Appendix I

Greenhouse Gas Emissions Supplemental Information

Appendix I-1

Greenhouse Gas Scientific Discussion

Greenhouse Gases: The Physical Scientific Basis

Certain gases in the earth's atmosphere, classified as greenhouse gases (GHGs), play a critical role in determining the earth's surface temperature. Solar radiation enters the earth's atmosphere from space. A portion of the radiation is absorbed by the earth's surface and a smaller portion of this radiation is reflected back toward space. This absorbed radiation is then emitted from the earth as low-frequency infrared radiation. The frequencies at which bodies emit radiation are proportional to temperature. The earth has a much lower temperature than the sun; therefore, the earth emits lower frequency radiation. Most solar radiation passes through GHGs; however, infrared radiation is absorbed by these gases. As a result, radiation that otherwise would have escaped back into space is instead "trapped," resulting in a warming of the atmosphere. This phenomenon, known as the greenhouse effect, is responsible for maintaining a habitable climate on earth.

Prominent GHGs contributing to the greenhouse effect are carbon dioxide (CO_2), methane (CH_4), nitrous oxide (N_2O), hydrofluorocarbons, perfluorocarbons, and sulfur hexafluoride. Human-caused emissions of these GHGs in excess of natural ambient concentrations are believed responsible for intensifying the greenhouse effect and leading to a trend of unnatural warming of the earth's climate, known as global climate change or global warming. It is "extremely likely" that more than half of the observed increase in global average surface temperature from 1951 to 2010 was caused by the anthropogenic increase in GHG concentrations and other anthropogenic causes of climate change together (Intergovernmental Panel on Climate Change [IPCC] 2014:3, 5).

Climate change is a global problem. GHGs are global pollutants, unlike criteria air pollutants and toxic air contaminants, which are pollutants of regional and local concern. Whereas pollutants with localized air quality effects have relatively short atmospheric lifetimes (about one day), GHGs have long atmospheric lifetimes (one to several thousand years). GHGs persist in the atmosphere for long enough time periods to be dispersed around the globe. Although the lifetime of any particular GHG molecule is dependent on multiple variables and cannot be determined with any certainty, it is understood that more CO_2 is emitted into the atmosphere than is sequestered by ocean uptake, vegetation, and other forms of sequestration. Of the total annual human-caused CO_2 emissions, approximately 55 percent is sequestered through ocean and land uptake every year, averaged over the last 50 years, whereas the remaining 45 percent of human-caused CO_2 emissions remains stored in the atmosphere (IPCC 2013:467).

The quantity of GHGs in the atmosphere that ultimately result in climate change is not precisely known, but is enormous; no single project alone would measurably contribute to an incremental change in the global average temperature, or to global, local, or micro climates. From the standpoint of CEQA, GHG impacts relative to global climate change are inherently cumulative.

References

Intergovernmental Panel on Climate Change. 2013. *Carbon and Other Biogeochemical Cycles.* In: *Climate Change 2013: The Physical Science Basis. Contribution of Working Group I to the Fifth Assessment Report of the Intergovernmental Panel on Climate Change*. Available: http://www.ipcc.ch/report/ar5/wg1/. Accessed June 8, 2015.

_____. 2014 (November). *Climate Change 2014 Synthesis Report: Approved Summary for Policymakers.* Available at http://www.ipcc.ch/. Accessed June 8, 2015.

IPCC. *See* Intergovernmental Panel on Climate Change.

Appendix I-2

PCTBAP Greenhouse Gas Calculations

GHG Emission Factors for PCTBAP Analysis

Off-Road Emissions Inventory from OFFROAD 2007 for the Lake Tahoe Basin portion of Placer County		MT/year			
Year	Source	CO2	CH4	N2O	CO2e
2015	Pleasure Craft	5064.59	2.95	1.10	5464.87
2015	Other Offroad	7604.62	4.21	1.01	8009.81
2035	Pleasure Craft	9533.12	3.34	1.63	10102.61
2035	Other Offroad	4903.53	0.18	0.00	4909.41

Average Mobile Source Emission Factors from EMFAC 2014 for the Lake Tahoe Basin portion of Placer County								
For SB375 Threshold (not counting LCFS, Pavley, or ACC).					MT/year			
Year	Source	Value	Units	Type of Emissions	CO2	CH4	N2O	CO2e
2015	VMT	1	mile	Mobile	0.000444	0.000000037	0.000000020	0.00
2020	VMT	1	mile	Mobile	0.000425	0.000000021	0.000000012	0.00
2035	VMT	1	mile	Mobile	0.000406	0.000000007	0.000000004	0.00
For Statewide Threshold (counting LCFS, Pavley, and ACC).					MT/year			
Year	Source	Value	Units	Type of Emissions	CO2	CH4	N2O	CO2e
2015	VMT	1	mile	Mobile	0.000492	0.000000	0.000000	0.00
2020	VMT	1	mile	Mobile	0.000423	0.000000	0.000000	0.00
2035	VMT	1	mile	Mobile	0.000272	0.000000	0.000000	0.00

Land Use Operational Emission Factors using CalEEMod

2015 Emission Factors per unit					MT/year		
Land Use	X	Units	Type of Emissions	CO2	CH4	N2O	CO2e
Commercial	100,000	sqft	Area	0.00	0.00	-	0.00
Commercial	100,000	sqft	Energy	407.52	0.00	0.00	408.29
Commercial	100,000	sqft	Waste	18.88	1.12	-	46.77
Commercial	100,000	sqft	Water	33.76	0.58	0.01	52.32
Commercial	100,000	sqft	Total	460.16	1.70	0.02	507.39
TAU	100	units	Area	0.00	0.00	-	0.00
TAU	100	units	Energy	439.94	0.00	0.00	440.95
TAU	100	units	Waste	11.11	0.66	-	27.53
TAU	100	units	Water	3.89	0.08	0.00	6.53
TAU	100	units	Total	454.94	0.74	0.01	475.02
Residential	100	units	Area	121.30	0.10	0.00	124.92
Residential	100	units	Energy	257.03	0.00	0.00	257.63
Residential	100	units	Waste	17.71	1.05	-	43.87
Residential	100	units	Water	12.46	0.21	0.01	19.26
Residential	100	units	Total	408.49	1.36	0.01	445.68

2015 Emission Factors per unit					MT/year		
Land Use	Value	Units	Type of Emissions	CO2	CH4	N2O	CO2e
Commercial	1	sqft	Area	0.00	0.00	-	0.00
Commercial	1	sqft	Energy	0.00	0.00	0.00	0.00
Commercial	1	sqft	Waste	0.00	0.00	-	0.00
Commercial	1	sqft	Water	0.00	0.00	0.00	0.00
Commercial	1	sqft	Total	0.00	0.00	0.00	0.01
TAU	1	unit	Area	0.00	0.00	-	0.00
TAU	1	unit	Energy	4.40	0.00	0.00	4.41
TAU	1	unit	Waste	0.11	0.01	-	0.28
TAU	1	unit	Water	0.04	0.00	0.00	0.07
TAU	1	unit	Total	4.55	0.01	0.00	4.75
Residential	1	unit	Area	1.21	0.00	0.00	1.25
Residential	1	unit	Energy	2.57	0.00	0.00	2.58
Residential	1	unit	Waste	0.18	0.01	-	0.44
Residential	1	unit	Water	0.12	0.00	0.00	0.19
Residential	1	unit	Total	4.08	0.01	0.00	4.46

2035 Emission Factors per X new units (accounts for new 2016 T24 code)					MT/year		
Source	X	Units	Type of Emissions	CO2	CH4	N2O	CO2e
Commercial	100,000	sqft	Area	0.00	-	-	0.00
Commercial	100,000	sqft	Energy	235.52	0.00	0.00	235.99
Commercial	100,000	sqft	Waste	18.88	1.12	-	46.77
Commercial	100,000	sqft	Water	26.65	0.58	0.01	45.21
Commercial	100,000	sqft	Total	281.05	1.70	0.02	327.97
TAU	100	units	Area	0.00	-	-	0.00
TAU	100	units	Energy	276.16	0.00	0.00	276.88
TAU	100	units	Waste	11.11	0.66	-	27.53
TAU	100	units	Water	3.11	0.08	0.00	5.75
TAU	100	units	Total	290.38	0.74	0.00	310.17
Residential	100	units	Area	121.30	0.10	0.00	124.92
Residential	100	units	Energy	181.69	0.00	0.00	182.16
Residential	100	units	Waste	17.71	1.05	-	43.87
Residential	100	units	Water	9.83	0.21	0.01	16.63
Residential	100	units	Total	330.53	1.36	0.01	367.57

2035 Emission Factors per new unit (accounts for new 2016 T24 code)					MT/year		
Land Use	Value	Units	Type of Emissions	CO2	CH4	N2O	CO2e
Commercial	1	sqft	Area	0.00	-	-	0.00
Commercial	1	sqft	Energy	0.00	0.00	0.00	0.00
Commercial	1	sqft	Waste	0.00	0.00	-	0.00
Commercial	1	sqft	Water	0.00	0.00	0.00	0.00
Commercial	1	sqft	Total	0.00	0.00	0.00	0.00
TAU	1	unit	Area	0.00	-	-	0.00
TAU	1	unit	Energy	2.76	0.00	0.00	2.77
TAU	1	unit	Waste	0.11	0.01	-	0.28
TAU	1	unit	Water	0.03	0.00	0.00	0.06
TAU	1	unit	Total	2.90	0.01	0.00	3.10
Residential	1	unit	Area	1.21	0.00	0.00	1.25
Residential	1	unit	Energy	1.82	0.00	0.00	1.82
Residential	1	unit	Waste	0.18	0.01	-	0.44
Residential	1	unit	Water	0.10	0.00	0.00	0.17
Residential	1	unit	Total	3.31	0.01	0.00	3.68

2035 Emission Factors per X existing units (accounts for historical energy use)					MT/year		
Source	X	Units	Type of Emissions	CO2	CH4	N2O	CO2e
Commercial	100,000	sqft	Energy	302.90	0.00	0.00	303.55
TAU	100	units	Energy	358.05	0.00	0.00	359.05
Residential	100	units	Energy	208.49	0.00	0.00	209.05

2035 Emission Factors per existing unit (accounts for historical energy use)					MT/year		
Land Use	Value	Units	Type of Emissions	CO2	CH4	N2O	CO2e
Commercial	1	sqft	Energy	0.00	0.00	0.00	0.00
TAU	1	units	Energy	3.58	0.00	0.00	3.59
Residential	1	units	Energy	2.08	0.00	0.00	2.09

GHG Emission Assumptions

Category	Value	Notes	Source
Conversions			
g/lb	453.592		
g/MT	1000000		
lb/MT	2204.622622		
kg/MT	1000		
kWh/MWh	1000		
MWh/GWh	1000		
Btu/therm	100000		
MMBtu/therm	0.1		
LPG Gallons/GGE	1.344086022		
LNG Gallons/GGE	1.572327044		
gal/cubic foot	7.480519481		
gal/Liter	3.785411784		
gallon/acrefoot	325851.429		
GWP			
CO2	1		
CH4	25	IPCC Fourth Assessment Report	
N2O	298	IPCC Fourth Assessment Report	
Energy Emission Factors			
2013			
Liberty Utilities RPS Status	**21.70%**		**http://www.cpuc.ca.gov/PUC/energy/Renewables/**
lb CO2e/MWh	462	Electricity	Calculated
MT CO2e/MWh	0.209	Electricity	Calculated
MT CO2e/MWh	589.502		
2018			
Liberty Utilities RPS Status	**29.8%**		**Assumption**
MT CO2e/MWh	414.00	Electricity	Calculated
2020			
Liberty Utilities RPS Status	**33%**		**Assuming SDG&E will meet state RPS goals**
MT CO2e/MWh	394.97	Electricity	Calculated
2035			
Liberty Utilities RPS Status	**41.5%**		**Assumption**
MT CO2e/MWh	344.86	Electricity	Calculated
2050			
Liberty Utilities RPS Status	**50%**		**Assumption**
MT CO2e/MWh	294.751	Electricity	Calculated