

Appendix C Air Quality and Greenhouse Gas Emissions Modeling

Appendices

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Model Inputs

	Baseline Year 2020		Proposed GP 2045		Net Change
	City	Total	City	Total	Total
Households	78,792	78,792	115,053	115,053	36,261
Non-Residential Square Footage ¹	67,118,596	67,118,596	72,967,816	72,967,816	5,849,220
Population	334,774	334,774	431,629	431,629	96,855
Employment	158,980	158,980	170,416	170,416	11,436
Service Population	493,754	493,754	602,045	602,045	108,291

Notes:

¹ Based on the City of Santa Ana Existing Conditions, Potential Growth, and Buildout Conditions, 2020 to 2045.

Growth Rates from Baseline	Existing	2045
Housing Growth Rate	1.00	1.46
Population Growth Rate	1.00	1.29
Employment Growth Rate	1.00	1.07
Service Population Growth Rate	1.00	1.22

	Existing	Proposed	Net Change
	2020	2045	
ELECTRICITY			
City			
Residential Electricity (kWh)	380,621,219	555,787,557	175,166,337
Nonresidential Electricity (kWh)	1,189,836,014	1,275,425,174	85,589,160
Total Electricity (kWh)	1,570,457,233	1,831,212,730	260,755,497
NATURAL GAS			
City			
Residential Natural Gas (Therms)	21,783,050	31,807,865	10,024,814
Nonresidential Natural Gas (Therms)	27,074,864	29,022,456	1,947,592
Total Natural Gas (Therms)	48,857,914	60,830,320	11,972,406
TRANSPORTATION			
City			
VMT/Day	11,407,124	11,518,959	111,835
WATER			
City			
Water (acre-feet/year)	31,151	38,101	6,950
WASTEWATER			
City			
Indoor Water as a Percent of Total Water Use	95%	95%	
Wastewater (acre-feet/year)	29,593	36,196	6,603
SOLID WASTE			
City			
Waste Generation (tons/year)	324,679	396,172	71,492
Waste Generation ADC (tons/year)	30,778	37,555	6,777
Total Waste Disposal (tons/year)	355,457	433,726	78,269

Sources:

Energy use utilizes a seven-year (2012-2018) average annual electricity consumption based on data provided by Southern California Edison (SCE) and and five-year (2014-2018) average annual natural gas consumption average based on data provided by SoCal Gas. Baseline year energy estimates are also adjusted to account for energy consumption associated with the former SOI area recently annexed into the City. Forecasts in energy are based on the change in households.

VMT provided by IBI Group.

Total water demand and wastewater generation data provided by Fuscoe Engineering, Inc.

Waste generation based on waste commitment for the City of Santa Ana is obtained from CalRecycle. Forecasts are based on an average 2014-2016 disposal rate and adjusted for increases in population and employment for the City and SOI.

CITY OF SANTA ANA - CRITERIA AIR POLLUTANT INVENTORY

EXISTING BASELINE	2020 - lbs/day					
SECTORS	ROG	NO _x	CO	SO _x	PM ₁₀	PM _{2.5}
Transportation	831	5,596	25,067	90	1,362	602
Energy - Residential (Natural Gas)	64	550	234	4	44	44
Energy - Nonresidential* (Natural Gas)	80	727	611	4	55	55
<i>Energy sub-total</i>	144	1,277	845	8	100	100
Area Source - Consumer Products	4,212	0	0	0	0	0
Area Sources (Light Commercial Equipment, Portable Equip)	154	415	6,330	1	38	31
Other (Construction Equipment) **	28	182	589	0	13	11.11
Total	5,369	7,470	32,832	99	1,513	744

EXISTING w/2045 EMISSION RATES	2045 Existing Land Uses - lbs/day					
SECTORS	ROG	NO _x	CO	SO _x	PM ₁₀	PM _{2.5}
Transportation	355	2,232	13,143	59	1,296	532
Energy - Residential (Natural Gas)	64	550	234	4	44	44
Energy - Nonresidential* (Natural Gas)	80	727	611	4	55	55
<i>Energy sub-total</i>	144	1,277	845	8	100	100
Area Sources - Consumer Products	4,212	0	0	0	0	0
Area Sources (Light Commercial Equipment, Portable Equip)	154	415	6,330	0.96	38	31
Other (Construction Equipment) **	28	182	589	0	13	11
Total	4,893	4,106	20,907	69	1,447	673
Net Change from Baseline (2020)	-475	-3,364	-11,925	-30	-66	-71

FORECAST YEAR 2045	2045 Land Uses - lbs/day					
SECTORS	ROG	NO _x	CO	SO _x	PM ₁₀	PM _{2.5}
Transportation	359	2,254	13,272	60	1,309	537
Energy - Residential (Natural Gas)	94	803	342	5.13	65	65
Energy - Nonresidential* (Natural Gas)	86	780	655	4.68	59	59
<i>Energy sub-total</i>	180	1,583	997	9.80	124	124
Area Sources - Consumer Products	6,156	0	0	0	0	0
Area Sources (Light Commercial Equipment, Portable Equip)	165	445	6,786	1	41	33
Other (Construction Equipment) **	28	182	589	0	13	11
Total	6,888	4,463	21,643	71	1,487	705
Net Change from Baseline (2045 Existing)	1,994	357	736	3	40	32
Net Change from Baseline (2020)	1,519	-3,007	-11,189	-28	-26	-39

Notes:

Transportation. EMFAC2017 and IBI Group. The SAFE Rule NO_x, CO, PM₁₀, and PM_{2.5} exhaust adjustment factors for light duty vehicles (LDA, LDT1, LDT2, and MDV) is applied for year 2045.

Emissions forecasts estimated based on changes in housing (residential energy), employment (nonresidential energy), or service population (transportation)

Energy. Based on a five-year average (2014-2018) of natural gas data as provided by SoCal Gas.

Area Sources. OFFROAD2017. Estimated based on employment (Light Commercial Equipment) for City of Santa Ana as a percentage of Orange County. Does not include emissions from wood-burning fireplaces.

Other Sources. OFFROAD2017. Construction emissions estimated based on housing permit data for Orange County and City of Santa Ana from the US Census. **Excludes fugitive emissions from construction sites.

Excludes Permitted Sources: Because the reductions associated with the Industrial sector are regulated separately by SCAQMD and are not under the jurisdiction of the City of Santa Ana, these emissions are not included in the emissions inventory.

CITY OF SANTA ANA - COMMUNITY GHG EMISSIONS INVENTORY

SECTORS	MTCO ₂ e			
	2020	Percent of Total	2045	Percent of Total
Transportation	1,463,006	66%	1,061,237	54%
Residential (Natural Gas and Electricity)	208,050	9%	303,797	16%
Nonresidential* (Natural Gas and Electricity)	432,202	20%	463,292	24%
Solid Waste (Waste Commitment)	56,603	3%	69,017	4%
Water/Wastewater	34,084	2%	41,688	2%
Other - Offroad Equipment	18,678	1%	17,713	1%
Total Community Emissions	2,212,622	100%	1,956,744	100%
Service Population	493,754		602,045	
MTCO ₂ e/SP	4.48		3.25	

Notes: Based on IPCC's Fourth Assessment Report GWPs

Emissions forecast based on changes in housing (residential energy), employment (nonresidential energy), or service population (waste, water/wastewater, transportation).

Transportation. EMFAC2017 and IBI Group. The SAFE Rule CO₂ exhaust adjustment factor for light duty vehicles (LDA, LDT1, LDT2, and MDV) is applied for year 2045.

Energy. Energy use utilizes a seven-year (2012-2018) average annual electricity consumption average based on data provided by Southern California Edison (SCE) and a five-year (2014-2018) natural gas consumption average based on data provided by SoCal Gas. Emissions from electricity utilizes a CO₂e intensity factor based on the SCE CO₂ intensity factor reported for year 2019 identified in the SCE 2019 Corporate Responsibility & Sustainability report and the CH₄ and N₂O intensity factors from the latest US EPA eGRID data. Electricity and natural gas use from industrial and permitted facilities may be included with the overall amounts for non-residential uses as the 15/15 Rule was triggered.

Water/Wastewater. Includes fugitive emissions from wastewater processing and energy associated with water/wastewater treatment and conveyance. Water use is estimated based on data provided by Fuscoe Engineering.

Waste. Landfill Emissions Tool Version 1.3 and CalRecycle. Waste generation based on three year average (2016-2018) waste commitment for the City of Santa Ana obtained from CalRecycle. Assumes 75 percent of fugitive GHG emissions are captured within the landfill's Landfill Gas Capture System with a landfill gas capture efficiency of 75%. The Landfill gas capture efficiency is based on the California Air Resources Board's (CARB) Local Government Operations Protocol (LGOP), Version 1.1. Significant CH₄ production typically begins one or two years after waste disposal in a landfill and continues for 10 to 60 years or longer. Consequently, the highest CH₄ emissions from waste disposal in a given year are reported and have been adjusted to utilize IPCC's Fifth Assessment global warming potential assigned for CH₄.

Other Sources. OFFROAD2017. Estimated based on employment (Light Commercial Equipment) and construction permits (Construction Equipment) for the City of Santa Ana as a percentage of Orange County.

Industrial Sector are "point" sources that are permitted by SCAQMD and are not under the jurisdiction of the City of Santa Ana; and therefore, not included in the City of Santa Ana's community GHG emissions inventory.

CITY OF SANTA ANA - GHG EMISSIONS INVENTORY COMPARISON

SECTORS	Substantial Increase	
	Change from 2020	
	2045 Buildout	Percent Change from 2020
Transportation	(401,769)	-27%
Residential (Natural Gas and Electricity)	95,747	46%
Nonresidential* (Natural Gas and Electricity)	31,090	7%
Waste	12,414	22%
Water/Wastewater	7,604	22%
Other - Offroad Equipment	(965)	-5%
Total Community Emissions	(255,878)	-11.6%

Criteria Air Pollutants (VOCs): Area Sources - Consumer Products

Source: CalEEMod Users Guide. Version 2016.3.2

Residential and Non-Residential Consumer Product Use^a

Emissions = EF x Building Area

SCAQMD EF =	2.04E-05	lbs/sqft/day
Non-SCAQMD EF =	2.14E-05	lbs/sqft/day

Sources/Notes:

a. California Emissions Estimator Model, Version 2016.3.2, Users Guide. Appendix A.

AVERAGE HOUSING SQFT ASSUMPTIONS

Year Structure was Built	Percent of Housing Stock ^a	Average Square Feet of New Single Family Homes ^b	Average Square Feet (Weighted)
2010 or later	0.9%	2,533	24
2000 to 2009	3.0%	2,404	72
1980 to 1999	15.0%	1,968	295
1979 or earlier	81.1%	1,699	1,378
	100%		<u>1,768</u>

Sources/Notes:

a. United States Census Bureau, American FactFinder, City of Santa Ana, California, Selected Housing Characteristics, 2016 American Community Survey 5-Year Estimates, Year structure built. <https://factfinder.census.gov/faces/tableservices/jsf/pages/productview.xhtml?src=CF>

b. United States Census Bureau, Characteristics of New Housing, Characteristics of New Single-Family Houses Completed, Median and Average Square Feet by Location. Obtained from <https://www.census.gov/construction/chars/completed.html>

	2020	2045
	CEQA Baseline	Proposed Project
Non-Residential SQFT	67,118,596	72,967,816
Housing Units	78,792	115,053
Residential SQFT	139,342,204	228,798,091
lbs VOC per day	4,212	6,156

Water and Wastewater

Water Demand/Wastewater Generation Calculations

Source: Fuscoe Engineering, Inc. 2020, May 29. City of Santa Ana General Plan Update: Water Supply and Demand Technical Report

Year	Water Demand (acre-feet/year)	Water Demand (gallons/year)
	Total	Total
2020	31,151.00	10,150,597,865
2045	38,101.00	12,415,265,296

Year	Wastewater Generation (acre-feet/year)	Wastewater Generation (gallons/year)
	Total	Total
2020	29,593.45	9,643,067,972
2045	36,195.95	11,794,502,032

Wastewater, Percent of total Water Use: 95%

Fugitive Emissions - Process Emissions from WWTP with Nitrification/Denitrification

CH₄ - Microorganisms can biodegrade soluble organic material in wastewater under aerobic (presence of oxygen) or anaerobic (absence of oxygen) conditions. Anaerobic conditions result in the production of CH₄.

N₂O - Treatment of domestic wastewater during both nitrification and denitrification of the nitrogen present leads to the formation of N₂O, usually in the form of urea, ammonia, and proteins. These compounds are converted to nitrate through the aerobic process of nitrification. Denitrification occurs under anoxic conditions (without free oxygen), and involves the biological conversion of nitrate into dinitrogen. N₂O can be an intermediate product of both processes, but more often is associated with denitrification.

Notes: Waste discharge facilities in compliance with the United States Environmental Protection Agency's Clean Water Standards do not typically result in CH₄ emissions. However, poorly-operated aerobic wastewater treatment systems can result in the generation of CH₄. Because wastewater treatment systems are assumed to operate in compliance with state and federal laws pertaining to water quality, CH₄ emissions from centralized aerobic treatments are not included in the inventory.

Fugitive Emissions - Process Emissions from WWTP with Nitrification/Denitrification for combustion of biogas.

Anaerobic digesters produce methane-rich biogas which is typically combusted on-site. In some cases the biogas is combusted simply for the purpose of converting methane to CO₂, which has a lower global warming potential than methane. In many cases, a cogeneration system is used to harvest the heat from combustion and use it to generate electricity for on-site energy needs. In both cases, inherent inefficiencies in the system result in incomplete combustion of the biogas, which results in remaining methane emissions. Excludes biogenic emissions from combustion of biogas.

LGOP Version 1.1. Equation 10.1.

$$CH_4 = \text{Wastewater} \times \text{Digester Gas} \times F_{CH_4} \times P_{CH_4} \times (1-DE) \times 0.0283 \times 10^{-3} \times 10^{-3}$$

	CEQA Baseline	Proposed Project
wastewater (gallons)=	9,643,067,972	11,794,502,032
Digester gas	0.01	ft ³ biogas/gallon wastewater
F _{CH₄}	0.65	fraction of CH ₄ in biogas
P _{CH₄}	662.00	g/m ³ ; density of CH ₄ at standard conditions
DE	0.99	CH ₄ destruction efficiency
0.0283	= 0.0283	m ³ /ft ³ ; conversion factor
10 ⁻³	= 1.00E-03	MT/kg conversion factor
10 ⁻³	= 1.00E-03	kg/g conversion factor

	CEQA Baseline	Proposed Project
	MTons	
CH ₄ =	11.74	14.36
CO ₂ e =	329	402

Source: California Air Resources Board (CARB). 2010, May. Local Government Operations Protocol (LGOP), Version 1.1. The LGOP protocol provides default values for all the terms except the digester gas, which is assumed to be 0.1 cubic feet of biogas per gallon of wastewater effluent based on USEPA methodology outlined in the CalEEMod program manual. California Air Pollution Control Officers Association (CAPCOA). 2017. California Emissions Estimator Model (CalEEMod), Version 2016.3.2. User's Manual. USEPA. 2008. Page 8-12. USEPA cites Metcalf & Eddy, Inc., 1991, "Wastewater Engineering: Treatment Disposal, and Reuse," 3rd Ed. McGraw Hill Publishing.

Water and Wastewater

Buildout Fugitive Emissions - Process Emissions from WWTP with Nitrification/Denitrification from discharge into aquatic environments

LGOP Version 1.1. Equation 10.9.

$$N_2O = \text{Wastewater} \times 10^{-6} \times \text{Nload} \times 44/28 \times \text{EF effluent} \times 10^{-3}$$

	2020	2040	
wastewater (Liters)=	36,499,012,272	44,642,190,189	
$10^{-6} = 1.00E-06$			conversion factor; kg/mg
N Load 26.00			mg/L of wastewater
44/28 1.57			Ratio of molecular weights for N ₂ O and N ₂
EF effluent 0.005			kg/N ₂ O/kg N
$10^{-3} = 1.00E-03$			conversion factor: MTons/kg

	2020	2040
	MTons	
N ₂ O	7.46	9.12
CO ₂ e =	1,976	2,417

Source: California Air Resources Board (CARB). 2010, May. Local Government Operations Protocol (LGOP), Version 1.1. The LGOP protocol provides default values for all the terms except the Nitrogen Load, which is assumed to be 26 mg of N per Liter of wastewater effluent based on USEPA methodology outlined in the CalEEMod program manual. California Air Pollution Control Officers Association (CAPCOA). 2017. California Emissions Estimator Model (CalEEMod), Version 2016.3.2. Appendix A. USEPA 2013. California Statewide average. USEPA Database at http://cfpub.epa.gov/dmr/ez_search.cfm.

Total Fugitive Emissions - Process Emissions from WWTP with Nitrification/Denitrification

	2020	2045
CO ₂ e =	2,305	2,819

Wastewater Modeling assumes 0% septic treatment for years 2020 and 2045.

Water and Wastewater

Energy for Water Conveyance, Treatment, Distribution, and Wastewater Treatment (Southern California)

Water Supply and Conveyance	Water Treatment	Water Distribution	Total Water	Wastewater Treatment (Tertiary)
kWhr/million gallons				
9,727	111	1,272	11,110	1,911

Source: California Energy Commission (CEC). 2006, December. Refining Estimates of Water-Related Energy Use in California. CEC-500-2006-118. Prepared by Navigant Consulting, Inc. Based on the electricity use for Southern California.

SCE

	WCI -WECC Region Intensity factor			CO ₂ e
	CO ₂ MTons/MWh ^{1,2}	CH ₄ MTons/MWh ³	N ₂ O MTons/MWh ³	MTons/MWh
2019	0.241	0.000015	0.000002	0.242

¹ Southern California Edison. 2020. 2019 Sustainability Report. <https://www.edison.com/content/dam/eix/documents/sustainability/eix-2019-sustainability-report.pdf>

² Based on SCE 2019 reported CO₂e intensity factor of 534 lbs/MWh subtracted by the CH₄ intensity factor of 0.034 lb/MWh and the N₂O intensity factor of 0.004 lb/MWh utilizing the IPCC Fifth Assessment Report global warming potentials of 28 and 265, respectively, to avoid double counting. Per methodology utilized in CalEEMod. Version 2016.3.2, User's Guide, however N₂O and CH₄ intensity factors based on US EPA eGRID2018 data.

³ United State Environmental Protection Agency. 2020, March 9. eGRID2018 Total Output Emission Rates, WECC California Region. (CH₄ = 0.034 lbs/MWh & N₂O = 0.004 lbs/MWh)

ABAU Carbon Intensity for SCE Energy

	2019	2030	CO ₂ e
Assumed Percent Renewable ¹	35.0%	60%	MTons/MWh
CO ₂ e MTons/Mwh without Renewable	0.3726436		0.149

¹ Southern California Edison. 2020. 2019 Sustainability Report. <https://www.edison.com/content/dam/eix/documents/sustainability/eix-2019-sustainability-report.pdf>.

GHG Emissions from Energy Associated with Water/Wastewater

Energy Associated with Water Use	2020	2045
	MwH/Year	
Water	112,773	137,934
Wastewater	18,428	22,539
Total Water/Wastewater	131,201	160,473

Wastewater Modeling assumes 0% septic treatment for years 2020 and 2045.

GHG Emissions from Energy Associated with Water Use/Wastewater Generation	2020	2045
	MTCO ₂ e/Year	
Water	27,316	33,410
Wastewater	4,464	5,459
Total Water/Wastewater	31,779	38,869

Total GHGs

GHG Emissions from Water/Wastewater Use	2020	2045
	MTCO ₂ e/Year	
Water	27,316	33,410
Wastewater	6,768	8,278
Total Water/Wastewater	34,084	41,688

General Conversion Factors

lbs to kg	0.4536
kg to MTons	0.001
Mmbtu to Therm	0.1
Therms to kwh	29.30711111
kilowatt hrs to megawatt hrs	0.001
lbs to Tons	2000
Tons to MTon	0.9071847

Source: California Air Resources Board (CARB). 2010. Local Government Operations Protocol. Version 1.1. Appendix F, Standard Conversion Factors

General Conversion Factors

	Global Warming Potentials (GWP)
	AR5
CO ₂	1
CH ₄	28
N ₂ O	265

Water and Wastewater

Source: Intergovernmental Panel on Climate Change (IPCC), 2013. Fifth Assessment Report: Climate Change 2013. New York: Cambridge University Press.

gallons to Liters	3.785
kilowatt hrs to megawatt hrs	0.001
gallons to AF	325851.4290

Water Demand and Wastewater for City of Santa Ana

Existing Annual AFY¹

	Water Demands (AFY)	Average 2016-2018 Annual Units
Single Family Residential	19,323	19,323
Multi-Family Residential	5,862	5,862
Commercial	4,318	4,318
Potable and Recycled Irrigation	1,648	1,648
Total	31,151	31,151

¹ Fuscoe Engineering, Inc. 2020, May 29. City of Santa Ana General Plan Update: Water Supply and Demand Technical Report

Annual Gallons¹

	7/1/17 to 6/30/18	Average 2016-2018 Annual Gallons
Single Family Residential	6,296,418,873	6,296,418,873
Multi-Family Residential	1,910,138,562	1,910,138,562
Commercial	1,407,024,618	1,407,024,618
Potable and Recycled Irrigation	537,002,448	537,002,448
City	10,150,584,501	10,150,584,501

¹ 1 acre-foot/year (AFY): 325,851 gallons/year

Fuscoe Wastewater Generation

Annual Gallons¹

	2016	Average 2012-2016 Annual Therms
Single Family Residential	5,981,597,929	5,981,597,929
Multi-Family Residential	1,814,631,634	1,814,631,634
Commercial	1,336,673,387	1,336,673,387
Potable and Recycled Irrigation	510,152,326	510,152,326
City	9,643,055,276	9,643,055,276

Area	Population	Employment
City	334,774	158,980

Water Demand*

Residential Annual Gal/Resident: 18,808 gal/resident
 Non-Residential Annual Gal/Employee: 3,378 gal/employee

* Annual use divided by residents/employees within the City of Santa Ana boundaries.

Wastewater*

Residential Annual Therms/Resident: 17,868 kWh/resident
 Non-Residential Annual Therms/Employee: 3,209 kWh/employee

** Annual use divided by residents/employees within the City of Santa Ana boundaries.*

Solid Waste Disposal - City of Santa Ana

Source: CalRecycle, 2019, Disposal Reporting System, Jurisdiction Reporting by Facility, <https://www2.calrecycle.ca.gov/LGCentral/DisposalReporting/Destination/DisposalByFacility>

Waste Generated Within City Limits

Waste in Place Method

Years	historic population estimates	Interstate Tons + Transform			
		Year	Tons	ADC+AIC	Total
		2016	321,938	29,720	
		2017	309,695	33,281	
		2018	342,405	29,332	
		2020 ^a	324,679	30,778	355,457
	City Service Population ^b	493,401	persons		
	Former SOI Area Service Population ^{c,d}	353	persons		
		Interstate Tons + Transform			
		Year	Tons	ADC+AIC	Total
	Disposal Rate / SP		0.658	0.062	0.720
	2020 (Former SOI Area)		232	22	254
	2020 (City)		324,679	30,778	355,457
	2020 (Total City)		324,911	30,800	355,711
	Year 2045 Buildout		396,172	37,555	433,726
	Increase from 2020		71,260	6,755	78,015

^a Average 3-year disposal used to forecast waste disposal in 2040

^b Represents the net change between the baseline service population for the City of 493,754 persons subtracted by the service population for the former 17th Street and Tustin Unincorporated Island SOI.

^c Associated with the recently annexed 17th Street and Tustin Unincorporated Island area.

^d Service population of 375 persons consist of 275 residents and 78 employees. Source: Orange County Local Agency Formation Commission. 2019, November 13. Proposed "Reorganization of the 17th Street and Tustin Unincorporated Island to the City of Santa Ana and Municipal Water District of Orange County (RO 19-07)"; Data compiled by MIG.

Landfill Emission Tool (version 1.3) Model Results using the Methane Commitment Method (~50 years of decomposition)

Year	MT CH ₄ in CO ₂ e	MTCO ₂ e w/LFG Capture		MTCO ₂ e w/LFG Capture	
	2020 Disposal	2020 Disposal	2020 Disposal (AR5 GWPs)*	2045 Disposal	2045 Disposal (FAR GWPs)*
1	2,999	750	1,000	914	1,219
2	5,919	1,480	1,973	1,804	2,406
3	5,802	1,450	1,934	1,769	2,358
4	5,687	1,422	1,896	1,734	2,311
5	5,574	1,394	1,858	1,699	2,266
6	5,464	1,366	1,821	1,666	2,221
7	5,356	1,339	1,785	1,633	2,177
8	5,250	1,312	1,750	1,600	2,134
9	5,146	1,286	1,715	1,569	2,091
10	5,044	1,261	1,681	1,538	2,050
11	4,944	1,236	1,648	1,507	2,009
12	4,846	1,212	1,615	1,477	1,970
13	4,750	1,188	1,583	1,448	1,931
14	4,625	1,156	1,542	1,410	1,880
15	4,519	1,130	1,506	1,377	1,837
16	4,412	1,103	1,471	1,345	1,793
17	4,306	1,077	1,435	1,313	1,750
18	4,200	1,050	1,400	1,280	1,707
19	4,094	1,023	1,365	1,248	1,664
20	3,988	997	1,329	1,216	1,621
21	3,881	970	1,294	1,183	1,578
22	3,775	944	1,258	1,151	1,534
23	3,669	917	1,223	1,118	1,491
24	3,563	891	1,188	1,086	1,448
25	3,457	864	1,152	1,054	1,405
26	3,350	838	1,117	1,021	1,362
27	3,244	811	1,081	989	1,319

28	3,138	785	1,046	957	1,275
29	3,032	758	1,011	924	1,232
30	2,926	731	975	892	1,189
31	2,819	705	940	859	1,146
32	2,713	678	904	827	1,103
33	2,607	652	869	795	1,060
34	2,501	625	834	762	1,016
35	2,395	599	798	730	973
36	2,288	572	763	698	930
37	2,182	546	727	665	887
38	2,076	519	692	633	844
39	1,970	492	657	600	801
40	1,864	466	621	568	757
41	1,757	439	586	536	714
42	1,651	413	550	503	671
43	1,545	386	515	471	628
44	1,439	360	480	439	585
45	1,333	333	444	406	542
46	1,226	307	409	374	498
47	1,120	280	373	341	455
48	1,014	254	338	309	412
49	908	227	303	277	369
50	802	200	267	244	326
51	695	174	232	212	283
52	589	147	196	180	239
53	483	121	161	147	196
54	377	94	126	115	153
55	271	68	90	82	110
56	164	41	55	50	67
57	58	15	19	18	24
TOTAL	169,808	42,452	56,603	51,763	69,017

*Landfill Emissions Tool Version 1.3 is based on the IPCC Second Assessment Report global warming potential. The numbers in this column are the CO₂e emissions from CH₄ based on IPCC's Fourth Assessment GWPs.

Conversion

SAR GWP CH4:*	21
AR5 GWP CH4:**	28

*Intergovernmental Panel on Climate Change (IPCC). 1995. Second Assessment Report: Climate Change 1995.

**Intergovernmental Panel on Climate Change (IPCC). 2014. Fifth Assessment Report: Climate Change 2014.

Waste. Landfill Emissions Tool Version 1.3 and CalRecycle. Biogenic CO₂ emissions are not included.

Notes

LFG capture Efficiency 0.75

Waste generation based on three year average (2016-2018) waste commitment for the City of Santa Ana obtained from CalRecycle. This sector captures only the waste that is generated by the City of Santa Ana residents in the inventory year. This sector does not include historically generated waste disposal.

This method assumes that the degradable organic component (degradable organic carbon, DOC) in waste decays slowly throughout a few decades, during which CH₄ and biogenic CO₂ are formed. If conditions are constant, the rate of CH₄ production depends solely on the amount of carbon remaining in the waste. As a result emissions of CH₄ from waste deposited in a disposal site are highest in the first few years after deposition, then gradually decline as the degradable carbon in the waste is consumed by the bacteria responsible for the decay. Significant CH₄ production typically begins one or two years after waste disposal in a landfill and continues for 10 to 60 years or longer.

Decomposition based on an average annual rainfall of 13.69 inches per year average in the City of Santa Ana (anaerobic decomposition factor (k) of 0.020) (Western Regional Climate Center. 2019. <https://wrcc.dri.edu/cgi-bin/cliMAIN.pl?ca7888>).

The Landfill Gas Estimator only includes the landfill gas (LFG) capture in the landfill gas heat output and therefore the reduction and emissions from landfill gas capture are calculated separately. Assumes 75 percent of fugitive GHG emissions are captured within the landfill's Landfill Gas Capture System with a landfill gas capture efficiency of 75%. The Landfill gas capture efficiency is based on the California Air Resources Board's (CARB) Local Government Operations Protocol (LGOP), Version 1.1. Biogenic CO₂ emissions are not included.

Electricity and Natural Gas Use Consumption for City of Santa Ana

Southern California Edison Electricity Use

	Annual KWH							Average 2012-2018
	2012	2013	2014	2015	2016	2017	2018	Annual KWH
Residential	382,173,371	375,962,888	384,502,945	387,235,367	376,464,025	376,818,302	379,003,010	380,308,558
Commercial + Industrial	1,216,778,299	1,198,174,695	1,217,353,861	1,180,785,021	1,133,169,360	1,111,077,462	1,095,758,235	1,189,252,247

SoCal Gas Natural Gas Use

	Annual Therms							Average 2014-2018
	2012	2013	2014	2015	2016	2017	2018	Annual Therms
Residential			21,909,034	21,220,339	21,842,233	22,062,372	21,791,804	21,765,156
Commercial + Industrial			26,450,661	27,324,706	24,279,474	28,365,442	28,887,618	27,061,580

Area	Population	Employment
City	334,499	158,902
Former SOI Area ^{a,b}	275	78

^a Associated with the recently annexed 17th Street and Tustin Unincorporated Island area.

^b Source: Orange County Local Agency Formation Commission. 2019, November 13. Proposed "Reorganization of the 17th Street and Tustin Unincorporated Island to the City of Santa Ana and Municipal Water District of Orange County (RO 19-07)"; Data compiled by MIG.

Electricity*

Residential Annual KWH/Resident:	1,137	kWH/resident
Non-Residential Annual KWH/Employee:	7,484	kWH/employee

* Annual use divided by residents/employees within the City of Santa Ana boundaries minus the residents/employees in the former SOI area.

Area	Commercial +	
	Residential Annual kWH	Industrial Annual kWH
Former SOI Area	312,661	583,767

Natural Gas*

Residential Annual Therms/Resident:	65	kWH/resident
Non-Residential Annual Therms/Employee:	170	kWH/employee

* Annual use divided by residents/employees within the City of Santa Ana boundaries minus the residents/employees in the former SOI area.

Area	Commercial +	
	Residential Annual Therms	Industrial Annual Therms
Former SOI Area	17,894	13,284

Disclaimer. The 15/15 Rule is intended to protect customer confidentiality by reducing the possibility of identifying customers through the release of usage information. The utilities apply the 15/15 Rule in releasing aggregated customer information. The rule was initially implemented by the California Public Utilities Commission during Direct Access proceedings in 1997 and was adopted through D. 97-10-031. The 15/15 rule requires that any aggregated information provided by the Utilities must be made up of at least 15 customers, and a customer's load must be less than 15% of an assigned category. If the number of customers in the compiled data is below 15, or if a single customer's load is more than 15% of the total data, categories (e.g., rate classes) must be combined before the information is released. The rule further requires that if the 15/15 rule is triggered for a second time after the data has been screened once already using the 15/15 rule, then the customer is dropped from the information provided.

Energy

Natural Gas Emission Factors

Natural Gas	Intensity factor			CO ₂ e
	MTCO ₂ /Therm	CH ₄ MT/Therm	N ₂ O MT/Therm	MT/Therm
All Years	0.005302	5.E-07	1.E-08	0.00532

Source: CO₂, CH₄ and N₂O intensity based on Table G.3 of the LGOP for residential and non-residential (CO₂, 53.02 kg/Mmbtu; CH₄: 0.005 kg/MMBtu; N₂O: 0.0001 kg/MMBtu)

SCE

2019	WCI -WECC Region Intensity factor			CO ₂ e	0.320
	CO ₂ MTons/MWH ^{1,2}	CH ₄ MTons/MWH ³	N ₂ O MTons/MWH ³	MTons/MWh	
	0.241	0.000015	0.000002	0.242	

¹ Southern California Edison. 2020. 2019 Sustainability Report. <https://www.edison.com/content/dam/eix/documents/sustainability/eix-2019-sustainability-report.pdf>

² Based on SCE 2019 reported CO₂e intensity factor of 534 lbs/MWh subtracted by the CH₄ intensity factor of 0.034 lb/MWh and the N₂O intensity factor of 0.004 lb/MWh utilizing the IPCC Fifth Assessment Report global warming potentials of 28 and 265, respectively, to avoid double counting. Per methodology utilized in CalEEMod. Version 2016.3.2, User's Guide, however N₂O and CH₄ intensity factors based on US EPA eGRID2018 data.

³ United State Environmental Protection Agency. 2020, March 9. eGRID2018 Total Output Emission Rates, WECC California Region. (CH₄ = 0.034 lbs/MWh & N₂O = 0.004 lbs/MWh)

ABAU Carbon Intensity for SCE Energy

Assumed Percent Renewable ¹	2019	2030	CO ₂ e
	35.0%	60%	MTons/MWh
CO ₂ e MTons/Mwh without Renewable	0.3726436		0.149

¹ Southern California Edison. 2020. 2019 Sustainability Report. <https://www.edison.com/content/dam/eix/documents/sustainability/eix-2019-sustainability-report.pdf>.

GHG Emissions from Energy Use

Electricity	Proposed Project		Proposed Project 2040 ABAU
	2020	2045	
	MTCO₂e/Year		
Residential Electricity - City	92,193	134,622	82,844
Commercial + Industrial - City	288,200	308,931	190,112
Total	380,394	443,553	272,956
	Proposed Project		Proposed Project
	2020	2045	2040 ABAU
Natural Gas			
Residential Electricity - City	115,856	169,175	169,175
Commercial + Industrial - City	144,002	154,360	154,360
Total	259,858	323,535	323,535
	Proposed Project		Proposed Project
	2020	2045	2040 ABAU
Summary			
Residential Total - City	208,050	303,797	252,019
Commercial Total - City	432,202	463,292	344,472
Total	640,252	767,088	596,491

General Conversion Factors

lbs to kg	0.4536
kg to MTons	0.001
Mmbtu to Therm	0.1
Therms to kwh	29.30711111
kilowatt hrs to megawatt hrs	0.001
lbs to Tons	2000
Tons to MTON	0.9071847

Source: California Air Resources Board (CARB). 2010. Local Government Operations Protocol. Version 1.1. Appendix F, Standard Conversion Factors

Global Warming Potentials (GWP) AR5

CO ₂	1
CH ₄	28
N ₂ O	265

Source: Intergovernmental Panel on Climate Change (IPCC). 2013. Fifth Assessment Report: Climate Change 2013. New York: Cambridge University Press.

Criteria Air Pollutants from Natural Gas

Rate	lbs/MBTU					
	ROG	NO _x	CO	SO ₂	PM ₁₀	PM _{2.5}
Natural Gas						
Residential	0.01078431	0.09215686	0.03921569	0.00058824	0.00745098	0.00745098
Non-Residential	0.01078431	0.09803922	0.08235294	0.00058824	0.00745098	0.00745098

Source: CalEEMod Version 2016.3.2

Natural Gas	2020 lbs/day					
	ROG	NO _x	CO	SO ₂	PM ₁₀	PM _{2.5}
Residential	64	550	234	4	44	44
Nonresidential	80	727	611	4	55	55
Total	144	1277	845	8	100	100

Natural Gas	Project 2045 lbs/day					
	ROG	NO _x	CO	SO ₂	PM ₁₀	PM _{2.5}
Residential	94	803	342	5	65	65
Nonresidential	86	780	655	5	59	59
Total	180	1583	997	10	124	124
Increase from Baseline	35	305	152	2	24	24

General Conversion Factors

Mmbtu to Therm	0.1
lbs to Tons	2000
Tons to MTON	0.9071847

Source: California Air Resources Board (CARB). 2010. Local Government Operations Protocol. Version 1.1. Appendix F, Standard Conversion Factors

City of Santa Ana — TRANSPORTATION SECTOR

CRITERIA AIR POLLUTANTS

	lbs/day					
	ROG	NO _x	CO	SO _x	PM10	PM2.5
Year 2020						
City	831	5,596	25,067	90	1,362	602
Total	831	5,596	25,067	90	1,362	602
Baseline in 2045						
City	355	2,232	13,143	59	1,296	532
Total	355	2,232	13,143	59	1,296	532
Year 2045						
City	359	2,254	13,272	60	1,309	537
Total	359	2,254	13,272	60	1,309	537

Source: EMFAC2017, Version 1.0.2.; California Air Resources Board. 2019, November 20. EMFAC Off-Model Adjustment Factors to Account for the SAFE Vehicle Rule Part One. https://ww3.arb.ca.gov/msei/emfac_off_model_adjustment_factors_final_draft.pdf.

GHG EMISSIONS

	MTons/year			
	N ₂ O	CO ₂	CH ₄	CO ₂ e
Year 2020				
City	57	1,447,080	26	1,463,006
Total	57	1,447,080	26	1,463,006
Year 2045				
City	42	1,049,931	10	1,061,237
Total	42	1,049,931	10	1,061,237

Source: EMFAC2017, Version 1.0.2

Note: MTons = metric tons; CO₂e = carbon dioxide-equivalent.

Source: EMFAC2017 v1.0.2 Web Database, <https://www.arb.ca.gov/emfac/2017/>; California Air Resources Board. 2020, June 26. EMFAC Off-Model Adjustment Factors for Carbon Dioxide (CO₂) Emissions to Account for the SAFE Vehicles Rule Part One and the Final Safe Rule.

https://ww3.arb.ca.gov/msei/emfac_off_model_co2_adjustment_factors_06262020-final.pdf?utm_medium=email&utm_source=govdelivery; Based on the Intergovernmental Panel on Climate Change (IPCC) Fifth Assessment Report (AR5) Global Warming Potentials (GWPs)

Note: MTons = metric tons; CO₂e = carbon dioxide-equivalent. Includes Pavley + California Advanced Clean Car Standards, the Low Carbon Fuel Standard (LCFS), on-road diesel fleet rules, and the Smartway/Phase I Heavy Duty Vehicle Greenhouse Gas Regulation.

Year 2045 Existing: Criteria Air Pollutants

Based on EMFAC2017, Version 1.0.2., Orange County - South Coast Air Basin

		VMT Per Trip Type			
		I-I	I-X	X-I	Total
City		697,779	5,356,504	5,352,841	11,407,124
	TOTAL	697,779	5,356,504	5,352,841	11,407,124

¹: Based on data provided by IBI Group

Emission year									
Year 2020									
lbs/day									
Vehicle Type	Speed	Percent of VMT of SpeedBin	ROG	NOx	CO	SOx	PM10	PM2.5	
City of Santa Ana									
All Other Buses	DSL	Aggregated	0.04%	0.08	13.70	0.81	0.08	1.58	0.70
LDA	GAS	Aggregated	52.02%	23.40	218.77	5,355.80	25.21	592.86	239.07
LDA	DSL	Aggregated	0.65%	0.82	1.43	27.24	0.24	7.42	3.01
LDA	ELEC	Aggregated	3.54%	0.00	0.00	0.00	0.00	39.86	15.81
LDT1	GAS	Aggregated	6.08%	3.07	28.28	638.12	3.41	69.33	28.00
LDT1	DSL	Aggregated	0.00%	0.00	0.01	0.04	0.00	0.01	0.00
LDT1	ELEC	Aggregated	0.25%	0.00	0.00	0.00	0.00	2.77	1.10
LDT2	GAS	Aggregated	16.89%	11.17	73.32	2,020.78	9.38	192.55	77.69
LDT2	DSL	Aggregated	0.17%	0.75	1.39	7.67	0.09	2.16	0.97
LDT2	ELEC	Aggregated	0.56%	0.00	0.00	0.00	0.00	6.27	2.49
LHD1	GAS	Aggregated	1.15%	0.94	26.51	34.39	1.83	24.67	10.33
LHD1	DSL	Aggregated	1.33%	12.79	23.15	60.44	1.19	31.42	13.71
LHD2	GAS	Aggregated	0.20%	0.17	5.22	6.10	0.37	5.03	2.11
LHD2	DSL	Aggregated	0.52%	5.18	15.21	25.04	0.52	14.97	7.01
MCY	GAS	Aggregated	0.48%	271.72	132.73	2,016.47	0.25	2.18	1.00
MDV	GAS	Aggregated	10.52%	7.90	51.40	1,289.98	7.12	120.04	48.46
MDV	DSL	Aggregated	0.38%	0.55	0.97	18.08	0.24	4.37	1.78
MDV	ELEC	Aggregated	0.41%	0.00	0.00	0.00	0.00	4.59	1.82
MH	GAS	Aggregated	0.06%	0.14	2.91	2.58	0.20	2.27	0.95
MH	DSL	Aggregated	0.03%	0.31	14.93	0.94	0.05	1.21	0.59
Motor Coach	DSL	Aggregated	0.02%	0.09	10.27	0.95	0.06	0.92	0.43
OBUS	GAS	Aggregated	0.04%	0.12	4.06	2.54	0.14	1.59	0.66
PTO	DSL	Aggregated	0.05%	0.31	56.15	4.97	0.17	0.06	0.06
SBUS	GAS	Aggregated	0.04%	0.11	1.32	1.94	0.06	6.88	2.94
SBUS	DSL	Aggregated	0.04%	0.10	18.92	1.29	0.09	7.82	3.35
T6 CAIRP heavy	DSL	Aggregated	0.02%	0.04	5.73	0.39	0.04	0.90	0.39
T6 CAIRP small	DSL	Aggregated	0.00%	0.01	0.78	0.05	0.01	0.12	0.05
T6 instate construction heavy	DSL	Aggregated	0.02%	0.05	8.05	0.48	0.04	0.93	0.42
T6 instate construction small	DSL	Aggregated	0.13%	0.23	34.91	2.27	0.22	4.88	2.14
T6 instate heavy	DSL	Aggregated	0.95%	1.72	273.96	17.27	1.53	35.92	15.83
T6 instate small	DSL	Aggregated	1.26%	2.19	337.39	21.96	2.16	47.31	20.74
T6 OOS heavy	DSL	Aggregated	0.01%	0.02	3.24	0.22	0.02	0.51	0.22
T6 OOS small	DSL	Aggregated	0.00%	0.00	0.47	0.03	0.00	0.07	0.03
T6 Public	DSL	Aggregated	0.01%	0.02	2.68	0.19	0.02	0.46	0.20
T6 utility	DSL	Aggregated	0.01%	0.01	1.14	0.09	0.01	0.24	0.10
T6TS	GAS	Aggregated	0.24%	0.54	4.96	10.97	0.77	8.57	3.58
T7 Ag	DSL	Aggregated	0.00%	0.00	0.00	0.00	0.00	0.00	0.00
T7 CAIRP	DSL	Aggregated	0.23%	0.95	115.41	10.20	0.48	6.61	3.00
T7 CAIRP construction	DSL	Aggregated	0.02%	0.07	9.03	0.80	0.04	0.51	0.23
T7 NNOOS	DSL	Aggregated	0.28%	1.08	128.26	11.68	0.59	7.91	3.52
T7 NOOS	DSL	Aggregated	0.09%	0.37	45.43	4.01	0.19	2.60	1.18
T7 POLA	DSL	Aggregated	0.39%	1.69	212.60	18.29	0.89	11.41	5.28
T7 Public	DSL	Aggregated	0.02%	0.10	9.95	0.84	0.06	0.64	0.27
T7 Single	DSL	Aggregated	0.24%	0.88	101.40	9.51	0.60	6.76	2.94
T7 single construction	DSL	Aggregated	0.04%	0.16	18.38	1.72	0.11	1.22	0.53
T7 SWCV	DSL	Aggregated	0.00%	0.00	3.99	0.01	0.01	0.03	0.01
T7 SWCV	NG	Aggregated	0.07%	1.29	9.62	256.19	0.00	1.77	0.67
T7 tractor	DSL	Aggregated	0.33%	1.38	168.62	14.87	0.72	9.63	4.37
T7 tractor construction	DSL	Aggregated	0.04%	0.16	19.38	1.68	0.09	1.06	0.49
T7 utility	DSL	Aggregated	0.00%	0.00	0.50	0.05	0.00	0.04	0.02
T7IS	GAS	Aggregated	0.00%	0.17	1.67	16.47	0.01	0.05	0.02
UBUS	GAS	Aggregated	0.02%	0.13	1.69	2.17	0.10	0.81	0.34
UBUS	DSL	Aggregated	0.00%	0.00	0.00	0.00	0.00	0.00	0.00
UBUS	NG	Aggregated	0.10%	2.25	11.94	1,224.03	0.00	2.51	0.97

TOTAL	355.23	2,231.84	13,142.67	59.42	1,296.34	531.60
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Based on EMFAC2017, Version 1.0.2, emission factors for Orange County - South Coast Air Basin

Year 2020 Existing: Criteria Air Pollutants

Based on EMFAC2017, Version 1.0.2., Orange County - South Coast Air Basin

		VMT Per Trip Type			
		I-I	I-X	X-I	Total
City		697,779	5,356,504	5,352,841	11,407,124
	TOTAL	697,779	5,356,504	5,352,841	11,407,124

¹: Based on data provided by IBI Group

		Emission year							
		Year 2020		lbs/day					
Vehicle Type	Speed	Percent of VMT of SpeedBin	ROG	NOx	CO	SOx	PM10	PM2.5	
City of Santa Ana									
All Other Buses	DSL	Aggregated	0.03%	1.32	26.92	4.45	0.07	1.77	1.10
LDA	GAS	Aggregated	53.63%	165.55	602.41	10,197.06	37.16	626.86	260.82
LDA	DSL	Aggregated	0.49%	2.41	10.58	32.69	0.25	6.69	3.28
LDA	ELEC	Aggregated	0.90%	0.00	0.00	0.00	0.00	10.17	4.03
LDT1	GAS	Aggregated	5.53%	43.73	161.49	1,962.44	4.44	65.67	27.84
LDT1	DSL	Aggregated	0.00%	0.07	0.35	0.38	0.00	0.07	0.06
LDT1	ELEC	Aggregated	0.02%	0.00	0.00	0.00	0.00	0.23	0.09
LDT2	GAS	Aggregated	18.67%	86.40	399.01	4,694.99	16.49	218.08	90.67
LDT2	DSL	Aggregated	0.12%	0.55	1.32	4.54	0.08	1.51	0.69
LDT2	ELEC	Aggregated	0.09%	0.00	0.00	0.00	0.00	1.06	0.42
LHD1	GAS	Aggregated	1.52%	12.33	79.32	299.59	3.05	32.64	13.67
LHD1	DSL	Aggregated	0.99%	19.37	488.87	107.46	1.13	26.34	13.00
LHD2	GAS	Aggregated	0.25%	1.43	13.67	36.13	0.59	6.27	2.63
LHD2	DSL	Aggregated	0.38%	6.65	153.36	35.88	0.48	11.18	5.42
MCV	GAS	Aggregated	0.45%	272.17	126.17	2,163.37	0.24	2.00	0.90
MDV	GAS	Aggregated	12.51%	91.25	376.37	3,955.38	13.56	146.35	60.99
MDV	DSL	Aggregated	0.28%	1.09	4.39	17.65	0.26	3.53	1.63
MDV	ELEC	Aggregated	0.03%	0.00	0.00	0.00	0.00	0.32	0.13
MH	GAS	Aggregated	0.07%	1.20	7.58	34.90	0.31	2.63	1.10
MH	DSL	Aggregated	0.03%	0.58	31.93	2.54	0.07	1.97	1.25
Motor Coach	DSL	Aggregated	0.02%	1.06	22.53	4.00	0.07	1.16	0.74
OBUS	GAS	Aggregated	0.05%	0.83	6.33	21.58	0.21	1.78	0.74
PTO	DSL	Aggregated	0.03%	3.17	60.23	10.81	0.17	0.88	0.85
SBUS	GAS	Aggregated	0.02%	0.62	3.92	14.07	0.05	4.24	1.81
SBUS	DSL	Aggregated	0.05%	1.88	110.89	4.99	0.14	9.47	4.46
T6 Ag	DSL	Aggregated	0.00%	0.00	0.03	0.01	0.00	0.00	0.00
T6 CAIRP heavy	DSL	Aggregated	0.02%	0.19	7.12	0.81	0.04	0.81	0.40
T6 CAIRP small	DSL	Aggregated	0.00%	0.05	1.18	0.18	0.01	0.12	0.07
T6 instate construction heavy	DSL	Aggregated	0.03%	1.33	30.25	4.47	0.07	1.81	1.15
T6 instate construction small	DSL	Aggregated	0.16%	6.89	123.72	23.75	0.37	9.71	6.25
T6 instate heavy	DSL	Aggregated	0.65%	18.36	430.76	64.97	1.47	34.14	19.94
T6 instate small	DSL	Aggregated	1.05%	36.34	697.94	128.14	2.47	59.68	36.73
T6 OOS heavy	DSL	Aggregated	0.01%	0.10	3.92	0.45	0.02	0.46	0.23
T6 OOS small	DSL	Aggregated	0.00%	0.03	0.70	0.11	0.00	0.07	0.04
T6 Public	DSL	Aggregated	0.01%	0.22	24.30	0.68	0.04	0.68	0.36
T6 utility	DSL	Aggregated	0.01%	0.03	2.38	0.13	0.01	0.23	0.10
T6TS	GAS	Aggregated	0.46%	5.41	40.24	142.66	1.93	16.52	6.88
T7 Ag	DSL	Aggregated	0.00%	0.00	0.02	0.01	0.00	0.00	0.00
T7 CAIRP	DSL	Aggregated	0.19%	3.22	144.21	15.68	0.60	6.31	3.32
T7 CAIRP construction	DSL	Aggregated	0.02%	0.36	16.11	1.75	0.07	0.72	0.37
T7 NNOOS	DSL	Aggregated	0.23%	4.01	152.07	19.65	0.70	7.99	4.34
T7 NOOS	DSL	Aggregated	0.07%	1.21	55.86	5.94	0.23	2.46	1.29
T7 POLA	DSL	Aggregated	0.17%	6.50	222.30	20.83	0.65	5.88	3.13
T7 Public	DSL	Aggregated	0.02%	0.50	61.13	2.11	0.09	0.91	0.53
T7 Single	DSL	Aggregated	0.17%	7.33	193.85	28.27	0.60	8.12	5.27
T7 single construction	DSL	Aggregated	0.05%	2.54	72.08	9.61	0.19	2.63	1.75
T7 SWCV	DSL	Aggregated	0.02%	0.03	69.29	0.12	0.19	0.47	0.21
T7 SWCV	NG	Aggregated	0.04%	3.30	30.12	118.35	0.00	0.93	0.37
T7 tractor	DSL	Aggregated	0.29%	13.40	349.10	51.14	0.99	13.17	8.37
T7 tractor construction	DSL	Aggregated	0.04%	2.27	58.15	8.44	0.16	2.09	1.36
T7 utility	DSL	Aggregated	0.00%	0.02	1.54	0.08	0.01	0.04	0.02
T7IS	GAS	Aggregated	0.00%	0.19	1.38	7.98	0.01	0.02	0.01
UBUS	GAS	Aggregated	0.02%	0.12	2.19	2.56	0.13	0.78	0.32
UBUS	DSL	Aggregated	0.00%	0.00	0.00	0.00	0.00	0.00	0.00
UBUS	NG	Aggregated	0.09%	3.07	115.95	803.66	0.00	2.52	1.01
			TOTAL	830.68	5,595.54	25,067.39	89.87	1,362.14	602.16

Based on EMFAC2017, Version 1.0.2, emission factors for Orange County - South Coast Air Basin

Year 2045 Project: Criteria Air Pollutants

Based on EMFAC2017, Version 1.0.2., Orange County - South Coast Air Basin

		VMT Per Trip Type			
		I-I	I-X	X-I	Total
City		637,655	5,432,337	5,448,967	11,518,959
	TOTAL	637,655	5,432,337	5,448,967	11,518,959

¹: Based on data provided by IBI Group

Emission year									
Year 2020									
		lbs/day							
Vehicle Type	Speed	Percent of VMT of SpeedBin	ROG	NOx	CO	SOx	PM10	PM2.5	
City of Santa Ana									
All Other Buses	DSL	Aggregated	0.04%	0.08	13.83	0.82	0.08	1.60	0.71
LDA	GAS	Aggregated	52.02%	23.63	220.91	5,408.31	25.45	598.67	241.42
LDA	DSL	Aggregated	0.65%	0.83	1.44	27.51	0.24	7.49	3.04
LDA	ELEC	Aggregated	3.54%	0.00	0.00	0.00	0.00	40.25	15.97
LDT1	GAS	Aggregated	6.08%	3.10	28.56	644.38	3.45	70.01	28.27
LDT1	DSL	Aggregated	0.00%	0.00	0.01	0.04	0.00	0.01	0.00
LDT1	ELEC	Aggregated	0.25%	0.00	0.00	0.00	0.00	2.80	1.11
LDT2	GAS	Aggregated	16.89%	11.28	74.04	2,040.59	9.48	194.44	78.45
LDT2	DSL	Aggregated	0.17%	0.76	1.41	7.75	0.09	2.18	0.98
LDT2	ELEC	Aggregated	0.56%	0.00	0.00	0.00	0.00	6.34	2.51
LHD1	GAS	Aggregated	1.15%	0.95	26.77	34.73	1.85	24.91	10.43
LHD1	DSL	Aggregated	1.33%	12.92	23.38	61.03	1.20	31.73	13.85
LHD2	GAS	Aggregated	0.20%	0.17	5.27	6.16	0.38	5.08	2.13
LHD2	DSL	Aggregated	0.52%	5.24	15.36	25.29	0.52	15.12	7.08
MCV	GAS	Aggregated	0.48%	274.38	134.03	2,036.24	0.26	2.20	1.01
MDV	GAS	Aggregated	10.52%	7.98	51.90	1,302.63	7.19	121.22	48.94
MDV	DSL	Aggregated	0.38%	0.56	0.98	18.26	0.24	4.42	1.80
MDV	ELEC	Aggregated	0.41%	0.00	0.00	0.00	0.00	4.63	1.84
MH	GAS	Aggregated	0.06%	0.14	2.94	2.61	0.21	2.29	0.96
MH	DSL	Aggregated	0.03%	0.31	15.08	0.95	0.05	1.23	0.59
Motor Coach	DSL	Aggregated	0.02%	0.09	10.37	0.96	0.06	0.93	0.43
OBUS	GAS	Aggregated	0.04%	0.12	4.10	2.57	0.14	1.60	0.67
PTO	DSL	Aggregated	0.05%	0.31	56.70	5.02	0.17	0.06	0.06
SBUS	GAS	Aggregated	0.04%	0.11	1.33	1.96	0.07	6.95	2.97
SBUS	DSL	Aggregated	0.04%	0.10	19.11	1.31	0.09	7.89	3.38
T6 CAIRP heavy	DSL	Aggregated	0.02%	0.04	5.79	0.40	0.04	0.91	0.40
T6 CAIRP small	DSL	Aggregated	0.00%	0.01	0.79	0.05	0.01	0.12	0.05
T6 instate construction heavy	DSL	Aggregated	0.02%	0.05	8.13	0.49	0.05	0.94	0.42
T6 instate construction small	DSL	Aggregated	0.13%	0.23	35.25	2.29	0.23	4.93	2.16
T6 instate heavy	DSL	Aggregated	0.95%	1.74	276.64	17.44	1.55	36.27	15.98
T6 instate small	DSL	Aggregated	1.26%	2.21	340.70	22.18	2.19	47.77	20.94
T6 OOS heavy	DSL	Aggregated	0.01%	0.02	3.27	0.23	0.02	0.52	0.22
T6 OOS small	DSL	Aggregated	0.00%	0.00	0.48	0.03	0.00	0.07	0.03
T6 Public	DSL	Aggregated	0.01%	0.02	2.71	0.19	0.02	0.46	0.20
T6 utility	DSL	Aggregated	0.01%	0.01	1.15	0.09	0.01	0.24	0.10
T6TS	GAS	Aggregated	0.24%	0.54	5.01	11.08	0.78	8.65	3.61
T7 Ag	DSL	Aggregated	0.00%	0.00	0.00	0.00	0.00	0.00	0.00
T7 CAIRP	DSL	Aggregated	0.23%	0.95	116.55	10.30	0.49	6.68	3.03
T7 CAIRP construction	DSL	Aggregated	0.02%	0.07	9.12	0.80	0.04	0.52	0.24
T7 NNOOS	DSL	Aggregated	0.28%	1.09	129.52	11.80	0.59	7.99	3.55
T7 NOOS	DSL	Aggregated	0.09%	0.38	45.88	4.05	0.19	2.63	1.19
T7 POLA	DSL	Aggregated	0.39%	1.71	214.69	18.47	0.90	11.53	5.34
T7 Public	DSL	Aggregated	0.02%	0.11	10.05	0.85	0.06	0.64	0.27
T7 Single	DSL	Aggregated	0.24%	0.89	102.39	9.60	0.60	6.83	2.97
T7 single construction	DSL	Aggregated	0.04%	0.16	18.56	1.74	0.11	1.23	0.54
T7 SWCV	DSL	Aggregated	0.00%	0.00	4.03	0.01	0.01	0.03	0.01
T7 SWCV	NG	Aggregated	0.07%	1.30	9.72	258.70	0.00	1.79	0.68
T7 tractor	DSL	Aggregated	0.33%	1.39	170.28	15.01	0.72	9.72	4.42
T7 tractor construction	DSL	Aggregated	0.04%	0.16	19.57	1.70	0.09	1.07	0.49
T7 utility	DSL	Aggregated	0.00%	0.00	0.50	0.05	0.00	0.04	0.02
T7IS	GAS	Aggregated	0.00%	0.17	1.69	16.63	0.01	0.05	0.02
UBUS	GAS	Aggregated	0.02%	0.13	1.70	2.19	0.10	0.82	0.35
UBUS	DSL	Aggregated	0.00%	0.00	0.00	0.00	0.00	0.00	0.00
UBUS	NG	Aggregated	0.10%	2.27	12.06	1,236.03	0.00	2.53	0.98
TOTAL			358.71	2,253.72	13,271.52	60.01	1,309.05	536.81	

Based on EMFAC2017, Version 1.0.2., emission factors for Orange County - South Coast Air Basin

Year 2020 GHG Emissions: Existing

Based on EMFAC2017, Version 1.0.2., Orange County - South Coast Air Basin

				Days per year ¹	347
City	VMT Per Trip Type ²			Total	Annual
	I-I	I-X	X-I		
TOTAL	697,779	5,356,504	5,352,841	11,407,124	3,958,272,028

¹ Adjusted Daily vehicles miles traveled (VMT) multiplied by 347 days/year to account for reduced traffic on weekends and holidays. This assumption is consistent with the California Air Resources Board's (CARB) methodology within the Climate Change Scoping Plan Measure Documentation Supplement.

² Based on data provided by IBI Group

Emission year				N ₂ O	CO ₂ (Pavley)	CH ₄	
				AR5 GWP	AR5 GWP	AR5 GWP	
Year 2020				265	1	28	
Vehicle Type	Fuel Type	Speed	Percent of VMT of SpeedBin	N ₂ O	CO ₂ (Pavley)	CH ₄	CO ₂ e w/ Pavley + LCFS
Valley Region							
All Other Buses	DSL	Aggregated	0.03%	0.19	1,228.69	0.01	1,280
LDA	GAS	Aggregated	53.63%	10.47	591,003.93	6.67	593,966
LDA	DSL	Aggregated	0.49%	0.66	4,199.62	0.02	4,375
LDA	ELEC	Aggregated	0.90%	0.00	0.00	0.00	0
LDT1	GAS	Aggregated	5.53%	1.92	70,577.23	1.56	71,131
LDT1	DSL	Aggregated	0.00%	0.00	20.00	0.00	21
LDT1	ELEC	Aggregated	0.02%	0.00	0.00	0.00	0
LDT2	GAS	Aggregated	18.67%	5.28	262,326.86	3.37	263,822
LDT2	DSL	Aggregated	0.12%	0.22	1,404.45	0.00	1,463
LDT2	ELEC	Aggregated	0.09%	0.00	0.00	0.00	0
LHD1	GAS	Aggregated	1.52%	0.78	48,541.26	0.41	48,760
LHD1	DSL	Aggregated	0.99%	2.97	18,896.92	0.14	19,688
LHD2	GAS	Aggregated	0.25%	0.14	9,346.14	0.05	9,386
LHD2	DSL	Aggregated	0.38%	1.25	7,933.36	0.05	8,265
MCV	GAS	Aggregated	0.45%	1.15	3,792.42	6.25	4,273
MDV	GAS	Aggregated	12.51%	4.60	215,744.15	3.22	217,052
MDV	DSL	Aggregated	0.28%	0.68	4,295.85	0.01	4,475
MDV	ELEC	Aggregated	0.03%	0.00	0.00	0.00	0
MH	GAS	Aggregated	0.07%	0.07	4,876.32	0.04	4,897
MH	DSL	Aggregated	0.03%	0.19	1,226.78	0.00	1,278
Motor Coach	DSL	Aggregated	0.02%	0.18	1,149.15	0.01	1,197
OBUS	GAS	Aggregated	0.05%	0.05	3,314.03	0.03	3,328
PTO	DSL	Aggregated	0.03%	0.44	2,818.32	0.02	2,936
SBUS	GAS	Aggregated	0.02%	0.03	785.49	0.02	794
SBUS	DSL	Aggregated	0.05%	0.36	2,292.48	0.01	2,388
T6 Ag	DSL	Aggregated	0.00%	0.00	0.45	0.00	0
T6 CAIRP heavy	DSL	Aggregated	0.02%	0.11	693.80	0.00	723
T6 CAIRP small	DSL	Aggregated	0.00%	0.02	98.88	0.00	103
T6 instate construction heavy	DSL	Aggregated	0.03%	0.19	1,199.66	0.01	1,250
T6 instate construction small	DSL	Aggregated	0.16%	0.98	6,236.53	0.05	6,498
T6 instate heavy	DSL	Aggregated	0.65%	3.84	24,423.22	0.13	25,444
T6 instate small	DSL	Aggregated	1.05%	6.46	41,121.43	0.27	42,842
T6 OOS heavy	DSL	Aggregated	0.01%	0.06	395.32	0.00	412
T6 OOS small	DSL	Aggregated	0.00%	0.01	58.15	0.00	61
T6 Public	DSL	Aggregated	0.01%	0.10	634.89	0.00	661
T6 utility	DSL	Aggregated	0.01%	0.04	237.83	0.00	248
T6TS	GAS	Aggregated	0.46%	0.34	30,635.67	0.18	30,730
T7 Ag	DSL	Aggregated	0.00%	0.00	0.47	0.00	0
T7 CAIRP	DSL	Aggregated	0.19%	1.61	10,240.27	0.02	10,667
T7 CAIRP construction	DSL	Aggregated	0.02%	0.17	1,089.39	0.00	1,135
T7 NNOOS	DSL	Aggregated	0.23%	1.91	12,123.28	0.03	12,629
T7 NOOS	DSL	Aggregated	0.07%	0.73	4,641.11	0.02	4,835
T7 POLA	DSL	Aggregated	0.17%	1.74	11,094.74	0.03	11,558
T7 Public	DSL	Aggregated	0.02%	0.21	1,343.32	0.01	1,399
T7 Single	DSL	Aggregated	0.17%	1.61	10,272.53	0.06	10,702
T7 single construction	DSL	Aggregated	0.05%	1.59	10,145.44	0.00	10,568
T7 SWCV	DSL	Aggregated	0.02%	0.46	2,259.52	3.32	2,475
T7 SWCV	NG	Aggregated	0.04%	0.32	2,032.76	0.01	2,118
T7 tractor	DSL	Aggregated	0.29%	2.74	17,399.94	0.11	18,128
T7 tractor construction	DSL	Aggregated	0.04%	0.43	2,712.82	0.00	2,826
T7 utility	DSL	Aggregated	0.00%	0.01	119.88	0.01	123
T7IS	GAS	Aggregated	0.00%	0.00	95.20	0.00	96
UBUS	GAS	Aggregated	0.02%	0.00	0.00	0.00	0

UBUS	DSL	Aggregated	0.00%	0.00	0.00	0.00	0
UBUS	NG	Aggregated	0.09%	0.00	0.00	0.00	0
				57.33	1,447,079.91	26.17	1,463,005.85

Based on EMFAC2017, Version 1.0.2, emission factors for Orange County - South Coast Air Basin

Year 2045 GHG Emissions: Existing

Based on EMFAC2017, Version 1.0.2., Orange County - South Coast Air Basin

				Days per year ¹	347
City	VMT Per Trip Type ²			Total	Annual
	I-I	I-X	X-I		
TOTAL	637,655	5,432,337	5,448,967	11,518,959	3,997,078,773

¹ Adjusted Daily vehicles miles traveled (VMT) multiplied by 347 days/year to account for reduced traffic on weekends and holidays. This assumption is consistent with the California Air Resources Board's (CARB) methodology within the Climate Change Scoping Plan Measure Documentation Supplement.

² Based on data provided by IBI Group

Emission year				N ₂ O	CO ₂ (Pavley)	CH ₄	
				AR5 GWP	AR5 GWP	AR5 GWP	
Year 2045				265	1	28	
Vehicle Type	Fuel Type	Speed	Percent of VMT of SpeedBin	N ₂ O	CO ₂ (Pavley)	CH ₄	CO ₂ e w/ Pavley + LCFS
Valley Region							
All Other Buses	DSL	Aggregated	0.04%	0.20	1,277.86	0.00	1,331
LDA	GAS	Aggregated	52.02%	5.92	455,179.15	1.37	456,786
LDA	DSL	Aggregated	0.65%	0.63	4,033.78	0.01	4,202
LDA	ELEC	Aggregated	3.54%	0.00	0.00	0.00	0
LDT1	GAS	Aggregated	6.08%	0.73	61,645.67	0.17	61,845
LDT1	DSL	Aggregated	0.00%	0.00	9.89	0.00	10
LDT1	ELEC	Aggregated	0.25%	0.00	0.00	0.00	0
LDT2	GAS	Aggregated	16.89%	1.93	169,438.33	0.62	169,968
LDT2	DSL	Aggregated	0.17%	0.23	1,444.03	0.01	1,504
LDT2	ELEC	Aggregated	0.56%	0.00	0.00	0.00	0
LHD1	GAS	Aggregated	1.15%	0.35	29,407.21	0.05	29,502
LHD1	DSL	Aggregated	1.33%	3.14	19,959.32	0.09	20,793
LHD2	GAS	Aggregated	0.20%	0.07	5,997.39	0.01	6,016
LHD2	DSL	Aggregated	0.52%	1.37	8,690.54	0.04	9,054
MCV	GAS	Aggregated	0.48%	1.22	4,074.84	6.43	4,579
MDV	GAS	Aggregated	10.52%	1.28	114,304.75	0.42	114,655
MDV	DSL	Aggregated	0.38%	0.64	4,076.95	0.00	4,247
MDV	ELEC	Aggregated	0.41%	0.00	0.00	0.00	0
MH	GAS	Aggregated	0.06%	0.04	3,292.59	0.01	3,304
MH	DSL	Aggregated	0.03%	0.14	900.40	0.00	938
Motor Coach	DSL	Aggregated	0.02%	0.16	1,039.32	0.00	1,083
OBUS	GAS	Aggregated	0.04%	0.04	2,298.20	0.01	2,308
PTO	DSL	Aggregated	0.05%	0.46	2,913.52	0.00	3,035
SBUS	GAS	Aggregated	0.04%	0.02	1,035.38	0.00	1,040
SBUS	DSL	Aggregated	0.04%	0.23	1,442.28	0.00	1,502
T6 CAIRP heavy	DSL	Aggregated	0.02%	0.10	624.73	0.00	651
T6 CAIRP small	DSL	Aggregated	0.00%	0.01	91.04	0.00	95
T6 instate construction heavy	DSL	Aggregated	0.02%	0.12	753.33	0.00	785
T6 instate construction small	DSL	Aggregated	0.13%	0.59	3,760.13	0.00	3,917
T6 instate heavy	DSL	Aggregated	0.95%	4.05	25,753.26	0.01	26,826
T6 instate small	DSL	Aggregated	1.26%	5.72	36,410.17	0.02	37,927
T6 OOS heavy	DSL	Aggregated	0.01%	0.06	353.87	0.00	369
T6 OOS small	DSL	Aggregated	0.00%	0.01	55.22	0.00	58
T6 Public	DSL	Aggregated	0.01%	0.06	364.82	0.00	380
T6 utility	DSL	Aggregated	0.01%	0.03	187.71	0.00	196
T6TS	GAS	Aggregated	0.24%	0.07	12,378.18	0.02	12,398
T7 Ag	DSL	Aggregated	0.00%	0.00	0.24	0.00	0
T7 CAIRP	DSL	Aggregated	0.23%	1.41	8,976.57	0.01	9,351
T7 CAIRP construction	DSL	Aggregated	0.02%	0.10	627.36	0.00	654
T7 NNOOS	DSL	Aggregated	0.28%	1.55	9,875.73	0.01	10,287
T7 NOOS	DSL	Aggregated	0.09%	0.55	3,470.66	0.00	3,615
T7 POLA	DSL	Aggregated	0.39%	2.59	16,451.62	0.01	17,137
T7 Public	DSL	Aggregated	0.02%	0.15	971.08	0.00	1,012
T7 Single	DSL	Aggregated	0.24%	1.58	10,027.42	0.01	10,445
T7 single construction	DSL	Aggregated	0.04%	1.33	8,462.87	0.00	8,815
T7 SWCV	DSL	Aggregated	0.00%	0.02	116.61	0.18	128
T7 SWCV	NG	Aggregated	0.07%	0.40	2,536.02	0.00	2,642
T7 tractor	DSL	Aggregated	0.33%	2.11	13,449.72	0.01	14,010
T7 tractor construction	DSL	Aggregated	0.04%	0.24	1,526.39	0.00	1,590
T7 utility	DSL	Aggregated	0.00%	0.01	95.07	0.00	97
T7IS	GAS	Aggregated	0.00%	0.00	149.51	0.00	150
UBUS	GAS	Aggregated	0.02%	0.00	0.00	0.00	0
UBUS	DSL	Aggregated	0.00%	0.00	0.00	0.00	0

UBUS	NG	Aggregated	0.10%	0.00	0.00	0.00	0
				41.66	1,049,930.76	9.53	1,061,237.21

Based on EMFAC2017, Version 1.0.2, emission factors for Orange County - South Coast Air Basin
