Appendix A

Greenhouse Gas Emissions Inventory and Projections

City of Vista Greenhouse Gas Emissions Inventories and Projections

Draft

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Prepared for the City of Vista

Prepared by the Energy Policy Initiatives Center

About EPIC

The Energy Policy Initiatives Center (EPIC) is a non-profit research center of the USD School of Law that studies energy policy issues affecting California and the San Diego region. EPIC's mission is to increase awareness and understanding of energy- and climate-related policy issues by conducting research and analysis to inform decision makers and educating law students.

For more information, please visit the EPIC website at www.sandiego.edu/epic.

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1 OVERVIEW

This document presents a summary of the greenhouse gas (GHG) emissions for the City of Vista (referred to as Vista or the City) from 2012 to 2014, and the business-as-usual (BAU) emissions projections for 2020, 2030, and 2035. The BAU projection demonstrates emissions growth in the absence of any new policies and programs and does not consider future impacts of currently adopted federal and State policies. GHG reductions from these policies are not included in this report but are considered later in the climate action planning process in a projection referred to as the "legislatively-adjusted BAU".

Section 2 describes the background sources and common assumptions used for the inventory and projections. Section 0 provides the results of the GHG emissions inventory for 2012 to 2014. The methods used to prepare each category of the inventory are provided in Section 4. Section 0 provides a summary of the emissions projections for 2020, 2030, and 2035, and the methods used to prepare each category of the projections.

2 BACKGROUND

2.1 Greenhouse Gases

The primary GHGs included in the emissions estimates presented here are carbon dioxide (CO_2), methane (CH_4), and nitrous oxide (N_2O). Each GHG has a different capacity to trap heat in the atmosphere, known as its global warming potential (GWP), which is normalized relative to CO_2 and expressed in carbon dioxide equivalents (CO_2e). In general, the 100-year GWPs reported by the Intergovernmental Panel on Climate Change (IPCC) are used to estimate GHG emissions. The GWPs used in this inventory are from the IPCC Fourth Assessment Report (AR4)[1] provided in Table 1.

Table 1 Global Warming Potentials Used in the Vista GHG Emission Inventory & Projections

Greenhouse Gas	Global Warming Potential
Carbon dioxide (CO_2)	1
Methane (CH_4)	25
Nitrous oxide (N_2O)	298

2.2 Categories of Emissions

The U.S. Community Protocol for Accounting and Reporting of Greenhouse Gas Emissions (U.S. Community Protocol),[2] developed by ICLEI USA, requires a minimum of five basic emissions-generating activities to be included in a Protocol-compliant community-scale GHG inventory. These categories are: electricity, natural gas, on-road transportation, water and wastewater, and solid waste. GHG emissions are calculated by multiplying activity data (e.g., kilowatt-hours of electricity, tons of solid waste) by an emission factor (e.g., pounds of CO_2e per unit of electricity). For these five categories, methods used in

[1] IPCC Fourth Assessment Report: Climate Change 2007: Direct Global Warming Potentials (2013).
[2] ICLEI – Local Governments for Sustainability USA: U.S. Community Protocol for Accounting and Reporting of Greenhouse Gas Emissions, Version 1.0 (2012).

this inventory were based on the U.S. Community Protocol standard methods and modified with regional- or City-specific data when available.

Additionally, GHG emissions from off-road transportation were included in the inventory and projections, based on the methods and models used by California Air Resources Board (CARB) in the statewide GHG emission inventory.[3]

All activity data and GHG emissions reported in this document are annual values, and all emission factors reported in this document are annual average values, unless stated otherwise.

2.3 Demographics

The San Diego Association of Governments (SANDAG) estimates and forecasts population and employment for all jurisdictions in the San Diego region. The population and jobs estimate from 2012 to 2014 for Vista are provided in Table 2.[4]

Table 2 Population and Jobs Estimates (Vista, 2012-2014)

Year	Population	Jobs
2012	95,292	35,840
2013	96,474	36,481
2014	97,043	37,121
SANDAG 2013, 2017. Energy Policy Initiatives Center, 2018.		

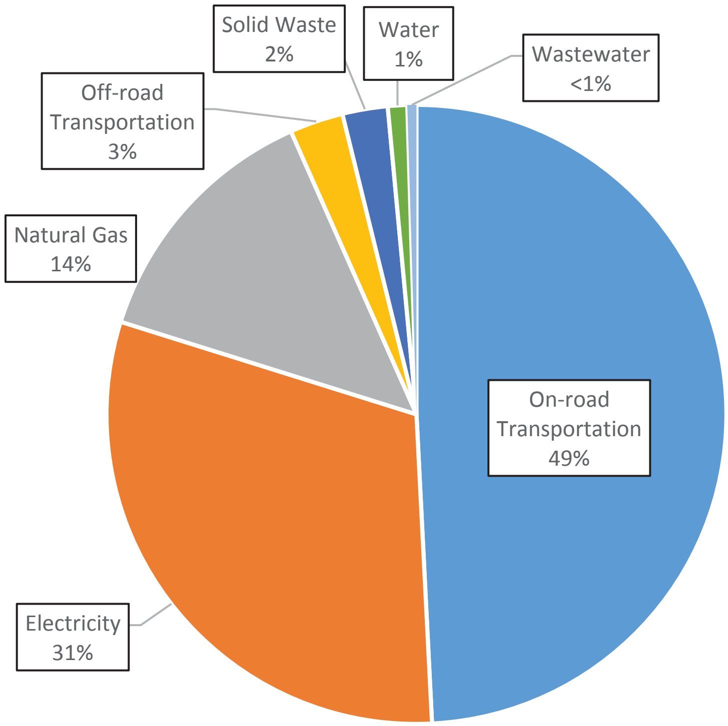
2.4 Rounding of Values in Tables and Figures

Rounding is often used within the tables and figures throughout the document. Values are not rounded in the intermediary steps in the actual calculation to preserve accuracy. As a result of rounding, totals may not equal the exact values summed in any table or figure.

3 SUMMARY OF GHG EMISSIONS INVENTORY

The total GHG emissions from Vista in 2012 were estimated at 603,000 metric tons CO_2e (MT CO_2e), distributed into categories as shown in Figure 1.

[3] California Air Resources Board (CARB): California Greenhouse Gas Emission Inventory – 2016 Edition (June 2016).
[4] The 2012-2014 population is from SANDAG's Demographic & Socio-Economic Estimates (March 9, 2017 Version). Jobs in 2012 are from the SANDAG Series 13 Regional Growth Forecast (October 2013). Jobs in 2013 and 2014 are interpolated linearly by EPIC based on 2012 and 2020 jobs estimates. The number of jobs is for civilian jobs only. SANDAG Data Surfer, accessed May 11, 2018.



Percentage may not add to 100% due to rounding
Energy Policy Initiatives Center, 2018

Figure 1 Breakdown of GHG Emissions in Vista (2012)

Total GHG emissions in the years 2012, 2013, and 2014 and broken down by category are provided in Table 3. The 2013 estimate was 602,000 MT CO_2e and the 2014 estimate was 567,000 MT CO_2e, 6% lower than the total emissions in 2012. The largest categories of emissions are on-road transportation, electricity, and natural gas end-use.

Table 3 Total and Breakdown of GHG Emissions in Vista (2012–2014)

Emissions Category	2012 GHG Emissions (MT CO_2e)	2013 GHG Emissions (MT CO_2e)	2014 GHG Emissions (MT CO_2e)
On-Road Transportation*	297,000	297,000	296,000
Electricity	185,000	177,000	155,000
Natural Gas	82,000	86,000	75,000
Off-Road Transportation	17,000	17,000	16,000
Solid Waste	14,000	15,000	15,000
Water	6,000	7,000	7,000
Wastewater	3,000	3,000	3,000
Total	**603,000**	**602,000**	**567,000**

Sums may not add up to totals due to rounding.
GHG emissions for each category are rounded to the nearest thousands. Values are not rounded in the intermediary steps in the calculation.
* Based on SANDAG Series 13 vehicle miles traveled (VMT) estimates. 2012 is the Base Year.
Energy Policy Initiatives Center, 2018.

4 METHODS TO CALCULATE EMISSIONS INVENTORY

4.1 On-Road Transportation

The emissions associated with on-road transportation in Vista are calculated by multiplying the estimated vehicle miles traveled (VMT) and the average vehicle emission rate in the San Diego region in a given year. Average weekday VMT data were provided by SANDAG based on its activity-based model[5] and the Origin-Destination (O-D) method.[6] The O-D VMT method is the preferred method proposed by the U.S Community Protocol in 'TR.1 Emissions from Passenger Vehicles' and 'TR.2 Emissions from Freight and Service Trucks' that estimates miles traveled based on where a trip originates and where it ends to attribute on-road emissions to cities and regions of miles traveled (Figure 2).[7]

[5] SANDAG (2015): San Diego Forward: The Regional Plan. Appendix T Travel Demand Model Documentation.
[6] SANDAG (2013): Vehicle Miles Traveled Calculation Using the SANDAG Regional Travel Demand Model. Technical White Paper.
[7] ICLEI – Local Governments for Sustainability USA: U.S. Community Protocol for Accounting and Reporting of Greenhouse Gas Emissions, Version 1.0 (2012), Appendix D: Transportation and Other Mobile Emission Activities and Sources.

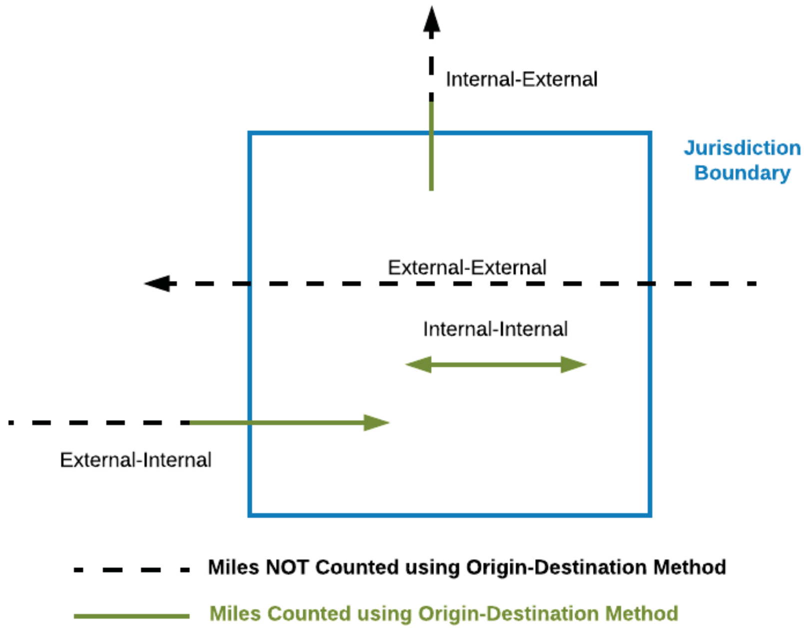


Figure 2 Components of O-D Method for VMT Calculation

O-D VMT data include all miles traveled for trips that originate and end within Vista city limits (referred to as Internal-Internal) and half of the miles traveled of the trips that either begin within Vista and end outside the City (referred to as Internal-External), or vice versa (referred to as External-Internal). In accordance with the methodology, VMT from trips that begin and end outside Vista that only pass through the City limits (referred to as External-External) are not included in the total City VMT.

The average weekday O-D VMT data for each trip type in 2012 and 2014 were provided by SANDAG, and 2013 VMT were interpolated linearly by EPIC using 2012 and 2014 values (Table 4).[8]

Table 4 O-D VMT and Trip Types (Vista, 2012–2014)

Year	Internal-Internal Trips (Miles/Average Weekday)	External-Internal/Internal-External Trips (Miles/Average Weekday)	External-External Trips (Miles/Average Weekday (Information only, excluded from City VMT)*
2012	241,151	3,056,636	596,264
2013	245,236	3,103,939	612,036
2014	249,320	3,151,243	627,807

*Miles from External-External trips (pass-through trips) are the portion within the City boundary, not the entire trip.
Based on SANDAG Series 13 VMT estimates. 2012 is the Base Year. 2013 is linearly interpolated between 2012 and 2014.
SANDAG, 2018; Energy Policy Initiatives Center, 2018.

[8] Series 13 2012 (Base Year) and 2014 average weekday VMT estimates were provided by SANDAG (September 15, 2017). 2013 VMT were interpolated linearly between 2012 and 2014 VMT. Original data tables provided by SANDAG are in Appendix A.

In accordance with the methodology, all estimated and projected Internal-External and External-Internal miles associated with Vista are divided in half to allocate the miles between Vista and all other outside jurisdictions (see Appendix A for source data). EPIC multiplies the total average weekday VMT by 347 to adjust from average weekday VMT to average annual VMT (Table 5), which includes weekends.[9]

The average annual vehicle emission rate expressed in grams of CO_2e per mile driven (g CO_2e/mile) is derived from the statewide mobile source emissions model EMFAC2014 developed by CARB.[10] EMFAC2014 was used to generate average emission rates for the San Diego region for all vehicle classes, model years, speeds, and fuel types.[11] The average emission rates (g CO_2e/mile) were calculated based on the VMT distribution of each vehicle class and its emission rate. This report assumes Vista has the same distribution of vehicle types as the region. The average vehicle emission rate was adjusted from g CO_2/mile to g CO_2e/mile, to account for total GHG emissions, including CO_2, CH_4, and N_2O.[12]

The total VMT, average vehicle emission rates, and corresponding GHG emissions from the on-road transportation category for years 2012 to 2014 are given in Table 5.

Table 5 VMT, Emission Rate, and GHG Emissions from the On-Road Transportation Category (Vista, 2012–2014)

Year	Average Vehicle Emission Rate (g CO_2e/mile)	Total VMT		GHG Emissions (MT CO_2e)
		Average Weekday Miles*	Average Annual Miles	
2012	483	1,769,469	614,005,743	297,000
2013	476	1,797,205	623,630,257	297,000
2014	467	1,824,942	633,254,772	296,000

*Consistent with the methodology, this is the sum of internal-internal and half of both external-internal and internal-external VMT from Table 4. Weekday miles are converted to annual average before converting to GHG emissions.
Based on SANDAG Series 13 VMT estimates. 2012 is the Base Year. 2013 is linearly interpolated between 2012 and 2014.
GHG emissions for each category are rounded to the nearest thousands. Values are not rounded in the intermediary steps in the calculation.
CARB, 2015; SANDAG, 2018; Energy Policy Initiatives Center, 2018.

The decrease in the emission rate is likely due to improved vehicle emission standards of new vehicles. Figure 3 gives the breakdown of emissions by vehicle class in 2012, based on the EMFAC vehicle class distribution in the San Diego region. Passenger cars and light-duty trucks account for about 63% of the City's on-road transportation emissions, while medium- and heavy-duty trucks account for an additional 35 percent of the on-road transportation emissions.[13]

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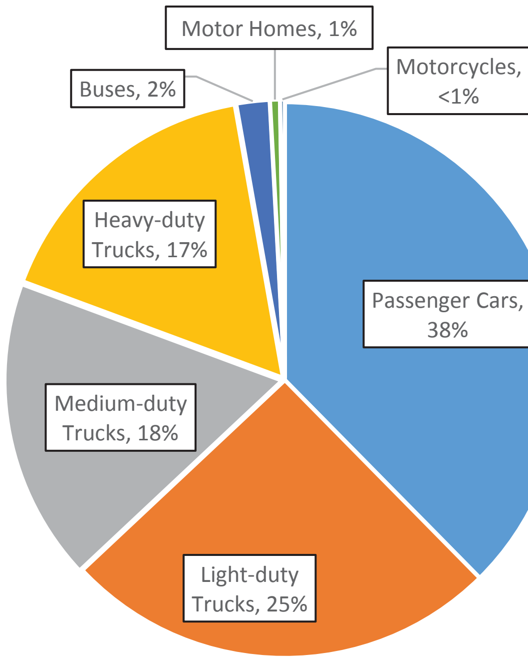
[9] The conversion of 347 weekdays to 365 days per year as used by CARB. CARB: California's 2000-2014 Greenhouse Gas Emission Inventory Technical Support Document (2016 Edition), p. 41 (September 2016).
[10] CARB: EMission FACtors model, EMFAC2014 (2015).
[11] EMFAC2014 Web Database: Emission rates for SANDAG, download date: January 22, 2016. The vehicle classes in EMFAC2014 are the same as the vehicle classes in the previous model EMFAC2011.
[12] The conversion factor, 1.01, was calculated based on the ratio of CO_2 emissions to total GHG emissions (CO_2, CH_4 and N_2O expressed as CO_2e) using methods from EPA GHG Equivalencies Calculations and References. Emissions were from mobile fossil fuel combustion in the transportation end-use category in 2013 (the latest available data year), on-road emissions. EPA *Inventory of U.S. Greenhouse Gas Emissions and Sinks: 1990-2013* (2015), Table 3-12 to 3-14.
[13] In California's EMFAC2014, passenger cars are all cars and fuel types designated as Light Duty Automobiles (LDAs). Light Duty Trucks (LDTs) are divided into LDT1 and LDT2, where LDT1 includes gas, diesel, and electric fuel vehicles, while LDT2 does not



EMFAC2014. Energy Policy Intiatvies Center, 2018
Percentages may not add to totals due to rounding.
*EMFAC vehilce categorization is different from Enviromental Protect Agency (EPA) Emission Standards categorization.

Figure 3 On-Road Transportation Emissions by Vehicle Class in the San Diego Region

4.2 Electricity

Emissions from electricity use in Vista were estimated using the Built Environment (BE.2) method from the U.S Community Protocol.[14] Annual electricity sales by the local utility, San Diego Gas & Electric (SDG&E), to Vista customers[15] were adjusted by 1) a loss factor[16] of 1.07[17] to account for transmission and distribution losses; and 2) subtracting electricity use associated with moving water within the City limits, which is allocated to the water category emissions.

Emissions are calculated by multiplying the adjusted net energy for load (electricity sales + losses) by the corresponding City-specific electricity emission factor, given in Table 6, expressed in pounds of CO_2e per megawatt-hour (lbs CO_2e/MWh). For a given year, the City-specific electricity emission factor is

include electric vehicles. Medium-duty trucks included medium duty vehicles (MDV with Gross Vehicle Weight Rating (GVWR) 5751-8,500 lbs), and heavy-duty trucks (HDTs), with GVWR larger than 8,500 lbs. In contrast, under the EPA Emission Standard category vehicles with GVWR under 8,500 lbs are considered light-duty trucks/vehicles.

[14] ICLEI – Local Governments for Sustainability USA: U.S. Community Protocol for Accounting and Reporting of Greenhouse Gas Emissions, Version 1.0 (2012), Appendix C: Built Environment Emission Activities and Sources.

[15] 2012–2016 metered electricity sales were provided by SDG&E to EPIC (May 31, 2017).

[16] The transmission and distribution loss factor is used to scale end-use demand or retail sales to produce net energy for load. L. Wong, *A Review of Transmission Losses In Planning Studies*, CEC Staff Paper (August 2011).

[17] California Energy Commission (CEC): *California Energy Demand 2015–2025 Final Forecast Mid-Case Final Baseline Demand Forecast Forms,* SDG&E Mid. The transmission and distribution loss factor is calculated based on the ratio of net energy for load (total sales + net losses) and total sales from SDG&E Form 1.2 Mid.

estimated based on the specific power mix of bundled power[18] and Direct Access (DA) power[19] and their respective emission factors. The SDG&E bundled emission factors are calculated using Federal Energy Regulatory Commission (FERC) Form 1[20] data, the California Energy Commission (CEC) Power Source Disclosure Program,[21] data on SDG&E-owned and purchased power, and U.S. EPA Emissions and Generating Resource Integrated Database (eGRID)[22] on specific power plant emissions. The DA emission factor is taken from the California Public Utilities Commission (CPUC) Decision D.14-12-037.[23]

The differences in the electricity emission factors from 2012 to 2014 reflect in part the change in the electricity power mix in the City and in SDG&E's service territory. The emission factor increased in 2012 due to the shutdown of the zero-emissions electricity supply from the San Onofre Nuclear Generation Station (SONGS) and replacement by natural gas-fired power plant sources.[24] In the later years, more renewable resources were included in the power mix that resulted in a lower electricity emission factor. SDG&E had 32% renewable sources in the electricity supplied to its bundled customers in 2014, an increase from 19% in 2012.[25]

The net energy for Vista's load (electricity sales + losses), electricity emission factors, and corresponding GHG emissions from the electricity category for the years 2012–2014 are given in Table 6.

Table 6 Net Energy for Load, Emission Factor and GHG Emissions from Electricity Category (Vista, 2012–2014)

Year	Net Energy for Load (electricity sales + losses) (MWh)	City-Specific Emission Factor (lbs CO_2e/MWh)	GHG Emissions (MT CO_2e)
2012	536,933	758	185,000
2013	527,813	741	177,000
2014	527,226	646	155,000
GHG emissions for each category are rounded to the nearest thousands. Values are not rounded in the intermediary steps in the calculation. SDG&E, 2017; Energy Policy Initiatives Center, 2018.			

GHG emissions from the electricity category decreased 15% from 2012 to 2014; this may be partly attributed to the increase of renewable content in the electricity supply, as reflected in the decrease in the electricity emission factor.

The net energy for load does not include self-serve renewable supply, such as distributed photovoltaic (PV) systems, or self-serve non-renewable supply. The distributed PV systems in Vista increased

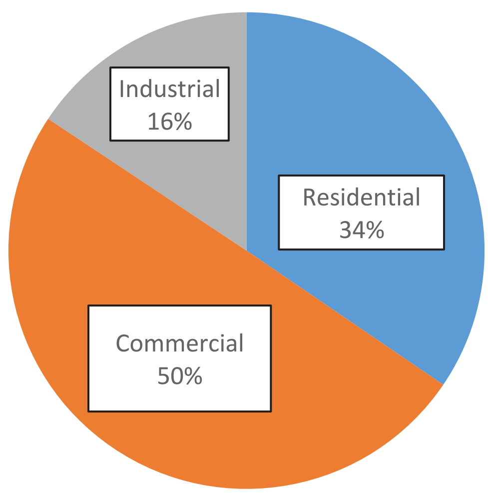
[18] SDG&E bundled power includes the electricity from SDG&E-owned power plants and the electricity from its net procurements.
[19] The SDG&E Direct Access Program includes electricity that customers purchased from non-SDG&E electric service providers (ESPs), but SDG&E still provides transmission and distribution services.
[20] FERC: Form 1- Electricity Utility Annual Report, download date: July 20, 2015.
[21] CEC Power Source Disclosure Program under Senate Bill 1305. The SDG&E annual power source disclosure report (2012-2014) was provided by CEC staff to EPIC.
[22] U.S. EPA. eGRID 2012 (2015) and eGRID 2014 v2 (2017).
[23] Decision 14-12-037, December 18, 2014 in Rulemaking 11-03-012 (filed March 24, 2011). The recommended emission factor is 0.379 MT CO_2e/MWh (836 lbs CO_2e/MWh).
[24] SONGS historically accounted for approximately 15–20% of SDG&E power generation. SONGS was permanently closed in 2013 and the energy generation was replaced by other sources, including non-renewable sources, which increased the emission factor of SDG&E-generated electricity.
[25] CEC: Utility Annual Power Content Label.

significantly from 2012 to 2014. The estimated cumulative solar PV capacity at the end of 2014 was 9.8 MW, with an estimated 16,955 MWh of self-serve solar generation. This is almost three times higher than the cumulative PV capacity at the end of 2012 (3.4 MW). The newly added PV systems in 2014 tripled when compared with 2012, as shown in Table 7.[26] Electricity generation from PV systems is considered renewable and assumed to have no associated GHG emissions.

Table 7 Behind-the-meter PV Systems and Electricity Generation (Vista, 2012–2014)

Year	New PV Systems		Cumulative PV Systems since 2000		Estimated Behind-the-meter Solar Generation (MWh)
	Number of Systems	Capacity (MW_{dc})	Number of Systems	Capacity (MW_{dc})	
2012	126	1.0	493	3.4	5,856
2013	287	2.2	780	5.7	9,710
2014	466	4.2	1,246	9.8	16,955
California Distributed Generation Statistics, 2017; Energy Policy Initiatives Center, 2018.					

The emissions can be broken down further into residential, commercial and industrial customer classes. In 2012, 50% of emissions were attributed to commercial electricity use, 34% were attributed to residential electricity use, and 16% to industrial electricity use, as shown in Figure 4.



Energy Policy Initiatives Center, 2018

Figure 4 Electricity Emissions by Customer Class (Vista, 2012)

4.3 Natural Gas

Emissions from natural gas end-use in Vista were estimated using method Built Environment (BE.1) from the U.S. Community Protocol.[27] Annual natural gas sales were provided by SDG&E. Natural gas end-use

[26] NEM Interconnection Data Set (current as of May 31, 2017), download date: September 12, 2017. Based on the date of NEM interconnection applications approved. Solar capacities are reported in direct current (DC). Estimated electricity generation is converted from capacity using an average solar PV system capacity factor of 20% and an annual system degradation rate of 1%.
[27] ICLEI– Local Governments for Sustainability USA: U.S. Community Protocol for Accounting and Reporting of Greenhouse Gas Emissions, Version 1.0 (2012), Appendix C: Built Environment Emission Activities and Sources.

does not include the natural gas used for utility-level electric generation (UEG) because those emissions are included in the electricity category.[28]

To estimate emissions from the combustion of natural gas, fuel use was multiplied by an emission factor for natural gas based on data from CARB.[29] The total natural gas use and corresponding GHG emissions from the natural gas category for the years 2012–2014 are given in Table 8.

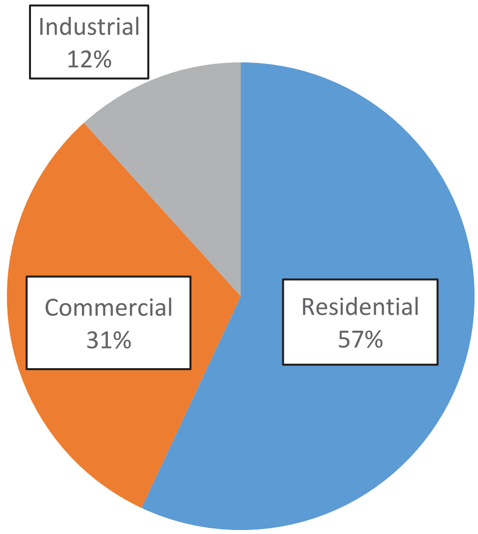
Table 8 Natural Gas Use and GHG Emissions from Natural Gas Category (Vista, 2012–2014)

Year	Natural Gas Use (Million Therms)	GHG Emissions (MT CO_2e)
2012	14.9	82,000
2013	15.7	86,000
2014	13.6	75,000

GHG emissions for each category are rounded to the nearest thousands. Values are not rounded in the intermediary steps in the calculation.
SDG&E, 2018; Energy Policy Initiatives Center, 2018.

Emissions from the natural gas category can be broken down further into residential, commercial and industrial customer classes. In 2012, 57% of emissions resulted from residential natural gas use, 31% resulted from commercial natural gas use, and 12% resulted from industrial natural gas use, as shown in Figure 5.

[28] 2012–2016 metered natural gas sales were provided to EPIC by SDG&E May 31, 2017).
[29] Emission factor for natural gas: 0.00554 million metric tons CO_2e/Million therms. CARB: Documentation of California's GHG Inventory – Index.



Energy Policy Initiatives Center, 2018

Figure 5 Natural Gas Emissions by Customer Class (Vista, 2012)

4.4 Off-Road Transportation

The emissions from off-road transportation in Vista, such as gasoline and diesel fuel use for off-road vehicles and equipment, were estimated based on CARB off-road models. OFFROAD2007 is the main model for estimating off-road transportation emissions.[30] After the release of OFFROAD2007, CARB has been developing inventories and models for each sub-category based on specific regulatory requirements.[31] For example, the recreational equipment category in OFFROAD2007 was replaced by RV2013.[32] In this section, new inventories and models were used if available; otherwise, OFFROAD2007 was used.

Due to the lack of jurisdiction-specific data from CARB models, the emissions or fuel consumption from CARB model outputs for the San Diego region were scaled to the City based on sub-category-specific scaling factors. The off-road activity sub-categories that are relevant to Vista and the scaling factors are given in Table 9.[33]

[30] CARB: Off-Road Motor Vehicles, OFFROAD 2007.
[31] CARB: Mobile Source Emissions inventory – Off-Road Diesel Vehicles.
[32] CARB: Off-Road Gasoline-Fueled Equipment. Recreational Vehicles, RV2013 (Inventory Model Database).
[33] The sub-categories listed in this table are not the comprehensive off-road mobile sources listed in CARB, as some of the sub-categories are not relevant to Vista, such as airport ground support, pleasure craft, commercial marine vessels, etc.

Table 9 Sub-Categories Included in the Off-Road Transportation Categories

Sub-Category	Model Source	Common Equipment Type	Scaling Factor
Recreational Vehicles	CARB RV2013	Terrain vehicles, golf carts, minibikes, off-road motorcycles	Population
Lawn and Garden Equipment	CARB OFFROAD2007	Lawn mowers, trimmers, brush cutters, chainsaws, leaf blowers/ vacuums	Population
Light Commercial Equipment	CARB OFFROAD2007	Generator set, pumps, welders	Commercial Jobs
Construction and Mining	CARB In-Use Off-Road Equipment 2011 Inventory	Excavators, off-highway tractors, loaders, paving equipment	Construction Jobs
Industrial	CARB In-Use Off-Road Equipment 2011 Inventory	Aerial lifts, forklifts, sweepers/scrubbers	Industrial Jobs
Diesel-Fueled Portable Equipment	CARB Portable Equipment 2017	Compressors, generators, pumps	Jobs

In the RV2013 model, the GHG emissions from recreational vehicles in the San Diego region were reported in tons per day and converted to annual emissions. In the Portable Equipment 2017 model and In-Use Off-Road Equipment 2011 Inventory, the fuel consumptions for the equipment in the San Diego region were reported in gallons per year and converted to annual GHG emissions. For other sub-categories, the OFFROAD2007 model outputs are annual emissions for the San Diego region. The scaling factors and the corresponding GHG emissions from the off-road transportation category in 2012 to 2014 are given in Table 10.[34]

[34] The population scaling factors were calculated based on Vista 2012-2014 populations compared to the regional population. The regional population is from the SANDAG Demographic & Socio Economic Estimates (Updated in September 2015). Download Date: 10/29/2015. Regional commercial jobs in 2012 is from the SANDAG Series 13 Regional Growth Forecast (Updated in October 2013). Download Date: 03/29/2017. SANDAG Data Surfer. Commercial jobs include all employment types other than agriculture and mining, construction and manufacturing. Jobs estimates in 2013 and 2014 were interpolated linearly based on 2012 and 2020 jobs estimates.

Table 10 GHG Emissions from Off-Road Transportation Category (Vista, 2012–2014)

Sub-category	Scaling Factor	San Diego Region (Million MT CO_2e)			Vista (MT CO_2e)		
		2012	2013	2014	2012	2013	2014
Recreational Vehicles	3%	0.004	0.004	0.004	115	111	111
Lawn and Garden Equipment	3%	0.095	0.094	0.093	2,889	2,876	2,825
Light Commercial Equipment	2%	0.103	0.102	0.102	2,255	2,253	2,250
Construction and Mining	5%	0.184	0.185	0.186	8,951	8,868	8,759
Industrial	7%	0.012	0.012	0.013	762	792	823
Diesel-Fueled Portable Equipment	3%	0.070	0.064	0.065	1,869	1,711	1,729
Total					17,000	17,000	16,000

Only total GHG emissions from off-road transportation have been rounded to the nearest thousands. Values are not rounded in the intermediary steps in the calculation.
CARB, 2007, 2011, 2013 and 2017; Energy Policy Initiatives Center, 2018.

4.5 Solid Waste

Emissions from solid waste disposed by Vista were estimated using method Solid Waste (SW.4) from the U.S. Community Protocol.[35] To estimate emissions, the amount of waste disposed by a city in a given year is multiplied by an emission factor for mixed solid waste. Solid waste disposal data were retrieved from the California Department of Resources Recycling and Recovery (CalRecycle) Disposal Reporting System (DRS).[36]

The emission factor of mixed solid waste depends on the percentage of each waste type within the waste stream disposed in a landfill. The City of San Diego's 2012–2013 Waste Characterization Study was used as a reasonable proxy for Vista's solid waste composition and applied to 2012–2014 waste disposed for the emission calculation.[37] Only the CH_4 emissions from waste degradation are considered non-biogenic and included in this category in accordance with the methodology. The CO_2 emissions from waste degradation are considered biogenic and not included in this category.

The default capture rate of CH_4 emissions from landfills is 75% based on that in the U.S. Community Protocol; any CH_4 emissions above this are included as emissions from the solid waste category. The total and per-capita solid waste disposal and the corresponding GHG emissions for the years 2012–2014 are given in Table 11.

[35] ICLEI – Local Governments for Sustainability USA: U.S. Community Protocol for Accounting and Reporting of Greenhouse Gas Emissions, Version 1.0 (2012), Appendix E: Solid Waste Emission Activities and Sources.
[36] CalRecycle: Disposal Reporting System (DRS): Jurisdiction Disposal and Alternative Daily Cover (ADC) Tons by Facility. 2012–2014 solid waste disposal data from CalRecycle. Download date: May 11, 2018.
[37] City of San Diego 2014, *Waste Characterization Study 2012–2013 Final Report*. The emission factor of 0.744 MT CO_2e/short ton was calculated based on the waste distribution and emission factor for each waste type in *Version 13 Waste Reduction Model (WARM)*.

Table 11 Solid Waste Disposal and GHG Emissions from Solid Waste Category (Vista, 2012–2014)

Year	Solid Waste Disposal (MT/year)	Per Capita Solid Waste Disposal (kg/person/day)	GHG Emissions (MT CO_2e)
2012	77,189	2.2	14,000
2013	83,799	2.4	15,000
2014	82,491	2.3	15,000
GHG emissions for each category are rounded to the nearest thousands. Values are not rounded in the intermediary steps in the calculation. CalReycle, 2017; Energy Policy Initiatives Center, 2018.			

4.6 Water

Vista Irrigation District (VID), a San Diego County Water Authority (SDCWA) member agency, provides potable water to the City of Vista. The water supply sources for VID include: 1) imported untreated water from SDCWA; 2) imported treated water from SDCWA; and 3) local surface water from Lake Henshaw. VID's entire service area is larger than the City of Vista; however, it is assumed the percentage of water from each source supplied to the City of Vista is the same as that of the entire service area. The potable water supplied in Vista and the percentage of water from each source are given in Table 12.[38]

Table 12 Potable Water Supplied and Supply Source (Vista, 2012–2014)

Year	% of Potable Water from each Water Supply			Potable Water Supplied (acre-feet)
	SDCWA Treated Water	SDCWA Untreated Water	Local Surface Water (Lake Henshaw)	
2012	37%	46%	17%	13,028
2013	29%	60%	11%	13,167
2014	16%	76%	7%	13,366
City of Vista, 2017.				

The energy used to produce and distribute potable water from each supply is different due to the different raw source type and its location. Emissions from water use in Vista were estimated using method Wastewater and Water (WW.14) from the U.S. Community Protocol.[39] The method considers each segment of the water-use cycle (water supply and conveyance, water treatment, and water distribution) individually, as described below.

Upstream Supply and Conveyance – This is defined as supply and conveyance of water from the raw sources to the local service area. The upstream supply and conveyance energy use for SDCWA treated and untreated water consists of conveyance of water from the State Water Project and Colorado River through Metropolitan Water District's service area and SDCWA's service area before reaching the VID service area.

[38] Potable water supplied from Vista Irrigation District (VID) to the City of Vista from 2010 to 2015 and water production sources for VID's entire service area from 2010 to 2015 were provided by City staff on May 27, 2017 and June 02, 2017.
[39] ICLEI – Local Governments for Sustainability USA: U.S. Community Protocol for Accounting and Reporting of Greenhouse Gas Emissions, Version 1.0 (2012), Appendix F: Wastewater and Water Emission Activities and Sources.

Local Water Treatment –This is the energy used for water treatment plant operations. VID and the City of Escondido jointly own the Escondido-Vista Water Treatment Plant (EVWTP), and the City of Escondido operates the plant. EVWTP treats both SDCWA untreated water and local surface water to potable water standards.

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Local Water Distribution – This is defined as the energy required to move treated water from water treatment plants to end-use customers. Distribution energy use includes energy use for water pump stations and/or pressure reduction stations, water tanks, etc.

The energy intensity per unit of water for each segment of the water-use cycle is given in Table 13.

Table 13 Energy Intensity for Each Segment of Water-Use Cycle (Vista, 2012–2014)

Year	Upstream Supply and Conveyance - SDCWA Treated Water[40]	Upstream Supply and Conveyance - SDCWA Untreated Water[41]	Local Water Treatment[42]	Local Distribution[43]
	(kWh/acre-foot)			
2012	1,816	1,755	56	58
2013				64
2014				55

For upstream supply and conveyance emissions, the amount of water from SDCWA (treated and untreated) was multiplied by the upstream energy intensities, respectively, to estimate the total electricity use from upstream supply. The electricity use was multiplied by the average California electricity emission factor to calculate the GHG emissions.[44] Because the electricity use and GHG emissions associated with upstream supply and conveyance are outside the City boundary and would not be included in the electricity category, they are accounted for in the water category.

[40] Anything upstream of the agency or district is part of upstream supply and conveyance, therefore, the upstream supply and conveyance energy intensity for SDCWA *treated* water includes conveyance from the State Water Project and Colorado River water to Metropolitan Water District's (MWD) distribution system, distribution from MWD to MWD's member agencies, SDCWA conveyance of raw water to its water treatment plants, treatment in SDWCA's plants and distribution of treated water from SDCWA's treatment plant to SDCWA's member agency. SDCWA 2016: Urban Water Management Plan 2015, Metropolitan Water District of Southern California, Urban Water Management Plan 2015.

[41] Upstream supply and conveyance energy intensity for SDCWA *untreated* water includes conveyance from the State Water Project and Colorado River water to MWD's distribution system, distribution from MWD to MWD's member agencies, and SDCWA's conveyance of raw water supplies to SDCWA's member agencies.

[42] The energy intensity at the Escondido-Vista Water Treatment Plant in 2015 was used as a proxy for 2012-2014. The entire plant's operational electricity use (SDCWA untreated and local surface water) for treatment in 2015 was provided by the City of Escondido in March 2017. The amount of water (SDCWA untreated and local surface water) treated at the EVWTP in 2015 was provided by the City of Vista in May and June 2017. The energy intensity at the plant in 2015 was calculated by dividing electricity use (kWh) by volume of water treated (acre feet).

[43] The distribution electricity use for the entire VID service area from 2010-2015 was provided by the City of Vista in June 2017 and used as a proxy to calculate the distribution energy intensity for the City of Vista.

[44] The Western Electricity Coordinating Council (WECC) CAMX (eGRID Subregion) emission rate (653 lbs CO_2e/MWh) from eGRID was used as representative of the average California electricity emission rate for upstream electricity. U.S. EPA. eGRID 2012 (2015) and eGRID 2014 v2 (2017).

For water treatment emissions, the potable water used by Vista was multiplied by the water treatment energy intensity and SDG&E's electricity emission factor to obtain GHG emissions associated with water treatment. The electricity use associated with water treatment are not included in the electricity use for Vista since the treatment plant is located outside Vista boundaries, but the GHG emissions are accounted for in the water category.

For water distribution emissions, potable water used by Vista was multiplied by the energy intensity for local water distribution and the SDG&E electricity emission factor. The electricity and GHG emissions associated with water distribution occur within the City boundary, and have been subtracted from the electricity category, as they are accounted for in the water category.

In 2012, 93 percent of the GHG emissions in the water category were from upstream supply and conveyance. The breakdown of emissions for the water category is given in Figure 6.

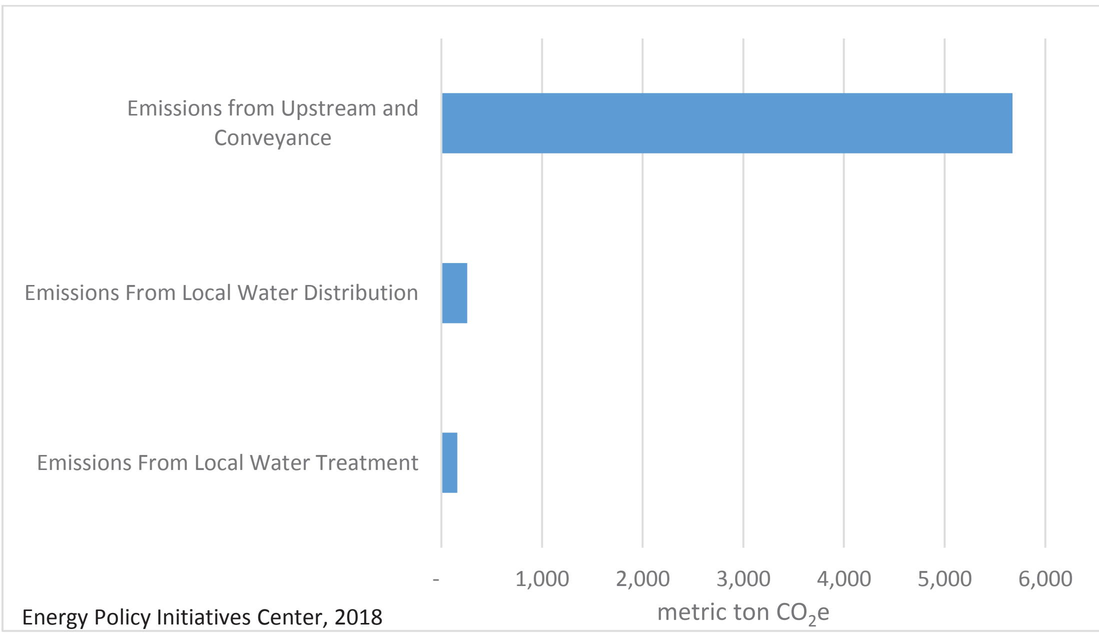


Figure 6 Emissions from the Water Category by Water System Segment (Vista, 2012)

For inventory years 2012 to 2014, no recycled water was supplied to the City. The total and per-capita potable water supplied, as well as the corresponding GHG emissions from the water category from the years 2012-2014 are given in Table 14.

Table 14 Water Supplied and GHG Emissions from the Water Category (Vista, 2012–2014)

Year	Potable Water Supplied (acre feet)	Per Capita Potable Water Supplied (gallons/person/day)	GHG Emissions (MT CO_2e)
2012	13,028	122	6,000
2013	13,167	122	7,000
2014	13,366	123	7,000
GHG emissions for each category are rounded to the nearest thousands. Values are not rounded in the intermediary steps in the calculation. Energy Policy Initiatives Center, 2018.			

Emissions associated with water end-use, such as water heating and cooling, are included in the electricity and natural gas category, and not in this water category, as data are not available to separate out those values.

4.7 Wastewater

The emissions from wastewater generated by Vista were estimated based on the total amount of wastewater generated in a given year and the emission factor of the wastewater treatment processes.

The wastewater in Vista is collected and delivered to the Encina Wastewater Authority for treatment at the Encina Water Pollution Control Facility (Encina WPCF). The wastewater treatment GHG emissions and total wastewater flow for the Encina WPCF were provided by the Encina Wastewater Authority. In 2013, the Encina WPCF treated an average of 22.8 millions of gallons per day (MGD) with annual CO_2e emissions of 11,359 metric tons. This resulted in an emission factor of 1.37 MT CO_2e/million gallons treated, which consists of emissions from: 1) stationary combustion of anaerobic digester gas; 2) process emissions from wastewater treatment with nitrification and denitrification; and 3) direct anaerobic digester gas. The wastewater emission factor derived from the Encina WPCF was applied to all wastewater flow in the City of Vista.[45] As similar data were not available for the other years; the emission factor was used as an estimate for all inventory years.

The total and per-capita wastewater treated at the centralized wastewater treatment plant (WWTP), as well as the corresponding GHG emissions, are given in Table 15.[46]

Table 15 Wastewater Generated and Treated at Centralized Treatment Plant (Vista, 2012–2014)

Year	Total Wastewater Generated (Million Gallons/year)	Wastewater Emission Factor (MT CO_2e/ Million Gallon)	GHG Emissions (MT CO_2e)
2012	1,956	1.37	2,680
2013	1,953	1.37	2,675
2014	1,978	1.37	2,710
City of Vista, 2017; Energy Policy Initiatives Center, 2018.			

[45] EPIC was informed by SEWRF staff that the treatment processes in SEWRF is similar to Encina's WPCF and can be used a proxy.
[46] Wastewater (million gallons per day) data from 2010 to 2016 were provided by City of Vista in May 2017 and converted to million gallons per year.

In addition to wastewater collected and treated at the centralized WWTP, approximately 500 homes (1,600 persons) within the City are on septic systems[47], the commonly used on-site wastewater treatment systems.[48] The GHG emissions were estimated based on Method WW.11 (Methane Emissions from Septic Systems) from the U.S. Community Protocol. CH_4 emissions were calculated based on the total population served by septic systems (1,600) and a septic system CH_4 emissions factor (10.7 grams CH_4/person/day).[49]

The total GHG emissions from the wastewater category are given in Table 16.[50]

Table 16 GHG Emissions from Wastewater Category (Vista, 2012-2014)

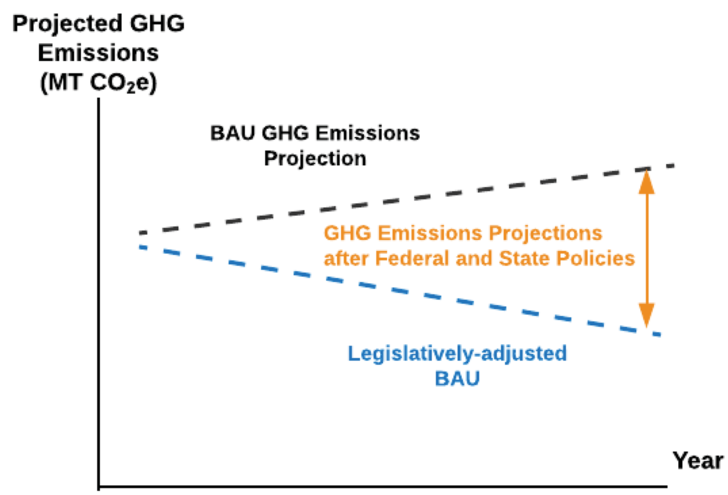
Year	GHG Emissions from Centralized Wastewater Treatment (MT CO_2e)	GHG Emissions from Septic Systems (MT CO_2e)	Total GHG Emissions (MT CO_2e)
2012	2,680	156	3,000
2013	2,675	156	3,000
2014	2,710	156	3,000
City of Vista, 2017; Energy Policy Initiatives Center, 2018.			

5 BUSINESS-AS-USUAL GHG EMISSIONS PROJECTIONS

To inform the development of GHG reduction strategies within a jurisdiction's Climate Action Plan (CAP), GHG emissions are projected using the baseline year from the GHG inventory, as well as estimates for population, housing, and job growth. This is used to develop a business-as-usual (BAU) projection, which demonstrates emissions growth in the absence of any new policies and programs. The latest year with available data may be different for different inventory categories. Next, emissions from federal and State policies and programs are applied in the future, creating a legislatively-adjusted BAU.

Figure 7 provides an illustrative example of the difference between a BAU and a legislatively-adjusted BAU. Only the BAU projection is discussed in this document; GHG reductions from the policies and programs included in the legislatively-adjusted BAU are considered later in the climate action planning process.

[47] The number of homes on septic systems were estimated by City staff. From 2012 to 2014, on average the City has 3.2 persons per household based on the SANDAG Demographic & Socio-Economic Estimates (March 8, 2017 Version).
[48] U.S. Environmental Protection Agency (EPA). Septic Systems. For a septic system, wastewater is treated through physical settling and biological activities only.
[49] Air Resources Board (ARB). Documentation of California's Greenhouse Gas Inventory (8th Edition). 2015. IPCC 4D1 Domestic Wastewater Treatment and Discharge. Septic Systems.
[50] Wastewater data (million gallons per day) from 2010 to 2016 were provided by the City of Vista in May 2017 and converted to million gallons per year.



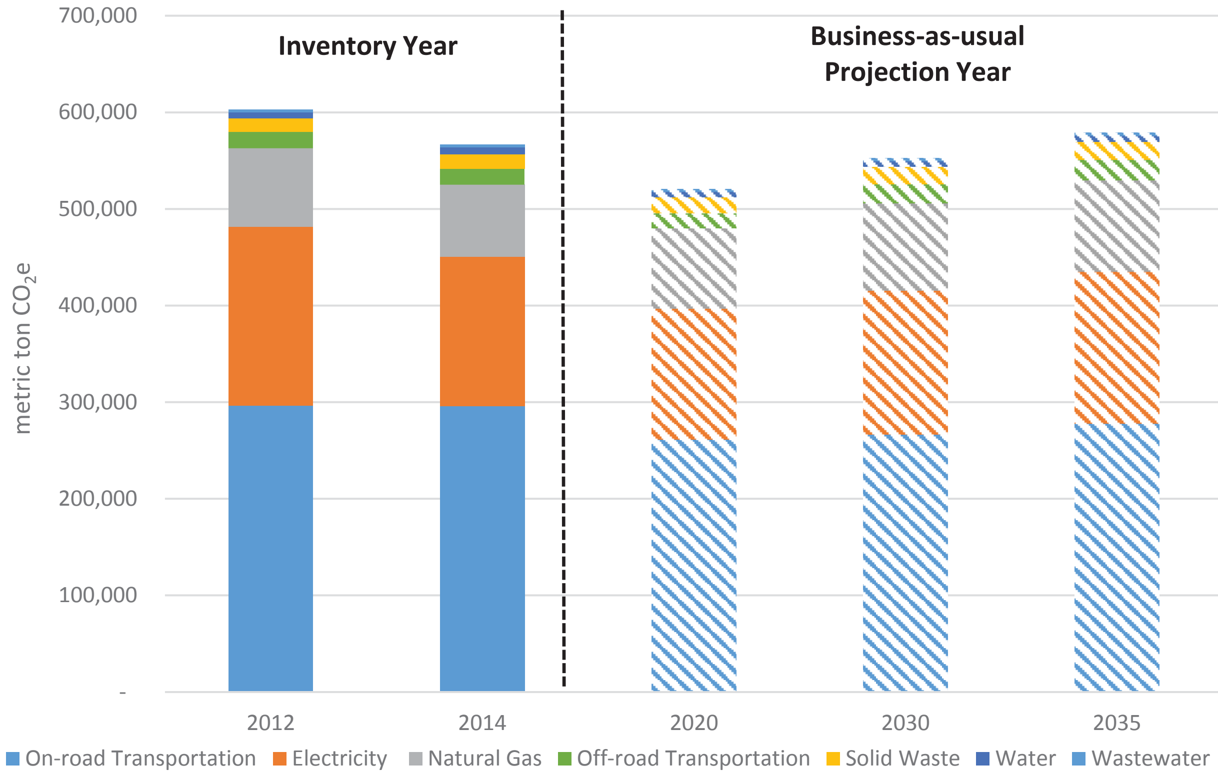
Energy Policy Initiatives Center, 2018

Figure 7 Illustrative Example Only: BAU and Legislatively-adjusted BAU Emissions Projections

Section 5.1 provides a summary of the BAU emissions projections for years 2020, 2030, and 2035, and Section 5.2 provides the projection methodologies used for each category.

5.1 Emissions Projections for 2020, 2030, and 2035

The total GHG emissions in 2020 are projected to be approximately 521,000 MT CO_2e, 14% lower than the 2012 emissions level and 8% lower than the 2014 emissions level. The total GHG emissions in 2030 are projected to be approximately 553,000 MT CO_2e, and the total GHG emissions in 2035 are projected to be approximately 579,000 MT CO_2e. Figure 8 below shows a comparison of the emissions breakdown by category for the inventory years and projection years.



Energy Policy Initiatives Center, 2018

Figure 8 BAU GHG Emissions Projections (Vista, 2020, 2030, and 2035)

As shown in Figure 8, the on-road transportation category contributes the most to the overall emissions in each projection year; however, emissions from on-road transportation are expected to decline through 2020 and then rise again through 2035, but are not projected to be higher than the transportation emissions in 2012 through 2014. One of the reasons for the decline of on-road transportation emissions is likely due to the decline of average vehicle emission rates, as newer, more efficient vehicles replace old vehicles in the region. The total and distribution of projected emissions by category are presented in Table 17.

Table 17 Projected Total and Category-GHG Emissions in Vista (2020, 2030, and 2035)

Year	Projected GHG Emissions (MT CO_2e)							
	On-Road Transportation	Electricity	Natural Gas	Off-Road Transportation	Solid Waste	Water	Wastewater	Total
2020	262,000	135,000	83,000	15,000	17,000	6,000	3,000	521,000
2030	267,000	149,000	90,000	20,000	18,000	6,000	3,000	553,000
2035	278,000	157,000	95,000	21,000	18,000	6,000	3,000	579,000
Sum may not add up to totals due to rounding. Projected GHG emissions for each category are rounded to the nearest thousands. Values are not rounded in the intermediary steps in the calculation. Energy Policy Initiatives Center, 2018.								

5.2 Methods to Project GHG Emissions

The SANDAG Series 13 Regional Growth Forecast was used as the basis of population and job growth in Vista, as shown in Table 18.[51] The methods used to project future emissions are provided below for each emissions category.

Table 18 SANDAG Population Projection and Job Growth Forecast (Vista, 2020, 2030, and 2035)

Year	Population	Commercial Jobs	Industrial Jobs	Total Jobs
2020	101,058	30,540	10,315	40,965
2030	107,784	34,660	10,553	45,317
2035	111,771	37,264	10,699	48,065
SANDAG, 2013; Energy Policy Initiatives Center, 2018.				

5.2.1 On-Road Transportation

Average weekday O-D VMT forecast for each trip type in 2020, 2030, and 2035 were provided by SANDAG based on its Series 13 activity-based model, as shown in Table 19 (See Appendix A for original data tables provided).[52]

[51] Population and jobs data are from the SANDAG Series 13 Regional Growth Forecast (updated in October 2013). The number of jobs is for civilian jobs only. SANDAG Data Surfer, Accessed August 7, 2017. The 2020 population from the Series 13 Forecast for Vista was not used because it is lower than the current (2016) SANDAG population estimates for Vista. The 2020 population (101,058) was instead interpolated between the 2016 population estimates and the 2025 Series 13 population forecast. The employment types included in the commercial jobs class exclude construction, manufacturing and agriculture jobs. Construction and manufacturing jobs are considered industrial jobs.
[52] Series 13 2020, 2030, and 2035 VMT average projections were provided by SANDAG (September 15, 2017).

Table 19 Projected O-D VMT and Trip Types (Vista, 2020, 2030, and 2035)

Trip Type (Miles/Average Weekday)	2020	2030	2035
Internal-Internal	241,621	272,582	296,979
Internal-External/External-Internal	3,171,670	3,513,243	3,660,351
External-External (Information only, excluded from VMT and GHG calculations)*	620,610	684,255	675,421
*Miles from External-External trips are the portion within the City boundary, not the entire trips. SANDAG, 2018.			

To convert VMT of each type to total VMT, the method discussed in Section 4.1 was used. The VMT was multiplied by the adjusted average vehicle emission rate derived from EMFAC2014 for each projection year. Two adjustments were made to the EMFAC2014 emission rates for the projections: 1) the electric vehicle penetration rate in 2016 was kept constant for all projection years;[53] and 2) for all new vehicles entering the fleet after 2016, the emission rates are equal to the emission rates of new model year 2016 vehicles with the same vehicle class and fuel type.[54]

The projected total VMT, average vehicle emission rates, and corresponding GHG emissions from the on-road transportation category are given in Table 20.

Table 20 Projected VMT, Average Vehicle Emission Rate and GHG Emissions from On-Road Transportation Category (Vista, 2020, 2030, and 2035)

Year	Projected Total VMT		Average Vehicle Emission Rate (g CO_2e/mile)	Projected GHG Emissions (MT CO_2e)
	Average Weekday Miles	Average Annual Miles		
2020	1,827,456	634,127,304	412	262,000
2030	2,029,204	704,133,650	379	267,000
2035	2,127,154	738,122,545	377	278,000
Projected GHG emissions for each category are rounded to the nearest thousands. Values are not rounded in the intermediary steps in the calculation. CARB, 2015. SANDAG, 2018. Energy Policy Initiatives Center, 2018.				

As newer, more efficient vehicles replace older, less efficient vehicles in the region, the average vehicle emission rate decreases.

5.2.2 Electricity

Electricity use in the City was projected separately for residential and commercial/industrial customer classes. For the residential customer class, the per-capita electricity use (metered electricity sales) in

[53] This uses a fixed 2016 electric vehicle penetration rate of about 2% of light duty vehicles instead of using the estimated impact of the state Zero Emission Vehicle (ZEV) program on BAU emissions. The 2016 electric vehicle penetration rate is based on EMFAC2014 Technical Documentation, Section 3.2.2.4.3. The ZEV program requires auto manufacturers to make and sell ZEVs that will increase VMTs driven by ZEVs.
[54] This uses a fixed actual emission rate of the new 2016 models instead of the effect of adopted federal and state vehicle efficiency standards 2017–2025 for light-duty and heavy-duty vehicles.

2016 (1,602 kWh/person/year), the latest year with available SDG&E data, was calculated by dividing the total electricity sales in the residential class by the population in 2016. The per-capita electricity use is held constant and used to project total electricity use for a future year by multiplying by the SANDAG Series 13 population forecast for the future year. The projected total electricity use was multiplied by the City-specific electricity emission factor in 2016 (562 lbs CO_2e/MWh), held constant, for a projected total GHG emission. The City-specific electricity emission factor in 2016 is significantly lower than that of 2012 and 2014 because SDG&E has since reached 43% renewable energy in its power mix.[55]

For the commercial/industrial class, a similar method was used. The total commercial/industrial electricity use was projected based on job growth and the per-job electricity consumption in 2016 (8,154 kWh/job/year) for all future years.

The total projected net energy for load (electricity sales + transmission and distribution losses) and corresponding GHG emissions from the electricity category are given in Table 21.[56]

Table 21 Projected Net Energy for Load and GHG Emissions from the Electricity Category (Vista, 2020, 2030, and 2035)

Year	Projected Net Energy for Load (electricity sales + losses) (MWh)	Projected GHG Emissions (MT CO_2e)
2020	531,449	135,000
2030	583,637	149,000
2035	616,142	157,000

Projected GHG emissions for each category are rounded to the nearest thousands. Values are not rounded in the intermediary steps in the calculation.
Energy Policy Initiatives Center, 2018.

5.2.3 Natural Gas

The projection method for the natural gas category is similar to that for the electricity category. The natural gas use in residential and commercial/industrial classes are calculated separately. The per-capita residential natural gas consumption (76therms/person/year) and the per-job natural gas consumption (185 therms/job/year) in 2016 were held constant with population and job growth for the projection. The natural gas emission factor used in Section 4.3 was held constant for future years. The projected total natural gas use and corresponding GHG emissions from the natural gas category are given in Table 22.

[55] 2016 renewable content in SDG&E bundled power is based on SDG&E's 2016 power source disclosure report submitted to the California Energy Commission (CEC). The 2016 report was provided by CEC staff to EPIC in July 2017.
[56] The net energy for load of each future year is adjusted using the method described in Section 4.2. The net energy for load does not include self-serve renewable supply, such as electricity generation from behind-the-meter PV systems.

Table 22 Projected Natural Gas Use and GHG Emissions from Natural Gas Category (Vista, 2020, 2030, and 2035)

Year	Projected Total Natural Gas Use (Million Therms)	Projected GHG Emissions (MT CO_2e)
2020	15.3	83,000
2030	16.6	90,000
2035	17.4	95,000

Projected GHG emissions for each category are rounded to the nearest thousands. Values are not rounded in the intermediary steps in the calculation.
Energy Policy Initiatives Center, 2018.

5.2.4 Off-Road Transportation

In the off-road transportation category, the direct output of OFFROAD2007 (lawn and garden equipment and light commercial equipment), RV2013 model (recreational equipment), and diesel-fueled portable equipment for the San Diego region were used and scaled down to Vista based on the scaling factor as determined in Section 4.4. For the construction and industrial equipment sub-category, the In-Use Off-Road Equipment 2011 Inventory does not include emissions output after 2030. For the years 2020 and 2030, the direct output for the San Diego region from the model was used and scaled down to Vista. For 2035, the emissions were estimated based on the commercial and industrial job growth. The projected total and sub-category off-road transportation emissions are given in Table 23.

Table 23 Projected GHG Emissions from Off-Road Transportation Category (Vista, 2020, 2030, and 2035)

Year	Projected GHG Emissions (MT CO_2e)						
	Recreational Equipment	Lawn and Garden Equipment	Light Commercial Equipment	Construction and Mining	Industrial	Diesel-Fueled Portable Equipment	Total
2020	144	2,573	2,225	7,652	998	1,808	15,000
2030	173	2,952	2,524	10,841	1,180	2,296	20,000
2035	188	3,190	2,703	11,408	1,197	2,605	21,000

Only total GHG emissions are rounded to the nearest thousands. Values are not rounded in the intermediary steps in the calculation.
CARB, 2007, 2011, 2013 and 2017; Energy Policy Initiatives Center, 2018.

5.2.5 Solid Waste

The BAU solid waste disposal by Vista was projected using the population growth and the per-capita solid waste disposed in 2016 (2.4 kg/person/day), held constant for future years, to be consistent with other categories. The projected emissions from the disposal were calculated by multiplying the disposal amount with the emission factor for mixed solid waste, provided in Section 4.5. The projected total waste disposal and corresponding GHG emissions from the solid waste category are given in Table 24.

Table 24 Projected Solid Waste Disposal and GHG Emissions from Solid Waste Category (Vista, 2020, 2030, and 2035)

Year	Projected Solid Waste Disposal (MT)	Projected GHG Emissions (MT CO_2e)
2020	90,177	17,000
2030	96,178	18,000
2035	99,736	18,000

Projected GHG emissions for each category are rounded to the nearest thousands. Values are not rounded in the intermediary steps in the calculation.
Energy Policy Initiatives Center, 2018.

5.2.6 Water

The total water use for all projection years was determined using the same method as the solid waste section and was based on per-capita water consumption and population growth. The 2016 potable water supplied to the City was not available; therefore, the total potable water supplied to the City and the percentage of water from each supply source (SDCWA treated, SDCWA untreated, and local surface water) in 2015 were used. It is assumed that no recycled water source or new potable water source is developed under the BAU projection.

The per-capita potable water supplied in 2015 was 98 gallons/person/day, significantly lower than in 2012 and 2014. The energy intensity for each element of the water cycle (Table 13) and the electricity emission factor were held constant for all projection years. The projected total potable water supplied and corresponding GHG emissions from the water category are given in Table 25.

Table 25 Projected Water and GHG Emissions from the Water Category (Vista, 2020, 2030, and 2035)

Year	Projected Water Supply (Acre-Feet)	Projected GHG Emissions (MT CO_2e)
2020	11,122	6,000
2030	11,863	6,000
2035	12,301	6,000

Projected GHG emissions for each category are rounded to the nearest thousands. Values are not rounded in the intermediary steps in the calculation.
Energy Policy Initiatives Center, 2018.

5.2.7 Wastewater

The total wastewater generation for all projection years was determined using the same method as the solid waste and water sections, based on per-capita wastewater generation and projected population growth. The per-capita wastewater generated and treated at the centralized wastewater treatment plant in 2016, the latest year with data available, and the emission factor derived from data based on the Encina Wastewater Authority (Section 4.7) was held constant for all projection years. It is assumed the 500 homes that currently have on-site septic systems for wastewater treatment still use the systems and no new homes use septic systems in future years under the BAU projection.

The projected total wastewater treated at the centralized WWTP and the GHG emissions from the wastewater category are given in Table 26.

Table 26 Projected Wastewater Generated and GHG Emissions from the Wastewater Category (Vista, 2020, 2030, and 2035)

Year	Projected Wastewater Generated (Million Gallons)	Projected GHG Emissions from Centralized Wastewater Treatment (MT CO_2e)	Projected GHG Emissions from Septic Systems (MT CO_2e)	Projected GHG Emissions (MT CO_2e)
2020	1,999	2,739	156	3,000
2030	2,132	2,921	156	3,000
2040	2,211	3,029	156	3,000

Projected GHG emissions for each category are rounded to the nearest thousands. Values are not rounded in the intermediary steps in the calculation.
Energy Policy Initiatives Center, 2018.

Appendix A. VISTA VMT BY TRIP TYPE

Average weekday VMT data tables were provided by SANDAG (from SANDAG ABM Series 13, Release 13.3.0). Revenue Constrained refers to the transportation network scenario adopted in San Diego Forward: The 2015 Regional Plan.[57] Emphasis (red squares and text) was added by EPIC.

2012 Base Year

JURISDICTION	TOTAL VMT	TOTAL City of Vista VMT	Two Trip End City of Vista VMT	One Trip End City of Vista VMT	NON-City of Vista VMT
		I-I, I-E and E-I	I-I	I-E and E-I	E - E
CARLSBAD TOTAL	3,112,142	310,083	-	310,083	2,802,059
CHULA VISTA TOTAL	3,516,776	3,339	-	3,339	3,513,437
CORONADO TOTAL	369,020	220	-	220	368,800
DEL MAR TOTAL	77,409	645	-	645	76,764
EL CAJON TOTAL	1,895,376	1,540	-	1,540	1,893,836
ENCINITAS TOTAL	1,798,588	62,382	-	62,382	1,736,206
ESCONDIDO TOTAL	2,644,337	127,718	-	127,718	2,516,619
External TOTAL	173,565	1,815	-	1,815	171,750
IMPERIAL BEACH TOTAL	92,294	19	-	19	92,275
LA MESA TOTAL	1,529,817	1,153	-	1,153	1,528,664
LEMON GROVE TOTAL	790,801	163	-	163	790,638
NATIONAL CITY TOTAL	1,545,818	2,253	-	2,253	1,543,565
OCEANSIDE TOTAL	2,675,295	410,084	-	410,084	2,265,211
POWAY TOTAL	868,013	4,683	-	4,683	863,330
SAN DIEGO TOTAL	36,928,734	272,985	-	272,985	36,655,749
SAN MARCOS TOTAL	1,838,273	371,904	-	371,904	1,466,369
SANTEE TOTAL	947,193	3,230	-	3,230	943,963
SOLANA BEACH TOTAL	603,982	15,397	-	15,397	588,585
Unincorporated TOTAL	16,372,819	693,838	-	693,838	15,678,981
VISTA TOTAL	1,610,600	1,014,336	241,151	773,185	596,264
REGIONWIDE TOTAL	79,390,852	3,297,787	241,151	3,056,636	76,093,065

0% of E-E VMT
100% of I-I VMT
50% of I-E/E-I VMT

Figure A-1 Estimated Vista 2012 VMT by Trip Type

2014 Estimates

JURISDICTION	TOTAL VMT	TOTAL City of Vista VMT	Two Trip End City of Vista VMT	One Trip End City of Vista VMT	NON-City of Vista VMT
		I-I, I-E and E-I	I-I	I-E and E-I	E - E
CARLSBAD TOTAL	3,203,488	307,546	-	307,546	2,895,942
CHULA VISTA TOTAL	3,692,997	3,424	-	3,424	3,689,573
CORONADO TOTAL	376,307	221	-	221	376,086
DEL MAR TOTAL	78,343	656	-	656	77,687
EL CAJON TOTAL	1,995,802	1,822	-	1,822	1,993,980
ENCINITAS TOTAL	1,847,350	62,408	-	62,408	1,784,942
ESCONDIDO TOTAL	2,773,383	125,873	-	125,873	2,647,510
External TOTAL	207,246	2,184	-	2,184	205,062
IMPERIAL BEACH TOTAL	92,994	12	-	12	92,982
LA MESA TOTAL	1,574,973	1,269	-	1,269	1,573,704
LEMON GROVE TOTAL	826,374	204	-	204	826,170
NATIONAL CITY TOTAL	1,587,714	2,266	-	2,266	1,585,448
OCEANSIDE TOTAL	2,812,792	431,754	-	431,754	2,381,038
POWAY TOTAL	875,057	4,838	-	4,838	870,219
SAN DIEGO TOTAL	37,907,376	278,229	-	278,229	37,629,147
SAN MARCOS TOTAL	1,896,873	374,815	-	374,815	1,522,058
SANTEE TOTAL	973,959	3,490	-	3,490	970,469
SOLANA BEACH TOTAL	623,215	15,635	-	15,635	607,580
Unincorporated TOTAL	17,593,241	743,886	-	743,886	16,849,355
VISTA TOTAL	1,667,838	1,040,031	249,320	790,711	627,807
REGIONWIDE TOTAL	82,607,322	3,400,563	249,320	3,151,243	79,206,759

0% of E-E VMT
100% of I-I VMT
50% of I-E/E-I VMT

Figure A-2 Estimated Vista 2014 VMT by Trip Type

[57] San Diego Forward: The 2015 Regional Plan was adopted by the SANDAG Board of Directors on October 9, 2015.

2020 Revenue Constrained

JURISDICTION	TOTAL VMT	TOTAL City of Vista VMT	Two Trip End City of Vista VMT	One Trip End City of Vista VMT	NON-City of Vista VMT
		I-I, I-E and E-I	I-I	I-E and E-I	E-E
CARLSBAD TOTAL	3,472,436	339,101	-	339,101	3,133,335
CHULA VISTA TOTAL	4,110,315	3,601	-	3,601	4,106,714
CORONADO TOTAL	376,776	203	-	203	376,573
DEL MAR TOTAL	75,193	642	-	642	74,551
EL CAJON TOTAL	1,999,957	1,682	-	1,682	1,998,275
ENCINITAS TOTAL	1,882,878	65,882	-	65,882	1,816,996
ESCONDIDO TOTAL	2,805,409	123,706	-	123,706	2,681,703
External TOTAL	194,117	1,859	-	1,859	192,258
IMPERIAL BEACH TOTAL	91,844	7	-	7	91,837
LA MESA TOTAL	1,600,130	1,144	-	1,144	1,598,986
LEMON GROVE TOTAL	822,920	159	-	159	822,761
NATIONAL CITY TOTAL	1,620,907	2,214	-	2,214	1,618,693
OCEANSIDE TOTAL	2,854,499	440,398	-	440,398	2,414,101
POWAY TOTAL	925,978	4,677	-	4,677	921,301
SAN DIEGO TOTAL	39,059,773	272,540	-	272,540	38,787,233
SAN MARCOS TOTAL	1,971,319	379,965	-	379,965	1,591,354
SANTEE TOTAL	1,028,034	3,312	-	3,312	1,024,722
SOLANA BEACH TOTAL	643,319	17,552	-	17,552	625,767
Unincorporated TOTAL	17,475,190	708,883	-	708,883	16,766,307
VISTA TOTAL	1,666,374	1,045,764	241,621	804,143	620,610
REGIONWIDE TOTAL	84,677,368	3,413,291	241,621	3,171,670	81,264,077

100% of I-I VMT
50% of I-E/E-I VMT
0% of E-E VMT

Figure A-3 Projected Vista 2020 VMT by Trip Type

2030 Revenue Constrained

JURISDICTION	TOTAL VMT	TOTAL City of Vista VMT	Two Trip End City of Vista VMT	One Trip End City of Vista VMT	NON-City of Vista VMT
		I-I, I-E and E-I	I-I	I-E and E-I	E - E
CARLSBAD TOTAL	3,612,570	356,853	-	356,853	3,255,717
CHULA VISTA TOTAL	4,707,744	4,176	-	4,176	4,703,568
CORONADO TOTAL	385,001	193	-	193	384,808
DEL MAR TOTAL	76,024	567	-	567	75,457
EL CAJON TOTAL	2,161,071	1,993	-	1,993	2,159,078
ENCINITAS TOTAL	1,924,311	69,863	-	69,863	1,854,448
ESCONDIDO TOTAL	2,972,037	135,254	-	135,254	2,836,783
External TOTAL	222,080	2,296	-	2,296	219,784
IMPERIAL BEACH TOTAL	95,173	7	-	7	95,166
LA MESA TOTAL	1,755,098	1,323	-	1,323	1,753,775
LEMON GROVE TOTAL	867,492	173	-	173	867,319
NATIONAL CITY TOTAL	1,777,970	2,740	-	2,740	1,775,230
OCEANSIDE TOTAL	3,048,450	485,278	-	485,278	2,563,172
POWAY TOTAL	966,183	5,076	-	5,076	961,107
SAN DIEGO TOTAL	41,736,317	297,561	-	297,561	41,438,756
SAN MARCOS TOTAL	2,215,053	427,730	-	427,730	1,787,323
SANTEE TOTAL	1,097,270	3,426	-	3,426	1,093,844
SOLANA BEACH TOTAL	667,905	18,914	-	18,914	648,991
Unincorporated TOTAL	19,108,723	827,336	-	827,336	18,281,387
VISTA TOTAL	1,829,321	1,145,066	272,582	872,484	684,255
REGIONWIDE TOTAL	91,225,793	3,785,825	272,582	3,513,243	87,439,968

100% of I-I VMT
50% of I-E/E-I VMT
0% of E-E VMT

Figure A-4 Projected Vista 2030 VMT by Trip Type

2035 Revenue Constrained					
JURISDICTION	**TOTAL VMT**	**TOTAL City of Vista VMT**	**Two Trip End City of Vista VMT**	**One Trip End City of Vista VMT**	**NON-City of Vista VMT**
		I-I, I-E and E-I	**I-I**	**I-E and E-I**	**E-E**
CARLSBAD TOTAL	3,668,094	367,178	-	367,178	3,300,916
CHULA VISTA TOTAL	4,783,453	4,325	-	4,325	4,779,128
CORONADO TOTAL	379,321	191	-	191	379,130
DEL MAR TOTAL	74,771	516	-	516	74,255
EL CAJON TOTAL	2,198,458	2,133	-	2,133	2,196,325
ENCINITAS TOTAL	1,951,056	69,583	-	69,583	1,881,473
ESCONDIDO TOTAL	3,050,942	137,348	-	137,348	2,913,594
External TOTAL	234,505	2,501	-	2,501	232,004
IMPERIAL BEACH TOTAL	99,513	8	-	8	99,505
LA MESA TOTAL	1,785,371	1,291	-	1,291	1,784,080
LEMON GROVE TOTAL	864,461	151	-	151	864,310
NATIONAL CITY TOTAL	1,772,554	2,673	-	2,673	1,769,881
OCEANSIDE TOTAL	3,136,145	515,175	-	515,175	2,620,970
POWAY TOTAL	990,763	5,741	-	5,741	985,022
SAN DIEGO TOTAL	42,048,607	294,320	-	294,320	41,754,287
SAN MARCOS TOTAL	2,248,294	444,129	-	444,129	1,804,165
SANTEE TOTAL	1,108,219	3,796	-	3,796	1,104,423
SOLANA BEACH TOTAL	666,221	18,937	-	18,937	647,284
Unincorporated TOTAL	19,851,083	880,409	-	880,409	18,970,674
VISTA TOTAL	1,882,346	1,206,925	296,979	909,946	675,421
REGIONWIDE TOTAL	92,794,177	3,957,330	296,979	3,660,351	88,836,847

100% of I-I VMT
50% of I-E/E-I VMT
0% of E-E VMT

Figure A-5 Projected Vista 2035 VMT by Trip Type

Appendix B. SOURCE DATA FOR THE SOLID WASTE EMISSION FACTOR

Waste Component	Waste Distribution (%)[1]	Landfill Gas Emissions	
		CH_4 without LFG Recovery ($MT CO_2e$/short ton)	Source[2]
Paper	16.8%	-	-
Corrugated Containers/Cardboard	*5.0%*	2.36	Exhibit 3-27, WARM v14 Containers /Packaging
Newspaper	*0.8%*	0.95	Exhibit 3-27, WARM v14 Containers /Packaging
Magazine	*0.6%*	1.08	Exhibit 3-27, WARM v14 Containers /Packaging
Mixed Paper (general)	*10.4%*	2.14	Exhibit 3-27, WARM v14 Containers /Packaging
Plastic	8.9%	-	-
Glass	1.7%	-	-
Metal	3.5%	-	-
Organics	38.9%	-	-
Food	*15%*	1.57	Exhibit 1-49, WARM V14 Organic Materials
Tree	*5.3%*	0.77	Exhibit 2-11 WARM V14 Organic Materials
Leaves and Grass	*6.8%*	0.59	Exhibit 2-11 WARM V14 Organic Materials
Trimmings	*3.5%*	0.59	Exhibit 2-11 WARM V14 Organic Materials
Mixed Organics	*8.3%*	0.53	Exhibit 2-11 WARM V14 Organic Materials
Electronics	0.6%	-	-
Construction & Demolition	24.6%	-	-
Household Hazardous Waste	0.2%	-	-
Special Waste	3.1%	-	-
Mixed Residue	1.6%	0.53	
Mixed Waste Emission Factor		**0.744**	
Source: 1) City of San Diego 2014. 2) EPA Waste Reduction Model (WARM) Version 14 (2016)			

Appendix B

Greenhouse Gas Emissions

Reduction Targets and Measures

Methods for Estimating Greenhouse Gas Emissions Reductions in the Vista Climate Action Plan

Draft

July 2019

Prepared for the City of Vista

Prepared by the Energy Policy Initiatives Center

About EPIC

The Energy Policy Initiatives Center (EPIC) is a non-profit research center of the USD School of Law that studies energy policy issues affecting California and the San Diego region. EPIC's mission is to increase awareness and understanding of energy- and climate-related policy issues by conducting research and analysis to inform decision makers and educate law students.

For more information, please visit the EPIC website at www.sandiego.edu/epic.

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1 OVERVIEW

This document provides a summary of the methods used to calculate the greenhouse gas (GHG) emissions reductions for the strategies and measures included in the City of Vista's (referred to as "the City" or "Vista") Climate Action Plan (CAP).

Section 2 provides emission reduction targets for Vista in the years 2020 and 2030. Section 3 provides a summary of emissions reduction estimates from federal and State (California) actions and seven CAP strategies in 2030. Section 4 provides the common data sources and methods used throughout the document. The detailed methods used to estimate emissions reductions from each strategy and measure are presented in Sections 5 and 6.

1.1 Rounding of Values in Tables and Figures

Rounding is used only for the final GHG values within the tables and figures throughout the document. Values are not rounded in the intermediary steps in the calculation. Because of rounding, some totals may not equal the values summed in any table or figure.

2 EMISSION REDUCTION TARGETS

California has a statewide target to reach the 1990 GHG emissions level by 2020, or 431 million metric tons of carbon dioxide equivalent (MMT CO_2e), and to reach 40% below the 1990 level by 2030, or 260 MMT CO_2e.[1] According to the California Air Resources Board's (CARB) statewide inventory, the statewide total GHG emissions level in 2012 was 450 MMT CO_2e.[2] At the State level, the emissions reduction target for 2020 is equivalent to 4% below 2012; for 2030, it is equivalent to 42% below 2012, as illustrated in Figure 1.

[1] Assembly Bill 32 (Nunez) (Chapter 488, Statutes of 2006): California Global Warming Solutions Act of 2006. Senate Bill 32 (Pavley) (Chapter 249, Statutes of 2016): California Global Warming Solutions Act of 2006: emissions limit (2015-2016).
[2] California Air Resources Board: California Greenhouse Gas Inventory for 2000–2016 (June, 2018), accessed on December 13, 2018.

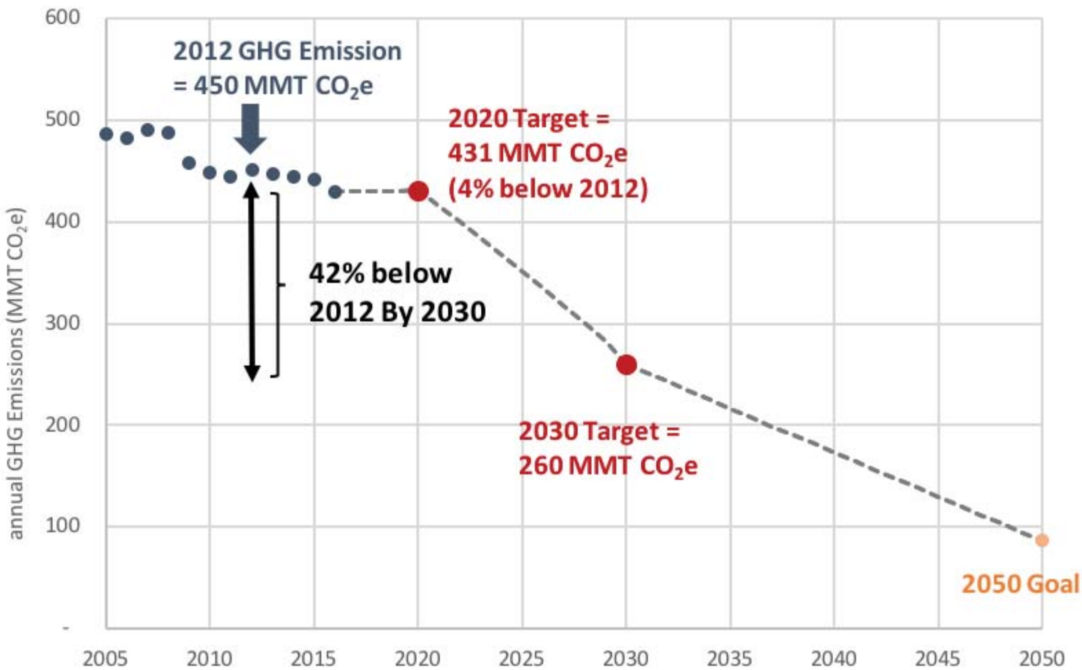


Figure adapted from California's 2017 Climate Change Scoping Plan Figure 6 that shows a linear, straight-line path to the 2030 target. The 2050 goal is 80% below 1990 level
Source: California Air Resources Board California Greenhouse Gas Emission Inventory - 2018 Edition (June 2018) 2017 Climate Change Scoping Plan.

Figure 1 California Statewide GHG Inventory and Emissions Reduction Targets

The Vista CAP has a baseline year of 2012. 2012 was selected as the baseline year for the CAP because it was the year with the best available transportation activity data during development of the City's GHG emissions inventory. As emissions from transportation account for more than half of the total city emissions, the quality of transportation activity data determines the quality of the inventory. To be consistent with the emissions reduction targets at the State level, the target emissions levels for Vista are set at 4% below the 2012 emissions level by 2020 and 42% below the 2012 emissions level by 2030.

Table 1 shows the business-as-usual (BAU) emissions projections, targets, and CO_2e reductions needed in 2020 and 2030 to achieve the target levels.[3]

Table 1 Emissions Projections, Targets, and Emissions Reductions Needed

Year	Business-as-usual Projection (MT CO_2e)	Target Emissions Level (% below baseline)	Target Emissions Level (MT CO_2e)	Emissions Reduction Needed to Meet Target (MT CO_2e)
2012	603,000	-	-	-
2020	521,000	4%	580,000	none
2030	553,000	42%	350,000	203,000

Emissions projections and reductions are rounded.
Energy Policy Initiatives Center 2019.

[3] The method to project emissions at 2020 and 2030 is provided in *Appendix A: City of Vista Greenhouse Gas Emissions Inventories and Projections* (EPIC, 2018).

No local actions are needed for Vista to reach its 2020 target. In 2030, a reduction of 203,000 metric tons CO_2e (MT CO_2e) is needed to meet Vista's 2030 target. This document focuses on the State and local measures needed to reach the 2030 target.

3 SUMMARY OF EMISSIONS REDUCTION ESTIMATES

This section summarizes the GHG emissions reductions from strategies and measures included in the Vista CAP. Table 2 below presents a summary of emissions reductions from the seven local strategies in the Vista CAP, as well as the reductions from federal and State actions.

Table 2 Summary of 2030 GHG Emissions Reduction by Strategy in the Vista CAP

Summary of Federal and State Actions and CAP Strategies		2030 Emissions Reduction (MT CO_2e)
CAP Strategies	1: Increase Use of Zero-Emission or Alternative Fuel Vehicles	1,999
	2: Reduce Vehicle Miles Traveled	1,272
	3: Reduce Fossil Fuel Use	3,252
	4: Increase Building Energy Efficiency	45
	5: Increase Renewable and Zero-Carbon Energy	30,419
	6: Reduce and Recycle Solid Waste	13,898
	7: Carbon Sequestration	241
Federal and State Actions		152,043
Total Emissions Reduction*		203,000
*The total emissions reduction in 2030 is rounded. Energy Policy Initiatives Center 2019.		

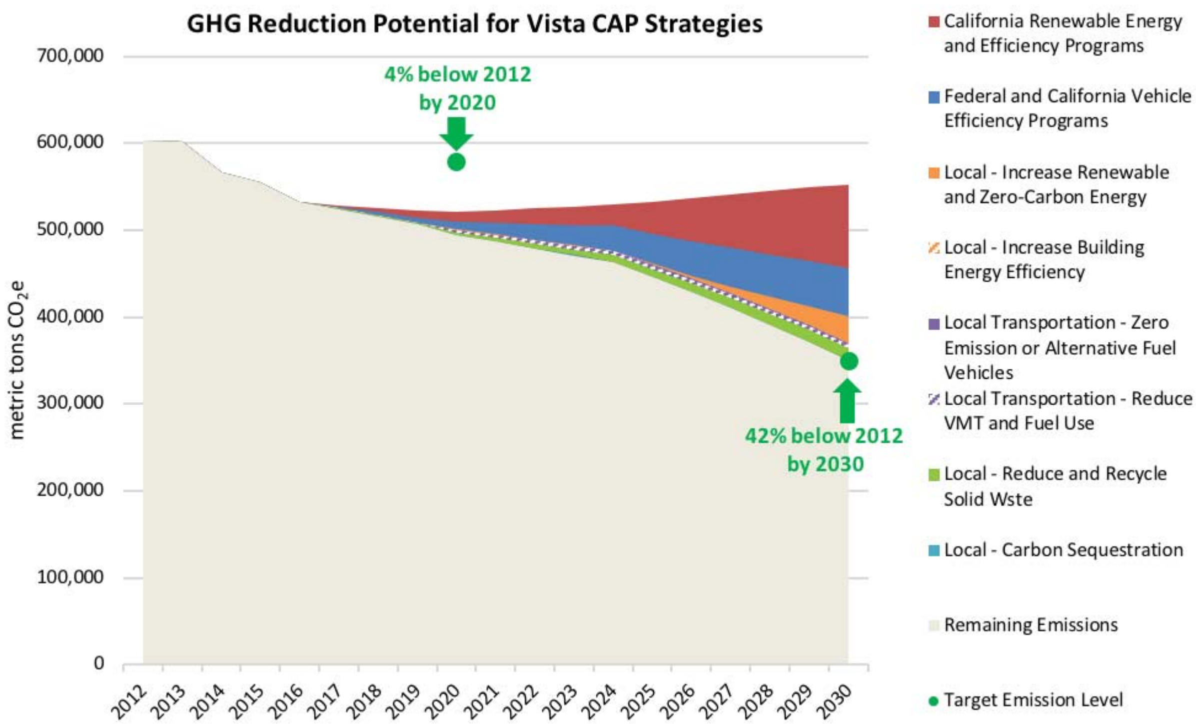
Each CAP strategy includes several quantifiable measures,
Table 3 presents a detailed summary of the emissions reductions from each CAP measure and from each federal and State action.

Table 3 Summary of 2030 GHG Emissions Reductions from Strategies and Measures in Vista CAP

CAP Strategies	Federal and State Actions and CAP Measures	2030 Emissions Reduction (MT CO_2e)
1: Increase the Use of Zero-Emission or Alternative Fuel Vehicles	**CAP Measures**	
	T-1: Transition to a clean and more efficient municipal vehicle fleet	106
	T-2: Increase electric vehicle charging stations at public facilities	405
	T-3: Require electric vehicle charging stations at new multi-family and commercial developments	1,489
	Federal and State Actions	
	ST-1: Federal and California Vehicle Efficiency Standards	55,978
2: Reduce Vehicle Miles Traveled	**CAP Measures**	
	T-4: Participate in San Diego Association of Government's iCommute vanpool program	361
	T-5: Implement the City's Bicycle Master Plan	633
	T-6: Increase density and mixed-use development	278
3: Reduce Fossil Fuel Use	T-7: Require electric-powered or alternative fueled construction equipment	3,252
4: Increase Building Energy Efficiency	**CAP Measures**	
	E-1: Implement energy efficient projects in municipal facilities	45
	Federal and State Actions	
	SE-3: California energy efficiency programs	13,416
5: Increase Renewable and Zero-Carbon Energy	**CAP Measures**	
	E-2: Continue PV installation at municipal facilities	141
	E-3: Support Vista Unified School District's efforts to install PV systems	1,941
	E-4: Join program to increase grid-supply renewable and zero-carbon electricity	28,338
	Federal and State Actions	
	SE-1: California Renewables Portfolio Standard	62,972
	SE-2: California Solar Programs, Policies and 2019 Mandates	19,677
6: Reduce and Recycle Solid Waste	**CAP Measures**	
	W-1: Reduce solid waste disposal and increase recycling	13,898
7: Carbon Sequestration	C-1: Increase tree planting at municipal facilities and public rights-of-way	46
	C-2: Increase tree planting at new private properties	195
	Total Reduction from Federal and State Actions	152,043
	Total Reduction from CAP Measures	51,127
	Total Reduction (Federal, State and City) *	203,000

*The total emissions reduction in 2030 is rounded.
Energy Policy Initiatives Center 2019.

Figure 2 provides a visualization of the emissions trend for the CAP horizon year through 2030.



Energy Policy Initiatives Center, 2019

Figure 2 Vista GHG Emissions Trend (2012–2030)

In Figure 2, the BAU emissions projection is represented along the top of the graph. The green dots represent the target emissions levels in 2020 and 2030. In this case, the City meets both 2020 and 2030 targets with the federal and State actions, and local measures identified in the CAP. The colored wedges represent the reduction of each local CAP strategy and of federal and State actions. Each wedge represents the cumulative GHG reduction from each strategy, from when the strategy is initiated through 2030. Although implementation of Strategy 5 (Increase Renewable and Zero-Carbon Energy) would be initiated later than other strategies, it has the largest cumulative reduction potential and largest 2030 reduction potential among all CAP strategies. The grey area beneath the colored wedges represents the remaining emissions after all the actions have taken place.

4 BACKGROUND AND COMMON ASSUMPTIONS

Unless stated otherwise, all activity data and GHG emissions reported in this document are annual values for the calendar year, and all emission factors reported in this document are annual average values for the calendar year.

A set of common assumptions and sources was used to calculate potential emissions reductions for many of the measures included in the CAP. The following section provides assumptions that are applied to measures related to electricity, natural gas, and on-road transportation. Actions related to other categories do not have common assumptions. The detailed methods and data for each measure are provided in Sections 5 and 6.

4.1 Common Background Data

Table 4 presents a summary of common data used to estimate overall GHG emissions levels and the reduction estimates across several CAP measures.

Table 4 Common Data Used for the Vista CAP

Year	2012	2030
Population[4]	95,292	107,784
Labor Force[5]	43,300	54,750
Vehicle Miles Traveled (VMT) (annual miles)[6]	614,005,743	704,133,650
Electricity Gross Generation (GWh)[7]	544	643
VMT projections are based on the SANDAG Series 13 forecast. 2012 is the Series 13 Base Year. Data in 2012 are historical data and data in 2030 are the latest available forecasted data as of November 2018. Energy Policy Initiatives Center 2019.		

4.2 Common Assumptions and Methods for Calculating Electricity Emissions Reductions

The following overall assumptions and methods are used in the calculation of emissions reductions related to electricity, including from federal and State actions and CAP local measures. Details for the calculation of each action are provided in Sections 5 and 6.

4.2.1 GHG Emission Factor for Electricity

The GHG emission factor for electricity for a city, expressed in pounds of CO_2e per megawatt-hour (lbs CO_2e/MWh) is specific to the city and depends on the types of supply to the city. Therefore, for the purpose of estimating GHG reductions, the GHG emission factor for electricity in Vista is the weighted average emission factor of gross generation from three sources of supply: the utility (San Diego Gas & Electric (SDG&E) and other electric retail supplier), a local renewables and zero-carbon program, and behind-the-meter photovoltaic (PV) systems. This citywide emission factor is used to estimate the effects of State actions and local CAP measures that increase the grid-supply of renewable and zero-carbon electricity, and to estimate the impact of adding behind-the-meter PV systems and increasing building energy efficiency.

[4] The 2012 population is from SANDAG's Demographic & Socio-Economic Estimates (March 9, 2017 version). The population in 2030 is from SANDAG's Series 13 Regional Growth Forecast (Updated in October 2013). SANDAG Data Surfer, accessed on August 7, 2017. Series 13 has a base year of 2012. Projections from 2012 may differ from more recent estimates by the State, such as from the Department of Finance (DOF).
[5] The 2012 labor force is from the California Employment Development Department (EDD) Database, accessed on February 28, 2019. The 2030 labor force is based on the SANDAG Series 13 forecast for civilian jobs estimates in 2030, and the ratio of the 2012 labor force and 2012 SANDAG Series 13 civilian jobs estimate (2012 is the forecast base year). SANDAG's Series 13 Regional Growth Forecast (Updated in October 2013). SANDAG Data Surfer, accessed August 7, 2017.
[6] Based on SANDAG Series 13 Origin-Destination weekday VMT, provided by SANDAG (September 15, 2017). Weekday VMT were converted to annual VMT using the methods described in *Appendix A: City of Vista Greenhouse Gas Emissions Inventories and Projections* (EPIC, 2018).
[7] Gross generation is the sum of the forecasted utility electricity sales, electricity generated from behind-the-meter PV systems, additional load from electric vehicles (EVs) and transmission and distribution losses.

The citywide emission factor is calculated based on the percentage of renewable and zero-carbon content in, and the percentage of, gross generation from each source of supply as described below. This method is applied to 2016, the emissions projection starting year, as well as to each year included in the CAP horizon.[8] As the percentage of renewable and zero-carbon supply in the mix increases, the weighted average emission factor of electricity supply decreases.

4.2.1.1 Renewables Content in Supply from SDG&E and Other Electric Service Providers

SDG&E's power mix includes electricity generated from SDG&E's own power plants and electricity procured by SDG&E (both specified and unspecified sources), known as bundled power. As of 2016, SDG&E's bundled power mix is 43% renewable.[9] It is assumed that SDG&E and the electric retail suppliers of SDG&E's Direct Access customers will be at 60% renewable by 2030, as required by the Renewables Portfolio Standard (RPS) under SB 100 (de León) (Chapter 312, Statutes of 2016) .[10] The RPS mandate is discussed in Section 5.1.

4.2.1.2 Supply from Renewables and Zero-Carbon Program

Under CAP Measure E-4, the City would join program to increase grid-supply renewable and zero-carbon electricity. It is assumed that such a program would increase the renewable and zero-carbon electricity to 90% in 2030, or 30% beyond the current RPS mandate for that year.

The renewable and zero-carbon content of the program would affect the citywide weighted average emission factor. Because the RPS requires all of California's electricity retail suppliers to meet the RPS requirement, a portion of the emissions reduction from the program is attributed to RPS compliance as a reduction from State actions. The remaining portion of reduction, beyond the 60% in 2030, is attributed to the City under Measure E-4.

4.2.1.3 Renewables Supply from behind-the-meter PV Systems

Electricity generation from behind-the-meter PV systems in the city, including residential and non-residential PV systems, is considered part of the overall electricity supply. Electricity generation from PV is considered 100% zero-carbon (i.e., GHG-free). The State's solar policies and programs, the 2019 California Building Energy Efficiency Standards (Title 24, Part 6) residential PV mandates, and CAP Measure E-2 and E-3 all increase behind-the-meter PV systems in the city; they are discussed in Sections 6.5.1 and 6.5.2.

Considering behind-the-meter PV as a supply source that contributes to the citywide emission factor allows for calculating the effects of energy efficiency programs that may reduce behind-the-meter electricity use, or from additional EV charging load, which may come from behind-the-meter electricity sources and not just from grid supply.

4.2.1.4 Weighted Average GHG Emission Factor for Electricity

The weighted average GHG emission factor for electricity is based on the percentage of gross generation supplied by each of the previously referenced supplies, as well as the percentage of renewable or zero-carbon content in each supply.

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[8] The method to project emissions in 2030 is provided in the *Appendix A: City of Vista Greenhouse Gas Emissions Inventories and Projections* (EPIC, 2018).
[9] California Energy Commission: 2016 Power Content Label San Diego Gas & Electric.
[10] SB 100 (de León) California Renewables Portfolio Standard Program: emissions of greenhouse gases (2017–2018). The interim RPS targets are 44% by 2024 and 52% by 2027 from eligible renewable energy resources.

Table 5 shows the contribution from each supply to gross generation and its renewable content, as well as the overall citywide annual weighted average emission factors for 2016 and 2030.

Table 5 2016 and Projected 2030 GHG Emission Factor for Electricity in Vista

Year	Renewables and Zero-Carbon Program		Utility		Behind-the-meter PV		Overall Citywide	
	% of Gross Generation Supplied	Zero-Carbon Content in Supply	% of Gross Generation Supplied	Renewable Content in Supply	% of Gross Generation Supplied	Renewable Content in Supply	Citywide Renewable and Zero-Carbon Supply	Annual Electricity Emission Factor (lbs CO_2e/MWh)
2016	-	-	93%	43%	7%	100%	47%	487
2030	75%	90%	8%	60%	17%	100%	89%	99

2016 is the latest year with utility data available. The 2016 electricity emission factor is used for BAU emissions projections in future years, including 2030.
2030 data are projections under the CAP based on CAP assumptions, current status, and future impact of State policies and programs.
Energy Policy Initiatives Center 2019.

In 2016, SDG&E supplied 93% of the gross generation with 43% eligible renewable sources; behind-the-meter PV systems supplied the remainder. SDG&E's 2016 bundled emission factor was 525 lbs CO_2e/MWh, resulting in a citywide emission factor of 487 lbs CO_2e/MWh in 2016.[11]

In 2030, the projected electricity supply from behind-the-meter PV systems is estimated to be 17% of gross generation. To comply with the 2030 RPS target, the renewable content in SDG&E's supply will increase to 60%; this document assumes the utility's supply is fixed at the RPS mandate level to avoid overestimating the emissions reduction from the utility's renewable program. The renewables and zero-carbon program (CAP Measure E-4) is assumed to have 90% zero-carbon sources in 2030. Based on these supplies' contributions, the citywide annual weighted electricity emission factor in 2030 is projected to be 99 lbs CO_2e/MWh (89% renewable or zero-carbon).[12]

This annual weighted citywide electricity emission factor is used to calculate the GHG reductions from CAP measures that increase renewable and zero-carbon supply or reduce electricity use.

4.2.2 Allocation of GHG Emissions Reductions from Actions that Increase Renewables in Electricity to State Actions and Local CAP Measures

The projected citywide electricity emission factor is used to estimate the GHG emissions reductions from any action that increases the overall renewable and zero-carbon supply. The total reduction from State and local CAP actions to increase renewable and zero-carbon supply is given in Table 6; it is calculated using the projected gross generation in 2030 and the difference in the 2030 citywide emission factor and BAU emission factor.

[11] The SDG&E bundled emission factor is calculated by EPIC and reported in the SANDAG Regional Climate Planning Framework (ReCAP) Technical Appendix I, Table 6 (2018). The 2016 citywide emission factor is 525 lbs CO_2e/MWh*93%.
[12] Starting with SDG&E's 2016 bundled emission factor 525 lbs CO_2e/MWh (43% renewable), the projected 2030 utility emission factor is 368 lbs CO_2e/MWh (60% renewable) and the projected 2030 local program emission factor is 92 lbs CO_2e/MWh (90% renewable or zero-carbon). The 2030 citywide emission factor is then 92 lbs CO_2e/MWh*75% + 368 lbs CO_2e/MWh*8%.

Table 6 Emissions Reductions from All Actions Increasing Renewable and Zero-Carbon Supply in Vista

Year	Gross Generation (GWh)	BAU Projections		Projections with State and Local Actions Increasing Renewable and Zero-Carbon Supply		Emissions Reduction from Increased Renewable and Zero-Carbon Supply ($MT\ CO_2e$)
		BAU Electricity Emission Factor (lbs CO_2e/MWh)	BAU Emissions from Electricity ($MT\ CO_2e$)	Projected Electricity Emission Factor (lbs CO_2e/MWh)	Projected Emissions from Electricity ($MT\ CO_2e$)	
2030	643	487	142,015	99	28,947	113,068

The projections with increasing renewable and zero-carbon supply are based on CAP assumptions and State policies and programs.
Energy Policy Initiatives Center 2019.

The BAU emission factor for 2016 (Table 5) is kept constant through the year 2030, as opposed to using the emission factor for the 2012 baseline year, because the additional renewable content in SDG&E's supply and behind-the-meter PV supply in 2016 are already included in the BAU emissions projection.[13]

The total emissions reduction from increasing renewable and zero-carbon supply as calculated above (Table 6) is then allocated to each supply based on its renewable (or zero-carbon, if beyond the RPS mandate) contribution to the total citywide renewable content. This allocation and its impact on GHG reduction from each supply shown in Table 7.

Table 7 Allocation of Emissions Reductions to Supplies that Increase Renewable (or Zero-Carbon) Supply in Vista

Year	Electricity Supply	Total	Local Renewables and Zero-Carbon Program	Utility	Behind-the-meter PV
2030	% of Gross Generation Supplied by Renewables and Zero-Carbon Sources	89%	67%	5%	17%
	Emissions Reduction from Increased Renewables and Zero-Carbon Supply ($MT\ CO_2e$)	113,068	85,013	6,297	21,759

2030 data are the projections under the CAP, based on CAP assumptions and future impact of State policies and programs.
Energy Policy Initiatives Center 2019.

4.3 Common Assumptions and Methods for Calculating Natural Gas Emissions Reductions

The default emission factor of 0.0054 $MT\ CO_2e$ per therm is used for all years to estimate the emissions reductions for the CAP measures related to reducing natural gas (e.g., reduce natural gas use in buildings).

4.4 Common Assumptions and Methods for Calculating On-Road Transportation Emissions Reductions

The following assumptions and methods are used to calculate emissions reductions for strategies related to on-road transportation, including federal and State actions, and local CAP measures.

[13] The method to project emissions in 2030 is provided in the *Appendix A: City of Vista Greenhouse Gas Emissions Inventories and Projections* (EPIC, 2018).

4.4.1 GHG Emission Factor for On-Road Transportation

The GHG emission factor for on-road transportation, expressed in grams of CO_2e per mile (g CO_2e/mile), is used in several ways throughout the document. It is used to estimate the effect of State actions to increase the vehicle fuel standard, the impact of reduced VMT, and the effect of State and local actions to increase the miles driven by EVs.

The default outputs of the CARB's Mobile Source Emissions Factor model (EMFAC2014) are used to determine the average vehicle emission rates for the San Diego region.[14] The average vehicle emission rates for the San Diego region were used as proxies for Vista. The EMFAC2014 model outputs include all key federal and State regulations related to tailpipe GHG emissions reductions that were adopted before the model release date in 2015. The regulations embedded in the outputs are:

- For passenger cars and light-duty vehicles – Federal Corporate Average Fuel Economy (CAFE) standards and California Advanced Clean Car (ACC) Program[15]
- For heavy-duty vehicles (heavy-duty trucks, tractors, and buses) – U.S. Environmental Protection Agency's Phase-I GHG Regulation and CARB Tractor-Trailer GHG Regulation[16]

The Low Carbon Fuel Standard (LCFS), which requires a reduction of at least 10% in the carbon intensity of California's transportation fuels by 2020, is not included in the EMFAC2014 model because most of the emissions benefits come from the production aspect of the fuel cycle rather than the combustion cycle. Therefore, the LCFS does not have a significant impact on tailpipe GHG emissions reduction.[17]

Using the EMFAC2014 default output, the average vehicle emission rates (g CO_2/mile) are calculated based on the distribution of VMT for each vehicle class and its emission rate. The results are adjusted to convert from g CO_2/mile to g CO_2e/mile to account for total GHG emissions, including CO_2, CH_4, and N_2O.[18] The average vehicle emission rates (Table 8) are used to estimate the GHG emissions reduction impact of policies that increase vehicle efficiency and increase the number of ZEVs on the road.[19]

[14] CARB: Mobile Source Emissions Inventory. EMFAC2014 was the latest model available at the beginning of the CAP development process (early 2017). The latest model is EMFAC2017, released in March 2018.
[15] ACC program includes additional standards for vehicle model years 2017–2025, and the Zero-Emission Vehicle (ZEV) program requires manufacturers to produce increasing numbers of ZEVs and plug-in hybrid electric vehicles for 2017–2025 model year vehicles. CARB: EMFAC2014 Technical Documentation, Section 1.4 (v1.0.7 May 2017).
[16] EPA's Phase-I GHG regulation includes GHG emission standards for heavy-duty vehicle model years 2014–2018. CARB's Tractor-Trailer GHG Regulation includes the aerodynamic and tire improvements requirements to reduce GHG emissions from heavy-duty trucks. CARB: EMFAC2014 Technical Documentation, Section 1.4.
[17] CARB: EMFAC2014 Technical Documentation. Section 1.4. In the previous version of the Mobile Source Emissions Inventory model, EMFAC2011, the emissions effects of the LCSF were incorporated into the model output.
[18] The calculation and adjustment method are described in Section 4.1 of the *Appendix A: City of Vista Greenhouse Gas Emissions Inventories and Projections* (EPIC, 2018).
[19] EVs are ZEVs, however, ZEVs may include vehicles with other technologies such as fuel cell vehicles. EMFAC2014 only modeled the impact of EVs as ZEVs, therefore, in this document EVs and ZEVs are interchangeable.

Table 8 Average Vehicle Emission Rate in the San Diego Region

Year	Average Vehicle Emission Rate - with the Impact of all Adopted State and Federal Policies ($g\ CO_2e/mile$)
2016	446
2030	297
Based on CARB EMFAC2014 Model. The model includes all key federal and State regulations related to tailpipe GHG emissions reductions that were adopted before the model release date in 2015. CARB 2015, Energy Policy Initiatives Center 2019.	

The projected 2030 average vehicle emission rate in Table 8 is also used to estimate the emissions reduction from actions that reduce VMT (Section 6.2). Because vehicle efficiency improves and the population of ZEVs increases over time, the average vehicle emission rate decreases. Therefore, measures that reduce VMT offset decreasing amounts of GHG emissions throughout the CAP horizon.

4.4.2 GHG Emissions Reduction from Increasing Zero Emission Vehicles

CAP Measure T-2: Increase Electric Vehicle Charging Stations at Public Facilities and Measure T-3: Require Electric Vehicle Charging Stations at New Multi-family and Commercial Development assist the implementation of the State ZEV program that requires manufacturers to produce increasing numbers of ZEVs including battery electric vehicles (BEVs) and plug-in hybrid electric vehicles (PHEVs).

The total effect of the ZEV program in future years is estimated by comparing the emissions rate in the BAU projection with no additional policy impacts after 2016 (fixed 2016 ZEV penetration rate for the CAP horizon) and the emissions rate with the impact of the ZEV program (EMFAC2014's default ZEV penetration rate), as shown in Table 9.[20] The BAU projection is based on 2016, not the 2012 baseline year, to be consistent with the projection methodology in the electricity category. The additional 2016 model year vehicle fuel efficiency and ZEVs are already taken into consideration in the BAU emissions projection.

Table 9 Emissions Reduction from Increasing Miles Driven by Zero Emission Vehicles

Year	Projected VMT (annual million miles)	BAU Projection - With No Policy Impact after 2016		With Impact of Adopted ZEV Program		Total Emissions Reduction from ZEVs ($MT\ CO_2e$)
		BAU Average Vehicle Emission Rate ($g\ CO_2e/mile$)	BAU Emissions from On-Road Transportation ($MT\ CO_2e$)	Average Vehicle Emission Rate ($g\ CO_2e/mile$)	Emissions from On-Road Transportation ($MT\ CO_2e$)	
2030	704	379	266,739	361	253,947	12,792
The 2030 VMT projection is based on the SANDAG Series 13 Growth Forecast. The projected emission rates are based on future impact of State policies and programs used in the CARB EMFAC2014 model. Energy Policy Initiatives Center 2019.						

[20] The method to project emissions at 2020 and 2030 is provided in the *Appendix A: City of Vista Greenhouse Gas Emissions Inventories and Projections* (EPIC, 2018).

Portions of the total emissions reduction from ZEVs (12,792 MT CO_2e) are allocated to Measure T-2 and Measure T-3 in proportion to the Measures' contributions of EV miles. Table 10 provides the key assumptions and results of the allocation.

Table 10 Allocation of GHG Emissions Reduction from Increasing Zero Emission Vehicles

Year	Projected Miles Driven by EVs of Total VMT	Projected Miles Driven by EVs Due to (annual million miles)			Emissions Reduction from EVs Due to (MT CO_2e)		
		With Impact of Adopted ZEV Program	Measure T-2	Measure T-3	With Impact of Adopted ZEV Program	Measure T-2	Measure T-3
2030	7.6%	53.6	1.7	6.2	12,792	405	1,489

Measure T-2: Increase Electric Vehicle Charging Stations at Public Facilities and Measure T-3: Require Electric Vehicle Charging Stations at New Multi-family and Commercial Developments

Projected miles driven by EVs as percent of total VMT are based on the assumptions in the CARB EMFAC2014 model for the San Diego Region.
The emissions reduction from EVs is projected based on future impact of State policies and programs used in the CARB EMFAC2014 model and assumptions used for local CAP measures.
Energy Policy Initiatives Center 2019.

Based on the EMFAC2014 model assumptions, in 2030, 7.6% of all VMT in the San Diego region will be driven by EVs, equivalent to 53.6 million miles in Vista. The EVCS added under Measure T-3 would result in about an additional 1.7 million EV miles in 2030. Therefore, 3% (the ratio of 1.7 million miles to 53.6 million miles) of emissions reduction from the ZEV program is allocated to Measure T-3. The emissions reduction from the other CAP measure is allocated using the same method.

5 FEDERAL AND STATE ACTIONS

Federal and State actions are expected to reduce emissions significantly over the CAP horizon. This section provides a summary of the methods used to estimate the emissions reductions associated with the following federal and State actions to increase renewable electricity, building energy efficiency, and clean and efficient transportation.

- SE-1: California Renewables Portfolio Standard
- SE-2: California Solar Programs, Policies and 2019 Mandates
- SE-3: California Energy Efficiency Programs
- ST-1: Federal and California Vehicle Efficiency Standards

5.1 SE-1: California Renewables Portfolio Standard

SB 100, the 100 Percent Clean Energy Act of 2018, approved by Governor Brown in September 2018, adopts a 60% RPS for all of California's retail electricity suppliers by 2030; this increases the current RPS standard from 50% to 60%. The legislation also provides goals for intervening years before 2030 and establishes a State policy requiring that "zero-carbon" resources supply 100% of all retail electricity sales to end-user customers and all State agencies by December 31, 2045.[21] The SB 100 renewable and zero-carbon targets are shown in Figure 3 below.

[21] SB 100 (de León): California Renewables Portfolio Standard Program: emissions of greenhouse gases (2017–2018). The interim RPS targets are 44% by 2024 and 52% by 2027 from eligible renewable energy resources.

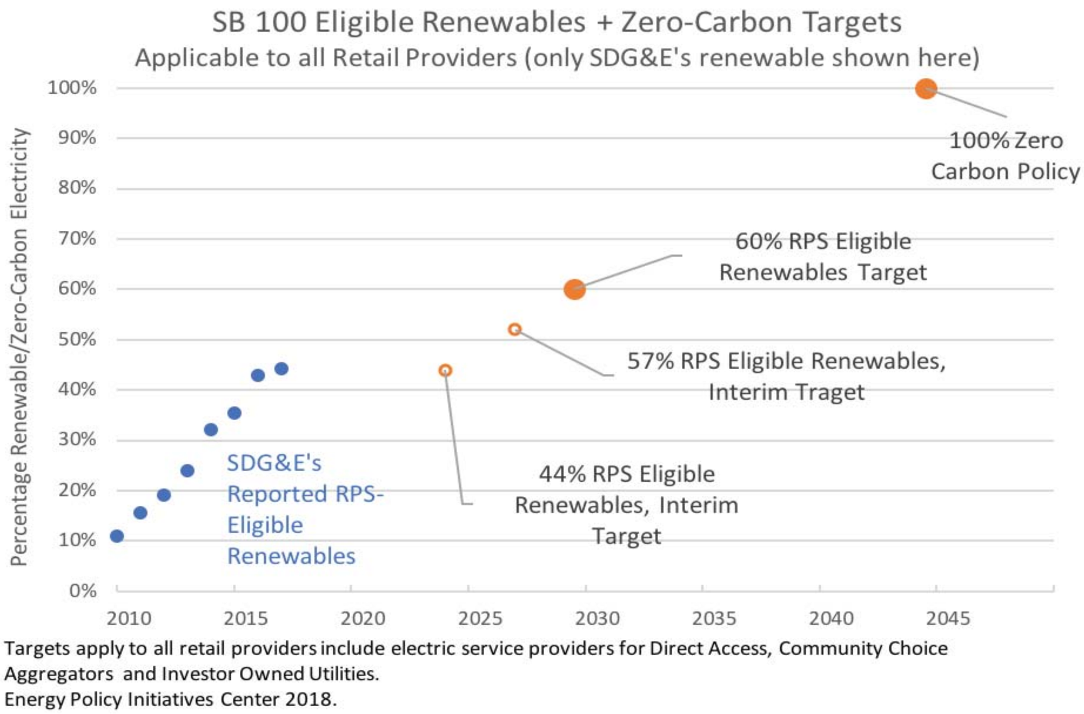


Figure 3 SB 100 Renewables and Zero-Carbon Targets

All retail electricity suppliers are required to meet the State's RPS requirements, including SDG&E, electric service suppliers for SDG&E's Direct Access (DA) customers, and any other renewables and zero-carbon programs. In this document, a conservative approach is taken that assumes all providers for utility customers, including electricity sales to DA customers, will meet the RPS requirements for 2030 and not go beyond. Under this assumption, all emissions reduction from a utility reaching 60% renewables is due to RPS requirement.

For the renewables and zero-carbon program considered under Measure E-4, the target is to reach 90% zero-carbon by 2030. A portion of the emissions reduction from the program will be attributed to RPS compliance, and the remaining reduction will be attributed to E-4, as described in Section 6.5.3. Table 11 shows results from SE-1 only.

Table 11 Electricity Suppliers and Projected 2030 Emissions Reduction from SE-1: California Renewables Portfolio Standard

Year	(a) RPS-Related Emissions Reduction from the Utility* (MT CO_2e)	(b) RPS-Related Emissions Reduction from Renewables and Zero-Carbon Program Under Measure E-4 (MT CO_2e)	(a + b) All RPS-Related Emissions Reductions (MT CO_2e)
2030	6,297	56,675	62,972

*Includes utility and electricity suppliers of utility's Direct Access customers.
2030 data are projections under the CAP based on current status, future impact of State policies and programs, and local CAP measures.
Energy Policy Initiatives Center 2019.

5.2 SE-2: California Solar Programs, Policies and 2019 Mandates

5.2.1 Solar Policies and Programs

California has several policies and programs to encourage customer-owned, behind-the-meter PV systems, including the California Solar Initiatives, New Solar Home Partnership, Net Energy Metering, and electricity rate structures designed for solar customers.

The latest California Energy Demand 2018–2030 Revised Forecast, developed by the California Energy Commission (CEC), has projections for behind-the-meter PV generation in the SDG&E planning area through 2030.[22] The demand forecast provides three scenarios: the high demand case, mid demand case and low demand case. The PV projection from 2018–2030 in the SDG&E planning area mid demand case forecast is used to project the PV generation in Vista.[23]

The California Distributed Generation (DG) Statistics database includes capacities of behind-the-meter PV systems interconnected in a jurisdiction in a given year for each of the three Investor Owned Utility (IOUs) planning areas, including SDG&E. The DG Statistics provide detailed information about the behind-the-meter PV systems installed in a jurisdiction from the start year of incentive programs through the current year. This provides a historical record used to determine the capacity in GHG inventory years and can also help determine trends in PV installation.

A comparison of the estimated capacity and electricity generation from PV systems in Vista and in the SDG&E planning area are given in Table 12.[24] The SDG&E planning area estimates are used for PV projections for the city, as described below.

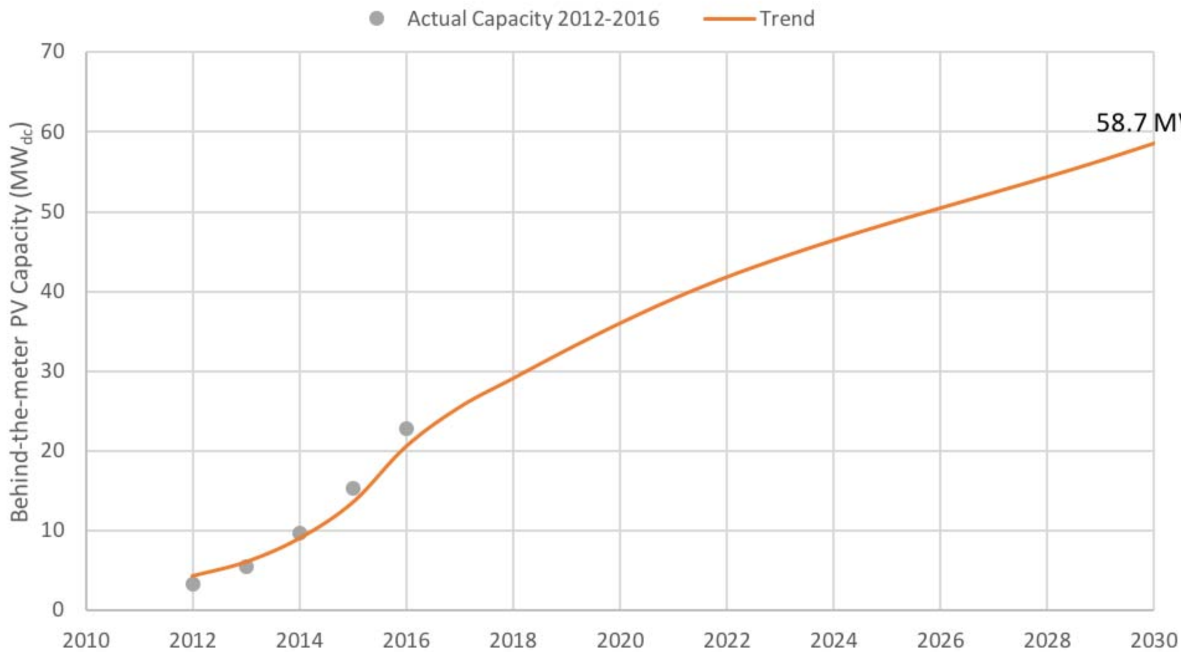
[22] Kavalec et al., 2018. California Energy Demand 2018 — 2030 Revised Forecast. CEC, Electricity Assessments Division. Publication Number: CEC-200-2018-002-CMF, accessed July 11, 2018. SDG&E planning area is larger than San Diego region.
[23] Kavalec et al., 2018. Mid Case Revised Demand Forecast (February 2018). CEC, Electricity Assessments Division. Publication Number: CEC-200-2018-002-CMF, accessed July 11, 2018.
[24] The capacity of all interconnected PV systems in Vista are from the California Distributed Generation Statistics NEM Currently Interconnected Data Set (current as of May 31, 2017), download date: September 12, 2017.

Table 12 Behind-the-meter PV Capacity and Estimated Electricity Generation

Year	Vista*		SDG&E Planning Area**	Historical Ratio of Electricity Generation from PV (Vista to SDG&E)
	PV Capacity (MW)	Estimated Electricity Generation (GWh)	Estimated Electricity Generation (GWh)	
2012	3.4	5.9	238	2.5%
2013	5.6	9.7	335	2.9%
2014	9.8	17.1	496	3.4%
2015	15.4	26.9	744	3.6%
2016	22.8	40.0	1,129	3.5%
			Average	3.2%

*Estimated electricity generation based on PV capacity and 20% capacity factor
**California Energy Demand 2018–2030 Revised Forecast mid demand case (February 2018 version)
California Distributed Generation Statistics 2017, CEC 2018, Energy Policy Initiatives Center 2019.

For future years, the electricity generation and capacity of behind-the-meter PV systems in the city are estimated based on the PV generation in CEC's mid case forecast for SDG&E's planning area, and the average ratio of PV generation in the city to that of SDG&E's planning area from 2012–2016 (3.5%). Because of California's solar programs and policies, the estimated PV capacity in 2030 in Vista is projected to be 58.7 megawatts (MW), with 103 gigawatt hours (GWh) electricity generation. The trend of behind-the-meter PV in the city is shown in Figure 4.



2012 to 2016 histicial PV capacity is based on California Distributed Generation Statistics, 2017.
Trend based on California Energy Demand 2018-2030 Revised Forecast in SDG&E planning area, mid-demand scenario (Feburary 2018 version).
The forecat does not incldue the additional PV installation due to 2019 Title 24 Building Standard PV mandates or local CAP measures.
Energy Policy Initiatives Center, 2018.

Figure 4 Behind-the-meter PV Trend in Vista (2012–2030)

5.2.2 2019 Building Energy Efficiency Standards PV Mandates

The new California 2019 Building Energy Efficiency Standards, which go into effect on January 1, 2020, require all newly constructed single-family homes, low-rise multi-family homes, and detached accessory dwelling units (ADUs) to have PV systems installed, unless the building receives an exception.[25]

The SANDAG Series 13 Forecast assumes that approximately 300 new single-family homes and 2,800 new multi-family homes will be added in Vista from 2020 to 2030.[26] For this CAP, it is assumed that all new single-family homes will have PV systems installed and 90% multi-family homes will be low-rise and, therefore, also required to have PV systems.[27] For the PV system size requirement of each housing unit type, the minimum qualified size required by the 2019 Building Energy Efficiency Standards is calculated based on its average size, as shown in Table 13.[28]

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[25] CEC: 2019 Building Energy Efficiency Standards – 2019 Residential Compliance Manual (December 2018). For the requirements on newly constructed single-family and low-rise multi-family homes, see Section 7.2 Prescriptive Requirements for Photovoltaic System. For the requirements on newly constructed and detached ADU, see Section 9.3.5 Accessory Dwelling Units (ADUs).
[26] SANDAG Series 13 Regional Growth Forecast (October 2013). SANDAG Data Surfer, accessed on October 24, 2017.
[27] The assumption for multi-family buildings is based on the current status and confirmed by City staff, from 2016–2018, 90% of the new multi-family buildings built in the city are three stories or fewer.
[28] Multi-family unit size is based on new developments in the city. The unit size of Vista Palomar (town homes) and Vista Melrose multi-family projects in the city were used. The average size of apartments in the projects are estimated based on the total conditional floor areas and the total number of dwelling units.

Table 13 Estimated PV Requirement for New Homes after 2020 in Vista

Housing Unit Type	Average Size of Unit (sq. ft.)*	Minimum PV Required for the Unit Size (kW_{dc})**
Single-family	2,500	2.5
Multi-family	1,500	2.0
* For single-family, the size is based on a prototype home. For multi-family, the average size is based on the average unit size of new multi-family development projects in Vista. ** Calculated based on unit size (sq. ft.) and 2019 Building Energy Efficiency Standards Residential Compliance Manual Equation 7-1 and Table 7-1. Vista is in Climate Zone 7. Energy Policy Initiatives Center 2019.		

It is assumed that 20% of the new homes would be exempt for other reasons and consistent with the assumptions in the CEC additional achievable PV forecast mid-case scenario.[29] The Energy Demand 2018–2030 Revised Forecast already assumes that a certain percentage of new single-family homes will install PV systems even without the mandates; therefore, the result of the PV mandate is assumed to be the additional installation beyond the baseline assumption for single-family PV installation. The numbers of new homes with PV systems as a result of the PV mandate, as well as the estimated system capacity, are given in Table 14. The numbers of new homes with PV systems and capacity are those added between 2020 and 2030.

Table 14 New Homes with PV Systems after 2020 in Vista

Year	New Single-family Homes after 2020 with PV Systems due to State Mandates		New Multi-family Homes after 2020 with PV Systems due to State Mandates		All New Homes after 2020 with PV Systems due to State Mandates	
	Number of Additional Homes with PV Systems	PV System Capacity (kW)	Number of Homes with PV Systems	PV System Capacity (kW)	PV System Capacity (MW)	Estimated Electricity Generation (MWh)
2030	165	412	2,002	4,003	4.4	7,735
PV system capacity is the additional capacity in 2030 from all systems added to new homes after 2020 as a result of PV mandates. The capacity does not include existing PV, PV installation at new single-family homes already shown in the projection in Figure 4, or PV added on other new non-residential projects. Energy Policy Initiatives Center 2019.						

5.2.3 All Solar Policies, Programs and Mandates

The California Energy Demand 2018–2030 Revised Forecast, discussed in Section 5.2.1, does not include the additional impact of the 2019 PV mandates; therefore, the PV installation trend shown in Figure 4 does not include the additional 4.4 MW PV capacity from new homes after 2020.[30] The total estimated PV capacity in Vista resulting from California solar policies, programs, and PV mandates is projected to be 63 MW (the sum of 58.7 MW and 4.4 MW).

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[29] This approach is consistent with the CEC's additional achievable PV forecast mid-case scenario for single-family homes. CEC's forecasts do not model the impact of PV mandates on low-rise multi-family homes. Personal communication with CEC staff, December 14, 2018.

[30] The 2018–2030 Revised Forecast assumes a percentage of new single-family homes will install PV systems without the mandates. The 2020–2030 percentages vary by year. However, it does not model the impact of PV mandates on low-rise multi-family homes. Personal communication with CEC staff, December 14, 2018.

Through CAP Measure E-2, the City aims to complete PV installation at city facilities and identify additional PV opportunities, and through CAP Measure E-3, the City would support the Vista Unified School District (VUSD)'s PV installation. The impact of these two measures is assumed to be part of the statewide effort and is therefore included in the Energy Demand Forecast (included in 58.7 MW).

The emissions reductions from all State and CAP measures that increase behind-the-meter renewable supply is 21,759 MT CO_2e as given in Table 7 (Allocation of Emissions Reductions to Supplies that Increase Renewable (or Zero-Carbon) Supply in Vista). The total reduction is allocated based on estimated capacity (MW) that would result from each action. As shown in Table 15, GHG emissions reductions are the projected reduction amounts in the year 2030 only.

Table 15 Key Assumptions and Results for California Solar Policies, Programs and Mandates

Year	State or City Action	Total	Measure E-2	Measure E-3	California Solar Polices, Programs, and Mandates*
2030	Projected Behind-the-meter PV Capacity (MW)	63	0.4	5.6	57
	Projected Emissions Reduction (MT CO_2e)	21,759	141	1,941	19,677

CAP Measure E-2: Continue PV Installation at Municipal Facilities and Measure E-3: Support the Vista Unified School District's Efforts to Install PV Systems
*Solar policies, programs and mandates include the impact of the PV mandates from the 2019 Building Energy Efficiency Standard.
The projected capacity and emissions reductions are projected based on CAP assumptions, current status, and future impact of State policies and programs.
Energy Policy Initiatives Center 2019.

In 2030, 90% (57 MW out of 63 MW) of the projected citywide PV capacity will be due to State polices, programs, and mandates; therefore, 90% of the total emissions reduction from increasing behind-the-meter PV (21,759 MT CO_2e) is allocated to this State action (19,677 MT CO_2e).

5.3 SE-3: California Energy Efficiency Program

In September 2017, the California Public Utilities Commission (CPUC) adopted energy efficiency goals for ratepayer-funded energy efficiency programs, to begin in 2018 (Decision 17-09-025). The adopted energy saving goals for SDG&E's service territory are given in the Decision on an annual basis from 2018 to 2030.[31] The sources of the energy savings include, but are not limited to, rebated technologies, building retrofits, behavior-based initiatives, and codes and standards.[32]

To evaluate the impact of the energy efficiency program to Vista, the total energy savings in SDG&E's service territory by 2030 are allocated to the city using a ratio of the city's natural gas and electricity demand to those of SDG&E's entire service territory. In the past few years, the ratios have been 2.5% for

[31] CPUC: Decision 17-09-025, Adopting Energy Efficiency Goals for 2018–2030, accessed December 12, 2018. SDG&E's electricity service territory is larger than San Diego region.
[32] Navigant Consulting: Energy Efficiency Potential and Goals Study for 2018 and Beyond (August 2017), accessed December 12, 2018. Rebated technologies are the energy efficiency technologies from the utility's historic incentive programs, including equipment and retrofits.

electricity and 3% for natural gas.[33] SDG&E's service territory electricity and natural gas savings were allocated accordingly to Vista, as shown in Table 16.[34]

Table 16 Estimated Energy Savings from California Energy Efficiency Program

Year	Electricity Savings (GWh)		Natural Gas Savings (MM Therms)	
	SDG&E Service Territory	Allocation of Savings to Vista	SDG&E Service Territory	Allocation of Savings to Vista
2030	3,328	82	60	1.8
SDG&E service territory savings are the cumulative savings after 2018 based on the 2018–2030 annual saving goals in CPUC Decision 17-09-025. Energy Policy Initiatives Center 2019.				

Emissions reductions from electricity savings are calculated by multiplying the electricity savings by the GHG emission factor for electricity, discussed in Section 4.2.1 (GHG Emission Factor for Electricity) and shown in Table 5 (2016 and Projected 2030 GHG Emission Factor for Electricity in Vista). As the renewable and zero-carbon content in electricity increases, the emissions reduction from the electricity portion of the energy efficiency program decreases accordingly. Similarly, emissions reductions from natural gas savings were calculated using the natural gas savings amount and natural gas emission factor. Table 17 summarizes the energy savings and GHG emissions reductions in year 2030 only.

Table 17 Estimated Emission Reductions from California Energy Efficiency Programs

Year	Electricity Savings			Natural Gas Savings			Total Emissions Reduction (MT CO_2e)
	Electricity Savings (GWh)	Emission Factor (lbs CO_2e/MWh)	GHG Reduction from Electricity Savings (MT CO_2e)	Natural Gas Savings (MM therms)	Emission Factor (MT CO_2e/therm)	GHG Reduction from Natural Gas Savings (MT CO_2e)	
2030	82	99	3,670	1.8	0.0054	9,792	13,461
The emissions reductions are projected based on CAP assumptions and future impact of State policies and programs. Energy Policy Initiatives Center 2019.							

It is likely that CAP Measure E-1: would be associated with SE-3 For example, the City would perform energy audits and receive the energy retrofit incentives offered by SDG&E's energy efficiency programs. The SDG&E programs, while mandated by a State requirement, are carried out at the local level and therefore allocated to the local actions. To avoid double-counting, the emissions reduction from Measure E-1 is subtracted from the emissions reduction from the State measure provided in Table 17. The revised GHG emissions reduction from SE-3 is given in Table 18.

[33] SDG&E's service territory demand is from California Energy Demand 2018–2030 Revised Forecast, SDG&E's planning area load 2014–2016. 2016 is the latest year with historical data in the demand forecast. Electricity and natural gas demand in Vista were provided to EPIC by SDG&E for the GHG inventory. *Appendix A: City of Vista Greenhouse Gas Emissions Inventory and Projection* (EPIC, 2018).

[34] CPUC: Decision 17-09-025, Adopting Energy Efficiency Goals for 2018–2030, accessed December 12, 2018. The 2018 and beyond goals are given on an annual basis for each year from 2018 to 2030, different from previous studies, in which the cumulative goals are given. The cumulative savings in 2030 from 2018 are the sum of the annual savings.

Table 18 Revised Emission Reduction from SE-3: California Energy Efficiency Program

Year	State or City Action	Emissions Reduction (MT CO_2e)
2030	SE-3: California Energy Efficiency Program	13,461
	Measure E-1: Implement Energy Efficient Projects in Municipal Facilities	45
	Revised SE-3: California Energy Efficiency Program	13,416

The emissions reductions are projected based on CAP assumptions and future impact of State policies and programs.
Energy Policy Initiatives Center 2019.

5.4 ST-1: Federal and California Vehicle Efficiency Standards

As discussed in Section 4.4 (Common Assumptions and Methods for Calculating On-Road Transportation Emissions Reductions), CARB's EMFAC2014 model includes all key federal and State regulations related to tailpipe GHG emissions reductions for both light-duty and heavy-duty vehicles that were adopted before the model release date in 2015.

Table 19 shows a comparison of the average vehicle emission rate and emissions from on-road transportation under the BAU projection, as well as with the impact of policies that increase vehicle efficiency and ZEVs. As discussed in Section 4.4.2 (GHG Emissions Reduction from Increasing Zero Emission Vehicles), to avoid double-counting, the maximum emissions related to all measures in the CAP that increase miles driven by ZEVs are set at the amount expected from statewide programs and policies.

The effect of Measure T-2: Increase Electric Vehicle Charging Stations at Public Facilities and Measure T-3: Require Electric Vehicle Charging Stations at New Multi-family and Commercial Developments are subtracted from the emissions reductions from State policies. Table 19 summarizes the key assumptions and results. The GHG emissions reduction is the projected reduction amount in the year 2030 only.

Table 19 Key Assumptions and Results for Federal and California Vehicle Efficiency Standards

Year	Projected VMT (annual million miles)	BAU Projection - With No Policy Impact after 2016		With Impact of Adopted Statewide Policies		Emissions Reduction (MT CO_2e)		
		Average Vehicle Emission Rate (g CO_2e/mile)	Emissions from On-Road Transportation (MT CO_2e)	Average Vehicle Emission Rate (g CO_2e/mile)	Emissions from On-Road Transportation (MT CO_2e)	With Impact of Adopted Statewide Policies	From CAP Measure T-2 and T-3	Remaining ST-1
2030	704	379	266,739	297	208,868	57,871	1,893	55,978

Measure T-2: Increase Electric Vehicle Charging Stations at Public Facilities and Measure T-3: Require Electric Vehicle Charging Stations at New Multi-family and Commercial Development
The 2030 VMT projections are based on SANDAG's Series 13 Growth Forecast. The emission rates and emissions reductions are projected based on CAP assumptions and future impact of State policies and programs used in the CARB EMFAC2014 model.
Energy Policy Initiatives Center 2019.

6 CAP STRATEGIES AND MEASURES

The following section describes the methods used to estimate the GHG reductions from local CAP measures and actions, which are organized into the following seven strategies:[35]

- Strategy 1: Increase the Use of Zero-Emission or Alternative Fuel Vehicles (T)
- Strategy 2: Reduce Vehicle Miles Traveled (T)
- Strategy 3: Reduce Fossil Fuel Use (T)
- Strategy 4: Increase Building Energy Efficiency (E)
- Strategy 5: Increase Renewable and Zero-Carbon Energy (E)
- Strategy 6: Reduce and Recycle Solid Waste (W)
- Strategy 7: Carbon Sequestration (C)

6.1 Strategy 1: Increase the Use of Zero-Emission or Alternative Fuel Vehicles (T)

The goal of this strategy is to reduce on-road transportation fossil fuel use by increasing the use of zero-emission or alternative fuel vehicles citywide through the following measures.

6.1.1 Measure T-1: Transition to a Clean and More Efficient Municipal Vehicle Fleet

When non-public safety vehicles are scheduled for replacement, the City will replace light-duty vehicles and trucks with alternative fuel vehicles, including EVs and PHEVs.

Based on the City draft energy management plan's alternative fuels fleet assessment, there are a total of 47 vehicles that could be replaced with EVs or PHEVs. The potential replacement vehicles include sedans, sport utility vehicles (SUVs) and pick-up trucks that have suitable plug-in replacement options. The potential vehicles identified are gasoline vehicles only. Fire equipment, construction equipment, specialty medium-/heavy-duty vehicles, and diesel-powered vehicles were not included in the assessment.[36]

The potential gasoline fuel saving is approximately 13,000 gallons a year. The vehicles identified and the replacement vehicle types are provided in Appendix A.

The vehicles will be replaced by EVs, PHEVs of a similar size, or electric pickups, and the gasoline fuel savings are approximately 34% of the current municipal fleet gasoline use.[37] The GHG emissions reduction in 2030 from this change, but with the same vehicle usage as at present, is shown in Table 20.[38]

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[35] Transportation (T), Energy (E), Waste (W) and Carbon Sequestration (C).
[36] Draft Vista Energy Management Plan ("Energy Roadmap") were provided by SANDAG (July 2019).
[37] Annual municipal fleet gasoline use is estimated at 38,834 gallons, based on the vehicle fuel use data provided by City (March 2018).
[38] Gasoline carbon content based on estimates from U.S. Energy Information Administration. Frequently Asked Questions, accessed on October 24, 2018.

Table 20 Key Assumptions and Results for Measure T-1: Transition to a Clean and More Efficient Municipal Vehicle Fleet

Year	Gasoline Reduction (gallons)	Gasoline Carbon Content* (lbs CO_2/gallon)	GHG Emission Reduction (MT CO_2e)
2030	13,000	17.8	106

*Assume gasoline blend is 10% ethanol.
The gasoline reduction and emissions reduction are the projections based on CAP assumptions.
Energy Policy Initiatives Center 2019.

6.1.2 Measure T-2: Increase Electric Vehicle Charging Stations at Public Facilities

The City currently has two electric vehicle charging stations (EVCSs) installed downtown and is building infrastructure to support additional EVCSs in the downtown area and at the Civic Center. The City plans to install a total of 20 EVCSs at city-owned facilities by 2030, which will be available for public EV charging use.

For the EVCSs, it is assumed that Level 2, or better, chargers will be installed and the chargers will be available for use daily with approximately six hours of charging a day per charger.[39] The EV miles resulting from the EVCSs are estimated based on a Level 2 charger's charging capacity, EV drive efficiency, and hours in use, as shown in Table 21.[40] On average, it is assumed that 85,000 EV miles per year are from charging at a public EVCS.

Table 21 Electric Vehicle Charging Efficiency by Level 2 Charger Type

Type of Charging (Level 2)	Capacity (kW)*	Hours in Use per Day	EV load (kWh/day)	Vehicle Drive Efficiency (kWh/mile) **	EV miles per Day of Charge	EV miles per Year per Municipal EVCS
Low	3.3	6	20	0.25	79	28,908
Medium	6.6	6	40	0.25	158	57,816
High	9.6	6	58	0.25	230	84,096
Highest	19.2	6	115	0.25	461	168,192
					Average	84,753

*Based on Electric Vehicle Charging Station Installation Best Practice, Center for Sustainable Energy, 2016.
**Based on CEC Plug-in Electric Vehicle Infrastructure Projections: 2017–2025 vehicle driven efficiency assumptions.
Assume chargers are used daily (365 days per year).
Energy Policy Initiatives Center 2019.

Measure T-2's GHG emissions reduction is estimated based on the ratio of projected EV miles due to the measure to the total EV miles from EMFAC2014 model estimates, as discussed in Section 4.4.2 (GHG Emissions Reduction from Increasing Zero Emission Vehicles) and shown in Table 10 (Allocation of GHG Emissions Reduction from Increasing Zero Emission Vehicles). It is assumed that all EV miles driven by

[39] Idaho National Laboratory: Plugged In: How Americans Charge Their Electric Vehicles. Based on the study, public Level 2 charging stations at parking lots and garages serving multiple venues have the potential to support 7 to 11 chargers per day. The estimated number of charging hours is based on this potential and the minimum vehicle dwell time of 30 minutes.

[40] The Level 2 charger capacity range comes from the Center for Sustainable Energy: Electric Vehicle Charging Station Installation Best Practice (June 2016). The vehicle drive efficiency assumption is based on Bedir et al., 2018. California Plug-In Electric Vehicle Infrastructure Projections: 2017–2025. CEC. Publication Number: CEC-600-2018-001.

City employees and residents are within the city. The number of EVCSs, projected EV miles, and GHG emissions reduction in 2030 are shown in Table 22.

Table 22 Key Assumptions and Results for Measure T-2: Increase Electric Vehicle Charging Stations at Public Facilities

Year	Number of Public EVCSs	EV Miles Charged at Public EVCSs	Emissions Reduction (MT CO_2e)
2030	20	1,695,060	405
The emissions reduction is projected based on CAP assumptions and future impact of State policies and programs used in the CARB EMFAC2014 model. Energy Policy Initiatives Center 2019.			

6.1.3 Measure T-3: Require Electric Vehicle Charging Stations at New Multi-family and Commercial Developments

To facilitate the increasing demand of EV infrastructure at commercial developments and multi-family homes, the City will require the following at new developments: 1) require new multi-family developments to install EVCSs at 3% of total parking spaces, and 2) require new commercial developments to install EVCSs at 6% of total parking spaces. The estimated starting year of requirements is 2021.

Over the past few years, an average of 50,000 sq. ft. of new commercial development that might be subject to the requirement was added every year. Assuming that this trend continues, approximately 50,000 sq. ft. of new commercial development per year will be subject to the requirement after 2021.[41] The Vista Development Code off-street parking requirements have approximately one parking space required per 250 sq. ft. gross floor area; therefore, 200 parking spaces will be added every year at these new commercial developments.[42] Similar to the public EVCSs, it is assumed that Level 2 chargers will be installed, and at new commercial developments the charging profile would be similar to those described in Table 21. On average, 85,000 EV miles per year are estimated to be charged at commercial EVCSs. The estimated number of new EVCSs and EV miles are shown in Table 23.

[41] The average annual new commercial development sq. ft. is calculated based on the average of new sq. ft. added annually from 2015 to 2017 (23,000 sq. ft. in 2015, 75,000 sq. ft. in 2016, and 19,000 sq. ft. in 2017) based on the data provided by the City for CEQA screening level development (November 2018). The sq. ft. is new gross floor area added each year and does not include the sq. ft. added for energy storage and self-storage projects, that are unlikely to be subject to the requirement.
[42] Vista Development Code: Section 18.54 Off-street Parking & Loading Requirements, accessed on March 27, 2018. The minimum parking requirements are different for retail, offices, restaurants and hotels, in general they are 4 or 5 spaces required for 1,000 sq. ft. gross floor area. The average is used here.

Table 23 Assumptions for Commercial New Electric Vehicle Charging Stations under Measure T-3: Require Electric Vehicle Charging Stations at New Multi-family and Commercial Development

Year	New Annual Commercial Development Space Added after 2021* (sq. ft. per year)	Total Number of New Parking Spaces at Commercial Developments after 2021	% of Parking Spaces with EVCSs	Number of NEW EVCSs after 2021	Annual EV Miles Charged at the EVCSs (miles per year)	Annual Vista EV Miles due to the EVCS** (miles per year)
2030	50,000	2,000	6%	108	9,153,324	4,942,795

*New gross floor area. Based on recent years' new development data.
**54% of all EV miles are allocated to Vista based on Origin-Destination VMT allocation methods, assuming trips driven by EVs will have at least one trip-end within Vista.
The number of parking spaces is based on Vista off-street parking requirements and assumes 10% of new commercial development would qualify for exemption of the requirement. The projections are based on the current status and CAP assumptions.
Energy Policy Initiatives Center 2019.

For multi-family development in the city, SANDAG Series 13 projects that 2,800 new multi-family units will be added from 2021 to 2030.[43] The Vista Development Code off-street parking requirements have approximately 2.5 parking spaces for each multi-family unit; therefore, 200 parking spaces will be added every year at these new multi-family developments.[44] At new multi-family developments, the EVCSs will be used to charge the residents' personal EVs. Based on the EMFAC2014 model, approximately 35 miles per day are driven by EVs in the San Diego region.[45] The estimated number of new EVCSs and EV miles are shown in Table 24.

Table 24 Assumptions for Multi-family New Electric Vehicle Charging Stations under Measure T-3: Require Electric Vehicle Charging Stations at New Multi-family and Commercial Development

Year	Number of New Multi-Family Units after 2021*	Number of New Parking Spaces at Multi-Family Developments after 2021	% of Parking Spaces with EVCS	Number of NEW EVCSs after 2021	Annual EV Miles Charged at the EVCSs (miles per year)	Annual Vista EV Miles due to the EVCS** (miles per year)
2030	2,780	6,950	3%	188	2,397,229	1,294,504

*Based on SANDAG Series 13 Regional Growth Forecast.
**54% of all EV miles are allocated to Vista based on Origin-Destination VMT allocation methods, assuming trips driven by EVs will have at least one trip-end within Vista.
The number of parking spaces is based on Vista off-street parking requirements and assumes 10% of new multi-family development would qualify for exemption of the requirement. The projections are based on the current status and CAP assumptions.
Energy Policy Initiatives Center 2019.

The GHG emissions reduction from this measure is estimated based on the ratio of projected EV miles due to this measure to the total EV miles from EMFAC2014 model estimates, as discussed in Section 4.4.2 (GHG Emissions Reduction from Increasing Zero Emission Vehicles) and shown in Table 10 (Allocation of GHG Emissions Reduction from Increasing Zero Emission Vehicles). The total number of parking spaces with EVCSs, projected EV miles, and GHG emissions reductions are shown in Table 25.

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[43] SANDAG Series 13 Regional Growth Forecast (October 2013). SANDAG Data Surfer, accessed August 7, 2017. The annual new multi-family units added are estimated using linear interpolation between 2020 and 2030.
[44] Vista Development Code: Section 18.54 Off-street Parking & Loading Requirements, accessed on March 27, 2018. The minimum parking requirements are different for studio, 1-bedroom, 2-bedroom and 3+ bedroom, the average is used here.
[45] CARB: Mobile Source Emissions Inventory. EMFAC2014 San Diego County 2020–2030 estimates.

Commercial EVCSs provide greater EV miles due to more frequent use compared with multi-family homes. The GHG emissions reduction is the projected reduction amount in 2030 only.

Table 25 Key Assumptions and Results for Measure T-3: Require Electric Vehicle Charging Stations at New Multi-family and Commercial Development

New Development Type	Projected Number of EVCSs in 2030	Annual Vista EV Miles due to the EVCSs in 2030 (miles per year)	2030 Emissions Reduction (MT CO_2e)
Multi-Family	188	1,294,504	309
Commercial	108	4,942,795	1,180
		Total	1,489
The emissions reduction is projected based on CAP assumptions, current status, and future impact of State policies and programs used in the CARB EMFAC2014 model. Energy Policy Initiatives Center 2019.			

6.2 Strategy 2: Reduce Vehicle Miles Traveled (T)

The goal of this strategy is to reduce the labor force commute VMT citywide by increasing alternative modes of transportation and to reduce household VMT by increasing density and destination accessibility.

6.2.1 Measure T-4: Participate in the San Diego Association of Government's iCommute Vanpool Program

San Diego Association of Government (SANDAG)'s iCommute Vanpool Program provides a convenient way for groups of five or more people to get to work in and around the San Diego region. The Vanpool Program provides a subsidy of up to $400 per month to offset the vehicle lease cost and vanpool participants share the remaining vehicle lease and gas cost. The vanpools in general have a longer than average commute distance.[46] The number of vanpools that are in operation vary by year. On average, from 2016 to 2018, 18 SANDAG vanpools were in operation annually that started or ended within Vista.[47] Through this measure, the City would promote the SANDAG Vanpool Program at businesses in the City to encourage their participation. The goal is to maintain 18 SANDAG Vanpools that start or end in Vista every year through 2030.

The vanpools in the program have different commute distances, vanpool frequencies, and number of vanpool participants. The estimated average commute distance, commute VMT avoided due to vanpools, and the GHG emissions reduction are shown in Table 26.[48]

[46] SANDAG: iCommute Vanpool.
[47] SANDAG Vanpool Program: active vanpools as of November 16, 2018. 2006 to 2018 vanpool data were provided by SANDAG to EPIC (November 2018). If the vanpool has an origin or a business city identified as Vista, they are accounted for here.
[48] SANDAG Vanpool Program: active vanpools as of November 16, 2018. 2006 to 2018 vanpool data were provided by SANDAG to EPIC (November 2018). The average number of passengers are estimated based on van capacity and the 80% capacity requirement. All vanpools start or end in Vista run from Monday to Friday, therefore, the 255 workday to year conversion is used.

Table 26 Projected SANDAG Vanpools in Vista and GHG Emissions Reduction from Avoiding Single-Occupancy Vehicle Trips

Year	Number of SANDAG Vanpools	Average Number of Passengers in the Vanpool	Average Vanpool Distance (miles per roundtrip per workday)	Annual VMT Avoided due to Vanpool (miles per year)	Annual Vista VMT Avoided due to Vanpool (miles per year)*	Average Vehicle Emission Rate (g CO_2e/mile)	GHG Emissions Reduction (MT CO_2e)
2030	18	7	91	3,020,012	1,630,807	297	484

Average number of passengers and commute distance of the SANDAG vanpools in recent years. 255 workdays per year.
*54% of all avoided miles are allocated to Vista based on Origin-Destination VMT allocation methods.
The projections are based on the current status and CAP assumptions.
Energy Policy Initiatives Center 2019.

A portion of the emissions avoided from reducing single-occupancy vehicle trips is offset by the emissions from operating the vanpool vehicles. As the vehicle fleet becomes more efficient, the fuel economy of potential vanpool vehicles also improves. Assuming the average fuel economy (miles per gallon, or "MPG") of the vanpool vehicle is 20 MPG in 2019, it will improve to 28 MPG in 2030 that reduces fuel use and associated GHG emissions from operating the vanpool vehicles.[49] GHG emissions added from the vanpool vehicles are shown in Table 27.

Table 27 GHG Emissions Added from Projected SANDAG Vanpools in Vista

Year	Number of SANDAG Vanpools	Average Fuel Economy of Vanpool Vehicle (miles per gallon)	Average Fuel Use of Vanpool Vehicle (gallons per year)	GHG Emissions from Vanpool Gasoline* (lbs CO_2e/gallon)	GHG Emissions Added from Vanpools (MT CO_2e)
2030	18	28	842	17.8	122

*Assume gasoline blend is 10% ethanol.
Vehicle fuel economy in 2030 is based on the decrease in the average vehicle emission rate in San Diego and 2019 vanpool vehicle fuel economy. Annual fuel use is calculated based on commute distance of the SANDAG vanpools in recent years (91 mile per roundtrip per day) and 255 workdays per year.
The projections are based on the current status and CAP assumptions.
Energy Policy Initiatives Center 2019.

The net GHG emissions reduction in 2030, combining the reduction from avoiding single occupancy vehicle trips and emissions added from vanpool vehicles, is shown in Table 28.

[49] Based on the SANDAG Vanpool Program data the most common vanpool vehicles are Ford Traverse, Dodge Grand Caravan, and Buick Enclave. The 2019 new vehicle fuel economy of these vehicle models are approximately 20 MPG. U.S. Department of Energy: Fuel Economy Estimates, accessed January 10, 2019. The San Diego regional average vehicle emission rate in 2030, 297 g CO_2e/mile, is 28% less than that in 2019, 410 g CO_2e/mile. EMFAC2014. The ratio of emission rates is used to estimate 2030 MPG.

Table 28 Results for Measure T-4: Participate in the San Diego Association of Government's iCommute Vanpool Program

Emissions Reduction from SANDAG Vanpool Program	GHG Emissions Reduction in 2030 (MT CO_2e)
Emissions Reduction from Avoiding Single Occupancy Vehicle Commute	484
Emissions Added from Operating Vanpool Vehicles	-122
Net Emissions Reduction due to SANDAG Vanpool Program	361
Negative emissions reduction means emissions are added. The projections are based on the current status and CAP assumptions. Energy Policy Initiatives Center 2019.	

6.2.2 Measure T-5: Implement the City's Bicycle Master Plan

Vista's current Bicycle Master Plan, consistent with other City planning documents and San Diego regional bicycle network planning effort, provides goals, policies, recommendations and implementation steps for improving bicycling in Vista.[50]

Bicycle facilities are categorized as follows: 1) Class I bicycle paths, which have a completely separated right-of-way designed for the exclusive use of bicycles and pedestrians; 2) Class II separated bicycle lanes; and 3) Class III bicycle routes, where bicyclists share streets with motor traffic. Bicycle lanes are used for both recreational and commuting purposes. For this measure, only the impact on avoiding commute VMT is quantified. While Class III may have some impact on increasing bicycle commuting, studies of the impact of bicycle facilities on increasing bicycle commuting focus on separated bicycle lanes (Class II or better).

The City identified the list of projects recommended in the Bicycle Master Plan to be completed prior to 2030, a total of 12 miles of two-way bicycle lanes, including adding buffers to existing Class II bicycle lanes and adding new Class II or better bicycle lanes. Separately, through a regional effort, SANDAG has completed sections of the Inland Rail Trail of the Regional Bike Plan Early Action Program.[51] The Inland Rail Trail is a Class I bike path through the Cities of Oceanside, Vista, San Marcos, Escondido, and the unincorporated County of San Diego. The portion of the completed sections of the Inland Rail Trail in Vista is a four-mile segment in both directions.[52] The locations of the new bicycle infrastructure projects and length of the bicycle lanes are provided in Table 29.[53]

Table 29 Planned New Bicycle Infrastructure in Vista to be Completed by 2030

Segment	From	To	Facility Classification	Length - One-way (miles)	Planned Bicycle Lane (miles)*
W. Vista Way	Thunder Drive	N. Melrose Dr	Buffered Class II	2.2	4.4

[50] City of Vista Bicycle Master Plan (adopted January 27, 2015).
[51] SANDAG Transportation Committee October 19, 2018 Meeting Agenda: Item 6 – Regional Bikeway Program Status Report, accessed November 7, 2018.
[52] SANDAG: Inland Rail Trail-San Marcos to Vista Fact Sheet, accessed November 13, 2018.
[53] Bicycle lane locations, infrastructure type, length, and projected completion year were provided by City (November 2018).

Segment	From	To	Facility Classification	Length - One-way (miles)	Planned Bicycle Lane (miles)*
Olive Ave	N. Emerald Dr	Vista Village Dr	Buffered Class II	2.1	4.2
S. Melrose Dr	Hacienda Dr	Melrose Way	Buffered Class II	0.6	1.2
Sycamore Ave	SR-78	Green Oak Rd	Class II	0.8	1.6
Vale Terrace Dr	E. Vista Way	Foothill Dr	Class II	1.5	3
Hacienda Dr	Pomelo Dr	S. Melrose Dr	Class II	0.6	1.2
Thibodo Rd	Chaparral Ave	Sycamore Ave	Class II	0.7	1.4
Monte Vista Dr	S. Santa Fe Ave	City Boundary	Class II	1.2	2.4
Poinsettia Ave	W. City Boundary	Linda Vista Dr	Class II	1.1	2.2
Trail-BV Creek	E. Vista Way	Vale Terrace Dr	Soft Path	0.8	1.6
			Total:	12	23
				Vista Developed Area (square miles)	16
				Projected Additional Bicycle Lanes (miles per square mile)	1.4

*Planned bicycle lanes are all in both directions.
City of Vista 2018, SANDAG 2013.

The increase in percentage of bicycle commuters is assumed to be proportional to the increase in bicycle lane miles per square mile. The elasticity of adding each additional mile of Class II (or better) bicycle lane per square mile is roughly one percent for commuters.[54] Vista's developed area is approximately 16 square miles, with four miles of bicycle lanes completed through Inland Rail Trails and the City's Bicycle infrastructure projects, the City will have added an additional 1.9 miles of bicycle lane per square mile.[55]

Bicycle lanes are used for both recreational and commuting purposes. For this measure, only the impact on avoiding commute VMT is quantified. To calculate annual commute VMT avoided, the increase in percentage of commuters by bicycle was multiplied by an eight-mile commute distance avoided per day, assuming bicycle commuters are traveling within the city. The avoided VMT is converted to GHG emissions reductions using the average vehicle emission factor, discussed in Section 4.4.1 (GHG Emission Factor for On-Road Transportation). The GHG emissions reduction in 2030 is shown in Table 30.

[54] Dill and Carr (2013): Bicycle Commuting and Facilities in Major U.S. Cities: If you build them, commuters will use them – another look
[55] Developed based on SANDAG's Series 13 Regional Growth Forecast (Updated in October 2013). SANDAG Data Surfer, accessed October 24, 2017.

Table 30 Key Assumptions and Results for Measure T-5: Implement the City's Bicycle Master Plan

Year	Labor Force	Additional Bicycle Lanes Added (bicycle lane miles per square mile)	% of Additional Labor Force Using Bicycle to Commute	Additional Labor Force Using Bicycles to Commute	Commute VMT Avoided (miles per year)	Average Vehicle Emission Rate (g CO_2e/mile)	GHG Emissions Reduction (MT CO_2e)
2030	54,750	1.9	1.9%	1,046	2,133,423	297	633

Average VMT avoided by commuting by bicycle is assumed to be eight miles per workday, with 255 workdays per year.
The emissions reduction is projected based on CAP assumptions and future impact of State policies and programs used in the CARB EMFAC2014 model.
Energy Policy Initiatives Center 2019.

6.2.3 Measure T-6: Increase Density and Mixed-use Development

The City plans to identify areas with the potential for increasing density and destination accessibility in addition to the Opportunity Areas identified in the General Plan and the SANDAG Smart Growth Areas.[56] Increased density affects the distance people travel and provides greater options for the mode of travel people choose.

In recent years, the City has approved two projects with increased density and destination accessibility that are outside Opportunity Areas: the Vista Paloma and Vista Melrose 47 projects. For this measure, only the impact of these two projects on avoiding VMT is quantified.

The Vista Melrose 47 project, approved in 2017, proposed a zoning change from Rural Residential to Mixed Use for nine three-story building condo units. The new density approved for the project was 15 dwelling units per acre, which is an increase of over 1,000% as compared to the Rural Residential zoning requirement[57] of 1 dwelling unit per acre. Based on several studies, the ratio of VMT reduction to percent increase in density is 7% (i.e., the elasticity of VMT with respect to density is 7%). For example, a 20% increase in density would lead to 1.4% VMT reduction. However, these studies also cap the VMT reduction at 30% to eliminate the influence of any single factor, as community design relies on multiple land use strategies.[58] The more than 1,000% increase in density of the Vista Melrose project would yield 98% of VMT reduction beyond the capped VMT increase indicated by the studies. Therefore, the VMT reduction from the project is set at 30%.

Assuming the average household VMT in Vista is similar to that in the San Diego region, the VMT avoided in 2030 due to the Vista Melrose 47 project is shown in Table 31.[59]

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[56] The impact of the land use change in General Plan Opportunity Areas and SANDAG Smart Growth Areas on VMT reduction is captured in the Series 13 VMT projection.
[57] City of Vista: Mitigated Negative Declaration and Initial Study Checklist P16-0032 Vista Melrose 47 Project (September 2016).
[58] California Air Pollution Control Officers Association: Quantifying Greenhouse Gas Mitigation Measures (2010). LUT-1 Increase Density.
[59] SANDAG: San Diego Forward: The Regional Plan Program Environmental Impact Report 4.15 Transportation (2015), accessed on November 29, 2018. 2012, 2020, and 2035 San Diego region VMT per capita is from the Regional Plan, all other years are linearly interpolated. Number of persons per households based on SANDAG Series 13 Regional Growth Forecast (October 2013). SANDAG Data Surfer, accessed August 7, 2017.

Table 31 Household VMT Avoided due to Increasing Density (Vista Melrose 47 Project)

Year	% VMT Reduction per Household from Increased Density*	Average Household VMT** (miles/weekday)	VMT Reduction per Household (miles/year)	% of VMT that are Vista VMT	Vista VMT Reduction per Household (miles/year)	Number of Units in Vista Melrose 47	VMT Reduction due to Vista Melrose 47 (miles/year)
2030	30%	77	8,016	54%	4,248	47	199,671

*CAPCOA Quantifying GHG Mitigation Measures LUT-1 Maximum VMT reduction.
**Assumes 3.2 persons per household in Vista and 23-mile average weekday VMT per capita (SANDAG Series 13 projection for San Diego region). 347 average weekdays per year. 54% of all household VMT is allocated to Vista based on Origin-Destination VMT allocation methods, assuming trips will have at least one trip-end within Vista.
CAPCOA 2010, Energy Policy Initiatives Center 2019.

The Vista Palomar project, approved in 2016, proposed a zoning change from Research Lighting Industrial to Mixed Use for a 100-room hotel and 196 two-story or three-story condo units. The project is located in an area with higher accessibility to destinations such as jobs that will reduce commute distance. The VMT reduction associated with higher accessibility depends on the location, and urban or suburban setting. Based on studies, the ratio of VMT reduction and job accessibility by auto is 20% (i.e., 50% closer to job location would lead to a 10% VMT reduction). Assuming the residents at Vista Palomar will work at a closer job center in eastern Vista (approximately 2 miles one-way commute distance) instead of the average San Diego region commute distance (approximately 8.4 one-way commute distance), the increased accessibility would lead to a 15% VMT reduction.[60]

In addition, the Mixed Use Zone parking standards for multi-family residential are lower than the citywide parking standard. As approved, the project will have a 23% reduction in parking spaces as compared to the requirements of a regular Multi-Family Residential Zone.[61] The amount of VMT reduction from parking reduction depends on the size of projects and availability of alternative modes of transportation services nearby. Based on studies, the ratio of VMT reduction and parking reduction is 50% (i.e., 20% parking reduction would lead to 10% VMT reduction); therefore, the parking reduction at the Vista Palomar project would lead to 12% VMT reduction. [62]

Assuming the average household VMT in Vista is similar to that in the San Diego region, the VMT avoided in 2030 due to Palomar Vista project is shown in Table 32.[63]

[60] CAPCOA: Quantifying Greenhouse Gas Mitigation Measures (2010). LUT-4 Increase Destination Accessibility, accessed on November 19, 2018.
[61] City of Vista: Proposed General Plan Amendment & Specific Plan Amendment at 2100 W. San Marcos Boulevard (January 2016).
[62] CAPCOA: Quantifying Greenhouse Gas Mitigation Measures (2010). PDT-1 Parking Policy/Pricing, accessed on November 19, 2018.
[63] SANDAG: San Diego Forward: The Regional Plan Program Environmental Impact Report 4.15 Transportation (2015), accessed on November 29, 2018. 2012, 2020, and 2035 San Diego region VMT per capita is from the Regional Plan, all other years are linearly interpolated. Number of persons per households based on SANDAG Series 13 Regional Growth Forecast (October 2013). SANDAG Data Surfer, accessed on August 7, 2017.

Table 32 Household VMT Avoided due to Increase Density and Accessibility (Palomar Vista Project)

Year	% VMT Reduction per Household from Increased Density*	Average Household VMT** (miles/weekday)	VMT Reduction per Household (miles/year)	% of VMT that are Vista VMT	Vista VMT Reduction per Household (miles/year)	Number of Units in Palomar Vista	VMT Reduction due to Palomar Vista (miles/year)
2030	27%	77	7,089	54%	3,757	196	736,418

*CAPCOA Quantifying GHG Mitigation Measures LUT-4 Increase Destination Accessibility and PDT-1 Parking Policy/Pricing.
**Assumes 3.2 persons per household in Vista and 23-mile average weekday VMT per capita (SANDAG Series 13 projection for San Diego region). 347 average weekdays per year. 54% of all household VMT is allocated to Vista based on Origin-Destination VMT allocation methods, assuming trips will have at least one trip-end within Vista.
CAPCOA 2010, Energy Policy Initiatives Center 2019.

The avoided VMT from both projects is converted to GHG emissions avoided using the average vehicle emission factor, discussed in Section 4.4.1 (GHG Emission Factor for On-Road Transportation). The GHG emissions reduction in 2030 is shown in Table 33.

Table 33 Key Assumptions and Results for Measure T-6: Increase Density and Mixed-use Development

Year	VMT Reduction due to Vistas Melrose 47 (miles/year)	VMT Reduction due to Vista Palomar (miles/year)	Total Miles Avoided (miles/year)	Average Vehicle Emission Rate (g CO_2e/mile)	GHG Emissions Reduction (MT CO_2e)
2030	199,671	736,418	936,089	297	278

The emissions reduction is projected based on CAP assumptions and future impact of State policies and programs used in the CARB EMFAC2014 model.
Energy Policy Initiatives Center 2019.

6.3 Strategy 3: Reduce Fossil Fuel Use (T)

The goal of this strategy is to reduce off-road equipment fossil fuel use through the use of renewable or alternative fuel. The strategy includes the following measure.

6.3.1 Measure T-7: Require Electric-Powered or Alternative Fueled Construction Equipment

Through the construction permitting process, the City will require 30% of construction equipment in new development projects to be electric-powered or alternatively-fueled, that leads to approximately 30% reduction in construction emissions.[64] The method to project 2030 construction emissions are based on CARB's In-Use Off-Road Equipment 2011 Inventory and the number of construction jobs in Vista.[65] The GHG emissions reduction in 2030 is shown in Table 34.

[64] The requirement would be based on the construction equipment's horsepower.
[65] The method to project construction emissions in 2030 is provided in *Appendix A: City of Vista Greenhouse Gas Emissions Inventories and Projections* (EPIC, 2018).

Table 34 Key Assumptions and Results for Measure T-7: Require Electric-Powered or Alternative Fueled Construction Equipment

Year	Projected Emissions from Construction (MT CO_2e)	Percent Reduction in Emissions	GHG Emissions Reduction (MT CO_2e)
2030	10,841	30%	3,252
The construction emissions are projected based on the San Diego region's construction emissions and the ratio of construction jobs in Vista to those in the region. CARB 2011, Energy Policy Initiatives Center 2019.			

6.4 Strategy 4: Increase Building Energy Efficiency (E)

The goal of this strategy is to increase building energy efficiency through the following measure.

6.4.1 Measure E-1: Implement Energy Efficient Projects in Municipal Facilities

In 2018, the City completed heating, ventilation, and air conditioning (HVAC); and lighting audits at various municipal facilities and identified energy efficiency opportunities that have the potential to reduce energy use, energy cost, and improve building comfort and safety. The City will implement the energy efficiency projects recommended at the audited municipal facilities by 2030 and evaluate additional energy retrofits opportunities. The municipal facilities audited and the potential savings from energy efficiency projected recommended are provided in Table 35.[66]

Table 35 Potential Vista Municipal Facilities Energy Retrofit Project Energy Savings

Site	Annual Savings (kWh)	Annual Savings (therms)
Civic Center	303,362	0
Public Works	32,526	-10
Wave Water Park	224,071	-10
Fire Station No. 1	115,854	-48
Fire Station No. 2	24,959	-55
Fire Station No. 3	34,744	-92
Fire Station No. 4	45,050	-14
Fire Station No. 5	89,003	-49
Fire Station No. 6	70,777	-79
Jim Porter Recreation Center	99,942	0
Total	**1,040,288**	**-358**
Energy efficiency projects include interior and exterior lighting retrofits and HVAC system adjustments. Energy savings represent first-year on-bill savings and negative natural gas savings represent additional natural gas used. Project sites and energy savings are from the 2018 select facility audits. TRC Energy Services 2018.		

[66] The energy audit reports for City of Vista government facilities were provided by SANDAG (November 2018).

Emissions reductions from electricity savings are calculated by multiplying the electricity savings by the GHG emission factor for electricity. As the renewable and zero-carbon content in electricity increases, the emissions reduction decreases accordingly. The electricity emission factor used for this measure is the grid emission factor and higher than the citywide electricity emission factor used for citywide measures. A small portion of the emissions reductions are offset by the additional natural gas use added. The net emissions reduction is summarized in Table 36.

Table 36 Key Assumptions and Results for Measure E-1: Implement Energy Efficient Projects in Municipal Facilities

Year	Electricity Savings (kWh)	Electricity Emission Factor* (lbs CO_2e/MWh)	Reduction from Electricity Savings (MT CO2e)	Natural Gas Savings** (therm)	Natural Gas Emission Factor (MT CO2e/therm)	Reduction from Natural Gas Savings (MT CO2e)	Net Emissions Reduction (MT CO_2e)
2030	1,040,288	92	47	-358	0.0054	-2	45

*Grid electricity emission factor, higher than citywide electricity emission factor.
**Negative natural gas savings represent additional natural gas used.
The projected capacity and emissions reductions are based on CAP assumptions, current status, and future impact of State policies and programs.
Energy Policy Initiatives Center 2019.

6.5 Strategy 5: Increase Renewable and Zero-Carbon Energy (E)

The goal of this strategy is to increase grid-supply and behind-the-meter renewable and zero-carbon electricity through the following measures.

6.5.1 Measure E-2: Continue PV Installation at Municipal Facilities

Currently, the City has one behind-the-meter PV system (47 kW PV system) installed at the Senior Center since 2012 and is in the process of evaluating additional PV projects at the Public Works Yard and City office buildings. The goal of this measure is to add 400 kW of new PV systems by 2030.

The emissions reductions from all State actions and CAP measures that increase the behind-the-meter renewable supply is 21,759 MT CO_2e, given in Table 7 (Allocation of Emissions Reductions to Supplies that Increase Renewable (or Zero-Carbon) Supply in Vista). The total reduction is allocated based on estimated capacity (MW) that would result from each measure. As shown in Table 37, GHG emissions reduction from Measure E-2 is the projected reduction amounts in the year 2030 only.

Table 37 Key Assumptions and Results for Measure E-2: Continue PV Installation at Municipal Facilities

Year	State or City Action	Total	California Solar Polices, Programs, and Mandates*	Measure E-3	Measure E-2
2030	Projected Behind-the-meter PV Capacity (MW)	63	57	5.6	0.4
	Projected Emissions Reduction (MT CO_2e)	21,759	19,677	1,941	**141**

CAP Measure E-2: Continue PV Installation at Municipal Facilities and Measure E-3: Support the Vista Unified School District's Efforts to Install PV Systems
*Solar policies, programs and mandates include the impact of the PV mandates from the 2019 Building Energy Efficiency Standard.
The projected capacity and emissions reductions are based on CAP assumptions, current status, and future impact of State policies and programs.
Energy Policy Initiatives Center 2019.

6.5.2 Measure E-3: Support the Vista Unified School District's Efforts to Install PV Systems

In early 2018, Vista Unified School District (VUSD) conducted a site assessment and feasibility study of installing PV systems and battery energy storage systems at the District's public school facilities. Based on the study, PV systems are viable at 21 targeted school sites. The implementation schedule of the PV systems has two phases, with phase 1 during the 2018–2019 school year for the schools that can accommodate school year construction, and phase 2 for the remaining systems during summer 2019. Table 38 below includes the potential school sites and their PV system capacities.[67]

Table 38 Vista Unified School Districts Potential School Sites with PV Systems

Sites	Modeled System Size (kW)
Alamosa Park ES	85
California Avenue ES	130
Empresa ES	115
Foothill Oak ES	210
Grapevine ES	100
Hannalei ES	150
Lake ES	125
Madison MS	345
Maryland ES	170
Mission Meadows ES	115
Mission Vista HS	610
Monte Vista ES	115
District Office (ASC) & Transportation (OSC)	210
VIDA Main & Gym	355
Rancho Buena Vista HS	535

[67] Vista Unified School District's PV and Battery Feasibility Study provided by the City (June 2018).

Sites	Modeled System Size (kW)
Rancho Minerva MS	320
Roosevelt MS	275
Temple Heights ES	200
Vista Academy	105
Vista HS	1100
Vista Magnet MS	255
Total	**5,625**
Vista Unified School District 2018.	

The total PV capacity from the school sites is 5.6 MW.

The emissions reductions from all State actions and CAP measures that increase the behind-the-meter renewable supply is 21,759 MT CO_2e, given in Table 7 (Allocation of Emissions Reductions to Supplies that Increase Renewable (or Zero-Carbon) Supply in Vista). The total reduction is allocated based on estimated capacity (MW) that would result from each action. As shown in Table 39, GHG emissions reductions from Measure E-3 are the projected reduction amounts in the year 2030 only.

Table 39 Key Assumptions and Results for Measure E-3: Support the Vista Unified School District's Efforts to Install PV Systems

Year	State or City Action	Total	California Solar Polices, Programs, and Mandates*	Measure E-2	Measure E-3
2030	Projected Behind-the-meter PV Capacity (MW)	63	57	0.4	5.6
	Projected Emissions Reduction (MT CO_2e)	21,759	19,677	141	**1,941**

CAP Measure E-2: Continue PV Installation at Municipal Facilities and Measure E-3: Support the Vista Unified School District's Efforts to Install PV Systems
*Solar policies, programs and mandates include the impact of the PV mandates from the 2019 Building Energy Efficiency Standard.
The projected capacity and emissions reductions are based on CAP assumptions, current status, and future impact of State policies and programs.
Energy Policy Initiatives Center 2019.

6.5.3 Measure E-4: Join Program to Increase Grid-Supply Renewable and Zero-Carbon Electricity

As discussed in Section 5.1, SB 100 (100 Percent Clean Energy Act of 2018) adopts a 60% RPS for all California's retail electricity suppliers by 2030. Through Measure E-4, the City would establish or join a program to further increase grid-supply renewable and zero-carbon electricity to 90% by 2030; 30%

beyond the RPS mandate for that year. It is assumed the program would supply 90% of the electricity load (not including the behind-the-meter PV generation) in 2030.[68]

As previously explained in Section 5.1 and Table 7 Allocation of Emissions Reductions to Supplies that Increase Renewable (or Zero-Carbon) Supply in Vista)), because the local renewables and zero-carbon program is required to comply with the State's RPS mandates, a portion of the total emissions reduction from Measure E-4 is allocated to the State's RPS compliance. The remaining emissions reduction beyond RPS compliance is allocated to Measure E-4. The allocation of GHG emissions reduction in 2030 from this measure to the State and the City is shown in Table 40.

Table 40 Key Assumptions and Results for Measure E-4: Join Program to Increase Grid-Supply Renewable and Zero-Carbon Electricity

Year	State or City Action	Total for Local Renewables and Zero-Carbon Program	Local Renewables and Zero-Carbon program to Complying with RPS (SE-1)	Local Renewables and Zero-Carbon Program above RPS (E-4)
2030	Projected Renewables and Zero Carbon (%)	90%	60%	30%
	Emissions Reduction (MT CO_2e)	85,013*	56,675	28,338

*Calculated in Table 7.
The emissions reduction is the projection under the CAP, based on CAP assumptions and future impact of State policies and programs.
Energy Policy Initiatives Center 2019.

6.6 Strategy 6: Reduce and Recycle Solid Waste (W)

The goal of the strategy is to reduce emissions from landfill waste through the following measure.

6.6.1 Measure W-1: Reduce Solid Waste Disposal and Increase Recycling

Through Measure W-1, the City will work with its waste hauler to achieve a citywide 85% waste diversion rate by 2030. The 85% waste diversion rate would be equivalent to 2 pounds per person per day (PPD) of waste disposed in landfills.

The City had 4.9 PPD waste disposal in the 2012 baseline year and 5.4 PPD waste disposal in 2016, which are equivalent to approximately 62% and 59% diversion rates, respectively. From 2012 to 2016, the diversion rates fluctuated between 59% and 62%.[69] The City has not conducted a waste characterization

[68] Customer opt-out rates of current Community Choice Energy or Community Choice Aggregation (CCE or CCA) programs in California range from 1% to 23%. In general, DA customers are assumed to remain DA customers. The City of San Diego's CCA feasibility study used a 20% opt-out rate in the Base Case scenario, and the CCA business plan used a 5% opt-out rate. City of San Diego: Feasibility Study for a Community Choice Aggregate. Final Draft. July 2017. CCA Business Plan and Feasibility Study Comparison. November 2018. The San Diego North County coastal cities' (Carlsbad, Del Mar, Encinitas, and Oceanside) CCE Feasibility Study assumes an 85% participation rate for commercial and industrial customers and a 95% participation rate for residential customers. Community Choice Technical Feasibility Study. Draft. February 2019.
[69] Method to convert PPD to estimated diversion rate is based on Calrecycle. Per Capita Disposal and Goal Measurement. Jurisdiction PPD from 2012-2016 were downloaded from CalReycle Jurisdiction Diversion Summary.

study recently; therefore, it is assumed that the waste composition for the CAP time horizon would not change.[70] Landfills in the San Diego region are in the process of upgrading landfill gas collection systems.[71] It is assumed the landfill gas capture rate in 2030 will be 85%, higher than the default 75% used in the BAU emissions projection. The emissions avoided from increasing the waste diversion rate is the difference between the emissions from the waste category in the BAU emissions projection and the emissions from the solid waste category using the target diversion rates and PPD. Table 41 summarizes the key assumptions and results. The GHG emissions reduction projected is the reduction amount in the year 2030 only.

Table 41 Key Assumptions and Results for Measure W-1: Reduce Solid Waste Disposal and Increase Recycling

Projections	Waste Disposed at Landfills from Vista			Landfill Gas Capture Rate	Emissions from Waste Disposal (MT CO_2e)	GHG Emissions Reduction in 2030 (MT CO_2e)
	lbs./person/day	short tons/year	MT/year			
Business-as-usual	5.4	106,018	96,178	75%	17,752	13,898
With Targeted Diversion Rate	2.0	38,358	34,797	85%	3,854	
Emissions from waste are calculated based on the mixed waste emission factor (0.74 MT CO_2e/short ton), oxidation rate (10%), and the waste capture rates. The projected emissions reduction are based on the CAP assumptions. Energy Policy Initiatives Center 2019.						

6.7 Strategy 7: Carbon Sequestration (C)

The most recent urban tree canopy assessment in San Diego region, based on high-resolution Light Detection and Ranging (LiDAR), shows that as of 2014 Vista has approximately 20% existing urban tree canopy.[72] The goal of this strategy is to increase the urban tree cover within Vista through the following measures.

6.7.1 Measure C-1: Increase Tree Planting at Municipal Facilities and Public Rights-of-Way

Through Measure C-1, the City will develop a program to track tree planting and maintenance at city facilities, public parks and public rights-of-way. The number of trees planted by the City annually vary by year. In 2017, the City planted 38 trees at city parks and planned to plant approximately 200 trees during fiscal year 2019. The goal going forward is to plant an average of 100 new trees annually.

The carbon sequestration potential from the new trees is based on the projected total number of trees planted and the CO_2 absorption rate per tree.[73] Table 42 summarizes the key assumptions and results. The GHG emissions reductions are the projected reductions amount in the year 2030 only.

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[70] Recent State actions include organic waste recycling, which may reduce the mixed waste emission factor in future years.
[71] The main landfill, City of San Diego's Miramar Landfill, has added a landfill gas recovery improvement project to be completed late 2018.
[72] The assessment was done in 2014 for all urban areas in the San Diego County using method developed by University of Vermont and USDA Forest Service.
[73] On average, the CO_2 sequestration rate is 0.035 MT CO_2 per tree per year. The carbon sequestration rate depends on the tree species, climate zone, planting location, and tree age. A more accurate carbon sequestration rate will be evaluated once the parameters are decided in implementation of the measure. California Emissions Estimator Model (CALEEMOD). Appendix D Default Data Tables (October 2017).

Table 42 Key Assumptions and Results for Measure C-1: Increase Tree Planting at Municipal Facilities and Public Rights-of-Way

CAP Measure	Annual Number of New Trees Added	Number of New Trees Added by 2030*	CO2 Sequestered** (MT CO_2/tree/year)	Carbon Sequestration in 2030 (MT CO_2)
Measure C-1: Increase Tree Planting at Municipal Facilities and Public Rights-of-Way	100	1,300	0.0354	46

*Including the trees planted by City in FY2019.
**Average of trees. An improved estimate of the carbon sequestration rate can be evaluated once the implementation parameters are decided.
The projected carbon sequestration rates are based on the CAP assumptions.
Energy Policy Initiatives Center 2019.

6.7.2 Measure C-2: Increase Tree Planting at New Private Properties

The City currently requires development projects to plant trees in landscaped areas and surface parking lots.[74] The City anticipates that through the existing landscape requirements, approximately 500 new trees per year will be added.

Similar to Measure C-1, the carbon sequestration potential from the new trees is based on the projected total number of trees planted and the CO_2 absorption rate per tree.[75] Table 43 summarizes the key assumptions and results. The GHG emissions reductions are the projected reductions amount in the year 2030 only.

Table 43 Key Assumptions and Results for Measure C-2: Increase Tree Planting at New Private Properties

CAP Measure	Annual Number of New Trees Added	Number of New Trees Added by 2030	CO2 Sequestered* (MT CO_2/tree/year)	Carbon Sequestration in 2030 (MT CO_2)
Measure C-2: Increase Tree Planting at New Private Properties	500	5500	0.0354	195

*Average of trees. An improved estimate of the carbon sequestration rate can be evaluated once the implementation parameters are decided.
The projected carbon sequestration rates are based on the CAP assumptions.
Energy Policy Initiatives Center 2019.

[74] City of Vista Landscape Manual.
[75] On average, the CO_2 sequestration rate is 0.035 MT CO_2 per tree per year. The carbon sequestration rate depends on the tree species, climate zone, planting location, and tree age. A more accurate carbon sequestration rate will be evaluated once the parameters are decided in implementation of the measure. California Emissions Estimator Model (CALEEMOD). Appendix D Default Data Tables (October 2017).

Appendix A. VISTA MUNICIPAL FLEET POTENTIAL VEHICLE REPLACEMENT AND SAVINGS

Vehicle Model Year	Vehicle Make and Model	Potential Replacement Vehicle	Potential Fuel Saving (gallons per year)
2016	Ford Fusion Hybrid	Fusion PHEV	136
2017	Ford Escape	Chevrolet Bolt	58
2002	Dodge Durango	Ford F-150 HEV	260
2016	Ford Fusion Hybrid	Fusion PHEV	106
2016	Ford Fusion Hybrid	Fusion PHEV	78
2000	Dodge Dakota	Ford F-150 HEV	213
2008	Ford Escape	Chevrolet Bolt	243
2008	Ford F-150 XLT Crew Cab	Ford F-150 HEV	372
2014	Ford Escape	Chevrolet Bolt	190
2017	Ford Escape	Chevrolet Bolt	201
2017	Ford Escape	Chevrolet Bolt	210
2003	Ford Taurus	Fusion PHEV	144
2017	Ford Escape	Chevrolet Bolt	123
2016	Ford Fusion Hybrid	Fusion PHEV	78
2016	Ford F-150	Ford F-150 PHEV	253
2017	Ford F-150	Ford F-150 PHEV	228
2017	Ford F-150	Ford F-150 PHEV	228
1998	Ford F-150	Ford F-150 PHEV	64
2001	Ford F-350	Ford F-150 PHEV	172
2005	Ford Ranger	Ford F-150 PHEV	288
2005	Ford Ranger	Ford F-150 PHEV	225
2012	Ford Escape	Chevrolet Bolt	112
2000	Dodge Dakota	Ford F-150 PHEV	178
2007	Ford Ranger	Ford F-150 PHEV	284
2007	Ford Ranger	Ford F-150 PHEV	284
2008	Ford Escape	Chevrolet Bolt	380
2008	Ford Escape	Chevrolet Bolt	428
2008	Ford Escape	Chevrolet Bolt	403
2008	Ford Escape	Chevrolet Bolt	315
2003	Dodge Dakota	Ford F-150 PHEV	228
2006	Ford Ranger	Ford F-150 PHEV	422
2007	Ford Ranger	Ford F-150 PHEV	480
2008	Ford Escape	Chevrolet Bolt	340
2005	Chevrolet Suburban	Outland PHEV	326
2007	Ford Escape	Chevrolet Bolt	329

Vehicle Model Year	Vehicle Make and Model	Potential Replacement Vehicle	Potential Fuel Saving (gallons per year)
2007	Ford Escape	Chevrolet Bolt	380
2007	Ford Escape	Chevrolet Bolt	445
2007	Ford Escape	Chevrolet Bolt	427
2007	Ford Escape	Chevrolet Bolt	372
2007	Ford E-150 Van	Lightning Cargo Van BEV	496
2009	Ford Explorer	Outland PHEV	422
2011	Ford Expedition	Outland PHEV	479
2012	Ford Expedition	Outland PHEV	325
2012	Ford Expedition	Outland PHEV	410
2015	Ford F-150	Ford F-150 PHEV	303
2015	Ford F-150	Ford F-150 PHEV	258
2015	Ford F-150	Ford F-150 PHEV	294

PHEV – plug-in hybrid electric vehicle.
City of Vista 2019, SANDAG 2019.

Appendix C

Fire Hazard Severity Map

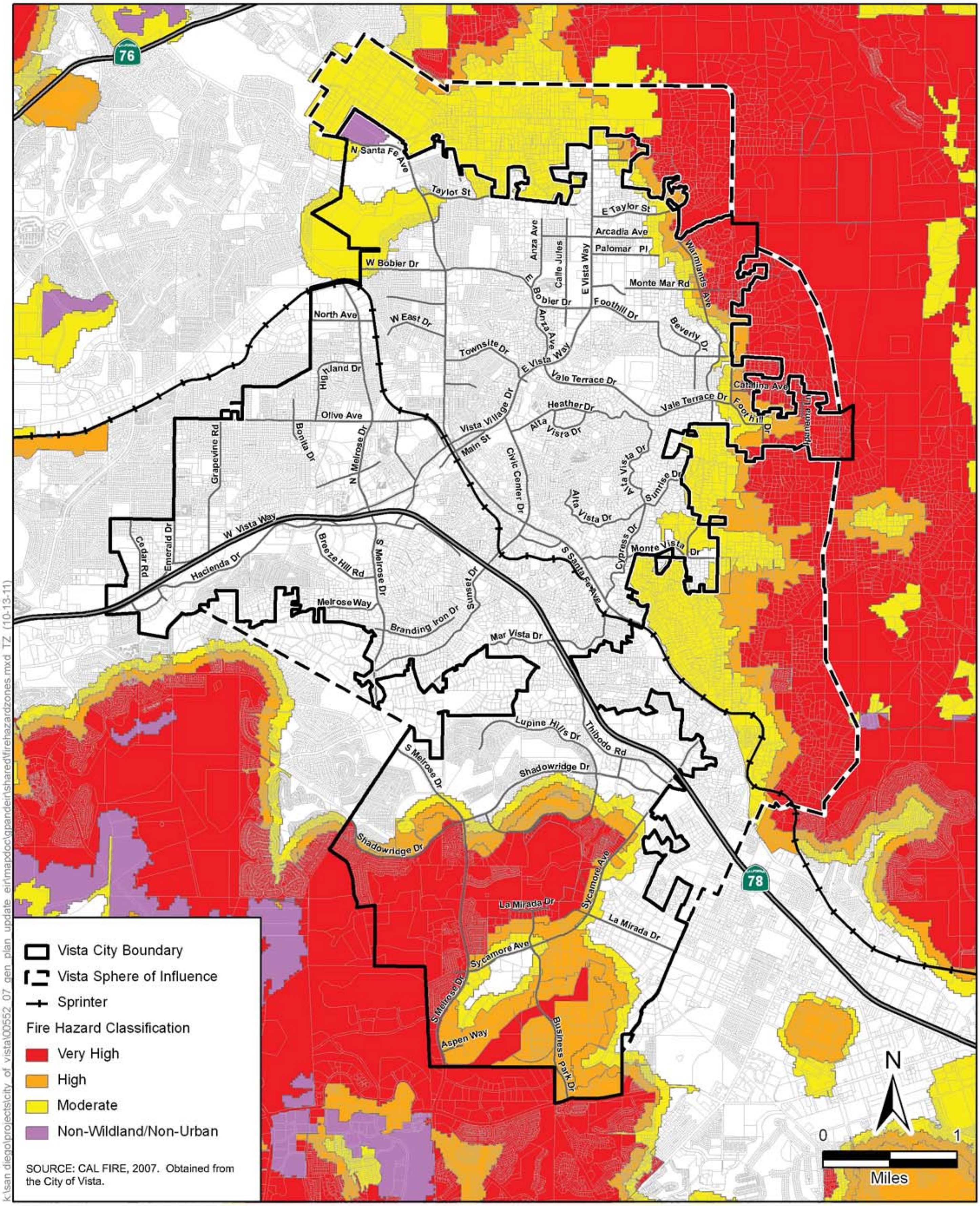

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Figure PSFS-6
Fire Hazard Severity Zones