organization to require more environmental review for a number of FCC actions, including those involving submarine cables, the 1974 order acknowledged environmental damage from cables in Maine and the U.S. Virgin Islands but illogically found no need for environmental review because the projects violated state law and permits.[20]

By not considering FCC actions major federal actions and by relying on a broad and unsupported categorical exclusion, countless activities with potentially significant environmental impacts or actual impacts proceed with little or no NEPA review or public involvement. Unlike many agencies, FCC lacks a NEPA coordinating office and most bureaus within the agency have no NEPA expertise or even awareness of the obligations the statute confers on the agency.

Streamlined Effects: The NEPA Checklist

The agency also skirts its NEPA obligations through its procedures and practice around "effects" consideration. It defines effects narrowly and by doing so, removes actions from public notice and comment. Most egregiously, it delegates the initial consideration of effects to applicants and licensees—telecom companies, for the most part—to determine whether an environmental assessment is warranted or whether the project is categorically excluded, and because the review is not submitted to the FCC, it typically performs no subsequent review of the applicants' documentation.

Council on Environmental Quality regulations define effects broadly.[21] FCC rules and practices limit the consideration of environmental effects. They also limit the extraordinary circumstances that would warrant a higher level of environmental review (i.e., an environmental assessment) and public input for the action—through both its narrow list of circumstances and its narrow interpretation of those circumstances. Those limited circumstances are actions involving facilities that: may affect Indian cultural sites or historic resources (i.e., National Historical Preservation Act triggers); may affect threatened or endangered species or their habitat; may involve significant changes in surface features (such as to wetlands or forests); are in a floodplain if equipment is not raised; exceed radio frequency emissions limitations; involve high-intensity lights in residential areas; are in wilderness areas or wildlife



Tall, guyed towers kill millions of birds a year.

refuges; or are more than 450 feet tall in light of potential impacts to migratory birds.[22] These circumstances are referred to as "the NEPA checklist."

Even so, FCC has in effect gutted most elements of the checklist. For example, for the floodplain trigger,[23] as long as equipment is raised for a facility in a floodplain, no environmental assessment is required, although no evidence of raising the equipment or a local permit need be submitted. Although required by Council on Environmental Quality (which unfortunately approved the 2018 rule change), no cumulative effects of building in floodplains are considered. Similarly, applicants often fail to submit an environmental assessment when they have received a federal or state wetlands permit, so again, no evidence is submitted to the agency or for public review.

To eliminate another environmental assessment trigger, rule changes in 2020 allow projects that affect historic properties and cultural resources to proceed without an environmental assessment.[24] "Change in surface features" has in practice required consideration of wetlands impacts (i.e., whether a federal permit is needed), rather than considering large-scale vegetation or soil removal, or grading of sensitive habitats. Thus, even if several acres are bulldozed or dozens of trees cleared, an environmental assessment is not required.

A comprehensive NEPA review for telecommunications infrastructure is both possible and required by other agencies. For instance, the National Telecommunications and Information Administration, which also supports expanding broadband access and adoption, considers a breadth of effects under NEPA that the FCC's checklist fails to consider.[25] National Telecommunications and Information Administration, for example, requires consideration of cumulative effects.[26]

Delegation of Review: Fox Guarding the Hen House

Even more extraordinary than its failure to consider a breadth of environmental effects for most of its actions is the FCC's delegation of consideration of environmental effects to the applicant or licensee. In other words, self-interested parties conduct the NEPA checklist environmental review. Under Council on Environmental Quality rules, the federal agency is ultimately responsible for the environmental document, regardless of who prepares it.[27] Yet under FCC procedures, the agency never even sees the

initial environmental review documenting that a categorical exclusion, rather than a more extensive environmental review, is supported—except in the unlikely event it requests checklist documentation following a complaint.

No other agency allows the applicant to make the initial determination of whether a project is categorically excluded or requires an environmental assessment. Other agencies require submission of documentation of that determination or make the determination themselves. Instead, the FCC relies on applicants to be truthful in their dealings with the agency—yet rarely if ever has it enforced against applicants who make false statements on its forms. Applicants submit documentation only when checklist review triggers an environmental assessment. This approach to ensuring compliance with the NEPA rule is at best unrealistic and at worst, a license to deceive.

No FCC oversight ensures that applicants have done their due diligence to consider the checklist circumstances properly or to even review the circumstances at all. With no agency or public awareness, applicants can simply categorically exclude their projects that involve even larger scale impacts. In East Fishkill, New York, for example, more than 50 trees were cleared from a forested area along a highway known for its scenic views, with no environmental assessment.[28]

Incorrect, confusing, or inadequate filing instructions further ensure that the applicant's work will be incomplete.[29] The instructions themselves fail to even reflect the inadequate rules because they omit Endangered Species Act considerations, do not capture National Historical Preservation Association requirements, omit wetlands concerns, and include outdated floodplain requirements. Similarly, NEPA checklist guidance used until June 2022 did not even reflect the rules on environmental assessment triggers or environmental assessment content requirements.[30]

The checklist allows for only a very narrow set of environmental assessment triggers. In theory, FCC rules do allow for consideration of non-checklist effects or effects missed in the checklist review—those raised by members of the public and those raised by the FCC on its own motion.[31] In reality, this almost never happens. The FCC inevitably fails to consider some potentially significant effects outside of the checklist because it relies entirely on the public to identify them, it never initiates its own review, it relies on self-interested applicants to review projects, and it views its mission as facilitating deployment.

Lack of Notice and Public Availability of Documents

Limiting notice and public availability of documents is another way the agency fails to meet fundamental NEPA responsibilities. Council on Environmental Quality rules require both notice of

The effects of cell towers in sensitive areas like coastal zones and wetlands are not fully considered in the FCC's NEPA process.

actions and opportunities for public comment.[32] In fact, the rules require that agencies make "diligent efforts" to involve the public in implementing their NEPA procedures.[33] Instead, the FCC makes diligent efforts to exclude the public from raising concerns under NEPA.

Applicants and licensees submit no documentation of their determination that their project is categorically excluded, and the agency does not track categorically excluded actions. With the applicant conducting the initial environmental review of whether the project is categorically excluded by assessing the list of extraordinary circumstances (i.e., the NEPA checklist), as well as preparing the environmental assessment, the burden falls on the public to learn of the proposed action and to raise a potential effect.

But categorically excluded actions, including authorization of certain towers, do not receive public notice; only applications for towers that require registration (generally taller than 199 feet) are put on notice, and those may or may not have associated environmental assessments. In addition to towers under 200 feet not posing an air hazard, these stealth projects that the agency has no record of include small wireless facilities associated with 4G and 5G.

That the public has no access to this information is particularly problematic in the radio frequency context, where applicants are required to meet radio frequency emissions standards or submit an environmental assessment. If the applicants do analyze the checklist and radio frequency studies at all, they routinely categorically exclude small wireless facilities, despite growing public concern about radio frequency associated with such technologies. Without access to the documented checklist, the public has little to no basis on which to refute or comment on checklist conclusions on radio frequency. And given the streamlined process, citizens often find out about facilities only after they are built.

Lack of Transparency: Notice of EAs

While the public is completely disenfranchised on categorically excluded projects, the situation with environmental assessments is only slightly better. If an environmental assessment is required because the applicant identified a trigger on the NEPA checklist, the tower or other structure must be registered. But it is not the environmental assessment itself that is publicly noticed—it is the application for the tower registration or license modification. The notice serves only to notice for 30 days that an application for an antenna structure at a particular location has been submitted. Members of the public interested in that structure must track down the application in the antenna structure registration system and then see whether an environmental assessment is attached. To find environmental assessments that are "accessible," a member of the public would have to know that a proposed antenna structure registration included an environmental assessment.

Hence, notice is hardly "public." Rather than being posted on a readily accessible, centralized site for NEPA documents,[34] the registration application and the associated environmental assessment, if done, are buried in a hard-to-access, byzantine website.[35] Without project coordinates or an exact site location, it is difficult to get into the website and, once in, to find the environmental documents. To complicate matters further, environmental assessments associated with licensee towers that do not need to be registered (i.e., short towers) are noticed separately and are buried on a different webpage.[36]

Comments Deemed "Complaints"

Even if the public manages to overcome FCC hurdles and ascertain information about a proposed facility, it faces nearly insurmountable obstacles to get its concerns heard or addressed. Under NEPA, the burden of looking at effects is a federal obligation—it is not up to the public to establish a case but merely to apprise the agency of potential effects to consider; the comment period allows the agency to meet its NEPA obligations by giving the public an opportunity to raise effects or alternatives not considered in the environmental review process.

But rather than a standard, fair, or open comment process in which the agency considers and responds to concerns raised by the public, the FCC administers an adversarial complaints process that requires the public to meet a high burden of proof about a potential effect that may have been overlooked in the checklist or inaccurately documented.[37] With a process that unfairly shifts the burden of raising and establishing environmental concerns from the agency to the public, the outcome is always the same. The FCC virtually never finds that complaints are valid. To dismiss them or resolve them in the applicant's favor so that the project can proceed, it routinely finds that the complainant has not provided specific enough detail or an adequate scientific showing for the agency to consider an effect.

Compounding the unlikelihood that the public will learn about a project and be able to weigh in is a timing issue. When the public finds out about a project that the applicant has deemed categorically excluded (either by doing the checklist or failing to do the checklist), there is no timeline to comment on or complain about the project. With no notice and no timeline for these projects that proceed with no agency awareness, the public often learns about the projects when construction begins or, just as likely, when the facility is already built.

Because the applicant need not consider aesthetics, for example, a tower visible from a state park could be deemed categorically excluded and built before the public sees the impact to its viewshed. Rarely, if ever, will the FCC decide an environmental assessment is required under the circumstances because the applicant ostensibly did what was required of it by assessing the minimal checklist. Furthermore, in terms of failure to comply with NEPA, environmental assessments are submitted so late in the process that a meaningful alternatives analysis—a hallmark and requirement of NEPA[38]—is foreclosed.

Aesthetic Effects: The Greatest Impacts Never Addressed

Perhaps most egregious is the agency's approach to aesthetic impacts.

Applicants should be required to consider aesthetic impacts because, by the FCC's own account in its rulemaking, visual impacts are by far the most significant impact a tower could have.[39] As originally promulgated, FCC's NEPA regulations triggered an environmental assessment when facilities were to be located "in areas which are recognized either nationally or locally for their special scenic or recreational value."[40] Again and again in the rulemaking, visual effects were cited as the greatest impact, as well as an impact to be mitigated.[41] Yet in 1985, the FCC decided the standard was "unduly vague," and that it was unnecessary for applicants to submit environmental assessments in cases that "may raise aesthetic concerns."[42] It also noted that "aesthetic concerns may more appropriately be resolved by local, state, regional or local land use authorities"[43]—although NEPA is an independent federal obligation.

On the rare occasion when the FCC does consider aesthetics, its examination is generally limited to consideration of impacts to nationally designated scenic trails and historic sites (the latter falling under visual effects under National Historical Preservation Association) or to national parks, although nothing in NEPA or Council on Environmental Quality rules limits consideration of aesthetic impacts solely to those designated areas. This practice precludes consideration of impacts to, for example, scenic tourist areas or state or locally designated battlefields and parks. In 2014, AT&T built a tower in Fort Ransom, North Dakota, visible from a nearby National Scenic Tail and Scenic Byway, without having to consider aesthetic impacts.[44] Towers have been built in the viewsheds of, for example, a National Scenic Trail in Vergennes, Michigan, an iconic bridge in New York, a civil rights site in Selma, Alabama, and on Dewey Beach, Delaware's sand dunes, with little notice, consideration of visual impacts, or mitigation.

Little Compliance, Little Enforcement

With no oversight to ensure applicants have done the due diligence required to consider the checklist and no on-the-ground inspections, lack of compliance with the rules is rampant

Large-scale projects with multiple facilities built without NEPA review include hundreds of towers in Alaska built by GCI.[45] Between 2001 and 2015, T-Mobile built hundreds of towers in 22 states without environmental review.[46] In New Mexico and Texas, Plateau Telecommunications built 58 towers with no National Historical Preservation Association review.[47] Telalaska built 28 towers near and in sensitive areas in Alaska with no repercussions.[48] With no Enforcement Bureau action, the Wireless Telecommunications Bureau and Alliant Energy Corporation agreed in 2017 to a compliance plan after Alliant built 109 towers and 93 poles without NEPA review.[49] Railroad noncompliance was so widespread that the FCC entered into a settlement agreement with several railroads that created a $10 million cultural resources fund for 11,000 constructed poles that had not gone thru National Historical Preservation Association or NEPA review.[50]

Smaller-scale projects and individual towers also have significant impacts. For example, in 2019, licensees in Broward County, Florida, cleared 36 trees and built a driveway through a forested wetland before completing environmental review.[51] In Sabana Grande, Puerto Rico, a tower builder in 2014 bulldozed critical habitat for an endangered bird.[52] Dozens of sacred sites have been similarly destroyed or damaged across the country, as have multiple cultural resources and historic and archaeological sites.

Although towers can alter iconic views, the FCC does not require licensees to consider aesthetic impacts.

Cell towers are altering and marring views across the country.

Many of these failures to comply with environmental requirements come to light as National Historical Preservation Association violations, rather than as NEPA violations, because the National Historical Preservation Association process, as part of the checklist, requires photo documentation and official state and tribal review. Complaints from these officials or the public and self-reporting—often unintentionally with photos submitted through increasingly rare environmental assessment submissions[53]—are generally the sole bases for enforcement.

Conveniently for an agency intent on deployment, the FCC's Enforcement Bureau operates under a one-year statute of limitations—one year from the time the facility was built, not from when the agency learned of the violation. As a result, by the time the agency learns of the violation and decides to take action, it is often prohibited from levying fines against the violator.

When the agency does take action, it amounts, with few exceptions, to a slap on the wrist. In 2016, six licensees got admonishment letters with no penalties and little agency publicity.[54] For the past decade or so, Wireless Telecommunications Bureau admonishment letters, which number from zero to six per year, warn of the potential for increased fines and punishments if violators break rules again. But the agency could not fine the violators and does not track the letters. Fines are rare and if levied, de minimis.[55] At most, penalties are ordered once or twice a year, and tower removal, which would be a reasonable and authorized remedy for violations, is never ordered.

In one instance, clearing guy-wire areas for a 1,500-foot broadcast tower in Punta Gorda, Florida, destroyed 2.6 acres of treed habitat for bonneted bats, an endangered species. As mitigation, the applicant paid $28,000 to the U.S. Fish and Wildlife Service, while the FCC issued a Finding of No Significant Impact and imposed a fine of $28,000.[56]

Ex Post Facto NEPA: A Concept Not Contemplated by NEPA

To address instances of noncompliance, the agency has instead devised an ex post facto NEPA process under which the violators conduct and submit an after-the-fact checklist or environmental assessment. If an environmental assessment is required, these half-built or fully built projects then receive the FONSIs that are a prerequisite for construction. Enforcement action may, but more likely will not, follow; with no repercussions, a 485-foot broadcast tower in Chattanooga, Tennessee, was built and operating for months before it got its FONSI in 2021.[57]

Since 2002, the agency has used a clearance process for noncompliant towers (i.e., those that have not gone through the National Historical Preservation Association and NEPA process).[58] For example, on March 28, 2012, the FCC "cleared" with a post-construction review the 58 towers that Plateau Telecommunications had built in violation of historic preservation procedures.[59] Other elements of the requisite NEPA review were ignored—and are often ignored in this process.

Regardless, NEPA may not be done retroactively, and the substantive value of this follow-up exercise is unclear. It

Beyond visual impacts, cell towers built in pristine areas can affect sensitive species and ecosystems.

is hard to assess damage to a site never evaluated for the presence of, for example, wetlands, sensitive species, historic resources, or sacred sites before clearing took place. More importantly, given the dearth of documentation, little means for the agency to discover violations, and lack of oversight at the agency, it is unclear just how many projects that impact environmentally sensitive areas are constructed with improper or no checklist review, or get started without waiting for a FONSI to construct; most of the sites where environmental damage occurred and the degree of destruction will never be known.

By routinely clearing towers with post-construction checklist reviews, the agency creates incentives for tower companies and carriers to build their towers and, if necessary, do paperwork later. Given the lax enforcement and the statute of limitations issue, this approach from industry's perspective would be quite reasonable.

Conclusion: Prospects for a More Accountable FCC

Clearly, the FCC's NEPA process falls short of what NEPA and Council on Environmental Quality require.

- It ignores major federal actions requiring environmental review, such as its distribution to industry of billions of dollars that support build-outs for updated wireless service, or improperly deems certain major federal actions nonmajor federal actions to circumvent NEPA.
- Its NEPA rules create an unsupported and overbroad categorical exclusion so that, for example, satellite licensing and submarine cable licensing are excluded from review.
- With little oversight or tracking, it delegates environmental review of NEPA determinations to industry proponents of the project.
- It fails to vigorously enforce its rules so that industry noncompliance is rampant.
- It fails to provide adequate notice and opportunities for public comment.
- It fails to make environmental documents, including radio frequency emissions studies, publicly available or readily accessible.
- It routinely ignores or dismisses public comments and concerns and places an unfair burden of proof on the public when it raises concerns.

These practices serve to facilitate deployment for carriers while ignoring environmental rules and the public. Besides environmental costs, the FCC's approach bespeaks a lack of transparency

and accountability that undermines good governance and erodes democracy. It also bespeaks an agency completely captured by the entities it is tasked with regulating.

Recent Biden-era NEPA implementing rules[60] require agencies to revisit their NEPA rules and procedures by September 2023.[61] They also require that the agencies have the capacity to comply with NEPA,[62] something the FCC has to date lacked. Perhaps when Council on Environmental Quality reviews the FCC's procedures this time, it will scrutinize the rules more carefully and hold the agency to a higher standard for NEPA compliance.

An environmental and public lands policy attorney with over 30 years of experience, including in agencies, Congress, and academia, **Erica Rosenberg** worked at the FCC's Wireless Telecommunications Bureau from 2014 to 2021; for the last six of those years, she was Assistant Chief of the Competition and Infrastructure Policy Division.

NOTES

1. Unlike macro-cells or wireless cell towers, a small cell installation consists of radio equipment and antennas placed every few meters on structures such as streetlights, buildings, or poles.
2. 42 U.S.C. §4371 *et seq*.
3. Telecommunications Act of 1996, Section 704, 47 U.S.C §332.
4. 40 CFR §1508.18 (1978). Note: Unless otherwise noted, NEPA regulations cited are 1978 regulations (i.e., pre-Trump and Biden-era regulations). The FCC was bound by those regulations until April 2022.
5. 40 CFR §1508.18.
6. 40 CFR §1508.8.
7. 40 CFR §§1501.2(d)2), 1.1501.7((a)(1), 1.1503.1, 1.1506.6.
8. Other agencies, such as the National Telecommunications and Information Administration (NTIA), do conduct NEPA reviews for such actions.
9. *See* Accelerating Wireless Broadband Deployment by Removing Barriers to Infrastructure Investment ("Infrastructure Order") (WT Docket 17-79, FCC 18-30), (March 22, 2018), 33 FCC Rcd 3102 (4).
10. *See* CTIA blog, March 27, 2018 ctia.org/news/what-is-a-small-cell.
11. 11. *See* Infrastructure Order, Rosenworcel dissenting statement.
12. 12. *Id.*
13. 13. *Id.*
14. *United Keetoowah Band of Cherokee Indians v. FCC,* 933 F. 3d 728 (D.C. Cir. 2019).
15. *Id.* at 741. Between the time the Order was issued and the decision handed down, however, countless small wireless facilities were deployed without NEPA review.
16. Final Programmatic Environmental Assessment for the Antenna Structure Registration Program, FCC (March 13, 2013).
17. *See* 40 CFR §1508.7(cumulative impacts); §1508.8 (b) (effects include cumulative).
18. 47 CFR §1.1306(a).
19. 49 FCC 2d 1313,para. 14(a) (1974); *see also* 47 CFR §1.1306 Note 1. (EA requirements do not "encompass the construction of new submarine cables systems.")
20. *See* In the matter of Public Employees for Environmental Responsibility, FCC 01-319, n. 46.
21. *See* §1501.3; §1508.1(g)(1) (definition of effects includes aesthetic, health, economic, etc.).
22. 47 CFR § 1.1307.
23. 47 CFR §1.1307(a)(6).
24. Declaratory Ruling and Notice of Proposed Rulemaking, In the Matter of Implementation of State and Local Governments' Obligation to Approve Certain Wireless Facility Modification Requests Under Section 6409(a) of the Spectrum Act of 2012, FCC 20-75A (June 9, 2020), paras. 45–50. 35 FCC Rcd 5977.
25. https://broadbandusa.ntia.doc.gov/sites/default/files/2021-07/July%202021%20BB%20Infra%20Webinar_FINAL%20Presentation_0.pdf, p. 23.
26. *See id.* at p. 50.
27. *See generally* 40 CFR §1506.5.
28. *See* letter from Michael S. Fishman, Conservation Biologist, Edgewood Environmental Consulting, to Noelle Rayman USFS biologist, Cortland, NY, November 13, 2020, Re: Determination of Adverse Effects from Wireless EDGE—WEC-NY-23 Cell Tower 90 Carpenter Road, East Fishkill, Dutchess County, NY 41°34'40.37"N, 73°47'03.84"W.
29. *See, e.g.*, Form 601 instructions (https://www.fcc.gov/sites/default/files/fcc-form-601.pdf): Item 22.
30. 30. *See* "FCC Environmental Assessment" (checklist) (undated).
31. *See* 47 CFR §§1.1307(c) and (d).
32. 40 CFR §1506.6 (provide public notice of availability of environmental documents).
33. 40 CFR §1506.6(a).
34. 40 CFR §1506.6 ("provide public notice of NEPA related-hearings … and the availability of environmental documents").
35. wireless2.fcc.gov/UlsApp/AsrSearch/asrApplicationSearch.jsp (application) and wireless2.fcc.gov/UlsApp/AsrSearch/asrApplicationSearch.jsp (environmental notice).
36. wireless2.fcc.gov/UlsApp/AsrSearch/asrApplicationLicense.jsp.
37. In *American Bird Conservancy, v. CTIA*, 516 F.3d 1027, 1033 (D.C. Cir. 2008). the court admonished the FCC for setting too high a standard.
38. *See* 40 CFR §1508.9 (EAs include consideration of alternatives).
39. *See, e.g.,* 49 FCC 2d 1313 (1974), para. 32 ("we have stressed the visual or aesthetic impacts of [such] facilities as their primary environmental effect").
40. *Id.* at para. 14.
41. *See, e.g., id.,* at paras. 18, 23, 27, 28, 32.
42. 986 WL 292182, 60 Rad. Reg. 2d, para. 11 (November 25, 1985).
43. *Id*. at para. 122.
44. AT&T Mobile Services, Inc. Construction of Tower Fort Ransom, North Dakota; Complaints of the Sheyenne River Valley National Scenic Byway, Don Busta, Judith L. Morris, and the North Country Trail Ass'n, Memorandum Opinion and Order, 30 FCC Rcd 11023, 11032, para. 28 (WTB/CIPD 2015).
45. *See* Consent Decree (DA 15-1179) (October 20, 2015).
46. Phoenix Towers International acquired the towers and in 2016, sought to bring them into compliance.
47. 27 FCC Rcd. 2972 (March 29, 2012) (letter to Gregory W. Whitaker from Dan Abeyta, WTB).
48. *See* email from Amy Summe, Shannon and Wilson, to Erica Rosenberg, Assistant Chief, Competition and Infrastructure Policy Division, Wireless Bureau, FCC re: Towers, after-the-fact NEPA compliance, February 14, 2020.
49. *See* email from Michelle Yun, Senior Attorney, Alliant to Jiaming Shang, Attorney Advisor, Wireless Telecommunications Bureau, FCC and attachment "Final Compliance Plan.pdf (May 23, 2017).
50. https://www.fcc.gov/document/fcc-announces-actions-facilitate-ptc-implementation; https://www.indianz.com/News/2014/06/04/tribes-take-role-in-major-rail.asp.
51. *See* ASR No. 1136027, Broward County, West Hollywood Telecommunications facility, filed November 2019 (attached EA).
52. See ASR No. A1062663, Wise Towers, filed December 29, 2016 (attached EA and filings).
53. *See., e.g.,* ASR No. A1179538 (attached EA, dated December 8, 2020, for a 610-foot tower in Weedville, PA indicates that the applicant cleared several acres of sensitive species habitat before completing environmental review). (Appendix III, pp. 17-18).
54. *See, e.g.,* letter to Kenneth Meyers, President and CEO, United States Cellular Corporation from Jeffrey Steinberg, Deputy Chief, CIPD, WTB, June, 16, 2016, re: Violation of FCC Environmental Rules.
55. *See, e.g.,* In re: Western Wireless Corp, FCC 03-109 (May 6, 2003) (tower built near several historic sites and operating in violation of environmental rules fined $200,000). The fine was ultimately rescinded on November 17, 2004.
56. *See* Consent Decree, In re: Fort Myers Broadcasting Company (DA21- 1365) (November 2, 2021).
57. *See* FONSI letter to Brian Fuqua, Greater Chattanooga Public TV Corp from Erica Rosenberg, Assistant Chief, Competition and Infrastructure Policy Division, Wireless Bureau, FCC (April 14, 2021).
58. In 2009, over 1,000 AT&T towers built pre-2001 without NEPA documentation were "cleared." Letter from Jeffrey Steinberg Deputy Chief, SPCD to Jeanine Poltronieri, AT&T (January 16, 2009).
59. 27 FCC Rcd 2972 (March 29, 2012) (letter to Gregory W. Whitaker from Dan Abeyta, WTB, FCC).
60. 40 CFR §100 et seq. (April 20, 2022).
61. *See* 40 CFR §1507.3 (2022).
62. *See id.*

International Commission on the Biological Effects of Electromagnetic Fields (ICBE-EMF)
Environmental Health (2022) 21:92
https://doi.org/10.1186/s12940-022-00900-9

Environmental Health

COMMENT

Open Access

Scientific evidence invalidates health assumptions underlying the FCC and ICNIRP exposure limit determinations for radiofrequency radiation: implications for 5G

International Commission on the Biological Effects of Electromagnetic Fields (ICBE-EMF)*

Abstract

In the late-1990s, the FCC and ICNIRP adopted radiofrequency radiation (RFR) exposure limits to protect the public and workers from adverse effects of RFR. These limits were based on results from behavioral studies conducted in the 1980s involving 40–60-minute exposures in 5 monkeys and 8 rats, and then applying arbitrary safety factors to an apparent threshold specific absorption rate (SAR) of 4 W/kg. The limits were also based on two major assumptions: any biological effects were due to excessive tissue heating and no effects would occur below the putative threshold SAR, as well as twelve assumptions that were not specified by either the FCC or ICNIRP. In this paper, we show how the past 25 years of extensive research on RFR demonstrates that the assumptions underlying the FCC's and ICNIRP's exposure limits are invalid and continue to present a public health harm. Adverse effects observed at exposures below the assumed threshold SAR include non-thermal induction of reactive oxygen species, DNA damage, cardiomyopathy, carcinogenicity, sperm damage, and neurological effects, including electromagnetic hypersensitivity. Also, multiple human studies have found statistically significant associations between RFR exposure and increased brain and thyroid cancer risk. Yet, in 2020, and in light of the body of evidence reviewed in this article, the FCC and ICNIRP reaffirmed the same limits that were established in the 1990s. Consequently, these exposure limits, which are based on false suppositions, do not adequately protect workers, children, hypersensitive individuals, and the general population from short-term or long-term RFR exposures. Thus, urgently needed are health protective exposure limits for humans and the environment. These limits must be based on scientific evidence rather than on erroneous assumptions, especially given the increasing worldwide exposures of people and the environment to RFR, including novel forms of radiation from 5G telecommunications for which there are no adequate health effects studies.

Keywords: Federal Communications Commission (FCC), International commission on non-ionizing radiation protection (ICNIRP), Radiofrequency radiation (RFR), Exposure limits, Exposure assessment, Radiation health effects, Reactive oxygen species (ROS), DNA damage, 5G, Scientific integrity, Cell phone*, Mobile phone*

Introduction

In establishing exposure limits for toxic or carcinogenic agents, regulatory agencies generally set standards that take into account uncertainties of health risks for the general population [1] and for susceptible subgroups such as children [2]. That approach has not been applied in the same way to the setting of exposure limits for

*The terms cell phone and mobile phone are used interchangeably in this commentary; cell phone is the term used in the United States, while mobile phone is the term used in most of Europe.

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radiofrequency radiation (RFR) (frequency range: 3 kHz to 300 GHz). Moreover, assumptions underlying the current RFR exposure limits are flawed; hence, the limits that are currently applied do not adequately protect human and environmental health. This issue is discussed in greater detail under Assumption #9.

The Federal Communications Commission's (FCC) limits for maximum permissible exposure to RF electromagnetic fields (EMF) [3] were established in 1996 [4], and currently include many recommendations from the International Commission on Non-Ionizing Radiation Protection [5]. These exposure limits were expected to protect against adverse health effects in humans that might occur from short-term (i.e., acute) exposures to RFR and have been maintained by the FCC for the past 26 years. The exposure limits that were established by the FCC in 1996 relied on criteria recommended by the National Council on Radiation Protection & Measurements (NCRP) [6] and the Institute of Electrical and Electronics Engineers (ANSI/IEEE) [7, 8]. The limits were "based on a determination that potentially harmful biological effects can occur at a SAR (specific absorption rate) level of 4.0 W/kg as averaged over the whole-body." The SAR is a measure of the rate of RF energy absorbed per unit mass.

The threshold for a behavioral response and for acute thermal damage in sensitive tissues was considered to be an exposure that produced a whole-body SAR greater than 4 W/kg. In parallel with the development of the FCC's RFR exposure limits, ICNIRP's guidelines for limiting exposure to RF-EMF were also based on behavioral studies conducted in rats and monkeys in the 1980s [9].

The harmful effects that served as the basis for the exposure criteria were changes in behavior observed in small numbers of rats and monkeys when exposed to RFR for up to 60 minutes to power densities at which the whole-body SAR was approximately 4 W/kg or higher [10, 11]. Those studies were conducted in the early 1980s (1980 and 1984, respectively) by investigators of the US Navy Department. Consequently, 4 W/kg was identified as the threshold SAR for adverse health effects induced by RFR. In food-deprived monkeys that were exposed to three different frequencies (225 MHz, 1.3 GHz, and 5.8 GHz) during 60-min sessions, lever-pressing response rates for the delivery of food pellets were reduced compared to sham exposure sessions. The threshold SAR for this decreased response was reported to range from 3.2 to 8.4 W/kg [11]. Similarly, in food-deprived rats exposed to 40-min sessions at 1.28 or 5.62 GHz radiation, the threshold SAR for a decrease in response rate was reported to range from approximately 3.8 to 4.9 W/kg [10]. In experimental studies in which monkeys were exposed in an anechoic chamber for 4 hours to 1.29 GHz radiation at various power densities, an increase in mean body temperature of 0.7 °C was associated with a whole-body SAR of 4 W/kg [12]. Behavior disruption associated with an increase in body temperature of approximately 1.0 °C was assumed to be the most sensitive measure of harmful effects from RF-EMF exposure.

After establishing 4 W/kg as the threshold dose for acute harmful effects, both the FCC [3, 4] and ICNIRP [5, 9] set exposure limits for controlled occupational exposures to 0.4 W/kg SAR averaged over the whole body (based on applying a 10-fold safety/uncertainty factor). For the general population, the FCC's and ICNIRP's exposure limits were set at 0.08 W/kg SAR averaged over the whole body (by applying an additional 5-fold safety/uncertainty factor) for frequencies between 3 MHz and 3 GHz. The exposure limits established by the FCC and ICNIRP do not account for any impact of differing signal characteristics, such as carrier wave modulations or pulsing of the signal. Whole-body exposures for the general population are based simply on power levels averaged over 30-minute periods [3, 5].

Based on SAR distributions from whole-body exposures in which local (i.e., partial body) SARs were estimated to be 10 to 20 times the average value, local exposure limits were set 20 times higher than the average whole-body exposure limit [4–7]. For occupational exposures, local peak exposure limits were permitted up to 8 W/kg averaged over any 1-g cube of tissue [4] or 10 W/kg averaged over any 10 g of contiguous tissue [9] by the FCC and ICNIRP, respectively. For the general population, local peak SARs for partial-body exposures were not to exceed 1.6 W/kg averaged over any 1 g of cube-shaped tissue [3], or not to exceed 2.0 W/kg averaged over any 10 g of cube-shaped tissue [5]. Higher limit values are permissible for extremities. Extremities include the hands, wrists, feet, ankles, and pinnae (the external part of the ear), despite the close proximity of the ear to the brain. These adjustments were made long before the widespread use of wireless communication devices in which the emitting antenna is typically held close to local body organs such as the brain. The NCRP document [6] acknowledges that exposures could be greater than the recommended safety limit values when people are in close proximity to emitters of RFR.

The setting of exposure limits for the prevention of excessive tissue heating was based on the following assumptions: 1) electromagnetic waves at frequencies used in wireless communications do not have sufficient energy to break chemical bonds or ionize molecules [13]; 2) RFR could not damage DNA; and 3) tissue heating was the only possible biological effect of nonionizing radiation [5, 9, 14–16]. For potential environmental and human health issues that are not addressed in the

A) Effects of RF radiation at exposures below the putative threshold SAR of 4 W/kg

Assumption 1) There is a threshold exposure for any adverse health effect caused by RF radiation; in the frequency range of 100 kHz to 6 GHz it is a whole-body exposure that exceeds an SAR of 4 W/kg. Any biological effect of RF radiation above the threshold exposure is due to tissue heating.

Assumption 2) RF radiation is incapable of causing DNA damage other than by heating; there is no mechanism for non-thermal DNA damage.

Assumption 3) Two to seven exposures to RF radiation for up to one hour duration are sufficient to exclude adverse effects for any duration of exposure including chronic exposures.

Assumption 4) No additional effects would occur from RF radiation with co-exposure to other environmental agents.

B) Factors affecting dosimetry

Assumption 5) Health effects are dependent only on the SAR value; carrier wave modulations, frequency, or pulsing do not matter except as they influence the SAR.

C) Human brain cancer risk

Assumption 6) The multiple human studies that find associations between exposure to cell phone RF radiation and increases in brain cancer risk are flawed because of biases in the published case-control studies, and because brain cancer rates have remained steady since the time that use of wireless communication devices became widespread.

D) Individual variations in exposure and sensitivity to RF-EMF

Assumption 7) There are no differences among individuals, including children, in the absorption of RF-EMF and susceptibility to this radiation.

Assumption 8) There are no differences among individuals in their sensitivity to RF radiation-induced health effects.

E) Applied safety factors for EMF-RF workers and the general population

Assumption 9) A 50-fold safety factor for whole body exposure to RF radiation is adequate for protecting the general population to any health risks from RF radiation.

Assumption 10) A 10-fold safety factor for whole body exposure to RF radiation is adequate for protecting workers to any health risks from RF radiation.

Assumption 11) Exposure of any gram of cube-shaped tissue up to 1.6 W/kg, or 10 grams of cube-shaped tissue up to 2 W/kg, (duration not specified) will not increase the risk of that tissue to any toxic or carcinogenic effects in the general population.

Assumption 12) Exposure of any gram of cube-shaped tissue up to 8 W/kg, or 10 grams of cube-shaped tissue up to 10 W/kg, (duration not specified) will not increase the risk of that tissue to any toxic or carcinogenic effects in workers.

F) Environmental exposure to RF radiation

Assumption 13) There is no concern for environmental effects of RF radiation or for effects on wildlife or household pets.

G) 5G (5^{th} generation wireless)

Assumption 14) No health effects data are needed for exposures to 5G; safety is assumed because penetration is limited to the skin ("minimal body penetration").

Fig. 1 Assumptions Underlying the FCC/ICNIRP Exposure Limits for RF Radiation

setting of exposure limits (for example effects of chronic exposures, or effects of co-exposure of skin to RFR and other environmental agents, such as would occur with 5G exposure in combination with sunlight), the implicit assumption is that such effects do not matter, or that the arbitrarily selected safety/uncertainty factor is sufficient to deal with those concerns. In any case, it is expected that underlying assumptions applied to health risk assessments would be clearly described [1].

Exposure limits for RF radiation are based on numerous assumptions; however, research studies published over the past 25 years show that most of those assumptions are not supported by scientific evidence. In the NCRP report [6], the authors noted that when further understanding of biological effects of RF radiation becomes available, exposure guidelines will need to be evaluated and possibly revised. The ANSI/IEEE document [7] also notes that effects of chronic exposure or evidence of non-thermal interactions could result in revising exposure standards. Unfortunately, these recommendations were never implemented. Assumptions of safety from exposures that could adversely affect human or environmental health should be tested and validated *before* widespread exposures occur, not afterwards, by agencies responsible for protecting public health.

In this paper, we highlight studies that demonstrate the fallacy of inherent assumptions in the FCC/ICNIRP guidelines for RF radiation exposure limits, and we find that the limits fail to protect human and environmental health. Fourteen assumptions that underlie the RFR exposure limits established in the 1990s and reaffirmed in 2020 by the FCC [4, 5] and ICNIRP [5, 9] are addressed in this paper and are shown in Fig. 1.

Assumptions underlying exposure limits for RF radiation and the scientific evidence demonstrating that these assumptions are not valid

A. Effects of RF radiation at exposures below the putative threshold SAR of 4 W/kg

Assumption 1) *There is a threshold exposure for any adverse health effect caused by RF radiation; in the*

frequency range of 100 kHz to 6 GHz it is a whole-body exposure that exceeds an SAR of 4 W/kg. Any biological effect of RF radiation above the threshold exposure is due to tissue heating.

Cardiomyopathy and carcinogenicity

In response to a request from the Food and Drug Administration's (FDA) Center for Devices and Radiological Health [17], the National Toxicology Program (NTP) conducted toxicity and carcinogenicity studies of cell phone (CDMA- or GSM-modulated) radiation in rats and mice exposed to RFR at frequencies of 900 MHz and 1800 MHz, respectively [18, 19]. Exposures to RFR for up to 2 years occurred in reverberation chambers over 18 hours/day on a continuous cycle of 10 minutes on and 10 minutes off. In rats, the whole-body SAR levels during the 10-minute on cycles were 0, 1.5, 3, or 6 W/kg.

The major histopathological findings from the NTP study in male rats [18] included dose-related increases in cardiomyopathy, increased incidence of cancers and preneoplastic lesions in the heart (schwannoma and Schwann cell hyperplasia) and brain (glioma and glial cell hyperplasia), increases in prostate gland tumors and hyperplasias, significant increases in adrenal gland tumors, and significant increases in the overall incidence of benign or malignant neoplasms in all organs in the 3 W/kg groups. The incidence of cardiomyopathy was also increased in GSM-exposed female rats, and significant increases in DNA damage were found in rats and mice [18, 19]. Similarly, an earlier study by Chou et al. [20] found a significant (3.6-fold) increase in the incidence of primary malignant neoplasms in male rats exposed to 2450 MHz pulsed RFR for 25 months (21.5 hr./day) at an SAR that ranged from 0.15 to 0.4 W/kg.

A 3-day external peer-review of the NTP studies confirmed there was "clear evidence of carcinogenic activity" in male rats for heart schwannomas, and "some evidence of carcinogenic activity" for brain gliomas and adrenal gland tumors with exposure to either GSM- or CDMA-modulated RF radiation [21]. In addition, a lifetime study by the Ramazzini Institute reported a significant increase in heart schwannomas in male rats exposed 19 hour/day to 1800 MHz GSM-modulated RFR at a field strength of 50 V/m, equivalent to a whole-body SAR of 0.1 W/kg [22]. The incidence of heart Schwann cell hyperplasia was also increased in that exposure group. These findings are consistent with results from the NTP study and demonstrate that the proliferative effect of modulated RFR in heart Schwann cells is a reproducible finding that can occur at doses far below the assumed whole-body threshold SAR of 4 W/kg.

ICNIRP [23] dismissed the evidence of carcinogenicity for RFR that was provided in the studies by the NTP [18] and the Ramazzini Institute [22] based on their earlier critique of those studies [24]. However, that critique demonstrated an unfortunate lack of understanding together with a misrepresentation of the design, conduct, and interpretation of experimental carcinogenicity studies in animal models [25], as well as a lack of appreciation for the remarkable concordance between the tumor responses observed in experimental animals with those identified in cancer epidemiology studies of mobile phone users described under Assumption #6.

Neither heating effects nor thermal stress was likely causal of the adverse health effects observed in the NTP [18] study, since there was no tissue damage observed in a 28-day study at the same SARs, there was no significant effect on body weight during the 2-year study, and there were no exposure-related clinical observations that would indicate thermal or metabolic stress. Furthermore, a preliminary thermal pilot study demonstrated that body temperatures did not increase by more than 1^{O} C at the exposure levels used in the chronic studies [26], and there is no evidence that a small change in body temperature associated with the RFR exposures in the NTP study can cause the types of carcinogenic effects that were observed. The similar findings of GSM-modulated RFR on Schwann cells by the Ramazzini Institute [22] at much lower whole-body SARs confirm these effects to be independent of tissue heating.

Neurological effects

Though the FCC and ICNIRP exposure limits are based on a putative threshold dose of 4 W/kg due to behavioral disruption observed at higher doses in rats and monkeys [10, 11] numerous studies have shown consistent and reproducible deficits in spatial learning and memory in laboratory animals exposed to RF radiation at SARs below 4 W/kg. Examples of study exposures that demonstrated these neurological effects included 900 MHz GSM at 0.41–0.98 W/kg, 2 hr./day for 4 days in mice [27]; 900 MHz GSM at 0.52–1.08 W/kg, 2 hr./day for 1 month in rats [28]; 900 MHz GSM at 1.15 W/kg, 1 hr./day for 28 days in rats [29]; 900 MHz pulsed RFR at 0.3–0.9 W/kg for 6 hr./day in rats from conception to birth and tested at 30 days of age [30]; 900 MHz GSM and 1966 MHz UMTS at 0.4 W/kg for 6 months in rats [31]; and 900 MHz continuous wave EMF at 0.016 W/kg 3 hr./day for 28 days in rats [32]. The studies cited above are not the only studies showing these effects, but they clearly demonstrate that exposure to RFR at an SAR of 4 W/kg is not a threshold dose for neurological effects in rodents. The effects of RF radiation on spatial learning and memory indicate

the hippocampus as a target site of these exposures. For a more complete listing of neurological effects of RFR reported between 2007 and 2017 see Lai [33].

In addition, many studies have reported changes in brain electrical activities in human subjects, measured by electroencephalography (EEG), including sleep disturbance from single exposures to cell phone RF radiation. This is not surprising since the nervous system transmits messages based on electrical signals generated by nerve cells. Decreased β-trace protein, which is a key enzyme in the synthesis of a sleep-promoting neurohormone, has been seen in young adults with high-cumulative amounts of hours of mobile phone use [34]. Another frequently reported effect of RF radiation is increased blood-brain barrier permeability in rats at SARs much lower than 4 W/kg, e.g. [32, 35–41]. Oxidative stress induced in the brain of animals exposed to RF-EMF has been associated with observed neurological effects [42]. Although many studies did not observe significant changes in neurological effects in humans and several studies did not observe increased permeability in the blood-brain barrier in animal models [33], differences in EMF frequency, modulation, duration of exposure, and direction of incident waves to the exposed subject, as well as difference in dielectric properties and the size and shape of the exposed subject likely account for differences in observed effects [43, 44].

Sperm damage

The effect of non-ionizing microwave radiation on the testis (testicular degeneration in mice) was first reported 60 years ago [45]. Since then, and with the rapid increase in use of RF-EMF emitting devices, numerous studies have investigated testicular effects of RFR and potential associations with male infertility [46–50]. Human and animal studies have shown that the testis is one of the most sensitive organs to RF-EMF exposures, and that keeping a mobile phone in trouser pockets in talk mode can affect fertility parameters e.g., sperm motility, sperm count, sperm morphology, and apoptosis [48, 51]. Meta-analyses of published epidemiologic studies on the impact of mobile phone radiation on sperm quality in adult men have found significant decreases in sperm motility, sperm viability and/or sperm concentrations that were associated with mobile phone usage [52–55]. Several physical factors associated with exposure conditions can affect the outcome of human studies, including depth of energy penetration, duration of call, type of transmission technology, distance of the device to the body or testis, and power density with defined SAR. For example, Zilberlicht et al. [56] observed higher rates of abnormal sperm concentrations among men who held their phones less than 50 cm from their groin.

The effects of RFR on reproductive parameters in humans are consistent with results from experimental studies in animals and in vitro studies. For example, exposure of human semen to 850 MHz radiation from mobile phones for 1 hour at an SAR of 1.46 W/kg caused a significant decrease in sperm viability that was associated with an increase in reactive oxygen species (ROS) [50] or an increase in sperm DNA fragmentation [57]. Exposure of isolated human spermatozoa to 1.8 GHz RF-EMF significantly reduced sperm motility and induced ROS generation at an SAR of 1.0 W/kg, and significantly increased oxidative DNA damage and DNA fragmentation at an SAR of 2.8 W/kg [58].

Some examples of effects of RFR on male fertility factors in studies with experimental animals at SARs below 4 W/kg include: a decrease in sperm count and an increase in ROS in rats exposed to mobile phone frequencies 2 hr./day, for 35 days (SAR = 0.9 W/kg) [59]; increases in oxidative stress, 8-hydroxy-deoxyguanosine (8-OHdG), and DNA strand breaks in the testes of rats exposed to 900 MHz (SAR = 0.166 W/kg), 1800 MHz (0.166 W/kg), or 2100 MHz (0.174 W/kg) 2 hr./day for 6 months [60]; an increase in ROS, a decrease in sperm count, and altered sperm morphology in rats exposed to 900 MHz 3G mobile phone radiation (SAR = 0.26 W/kg) 2 hr./day for 45 days [61]; decreased sperm quality in rats in which local exposure of the scrotum to 2575–2635 MHz 4G smartphone time division LTE radiation occurred for 1 min over 10 min intervals 6 hr./day for 150 days [62]; impaired testicular development at 35 days of age in male offspring of pregnant rats that were exposed to 2.45 GHz RFR (SAR = 1.75 W/kg) 2 hr./day throughout pregnancy [63]; decreased sperm motility in mice exposed to 905 MHz RFR (SAR = 2.2 W/kg) 12 hr./day for 5 weeks, and increased ROS formation and DNA fragmentation after 1 week of exposure [64]. Although negative studies have also been reported, it is important to remember that the outcome of experimental studies can be affected by differences in exposure conditions, including the frequency, modulation, polarization, stray electromagnetic fields, local SAR, duration of exposure, and analytical methods [43, 44].

Although the mechanism of testicular effects from exposure to non-thermal levels of RFR is not fully known, numerous studies in rats and mice, and in human sperm have found associations between negative effects on fertility parameters and increases in ROS and/or DNA damage [48, 51, 57, 58, 60, 61, 64–68]. Thus, the adverse effects of RFR on sperm quality are likely due in large part to induced generation of ROS.

Assumption 2) *RF radiation is incapable of causing DNA damage other than by heating; there is no mechanism for non-thermal DNA damage.*

In 2009, ICNIRP [16] claimed that "low energy photons of RF radiation are too weak to affect ionization or cause significant damage to biological molecules such as DNA, under ordinary circumstances." However, DNA damage and other genotoxic effects have been observed in numerous studies of low intensity RFR in animal models and in humans. For example, the NTP study found statistically significant increases in DNA damage in brain cells of exposed rats and mice compared to sham controls [18, 19, 69], and Akdag et al. [70] found statistically significant increases in DNA damage in hair cells in the ear canal among 30 to 60 year-old men who used mobile phones for 10 years for 0–30 min/day, 30–60 min/day, or greater than 60/min/day compared to people who did not use mobile phones. In the latter study, the extent of DNA damage increased with increasing daily exposure duration. In a review of published studies on genetic effects of ELF- and RF-EMF, Lai [71] listed more than 150 studies in which non-thermal exposures to RFR produced increases in DNA damage, chromosome aberrations, or micronuclei formation.

In addition, it is well established that DNA damage can also be caused by indirect processes, such as by the generation of reactive oxygen species (ROS), and numerous studies have demonstrated DNA damage at exposures below the putative threshold SAR of 4 W/kg. More than 120 published studies have demonstrated oxidative effects associated with exposure to low intensity RFR (Additional file 1: Appendix 1). An analysis of experimental studies on molecular effects of low intensity RF radiation (RFR) in biological systems found that the majority (93 of 100 studies) demonstrated the induction of oxidative effects [72]. More recent studies (from 2017) revealed that all 30 relevant publications (100%) detected significant oxidative effects under low intensity RFR exposures, and most of these studies used modulated RFR from wireless communication devices.

Increased production of ROS in living cells may be caused by weak magnetic fields altering recombination rates of short-lived radical pairs generated by normal metabolic processes leading to changes in free radical concentrations [73], or by low intensity extremely low frequency (ELF) EMFs resulting in alterations in voltage-gated ion channels in cell membranes causing changes in cation flow across membranes [74]. These mechanisms apply to both ELF-EMFs and to RFR modulated by pulsed fields at extremely low frequencies. Other biophysical mechanisms by which non-thermal RF-EMF can cause biological effects through interactions with normal cellular processes have been described [75].

Increasing NADH oxidase activity is another mechanism by which RFR can increase ROS production. NADH oxidases, which are membrane-associated enzymes that catalyze one-electron reduction of oxygen to superoxide radical using NADH as the electron donor, have been identified as primary mediators of RFR interactions in cellular systems [76]. A significant (3-fold) increase in the activity of NADH oxidase was measured in purified plasma membranes from HeLa cells exposed to 875 MHz for 5 or 10 min at a power density of 200 μW/cm^2. This exposure intensity is significantly lower than the ICNIRP [5] safety limit.

The major source of ROS in living cells is the mitochondrial electron transport chain, where leakage of electrons generates superoxide radicals due to the partial reduction of oxygen [77]. A dose-dependent effect of 1.8 GHz modulated RFR exposure (SAR = 0.15 and 1.5 W/kg) on mitochondrial ROS production was detected in mouse spermatogonial germ cells [65]. Exposure of quail embryos to extremely low intensity modulated RFR (GSM 900 or 1800 MHz, 0.25 or 0.32 μW/cm^2) during the initial days of embryogenesis resulted in a robust overproduction of superoxide radical and nitrogen oxide in mitochondria of embryonic cells [78, 79]. Thus, multiple mechanisms for the increased production of ROS by low intensity RF radiation have been demonstrated.

Numerous studies have been published on mutagenic effects of low intensity RF-EMFs, especially studies that identified increases in levels of a specific marker of oxidative DNA damage and a risk factor for cancer, 8-hydroxy-2′-deoxyguanosine (8-OHdG) [58, 60, 78–84]. For example, the level of 8-OHdG in human spermatozoa was increased significantly after in vitro exposure for 16 hr. to 1.8 GHz at a power level of 2.8 W/kg and correlated with levels of ROS generation [58]. Likewise, exposure of quail embryos *in ovo* to GSM-modulated 900 MHz of 0.25 μW/cm^2 for 1.5, 5, or 10 days was sufficient to produce a significant, two-threefold, increase in 8-OHdG levels in embryonic cells [79]. Umbilical cord blood and placenta tissue samples obtained after delivery from women who used mobile phones during pregnancy had significantly higher levels of oxidative stress parameters, including 8-OHdG and malondialdehyde, compared to cord blood and placental tissue from women who did not use mobile phones during pregnancy [85]. In addition, DNA damage, analyzed by the comet assay, was increased significantly in cord blood lymphocytes obtained from women who used mobile phones during pregnancy compared to cord blood lymphocytes obtained from women who did not use mobile phones.

As low intensity RF radiation does not have sufficient energy to ionize DNA molecules, and as increased production of ROS in living cells due to RF-EMF exposures has been reliably documented, an indirect effect of this type of radiation is the formation of oxidative damage to DNA. The most aggressive form of ROS that can cause oxidative DNA damage is the hydroxyl radical; this reactive oxygen species can be generated from superoxide radical and hydrogen peroxide [86], which may be produced in living cells exposed to low intensity RF radiation. Ultraviolet radiation (UVR, encompassing UVA, UVB, and UVC), which is classified by IARC as "carcinogenic to humans"), can also cause indirect DNA damage by generating ROS [87]. Thus, both RFR and UVR, which can similarly induce oxidative DNA damage, can increase cancer risk by a similar mechanism.

Increased production of ROS and depletion of antioxidant capacity in living cells exposed to low intensity RF radiation can result in oxidative DNA damage. Induction of oxidative stress, which is a key characteristic of many human carcinogens [88], including UVR and asbestos, can also lead to genotoxicity and carcinogenicity of non-ionizing RF radiation without causing direct DNA damage.

> **Assumption 3**) *Two to seven exposures to RF radiation for up to 1 hour duration are sufficient to exclude adverse effects for any duration of exposure including chronic exposures.*

The behavioral studies in 8 male rats and 5 male monkeys that served as the basis for the exposure limits to RF radiation adopted by the FCC and ICNIRP involved 2 to 7 exposure sessions of 40-minute duration for rats [10] and 3 exposure sessions of 60-minute duration for monkeys at each power density [11]. Additional support for the threshold SAR of 4 W/kg in the frequency range of 100 kHz to 6 GHz came from behavioral studies conducted in rats and monkeys by D'Andrea et al. [89, 90]. However, D'Andrea et al. [91, 92] also reported that exposure of rats to continuous wave 2450 MHz RFR for 14 or 16 weeks caused significant differences in behavioral activity between sham-exposed rats and RFR-exposed rats at mean SARs of 0.7 W/kg and at 1.23 W/kg, indicating that 4 W/kg is not a threshold SAR with extended exposure durations. Since that time many studies have shown that responses to non-thermal RFR depend on both exposure intensity and exposure duration [93]. Importantly, the same response was observed with lower exposure intensity but prolonged exposure duration as at higher exposure intensity and shorter duration [94].

Recognizing that the exposure limits do not address potential health effects after long-term exposures to RF radiation emitted from wireless devices that people are experiencing, the FDA [17] nominated RF radiation to the NTP for chronic toxicology and carcinogenicity studies out of concern that "existing exposure guidelines are based on protection from acute injury from thermal effects of RFR exposure, and may not be protective against any non-thermal effects of chronic exposures." Adverse health effects noted in Assumption #1, including cardiomyopathy, carcinogenicity, sperm damage, and neurological effects, as well as the human epidemiology studies to be described in Assumption #6, occurred with much longer exposures to RF radiation than the exposure durations used in the acute studies in rats [10] and monkeys [11]. Consequently, the acute behavioral exposure studies that served as the basis for exposure limits to RF radiation established by the FCC and ICNIRP are inadequate to identify and characterize adverse effects of RF radiation after longer exposure durations. Neither the exposure limits established in the 1990s by the FCC [4] or by ICNIRP [9], nor those reaffirmed more recently by these groups [3, 5] address health risks associated with long-term exposure to RF radiation.

> **Assumption 4**) *No additional effects would occur from RF radiation with co-exposure to other environmental agents.*

The current FCC/ICNIRP exposure limits do not take into consideration interactive effects of RF radiation with other environmental agents even though such effects have been documented. Interactions of RF radiation with other agents may result in antagonistic or synergistic effects, i.e., effects that are greater than the sum of each agent alone.

In the International Agency for Research on Cancer (IARC) evaluation of the carcinogenicity of RF-EMF [44], the expert working group noted that 4 of 6 co-carcinogenesis studies available at that time showed increased responses with exposure to RF-EMF. One of those studies reported co-carcinogenic effects of UMTS-modulated RF radiation at 4.8 W/m^2 in the liver and lung of mice that had been treated with the carcinogen ethylnitrosourea (ENU) in utero [95]; the incidence of liver and lung cancers were increased in mice exposed to ENU plus RF radiation compared to cage controls, sham controls and ENU alone. After the IARC evaluation, Lerchl et al. [96] replicated the experimental design of Tillmann et al. [95] by exposing mice to RF-EMF at whole-body SAR levels of 0 (sham), 0.04, 0.4, and 2 W/kg. Significant increases in lung adenomas and/or liver carcinomas were observed at all exposure levels. Lerchl et al. [96] concluded that their "findings are a very clear indication that tumor-promoting effects

of life-long RF-EMF exposure may occur at levels supposedly too low to cause thermal effects." Thus, the reproducibility of the tumor-promoting effects of RFR at non-thermal exposure levels has been demonstrated.

Other examples of reported synergistic effects include the following study results. Synergistic effects on damage to human lymphocytes were observed with co-exposure to RFR (1.8 GHz RFR, SAR 3 W/kg) and 2 different mutagens, namely, mitomycin C or 4-nitroquinoline-1-oxide [97], or with co-exposure to ultralight (UVC) light [98]. A synergistic effect was found on DNA damage in human blood cells exposed to 2450 MHz radiation (5 mW/cm^2) and then exposed to mitomycin C [99]. A potentiation effect on DNA damage was observed in cultured mammalian cells exposed to CDMA-modulated 835 MHz RF-EMF (SAR = 4 W/kg) and the clastogens cyclophosphamide or 4-nitroquinoline-1-oxide [100]. Gene expression was altered in neuronal and glial cells of rats pre-treated with lipopolysaccharide, a neuroinflammatory agent, and then exposed to 1800 MHz GSM modulated radiation (SAR = 3.22 W/kg) for 2 hr. [101]. In rats pre-treated with picrotoxin, a chemical that induces seizures, exposure to pulse-modulated 900 MHz GSM-modulated RF radiation of mobile phones increased regional changes in brain activity and c-Fos expression [102, 103].

Exposure limits based on exposure to only RF radiation will result in an underestimation of the true risk and inadequate protection of human health under conditions in which co-exposures to other toxic agents lead to synergistic adverse effects [104].

B. Factors affecting dosimetry

Assumption 5) *Health effects are dependent only on the time-averaged SAR value; carrier wave modulations, frequency, or pulsing do not matter except as they influence the SAR.*

The FCC's and ICNIRP's exposure limits to RFR are based on SARs for frequencies up to 6 GHz and on power densities for frequencies between 6 GHz and 300 GHz averaged over 6-minute or 30-minute intervals for local areas and whole-body exposures [3, 5]. However, time-averaged dosimetry does not capture the unique characteristics of modulated or pulsed RFR. For example, GSM modulation may involve as many as 8 voice channels with a duration of 0.577 msec for each channel. Thus, the exposure from GSM modulation can be 8-times higher during each time slot pulse compared to exposure to a continuous wave at equivalent time-averaged SARs. Also, as noted under assumption #14, repetitive pulses of data in bursts with short exposures to 5G can cause localized temperature spikes in the skin [105]. The impact of pulsed radiation on biological activities at the molecular or cellular levels is not taken into consideration with time-averaged dosimetry.

Another issue not addressed by time-averaged dosimetry is the importance of low frequency modulations on biological systems. As discussed under assumption #2, increased production of ROS in living cells and DNA damage have been demonstrated with exposure to low frequency modulations of radiofrequency carrier waves [106]. Exposure limits based on time-averaged SAR dosimetry or power density, without consideration of the impact of amplitude or frequency modulations, do not adequately address potential health effects of real-world exposures to RFR. There is ample evidence that various effects of RFR exposure depend on carrier wave modulations, frequency, or pulsing [43, 107, 108]. In contrast to ICNIRP/FCC, the IARC monograph on RFR carcinogenicity noted that RFR effects may be influenced by such exposure characteristics as duration of exposure, carrier frequency, type of modulation, polarization, exposure intermittence, and background electromagnetic fields [44].

C. Human brain tumor risk

Assumption 6) *The multiple human studies that find associations between exposure to cell phone RF radiation and increases in brain tumor risk are flawed because of biases in the published case-control studies, and because brain cancer rates have remained steady since the time that use of wireless communication devices became widespread.*

Although claims have been made that "current limits for cell phones are acceptable for protecting the public health" because "even with frequent daily use by the vast majority of adults, we have not seen an increase in events like brain tumors" [109], the SEER (Surveillance, Epidemiology, and End Results Program) database shows an annual decrease of 0.3% for all brain tumors, but an increase of 0.3% per year for glioblastoma in the US between 2000 and 2018 (https://seer.cancer.gov/explorer/). Most concerning was that the annual increase for glioblastoma was 2.7% per year for people under 20 years of age. In addition, Zada et al. [110] reported that the incidence of glioblastoma multiforme (GBM) in the frontal lobe, temporal lobe, and cerebellum increased in the US between 1992 and 2006, and Philips et al. [111] likewise reported a statistically significant increasing incidence of GBM in the frontal and temporal lobes of the brain in the UK during 1995–2015. In Sweden, rates of brain tumors in the Swedish National Inpatient Register and the Swedish Cancer Register increased from 1998 to

2015 [112]. In addition, it should be realized that cumulative exposure, side-of-head use, and latency for tumor formation from RFR are not fully captured in national cancer registries. Thus, the claim that trends in brain cancer incidence rates have not increased since mobile phones were introduced is both wrong and misleading. The specificity of effect needs to be factored into such trend analyses.

Case-control studies, using sound scientific methods, have consistently found increased risks with long-term, heavy mobile phone use for brain tumors of the glioma type and acoustic neuroma. This association was evaluated at IARC in 2011 by 30 expert participants who concluded that radiofrequency (RF) radiation is a "possible" human carcinogen [44]. In contrast, the much-cited Danish cohort study on 'mobile phone users' [113] was disregarded by IARC due to serious methodological shortcomings in the study design, including exposure misclassifications [44, 114].

Results of meta-analyses of glioma risk and acoustic neuroma from Swedish case-control studies conducted by Hardell and coworkers [115, 116], the 13-nation Interphone study [117], and the French study by Coureau et al. [118] are shown in Table 1 as odds ratios (OR) with 95% confidence intervals. For glioma on any location in the head, a statistically significant increase of nearly two-fold was found, while for ipsilateral mobile phone use (tumor and phone use on the same side of the head) the risk was increased by 2.5-fold. These ORs are based on the groups in each study with the highest category of cumulative call time, which were ≥ 1640 hr. in the Interphone study [117, 119] and the Swedish studies [115, 116], and ≥ 896 hr. in the study by Coureau et al. [118]. Decreased survival among glioma cases, especially astrocytoma grade IV, was associated with long-term and high cumulative use of wireless phones [120]. Increased risk for the mutant type of *p53* gene expression in the peripheral zone of astrocytoma grade IV was associated with use of mobile phones for ≥3 hours a day. Increase in this mutation was significantly correlated with shorter overall survival time [121].

For acoustic neuroma, risk was significantly increased with cumulative exposure and ipsilateral use by 2.7-fold. A random effects model, which was based on a test for heterogeneity, was used for the meta-analyses of these published studies. Tumor volume of acoustic neuroma increased per 100 hr. of cumulative use of wireless phones in the Swedish study and years of latency, indicating tumor promotion [115].

Other case-control studies of mobile phone use also reported increased risk of acoustic neuroma [122–124]. Those studies were not included in the meta-analysis because data on cumulative mobile phone use with numbers of cases and controls were not given or there were other shortcomings. It is also noteworthy that tumor risks were increased in subsets of the Interphone study; for example, there was nearly a 2-fold increase in the risk of acoustic neuroma for ≥10 y and ipsilateral use among the North European countries that participated in the Interphone study [125].

Claims have been made that associations between increases in brain cancer risk and exposure to cell phone RF radiation in the published case-control studies may be attributable to recall and/or selection biases [5, 109]. However, a re-analysis of the Canadian data that was included in the Interphone study showed that there was no effect on the risk of glioma after adjustments were made for selection and recall biases [126]. Odds ratios (OR) for glioma were increased significantly and to a similar extent when comparing the highest quartile of use to those who were not regular users whether or not adjustments for biases were made. In addition, Hardell

Table 1 Odds ratios (OR) with 95% confidence interval (CI) for glioma and acoustic neuroma in case-control studies in the highest category for cumulative mobile phone use in hours[a]

	Glioma				Acoustic neuroma			
	All		Ipsilateral		All		Ipsilateral	
	OR	95% CI	OR	95% CI	OR	95% CI	OR	95% CI
Interphone [117, 119] Cumulative use ≥1640 hr	1.40	1.03–1.89	1.96	1.22–3.16	1.32	0.88–1.97	2.33	1.23–4.40
Coureau et al. [118] Cum use ≥896 hr	2.89	1.41–5.93	2.11	0.73–6.08				
Hardell et al. [115, 116] Cumulative use ≥1640 hr	2.13	1.61–2.82	3.11	2.18–4.44	2.40	1.39–4.16	3.18	1.65–6.12
Meta-analysis longest cumulative use	**1.90**	**1.31–2.76**	**2.54**	**1.83–3.52**	**1.73**	**0.96–3.09**	**2.71**	**1.72–4.28**

[a] Note Hardell et al. [115, 116] also assessed use of cordless phones

and Carlberg [116] showed that the risk for glioma with mobile phone use was increased significantly even when compared to the risk for meningioma. Because risk of meningioma was not increased significantly, this tumor response could not be attributed to recall bias. Clearly, selection and recall biases do not explain the elevated brain tumor risk associated with the use of mobile phones. Thus, epidemiological evidence contradicts the opinions of the FCC and ICNIRP on brain tumor risk from RF radiation.

It should also be noted that the thyroid gland is a target organ for RFR from smartphones. A case-control study on mobile phone use suggested an increased risk for thyroid microcarcinoma associated with long-term cell phone use [127]. Peripheral lymphocyte DNA obtained from cases and controls was used to study genotype-environment interactions. The study showed that several genetic variants based on single nucleotide polymorphisms (SNPs) increased the risk of thyroid cancer with mobile phone use [128]. Increasing incidence of thyroid cancer in the Nordic countries, especially over the last two decades, has also been reported [129, 130]. In addition, a recent case-control study found significant increases in breast cancer risk among Taiwanese women based on their use of smartphones and distance between the breast and placement of their smartphone [131].

D. Individual variations in exposure and sensitivity to RF-EMF

Assumption 7) *There are no differences among individuals, including children, in the absorption of RF-EMF and susceptibility to this radiation.*

Differences between children and adults regarding the absorption of radiofrequency electromagnetic fields when mobile phones are operated close to the head have been demonstrated and widely documented [132–137]. The main factors accounting for these dissimilar absorption rates include differences in anatomy, tissue dielectric properties, and physiology. Through finite-difference time-domain (FDTD) simulations, employing detailed computational anthropomorphic models, it is possible to find differences relating to anatomy and to dimensions of the head.

Since EMF penetration into human tissues can be in the order of a few centimeters, depending on the wavelength, the inner tissues in the brain clearly will receive a significantly higher dose in the smaller heads of children compared to adults, despite the total absorption and the peak spatial SAR (psSAR) calculated across the whole head varying by smaller amounts [132, 133, 138]. Fernández et al. [136] estimated that the cell phone radiation psSAR in the hippocampus was 30-fold higher in children compared to adults, while the psSAR in the eyes was 5-fold higher in children; these differences were due largely to closer proximity to the cell phone antennas. The thinner dimensions of children's skulls also contribute to this difference [135], resulting in a psSAR around 2-fold higher in children's brains [134–137, 139] compared to adults.

Additionally, tissues of young mammals have higher conductivity and electrical permittivity than those of mature animals [140]. This also contributes to greater EMF penetration and absorption, resulting in further increases in the psSAR. The psSAR in the skull bone marrow of children was estimated to increase by 10-fold due to higher conductivity in this tissue [137]. Distance between the mobile device and the body tissues is important in characterizing tissue dosimetry. The National Agency ANFR of France recently released cell phone SAR test data for 450 cell phones. Ten gram psSARs increased by 10–30% for each millimeter of proximal placement of the cell phone to the planar body phantom (http://data.anfr.fr/explore/dataset/das-telephonie-mobile/?disjunctive.marque&disjunctive.modele&sort=marque).

Finally, it is important to note that simulations of tissue dosimetry consider only the physical parameters of the tissues; they do not consider biological processes occurring in living tissues. While children are growing, developing organs and multi-organ systems are more susceptible to adverse effects of environmental agents; finite-difference time-domain (FDTD) simulations do not address differences in organ or system susceptibility for exposures occurring during child development.

Assumption 8) *There are no differences among individuals in their sensitivity to RF radiation-induced health effects.*

All life is "electrosensitive" to some degree as physiological processes are dependent on both subtle and substantial electromagnetic interactions at every level, from the molecular to the systemic. Responses to multiple types of electromagnetic exposure reveal that there is a far broader range of EMF sensitivity than previously assumed, and subgroups of extremely hypersensitive subjects exist [141–151]. Given the adverse health effects noted in Assumption #1, including cardiomyopathy, carcinogenicity and neurological effects, the acute, conscious symptoms manifesting in some individuals should not be unexpected. The term currently and most frequently used within the medical profession to describe those who are acutely, symptomatically sensitive to non-ionizing radiation exposures is Electromagnetic Hypersensitivity (EHS).

EHS is a multisystem, physical response characterized by awareness and/or symptoms triggered by EMF exposures. Common symptoms include (but are not limited to) headaches, dizziness, sleep disturbance, heart palpitations, tinnitus, skin rashes, visual disturbance, sensory disturbance, and mood disturbance [152, 153]. These symptoms are reported in response to even extremely low intensity (orders of magnitude below current safety levels) EMFs of multiple types (in terms of frequency, intensity and waveforms). Commonly noticed triggers of frequent and persistent EHS symptoms are pulse-modulated RF emissions, modulated at extremely low frequencies. Common triggering sources include mobile phones, DECT cordless landlines, Wi-Fi/Bluetooth-enabled computers, Wi-Fi routers, smart meters, base station antennas, and household electrical items. EMF avoidance/mitigation is found to be the most effective way to reduce symptoms [154].

Guidelines for EHS diagnosis and management have also been peer-reviewed and concur that the mainstay of medical management is avoidance of anthropogenic electromagnetic fields [152, 155, 156]. Case histories detailing clinical presentations, EMF measurements and mitigation are also published [157], and biomarkers including elevated markers of oxidative stress, inflammatory markers and changes in cerebral blood flow continue to be explored [152].

EHS has been proven to be a physical response under blinded conditions [145, 151, 158, 159] and, in addition to these studies, acute EMF-induced changes in cognition, behavior, and physiology reactions have been observed in studies involving animals [27, 30, 160–172]; plus further references under Assumption 13), which cannot be biased by media-cultivated fears. These studies provide further evidence which invalidates the nocebo response (physical symptoms induced by fear) as causal regarding symptoms.

It should not be expected that all provocation studies will reliably demonstrate adverse reactions; however, suggestions that the nocebo response may cause EHS symptoms were claimed from provocation studies which failed to show a relationship between the EMF exposure and the reported symptoms [173]. The failures of these studies are explainable given the very poor methodology in the majority of them. There were failures to account for a multitude of essential factors that must be tailored to the individual, such as variable symptom onset and offset, the necessity for adequate washout periods, specificity of trigger frequencies and intensities, requirement for complete EMF hygiene during sham exposures, requirement for life-like exposures (e.g., pulse-modulated information-carrying waves), etc. For example, it has been shown that various frequency channels from GSM/UMTS mobile phones affect the same human cells differently [174–177]. Similarly, EHS has been shown to be frequency dependent [151]. As noted above, meaningful provocation studies need to take into consideration multiple physical parameters of exposure, including frequency, modulation, duration of exposure, and time after exposure [155]; however, most provocation studies that have failed to establish causative connection between RFR exposure and EHS symptoms [173] used only one or two conditions with short-term exposures.

There are many issues with the nocebo response as a cause of EHS, not least of which is also the absence of the required temporal link. For the nocebo response to be the cause of EHS, awareness and concern of negative health impacts from EMFs must precede symptoms. But, in the majority of EHS persons this is not the case [178]. As public risk communication improves, this will no longer be verifiable; however, this has been importantly observed at the only point in time when it could have been – prior to generalized awareness of health detriments from non-ionizing radiation (NIR).

While recognizing that some vulnerable groups may be more susceptible to effects of NIR exposure, ICNIRP [179] acknowledged that their guidelines may not safely accommodate these sensitive subgroups:

> *"Different groups in a population may have differences in their ability to tolerate a particular NIR [Non-Ionizing Radiation] exposure. For example, children, the elderly, and some chronically ill people might have a lower tolerance for one or more forms of NIR exposure than the rest of the population. Under such circumstances, it may be useful or necessary to develop separate guideline levels for different groups within the general population, but it may be more effective to adjust the guidelines for the general population to include such groups. Some guidelines may still not provide adequate protection for certain sensitive individuals nor for normal individuals exposed concomitantly to other agents, which may exacerbate the effect of the NIR exposure, an example being individuals with photosensitivity".*

In 2020, ICNIRP [23] also noted that biological effects are not easily discernible from adverse health effects, and that their guidelines:

> *"…are not intended to protect against biological effects as such (when compensatory mechanisms are overwhelmed or exhausted), unless there is also an associated adverse health effect. However, it is not always easy to draw a clear distinction between biological and adverse health effects, and indeed this can vary depending on individual susceptibility*

to specific situations. An example is sensory effects from nonionizing radiation exposures under certain circumstances, such as a tingling sensation resulting from peripheral nerve stimulation by electric or magnetic fields; magnetophosphenes (light flickering sensations in the periphery of the visual field) resulting from stimulation of the retina by electric fields induced by exposure to low-frequency magnetic fields; and microwave hearing resulting from thermoelastic waves due to expansion of soft tissues in the head which travel via bone conduction to the inner ear. Such perceptions may sometimes lead to discomfort and annoyance. ICNIRP does not consider discomfort and annoyance to be adverse health effects by themselves, but, in some cases, annoyance may lead to adverse health effects by compromising well-being. The exposure circumstances under which discomfort and annoyance occur vary between individuals".

Trivializing "discomfort" which is the pre-cursor to pain is not in keeping with WHO recommendations quoted by the same ICNIRP [23] document: "Health is a state of complete physical, mental and social well-being and not merely the absence of disease or infirmity."

Discomfort is a sign that an organism is experiencing something which is compromising optimal health and although in some cases this can be trivial and reversible, in other cases it may not be reversed. There is an extremely broad range of both pain tolerance and also of pain perception among humans, and to achieve meaningful preventative health care, "discomfort" must be taken seriously and mitigated whenever possible. This is especially true in this case where symptoms such as headaches are being reported in response to mobile phone exposures at the same time as increased brain tumor risk is noted from those same exposures (see Assumption 6).

In reality, people with EHS are reporting far more serious health disruption than "discomfort" or "annoyance" and in some cases these symptoms are disabling [180, 181]. Increasingly, EHS is being recognized as a disability by national courts in France, Sweden, and Spain, which amplifies the requirement for safety guidelines that are deliberately accommodating to this more susceptible group [180].

E. Applied safety factors for RF-EMF-RF workers and the general population

Assumption 9) *A 50-fold safety factor for whole body exposure to RF radiation is adequate for protecting the general population to any health risks from RF radiation.*

Public health agencies in the US and worldwide apply multiple uncertainty factors to health effects data to establish exposure levels that are considered safe for the great majority of exposed populations [182–184]. Although guidelines for the use of uncertainty factors were developed for chemicals, they are also pertinent to other toxic agents, such as RFR. The uncertainty factors needed for toxic effects of RFR based on studies that demonstrate a no-observed-adverse-effect level (NOAEL) in experimental animals include:

1) Animal-to-human extrapolation. When data are based on studies in experimental animals, a factor of 3–10 is applied (for potential species differences in tissue dosimetry and response) unless there are convincing data demonstrating equivalent sensitivity in animals and humans. However, there is no evidence showing that humans are equally or less sensitive to RFR than animals that were used in studies from which exposure limits were established by the FCC and ICNIRP.
2) Adjustment for human variability. A second factor of 10 is used to account for interindividual variability in susceptibility (for instance, due to differences in age, sex, genetic variation, pre-existing diseases) to the toxic agent among the general population. It has been recognized that a factor of 10 for human variability is likely inadequate for sensitive subpopulations and may require an additional adjustment.
3) Extrapolation from short-term studies to lifetime exposure. An additional factor of 10 is applied for short-term studies, such as those used to establish exposure limits to RF radiation, to provide lifetime protection from chronic exposure. This is of particular importance considering the remarkably short periods over which RFR toxicity was originally assessed [10, 11].
4) Database insufficiencies. Finally, an uncertainty factor of 3-to-10 is applied for database inadequacy, i.e., for incomplete characterization of an agent's toxicity. The behavioral studies [10, 11] that were used to establish the FCC and ICNIRP exposure limits to RFR do not provide a full characterization of the effects of this type of radiation nor did they identify the most sensitive adverse effect of RFR exposures.

Basing exposure limits to RFR on the behavioral studies in rats and monkeys [10, 11, 90, 91] would require the application of a composite uncertainty factor of about 900 to 10,000 to be consistent with approaches used by public health agencies to establish protective exposure limits for workers and the general population. Based on the size of the needed uncertainty/safety factor, the

data sets used by the FCC and ICNIRP are clearly inadequate to establish RF exposure limits with reasonable confidence. The arbitrarily selected safety factors of 10 for workers and 50 for the general population by the FCC and ICNIRP are woefully inadequate for protecting exposed populations.

When uncertainty/safety factors are applied to a misrepresented threshold exposure value for adverse effects, the resulting level does not provide assurance of health protection for the general population exposed to that agent. Studies cited above [18, 22, 91, 92, 96] show that the whole-body SAR of 4 W/kg is not a threshold level for adverse effects caused by RFR. In a recent quantitative analysis of various adverse health effects from the NTP study, Uche and Naidenko [185] showed that the permissible whole-body SAR of 0.08 W/kg (based on a 50-fold reduction of the assumed threshold SAR of 4 W/kg) was 20–40-fold higher than health protective SAR values derived by benchmark dose modelling of NTP data for cardiomyopathy (following application of 10-fold safety factors for interspecies and intraspecies variability). The approaches used by these authors are consistent with methodologies recommended by the US Environmental Protection Agency for quantifying health risks for toxic and carcinogenic environmental agents [1, 182]. Thus, a 50-fold reduction of the assumed threshold whole-body SAR of 4 W/kg is inadequate to protect the health of the general population from exposure to RF radiation.

> **Assumption 10)** *A 10-fold safety factor for whole body exposure to RF radiation is adequate for protecting workers to any health risks from RF radiation.*

When RFR exposure limits were implemented in 1997, the rationale given for the difference in safety factors for the general population (50-fold) and for workers (10-fold) was "based on the exposure periods of the two populations, rounded to one digit (40 work hours per week/168 hours per week = ~0.2)" [6]. In addition to differences in exposure periods between workers and the general population, ICNIRP rationalizes the appropriateness of the lower safety factor for workers because "occupationally-exposed individuals can be considered a more homogeneous group than the general population," they are, "in general, relatively healthy adults within a limited age range," and "occupationally-exposed individuals should be operating under controlled conditions and be informed about the risks associated with non-ionizing radiation exposure for their specific situation and how to reduce these risks" [23]. In contrast, "the general public are, in most cases, unaware of their exposure to non-ionizing radiation and, without education, cannot reasonably be expected to take precautions to minimize or avoid any adverse effects of exposure."

The assumption that workers are trained in understanding health risks associated with exposure to RFR and in mitigating those risks to the greatest possible degree is not correct because neither the FCC nor the ICNIRP guidelines recognize any health effects from RFR at SARs below 4 W/kg, and the exposure limits authorized by the FCC and ICNIRP do not consider health effects from long-term exposures [3, 5]. The only health effect addressed by the FCC and ICNIRP is tissue damage due to excessive heating from acute exposures. Thus, the 10-fold reduction from the threshold whole-body SAR calculated from acute behavioral studies in rats and monkeys is inadequate for protecting the health of workers exposed long-term to RFR (see comments under assumption #9). There are no data demonstrating the adequacy of this arbitrarily chosen safety/uncertainty factor for occupationally-exposed workers, while on the contrary, excess cancer risks have been associated with exposure to RFR workers who operate radar and communication systems in military and occupational settings [186].

> **Assumption 11)** *Exposure of any gram of cube-shaped tissue up to 1.6 W/kg, or 10 g of cube-shaped tissue up to 2 W/kg, (duration not specified) will not increase the risk of that tissue to any toxic or carcinogenic effects in the general population.*

Tissue dosimetry was analysed in the NTP study of cell phone RF radiation in rats and mice [187]. In rats, whole body exposures during the 10-minute on cycles were 1.5, 3.0, or 6.0 W/kg, and the brain and heart SARs varied from the whole-body SARs by about 7% to under 2-fold for the brain and heart, respectively. A quantitative risk assessment of the NTP tumor incidence data is needed to evaluate organ-specific cancer risk. The FDA [19] nomination to the NTP recognized the need for "large well-planned animal experiments …. to provide the basis to assess the risk to human health of wireless communications devices." However, more than 3 years after an external peer-review of the NTP studies found "clear evidence of carcinogenic activity," the FDA [109] has continued to downplay the importance of these findings and avoid conducting a quantitative risk assessment of the tumor data that they (the FDA) originally requested. In contrast to the FDA, Uche and Naidenko [185] analysed the NTP data on cardiomyopathy by a benchmark dose approach and found that the 10% extra risk level for this effect was in the range of a whole-body SAR of 0.2 to 0.4 W/kg. Thus, there is an increased risk (greater than 10%) of developing cardiomyopathy at local tissue SARs below 1.6 or 2.0 W/kg.

The peak spatial specific absorption rate (psSAR), as used by ICNIRP and the FCC, is an inadequate dosimetric of RF radiation at frequencies above 1 GHz. The psSAR is calculated by averaging fixed cubic volumes containing a given amount of mass, and assumes a homogeneous material with a given mass density. The ICNIRP recommendation is to average cubic volumes containing 10 g of tissue (10 g-psSAR), while the FCC recommendation is to average cubic volumes containing 1 g of tissue (1 g-psSAR). Current recommendations limit the use of psSAR to frequencies up to 6 GHz [3, 5].

An evaluation of the utility of using psSAR as a dosimetric parameter at different frequencies ranging from 100 MHz to 26 GHz and with cube sizes ranging from 10 mg to 10 g is shown in Additional file 2: Appendix 2. For the smaller cubes and lower frequencies, averaging in the cube does not underestimate the maximum value on the cube surface, but at higher frequencies the psSAR averaged on larger cubes can be several-fold lower than the psSAR averaged on smaller cubes. For example, at 2.45 GHz, averaging over a 10-g cube underestimates by 4 dB (approximately 2.5-fold) the psSAR averaged in smaller cubes, while for 5.8 GHz, averaging over a 10-g cube underestimates the psSAR by 12 dB (approximately 16-fold) compared with averaging in a 10-mg cube, and by 6 dB (approximately 4-fold) compared with averaging over a 1-g cube. When the frequency is increased, the underestimation of the psSAR averaged in larger cubes (e.g. 10 g or 1 g) compared to smaller cubes (e.g. 100 mg and 10 mg) becomes more pronounced. Considering the 10-g cube, the difference between the psSAR for 5.8 GHz EMF compared to 0.9 GHz EMF is around 7 dB (or approximately 5-fold underestimation). These large differences are due to reduced penetration of EMFs at higher frequencies. Therefore, the ICNIRP's 10 g-psSAR and FCC's 1 g-psSAR recommendations do not provide reliable dosimetric parameters to evaluate EMF absorption above 1 GHz.

The SAR averaging over a 10-g cube is also flawed for assessing carcinogenicity because it is too large a volume to focus on stem cells and their important role in carcinogenesis. Human stem cells were more sensitive to RFR exposures from GSM and UMTS mobile phones than lymphocytes and fibroblasts [175]. Instead of a random distribution of targets for carcinogenesis, localized distribution of SAR in smaller volumes is needed to more accurately characterize relationships between SAR and tumor induction. From the point of view of stem cell organization, the volume of SAR determinations may be especially important for setting safety limits for children, because most stem cells and their niches are spatially and temporally transient during brain development [188].

Assumption 12) *Exposure of any gram of cube-shaped tissue up to 8 W/kg, or 10 g of cube-shaped tissue up to 10 W/kg, (duration not specified) will not increase the risk of that tissue to any toxic or carcinogenic effects in workers.*

Based on the analyses of tissue dosimetry in the NTP study [187], organ-specific toxic and carcinogenic effects were observed in rats at local tissue SARs that were much lower than 8 or 10 W/kg [18]. The tissue dosimetry in the NTP study and the inadequacy of the local SAR as specified by ICNIRP and the FCC is described in assumption #9.

F. Environmental exposure to RF radiation

Assumption 13) *There is no concern for environmental effects of RF radiation or for effects on wildlife or household pets.*

While background levels of RF-EMF are increasing in the environment, including rural remote areas [189], neither the FCC nor the ICNIRP take into consideration effects of this radiation on wildlife. The constant movement of most wildlife species in and out of varying artificial EMF can result in high exposures near communication structures, especially for flying species such as birds and insects. There is a substantial amount of scientific literature on the disrupting effects of RFR on wildlife (e.g., [190–206]).

Many nonhuman species use Earth's geomagnetic fields for activities such as orientation and seasonal migration, food finding, mating, nest and den building [190]. For example, migratory bird species [191, 192], honeybees [193], bats [194], fish [195–197], and numerous other species sense Earth's magnetic fields with specialized sensory receptors. Mechanisms likely involved in magneto-reception include magnetic induction of weak electric signals in specialized sensory receptors [198], magneto-mechanical interactions with the iron-based crystal magnetite [194], and/or free-radical interactions with cryptochrome photoreceptors [191, 192]. Each of these sensing processes shows extreme sensitivity to low intensity changes in electromagnetic fields. For a fuller description of the mechanisms by which non-human species use magneto-reception to perform essential life activities see Levitt et al. [190].

The following studies represent a few of the many examples of the disrupting effects of low-level exposures to RF-EMF on magneto-reception and the natural behavior of wildlife. Oscillating magnetic fields have been reported to disrupt the ability of migratory birds to orient and navigate in Earth's geomagnetic field [199–202].

Garden warblers became disoriented by exposure to a weak oscillating magnetic field of 1.403 MHz at an intensity as low as 2–3 nT [200]. The orientation of European robins that use Earth's magnetic field for compass orientation was completely disrupted by exposure to electromagnetic noise in the frequency range of 50 kHz to 5 MHz or a broadband noise-modulated ELF covering the range ~ 2 kHz to ~ 9 MHz [199, 201]. RFR in the low MHz range (7.0 MHz of 480 nT or 1.315 MHz of 15 nT) has been shown to disable the magneto-reception avian compass as long as the exposure was present [202].

In addition to effects on migratory birds, Landler et al. [203] found that exposure to a low-level magnetic field (1.43 MHz at an intensity of 30–52 nT) disrupted the natural orientation of juvenile turtles hatched on land. GSM-modulated 900 MHz RF radiation caused ants to lose their visual and olfactory memory for finding food [166]. Navigational abilities of trout were reduced when reared under conditions in which magnetic fields were spatially distorted [204].

Activities of honeybees are also disrupted by exposure to RF radiation. GSM-modulated cell phone radiation (900 MHz) caused a reduction in egg laying by queen bees and depletion of beehive pollen and honey counts [205]. GSM-modulated cell phone radiation (900 MHz) reduced hatching and altered pupal development of honey queen bee larvae [206].

The lack of consideration of chronic low-level RF radiation exposure on wildlife could result in dangerously disruptive effects on fragile ecosystems and on the behavior and survival of species that have long existed in Earth's natural environment.

G. 5G (5th generation wireless)

Assumption 14) *No health effects data are needed for exposures to 5G; safety is assumed because penetration is limited to the skin ("minimal body penetration").*

Fifth generation (5G) wireless communication systems are being deployed worldwide to provide higher data transfer rates with shorter lag times between massive numbers of connected wireless devices. To provide faster transfer of large amounts of data (up to 20 gigabits per second peak data rates), the frequency range for 5G includes millimeter waves (30 to 300 GHz), in addition to carrier frequencies as low as 600 MHz. Extremely high frequency millimeter waves (MMW) that transmit large amounts of data to user devices are directed into narrow beams by line-of-sight transmission with beamforming antennas. Because millimeter waves do not penetrate solid structures such as building materials, hills, foliage, etc., and travel only short distances (a few hundred meters), denser networks of base-stations with massive Multiple Input/Multiple Output (MIMO) transmitters and receivers in millions of small cell towers are being installed on structures such as utility poles. These features can lead to much closer proximity between humans and radiation-emitting antennas, and thereby change individual peak and average exposures to RFR.

For a 5G frequency of 26 GHz, EMF absorption is very superficial, which means that for typical human skin, more than 86% of the incident power is absorbed within the first millimeter. The skin penetration depth was computed as 1 mm based on the electrical conductivity of the skin and its electrical permittivity [5, 207]. This is expected to bring the SAR in this tissue well above the recommended limits ([208], and Additional file 2: Appendix 2). This is also expected to be harmful to very small species, such as birds and other small animals (e.g., insects) [209]. It is often claimed that because of its shallow penetration, exposure to high frequency 5G radiation is safe, and that the only effect is tissue heating [210]. However, this view ignores the deeper penetration of the ELF components of modulated RF signals, which are rated on the basis of heat alone, as well as the effects of short bursts of heat from pulsed signals [211, 212]. Within the first 1 mm of skin, cells divide to renew the stratum corneum (a consideration for skin cancer), and nerve endings in the dermis are situated within 0.6 mm (eyelids) to 3 mm (feet) of the surface (a consideration for neurological effects). Ultraviolet light, which exerts its action at a penetration depth of less than 0.1 mm [213, 214] is a recognized cause of skin cancer [87].

The higher the frequency of electromagnetic waves, the shorter the wavelength and the shallower the penetration of energy into exposed people or animals. For example, penetration depth in the human body is about 8 mm at 6 GHz and 0.92 mm at 30 GHz [5]. Because of the minimal depth of energy absorption at frequencies above 6 GHz, the FCC and ICNIRP have based exposure limits on power density instead of on SAR levels. The FCC [3] proposed a general localized power density exposure limit of 4 mW/cm^2 averaged over 1 cm^2 and not to exceed 30 minutes for 5G services up to 3000 GHz for the general population, claiming that this exposure is consistent with the peak spatial-average SAR of 1.6 W/kg averaged over any 1 g of tissue at 6 GHz. ICNIRP's [5] exposure limits for 5G are an absorbed power density of 200 W/m^2 (0.2 W/cm^2) averaged over 4 cm^2 and a 6-minute interval for frequencies up to 30 GHz, and 400 W/m^2 (0.4 mW/cm^2) averaged over 1 cm^2 and a 6-minute interval for frequencies of 30 GHz to 300 GHz.

Because of its minimal penetration, exposure to 5G radiation results in higher energy intensity on the skin and other directly-exposed body parts, such as the eye

cornea or lens. However, the skin, which is the largest organ in the human body, provides important functions such as acting as a protective physical and immunological barrier against mechanical injury, infection by pathogenic microorganisms, and entry of toxic substances. In addition, skin cancers, including basal cell carcinomas and squamous cell carcinomas, are the most prevalent human cancers, while melanomas are highly metastatic and increasing in prevalence. Although the high incidence of skin cancers are largely attributed to exposure to ultraviolet light, no studies have been reported on the effects of 5G radiation on (i) the skin's ability to provide protection from pathogenic microorganisms, (ii) the possible exacerbation of other skin diseases, (iii) promotion of sunlight-induced skin cancers, or (iv) initiation of skin cancer by itself. Information is also lacking on the effects of 5G radiation on nervous and immune systems which are also exposed even by the shallower penetration of MMW.

Another important factor is the maximum bandwidth with 5G radiation, which is up to 100 MHz in the frequency range of 450 MHz to 6 GHz, and up to 400 MHz in the ranges from 24 GHz to 52 GHz, compared to previous types of mobile communication where bandwidth is limited to 20 MHz. Because many studies indicated frequency-dependent, non-thermal RF effects from mobile communication RFR [43, 177] and for MMW effects [215, 216], the possibility of effective frequency windows for biological effects would increase with the increased bandwidth of 5G radiation.

Another consideration for effects of 5G exposures on human health is that radiation pulses created by extremely fast data transmission rates have the potential to generate bursts of energy that can travel much deeper than predicted by conventional models [217, 218]. Neufeld and Kuster [105] showed that repetitive pulses of data in bursts with short exposures to 5G can cause localized temperature spikes in the skin leading to permanent tissue damage even when the average power density values were within ICNIRP's acceptable safety limits. The authors urged the setting of new thermal safety standards to address the kind of health risks possible with 5G technology:

> *"The FIFTH generation of wireless communication technology (5G) promises to facilitate transmission at data rates up to a factor of 100 times higher than 4G. For that purpose, higher frequencies (including millimetre-wave bands), broadband modulation schemes, and thus faster signals with steeper rise and fall times will be employed, potentially in combination with pulsed operation for time domain multiple access…The thresholds for frequencies above 10 MHz set in current exposure guidelines (ICNIRP 1998, IEEE 2005, 2010) are intended to limit tissue heating. However, short pulses can lead to important temperature oscillations, which may be further exacerbated at high frequencies (>10 GHz, fundamental to 5G), where the shallow penetration depth leads to intense surface heating and a steep, rapid rise in temperature…"*

Areas of uncertainty and health concerns with 5G radiation include potential increase in skin cancer rates with (or possibly without) co-exposure to sunlight, exacerbation of skin diseases, greater susceptibility to pathogenic microorganisms, corneal damage or early development of cataracts, testicular effects, and possible resonant-enhanced absorption due to skin structures [219]. One of the complex technical challenges in relation to human exposure to 5G millimeter waves is that the unpredictable propagation patterns that could result in unacceptable levels of human exposure to electromagnetic radiation are not well understood [220]. Although MMW are almost completely absorbed within 1–2 mm in biologically-equivalent tissues, their effects may penetrate deeper in a live human body possibly by affecting signal transduction pathways. Thus, there are too many uncertainties with exposure to 5G to support an assumption of safety without adequate health effects data. There are no adequate studies on health effects from short-term or long-term exposures to 5G radiation in animal models or in humans.

Discussion

To develop health-based exposure limits for toxic and carcinogenic substances, regulatory agencies typically rely on available scientific evidence about the agent under review. In the mid- and late-1990s when the FCC [4] and the ICNIRP [9] initially established exposure limits for RFR, the prevailing assumptions were that any adverse effects from exposure to RFR were due to excessive heating because non-ionizing radiation did not have sufficient energy to break chemical bonds or damage DNA. However, non-thermal effects of RFR are demonstrated from studies that find different effects with exposure to continuous waves versus pulsed or modulated waves at the same frequency and the same SAR or power density, e.g., [221–226], and from studies that show adverse effects at very low exposure intensities, e.g., [78, 96].

Acute exposure studies conducted in rats and monkeys in the 1980s [10, 11] suggested that an SAR of 4 W/kg could be a threshold dose for behavioral effects. Because this SAR was associated with an approximate increase in body temperature of 1 °C, it was again assumed that no adverse health effects would occur if increases in core

body temperature were less than 1 °C. From this putative threshold dose a "safety factor" of 10 was applied for occupational exposures and an additional factor of 5 (50x total) was applied for the general population, resulting in exposure limits in which the whole-body SAR was less than 0.4 W/kg for workers and 0.08 W/kg for the general population. However, realizing that local parts of the body could receive doses of RFR that were 10 to 20 times higher than the whole-body SARs, local peak exposure limits were set by the FCC at SARs 20-times higher than the whole-body SARs, i.e., 8 W/kg averaged over any 1-g of tissue for localized exposures for workers and 1.6 W/kg averaged over any 1-g for the general population [3, 4]. ICNIRP opted for partial body exposures that would not exceed 2.0 W/kg averaged over any 10 g of cube-shaped tissue for the general population [5, 9]. To rationalize the smaller safety factor for workers (10-fold) versus the general population (50-fold), one claim made by ICNIRP [24] is that workers are informed about risks associated with non-ionizing radiation exposure and how to reduce these risks, whereas "the general public are, in most cases, unaware of their exposure to non-ionizing radiation and, without education, cannot reasonably be expected to take precautions to minimize or avoid any adverse effects of exposure." From a public health perspective, the FCC and ICNIRP should make the public aware of their exposures to RFR and promote precautionary measures to minimize potential adverse effects, especially for children and pregnant women. Eight practical recommendations by the International EMF Scientist Appeal aimed at protecting and educating the public about potential adverse health effects from exposures to non-ionizing EMFs [227] are shown in Table 2.

The acute behavioral studies that provide the basis for the FCC's and ICNIRP's exposure limits lacked any information on potential effects of RF radiation that can occur after longer durations of exposure, and they did not address effects of carrier wave modulations used in wireless communications. Research on RFR conducted over the past 25 years has produced thousands of scientific papers, with many demonstrating that acute behavioral studies are inadequate for developing health protective exposure limits for humans and wildlife, and that inherent assumptions underlying the FCC's and ICNIRP's exposure limits are not valid. First, 4 W/kg is not a threshold SAR for health effects caused by RFR exposures; experimental studies at lower doses and for longer durations of exposure demonstrated cardiomyopathy, carcinogenicity, DNA damage, neurological effects, increased permeability of the blood brain barrier, and sperm damage (see Assumptions 1–3). Multiple robust epidemiologic studies on cell phone radiation have found increased risks for brain tumors (Assumption 6), and these are supported by clear evidence of carcinogenicity of the same cell types (glial cell and Schwann cell) from animal studies. Even studies conducted by D'Andrea et al. [89, 90] before the limits were adopted found behavioral disruption in rats exposed to RFR for 14 or 16 weeks at mean SARs of 0.7 W/kg and at 1.23 W/kg. A combination of exposure duration and exposure intensity would be more appropriate for setting safety standards for exposure to RFR from mobile communication systems including mobile phones, base stations, and WiFi.

More than 120 studies have demonstrated oxidative effects associated with exposure to low intensity RFR (Additional file 1: Appendix 1). DNA damage that has been reported in studies of RFR was most likely caused by induction of oxidative stress, which is a key characteristic of human carcinogens [88], rather than by direct ionization (Assumption 2). The generation of reactive oxygen species has also been linked to DNA damage and the carcinogenicity of UVA radiation [87] and asbestos [228]. Despite the enormous amount of scientific evidence of low-dose effects of RFR, the IEEE [229] maintains that behavioral disruption is still the most sensitive and reproducible effect of RFR. It is this opinion that contributed to the FCC [3] and ICNIRP [5] reaffirming their previous exposure limits to RFR.

Table 2 Precautionary Measures Recommended by the International EMF Scientist Appeal

1) Priority should be given to protect children and pregnant women
2) Guidelines and regulatory standards should be strengthened
3) Manufacturers should be encouraged to develop safer technologies
4) The public should be fully informed about the potential health risks from electromagnetic energy and taught harm reduction strategies
5) Medical professionals need to be educated about the biological effects of electromagnetic energy and be provided training on treatment of patients with electromagnetic sensitivity
6) Governments need to fund training and research on electromagnetic fields and health that is independent of industry
7) The media should disclose experts' financial relationships with industry when citing their opinions regarding health and safety aspects of EMF-emitting technologies
8) Radiation-free areas need to be established, especially for individuals with EHS

Other concerns about the current exposure limits for RFR are that they do not consider potential synergistic effects due to co-exposure to other toxic or carcinogenic agents, the impact of pulsed radiation or frequency modulations, multiple frequencies, differences in levels of absorption or of susceptibility by children, or differences among individuals in their sensitivity to RFR (see Assumptions 4, 5, 7, 8). Currently, children's cumulative exposures are much higher than previous generations and they continue to increase [230]. ICNIRP [23, 179] acknowledged that their guidelines do not accommodate sensitive subgroups and admit to difficulties separating "biological effects" from "health effects." Neurological symptoms, some of which are acknowledged by ICNIRP and currently being experienced by persons with EHS, are most certainly non-thermal "health effects" that need to be mitigated by providing environments with reduced exposures to anthropogenic EMF for hypersensitive individuals.

The debilitating effects and restrictions suffered by adults and children with EHS constitutes a contravention of the 2010 Equalities Act, Human Rights Act and other ethical and legal frameworks. Failure to respond and appropriately safeguard this group is already causing preventable morbidity, mortality and economic deficit due to lost workdays, compensations for health damages and increased healthcare costs. Conversely, accommodating this group by, as suggested by ICNIRP [179], acting to 'adjust the guidelines for the general population to include such groups' would not only lessen the negative impacts for people with EHS, but would also improve public health more broadly, given the other NIR-related health concerns that are highlighted in this paper.

Basing local tissue exposure limits on 1-g [3] or 10-g [5] cubes substantially underestimates the peak spatial SAR compared to basing local tissue exposure limits on smaller cubes (e.g., 100 mg or 10 mg), and therefore are not reliable dosimetric parameters to evaluate EMF absorption at frequencies above 1 GHz (Assumptions 11, 12). The volumes specified by the FCC and ICNIRP for local tissue SAR limits are too large to focus on stem cells which are important targets for carcinogenesis. To reduce health risks from exposures to RFR, limits for localized distribution of the SAR should be based on 100 mg, or preferably 10 mg cubes.

Another important deficiency raised in this paper is that neither the FCC nor ICNIRP addresses concerns for environmental effects of RFR on wildlife, even though there is extensive literature demonstrating the disrupting effects of RFR on wildlife behavior (Assumption 13).

The arbitrarily selected uncertainty/safety factors applied to the putative threshold SAR for RFR are woefully inadequate for protecting public health (Assumptions 9, 10). Based on the way the US Environmental Protection Agency, the International Council for Harmonization, and the National Institute for Occupational Safety and Health (US NIOSH) apply uncertainty/safety factors to a no-observed-adverse-effect level (NOAEL) in experimental animals [182–184], the safety factor for RFR would be at least 900 to 10,000, which is 18 to 200 times larger than the safety factor recommended by the FCC and ICNIRP for the general population. This large safety factor is based on adjustments for human variability, lifetime exposure from short-term studies, and database insufficiencies that include incomplete characterization of the toxicity of RFR. Clearly, the acute behavioral studies that served as the basis for the current exposure limits for RFR are not suitable for characterizing human health risks associated with long-term exposure to this type of radiation. The NCRP report from 1986 [6] and the ANSI/IEEE document from 1992 [7] recognized that when future studies on biological effects of RFR become available including effects of chronic exposures or evidence of non-thermal interactions there will be a need to evaluate and possibly revise exposure standards. When the FCC [3] and ICNIRP [5] reaffirmed their exposure limits from the 1990s, they dismissed the scientific evidence that invalidated the assumptions that underlie the basis for those exposure limits. An independent re-evaluation of RFR exposure limits based on the scientific knowledge gained over the past 25 years is needed and is long overdue. This evaluation should be performed by scientists and medical doctors who have no conflicting interests and who have expertise in RF-EMF exposure and dosimetry, toxicology, epidemiology, clinical assessment, and risk assessment. Special precautions should be taken to ensure that interpretations of health effects data and the setting of exposure limits for RFR are not influenced by the military or the telecommunications industry. In the meantime, manufacturers should be obliged to develop safer technologies [227].

Finally, we note our concern about the worldwide deployment of 5G communication networks for faster transfer of large amounts of data, but with no adequate health effects studies demonstrating the safety of high frequency millimeter waves. Because of limitations of the penetration and distance of travel of millimeter waves, dense networks of base stations are being mounted on structures such as utility poles in highly populated cities. Also, because the absorption of EMF at frequencies above 6 GHz is minimal, ICNIRP [5] has specified absorbed power density (S_{ab}) as the dosimetric parameter for "heating effects" at the higher frequencies. S_{ab} is a function of the incident power density (S_{inc}) and the input reflection coefficient (Γ). In near field scenarios, the S_{inc} does not have a singular value; this is largely due

to the heterogeneous nature of human body tissues and their relevant parameters (such as the permittivity, equivalent conductivity, mass density), which vary in different body regions and with frequency. Therefore, unless a powerful EMF simulation method together with realistic human models are used, the S_{inc} and the reflection coefficient values would be difficult to accurately estimate, making the resulting S_{ab} unreliable.

The assumption that 5G is safe at the power density limits recommended by ICNIRP (50 W/m^2 and 10 W/m^2 averaged over 6 min for occupational and 30 min for public exposures, respectively) because of its minimal penetration into the body does not justify the dismissal of the need for health effects studies prior to implementing 5G networks. The new communication networks will result in exposures to a form of radiation that has not been previously experienced by the public at large (Assumption 14). The implementation of 5G technology without adequate health effects information raises many questions, such as: Will exposure to 5G radiation: (i) compromise the skin's ability to provide protection from pathogenic microorganisms? (ii) will it exacerbate the development of skin diseases? (iii) will it increase the risk of sunlight-induced skin cancers? (iv) will it increase the risk of damage to the lens or cornea? (v) will it increase the risk of testicular damage? (vi) will it exert deeper tissue effects either indirectly following effects on superficial structures or more directly due to deeper penetration of the ELF components of modulated RF signals? (vii) will it adversely affect wildlife populations? Answers to these questions and others that are relevant to human and wildlife health should be provided *before* widespread exposures to 5G radiation occur, not afterwards. Based on lessons that should have been learned from studies on RFR at frequencies below 6 GHz, we should no longer rely on the untested assumption that current or future wireless technology, including 5G, is safe without adequate testing. To do otherwise is not in the best interest of either public or environmental health.

Abbreviations

ANSI: American National Standards Institute; CDMA: Code-division multiple access; dB: Decibel; DECT: Digital enhanced cordless technology; EHS: Electromagnetic hypersensitivity; ELF: Extremely low frequency; EMF: Electromagnetic field; FCC: Federal Communications Commission; FDA: Food and Drug Administration; GHz: Gigahertz; GBM: Glioblastoma multiforme brain cancer; GSM: Global system for mobile communication; IARC: International Agency for Research on Cancer; ICNIRP: International Commission on Non-Ionizing Radiation Protection; IEEE: Institute of Electrical and Electronics Engineers; LTE: Long Term Evolution (4G); MMW: Millimeter wave; NCRP: National Council on Radiation Protection and Measurements; NIR: Non-ionizing radiation; nT: Nanotesla; NTP: National Toxicology Program; 8-OHdG: 8-hydroxy-2'deoxyguanosine; psSAR: Peak spatial specific absorption rate; RFR: Radiofrequency radiation; ROS: Reactive oxygen species; SAR: Specific absorption rate; UMTS: Universal mobile telecommunications service (3G); UVR: Ultraviolet radiation; 5G: 5th generation wireless.

Supplementary Information

The online version contains supplementary material available at https://doi.org/10.1186/s12940-022-00900-9.

Additional file 1: Appendix 1 Table 1. Studies demonstrating increased oxidative DNA damage and other indicators of oxidative stress at SAR < 4 W/kg.

Additional file 2: Appendix 2. On the Inadequacy of the psSAR Dosimetric Parameter at Frequencies above 1 GHz. **Table 1.** Electric permittivity and electric conductivity of the gray matter. **Figure 1.** A block of gray matter radiated by different frequencies. The highlighted cubes are of 10 g, 1 g, 100 mg and 10 mg. **Fig. 2.** A block of gray matter radiated by different frequencies. The highlighted cubes are of 10 g, 1 g, 100 mg and 10 mg. **Fig. 3.** Electric field intensity averaged in each cube for different frequencies: in the left axis, the electric field is in dB and in the right axis the electric field is in V/m normalized to 100 V/m.

Acknowledgements

Igor Belyaev: Cancer Research Institute, Biomedical Research Center, Slovak Academy of Sciences, Slovakia
Carl Blackman: US Environmental Protection Agency (retired), North Carolina, USA
Kent Chamberlin: Department of Electrical and Computer Engineering, University of New Hampshire, USA
Alvaro DeSalles: Graduate Program on Electrical Engineering (PPGEE), Federal University of Rio Grande do Sul (UFRGS). Porto Alegre, Brazil
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Authors' contributions

IB, AD, CF, LH, PH, KK, DM, EMB, RLM, and IY drafted the initial sections of this manuscript: by IB (factors affecting dosimetry), AD and CF (absorption in children versus adults, peak spatial specific absorption rate), LH (human brain cancer risk), KK (sperm damage), DM and DM (5G), EMB (electromagnetic hypersensitivity), RLM (cardiomyopathy, carcinogenicity, neurologic effects, safety factors), and IY (oxidative stress and DNA damage). IY prepared Appendix 1, and AD and CF prepared Appendix 2. The authors who drafted sections of the manuscript, as well as CB, KC, SD, EK, AM, JMM, and WS reviewed multiple manuscript drafts and made revisions. All authors reviewed and approved the final manuscript.

Funding
The Electromagnetic Safety Alliance provided funding for publication costs.

Availability of data and materials
All literature citations are available online.

Declarations

Ethics approval and consent to participate
Not Applicable.

Consent for publication
Not Applicable.

Competing interests
IB, EMB, and AM have served as plaintiff's expert witnesses in cases involving radiofrequency radiation. All other authors declare they have no competing interests.

Received: 14 July 2022 Accepted: 8 September 2022
Published online: 18 October 2022

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Publisher's Note

The FCC Is Supposed to Protect the Environment. It Doesn't.

by Peter Elkind

In a mountainous forest in southwest Puerto Rico, workers cleared a patch to make room for a 120-foot cellphone tower intended for use by AT&T and T-Mobile. The site, as the tower company later acknowledged, destroyed some of the nesting habitat of the Puerto Rican nightjar, a tiny endangered songbird. Fewer than 2,000 are believed to be alive today.

In the northwestern New Mexico desert, a company called Sacred Wind Communications, promising to bring broadband to remote Navajo communities, planted a cell tower near the legally protected Pictured Cliffs archaeological site, which contains thousands of centuries-old tribal rock carvings.

And in Silicon Valley, a space startup pursued plans to equip thousands of satellites to use mercury fuel in orbit, even as an Air Force official at one of the possible launch sites voiced "extreme concern" that the toxic element could rain back down to earth.

You may be surprised to learn that these potential harms fall under the jurisdiction of the Federal Communications Commission. Few people think of the FCC as an environmental cop. It's known for regulating television and radio and overseeing the deployment of communications technology. But the agency also has a broad mandate to ensure that technology doesn't damage the environment. The task includes everything from protecting wildlife and human health to preserving historic sites and even preventing aesthetic blight.

This role is particularly critical now, as the FCC presides over a nationwide buildout for 5G service, which will require 800,000 new "small cell" transmitters, those perched on street poles and rooftops, often near schools, apartments and homes. But even with this massive effort underway, as ProPublica previously reported, the FCC has refused to revise its radiation-exposure limits, which date back to the era of flip phones. In addition, the agency has cut back on the environmental reviews that it requires while also restricting local governments' control over wireless sites.

And as the satellite-fuel example reflects, the FCC's ambit extends even into space. The agency is licensing thousands of commercial satellites at a moment when the profusion of objects circling the planet is raising concerns about collisions in space, impediments to astronomy, pollution, and debris falling back to earth.

To call the FCC's environmental approach hands-off would be an understatement. The agency operates on the honor system, delegating much of its responsibility to the industries that it regulates. It allows companies to decide for themselves whether their projects require environmental study. And if the companies break the rules, they're expected to report their own transgression. Few do. In the rare instances in which the FCC investigates, even brazen illegality is often met with a minor fine, a scolding "admonishment" or no action at all. (The FCC declined to make officials available for interviews for this article or to respond to questions sent in writing.)

The FCC's inaction can have dire consequences. For years, the agency refused to take action even as millions of birds died by flying into communications towers. Only after a federal appeals court castigated the agency for its "apparent misunderstanding" of its environmental obligations did the FCC take steps that addressed some, but not all, of the problem.

In most instances, the scale of damages is relatively small: a half-acre of demolished habitat, a mound of damaged Native American artifacts, an ugly tower looming over a national scenic trail. But the FCC authorizes thousands of projects each year, and the effects add up.

These days, the FCC's laissez-faire approach is sparking resistance. Hundreds of conflicts have erupted across the country, triggered by citizens fearing risks to their health from wireless radiation, harm to their property values, damage to the environment and the destruction of treasured views. Fights are raging from rural Puerto Rico, where protesters have been arrested for blocking roads used by cell-tower-construction crews, to New York City, where a dozen community boards protested the appearance of visually jarring three-story 5G poles on neighborhood sidewalks. In New York, state officials got involved, then a local congressman. Finally, in late April, the furor grew intense enough that the FCC was forced to act; it belatedly ordered a company to halt construction — after more than a hundred poles had been built — and begin the type of reviews that are supposed to be completed before breaking ground.

A 5G tower in New York City Credit: Amir Hamja/The New York Times/Redux

Environmentalists are routinely infuriated by the FCC's stance. The telecommunications industry, which is eager to avoid the costs and delays of reviews, is considerably happier. In 2014, the FCC hired its first full-time environmental lawyer, Erica Rosenberg. Her mission was an afterthought at the agency, she told ProPublica: "Everybody was set on deployment. These environmental laws just got in the way." Rosenberg finally quit in frustration in 2021. "It was just the culture of the place," she said. "Nobody cared."

The FCC's ecological role originated in the National Environmental Policy Act, passed in 1969 at a moment of fervor for protecting the earth. The law requires federal agencies to assess whether projects they've authorized will cause harm. The goal is to "assure for all Americans safe, healthful, productive and aesthetically and culturally pleasing surroundings."

The law mandates an exhaustive environmental impact statement for big federal projects, such as a new dam or highway. Smaller agency actions that are judged to pose a risk of significant harm, either individually or cumulatively, require a less detailed environmental assessment. Any finding of significant impact is supposed to trigger an effort to avoid or minimize the damage.

Since the anti-regulatory era under President Ronald Reagan, the FCC has largely abandoned direct environmental oversight. Using a provision of the law that allows agencies to grant themselves "categorical exclusions" — exemptions from any review — for actions they deem risk-free, the FCC removed review requirements for the vast majority of its actions. The only FCC actions still requiring review are those that fall into one of eight categories, including construction in protected habitat or wilderness areas, building in or near historic or Native American sites, projects that would significantly alter a site's "surface features" and towers taller than 450 feet. Aesthetic harms were dropped from routine consideration, even though NEPA required federal agencies to consider them.

Stricter rules were a "waste of time," according to comments cited by the FCC. In the decades since, the agency has never required a single environmental impact statement.

The FCC's blanket exemption for its actions went unchallenged by a White House office, called the Council on Environmental Quality, that was set up to review agency NEPA rules. Dinah Bear, who

joined the council under Reagan and served as general counsel there for 23 years, told ProPublica that "never should have happened. … It's completely abysmal."

By the time Republican Michael Powell took office as FCC chairman in 2001, the agency had yet to fine a single company for violating environmental rules. (At the FCC, he told ProPublica, environmental regulation is "chronically unattended to.") Powell vowed to get "serious" about enforcement, telling a congressional committee, "When you cheat, I'm going to hurt you and hurt you hard."

Powell took aim at a major obstacle to punishing violators, urging Congress to extend the FCC's unusually short one-year statute of limitations for prosecuting misconduct, which starts running from the date of an alleged offense, not when the violation is discovered. Congress refused; the rule remains in place today. Powell, who now heads NCTA, a Washington trade association representing the cable industry, calls the rule "ridiculous. You don't have a real statute if the offense can hide in the woods and by the time you know about it, it's too late."

Under Powell, the FCC proposed its first environmental fine against a company, citing a 180-foot cell tower built without approval near five historic sites in North Dakota, including a cabin where Teddy Roosevelt lived while hunting bison. The agency promptly dropped the matter after the company fought back.

Of the technologies the FCC oversees, broadcast and cell towers have long generated the most environmental controversy. They're mammoth eyesores. They emit wireless radiation. Their construction requires clearing the ground of trees and vegetation, pouring concrete and building fences, access roads and support structures.

Yet for decades, the FCC refused to address their most gruesome impact: dead birds. Drawn by red nighttime lights intended to warn aircraft, migrating birds were slamming into communications towers, crashing into their support wires or tumbling to the ground in exhaustion after circling the lights for hours. As far back as 1974, the agency had identified this as "a matter of concern."

Experts would later estimate the annual toll from North American towers at around seven million birds. In one much-cited tale of carnage, a researcher reported in 1996 that a 1,000-foot TV tower in Eau Claire, Wisconsin, had claimed more than 12,000 birds on a single stormy night.

"We don't have the resources to investigate or monitor sites," FCC attorney Ava Berland said at a 1999 workshop convened to discuss the bird issue. "What the FCC does is delegate our environmental responsibilities to our licensees and our applicants." Consideration of bird mortality, she noted, wasn't required.

The FCC resisted pleas to require environmental assessments of new towers as industry groups insisted that the bird-mortality estimates were grossly overstated. ("Not one member has witnessed

more than a few dead birds at one time," wrote the National Association of Tower Erectors.) In 2008, following a lawsuit by the American Bird Conservancy, a U.S. Court of Appeals panel scolded the agency's "refusal to take action," noting that the environmental law required agencies to assess the risks of their actions up front, "rather than wait until it is too late." It ordered the FCC to examine the problem.

As the agency slowly moved to do so, Joelle Gehring, then a biologist at Michigan State University, published a study suggesting that switching from steadily burning to flashing lights could cut bird mortality by as much as 70%. In January 2013, she joined the FCC as its first staff biologist, focused on reducing the toll.

In December 2015, the agency, with the FAA's concurrence, finally approved a requirement for all new towers over 150 feet to use flashing lights. But the FCC rejected pleas to mandate that the tens of thousands of existing towers be retrofitted. Gehring quietly launched a personal persuasion campaign, emailing tower operators individually with a plea to voluntarily make the shift. Just a third of the tallest towers, the ones most lethal to birds, have been switched over to date.

Erica Rosenberg was shocked by the FCC's approach to environmental oversight when she arrived at the agency in 2014. Then 53, Rosenberg had spent most of her career doing environmental work, with stints at the EPA, on the staff of congressional committees, as a consultant for nonprofits and as director of a public policy program at Arizona State University.

Part of her new job involved reviewing submissions involving broadcast and cell towers. Most could be built without any notice to the FCC. Environmental assessments were required only when companies volunteered that their project would be built on a sensitive site, one that fell into any of the eight categories on the FCC checklist. Projects near historic or Native American sites also required prior reviews by state and tribal officials to avoid or minimize any "adverse impacts."

But as Rosenberg and Gehring, the FCC's biologist, reviewed the reports, which were supposed to be submitted for FCC approval before construction started, they sometimes discovered photos revealing that the tower had already been built or trees and vegetation removed in preparation for building. It happened frequently enough that they even coined a term for it: "premature construction."

Such rule-breaking was rarely penalized. Companies were simply instructed to perform their own after-the-fact reviews; unless the companies confessed that they expected to cause harm, they were granted permission to build their tower.

In one rare instance in which a tower was blocked, it happened only because of the FCC's inaction — and only after the tower's developer had already damaged a sensitive site. In that episode in Puerto Rico, a developer had cleared scarce habitat of the endangered nightjar in 2014 before completing any environmental review. An uproar ensued, including a hearing in Puerto Rico's Senate. In 2017, FCC

officials finally drafted an order denying the developer the usual no-impact finding, citing the habitat destruction. But the denial was never issued, leaving the project on terminal hold. Even in this case, Rosenberg said, the FCC simply didn't want to set a precedent of formally rejecting a tower approval.

Much has escaped the FCC's notice. In 2020, Alabama's historic preservation office alerted the FCC about a 160-foot TV tower in downtown Montgomery, which had already been built and was operating within blocks of the state Capitol and the Selma to Montgomery civil rights trail, in violation of requirements to assess harm (including aesthetic impact) to any national historic site within a half-mile. Because the structure had been built more than a year earlier, the company was immune from any enforcement action.

Self-reporting is rare, according to FCC officials speaking on condition of anonymity. As one put it, "It's a game that gets played. A very small percentage of actual violations come to our attention." Industry executives seemed to confirm that indirectly in a 2017 Government Accountability Office report on FCC enforcement (which addressed all forms of agency enforcement, not just environmental). Nine stakeholders offered the seemingly improbable explanation that they had "lost the incentive to self-report potential violations" because they felt they'd be treated too harshly.

There was little evidence of harsh consequences in that same GAO report: Just 10% of FCC enforcement cases between 2014 and 2016 resulted in a monetary penalty, while 40% ended with a warning and the rest resulted in no action. In a 2018 email, the agency's federal preservation officer commented, "Industry treats our environmental rules like a joke."

A year into her time at the FCC, Rosenberg started keeping a color-coded enforcement cheat sheet listing the status of apparent violations crossing her desk, which was then happening at a pace of about one a week. Among them was the case of Sacred Wind Communications, the New Mexico company that had built a 199-foot cellphone tower without undergoing any cultural review near a site containing Native American rock carvings. (In an interview with ProPublica, Sacred Wind co-founder John Badal blamed the violations on an outside consultant and the company's failure to properly oversee him.)

Frustrated to see that the FCC's enforcement team wasn't pursuing many of these cases, Rosenberg began promoting the idea of sending violators public "admonishment letters" to deter future violations. After months of internal debate, a half-dozen letters finally went out in June 2016. But the agency declined to issue a press release publicly shaming the offenders, and it abandoned the effort months later.

The arrival of the 5G era stirred the FCC to make things even easier for the telecom industry. In September 2016, five senior agency officials met with 20 representatives from wireless and cell tower companies, including AT&T, Verizon and T-Mobile, who were eager to press their agenda. Jon

Wilkins, chief of the FCC's wireless telecommunications bureau, began by stating that "there is bipartisan support among the Commissioners for doing all that they can to help the industry with infrastructure deployment," according to a summary of the session obtained through a public records request.

The industry delegation laid out a wish list of changes aimed at making the 5G rollout cheaper and faster. After Trump appointees assumed majority control of the agency in 2017, the FCC would seek to give the industry virtually everything it wanted. The agency passed new rules limiting what local governments could charge for access to utility poles and restricting the aesthetic requirements they could put in place. In 2018, with one commissioner blaming "outdated NEPA procedures" for slowing 5G deployment, the FCC exempted most small cell sites from environmental, historic-preservation and tribal reviews. In 2019, the commission shut down reconsideration of whether its wireless-radiation limits adequately protect people and the environment.

Federal appeals court challenges overturned most of these actions. Citing the vast scale of the 5G deployment, one court rejected the FCC's claim that deregulating small cell sites would have "little to no environmental footprint." It wrote that the FCC had "dismissed the benefits of historic-preservation and environmental review in a two-sentence paragraph." A second appeals court later ordered the FCC to revisit the adequacy of its wireless-radiation safeguards, excoriating the agency for its "cursory analysis" of human health and environmental risks.

The FCC doesn't release the totals, but, according to current and former agency employees, companies overseen by the FCC now submit just a few dozen environmental assessments a year, down from several hundred in 2016.

The FCC's biggest environmental penalty ever — $10 million imposed on Sprint Corp. — stemmed from an investigation prompted not by the FCC, but by a wireless industry website called Event Driven. In May 2017, it published an internal Sprint memo detailing a "trial" aimed at speeding small cell deployment. The memo authorized Mobilitie, a Sprint infrastructure contractor, to start construction on scores of sites "without fully completing regulatory compliance." The FCC's consent decree in the Sprint case, made public in April 2018, noted that ignoring review requirements displayed "contempt" for regulatory authority. A spokesperson for T-Mobile, which purchased Sprint in 2020, said the violations occurred "long before" T-Mobile acquired it and "Sprint took steps to address their procedures at the time." Mobilitie, which paid $1.6 million in a separate consent decree, said the episode involved "less than 1%" of the small cell sites it has constructed and that the company has subsequently developed "a robust compliance program."

The latest environmental threat that falls under the FCC's jurisdiction is in the heavens. Because the agency has broad authority over communications, it also licenses commercial satellites. And under the FCC's watch, space is rapidly becoming a far more crowded place. Five years ago, there were fewer

than two thousand satellites in orbit. Last December, the FCC approved the deployment of 7,500 satellites by a single company, Elon Musk's SpaceX, that is building an extraterrestrial broadband network called Starlink. By 2030, experts project that as many as 60,000 satellites will be orbiting the Earth. In January the FCC approved the creation of a new Space Bureau to "better support the needs of the growing satellite industry."

The FCC has approved Musk's space armada, and many other satellite constellations, without requiring an environmental assessment, on the premise that, even cumulatively, they present no serious risk. (Musk has also argued that NEPA rules don't apply to space.)

The agency has rejected fears from multiple quarters that tens of thousands of satellites pose worrisome threats. These include toxic emissions from rocket fuels that could pollute the earth, deplete the ozone layer and worsen global warming; increased radio congestion and space traffic that could destroy other satellites and impede critical astronomy used for weather tracking, national security and science; and a growing threat of human casualties and property damage from falling bits of satellite debris. The GAO inventoried the concerns in a September 2022 report.

For more than a year, the FCC did nothing to stop a more imminent environmental threat that emerged in 2018. It involved a Silicon Valley startup called Apollo Fusion, which was developing a low-cost satellite thruster system that uses a secret, proprietary fuel: liquid mercury. Mercury has big advantages as a fuel, but it's also a toxic heavy metal that causes an array of harms to humans and the environment. NASA discarded it as a fuel option decades earlier. Ten years ago, the U.S. was among more than 140 countries that signed a United Nations treaty aimed at cutting global mercury emissions. But the restrictions didn't apply to space.

Apollo was engaging in discussions with multiple big companies interested in purchasing its mercury-fueled thruster for their satellites. Its website claimed the company had a signed contract with at least one customer, with plans for a trial launch by the end of 2018.

That November, Public Employees for Environmental Responsibility, a nonprofit that had been tipped off by a whistleblower, revealed Apollo's plans, warning that they could create an "eco-catastrophe." The group accused the FCC of abdicating its responsibility to protect the public and petitioned the agency to halt the use of mercury. Two experts voiced concern in a Bloomberg Businessweek article that much of the toxic mercury emitted in space would descend back to earth.

At least two companies in 2019 sought FCC approval to launch satellites using Apollo's mercury-fueled thrusters, FCC documents show. One later withdrew its request. The second, Astro Digital, applied in April for an experimental satellite license.

At what was then known as Vandenberg Air Force Base, a California site for the planned launches, an environmental reviewer in 2019 voiced "extreme concern" about flight "anomalies" that could allow

mercury “to enter the terrestrial or ocean environment,” according to documents obtained from a public records request.

In August, Astro Digital and Apollo executives insisted to FCC officials that the mercury they’d release in space would remain there and cause no harm. They pressed to move forward with the planned launch.

In mid-September, the FCC finally ordered Astro Digital to submit an environmental assessment covering Apollo’s thruster system. Astro Digital agreed to comply, but asked the FCC to reconsider whether it had the authority to order such an assessment, noting that it was “not aware that the FCC has ever requested such information from other satellite operators.”

The FCC never responded, either to grant Astro Digital’s request or to deny it, according to Apollo co-founder Mike Cassidy. “We spent a year and a half waiting,” he said. (Cassidy defended his company’s fuel while acknowledging that “you obviously have to be really careful with mercury from an environmental perspective.”) Astro Digital eventually withdrew its application and Apollo switched to another propellant.

In March 2022, a United Nations conference in Indonesia did what the FCC wouldn’t: It banned the use of mercury to propel spacecraft.

Doris Burke contributed research.