City of San Diego

DRAFT Climate Action Plan

December 2015

APPENDICES

CITY OF SAN DIEGO

DRAFT CLIMATE ACTION PLAN

DECEMBER 2015

APPENDIX A

METHODS FOR ESTIMATING GREENHOUSE GAS REDUCTIONS

APPENDIX A.1

METHODS FOR ESTIMATING GREENHOUSE GAS REDUCTIONS

Appendix B provides information about the data, methods, and sources used to estimate the greenhouse gas reductions associated with the implementation measures included in the City of San Diego Climate Action Plan (CAP). The Energy Policy Initiatives Center (EPIC) estimated emissions reduction values for the federal, state, regional, and city - based actions selected by the City of San Diego.

There are five main strategies in the CAP:

- Energy and Water Efficient Buildings;
- Clean and Renewable Energy; Bicycling,
- Walking, Transit & Land Use;
- Zero Waste Management;
- Climate Resiliency.

The first section below provides common assumptions used across multiple measures, the following sections address the implementation measures at the state/federal level, regional level, and local actions included within each of the five main strategies.

GREENHOUSE GAS REDUCTIONS SUMMARY

Table 1 provides a summary of the CAP measures and their contribution to the overall reduction.

Table 1: Summary of Greenhouse Gas Emissions Reductions by Action (Metric Tons CO2e/Year)

CAP Measure	2020	2030	2035
Strategy 1: Water & Energy Efficient Buildings			
1.1 Residential Energy Conservation and Disclosure Ordinance	3,218	6,078	5,605
1.2 City of San Diego's Municipal Energy Strategy and Implementation Plan	11,580	12,321	.9,011
1.3 New Water Rate and Billing Structure	12,210	14,948	12,277
1.4 Water Conservation, Disclosure and Ordinance	12,589	19,898	21,470
1.5 Outdoor Landscaping Ordinance	2,090	1,888	653
Strategy 2: Clean & Renewable Energy			
2.1 Community Choice Aggregation Program (CCA) or Another Program	-	531,254	1,592,878
2.2 Municipal Zero Emissions Vehicles	12,144	18,621	21,859
2.3 Convert Municipal Waste Collection Trucks to Low Emission Fuel	2,018	8,501	10,144
Strategy 3: Bicycling, Walking, Transit & Land Use			
3.1 Mass Transit	119,234	138,016	213,573
3.2 Commuter Walking	1,092	1,338	1,488
3.3 Commuter Biking	19,077	40,177	50,574
3.4 Retiming Traffic Signals	11,024	9,032	8,508
3.5 Install Roundabouts	2,110	2,506	2,172
3.6 Promote Effective Land Use to Reduce Vehicle Miles Traveled	-	73,051	109,576
Strategy 4: Zero Waste			
4.1 Divert Solid Waste and Capture Landfill Emissions	154,467	283,309	344,213
4.2 Capture Methane from Wastewater Treatment	16,424	18,000	18,735
Strategy 5: Climate Resiliency			
5.1 Urban Tree Planting Program	43,839	82,806	102,290
Supporting Regional Action*			
SANDAG - SB 375	397,580	661,061	792,801
Supporting State and Federal Actions*			
CA Renewable Portfolio Standard - Utility	887,084	840,086	398,219
CA Renewable Portfolio Standard – CCA or Another Program	-	960,098	1,592,878
CA Energy Efficiency Policies and Programs	202,142	387,265	257,192
CA Solar Programs	154,975	426,262	572,333
CA Vehicle Efficiency Standards - Pavley I/CAFE	1,407,061	2,373,735	2,498,388
CA Low Carbon Fuel Standard	628,425	571,210	569,268
CA Electric Vehicle Policies and Programs	196,542	758,803	1,185,078
CA CARB Tire Pressure Program	25,920	27,840	28,800
CA CARB Heavy Duty Vehicle Aerodynamics	8,100	8,700	9,000
GHG Reductions Summary			
Total Reduction from State and Federal Actions	**3,510,249**	**6,353,998**	**7,111,156**
Total Reductions from Regional Action	**397,580**	**661,061**	**792,801**
Total Reductions from Local Actions	**423,116**	**1,261,745**	**2,525,027**
Total GHG Reductions with Implementation of the Climate Action Plan	**4,330,945**	**8,276,803**	**10,428,984**

COMMON ASSUMPTIONS AND SOURCES

A set of common assumptions and sources was used to calculate emissions reductions for many of the mitigation measures included in the CAP. The following section provides assumptions that were applied to measures related to electricity, natural gas, and transportation. Other measures have specific methods and data that are provided later in the document.

Common Background Data

Table 2 presents a summary of common data used to estimate both overall GHG emissions and the reduction estimates for each specific action.

Table 2: Common Data Sources for City of San Diego Climate Action Plan

Data Category	2010	2020	2035
Population[1]	1,359,578	1,542,324	1,759,271
Vehicle Miles Traveled[2]	13,745,004,004	15,114,486,656	18,255,806,585
Number of Vehicles[3]	956,789	1,068,787	1,288,272
Net Energy for Load (GWh)[4]	9,505	10,220	12,061
Gross Generation (GWh)[5]	9,580	10,826	13,910
Natural Gas Use (Million Therms)[6]	396	397	430
Single Family Units[7]	280,455	286,261	277,679
Multi-Family Units[8]	233,383	286,675	374,215
Water Consumption (Gallons)[9]	74,933,119,424	85,005,187,260	96,962,221,165
Commercial Building Area (Million Square Feet)[10]	291	328	398

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[1] Series 12 Population Forecast, San Diego Association of Governments (SANDAG). Available at http://datawarehouse.sandag.org/.
[2] California Air Resources Board Emissions Factor Model (EMFAC2011). Available at http://www.arb.ca.gov/msei/modeling.htm.
[3] EMFAC2011.
[4] Kavalec, Chris, Nicholas Fugate, Bryan Alcorn, Mark Ciminelli, Asish Gautam, Kate Sullivan, and Malachi Weng - Gutierrez, 2013. California Energy Demand 2014 - 2024 Final Forecast, Volume 1: Statewide Electricity Demand, End - User Natural Gas Demand, and Energy Efficiency. California Energy Commission, Electricity Supply Analysis. Division. Publication Number: CEC - 200 - 2013 - 004 - SF - VI. Values beyond 2024 are extrapolated.
[5] Gross generation is the sum of net energy for load (GWh), additional electricity load in the City of San Diego from CA Electric Vehicle Policies and Program (includes transmission and distribution losses), and electricity generation from CA Solar Programs (does not include transmission and distribution losses).
[6] Kavalec et al. 2013.
[7] San Diego Association of Governments (SANDAG), Forecast Housing Data. Available at http://datawarehouse.sandag.org/.
[8] SANDAG Forecast Housing Data
[9] Urban Water Management Plan 2010 (Table 3-10). Available at http://www.sandiego.gov/water/pdf/uwmp2010.pdf.
[10] Collier International, email on 6 February 2014 and Kavalec et al. 2013.

Electric and Natural Gas Related Measures

The following assumptions were used in calculating greenhouse gas reductions for measures related to electric and natural gas usage, including those in the Energy and Water Efficient Buildings and Clean and Renewable Energy Resources strategies, and those in the Federal and State Actions.

Greenhouse Gas Emissions Factor for Electricity

The greenhouse gas emissions factor for electricity is the amount of greenhouse gases in each unit of electricity supplied to City of San Diego consumers. This value is used in several ways throughout the CAP, including to determine the emissions associated with electricity production for the overall emissions inventory and to estimate the effect of measures in the CAP to reduce energy. To estimate the electricity emissions factor, measured in pounds CO_2e per megawatt - hour (lbs CO_2e/MWh), we include electricity supplied from three categories of supply: the utility (SDG&E), a Community Choice Aggregation program or another program (Action 2.1), and net-metered solar and shared solar (CA Solar Programs). Each category of supply has its own renewable content , which affects the overall emissions factor. The following sections describe the method used to determine the emissions intensity for the three categories of supply and to develop a weighted average of all three. This methodology applies to the 2010 baseline emissions factor as well as to calculations for each year within the CAP time horizon. As the percentage of renewable energy increases due to policy changes, the percentage of non-renewable supply decreases, thus the overall average emissions factor of the electricity supply decreases over the CAP time horizon.

SDG&E (Utility) Supplied Electricity

The emissions factor for electricity supplied by SDG&E takes into consideration several sources of supply, including the emissions from power plants owned by SDG&E and from power purchased by SDG&E. For SDG&E-owned power plants, we used actual fuel consumption and electricity production data.[11] Next, we calculated the emissions from power purchased by SDG&E from other suppliers. We multiplied the total

[11] Federal Energy Regulatory Commission (FERC) Form 1, information available at http://www.ferc.gov/docs-filing/forms/form-1/viewer-instruct.asp, and SDG&E (email January 22, 2014).

electric energy purchased (from FERC Form 1) by the emissions factor[12] for the appropriate power plant. This yielded a total emissions value for each plant. A similar approach is used for the quantity of supply for which the source is unspecified. In this case, we use an emissions factor provided by the California Air Resources Board.[13]The sum of the emissions values in pounds (lbs) for all plants (SDG&E-owned and those selling to SDG&E) and unspecified sources divided by the sum of the electricity purchased (MWh) for all plants yields an average emissions rate for all SDG&E supplied electricity. We assumed that direct access providers, which are those suppliers other than SDG&E that account for about 18% of total electricity use in the City of San Diego, have the same emissions rate as SDG&E.[14]

Community Choice Aggregation or Another Program

The City of San Diego CAP includes a goal to achieve a 100% renewable electricity supply in the City.[15] The CAP includes the formation of a Community Choice Aggregation (CCA) or another program (Action 2.1) to help achieve this goal. Under a CCA or another program, the City of San Diego would enable the alternative supply of electricity to a subset of overall electricity customers within the City. A CCA essentially is an alternative supplier of electric energy that would use the existing SDG&E distribution and transmission system to supply the electricity. We assume that 80% of eligible customers participate in a CCA or another program in 2035. We also assume that the electricity supply from a CCA or another program is 100% renewable in 2035 through a combination of renewable energy contracts and purchase

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[12] U.S. Environmental Protection Agency Emissions & Generation Resource Integrated Database (eGRID), Ninth edition with year 2010 data (Version 1.0). Available at http://www.epa.gov/cleanenergy/energy-resources/egrid/.

[13] California Air Resources Board Regulation for Mandatory Reporting of Greenhouse Gas Emissions Section 95111(b)(1). Included as 0.428 metric tons of CO_2e/MWh. Conversion to pounds yields 943.6 lbs CO_2e/MWH.

[14] SDG&E, Electricity and Natural Gas Consumption by Customer Class for City of San Diego. 2010-2012

[15] We assume for purposes of estimating the greenhouse gas impacts of 100% renewable supply that this target applies to all the electricity supplied to all customers within the City of San Diego boundary, including that supplied by behind-the-meter technologies such as rooftop solar. Given the assumptions included in the CAP for those categories, 91% of electricity supply would be renewable by 2035. This level of renewable supply still allows the City to achieve the target reduction 10,223,523 Metric Tons CO2e/Year by 2035, which puts the City on pace to achieve the 2050 greenhouse gas reduction targets. The remaining 9% could be offset through the additional purchase of renewable energy credits or other means to be identified. As the CAP is reviewed and updated annually in 2020 and beyond, the renewable electricity supply will be reviewed to determine how the City is progressing in meeting the 100% renewable energy goal by 2035.

of renewable energy credits (see Action 2.1 for more detail). Currently, Marin Clean Energy has a 75% participation rate and has a default renewable content in its supply of of 50%.[16] Sonoma County has 87% participation rates in the first phase of implementation but expects to level off at 80%-85% participation of eligible customers.[17] Governor Jerry Brown recently signed legislation (SB 350) to increase the renewable electricity supply target to of 50% by 2030.[18]

We use the quantity of renewable energy supplied by a CCA or another program to adjust the baseline emissions factor of 736 lbs CO_2e/MWh from SDG&E supplied electricity. There is no effect from a CCA or another program until after 2020 because the CCA or another program is not implemented until after that date. By 2035 a CCA or another program would significantly affect the emissions factor of electricity with 100% renewable energy supply.

The Renewable Portfolio Standard (RPS) requires all California's electric service providers, including CCA or another program, to procure 50% of electricity sales from renewable sources by 2035. Therefore we attribute 50% of the total emissions reductions from achieving a 100% renewable supply (through the CCA or another program) to the RPS and the remaining to local action.[19]

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[16] Marin Energy Authority, 2013. Integrated Resource Plan Annual Update. Available at http://marincleanenergy.org/sites/default/files/key-documents/Integrated_Resource_Plan_2013_Update.pdf. See also: Understanding MCE's GHG Emissions Factors – Calendar Year 2012. Available at http://marincleanenergy.org/sites/default/files/key-documents/Att.%20A%20-%20Understanding%20MCE%20GHG's%20Emission%20Factor_2012_3%2021%202014.pdf.

[17] Sonoma Clean Power. 2014-2018 Resource Plan Draft, Version V0.4. Available at https://sonomacleanpower.org/wp-content/uploads/2014/08/SCP-Resource-Plan-Draft-v0.4-clean.pdf.

[18] Senate Bills 350 – Clean Energy and Pollution Reduction Act of 2015. Available at https://leginfo.legislature.ca.gov/faces/billNavClient.xhtml?bill_id=201520160SB350..

[19] Note that because SB 350 was not in force when the CAP was finalized in 2014, the emissions reductions attributable to this target were not specifically identified. Since the assumed levels of renewable energy supply in the CAP are already higher than this value, there is no change in total emissions reduced. Future updates to the CAP can reallocate the total emissions reduction from the Renewable Portfolio Standard to account for this change.

CA Solar Programs (Net-Metered and Shared Solar[20])

We consider solar as part of the overall supply of electricity for the City of San Diego rather than a demand reduction for the utility. For purposes of estimating emissions reductions in the CAP, we assume net-metered and shared solar is 100% renewable and has no associated greenhouse gas emissions. Energy produced by solar programs is also used to adjust the overall emissions factor for electricity. As more solar is installed it has a greater influence on the overall emissions factor, which declines as a result.

It is important to note that considering solar as a supply that serves a part of the overall energy demand of the City of San Diego allows for proper allocation of emissions reductions to solar. If solar is considered a demand reduction in a scenario of 100% renewable supply, then any type of solar would show no emissions reductions benefits.

Weighted Average Emissions Factor for Electricity

To develop the overall 2010 baseline emissions factor for electricity of 730 lbs CO_2e/MWh, we used a weighted average of all three supply categories described above: utility, CCA or another program, and solar programs. The 2010 baseline emissions factor was weighted by the percentage of gross generation supplied by each category and the percentage of renewable content in each category. In 2010, the only renewables contributions are from SDG&E and the net-metered portion of Solar Programs because no CCA or another program or shared solar were in existence. Using the methodology described in Utility (SDG&E) Supplied Electricity above the 2010 baseline emissions factor for electricity supplied by SDG&E is 736 lbs CO_2e/MWh. This emissions factor includes the effects of the existing 10% renewable content in the electricity supplied by SDG&E in that year (2010). The 2010 SDG&E supply baseline of 736 lbs CO_2e /MWh was adjusted down to 730 lbs CO_2e /MWh due to a small contribution of net-metered solar photovoltaics.[21]

[20] Net-metered solar are photovoltaics systems on the customer's premise that are interconnected to the electric distribution system. Shared solar are larger systems installed on the distribution system that provide energy to customers who opt into programs to supply all or a portion of electricity from these systems. Both categories of solar are described more in the Federal and State Actions Section below.
[21] Kavalec et al. 2013.

The same method is used to calculate the emissions factor for each year in the CAP time horizon. This allows for an accurate allocation of emissions between the categories of supply as the influence of each changes over time. Table 3 shows the contribution from each category to gross generation and overall renewable content, as well as the weighted average emissions factors.

Table 3 Weighted Average Emissions Factor and Contribution from each Category

Year	Gross Generation Supplied by SDG&E	Renewable Content in SDG&E Supply	Gross Generation Supplied by SDG&E Renewable	Gross Generation Supplied by CCA	Renewable Content in CCA Supply	Gross Generation Supplied by CCA Renewable	Gross Generation Supplied by Solar	Renewable Content in Solar Supply	Gross Generation Supplied by Solar Renewable	Weighted Average Emissions Factor (lbs CO2e/MWh)
2020	95%	33%	31%	0%	33%	0%	5%	100%	5%	518
2035	17%	50%	9%	70%	100%	70%	13%	100%	13%	72

In 2020, there is still no influence from a CCA or another program, solar programs supply an increasing portion of overall supply, and SDG&E has 33% renewable in its electricity supply. The combination of these factors adjusts the CO_2e lbs/MWh to 518 lbs CO_2e /MWh using this methodology. In 2035 when it is assumed that a CCA or another program supplies 80% of the remaining gross generation after solar with 100% renewable content, the renewable supply from the utility is increased to 50% to comply with the new renewable electricity supply targets[22], and solar reaches significant penetration levels, the weighted emissions factor for electricity is 72 lbs CO_2e/MWh.

This weighted average emissions factor was used to estimate the total reduction from measures affecting the overall emissions factor (e.g., Renewable Portfolio Standards, CCA or another program, and CA Solar Programs) The emissions reduction for each measure was calculated using gross generation and the difference between 2010 baseline emissions factor 730 lbs CO_2e/MWh and weighted average emissions factor in a given year (Table 4).

Table 4 Total Emissions and Emissions Reductions due to SDG&E, CCA and CA Solar Programs

Year	Gross Generation (GWh)	Baseline Emissions Factor (lbs CO_2e/MWh)	Weighted Emissions Factor (lbs CO_2e/MWh)	Total Emissions Using Baseline Emissions Factor (MMT CO_2e)	Total Emissions Use Weighted Emissions Factor (MMT CO2e)	Total Emissions Reduction (MMT CO_2e)
2010	9,580	730	730	3.17	3.17	-
2020	10,826	730	518	3.58	2.54	1.04
2035	13,910	730	72	4.61	0.45	4.16

[22] See CA Renewable Portfolio Standard in the Federal and State Actions section.

A method similar to that used to adjust the overall emissions factor for electricity was used to allocate the total emissions from changes in clean energy supply to the three categories described above. We allocate the total emissions reduction to each category using the percentage of the renewable content in gross generation from each category of total renewable content. These percentages are presented in Table 5. For example, in 2020 a total of 37% of gross generation was provided by renewable supply: 31% from SDG&E, 0% from CCA, and 5% from CA Solar Programs. Of the total gross generation provided by renewable supply, SDG&E provided 85% in 2020. To estimate the contribution of SDG&E attaining the Renewable Portfolio Standard targets of 33% renewable supply by 2020, we multiplied the total emissions reduction from Table 4 above of 1.04 MMT CO_2e by the total contribution to the overall percent renewable (85%) to yield 0.89 MMT CO_2e. .

Table 5 Emission Reduction from SDG&E, CCA and Solar Program

Category	2020			2035		
	% of Gross Generation Supplied by Renewable	**% Renewable from Each Category/Total**	**Emission Reduction (MMT CO_2e)**	**% of Gross Generation Supplied by Renewable**	**Renewable from Each Category/Total**	**Emission Reduction (MMT CO_2 e)**
SDG&E	31%	85%	0.89	9%	10%	0.40
CCA or another program	0%	0%	0.00	70%	77%	3.19
CA Solar Programs	5%	15%	0.15	13%	14%	0.57
Total	**37%**	**100%**	**1.04**	**91%**	**100%**	**4.16**

Relationship between GHG Emissions Rate and CAP Measures

The electricity emissions rate is an important factor in determining the emissions reductions that result from measures and actions in the CAP. Importantly, there is a relationship between the emissions rate and the amount of greenhouse gas reductions expected from CAP measures. For example, as the percentage of electricity provided by renewable sources increases, the electricity emissions factor decreases. Consequently, each reduction in electricity use or efficiency improvements would yield a smaller greenhouse gas reduction. On the other hand, as the total amount of electricity is reduced by efficiency, the total amount of renewable energy needed and the emissions reductions from increasing renewable energy supply declines.

Transmission and Distribution Losses

Electricity losses due to transmission and distribution are added to electricity consumed in order to account for the total quantity of electricity generated to serve energy demands and to ensure that all greenhouse gas emissions generated to serve total consumption are captured. If a specific quantity of end-use electricity is reduced due to efficiency measures, it is necessary to add transmission losses to account for the total emissions associated with that end use consumption because such actions offset the energy at the customer meter and the additional losses that would be incurred to deliver the electricity. A loss factor of 6.8% is used based on the 2014-2024 California Energy Commission's Energy Demand Forecast.[23]

Natural Gas

For all measures involving natural gas, we used an emissions factor of 0.0054 metric tons of CO2e per therm.[24] This represents emissions from natural gas from carbon-dioxide, methane, and nitrous oxide.

Transportation Related Measures

The following assumptions were used in calculating greenhouse gas reductions for measures related to transportation, including those in the Biking, Walking and Transit strategy.

Vehicle Miles Traveled (VMT)

EPIC used vehicle miles traveled (VMT) values for 2010, 2020 and 2035 from the California Air Resources Board's (CARB) Emissions Factor Model (EMFAC) 2011 model. Regional results were scaled to the City of San Diego on the basis of historical VMT ratios available from SANDAG.[25]

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[23] Kavalec et al. 2013.
[24] California Air Resources Board 2012 Greenhouse Gas Inventory documentation. Available at http://www.arb.ca.gov/cc/inventory/doc/doc_index.php.

Greenhouse Gas Emissions Factor for Transportation

The greenhouse gas emissions factor for vehicle miles traveled is the amount of greenhouse gas emissions associated with a mile driven. This value, expressed in grams of carbon dioxide equivalent per VMT (CO_2e/VMT), is used in several ways throughout the CAP, including to determine the emissions associated with on-road transportation for the overall emissions inventory and to estimate the emissions impact of measures in the CAP that affect both the rate of emissions (e.g., vehicle efficiency standards) and vehicle miles traveled (e.g., bike and walk policies).

The 2010 baseline emissions factor used in the CAP is based on regional results from the California Air Resources Board EMFAC 2011 model. EMFAC 2011 is used by regional transportation planning agencies in California to estimate air pollutants, including carbon emissions, from all on-road vehicles on all roads. EMFAC 2011 combines tested vehicle emission rate data with regional vehicle activity to provide greater accuracy for regional emissions. The EMFAC 2011 model also provides emission reductions from Pavley I and the Low Carbon Fuel Standard but it does not provide reductions expected from SB375 targets, and includes a *de minimis* level of miles driven by electric vehicles (EV) or other alternative fuel vehicles. Effects of the new CAFE standards that will apply to vehicles produced from 2017 to 2025 were also incorporated with the results from EMFAC 2011 to account for their effect on emissions.

Weighted Average Emissions Factor for Vehicle Miles Traveled

As with electricity, to properly account for the interdependencies of CAP actions in the transportation sector, EPIC developed a weighted emissions factor for VMT. Using the methodology described below, the 2010 baseline value is 499 grams CO_2e per mile. The 2020 value is 360 grams CO_2e per mile and for 2035 it is 278 grams CO_2e per mile.

We developed an emissions rate that is weighted according to the relative shares of each action affecting the emissions rate. Accordingly, EPIC identified the actions that affect the fleet-wide emissions rate: CAFE standards, the Low Carbon Fuel Standard (LCFS), and California electric vehicle policies and programs.

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[25] Total Daily Vehicle Miles of Travel (by City). Available at http://www.sandag.org/resources/demographics_and_other_data/transportation/adtv/index.asp.

Next EPIC determined the percentage reduction in emissions rate that each action has upon vehicles of the appropriate fuel type. For example, CAFE standards result in about a 30% reduction in the emissions rate as compared to the business-as-usual forecast. Electric vehicles resulting from state policies and programs offset gasoline VMT, and thus result in a 100% reduction in the emissions rate as compared to the business-as-usual forecast.

Next, EPIC identified the percentage of VMT associated with each action. Starting with the total VMT as stated in Table 2 we allocated miles driven by electric vehicles resulting from state policies and programs (Pavley I/CAFE standards and the LCFS). In this way, all miles are allocated among the three categories, similar to allocating the gross generation into three categories in the previous electricity measures section. Electric vehicles resulting from state policies and programs apply to 13% of the total VMT by this time.

Therefore the weighted emissions factor, when used to determine the greenhouse gas effects of an action that reduces VMT (or gasoline consumption) will allocate emissions reductions proportionately. This relation can also be used to determine the total greenhouse gas reductions resulting from the combination of the CAFE standards, LCFS, and California electric vehicles policies and programs. This is done in each year in the CAP time frame by multiplying the difference between the BAU emissions factor and the weighted emissions factor by the VMT amount avoided by a measure.

Finally, this combined greenhouse gas reduction can be apportioned to each of the three categories (CAFE, LCFS, and California electric vehicles policies and programs) according to their relative impact upon the weighted emissions rate. The relative impact of each action is a function of the product of the fractional reduction in the emissions rate for the relative fuel type and the fraction of the total VMT affected by the action.

Weighted Average Emissions Factor per Vehicle

A similar methodology as described above for the emissions factor for miles driven was used to determine the weighted average emissions factor for emissions per vehicle – a separate value from emissions per mile. These emissions occur when a fuel combustion vehicle is started and after the ignition is stopped. As the number of electric vehicles increases, this emissions factor is reduced because there are no emissions from an electric vehicle during the start and stop phases of use. Also, as vehicles become more fuel efficienct due to CAFE standards and fuel becomes less carbon intense due to the Low-Carbon Fuel Standard, the emissions per vehicle decreases. The baseline 2010 emissions factor for based on EMFAC2011 is 597 grams/vehicle/day decreasing to 467 grams CO2e/vehicle/day in 2020 and 401 grams CO2e/vehicle/day in 2035.

The CO_2e/vehicle/day emissions factor is used in combination with the CO_2e/mile factor to calculate the emissions reduction from measures.

Relationship between GHG Emissions Rate and CAP Measures

Because vehicle efficiency improves over time due to Pavley I, the CAFE standards, the LCFS, increased use of electric vehicles, the greenhouse gas intensity per mile decreases. Consequently, measures that reduce VMT offset a proportionally smaller greenhouse gas reduction over time.

Rounding of Values in Tables and Figures

Within the tables, charts, and figures found throughout the Appendices, rounding of values is often required. Conventional rounding is used throughout the document, meaning values are rounded to the nearest integer of a higher order of magnitude. Within the actual calculations however, values are not rounded at intermediary steps to avoid introducing unnecessary error. As a result of rounding, some totals may not equal the values summed.

CITY OF SAN DIEGO CAP MEASURES

The following presents calculated emissions reduction values for a series of city - based actions leading to GHG emissions reductions from the five main strategies of the CAP: Energy and Water Efficient Buildings; Clean and Renewable Energy; Biking, Walking & Transit; Zero Waste Management; and, Climate Resiliency.

Strategy 1: Energy & Water Efficient Buildings

Electricity consumption accounts for about 25% of citywide greenhouse gas emissions, while natural gas accounts for about 17%. Because approximately 80% of electricity use and 90% of natural gas use is associated with buildings, many of the measures included in the City of San Diego CAP target building energy use. There is also a strong connection between water use and energy use. Energy is required to transport, treat, heat, and cool water locally, as well as to produce electricity and transportation fuels. Overall, about 25% of California's combined electric and natural gas consumption is associated with water.[26] While a significant amount is used to move water around the state, the vast majority of energy is used to heat water, typically in residential units and businesses. Therefore, reducing use of water will positively impact both water and energy use resources.

The City of San Diego CAP includes 5 actions (Actions 1.1 to 1.5) to reduce emissions from energy and water use. The following provides information about the data and methods used to calculate the related energy and greenhouse gas emissions reductions.

Goal: Reduce Residential Energy Consumption

Action 1.1 Residential Energy Conservation and Disclosure Ordinance

For the Residential Energy Conservation and Disclosure Ordinance, we assumed that residential units being sold or remodeled would be required to disclose energy use. Additionally, we assumed that rented units would not be captured by this policy as renters may have no incentive to improve efficiency since there is no ownership interest in the property and the building owner may have no incentive since the

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[26] Energy Policy Initiatives Center estimate based on data from the California Energy Commission.

renter typically pays the energy costs. To calculate reductions from this measure, we first estimated the number of residential units affected by using the rate of remodels and additions and the rate of sales of residential units. According to the City of San Diego Development Services Department[27], approximately 0.5% of the existing stock of residential units in the City conducts a remodel or addition in an average year. According to the San Diego Association of Realtors, about 3% of the existing stock of residential units was sold in 2012 - 13 in the County of San Diego. [28] We assumed that the rate was the same for residential units in the City of San Diego. To account for the fact that rented units would not be captured by this policy, we assumed that 48% of residential units – applied equally to multi- and single-family units – were owner occupied, according to the U.S. Census Bureau.[29] To eliminate the possibility of double counting, we reduced the total quantity of owner-occupied units by the amount that already was affected by the policy. As a result, approximately 20% of single - family and multi - family owner-occupied units would be affected by this local disclosure policy by 2020 and approximately 50% of single-family and multi-family owner-occupied units in 2035. We then multiplied this value by the number of single and multi-family units in the City to determine the total number of units disclosing energy use. Of those disclosing energy use, we assumed that 12% implemented efficiency activities and, therefore, multiplied the number of units disclosing energy use by 12% to determine the number of units implementing efficiency activities.[30]

To estimate the total energy and emissions reductions associated with this policy, we assumed that each participating unit reduced energy use by 15%[31] below the average residential energy consumption value.[32] We then calculated average residential electric and natural gas consumption per unit by dividing total consumption by the total number of units (single and multi-family). We then determined the reduction in electric and natural gas consumption per unit by multiplying the resulting values by 15%.

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[27] Communication with City of San Diego Development Services, email on 19 December 2013.
[28] San Diego County Association of Realtors, 2013. Comparative Sales of Existing Homes in San Diego County.
[29] U.S. Census Bureau. Available at http://www.census.gov/.
[30] Climate Leadership Academy Network, 2010. Case Study: Austin, Texas, Using Energy Disclosure to Promote Retrofitting. Available at https://stuff.mit.edu/afs/athena/dept/cron/project/urban-sustainability/Energy%20Efficiency_Brendan%20McEwen/Cities/Austin/austin_energy_disclosure.pdf.
[31] Based on data from the Energy Upgrade California program in SDG&E service territory.
[32] Kavalec et al. 2013.

The values were multiplied by total number of residential units implementing efficiency activities and respective emissions factors, and then summed for each year to determine GHG reductions from the action for 2020 and 2035. Because this measure is dependent on a number of residential housing units per year, the greenhouse gas reduction is based on a 2015 start date. Also as the electric emissions factor declines over time, as the electricity supply comprises more and more renewable sources, the greenhouse gas reductions from efficiency decline accordingly. Energy reductions associated with natural gas are not affected by this trend. Table 6 summarizes key assumptions and results.

Table 6 Key Assumptions and Results Residential Energy Conservation and Disclosure Ordinance

Year	Total Owner Occupied Single Family Units[33]	Total Owner Occupied Multi Family Units[34]	Percent of Units Sold Annually[35]	Percent of SF Units Remodeled Annually[36]	Percent of MF Units Remodeled Annually[37]	Total Percent of SF & MF Units Disclosing Energy Use	Total Units Disclosing Energy use	Percentage of Units that Implemented Efficiency Activities[38]	Total Units Implementing Efficiency Activities
2020	137,405	137,604	3.0%	0.5%	0.5%	20%	52,699	12%	6,324
2035	133,286	179,623	3.0%	0.5%	0.5%	50%	149,492	12%	17,939

Year	Average Residential Electric Consumption per Unit	Electricity Reduction per Unit	Electricity Reductions	Average Residential Natural Gas Consumption per Unit	Natural Gas Reduction per Unit	Natural Gas Reductions	GHG Reductions from Action 1.1
	(kWh/yr)	(kWh/yr)	(GWh)	(Therms/yr)	(Therms/yr)	(MM Therms)	(MT CO_2e)
2020	7,101	1,065	6.7	319	48	0.3	3,218
2035	8,460	1,269	22.8	334	50	0.9	5,605

33 SANDAG Forecast Housing Data
34 SANDAG Forecast Housing Data
35 San Diego County Association of Realtors 2013.
36 Communication with City of San Diego Development Services, email on 19 December 2013.
37 Communication with City of San Diego Development Services, email on 19 December 2013.
38 Climate Leadership Academy Network 2010.

Goal: Reduce Municipal Energy Consumption

Action 1.2 City of San Diego's Municipal Energy Strategy and Implementation Plan

To estimate the emissions reductions associated with this local action, we assume that the City adopts a policy to reduce overall energy use by 15% in 2020 and an additional 25% in 2035.[39] We also assume City energy consumption will increase at a rate of 1.5% annually from 2010 levels, consistent with internal forecasting methods.[40] Additionally, the reduction was applied equally to electricity and natural gas consumption.

To calculate GHG reductions from energy reductions in 2020 and 2035, electricity and natural gas consumption from City operations[41] was multiplied by the respective energy reduction (15% for 2020 and 25% for 2035). Those reductions were multiplied by the emissions factors for electricity and natural gas, respectively, and summed to determine total GHG reductions.[42]

Also as the electric emissions factor declines over time, as the electricity supply comprises more and more renewable sources, the greenhouse gas reductions from efficiency decline accordingly. Energy reductions associated with natural gas are not affected by this trend. Table 7 summarizes the key assumptions and results.

Table 7: Key Assumptions and Results for Municipal Energy Strategy and Implementation Plan

Year	Overall Energy Reductions[43]	Electricity Reductions (GWh)	Natural Gas Reductions (MM Therms)	GHG Reductions (MT CO_2e)
2020	15%	36	0.6	11,580
2035	25%	75	1.2	9,011

[39] Goldman et al. 2005.
[40] Communication with City of San Diego Department of Environmental Services, conversation 17 February 2015.
[41] Municipal energy consumption provided by the City of San Diego.
[42] "Common Assumptions and Sources" Section, this document.
[43] Goldman et al. 2005.

Goal: Reduce Daily Per Capita Water Consumption

The water use reduction goal for the City of San Diego is based on SB X7 to achieve a daily per capita consumption of 142 gallons by 2020.[44] The city target for 2035 is to achieve a daily per capita consumption of 100 gallons. The CAP includes three actions that result in per capita water consumption reduction from its *projected* per capita use in 2020 and 2035: water rate structures that encourage water conservation and reuse, a water conservation and disclosure ordinance, and an outdoor landscaping ordinance.

We used the following assumptions to estimate the GHG reductions from reducing water use.

- Energy Reduction – The energy reduction associated with a decrease in water use is calculated on the basis of the most recent data available for the energy intensity for the four of the five stages of water supply and use in the City. The five stages are: water supply and conveyance, water treatment, water distribution, end‐use, and wastewater treatment. Each stage has a different intensity of energy (see below and Table 8). We do not include the energy use related to water supply and conveyance from upstream as this component is not included in the 2010 inventory.
- Water Consumption Levels –The reported 2010 per capita use in the City was 151gallons.[45] This includes residential, commercial, industrial, institutional and irrigational uses as well as system losses.
- Energy Intensity of Water – Table 8 provides the energy intensity factors used to estimate water‐related GHG reductions in the CAP.

Table 8: Energy Intensity of Water for City of San Diego

Stage of Energy Use	Energy Intensity (kWh per Million Gallons)
Water Treatment[46]	111
Water Distribution[47]	1,272
End Use[48]	11,968

[44] Brown and Caldwell, 2011. Urban Water Management Plan 2010 (Section 3.3, Method 3). Available at http://www.sandiego.gov/water/pdf/uwmp2010.pdf.
[45] Brown and Caldwell, 2011. Urban Water Management Plan 2010 (Table 3-10). Available at http://www.sandiego.gov/water/pdf/uwmp2010.pdf.
[46] Navigant Consulting, Inc., 2006. Refining Estimates of Water‐Related Energy Use in California, CEC–500–2006-118. Available at http://www.energy.ca.gov/2006publications/CEC-500-2006-118/CEC-500-2006-118.PDF
[47] See above, Navigant Consulting, Inc. 2006.
[48] Natural Resources Defense Council (NRDC). Energy Down the Drain. (2004) Figure 4. https://www.nrdc.org/water/conservation/edrain/edrain.pdf End use energy intensity was converted from 3900 kWh/acre-foot to 11,968 kWh/million gallons.

- **Greenhouse Gas Emissions Factor for Electricity** –The greenhouse gas emissions factor for electricity used to move water varies depending on the actions included in the CAP. The 2010 weighted GHG intensity value is 730 lbs CO_2e/MWh.[49]

[49] Refer to Weighted Average Emissions Factor for Electricity section in this document.

Action 1.3 New Water Rate and Billing Structure

Proposition 218 authorizes rate increases that could be passed on to customers contingent upon City Attorney review followed by Council adoption.[50] Based on a proposal by City of San Diego Public Utilities Department, there was an increase in water rates of 7.25% in 2014 compared with 2012 and an additional 7.5% increase in 2015 compared to 2012.[51] We assume an additional rate increase of 15% by year 2020, 25% increase by year 2030, and 30% increase by year 2035, which is lower than the historical rate increase of 7.6% annually from 2007-2013[52]. The elasticity of water use due to rates was set at -0.2 based on a 2009 CEC study of residential water use in California.[53] This means that a 7.5% increase in water rates would result in a 1.5% reduction in usage. The elasticity was kept constant at -0.2 through 2035.

Rate increases are assumed to reduce electricity use associated with water distribution, treatment, and a portion (20%) of the end-use energy use.[54] Natural gas constitutes the majority of end use energy use and accounts for about of about 80% of total end-use energy consumption.

To determine the GHG emissions reductions from a potential new water rate billing structure we first developed a BAU water consumption projection through 2035 using the total BAU per capita consumption and population forecasts. Next, the water use reduction for a given year was determined taking the consumption in the previous year and deducting the product of the rate increases, the water price elasticity, and the previous year's consumption. Next, the water use reduction was converted into (1) electricity reduction using the water treatment energy intensity (111 kWh/Million Gallons)[55], the water

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[50] Proposition 218 Notice. Available at http://docs.sandiego.gov/councilcomm_agendas_attach/2013/NRC_130731_5b.pdf.
[51] Proposition 218 Notice.
[52] City of San Diego Water Branch of Public Utilities. Rate Increases. Available at http://www.sandiego.gov/water/rates/increases/. (Note: These documents show that rates have increased by more than 7% per year over the last 7 years. Therefore, an annual increase of 15% over the next 15 years appears conservative and reasonable.)
[53] Dale, Larry, Fujita, Sydney K., Lavin Vasquez, Felpie, Moezzi, Mithra, Hanemann, Michael, Lutzenhiser, Loren, 2009. Price Impact of the Demand for Water and Energy in California Residences. California Climate Change Center. Available at http://eetd.lbl.gov/sites/all/files/price_impact_on_the_demand_for_water_and_energy_in_califoria_residences_cec-500-2009-032-f.pdf.
[54] EPIC's calculations based on electricity use for water end uses available from Natural Resources Defense Council (NRDC). Energy Down the Drain. (2004) Figure 4.and natural gas data from **CEC** http://www.energy.ca.gov/2005publications/CEC-700-2005-011/CEC-700-2005-011-SF.PDF **Table 1-6.**
[55] Navigant Consulting, Inc. 2006.

distribution energy intensity (1,272 kWh/Million Gallons)[56], and the end use energy intensity (11,968 kWh/Million Gallons)[57], and (2) natural gas reductions using the million therms conversion factor. Finally, the energy reductions are used to determine the emissions reductions using the greenhouse gas emission factors for electricity and natural gas.

Also the electric emissions factor declines over time. As the electricity supply comprises more and more renewable sources, the greenhouse gas reductions from efficiency decline accordingly. Energy reductions associated with natural gas are not affected by this trend. Table 9 summarizes the key assumptions and results.

Table 9: Key Assumptions and Results for Updated Water Rate and Billing Structure

Year	Total BAU Water Consumption[58]	Cumulative Increase in Water Rates by Target Year[59]	Reduction in Daily Per Capita Water Consumption Due to Water Rate Structure	Daily Per Capita Water Use after New Rate and Billing Structure	Target Daily per Capita Water Use	GHG Reductions from Water Rate Structure
	(Gallons/Year)	(%)	(Gallons)	(Gallons)	(Gallons)	(MT CO_2e)
2020	85,005,187,260	15%	4.4	146.6	141	12,210
2035	96,962,221,165	30%	8.7	142.3	100	12,277

[56] Navigant Consulting, Inc. 2006.
[57] Natural Resources Defense Council (NRDC). Energy Down the Drain. (2004) Figure 4. https://www.nrdc.org/water/conservation/edrain/edrain.pdf End use energy intensity was converted from 3900 kWh/acre-foot to 11,968 kWh/million gallons.
[58] Brown and Caldwell, 2011. Urban Water Management Plan 2010 (Table 3-10). Available at http://www.sandiego.gov/water/pdf/uwmp2010.pdf.
[59] Proposition 218 Notice.

Action 1.4 Water Conservation, Disclosure, and Ordinance

Reductions were based on reported water use decreases in the City of Berkeley due to their Commercial and Residential Conservation Ordinances that resulted in a 17% absolute consumption decrease over 13 years, from 2000 to 2013, or 2% per year from all households. We applied this 2% decrease per year to residential water use. We assume that the water reductions would occur through a Water Conservation and Disclosure Ordinance presented to the City Council for consideration. The ordinance would result in indoor water-saving measures such as low - flow toilets and showers, similar to those required by the City of Berkeley.[60]

The effects of the water conservation and disclosure ordinance were determined as follows. First, the total BAU water consumption was determined using the total BAU per capita consumption and population forecasts.[61] The City of San Diego set conservation targets of an additional 4 gallons per capita per day in 2020 (beyond the water rate measure reduction) and 9 gallons per capita per day in 2035 (beyond the water rate measure reduction). To test the feasibility of this, we calculated the corresponding cumulative reduction in indoor water consumption in single-family residential units. The results appear feasible in view of the reported decreases in the City of Berkeley. Next, the water conservation was converted into (1) electricity reductions using the water treatment energy intensity (111 kWh/Million Gallons)[62], the water distribution energy intensity (1,272 kWh/Million Gallons)[63], and the end use energy intensity (11,968 kWh/Million Gallons)[64], and (2) natural gas reductions using the standard greenhouse gas conversion factor.[65] Finally, the energy reductions are used to determine the equivalent emissions using the greenhouse gas emissions factor for electricity and natural gas.

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[60] Burroughs, Timothy, 2011. Berkley's Climate Action Plan: Tracking our Progress. Office of Energy and Sustainable Development, City of Berkley. Available at http://epa.gov/statelocalclimate/documents/pdf/burroughs_presentation_12-7-2011.pdf.
[61] Brown and Caldwell, 2011. Urban Water Management Plan 2010 (Table 3-10). Available at http://www.sandiego.gov/water/pdf/uwmp2010.pdf.
[62] Navigant Consulting, Inc. 2006.
[63] Navigant Consulting, Inc. 2006.
[64] Natural Resources Defense Council (NRDC). Energy Down the Drain. (2004) Figure 4. https://www.nrdc.org/water/conservation/edrain/edrain.pdf End use energy intensity was converted from 3900 kWh/acre-foot to 11,968 kWh/million gallons.
[65] Navigant Consulting, Inc. 2006.

Because this measure is dependent on a number of residential housing units per year, the greenhouse gas reduction is based on a 2015 start date. Also, as the electric emissions factor declines over time, as the electricity supply comprises more and more renewable sources, the greenhouse gas reductions from efficiency decline accordingly. Energy reductions associated with natural gas are not affected by this trend. Table 10 summarizes key assumptions and results for this measure.

Table 10: Key Assumptions and Results from Water Conservation and Disclosure Ordinance

Year	Daily per Capita Reduction in Indoor Water Consumption in Residential Single Family Homes due to Point of Sale Disclosure Measure (Gallons)	Daily per Capita Water Use After Point of Sale Disclosure Measure + Rate Measure (Gallons)	Target Daily per Capita Water Use (Gallons)	GHG Reductions from Disclosure Ordinance (MT CO2e)
2020	4	143	141	12,589
2035	9	133	100	21,470

Action 1.5 Outdoor Landscaping Ordinance

This action is designed to address outdoor water use only, and reductions are based on a study by the Irvine Ranch Water District that found a reduction potential of over 43 gallons per household per day.[66] We assumed this rate is valid for the City of San Diego given similarity in climate, and it was applied to outdoor water use to determine possible water use reductions. Outdoor water use constitutes the majority, or about 58%[67] of total water use in San Diego. The water reductions were converted to electricity reductions, and therefore GHG emissions. When calculating energy reductions from this action, only electricity reductions from distribution and treatment were included since outdoor water is not subject to wastewater treatment and there is no natural gas reductions associated with outdoor water use.

To determine the effects of an outdoor landscaping ordinance, we developed a BAU projection for water consumption using the total BAU per capita consumption and population forecasts.[68] The City of San Diego set outdoor water conservation targets of 3 gallons per capita per day in 2020 (beyond the above two water measures) and 5 gallons per capita per day in 2035 (beyond the above two water reduction measures). The corresponding reduction in outdoor water consumption is well within the range of the results of the Irvine Ranch Water District findings. Since there is no end use electricity or natural gas associated with outdoor water use, the total greenhouse gas reductions were determined using only the water treatment energy intensity (111 kWh/Million Gallons)[69] and the water distribution energy intensity (1,272 kWh/Million Gallons).[70] The quantity of energy reductions was multiplied by the emissions factor for electricity in that year.

Because electric emissions factor declines over time, as the electricity supply comprises more and more renewable sources, the greenhouse gas reductions from efficiency decline accordingly. Energy reductions

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[66] ConSol, 2010. Water Use in the California Residential Home. California Homebuilding Foundation. Available at http://www.cbia.org/go/cbia/?LinkServID=E242764F-88F9-4438-9992948EF86E49EA.
[67] Brown and Caldwell, 2011. Urban Water Management Plan 2010 (Table 3-10). Available at http://www.sandiego.gov/water/pdf/uwmp2010.pdf.
[68] Brown and Caldwell, 2011. Urban Water Management Plan 2010 (Table 3-10 & 3-12). Available at http://www.sandiego.gov/water/pdf/uwmp2010.pdf.
[69] Navigant Consulting, Inc. 2006. Available at http://www.energy.ca.gov/2006publications/CEC-500-2006-118/CEC-500-2006-118.PDF.
[70] Navigant 2006.

associated with natural gas are not affected by this trend. Table 11 summarizes key assumptions and results.

Table 11 Key Assumptions and Results for Outdoor Landscaping Ordinance

Year	Daily per Capita Water Use Reduction due to Outdoor Ordinance (Gallons)	Daily per Capita Water Use After Outdoor Landscape Ordinance + Point of Sale + Rate Measures (Gallons)	Target Daily per Capita Water Use (Gallons)	GHG Reductions from Landscaping Ordinance (MT CO_2e)
2020	3	140	141	2,090
2035	5	128	100	653

Strategy 2: Clean and Renewable Energy

The City of San Diego is committed to a goal of supplying 100% of electricity needs in the City by renewable sources by 2035.

Goal: 100% Renewable Energy Supply to the City by 2035

Action 2.1 Community Choice Aggregation Program or Another Program

As described in the Greenhouse Gas Emissions Factor for Electricity section above, several categories of supply contribute to the goal of reaching 100% renewable electricity supply by 2035, including the renewable electricity supply by the utility (SDG&E), CA Solar Programs (net energy metered solar and shared solar), and a community choice aggregation (CCA) program or another program. Given the assumptions included in the CAP for those categories, 91% of electricity supply would be renewable by 2035. This level of renewable supply still allows the City to achieve the target reduction 10,223,523 Metric Tons CO2e/Year by 2035, which puts the City on pace to achieve the 2050 greenhouse gas reduction targets. The remaining 9% could be offset through the additional purchase of renewable energy credits or other means to be identified. As the CAP is reviewed and updated annually in 2020 and beyond, the renewable electricity supply will be reviewed to determine how the City is progressing in meeting the 100% renewable energy goal by 2035.

To estimate the effect of policies due to a CCA or another program, it is necessary to account for the interaction among the categories of supply. The percentage of electricity and renewable content attributed by CA Solar Programs, CCA or another program, and the investor-owned utility supplier are given in Table 3. As mentioned above in the Greenhouse Gas Emissions Factor for Electricity section, we assume that 80% of eligible customers participate in a CCA or another program and therefore 80% of the total remaining electricity is supplied by the CCA or another program. Currently, Marin Clean Energy has 75% participation and has a renewable content of 50%.[71] Sonoma County has 87% participation rates in

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[71] Marin Energy Authority, 2013. Integrated Resource Plan Annual Update. Available at http://marincleanenergy.org/sites/default/files/key-documents/Integrated_Resource_Plan_2013_Update.pdf. See also: Understanding MCE's GHG Emissions Factors – Calendar Year 2012. Available at http://marincleanenergy.org/sites/default/files/key-

the first phase of implementation but expects to level off at 80%-85% participation of eligible costumers.[72]

To estimate the greenhouse gas reductions from Action 2.1, we assume that all the electricity provided by a CCA or another program is 100% renewable in 2035 through a combination of renewable supply and purchase of renewable energy credits; however, it is reasonable to assume that the electricity supply to customers of a CCA or another program would comprise 75% renewable content. The remaining emissions would be offset with renewable energy credits. As described above, Governor Jerry Brown recently signed legislation to increase the renewable portfolio standard supply targets to 50% renewable electricity by 2030.[73] Table 12 below shows the role of each category of supply toward the goal of reaching the 100% renewable electricity target by 2035.

Table 12: Contribution of Electricity Supply Categories to 100% Renewable Target

Category	Percentage of Total Electricity Supply in 2035	Percentage of Supply from Renewables in 2035	Percentage of TOTAL supply from Renewables in 2035
Utility	17%	50%	9%
CA Solar Programs	13%	100%	13%
CCA or Another Program	70%	100%	70%
Total	100%	N/A	91%

documents/Att.%20A%20-%20Understanding%20MCE%20GHG's%20Emission%20Factor_2012_3%2021%202014.pdf.
[72] Sonoma Clean Power. 2014-2018 Resource Plan Draft, Version V0.4. Available at https://sonomacleanpower.org/wp-content/uploads/2014/08/SCP-Resource-Plan-Draft-v0.4-clean.pdf.
[73] Senate Bills 350 – Clean Energy and Pollution Reduction Act of 2015. Available at https://leginfo.legislature.ca.gov/faces/billNavClient.xhtml?bill_id=201520160SB350. Note that because SB 350 was not in force when the CAP was finalized in 2014, the emissions reductions attributable to this target were not specifically identified. Since the assumed levels of renewable energy supply in the CAP are already higher than this value, there is no change in total emissions reduced. Future updates to the Cap can reallocate the total emissions reduction from the Renewable Portfolio Standard to account for this change. .

To estimate the greenhouse gas reductions from a CCA or another program for 2035, the total emission reductions from the categories above were allocated using the method described in Greenhouse Gas Emissions Factor for Electricity section and Table 5. Because a CCA is required to comply with the statewide 50% renewable electricity requirement, a portion of the total emissions reduction from a CCA or another program can be attributable to this policy, while the remaining emissions impacts associated with renewable supply from 51%-100% are allocated to local action. In 2035, CCA or another program seeks to achieve a 100% renewable supply, so half of the emission reductions are separated out and attributed to RPS. The breakdown of CCA-RPS and CCA-Local Action is presented in Table 13 below.

Table 13 Result for Community Choice Aggregation or another program in 2035

Category	**2035**	
	% Renewable in the Supply	**GHG Reductions (MT CO2e)**
CCA-RPS	50%	1,592,878
CCA-Local Action 2.1	50%	**1,592,878**
CCA-Total	100%	3,185,755

Because of the interrelated nature of the actions in the CAP, as the greenhouse gas emissions intensity of electricity decreases throughout 2035, measures implemented in 2035 to reduce electricity yield little emissions reductions. However, the electricity reductions are accounted for in the overall calculations.

Goal: Increase Municipal Zero Emissions Vehicles

Action 2.2 Municipal Zero Emissions Vehicles

The City of San Diego maintains a fleet of more than 1,000 vehicles for municipal operations.[74] Converting the municipal passenger vehicle fleet gradually to EVs will reduce gasoline use, thereby reducing GHG emissions. The City of San Diego provided current municipal fleet gasoline consumption data. We assumed that there would be no changes in 2020 and 2035 to this gasoline demand for its municipal passenger vehicle fleet. The City's goals are to convert 50% of gasoline fleet to EV's by 2020 and 90% of gasoline the gasoline fleet to EV's by 2035. If the City of San Diego amends AR 90.73 to incorporate the fleet conversion goals, then the target greenhouse gas reductions for this action can be met.

To determine the effects of converting the municipal fleet to EV's we followed these steps. First, we determined the amount of greenhouse gas emissions produced by combusting the gasoline used by the municipal fleet. Next, we multiplied this value by the fleet conversion targets. This results in the total emissions offset if the city achieves its conversion targets. Table 14 summarizes key assumptions and results.

Table 14 Key Assumptions and Results for Municipal Fleet Conversion to Zero Emissions Vehicles

Year	Gasoline Consumption[75]	CO_2e per Gallon of Gas[76]	GHG From Gasoline Use	Gasoline Fleet VMT Converted to EVs	GHG Reduced Due to EV Conversion
	(Gallons)	(Pounds)	(MT CO_2e)	(%)	(MT CO_2e)
2020	2,598,220	20.62	24,288	50%	12,144
2035	2,598,220	20.62	24,288	90%	21,859

Goal: Convert Municipal Waste Collection Trucks to Natural Gas

[74] Municipal Fleet Fuel Consumption provided by the City of San Diego.
[75] Municipal Fleet Fuel Consumption provided by the City of San Diego.
[76] United State Energy Information Administration. How much carbon dioxide is produced by burning gasoline and diesel fuel? Available at http://www.eia.gov/tools/faqs/faq.cfm?id=307&t=11.

Action 2.3 Convert Municipal Waste Collection Trucks to Low Emission Fuel

The City of San Diego seeks to reduce emissions associated with hauling municipal solid waste by converting from diesel fuel use to compressed natural gas. The conversion leads to a net reduction in GHGs despite an increase in emissions due to natural gas consumption. It was assumed that the energy needs of the City Collection Services fleet would remain the same through 2035.

To determine the effects of converting the municipal waste fleet to low emissions fuels, we did the following. First, we multiplied the total fleet diesel fuel use[77] by the fleet conversion targets[78] in order to determine the diesel fuel reduction amount. Next we multiplied the diesel fuel reduction by the CO_2 per pound value for diesel fuel[79] to obtain the business-as-usual waste fleet emissions. Next, we offset the emissions reduction by the increased natural gas emissions. The result is the net reductions in greenhouse gas emissions as a result of converting the waste fleet to natural gas. Table 15 summarizes key assumptions and results.

Table 15 Key Assumptions and Results for Municipal Waste Collection Truck Conversion to Low Emission Fuel

Year	Annual Diesel Fuel Use by Waste Fleet Before Conversion[80]	Total Diesel Fuel Emissions Before Conversion	% of Fleet Converted to NG[81]	Diesel Fuel Reduction	CO_2 per pound for Diesel[82]	Emissions Reductions Due to Diesel Fuel Offsets	Total Annual Emissions Associated with Fleet NG Consumption	Net GHG Reduced
	(Gallons)	(MT CO_2e)	(%)	(Gallons)		(MT CO_2e)	(MT CO_2e)	(MT CO_2e)
2020	1,000,000	10,151	20%	200,000	22.4	2,020	1.4	2,018
2035	1,000,000	10,151	100%	1,000,000	22.4	10,151	7.2	10,144

77 Personal communication with the City of San Diego, November 2010.
78 City of San Diego. Conversion of the waste collection fleet will commence in 2018 with the goal to achieve complete conversion by 2035.
79 Annual Energy Outlook 2012, DOE/EIA-0383 June 2012, page 37. (Note: We assumed that the energy content of diesel remains constant in 2020 and 2035 at 129,500 British Thermal Units (BTU) per gallon of diesel.)
80 Personal communication with the City of San Diego, November 2010.
81 City of San Diego. Conversion of the waste collection fleet will commence in 2018 with the goal to achieve complete conversion by 2035.
82 Annual Energy Outlook 2012, DOE/EIA-0383 June 2012, page 37. (Note: We assumed that the energy content of diesel remains constant in 2020 and 2035 at 129,500 British Thermal Units (BTU) per gallon of diesel.)

Strategy 3: Bicycling, Walking, Transit & Land Use

The transportation sector accounts for over 50% of all GHG emissions within the City of San Diego. The CAP includes eight transportation actions. The effects of regional action under SB 375 (i.e., telecommute, carpool, vanpool, buspool, bottleneck Relief, HOV/HOT lanes) were calculated in the Regional Action Section below. As explained in the that Section, GHG emissions reductions from mass transit, bicycle and walking were separated from that calculation since stakeholders were interested in assessing local impacts of measures related to mass transit, walking and biking. The amount of GHG reductions depends on the percentage mode share of commuters by transit, walking and bicycle. The following measures are restricted to GHG reductions from only commuter mode shares, which will nonetheless have co - benefits for all users of alternative transportation. The GHG reduction amount is based on the projected number of employed persons in Priority Transit Areas (TPAs). The projected employment numbers for these areas were modeled by SANDAG for the City.

Goal: Increase Use of Mass Transit

Action 3.1 Mass Transit

According to the American Community Survey[83], about 4% of city commuters used mass transit in 2010. Under the current Regional Transportation Plan (RTP) 2050[84], SANDAG expects this value to increase to about 7.8% in 2020 and about 10.1% in 2035 by increasing transit frequency, providing incentives, and adding new routes. Based on current transit mode share in TPAs[85], the City planners and transportation engineers we consulted anticipate that by prioritizing these areas for transit improvements, it will be possible to achieve 12% commuter transit (peak period) mode share in 2020 and 25% commuter transit (peak period) mode share in 2035 in these high density areas. These goals are 4.2% greater than the regionally projected transit mode share for 2020 and 13% greater for 2035.

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[83] American Community Survey Briefs 2008 and 2009 (Table 2), for San Diego-Carlsbad-San Marcos area.
[84] SANDAG RTP 2050.
[85] City of San Diego Planning Department. Pedestrian Mobility Plan. Available at http://www.sandiego.gov/planning/programs/transportation/mobility/pedestrian.shtml, Appendix D for current pedestrian mode shares. The Bicycle Master Plan is available at http://www.sandiego.gov/planning/programs/transportation/mobility/bicycleplan.shtml. Current bicycle mode shares are derived from Tables 5.12 and include college commuters.

To determine the GHG emissions reductions from mass transit, we used the total employment numbers in TPAs provided by the City of San Diego as an estimate of commuters in TPAs Transit Areas.[86] Next, the target ridership within TPAs of 12% in 2020 and 25% in 2035 is applied to the total number of *potential* commuters to obtain the target number of commuters in TPAs. Next, this value is multiplied by the average round trip commute distance (25 miles) and the number of working days per year (255) to obtain the total VMT offset by mass transit ridership in TPAs. Finally, the VMT is multiplied by the weighted fleet emissions factor derived from EMFAC2011 to obtain the total greenhouse gas emissions offset by mass transit ridership in Priority Transit Areas. This is discussed in detail in Greenhouse Gas Emissions Factor for VMT section above. Table 16 summarizes key assumptions and results.

Table 16 Key Assumptions and Results for Mass Transit

Year	Labor Force in TPAs[87]	Mass Transit Commuter Ridership in TPAs (%)	Projected Number of Commuters Using Mass Transit in TPAs	Average Commute Distance of Labor Force Living in TPAs (Miles)	VMT Avoided due to Mass Transit Use	GHG Reduced (MT CO_2e)
2020	433,128	12%	51,977	25	331,350,936	119,234
2035	482,540	25%	120,635	25	769,048,125	213,573

[86]Personal Communication with City of San Diego, 18 February 2015.
[87] Personal Communication with City of San Diego, email 18 February 2015.

Goal: Increase Commuter Walking Opportunities

Action 3.2 Commuter Walking

The City of San Diego Pedestrian Master Plan of 2006 provides estimates for walking mode share in all the Community Planning Areas of the City.[88] We assume an increase in pedestrian commuter mode share from 3.5% for the whole city in 2006 (assumed for 2010, same as 2006) to 4.1% in 2020 and 6.5% in 2035 in Transit Priority Areas. It is assumed that commuter walking will lead to an avoidance of 0.67[89] miles per day per commuter in 2020 and 2035.

The effects of increased commuter walking opportunities were determined as follows. The City of San Diego provided the total employment numbers in TPAs as an estimate of commuters in TPAs Transit Areas.[90] Next, the mode share targets are applied to determine the projected number of walking commuters. Finally, this value is multiplied by the round-trip commute distance and the number of working days per year to obtain the total VMT offset by commuter walking. Finally, the VMT is multiplied by the weighted fleet emissions factor derived from EMFAC2011 to obtain the total greenhouse gas emissions offset by mass transit ridership in Priority Transit Areas. Table 17 summarizes key assumptions and results.

Table 17 Key Assumptions and Results for Commuter Walking

Year	Labor Force in TPAs[91]	Mode Share Goals in TPAs	Projected Number of Commuters Commuting by Walking	Round-trip Commute Distance	VMT Avoided Due to Pedestrian Commuters	GHG Reduced
		(%)		(Miles)	(Miles)	(MT CO_2e)
2020	433,128	4.1%	17,759	0.67	3,034,070	1,092
2035	482,540	6.5%	31,365	0.67	5,358,727	1,488

[88] City of San Diego Planning Department. Pedestrian Mobility Plan. Available at http://www.sandiego.gov/planning/programs/transportation/mobility/pedestrian.shtml, Appendix D for current pedestrian mode shares.
[89] Personal communication with SANDAG, email 9 January 2015.
[90] Personal Communication with City of San Diego, email 18 February 2015.
[91] Personal Communication with City of San Diego, email 18 February 2015.

Goal: Increase Commuter Bicycling Opportunities

Action 3.3 Commuter Bicycling

The City of San Diego Bicycle Master Plan of 2013 projects a 279% increase in bicycle commuters by 2022. Based on this and discussions with City staff and transportation experts, implementation of the Bicycle Master Plan could lead to increases in commuter bicycle mode share from less than 2% in 2010 to 6% in 2020 and 18% in 2035 in Priority Transit Areas.[92]

The effects of increased commuter biking opportunities were determined as follows. The City of San Diego provided the total employment numbers in TPAs as an estimate of commuters in TPAs.[93] Next, the mode share targets are applied to determine the projected number of biking commuters. This value is then multiplied by the round-trip commute distance and the number of working days per year to obtain the total VMT offset by commuter biking. Finally, the VMT is multiplied by the fleet emissions rate derived from EMFAC2011 to obtain the total greenhouse gas emissions offset by mass transit ridership in Priority Transit Areas. Table 18 summarizes the key assumptions and results.

Table 18 Key Assumptions and Results for Commuter Bicycling

Year	Labor Force in TPAs[94]	Mode Share Goals in TPAs (%)	Projected Number of Commuters Commuting by Bike	Round-trip Commute Distance (Miles)	VMT Avoided Due to Bicycle Commuters (Miles)	GHG Reduced (MT CO_2e)
2020	433,128	6.0%	25,988	8	53,016,150	19,077
2035	482,540	18.5%	89,270	8	182,110,596	50,574

[92] City of San Diego Bicycle Master Plan, Prepared by Alta Planning and Design, available at http://www.sandiego.gov/planning/programs/transportation/mobility/bicycleplan.html. Table 5-12 for estimates of mode shares in the City. Personal communication with Dr. S Ryan and discussions on monitoring of bicycle mode shares using surveys and cameras at certain points in the City of San Diego, conversation 19 November 2013.
[93] Personal Communication with City of San Diego, email 18 February 2015.
[94] Personal Communication with City of San Diego, email 18 February 2015.

Goal: Reduce Vehicle Fuel Consumption

While the following transportation actions are not directly within a transit, bicycle or walking strategy, local actions to reduce vehicle fuel consumption in ways that do not reduce VMT are kept within the main strategy in order to have all local transportation actions within one overarching transportation strategy.

Action 3.4 Retiming Traffic Signals

Interconnecting previously uncoordinated signals in a centralized manner instead of independent unconnected lights has been shown to provide significant reductions in delays, congestion and, thus, emissions.[95] In 2001, SANDAG reported that, of the then existing 1430 signals, 486 traffic signals had been retimed since 1998 with plans to re-time 320 more in the City of San Diego in an unspecified time frame. However, discussions with City traffic engineers indicated that it is reasonable to retime 200 traffic signals, which equates to 40 traffic signals per year, in the City by 2020.[96]

To calculate emissions reductions from retiming traffic signals, the amount of fuel reduction per intersection was estimated based on studies conducted by the insurance industry[97] and a SANDAG study in traffic signal optimization.[98] Energy reductions per intersection were multiplied by the number of retimed traffic signals and then divided by average miles per gallon for the San Diego County private fleet[99] to determine reduced VMT. Reduced VMT was then multiplied by the CO_2e/mile to determine GHG reduced. Table 19 summarizes key assumptions and results.

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[95] Rowe, Edwin, 1991. The Los Angeles Automated Traffic Surveillance and Control System. Available at http://ieeexplore.ieee.org/stamp/stamp.jsp?tp=&arnumber=69967.
[96] Personal Communication with Brian Schoenfisch, email 24 August 2014.
[97] Bergh, Casey, Retting, Richard A., and Myers, Edward, 2005. The Cost of Missed Opportunities to Improve Traffic Flow and Safety at Urban Intersections. Insurance Institute for Highway Safety. Available at www.iihs.org
[98] SANDAG study on Traffic Signal Optimization Program, April 1994, page 4-17, Appendix C Exhibit 5.2.
[99] EMFAC 2011.

Table 19 Key Assumptions and Results for Traffic Signal Retiming

Year	Number of Retimed Traffic Signals	Fuel Saved Per Intersection[100]	Total Fuel Saved Annually	Total Equivalent VMT Reduced	GHG Reduced
		(Gallons/Day)	(Gallons/Year)	(Miles/Year)	(MT CO_2e)
2020	200	7,835	571,955,000	30,634,976	11,024
2035	200	7,835	571,955,000	30,634,976	8,508

[100] SANDAG study on Traffic Signal Optimization Program, April 1994, page 4-17, Appendix C Exhibit 5.2 and Bergh et al. 2005.

Action 3.5 Install Roundabouts

Roundabouts can have a traffic flow smoothing effect leading to reduced fuel use by passenger vehicles. Discussions with City traffic engineers indicated that it is feasible to identify and install roundabouts in place of 15 intersections by 2020.[101] This value was held constant to 2035. Based on a case study by Andras Varhelyi[102], we assumed that 20,000 gallons of gasoline fuel would be saved per intersection by improving traffic flow. The amount of fuel reduced per intersection was multiplied by the number of installed roundabouts and then divided by average miles per gallon for the San Diego County private fleet to determine reduced VMT. The effective reduced VMT was then multiplied by the weighted emissions factor to determine GHG reduced. Table 20 summarizes key assumptions and results.

Table 20 Key Assumptions and Results for Installation of Roundabouts

Year	Number of Roundabouts Installed	Fuel Saved Per Intersection[103]	Total Fuel Saved Annually	Total Equivalent VMT Reduced	GHG Reduced
		(Gallons/Day)	(Gallons/Year)	(Miles/Year)	(MT CO_2e)
2020	15	20,000	109,500,000	5,865,024	2,110
2035	20	20,000	146,000,000	7,820,032	2,172

[101] Communication with City of San Diego, email 24 August 2014.
[102] Varhelyi, Andras, 2002. The effects of small roundabouts on emissions and fuel consumption: a case study, Transportation Research Part D,65 - 71. See also: City of San Diego Manager's Report, Feb 4, 2004, Report No. 04-028 for discussions of cost of Traffic Management Plan for the Bird Rock area of La Jolla.
[103] Varhelyi, Andras 2002.

Goal: Decrease Emissions Associated with Commuter Miles Traveled

Action 3.6 Reduction in Commute Miles

The CAP goals include decreasing the average commute distance. The city has set targets of decreasing the average round-trip commute from 25 miles in 2010 down to 23 miles in 2035, with efforts aimed at achieving the goal beginning in 2020. It is assumed that city planning efforts aimed at densifying the urban environment will result in a decreased average commute beyond those achievable through the mass transit, bicycle and pedestrian measures.

The effects of reducing the average commute were calculated as follows. First, the labor force population was multiplied by the BAU average commute (25 miles per day in 2010) and the number of workdays per year to get the BAU commuted VMT. Next, the VMT reduction is calculated by multiplying the labor force population by the workdays per year and the reduced average commute, and subtracting the result from the BAU commuted VMT. Finally, the total mitigated VMT is multiplied by the emissions rate derived from EMFAC 2011 to obtain the total greenhouse gas emissions reductions. Table 21 summarizes key assumptions and results.

Table 21 Key Assumptions and Results for Average Commute Reduction

Year	Labor Force	Average Commute (Miles/Day)	Work Days Per Year	BAU Commuted VMT	Total Mitigated VMT	Emissions Rate[104] (Grams CO2e/mi)	Emissions Reductions (MT CO_2e)
2020	504,178	25	255	3,214,134,750	-	382	-
2035	569,416	23	255	3,630,027,000	290,402,160	347	109,576

[104] EMFAC 2011

Strategy 4: Zero Waste

Solid waste and wastewater management emissions account for about 5% of all GHG emissions within the City of San Diego. The CAP includes 2 measures to reduce emissions from waste: diverting solid waste and capturing landfill emissions, and capturing emissions from the wastewater treatment process.

Goal: Divert Solid Waste and Capture Landfill Emissions

Action 4.1 Divert Solid Waste and Capture Landfill Emissions

The CAP goals are to increase landfill gas capture to 80% by 2020 and 90% by 2035 to be in compliance with state landfill methane capture regulations.[105] The CAP goal for waste diversion is to reach zero waste disposed (90% diversion) by 2040. Under AB 341, the State of California required jurisdictions to achieve a 50% diversion rate by 2000. AB 341 was amended in 2011 to read that it is state policy to achieve at least 75% diversion by 2020. The San Diego City Council approved the objectives of a Zero Waste Initiative in 2013 with the goal of reaching zero waste disposed in landfills in 2040. To achieve this goal, it was assumed that 75% diversion would be reached by 2020 and 90% by 2035. We calculated BAU emissions and emissions reductions from this measure using method SW.4 from the U.S. Community Protocol for solid waste.[106] The method uses disposed waste in a given year, the characterization of waste, and emissions factors from the U.S. EPA Waste Reduction Model (WARM)[107] to estimate emissions from the disposal of solid waste by the City of San Diego. Because a recent waste characterization study was not available for the City of San Diego, it was assumed that the City's characterization is the same as that reported in a 2008 statewide study for California.[108] Solid waste disposal data for the City of San Diego

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[105] California Air Resources Board (CARB), 2009. Final Regulation Order: Methane Emissions from Municipal Solid Waste Landfills. Available at http://www.arb.ca.gov/regact/2009/landfills09/landfillfinalfro.pdf.
[106] ICLEI, 2013. U.S. Community Protocol for Accounting and Reporting of Greenhouse Gas Emissions. Available at http://www.icleiusa.org/tools/ghg-protocol/community-protocol.
[107] U.S. EPA. Waste Reduction Model (WARM). Available at http://epa.gov/epawaste/conserve/tools/warm/index.html
[108] California Department of Resources Recycling and Recovery (CalRecycle). California 2008 Statewide Waste Characterization Study. Available at http://www.calrecycle.ca.gov/publications/Documents/General/2009023.pdf.

was obtained from Cal Recycle[109] for 2010, 2011, 2012, and 2013 and projected to 2035 based on SANDAG series 12 population data for the City.

For emissions reductions, we first calculated reductions due to the increasing diversion of the generated waste from landfills. We assumed a BAU diversion rate of 52%[110] and subtracted the BAU rate from the 2020 (75%) and 2035 (90%) rates. The resulting number was then multiplied by total waste disposal to determine waste kept out of the landfill as the result of increased diversion. We then used method SW.4 of the U.S. Community Protocol to calculate emission reductions, assuming a 75% capture rate in 2010, 80% capture rate in 2020, and 90% capture rate in 2035. Table 22 below provides reductions from both diversion and capture and summarizes key assumptions and results.

Table 22 Key Assumptions and Results for Waste Diversion and Landfill Gas Capture

Year	Total Solid Waste Disposed[111]	Total Emissions Post-BAU Capture and Diversion	Solid Waste Diversion Rate[112]	Landfill Emissions Capture Rate[113]	Total Emissions After Additional Diversion and Capture in 2020 and 2035	Total Emission Reductions From Additional Diversion and Additional Capture
	(Wet Short Tons[114])	(MT CO_2e)			(MT CO_2e)	(MT CO_2e)
2020	1,400,628	402,257	75%	80%	247,790	**154,467**
2035	1,290,892	457,731	90%	90%	113,517	**344,213**

[109] CalRecycle. Disposal Reporting System (DRS). Available at http://www.calrecycle.ca.gov.
[110] City of San Diego Environmental Services Department. Frequently Asked Questions, "How successful has San Diego been so far?" Available at http://www.sandiego.gov/environmental-services/geninfo/faq/mandates.shtml#a4.
[111] CalRecycle DRS.
[112] City of San Diego Environmental Services Department. Frequently Asked Questions, "How successful has San Diego been so far?" City of San Diego, Available at http://www.sandiego.gov/environmental-services/geninfo/faq/mandates.shtml#a4.
[113] CARB 2009.
[114] 1 short ton= 2000 lbs; material in natural, wet state.

Goal: Capture Methane from Wastewater Treatment

Action 4.2 Capture Methane from Wastewater Treatment

The goal of the CAP is to achieve a 98% methane capture rate for wastewater treatment by 2035. The City of San Diego staff provided baseline and projected GHG emissions from wastewater management, and the capture rate in 2010 was reported to be 71%.[115] As such, the GHG emission reductions arise from a 27% difference in capture rate, compared to the 2010 baseline.

To calculate baseline emissions from wastewater, we used GHG data from Point Loma Wastewater Treatment Plant, as reported to CARB in 2010.[116] Annual emissions were divided by gallons of wastewater processed at the plant in that year[117] to estimate a typical CO_2e/gallon of wastewater processed in the City of San Diego. In order to obtain an estimate for total gallons of wastewater produced by the City of San Diego, we then multiplied per capita water use by a wastewater fraction derived from the ICLEI Community Protocol[118] and then by the City's population.[119] Finally, we multiplied the total gallons of wastewater produced by our estimate of typical CO_2e/gallon of wastewater processed to calculate total GHG emissions from wastewater treatment for the City of San Diego.

For years in between 2010 and 2020, capture rates were interpolated linearly. GHG reductions from an increased capture rate were calculated by taking the difference between the baseline capture rate (71%) and the increased capture rate for a given year, then multiplying that value by BAU emissions for wastewater in that year. Table 23 summarizes key assumptions and results.

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[115] A capture rate of about 71% was calculated by EPIC and confirmed by the City of San Diego.
[116] Emissions from Point Loma Wastewater Treatment Plant from Report to CARB in 2010.
[117] The City of San Diego Wastewater, 2010. Point Loma Wastewater Treatment Plant Annual Report (2010)- Section 3 Plant Operations. Available at http://www.sandiego.gov/mwwd/pdf/2012/reports/ploperations.pdf.
[118] http://www.icleiusa.org/tools/ghg-protocol/community-protocol.
[119] SANDAG Series 12.

Table 23 Key Assumptions and Results for Wastewater Emissions Capture

Year	BAU Wastewater Capture Rate[120]	BAU Wastewater Emissions (MT CO2e)	Target Wastewater Capture Rate	Post-Target Capture Wastewater Emissions (MT CO2e)	GHG Reduced (MT CO2e)
2020	71%	9,125	98%	1,217	16,424
2035	71%	10,408	98%	1,388	18,735

[120] A capture rate of about 71% was calculated by EPIC and confirmed by the City.

Strategy 5: Climate Resiliency

Increasing urban tree cover contributes to the capture and storage (sequestration) of carbon, as growing plants take up CO_2.

Goal: Increase Urban Tree Coverage

Action 5.1 Urban Tree Planting Program

The goal of this action is to achieve 15% urban canopy cover by 2020 and 35% urban canopy cover by 2035, achievable with the City of San Diego's Urban Forest Management Plan.[121] This action targets Community Planning Areas (CPAs) and assumes an increase of hardwood tree cover as the type of urban tree

The current urban tree coverage is estimated to be 6.4%,[122] which is equivalent to about 12,000 acres of tree coverage in the City. There is a great diversity of trees per acre in the CPAs. The greatest number of trees per acre, 3.99, is found in Greater Golden Hill, while the lowest number of trees per acre is found in Tierrasanta, 0.5. Total developed area in the City of San Diego was estimated to be about 187,500 acres, based on GIS analysis.

To determine acres of tree cover for 2020 and 2035, the difference in percentage of urban tree canopy cover compared to BAU for 2020 and 2035 were multiplied by total developed area. GHG removal from these trees was then calculated using a CO_2e absorption rate per acre obtained from a study for the California Energy Commission (CEC).[123] Based on this study, typical hardwood trees absorb about 1.56 tons CO_2 per acre. Table 24 summarizes key assumptions and results.

[121] The City of San Diego Community Forest Advisory Board, 2013. Urban Forest Management Plan: background and current conditions. Available at http://sdapa.org/go/wp-content/uploads/2013/10/CitySD_UFMPlan_2013-02-12.pdf.
[122] The City of San Diego Community Forest Advisory Board 2013.
[123] Brown, S., T. Pearson, A. Dushku, J. Kadyzewski, and Y. Qi, 2004. Baseline Greenhouse Gas Emissions and Removals for Forest, Range, and Agricultural Lands in California. Winrock International, for the California Energy Commission, PIER Energy-Related Environmental Research. 500-04-069F. See also: Energy Policy Initiatives Center, 2008. An Analysis of Regional Emissions and Strategies to Achieve AB 32 Targets: Agriculture, Forestry and Land Use Report. Available at http://catcher.sandiego.edu/items/epic/GHG-Agriculture1.pdf .

Table 24 Key Assumptions and Results for Urban Tree Planting Program

Year	% Urban Tree Canopy Cover	Corresponding Total Acres of Tree Cover	CO2e Absorption per Acre[124]	GHG Reduced
		(Acres)	(MT CO_2e)	(MT CO_2e)
2020	15%	28,125	1.56	43,839
2035	35%	46,875	1.56	102,290

[124] Brown et al. 2004.

REGIONAL ACTIONS

The following action provides a summary of transportation actions that are implemented at the regional level by the San Diego Association of Governments (SANDAG).

SANDAG- SB 375

Based on targets established under California's Senate Bill 375 (SB 375) [125], the region is required to reduce per capita GHG emissions from personal miles driven (passenger cars and light-duty trucks) by 7% in 2020 and 13% in 2035 compared with the value in 2005.[126] SANDAG indicates how these reductions are to be achieved in the Sustainable Community Strategy of its Regional Transportation Plan 2050. The SB 375 measures include incentives for telecommute and carpools, subsidies for vanpools and buspools, safe routes to schools to encourage walking to school, bottleneck relief projects such as increase in miles of freeway lanes to reduce fuel inefficient congestion, increase in miles of high occupancy vehicle lanes and freeway tolls, increase in the price of parking, bicycle lane increases and pedestrian zone improvements, smart growth and population density increases, and mass transit use increases.[127]

SB 375 requires that our region achieve a per capita CO_2 reduction of 7% from passenger vehicles and light duty trucks in 2020 compared with the baseline year 2005 and a 13% per capita GHG reduction in 2035. To calculate the effects of SB 375, we determined the total VMT in the region driven by vehicles subject to SB 375 using the EMFAC2011 model.[128] Next, using emissions rates also derived from EMFAC2011, we determined the CO_2 per capita for the region. Using the 2005 baseline per capita value (4.98 MT CO_2 per capita per year), we determined the per capita reduction that would correspond to the reduction targets set by SB 375. To better clarify emission reduction sources that the city may have some jurisdiction over, we identified emissions reductions resulting from mass transit, bicycle mode share, and

[125] Senate Bill No. 375. Available at http://www.leginfo.ca.gov/pub/07-08/bill/sen/sb_0351-0400/sb_375_bill_20080930_chaptered.html.
[126] San Diego Association of Governments (SANDAG). Regional Transportation Plan (RTP) 2050, Chapter 3: Sustainable Communities Strategy. Available at http://www.sandag.org/index.asp?projectid=349&fuseaction=projects.detail.
[127] San Diego Association of Governments Board. Meeting on July 9, 2010, Item 3, SB 375 Implementation. Available at http://www.sandag.org/index.asp?committeeid=31&fuseaction=committees.detail–mSched.
[128] EMFAC 2011.

pedestrian measures. Accordingly, we calculated emissions reductions for these measures separately and removed the corresponding amount of emissions from the SB 375 total to avoid double counting. Table 25 summarizes the key assumptions used and results.

Table 25 Key Assumptions and Results for SB 375

Year	Total VMT Subject to SB 375[129]	Per Capita CO_2e Emissions Before SB 375[130]	Reduction in Per Capita CO_2e Emissions[131]	Reduction in CO_2e Per Capita If SB375 Target Achieved	Total GHG Reductions (Excluding measures determined separately)
		(MT CO_2/Capita)	(% below 2005 value)	(MT CO_2)	(MT CO_2e)
2020	11,721,966,754	4.88	7%	0.35	397,580
2035	14,158,202,176	5.21	13%	0.65	792,801

FEDERAL AND STATE ACTIONS

Federal and state measures are expected to reduce GHG emissions significantly over the timeframe of the CAP. This section provides a summary of the methods used to estimate the GHG reductions associated with the following actions:

- CA Renewable Portfolio Standard (50% by 2020)
- CA Energy Efficiency Policies and Programs
- CA Solar Programs
- CA Vehicle Efficiency Standards – Pavley I/CAFE
- CA Low Carbon Fuel Standard
- CA Electric Vehicle Policies and Programs
- CA CARB Tire Pressure Program
- CA CARB Heavy Duty Vehicle Aerodynamics Program

[129] EMFAC 2011.
[130] SANDAG RTP 2050.
[131] SANDAG RTP 2050.

CA Renewable Portfolio Standard (50% by 2020)

Signed into law in 2011, the Renewable Portfolio Standard (RPS) requires California's electric service providers to procure 33% of electricity sales from renewable sources by 2020.[132] In 2015 Governor Brown signed into law SB 350, which increases renewable electricity targets to 50% by 2030.[133] We base our estimates of these state policies on the 33% renewables RPS requirements being achieved by 2020, the new proposed state target of 50% renewables being reached by 2030. Further explanation of this is provided below.

The CAP has a long-term goal of 100% renewable supply by 2035. In order to meet this goal, it is necessary to consider all categories of supply together to determine, how much of the total supply is attributed to each category of supply. A particular supply's level of activity in one category directly affects the energy supplied by other categories and the weighted emissions factor for electricity. And because the RPS is based on total sales by all electricity supply providers including the utility and a CCA or another program, the total emissions reductions from these policies is affected by the level of solar photovoltaics from the combination of net metered and shared solar systems. As the level of solar supply increases, the amount of electricity that applies by utility or CCA or another program decreases.

CA Renewable Portfolio Standard - Utility Supplied Electricity

The greenhouse gas emissions reductions form utility (SDG&E) supplied electricity, is calculated based on its contribution to gross generation and its renewable content. We assume that renewable sources emit no greenhouse gases. Our greenhouse gas reduction estimates are based on SDG&E and other suppliers reaching the 33% RPS target by 2020 and the newly adopted 50% renewable target by 2030. Between 2030 and 2035, we hold the renewable content constant at 50%.

To calculate the greenhouse gas emissions reductions from the utility RPS requirement for 2020 and 2035, the total emission reductions from utility, CCA or another program and solar programs were

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[132] Senate Bill No. 2. Available at http://www.leginfo.ca.gov/pub/11-12/bill/sen/sb_0001-0050/sbx1_2_bill_20110412_chaptered.pdf.
[133] [133]Senate Bills 350 – Clean Energy and Pollution Reduction Act of 2015. Available at https://leginfo.legislature.ca.gov/faces/billNavClient.xhtml?bill_id=201520160SB350..

allocated using the method described in Greenhouse Gas Emissions Factor for Electricity section and Table 5. Table 26 summarizes the key assumptions, values used, and results.

Table 26 Key Assumptions and Results for CA Renewable Portfolio Standard – Utility

Year	% of gross generation supplied by SDG&E	Energy Supplied (GWh)	% Renewable Content in SDG&E	GHG Reduction from RPS - Utility (MT CO_2e)
2020	95%	10,236	33%	887,084
2035	17%	2,432	50%	398,219

CA Renewable Portfolio Standard – CCA or another Program

As CCA or another program would phase in starting 2020, it is also subject to the Renewable Portfolio Standard and a portion of the total emission reduction would be attributed to RPS. In 2035, CCA or another program reach 100% renewable, half of the emission reductions are separated out and attributed to RPS to meet the 50% renewable content requirement. The breakdown of CCA-RPS and CCA-Local Action is presented in Table 27 below.

Table 27 Result for Community Choice Aggregation or another program in 2035

Category	2035	
	% Renewable in the Supply	GHG Reductions (MT CO2e)
CCA-RPS	50%	**1,592,878**
CCA-Local Action 2.1	50%	1,592,878
CCA-Total	100%	3,185,755

California Energy Efficiency Policies and Programs

The California Public Utilities Commission (CPUC) developed the Strategic Energy Efficiency Plan with detailed goals and targets for improvement in energy use among all sectors of the economy in California.[134] California has numerous policies to help realize the long-term strategic goals in the Plan and to encourage energy efficiency, including standards for new buildings and appliances, programs administered by investor-owned utilities under the auspices of the CPUC, and specific requirements for commercial buildings to disclose energy use as required by AB 1103. For purposes of estimating the greenhouse gas emissions reductions associated with these state energy efficiency policies and programs, it is necessary to identify which aspects of efficiency are already accounted for in the California Energy Commission forecast. As provided in Appendix B.2 in more detail, the CEC forecast includes building standards through 2013 and energy efficiency programs through the 2013-14 cycle.

Below we provide information about the greenhouse gas reduction estimates that could result from statewide utility efficiency programs and commercial building energy disclosure (AB1103). To avoid double counting and because it is likely that many of the other energy reductions in the CAP will be associated with utility efficiency programs, the emission reductions from commercial building energy disclosure program were calculated but considered part of utility efficiency program. As such we subtracted the emission reductions from Local Action 1.1 (Residential Energy Conservation and Disclosure Ordinance) and Local Action 1.2 (Municipal Energy Strategy and Implementation Plan) from the emission reductions from Utility Efficiency Program to avoid double counting.

Utility Efficiency Programs

Under the auspices of the CPUC, investor-owned utilities like SDG&E administer energy efficiency programs funded through ratepayer fees. To determine the greenhouse gas emission reductions associated with these efficiency programs, we estimated the amount of energy that would be reduced by

[134] Engage 360, 2011. California Energy Efficiency Strategic Plan. Available at http://www.cpuc.ca.gov/NR/rdonlyres/A54B59C2-D571-440D-9477-3363726F573A/0/CAEnergyEfficiencyStrategicPlan_Jan2011.pdf.

such programs. On October 16, 2014 the CPUC adopted Decision 14-10-046 in Rulemaking 13-11-005[135], which among other things, established electric and natural gas reduction targets for the investor-owned utilities in California for 2015. The goals included in this decision were based on an energy saving goals study conducted by Navigant.[136] The study broke overall energy efficiency goals into two categories: (1) programs and (2) codes and standards (other than appliance and building standards). It estimated annual energy reduction potential for both electricity and natural gas for the years 2015-2024. Electric and natural gas values were provided for each category. The final 2015 energy reduction target for SDG&E included in CPUC Decision 14-10-046 was slightly lower than the values in the Navigant study. To account for this difference, we adjusted the study values for 2015-2024 by the ratio of those in the Decision with those in the Navigant study. We then projected the energy reduction targets to 2035 using the best-fit curve. To allocate the appropriate amount to the City of San Diego we used scaling factors for electricity and natural gas. For electricity, the scaling factor (0.44) was derived by comparing the electricity consumption in the City of San Diego[137] to the total net energy for load for the SDG&E service..[138] For natural gas, the scaling factor (0.46) was derived by comparing the natural gas consumption in the City of San Diego[139] to the total natural gas consumption in the San Diego region.[140]

Next it is necessary to convert the expected level of energy savings to the equivalent greenhouse gas emissions. To do this we multiplied the cumulative electric savings by the weighted greenhouse gas emissions rate of electricity for that year. For natural gas we multiplied the cumulate natural gas savings by the emissions factor for natural gas. Note that the quantity of electricity savings declines in the last 10 years of the time horizon because the emissions factor for electricity declines as more renewable energy is provided. As noted above, to avoid double counting, we subtracted the emissions reductions

[135] Decision Establishing Energy Efficiency Savings Goals and Approving 2015 Energy Efficiency Programs and Budgets, 2014. Available at http://docs.cpuc.ca.gov/PublishedDocs/Published/G000/M129/K228/129228024.pdf.
[136] Navigant Consulting, 2013. California Energy Efficiency and Potential Goals Study. Prepared for the California Public Utilities Commission. Available at http://www.cpuc.ca.gov/nr/rdonlyres/29adacc9-0f6d-43b3-b7aa-c25d0e1f8a3c/0/2013californiaenergyefficiencypotentialandgoalsstudynovember262013.pdf.
[137] SDG&E, Electricity and natural gas consumption in City of San Diego, 2010-2012
[138] Kavalec et al. 2013
[139] SDG&E, Electricity and natural gas consumption in City of San Diego, 2010-2012
[140] SDG&E, Natural gas consumption in San Diego region. 2010.

associated with other local efficiency measures in the CAP (Action 1.1 and 1.2) from the total reductions from Statewide Energy Efficiency Policies and Programs. Table 28 summarizes assumptions used and results for this measure.

Table 28 Key Assumptions and Results for Utility Energy Efficiency Programs

Year	Cumulative Electric Savings (GWh)	Cumulative Natural Gas Savings (Million Therms)	Electric GHG Emissions Rate (lbs CO_2e/MWh)	Electric Emissions Reductions (MT CO_2e/Year)	Natural Gas Emissions Reductions (MT CO_2e/Year)	GHG Reduced from Utility Energy Efficiency Program (MT CO_2e/Year)	GHG Reduced from Utility Energy Efficiency Program exclude local action 1.1 (MT CO_2e/Year)
2020	638	9	518	168,747	48,194	216,941	202,142
2035	2270	36	72	73,616	198,192	271,808	257,192

AB 1103: Commercial Building Energy Disclosure

In October 2007 California Governor Schwarzenegger signed into law Assembly Bill No. 1103 (AB 1103).[141] AB 1103 requires commercial building owners to disclose energy use to allow prospective tenants, purchasers, and lenders to compare energy use in affected commercial buildings. To calculate reductions from this action, we first estimated the total amount of square footage that would be affected by this policy. Based on property sales data for the City of San Diego[142], we assumed that 4.3% of commercial building space is sold each year. To eliminate the possibility of double counting, once building space is affected by the policy it is removed from the building population. As such, about 23% of total commercial square footage would be affected by AB 1103 disclosure requirement and about 52% would be affected by 2035. These percentages were multiplied by total area of real estate for the given year to determine the total area disclosing energy use. The greenhouse gas reduction for this policy is based on 12% of the building area that discloses energy use implementing efficiency activities as a result of disclosure and,

[141] Assembly Bill No. 1103. Available at http://leginfo.legislature.ca.gov/faces/billNavClient.xhtml?bill_id=200720080AB1103.
[142] Personal communication with Collier International, email on 6 February 2014.

therefore, multiplied total area disclosing energy use by 12% to determine total area implementing efficiency activities.[143]

To estimate the energy reductions from this policy, we used findings from a Lawrence Berkeley National Laboratory (LBNL) study[144] that found a median total energy reduction of about of 15 kBTU/ft^2, or 18% of the average commercial energy consumption of about 82 kBTU/ft^2 in 2010. Based on this value, we assumed a slightly more conservative 15% reduction in commercial building energy consumption per square foot for 2020 and 2035. We calculated average electric and natural gas consumption per square foot by dividing total consumption by total square footage.[145] We then multiplied the resulting values by the 15% energy reduction to determine electricity and natural gas consumption reduced per square foot. These values were multiplied by total area assumed to be implementing efficiency activities and respective emissions factors, then summed for each year to determine GHG reductions from the action in 2020 and 2035. Because this measure is dependent on commercial square footage per year, the greenhouse gas emissions reductions are based on a 2015 start date.

Because the electric emissions factor declines over time, as the electricity supply comprises more and more renewable sources, the greenhouse gas emissions reductions from efficiency decline accordingly. Energy reductions associated with natural gas are not affected by this trend. Table 29 below summarizes key assumptions and results.

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[143] Climate Leadership Academy Network, 2010. Case Study: Austin, Texas, Using Energy Disclosure to Promote Retrofitting. Available at https://stuff.mit.edu/afs/athena/dept/cron/project/urban-sustainability/Energy%20Efficiency_Brendan%20McEwen/Cities/Austin/austin_energy_disclosure.pdf.
[144] Goldman, C., N. Hopper, J. Osborn, and T. Singer, 2005. Review of U.S. ESCO Industry Market Trends: An Empirical Analysis of Project Data. LBNL- - 52320. Available at http://eetd.lbl.gov/ea/emp/reports/52320.pdf.
[145] Personal communication with Collier International, email on 6 February 2014 and Kavalec et al. 2013.

Table 29 Key Assumptions and Results for AB 1103 Commercial Energy Disclosure Requirement

Year	Total Area of Commercial Real Estate[146] (Million Sq Ft)	Percentage of Total Area Sold Annually[147]	Total Percentage of Area Disclosing Energy Use	Total Area Disclosing Energy Use (Million Sq Ft)	% of Area That Implemented Efficiency Activities[148]	Total Area Implementing Efficiency Activities (Million Sq Ft)
2020	328	4.3%	23%	76	12%	9
2035	398	4.3%	52%	205	12%	25
Year	**Energy Reduction (per Sq Ft)**	**Average Commercial Electricity Consumption (kWh/Sq Ft/Year)**	**Electricity Reduction (kWh/Sq Ft/Year)**	**Average Commercial Natural Gas Consumption (Therms/Sq Ft /Year)**	**Natural Gas Reduction (Therms/Sq Ft/Year)**	**GHG Reductions from AB 1103 (MT CO_2e)**
2020	15%	14.7	2	0.3	0.04	6,850
2035	15%	14.4	2	0.3	0.05	8,342

California Solar Policies and Programs

California has a suite of policies and programs for solar photovoltaics. We consider two types of solar photovoltaic systems here: those that are located on the customer premises, interconnected to the electric utility, and that participate in net energy metering (net energy metered solar); and community, or shared solar where customers purchase electricity from a designated solar project not located on their premises. The sections below describe the method used to estimate the greenhouse gas emissions reductions for each.

Net Energy Metered Systems

Programs and policies that encourage customer-sited distributed solar photovoltaics, include the California Solar Initiative (and previously the Emerging Renewables Program), New Solar Homes

146 Personal communication with Collier International, email on 6 February 2014, and Kavalec et al. 2013.
147 Personal communication with Collier International, email on 6 February 2014.
148 Climate Leadership Academy Network, 2010. Case Study: Austin, Texas, Using Energy Disclosure to Promote Retrofitting. Available at https://stuff.mit.edu/afs/athena/dept/cron/project/urban-sustainability/Energy%20Efficiency_Brendan%20McEwen/Cities/Austin/austin_energy_disclosure.pdf.

Partnership, and Net Metering. California's current residential rate structure, which is an inclining block structure that charges a higher marginal rate as consumption increases, also encourages customers to install solar photovoltaics at their premises. In addition to state measures, a federal tax credit and accelerated depreciation also provide financial incentive for this technology. To estimate the capacity (MW) of net energy metered solar systems that would be installed in 2020 and 2035, and thus the resulting greenhouse gas emissions reductions, we projected actual installation data provided by SDG&E to the CPUC and data included in the CEC Staff Energy Forecast. The values used in the CAP are 311 MW in 2020 and 973 MW for 2035.

Shared Solar Program

In addition to the programs mentioned above, California law also provides for shared solar. The Green Tariff Shared Renewables program (SB 43) allows up to 59 MW of solar to be installed in SDG&E territory under a pilot that lasts until Jan 1, 2019.[149] Utilities are required to retire renewable energy credits under the program and cannot count the energy toward the RPS. For purposes of estimating GHG emissions reductions from this program, we assume that all electricity produced through the Shared Solar Program is additional to the RPS. Therefore, there is no double counting and any reductions under the program would be additive with those resulting from the RPS or other supply policy. Assuming all of the allowed capacity is installed by 2019 and that 44% of the capacity is located in the City of San Diego[150], it would result in about 25 MW of capacity not presently counted toward the RPS or the net energy metered projects described above.

Total greenhouse gas emissions reductions due to state solar programs were calculated as follows. Total projected installed capacity (net energy metered plus shared solar)[151] for a given year was multiplied by a

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[149] State of California Public Utilities Commission, 2014. Decision Approving Green Tariff Shared Renewables Program for San Diego Gas and Electric Company, Pacific Gas and Electric Company, and Southern California Edison Company Pursuant to Senate Bill 43. Available at http://docs.cpuc.ca.gov/PublishedDocs/Efile/G000/M143/K989/143989599.PDF.

[150] 44% is the percentage of total electricity use in SDG&E's service territory that is consumed in the City of San Diego.

[151] Personal Communication with California Energy Commission, email 22 October 2013 and San Diego Gas & Electric Advice Letter filings in Compliance with Decision 14-03-041 to report Progress Towards the Net Energy Metering Transition Trigger Level.

capacity factor of 20%[152] and the total number of hours in a year (8,760) to determine the total amount of electricity produced by the installed capacity. To estimate emissions reductions for solar programs, a portion of the total emission reductions from utility, CCA or another program and solar programs were allocated to solar programs, using the method described in Greenhouse Gas Emissions Factor for Electricity section and Table 5. Table 30 summarizes key assumptions used and results.

Table 30 Key Assumptions and Results for CA Solar Policies and Programs

Year	Total Installed Capacity (Net Metered+Shared) (MW)	Energy Supplied (GWh)	% of gross generation supplied by SDG&E	% Renewable Content in SDG&E	GHG Reduction from Solar Program (MT CO_2e)
2020	337	590	5%	100%	154,975
2035	998	1748	13%	100%	572,333

California Vehicle Efficiency Standards – Pavley I/CAFE

California's AB 1493 (2002, Pavley I) required manufacturers to achieve tailpipe emissions standards for greenhouse gases. In May 2009, the federal Corporate Average Fuel Economy (CAFE) Standards were adjusted to conform to California's Pavley I. California then amended AB 1493 (Pavley I) to conform to the federal CAFE standard from 2012 to 2016, on condition that it receives a waiver to set its own vehicle standards after 2016 and enforce its standards for model years 2009 to 2011. CAFE mandates the sales-weighted average fuel economy in miles per gallon (mpg) for passenger cars and light-duty trucks in a manufacturer's fleet. New passenger vehicles must meet a sales weighted average of 39 mpg and light duty trucks must meet a value of 30 mpg, resulting in a fleet average 34.5 mpg. If achieved solely by fuel economy, this corresponds to tailpipe CO_2e emissions of 250 grams per mile (g/mi) in 2016 from those vehicles.

To estimate the greenhouse gas reductions from Pavley I/CAFE, we used EMFAC2011 to provide (1) total regional VMT, (2) total regional vehicle population, and (3) two different emissions rates. The two emissions rates output by EMFAC2011 are (1) a fleet-wide CO_2 per mile driven, and (2) a fleet-wide CO_2 per vehicle per day. Consideration of both emission rates is required to obtain the most accurate

[152] Personal Communication with California Energy Commission, email 22 October 2013. The capacity factor is the percentage of hours in the year that solar is producing electricity.

greenhouse gas emissions from the transportation sector. CO_2 is converted to CO_2e by multiplying with a factor of 1.05 to account for other typical GHGs from vehicle tailpipe emissions (CH_4 and N_2O). Additionally, EMFAC2011 can output emissions rates either including or excluding the effects of Pavley I and Low Carbon Fuel Standard (LCFS). EMFAC 2011 also provides multipliers to separate out the effects of Pavley and LCFS, which helped to develop the weighted emission factor and allocated emissions to each of the VMT measures considered.

As indicated in the Emissions Factor for Transportation section above, it is necessary to consider all the measures that affect VMT. This also applies to estimating GHG emissions from the Pavley I/CAFE measure. To estimate the GHG emissions reductions from Pavley I and CAFE, we used the total VMT in City of San Diego and weighted average emissions factor for VMT. The result yielded the total emissions related to VMT measures. This value was allocated to Pavley I/CAFE, Low Carbon Fuel Standard, and electric vehicles using the same weighting factor used to develop the weighted emissions factor for VMT, namely the combination of miles affected and the percentage reduction in carbon intensity of a mile driven. Table 31 summarizes key assumptions used and results.

Table 31 Key Assumptions and Results for California Vehicle Efficiency Standards- Pavley I/CAFE

Year	BAU Fleet CO_2e Emissions Per VMT[153] (Grams/ Mile)	BAU Fleet CO_2e Emissions Per Vehicle[154] (Grams/Veh/ Day)	Percent Reduction in CO_2e/ mile from Pavley/ CAFE	Percent Reduction in CO_2e/ vehicle/ day from Pavley/ CAFE	Total VMT in City of San Diego[155]	Total Number of Vehicles in City of San Diego[156]	Percent of VMT Driven by Gasoline/ Diesel Vehicles	Percent of Gasoline/ Diesel Vehicles in Vehicle Population	Total GHG Reductions (MT CO_2e)
2020	508	643	19%	18%	15,114,486,656	1,068,787	97%	98%	1,407,061
2035	511	657	31%	31%	18,255,806,585	1,288,272	86%	88%	2,498,388

California Low Carbon Fuel Standard

California's Low Carbon Fuel Standard (LCFS) requires that a regulated party (e.g., supplier of transportation fuel, including importers) reduce the carbon intensity of its transportation fuel (gasoline

153 EMFAC 2011.
154 EMFAC 2011.
155 EMFAC 2011.
156 EMFAC 2011.

and diesel) by 10% by 2020.[157] To estimate the greenhouse gas emissions reductions associated with this state measure, we assume that the LCFS leads to a 10% reduction in carbon intensity by 2020, and that value was held constant between 2020 and 2035. Electricity suppliers are considered regulated parties only if they elect to provide credit to fuel distributors. At this time, there are no monitoring reports on the status of use of electricity credits for the LCFS to indicate the magnitude of carbon intensity reduction that electric vehicles will play in 2020. Therefore, for our purposes here, miles driven by electric vehicles are not considered a part of this standard. A separate measure estimates the effects of electric vehicles. The CAP also assumes no new low carbon fuel mandates in 2020.

Table 32 Key Assumptions and Results for Low - Carbon Fuel Standard (LCFS)

Year	BAU Fleet CO_2e Emissions Per VMT[158] (Grams/Mile)	BAU Fleet CO_2e Emissions Per Vehicle[159] (Grams/Veh/Day)	Percent Reduction in CO_2e/mile from LCFS	Percent Reduction in CO_2e/vehicle/day from LCFS	Total VMT in City of San Diego[160]	Total Number of Vehicles in City of San Diego[161]	Percent of VMT Driven by Gasoline/Diesel Vehicles	Percentage of Gasoline/Diesel Vehicles in Vehicle Population	Total GHG Reductions ($MT\ CO_2e$)
2020	508	643	8%	8%	15,114,486,656	1,068,787	97%	98%	628,425
2035	511	657	7%	7%	18,255,806,585	1,288,272	86%	88%	569,268

The method to calculate the effects of the LCFS are similar to that of the Pavley I/CAFE measure described above. First, EMFAC2011 was used to derive emissions rates that include the effects of Pavley I/CAFE and LCFS. EMFAC's technical documentation provides the multipliers used to determine the effects of LCFS in a given year. Using these multipliers and the reduced emissions rates, we determined what reductions are due to LCFS in terms of CO_2/VMT and CO_2/vehicle/day. This was used to help develop the weighted emissions factor for VMT. With the weighted factor, it is possible to estimate the total emissions from miles driven. This total was allocated to the three measures affecting the emissions factor, Low-Carbon Fuel Standard, Pavley I/CAFE, and electric vehicles.

[157] California Air Resources Board, 2015. Low Carbon Fuel Standard Program. Available at http://www.arb.ca.gov/fuels/lcfs/lcfs.htm.
[158] EMFAC 2011.
[159] EMFAC 2011.
[160] EMFAC 2011.
[161] EMFAC 2011.

California Electric Vehicle Policies and Programs

On March 23, 2012, California Governor Jerry Brown adopted Executive Order B–16–2012 which, among other things, sets a statewide target of 1.5 million zero emissions vehicles by 2025.[162] In addition, California has adopted a number of policies to encourage adoption of electric vehicles, including the Clean Vehicle Rebate Project, which provides cash incentives to offset a portion of the cost of a qualified vehicle.[163]

To estimate the number of electric vehicles that could be expected during the time horizon of the CAP, we converted the estimated energy requirements of electric vehicles included in the California Energy Commission Energy Forecast to the expected number of vehicles.[164] Since the forecast only extends to 2024, we projected electric energy use for electric vehicles from 2025 to 2035 using a best-fit curve. This value was scaled to the City of San Diego using a scaling factor of 0.44, which represents the ratio of electric consumption in the City of San Diego[165] to the total SDG&E service territory[166] and also the approximate ratio of vehicles in the City of San Diego and the region as a whole.[167] This energy value was converted to miles using a factor of 0.3 kWh per mile.[168] In turn, total miles were converted to the number of vehicles using a factor of 15,000 miles per year.[169]

To validate our results, we scaled the targets in the Governor's Executive Order to compare our results to those from the method described above. The Executive Order sets a target of 1 million emissions-free vehicles by 2020 and 1.5 million by 2025. Also, the Governor seeks to have "virtually all personal transportation in the State···based on zero-emission vehicles." To be conservative, we assumed that 80%

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[162] Office of Edmund G. Brown Jr., 2012. Governor Brown Offers $120 Million Settlement to Fund Electric Car Charging Stations Across California. Available at http://gov.ca.gov/news.php?id=17463.
[163] Center for Sustainable Energy. Clean Vehicle Rebate Project. Available at https://energycenter.org/clean-vehicle-rebate-project.
[164] Kavalec et al. 2013.
[165] SDG&E, Consumption by Customer Class for City of San Diego, 2010-2012.
[166] Kavalec et al. 2013
[167] EMFAC 2011.
[168] United States Department of Energy. Available at http://www.fueleconomy.gov/feg/PowerSearch.do?action=noform&path=1&year1=1984&year2=2016&vtype=Electric.
[169] United States Department of Energy. Gasoline Vehicles: Learn more about the New Label. Available at http://www.fueleconomy.gov/feg/label/learn-more-gasoline-label.shtml#details-in-fine-print.

of all vehicles would be zero emissions in 2050. To scale statewide values we used the ratio of the vehicle population in the City of San Diego and that of the state as a whole.[170] The results of scaling the Governor's vehicle targets to City of San Diego matched closely the value derived by starting with the projected energy requirements for electric vehicles in the CEC forecast through most of the time horizon of the CAP but began to diverge closer to 2035 with the estimate of vehicles using the Governor's targets slightly higher than the estimate using projected energy use. To be conservative, we chose to use the slightly lower value derived from the energy projection.

To estimate the greenhouse gas reductions from electric vehicles, we used the same method described for Pavley I/CAFE and the Low-Carbon Fuel Standard. This yielded total emissions associated with VMT. We then allocated these emissions using the same weighting factors used to determine the weighted emissions factor. Table 33 summarizes key assumptions used and results.

Table 33 Key Assumptions and Results for California Electric Vehicles Policies and Programs

Year	BAU Fleet CO_2e Emissions Per VMT[171]	BAU Fleet CO_2e Emissions Per Vehicle[172]	Percent Reduction in CO_2e/mile from Electric Vehicles	Percent Reduction in CO_2e/ vehicle/day from Electric Vehicles	Projected VMT from Electric Vehicles[173]	Projected Population of Electric Vehicles[174]	Percent of VMT Driven by Electric Vehicles	Percentage of Electric Vehicles in Vehicle Population	Total GHG Reductions
	(Grams/ Mile)	(Grams/Veh /Day)							(MT CO_2e)
2020	508	643	100%	100%	388,014,324	25,868	3%	2%	196,542
2035	511	657	100%	100%	2,373,376,573	158,225	14%	12%	1,185,078

CARB Tire Pressure Regulation

The California Air Resources Board (CARB) Tire Pressure Regulation[175] that went into effect in September 2010 leads to improved fuel efficiency and thus reduces GHG emissions. In its *Status of the Updated Scoping Plan 2010*[176], CARB estimated that this requirement, which applies to all vehicles less than 10,000

[170] EMFAC 2011.
[171] EMFAC 2011.
[172] EMFAC 2011.
[173] EPIC estimate based on Kovalik et al, 2014
[174] EPIC estimate based on Kovalik et al 2014.
[175] Regulation To Reduce Greenhouse Gases from Vehicles Operating with Under Inflated Tires: Section 95550, sc10, c10, div 3, title 17, California Code of Regulations, Subarticle 8.
[176] California Air Resources Board, 2008. Status of Scoping Plan Measures, pg. 4, Available at http://www.arb.ca.gov/cc/scopingplan/status_of_scoping_plan_measures.pdf.

pounds and is implemented by all automotive service providers, would reduce statewide emissions by 0.6 MMT CO_2e in 2020. We scaled statewide emission reductions to the City of San Diego using the ratio of the City of San Diego's VMT[177] to the State of California's VMT.[178] This ratio is held constant between 2020 and 2035. It is assumed that 90% of the statewide goals will be met in 2020, and 100% of the statewide goals will be met in 2035. Table 34 summarizes the assumptions used and results.

Table 34 Key Assumptions and Results for CARB Tire Pressure Program

Year	Statewide GHG Reductions[179] (MT CO_2e)	Fraction of CA VMT in San Diego[180]	% of Statewide Goal Achieved	Total GHG Reductions (MT CO_2e)
2020	0.6	5%	90%	25,920
2035	0.6	5%	100%	28,800

CARB Heavy Duty Vehicle Aerodynamics Regulation

The CARB Heavy-Duty Vehicle Aerodynamics Regulation requires owners to use devices to make trucks more aerodynamic, which in turn improves fuel efficiency and reduces GHG emissions. In its *Status of Update Scoping Plan Measures*[181], CARB estimated that this regulation would reduce statewide emissions by 0.9 MMT CO_2e in 2020. This value is held constant between 2020 and 2035. We scaled emissions reductions to the City of San Diego by using the ratio of the City of San Diego's VMT from heavy duty trucks[182] to the State of California's VMT[183], assuming that miles driven by heavy duty trucks are distributed evenly throughout the state. This ratio is held constant between 2020 and 2035. Table 35 summarizes key assumptions used and results.

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[177] EMFAC 2011.
[178] California Department of Transportation, 2010. Highway Performance Monitoring System (HPMS). Available at http://www.dot.ca.gov/hq/tsip/hpms/hpmslibrary/hpmspdf/2010PRD.pdf.
[179] California Air Resources Board, 2008. Status of Scoping Plan Measures, pg. 4, Available at http://www.arb.ca.gov/cc/scopingplan/status_of_scoping_plan_measures.pdf.
[180] HPMS 2010 and EMFAC 2011.
[181] California Air Resources Board, 2008. Status of Scoping Plan Measures, pg. 5, Available at http://www.arb.ca.gov/cc/scopingplan/status_of_scoping_plan_measures.pdf.
[182] EMFAC 2011.
[183] HPMS 2010.

Table 35 Key Assumptions and Results for CARB Heavy - Duty Vehicle Aerodynamics

Year	Statewide GHG Reductions[184] (MT CO_2e)	Fraction of CA Heavy Duty Truck VMT in San Diego[185]	% of Statewide Goal Achieved	Total GHG Reductions (MT CO_2e)
2020	0.9	0.9%	100%	8,100
2035	0.9	1.0%	100%	9,000

[184] California Air Resources Board, 2008. Status of Scoping Plan Measures, pg. 5, Available at http://www.arb.ca.gov/cc/scopingplan/status_of_scoping_plan_measures.pdf.
[185] HPMS 2010 and EMFAC 2011.

APPENDIX A.2

BASELINE AND EMISSIONS PROJECTION METHODS

EPIC estimated greenhouse gas emissions for the 2010 baseline value and a business - as-usual projection for the City of San Diego to estimate the level of emissions in 2020 and 2035 if no action were taken. The projection assumes that no new policies affecting GHG emissions are adopted after 2010 and that there is no further activity on existing policies. This estimate becomes the level of emissions from which emissions from all CAP implementation measures are subtracted to determine if CAP targets are reached. There are a number of assumptions that are used to estimate future projections. The methods used to estimate GHG emissions for 2010 are consistent with the U.S. Community Protocol for Accounting and Reporting of Greenhouse Gas Emissions. The following sections provide information on the methodology used to project emissions and the assumptions included in those calculations.

On Road Transportation

EMFAC 2011[186] was used to obtain regional VMT and GHG emissions for 2010, 2020 and 2035. This data was scaled to City VMT and GHGs, using a City to statewide population ratio. EMFAC 2011 was also used to calculate a regional CO_2e/VMT, which was assumed to represent CO_2e/VMT for the City. The BAU projection for on-road transportation does not include emissions reductions due to the Pavley I/CAFE fuel economy standards or the Low Carbon Fuel Standard, or the miles driven by electric vehicles.

Electricity

To estimate the GHG emissions from electricity use in 2010, we multiplied net energy for load data for the City of San Diego provided by San Diego Gas and Electric (SDG&E)[187] by the SDG&E electricity emissions

[186] EMFAC 2011.
[187] SDG&E, Electric consumption in San Diego region, 2010.

factor in 2010, 736 lbs CO_2e/MWh, described in Appendix B.1. For years after 2010, the 2010 SDG&E emissions factor was kept fixed.

To project emissions from electricity use, we used California Energy Commission (CEC) forecasts[188] for the San Diego Gas and Electric (SDG&E) service territory through 2024 (and projected to 2035 using the best fit curve) to develop an average ratio between City of San Diego total consumption and SDG&E consumption for years 2009-2012. This ratio (44%) was multiplied by the CEC forecast through 2024 and extended to 2035 to get an estimate of the City of San Diego consumption levels. The emissions associate with water sector, including water treatment and distribution, were deducted from the electricity sector to avoid double counting.

CEC Forecast Assumptions

The following provides a list of programs and policies that are included in the CEC's electricity forecast189

Renewable Portfolio Standard – 11.9% of retail electricity sales in 2010

- GHG Intensity of electricity 736 lbs/MWh
- Assumes direct access providers have the same GHG intensity

Utility Energy Efficiency Programs – electric reductions from 2013 - 14 program cycle

Residential Sector

- 1975 HCD Building Standards 1992 Federal Appliance Standards
- 1978 Title 24 Residential Building Standards
- 2002 Refrigerator Standards
- 1983 Title 24 Residential Building Standards
- 2005 Title 24 Residential Building Standards
- 1991 Title 24 Residential Building Standards
- AB 1109 Lighting (Through Title 20)

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[188] California Energy Demand Forecast 2014-2024. Available at http://www.energy.ca.gov/2013publications/CEC-200-2013-004/CEC-200-2013-004-V1-CMF.pdf.
[189] Kavalec et al. 2013, Table 21: Committed Building Codes and Appliance Standards Incorporated in CED 2013 Revised.

- 2010 Title 24 Residential Building Standards
- 1976 - 82 Title 20 Appliance Standards
- 1988 Federal Appliance Standards
- 2011 Television Standards
- 2011 Battery Charger Standards
- 1990 Federal Appliance Standards
- 2013 Title 24 Residential Building Standards

Commercial Sector

- 1978 Title 24 Nonresidential Building Standards
- 2001 Title 24 Non - Residential Building Standards
- 1978 Title 20 Equipment Standards 2004 Title 20 Equipment Standards
- 1984 Title 24 Non-Residential Building Standards
- 2005 Title 24 Non-Residential Building Standards
- 1984 Title 20 Non-Res. Equipment Standards
- 2010 Title 24 Non-Residential Building Standards
- 1985-— - 88 Title 24 Non-Residential Building
- AB 1109 Lighting (Through Title 20)
- Standards 2011 Television Standards
- 1992 Title 24 Non-Residential Building 2011 Battery Charger Standards
- 1998 Title 24 Non-Residential Building Standards
- 2013 Title 24 Non-Residential Building Standards

Natural Gas

To estimate the GHG emissions from natural gas use in 2010, we used consumption data for the City of San Diego provided by SDG&E.[190] To project emissions from electricity use, we used California Energy Commission (CEC) forecasts[191] for the San Diego Gas and Electric (SDG&E) service territory through 2024

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[190] San Diego Gas and Electric.
[191] California Energy Demand Forecast 2014-2024.

(best fit curve projections to 2035) to develop an average ratio between City of San Diego total consumption and SDG&E consumption for years 2009-2012. This ratio value was multiplied by the CEC forecast through 2035 to get an estimate of the City of San Diego consumption levels. Note that the gas data used to calculate their inventory includes gas used for electric generation using cogeneration, therefore the ratio of City-provided consumption levels is higher than the ratio (about 75%) without natural gas for cogeneration (about 45%).

To estimate emissions from projected consumption levels were multiplied by a conversion factor of 0.0053052 MT CO_2e/therm of natural gas.

Solid Waste and Wastewater

Solid waste emissions were estimated using method SW.4 from the U.S. Community Protocol for Accounting and Reporting of Greenhouse Gas Emissions.[192] This method uses disposed waste in a given year (2010 for the baseline)[193], the characterization of waste, and emissions factors from the U.S. EPA Waste Reduction Model (WARM).[194] Because a recent waste characterization study was not available for the City of San Diego or the region, we assumed that the City's characterization was the same as that of California as a whole.[195] Further, we assumed a methane capture rate of 75%.[196]

To calculate baseline emissions from wastewater, we used GHG data from Point Loma Wastewater Treatment Plant, as reported to CARB in 2010.[197] Annual emissions were divided by gallons of wastewater processed at the plant in that year[198] to estimate a typical CO_2e/gallon of wastewater processed in the City of San Diego. In order to obtain an estimate for total gallons of wastewater produced by the City of

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[192] ICLEI 2013.
[193] CalRecycle DRS.
[194] U.S. EPA Waste Reduction Model (WARM).
[195] California Department of Resources Recycling and Recovery (CalRecycle). California 2008 Statewide Waste Characterization Study. Available at http://www.calrecycle.ca.gov/publications/Documents/General/2009023.pdf.
[196] ICLEI 2013.
[197] Emissions from Point Loma Wastewater Treatment Plant from, Report to CARB in 2010.
[198] The City of San Diego Wastewater, 2010. Point Loma Wastewater Treatment Plant Annual Report (2010), Section 3 Plant Operations. Available at https://www.sandiego.gov/mwwd/pdf/2012/reports/ploperations.pdf.

San Diego, we then multiplied per capita water use by a wastewater fraction derived from the ICLEI Community Protocol[199] and then by the City's population.[200] Finally, we multiplied the total gallons of wastewater produced by our estimate of typical CO_2e/gallon of wastewater processed to calculate total GHG emissions from wastewater treatment for the City of San Diego. We assumed a BAU wastewater capture rate of 71%.[201]

Water

To estimate the total water consumption in the City of San Diego, the per capital water consumption reported in 2010, 151 gallons/person/day, was kept fixed and multiplied by the City population for baseline year 2010 and all years until 2035[202]. The energy intensities associated with upstream water supply and conveyance, water treatment and local water distribution (Appendix B.1, Table 5) were used to convert water consumption to total electricity used for water. For emissions from water in baseline year 2010, total electricity used for water was multiplied by the SDG&E electricity emissions factor in 2010, 736 lbs CO_2e/MWh, described in Appendix B.1. To project the BAU emissions from water consumption for years after 2010, the 2010 SDG&E emissions factor was kept fixed and used to convert total electricity used to emissions.

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[199] ICLEI 2013.
[200] SANDAG Series 12.
[201] A capture rate of about 71% was calculated by EPIC and confirmed by the City of San Diego.
[202] SANDAG Series 12.

APPENDIX A.3

GLOSSARY TERMS AND ACRONYMS

Adaptation: This is the response to the climate changes that are occurring because of the excessive human-induced GHGs that have been collecting in the atmosphere for the past 100 years. While GHG reduction strategies are similar for most areas of the United States, the way that a community chooses to adapt to a changing climate is very specific for each region.

Baseline: The baseline serves as a reference point to assess changes in greenhouse gas emission from year to year. For purposes of calculating the baseline emissions, local governments generally estimate emissions from government operations and sources within the community. This Climate Action Plan (CAP) uses 2010 emissions as the baseline.

Business-As-Usual (BAU): The BAU projection starts with the baseline year, a regulatory snapshot of the world at that time, and projects emissions into the future based on expected changes to population and economic activity.

Carbon Dioxide (CO_2): This is the reference as against which other greenhouse gases are measured and therefore has a Global Warming Potential of 1. It is naturally occurring and is also a primary by-product from combustion of fossil fuels and other industrial and agricultural processes.

Carbon Dioxide Equivalent (CO_2e): This is a common unit for normalizing greenhouse gases with different levels of heat trapping potential. For carbon dioxide itself, emissions in tons of CO_2 and tons of $CO_2e$are the same, whereas for nitrous oxide and methane, stronger greenhouse gases, one ton of emissions is equal to 310 tons and 21 tons of CO_2e respectively.

Carbon Sequestration: Carbon sequestration is the capture and long-term storage of atmospheric carbon dioxide through biological, chemical, or physical processes.

Chlorofluorocarbons (CFCs): A family of inert, nontoxic, and easily liquefied chemicals used in refrigeration, air conditioning, packaging, insulation, or as solvents and aerosol propellants. Because CFCs are not destroyed in the lower atmosphere, they drift into the upper atmosphere, where their chlorine components destroy the ozone layer.

The California Environmental Quality Act (CEQA): This was a California statute passed in 1970, shortly after the United States federal government passed the National Environmental Policy Act (NEPA), to institute a statewide policy of environmental protection. CEQA does not directly regulate land uses, but instead requires state and local agencies within California to follow a protocol of analysis and public disclosure of environmental impacts of proposed projects and adopt all feasible measures to mitigate those significant impacts.

Climate: This is typically defined as the "average weather," or more rigorously, as the statistical description in terms of the average and variability of weather over a period of time ranging from months to thousands of years. These variables are most often temperature, precipitation, and wind. Climate can also refer to the global climate system.

Climate Action Plan: A description of the measures and actions that an organization will take to reduce greenhouse gas emissions and achieve an emissions reduction target. Most plans include a description of existing and future year emissions; a reduction target; a set of measures, including performance standards that will collectively achieve the target; and a mechanism to monitor the plan.

Climate Change: Climate change refers to any significant change in measures of climate (such as temperature, precipitation, or wind) lasting for an extended period (decades or longer). Climate change results from: 1) natural factors, such as changes in the sun's intensity or slow changes in the Earth's orbit around the sun; 2) natural processes within the climate system (e.g. changes in ocean circulation); and 3) human activities that change the atmosphere's composition (e.g. through burning fossil fuels) and the land surface (e.g. deforestation, reforestation, urbanization, desertification, etc.).

Co-Benefit: Multiple, ancillary benefits of a policy, program or intervention. Many measures designed to reduce greenhouse gas emissions have other benefits such as energy and cost savings.

Corporate Average Fuel Economy (CAFE): The CAFE standards were originally established by Congress for new automobiles, and later for light trucks, in Title V of the Motor Vehicle Information and Cost Savings Act. Under CAFE, automobile manufacturers are required by law to produce vehicles with composite sales-weighted fuel efficiency, which cannot be lower than the CAFE standards in a given year. Standardized tests are used to rate the fuel economy of new vehicles.

Energy Efficiency: This refers to the use of less energy, usually in the form of electricity, for the same function. Energy efficiency is often achieved by technology forcing regulations to reduce energy use in new appliances, such as televisions and lighting.

Energy Conservation: This is a typical practice using what you have more efficiently, such as shutting off the light or only using the dishwasher when it is full.

Emissions: The release of a substance (usually a gas when referring to the subject of climate change) into the atmosphere.

Emissions Factor: A set of coefficients used to convert data from electricity, natural gas, fuel and waste to calculate GHG emissions. These emission factors are the ratio of emissions of a particular pollutant (e.g., carbon dioxide) to the quantity of the fuel used (e.g., kilograms of coal). For example, when burned, 1 ton of coal = 2.071 tons of CO_2.

Forecast Year: Any future year in which predictions are made about emissions levels based on growth multipliers applied to the base year.

Global Warming: Global warming is an average increase in the temperature of the atmosphere near the Earth's surface and in the troposphere, which can contribute to changes in global climate patterns. Global warming can occur from a variety of causes, both natural and human induced. In common usage, "global warming" often refers to the warming that can occur as a result of increased emissions of greenhouse gases.

Global-warming Potential (GWP): This is a relative measure of how much heat a greenhouse gas traps in the atmosphere. It compares the amount of heat trapped by a certain mass of the gas in question to the amount of heat trapped by a similar mass of carbon dioxide. A GWP is calculated over a specific time interval, commonly 20, 100 or 500 years. GWP is expressed as a factor of carbon dioxide (whose GWP is standardized to 1). For example, the 20 year GWP of methane is 72, which means that if the same mass of methane and carbon dioxide were introduced into the atmosphere, that methane will trap 72 times more heat than the carbon dioxide over the next 20 years.

Greenhouse Effect: The build-up of heat in the atmosphere (troposphere) near the Earth's surface due to infrared radiation from the sun being absorbed by water vapor, carbon dioxide, ozone, and several other gases. This heat is then re-radiated back toward the Earth's surface. As atmospheric concentrations of these greenhouse gases rise, the average temperature of the lower atmosphere gradually increases.

Greenhouse Gas: Any gas that absorbs infrared radiation in the atmosphere. Greenhouse gases include, but are not limited to, water vapor, carbon dioxide (CO_2), methane (CH_2), nitrous oxide (N_2O), chlorofluorocarbons (CFCs), hydrochlorofluorocarbons (HCFCs), ozone (O_3), hydrofluorocarbons (HFCs), perfluorocarbons (PFCs), and sulfur hexafluoride (SF_6).

Green Streets: Urban transportation right-of-ways integrated with green techniques. Green streets provide a source control for a main contributor of stormwater runoff and pollutant load. In addition, green infrastructure approaches complement street facility upgrades, street aesthetic improvements, and urban tree canopy efforts that also make use of the right-of-way and allow it to achieve multiple goals and benefits. (EPA 2008)

Greywater: Untreated wastewater that has not been contaminated by any toilet discharge or by any infectious, contaminated, or unhealthy bodily wastes, and does not present a threat from contamination by unhealthful processing, manufacturing, or operating wastes. Greywater includes but is not limited to wastewater from bathtubs, showers, bathroom washbasins, clothes washing machines, and laundry tubs, but does not include wastewater from kitchen sinks, dishwashers, or toilets.

Heating, Ventilation, and Air Conditioning (HVAC): These are mechanical systems that control the ambient environment (temperature, humidity, air flow and air filtering) of a building.

Hydrofluorocarbons (HFCs): Man-made compounds containing hydrogen, fluorine, and carbon that were developed as an alternative to ozone-depleting substances for industrial, commercial, and consumer products. HFCs do not have the potential to destroy stratospheric ozone, but they are still powerful greenhouse gases.

Intergovernmental Panel on Climate Change (IPCC): The IPCC was established jointly by the United Nations Environment Program and the World Meteorological Organization in 1988. The purpose of the IPCC is to assess information in the scientific and technical literature related to all significant components of the issue of climate change. The IPCC draws upon hundreds of the world's expert scientists as authors and thousands as expert reviewers. Leading experts on climate change and environmental, social, and economic sciences from some 60 nations have helped the IPCC to prepare periodic assessments of the scientific underpinnings for understanding global climate change and its consequences. With its capacity for reporting on climate change, its consequences, and the viability of adaptation and mitigation measures, the IPCC is also looked to as the official advisory body to the world's governments on the state of the science of the climate change issue. For example, the IPCC organized the development of internationally accepted methods for conducting national greenhouse gas emission inventories. The IPCC Methodologies (2nd Assessment) for GHG inventories also provide the Global Warming Potentials for GHGs.

Methane (CH4): A hydrocarbon that is a greenhouse gas with a global warming potential most recently estimated at 23 times that of carbon dioxide ($CO_2$2). Methane is produced through anaerobic (without oxygen) decomposition of waste in landfills and sewage treatments, animal digestion, decomposition of animal wastes, production and distribution of natural gas and petroleum, coal production, and incomplete fossil fuel combustion.

Measures: Any action taken to reduce GHG emissions.

Mitigation: CEQA defines mitigation as including: "(a) avoiding the impact altogether by not taking a certain action or parts of an action; (b) minimizing impacts by limiting the degree or magnitude of the action and its implementation; (c) rectifying the impact by repairing, rehabilitating, or restoring the impacted environment; (d) reducing or eliminating the impact over time by preservation and maintenance operations during the life of the action; and (e) Compensating for the impact by replacing or providing substitute resources or environments. See CEQA Guidelines section 15370.

Metric Ton (MT): Common international measurement for the quantity of greenhouse gas emissions. A metric ton is equal to 2205 lbs. or 1.1 short tons.

Mixed-Use: In a land-use planning context, a project that has at least three of the following amenities within a 1/4 mile radius: 1) residential development, 2) retail and/or commercial development, 3) park, and 4) open space. Mixed-use developments encourage walking and other non-auto modes of transport from residential to office/commercial locations. The project should minimize the need for external vehicle trips by including services and facilities for day care, banking/ATM, restaurants, vehicle refueling, and shopping.

Natural Gas: This is the typical fuel used in new power generating facilities in California. Underground deposits of gases consist of 50 to 90% methane and small amounts of heavier gaseous hydrocarbon compounds such as propane and butane.

Non-Potable Water: Water that is not suitable for drinking because it has not been treated to drinking water standards.

Perfluorocarbons (PFCs): Potent greenhouse gases that accumulate in the atmosphere and remain there for thousands of years. Aluminum production and semiconductor manufacture are the largest known man-made sources of perfluorocarbons.

Potable Water: Water that meets federal drinking water standards as well as state and local water quality standards so that it is safe for human consumption. Water treatment facilities that produce drinking water require a state permit.

Recycled Water: Treatment of wastewater beyond secondary treatment using tertiary filtration and chlorination. Water treated to this tertiary level is considered to be recycled water, which is suitable for many beneficial uses including irrigation or industrial processes. Recycled water meets treatment and reliability criteria established by Title 22, Chapter 4 of the California Code of Regulations.

Risk: Denotes the result of the interaction of physically defined hazards with the properties of the exposed systems - i.e., their sensitivity or social vulnerability. Risk can also be considered as the combination of an event, its likelihood and its consequences - i.e., risk equals the probability of climate hazard multiplied by a given system's vulnerability.

Resiliency : When referring to natural systems, the amount of change a system can undergo without changing state. When referring to human systems, the term "resiliency" can be considered as a synonym of adaptive capacity. This is determined by the degree to which the social system is capable of organizing itself to increase its capacity for learning from past disasters for better future protection and to improve risk reduction measures.

Sector: A term used to describe emission inventory source categories for greenhouse gases based on broad economic sectors.

Target Year: The year by which the emissions reduction target should be achieved.

Transit Oriented Development (TOD): A moderate- to high-density development located within 1/4 mile of a major transit stop, generally with a mix of residential, employment, and shopping opportunities. TOD encourages walking, bicycling, and transit use without excluding the automobile.

Urban Heat Island Effect: The significantly higher temperatures in a metropolitan area, relative to its surrounding rural areas, caused by waste heat generated by energy use and the modification of land by buildings and surface materials that retain heat.

Vehicles Miles Traveled (VMT): This unit measures the aggregate mileage traveled by all vehicles in a specific location. VMT is a key measure of street and highway use. Reducing VMT is often a major objective in efforts to reduce vehicular congestion and achieve air quality goals.

Vulnerability: The degree to which systems affected by climate change are susceptible to and unable to cope with adverse impacts.

Unbundled Parking: Unpriced parking is often "bundled" with building costs, which means that a certain number of spaces are automatically included with building purchases or leases. Unbundling Parking means that parking is sold or rented separately. Occupants only pay for the parking spaces the actually need.

Acronyms

AB - Assembly Bill

APCD – Air Pollution Control District (County of San Diego)

CACP - Clean Air and Climate Protection Software

CAP - Climate Action Plan

CAPPA - Climate and Air Pollution Planning Assistant

CARB - California Air Resources Board

CEC - California Energy Commission

CEQA - California Environmental Quality Act

CH4 - Methane

CO_2 - Carbon dioxide

CO_2e - Carbon dioxide equivalent

EPA - U.S. Environmental Protection Agency

GHG - Greenhouse gas

HFC - Hydrofluorocarbons

HVAC - Heating, ventilating, and air conditioning

IPCC - Intergovernmental Panel on Climate Change

KWh - Kilowatt-hours

LCFS - Low Carbon Fuel Standard

MMT - Million metric tons

MW - Megawatt

N_2O - Nitrous oxide

PPM - Parts per million

SANDAG – San Diego Association of Governments

SB - Senate Bill

TOD - Transit oriented development

USGBC - U.S. Green Building Council

VMT - Vehicle miles traveled

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City of San Diego

DRAFT Climate Action Plan

December 2015

Appendix B

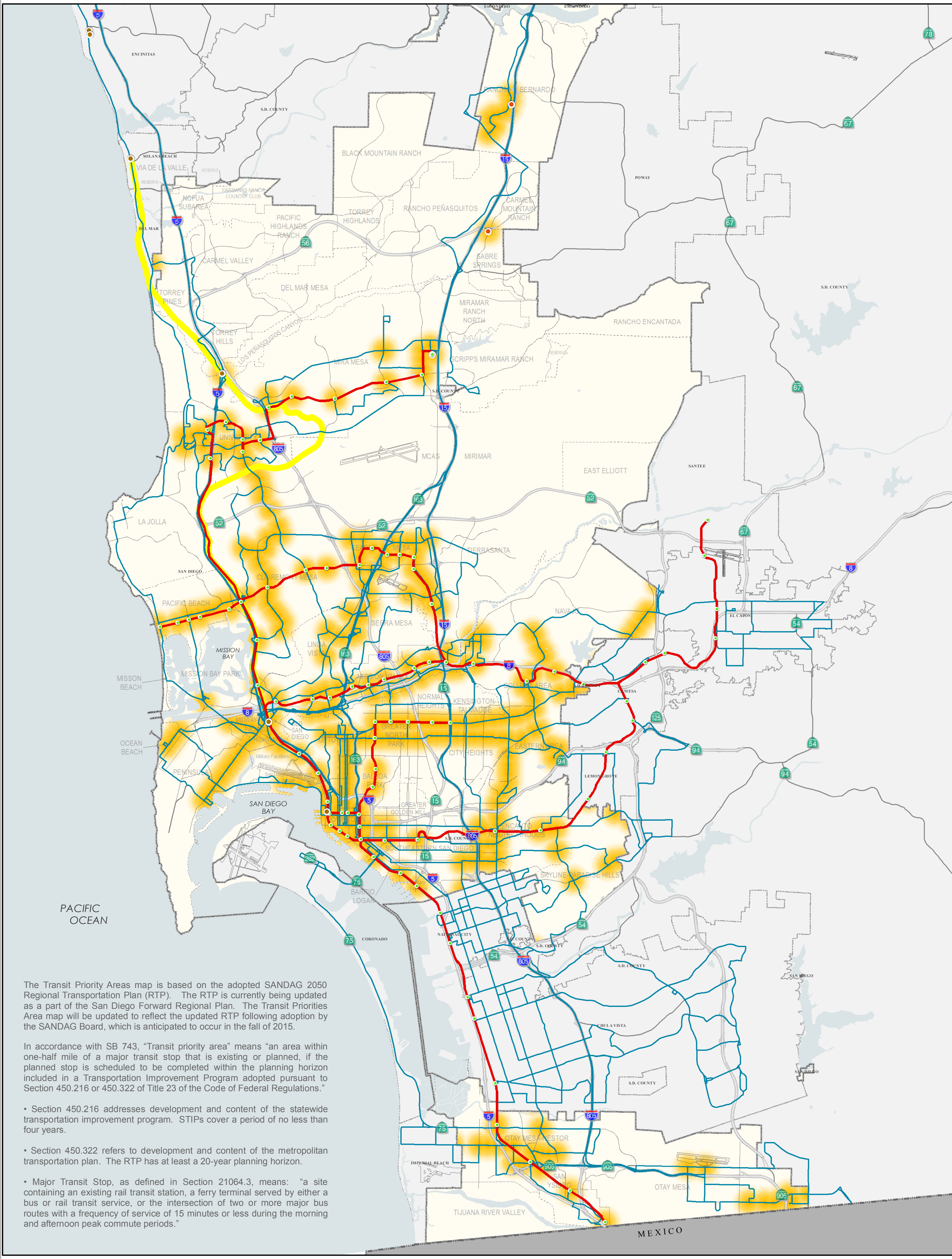
Transit Priority Area Map

Transit Priority Areas per SB743

CITY OF SAN DIEGO • PLANNING DEPARTMENT

DRAFT

Current as of:
1/30/2015



The Transit Priority Areas map is based on the adopted SANDAG 2050 Regional Transportation Plan (RTP). The RTP is currently being updated as a part of the San Diego Forward Regional Plan. The Transit Priorities Area map will be updated to reflect the updated RTP following adoption by the SANDAG Board, which is anticipated to occur in the fall of 2015.

In accordance with SB 743, "Transit priority area" means "an area within one-half mile of a major transit stop that is existing or planned, if the planned stop is scheduled to be completed within the planning horizon included in a Transportation Improvement Program adopted pursuant to Section 450.216 or 450.322 of Title 23 of the Code of Federal Regulations."

• Section 450.216 addresses development and content of the statewide transportation improvement program. STIPs cover a period of no less than four years.

• Section 450.322 refers to development and content of the metropolitan transportation plan. The RTP has at least a 20-year planning horizon.

• Major Transit Stop, as defined in Section 21064.3, means: "a site containing an existing rail transit station, a ferry terminal served by either a bus or rail transit service, or the intersection of two or more major bus routes with a frequency of service of 15 minutes or less during the morning and afternoon peak commute periods."

Long Term through 2035

Legend

- Trolley Stations
- Coaster Station
- Rapid Bus Station
- High Frequency Routes
- Trolley Lines
- Coaster Line
- Transit Priority Area
- Planning Areas
- Municipal Boundaries

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