From: Marja Ambler <mambler@trpa.gov>
Sent: 6/27/2023 2:25:37 PM
To: Katherine Huston <khuston@trpa.gov>
Subject: FW: TRPA Governing Board Meeting Public Comment {May 24 2023 TRPA GB meeting}
Attachments: Capture-email record of David Chain Comments.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

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From: Al Miller <syngineer1@gmail.com>
Sent: Monday, June 26, 2023 4:34 PM
To: Cindy.Gustafson <cindygustafson@placer.ca.gov>; John Marshall <jmarshall@trpa.gov>; Marja Ambler <mambler@trpa.gov>; Julie Regan <jregan@trpa.gov>
Subject: Fwd: TRPA Governing Board Meeting Public Comment {May 24 2023 TRPA GB meeting}

Objection to Adoption of the Minutes of the May 24, 2023 Governing Board Meeting; June 28, 2023 TRPA Governing Board Meeting; Public Comment for Agenda Item IV

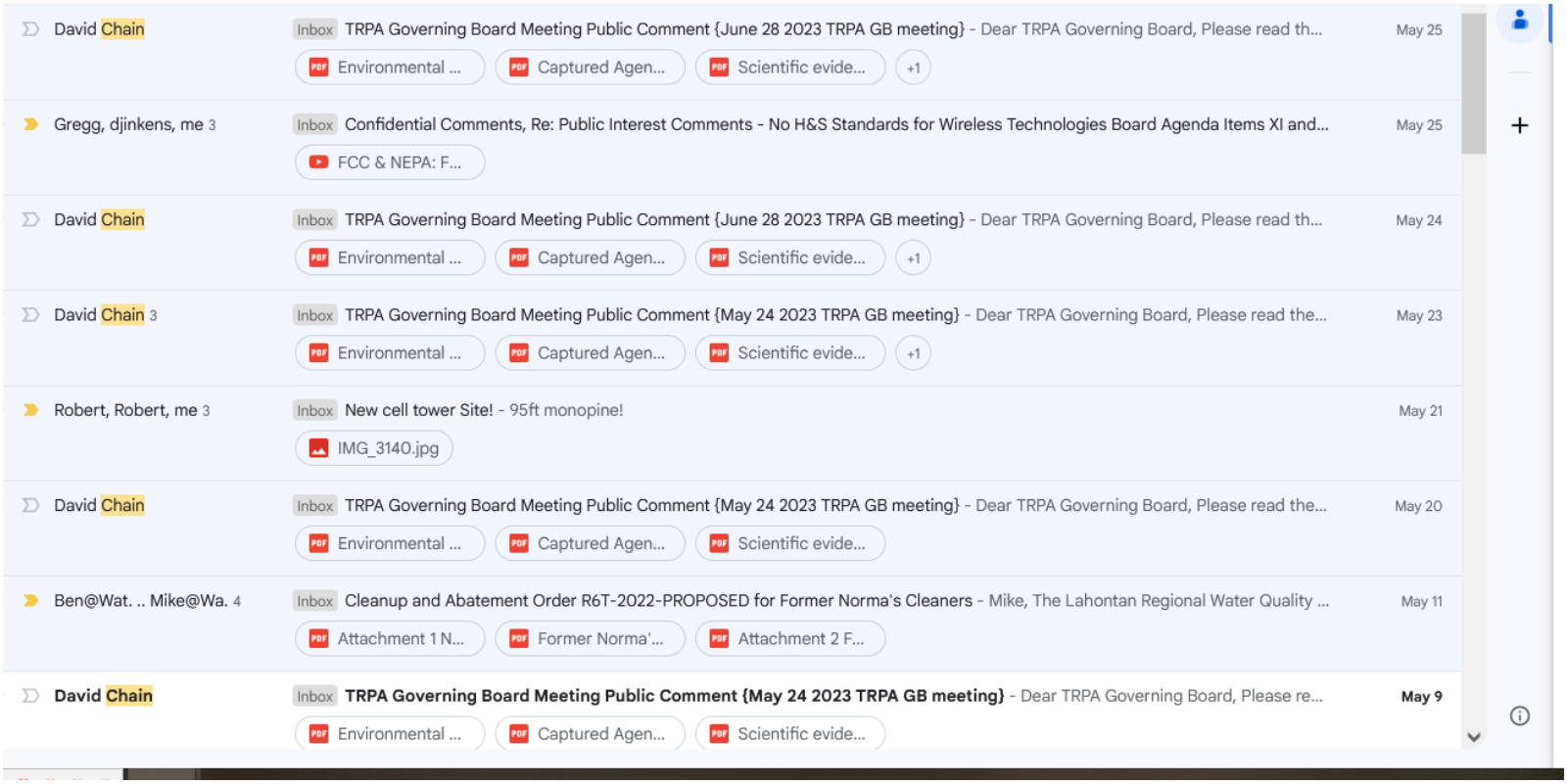
Dear Board Members and Members of the Public,

I provide these comments for the public record for the upcoming June Board meeting. These comments follow other comments I provided for the public record of the June 2023 meeting indicating that the meeting is being conducted in violation of open meeting law due to late publication of the Agenda online. I apologize for any confusion caused by the subject line of this e-mail's reference to the prior May 2023 meeting. However, it is a consequence of forwarding email from David Chain of May 20, 2023 that was deliberately excluded from the public record of the May meeting by the TRPA staff. I am therefore forwarding Mr. Chain's email in it's entirety for inclusion in the public record of Item IV of the June 28, 2023 Governing Board meeting.

TRPA forgets the California requirements, and the public it works for, which requirements state in relevant part:

> The people of this state do not yield their sovereignty to the agencies which serve them. The people, in delegating authority, do not give their public servants the right to decide what is good for the people to know and what is not good for them to know. The people insist on remaining informed so that they may retain control over the instruments they have created.
>
> This article shall be known and may be cited as the Bagley-Keene Open Meeting Act.

Further, I am objecting to the adoption of the minutes as proposed because the record of public comments is incomplete. Mr. Chain submitted the same comments at the conclusion of this email, again and again in an effort to get them included in the record, including multiple sends to EACH AND EVERY BOARD MEMBER. See the screenshot below of these records, which I also received simultaneously. Furthermore, emails from Mr. Chain with public comments for the June 28, 2023 Board meeting have not been posted online as of this writing. This is an example of TRPA subterfuge and fraud with regard to the public records.



Indeed, the Minutes as presented for adoption include a discussion with the Board Chair concerning these and other emails (pdf p 38-39):

"Ms. Gustafson asked Mr. Marshall if he could talk about the written public comment. She's assuming that when the Board members receive these and staff are copied that staff is keeping track of them for the public record. **She received an email from Mr. Chain threatening to sue her because his comments were not made part of the record yet. (emphasis added)**

Mr. Marshall said there is a difference between what the public record is and public documents or public records. Something that is sent to you is a public record. The Agency keeps it and if someone requests it, we'll provide it to them. If it's submitted to us in response to an agenda item, then it becomes part of the public record for this meeting. There may be some expectation that once you submit something to the Governing Board, no matter what it is, it needs to be posted on our website.Maybe that's what they are trying to get at, is its now part of the public record and am going to sue because it hasn't been posted yet. That is a different question for us to handle on a case by case basis."

The records of emails listed above include Mr. Marshall as a recipient, as inspection of the transmittal record below shows (addresses in the emails are all the same). Mr. Marshall's comments are deceptive, as he knew, or should have known: the emails were submitted as Public Comments for the May meeting, as the titles clearly indicate. Mr. Marshall is simply covering for staff censorship and omission of e-mails critical of the TRPA from the public record and before the public online with his lies. Board member Gustafson and the others deserve to be sued, for believing Mr. Marshall and held personally liable for the subterfuge and fraudulent representation of the public record, as this is but one example of standard practice.

I therefore object to adoption of the Minutes of the May 24, 2023, Governing Board Meeting. The forward of Mr. Chain's email of May 20, 2023, is provided as an example for all, below my name.

Alan Miller

---------- Forwarded message ---------
From: **David Chain** <david.chain@barmail.ch>
Date: Sat, May 20, 2023 at 4:58 PM
Subject: TRPA Governing Board Meeting Public Comment {May 24 2023 TRPA GB meeting}
To: <cindygustafson@placer.ca.gov>, <hayley.a.williamson@gmail.com>, <shellyaldean@gmail.com>, <cisco@sos.nv.gov>, <ashleyc@alumni.princeton.edu>, <jdiss.trpa@gmail.com>, <belindafaustinos@gmail.com>, <jfriedrich@cityofslt.us>, <ajhicks@mcdonaldcarano.com>, <AHill@washoecounty.us>, <vhoenigman@yahoo.com>, <jsettelmeyer@dcnr.nv.gov>, <BOSFive@edcgov.us>, <wrice@douglasnv.us>, <trpa@trpa.gov>, Julie Regan <jregan@trpa.gov>
Cc: Cristi Creegan <ccreegan@cityofslt.us>, Cody Bass <cbass@cityofslt.us>, Scott Robbins <srobbins@cityofslt.us>, Tamara Wallace <twallace@cityofslt.us>, Joe Irvin <jirvin@cityofslt.us>, Lindsey Baker <lbaker@cityofslt.us>, Sheree Juarez <sjuarez@cityofslt.us>, <sletton@cityofslt.us>, Heather Leyn Stroud <hstroud@cityofslt.us>, Daniel Bardzell <dbardzell@cityofslt.us>, <nwieczorek@cityofslt.us>, <gfeiger@cityofslt.us>, <showard@cityofslt.us>, <kroberts@cityofslt.us>, <nspeal@cityofslt.us>, Marja Ambler <mambler@trpa.gov>, John Ladue Marshall <jmarshall@trpa.gov>, Katherine Huston (Hangeland) <khuston@trpa.gov>, Wendy Jepson <wjepson@trpa.org>, <jself@trpa.gov>, Bridget Cornell <bcornell@trpa.org>, Ken Kasman <kkasman@trpa.gov>, Devin Middlebrook <dmiddlebrook@trpa.gov>, <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>

Dear TRPA Governing Board,

Please read the attached PDF(s). The TRPA has alleged to have exonerated itself 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 (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):

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You may also watch an video interview of the author:

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:
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)). *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. 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)).

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*, 515 U.S. 687 (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 NIH study are not "bunk science" reasonably subject to dispute. This finding has been reproduced in by other prestigious 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).

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")

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 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 may not use *post facto* environmental review which would be arbitrary and capricious. "[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, "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).

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).

Pursuant to PUBLIC LAW 96-551 – DEC. 19, 1980, Arts. III(i), VI(b)&(j)(5), & VII(d); CA Government Code §§ 54954.1, 54957.5, & 54959; N.R.S. Ch. 239 & § 241.020; and TRPA Rules of Procedure §§ 2.6, 15.2, & 15.5, public comments must be readily and immediately available to the entire public at the time the documents are disseminated to a quorum of the hearing body—intentive deprivation to the public of such information is a crime.

As you know, PUBLIC LAW 96-551 – DEC. 19, 1980, Art. III(d), requires that:

"The governing body of the agency shall meet at least monthly. All meetings shall be open to the public to the extent required by the law of the State of California or the State of Nevada, whichever imposes the greater requirement, applicable to local governments at the time such meeting is held."

This is also reflected in TRPA Rules of Procedure §§ 2.6.

Nevada promulgates its open meeting at N.R.S. § 241.020 wherein (3)(d)(3) requires that meetings have:

"An agenda consisting of:

Periods devoted to comments by the general public, if any, and discussion of those comments. Comments by the general public must be taken:

(I) At the beginning of the meeting before any items on which action may be taken are heard by the public body and again before the adjournment of the meeting; or

(II) After each item on the agenda on which action may be taken is discussed by the public body, but before the public body takes action on the item.

...

the public body must allow the general public to comment on any matter that is not specifically included on the agenda as an action item at some time before adjournment of the meeting."

wherein (3)(d)(7) requires the agenda give notice of:

"Any restrictions on comments by the general public. Any such restrictions must be reasonable and may restrict the time, place and manner of the comments, but may not restrict comments based upon viewpoint."

N.R.S. Ch. 239 further promulgates such comment materials are public records.

CA Government Code § 54954.3(a)&(c) reiterates Nevada Law:

"Every agenda for regular meetings shall provide an opportunity for members of the public to directly address the legislative body on any item of interest to the public, before or during the legislative body's consideration of the item, that is within the subject matter jurisdiction of the legislative body...

The legislative body of a local agency shall not prohibit public criticism of the policies, procedures, programs, or services of the agency, or of the acts or omissions of the legislative body. Nothing in this subdivision shall confer any privilege or protection for expression beyond that otherwise provided by law."

Moreover, CA Government Code § 54957.5(b) further states:

"If a writing is a public record related to an agenda item for an open session of a regular meeting of the legislative body of a local agency and is distributed to all, or a majority of all, of the members of a legislative body of a local agency by a person in connection with a matter subject to discussion or consideration at an open meeting of the body less than 72 hours before that meeting, the writing shall be made available for public inspection ... at the time the writing is distributed to all, or a majority of all, of the members of the body."

CA Government Code § 54954.2(a)(1):

"At least 72 hours before a regular meeting, the legislative body of the local agency, or its designee, shall post an agenda containing a brief general description of each item of business to be transacted or discussed at the meeting"

See also, CA Government Code § 54954.1 & 54959; TRPA Rules of Procedure §§ 2.6, 15.2, & 15.5; Governing Board Meeting October 26-27, 2022 Agenda Item No. VIII.B.1 Open Meeting Law Requirement.

Nevada law "imposes the greater requirement" whereas it requires three opportunities for public comment: "at the beginning of the meeting" and "before the adjournment of the meeting" and "after each item on the agenda is discussed by the public body" (N.R.S. § 241.020(3)(d)(3)). However, TRPA purposefully fails to provide notice of public comment in its published agenda and then fails to provide for public comment "at the beginning of the meeting." Compare the left two TRPA public notices published in the Tahoe Daily Tribune with the right notice published in the same newspaper by the NTRPA:

Again, there is no public comment on the agenda for the upcoming May 24 2023 TRPA GB meeting either:

Nevada also "imposes the greater requirement" whereas it requires 3 working days notice notice of the meeting agenda compared to California's 72 hours notice with weekend and holidays inclusive (N.R.S. § 241.020(3); CA Government Code § 54954.2(a)(1)).

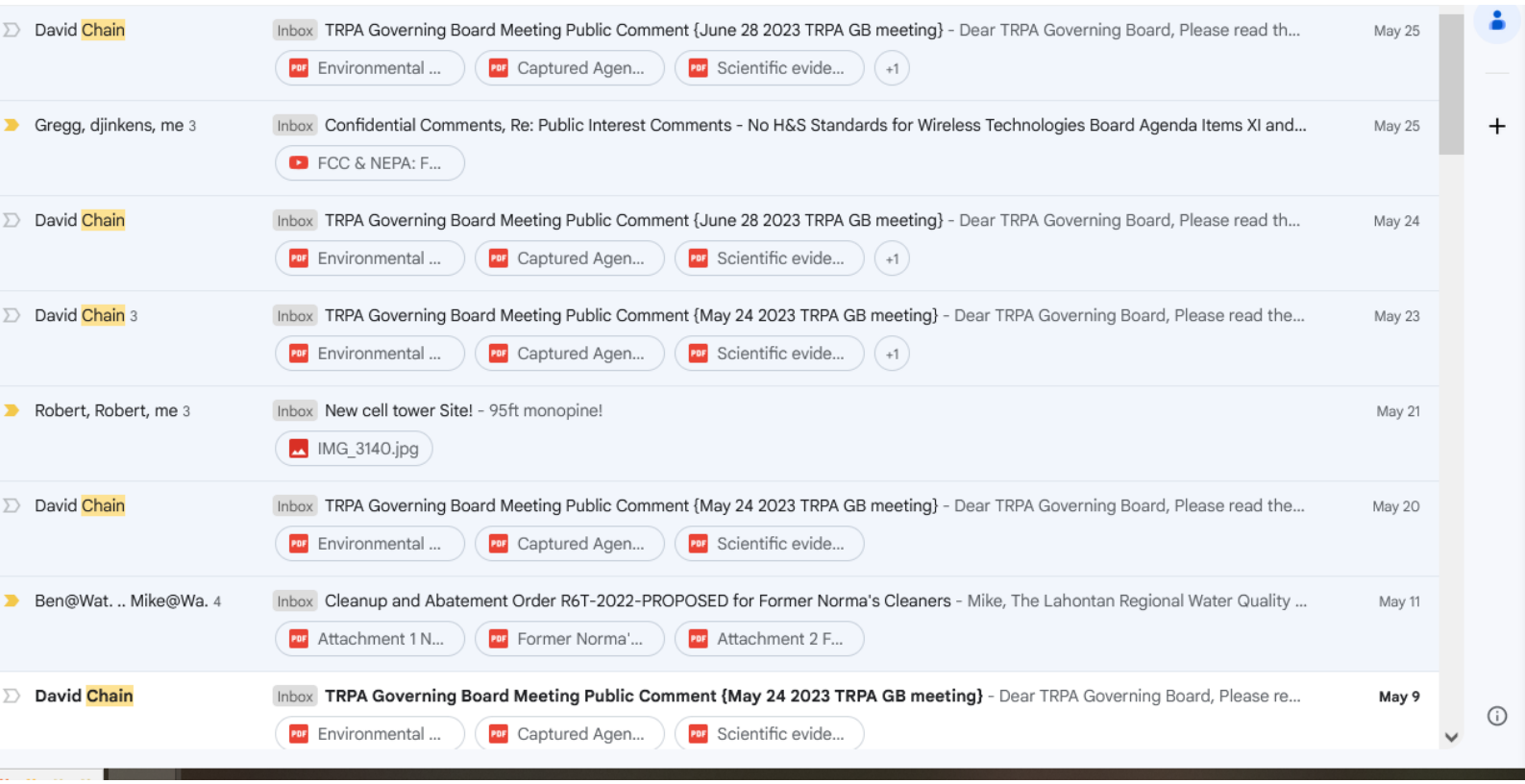
TRPA Rule of Procedure § 2.10.2 is in egregious violation of TRPA Compact Art. III(d) whereas N.R.S. § 241.020(3)(d)(3)(I) requires that meetings have "Periods devoted to comments by the general public, if any, and discussion of those comments. Comments by the general public must be taken...At the beginning of the meeting before any items on which action may be taken are heard by the public body and again before the adjournment of the meeting." The TRPA Rules of Procedure are routinely modified for *ad hoc* political purposes in without published public notice in violation of basic due process of law (*infra*, *Mullane v. Central Hanover Tr. Co.*, at 314, 315 (holding It would be idle to pretend that publication alone is a reliable means of acquainting interested parties of the fact that their rights are before the tribunal; "Where the names and postoffice addresses of those affected by a proceeding are at hand, the reasons disappear for resort to means less likely than the mails to apprise them of its pendency"; published notice "is inadequate, not because in fact it fails to reach everyone, but because under the circumstances it is not reasonably calculated to reach those who could easily be informed by other means at hand"; "Publication may theoretically be available for all the world to see, but it is too much in our day to suppose that each or any individual...does or could examine all that is published to see if something may be tucked away in it that affects his property interests"). *Cf.*, Cal. Gov. Code §§ 11343, 25124, & 36933; N.R.S. §§ 233B.060, 244.100, & 266.115). Whereas TRPA does not post public comment on its website, it is in violation of CA Government Code § 54957.5(b). No deference is given to an agency's interpretation of a statute that it does not administer or is outside of its expertise (*see, Medina-Lara v. Holder*, 771 F.3d 1106, 1117 (9th Cir. 2014); *Trung Thanh Hoang v. Holder*, 641 F.3d 1157, 1163-64 (9th Cir. 2011); *Mandujano-Real v. Mukasey*, 526 F.3d 585, 589 (9th Cir. 2008)). An agency action that departs from a prior policy without acknowledging the change, or that creates an "unexplained inconsistency" with prior policy is generally viewed as arbitrary and capricious (*National Cable & Telecommunications Assn. v. Brand X Internet Services*, 545 U.S. 967, 981 (2005); *Perez v. Mortg. Bankers Ass'n*, 575 U.S. 92 (2015) (holding that the APA "mandate[s] that agencies use the same procedures when they amend or repeal a rule as they used to issue the rule in the first instance")).

Violation of Open Meeting Laws is a crime and may also amount to a constitutional violation actionable under 42 U.S.C § 1983. It is well-established that government officers such as **TRPA Governors can be held liable for knowing about but failing to prevent constitutional violations** (*Reynaga Hernandez v. Skinner*, 969 F.3d 930, 941-42 (9th Cir. 2020) (An actor may be deemed to have caused a constitutional violation under the "integral-participant doctrine," if the defendant knew about and acquiesced in the constitutionally defective conduct as part of a common plan with those whose conduct constituted the violation)).The TRPA itself can also be held liable (*Monell v. Department of Social Services*, 436 U.S. 658, 691-92 (1978) (when execution of a government's policy or custom, whether made by its lawmakers or by those whose edicts or acts may fairly be said to represent official policy, inflicts the injury that the government as an entity is responsible under § 1983); *Connick v. Thompson*, 563 U.S. 51, 61 (2011) (when municipality policymakers are on actual or constructive notice of city's programmatic violation of citizens' constitutional rights, the city may be deemed deliberately indifferent)). It is well settled that a "person" subject to liability can be an individual sued in an individual capacity (*see Devereaux v. Abbey*, 263 F.3d 1070, 1074 (9th Cir. 2001) (*en banc*)) or in an official capacity (*see, Hartmann v. Cal. Dep't of Corr. & Rehab.*, 707 F.3d 1114, 1127 (9th Cir. 2013)). A "person" subject to liability can also be a local governing body (*see, Waggy v. Spokane County*, 594 F.3d 707, 713 (9th Cir. 2010)). This general doctrine applies to First Amendment violations as well (*Ariz. Students' Ass'n v. Ariz. Bd. of Regents*, 824 F.3d 858, 867 (9th Cir. 2016) ("A plaintiff may bring a Section 1983 claim alleging that public officials, acting in their official capacity, took action with the intent to retaliate against, obstruct, or chill the plaintiff's First Amendment rights. To bring a First Amendment retaliation claim, the plaintiff must allege that (1) it engaged in constitutionally protected activity; (2) the defendant's actions would 'chill a person of ordinary firmness' from continuing to engage in the protected activity; and (3) the protected activity was a substantial or motivating factor in the defendant's conduct—i.e., that there was a nexus between the defendant's actions and an intent to chill speech. Further, to prevail on such a claim, a plaintiff need only show that the defendant 'intended to interfere' with the plaintiff's First Amendment rights and that it suffered some injury as a result; the plaintiff is not required to demonstrate that its speech was actually suppressed or inhibited")). A "person" subject to liability can also be a local governing body (*see, Waggy v. Spokane County*, 594 F.3d 707, 713 (9th Cir. 2010)). An institutional defendant is not entitled to qualified immunity (*see, Owen v. Independence*, 445 U.S. 622, 638 (1980) (holding that "municipality may not assert the good faith of its officers or agents as a defense to liability under § 1983")). Even a private party involved in conspiracy to deprive such rights with a government official may, even though not himself official of the government, be liable as well (*Adickes v. S. H. Kress & Co.*, 398 U.S. 144, 152 (1970)). Any ordinance which precludes the disproof in [quasi-]judicial proceedings of facts which would show or tend to show that an ordinance depriving suitor of life, liberty, or property has a rational basis is a "denial of due process" (*U.S. v. Carolene Products Co.*, 304 U.S. 144, 152 n.4 (1938) (noting heightened scrutiny in situations in which a law or regulation conflicts with Bill of Rights protections, where the political process has closed or is malfunctioning, and when regulations adversely affect "discrete and insular minorities").

Due process of law under the Fifth, Sixth, and Fourteenth Amendments to the U.S. Constitution—supreme over all state law—have the requirements that a tribunal allow all parties and public attendance to an opportunity to be heard, an opportunity to know all opposing evidence, and that it prepare a record of the evidence presented (*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); *Greene v. McElroy*, 360 U.S. 474, 946-947 (1959) (the right to be confronted with evidence is protected in all types of cases where administrative and regulatory actions were under scrutiny); *Goldberg v. Kelly*, 397 U.S. 254, 269-70 (1970) ("In almost every setting where important decisions turn on questions of fact, due process requires an opportunity to confront and cross-examine adverse witnesses")). A transcript being made tends to restrain abuses by hearing officers and is almost essential if there is to be judicial review (Henry J. Friendly, *Some Kind of Hearing*, 123 U. Pa. L. Rev. 1267, 1282-87, 1291-94 (1975)). Due process requires an impartial tribunal (*supra, Goldberg v. Kelly*, at 271 ("impartial decision maker is essential"); *Arnett v. Kennedy*, 416 U.S. 134, 197 (1974) (the right to an impartial decisionmaker is required by due process); *see also, supra, Mullane v. Central Hanover Tr. Co.*, at 314; *Mullane v. Central Hanover Tr. Co.*, at 314, 315 , 318-20 ("An elementary and fundamental requirement of due process in any proceeding which is to be accorded finality is notice reasonably calculated, under all the circumstances, to apprise interested parties of the pendency of the action and afford them an opportunity to present their objections"; "when notice is a person's due, process which is a mere gesture is not due process"); *supra, Greene v. McElroy*, at 946-947 (the right to be confronted with evidence is protected in all types of cases where administrative and regulatory actions were under scrutiny)).

The constitutional due process right to a public hearing dovetails with the First Amendment whereas, the "right conclusions are more likely to be gathered out of a multitude of tongues, than through any kind of authoritative selection. To many this is, and always will be, folly; but we have staked upon it our all" (*supra, New York Times Co. v. Sullivan*, at 270). "[T]he path of safety lies in the opportunity to discuss freely supposed grievances and proposed remedies" (*id*). Contrary city practices to systemically rig an egregiously unlevel playing field towards succumbing to an authoritarian outcome are "conscious shocking" in the constitutional sense (*cf., supra, County of Sacramento v. Lewis*, at 846). It is well-established that the chilling of witness testimony or other suppression of evidence is a form of constitutional violation (*see, Mellen v. Winn*, 900 F.3d 1085, 1096 (9th Cir. 2018); *Tennison v. City & Cnty. of S.F.*, 570 F.3d 1078, 1087, 1089 (9th Cir. 2009); *see also, Carrillo v. Cnty. of L.A.*, 798 F.3d 1210, 1219 (9th Cir. 2015); *cf., Park v. Thompson*, 851 F.3d 910 (9th Cir. 2017)).

The TRPA appears to believe they answer to nobody.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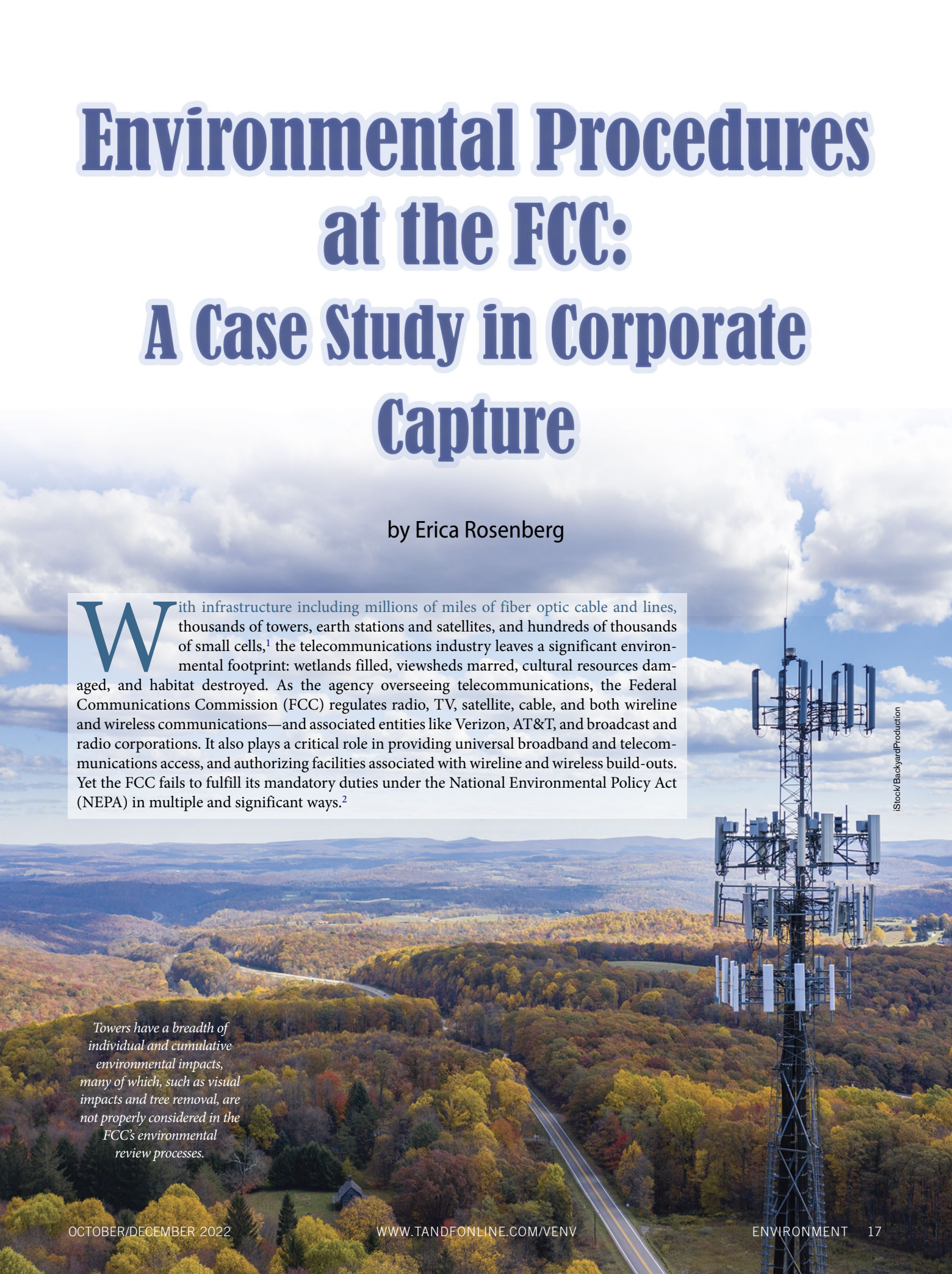
Environmental Procedures at the FCC: A Case Study in Corporate Capture

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]

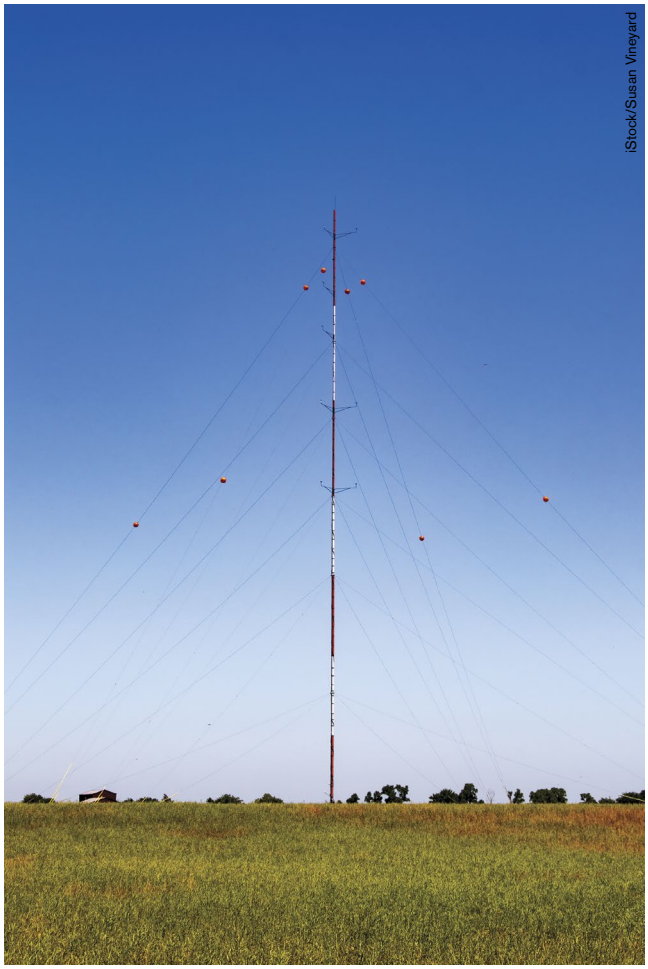
In dismissing the petition brought by an environmental nongovernmental organization to require more environmental review for a number of FCC actions, including those involving submarine cables, the 1974 order acknowledged environmental damage from cables in Maine and the U.S. Virgin Islands but illogically 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.

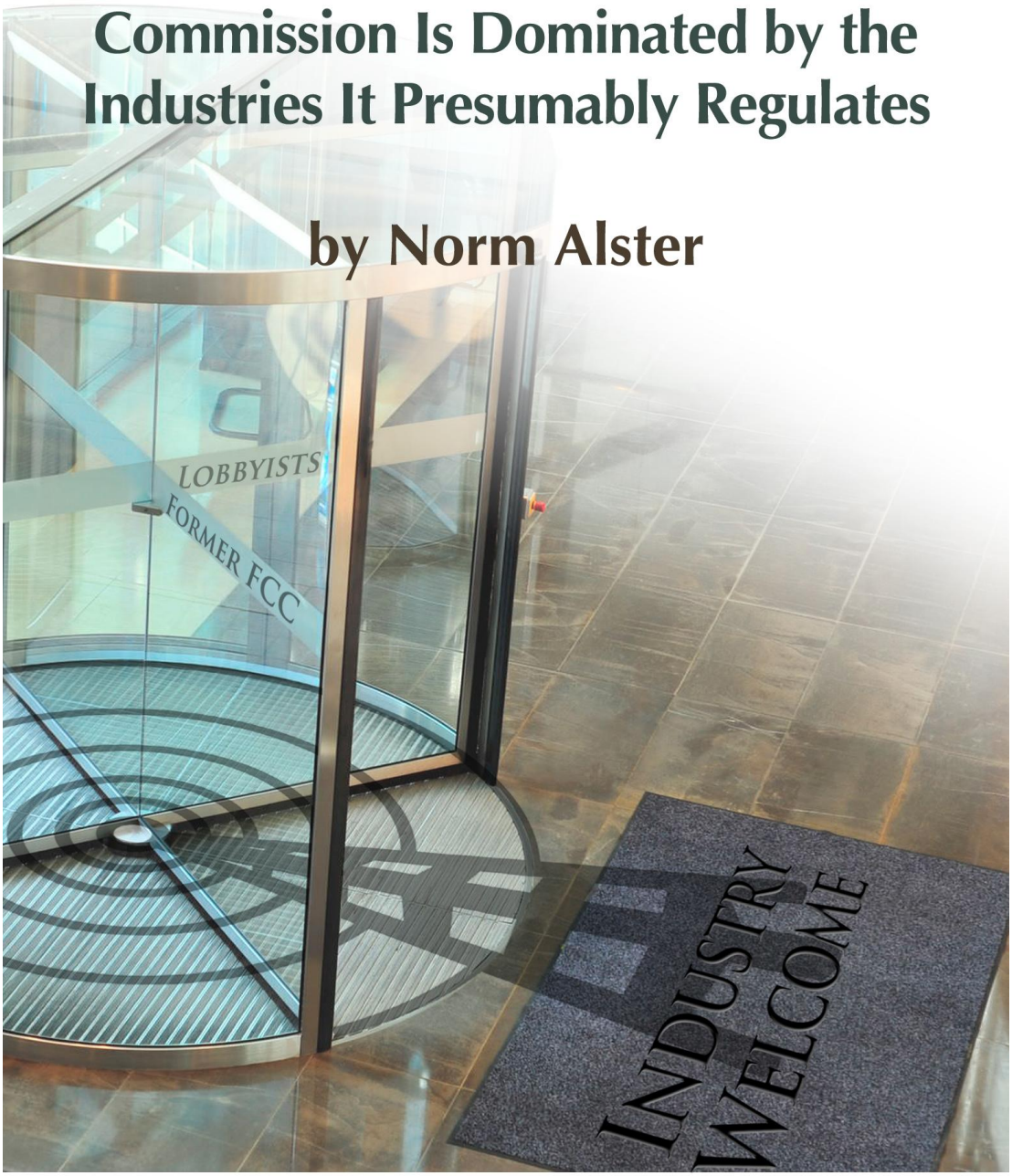
NOTES

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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Appendix – Survey of Consumer Attitudes

Endnotes

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.

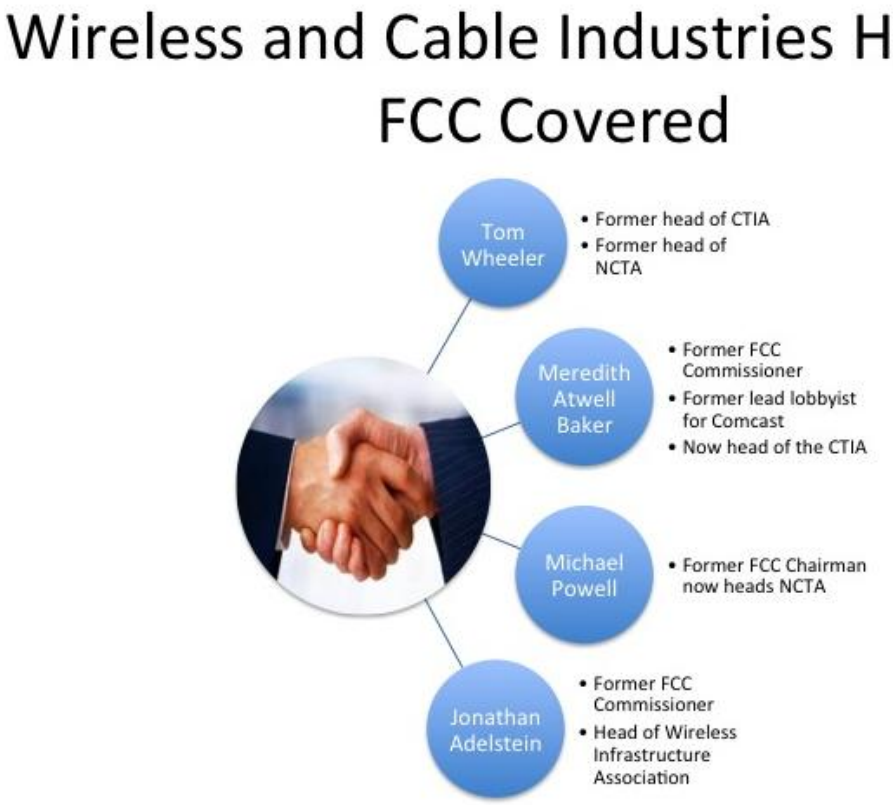
Industry controls the FCC through a soup-to-nuts stranglehold that extends from its well-placed campaign spending in Congress through its control of the FCC's Congressional oversight committees to its persistent agency lobbying. "If you're on a committee that regulates industry you'll be a major target 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]

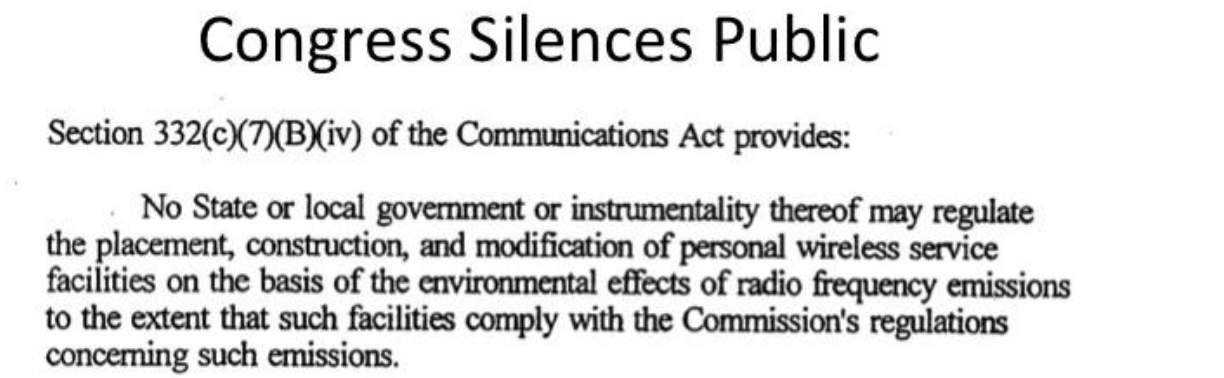
More than 50 years later, the mess continues to pile up.

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.

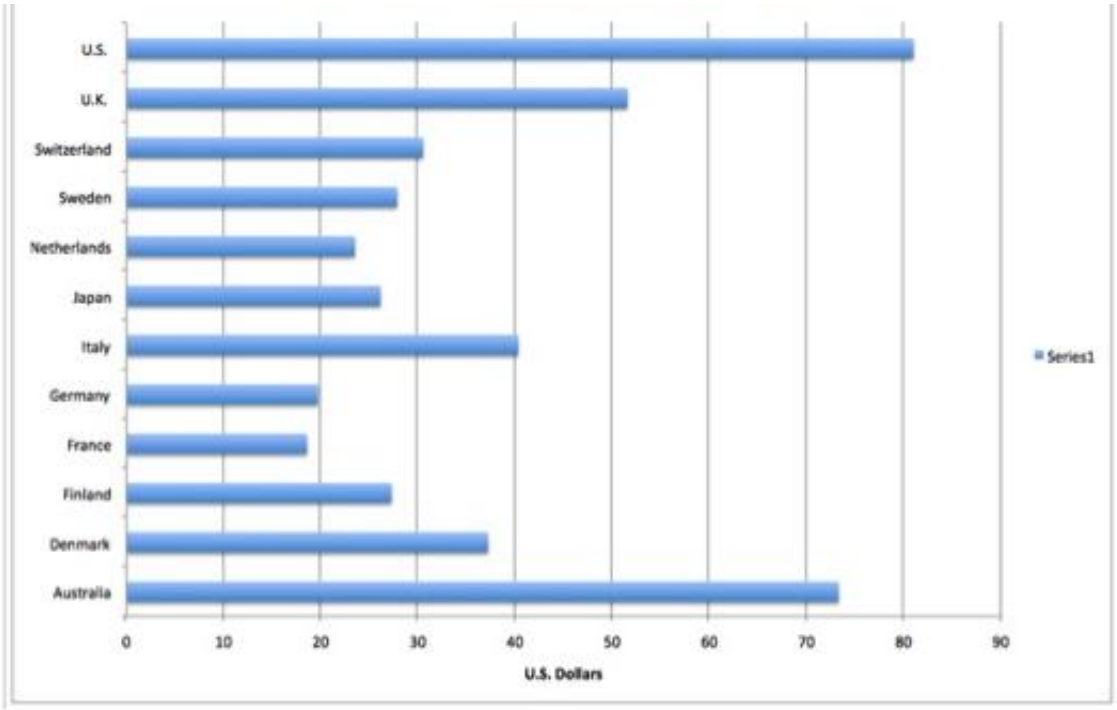
Chapter Six: The Cable Connection

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.

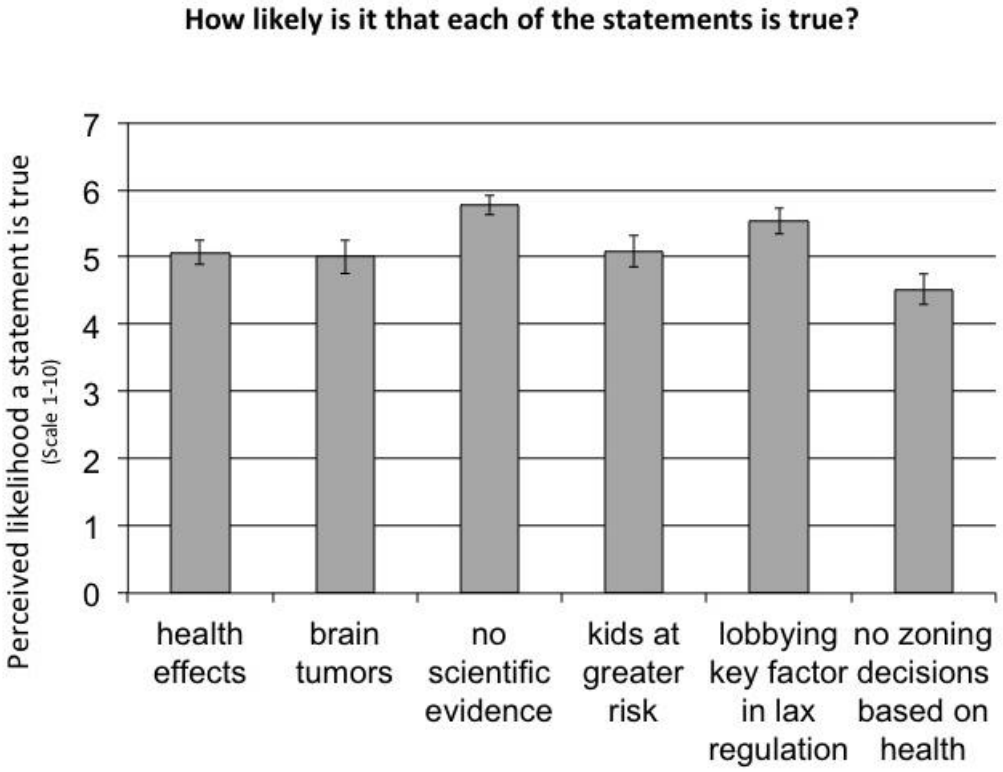
Appendix—Survey of Consumer Attitudes

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.

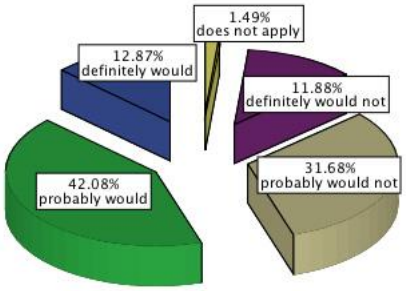


Two findings seem especially interesting:

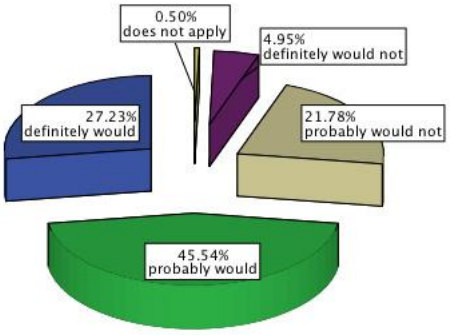
1. Statement 3 received a higher credibility rating than Statements 1 and 2. The different credibility levels are statistically significant. Respondents are more likely to trust in wireless safety than to believe there are general or specific health risks.

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.

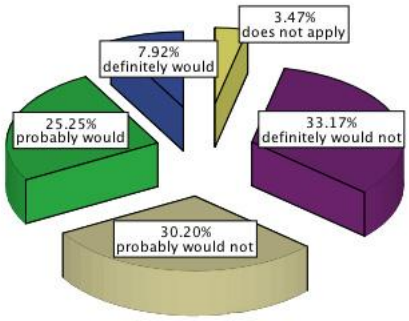
Participants were also asked how they would change behavior if claims of wireless health risks were established as true:



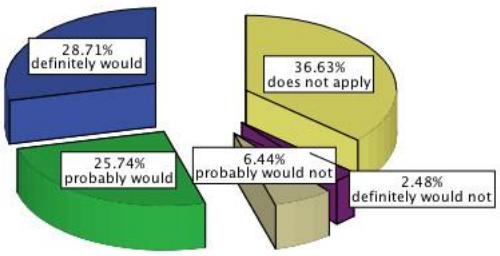
**If statement 1 was true,
I would start using headphones.**



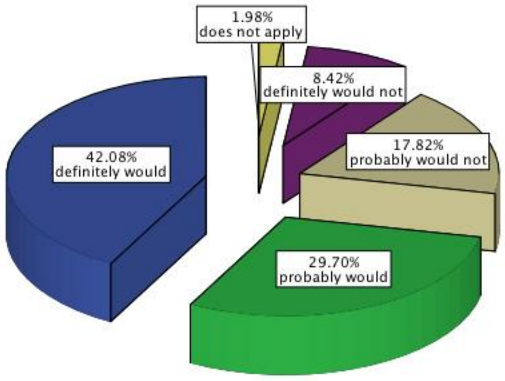
**If statement 1 was true,
I would restrict the amount of time
I spend on the phone.**



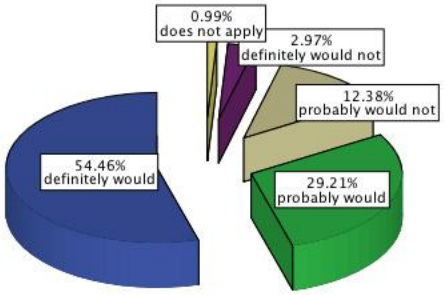
**If statement 1 was true,
I would start up a new land line
account for home use.**



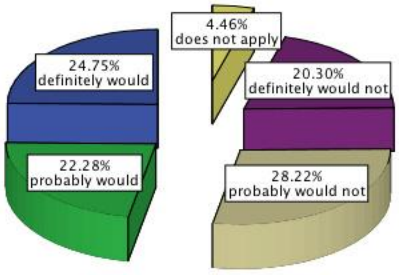
**If statement 1 was true,
I would restrict my children's cell phone use.**



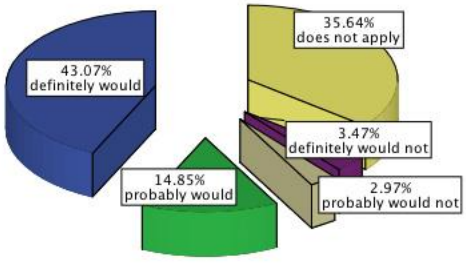
If statement 2 was true,
I would start using headphones.



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.



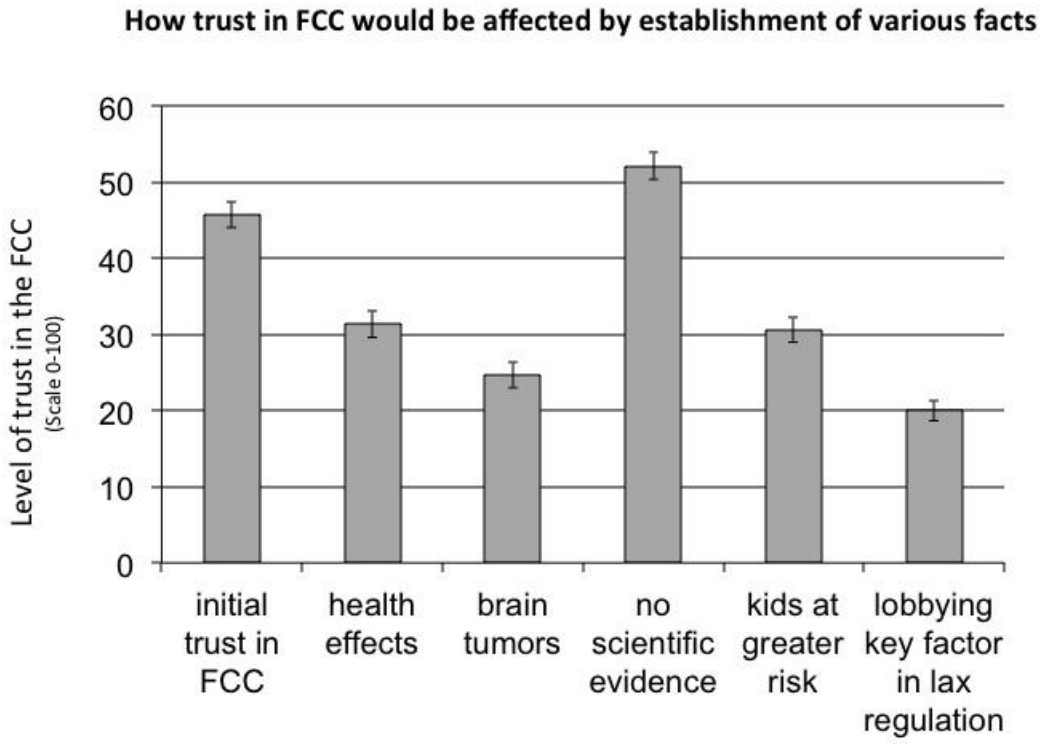
If statement 2 was true,
I would restrict my children's cell phone use.

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

[1] Former CTIA vice president John Walls in Kevin Kunze's documentary film *Mobilize*, introduced in 2014 at the California Independent Film Festival.

[2] November 2014 interview with Renee Sharp.

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[5] Center for Responsive Politics.

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[9] Daniel Lathrop, "From Government Service to Private Practice: Writers of Telecom Law Move to K Street," Center for Public Integrity, October 28, 2004, http://www.publicintegrity.org/2004/10/28/6597/government-service-private-practice.

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[14] Id., 206-208.

[15] January 2015 interview with Robert Weller.

[16] Letter from Michelle C. Farquhar, Chief of the FCC's Wireless Telecommunications Bureau, to Thomas Wheeler, President and CEO of the Cellular Telecommunications Industry Association, January 13, 1997.

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[25] Online survey conducted in April 2015 on Amazon's Mechanical Turk platform.

[26] CTIA, "Policy & Initiatives: Innovation," http://www.ctia.org/policy-initiatives/policy-topics/innovation.

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[28] Alexander Lerchl, Melanie Klose, and Karen Grote et al., "Tumor Promotion by Exposure to Radiofrequency Electromagnetic Fields below Exposure Limits for Humans," *Biochemical and Biophysical Research Communications* 459.4 (2015): 585-590.

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[30] Medscape, "Brain Cancer CME Learning Center," http://www.medscape.org/resource/brain-cancer/cme.

[31] Anke Huss, Matthias Egger, Kerstin Hug, Karin Huwiler-Muntener, and Martin Roosli, "Source of Funding and Results of Studies of Health Effects of Mobile Phone Use: Systemic Review of Experimental Studies," *Environmental Health Perspectives* 115.1 (2007): 1-4, 1.

[32] Id.

[33] Federal Communications Commission, "Wireless Devices and Health Concerns," http://www.fcc.gov/guides/wireless-devices-and-health-concerns.

[34] Lennart Hardell, Michael Carlberg, Fredrik Soderqvist, and Kjell Hansson Mild, "Case-Control Study of the Association between Malignant Brain Tumours Diagnosed between 2007 and 2009 and Mobile and Cordless Phone Use," *International Journal of Oncology* 43.6 (2013): 1833-1845.

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[36] Lennart Hardell and Michael Carlberg, 'Using the Hill Viewpoints from 1965 for Evaluating Strengths of Evidence of the Risk for Brain Tumors Associated with Use of Mobile and Cordless Phones," *Reviews on Environmental Health* 28.2-3 (2013): 97-106.

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[44] November 2014 interview with Joel Moskowitz.

[45] February 2015 interview with Carl Blackman.

[46] Id.

[47] Id.

[48] Lawrence Lessig, Roy L. Furman Professor of Law and Leadership at Harvard Law School, helped to draft the Right to Know ordinance and has offered pro bono legal representation to the city of Berkeley. Professor Lessig was director of the Lab at Harvard's Safra Center for Ethics, from which the Project on Public Narrative was spun off in November of 2014.

[49] May 2015 interview with Berkeley City Attorney Zach Cowan

[50] December 2014 interview with Jerry Phillips.

[51] Id.

[52] February 2015 interview with Om P. Gandhi.

[53] Id.

[54] Radio interview on WBAI-FM, "Wireless Radiation: What Scientists Know and You Don't, With Dr. Joel Moskowitz," March 10, 2015.

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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

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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.

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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.

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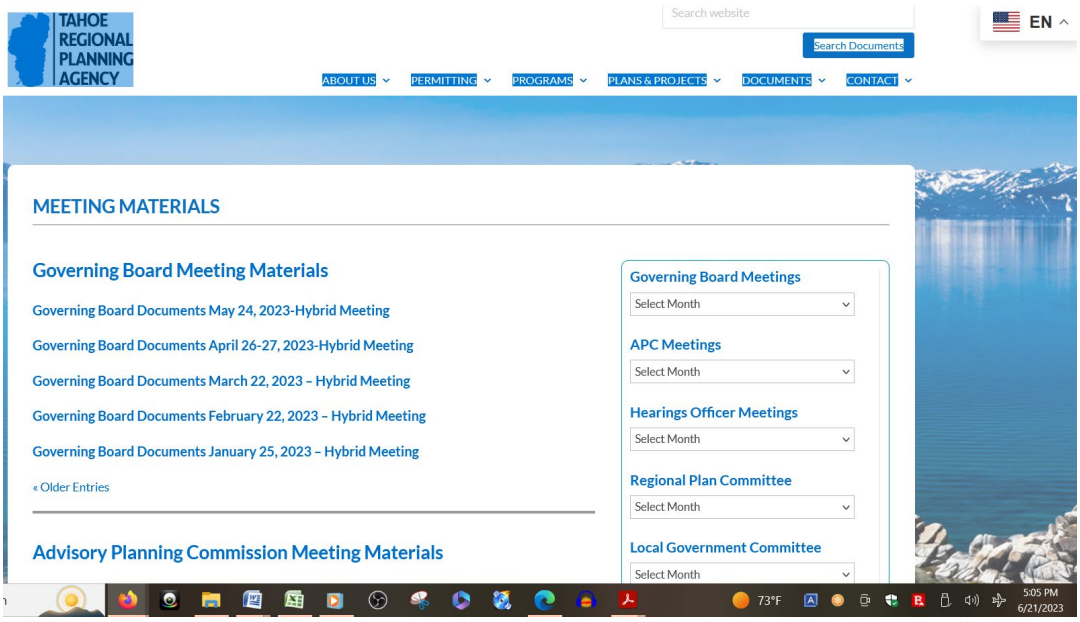
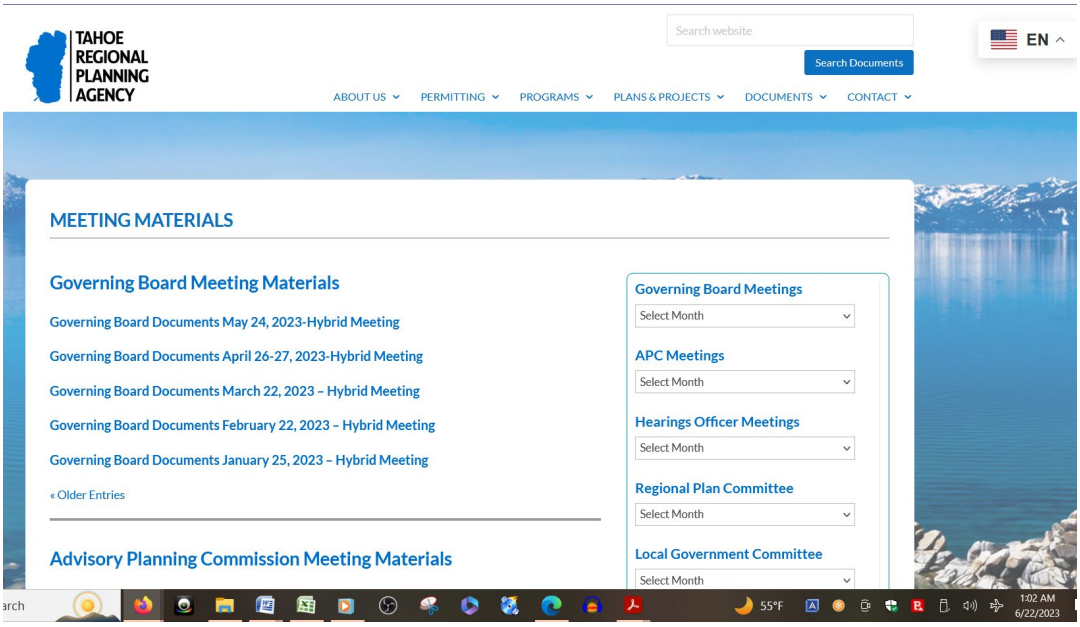
Publisher's Note

From:	Al Miller
To:	Marja Ambler; John Marshall; Cindy.Gustafson; Julie Regan
Subject:	Comment on Agenda Item 6.A.: June 28, 2023 TRPA Meeting is in Violation of OPEN MEETING Law
Date:	Sunday, June 25, 2023 11:20:29 PM
Attachments:	Capture-TRPA Fraudulent 6-21-23 Agenda Posting.PNG Capture- 2023 June Agenda posted late, 9am June 22.PNG Capture- 2023 June Agenda not posted by 5 pm June 21.PNG Capture- 2023 June Agenda not posted by 1 am June 22.PNG

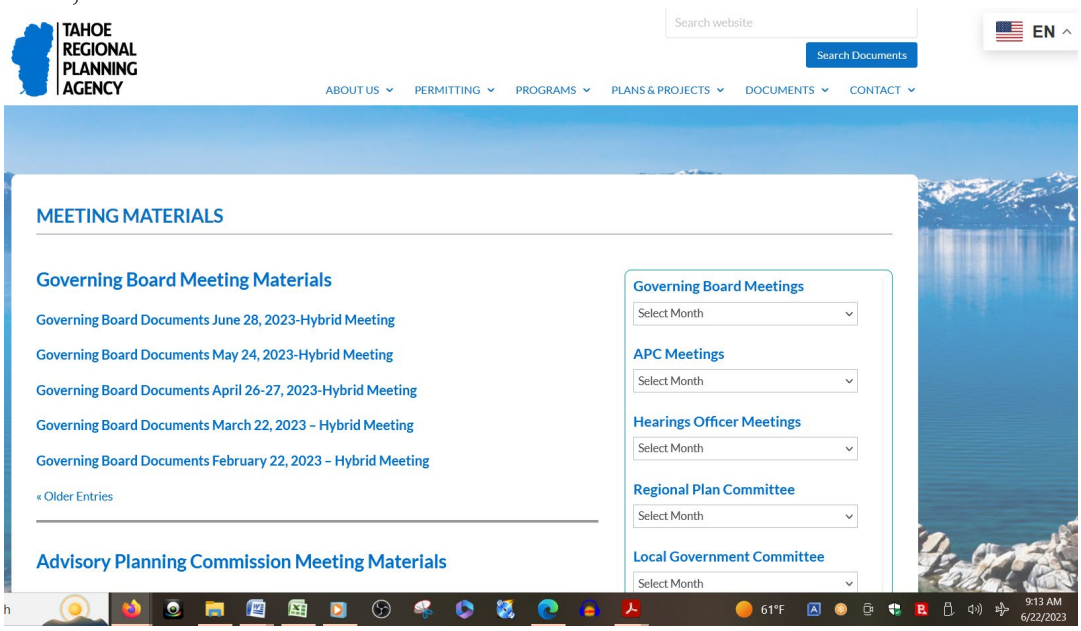
I'm not here to provide legal advice, but if my comments are suppressed, denied to the public, and not posted online as TRPA is known to do, I expect I will be addressing the Board orally in testimony during the meeting. Your General Counsel Mr. Marshall has already done legal training concerning OPEN MEETING LAW requirements, during recent training he provided in open sessions with the Governing Board, as well as the Planning Advisory Commission. Training materials indicated the meeting and the specific agenda for the meeting must be Noticed and made available to the public seven days before the scheduled meeting. TRPA publishes its agenda on its website and nowhere else. Therefore when the agenda was not posted at 5:05 pm on 6/21/23, as the attached screenshot shows (date and time in lower right corner), I became aware that TRPA was not meeting its legal requirements. One can see that the June agenda link is not posted, leaving off at May. I became concerned that I and the rest of the general public, permit applicants and their opponents, and others, were being deprived of lawful rights to oversee the work of our public servants by reviewing and commenting as desired.



I figured the staff was probably just a little late in getting the Agenda posted online so I looked again at 1:02 am on Thursday, 6/22/23, and no, it still wasn't posted, as the screenshot below shows.

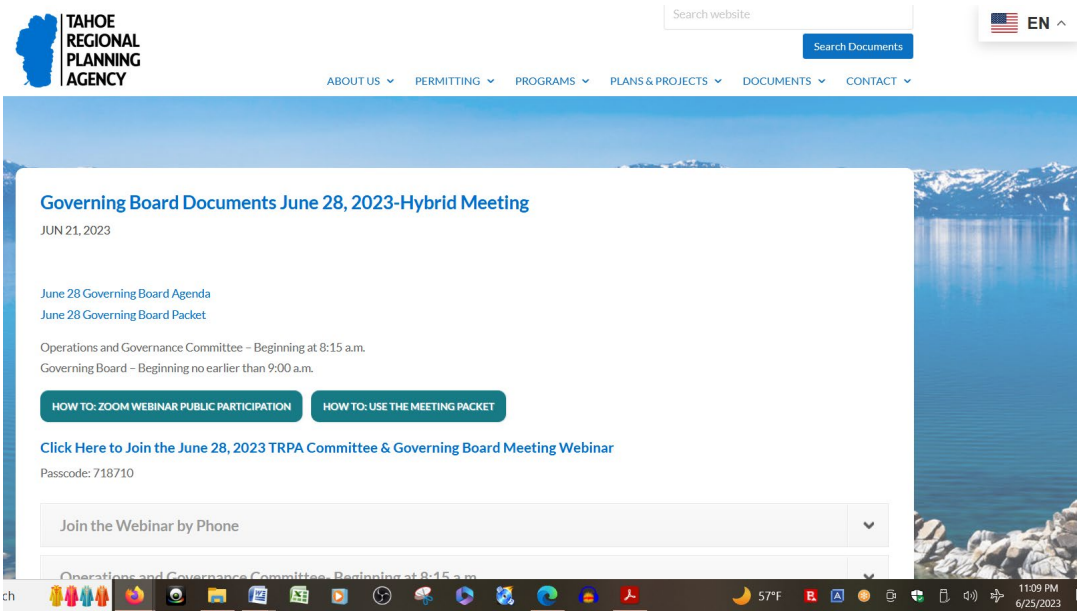


The next time I checked TRPA's website was at 9:13 am on 6/22/23, and by that time it was posted, as can be seen in the screenshot below.



But that was too late to be legal. The Agenda has to be posted seven days in advance of the meeting to provide legal public notice, as Mr. Marshall instructed, and there are only six full days, Fri – Weds, for the public to comment between the posting and the 9 am Thursday morning meeting.

Then TRPA went one step further, and in an apparent attempt to defraud the public, posted its link with a 6/21/23 date (second line), as the attached screenshot shows (persisting to now). This makes it appear as though the legal Agenda Noticing requirements were met by TRPA, when they were not met in fact.



Therefore, TRPA can either continue with the meeting in violation of Open Meeting the law or postpone the items to the next properly noticed meeting. I suggest following the law, but note my past suggestions to TRPA in that regard have fallen on DEAF EARS. Of course, any public business conducted under the circumstances would likely not withstand an administrative challenge or appeal.

Follow the Law, Alan Miller

South Lake Tahoe

From:	Al Miller
To:	Marja Ambler; John Marshall; Cindy.Gustafson; Julie Regan
Subject:	Comment on Agenda Item 6.B.: June 28, 2023 TRPA Meeting is in Violation of OPEN MEETING Law
Date:	Sunday, June 25, 2023 11:24:26 PM
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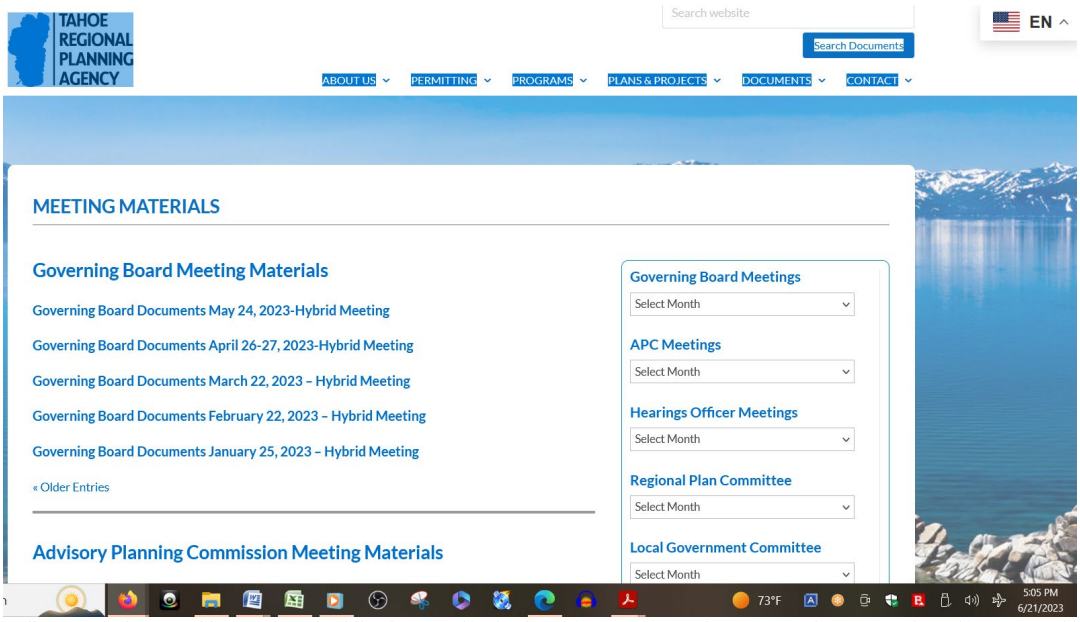

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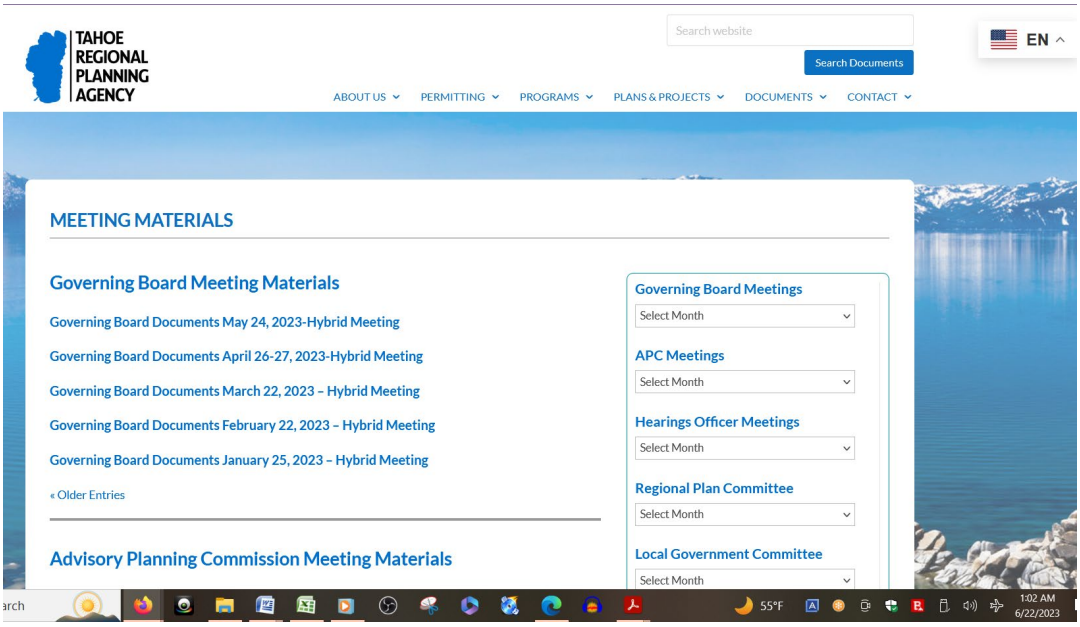

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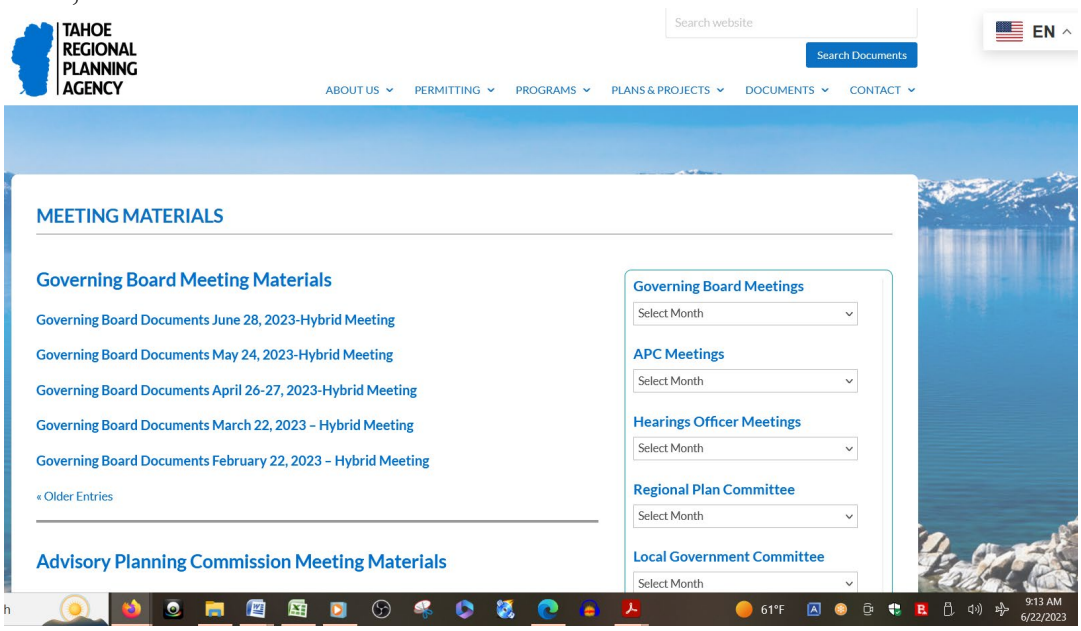

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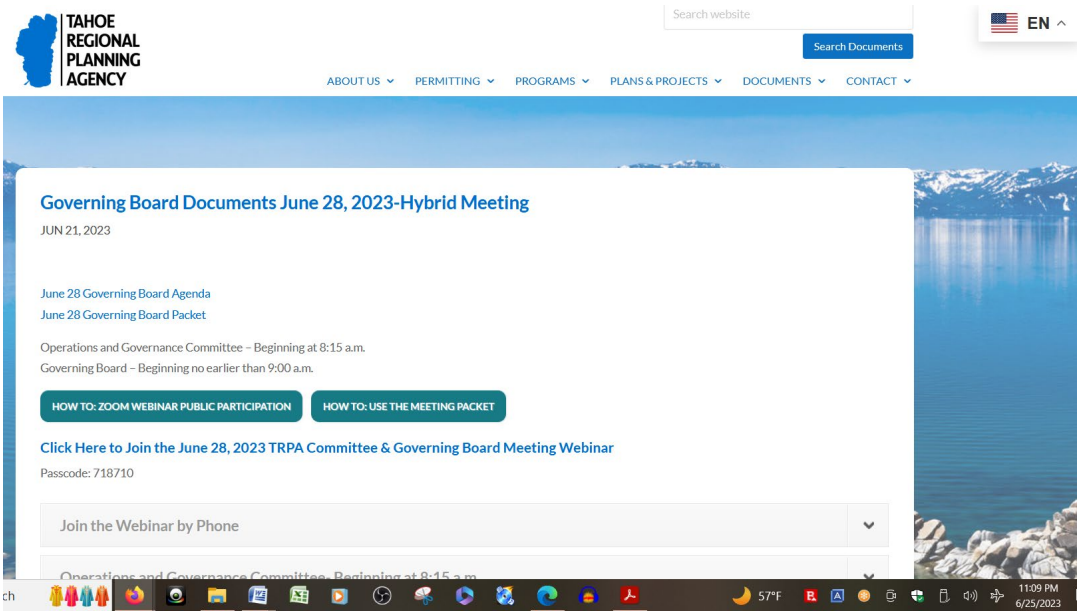

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Follow the Law, Alan Miller

South Lake Tahoe

From:	Al Miller
To:	Marja Ambler; John Marshall; Cindy.Gustafson; Julie Regan
Subject:	The TRPA Governing Board Meeting of June 28, 2023 Is Being Illegally Conducted in Violation Of OPEN MEETING LAW; Public Comment, Agenda Item No. X
Date:	Sunday, June 25, 2023 11:01:32 PM
Attachments:	Capture- 2023 June Agenda not posted by 5 pm June 21.PNG Capture- 2023 June Agenda not posted by 1 am June 22.PNG Capture- 2023 June Agenda posted late, 9am June 22.PNG

Dear Board Members and Interested Public,

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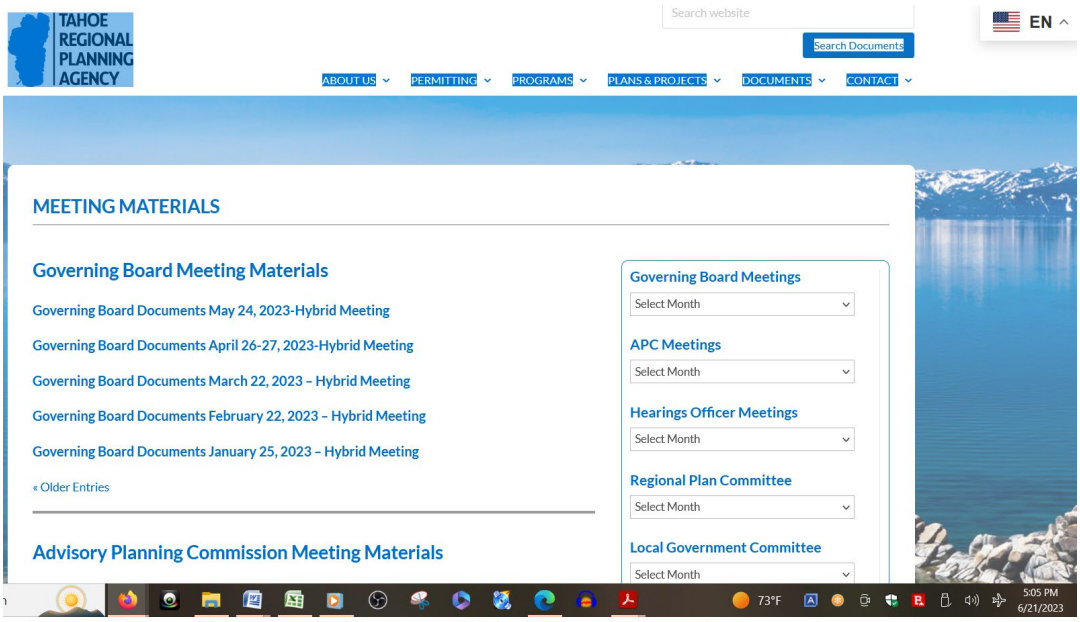

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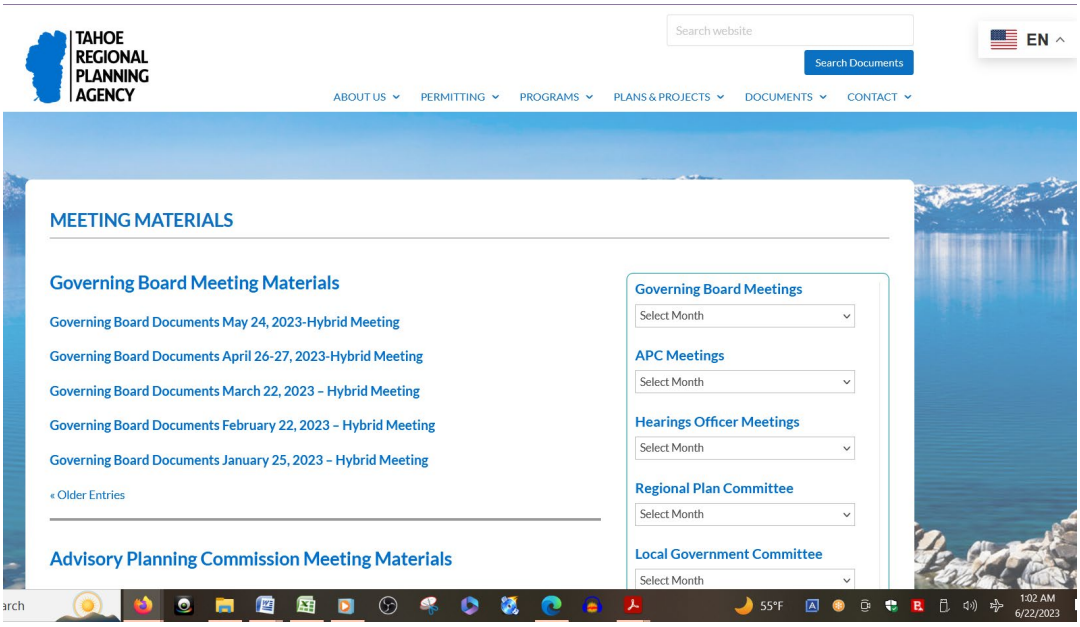

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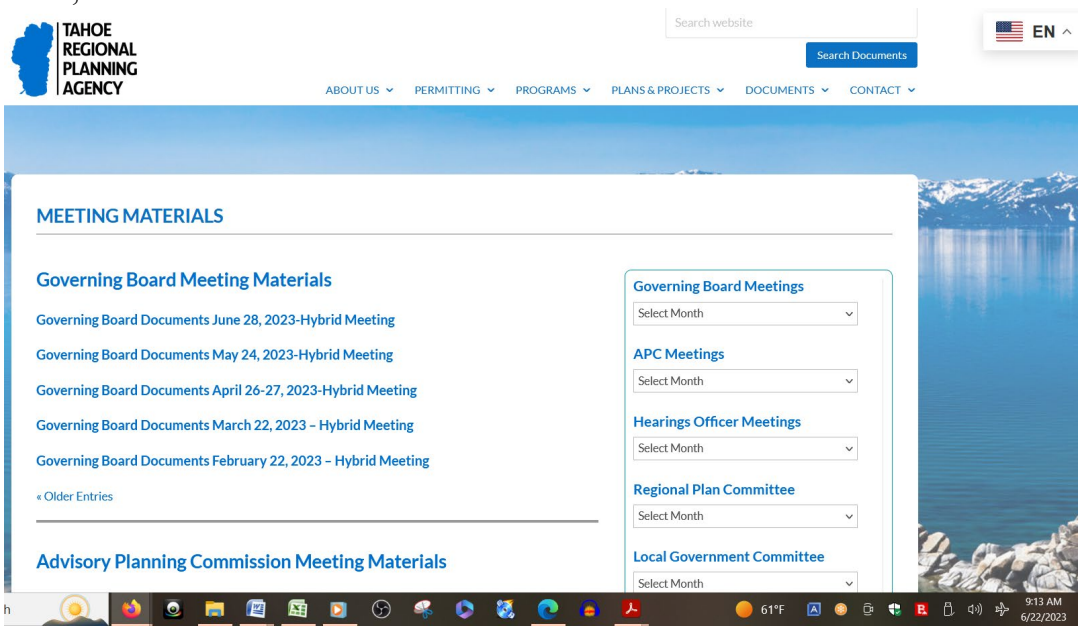


But that was too late to be legal. The Agenda has to be posted seven days in advance of the meeting to provide legal public notice, as Mr. Marshall instructed, and there are only six full days, Fri – Weds, for the public to comment between the posting and the 9 am Thursday morning meeting.

Therefore, TRPA can either continue with the meeting in violation of Open Meeting the law or postpone the items to the next properly noticed meeting. I suggest to follow the law, but note my past suggestions to TRPA in that regard have fallen on DEAF EARS. Of course, any public business conducted under the circumstances would likely not withstand an administrative challenge or appeal.

Sincerely, Alan Miller

South Lake Tahoe

From: Al Miller
To: Marja Ambler; John Marshall; Cindy.Gustafson; Julie Regan
Subject: TRPA Governing Board Meeting of June 28, 2023; Public Interest Comments, Agenda Item No. X
Date: Monday, June 26, 2023 2:03:36 AM
Attachments: Capture-email record of David Chain Comments.PNG

Dear Board Members and Members of the Public,

I am an environmental engineer and activist for alternatives to unsafe wireless technologies such as 5G microwave towers for cellular communications, and especially the fake-tree monopines and their industrial plastic and microplastics wastes, which TRPA has completely failed to control for decades. In addition, while TRPA likes to promote it 2012 Regional Plan as a "Plan for the Future" it fails to include any mention of wireless technologies which are now being rolled out by TRPA in league with the telecoms in the absence of any panning by TRPA whatsoever, not even the least setback. I consider TRPA a total planning failure, an agency completely unable to or unwilling to follow its charter law, the Tahoe Regional Planning Compact, which requires environmental evaluations for undeniable impacts to human health and the environment, extensive in the TRPA record. In this regard TRPA has shown itself to not only be a A PLANNING FAILURE, but a scofflaw with regard to environmental protection mandates, while it pushes its psy-ops on the public with its propaganda about how great it is.

Therefore, when I learned recently that the City of South Lake Tahoe and the TRPA are processing applications for yet another 95-foot tall monopine tower on Shop Street I thought I'd provide a Public Interest Comment about that for the record. I'll admit that I got my dates mixed up and submitted the comments after the May meeting was over. Not to worry, there is still time to get those comments in the record, which is the purpose here, with expansion.

Importantly, those late comments included proof of TRPA's subversion of the public record in email I forwarded from David Chain to TRPA et al. which was not disclosed in TRPA's online record of public comments. I complained that TRPA had deliberately excluded the email I forwarded from Mr. Chain in the online record, which is the ONLY record available to the public from TRPA without onerous costs. My comments showed how TRPA illegally censors and excludes comments critical to TRPA or adverse to its public face in matters of wireless technologies and telecommunications in its purported record before the public.

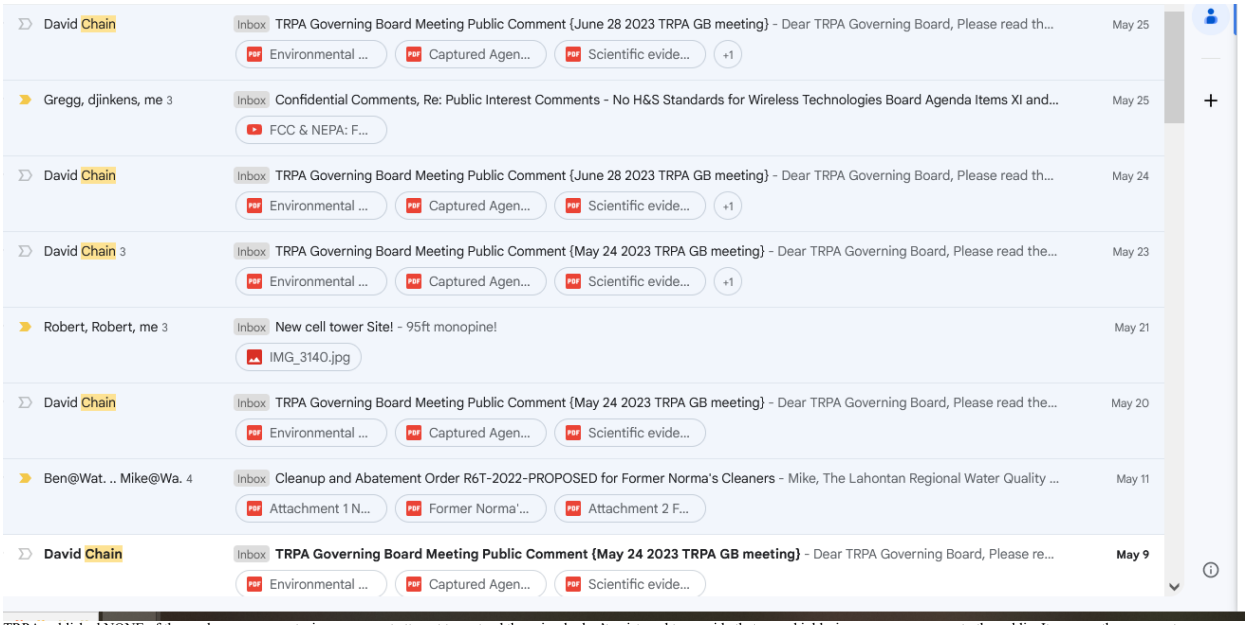
I followed up by emailing the Board Clerk, Ms. Ambler, and requesting to add the comments to the Public Interest Comments for the June meeting (as this is a standing item at every meeting), forward the comments to the Executive Director and inform me of the actions planned and taken. I received no reply from Ms. Ambler, but only a reply email from the Governing Board's General Counsel, John Marshall. His email stated, in essence, the reason the comments from Mr. Chain weren't included in the record is because there is no law requiring TRPA to post comments received late the night before the meeting.

That may be the case, and I agree that it is not reasonable or possible for written public comments submitted late the night before a meeting, or even right up to the moment of decision, as every published TRPA agenda provides. It is also not possible for the Governing Board members to receive and review such email sent to the last minute. That is why TRPA often acts arbitrarily and capriciously, because it doesn't publish its agenda and conclude comment periods with sufficient time to review and consider the public comments. TRPA can't possibly consider such comments, and so that is just a sham before the public, the operation of the rules TRPA made up.

Mr. Marshall left me off with no indication my comments were forwarded to Executive Director as I requested, or that they would be published online with the June agenda. Indeed, my requests to publish my comment in June were ignored. As of this writing, they are not online for the June agenda. Apparently, from Mr. Marshall TRPA only accepts public comments in a narrow seven-day window between when it publishes its agenda online and when it has it meeting, and only accepts public comments that are directed at a specific agenda item, including Public Interest Comments. Thus, any general comments sent to TRPA by the public for review by the Governing Board members *and the public* are discarded or suppressed electronically if they are not related to a specific published agenda item. This is but one way TRPA hides its failings from the public.

In my view, any comments TRPA receives in the public interest about the agency, good or bad, ought to be published online with the Agenda each month under Public Interest Comments. Anything else is just lousy government and administrative tom-foolery to deprive the public of its right to oversee its public servants and be transparent, which the TRPA is NOT, as we shall see.

Mr. Marshall replied in legalese and unawareness that not only had Mr. Chain provided the email that I forwarded from late May, but had on numerous earlier occasions in May provided the very same email to TRPA with sufficient time to include them in the public record online. I also received those emails, which I show in the screen shot below. There is no plausible excuse for not posting these and other emails online because they criticize TRPA. It's simply fraud and subterfuge.



TRPA published NONE of these adverse comments, in an apparent attempt to pretend they simply don't exist, and to provide that same highly-improper appearance to the public. It appears the comments continued to be submitted at intervals by Mr. Chain. Perhaps this was because they never got posted online with the Agenda by TRPA and he was seeking to get the comments noticed? At a minimum, TRPA could provide the comments online once, and say they were received also on other dates, which dates should be provided. In addition, I have records of public comments suppressed from other individuals by TRPA in May 2023, not disclosed here.

No, the evidence is very clear that TRPA is all about suppressing comments it doesn't like or that are critical of it. The comments I provide below are only an excerpt from the Chain emails. There is no plausible deniability here. Just optics and subterfuge. This sort of behavior is what makes TRPA despotic in my view. TRPA forgets the California requirements, which state in relevant part:

> The people of this state do not yield their sovereignty to the agencies which serve them. The people, in delegating authority, do not give their public servants the right to decide what is good for the people to know and what is not good for them to know. The people insist on remaining informed so that they may retain control over the instruments they have created.
>
> This article shall be known and may be cited as the Bagley-Keene Open Meeting Act.

If I see that these comments are not posted online and are therefore excluded from the *visible* record of public comments, I may testify on these matters at the June Governing Board meeting so all can hear, unless it is cancelled (which I stated should happen for insufficient public notice of six days only), and I reserve that right in any case. The text of my May email is provided after my name below, the comments I provided that TRPA sought not to publish, including the comments excerpted from Mr. Chain:

Sincerely, Alan Miller 6/26/23

The Subject Line of my email was:

"Public Interest Comments - No H&S Standards for Wireless Technologies Board Agenda Items XI and VIII.B.1., May 24, 2023 Meeting"; the contents follow

Dear Chair Gustafson and Governing Board members,

I wish to provide the following comments for the Board's consideration pursuant to Board Agenda Item XI., and May 24, 2023 Meeting.

1. I am aware of certain comments submitted by email to TRPA from David Chain with comments prior to this Board meeting for inclusion in the Agenda, and find that TRPA has omitted the comments received from the record. Without respect to these comments, which I may or may not agree with, I object to the omission as improper, and reproduce the comments below, without the attachments in the original email. Mr. Chain wrote:

Dear TRPA Governing Board,

Please read the attached PDF(s). The TRPA has alleged to have exonerated itself 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 (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) . . . "

Depriving the public of this information was done without comment by TRPA. Under requirements discussed in Agenda Item VIII.B., the TRPA may not limit or exclude public comment in this way, as discussed in Mr. Marshall's presentation for Item VIII.B.1.

" • Restrictions on public comment must be specified on the Notice

• Restrictions must be reasonable "time, place, and manner" restrictions. NRS 241.020(d)(7). This means NO:
– Halting comment based on viewpoint of speaker;
– Halting comment upon belief defamation is occurring; or
– Halting comment critical of a public official."

I SUGGEST THE COMMENTS WERE EXCLUDED ILLEGALLY BECAUSE THE VIEWPOINTS DO NOT ACCORD WITH THOSE OF THE TRPA STAFF. STAFF THEREFORE APPARENTLY SEES IT AS THEIR JOB TO DEPRIVE THE BOARD OF PUBLIC INPUT.

2. The federal Food and Drug Administration (FDA) has the legal duty to adopt national standards to protect humans and the environment from the adverse effects of electromagnetic fields (EMF) and has failed to do so in abject violation of the laws and regulations enacted by Congress. This means there are no applicable Health and Safety (H&S) standards set for ANY wireless technology. Therefore, any pronouncements concerning the Health and Safety of wireless technologies by TRPA and others is unfounded, just a lie predicated on NOTHING. Federal Communication Commission requirements setting exposure levels are essentially meaningless, as the FCC is not a designated agency for developing H&S standards for wireless technologies. By its own admission FCC has no expertise with regard to H&S requirements for wireless exposures. The attached article explains that the FDA has been petitioned for its inaction and failures to adopt H&S standards for the Nation. Because of that failure, under Compact requirements, in the absence of applicable standards TRPA must develop its own protective standards for wireless exposures, or cease to approve of wireless installations until they can be proven safe. TRPA needs to cease lies purporting that wireless technologies are benign in their effects on humans and the environment until it can cite valid science to back up its specious claims, against mountains of contrary evidence. Public agencies may be held civilly liable for harms caused in violation of law, especially when they are caught lying.

3. I am aware that TRPA may improperly exclude attached items from the public record of emails that are sent to TRPA. Therefore I am pasting the text from this link (https://www.americansforresponsibletech.org/fda), concerning a new Petition before the FDA concerning the wireless H&S failure, as follows:

It's not complicated. The FDA is violating its own law.

Federal law requires the FDA to undertake specific actions to protect Americans from unnecessary exposure to RF radiation from electronic devices. The agency is doing **none** of those things.

Back in 1968, Congress passed Public Law 90-602, **"An Act to Amend the Public Health Service Act to provide for the protection of the public health from radiation emissions from electronic products."** In its Declaration of Purpose, Congress wrote, "The Congress hereby declares that the public health and safety must be protected from the dangers of electronic product radiation."

Congress went on to prescribe certain mandatory activities which FDA is required to carry out (see box at right). These are not optional. They are not dependent on any "finding" by the FDA or subject to interpretation. This is black-letter law, pure and simple.

For more than fifty years, the FDA has ignored this Congressional mandate. Despite the rapid and profound proliferation of wireless devices around the world, the agency is not actively **evaluating** the many ways people are being exposed to non-ionizing radiation, **developing techniques** to reduce those exposures, or **warning the public** about potential harm from exposure.

On May 24, 2023, Americans for Responsible Technology and other petitioners filed a formal **Citizens Petition** with the FDA, demanding that the agency obey the law and undertake the clear requirements which Congress established for protecting Americans from all kinds of radiation, including radiofrequency (RF) radiation from the large and growing list of wireless devices.

Learn more about the issues involved by clicking on the images below, and consider supporting this Petition with a comment to the FDA. A link to the FDA portal will be posted as soon as it is available. "

There is additional info in the link to the article, and I am pleased to note that my associate, Mr. Gresser, is assisting Americans for Responsible Technology (ART). You may recall his testimony in TRPA hearings on the Ski Run Boulevard macrotower the TRPA approved on Appeal.

4. TRPA has posted a public notice (image attached) onsite for a new monopine wireless macrotower at 1670 Shop Boulevard, South Lake Tahoe, El Dorado County CA. As to when the sign was posted, I do not know, as the notice is undated. The notice has no date for proposed permit actions planned by TRPA in the absence of a public hearing. I request to be informed of the date the application was received, if it has been received, and the TRPA permitting tracking number(s) for any application for wireless technology implementation at the above-cited address. I make this request pursuant to Rule of Procedure 12.14. noting that despite the fact that I live over 300 feet from the site of the planned development, I am a real estate property owner at Lake Tahoe and assert my property values may be affected by this and other potential projects like this for wireless facilities being rolled out by TRPA in gross violation of Compact requirements for environmental impact assessments, and in light of the foregoing comments. I object to any exemption from environmental review requirements that may be cited, on the basis of the foregoing. I also oppose this tower approval because the plastic monopine needles are demonstrably subject to degradation and dispersal to the environment as litter and microplastics, which are not subject to control under the Lake Tahoe weather extremes, and will contaminate soil, groundwater and storm water runoff to surface waters with uncontrolled microplastic wastres detrimental to water quality and the environment. I request notice concerning any approval action by TRPA. I can be reached by email at syngineer1@gmail.com for notices concerning any contemplated approval by TRPA of wireless facilities at 1670 Shop Street . . . .

Sincerely, Alan Miller, PE

Tahoe Regional Planning Agency Governing Board June 28, 2023
Ellie Waller Public Comment for the record Consent Calendar Items

I found that information provided on Open Meeting Law rules picqued my interest on Consent Calendar items. My opinion, a recent misjudgement on the part of staff on Latitude 39 project put that project on the Consent Calendar. John Hester remarked it was similar to the Incline Village 947 project which was also controversial and shouldnot have been on consent.

I understand the public, TRPA Board members etc. can ask items to be removed for discussion. My opinion, the issue with this option is some people look at consent be pre-empted it's not controversial and do not look any further into the details.

Also now, with general public comment about items not on agenda is only at the end of the Governing Board. What is the preferred way to ask to have a consent item pulled? Contact who: a Board member, Executive Director ?

Back to Latitude 39

That project is in the Douglas County portion of the tourist core, a location heavily traveled. The VMT amalysis was challenged by Bill Yeates and questions arose from others. A more indepth conservsation ensued. Gordon Shaw LSC Consultant was contacted to further explain his calculations.There was no reason not to table the approval until the VMT analysis was thorughly vetted. My opinion is the only reason the project was moved forward was a plea from the delvelopers representative to get the project started. What is the current time table for Latitude 39 project start, phasing and completion? This project also resulted in Exective Director Julie Regan stating that the project didn't meet all the 2012 Regional Plan objectives and that TRPA needs to evaluate these types of issues i.e. no affordbale housing component required. And I believe the TRPA Governing Board has options to suggest and strongly urge project respresentives to add the affordable component regardless if the current Area Plan doesn't require it.

Back to Consent items: similar to OML the Consent Calendar items are not supposed to be controversial. Who decides what controversial is ?

TAHOE REGIONAL PLANNING AGENCY

What Does it Mean to be "Clear and Complete"?

- Agenda items must be **clear and complete**. NRS 241.020(2)(d)(l).
- A **higher degree of specificity** is necessary for topics of **substantial public interest**. *Sandoval*, 119 Nev. at 154-55, 67 P.3d at 906. Factors to consider include:
  - Does the topic generate public comment?
  - Does the topic generate debate among the members of the body?
  - Does the topic generate media interest/coverage?

Does the notice provide enough information to the public of its government is doing, has done, or may do?

https://www.trpa.gov/wp-content/uploads/Agenda-Item-No-VIII-B-1-Review-of-Compact-Open-Meeting-Law-and-Conflict-of-Interest-Requirements.pdf

In reviewing the TRPA Meeting Calendar on-line as well the pull-down options to find meeting information, I find that some meetings in the past have not been posted for reference allowing the public to look at past recommendations by the Governing Board. Some info can be found by going to each individual meeting but very time consuming.

There is no historical information for Example: The Bi-State Consulation on Transporation. When was their last recorded meeting and other past meeting information and where can the public find that on the TRPA website?

Above is the pull down for the Local Government Committee. So, March 2020 to February 2023 the public has to go to the Governing Board packet to find committee meeting minute information?

This is Regional Plan Implementation Committee July 2013- July 2019 is missing. Where do I find committee meeting minutes? Is available within each Governing Board meeting packet from 2020 forward?

The Hearings Officer seems to be mostly complete list but missing Dec 2007-December 2010

Advisory Planning Commission and Governing Board meetings all found starting in 1978/79

Have there been NO Threshold Update Initiative Working Group meetings in 2023?

Residential Allocation Performance Review 2023 is part of the Local Governance Committee. Where do I find 2022? I found 2019 under older entries.

Other Meeting Materials

Tahoe Living: Housing and Community Revitalization Working Group

Local Government & Housing Committee Documents June 9, 2021-Online Meeting

Climate Change Webinar on Regional GHG Emissions

Residential Allocation Performance Review Committee Meeting Documents February 23, 2021 – Online Meeting

Transportation Technical Advisory Committee December 10, 2020

« Older Entries Next Entries »

I will note that it was nice to see some meeting information posted on the Tahoe Living: Housing and Community Revitalization Working Group. But that gets confused with the TRPA Local Government Committee on Housing as there is a separate pull down as stated on Page 1 but missing some meetings.

Where do I find the most current Transportation Technical Advisory Committee meeting minutes?

Other Meeting Materials

Governing Board & Advisory Planning Commission tour of the proposed Heavenly Epic Discovery Adventure Park

TRPA BMP Compliance Options Working Group

Coverage Working Group Meeting Materials

BMP Compliance Working Group March 2014. When was the number of BMPs tracked for Residential Allocations Review removed as a necessary compliance issue and why ? Enforcement? So why is enforcement impossible and not mandatory?

This seemly has been replaced with Vacation Home Rental compliance where TRPA really doesn't engage. At the very least TRPA should be tracking the VMT issues related to almost 365 days visitations by tourists in every jurisdiction.

From: Ellie
To: Marja Ambler
Subject: Comment 6: 6-28-2023 TRPA Governing Board SFGate article on Tahoe
Date: Thursday, June 22, 2023 9:30:15 PM

Please accept and distribute this public comment to the Governing Board members and appropriate staff members for the 6-28-2023 TRPA Governing Board meeting. Thank you ~Ellie Waller

SF Gate : Lake Tahoe has a staggering tourism problem,

Tahoe has 'three times the amount' of visitors of Yosemite

Hot off the press June 22, 2023 Excerpts below

https://www.sfgate.com/renotahoe/article/lake-tahoe-tourism-report-stewardship-and-impact-18163430.php?IPID=SFGate-HP-CP-Spotlight

"Lake Tahoe and the surrounding national lands are about one-third the size of Yosemite National Park but have more than twice as many annual visitors, according to a new Lake Tahoe stewardship plan released on Tuesday."

"The greater Lake Tahoe Basin Management Unit, which includes all national forest lands around the basin, saw about 5.9 million visitors in 2020, while Yosemite reported just 2.27 million."

My opinion and others that have voiced in public comment, Moonshine Ink, Reno Gazette Journal, etc. it's a CAPACITY ISSUE that is not being addressed. Changing behavior is not a given. People drive cars, the transportation system doesn't get people where they want to go in a timely manner or at all.

"By that measure, if the Lake Tahoe Basin Management Unit was a national park, it would be the second-most visited in the entire park system. Only one federal forest unit (Colorado's White River National Forest) unit had more visitors, at 13 million visitors per year — but it's nearly 18 times larger than the Tahoe Basin Unit."

"The report estimates that Tahoe saw nearly 17 million visitor days in 2022, calculated by multiplying the number of overnight visitors with how many days they spent in and around the Tahoe basin, then adding the approximately 4 million day visitors who "pass through or use trails and beaches without reserving or purchasing services."

Does the overnight visitor calculation include Vacation Home Rental stays?

"The pandemic saw even more strain on Tahoe's fragile ecosystem."

"Visitors couldn't go to Disney. They couldn't go to Hawaii. They all came here," said Tahoe Fund CEO and stewardship partner Amy Berry, who added that organizations around the lake were hearing complaint after complaint from residents. "Everyone was at the table all listening to the same issues

about crowding, and there was a real recognition of, **'Hey, things are not working for anyone in Tahoe.'"**

Also recently, Hot off the press: LAKE TAHOE DESTINATION STEWARDSHIP PLAN Taking Care of Tahoe in my opinion is a big wish list of future funding sources that may or may not materialize. Add the 7-7-7 section form the TRPA Regional Transportation Plan and where do you believe all this funding can be or will be sourced?

"While Tahoe's most popular recreation sites are limited by parking, "we're not considering limitations of access," says Carol Chaplin of the Lake Tahoe Visitors Authority and a partner in building the plan. "Sand Harbor would be a good example. We're trying to incentivize people to visit other areas. What we'd like to do is influence behavior. We're creating programs like transit systems and telling people, 'Hey, if you stay on that bus, you can get to a less-crowded beach.'"

Incentivizing people to go to other less crowded beaches may result in more overcrowding at those locations.

The stewardship plan was created in response to these overwhelming numbers and the need to balance Tahoe's record-breaking tourism with growth that positively impacts Tahoe residents, local economies, and the overall environmental health of the great Sierra Nevada.

"The report shows a major disconnect between residents and visitors"

"The report also highlights local and visitor sentiment on tourism in Tahoe, with more than 70% of residents reporting in a 2022 survey that they felt the impact of tourism was primarily negative. It also cited "increased enforcement of litter regulations" as residents' top way to make tourism feel more positive, despite the fact that a visitor survey at the same time found that 82% of visitors think they "do their part to keep a destination clean when they visit."

My opinion, and one example is the sled hill at the intersection of SR 28 and Highway 50 (Douglas County) where the League provides trash receptacles but it's not enough. Another example is the overflowing trash receptacles in Tahoe City and Kings Beach all summer long while businesses do their fair-share trying to empty County receptacles.

"The report also outlines Tahoe residents' other primary concerns about tourists, including an increased wildfire risk due to careless visitor behavior, concerns about pollution and impacts on Tahoe's water quality, and a worry about encroaching onto wildlife health and habitats. And more than half reported frustrations with crowds and road congestion at least 120 days a year, rather than being limited just to holiday weekends and school breaks"

Shoulder season visitor expectation, which has been a tourism target period to try to offset capacity issues, is not a given and roads are not only congested by tourists but basin-wide seasonal roadwork creates frustrations for all. Evacuation nightmare has already occurred with the recent Caldor fire. Visitors are not familiar with the lay.

"Estimated direct spending from tourism in the Tahoe basin in 2022 was $4.5 billion, ultimately being recirculated several times over in the local economy to spur nearly $10 billion in total spending. Tourism also employed more than 84,000 seasonal, hourly and full-time employees in 2022, though the jobs aren't necessarily paying enough to keep up with rising real estate rates. The average annual income from a tourism-related job in Tahoe is $46,000 — not enough when the median monthly rent is about $2,999."

I'd like to see, "local economy $10 billion in total spending", statistics breaking down where the money was spent.

There is way too much to be said about affordable, achievable, workforce whatever term suits the housing crisis. Happy to a statistic addressing the average seasonal workers inability to work and live in-basin.

"It's the 14th such plan in the last decade — but supporters say this one is different "

"The new plan is among the most comprehensive of any stewardship plans to date. It's also the first time the Forest Service, which manages 154,000 acres of public land around Tahoe, has ever been in partnership with visitor and outreach agencies, Berry told SFGATE. And all partners have committed to making sure their individual future actions support this overarching master plan.

Again, where is all this money going to come from????

But the plan doesn't include many specific details on actionable items to combat overtourism and relieve residents frustrated with trash-covered beaches and hourslong traffic delays. Instead, it focuses on criteria for what type of visitor the basin wants to attract — and what kind of regional programs will make visiting Tahoe a more enjoyable experience for everyone involved."

"While the report has no legally binding enforcement or commitments, all partners have agreed to fund the plan's initiatives for at least the next two years, says Chaplin of the Lake Tahoe Visitors Authority. And Berry is confident the plan will lead to significant change. "

I'd like the list of the other 13 plans that this will succeed where they did not.

From:	Ellie
To:	Marja Ambler
Subject:	Comment 5: 6-28-2023 TRPA Governing Board: Lake Tahoe Destination Stewardship Plan: Douglas Cty NOT REPRESENTED
Date:	Thursday, June 22, 2023 8:41:40 PM

Please accept and distribute this public comment to the Governing Board members and appropriate staff members for the 6-28-2023 TRPA Governing Board meeting. Thank you ~Ellie Waller

Dear Governing Board Members,
I'm astonished that Douglas County has NO REPRESENTATION.
Point of interest this signing was at Round Hill Pines Resort (Douglas County)

https://stewardshiptahoe.org/wp-content/uploads/2023/06/Lake-Tahoe-Stewardship-Plan-6-19-23-FINAL.pdf

I noticed Carson City is not on the list either. Highway 28 through rural Carson is notoriously dangerous during the Summer season with haphazard parking creating havoc for the residents and tourists driving through that area to get to other locations in and around Lake Tahoe.

General traffic issues for those residents commuting to and from the Carson Valley (Douglas County) and Carson City deserve representation.

The sled hill/invasive species boat check parking area located in Douglas County is another chaotic location in the Winter where I believe mostly tourists visit to utilize a natural sled area. Broken sleds, winter gear, etc. litter the parking lot, the forested land and SR 28. Also, in the same general vicinity is Spooner Lake, with additional vehicle traffic.

Douglas County is mentioned on pages 53,64,67,109,123 in the 126 page report.

If there is future expectation for funding from Douglas County and Carson City they should have been part of the "stakeholder" group.

Overview of Funding Mechanisms Background Pages 118-120.

If future funding sources need to be identified then Douglas County needs a seat at the table. Suggestions all explained in the report in detail.
1)Overview of Funding Mechanisms Public and Private Funding Mechanisms
2)Sales Tax Increment Financing Districts (TIFs)
3)Tourism Improvement Districts (TIDs)
4)Property and Business Improvement Districts (PBIDs)

5)**Voluntary Districts (explanation below)**
Both TIDs and PBIDs are examples of compulsory levies. If enough of the business or property owners meet the legal threshold of consensus to form a TID or PBID in a certain geographical area, then all businesses or properties proposed for assessment within the district will be required to pay the assessment. In some cases, the implementation of such a compulsory levy may not be viable. In such a case, funding may be generated through the creation of a voluntary district. Voluntary districts are ones in which businesses that wish to be included opt-in through an agreement with the managing entity, e.g. a City or a private non-profit corporation, to receive specified services. Unlike other compulsory funding mechanisms, not all businesses within the designated geographic area are included - only those who opt-in to pay the charge, and only those paying the charge receive the additional services. The businesses who wish to be included in the district typically contract with a designated non-profit to manage the assessment funds collected by the businesses

"Thank you to the group of organizations and individuals that collaborated throughout this 15-month process, dedicated time and attention and care, and now commit to working together to bring the Lake Tahoe Destination Stewardship Plan to life. And to all of the thousands of community members; from business owners, to residents, to property managers, to visitors, thank you for shaping the plan and contributing to Tahoe's future."

"The Lake Tahoe Destination Stewardship Planning Team (aka "Core Team") included the following participating organizations in the Greater Lake Tahoe Region, including Truckee."

Thank you to the group of organizations and individuals that collaborated throughout this 15-month process, dedicated time and attention and care, and now commit to working together to bring the Lake Tahoe Destination Stewardship Plan to life. And to all of the thousands of community members; from business owners, to residents, to property managers, to visitors, thank you for shaping the plan and contributing to Tahoe's future.

The Lake Tahoe Destination Stewardship Planning Team (aka "Core Team") included the following participating organizations in the Greater Lake Tahoe Region, including Truckee.

Cover image Courtesy of Tahoe Regional Planning Agency | Drone Promotions

Is the "Core Team" the same as the stakeholders ?

No Douglas County or Carson City representatives listed. Please provide any information on who from Douglas County and Carson City may have participated that are not listed below.

Representatives (Alphabetical by Organization):

California Tahoe Conservancy
Kevin Prior, Director of the Land Division
Chris Mertens, Senior Environmental Planner

City of South Lake Tahoe
Joe Irvin, City Manager
Lindsey Baker, Public Information Officer

El Dorado County
Brendan Ferry, Deputy Director Tahoe Planning

Lake Tahoe Visitors Authority
Carol Chaplin, President & CEO
Stuart Maas, Senior Director of Marketing & Business Development

Nevada Division of Outdoor Recreation
Matthew Weintraub, Deputy Administrator
Kendal Scott, Outdoor Education Lead
Colin Robertson, Former Administrator

North Tahoe Community Alliance
Tony Karwowski, President & CEO

Placer County
Stephanie Holloway, Deputy County Executive Officer, Tahoe

Tahoe Chamber
Steve Teshara, Director of Government Relations

Tahoe City Marina
Jim Phelan, General Manager

Tahoe Fund
Amy Berry, CEO
Caroline Waldman, Program Director

Tahoe Prosperity Center
Heidi Hill Drum

Tahoe Regional Planning Agency
Julie Regan, Executive Director
Jennifer Self, Principal Planner
Devin Middlebrook, Government Affairs Manager
Jeff Cowen, Public Information Officer

Travel North Tahoe Nevada
Andy Chapman, President & CEO

USDA Forest Service, Lake Tahoe Basin Management Unit
Daniel Cressy, Public Services Staff Officer
Vicki Lankford, Deputy Forest Supervisor
Erick Walker, Forest Supervisor

Visit Reno Tahoe
Charles Harris, President & CEO
Christina Erny, Vice President of Marketing
Ben McDonald, Director of Communications

Visit Truckee-Tahoe
Colleen Dalton, CEO

Washoe County
Alexis Hill, Washoe County Commissioner District 1

Washoe Development Corporation
Wendy Loomis, Executive Director

Stakeholder Engagement

By its nature, a Destination Stewardship Plan must be deeply rooted in stakeholder engagement, and the views of the region's stakeholders influence every aspect of this plan. Led by Better Destinations with support from other consortium members, the engagement plan included public sessions, discussion groups, in-depth interviews, and a resident survey.

To ensure that the voices of the Tahoe region were heard and honored, the planning process provided a rich array of ways for locals to weigh in. Collectively, public engagement sessions, discussion groups, in-depth interviews and a resident survey
gave more than 3,950 Tahoe area residents and visitors a chance to share direct input into this plan.

From:	Ellie
To:	Marja Ambler
Subject:	Comment 4: TRPA 6-28-2023 Governing Board mtg Public Comment for the Record:Take your pick of Transportation Plans
Date:	Thursday, June 22, 2023 8:12:22 PM

Please accept and distribute this public comment to the Governing Board members and appropriate staff members for the 6-28-2023 TRPA Governing Board meeting. Thank you ~Ellie Waller

Take your pick of Transportation Plans. Some details below.

Page 3 of the the 2020 RTP the most recent Regional Transportation Plan with ACR 5 making it's debut at the 82nd Legislative session.
Visitation is the main driver of the Lake Tahoe Region's $5 billion annual economy, based largely on seasonal tourism and outdoor recreation. But this puts metropolitan-level travel demands on the region's limited and largely rural transportation system.

Even changing our "rural" status to "metropolitan" status-population allowing for grants, Federal funds, etc. WE NEVER SEEM TO GET OUR ARMS AROUND ENOUGH FUNDING SOURCES.

We continue to update Regional Transportation Plans (RTP) which is necessary with the increase in tourist population, but no real solutions have arisen to address the continued grid-lock, parking issues, etc. Capacity (the maximum number of individuals that a given environment can support without detrimental effects) is not being addressed.

It would be nice to know what was accomplished in each of the plans below and how much was spent on those accomplishments.

2012 RTP This plan was adopted the same day as the TRPA Regional Plan Update 12-12-2012 Lake Tahoe Regional Transportation Plan and Sustainable Communities Strategy Mobility 2035 PREPARED BY: Tahoe Metropolitan Planning Organization
and Tahoe Regional Planning Agency
http://tahoempo.org/rtp_final/TAHOE%202012%20RTP%20Final.pdf
WITH ASSISTANCE FROM: Nelson\Nygaard Consulting AssociatesNelson\Nygaard – Mobility | Accessibility | Sustainability

OBJECTIVES OF THE RTP
• Establish a safe, secure, efficient, and integrated transportation system that reduces reliance on the private automobile by investing in mixed-mode
facilities that serve the transportation needs of the citizens and visitors of the Tahoe Region.
• Fulfill the requirements of the Tahoe Regional Planning Agency Bi-State

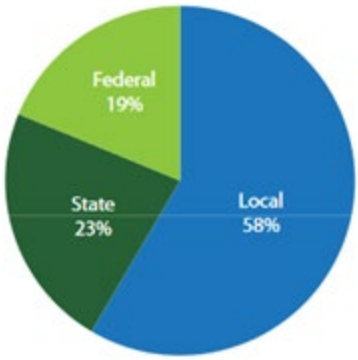
Compact (Public Law 96-551).
• Attain and maintain the Environmental Threshold Carrying Capacities, along with federal, state, and local transportation standards.

Funding and Implementation

Mobility 2035 proposes a set of transportation investments that will require both capital funds to build facilities, as well as ongoing operations and maintenance funds. Funding from federal, state (California and Nevada), and local sources will be pursued by the TMPO and local jurisdictions to develop the proposed projects. Total revenues estimated for *Mobility 2035* are about $1.6 billion (escalated to the year that dollars are expended). Local funds are anticipated to make up almost 60 percent of the total revenue, with state and federal funds potentially providing 23 percent and 19 percent of the revenues respectively. However, federal funding is not certain; the Congressional Budget Office estimates that without adjustments to the 18.4 cent-per-gallon federal gas tax that provides the Trust Fund's revenue, it will be unable to meet its obligations beginning in 2012.

As shown in Figure 6-2, under the baseline revenue forecast an estimated $1.6 billion will be pursued over the 23-year forecast period. Just over one billion is estimated to be available over the first ten-year period of the plan (2013-2023). This is similar to the amount that was estimated to be available during the first ten years of the 2008 RTP.

Figure 6-1 Reasonably Foreseeable Forecast Revenue Percentages by Source (2013 – 2035)



2017 RTP Five year later April 2017
https://www.trpa.gov/wp-content/uploads/documents/archive/2017-Regional-Transportation-Plan_Final.pdf

https://www.trpa.gov/wp-content/uploads/documents/archive/02_Appendix-B_Project-List_FINAL.pdf

LINKING TAHOE: REGIONAL TRANSPORTATION PLAN 2017 - 2040 REVENUE FORECASTS

Source	2017-2020	2021-2030	2031-2040	Total
LOCAL SOURCES				
Farebox Revenues	$4,071,661	$507,333	$0	$4,578,995
TRPA Rental Car Mitigation Fund	$502,408	$1,444,753	$1,761,146	$3,708,307
TRPA Air Quality Mitigation Fund	$1,677,828	$4,824,858	$5,881,475	$12,384,162
TRPA Water Quality Mitigation Fund	$1,999,240	$5,749,127	$7,008,154	$14,756,521
Local Funds (on-going)	$28,343,639	$81,506,578	$99,356,064	$209,206,281
Local Funds (project specific)	$13,172,000	$81,350	$0	$13,253,350
Private Funds	$6,100,000	$14,375,000	$12,200,000	$32,675,000
Ferry Partnership	$46,000,000	$39,481,658	$59,014,979	$144,496,637
O&M (bike trail, ped facilities, roadway, stormwater)	$54,927,235	$175,431,279	$247,463,145	$477,821,659
Environmental Stormwater Capital	$112,241,793	$0	$0	$112,241,793
Total Local	**$269,035,804**	**$323,401,937**	**$432,684,964**	**$1,025,122,704**
STATE SOURCES				
State Transit Assistance and Local Transportation Fund	$8,086,656	$49,273,745	$60,064,420	$117,424,820
Regional Improvement Program (STIP)	$14,766,000	$22,378,423	$20,428,424	$57,572,847
Low Carbon Transit Operations	$735,707	$2,115,641	$2,578,954	$5,430,302
Affordable Housing Sustainable Communities	$3,250,000	$9,950,000	$11,940,000	$25,140,000
California Proposition 1B	$75,431	$0	$0	$75,431
California Tahoe Conservancy	$3,362,204	$6,154,007	$7,501,700	$17,017,911
Active Transportation Program (CA)	$10,198,800	$13,690,611	$16,688,779	$40,578,190
Emergency Road Repair	$420,404	$1,208,938	$1,473,688	$3,103,030
California SHOPP	$70,226,000	$25,184,358	$24,609,498	$120,019,856
Nevada Question 1	$2,700,000	$0	$0	$2,700,000
Nevada State Funds	$15,778,320	$13,283,177	$16,192,118	$45,253,615
Total State	**$129,599,522**	**$143,238,900**	**$161,477,582**	**$434,316,004**
FEDERAL SOURCES				
Surface Transportation Block Grant	$12,842,244	$38,030,347	$46,358,781	$97,231,372
Surface Transportation Block Grant Set-Aside (TAP)	$673,597	$1,937,032	$2,361,232	$4,971,861
Federal Lands Transportation Program	$840,808	$21,287,823	$7,079,790	$29,208,421
Federal Lands Access Program	$54,018,000	$82,050,000	$2,500,000	$138,568,000
Congestion Mitigation & Air Quality Program	$7,835,737	$22,323,481	$27,212,199	$57,371,417
National Highway Performance Program	$3,000,000	$6,000,000	$9,000,000	$18,000,000
Highway Safety Improvement Program	$5,034,860	$19,779,005	$11,018,456	$35,832,321
FHWA Ferry Program	$21,020,201	$5,520,404	$0	$26,540,605
FTA 5307 Urbanized Area Formula Program	$18,077,373	$51,984,320	$63,368,596	$133,430,289
FTA 5310 Enhancement Mobility of Seniors and Individuals with Disabilities	$344,731	$991,329	$1,208,424	$2,544,485
FTA 5311 Rural Area Formula Grants (NV)	$5,476,534	$14,338,995	$17,479,156	$37,294,685
FTA 5339 Bus and Bus Facilities	$1,051,010	$2,278,916	$2,426,442	$5,756,368
Federal Aviation Administration Airport Improvement Program	$0	$7,293,150	$0	$7,293,150
High Priority Projects Program	$1,655,000	$0	$0	$1,655,000
Total Federal	**$131,870,094**	**$273,814,803**	**$190,013,075**	**$595,697,972**
Total Local/State/Federal	**$530,505,420**	**$740,455,640**	**$784,175,620**	**$2,055,136,680**

RTP 2020 Final April 2021
https://gis.trpa.org/rtp/

The RTP project listings in Appendix B also include unfunded projects that are necessary to complete the vision. These are identified in the plan's project list so that they are ready to move forward into the constrained list as additional funds are secured. As shown below, transit investment is the most underfunded and represents the greatest additional need for ongoing funding to provide sustainable operations.

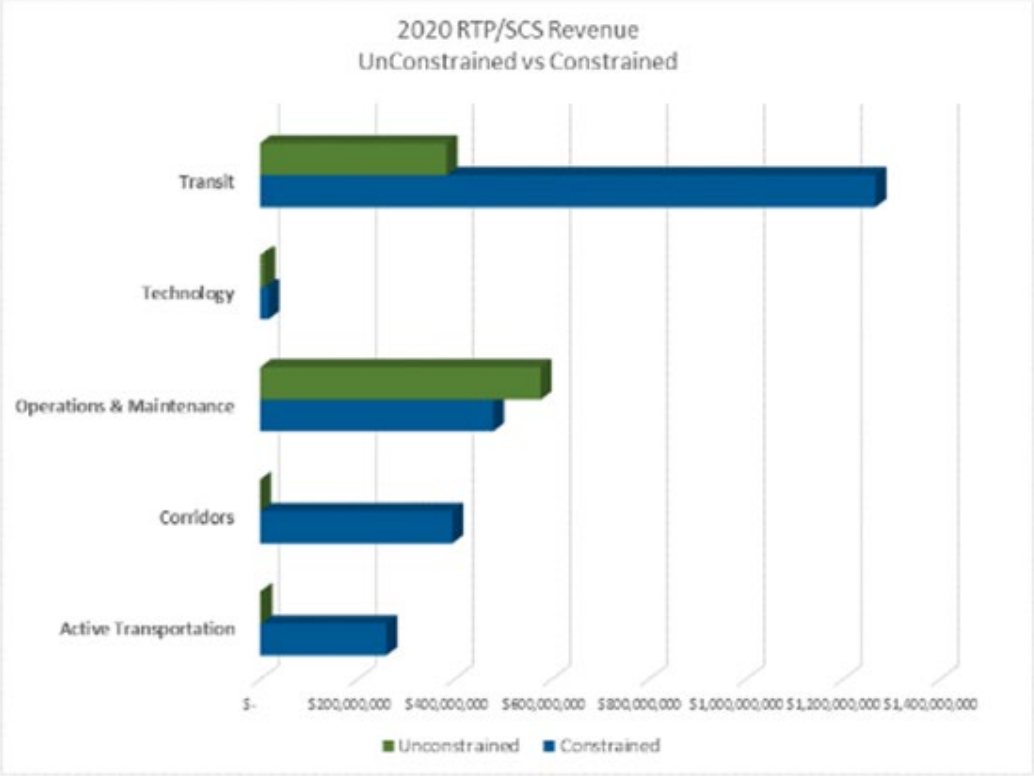
Overall, an approximate $1 billion shortfall is identified to fully fund the unconstrained project list over the next 25-year period.

By 2025, $97 million in additional funding is needed, $3 million for active transportation projects and $94 million for deferred operations and maintenance is needed.

By 2035, $240 million in additional funding is needed to address shortfalls of $22 million for transit and $218. million for deferred operations and maintenance

By 2045, $637 million in additional funding is needed, $9 million for technology improvements, $266 million for deferred operations and maintenance, and $362 million for transit.

Figure 69: Unconstrained vs. Constrained Revenue



Tahoe Region Transportation Revenue Forecast 2021-2045
Table 9:

Tahoe Region Transportation Revenue Forecast 2021-2045

	2021-2025	2026-2035	2036-2045	Total

Total Local/Regional/Private/State/Federal	$593,248,320	$821,819,569	$1,005,845,121	$2,420,913,010
	TOTAL		$2,420,913,010	

Recent Transportation funding request info before the 82nd Legislature
April 2023

ACR 5 - Expressing support for the Lake Tahoe Transportation Action Plan

Julie Regan, Executive Director Tahoe Regional Planning Agency

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TAHOE REGIONAL PLANNING AGENCY

Senate Concurrent Resolution 8 (81st Session)

1. Include, without limitation, an assessment of the **costs** of each project and **the benefits of each project** in **protecting and enhancing the ecosystem of the Lake Tahoe Basin**;

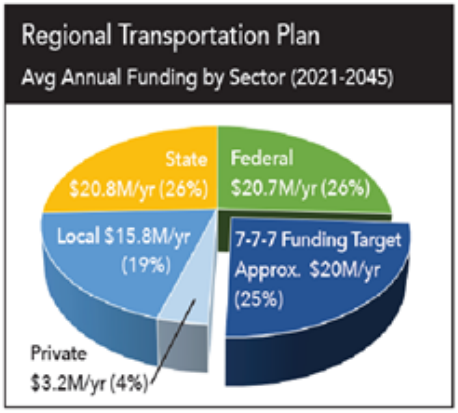
2. Coincide with both Nevada and California's goals, benchmarks and targets for **addressing climate change**; and

3. Identify any potential recommendations for **funding**, any **equity issues** associated with the funding recommendations, and any **other barriers**, both monetary and non-monetary, to **implementing an effective transportation system** for the Lake Tahoe Basin.

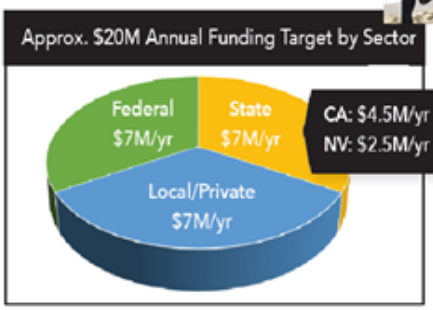
April 3, 2023

TAHOE REGIONAL PLANNING AGENCY

Shared Funding Commitment



Graphic: Tahoe Regional Planning Agency



Images: Tahoe Regional Planning Agency

April 3, 2023

From:	Ellie
To:	Marja Ambler
Subject:	Comment 3: TRPA 6-28-2023 Governing Board meeting Public Comment for the Record: 20 YEARS AGO: Article 2003
Date:	Thursday, June 22, 2023 8:04:40 PM

Please accept and distribute this public comment to the Governing Board members and appropriate staff members for the 6-28-2023 TRPA Governing Board meeting. Thank you ~Ellie Waller

Even after 20 years and millions of dollars of funding directly to TRPA and local jurisdictions from various funding sources we are still chasing the illusive pot of gold that will some how magically stop gridlock, get locals & tourists on public transit, etc.

Assembly Concurrent Resolution No.5 **expresses the Legislature's support** for the Lake Tahoe Transportation Action Plan and for funding of high priority transportation projects in the Lake Tahoe Basin. **ACR 5 did not receive a unanimous vote.** No actual funding was approved, just support for the plan. My opinion, the plan needs more scrutiny and an updated TRPA Bi-State Consultation Group review as I believe they have not met in several years and new members need to be brought up to date on the proposal.

"WHEREAS, Partners in the Bi-State Working Group agreed to pursue a multi-sector funding framework called the “7-7-7” strategy in which federal, state and local or private partners each seek to contribute $7 million annually to fund the high priority
transportation projects in the Lake Tahoe Basin identified in the Lake Tahoe Transportation Action Plan; and WHEREAS, Based on the historical division of responsibilities between the two states for the needs of the Lake Tahoe Basin,
Nevada’s one-third share of the $7 million state sector target under the “7-7-7” strategy is $2.5 million annually and California’s two-thirds share is $4.5 million annually"

Almost 20 years ago "seed money" efforts to obtain funding was undertaken. And even then housing was not affordable.

September 2003 Tahoe officials want to create shuttle service from valley

In a few years, workers and tourists may be able to leave their car behind and take a shuttle bus to Lake Tahoe.

Sen. Harry Reid, D-Nev., added $300,000 in federal seed money to start the ambitious project to the Senate version of the transportation budget.

Steve Teshara, director of the North Lake Tahoe Resort Association, said the Tahoe Transportation District and Tahoe Regional Planning Agency asked Reid's help because studies show more and more people who work in the basin live in Carson City, Minden, Gardnerville, the Truckee area or even in Reno.

"With the price of housing and economic displacement going on, elements of the work force have had to move out of the basin to get housing they can afford," said Teshara. "An increasing number of people are commuting to Tahoe."

Carl Hasty, deputy director of the TRPA, said the goal is to reduce the number of cars commuting to the basin every day, cutting both pollution and congestion. He said that means not only serving workers but tourists.

In fact, it is the tourists who create the greatest load on Tahoe's environment. While just over 50,000 people live in the basin, Hasty said tourists can swell the population to more than 250,000 on a busy weekend.

"Since we're not into building new roads at the lake, transit is the answer," he said. "That's how we've got to deal with the volume and congestion."

"One of the long-term goals would be to have visitors come here without bringing their car," Hasty said.

TRPA and local governments in the basin are already operating a shuttle service around parts of the lake. One shuttle carries people from community to community and to beaches and destinations around the south end of the lake. The other does the same for part of the north end. Hasty said the problem is they aren't connected. Riders can't shuttle all the way around the lake.

Teshara said Tahoe officials have to find a way to complete the shuttle around the lake, then tie it to a system that can bring workers and tourists to and from Tahoe from Carson City, Truckee, Reno and the California side of Highway 50.

"This becomes seed money," Hasty said. "We're trying to secure operating dollars for transit services so this isn't the total answer, but it is a piece."

Both men said they will be looking to local governments, private employers and to see if there is more federal money.

Teshara said he believes they'll find support. He said the fact some ski resorts have been operating a shuttle service to transport their own employees to and from the lake during the winter shows they recognize the need.

But he said residents and governments in the basin can't afford it by themselves, that they need federal help.

"Smaller communities typically aren't eligible to receive that kind of assistance," agreed Hasty.

Both men said that's why the funding in the Senate transportation budget is so important.

To remain in the budget, the funding must also be approved by the House.

https://www.nnbw.com/news/2003/sep/14/tahoe-officials-want-to-create-shuttle-service-fro/

From:	Ellie
To:	Marja Ambler
Subject:	Comment 1: TRPA 6-28-2023 Governing Board mtg Public Comment Western Resort Towns risk being 'loved to death' plus two others
Date:	Thursday, June 22, 2023 8:04:13 PM

Please accept and distribute this public comment to the Governing Board members and appropriate staff members for the 6-28-2023 TRPA Governing Board meeting. Thank you ~Ellie Waller

A few recent articles for your attention and excepts for each. Worth reading the articles as many relate to similar issues in Lake Tahoe.

UNIQUE LAKE TAHOE that really cannot be compared to other locations.

TRPA has been working with many local jurisdictions and agencies for over 20 years. New plans and studies come and go and get revamped. Some succeed in some environmental gain. My opinion, the push for economic gain has left the environment threatened and even more vulnerable. Housing for workers not attainable even 20 years ago is stated in another comment I submitted.

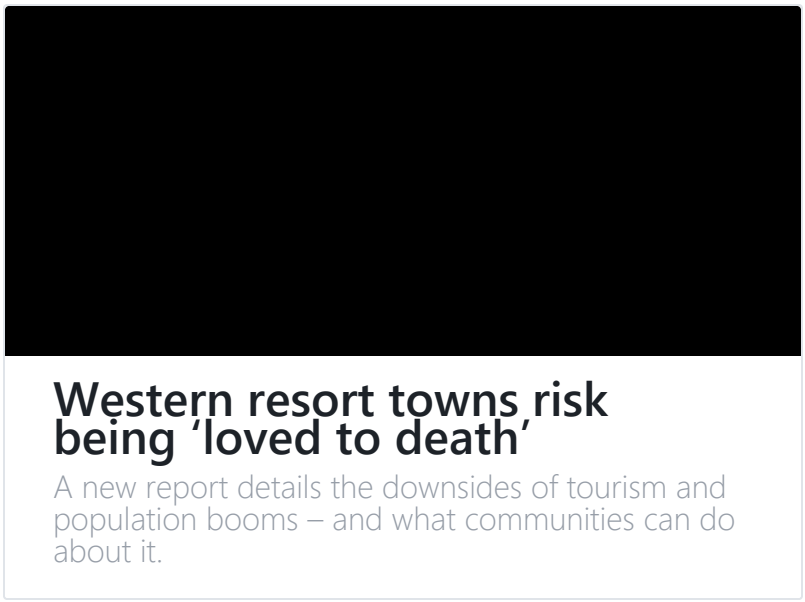
1). A new report details the downsides of tourism and population booms – and what communities can do about it.

Beautiful places tend to become popular destinations for tourists and outdoor recreationists. Visitors tell their friends and post pictures on social media, and businesses that serve those visitors — bars and restaurants, hotels, gear stores — proliferate. Soon people with financial means start moving in, driving up housing prices and reducing available stock. Unable to handle the population influx, infrastructure begins to crumble, while local government finds itself unable to pay for needed repairs.

Using local data and specific case studies, the report breaks down the amenity trap into a pressing few categories, including housing, infrastructure and natural disasters. It also discusses policies that have successfully addressed these problems in some of the West's most coveted destinations

"What we wanted to unpack here is why these places are unique, and why they have unique challenges, and why they need solutions that are really tailored," said Megan Lawson, one of the study authors.
Housing availability and affordability are perhaps the most pressing issues that face tourism- and recreation-dependent towns, sometimes called gateway communities. As an area becomes popular, housing prices tend to rise, and demand soon outstrips supply. Vacation homeowners and investors in short-term rentals like Airbnb and VRBO compound this problem. In Sedona, Arizona, for example, short-term rentals make up 17% of all

housing.
[Western resort towns risk being ‘loved to death’]



2). How growing Western rec towns might hold onto their futures

Update since the release of this article Alterra purchase of Schweitzer Mtn
https://www.spokesman.com/stories/2023/jun/01/schweitzer-mountain-sells-resort-operations-to-alt/
Danya Rumore, a professor of planning at the University of Utah, could feel her hometown changing. Sandpoint, Idaho, on the edge of Lake Pend Oreille in North Idaho, had always attracted visitors with its easy access to the Schweitzer ski area, but in the last decade, it had become much busier. As tourism grew, the town struggled to keep pace. It needed the visitors to keep the economy going, but the town’s infrastructure was being overwhelmed. When Rumore worked in communities like Springdale, Utah, right outside of Zion National Park, she noticed similar tensions, exacerbated by the uneven growth of the tourism economy. “They have big-city issues, but big-city solutions don’t work, or aren’t viable,” she said.
Recreation towns aren’t the only places that have been hammered by changing demographics and shifting economic tides during the past two years, but Rumore says many of them were already struggling with how to plan for growth, house their workers and manage the uneven economic progress. And then they all got inundated by Zoom-boom transplants and visitors desperate to spend time outdoors.

[How growing Western rec towns might hold onto their futures]

How growing Western rec towns might hold onto their futures

Researchers look to give small tourism communities the tools for a GNARly approach.

3). Billionaires Cowboy Up and Turn Wyoming Into a Gated Community

When the super-rich descended upon Teton County, they gushed about its natural beauty. They had less to say about the locals who got pushed out of paradise. Of the 3,144 counties in the United States, the one with the highest per capita income is Teton County, Wyoming. It's also the most unequal: Ninety percent of all income is made by 8 percent of households. Its average per capita income is $194,485, and the average income for the top 1 percent in the county is an astonishing $28.2 million.

I'm a big proponent of conservation, but I don't think we look enough at who benefits from conservation, not only in terms of tax breaks but in terms of how it affects property values and low-income people who can no longer live anywhere near where they work. Some people have to drive over an 8,000-foot mountain pass every day to get to work in the dead of a Wyoming winter. So the area is transformed into an ultra-exclusive enclave, where you need the money to buy entry. It's basically become a gated community to the extreme.

Billionaires Cowboy Up and Turn Wyoming Into a Gated Community

Billionaires Cowboy Up and Turn Wyoming Into a Gated Community

When the super-rich descended upon Teton County, they gushed about its natural beauty. They had less to say abou...

From:	skitumbleweed
To:	Ann Nichols; Alexis Hill; Sara Schmitz; Jeff Cowen; Marja Ambler; Jacob Stock
Subject:	Incline"s private beaches under siege again?
Date:	Monday, June 26, 2023 3:31:42 PM

So what's up with that goofy Kayak tourism thing out of Cave Rock? Douglas county? What's up with that junk stunt?

So we are not going to have 50 Kayaks managed by one dopey tourist guide storming Incline Village private beaches, correct? Better not!!!! I'll file a huge lawsuit if anyone attempts to pull that stunt!!! I'll have all of TRPA and elected officials in court over the matter!!! It'll be worse than the last lawsuit and I will definitely win that lawsuit!!! I'll win it!!! Count on it!!!

So you folks better get on it and figure out what that Cave Rock guy is all about. He better get off Carson County and Washoe County beaches and come nowhere near Incline or Crystal Bay with his little junk show he has going down.

Tim

From:	skitumbleweed
To:	Jeff Cowen; Jacob Stock; Alexis Hill; Ann Nichols; Sara Schmitz; Marja Ambler
Subject:	Shut down the Cave Rock Kayak operation right now!!!
Date:	Monday, June 26, 2023 2:10:55 PM

I have never seen this junk operation before. One darn tour guide, and was that 40, 50 or 60 kayaks that landed on Whale Beach???? What was that? What was that on Sunday June 25 at 9:45AM?

And yes, my wife and family were blown away by the remarkable stupidity of it all. I pointed out to them that a bunch of clowns on focus groups and committees along with TRPA are ruining the lake. And now they see this firsthand. Front and center.

You'd think common sense on a cold lake with snowpack still flowing into it plus the recent turning over the lake that 1 to 40, 50 , or 60 people ratio is without a shred of a doubt totally unacceptable safety wise as a tour guide. Any idiot can figure that one out. But hey it's TRPA and a pack of fools that know nothing running the show.

So maybe you folks allowed this guy and his junk operation on the lake????

And more.....This guide did not inform his tourists that he is responsible for of the sensitivity and proper behavior at Whale Beach. He just dumped them off and all these folks were scrambling up the fragile slopes to get onto the bluff to look for a bathroom.

A professional water guide would have more guides with him and they would land on the beach first and properly handle their people!!! Also a guide on Tahoe would fully know that taking such a large group to any of Tahoe's East Shore beaches is highly uncool. The local crowd might brawl with the man over it and that is never a good show or experience for the tourists that he is caring for.

A FAST BUCK IS NOT WORTH PISSING OFF A LOCAL POPULATION ANYWHERE IN THE WORLD!!!

I'll be blunt. I DON'T LIKE TRPA AND WHAT TRPA STANDS FOR AND I JUST DON'T LIKE YOU ALEXIS. YOU ALEXIS ARE RUINING MY COMMUNITY AND LAKE TAHOE'S EAST SHORE BEACHES. BLAME RESIDES DIRECTLY WITH TRPA AND ALEXIS ON THIS ONE.

This Cave Rock Kayak guide did not tell them that there were stairs at the end of the beach to make things safe for people and most of all to protect the fragile environment. Let alone who pays for the port a potties at Whale Beach???? Does this guy even have a permit for this?

So again as always I am the guy telling them to get off the fragile slope and to use the stairs to access the porta toilets. It was a stupid scene. I was polite but firm regarding the matter.

I am tired of the bullshit folks. Long tired.

These people were intending to kayak to Sand Harbor and back to Cave Rock. They came from Cave Rock.

And more. We all know that Alpine winds on a cold lake are dangerous. Sometimes going against the wind is a real challenge. So coming from Cave Rock these fragile tourists may not be able to make it back one day on a windy day. Wind happens for summer afternoons on Lake Tahoe. Everyone knows this. And if Sand Harbor is closed, what's up with trying to use Whale Beach restrooms and do these tourist companies pay for the Sand Harbor facilities or to even touch the sand at Sand Harbor or dispose of their trash? Who pays to use facilities at Sand Harbor? Should any tour group be allowed to storm Sand Harbor from the lake? So boats can land at Sand Harbor with people and not pay for that? Meanwhile we pay nickels to staff at Sand Harbor and this Kayak tour group guy makes an easy buck?

That guy can shove it!! I say no way!!! He comes from another county and lands a bunch of folks on my county beach and does not pay for the facilities. Really? Meanwhile all the cars and boats that launch from there have to pay. What's up with that????

Don't tell me you folks are allowing these guys to use those facilities while others have to pay for that!!

Public safety on the lake is fast becoming an absolute joke. You folks at TRPA with all these committees and focus groups are creating a toxic, angry and highly unsafe environment on the East Shore in all ways whether it be fire, road danger, environmental damage and public safety on the water. Not to mention the fire danger and ability to escape from the North Shore.

You are endangering our lives and perhaps you could be held criminally responsible. Especially when you have so many telling you of the danger and you ignore so many of us that are older and have more experience than you.

You folks at TRPA and Alexis own this. You own it. Anyone dies on our H28, drowns, or if people are killed in fire it is fully on you. You own that.

I AND MY FAMILY ARE NOT ALWAYS AVAILABLE TO SAVE FOKS FROM A STUPID DEATH!!! AND WEAR ME OUT AND I MIGHT NOT WANT TO BOTHER SHOULDERING RISK WITH A WATER RESCUE!

YES, MY FAMILY HAS PLUCKED DYING PEOPLE FROM THE WATER BEFORE SO YOU KNOW!! I AND MY KIDS WERE ALL THAT WAS AVAILABLE AND ABLE TO.

MY SON HAD SOME IMPRESSIVE RESCUES AND DUMPED A DYING MAN BEFORE MY FEET AT CARMEL BEACH CA IN FRONT OF THOUSANDS OF PEOPLE. HE SAVED THAT MAN AFTER BEING CAUGHT IN A RIP. A STUPID MAN OUT OF HIS ELEMENT. IN MY WORLD THAT DID NOT BELONG.

I HAVE SAVED MEN BEFORE WHILE SURFING. GET'S OLD AFTER A WHILE. CARMEL BEACH WAS MY 12 YEAR OLD SON SURFING THAT CAME TO THIS MAN'S AID. HE WAS LUCKY.

I FEEL FOR THE TOURISTS. I DON'T GIVE A SHIT ABOUT THE GUIDE AND HIS JUNKY KAYAK BUSINESS!!

SHUT HIM DOWN AND GET HIM OFF THE EAST SHORE OF TAHOE!!!

Tim Delaney

From:	skitumbleweed
To:	Ann Nichols; Sara Schmitz; Alexis Hill; Jacob Stock; Jeff Cowen; Marja Ambler
Subject:	Too many watercraft on the lake
Date:	Monday, June 26, 2023 3:51:11 PM

Stupid fools are ruining the tourist experience and experience for locals alike!!!

I used to swim from Ponderosa to Crystal bay. And I used to swim from Whale Beach to Chimney and sometimes down to Hidden Beach past Sand Harbor.

Now I worry about foils, too many jet skis, Kayak newbies, boat bozos with no experience, all getting too close to shore and not behaving properly inside or outside buoys.

Essentially you dumb fools created a circus on the lake in your easy buck desire to get a tourist dollar and totally forgot about the locals that live at the lake. So now I can't really swim out of fear of being chopped to bits by these idiots. And by the way. Other IV locals mentioned the same things to me while swimming the pool at Burnt Cedar. They don't swim the lake anymore fearing the idiot that will hit them with a foil. Or the uncontrolled newbie on a jet ski doing it all wrong and coming super close to swimmers and even going inside the buoy systems to do a trick. It's lame all the time and every time. Then comes Mickey the goofy tourist guide that is probably not even legit dumping off tourists to cause a calamity. Meanwhile Washoe County officers on the boat are overwhelmed and chuckle at the insanity full knowing that I wish I could swim in peace.

Oh, Never mind the bogus touch and go from the sea plane last year. And the helicopter that circled us relentlessly on the East Shore beaches. Oh yes there was the foil dude too. Oh did I mention the huge piles of garbage? Yep. I mentioned that too. And they never pick up after the dog. Instead my kids pick up these other folks dog messes.

You'd think people would not want dog poop washing into the lake with all the other things.

Oh one more....The folks with that Kayak tour by the way mentioned something about the tour guide telling them to pee in the lake if they could not find a bathroom to use. Gee. They don't even want them using the bushes. Most folks in nature pee away from the water sources. Common sense you'd think?

You folks at TRPA with your goofy focus group politicians wrecked my favorite beaches and wrecked Lake Tahoe. You are not my friends!!!

Tim

From:	skitumbleweed
To:	Ann Nichols; Sara Schmitz; Jacob Stock; Jeff Cowen; Marja Ambler; Alexis Hill
Subject:	TRPA + Titanic sub = Two peas of the same pod
Date:	Monday, June 26, 2023 4:12:18 PM

Sure does not seem like there is a difference between today's TRPA and that Titanic submarine disaster.

Same old BS for today's generation. A bunch of 30 and 40 year olds that refuse to take mentorship from older experienced people. Let alone the guy that actually has the Physics Degree and real world success and experience.

We don't listen to James Cameron and his professional highly experienced people do we TRPA???!!!

I was super happy to have a really old hobby engineer to work with at Lockheed. I leveraged off that guy and prior generations knowledge. Hence my things worked really well. After all, a good engineer will gladly admit that they don't know everything. NOT TRPA though. They ignore public input of all kinds. You have all these people. All these people that even have great professional backgrounds telling you to stop this nonsense and ya don't listen.

In TRPA's case you folks wrecked the entire shoreline of Lake Tahoe. You'd think you try to keep this overtoursim junk away from the East Shore. You'd think???

But NOOOOOOOOOOOOOOOOOO!!!! Instead you folks build and build and build and the digging and building never ends!!!!

Name calling is totally 100% fair ball. You TRPA and Alexis are a couple of BOZOS!!!

A pack of pathetic losers that are no different from the folks that killed those people in that sub to the Titanic. All ego. All face saving. All do nothing circus clown act stupidity. It's one stupid situation after another.

Shucks.....It's things like this that make me wonder why I ever bothered with any higher education. It's pointless. Education and skill and any sort of knowledge is a total waste. It's all about ego and face saving and simply running folks over in society. Law doesn't even matter. You folks at TRPA totally shut out public input and concern and free speech.

It's anything goes, land of fools running the show. Just like the folks dissing engineers and the folks that worked with James Cameron that actually had incredible experience.

Tim

From:	David Chain
To:	Cindy.Gustafson; Hayley Williamson; Shelly Aldean; Francisco Aguilar; Ashley Conrad-Saydah; jdiss.trpa@gmail.com; Belinda Faustinos; John Friedrich; Bud Hicks; Alexis Hill; Vince Hoenigman; James Settelmeyer; Brooke Laine; Wesley Rice; TRPA; Julie Regan
Cc:	Cristi Creegan; Cody Bass; Scott Robbins; Tamara Wallace; 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
Subject:	TRPA Governing Board Meeting Public Comment {June 28 2023 TRPA GB meeting}
Date:	Friday, May 26, 2023 9:20:08 PM
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

Dear TRPA Governing Board,

Please read the attached PDF(s). The TRPA has alleged to have exonerated itself 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:

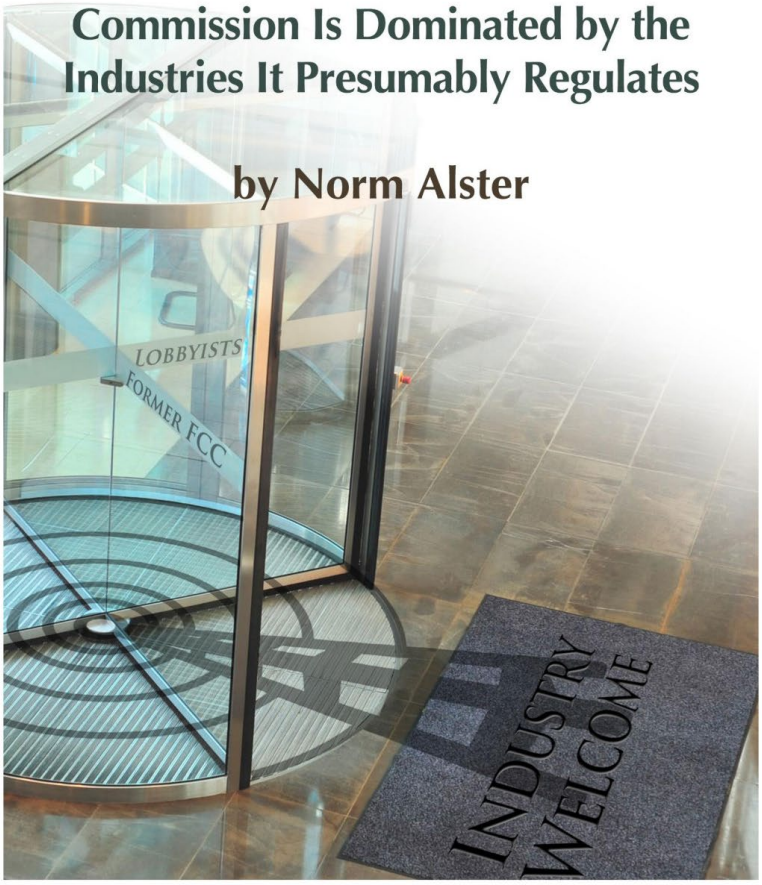
FCC & NEPA: FCC Fails to Protect the Environment Interview With Former FCC Lawyer Erica Rosenberg

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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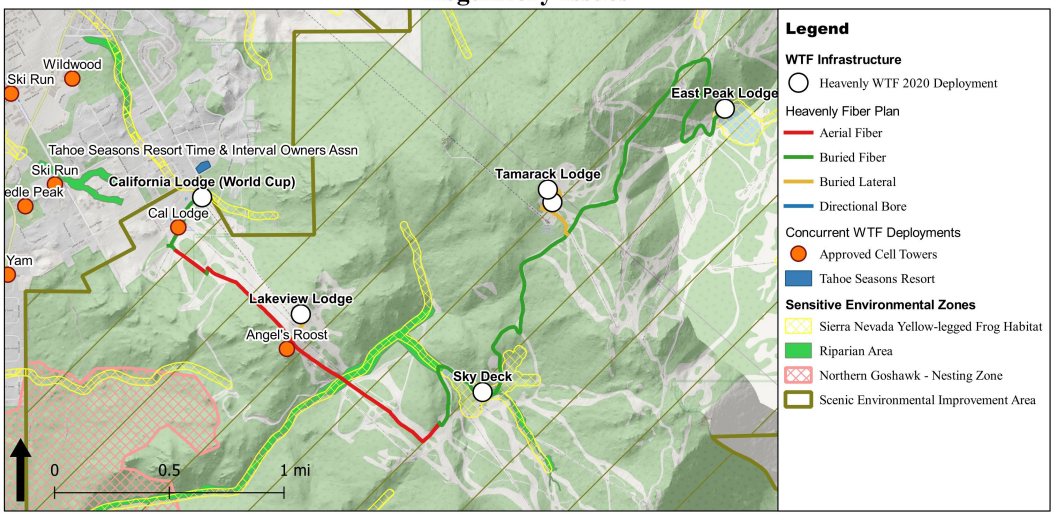
In summary, both the FCC and the TRPA allege they preempt our local governments over environmental regulation of radiofrequency radiation, and then they along with the USFS malfeasantly ignore this legal responsibility via deliberate indifference of known adverse environmental effects such as the undermentioned 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

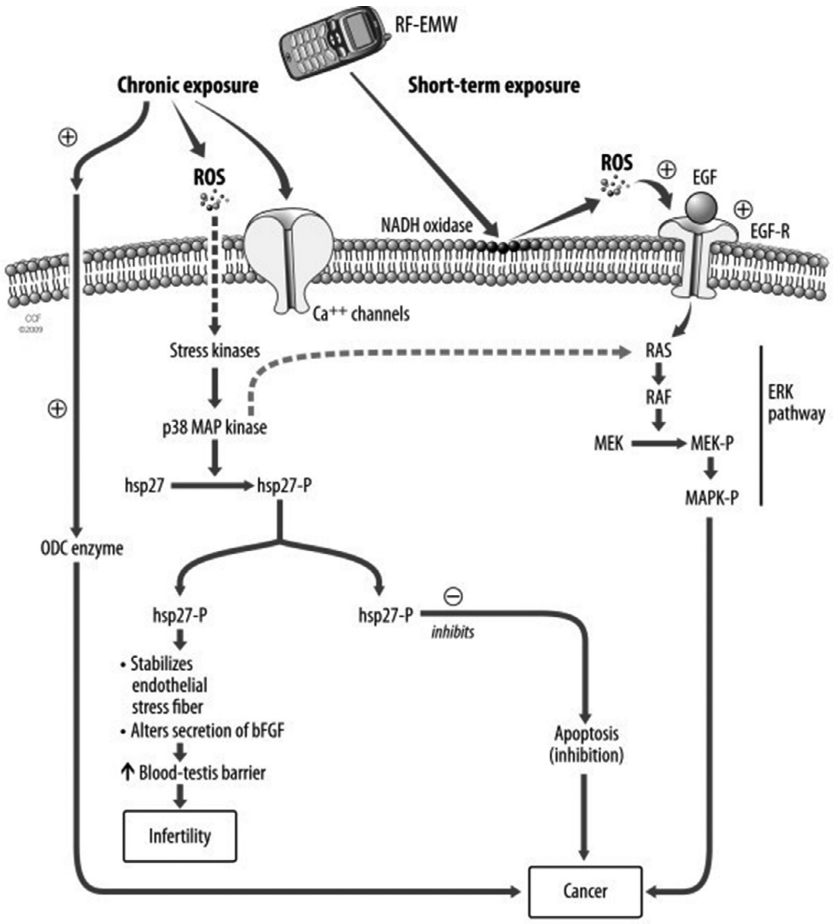
Numerous research studies have found that cell tower radiation causes mortality in frogs and amphibians [*e.g.,* Balmori, Alfonso. (2010). Mobile Phone Mast Effects on Common Frog (*Rana temporaria*) Tadpoles: The City Turned into a Laboratory. *Electromagnetic biology and medicine.* 29. 31-5. DOI: 10.3109/15368371003685363]. 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 (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).



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.

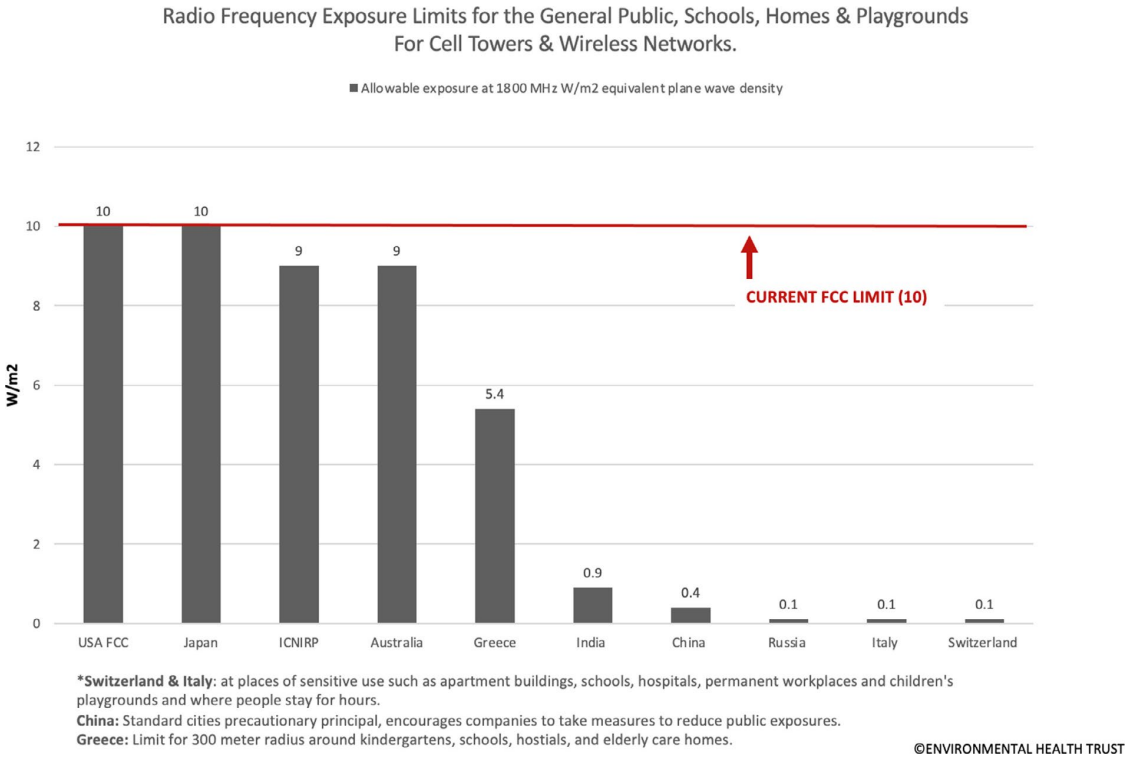
The only due process over RFR limits—the 1996 FCC "notice of proposed rulemaking (NPRM)" (61 FR 41006 (1996); 61 FR 42021 (1996); FCC 96-326 (1996)) for NEPA regulation promulgating the current radiofrequency exposure limits (47 CFR § 1.1310)—occurred nearly thirty years ago. Anyone who was legally an 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:



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).

Pursuant to PUBLIC LAW 96-551 – DEC. 19, 1980, Arts. III(i), VI(b)&(j)(5), & VII(d); CA Government Code §§ 54954.1, 54957.5, & 54959; N.R.S. Ch. 239 & § 241.020; and TRPA Rules of Procedure §§ 2.6, 15.2, & 15.5, public comments must be readily and immediately available to the entire public at the time the documents are disseminated to a quorum of the hearing body—intentive deprivation to the public of such information is a crime.

As you know, PUBLIC LAW 96-551 – DEC. 19, 1980, Art. III(d), requires that:

> "The governing body of the agency shall meet at least monthly. All meetings shall be open to the public to the extent required by the law of the State of California or the State of Nevada, whichever imposes the greater requirement, applicable to local governments at the time such meeting is held."

This is also reflected in TRPA Rules of Procedure §§ 2.6.

Nevada promulgates its open meeting at N.R.S. § 241.020 wherein (3)(d)(3) requires that meetings have:

> "An agenda consisting of:
>
> Periods devoted to comments by the general public, if any, and discussion of those comments. Comments by the general public must be taken:
>
> (I) At the beginning of the meeting before any items on which action may be taken are heard by the public body and again before the adjournment of the meeting; or
>
> (II) After each item on the agenda on which action may be taken is discussed by the public body, but before the public body takes action on the item.
>
> ...
>
> the public body must allow the general public to comment on any matter that is not specifically included on the agenda as an action item at some time before adjournment of the meeting."

wherein (3)(d)(7) requires the agenda give notice of:

> "Any restrictions on comments by the general public. Any such restrictions must be reasonable and may restrict the time, place and manner of the comments, but may not restrict comments based upon viewpoint."

N.R.S. Ch. 239 further promulgates such comment materials are public records.

CA Government Code § 54954.3(a)&(c) reiterates Nevada Law:

> "Every agenda for regular meetings shall provide an opportunity for members of the public to directly address the legislative body on any item of interest to the public, before or during the legislative body's consideration of the item, that is within the subject matter jurisdiction of the legislative body...
>
> The legislative body of a local agency shall not prohibit public criticism of the policies, procedures, programs, or services of the agency, or of the acts or omissions of the legislative body. Nothing in this subdivision shall confer any privilege or protection for expression beyond that otherwise provided by law."

Moreover, CA Government Code § 54957.5(b) further states:

> "If a writing is a public record related to an agenda item for an open session of a regular meeting of the legislative body of a local agency and is distributed to all, or a majority of all, of the members of a legislative body of a local agency by a person in connection with a matter subject to discussion or consideration at an open meeting of the body less than 72 hours before that meeting, the writing shall be made available for public inspection ... at the time the writing is distributed to all, or a majority of all, of the members of the body."

CA Government Code § 54954.2(a)(1):

> "At least 72 hours before a regular meeting, the legislative body of the local agency, or its designee, shall post an agenda containing a brief general description of each item of business to be transacted or discussed at the meeting"

See also, CA Government Code § 54954.1 & 54959; TRPA Rules of Procedure §§ 2.6, 15.2, & 15.5; Governing Board Meeting October 26-27, 2022 Agenda Item No. VIII.B.1 Open Meeting Law Requirement.

Nevada law "imposes the greater requirement" whereas it requires three opportunities for public comment: "at the beginning of the meeting" and "before the adjournment of the meeting" and "after each item on the agenda is discussed by the public body" (N.R.S. § 241.020(3)(d)(3)). However, TRPA purposefully fails to provide notice of public comment in its published agenda and then fails to provide for public comment "at the beginning of the meeting." Compare the left two TRPA public notices published in the Tahoe Daily Tribune with the right notice published in the same newspaper by the NTRPA:

TAHOE REGIONAL PLANNING AGENCY
GOVERNING BOARD
NOTICE OF PUBLIC HEARINGS

The Governing Board/Committee will be held at the **Tahoe Regional Planning Agency, 128 Market Street, Stateline, NV.** Pursuant to TRPA Rules of Procedure, 2.16 Teleconference/Video Conference Meetings and Participation, Board members may appear in person or on Zoom. Members of the public may observe the meeting and submit comments in person at the above location or on Zoom. Details will be posted on the day of the meeting with a link to Zoom.

NOTICE IS HEREBY GIVEN that at its regular meeting to be held on **Wednesday, April 26, 2023,** the **Regional Plan Implementation Committee** commencing at **10:00 a.m., and the Governing Board** commencing at **11:00 a.m.**, at the **Tahoe Regional Planning Agency**, the Governing Board/Committee of the Tahoe Regional Planning Agency will conduct a public hearing on the following:

1) Informational Presentation on proposed amendments to the City of South Lake Tahoe's Tahoe Valley Area Plan and Tourist Core Area Plan addressing, increased consistency with recently amended TRPA regulations and state regulations, increased housing opportunities and community equity in appropriate areas, increased density and the establishment of minimum densities in town centers, and general improvements to the design and development standards **(RPIC);**

2) Proposed amendments to Washoe County's Tahoe Area Plan to Allow Single Family Condominium Uses in Special Area 1 of the Incline Village Commercial Regulatory Zone (possible action) **(GB);**

3) Proposed code amendments to the "Achievable" deed restriction category definition, including changes to Sections 52.3.4 and 90.2, and an amendment to Section 34.3.3 regarding driveways for accessory dwelling units (possible action) **(GB).**

Julie W. Regan
Executive Director

Published: March 31, 2023

TAHOE REGIONAL PLANNING AGENCY
TAHOE LIVING: HOUSING AND COMMUNITY
REVITALIZATION WORKING GROUP
COMMITTEE OF THE ADVISORY PLANNING COMMISSION
NOTICE OF PUBLIC MEETING

The Tahoe Living: Housing and Community Revitalization Working Group will be held at the **Tahoe Regional Planning Agency, 128 Market Street, Stateline, NV.** Pursuant to TRPA Rules of Procedure, 2.16 Teleconference/Video Conference Meetings and Participation, members may appear in person or on Zoom. Members of the public may observe the meeting and submit comments in person at the above location or on Zoom. Details will be posted on the day of the meeting with a link to Zoom.

NOTICE IS HEREBY GIVEN that on **April 21, 2023** , via **Zoom and at the Tahoe Regional Planning Agency,** the Tahoe Living: Housing and Community Revitalization Working Group, a Committee of the Tahoe Regional Planning Agency (TRPA) Advisory Planning Commission, commencing at **9:00 a.m.** , will conduct a meeting at which the following items will be discussed and possible direction may be provided to staff: 1) Discussion and recommendation (possible action) of height, density, and coverage options to encourage affordable and workforce housing, including amendments to Chapters 12, 13, 30, 31, 37 and 90.

Julie W. Regan
Executive Director
Published: March 31, 2023

NOTICE IS GIVEN that on **Thursday November 3, 2022** commencing at **2:00 p.m.**, the **Nevada Tahoe Regional Planning Agency (NTRPA)** will meet at the Division of Health and Human Services Carson City Administrative Office Conference Room 149 1470 E College Parkway Carson City, NV. This will be a hybrid meeting with both in person and virtual attendance via Microsoft Teams, meeting ID 226 271 100 234. The public is invited and encouraged to participate in person or by phone at 775-321-6111, and when prompted, enter the meeting code 685 157 427#. Public comment may also be submitted via email prior to the meeting. Please submit public comments to scarey@lands.nv.us by 5 PM on November 2, 2022. The agenda is as follows: **1)** Call to Order; **1a)** Roll Call; **1b)** Pledge of Allegiance; **1c)** Approval of Agenda – For Possible Action; **1d)** Approval of Minutes of the August 1, 2022 Meeting – For Possible Action; **2)** Public Comment; **3)** Discussion and Selection of Nevada Member at Large – For Possible Action; **4)** Election of Chair – For Possible Action; **5)** Election of Vice Chair – For Possible Action; **6)** Recognition of Service to NTRPA for Secretary Barbara Cegavske – For Possible Action; **7)** Recognition of Service to NTRPA for Mark Bruce – For Possible Action; **8)** Recertification of the Certified Base Data for the Tahoe Nugget Structure Housing Gaming in Stateline – For Possible Action; **9)** Overview of Roles and Responsibilities of Nevada Tahoe Regional Planning Agency – Informational Only; **10)** Report of the Executive Officer on Activities of the Agency: August 2022 – October 2022; **11)** Board Member Comments; **12)** Public Comment; **13)** Adjournment

Published: October 28. 2022

Again, there is no public comment on the agenda for the upcoming May 24 2023 TRPA GB meeting either:

TAHOE REGIONAL PLANNING AGENCY
GOVERNING BOARD
NOTICE OF PUBLIC HEARINGS

The Governing Board/Committee will be held at the **Tahoe Regional Planning Agency, 128 Market Street, Stateline, NV.** Pursuant to TRPA Rules of Procedure, 2.16 Teleconference/Video Conference Meetings and Participation, Board members may appear in person or on Zoom. Members of the public may observe the meeting and submit comments in person at the above location or on Zoom. Details will be posted on the day of the meeting with a link to Zoom.

NOTICE IS HEREBY GIVEN that at its regular meeting to be held on **Wednesday, May 24, 2023** , the **Regional Plan Implementation Committee** commencing at **9:30 a.m., and the Governing Board** commencing at **10:30 a.m.,** at the **Tahoe Regional Planning Agency,** the Governing Board/Committee of the Tahoe Regional Planning Agency will conduct a public hearing on the following: **1)** Informational Presentation on proposed amendments to the City of South Lake Tahoe's Tahoe Valley Area Plan and Tourist Core Area Plan that would expand housing opportunities and community equity by increasing density allowances and establishing minimum densities in town centers, allowing more housing types such as employee housing, shared housing, and group home facilities, improvements to residential design standards to help streamline project review, and policies to support town center revitalization using special events, coverage exemptions, and CFA policy clarifications. Additionally, amendments would increase consistency with recently amended TRPA regulations and state regulations regarding accessory dwelling units and density bonuses for affordable housing **(RPIC); 2)** Proposed Amendments to Washoe County's Tahoe Area Plan to Allow Single Family Condominium Uses in Special Area 1 of the Incline Village Commercial Regulatory Zone (possible action) **(GB).**

Julie W. Regan
Executive Director
Published: April 28, 2023

Nevada also "imposes the greater requirement" whereas it requires 3 working days notice notice of the meeting agenda compared to California's 72 hours notice with weekend and holidays inclusive (N.R.S. § 241.020(3); CA Government Code § 54954.2(a)(1)).

TRPA Rule of Procedure § 2.10.2 is in egregious violation of TRPA Compact Art. III(d) whereas N.R.S. § 241.020(3)(d)(3)(I) requires that meetings have "Periods devoted to comments by the general public, if any, and discussion of those comments. Comments by the general public must be taken...At the beginning of the meeting before any items on which action may be taken are heard by the public body and again before the adjournment of the meeting." The TRPA Rules of Procedure are routinely modified for *ad hoc* political purposes in without published public notice in violation of basic due process of law (*infra*, *Mullane v. Central Hanover Tr. Co.*, at 314, 315 (holding It would be idle to pretend that publication alone is a reliable means of acquainting interested parties of the fact that their rights are before the tribunal; "Where the names and postoffice addresses of those affected by a proceeding are at hand, the reasons disappear for resort to means less likely than the mails to apprise them of its pendency"; published notice "is inadequate, not because in fact it fails to reach everyone, but because under the circumstances it is not reasonably calculated to reach those who could easily be informed by other means at hand"; "Publication may theoretically be available for all the world to see, but it is too much in our day to suppose that each or any individual...does or could examine all that is published to see if something may be tucked away in it that affects his property interests"). *Cf.*, Cal. Gov. Code §§ 11343, 25124, & 36933; N.R.S. §§ 233B.060, 244.100, & 266.115). Whereas TRPA does not post public comment on its website, it is in violation of CA Government Code § 54957.5(b). No deference is given to an agency's interpretation of a statute that it does not administer or is outside of its expertise (*see*, *Medina-Lara v. Holder*, 771 F.3d 1106, 1117 (9th Cir. 2014); *Trung Thanh Hoang v. Holder*, 641 F.3d 1157, 1163-64 (9th Cir. 2011); *Mandujano-Real v. Mukasey*, 526 F.3d 585, 589 (9th Cir. 2008)). An agency action that departs from a prior policy without acknowledging the change, or that creates an "unexplained inconsistency" with prior policy is generally viewed as arbitrary and capricious (*National Cable & Telecommunications Assn. v. Brand X Internet Services*, 545 U.S. 967, 981 (2005); *Perez v. Mortg. Bankers Ass'n*, 575 U.S. 92 (2015) (holding that the APA "mandate[s] that agencies use the same procedures when they amend or repeal a rule as they used to issue the rule in the first instance")).

Violation of Open Meeting Laws is a crime and may also amount to a constitutional violation actionable under 42 U.S.C § 1983. It is well-established that government officers such as **TRPA Governors can be held liable for knowing about but failing to prevent constitutional violations** (*Reynaga Hernandez v. Skinner*, 969 F.3d 930, 941-42 (9th Cir. 2020) (An actor may be deemed to have caused a constitutional violation under the "integral-participant doctrine," if the defendant knew about and acquiesced in the constitutionally defective conduct as part of a common plan with those whose conduct constituted the violation)).The TRPA itself can also be held liable (*Monell v. Department of Social Services*, 436 U.S. 658, 691-92 (1978) (when execution of a government's policy or custom, whether made by its lawmakers or by those whose edicts or acts may fairly be said to represent official policy, inflicts the injury that the government as an entity is responsible under § 1983); *Connick v. Thompson*, 563 U.S. 51, 61 (2011) (when municipality policymakers are on actual or constructive notice of city's programmatic violation of citizens' constitutional rights, the city may be deemed deliberately indifferent)). It is well settled that a "person" subject to liability can be an individual sued in an individual capacity (*see Devereaux v. Abbey*, 263 F.3d 1070, 1074 (9th Cir. 2001) (*en banc*)) or in an official capacity (*see, Hartmann v. Cal. Dep't of Corr. & Rehab.*, 707 F.3d 1114, 1127 (9th Cir. 2013)). A "person" subject to liability can also be a local governing body (*see, Waggy v. Spokane County*, 594 F.3d 707, 713 (9th Cir. 2010)). This general doctrine applies to First Amendment violations as well (*Ariz. Students' Ass'n v. Ariz. Bd. of Regents*, 824 F.3d 858, 867 (9th Cir. 2016) ("A plaintiff may bring a Section 1983 claim alleging that public officials, acting in their official capacity, took action with the intent to retaliate against, obstruct, or chill the plaintiff's First Amendment rights. To bring a First Amendment retaliation claim, the plaintiff must allege that (1) it engaged in constitutionally protected activity; (2) the defendant's actions would 'chill a person of ordinary firmness' from continuing to engage in the protected activity; and (3) the protected activity was a substantial or motivating factor in the defendant's conduct—i.e., that there was a nexus between the defendant's actions and an intent to chill speech. Further, to prevail on such a claim, a plaintiff need only show that the defendant 'intended to interfere' with the plaintiff's First Amendment rights and that it suffered some injury as a result; the plaintiff is not required to demonstrate that its speech was actually suppressed or inhibited")). A "person" subject to liability can also be a local governing body (*see, Waggy v. Spokane County*, 594 F.3d 707, 713 (9th Cir. 2010)). An institutional defendant is not entitled to qualified immunity (*see, Owen v. Independence*, 445 U.S. 622, 638 (1980) (holding that "municipality may not assert the good faith of its officers or agents as a defense to liability under § 1983")). Even a private party involved in conspiracy to deprive such rights with a government official may, even though not himself official of the government, be liable as well (*Adickes v. S. H. Kress & Co.*, 398 U.S. 144, 152 (1970)). Any ordinance which precludes the disproof in [quasi-]judicial proceedings of facts which would show or tend to show that an ordinance depriving suitor of life, liberty, or property has a rational basis is a "denial of due process" (*U.S. v. Carolene Products Co.*, 304 U.S. 144, 152 n.4 (1938) (noting heightened scrutiny in situations in which a law or regulation conflicts with Bill of Rights protections, where the political process has closed or is malfunctioning, and when regulations adversely affect "discrete and insular minorities").

Due process of law under the Fifth, Sixth, and Fourteenth Amendments to the U.S. Constitution—supreme over all state law—have the requirements that a tribunal allow all parties and public attendance to an opportunity to be heard, an opportunity to know all opposing evidence, and that it prepare a record of the evidence presented (*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); *Greene v. McElroy*, 360 U.S. 474, 946-947 (1959) (the right to be confronted with evidence is protected in all types of cases where administrative and regulatory actions were under scrutiny); *Goldberg v. Kelly*, 397 U.S. 254, 269-70 (1970) ("In almost every setting where important decisions turn on questions of fact, due process requires an opportunity to confront and cross-examine adverse witnesses")). A transcript being made tends to restrain abuses by hearing officers and is almost essential if there is to be judicial review (Henry J. Friendly, *Some Kind of Hearing*, 123 U. Pa. L. Rev. 1267, 1282-87, 1291-94 (1975)). Due process requires an impartial tribunal (*supra*, *Goldberg v. Kelly*, at 271 ("impartial decision maker is essential"); *Arnett v. Kennedy*, 416 U.S. 134, 197 (1974) (the right to an impartial decisionmaker is required by due process); *see also*, *supra*, *Mullane v. Central Hanover Tr. Co.*, at 314; *Mullane v. Central Hanover Tr. Co.*, at 314, 315 , 318-20 ("An elementary and fundamental requirement of due process in any proceeding which is to be accorded finality is notice reasonably calculated, under all the circumstances, to apprise interested parties of the pendency of the action and afford them an opportunity to present their objections"; "when notice is a person's due, process which is a mere gesture is not due process"); *supra*, *Greene v. McElroy*, at 946-947 (the right to be confronted with evidence is protected in all types of cases where administrative and regulatory actions were under scrutiny)).

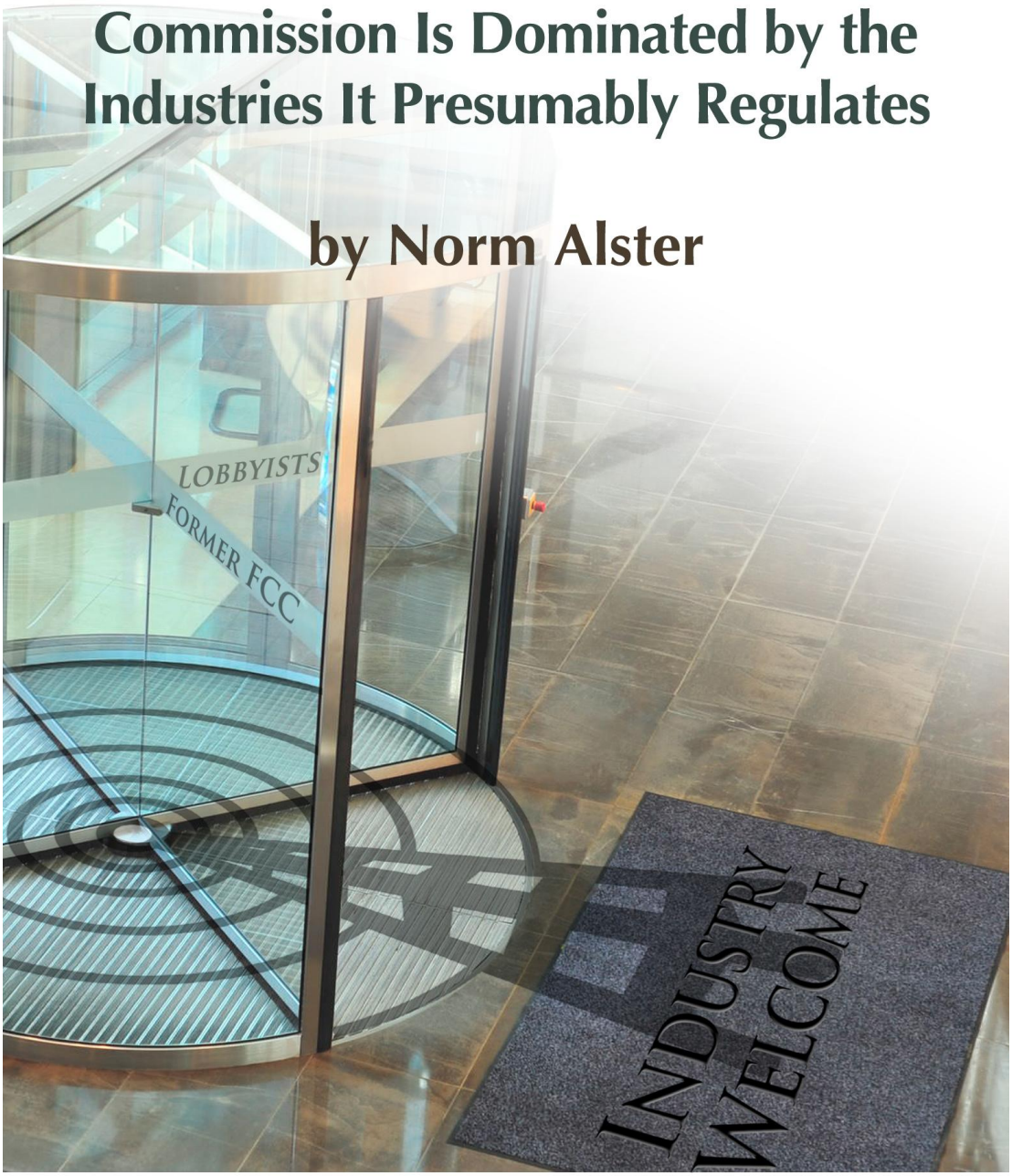
The constitutional due process right to a public hearing dovetails with the First Amendment whereas, the "right conclusions are more likely to be gathered out of a multitude of tongues, than through any kind of authoritative selection. To many this is, and always will be, folly; but we have staked upon it our all" (*supra*, *New York Times Co. v. Sullivan*, at 270). "[T]he path of safety lies in the opportunity to discuss freely supposed grievances and proposed remedies" (*id*). Contrary city practices to systemically rig an egregiously unlevel playing field towards succumbing to an authoritarian outcome are "conscious shocking" in the constitutional sense (*cf.*, *supra*, *County of Sacramento v. Lewis*, at 846). It is well-established that the chilling of witness testimony or other suppression of evidence is a form of constitutional violation (*see, Mellen v. Winn*, 900 F.3d 1085, 1096 (9th Cir. 2018); *Tennison v. City & Cnty. of S.F.*, 570 F.3d 1078, 1087, 1089 (9th Cir. 2009); *see also, Carrillo v. Cnty. of L.A.*, 798 F.3d 1210, 1219 (9th Cir. 2015); *cf.*, *Park v. Thompson*, 851 F.3d 910 (9th Cir. 2017)).

The TRPA appears to believe they answer to nobody.

Captured Agency:

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

by Norm Alster



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Captured Agency

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

By Norm Alster

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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.

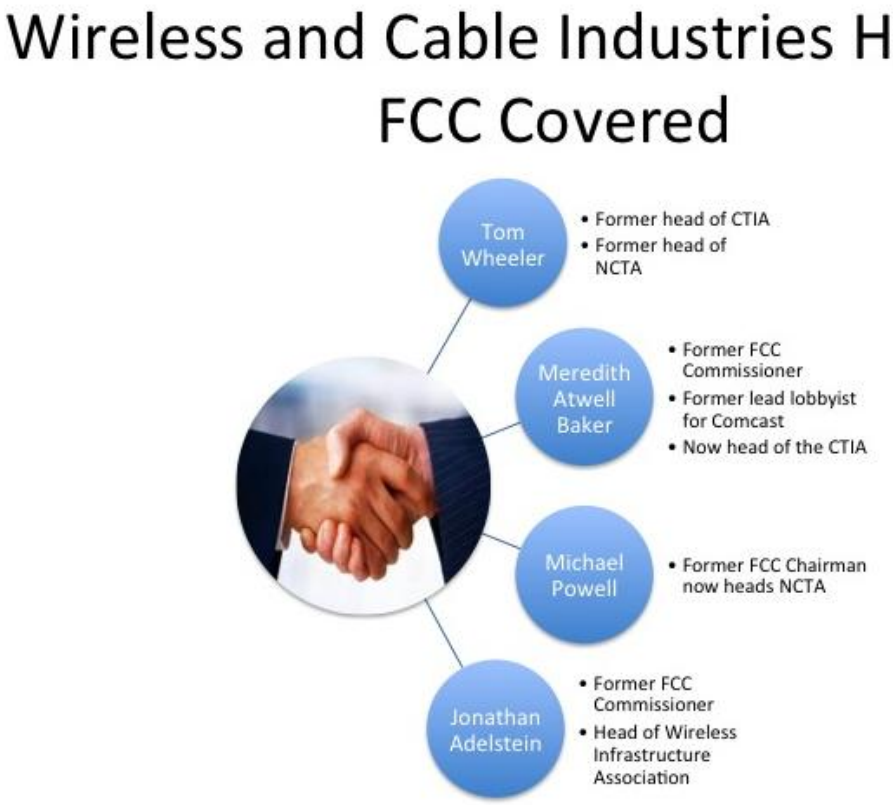
Industry controls the FCC through a soup-to-nuts stranglehold that extends from its well-placed campaign spending in Congress through its control of the FCC's Congressional oversight committees to its persistent agency lobbying. "If you're on a committee that regulates industry you'll be a major target 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]

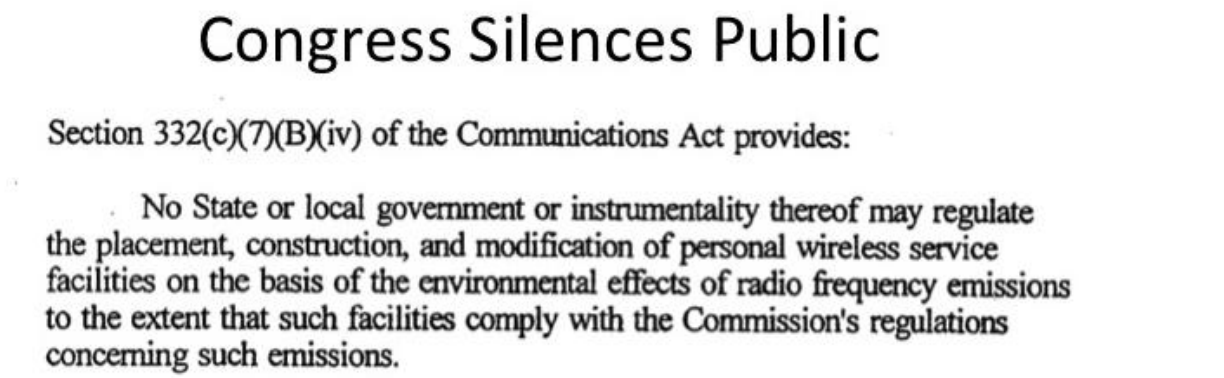
More than 50 years later, the mess continues to pile up.

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.

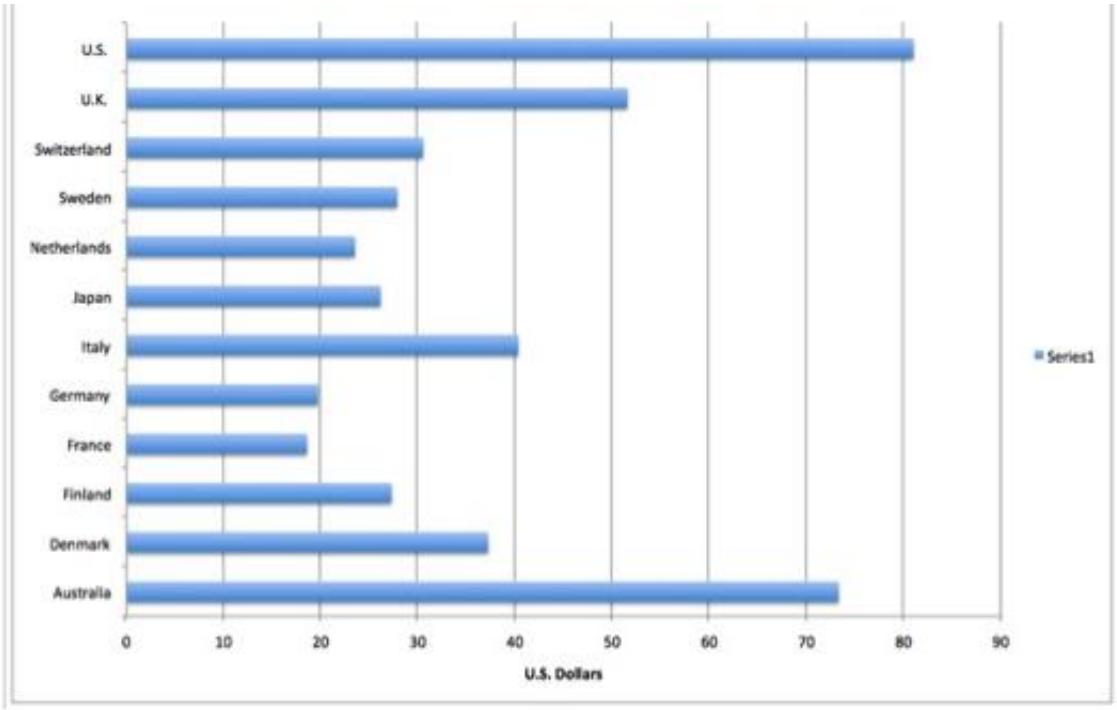
Chapter Six: The Cable Connection

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.

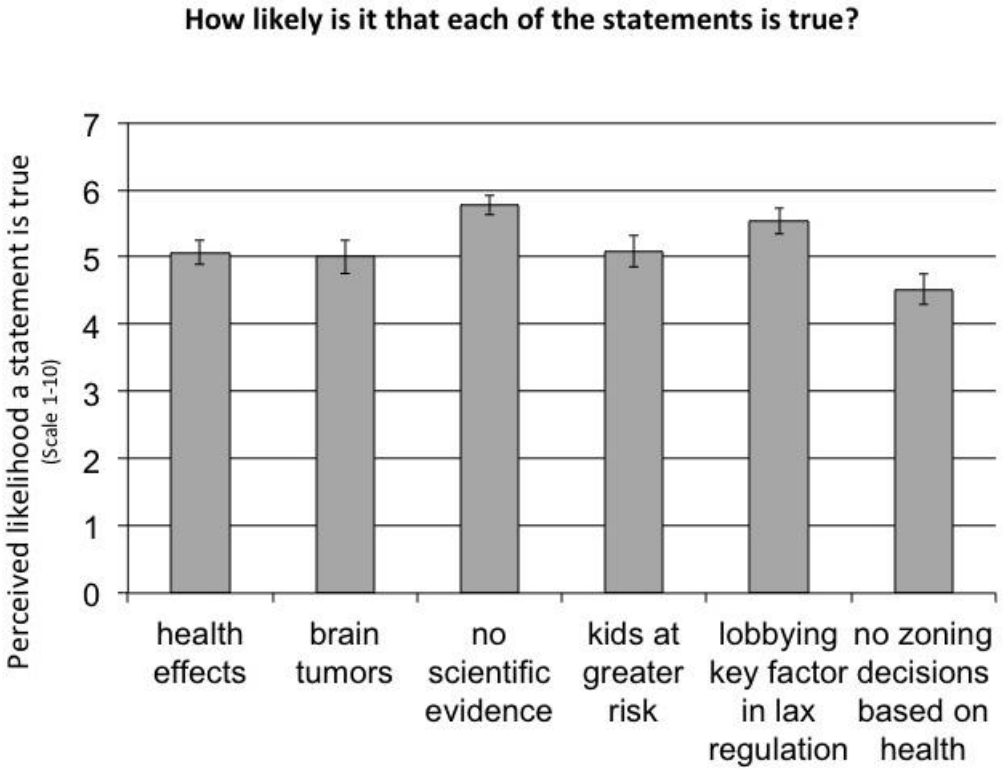
Appendix—Survey of Consumer Attitudes

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.

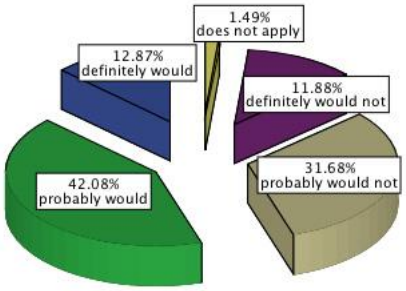


Two findings seem especially interesting:

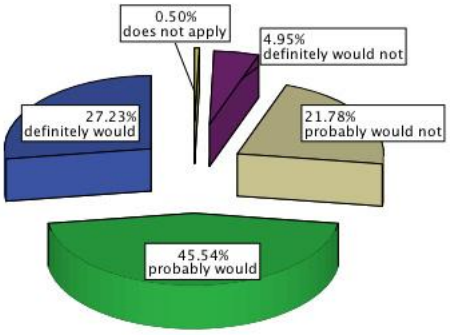
1. Statement 3 received a higher credibility rating than Statements 1 and 2. The different credibility levels are statistically significant. Respondents are more likely to trust in wireless safety than to believe there are general or specific health risks.

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.

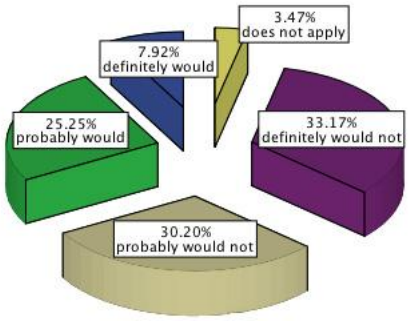
Participants were also asked how they would change behavior if claims of wireless health risks were established as true:



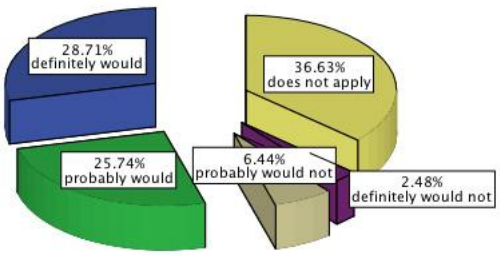
**If statement 1 was true,
I would start using headphones.**



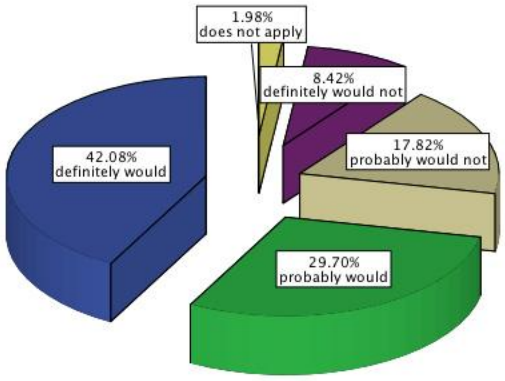
**If statement 1 was true,
I would restrict the amount of time
I spend on the phone.**



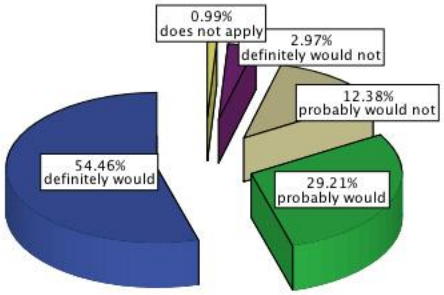
**If statement 1 was true,
I would start up a new land line
account for home use.**



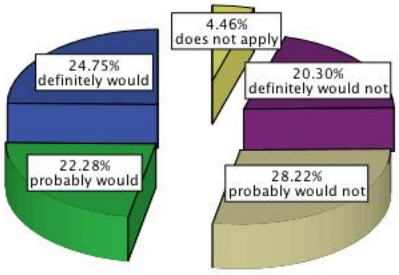
**If statement 1 was true,
I would restrict my children's cell phone use.**



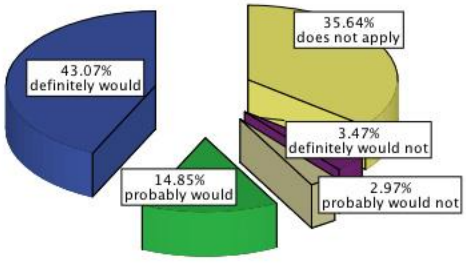
If statement 2 was true,
I would start using headphones.



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.



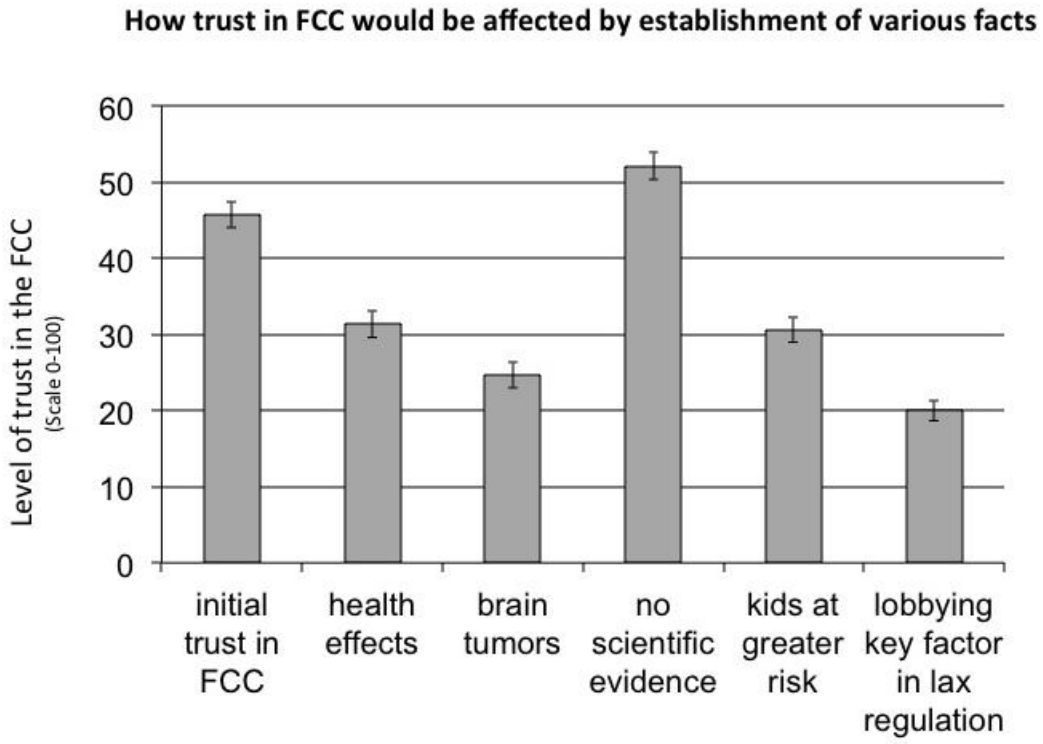
If statement 2 was true,
I would restrict my children's cell phone use.

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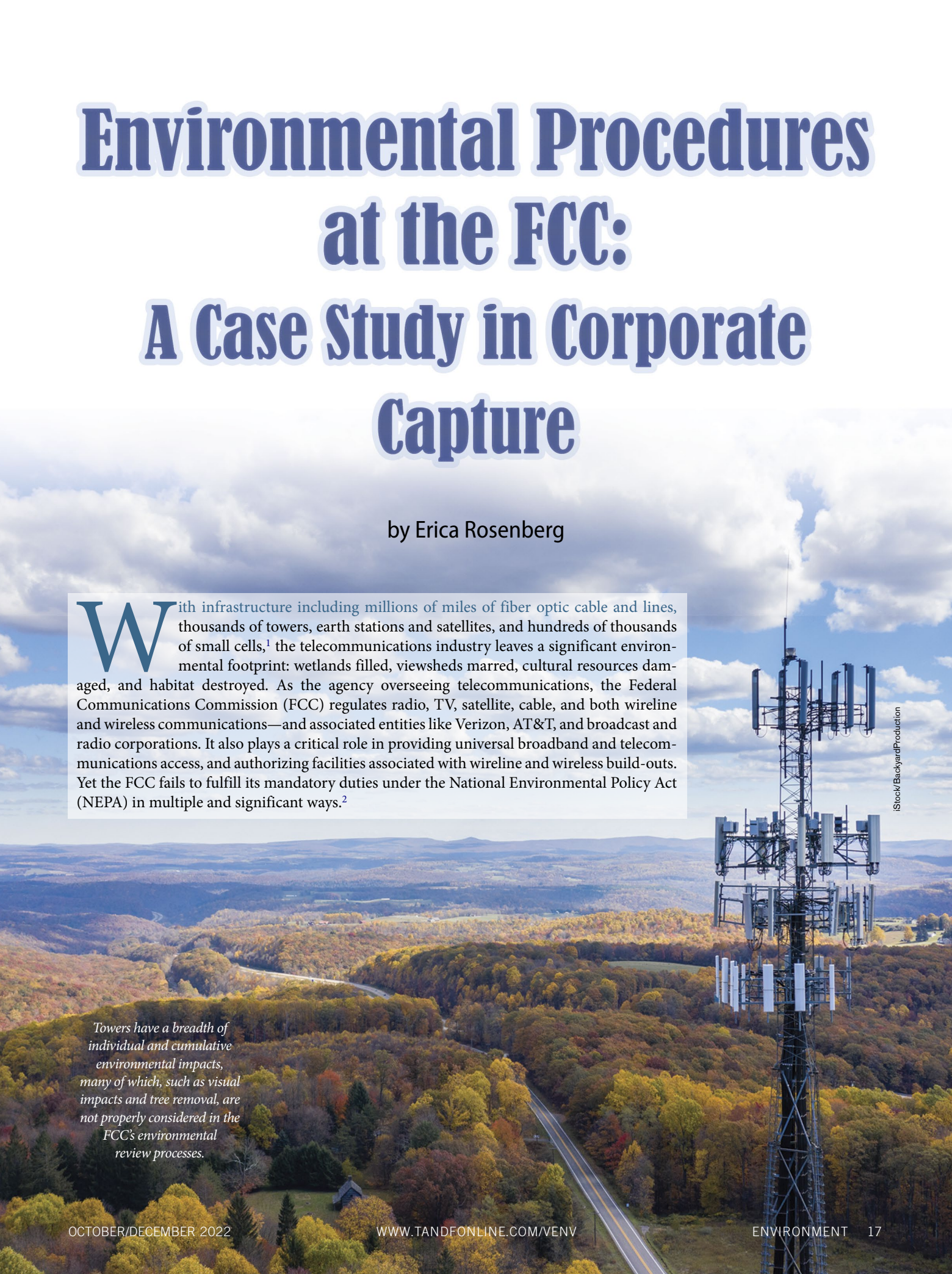
Environmental Procedures at the FCC: A Case Study in Corporate Capture

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]

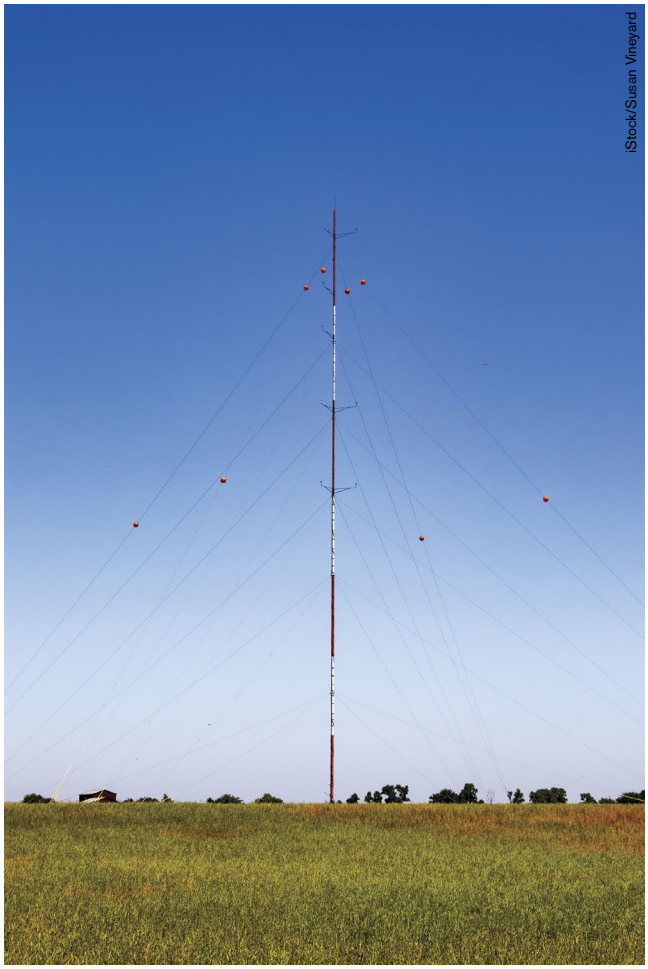
In dismissing the petition brought by an environmental nongovernmental organization to require more environmental review for a number of FCC actions, including those involving submarine cables, the 1974 order acknowledged environmental damage from cables in Maine and the U.S. Virgin Islands but illogically 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.*

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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

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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.

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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.

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Publisher's Note

Wireless technologies, non-ionizing electromagnetic fields and children: Identifying and reducing health risks

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Children today are conceived and live in a sea of wireless radiation that did not exist when their parents were born. The launch of the digital age continues to transform the capacity to respond to emergencies and extend global communications. At the same time that this increasingly ubiquitous technology continues to alter the nature of commerce, medicine, transport and modern life overall, its varied and changing forms have not been evaluated for their biological or environmental impacts. Standards for evaluating radiation from numerous wireless devices were first set in 1996 to avoid heating tissue and remain unchanged since then in the U.S. and many other nations. A wide range of evidence indicates that there are numerous non-thermal effects from wireless radiation on reproduction, development, and chronic illness. Many widely used devices such as phones and tablets function as two-way microwave radios, sending and receiving various frequencies of information-carrying microwave radiation on multiple simultaneously operating antennas. Expert groups advising governments on this matter do not agree on the best approaches to be taken. The American Academy of Pediatrics recommends limited screen time for children under the age of two, but more than half of all toddlers regularly have contact with screens, often without parental engagement. Young children of parents who frequently use devices as a form of childcare can experience delays in speech acquisition and bonding, while older children report feelings of disappointment due to 'technoference'—parental distraction due to technology. Children who begin using devices early in life can become socially, psychologically and physically addicted to the technology and experience withdrawal upon cessation. We review relevant experimental, epidemiological and clinical evidence on biological and other impacts of currently used wireless technology, including advice to include key questions at pediatric wellness checkups from infancy to young adulthood. We conclude that consistent with advice in pediatric radiology, an approach that recommends that microwave radiation exposures be As Low As Reasonably Achievable (ALARA) seems sensible and prudent, and that an independently-funded training, research and monitoring program should be carried out on the long term physical and psychological impacts of rapidly changing technological milieu, including ways to mitigate impacts through modifications in hardware and software. Current knowledge of electrohypersensitivity indicates the importance of reducing wireless exposures especially in schools and health care settings.

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Abbreviations: EMF, Electro-magnetic field; EMR, Electromagnetic Radiation; FCC, Federal Communications Commission (U.S.A.); ICNIRP, International Commission on Non-Ionizing Radiation Protection; IEEE, Institute of Electrical and Electronics Engineers; MF, Magnetic field; GSM, Global System for Mobile Communications; RFR, Radiofrequency radiation; SAR, Specific Absorption Rate (a measurement of the rate at which energy is absorbed into particular tissues, when exposed to RFR); SAM, Specific Anthropomorphic Mannequin (a physical model used to estimate SAR, based on a 220 pound male with a 12 pound head); HPG, Hypothalamic-Pituitary-Gonadal axis; HSP, Heat Shock Proteins; ORSAA, Oceania Radio Frequency Scientific Advisory Association; DECT, Digital Enhanced Cordless Telecommunications; ICBE-EMF, International Commission on the Biological Effects of Electromagnetic Fields; ELF-EMF, Extremely Low Frequency Electromagnetic Fields (0 − 3 kHz); CDMA, Code Division Multiple Access; UMTS, Universal Mobile Telecommunications System; LTE, Long Term Evolution; ROS, Reactive Oxygen Species

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Introduction. Children's exposures to wireless radiation are increasing rapidly

We live in the age of technological wonder, where the ability to respond to emergencies, engage in routine commerce, and even conduct warfare has been radically altered by wireless communications. At the same time, we are also in an age of technological imperatives; that is, the fact that something *can* technically be done has been misconstrued as an argument that this *should be done,* i.e., in favor of implementing that technology. Parents understand that—just because you *can* go skateboarding without a helmet and other protective equipment does not mean that is a *good* idea. From wireless baby monitors to the iPad potty for toddlers learning to use the toilet, Wi-Fi Barbie, tablets and cell phones, today's infants, toddlers, young children, and adolescents are surrounded by wireless technologies. None has been tested for their impacts on children. Especially when used at early stages of life these devices can interfere with social development, learning, and socialization. They also can have lifelong and potentially irreversible adverse biological effects.

"Children are not little adults and are disproportionately impacted by all environmental exposures, including cell phone radiation." American Academy of Pediatrics to the Federal Communications Commission (2013)[1]

Cell phones, tablets, and laptops typically operate as two-way microwave radios sending and receiving radiofrequency radiation (RFR) to and from internal and external antennas. Unchanged since 1996, RFR exposure standards for the use and operation of cell phones and other wireless devices rest on a crude physical model using an empty plastic ball for the head into which homogenous fluid is poured; this uniform medium cannot reflect the different densities and electromagnetic properties of developing physiology, morphology and tissues at different ages, and the greater vulnerability of infants, toddlers, and children. Health based standards have never been developed to take into account the vastly different technologies, uses and users employing devices today.

Although cellular communication systems and wireless technologies have demonstrated numerous direct benefits to society, they can also pose risks to the health and safety of the billions who are exposed to unnecessary levels of RFR throughout the life span. As demonstrated in this review, given the substantial experimental, epidemiological and clinical evidence that current levels of wireless radiation can be harmful, especially to the young, we concur with those experts who counsel that policies should be governed by the concept of ALARA—as low as reasonably achievable—while research continues to evolve.

The guiding principle of radiation safety, ALARA means avoiding exposure to radiation that does not have a direct benefit to you, even if the dose is small.[2]

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For more than a decade the American Academy of Pediatrics[3] and the American Academy of Child and Adolescent Psychiatry[4] advised that children age two and under have no screen time, yet infant and toddler use of devices is skyrocketing. That advice has now been modified to allow parentally supervised video calls for ages 18 to 24 months. The Pew Research Foundation surveyed parents in 2020 and 2021 and found that 8 out of 10 parents of a child who was age 11 or younger (81%) said their child had ever used a tablet computer in 2021 up from 68% in 2020[5]; 71% said their child had used a smartphone in 2021 (See Fig. 1). More recent numbers are sure to be higher, as the pandemic has led to increased reliance on digital

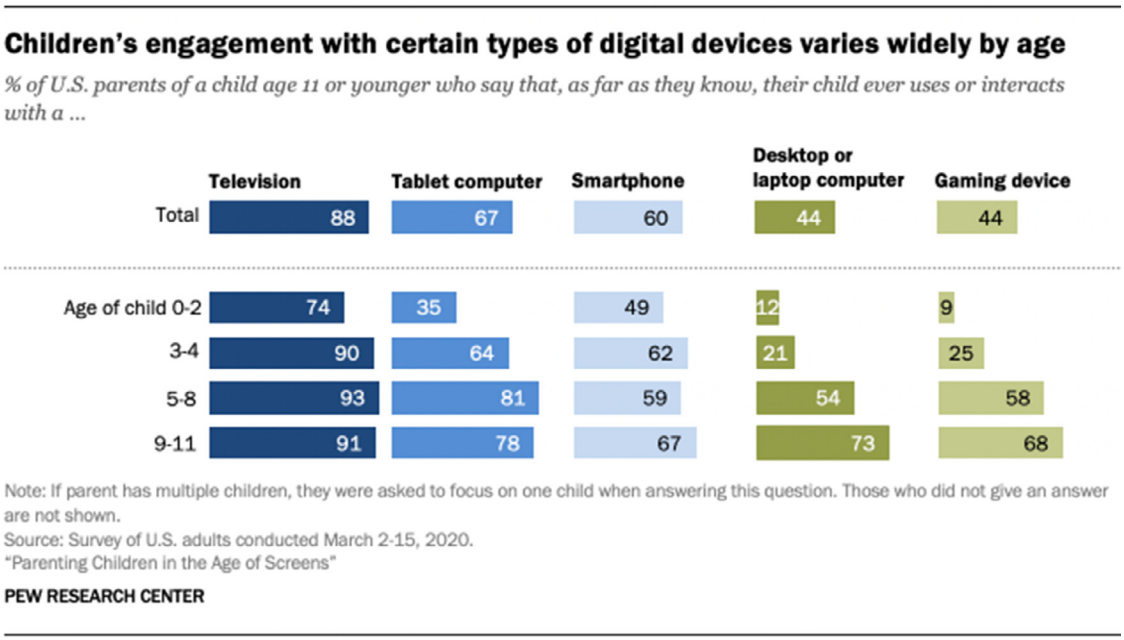

Fig. 1. Children's engagement with digital devices Survey 2020 by PEW Research Center. (For interpretation of the references to color in this figure legend, the reader is referred to the web version of this article.)

devices. Reports of serious behavioral problems including problems with self-control, socialization, language acquisition and the like have been associated with device addiction; and internet gaming disorder is on the rise in all age groups.[6]

Decades of research on RFR (including microwaves) indicate that everyday exposure to wireless devices can impact the physical, emotional and psychological health and well-being of adults and children.[7] A growing number of independent researchers find that while regulators, such as the U.S. Federal Communications Commission (FCC) and International Commission on Non-ionizing Radiation (ICNIRP) currently consider "low-level" exposures safe; these levels do in fact place children's endocrine, reproductive, and immune systems at risk. These current regulatory limits are based on the assumption that over-heating by high power RFR is the only established health effect to be avoided. Nevertheless, numerous studies find that nonthermal levels of RFR can cause major adverse effects such as induction of reactive oxygen species (ROS), DNA damage, cardiomyopathy, carcinogenicity, sperm damage, memory damage, and neurological effects.[8] As with many other chemical and physical hazards, there is evidence indicating that greater detrimental impacts take place when exposures occur during critical phases of growth and development, including pregnancy.[9]

Since the 1990s, member states of the European Union and the FCC have looked to the ICNIRP[10] and the Institute of Electrical and Electronics Engineers (IEEE)[11] for risk assessments and guidance on occupational and public exposure to RFR from all sources. These groups assume that only thermal effects (excessive heating) are to be avoided. In contrast, the International Commission on Biological Effects of Electromagnetic Fields (ICBE-EMF)[12] and the Oceania Radiofrequency Scientific Assessment Association (ORSAA),[13,14] among others, reject the assumptions on which ICNIRP relies, providing detailed grounds for their positions.[15] Moreover, the former editor-in-chief of the journal *Bioelectromagnetics*[16] contends that standards for evaluating wireless phones and other devices have not kept pace with developments in technology finding that nonthermal effects do occur and therefore current FCC standards do not protect public health.

Regulations on both sides of the Atlantic have in common that they are founded on risk assessments conducted in the 1980s and early 1990s by industry scientists and their affiliates in the IEEE. Despite a considerable weight of evidence indicating serious biological and environmental impacts of nonthermal levels of RFR, the FCC and the ICNIRP risk assessments of non-ionizing radiation from phones and other devices have remained unchanged for decades.

Several thousand apps have been developed for infants and toddlers to use on phones, watches and tablets with no research on their long-term physical or psychological impacts.

When phones were first brought to market, children's cell phone use was unheard of. Today children are exposed to wireless radiation from cell phones as well as numerous sources in their homes, child care settings and schools as shown in Fig. 2. Several thousand apps have been developed for infants and toddlers to use on phones, watches and tablets with no research on their long-term physical or psychological impacts. (Fig. 2)

This article assembles key scientific information regarding why and how to reduce wireless exposures to the young, including limiting prenatal and neonatal exposures. The latest scientific and clinical studies on the biological impacts of wireless radiation and models of exposure are considered briefly in terms of unexplained trends in cancer, autism spectrum disorder, learning difficulties, attention deficit, behavioral and psychiatric disorders, and other increasing pediatric disorders. Finally, health professional and U.S. national policy developments aimed at protecting children from inappropriate and harmful exposures are presented, with specific recommendations and practices for safer use of technologies.

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Electromagnetic radiation and biological effects

Radio communications lie at the heart of the cell phone and wireless radiation revolution via electromagnetic "radio waves" or RFR.

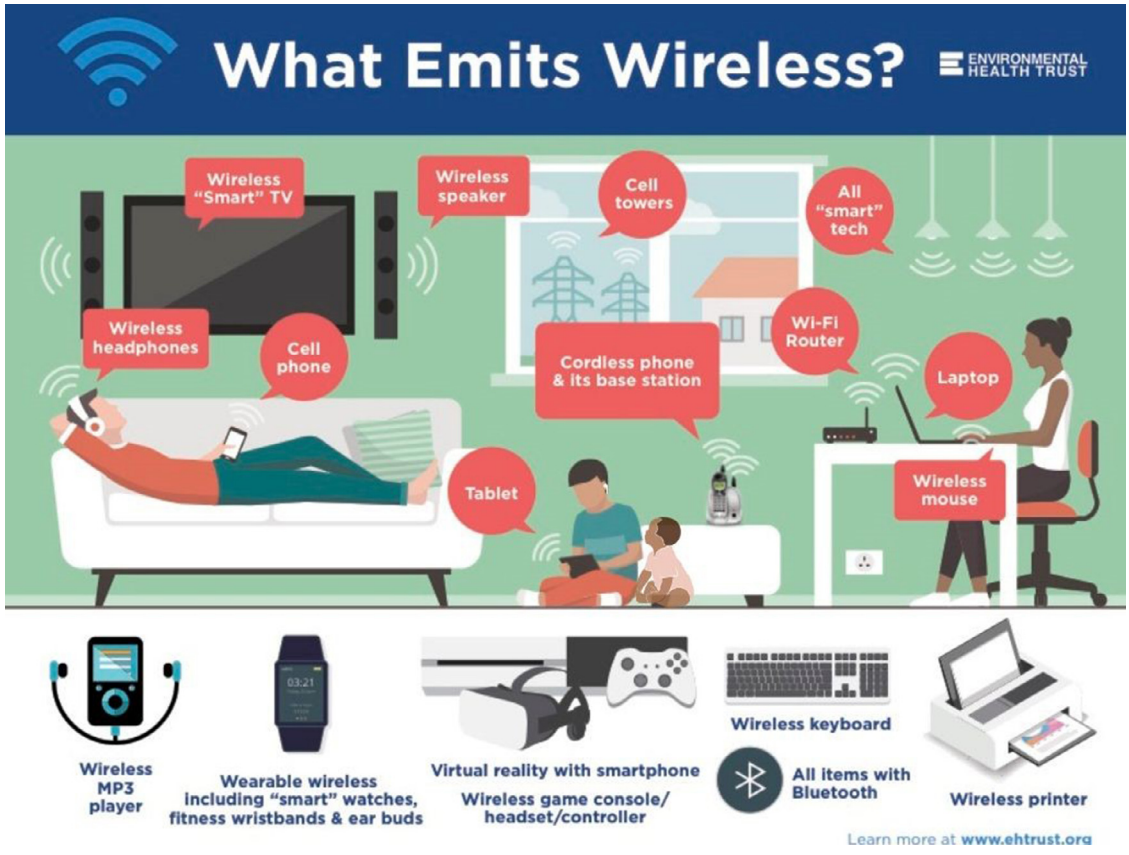

Fig. 2. Sources of wireless radiofrequency radiation in the home.

Electromagnetism

The theory of electromagnetism emerged in 1865 when James Clerk Maxwell unified Ampère's work on electricity, and Faraday's and others' work on magnetism into one unified theory.[17,18]

Simply put, an electric charge or the movement of electric charge (in electric currents through wires and devices) influences other charges or electrical currents at a distance. The influence, called a "field," results from attractive and repulsive forces between electrical charges. Positive and negative charges attract, while two charges of the same sign are forced apart. Of particular importance is how an oscillating charge creates a field that likewise oscillates, and this disturbance (called "radiation") propagates outward as a wave. Imagine a child flicking a skipping rope—the 'flick' propagates down the rope in the same fashion as the electric field propagates in the form of a wave. The theory was experimentally confirmed in 1887 by Heinrich Hertz.[19,20]

The duality of a wave is illustrated in Fig. 3. The oscillation can be described as a sine wave that depends both on the time and place of observation. The top frame of the Figure depicts the oscillation of the wave as seen by an observer standing in one place and looking over a period of time. One can imagine standing near the ocean and staring at a buoy as it undulates up and down as waves pass below. The bottom panel looks the same but depicts how at one instant in time the waves would look at every spot. Rather like standing on the same spot near the ocean and surveying open sea and all the waves before you. The characteristic features of the wave are its amplitude, A, its wavelength, λ (the distance between two sequential peaks) and its frequency, f (the number of oscillations per second, measured as Hertz [Hz] or reciprocal seconds [s^{-1}]). The relationship between these parameters, the cyclic frequency, ω, and the wavenumber, k, are illustrated in the Figure. Most importantly the multiplication of the frequency with the wavelength equals the speed of propagation, c.

Maxwell's theory predicted that the speed of light (visible light is a form of electromagnetic radiation) would be constant at 186,000 miles per second, confirming a measurement first made on earth (rather than by astronomical estimation as done by Ole Rømer and published in 1676[21]) by Hippolyte Fizeau in 1848.[22]

The frequencies of oscillation of electromagnetic waves can range from fractions of Hertz (a slow variation in field strength taking more than a second to complete) to billions of times a second. Each frequency can be exploited technologically in different ways and this is generally represented by the Electromagnetic Spectrum.

The electromagnetic spectrum

Physicians utilize electromagnetic radiation (EMR) in many forms. High-frequency, ionizing EMR is employed for diagnosis (e.g., X-ray and CAT scan imaging) and treatment (e.g., gamma-knife and other ionizing radiation treatments for cancer; non-ionizing ultraviolet radiation provides treatment of skin conditions such as psoriasis; infrared radiation is applied in physiotherapy and intensive care), while pulsed EMR are increasingly used in orthopedics and physical therapy. The electromagnetic spectrum includes visible light that forms a sliver of the spectrum (Fig. 4), with much of the remaining parts being invisible.

In public health, strong health and safety guidelines proscribe exposing infants and young children to the sun's rays beyond limited exposures. The problematic rays are found in the sun's ultraviolet (UV) light in the UVA and UVB frequency bands. While UVB is traditionally associated with direct DNA damage that leads to melanoma or less malignant forms of skin cancer, recent evidence indicates that UVA plays a greater role than previously assumed in the onset of skin cancers and can affect the immune system and other organs as well.[23] Other parts of the spectrum, especially that of blue light at 440 nanometers are used for their biological impacts on the skin to treat hyperbilirubinemia[24] by stimulating the production of di-hydroxy-vitamin D in the liver in jaundiced newborns. Untreated, the syndrome can result in bilirubin concentrations that can cause acute bilirubin encephalopathy and kernicterus– a permanent disabling neurologic condition. Blue light[25] is also known to interfere with sleep by impeding the production of melatonin, a natural hormone released by the pineal gland that is a potent anti-oxidant and free radical scavenger produced by sleeping in darkness.

Returning to the use of the spectrum for communication, the ability to transmit a travelling electrical field across space cannot itself establish a communication channel. For that to take place, information must be encoded into that transmission. The ability to code information on EMF was what Guglielmo Marconi

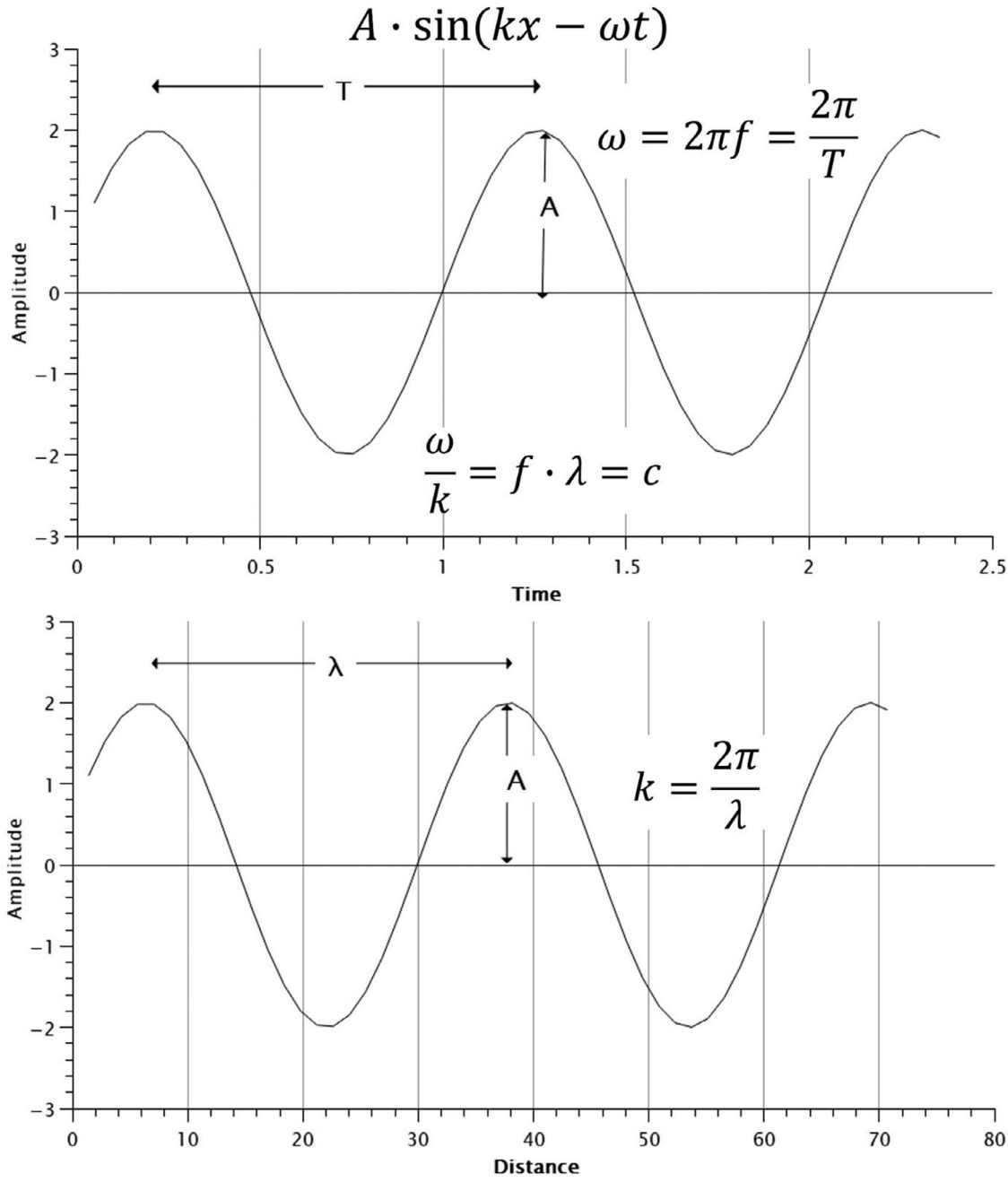

Fig. 3. Mathematical description of a continuous wave as a sine function. *A is the amplitude of the oscillation, f is the frequency, T is the time period for one complete oscillation, ω is the cyclic frequency (ω = 2pf) and k is the wave number.*

demonstrated in 1897[26] with his first transatlantic radio transmission.

Signals

The easiest way to encode information onto EMF is to turn the transmission on and off—Morse code in other words. Making a spark earned early Morse Code operators the moniker, "Sparky." Dots and dashes (a "digital" mode of communication) are comparable to the ones and zeros at the root of modern computing. More information can be transmitted by a careful modulation of the amplitude of the signal in proportion to the modulation of a sound, be it someone's

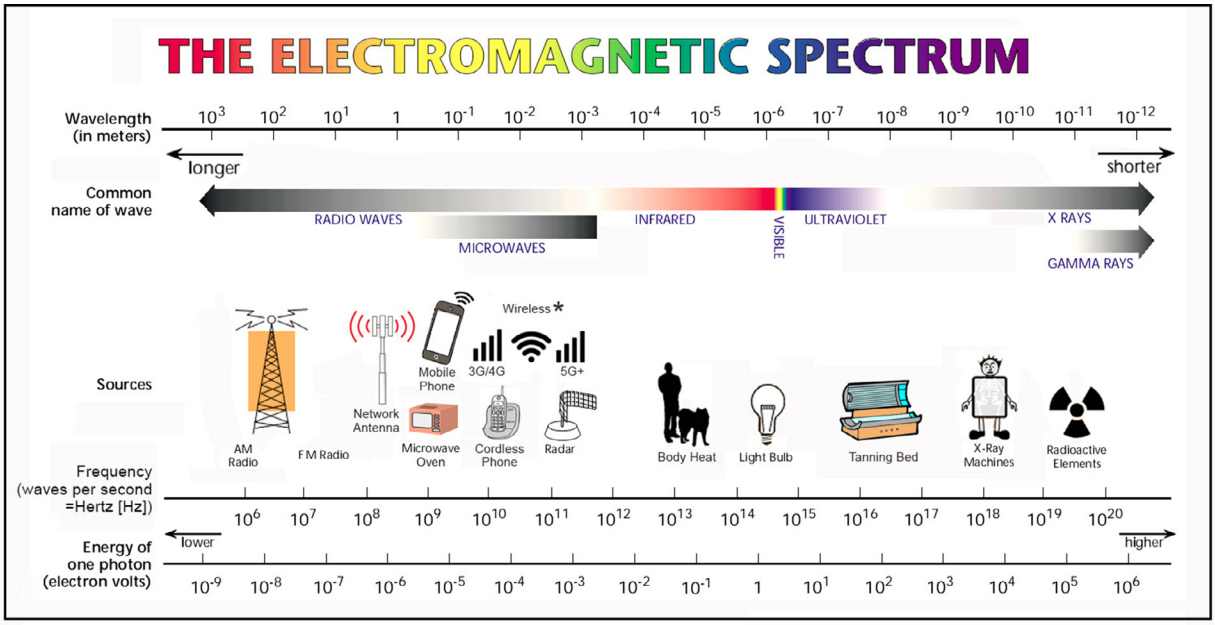

Fig. 4. Electromagnetic Spectrum

* Cellular and cordless phones; computers, laptops, tablets and peripheral equipment; antennae, Wi-Fi, access points and drones; monitors (e.g. security, medical, for babies); toys and entertainment systems; "smart" utility meters and appliances; control systems (e.g. indoor climate or lighting); "wearables"; power transfer/battery charging stations; and more. (For interpretation of the references to color in this figure legend, the reader is referred to the web version of this article.)

voice or music. This scheme, known as amplitude-modulated (AM) radio, dominated early radio and television broadcasts. However, there is a drawback with such a scheme in that only one operator can use the same radio frequency at a time. For two-way AM communication either, each side must wait for the other to stop and 'release' the frequency (hence the use of 'over' by radio operators) or there must be different carrier frequencies for each channel.

The first generation of cellular phones were little more than AM radio handsets working with 2 channel communication (by using a protocol known as Frequency Division Multiple Access[27] (FDMA) and transmitting to an antenna connected to the telephone network, often using relatively high powers of EMF, up to 5 Watts. Their transmissions could be famously picked up by ham radio operators, as the future King of England discovered to his chagrin, when an intimate conversation between then Prince Charles and his paramour, Mrs. Camilla Parker-Bowles was recorded by a scanner enthusiast.[28] Continuous analogue signals dominated telephone signals via copper wires that knitted together cities and countries, radio and television broadcasts right up until the early 1990s.

To overcome problems of limited exchange, and avoid interference and the embarrassment of royals, digital forms of transmission were introduced. The simplest form of digitization is to modulate a carrier signal, transmitting at a set frequency by multiplying it by zero or one. This is illustrated in Fig. 5.

The first panel in the Figure shows the base sinusoidal signal and is known as the "carrier frequency". The second panel is a digitization that turns on or off the signal. The bottom panel is the result of multiplying the two together, resulting in bursts - pulses- of transmission. A receiver tuned to the carrier frequency will translate the red envelope into ones and zeros, resulting in a digital series and information.

The increase in exposure to electromagnetic radiation

The quantity of data transmitted wirelessly and its associated radiation have increased many orders of magnitude since the inception of TV and radio programming. Rather than weekly anticipation of seeing a star on the Ed Sullivan Show or the next stage of a sitcom, we can now enjoy instant gratification with binge-watching, and endless offerings on many platforms, with important environmental implications,[29] including significantly increased energy and greenhouse gas emissions.

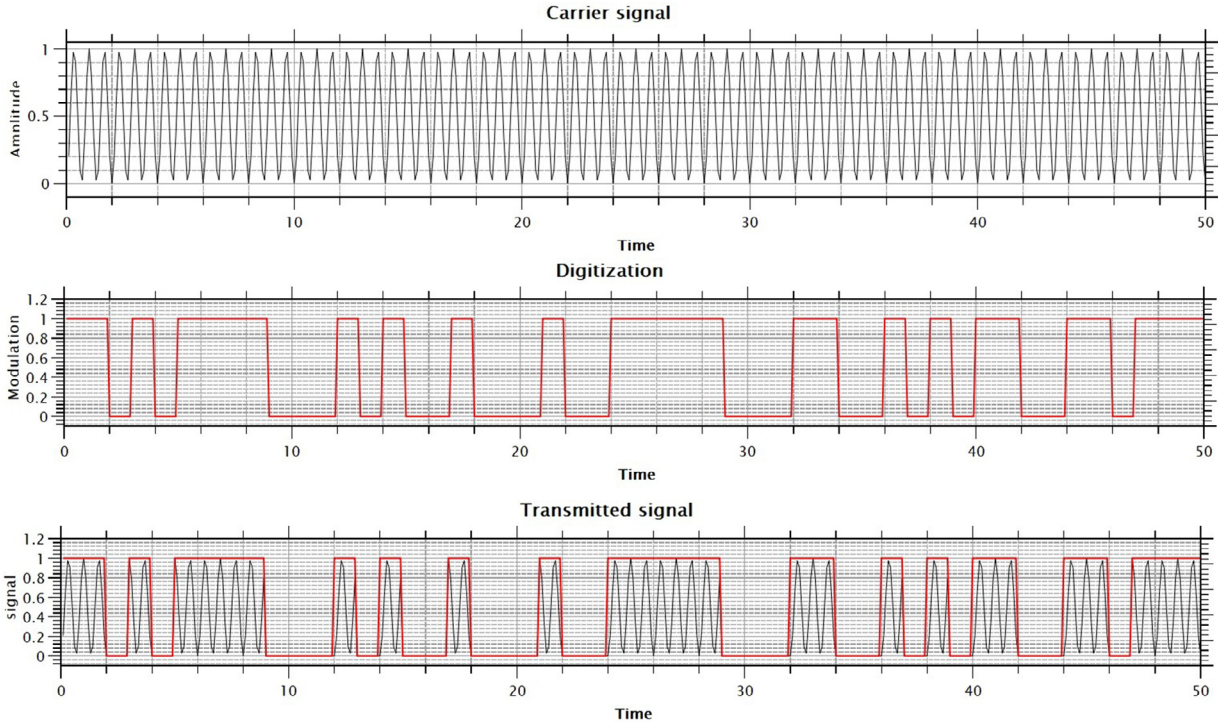

Fig. 5. A simple illustration of how a continuous carrier wave can be transformed into a pulsed signal for digital transmission. (For interpretation of the references to color in this figure legend, the reader is referred to the web version of this article.)

Since the inception of the mobile telephone age (the first commercial cellphone hit the marketplace in 1983[30]) 40 years ago there have been 5 generations of technological advances (see Table 1) culminating in the last 5th Generation (5G) Mobile networks. Each generation has led to consequent increases in exposure to EMR.[31] One often trumpeted claim is that the latest 5G networks will in fact be greener and reduce exposure levels. However, in discussing the energy implications of 5G rollouts, López-Pérez et al. noted in a recent survey that a 5G network may consume over 140% more energy than an equivalent 4G network.[32] Additionally, there is no corroborated evidence that 5G networks will reduce exposures. There are number of studies indicating the opposite will be true[33–36] Some industry experts report that ambient environmental exposures from near antenna installations from 5G and the densification of new wireless infrastructure can exceed those of current 3 and 4G networks up to 46 times.[33,37] 5G networks have multiple beam-forming antennas, located about every 100 m.[32] The public health and environmental impacts of 5G remain untested.

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Part of the reason for this increase in exposure with 5G is due to the fact that as higher frequencies are used atmospheric absorption and scattering increases. Because 5G frequencies operate along the millimeter wavelengths and signals cannot travel as far as previous systems, they are more prone to disruption from objects that interfere, such as walls and other barriers. Therefore, to maintain the same signal strength more base stations are required, a process known as "densification." Some estimates put the number of additional 5G base stations required for coverage in an urban environment to a 100-fold increase compared to an equivalent 4G network.[34] More base stations translate to more radiation. Another reason that greater exposures can occur is a

TABLE 1. Common cellular technologies and their respective frequency bands in the MHz (106 Hz) and GHz (109 Hz) ranges.[30]

Cellular technology	MHz frequencies	GHz frequencies
GMS (2G)	380 – 900	1.8 – 1.9
CDMA (2G & 3G)	400 – 900	1.8 – 2.5
UMTS (3G)	699 – 900	1.7 – 2.69
LTE (4G)	400 – 900	1.9 – 5.925
5G NR (5G) FR1	600 – 960	1.5 – 6.7
Bluetooth		2.4
Wi-Fi		2.45, 5 and 6
5G NR (5G) FR2	———–	24.25 – 71.0

The acronyms stand for Global System for Mobile communications (GSM), Code Division Multiple Access (CDMA), Universal Mobile Telecommunications System (UMTS), Long Term Evolution (LTE) and 5th Generation New Radio Frequency Range (5G NR FR). **Currently 5G NR FR1 is being nationally deployed, with limited applications of 5G NR FR2 being deployed in some major cities.**

result of the fact that the 5G standard relies on a new technological advance termed Multiple Input Multiple Output (MIMO) antennas. The number of users that can connect to a single base station increases by sharing out the frequency band to many more frequency channels (hence the requirement for higher frequencies) and by dividing the time each individual channel utilizes the same frequency band. In contrast to 2G to 4G standards, this division of frequency bands in 5G is multiplied by using beam-forming antennas. By using many small antennas and by closely timing individual transmissions on the same frequency, it is possible to form the signal into a tightly confined spatial beam from the base station directly to the user's 5G phone, 5G tablet or 5G computer. As long as 2 users are not standing together, they can both use the same signal frequency and not interfere with each other's transmission. These are known as "phased array antennas" and will form the heart of multiple beam-forming antenna and the need for MIMO in the 5G standard.[33] The electromagnetic frequencies utilized for wireless and cellular communications, from 1G up to 5G occupy the Megahertz (MHz) and Gigahertz (GHz) frequency ranges as depicted in Table 1.

How is EMF exposure quantified?

The metric used for measuring personal exposure from cell phones is called SAR (Specific Absorption Rate). It is a gauge of the rate of absorption of electromagnetic energy by the flesh of the user. Properly defined it is the rate of absorption of energy from a cell phone or other wireless device, measured in Watts per Kilogram (W/kg) averaged over a time period of 6 or 30 minutes distributed into a 1 g or 10 g volume within the plastic phantom 12-pound head of a large adult male filled with homogenous fluid or his 220-pound plastic body phantom. A local SAR of 1.6 W/kg is allowed for head and torso, and 4.0 W/kg is permitted for extremities which include the ear (the pinna).

Using a computer-controlled probe that dips into the fluid-filled phantom head (see Fig. 6), the electromagnetic field strength is measured at various points inside the model of 12-pound head of a large adult male. The SAR is then calculated by the equation,

$$SAR = \frac{\sigma \left| E \right|^2}{\rho} \quad (1)$$

where σ is conductivity of the saline solution at the frequency of interest, E is the electric field strength and ρ is the density of the media. The protocol of measurement is dictated by the IEEE standard C95.1-2019.[38] The human phantom is known as the Specific Anthropomorphic Mannequin (SAM) and is standardized by the IEEE.[39] The SAR rating has been criticized as under-estimating absorption for smaller persons and for children by a number of authors[40] because the dimensions of the SAM are based on a model of the 90th percentile of 1989 United States military recruits.[41,42,38] The homogenized saline liquid used to electrically mimic flesh cannot account for the varied and widely differing conductivities and densities of different tissues of different ages.[43] Underlying this model for estimating exposure is the assumption that the only harm that can be caused by an electromagnetic wave is heating of brain or body. In summary, if exposure heating results in a rise in core body temperature of less than 1 ˚C, then it is considered not hazardous. Criticisms of the SAR are further discussed in Section 7 on the need to update regulatory limits.

A further metric is the Ambient Power Density (PD), measured in Watts per square meter or milliwatts per square centimeter. The ambient PD metric measures the flow of electromagnetic energy per square meter from a distant source, such as a cellphone base station. In the US the safety limit for general public exposure to sources such as base stations, is set at 10 W/m^2 (sometimes quoted equivalently as mW/cm^2).

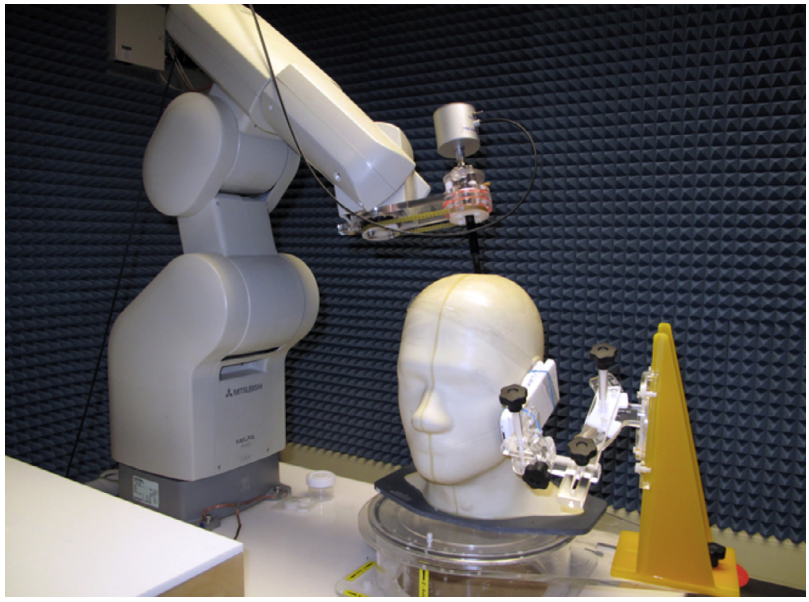

Fig. 6. Cell phone SAR RF test system using Specific Anthropomorphic Mannequin Model.

The origins of the ambient PD and the SAR regulations can be traced to the late 1950s when the U.S. Army and Navy became worried over potential harm to radar operators[44,45] from heating by carrying out studies on a handful of dogs, monkeys and rats. They had noted eye damage and burns from over exposure and the standard for PD was set at 10 W/m.[2,44,46] This became the established paradigm with the issuance of the first American standard in 1966 by the American Standard Association and then by the Institute of Electrical and Electronics Engineers (IEEE) for exposure to RFR and has remained ever since. Further research, including animal behavioral studies when exposed to EMF to a level that did not cause internal heating (of more than 1 ˚C) were used to confirm this initial assumption.[42] In 1996 the US Federal Communications Commission (FCC) set current guidelines for the allowable RFR exposure of the general public to RFR ranging from 300 kHz to 100 GHz (3G up to 5G and above).[47] based on a 1986 Report of the National Council on Radiation Protection & Measurements (NCRP) as well as the Institute of Electrical and Electronics Engineers (IEEE) C95.1-1991 standard.

In 2021, the U.S. Court of Appeals for the District of Columbia Circuit issued its judgment in* Environmental Health Trust et al v. FCC, *finding that the agency had failed to provide a rational record of review of all submitted science and specifically had not shown evidence of examination of studies provided to the agency on the greater vulnerability of children, the impacts of long term exposures, environmental impacts or the failure to update radiation test procedures for cell phones and other wireless devices which have not changed in more than 27 years.

Internationally, many national governments either take their cue for exposure levels from the FCC or from the International Commission for Non-Ionizing Radiation Protection (ICNIRP).[10]

A comparison of the allowed PD limits amongst counties is given in Fig. 7.

ICNIRP grew out of a working committee of the International Commission for Radiation Protection, a non-governmental organization representing professionals and bodies involved in radiation industries.[48]

Numerous publications have criticized ICNIRP as a close-knit invitation-only group that downplays and misrepresents research[49] indicating biological effects at nonthermal levels and

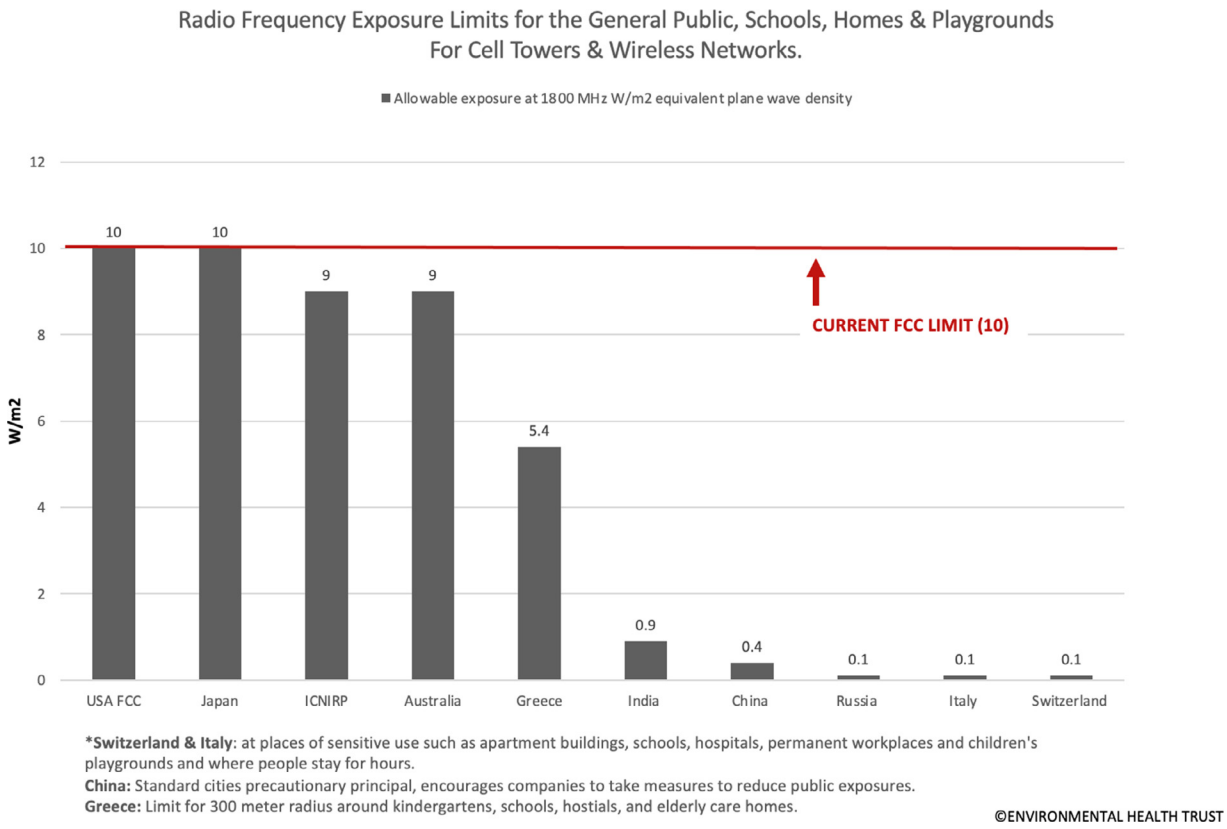

Fig. 7. Country variations for radiofrequency radiation exposure limits.

TABLE 2. ICNIRP and FCC SAR Limits in the U.S. and other countries

SAR Limits for Cell Phones and Wireless Devices	Whole -body average SAR (W/kg)	Head and Trunk * Localized SAR (W/kg)	Limbs and Extremities** Localized SAR (W/kg)	Examples of countries that adapted limits for cell phone and wireless device premarket tests
ICNIRP 100 kHz to 6 GHz All SAR limits averaged over 6 minutes. Local SAR averaged over 10 g of tissue.	0.4 W/kg 0.08 W/kg	Occupational 10 W/kg averaged over 10 grams tissue General Public 2 W/kg averaged over 10 grams tissue cube	20 W/kg averaged over 10 grams tissue 4 W/kg averaged over 10 grams tissue cube	Europe, Mexico, China, Greenland, Canada (for over 6 GHz), most countries in South America except Bolivia, most countries in Africa
ICNIRP (2020) >6-300 GHz *6 minute averaging *ICNIRP states, "Local Sab is to be averaged over a square 4-cm^2 surface area of the body. Above 30 GHz, an additional constraint is imposed, such that exposure averaged over a square 1-cm^2 surface area of the body is restricted to two times that of the 4-cm2 restriction."*	0.4 W/kg 0.08 W/kg	Occupational Local S_{ab} 100 mW/cm^2 General public Local S_{ab} 20 mW/cm^2		Australia
FCC Occupational, averaging time is 6 minutes. General public averaging time ranges from 6 minutes to 30 minutes.	0.4 W/kg 0.08 W/kg	Occupational 8 W/kg averaged over 1 gram of tissue cube General Public 1.6 W/kg averaged over 1 gram tissue cube	20 W/kg averaged over 10 grams tissue cube 4 W/kg averaged over 10 grams tissue cube	United States, India, Panama, Korea, Vietnam, Canada (for under 6 GHz), Iran, Republic of Bolivia, Cuba

ICNIRP's Head and Trunk tissues have both Type 1 and Type 2. ICNIRP defines Type 1 as all tissues in the upper arm, forearm, hand, thigh, leg, foot, pinna (visible portion of the outer ear) and the cornea, anterior chamber and iris of the eye, epidermal, dermal, fat, muscle, and bone tissue. ICNIRP defines Type 2 tissues: all tissues in the head, eye, abdomen, back, thorax, and pelvis, excluding those defined as Type-1 tissue. *Limbs do not contain any Type-2 tissue.

****FCC defines extremities as hands, wrists, feet, ankles, pinna/ ear.**

instead self-references its own commissioners, many of whom have a history of conflicts of interest.[50,51] ICNIRP and FCC limits for SAR are summarized in Table 2.

Despite innumerable studies demonstrating nonthermal biological effects of RFR, discussed below, ICNIRP and IEEE do not recognize non-thermal impacts as sufficiently "established" to be relevant to exposure limits.[7,8,31] Numerous scientific expert groups[7,29,52] such as ICBE-EMF and ORSAA emphatically do not agree with this view. Yet, the FCC reaffirmed their guidelines in 2019, by the expedient of simply reconfirming the existing 1996 standard.[53,54]

In 1996 the US Federal Communications Commission (FCC) set current guidelines for the allowable RFR exposure of the general public to RFR ranging from 300 kHz to 100 GHz (3G up to 5G and above).[47] This led to legal action against the FCC because more than 11,000 pages of published scientific studies and expert recommendations had been submitted to the FCC regarding the need to strengthen its RF exposure guidelines.[55] The FCC failed to provide a rational record of review of submitted science, and specifically did not take into account evidence on the greater vulnerability of children or environmental impacts. Human exposure limits and radiation test procedures for cell phones and other wireless devices have not changed in more than 27 years.

Public exposure limits for radiofrequency radiation from cellphone towers in Italy, Switzerland and Russia are 100 times lower than those of the U.S., last set in 1996.

The World Health Organization (WHO) maintains a dedicated EMF project[56] which collates national government regulations[57] and offers advice to national government agencies. However, the WHO EMF Project has not performed health risk assessment of radiofrequency electromagnetic fields since 1993[58] and several have questioned its independence as well as its role in the global harmonization of EMF standards.[59,60] The World Health Organization International Agency for Research on Cancer (IARC) constitutes a separate entity from the WHO EMF project. IARC classified RFR as a class 2B possible carcinogen in 2011.[61] Within the past few years, the IARC advisory group has recommended a re-evaluation of the body of evidence on cell phone risks to human health, in light of mounting evidence of adverse impacts discussed here.

Public exposure limits for radiofrequency radiation from cellphone towers in Italy, Switzerland and Russia are 100 times lower than those of the U.S., last set in 1996.

Since 1996, measurement of radiation permitted from any particular cell phone is made by testing temperature changes inside a plastic phantom 12-pound head of SAM (Specific Anthropomorphic Mannequin), filled with homogenous saline liquid to mimic the human brain with its diverse tissues and densities, making a 6 to 30 minute phone call, with a spacer between the head and the tested phone to allow for the ear/pinna.

Since 1996, measurement of radiation permitted from any particular cell phone is made by testing temperature changes inside a plastic phantom 12-pound head of SAM (Specific Anthropomorphic Mannequin), filled with homogenous saline liquid to mimic the human brain with its diverse tissues and densities, making a 6 to 30 minute phone call, with a spacer between the head and the tested phone to allow for the ear/pinna.

Physical mechanisms of the interaction of RFR and tissues

New 5G networks are using the frequencies of previous generations, but they can in addition employ higher submillimeter and millimeter wave frequencies. The higher the frequency, the less the radiation penetrates the body, but less penetration does not mean little or no biological impact. To the contrary, UVA and UVB are entirely absorbed in the skin, and can cause important immunological effects throughout the body including on the production of vitamin D. Indeed, immune effects of UV skin exposure can have consequences for the liver, kidney and other major organs, just as do the lower MHz and GHz frequencies that can penetrate deeper into the

body. Importantly, man-made RFR used in wireless and medical devices can be modulated, polarized and pulsed, which greatly influences and can alter their ultimate impacts.[62,63] Electroceuticals constitute an expanding field of clinical applications involving a range of medical devices, from pain control in orthopedics to cancer treatment, biofeedback, and the use of low-strength pulsed electromagnetic fields.[64] As with pharmaceuticals, any agent that promotes healing may also promote illness. It is therefore pertinent to explore potential mechanisms of interaction between tissues and electromagnetic waves.

An important division in the spectrum happens at a frequency of approximately 10^{15} Hz (wavelength 10^{-8} m). While Maxwell's theory, as described above, considers light as classical waves, modern quantum theory embraces a dualism in considering light as both a particle and concurrently as a wave.[65] One can consider an oscillating packet of waves confined spatially and moving as one through space. This is known as a photon and the energy it contains is proportional to the frequency of its oscillation. As the frequency is reduced and wavelengths get macroscopically longer (the wavelength of visible light is measured in hundreds of nanometers, whereas of radio waves in the MHz range the wavelengths are measured in hundreds of meters) the quantum description of light is indistinguishable for the classical theory of Maxwell.

The energy inherent in a photon of light at frequencies of UV and above is enough to cause the ionization of biological molecules. That means that the absorption of the photon by the molecule can result in the breaking of chemical bonds, leading to the destruction of the molecule. Specifically for DNA such an occurrence can lead to the promotion of cancers. At frequencies of radio waves direct ionization of DNA or other molecules cannot happen.

Physical mechanisms of the interaction of RFR and tissues

At the submicroscopic level molecules can be regarded as collections of potentially charged atoms held together by chemical bonds as they share electrons. RFR also affects atoms that tend to be charged; either positively charged "cations" (sodium Na^+ or calcium $Ca^{2+}$for example) or negatively charged "anions" (chloride Cl^-). Consequently, bonds will react to an external electromagnetic field, even if its frequency is not high enough to lead to direct ionization. One can view such a perturbation as gently "nudging" ions. Under certain conditions bonds can change and form new chemicals. Indeed, microwaves are used commercially to speed up and alter products of chemical reactions using "microwave catalysis".[66] Dysfunctional chemical reactions can lie at the root of many distinct forms of ill health for living organisms.

Biological pathways for non-ionizing effects

There are several pathways[67–71] that may be involved in biological effects of RFR, including the induction of ROS leading to oxidative stress, activation of the ERK1/2 signaling pathway, and induction of heat shock proteins. One of the more accepted pathways to damage is the perturbation of Voltage Controlled Calcium Gates (VCCG) by pulsed EMF.[72] VCCGs are an integral part of cell membranes that are responsible for the transport of Calcium ions across the cellular membrane for signaling and regulation of the cellular homeostasis. In 2000 Panagopoulos et al. concluded that the ELF EMF components of wireless communication signals are a critical factor in understanding how exposures can lead to pathology.[72,73] Repeated irregular gating of electro-sensitive ion channels disrupts the cellular electrochemical balance and homeostasis leading to the overproduction of reactive oxygen species. The cascading effects of repeated exposures can lead to numerous biological endpoints including the weakening of cell membranes.

Disturbance in ROS homeostasis leads to a pathological state[74] termed "oxidative stress", which plays an essential roles in regulation of cancer progression. ROS are understood to regulate every step of tumorigenesis and have been found to be upregulated in tumors; this can lead to aberrant signaling. In addition to cancer, oxidative stress plays a role[75] in the development of many other chronic diseases, including diabetes and neurodegenerative syndromes. Reviews of animal and cell studies consistently find even very low non-ionizing EMF exposures are associated with increased oxidative stress. Children whose immune systems are still developing are more vulnerable to these ROS effects.[76,77] In 2019 Lai found strong indications that exposure to static and extremely low frequency electromagnetic fields also affects oxidative status in cell cultures and experimental animals.[67–72]

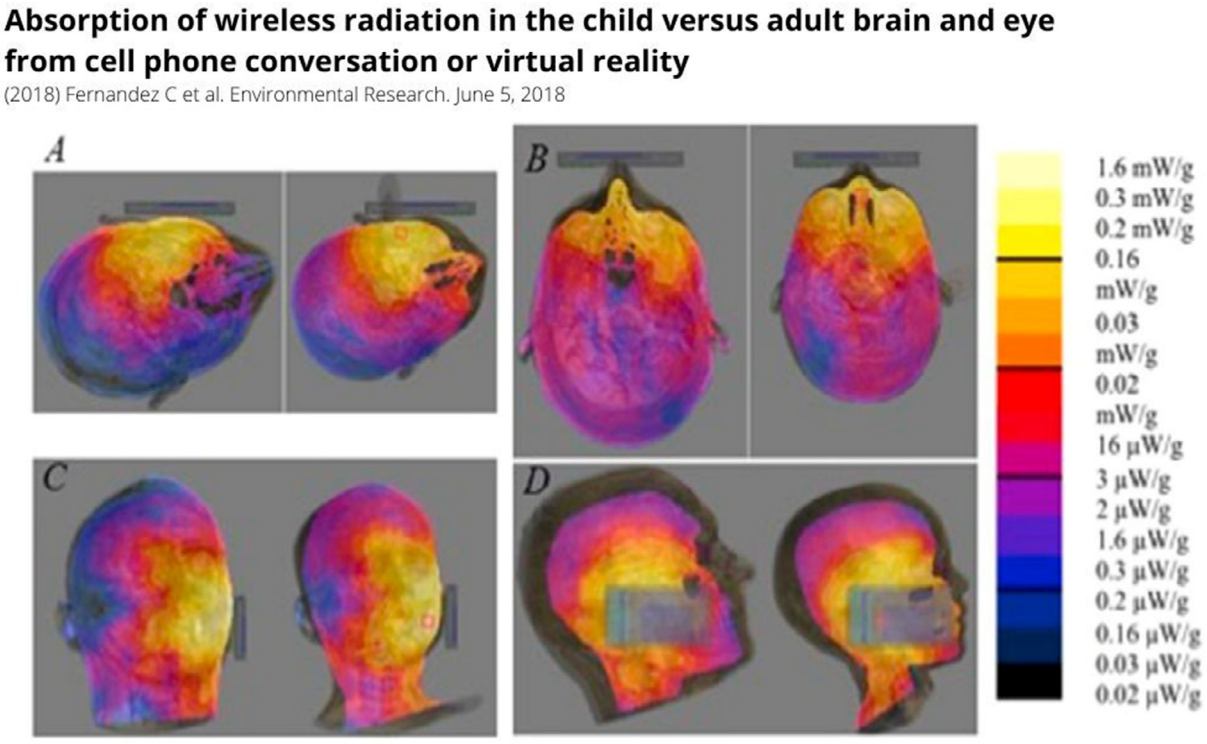

Fig. 8. Absorption of wireless radiation in child vs adult brain and eye from cell phone or Virtual Reality.[70] (For interpretation of the references to color in this figure legend, the reader is referred to the web version of this article.)

Children's unique vulnerability to wireless radiation

Children are more vulnerable to wireless radiation,[78–81] just as they are to other environmental pollutants[9] and medicines. Present and future generations will have many more hours of cumulative lifetime exposure to RFR, because exposures begin prenatally and continue throughout early and later life.

Children have a unique physiology, that results in proportionately greater RFR absorption compared with adults.[4] Children have smaller heads, resulting in shorter distances for RFR to travel to reach critical brain regions, and their brains contain more fluid that can absorb relatively more energy from radiofrequency radiation sources. Fig. 8[70] shows that simulations of exposure from cell phone use have determined that children absorb up to 10-fold greater RFR in the pediatric cerebellum, 10-fold greater in the bone marrow of the skull and up to 30-fold greater in the hippocampus.[82] Children's eyes can absorb 2 to almost 5-fold higher doses.

Children absorb proportionally more RFR than adults; about 2-fold greater in the pediatric cerebellum, ten-fold greater in the bone marrow of the skull and up to 30-fold greater in the hippocampus. Children's eyes can absorb 2- to almost 5-fold higher doses than adults.

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Children's brain and body tissues have a higher dielectric constant, a measurement of the ease with which electromagnetic fields can move through different media. Peyman[83] documented how the young brain has a higher dielectric constant due to the higher water content and less developed myelin sheath. Bony tissues also change over time depending on the degree of mineralization of the bone matrix. The largest age-dependent variation in dielectric properties is observed in bone because as an animal grows, the high water content of red marrow is transformed to the high fat content of yellow marrow.

Every tissue in the body has unique dielectric properties. For example, the distinctive dielectric properties of normal and cancerous breast are being employed to enhance detection of abnormal cells[84] and to devise EMR-based treatments for the disease.[85]

Pregnancy, infancy and childhood are periods of critical susceptibility, especially for the brain, which is developing rapidly.[86] Children have a faster rate of neuronal cell growth and the fatty protective sheath of myelin is not fully formed until the mid-20s.[87] Even very low levels of an environmental exposure early in development can have lifelong implications for neurodevelopment. Stem cells[88] are more active in children and have been found to be more sensitive to wireless frequencies than differentiated cells.[88]

Cell phones and wireless devices have premarket RF emission tests using the large adult SAM model, with an empty twelve pound head into which homogenous fluid is poured. Devices are not tested using a child's smaller head and body, nor with models of pregnancy.[42] Devices are also tested at a distance from the body, without direct contact between the antenna and the body or skull. This is why most smartphones, Wi-Fi devices and other wireless electronics have instructions, deeply buried in user manuals, which advise that devices be kept at a distance from the body.

Fig. 9[77] shows the radiation pattern simulated from a Wi-Fi tablet into the head of a 6 year old.

Reproduction and pregnancy

Reproductive capacity

Several, but not all reviews[89] of the effects of EMFs on male and female reproductive function have identified numerous serious effects that occur at levels of RFR that do not heat tissues. Gye and Park[90] and Jangid et al.[91] present a number of *in vivo* and *in vitro* experimental studies demonstrating that non-ionizing nonthermal EMF exposure can alter cellular homeostasis, endocrine function, reproductive function, and fetal development. Impacts on both male and female reproductive parameters have been reported, including: male germ cell death, the estrous cycle, reproductive endocrine hormones, reproductive organ weights, sperm motility, early embryonic development, and pregnancy success.

Mechanisms that appear to be involved at the cellular level include increases in free radicals and calcium ions [Ca^{2+}] related to effects of EMFs, which lead to cell growth inhibition, protein misfolding and DNA breaks.

Reproductive parameters reported to be affected by EMF include male germ cell damage and death. Females may experience impacts on the estrous cycle affecting ovarian follicles, reproductive endocrine hormones and reproductive organ weights. Effects on reproduction include impairments of early embryonic development, fertilization, miscarriage and a variety of pregnancy-related outcomes. As with other endpoints, experimental effects on reproductive function differ according to frequency, polarity, wave-form, strength (energy), and duration of exposure.

A robust body of research on the male reproductive system specifically has found decreased testosterone[92] as well as impacts to sperm viability,[93] motility and morphology[68,94–100] from current levels of RFR resulting from use of cell phones or other devices.

The induction of oxidative stress[101] is understood to be a key pathway of action that underlies the biological impacts of RFR on the reproductive organs and also can play a major role in the induction of cancer as discussed below.[101] At the cellular level, increased free radicals impact mitochondrial metabolism and affect nitric oxide levels and antioxidant mechanisms.[102] RFR may alter membrane transport and integrity, affecting ion (e.g., calcium) transport; these are among mediators of effects of EMFs that lead to cell growth inhibition, protein misfolding and DNA breaks. See Fig. 10.[56,92]

Acute exposure can stimulate plasma membrane NADH oxidase and increase the production of ROS. Increases in ROS can stimulate endothelial growth factor (EGF) receptors which in turn activate extracellular signal regulated kinase (ERK) pathways. The ERK pathway consists of subsequent activation of

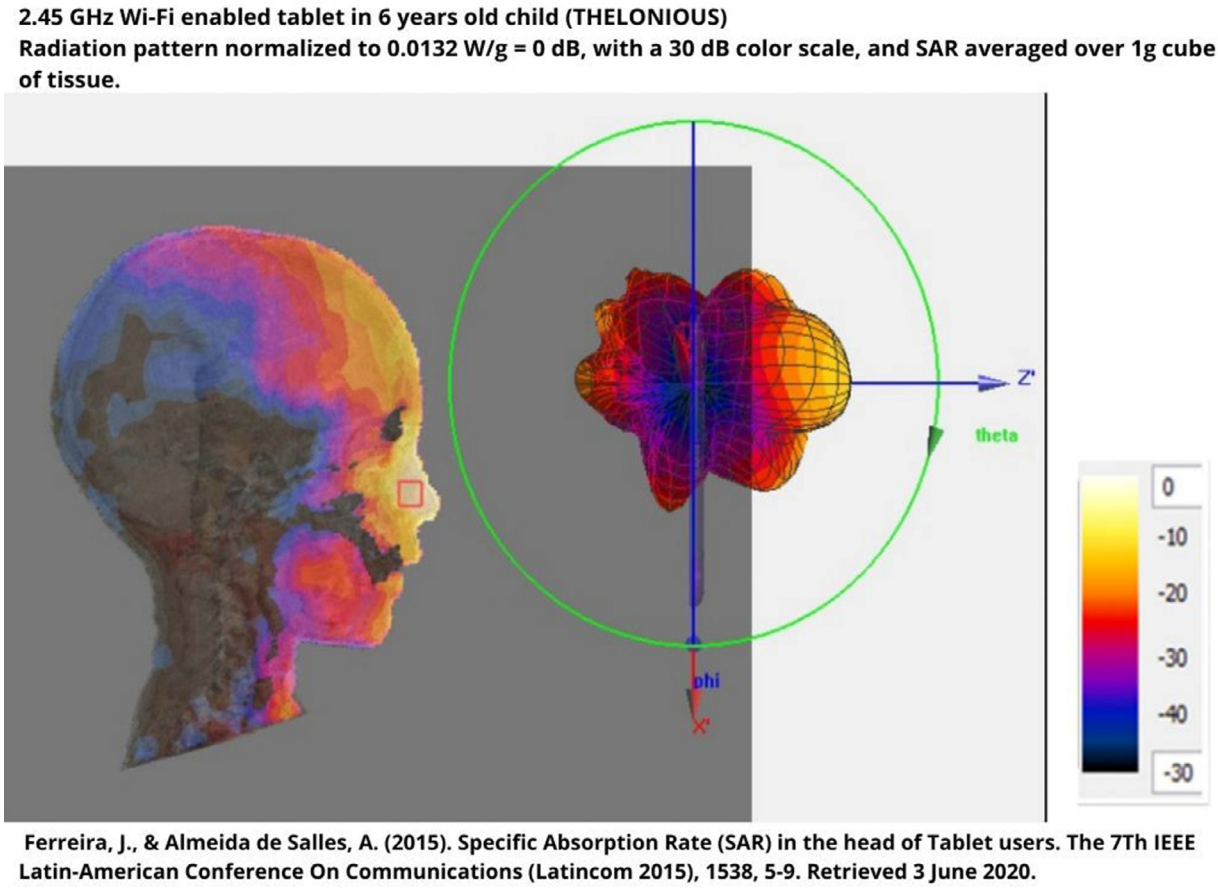

Fig. 9. Radiation pattern from 2.45 Wi-Fi enabled tablet into model of 6-year-old head. Radiation pattern normalized to 0.0132 W/g = 0 dB, with a 30 dB color scale, and SAR averaged over 1g cube of tissue.

Ras, Raf proteins, and mitogen-activated protein kinase (MAPK). The MAPK pathway also has a tumor promoting role. Chronic exposure to ROS can activate various stress kinases (p38 MAP kinase), stimulate the ERK pathway, and also lead to phosphorylation of heat shock proteins (Hsp) that inhibit apoptosis, thereby promoting survival of damaged cells and carcinogenesis. Hsp can increase the permeability of the blood-testis barrier and produce infertility. RFR also can interfere with membrane calcium channels and promote cancer by stimulating ornithine decarboxylase, a rate-limiting enzyme in polyamine synthesis.

Pregnancy is a critical window of vulnerability

In both animals and humans, prenatal EMF exposures have been linked with impaired development of structures and functions of the brain, as well as the reproductive organs and reproductive capacity of offspring. Experimental and epidemiological evidence indicates that prenatal impacts could range from impaired oogenesis and spermatogenesis, to reduced volume and number of brain pyramidal cells, other serious neuronal impairments, ovarian dysfunction[103] as well as increased DNA damage in multiple organs[104] of offspring.

Damage to oocytes in female offspring can in turn affect fertility as well as the health of following generations. Daily exposure of young Sprague-Dawley female rats for 2 h of GSM radiation for 1 and 2 months produced inflammation and impairment of ovarian function[103] consistent with endometritis, a growing problem for young adolescents. Intergenerational impacts are increasingly being understood; a 2021 study of more than 200 mother-daughter-granddaughter triads, found that granddaughters of those who had been in the top third of DDT exposure during pregnancy had 2.6 times the chances of having an unhealthy body mass index by their mid-twenties and

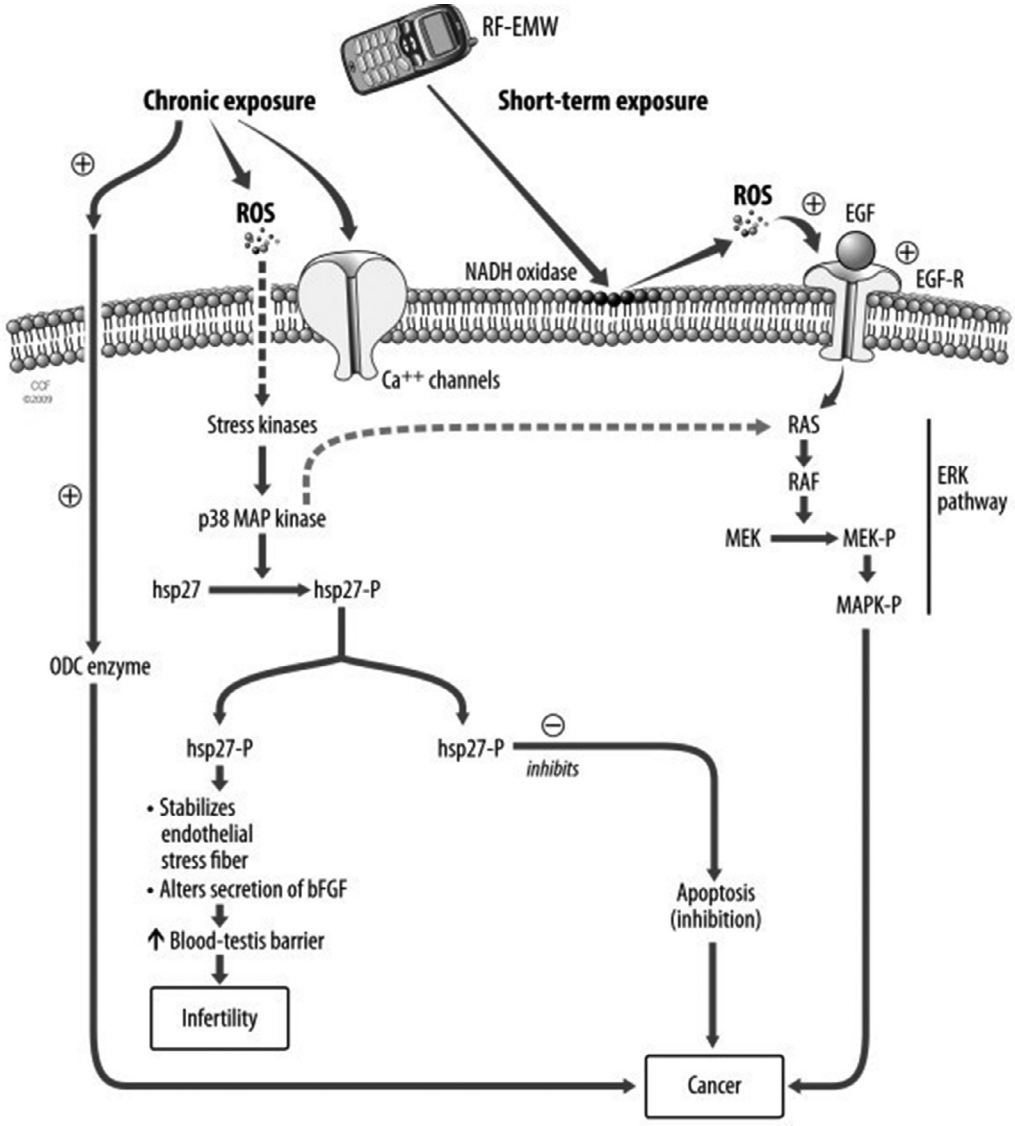

Fig. 10. Acute and chronic impacts of cell phone radiation on male reproduction. The Figure shows various acute and chronic cellular targets of radiofrequency electromagnetic waves (RF-EMW).[56,92]

were more than twice as likely to have started their periods before age 11—both of which increase their chances of developing breast cancer and other chronic illnesses later in life.[105]

Toxicological evidence of adverse impacts of RFR

Experimental studies form the foundation for evaluating pharmaceutical agents and other chemical and physical environmental exposures that can affect pediatric health. *In vitro* studies of well-established animal cell lines and human cell lines constitute one effective source of information that can be used to predict and prevent harm in humans. Employing validated rodent and other models, both short term and long-term *in vivo* studies on rodents and other animals are employed to clarify physiological consequences of exposures.

Studies of prenatal impacts can yield information on birthweight along with longer term consequences for health of offspring into adulthood. While the key male role ends at fertilization, damage to sperm *in utero* may have transgenerational effects on offspring.[106] There is growing evidence that male-mediated factors

relating both to preconception and fertilization, as well as prefertilization and perifertilization exposures also play roles in determining health outcomes of progeny. In addition, early-life RFR exposures have been demonstrated to cause a range of negative impacts on male and female reproductive health, including damage to the testicular proteome[107] and low birthweight. After a month of 4 h daily controlled exposure to nonthermal levels of cell phone radiation, signaling proteins in the rat testes and sperm production were significantly altered, indicating impaired reproductive function and increased cancer risk.

Experimental studies are especially useful in understanding the roles of avoidable early-life environmental exposures on outcomes that affect children and adolescents, since controlled human studies are unethical. As a result, most human studies that can be used to clarify the impact of RFR are observational. Frequently, such studies are opportunistic, complex and expensive, and also challenging to interpret with poor quality longitudinal data, and limited exposure data, particularly with evolving uses of ever-changing technologies. In the real world, children are exposed to numerous sources of RFR at various frequencies and modulations throughout their daily lives. Smart phones can operate with 5 or more antennae simultaneously sending and receiving radiation to and from towers or routers, as most apps are set to update automatically. Yet, most experimental studies only look at a single frequency at a time.

Prenatal exposures and the central nervous system

Over the past two decades a number of experimental investigations have found that prenatal exposure to some EMF negatively affects both the structure and function of the adult central nervous system (CNS).[108–110] As an example, a series of experiments by Odaci, Bas and Kaplan and colleagues measuring impacts through stereological analysis demonstrated that rodents exposed prenatally to 900 MHz had fewer cells and more indications of damage in various brain regions of the hippocampus responsible for learning and memory.[111] Likewise, studies on postnatal exposures of 8 week old rats also found impacts on hippocampal pyramidal cells.[112,113] This team also found prenatal and postnatal impacts occurred to the Purkinje cells in the cerebellum. The cerebellum is critical to memory, balance and impulse control and appears especially vulnerable to RFR. Others have hypothesized that RFR might also alter the membrane current of Purkinje cells within the cerebellum. Haghani et al. evaluated properties of Purkinje cells[108] following prenatal exposure to 900 MHz EMF and found that exposed progeny had significantly reduced spontaneous cell firing. While these areas of the brain have been well characterized after prenatal EMF exposure, it is likely that many other areas of the brain are similarly affected.

Prenatal exposures in humans alter behavior and cognition in offspring

Although they are few in number, human studies investigating *in utero* exposure to wireless and other non-ionizing EMF have found a variety of adverse effects on pregnancy outcomes as well as the health of offspring regularly exposed to EMF or EMF/RF.

Several studies by a team from Kaiser Permanente lead by Dr. De Kun Li report a range of impacts to pregnancy and offspring. They measured pregnant women's exposure to magnetic fields (MF) early in pregnancy using an EMDEX Lite meter (Enertech Consultants Inc.) that measures magnetic field MF exposure for 24 h during a typical day, and providing a detailed diary of activities to allow the researchers to: (1) identify locations of daily activities (at home, at home in bed, in transit, at work, and other); (2) verify if activities were reflective of a typical day; and (3) examine if locations and activities were associated with high MF exposure. Women and their progeny were followed over several years. After controlling for multiple other factors, they found that women who were exposed to higher MF levels had 2.7 times the risk of miscarriage compared to those with lower MF exposure, a finding that corroborated earlier research by the same team.[114] Later publications also found higher *in utero* MF exposures associated with childhood obesity, asthma, and ADHD.[115–117] Similarly designed research[118] that measured MF exposure with the EMDEX meter found lower neural volume and bud length, measured by ultrasound, in embryos of women with higher workplace and other exposures to EMF, who were seeking induced abortion of unwanted pregnancies that were terminated in the first trimester. Women in the top quartile of MF exposure had a four-fold increased risk of a shorter embryonic bud length than those in the bottom quartile.

Greater habitual self-reported maternal mobile device use was associated with less infant recovery upon reunion.[119]

Behavior and cognition in children and adolescents affected by cell phones

Researchers at the University of California School of Public Health in Los Angeles published studies in 2008 (13,159 children)[120] and 2012 (28,745 children)[121] that found that exposure to cell phones prenatally—and, to a lesser degree, postnatally—was associated with behavioral difficulties such as emotional and hyperactivity problems at the age of school entry. Although smaller studies have not found an association, in 2017 the largest study to date of 83,884 mother-child pairs in the five cohorts reported that high prenatal cell phone use was linked to hyperactivity/inattention problems in children, while no prenatal cell phone use was linked to low risk for any behavioral problems. The association was fairly consistent across and between these large cohorts. The nearly 40% of the cohort[122] reporting no cell phone use during pregnancy were much less likely to have a child with overall behavioral or emotional problems, while those with the highest reported use during pregnancy had 1.5 times more such problems documented in their children. The authors indicate that the "interpretation of these results is unclear as uncontrolled confounding may influence both maternal cell phone use and child behavioral problems." Greater habitual self-reported maternal mobile device use was associated with less infant recovery upon reunion.[119]

In addition, two studies reported consistent evidence associating RFR with lower figural memory performance in adolescents. Foerster et al.[123] confirmed Schoeni et al[124] in a larger study population of 843 adolescents. Teens who used the phone against one side of their head scored more poorly on tests that measured memory skills specific to the most highly exposed brain regions

Teens who used the phone against one side of their head scored more poorly on tests that measured memory skills specific to the most highly exposed brain regions.

Greater habitual self-reported maternal mobile device use was associated with less infant recovery upon reunion.[119]

Teens who used the phone against one side of their head scored more poorly on tests that measured memory skills specific to the most highly exposed brain regions.

Behavior in animals

In addition to effects on brain development, pre- and post natal EMF exposures in numerous studies have found that cell phone radiation significantly affects a range of learning, memory, and behavior disorders in rodents.[125–136] Thus, Aldad et al. showed that prenatal exposures to conventional cell phone radiation throughout pregnancy resulted in impaired memory and hyperactive behavior, as well as altered neuronal developmental programming, glutamatergic-synaptic transmission onto pyramidal neurons of the prefrontal cortex. Fragoupoulou and Margaritis demonstrated in several studies that animals exposed to radiation have impaired performance on several standard measures of learning. Employing the standard Morris water maze test of hippocampal-dependent spatial memory, they showed that just 2 h per day of exposure to pulsed nonthermal cell phone signals of 900 MHz resulted in significant deficits in performance in exposed animals. Moreover, sham-exposed animals showed the expected preference for the target quadrant, while exposed animals showed no preference. These results indicated that the RFR exposed mice had deficits in their capacity to consolidate and/or retrieve and recall learned spatial information.

Despite these and numerous other studies demonstrating nonthermal impacts of RFR, standard setting groups such as IEEE and ICNIRP generally dismiss experiments that use actual transmitting devices (cell phones, Wi-Fi routers) in their studies, arguing that the exact exposures are not adequately quantified. Indeed, it is true that real devices emit constantly varying signals and erratic pulsation patterns that are more bioactive than can be produced through controlled laboratory simulations.[137] A number of other expert groups including the ICBE-EMF and ORSAA contend that employing actual phones and devices in controlled studies with shielded systems can yield important findings that are more realistic than those achieved through other means. In fact, experimental

studies employing real mobile phone exposures are fairly consistent in showing adverse effects.[138] As an example, Aldad and colleagues[139] provided evidence that prenatal exposures to RFR from an operating phone significantly alter behavior of offspring.

Mice prenatally exposed to cell phone radiation from operating phones (800-1900 Mhz) through gestation exhibited behavioral and neurophysiological alterations that persisted into adulthood.

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The prenatally exposed mice were more hyperactive, with diminished memory and decreased anxiety. Findings further demonstrated impairment of glutamatergic synaptic transmission among pyramidal cells in the prefrontal cortex associated with these behavioral changes, suggesting a mechanism by which these exposures could lead to increased prevalence of neurobehavioral disorders. There was a significant trend across the groups treated for 0, 9, 15, and 24 h/day demonstrating that evidence of damage increased in direct proportion to the amount of exposure the animals experienced. Mice prenatally exposed to cell phone radiation from operating phones (800-1900 Mhz) through gestation exhibited behavioral and neurophysiological alterations that persisted into adulthood.

Mice exposed to mobile phone radiation at levels well below the permissible ICNIRP exposure limits for human-head exposure (SAR 2 W/kg) induced hippocampal lipidome and transcriptome changes that may underlie brain proteome changes and memory deficits.

In another example, Broom exposed mice to non-thermal levels of long-term evolution wireless (LTE) 1846 MHz downlink from late pregnancy (gestation day 13.5) to weaning (postnatal day 21) and observed 28-day-old offspring. They found significant effects on both eating behaviors and activity, and concluded that repeated exposure to low-level RFR in early life may have persistent and long-term effects on adult behavior.[140]

After finding cell phone radiation exposure affected spatial memory in mice, researchers from the Department of Cell Biology and Biophysics at the University of Athens, Greece conducted experiments investigating brain proteome responses in mice following whole body exposures to mobile phone or wireless DECT base radiation.[141] They found that long-term irradiation from both sources significantly altered the expression of 143 proteins in total, in critical brain regions such as the hippocampus, cerebellum, and frontal lobe. They speculated that these "underexpressed" or "overexpressed" proteins following EMF exposures may play a role in short term or long-term effects of RFR reported in humans as a consequence of mobile phone exposure, including memory deficits, headaches, sleep disorders, and brain tumors.

Mice exposed to mobile phone radiation at levels well below the permissible ICNIRP exposure limits for human-head exposure (SAR 2 W/kg) induced hippocampal lipidome and transcriptome changes that may underlie brain proteome changes and memory deficits.

Thus, Fragopoulou et al. showed that phone radiation (SAR 0.022−0.366 W/kg), well below ICNIRP limits for human-head exposure but comparable to SAR levels produced in human brain regions induces substantial phospholipid fatty acid remodeling in the brain, on the one hand, and on the other hand, alters the expression of genes that are implicated in lipid metabolism. These mechanisms are hypothesized to account for the deficits in memory that this group has reported.[142] Mice exposed to mobile phone radiation at levels well below the permissible ICNIRP exposure limits for human-head exposure induced hippocampal lipidome and transcriptome changes that may underlie brain proteome changes and memory deficits.

Carcinogenicity

In 2011 WHO/IARC designated wireless RFR as a Class 2B "possible" carcinogen based largely on

studies of heavy cell phone users, that found increased risks for tumorsboth glioblastoma brain tumors and acoustic neuroma, as well as some experimental data with animals. Earlier, in 2002, magnetic field ELF-EMF was also classified Group 2B possible carcinogen due to studies associating residential magnetic field exposure with childhood leukemia.[143] This association continues to be observed.[144,145]

Since the 2011 WHO/IARC designation, several large animal[71,146–148] and case-control human[149–152] studies investigating carcinogenicity have been published associating RFR with cancer. A 2020 systematic review and meta-analysis[153] of case-control studies found that 1,000 or more hours of cell phone use, or about 17 min per day over 10 years, was associated with a statistically significant increase in tumor risk.

Experimental carcinogenicity evidence

Every agent proven to cause cancer in humans will also produce it in animals when adequately tested—World Health Organization, International Agency for Research on Cancer

The international gold standard for rodent carcinogenicity studies has been developed by the U.S. National Toxicology Program (NTP), a program supported by several major federal agencies (NIH, CDC, FDA) that carries out transparent studies. To date the NTP has evaluated more than 600 different physical and chemical agents for their potential to cause cancer in animals under carefully controlled conditions. Every agent proven to cause cancer in humans will also produce it in animals when adequately tested—World Health Organization, International Agency for Research on Cancer.

In 2018, the NTP released the results of their large-scale rodent studies on cell phone radiation, which used non-thermal levels of RFR designed to mimic cell phone exposures. Especially relevant for pediatrics and long-term human impacts is the finding that the rodents exposed prenatally to RFR had significantly lower birth weights compared to unexposed animals. This finding constitutes an important signal that nonthermal radiation levels can impair development, as low birth weight is understood to reflect an important lifelong risk factor for adult health.

The NTP found significant increases in relatively rare and highly malignant schwannomas of the heart and gliomas in male rats. These tumor types are the same histotype found to be increased in epidemiological studies of long-term cell phone users.

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The NTP study also reported increases in DNA damage[71] in both mice and rats and the induction of cardiomyopathy of the right ventricle in male and female rats.[147,148]

When it was completed in 2018, the NTP study, which followed long-established protocols, was the largest rodent bioassay ever conducted on cell phone radiation that began with prenatal exposures and ended after 24 months of exposures. Soon afterwards, the Ramazzini Institute[146] employing similarly controlled protocols released its findings from an even larger animal study of 2448 rats, which employed both similar and lower exposures comparable to those of base stations such as Wi-Fi, and observed the same types of malignant tumors—schwannomas of the heart—in male rats. Overall, these two large scale animal studies alongside the human data[153] provide reasonably strong evidence of the potential for non-thermal levels of RFR to cause cancer in humans.

Every agent proven to cause cancer in humans will also produce it in animals when adequately tested—World Health Organization, International Agency for Research on Cancer

Analysis of the NTP and Ramazzini data according to current risk assessment guidelines concluded that to be consistent with other toxicological assessments, the protection of children requires that U.S. government

FCC limits should be strengthened by 200 to 400 times.[154]

U.S. RFR exposure standards would lower current standards by 200 to 400 times, if they were consistent with usual methods for assessing risks for chemical and other hazards.

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Cancer epidemiology—Case-control studies

The multi-nation Interphone case-control study[155] from 2010, defined a cell phone user as someone who made one call a week for 6 months. That study did not include any cases from the U.S., was led by the IARC, and reported no overall increased risk of brain cancer with cell phone use, but did find that the highest users of phones incurred the greatest risk. Combining participants with little phone use with those with heaviest use diluted the chances of finding any effect.

The case-control MobiKids study of 352 brain cancer patients between the ages of 10 to 24 reported cell phone use; it also found no overall increased risk for brain tumors in the age group diagnosed between 2010 and 2015. The latency for brain cancer in adults is known to range up to four decades; in children it is believed to be shorter. In fact, only 5% of the study participants—17 individuals—had used cell phones for more than 5 years. Unsurprisingly, no evidence of significant association emerged. This study has also been criticized as methodologically flawed[156] especially as so few of the participants had significant exposures to cell phones. Although no overall increased risk was reported for brain tumors in the temporal region of these young cases an increased risk was found in the age groups 10–14 and 20–24 years—age groups that had lived long enough to have incurred more exposure than the younger children included in this study.

Despite major limitations in design, the Mobikids study of cell phone use in Canadian children reported a doubled risk of glioblastoma multiforme from using cell phones, a risk that should provide a sobering message to those that seek to prevent such disease from occurring in the first place.

Researchers examining the Canadian MobiKids cohort carried out sophisticated statistical modeling including potential sources of biases and probabilistic methods, and did not find strong evidence of an association between reported cell-phone use and meningioma, acoustic neuroma, or parotid gland tumors—tumors plausibly linked with cell phone radiation, but they did note a significant association with glioma.

For glioma, when comparing those in the highest quartile of use (>558 lifetime hours) to those who were not regular users, the odds ratio among Canadian children participating in Mobikids was 2.0 (95% confidence interval: 1.2, 3.4). After adjustment for selection and recall biases, the odds ratio was 2.2 (95% confidence interval: 1.3, 4.1).

Despite major limitations in design, the Mobikids study of cell phone use in Canadian children reported a doubled risk of glioblastoma multiforme from using cell phones, a risk that should provide a sobering message to those that seek to prevent such disease from occurring in the first place.

More recent case-control studies of glioma in adults from Sweden[157] and France,[149] and systematic analyses that combine data on adult cell phone users carried out in China find 10 years or more of cell phone use significantly associated with increased risk of glioblastoma, with 20 years of exposure resulting in a more than doubled risk. Analyses of shorter-term exposures, such as predominated in the Interphone study, do not find such an association, suggesting that there is a latency of 10 years or more for glioblastoma. Thus, in those few studies that have followed longer term users, more hours of use and longer time periods of use have been found significantly associated with between a 40% to more than 200% increased risk of glioblastoma.

Cancer epidemiology—Cohort studies

In contrast to case controls studies, the UK 'Million' Woman Cohort study and the Danish Cohort Study constitute two studies often cited as proof that there is no relationship between cell phone use and brain cancer. Both have been roundly criticized for serious shortcomings. For example, in the UK cohort study of almost 800,000 older menopausal women, only 18% of cell phone users[158] talked 30 or more minutes per week, as self-reported from 2001 to 2011. Yet, the U. K. study combined slight and regular mobile phone users into a single category and compared them with those who reported no phone use. More than 80% of UK households had landlines during the study period. It is likely many in this cohort also used cordless phones, yet, this significant additional source of RF was not evaluated. In fact, the UK cohort authors acknowledge[159] their study was unable to assess the risks associated with considerably greater levels of exposure. Consequently, the authors note that: "advising heavy users on how to reduce unnecessary exposures remains a good precautionary approach."

Other cancers plausibly reported in epidemiological studies to be tied with cell phone radiation include: thyroid cancer, early-onset breast cancer, early-onset colorectal cancer, and testicular cancer. In a certain subset of those with a common genetic susceptibility, heavy cell phone usage is associated with significantly doubled risk of thyroid cancer.[69] Since the advent of smart phones in 2010, phone antennas tend to be located at the bottom of phones As a result, peak phone RFR exposure is more likely to occur in the neck than in the brain.[160] Smart phones include several different antennas, each one of which can send and receive RFR, with multiple antennas for data, photos, video and other applications located around the phone perimeter. In addition, women who have carried phones in their bras or worn Vocera devices next to their chest have developed unusual patterns of breast cancer, with tumors sometimes appearing precisely under the areas where their phone antennas were located.[161,162]

In those few studies that have followed longer term users, more hours of use and longer time periods of use have been found significantly associated with between a 40% to more than 200% increased risk of glioblastoma.

Several independent analyses published since the original IARC assessment in 2011 conclude that if the criteria that the WHO/IARC relied on when determining carcinogenicity were applied to current science, this would result in classification of cell phone radiation as a probable carcinogen (Group 2A) or proven (Group 1) human carcinogen.[7,8,16,163–167]

Unexplained increases in pediatric and young adult cancers are consistent with increasing wireless exposures

Trends in cancer can provide signals about underlying etiologic factors, as occurred with increases in lung cancer in male and female smokers in the mid-twentieth century, and increases in the rare clear-cell adenocarcinoma of the cervix in young women whose mothers had used diethylstilbestrol to prevent miscarriage.[168] Cancers tend to have multiple contributory causes, which can ebb and flow over time. Over the last several decades, incidence of several different early-onset cancers in adults[169] below 50 years of age have increased in many nations, including those of the breast, colorectum, bone marrow, and thyroid. Although explanations for these patterns will certainly be multi-factorial, wireless radiation is one of the factors that should be more widely explored.

Rates of rectal cancer have quadrupled in those under age 24 in the past decade in the U.S. and Iran and risen rapidly[170] in the U.K, Egypt, and Brazil. One recent study[171] asserts that these increases could, in part, be associated with radical changes in exposures to cell phone radiation due to devices kept close to the body for extended periods of time. More and more children and young adults keep transmitting smartphones with their multiple antennas that are constantly updating apps next to their abdomens inside their tight clothing for hours a day, along with a wireless earpiece in their ear. Thus, although speaking directly into phones has declined, close proximity to their radiation has not.

What makes the potential connection between colorectal cancer increases and cell phone exposures

especially plausible is an experimental study showing that colon and rectal cells are exquisitely sensitive to non-ionizing radiation like that emitted by phones today. Moreover, exposure to non-ionizing mobile phone radiation can lead to effects on treated colon tissues of rats similar to those observed from ionizing 3Gy gamma radiation. Mokarram et al.[172] reported that epigenetic patterns of the estrogen receptor (ERα) after exposure to ionizing radiation paralleled those occurring after exposure to non-ionizing RFR. Using biomarkers that have previously been established to signal damaging exposures, they further found that methylation patterns may constitute an important validated biomarker of exposure to radiofrequency radiation that has the potential to play a role in the expression and promotion of colorectal cancer.[172]

EMFs as endocrine disruptors

Endocrine disruptors are understood to be agents, either natural or man-made, which can mimic or interfere with the body's hormones and disrupt development leading to a range of developmental, reproductive, neurological, and immune problems, as well as cancers. Common sources include plastics, metal can liners, detergents, flame retardants, and pesticides.

EMF exposures have been linked to a range of classical endocrine disrupting effects.

A team from the California Institute of Behavioral Neurosciences & Psychology reviewed the effects[173] of both RFR and ELF on thyroid gland hormones and histopathology and found evidence that RFR was associated with alterations in T3, T4, and TSH hormone levels, disruption of the function of the HPG axis leading to thyroid insufficiency and hyper-stimulation of thyroid gland follicles. This caused apoptosis of follicular cells. Non-ionizing radiation was seen to be significantly associated with histopathological changes in the thyroid gland follicles and the authors contend that non-ionizing EMF radiation might be responsible for the recent increase in the incidence of thyroid insufficiency and cancer in the general population.

Critical research needs to be conducted to understand the effects especially to future generations. Cantürk et al.[174] investigated the effects of pre- and postnatal 2450 MHz RFR on the thymus of rats over four generations and found that the number of pups and weight of all rats decreased significantly in the third-generation.

RFR has all the classic hallmarks of endocrine disruptors that affect reproduction, development of the hypothalamic-pituitary-gonadal axis (HPG) and alter normal male and female reproductive endpoints.

Thus, it appears that non-ionizing [175] RFR has all the classic hallmarks of endocrine disruptors that affect reproduction, development of the hypothalamic-pituitary-gonadal axis (HPG) and alter normal male and female reproductive endpoints. Alterations in spermatogenesis and oogenesis, for example, in turn affect a number of endocrinological and other functions throughout life, including fertility and behavior in offspring along with the risk of cancer, neurological disorders and other chronic illnesses.

Animal studies of additive or synergistic effects of RFR with other agents

Replicated experiments show that RFR can have important co-carcinogenic and tumor promoting effects when combined with known carcinogens. Lerchl et al.[152] found carcinogen-induced tumor rates were significantly higher in mice exposed to nonthermal doses of radiofrequency below current regulatory limits. The authors argued that it was a "very clear indication that in principle tumor-promoting effects of life-long RFR exposure may occur at levels supposedly too low to cause thermal effects."

The Ramazzini Institute performed two large lifespan rat cancer studies[176] combining magnetic field non-ionizing EMF with either acute exposure to gamma radiation or chronic exposure to formaldehyde in drinking water and found significantly greater incidence of malignant tumors with either co-exposure than occurs without such combined exposures.

Investigators from the Beijing Institute of Radiation Medicine in China have also produced important evidence of synergistic effects. They determined that combining 2.8 GHz and 1.5 GHz microwaves[177] impaired spatial memory much more strongly than exposures to a single frequency. It is important to realize that such combined frequencies can easily occur at this time within a single smart phone that can operate on different frequencies at the same time. This same team has reported[178] that exposure to nonthermal levels of 2.8 GHz and 9.3 GHz—as could occur with 5G networks— led to significant impacts to the thymus and spleen, such as congestion and nuclear fragmentation of the lymphocytes, and more severe injuries. Their transcriptomic and proteomic analysis of peripheral blood and spleen suggested that alterations of DNA replication, cellular metabolism, and signal transduction might be involved in microwave-induced immune activation. The spleen not only filters blood-borne pathogens and antigens but also plays a critical role in immune system regulation.

Effects of screen time

Higher levels of adolescent screentime,[179] social media access[180] and cell phone use in teenagers' bedrooms are associated with reduced sleep time[181] as well as negative effects on daily functioning,[180] behavior[182] and mood. An ever growing body of evidence[183] is associating[184] children's addictive and excessive use of screens and digital media with a myriad of adverse social (relationships, social skills, cyberbullying), psychological (anxiety, depression, suicidal ideation, obsessive compulsive disorder[185]) neurodevelopmental (cognitive development, behavior, attention, speech[186]) and physical (obesity, high blood pressure) consequences. Key factors[187] determining screen time effects include duration, content, media type, degree of access to social media, whether screens are located in the bedroom[180] and the amount of after dark/evening use.[180,187]

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Axelsson et al.[188] found the amount of time spent with screens predicted shorter sleep in preschoolers. Regardless of the time of day that screens were accessed by children, greater screen time was associated with poorer sleep quality, poor communication, poor problem solving and greater attention problems. The AAP notes,[184] "the prevalence of problematic Internet use among children and adolescents is between 4% and 8%.

Up to 8.5% of U.S. youth 8 to 18 years of age and 4.6 % of Chinese youth meet criteria for Internet gaming disorder defined by the World Health Organization in its standard Diagnostic and Statistical Manual of Mental Disorders-Fifth Edition (DSM-5) as an uncontrollable, persisting need to engage directly with digital media and games that cannot be stopped.

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This diagnostic code is included in the DSM-5,[189] and in the 11th Revision of the International Classification of Diseases (ICD-11[6]), signaling interference with socialization, including disturbing important areas of life such as family relationships, school, work, eating, bathroom habits and sleep. In its criteria for gaming disorder, the WHO does not include in its criteria any specific number of hours spent with screens, but instead focuses on the inability to engage in normal social life of young children and teens, including outdoor activities as well as socializing indoors with family and at school. The category of internet gaming disorder was added in 2019. According to Pew,[190] 97% of teen boys and 83% of girls play games on

some kind of device. How many of them are addicted is a matter that should be seriously examined, as the toll on pediatric mental and physical health continues to mount.

Higher screen time has been associated with a higher prevalence of prospective disruptive behavior disorders.[191] Clinicians[187,192] posit that the effects of electronic screen time can mimic or exacerbate psychiatric disorders as the interactive media can lead to chronically high arousal levels which can lead to nervous system dysregulation. As a consequence, treating physicians have developed treatments including an "electronic fast" to rebalance the brain and relieve overstimulated reward (addiction) and sensory pathways. Interventions such as reducing screen media have been found to result in a substantial increase in children's engagement in physical activity[193] and increasing outdoor "green" time[194] is beneficial to mental health as well as lowering myopia incidence[195] in school-aged children.[196]

Studies[120] of infant parental dyads find that more frequent reported mobile device use was associated with less room exploration and positive affect, and less recovery (i.e., engagement with mother, room exploration positive affect) even when controlling for individual differences in temperament. Delays in speech acquisition and the development of interactive skills also have been reported in infants of parents that use devices more frequently.

Technoference contributes to speech and bonding delays

Studies[116] of infant parental dyads find that more frequent reported mobile device use was associated with less room exploration and positive affect, and less recovery (i.e., engagement with mother, room exploration positive affect) even when controlling for individual differences in temperament. Delays in speech acquisition[197] and the development of interactive skills also have been reported in infants of parents that use devices more frequently. In addition, the phenomenon of "technoference"[198] is receiving increased attention from experts in behavioral and development psychology. Heavy parental digital technology use has been associated with suboptimal parent-child interactions. Parental problematic technology use—termed "technoference" — is associated with technology-based interruptions in parent-child interactions and potentially associated with a range of child behavior problems.

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Parental distraction in early infancy can be problematic for obvious reasons. This remains a topic of increased research attention and a matter that should be routinely queried at every well child visit, beginning with infancy throughout the school years. Simple questions noted below can provide the foundation for teachable moments that convey the need for direct parental involvement in early years when lifelong benefits can accrue. Harried young parents, especially those who are raising children without partners, may rely heavily on digital devices as a form of childcare. They should be informed about the importance of direct eye and verbal contact with infants, as well as reading aloud starting in infancy, as these practices have been shown to have lifelong benefits to social and emotional development.

Clinical practice guidance

Avoidable environmental exposures can profoundly affect and alter children's development and health. Along with the benefits of nutrition and regular physical and social activity, clinicians are aware of adverse effects of lead, pesticides, food additives, air pollution, ultraviolet radiation, and more broadly climate change, on children's health. Exposures that take place early life can have disproportionately large impacts on later life health and well-being.

As recommended by the AAP, clinicians can integrate developmental as well as EMF issues in practice

by regularly discussing screentime and digital media use. AAP guidance regarding phones and other wireless devices should be widely shared and employed. These include:

- For children under 18 months, avoid screen-based media except video chatting.
- For children 18 months to 24 months, parents should choose high-quality programming and watch while interacting with their children, on a limited basis.
- For children 2 to 5, no more than one hour per day of high-quality screen time and engage with children regarding content and experiences.
- For children 6 and up, establish consistent limits on the time spent using media and the types of media.

Recognizing that RFR may contribute to ill health provides further incentive to include clinical practices such as:

- Query use of screens, digital media, cell phones and Wi-Fi linked devices at yearly physicals;
- Provide guidance to patients and their families on how to decrease excessive screen time and to reduce RFR exposure (See Section 7);
- Respond with additional interview questions, resources and referrals as appropriate if symptoms potentially related to use of screens or exposure to EMFs are reported;
- Engage in continuing education and training on EMF issues, and screen use;
- Record and report cases where links have been identified between EMF and symptoms or health outcomes;
- Encourage undistracted reading out loud to infants and young children; and
- Develop family media plans for parents as well as children, explaining that parental distraction with devices can impair child development including speech acquisition.

Practitioners also need training in EMF-related effects to be able to discern whether common pediatrics complaints such as headaches and problems sleeping could, in fact, be due to the excessive use of technologies in the home or school environment. Clinicians encountering patients presenting with unexplained symptoms can consider the complete clinical picture and health history, and investigate, treat if necessary, or exclude commonly recognized etiologies. For example, patients may come into the office with unexplained array of symptoms such as headaches and rashes that may be related to EMF (e.g., cell antennas recently mounted nearby, or upgraded school Wi-Fi system recently installed). Clinicians need greater awareness so that in differential diagnosis they include the possibility that symptoms may be associated with EMF and evaluate the patient in a systematic fashion.

Clinical practice guidelines for EHS have been developed by trained clinicians and experts,[199] EUROPAEM group,[200] Dr. Riina Bray, Medical Director, Environmental Health Clinic, at Women's College Hospital, University of Toronto[201] and the Austrian Medical Association,[202] among others.

Clinical practice guidelines include:

- Comprehensive case history that includes environmental exposure history including questions regarding typical daily EMF/ RFR exposure, toxic metal exposures, diet, mold, and other potentially toxic chemical exposures at home, child care settings, school, work and play, and in the community.
- Assess community, work, school and home exposures to EMFs: proximity of cell phone towers, routers, DECT cordless phones, and any other wireless technology, especially in sleeping areas
- Assess variation of health problems depending on time and location. For example, do headaches or other unexplained symptoms attenuate in different areas, but return chiefly when the child is in one specific location? Did headaches or symptoms begin when a new router or cell antenna was installed?

As technologies (and healthier alternatives) evolve and knowledge advances, there is a need for clinicians periodically to update their knowledge through continuing medical education with technical experts in bioelectromagnetics—a field that is not widely taught or studied in medical schools at this juncture. Some accredited programs[203] offering up to 24.5 continuing medical education credits can be found online.

Electromagnetic sensitivity—An underdiagnosed pediatric problem

The phenomenon of hyper-reactivity to chemical and physical phenomena remains poorly understood but is believed to be a serious and sometimes disabling problem.

Electromagnetic hypersensitivity (EHS)[204] is believed to affect a small but significant segment of the population—with estimates up to 15%. Its prevalence in children has never been evaluated, but could prove to be important in cases in which vague symptoms of headache, numbness, tingling and rash cannot otherwise be alleviated. EHS is characterized by headaches, sleeping problems, memory problems, nosebleeds, unexplained skin rashes, digestive problems, neurological problems, heart palpitations and fatigue. Symptoms[200] vary from person to person, making this a challenging subject to study and to treat. Notably, prenatal and postnatal exposure to cell phone RFR is linked to increased headaches in children,[205] adolescents,[206] and adults,[205] and use of smartphones have been identified as a trigger for migraines.[207]

EHS symptoms[208] have been linked to exposures to non-ionizing EMF, including from nearby cell towers and base station wireless antennas and routers. No studies have been conducted on EHS in children. Dieudonné[209] studied forty individuals convinced that they were sensitive to electromagnetic fields, and concluded that contrary to allegations of nocebo responses, attribution of their symptoms followed a common linear model: (1) onset of symptoms; (2) failure to find a solution; (3) discovery of EHS; (4) gathering of information about EHS; (5) implicit appearance of conviction; (6) experimentation; and (7) conscious acceptance of this knowledge.

Further evidence of the importance of identifying sources of exposure and reducing them comes from a recent report from Sweden on the sudden acquisition of highly reactive biological responses to a newly introduced source of RFR. Following the introduction of 5G networks in a dense urban environment, a previously healthy couple reported disabling symptoms of headache, palpitations, tingling, tinnitus and major discomfort. Upon detailed examination of their environment, it was determined that 5G network had recently been installed quite close to their apartment. A thoroughly detailed case report[210] documents this sudden change in RF exposure and the onset of severe symptoms in this couple just a few days after the installation of a 5G base station on the roof above their apartment. The deployment of 5G caused a dramatic increase in maximum (peak) microwave radiation exposure, from 9 000 μW/m2 to >2 500 000 μW/m2. The symptoms quickly reversed when the couple moved to a dwelling with much lower exposure.

Symptoms often are misdiagnosed as health professionals lack training on the matter. Preliminary clinical practice guidelines[201] have been developed. The U.S. Access Board[211] has recognized that "electromagnetic sensitivities may be considered disabilities" under the Americans with Disabilities Act, and the Job Accommodations Network supported by the U.S. Department of Labor's Office of Disability Employment Policy has issued a list of guidelines[212] for accommodation of electromagnetic sensitivity.[213] Adults in the U.S. are often accommodated in the workplace (being provided hardwired computer connections, or moving to a lower-EMF office) but in many cases they have had to file legal actions.

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Despite these accommodations for adults, parents seeking accommodations in U.S. public schools for children who experience EHS have been challenging as schools will refuse to accommodate and the families often must resort to homeschooling. In the UK, parents won a legal battle[214] against local authorities who are now compelled to provide an environment with reduced wireless radiation so that their child can attend school. There are also other examples internationally of legal decisions mandating workplace accommodations or payment for injuries[215] from EMF exposure.

In Canada, EHS is described in the report, Medical Perspectives on Environmental Sensitivities[216] to the Canadian Human Rights Commission.[217] Medical and legal[216] reports underpin a policy[218] for accommodation under the *Canadian Human Rights Act.*

Synergistic and combined toxic exposures in children

Children are exposed to numerous combinations of environmental exposures over their lifetime. Even where exposures are low, they can interact with each other resulting in additive or synergistic results.

Animal and human studies[219] indicate that non-ionizing EMF can act synergistically when combined with other toxic agents. For example, Sueiro-Benavides et al.[220] found that 2.45 GHz, a frequency used in Wi-Fi networks, combined with carbon black (CB) increased CB-induced toxicity and prolonged inflammatory immune responses. Exposures to non-ionizing EMF from magnetic resonance imaging (MRI) or cell phones has been found to enhance the release of mercury from dental amalgam.[221] RFR has been found in several studies to impact the integrity of the blood-brain barrier that protects the brain from toxic molecules circulating in the blood.[132,222–225]

A longitudinal study[226] of 2,422 children at 27 elementary schools in 10 Korean cities examined effects and interactions between voice call cell phone use and blood lead levels (lead levels were comparable to those in U.S. children). Attention-deficit/hyperactivity disorder symptom risk was significantly greater in the children with above-median lead levels and above-median weekly cell phone call duration.

A similar interaction was reported by Choi et al.[227] Across the cohort, maternal cell phone use during pregnancy was not associated overall with child neurodevelopment during the first three years. Among children exposed to higher maternal blood lead level *in utero*, however, a greater risk of both a poorer psychomotor development index and a lower mental development index up to 36 months of age was associated with higher cell phone calling time or frequency during pregnancy.

A theoretical role for RFR in the etiology of autistic spectrum disorder

Autism remains a puzzling and troubling problem for growing numbers of children, their families and their physicians. The disease[228] is increasing among both males and females, and among nearly all racial/ethnic subgroups, from 4.2 per 1,000 in 1996 to 15.5 per 1,000 in 2010. A recent report from the U.S. Centers for Disease Control and Prevention notes that rates have continued to increase. The prevalence of autism spectrum disorder (ASD) among 11 surveillance sites is 1 in 54 among children aged 8 years in 2016 (or 1.85%). This constituted a 10% increase from 2 years previously when it was 1 in 59, and the highest prevalence since the CDC began tracking ASD in 2000. Consistent with previous reports, boys were 4 to 5 times more likely to be identified with ASD than girls. The rate for ASD is 1 in 34 among boys (2.97 percent) and 1 in 145 among girls (0.69%). Although many environmental factors[229] have been posited, including air pollution, pesticides, and heavy metals, the potential role of RFR should also be seriously explored.

Experimental studies showing that prenatal exposures to RFR can disrupt the development of the hippocampus provide some foundation for speculating that EMFs could also be a contributing factor. Thus, RFR has plausibly been hypothesized to play a role in the development of ASD via disruption of the developing poorly myelinated central nervous system. When presented with serious behavioral disorders including autism, some psychiatrists have employed successful treatment protocols that involve family management systems to facilitate cessation and withdrawal from use of digital devices. Psychiatrist Victoria Dunckley[192] notes that early use of digital devices can create a heightened state of fight or flight among young brains and bodies, placing them under constant stress. Children are easily addicted to routines of falling asleep, eating and even using the toilet accompanied, not by parents soothing assurances, but by digitized music, visions and sounds that increase dopamine—the brain chemical tied with pleasure and addictive behaviors. Providing several impressive case reports of toddlers that had been out of control and unable to give up their digital fixations, Dunckley notes that digital fasting can yield impressive results, especially with children on the autism spectrum. Her book provides several detailed instances where altering children's access to digital devices can radically improve behavior. Other published reports also offer corroboration for this hypothesized connection.[230,231]

Psychiatrist Martha Herbert and research analyst and editor of the *Bioinitiative Report*, an ongoing record of relevant scientific findings, Cindy Sage, among others,

have called for more aggressive investigation of the possible connections between RFR uses and exposures and disorders on the autism spectrum. They speculate that behaviors on the autism spectrum could emerge from alterations of electrophysiological oscillatory synchronization and EMF/RFR could contribute and "worsen challenging biological problems and symptoms; conversely, reducing exposure might ameliorate symptoms of ASD by reducing obstruction of physiological repair."[232,233]

Inadequate regulatory limits

FCC and ICNIRP regulatory limits have been long criticized by experts and the court because they do not address children's unique vulnerability, the biological and health effects of long-term exposure nor the current ways that children are exposed to cell phone and wireless radiation. In 2012, the AAP wrote the FCC and other federal agencies calling for an update to the FCC's 1996 exposure limits stating, "it is essential that any new standard for cell phones or other wireless devices be based on protecting the youngest and most vulnerable populations to ensure they are safeguarded throughout their lifetimes." A decade later that call remains unanswered.

Cell phone and wireless device limits

Regulations regarding human exposure to RFR include: 1. allowable limits for ambient exposures created by cell tower network emissions and wireless networks, called maximum permissible exposure limits in the U.S.; and 2. exposure limits for localized exposures into areas of body tissue from phones, and personal and household devices, referred to as Head and Body SAR limits. The ICNIRP and IEEE[38] standards used as the basis for many governments' limits remain largely unchanged since the 1990s and they are intended to protect for effects caused by short term high powered exposures. These limits are not designed to protect for effects from long term, low level chronic exposures because ICNIRP and IEEE do not consider such effects as "established." As former ICNIRP member James C. Lin describes them: "*They are flawed and are not applicable to long-term exposure at low levels. Instead of advances in science, they are predicated on misguided assumptions with outdated exposure metrics that do not adequately protect children, workers, and the public from exposure to the RF radiation or people with sensitivity to electromagnetic radiation from wireless devices and systems. Thus, many of the recommended limits are debatable and absent of scientific justification from the standpoint of safety and public health protection.*"[16]

Wireless network exposure limits

U.S. limits for RFR were promulgated by the FCC in 1996, based largely on a 1986 Report of the National Council on Radiation Protection & Measurements (NCRP)[234] and the Institute of Electrical and Electronics Engineers (ANSI/IEEE) C95.1-1991 standard.[235] The U.S. limits for environmental RF levels are among the most lenient in the world, and are similar to those of Australia, Japan, Germany and other countries that also adopted inadequate ICNIRP limits.

However, some countries, including Italy, Switzerland, China, and Russia have adopted regulatory limits for cell towers and base station network emissions that are far more stringent[236] than the thermally based limits of the U.S. FCC and ICNIRP.

European nations with more stringent regulatory limits set their policies based on the precautionary principle, a key framework used in their decision making process. This principle rests on the sage advice of Benjamin Franklin—better to be safe than sorry.

In 2011, the Parliamentary Assembly of the Council of Europe (PACE) Resolution 1815: The potential dangers of electromagnetic fields and their effect on the environment " [237] strongly recommends that the ALARA (as low as reasonably achievable) principle is applied, covering both the so-

In 2011, the Parliamentary Assembly of the Council of Europe (PACE) Resolution 1815: The potential dangers of electromagnetic fields and their effect on the environment " [237] strongly recommends that the ALARA (as low as reasonably achievable) principle is applied, covering both the so-called thermal effects and the athermic or biological effects of electromagnetic emissions or radiation."

called thermal effects and the athermic or biological effects of electromagnetic emissions or radiation."

In contrast, the more strict RF limits in Russia and China[238] are considered "science based," not precautionary, and were developed based on their own government scientists' studies of the biological effects of nonthermal RFR levels. India lowered its limits to 1/10 of ICNIRP limits in 2012[239] in response to a report from an Inter-Ministerial Committee that reviewed the research[240] on impacts to wildlife, including honeybees and other pollinating insects, and concluded[239] that the "vast majority of published literature indicate deleterious effects of EMFs in various species." (See Fig. 7 for comparisons) It is notable that other groups have recommended even lower limits. For example, the Ecolog Report, commissioned by T-Mobile and Deutsche Telekom in 2000, reviewed the science recommended a limit of 0.01 W/m2 to" be rigorously adhered to by all base stations near sensitive places such as residential areas, schools, nurseries, playgrounds, hospitals and all other places at which humans are present for longer than 4 hours."[241]

Why the SAR standard is inadequate to protect children

Pre-market tests for cell phones and wireless devices measure the Specific Absorption Rate (SAR), which is the standard accepted measurement of the rate of RF (radiofrequency) energy absorption. (See Table 2.) For cell phones and other handheld wireless devices, many countries have adopted either FCC or the ICNIRP limits for premarket RF compliance. Although the FCC limit is slightly more restrictive compared to ICNIRP limits, both rest on avoiding the effects of heating as measured by the SAR.

The SAR metric is criticized as a heat-based measure unable to capture[72] the numerous characteristics[242] of nonthermal exposure considered relevant to bioeffects such as pulse, modulation, variability or duration of exposure.

That said, even if the SAR was a valid measure for health effects thresholds, the SAR testing protocol itself has long been criticized as unrealistic for numerous reasons. To start, it does not take into account the smaller sizes of women, infants and children, and other properties of children that place them at greater vulnerability. Thus, the child brain sits in a thinner skull that contains more fluid which can absorb more radiation per unit volume than the adult brain with its thicker skull.

In regards to children's exposure, the AAP[1] wrote the FCC in 2012 noting that, "although wireless devices sold in the United States must ensure that they do not exceed the maximum allowable SAR limit when operating at the device's highest possible power level, concerns have been raised that long-term RF exposure at this level affects the brain and other tissues and may be connected to types of brain cancer, including glioma and meningioma," and also that, "The current metric of RF exposure available to consumers, the Specific Absorption Rate, is not an accurate predictor of actual exposure."

The head and body phantom are filled with a homogenous liquid that does not capture the way the electromagnetic field moves through different tissues in the head such as brain tissue, which is of varying thicknesses and characteristics. The dielectric properties of tissues in children's head and brain differ from adults because children's tissues have more water content and thus are more conductive than adults.

The SAM model has long been argued to provide a conservative estimation of the exposure from a mobile phone, even for children. However, research supporting this position has generally used a scaled down version of an adult head which did not account for all age dependent variations in children, such the anterior fontanels which close between 7 and 18 months. When these more realistic variations are accounted for, the SAR values for children are significantly higher. For example, Mohammed[243] used realistic head models in several scenarios simulating young children between 3 months and 18 months holding phones near their ear and mouth as well as a person holding a mobile phone near a child's head. They found that 10g SAR values in the heads of young children are significantly higher than those for adults and also noticeably higher than the scaled models used in previous studies that considered dosimetry for children over 3 years old.

Research supporting the SAM model[244] is based on early phone models that were designed with antennas on the top of the phone body and more recent research has found that for newer phone models with antennas integrated along the bottom of the phone, the SAM does not always ensure[40] a conservative estimation.

Phones are tested while operating at the highest power level, in specific positions against the phantom head and body. Devices generally operate at the minimum necessary power, in order to maximize battery

life, but in many situations the power output is much higher, to ensure reception at the receiving antenna in the cellular base station. Low incoming signal strength triggers a significant increase a phone's emissions; people encounter low signal strength in rural areas far from base stations and also, for example, in rooms in basements or buildings where building materials block the signal. The many real world exposure scenarios result in highly variable emissions from any one cell phone model, regardless of the stated SAR value.

Although the standardized SAR test positions are supposed to simulate the way people typically hold a cell phone, the standardized positions do not test in body contact positions for body SAR tests. The test positions do not mimic a cell phone in full body contact such as in a pants pocket or resting against the abdomen. Parents today often hold their newborns with the cell phone right up against the baby and yet premarket SAR tests do not include such positions.

In summary, the SAR test and SAM have been roundly criticized as underestimating and not adequately capturing the real world exposures of children, babies, and toddlers, and children who are positioned in direct or close body contact with cell phones or other devices.

Furthermore, manufacturers SAR test phones at various distances from the body. In the U.S. a manufacturer can decide to test for body SARs at 5, or 10, or even 25 mm. The measured SAR value will increase the closer the phone is tested to the body phantom. Thus, the manufacturer posted SARs of different models that use different separation distances cannot be directly compared to each other.

Although SAR levels often are used to compare cell phones in terms of which phone emits more RF than others, the SAR value does not necessarily reflect a difference in a consumer's actual exposure for these reasons. Hence a phone with a lower SAR level does not necessarily mean lower RF exposure. Nonetheless, the SAR is the metric in use and the basis for exposure limits worldwide.

Regulatory gaps affecting children

The AAP[1] has long advocated[1] that federal agencies strengthen regulations calling for:

- A reassessment of human exposure limits and testing requirements to ensure children's unique vulnerabilities are addressed and to reflect the way children use phones today in close proximity to the body;
- Establishing a federal research program as the basis for exposure standards;
- Cell phone and wireless device product labeling requirements to "enable parents to better understand the potential dangers of RF energy exposure and protect their children."

The AAP supported[245] national legislation, the Cell Phone Right To Know H.R. 6358,[246] proposed in 2012, which would have addressed numerous regulatory gaps in federal policy regarding stating that, "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."

Prevention: medical organization, public health, government policy and actions to mitigate risk to children

Based on the established science, including children's special vulnerabilities, trajectories of exposures and diseases, clinicians need to know that they are supported by medical associations, have the resources to support their patients, and finally have the evidence in hand to advocate for them. A few of the supportive agencies and recommendations are noted below. Others can be found at www.ehtrust.org.[247]

Medical organizations and public health agencies

The AAP and several international medical organizations[248–251] have recommendations[252] on how to reduce cell phone radiation exposure. The AAP has long advocated for more protective[245] federal regulations and issued ten ways to decrease exposure in 2016[252] including "avoid carrying your phone against the body like in a pocket, sock, or bra. Cell phone manufacturers can't guarantee that the amount of radiation you're absorbing will be at a safe level."

"Avoid carrying your phone against the body like in a pocket, sock, or bra. Cell phone manufacturers can't guarantee that the amount of radiation you're absorbing will be at a safe level." American Academy of Pediatrics.[252]

In 2017, the California Department of Public Health (CDPH) released an advisory on cell phones.[253] CDPH's scientists had evaluated the RFR from almost[254] two dozen phones and found that when they transmit at their highest power due to use in areas of low service (one or two bars) the emissions can be up to 10,000-fold higher than when the phone is used in areas of strong signal. The CDPH's advice initially was based on the University of Pittsburgh Cancer Institute's 2008[253] cell phone radiation reduction advice to doctors and staff, constituting the first ever U.S. medical institution advisory on cell phone radiation.

In 2022, the Maryland State Children's Environmental Health and Protection Advisory Council[255] issued information on how families can reduce wireless and non-ionizing EMF exposures at home and also made recommendations to schools.

A summary of basic recommendations from these organizations and agencies is presented below.

"Avoid carrying your phone against the body like in a pocket, sock, or bra. Cell phone manufacturers can't guarantee that the amount of radiation you're absorbing will be at a safe level." American Academy of Pediatrics.[252]

How families can reduce EMF exposure

Cell phones

- Cell phones are not toys or teething items.
- When parents hold their babies or children in their arms, they should not simultaneously use or hold mobile phones or wireless devices as this will expose the child to RFR.
- Decrease overall time spent on wireless phones and prefer corded phones for long calls.
- Delay purchasing a first cell phone for a child. Cell phones should only be used by children for emergencies.
- Prefer text messaging over voice and video calls.
- Decrease exposure to and through the brain by using cell phones in speaker mode, away from the head and body, or wired airtube headsets with the phone away from the body. Avoid airpods. While Bluetooth signals are much weaker than cell phones, children and teens keep them in their ears for hours a day and the long term impact has never been independently evaluated.
- Avoid carrying cell phones against the body like in a pocket, sock, or bra.
- Do not talk or text while driving.
- Learn how to switch phone to airplane mode with Bluetooth, Wi-Fi, Hotspot antennas toggled off in settings. Many applications on phones can still be utilized in airplane mode. For example, in order to play movies and music but avoid unnecessary RFR exposure, download the files first, then switch the device to airplane mode and play.
- Keep an eye on your signal strength (i.e. how many bars you have). The weaker your cell signal, the harder your phone has to work and the more radiation it gives off. It's better to wait until you have a stronger signal before using your device.
- Avoid making calls in cars, elevators, trains, and buses. The cell phone works harder to get a signal through metal, so the power level increases.
- Learn how to connect the cell phone to the internet with ethernet cables.

Computer, laptop and tablet internet connections in buildings

- Install internet access via a hardwired ethernet connection instead of Wi-Fi.
- Wi-Fi routers should be distanced from areas where children sleep, play and school.
- At a minimum, power Wi-Fi networks off at bedtime and during periods when not in use.
- Connect computer/laptop/tablet accessories and peripherals such as printers, speakers, keyboard and mouse with cords, rather than Wi-Fi or Bluetooth.

At home

- Replace cordless phones with corded phones. Cordless phones and their base stations emit RFR.

- Avoid wireless digital baby monitors. If necessary, choose wired monitoring systems.
- Remove screens, electronics and wireless devices from the bedroom.
- Turn off devices at night and ensure sleep areas are not against a wall where utility meters are installed on the other side as "smart" meters are sources of RFR and other EMF.

Additional considerations during pregnancy

Simple preventive measures during pregnancy can significantly decrease fetal exposures, especially the high intensity exposures from a wireless device resting directly on the abdomen.

- Distance cell phones and wireless devices away from your abdomen.
- Power off cell phones when carrying them near your body.
- Always use laptops and tablets on a desk, not on your lap or close to your abdomen.
- For voice calls, use corded phones instead of cell phones or cordless phones.
- Use ethernet connections instead of Wi-Fi to connect devices.

Several governments, such as France, Israel, Greece and Switzerland have RFR measurement programs in place along with easy access to the data. For example, in France, the National Frequency Agency ANFR "Observatoire des Ondes"[257] posts online the RFR measurements taken numerous times a day in various cities.

Cell tower emission and ambient limits

As shown in Fig. 7 numerous countries such as India, Israel, Greece, China,[256] Russia and eastern European countries have RFR limits for cell tower network emissions that are much stricter than the limits of the US/FCC (although there is not always documented reliable monitoring or enforcement in every country). Australia, Japan, Italy and Switzerland have limits for areas such as schools and apartment buildings and areas where people spend several hours a day. Several governments, such as France, Israel, Greece and Switzerland have RFR measurement programs in place along with easy access to the data. For example, in France, the National Frequency Agency ANFR "Observatoire des Ondes"[257] posts online the RFR measurements taken numerous times a day in various major cities. Countries such as Greece and Israel have policies in place that specifically restrict the placement of cell towers near "sensitive areas" defined generally as schools and/or homes and hospitals and provide for online access to real-time radiation levels. Greece further restricts exposure to a stronger limit within 300 m of sensitive areas. Chile's "Antenna Law"[258] has established mitigation measures in areas with dense infrastructure and prohibits towers near "sensitive areas" defined as institutions serving children, the elderly, and the medically compromised. Again, monitoring and enforcement are not reliably determined in many instances.

At the local level, numerous municipalities in the U.S.[259] and other countries[260] have policies to restrict cell towers on school property and many communities have removed wireless antennas from school properties. For example, the Supreme Court of India upheld a decision by the High Court of the State of Rajasthan to remove installations on school properties and playgrounds.[261]

Several countries focus their RFR monitoring and oversight on children's areas. Brazilian Law nr 11,934 includes regulations[262] defining a critical area as the 50-meters-radius around hospitals, clinics, schools, day care centers, and facilities for the elderly. The RFR levels must be assessed within 60 days after the issuance of a license and then regularly re-evaluated. Like France, Brazil hosts an online map[263] with the country's RFR measurements. Greece's National Observatory of Electromagnetic Fields[264] has 500 sensors providing RFR level monitoring for schools and other sensitive areas. Further measures that are commonly implemented internationally are listed in Table 3.

Regulatory gaps in the U.S

At the federal level in the U.S., policy changes are needed to address numerous regulatory gaps regarding

TABLE 3. International policy to Increase transparency, ensure compliance and reduce cell phone and RF radiation.

Policy	Country examples
Public RFR exposure limits are more stringent than ICNIRP/ FCC limits	Italy, India, Israel, Croatia, Ukraine, Greece, China, Russia, Canada, Switzerland, Belgium, Bosnia Herzegovina, Grand Duchy of Luxembourg, Belarus, Georgia, Serbia, Slovenia, Montenegro, Bulgaria, Turkey, Liechtenstein, Tajikistan, Kazakhstan, Uzbekistan, Kyrgyzstan, Moldova, Kuwait, Republic of Moldova, Iraq
RFR monitoring program for cell tower/base station emission compliance and/or environmental RFR exposures.	France, Greece, Turkey, Spain, Romania, Serbia, India, Israel, French Polynesia, Croatia, Bulgaria, Tunisia, Malta, Brazil, Bahrain, Monaco, Bhutan, Senegal, United Kingdom, Australia, Spain, Austria, India, Israel, Gibraltar, Brussels Belgium, Switzerland, Norway, Lithuania.
Straightforward official government advice that the public and/ or children "should" minimize cell phone RF exposure.	United Kingdom, Russia, Switzerland, Finland, Ireland, Germany, Belgium, Greece, Israel, Turkey, Singapore, France, Denmark, India, Austria, Cyprus, Canada, Italy, French Polynesia - Maryland U.S. for Wi-Fi in Schools (CEHPAC), Korea, Sri Lanka, Croatia, Krakow Poland, European Parliament Resolution 1815
Ban on mobile phone advertising to children	France, Belgium, French Polynesia, Russia
Ban on sale of phones designed for young children	Belgium, France, French Polynesia
SAR labeling on device, packaging or by retailer at point of sale	France, Israel, India, Belgium, Russia, Korea
SAR levels for cell phone models are publicly posted on easily accessible government website	France, Korea, Austria, Senegal, Germany,
Market surveillance program for cell phone SAR compliance	France, Canada
Public awareness program, robust website and/or educational campaign to educate the public on how to minimize RFR exposures from cell phones	France, French Polynesia, Israel, Cyprus, Israel

all aspects of control, monitoring, measuring and remediating wireless radiation.

First, no federal agencies with health or environmental expertise have reviewed the totality of the science to ensure U.S. regulations are adequate. In 2021 the U.S. Circuit Court of Appeals for the District of Columbia issued a landmark ruling in the case of Environmental Health Trust et al. vs. the FCC[55] that challenged the FCC's decision not to update the human exposure limits for RFR emissions from cell phones, Wi-Fi, and cell tower networks. The Court found that the FCC did not provide evidence of properly examining scientific evidence on the record and had ignored studies indicating low level non-thermal exposures could cause harm, especially for children. The Court then ordered the FCC to provide a reasoned explanation regarding these issues:

- the impacts of wireless radiation on children;
- the health implications of long-term exposure to RF radiation;
- the ubiquity of wireless devices and the technological developments since the FCC last updated its guidelines;
- the cell phone radiation emission test methods that use heat measurements and allow a space between the phone and body; and
- the impacts of wireless radiation on the environment.

Another critical regulatory gap is that when considering cell tower network emissions, there is no U.S. agency with health or environmental expertise engaged in any funded activities regarding health effects.

Unlike other countries that are gathering data via countrywide monitoring programs, the U.S. has no active federal field measurement program for assessment, compliance, or enforcement regarding cell tower and base station antenna RF emissions. The last federal agency report on RFR measurements was compiled in 1986 by the EPA.[265] When companies apply to build a cell tower in the U.S. near a school or homes, there are no requirements for real world RFR measurements before and after the antenna facilities are built, nor any requirement for annual measurements. The computer simulations provided by the company do not always provide estimated RFR levels for all of the areas that will be impacted by the cell antenna installation, such as inside an apartment that shares a wall with a building mounted antenna, or inside the room of a school or home in direct line of sight of the main beam of an antenna. Such close

proximity installations can result in increased RF exposure[35,266,267] and are associated with various EMF-related symptoms.[208,210]

Although several nations post online maps with the location of cell towers and wireless facilities alongside RFR measurements, U.S. federal agencies neither collect, nor provide this information to the public. For example, small cell wireless facilities (such as those on poles less than 50 feet tall such as street lamps) generally do not need to be registered with the FCC.

International marketing, compliance and transparency measures

Some countries have enacted a variety of regulations designed to minimize children's exposure, ensure compliance with cell phone regulations, and ensure that the public has access to RFR information as shown in Table 3. For example, since 2010 France has prohibited the sale of cell phones designed for children under 6 years, and banned advertising cell phones to children under 14 years. In 2015, their cell phone labeling requirements were strengthened. Advertising must clearly recommend how to reduce exposure to the head or companies can be fined. In 2019, a joint order of the French Health and Finance Agencies[268] ordered that the cell phone consumer information should include several specific ways to reduce RF exposure to the brain, minimizing frequency and duration of use. In addition, the cell phone information includes "Keep radio equipment away from the belly of pregnant women," and "away from the lower abdomen of adolescents."[269]

2020 regulations[270] now mandate that computers, tablets and other handheld wireless electronics (as well as refurbished products) held close to the body were subject to the same labeling regulations as cell phones. In 2022, the French General Directorate for Competition, Consumer Affairs and Fraud Prevention found numerous violations[271] of their labeling requirements for wireless devices and issued over 200 warnings.

In 2014, Belgium implemented two Royal Decrees[272] that prohibited the sale and advertising of cell phones designed for children under 7 years old.[273]

Premarket cell phone and wireless device RFR testing

Some countries such as France and Canada perform independent SAR measurements of cell phone models to ensure regulatory compliance. Both countries have found that some phone models exceed their regulatory limits, even when tested at the manufacturer's stated separation distance, i.e. 5 or 10 or 15 mm from the head or body.

So far, over 35 non-compliant phone models have been either withdrawn from the French market or had software updates to decrease the RFR. The French National Frequency Agency, ANFR, posts their independent SAR test measurements for hundreds of cell phones online.[274] The U.S. does not have an oversight program for cell phone RFR emission compliance.

Furthermore, all cell phones and Wi-Fi devices such as routers, speakers, and gaming consoles have fine print instructions in their manuals stating that the user should maintain a specified minimum distance between their body and the phone or device in order to ensure compliance with regulatory safety limits.

Schools and child care settings

France, Israel, and regions in Belgium have removed Wi-Fi from kindergarten classrooms and restricted exposures in elementary classrooms. See Table 4. For example, French law (2015)[275] stipulates that Wi-Fi be off as the default setting, so that it is only turned on if needed for a particular classroom activity. The Parliamentary Assembly of the Council of Europe (PACE) Resolution 1815[276] (2011) recommends that "for children in general, and particularly in schools and classrooms, give preference to wired Internet connections, and strictly regulate the use of mobile phones by school children on school premises."

TABLE 4. International examples of policy measures to reduce RFR exposures in schools and child care settings.

Recommendations to prefer wired over Wi-Fi in kindergartens and schools	France, Israel, Germany, French Polynesia, Salzburg Austria, Maryland U.S.
Wi-Fi banned in child care settings and kindergarten	France, Israel, Ghent Belgium, French Polynesia, Cyprus
Wi-Fi off or minimized in elementary	France, Israel, Cyprus, Various municipal school districts worldwide

In the U.S., there are no specific school-focused or workplace-based federal regulations for RFR exposures. The Maryland State Children's Environmental Health and Protection Advisory Council report on Wi-Fi in school[277] recommends the reduction of RFR exposures in schools "as much as feasibly practical." Clegg et al.[278] outlines how to minimize RFR in buildings and includes the Collaborative for High Performance Schools[279] criteria to reduce RFR and ELF EMF in classrooms. (See a summary of recommendations below.)

Recommendations by Maryland Expert Advisors to the Governor and the Collaborative For High Performance Schools include:

- Install and use wired local area network (LAN) for internet access instead of Wi-Fi and connect classroom tech with cables whenever possible and always when building/remodeling.
- Ensure devices (tablets and laptops) are always used on a desk, not lap.
- Laptops, tablets and notebooks should have an Ethernet port and a physical switch to disable all wireless radios at once.
- Cell phones should be powered off and stored away during the school day. Wireless wearables should be turned to airplane mode.
- Prohibit use of DECT and cordless phones.
- Corded telephones should be installed in every classroom and there should be a way that students can contact parents and make calls during the day for planning purposes.
- Schools should integrate education on why and how to reduce RFR exposure into elementary, middle and high school class curriculum.
- Cell towers and wireless facilities should not be built on or adjacent/near to school property.
- Measure ELF and RFR levels in classrooms and sports areas yearly and when new technology is added to classrooms.

Healthcare settings

Sources of non-ionizing EMF exposure inside hospitals and healthcare facilities come from both the wireless networks (RFR) as well as electrical medical equipment (ELF-EMF).

EMF levels in neonatal units have been the subject of research due to the elevated exposure to an especially vulnerable patient group. Measurements of ELF inside incubators can range from 2 to 100 mG, depending on the distance from the top of the mattress to the electrical equipment.[280] After documenting higher levels of low frequency EMF levels inside closed incubators as compared to the ambient levels in the room, Penn State Medical Center researchers moderated the exposure through a grounding technique and found the mitigation improved infant's vagal tone, a marker of vulnerability to stress, and the risk of developing necrotizing enterocolitis.[281]

RFR in neonatal intensive care units primarily originates from staff and families' use of cell phones and wireless devices. A prudent avoidance strategy is recommended because these newborns are particularly vulnerable.[282]

In 2017, in Israel measurements of magnetic field EMF were taken for incubators in neonatal units at the request of the Ministry of Health and the Ministry of Environmental Protection[283] and they found a range from 0.05 to 5 μT. The Israel Ministry of Environmental Protection identified manufacturer approved efficient shielding methods to mitigate exposure in incubators and recommends reducing the duration of exposure as much as possible and prioritizing the use of low EMF incubators.

In Cyprus, the National Committee on Environment and Children's Health, under the auspices of the Ministry of Health, worked with the Archbishop Makarios III Hospital to pilot an RFR reduction program[284] in the pediatric intensive therapy unit and neonatal units. They removed the Wi-Fi access points, installed wired LAN networks and launched a multimedia educational program for families. RFR levels were measured before and after the mitigation and the measures resulted in a significant reduction in ambient exposure in the units.

The Agaplesion Diakonie Hospital in Hamburg, Germany has designed two "environmental" rooms for people with multiple chemical sensitivities and/or environmental allergies including sensitivity to electromagnetic fields. In addition to using low VOC emission building materials and fragrance free cleaning, several measures have been taken to reduce exposure to non-ionizing electromagnetic fields including the installation of power circuit breakers and prohibition of the use of cell phones.[285]

Recommendations for healthcare settings to minimize exposures, to support positive health outcomes as well as to accommodate patients with sensitivities:[13,83,197,199,215,275,281]

- Decrease RFR exposures in pediatric healthcare settings including waiting rooms, treatment areas, hospital rooms, and administrative workspaces by prioritizing wired connections and setting routers to their lowest operating settings;
- Ensure facilities have spaces with adequate EMF mitigation for treatment of sensitive patients;
- Educate patients, families, and staff;
- Utilize medical devices, equipment and technology designed without wireless features, or configured such that wireless connections are not essential and can be turned off when not in use; and
- Work with companies on research and design of safer technologies.

Conclusion: next steps for clinicians to better protect the young from impacts of RFR

Modern telecommunications have been embraced for their innumerable benefits to society, but we have been slower to acknowledge the need to avoid and reduce harms to youngsters or to the natural world on which our lives depend.[286] Fortunately, alternatives to employing wireless devices can provide safer, faster and more efficient technical performance for many modern applications. There are many distinct physical, psychological and sociological grounds for moderating children's screen time to promote healthy development. The principle of ALARA—as low as reasonably achievable—ought to be adopted as a strategy for RFR health and safety protection.

While such measures are being implemented in clinicians' offices, clinics and the like, there is a critical need for an independently funded training, research and monitoring program to identify major data gaps in the field which are substantial, to set relative priorities for research and training, and to conduct long term studies of the physical and psychological impacts of rapidly changing technological milieu, including ways to mitigate impacts through modifications in hardware and software.

The medical community has a critical role to play in the prevention and treatment of EMF associated illness. Steps that doctors and other healthcare professionals can take include:

- Federal level: Advocate with the AAP and other health professionals for a reassessment of RFR exposure limits and the development of standards that adequately address biological impacts, children's vulnerabilities and current use patterns.
- State level: Engage membership with educational and training activities as well as resolutions to support federal initiatives.
- Support policies that reduce EMF exposure for children in home, child care, school, health care, and recreational settings.
- Support the continued development of clinical guidelines for prevention, treatment and diagnosis of EMF related illness.

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