APPENDIX B

Emissions Forecasting and Reduction Methods

Purpose

This appendix describes the greenhouse gas (GHG) accounting and projection methods for the Adjusted Business-as-Usual (BAU) forecasts for 2030, 2035, and 2045, and the methods for quantifying GHG emissions reductions for the measures and actions listed in the *2045 Los Angeles County Climate Action Plan* (2045 CAP).

Section B.1: 2018–2045 Adjusted Business-as-Usual Forecasts

This section describes the approach for modeling an Adjusted BAU scenario that projects future emissions based on current population and regional growth trends; land use growth patterns; and implementation of federal, state, and County of Los Angeles (County) regulations and policies, including renewable-energy targets pursuant to the California Renewables Portfolio Standard (RPS) and Senate Bill (SB) 100, Title 24 Building Energy Efficiency updates, and the Advanced Clean Cars regulations and Pavley vehicle efficiency standards.

Section B.2: Greenhouse Gas Reduction Measures and Actions

This section describes the calculation methods for estimating local GHG emissions reductions for the 2045 CAP measures and actions. These emissions reductions occur beyond federal, state, and County regulations and policies accounted for in the Adjusted BAU forecast. The quantified measures and actions include:

- ES1: Develop a Sunset Strategy for All Oil and Gas Operations
- ES2: Procure Zero-Carbon Electricity
- ES3: Increase Renewable Energy Production
- E1: Transition Existing Buildings to All-Electric
- E2: Standardize All-Electric New Development

- E4: Improve Energy Efficiency of Existing Buildings
- E6: Reduce Indoor and Outdoor Water Consumption
- T1: Increase Density Near High-Quality Transit Areas
- T2: Develop Land Use Plans Addressing Jobs-Housing Balance and Increase Mixed Use
- T3: Expand Bicycle and Pedestrian Network to Serve Residential, Employment, and Recreational Trips
- T4: Broaden Options for Transit, Active Transportation, and Alternative Modes of Transportation
- T6: Increase ZEV Market Share and Reduce Gasoline and Diesel Fuel Sales
- T7: Electrify County Fleet Vehicles
- T8: Accelerate Freight Decarbonization
- T9: Expand Use of Zero-Emission Technologies for Off-Road Vehicles and Equipment
- W1: Institutionalize Sustainable Waste Systems and Practices
- A1: Conserve Agricultural and Working Lands, Forest Lands, and Wildlands
- A3: Expand Unincorporated Los Angeles County's Tree Canopy and Green Spaces

B.1 2018–2045 Adjusted Business-as-Usual Forecasts

Like the standard BAU forecast, the Adjusted BAU forecast provides an estimate of future emissions levels based on the continuation of existing trends in demographic growth (such as population and housing), activity or resource consumption (such as electricity use), technology changes, and regulation. Unlike the BAU forecast, the Adjusted BAU forecast accounts for expected outcomes of federal, state, and local measures. Specifically, the Adjusted BAU forecast includes the following programs and policies:

1. California's RPS program and SB 100 targets for renewable energy.
2. Updates to Title 24 standards.
3. Implementation of the Advanced Clean Cars regulations and Pavley standards.

These three adjustments are explained in the following sections.

Renewables Portfolio Standard and Senate Bill 100

The Clean Energy and Pollution Reduction Act of 2015, or SB 350 (Chapter 547, Statutes of 2015) was approved by then-Governor Jerry Brown on October 7, 2015. SB 350 increased the standards of the California RPS program by requiring that the amount of electricity generated and sold to retail customers per year from eligible renewable energy resources be increased from 33 percent to 50 percent by December 31, 2030. On September 10, 2018, Governor Brown signed SB 100, establishing that 100 percent of all electricity in California must be obtained from renewable and zero-carbon energy resources by December 31, 2045. SB 100 also creates new standards for the RPS goals that were established by SB 350 in 2015. Specifically, the bill increases required energy from renewable sources for both investor-owned utilities and publicly owned utilities from 50 percent to 60 percent by 2030. Incrementally, these energy providers must also have a renewable energy supply of 33 percent by 2020, 44 percent by 2024, and 52 percent by 2027. The updated RPS goals are considered achievable, because many California energy providers are already meeting or exceeding the RPS goals established by SB 350. The Adjusted BAU forecasts accounts for these renewable energy targets, as discussed below.

Electricity Emission Factors under the Renewables Portfolio Standard

To account for California's RPS targets under SB 100 in the Adjusted BAU forecast, the GHG emission factors for electricity consumption were adjusted. These emissions factors represent indirect GHG emissions generated at power plants and are applied to electricity consumption in unincorporated Los Angeles County (see Appendix A for discussion). The RPS has the effect of lowering indirect emissions associated with electricity consumption because it mandates increasing percentages of renewable sources of power supplied by electricity utilities in future years. The RPS requires 60 percent eligible renewables by 2030 and 100 percent RPS-eligible renewable resources by 2045.[1]

The two utilities supplying electricity to unincorporated Los Angeles County are Southern California Edison (SCE) and the Clean Power Alliance (CPA). To adjust for the RPS in future years, indirect electricity emission factors reported by SCE and CPA along with the energy power mix were collected for the years 2015–2020. SCE reports its emission factors in their annual sustainability reports and has values for 2015–2019. CPA reports its emission factors to the Climate Registry and has values for 2018–2020. The California Energy Commission (CEC) reports power mix data in Power Content Labels; these are available through 2020 for both SCE and CPA.[2]

Based on data reported for 2016–2020, a composite "non-RPS" emission intensity factor was generated for each year. This factor is calculated based on the reported total emission factor and the non-RPS power mix. For example, SCE's total reported emission factor in 2019 is 396.8 pounds (lb) of carbon dioxide equivalent (CO_2e) per megawatt-hour (MWh) for a non-RPS power mix of 65 percent; the "non-RPS" emission intensity factor is therefore 612.4 lb CO_2e/MWh. Then, for each forecast year (2030, 2035, and 2045), an emission factor for total delivered electricity was calculated based on these composite "non-RPS" emission intensity factors for each reported year and the projected RPS requirement for eligible renewables for each year. For example, a 60 percent eligible renewable mix (required by 2030) applied to the "non-RPS" emission intensity factor of 612.4 lb CO_2e/MWh results in a total emission factor of 245 lb CO_2e/MWh.

Table B-1 presents the electricity power mix values reported (2016–2020) and forecasted (2030, 2035, 2045) for SCE and CPA, incorporating the RPS. **Table B-2** presents the electricity emission factors reported for SCE and CPA for 2016–2020 along with the Adjusted BAU forecast for 2030, 2035, and 2045, incorporating the RPS.

1 RPS-eligible resources include solar, wind, geothermal, small hydroelectric, or biopower facilities that are located within the Western Electricity Coordinating Council (WECC) region, which encompasses 14 Western U.S. states and portions of Canada and Mexico. The majority of RPS-eligible electricity currently comes from solar and wind. Large hydroelectric dams and nuclear facilities, two major sources of carbon-free power, are not RPS-eligible.

2 California Energy Commission. 2019. 2018 Power Content Label. July 2019. Available: https://www.energy.ca.gov/sites/default/files/2020-01/2018_PCL_Southern_California_Edison.pdf. Accessed January 2021.

Table B-1: SCE and CPA Electricity Power Mix

ELECTRICITY POWER MIX	REPORTED 2016	2017	2018	2019	2020	FORECASTED 2030	2035	2045
SCE								
Eligible Renewables	28%	32%	36%	35%	n/a	60%	73%	100%
Nuclear & Hydroelectric	25%	28%	21%	24%	n/a	n/a	n/a	n/a
Natural Gas & Unspecified	60%	54%	54%	49%	n/a	n/a	n/a	n/a
CPA Lean Rate								
Eligible Renewables	n/a	n/a	65%	36%	41%	60%	73%	100%
Nuclear & Hydroelectric	n/a	n/a	24%	1%	5%	n/a	n/a	n/a
Natural Gas & Unspecified	n/a	n/a	11%	63%	55%	n/a	n/a	n/a
CPA Clean Rate								
Eligible Renewables	n/a	n/a	61%	51%	50%	60%	73%	100%
Nuclear & Hydroelectric	n/a	n/a	26%	14%	9%	n/a	n/a	n/a
Natural Gas & Unspecified	n/a	n/a	13%	36%	41%	n/a	n/a	n/a

NOTES:
Abbreviations: CPA = Clean Power Alliance; n/a = data not available or not applicable; SCE = Southern California Edison.
Reported values are shown for 2016–2020. Estimated (forecasted) values based on Renewables Portfolio Standard are shown for 2030, 2035, and 2045.

Table B-2: SCE and CPA Electricity Emission Factors under The Renewables Portfolio Standard

UTILITY AND CATEGORY OF ELECTRICITY SUPPLY	EMISSION FACTORS (LB CO_2E/MWH) 2016	2017	2018	2019	2020	2030	2035	2045
SCE								
Non-RPS Electricity	734.7	807.4	801.6	606.5	n/a	738.6	738.6	n/a
Total Delivered Electricity	529	549	513.0	393.0	n/a	295.5	197.0	0.0
CPA Lean								
Non-RPS Electricity	n/a	n/a	30.3	590.0	1029.6	809.8	809.8	n/a
Total Delivered Electricity	n/a	n/a	10.6	377.6	608.5	323.9	215.9	0.0
CPA Clean								
Non-RPS Electricity	n/a	n/a	25.1	342.2	685.7	513.9	513.9	n/a
Total Delivered Electricity	n/a	n/a	9.8	169.4	342.2	205.6	137.0	0.0

NOTES:
Abbreviations: CO_2e = carbon dioxide equivalent; lb = pounds; MWh = megawatt-hour; n/a = data not available or not applicable.
Reported values are shown for 2016–2020. Estimated (forecasted) values based on RPS are shown for 2030, 2035, and 2045.

Data Sources:

- SCE Emission Factors
  Link: https://www.edison.com/content/dam/eix/documents/sustainability/eix-esg-pilot-quantitative-section-sce.pdf
- CPA Emission factors
  Link: (account required for download): https://cris4.org/(S(rtuopf12t5k5ymsx3rurxtg4))/frmLILogin.aspx
- Power Content Labels
  Link: https://www.energy.ca.gov/programs-and-topics/programs/power-source-disclosure/power-content-label
- California RPS Program Overview
  Link: https://www.cpuc.ca.gov/RPS_Overview/
- SB 100
  Link: https://leginfo.legislature.ca.gov/faces/billNavClient.xhtml?bill_id=201720180SB100

Residential Buildings

Like the BAU Forecast, energy consumption in residential buildings is projected based on building footprint projections for residential stock in unincorporated Los Angeles County (see Appendix A). As discussed above, the electricity emission factors for electricity supplied by SCE are based on SCE's historical power mix (2015–2019) and RPS targets.[3] To account for the RPS and SB 100, SCE emission factors were applied to total residential electricity consumption for 2018, 2030, 2035, and 2045. As reported in Table B-2 above, SCE emission factors were estimated to be 513 lb CO_2e/MWh in 2018, 295.5 lb CO_2e/MWh in 2030, 197 lb CO_2e/MWh in 2035, and 0 lb CO_2e/MWh in 2045.

Beginning in 2019, residential customers in unincorporated Los Angeles County were automatically enrolled in the Clean Power Alliance's (CPA) "Clean" electricity rate option. While participation data for 2019 were unavailable when the 2018 inventory was developed, a July 2021 member status report indicated a 96 percent participation rate for all residential customers in unincorporated Los Angeles County in 2021.[4] Under the Clean rate option in 2019, residential customers received 61 percent of their electricity from eligible renewable sources via the CPA, 26 percent from carbon-free sources like hydropower, and 13 percent from unspecified fossil-fuel sources like natural gas and coal (see Table B-1 above). The remaining 4 percent of residential customers were enrolled in CPA's "Lean" electricity rate option. Under the Lean rate option in 2019, residential customers received 65 percent of their electricity from eligible renewable sources via the CPA, 24 percent from carbon-free sources like hydropower, and 11 percent from unspecified fossil-fuel sources like natural gas and coal (see Table B-1 above).

GHG emissions from CPA-provided electricity are calculated using CPA data including electricity consumption, emission factors, and power mix.[5] As reported in Table B-2 above, CPA's Lean emission rates are estimated to be 10.6 lb CO_2e/MWh in 2018, 323.9 lb CO_2e/MWh in 2030, 215.9 lb CO_2e/MWh in 2035, and 0 lb CO_2e/MWh in 2045.[6] CPA's Clean emission rates are estimated to be 9.8 lb CO_2e/MWh in 2018, 205.6 lb CO_2e/MWh in 2030, 137 lb CO_2e/MWh in 2035, and 0 lb

[3] California Energy Commission. 2019. 2018 Power Content Label. July 2019. Available: https://www.energy.ca.gov/sites/default/files/2020-01/2018_PCL_Southern_California_Edison.pdf. Accessed January 2021.
[4] Clean Power Alliance. 2021. *Member Status Report: Los Angeles County*. July 28, 2021.
[5] California Energy Commission. 2019. 2018 CPA Power Content Label. July 2019. Available: https://www.energy.ca.gov/sites/default/files/2020-01/2018_PCL_Clean_Power_Alliance.pdf. Accessed January 2021.
[6] The Climate Registry. 2020. Utility-Specific Emission Factors. Available: https://www.theclimateregistry.org/our-members/cris-public-reports/. Accessed January 2021.

CO_2e/MWh in 2045.[7] CPA emission factors were applied to total residential electricity consumption in 2018, 2030, 2035, and 2045 and emissions for interim years were linearly interpolated.

For emissions associated with natural gas consumption, emission factors are held constant from 2018.[8] RPS and SB 100 do not affect natural gas usage or emissions, and there are no federal, state, or local policies that would result in changes to the natural gas emission factors in the Adjusted BAU forecast.

Data Sources:

- SCE Emission Factors
  Link: https://www.edison.com/content/dam/eix/documents/sustainability/eix-esg-pilot-quantitative-section-sce.pdf
- CPA Emission factors
  Link: (account required for download): https://cris4.org/(S(rtuopf12t5k5ymsx3rurxtg4))/frmLILogin.aspx
- Power Content Labels
  Link: https://www.energy.ca.gov/programs-and-topics/programs/power-source-disclosure/power-content-label
- California RPS Program Overview
  Link: https://www.cpuc.ca.gov/RPS_Overview/
- SB 100
  Link: https://leginfo.legislature.ca.gov/faces/billNavClient.xhtml?bill_id=201720180SB100

Commercial and Institutional Buildings

Like the BAU Forecast, energy consumption in commercial, institutional, and agricultural buildings is forecasted based on building footprint projections for nonresidential building stock in unincorporated Los Angeles County (see Appendix A). In June 2018, nonresidential customers in unincorporated Los Angeles County were enrolled in CPA's Clean Power option, with less than 5 percent of customers opting out; the year-end CPA participation rate is held constant with the remaining customers continuing to receive electricity from SCE. The emission factors for CPA are based on historical power mix (2018–2020) and California's RPS targets, as discussed above and presented in Table B-1.[9] Emission factors for SCE and CPA are described under *Electricity Emission Factors under the Renewables Portfolio Standard*, above. Natural gas emission factors are held constant from 2018.

Data Sources:

- SCE Emission Factors
  Link: https://www.edison.com/content/dam/eix/documents/sustainability/eix-esg-pilot-quantitative-section-sce.pdf
- CPA Emission factors
  Link: (account required for download): https://cris4.org/(S(rtuopf12t5k5ymsx3rurxtg4))/frmLILogin.aspx
- Power Content Labels
  Link: https://www.energy.ca.gov/programs-and-topics/programs/power-source-disclosure/power-content-label
- California RPS Program Overview
  Link: https://www.cpuc.ca.gov/RPS_Overview/
- SB 100
  Link: https://leginfo.legislature.ca.gov/faces/billNavClient.xhtml?bill_id=201720180SB100

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7 The Climate Registry. 2020. Utility-Specific Emission Factors. Available: https://www.theclimateregistry.org/our-members/cris-public-reports/. Accessed January 2021.

8 The Climate Registry. 2018. Default Emission Factors. May 1, 2018. Available: https://www.theclimateregistry.org/wp-content/uploads/2018/06/The-Climate-Registry-2018-Default-Emission-Factor-Document.pdf. Accessed January 2021.

9 California Public Utilities Commission. 2018. Renewables Portfolio Standards (RPS). Available: https://www.cpuc.ca.gov/industries-and-topics/electrical-energy/electric-power-procurement/rps/rps-program-overview. Accessed January 2021.

Manufacturing and Industrial Buildings

ELECTRICITY AND NATURAL GAS

Like the BAU Forecast, energy consumption in manufacturing and industrial buildings are forecasted based on building footprint projections for nonresidential stock in unincorporated Los Angeles County (see Appendix A).[10] As discussed above, beginning in 2018, nonresidential customers in unincorporated Los Angeles County were enrolled in CPA's Clean Power rate option (50 percent eligible renewable), with less than 5 percent of customers opting out; the year-end CPA participation rate is held constant with the remaining customers continuing to receive electricity from SCE. The emission factors for CPA are based on historical power mix (2018–2020) and California's RPS targets, as discussed above and presented in Table B-1.[11] Emission factors for SCE and CPA are the same as described under *Electricity Emission Factors under the Renewables Portfolio Standard*, above.

California Building and Energy Efficiency Standards (Title 24)

The CEC first adopted Energy Efficiency Standards for Residential and Nonresidential Buildings (California Code of Regulations Title 24, Part 6) in 1978 in response to a legislative mandate to reduce energy consumption in the state. Although not originally intended to reduce GHG emissions, increased energy efficiency and reduced consumption of electricity, natural gas, and other fuels would result in fewer GHG emissions from residential and nonresidential buildings subject to the standard. The standards are updated periodically (typically every three years) to allow for the consideration and inclusion of new energy efficiency technologies and methods (CEC, 2016). The current Title 24, Part 6 standards (2019 standards) were made effective on January 1, 2020. The new Title 24, Part 6 standards (2022 standards) were adopted by the CEC in August 2021 and will be made effective on January 1, 2023. The Adjusted BAU forecasts accounts for these updates to Title 24, as discussed below.

Residential Buildings

Under the Adjusted BAU scenario, energy use in residential buildings was adjusted to reflect the effects of Title 24 standards. Title 24 Building Efficiency Standards are updated every three years by the California Energy Commission. The model uses approximate increased energy efficiency percentages for the 2019 Title 24 standards[12] implemented in 2020, and the 2022 standards to be implemented in 2023.[13] The 2019 percentages are based on CEC estimates for residential and nonresidential buildings and assume that the solar photovoltaic (PV) requirement is met. The 2022 percentages were calculated based on CEC's draft environmental impact report for the

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[10] UCLA Institute of Environmental Studies. 2018. Analysis of County of Los Angeles Parcel Assessor's Data.

[11] California Public Utilities Commission. 2018. Renewables Portfolio Standards (RPS). Available: https://www.cpuc.ca.gov/industries-and-topics/electrical-energy/electric-power-procurement/rps/rps-program-overview. Accessed January 2021.

[12] California Energy Commission. 2020. 2019 Building Energy Efficiency Standards FAQ. Available: https://www.energy.ca.gov/sites/default/files/2020-03/Title_24_2019_Building_Standards_FAQ_ada.pdf. Accessed December 2021.

[13] California Energy Commission. 2021. 2022 Building Energy Efficiency Standards Summary. Available: https://www.energy.ca.gov/sites/default/files/2021-08/CEC_2022_EnergyCodeUpdateSummary_ADA.pdf. Accessed December 2021.

2022 standards.[14] This document outlined the changes in building energy use from the 2019 to 2022 standards on a project-by-project basis. Weighted averages were taken to generate efficiency change values for single-family and multifamily residential buildings for both electricity and natural gas. These efficiency changes are applied to 2019 energy use intensity (EUI) values to generate 2022 EUI values for each building type, which are then applied to the square footage of new construction. In the model, the adjusted EUI is also applied to 15 percent of the total square footage of existing buildings to account for the approximately 15 percent of buildings that are retrofitted each year. Because Title 24 is updated on a three-year cycle, the 2022 changes in energy efficiency are applied every three years in the model.

Data Sources:

- Title 24 2019 Update
  Link: https://www.energy.ca.gov/sites/default/files/2020-03/Title_24_2019_Building_Standards_FAQ_ada.pdf
- Title 24 2022 Update
  Link: https://www.energy.ca.gov/sites/default/files/2021-08/CEC_2022_EnergyCodeUpdateSummary_ADA.pdf
- Title 24 2022 Environmental Impact Report
  Link: https://www.energy.ca.gov/publications/2021/environmental-impact-report-amendments-building-efficiency-standards-2022-energy

Commercial and Institutional Buildings

Under the Adjusted BAU scenario, energy use in commercial, institutional, and agricultural buildings was adjusted to reflect the effects of Title 24 standards. The methods for adjusting energy use under new Title 24 standards are the same as described for *Residential Buildings*, above.

Data Sources:

- Title 24 2019 Update
  Link: https://www.energy.ca.gov/sites/default/files/2020-03/Title_24_2019_Building_Standards_FAQ_ada.pdf
- Title 24 2022 Update
  Link: https://www.energy.ca.gov/sites/default/files/2021-08/CEC_2022_EnergyCodeUpdateSummary_ADA.pdf
- Title 24 2022 Environmental Impact Report
  Link: https://files.ceqanet.opr.ca.gov/268487-2/attachment/MNZKECIHPRRVXPxfeMxJjloL-VXe6AFxDecdnxi8c5vzAkZWPhhj5GPnAarnDp4zd7reUQfLY0fV2AI70

Manufacturing and Industrial Buildings

Under the Adjusted BAU scenario, energy use in manufacturing and construction buildings was adjusted to reflect the effects of Title 24 standards. The methods for adjusting energy use under new Title 24 standards are the same as described for *Residential Buildings*, above. Title 24 Building Efficiency Standards are updated every three years by the California Energy Commission.

[14] California Energy Commission. 2021. Draft Environmental Impact Report: Amendments to the Building Energy Efficiency Standards (2022 Energy Code). Available: https://www.energy.ca.gov/programs-and-topics/programs/building-energy-efficiency-standards/2022-building-energy-efficiency. Accessed December 2021.

Data Sources:

- Title 24 2019 Update
  Link: https://www.energy.ca.gov/sites/default/files/2020-03/Title_24_2019_Building_Standards_FAQ_ada.pdf
- Title 24 2022 Update
  Link: https://www.energy.ca.gov/sites/default/files/2021-08/CEC_2022_EnergyCodeUpdateSummary_ADA.pdf
- Title 24 2022 Environmental Impact Report
  Link: https://files.ceqanet.opr.ca.gov/268487-2/attachment/MNZKECIHPRRVXPxfeMxJjloL-VXe6AFxDecdnxi8c5vzAkZWPhhj5GPnAarnDp4zd7reUQfLY0fV2AI70

Advanced Clean Cars Regulations and Pavley Vehicle Efficiency Standards

In 2002, Governor Gray Davis signed Assembly Bill (AB) 1493. AB 1493 requires that the California Air Resources Board (CARB) develop and adopt, by January 1, 2005, regulations that achieve "the maximum feasible reduction of greenhouse gases emitted by passenger vehicles and light-duty trucks and other vehicles determined by CARB to be vehicles whose primary use is noncommercial personal transportation in the State." To meet the requirements of AB 1493, in 2004 CARB approved amendments to the California Code of Regulations, adding GHG emissions standards to California's existing standards for motor vehicle emissions. All mobile sources are required to comply with these regulations as they are phased in from 2009 through 2016. These regulations are known as the "Pavley standards" (named for the bill's author, State Senator Fran Pavley).

In January 2012, pursuant to Recommended Measures T-1 and T-4 of the Original Scoping Plan, CARB approved the Advanced Clean Cars Program, an emissions-control program for model year 2017 through 2025. The program combines the control of smog, soot, and GHGs with requirements for greater numbers of zero-emission vehicles. By 2025, when the rules will be fully implemented, the new automobiles will emit 34 percent fewer global warming gases and 75 percent fewer smog-forming emissions. The program also requires car manufacturers to offer for sale an increasing number of zero-emission vehicles (ZEVs) each year, including battery electric, fuel cell, and plug-in hybrid electric vehicles. In December 2012, CARB adopted regulations allowing car manufacturers to comply with California's GHG emissions requirements for model years 2017–2025 through compliance with the EPA GHG requirements for those same model years.[15]

The Adjusted BAU forecasts accounts for these vehicle fleet efficiency standards, as discussed below.

On-road Transportation: Passenger Vehicles and Trucks

Like the BAU forecast, vehicle miles traveled (VMT) from passenger vehicles and trucks were estimated using SCAG's 2016 Regional Travel Demand Model, which forecasts VMT for the year 2040 (see Appendix A). GHG emissions under the Advanced Clean Cars regulations and Pavley standards in unincorporated Los Angeles County are calculated using VMT and corresponding weighted emission factors by vehicle type (passenger vehicles and trucks)[16] for years 2018, 2030,

[15] Advanced Clean Cars Program information available online: https://ww2.arb.ca.gov/our-work/programs/advanced-clean-cars-program/about. Accessed on February 7, 2020.

[16] Passenger vehicles correspond to EMFAC categories LDA, LDT1, LDT2, MCY, and MD. Trucks correspond to EMFAC categories LHDT1, LHDT2, MHDT, HHDT, and MH.

2035, and 2045 from the EMFAC2021 model.[17] Interim year emissions were interpolated for 2019 through 2029, 2031 through 2034, and 2036 through 2044.

Data Sources:

- EMFAC2021 Model, v1.0.1
  Link: https://arb.ca.gov/emfac/emissions-inventory/4c9f04282a1f85d62a27721058b5a3bb6fd22fb9
- SCAG Regional Travel Demand Model
  Provided by SCAG

On-road Transportation: Buses

Fuel consumption from Metro buses for years 2019 through 2045 was calculated using fuel consumption and VMT data from the EMFAC2021 model. The EMFAC2021 model was run for years 2018, 2030, 2035, and 2045 and the fuel efficiency (miles per gallon, miles per gallon equivalent, or kWh/mile) were calculated.[18] An efficiency factor for diesel, gasoline, compressed natural gas, and electricity was then developed by dividing the 2030, 2035, and 2045 fuel efficiency by the baseline fuel efficiency in 2018. The efficiency factor was then applied to the 2018 fuel consumption by fuel type to determine the project fuel consumption for years 2030, 2035, and 2045. Emission factors for gasoline, diesel and compressed natural (CNG) gas-powered buses are taken from EMFAC2021 database to calculate GHG emissions. Electricity emissions were calculated using CPA Clean option emission factors for the corresponding year. Emissions for interim years were interpolated for years 2019 through 2030, 2031 through 2034, and 2036 through 2044.

Data Sources:

- Metro Bus Ridership
  Link: https://isotp.metro.net/MetroRidership/Index.aspx
- EMFAC2021 Model, v1.0.1
  Link: https://arb.ca.gov/emfac/emissions-inventory/4c9f04282a1f85d62a27721058b5a3bb6fd22fb9

Adjusted BAU Forecast Results

Table B-3 presents emissions for 2018 along with the Adjusted BAU forecast for 2030, 2035, and 2045 for the Stationary Energy sector.

[17] California Air Resources Board. 2021. EMFAC2021 Model. Version v1.0.1. Available: https://arb.ca.gov/emfac/emissions-inventory/4c9f04282a1f85d62a27721058b5a3bb6fd22fb9. Accessed October 2021.

[18] California Air Resources Board. 2021. EMFAC2021 Model. Version v1.0.1. Available: https://arb.ca.gov/emfac/emissions-inventory/4c9f04282a1f85d62a27721058b5a3bb6fd22fb9. Accessed October 2021.

Table B-3: Stationary Energy GHG Emissions – 2018 Inventory and Adjusted BAU Forecasts

	ANNUAL GHG EMISSIONS ($MTCO_2E$)			
STATIONARY ENERGY SUBSECTOR	2018	2030	2035	2045
Residential Buildings	962,743	825,053	755,555	617,836
Commercial, Institutional, and Agricultural Buildings	349,373	344,421	291,764	185,682
Manufacturing and Construction Buildings	244,417	251,607	212,726	133,633
Energy Industries	98,554	29,495	29,526	29,587
Fugitive Emissions from Oil and Natural Gas Systems	41,066	49,130	49,275	49,493
Agriculture, Forestry and Other Fishing Activities	2,658	2,600	2,580	2,562
TOTAL	**1,698,809**	**1,502,306**	**1,341,401**	**1,018,793**

NOTES:
Abbreviations: BAU = business-as-usual; GHG = greenhouse gas; $MTCO_2e$ = metric tons of carbon dioxide equivalent
These emissions account for the RPS, SB 100, and Title 24 updates.

Table B-4 presents emissions for 2018 along with the adjusted BAU forecast for 2030, 2035, and 2045 for the Transportation sector.

Table B-4: Transportation GHG Emissions – 2018 Inventory and Adjusted BAU Forecasts

	ANNUAL GHG EMISSIONS ($MTCO_2E$)			
TRANSPORTATION SUBSECTOR	2018	2030	2035	2045
Passenger Vehicles	2,665,824	2,166,604	2,047,769	1,977,297
Buses	29,371	29,026	22,076	5,326
Railways	9,490	10,255	10,389	10,658
TOTAL	**2,704,685**	**2,205,885**	**2,080,234**	**1,993,281**

NOTES:
Abbreviations: BAU = business-as-usual; GHG = greenhouse gas; $MTCO_2e$ = metric tons of carbon dioxide equivalent.
These emissions account for the Advanced Clean Cars regulations and Pavley vehicle efficiency standards.

Table B-5 presents total emissions for 2018 along with the Adjusted BAU forecast for 2030, 2035, and 2045 for all sectors.

Table B-5: Total GHG Emissions by Sector – 2018 Inventory and Adjusted BAU Forecasts

	ANNUAL GHG EMISSIONS ($MTCO_2E$)			
SECTOR	2018	2030	2035	2045
Stationary Energy	1,698,809	1,502,306	1,341,401	1,018,793
Transportation	2,704,685	2,205,885	2,080,234	1,993,281
Waste	469,382	451,919	454,097	482,489
IPPU	239,505	259,605	267,981	284,731
AFOLU	60,860	60,860	60,860	60,860
TOTAL	**5,173,240**	**4,480,574**	**4,204,572**	**3,840,154**

NOTES:
Abbreviations: AFOLU = Agriculture, Forestry, and Other Land Use; BAU = business-as-usual; GHG = greenhouse gas; IPPU = Industrial Processes and Product Use; $MTCO_2e$ = metric tons of carbon dioxide equivalent.
Compared to the BAU forecasts, the Adjusted BAU forecast only differs for the Stationary Energy and Transportation sectors. Waste, IPPU, and AFOLU are not changed.

Figure B-1 presents total emissions for 2018 along with the BAU and Adjusted BAU forecast for 2030, 2035, and 2045 for all sectors.

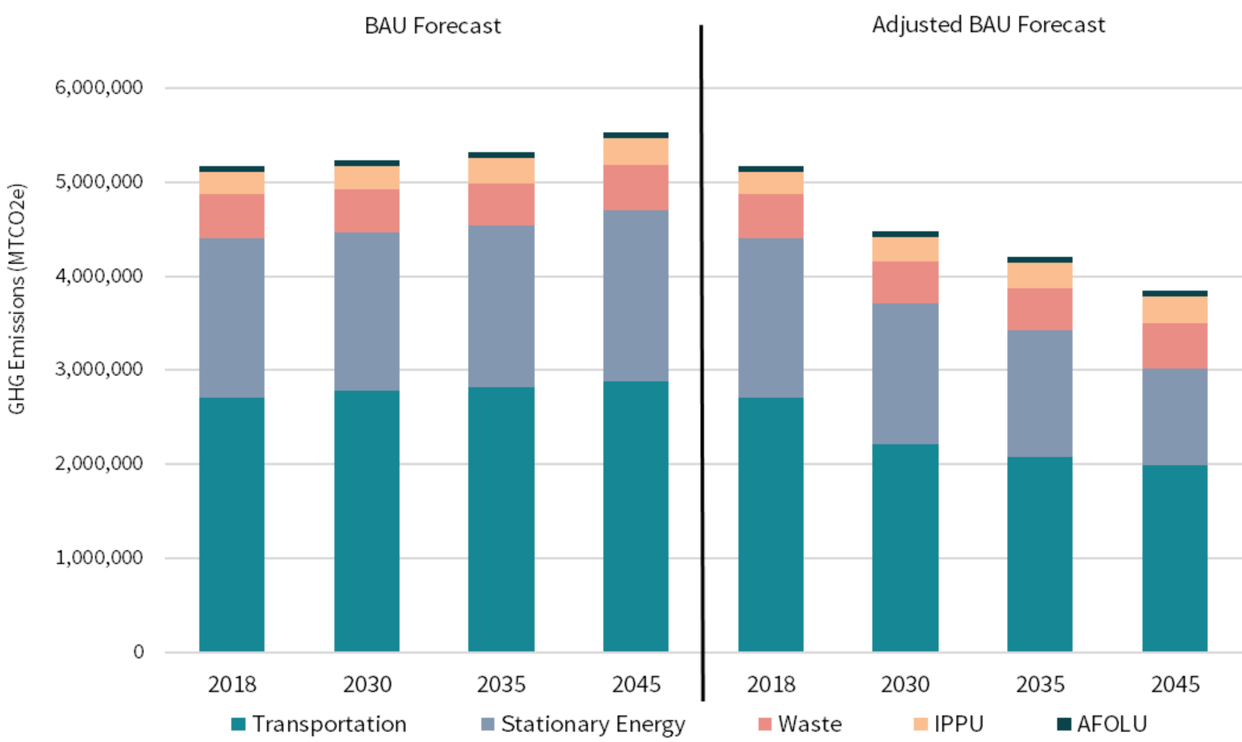

Figure B-1: GHG Emissions by Sector – 2018 Inventory, BAU Forecast, and Adjusted BAU Forecast

B.2 Greenhouse Gas Reduction Measures and Actions

Energy Supply

Strategy 1: Decarbonize the Energy Supply

MEASURE ES1: DEVELOP A SUNSET STRATEGY FOR ALL OIL AND GAS OPERATIONS

Table B-6: Measure ES1 GHG Reductions

YEAR	GHG REDUCTIONS ($MTCO_2E$)
2030	28,368
2035	40,178
2045	52,148

Abbreviations: GHG = greenhouse gas;
$MTCO_2e$ = metric tons of carbon dioxide equivalent.

Description

Develop a sunset strategy for all oil and gas operations that prioritizes disproportionately affected communities and develop a strategy for carbon removal.

Performance Objectives

The goal of Measure ES1 is to reduce oil and gas operations by 40 percent by 2030, 60 percent by 2035, and 80 percent by 2045 (compared to 2015 baseline levels). The aspirational goal of Measure ES1, based on the OurCounty Sustainability Plan, is to cease all oil and gas operations by 2040.

Modeling Approach

Measure ES1 would apply to emissions occurring in the Energy Industries subsector of the Stationary Energy sector of unincorporated Los Angeles County's GHG inventory. Specifically, Measure ES1 would reduce emissions from combined heat and power facilities and fugitive emissions from oil and natural gas systems. There are two combined heat and power facilities that would reduce emissions under this measure: the Pitchess Cogeneration Station in Saugus and the Olive View Medical Center Cogeneration Station in Sylmar. Both facilities combust natural gas to generate heat and electricity.

Both the Pitchess Cogeneration Station and the Olive View Medical Center Cogeneration Station are owned and operated by the County. The Pitchess Cogeneration Station was decommissioned in 2018 and its emissions decreased by 90 percent from 2017 to 2018. Under Measure ES1, these emissions were assumed to remain constant through 2045. The Olive View Medical Center Cogeneration Station will be decommissioned by 2023, so its emissions were reduced by 90 percent consistent with the reduction in emissions achieved when the Pitchess Cogeneration Station was decommissioned.

Measure ES1 would also reduce fugitive emissions from oil and natural gas systems equivalent to the measure's performance objectives: 40 below 2015 levels by 2030, 60 percent by 2035, and

80 percent by 2045. These percentages were multiplied by 2015 emissions to estimate emissions reductions for each future year.

Assumptions

- The decommissioning of the Olive View Medical Center Cogeneration Station would reduce natural gas-related GHG emissions by 90 percent.
- Under Measure ES1, both the Pitchess Cogeneration Station and the Olive View Medical Center Cogeneration Station would continue to combust residual natural gas at 10 percent of their fully operational levels through 2045.
- Measure ES1 will reduce fugitive emissions from oil and natural gas systems linearly with the measure's overall performance objectives for each future year.

Data Sources

- CARB Pollution Mapping Tool
  Link: https://www.arb.ca.gov/ei/tools/pollution_map/
- CARB MRR Database
  Link: https://ww2.arb.ca.gov/mrr-data

MEASURE ES2: PROCURE ZERO-CARBON ELECTRICITY

Table B-15: Measure ES2 GHG Reductions

YEAR	GHG REDUCTIONS ($MTCO_2E$)
2030	477,188
2035	317,915
2045	0

Abbreviations: GHG = greenhouse gas;
$MTCO_2e$ = metric tons of carbon dioxide equivalent.

Description

Supplying unincorporated Los Angeles County's power demand with zero-carbon electricity[19] is critical to achieving significant GHG emissions reductions. The CPA is a nonprofit and community choice energy provider that currently serves 32 communities across Southern California.

Performance Objectives

The goal of Measure ES2 is to enroll 100 percent of municipal facilities in CPA's Green Power rate option (100 percent Renewables), SCE's Green Rate option, or other available 100 percent zero carbon electricity service by 2030 and 96 percent of unincorporated Los Angeles County in CPA's Green Power rate option, SCE's Green Rate option, or other available 100 percent zero carbon electricity service by 2030 (4 percent opt-out rate).

Modeling Approach

The Measure ES2 calculations use Adjusted BAU electricity activity data and GHG emissions for residential and nonresidential uses in 2030, 2035, and 2045 as a baseline. The default participation rate in the CPA Lean and CPA Clean rate options was changed from 47 percent Clean and 48 percent Lean to 95.6 percent Green and 4.4 percent Lean by 2030 and 2035, and to 95.6 percent Green and 4.4 percent Clean by 2045. GHG emissions were calculated using the

[19] "Zero-carbon electricity" means energy resources that either qualify as "renewable" in the most recent Renewables Portfolio Standard (RPS) Eligibility Guidebook or generate zero greenhouse gas emissions on-site, such as hydropower.

Measure ES2 participation rates and CPA emission factors for 2030, 2035, and 2045 (as described in B.1, *Stationary Energy*). GHG emissions after implementation of Measure ES2 were then subtracted from the Adjusted BAU forecast emissions to estimate the GHG emissions reductions produced by Measure ES2.

Assumptions

- CPA and SCE emission factors for electricity are the same as those reported in section B.1 above.
- CPA Lean and SCE emission factors are equal; the SCE emission factors are applied to the to the "Opt Out/CPA Lean" category of electricity use in unincorporated Los Angeles County.
- The overall CPA participation rate (95.6 percent) remains constant through 2045.
- Measure ES2 is the first energy measure implemented; therefore, GHG emissions reductions associated with electricity savings as calculated in subsequent energy measures incorporate Measure ES2 participation rates and electricity emission factors.

Data Sources

- SCE Emission Factors
  Link: https://www.edison.com/content/dam/eix/documents/sustainability/eix-esg-pilot-quantitative-section-sce.pdf
- CPA Emission factors
  Link: (account required for download): https://cris4.org/(S(rtuopf12t5k5ymsx3rurxtg4))/frmLILogin.aspx
- CPA Member Status Report, July 28, 2021

MEASURE ES3: INCREASE RENEWABLE ENERGY PRODUCTION

Table B-18: Measure ES3 GHG Reductions

YEAR	GHG REDUCTIONS ($MTCO_2E$)
2030	5,919
2035	5,219
2045	0

Abbreviations: GHG = greenhouse gas;
$MTCO_2e$ = metric tons of carbon dioxide equivalent.

Description

Expand local solar power generation on existing and new development and for County projects.

Performance Objectives

The goal of Measure ES3 is to increase on-site solar electricity production for existing and new multifamily residential buildings, existing commercial buildings, and municipal buildings. The measure aims to install rooftop PV on 20 percent of existing multifamily residential buildings by 2030, 25 percent by 2035, and 35 percent by 2045; install rooftop solar PV on 15 percent of existing commercial buildings by 2030, 22 percent by 2035, and 32 percent by 2045; install rooftop solar PV on 80 percent of new multifamily residential buildings by 2030, 85 percent by 2035, and 95 percent by 2045; install rooftop solar PV on 40 percent of new commercial buildings by 2030, 50 percent by 2035, and 70 percent by 2045; and install 20,000 kilowatts (kW) of rooftop solar PV at county facilities. This measure also aims to install solar PV for community use and rooftop solar PV at all affordable housing developments.

Modeling Approach

Residential

GHG emissions reductions from rooftop solar PV were calculated using multifamily and single-family housing data and projections from the California Department of Finance. The baseline year for existing residential buildings is assumed to be 2023 because this is the earliest date that the 2045 CAP could be adopted and go into effect. Installation of rooftop solar PV on existing multifamily and single-family residential buildings therefore assumes a baseline year of 2023, and installation of rooftop solar PV on new multifamily residential buildings in 2030, 2035, and 2045 is based on the cumulative number of new multifamily households constructed from 2023 through each target years (e.g., the number of new multifamily residential buildings in 2030 is equal to the sum of all new multifamily housing built between 2023 and 2030).

The total number of existing and new households for each target year was then multiplied by the solar PV installation rate for each target year to obtain the number of participating households installing rooftop solar PV through implementation of Measure ES3. The average multifamily solar system size of 6.1 kW was calculated using data from Center for Sustainable Energy's *Fostering a Future for Multifamily Solar* study for the City of Santa Monica.[20] The average annual system electricity production (or system output) in kWh was then determined by inputting the 6.1 kW average system size into the National Renewable Energy Laboratory (NREL) PVWatts calculator for a project located in Los Angeles.[21] The average system output was then multiplied by the number of participating households for both existing and new multifamily development to determine the total solar production (in kWh) for each target year. GHG emissions reductions were calculated by multiplying the total solar production by the relevant SCE and CPA electricity emission factors, using the same participation rates and electricity emission factors implemented under Measure ES2.

For existing single-family residential buildings, the total number of households was multiplied by the solar PV installation rate for each target year to obtain the number of participating households installing rooftop solar PV through implementation of Measure ES5. The average single-family solar system size of 6.3 kW was calculated using data from using statewide data from Berkeley Laboratory's *Tracking the Sun* database.[22] The average annual system electricity production (or system output) in kWh was then determined by inputting the 6.3 kW average system size into the NREL PVWatts calculator for a project located in Los Angeles.[23] The average system output was then multiplied by the number of participating households for existing single-family development to determine the total solar production (in kWh) for each target year. GHG emissions reductions were calculated by multiplying the total solar production by the relevant SCE and CPA electricity emission factors, using the same participation rates and electricity emission factors implemented under Measure ES2.

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[20] Center for Sustainable Energy. 2018. *Fostering a Future for Multifamily Solar in Santa Monica, CA.* February 2018. Available: https://energycenter.org/sites/default/files/docs/nav/programs/smp/SantaMonicaMarketProfile.pdf. Accessed November 2021.

[21] National Renewable Energy Laboratory. 2021. PVWatts Calculator. Available: https://pvwatts.nrel.gov/. Accessed November 2021.

[22] Berkeley Laboratory. 2021. Tracking the Sun. September 2021. Available: https://emp.lbl.gov/tracking-the-sun. Accessed November 2021.

[23] National Renewable Energy Laboratory. 2021. PVWatts Calculator. Available: https://pvwatts.nrel.gov/. Accessed November 2021.

Measure E6 does not include rooftop solar PV installations on new single-family residential buildings because this is already required through the current 2019 Title 24 standards and also the new 2022 Title 24 standards and is therefore accounted for in the Adjusted BAU forecast.

Commercial

GHG emissions reductions from rooftop solar PV were calculated using existing and new commercial building square footage data from UCLA.[24] Like residential buildings above, the baseline year for existing commercial buildings is assumed to be 2023. Installation of rooftop solar PV on existing commercial buildings therefore assumes a baseline year of 2023, and installation of rooftop solar PV on new commercial buildings in 2030, 2035, and 2045 is based on the cumulative number of new commercial square footage constructed from 2023 through each target year (e.g., the number of new commercial square footage in 2030 is equal to the sum of all new commercial square footage built between 2023 and 2030).

Similar to residential buildings, the building square footage was multiplied by the solar PV installation rate for each target year to obtain the total participating commercial square footage installing rooftop solar PV through implementation of Measure ES3. The total number of commercial solar systems was determined by dividing the participating square footage by the average square footage of a commercial building in California of 15,599 square feet.[25] The average commercial solar system size was estimated using statewide data from Berkeley Laboratory's *Tracking the Sun* database; this value is 137.1 kW per commercial system.[26] The average annual electricity production (or system output) in kWh was then determined by inputting the average system size into the NREL PVWatts calculator for a project located in Los Angeles.[27] The average system output was then multiplied by the number of commercial solar systems for both existing and new development to determine the total solar production (in kWh) for each target year. GHG emissions reductions were calculated by multiplying the total solar production by the relevant SCE and CPA electricity emission factors, using the same participation rates and electricity emission factors implemented under Measure ES2.

Municipal

GHG emissions reductions from municipal solar PV installations assumes that the County will install a total of 30 solar systems on County facilities, producing a total capacity of 20 MW. The average system output was then determined by inputting a 20 MW production value into the NREL PVWatts calculator for a project located in Los Angeles.[28] The total system output for 20 MW of solar was then multiplied by the relevant SCE and CPA electricity emission factors, using the same participation rates and emission factors implemented under Measure ES2.

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24 UCLA Institute of Environmental Studies. 2018. Analysis of County of Los Angeles Parcel Assessor's Data.

25 Energy Information Administration. 2021. *2018 Commercial Buildings Energy Consumption Survey*. September 2021. Available: https://www.eia.gov/consumption/commercial/data/2018/pdf/CBECS_2018_Building_Characteristics_Flipbook.pdf. Accessed November 2021.

26 Berkeley Laboratory. 2021. Tracking the Sun. September 2021. Available: https://emp.lbl.gov/tracking-the-sun. Accessed November 2021.

27 National Renewable Energy Laboratory. 2021. PVWatts Calculator. Available: https://pvwatts.nrel.gov/. Accessed November 2021.

28 National Renewable Energy Laboratory. 2021. PVWatts Calculator. Available: https://pvwatts.nrel.gov/. Accessed November 2021.

Assumptions

- CPA and SCE emission factors for electricity are the same as those reported in Section B.1 above.
- CPA participation rates after implementation of Measure ES2.
- Existing building stock represents the built environment through the year 2023.
- New building stock represents new development starting in 2025.
- The average multifamily solar PV system size is 6.1 kW; each system produces 10,067 kWh per year.
- The average single-family solar PV system size is 6.3 kW; each system produces 10,466 kWh per year.
- The average commercial building solar PV system size is 137.1 kW; each system produces 227,758 kWh per year.
- 20 MW of solar PV is installed at municipal facilities; these systems produce 36,068,108 kWh per year.
- Annual GHG emissions reductions for each target year (2030, 2035, and 2045) reflect all buildings electrified in all previous years (e.g., all buildings electrified from 2025–2030 contribute to annual emissions reductions in 2030).
- New single-family residential buildings are required to install solar PV pursuant to the 2019 and 2022 Title 24 standards.

Data Sources

- SCE Emission Factors
  Link: https://www.edison.com/content/dam/eix/documents/sustainability/eix-esg-pilot-quantitative-section-sce.pdf
- CPA Emission factors
  Link: (account required for download): https://cris4.org/(S(rtuopf12t5k5ymsx3rurxtg4))/frmLILogin.aspx
- CPA Member Status Report, July 28, 2021
- California Department of Finance Demographic data
  Link: https://www.dof.ca.gov/Forecasting/Demographics/
- UCLA analysis of County of Los Angeles Parcel Assessor's Data
  Provided by UCLA Institute of Environmental Studies
- Center for Sustainable Energy, Fostering a Future for Multifamily Solar in Santa Monica, CA.
  Link: https://energycenter.org/sites/default/files/docs/nav/programs/smp/SantaMonicaMarketProfile.pdf
- USEIA, 2018 Commercial Buildings Energy Consumption Survey
  Link: https://www.eia.gov/consumption/commercial/data/2018/pdf/CBECS_2018_Building_Characteristics_Flipbook.pdf
- Berkeley Laboratory, Tracking the Sun
  Link: https://emp.lbl.gov/tracking-the-sun
- NREL, PVWatts Calculator
  Link: https://pvwatts.nrel.gov/

Transportation

GHG emissions reductions modeled for Measures T1, T2, T3, and T4 are based on changes to planned land use and transportation infrastructure (such as bikeways and transit) already envisioned in existing County plans and programs, such as the 2021 Housing Element Update and its Program EIR, the Los Angeles County Bike Master Plan (2012), the LA Metro NextGen Plan (2020), and LA Metro Long Range Transportation Plan (2020). The 2045 CAP does not result in any new changes to land use or transportation infrastructure than what was already analyzed in these existing plans and their CEQA documents. Consequently, the 2045 CAP merely models the GHG emissions reductions associated with the changes to land use and transportation infrastructure that were already analyzed elsewhere.

Strategy 2: Increase Densities and Diversity of Land Uses Near Transit

MEASURE T1: INCREASE DENSITY NEAR HIGH-QUALITY TRANSIT AREAS

Table B-7: Measure T1 GHG Reductions

YEAR	GHG REDUCTIONS ($MTCO_2E$)
2030	27,357
2035	26,019
2045	25,276

Abbreviations: GHG = greenhouse gas;
$MTCO_2e$ = metric tons of carbon dioxide equivalent.

Description

Increase housing opportunities that are affordable and near transit, to reduce VMT.

Performance Objectives

The goal of Measure T1 is to increase residential density by achieving a minimum of 20 dwelling units (DU) per acre (maximum of 30–150 DU/acre) for High Quality Transit Areas (HQTAs), locate residential and employment centers in unincorporated Los Angeles County within one mile of an HQTA, and increase the dwelling units within HQTAs by 27 percent.

Modeling Approach

VMT reductions were estimated using research documented in the 2021 California Air Pollution Control Officers Association (CAPCOA) publication *Quantifying Greenhouse Gas Mitigation Measures* (referred to herein as the "CAPCOA handbook").[29] To quantify VMT reductions, appropriate equations were used based on factsheets in the CAPCOA handbook. Using data from a County GIS shapefile layer showing the 2021–2029 Housing Element Rezone Areas and a major transit stop GIS layer developed as part of the County's SB 743 VMT Tool released in late 2020, along with CAPCOA equations, percent reductions in VMT were estimated for Measure T1. Specifically, it was assumed that the residential density within HQTAs as planned for in the 2021–2029 Housing Element would be 20 DU per acre (the Housing Element analyzed densities from 20 DU/acre to 50 du/acre) compared to the typical density value of 9.1 DU/acre, resulting in a 26.4 percent reduction in passenger vehicle VMT for affected areas. This reduction was applied to the specific home-based VMT occurring within the affected transit-oriented design (TOD) areas in unincorporated Los Angeles County.

VMT was calculated at the transportation analysis zone (TAZ) level.[30] Once the percent VMT reductions were determined, based on the geographic scope and VMT category of Measure T1, the appropriate VMT was aggregated across the relevant TAZs within which residential densities would increase. Percent reductions were then applied to appropriate VMT subtotals to obtain the VMT reduction estimates. The sum of these reductions was then subtracted from total light-duty

[29] California Air Pollution Control Officers Association. 2021. *Handbook for Analyzing Greenhouse Gas Emission Reductions, Assessing Climate Vulnerabilities, and Advancing Health and Equity, California Air Pollution Control Officers Association*. December 2021. Available: http://www.airquality.org/air-quality-health/climate-change/ghg-handbook-caleemod. Accessed January 2022.

[30] TAZs are comparable in size and shape to census tracts or block groups depending on the travel demand model used and level of modeling detail.

vehicle VMT to estimate adjusted daily VMT. This adjusted daily VMT was then projected to obtain VMT reductions and adjusted totals in each analysis year (2030, 2035, and 2045). These VMT calculations were prepared by Fehr & Peers and supplied to the County.

GHG reductions from Measure T1 are calculated using daily VMT reductions provided by Fehr & Peers, as described above.[31] The average daily VMT reductions achieved through implementation of Measure T1 were annualized by multiplying by 347 days, consistent with the GHG Inventory and Adjusted BAU forecast (see Appendix A). GHG emissions reductions were then calculated by multiplying the annual VMT reductions by the Adjusted BAU passenger vehicle emission factors for each target year as derived from EMFAC2021 (see Section B.1 above).[32]

Assumptions

- The residential density within HQTAs as planned for in the County's 2021–2029 Housing Element would be 20 DU per acre.
- The typical residential density without the County's 2021 Housing Element Update is 9.1 DU per acre.
- VMT reductions apply to home-based VMT occurring within the affected TOD and HQTA areas in unincorporated Los Angeles County.
- Daily VMT reductions are annualized by multiplying by 347 days.
- Passenger vehicle category corresponds to the EMFAC vehicle categories LDA, LDT1, LDT2, MCY, and MD.

References

- County of Los Angeles GIS shapefile layer for the 2021–2029 Housing Element Rezone Areas
- Major transit stop GIS layer developed as part of the County's SB 743 VMT Tool (2020)
- California Air Pollution Control Officers Association, Quantifying Greenhouse Gas Mitigation Measures
Link: http://www.airquality.org/air-quality-health/climate-change/ghg-handbook-caleemod
- Fehr & Peers, County of Los Angeles CAP VMT Reduction Estimate Summary (February 22, 2023)
- Fehr & Peers, County of Los Angeles 2045 Climate Action Plan Update - VMT Technical Memorandum (February 23, 2023)
- EMFAC2021 Model, v1.0.1
Link: https://arb.ca.gov/emfac/emissions-inventory/4c9f04282a1f85d62a27721058b5a3bb6fd22fb9

MEASURE T2: DEVELOP LAND USE PLANS ADDRESSING JOBS-HOUSING BALANCE AND INCREASE MIXED USE

Table B-8: Measure T2 GHG Reductions

YEAR	GHG REDUCTIONS ($MTCO_2E$)
2030	39,184
2035	37,267
2045	36,204

Abbreviations: GHG = greenhouse gas;
$MTCO_2e$ = metric tons of carbon dioxide equivalent.

Description

Increasing density and the mix of land uses can help reduce single-occupancy trips, the number of trips, and trip lengths.

[31] Fehr & Peers. 2021. County of Los Angeles CAP VMT Reduction Estimate Summary. February 22, 2023.
[32] California Air Resources Board. 2021. EMFAC2021 Model. Version v1.0.1. Available: https://arb.ca.gov/emfac/emissions-inventory/4c9f04282a1f85d62a27721058b5a3bb6fd22fb9. Accessed October 2021.

Performance Objectives

The goal of Measure T2 is to increase job density to 300 jobs per acre by 2030.

Modeling Approach

To quantify VMT reductions for Measure T2, appropriate equations were used based on factsheets in the CAPCOA handbook. Using data from a County GIS shapefile layer showing the 2021–2029 Housing Element Rezone Areas and a major transit stop GIS layer developed as part of the County's SB 743 VMT Tool released in late 2020, along with CAPCOA equations, percent reductions in VMT were estimated for Measure T2. Specifically, it was assumed that the transit mode share as planned for in the as planned for in the County's SB 743 VMT Tool would be 27 percent compared to the typical transit mode share of 15 percent, resulting in a 31.8 percent reduction in passenger vehicle VMT for affected areas. This reduction was applied to the total VMT occurring within the affected TOD areas in unincorporated Los Angeles County.

VMT was calculated at the TAZ level. Once the percent VMT reductions were determined, based on the geographic scope and VMT category of Measure T2, the appropriate VMT was aggregated across the relevant TAZs within which transit mode shift would increase. Percent reductions were then applied to appropriate VMT subtotals to obtain the VMT reduction estimates. The sum of these reductions was then subtracted from total light-duty vehicle VMT to estimate adjusted daily VMT. This adjusted daily VMT was then projected to obtain VMT reductions and adjusted totals in each analysis year (2030, 2035, and 2045). These VMT calculations were prepared by Fehr & Peers and supplied to the County.

GHG reductions from Measure T2 are calculated using daily VMT reductions provided by Fehr & Peers, as described above.[33] The average daily VMT reductions achieved through implementation of Measure T2 were annualized by multiplying by 347 days, consistent with the GHG Inventory and Adjusted BAU forecast (see Appendix A). GHG emissions reductions were then calculated by multiplying the annual VMT reductions by the Adjusted BAU passenger vehicle emission factors for each target year as derived from EMFAC2021 (see Section B.1 above).[34]

Assumptions

- The transit mode share would increase from 15 percent to 27 percent under this measure, based on the County's 2021 Housing Element Update and the County's SB 743 VMT Tool.
- VMT reductions apply to the total VMT occurring within the affected TOD areas in unincorporated Los Angeles County.
- Daily VMT reductions are annualized by multiplying by 347 days
- Passenger vehicle category corresponds to the EMFAC vehicle categories LDA, LDT1, LDT2, MCY, and MD.

References

- County of Los Angeles GIS shapefile layer for the 2021–2029 Housing Element Rezone Areas
- Major transit stop GIS layer developed as part of the County's SB 743 VMT Tool (2020)
- 2012 California Household Travel Survey
  Link: https://www.nrel.gov/transportation/secure-transportation-data/tsdc-california-travel-survey.html
- California Air Pollution Control Officers Association, Quantifying Greenhouse Gas Mitigation Measures
  Link: http://www.airquality.org/air-quality-health/climate-change/ghg-handbook-caleemod
- Fehr & Peers, County of Los Angeles CAP VMT Reduction Estimate Summary (February 22, 2023)

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[33] Fehr & Peers. 2021. County of Los Angeles CAP VMT Reduction Estimate Summary, February 22, 2023.
[34] California Air Resources Board. 2021. EMFAC2021 Model. Version v1.0.1. 2021. Available: https://arb.ca.gov/emfac/emissions-inventory/4c9f04282a1f85d62a27721058b5a3bb6fd22fb9. Accessed October 2021.

- Fehr & Peers, County of Los Angeles 2045 Climate Action Plan Update – VMT Technical Memorandum (February 22, 2023)
- EMFAC2021 Model, v1.0.1
  Link: https://arb.ca.gov/emfac/emissions-inventory/4c9f04282a1f85d62a27721058b5a3bb6fd22fb9

Strategy 3: Reduce Single-Occupancy Vehicle Trips

MEASURE T3: EXPAND BICYCLE AND PEDESTRIAN NETWORK TO SERVE RESIDENTIAL, EMPLOYMENT, AND RECREATIONAL TRIPS

Table B-9: Measure T3 GHG Reductions

YEAR	GHG REDUCTIONS ($MTCO_2E$)
2030	0
2035	2,811
2045	2,730

Abbreviations: GHG = greenhouse gas;
$MTCO_2e$ = metric tons of carbon dioxide equivalent.

Description

Travel options that serve a variety of land uses and trip purposes can help shift some trips away from single-occupancy vehicles.

Performance Objectives

The goal of Measure T3 is to increase bikeway miles by 300 percent by 2035.

Modeling Approach

To quantify VMT reductions for Measure T3, appropriate equations were used based on factsheets in the CAPCOA handbook. Using data from a County GIS shapefile layer showing the 2021–2029 Housing Element Rezone Areas and the 2012 County of Los Angeles Bicycle Master Plan, along with CAPCOA equations, percent reductions in VMT were estimated for Measure T3. Specifically, it was assumed that the bikeway network as planned for in the 2012 County of Los Angeles Bicycle Master Plan would be increased by more than threefold by 2035 as compared to existing conditions, resulting in a 0.5 percent reduction in Countywide passenger vehicle VMT. This reduction was applied to the total VMT occurring within unincorporated Los Angeles County. The sum of these VMT reductions was then subtracted from total light-duty vehicle VMT to estimate adjusted daily VMT. This adjusted daily VMT was then projected to obtain VMT reductions and adjusted totals in each analysis year (2030, 2035, and 2045). These VMT calculations were prepared by Fehr & Peers and supplied to the County.

GHG reductions from Measure T3 are calculated using daily VMT reductions provided by Fehr & Peers, as described above.[35] The average daily VMT reductions achieved through implementation of Measure T3 were annualized by multiplying by 347 days, consistent with the GHG Inventory and Adjusted BAU forecast (see Appendix A). GHG emissions reductions were

[35] Fehr & Peers. 2021. County of Los Angeles CAP VMT Reduction Estimate Summary, February 22, 2023.

then calculated by multiplying the annual VMT reductions by the Adjusted BAU passenger vehicle emission factors for each target year as derived from EMFAC2021 (see Section B.1 above).[36]

Assumptions

- The County's bikeway network as planned for in the 2012 County of Los Angeles Bicycle Master Plan would be increased by more than threefold by 2035 as compared to existing conditions.
- The reduction in VMT applies to the total VMT occurring within unincorporated Los Angeles County.
- Daily VMT reductions are annualized by multiplying by 347 days.
- Passenger vehicle category corresponds to EMFAC vehicle categories LDA, LDT1, LDT2, MCY, and MD.

References

- County of Los Angeles GIS shapefile layer for the 2021–2029 Housing Element Rezone Areas
- 2012 County of Los Angeles Bicycle Master Plan
  Link: https://pw.lacounty.gov/tpp/bike/masterplan.cfm
- California Air Pollution Control Officers Association, Quantifying Greenhouse Gas Mitigation Measure
  Link: http://www.airquality.org/air-quality-health/climate-change/ghg-handbook-caleemod
- Fehr & Peers, County of Los Angeles CAP VMT Reduction Estimate Summary (February 23, 2023)
- Fehr & Peers, County of Los Angeles 2045 Climate Action Plan Update - VMT Technical Memorandum (February 23, 2023)
- EMFAC2021 Model, v1.0.1
  Link: https://arb.ca.gov/emfac/emissions-inventory/4c9f04282a1f85d62a27721058b5a3bb6fd22fb9

MEASURE T4: BROADEN OPTIONS FOR TRANSIT, ACTIVE TRANSPORTATION, AND ALTERNATIVE MODES OF TRANSPORTATION

Table B-10: Measure T4 GHG Reductions

YEAR	GHG REDUCTIONS ($MTCO_2E$)
2030	11,465
2035	10,904
2045	10,593

Abbreviations: GHG = greenhouse gas;
$MTCO_2e$ = metric tons of carbon dioxide equivalent.

Description

Transit service, micro mobility services (such as bike-share, scooter-share, and drone deliveries), and access to these transportation options can help reduce VMT.

Performance Objectives

The goal of Measure T4 is to, by 2030, double transit service hours from 560,000 to 1.12 million hours, install bus-only lanes on all major transit thoroughfares, and that 75 percent of unincorporated Los Angeles County residents will live within one-half mile of shuttle or mobility service. Measure T4 has several additional performance goals, such as that all transit corridors will have micro mobility service and to prioritize micro mobility along equity areas and high-quality transit corridors.

[36] California Air Resources Board. 2021. EMFAC2021 Model. Version v1.0.1. Available: https://arb.ca.gov/emfac/emissions-inventory/4c9f04282a1f85d62a27721058b5a3bb6fd22fb9. Accessed October 2021.

Modeling Approach

To quantify VMT reductions for Measure T4, appropriate equations were used based on factsheets in the CAPCOA handbook. VMT reductions and associated GHG emissions reductions were quantified for two separate implementing actions that support Measure T4: Action T4.1 (Expand and improve frequency of County shuttles and explore new mobility services, such as micro transit, autonomous vehicles, micro mobility, and on-demand autonomous shuttles) and Action T4.2 (Install bus-only lanes and signal prioritization along major thoroughfares, and work with transit agencies and neighboring jurisdictions to plan and install full bus rapid transit infrastructure along priority corridors, as appropriate).

To calculate VMT reductions from Action T4.1, Fehr & Peers used a major transit stop GIS layer developed as part of the County's SB 743 VMT Tool released in late 2020 and information from the LA Metro NextGen Bus Plan (2020) and the LA Metro Long Range Transportation Plan (2020), along with CAPCOA equations. Specifically, the transit mode share of 4.6 percent per the 2012 California Household Travel Survey was used, and it was assumed that implementation of Action T4.1 would increase the total number of transit service hours in unincorporated Los Angeles County from 560,000 to 1.12 million after transit expansion. This value is based on the Metro NextGen report. This increase in transit service hours would result in a 1.9 percent reduction in Countywide passenger vehicle VMT. This reduction was applied to the total VMT occurring within unincorporated Los Angeles County. This VMT reduction was then subtracted from total light-duty vehicle VMT to estimate adjusted daily VMT. This adjusted daily VMT was then projected to obtain VMT reductions and adjusted totals in each analysis year (2030, 2035, and 2045).

To calculate VMT reductions from Action T4.2, Fehr & Peers used a major transit stop GIS layer developed as part of the County's SB 743 VMT Tool released in late 2020 and information from the LA Metro NextGen Plan and LA Metro Long Range Transportation Plan, along with CAPCOA equations. Specifically, the transit mode share of 4.6 percent per the 2012 California Household Travel Survey was used, and it was assumed that implementation of Action T4.2 would result in 100 percent of all transit routes in unincorporated Los Angeles County will receive bus-only lanes, signal prioritization along major thoroughfares, and full bus rapid transit infrastructure along priority corridors. This value is based on the LA Metro NextGen Plan and LA Metro Long Range Transportation Plan. This infrastructure would result in a 0.6 percent reduction in total VMT occurring in unincorporated Los Angeles County's TOD areas and HQTAs. VMT was calculated at the TAZ level. Once the percent VMT reductions were determined, based on the geographic scope and VMT category of Measure T4.2, the appropriate VMT was aggregated across the relevant TAZs within which transit mode shift would increase. Percent reductions were then applied to appropriate VMT subtotals to obtain the VMT reduction estimates. The sum of these reductions was then subtracted from total light-duty vehicle VMT to estimate adjusted daily VMT. This adjusted daily VMT was then projected to obtain VMT reductions and adjusted totals in each analysis year (2030, 2035, and 2045).

GHG reductions from Measure T4 are calculated using daily VMT reductions provided by Fehr & Peers, as described above.[37] The average daily VMT reductions achieved through implementation of Measure T4 were annualized by multiplying by 347 days, consistent with the GHG Inventory and Adjusted BAU forecast (see Appendix A). GHG emissions reductions were

[37] Fehr & Peers. 2021. County of Los Angeles CAP VMT Reduction Estimate Summary, February 22, 2023.

then calculated by multiplying the annual VMT reductions by the Adjusted BAU passenger vehicle emission factors for each target year as derived from EMFAC2021 (see Section B.1 above).[38]

Assumptions

- The baseline transit mode share is 4.6 percent, per the 2012 California Household Travel Survey.
- For Action T4.1, the total number of transit service hours in unincorporated Los Angeles County would increase from 560,000 to 1.12 million after transit expansion.
- For Action T4.1, the reduction in VMT applies to the total VMT occurring within unincorporated Los Angeles County.
- For Action T4.2, 100 percent of all transit routes in unincorporated Los Angeles County will receive bus-only lanes, signal prioritization along major thoroughfares, and full bus rapid transit infrastructure along priority corridors.
- For Action T4.2, VMT reductions apply to the relevant TAZs within which transit mode shift would increase.
- Daily VMT reductions are annualized by multiplying by 347 days.
- Passenger vehicle category corresponds to the EMFAC vehicle categories LDA, LDT1, LDT2, MCY, and MD.

References

- County of Los Angeles GIS shapefile layer for the 2021–2029 Housing Element Rezone Areas
- Major transit stop GIS layer developed as part of the County's SB 743 VMT Tool (2020)
- LA Metro 2020 Long Range Transportation Plan, March 2020.
  Link: https://www.metro.net/about/plans/long-range-transportation-plan/
- LA Metro NextGen Bus Plan, October 2020
  Link: https://www.metro.net/about/plans/nextgen-bus-plan/
- 2012 California Household Travel Survey
  Link: https://www.nrel.gov/transportation/secure-transportation-data/tsdc-california-travel-survey.html
- California Air Pollution Control Officers Association, *Quantifying Greenhouse Gas Mitigation Measures*
  Link: http://www.airquality.org/air-quality-health/climate-change/ghg-handbook-caleemod
- Fehr & Peers, County of Los Angeles CAP VMT Reduction Estimate Summary (February 22, 2023)
- Fehr & Peers, County of Los Angeles 2045 Climate Action Plan Update - VMT Technical Memorandum (February 22, 2023)
- EMFAC2021 Model, v1.0.1
  Link: https://arb.ca.gov/emfac/emissions-inventory/4c9f04282a1f85d62a27721058b5a3bb6fd22fb9

Strategy 4: Institutionalize Low-Carbon Transportation

MEASURE T6: INCREASE ZEV MARKET SHARE AND REDUCE GASOLINE AND DIESEL FUEL SALES

Table B-11: Measure T6 GHG Reductions

YEAR	GHG REDUCTIONS ($MTCO_2E$)
2030	482,515
2035	820,125
2045	1,535,101

Abbreviations: GHG = greenhouse gas;
$MTCO_2e$ = metric tons of carbon dioxide equivalent.

[38] California Air Resources Board. 2021. EMFAC2021 Model. Version v1.0.1. Available: https://arb.ca.gov/emfac/emissions-inventory/4c9f04282a1f85d62a27721058b5a3bb6fd22fb9. Accessed October 2021.

Description

Increase unincorporated Los Angeles County's ZEV market share and vehicle penetration to the maximum extent feasible. Set targets for reducing total gasoline and diesel vehicle fuel sales.

Performance Objectives

The goal of Measure T6 is to increase the total amount of light-duty vehicles in unincorporated Los Angeles County that are ZEVs to 30 percent by 2030, 50 percent by 2035, and 90 percent by 2045; to increase the sales of new light-duty vehicles in unincorporated Los Angeles County that are ZEVs to 68 percent by 2030 and 100 percent by 2035; to install 38,000 total new public and private shared EVCS (including EVCS at County facilities and properties) by 2030, 74,000 total new EVCS by 2035, and 140,000 total new EVCS by 2045; and to install 5,000 total new EVCS at County facilities and properties, 10,000 total new EVCS by 2035, and 25,000 total new EVCS by 2045.

Modeling Approach

The Measure T6 calculations use Adjusted BAU GHG emissions from passenger vehicles as a baseline. To calculate the portion of the passenger vehicle fleet that are ZEVs under Measure T6, the passenger vehicle electrification performance goals for each future year were applied to the total vehicle population and Countywide VMT outputs of the applicable EMFAC2021 model passenger vehicle types (LDA, LDT1, LDT2, MCY, and MDV). The remaining non-ZEV population and Countywide VMT by fuel type (diesel, gasoline, and plug-in hybrid) was distributed proportionally for each vehicle type based on Countywide fuel type distribution data from EMFAC2021. The adjusted ZEV population and VMT values with implementation of Measure T6 were then factored back in to the VMT-weighted emission factor calculations used for the Adjusted BAU forecast (see section B.2 above) to calculate new fleetwide vehicle emission rates under Measure T6. The recalculated weighted emission factors for passenger vehicles were then applied to the total passenger vehicle VMT by year to estimate GHG emissions with implementation of Measure T6.

Electric vehicle miles traveled (e-VMT) were then calculated for the Adjusted BAU forecast and for the scenario with implementation of Measure T6 by multiplying the total passenger vehicle VMT for each year by the electric vehicle share under each scenario. The e-VMT was then multiplied by electricity factors (kWh/mile) derived from EMFAC2021 to determine the total electricity consumption from electric vehicles. GHG emissions associated with this electricity use were estimated using the same participation rates and emission factors implemented under Measure ES2, as described below. Total GHG emissions reductions from Measure T6 were calculated by subtracting GHG emissions associated with Measure T6 implementation for passenger vehicles and electric vehicle charging from GHG emissions under the Adjusted BAU forecast for passenger vehicles and electric vehicle charging.

Measure T6 substantially reduces GHG emissions in the county; this measure is the most effective measure in the 2045 CAP.

Assumptions

- Increased electric vehicle adoption displaces all other vehicle types (diesel, gasoline, plug-in hybrid) and non-ZEV VMT is redistributed proportional to each fuel type's share of total population and VMT (from EMFAC2011).
- The efficiency of electric vehicles remains constant throughout all future years.

- The County passenger fleet vehicle population remains constant through 2045.
- CPA and SCE emission factors for electricity are the same as those reported in section B.1 below.
- CPA participation rates after implementation of Measure ES2.

Data Sources

- EMFAC2021 Model, v1.0.1
  Link: https://arb.ca.gov/emfac/emissions-inventory/4c9f04282a1f85d62a27721058b5a3bb6fd22fb9
- Alternative Fuels Data Center, Annual Average VMT per Vehicle
  Link: https://afdc.energy.gov/data/10309
- SCE Emission Factors
  Link: https://www.edison.com/content/dam/eix/documents/sustainability/eix-esg-pilot-quantitative-section-sce.pdf
- CPA Emission factors
  Link: (account required for download): https://cris4.org/(S(rtuopf12t5k5ymsx3rurxtg4))/frmLILogin.aspx
- CPA Member Status Report, July 28, 2021

MEASURE T7: ELECTRIFY COUNTY FLEET VEHICLES

Table B-12: Measure T7 GHG Reductions

YEAR	GHG REDUCTIONS ($MTCO_2E$)
2030	29,743
2035	24,335
2045	10,119

Abbreviations: GHG = greenhouse gas;
$MTCO_2e$ = metric tons of carbon dioxide equivalent.

Description

Electrify the County bus, shuttle, and light-duty vehicle fleet and shuttles.

Performance Objectives

The goals of this measure are to increase the total amount of light-duty vehicles in the County-owned fleet that are ZEVs to 35 percent by 2030, 60 percent by 2035, and 100 percent by 2045; to electrify the entire County bus and shuttle fleet by 2035; and to electrify 15 of the County's inmate buses by 2030, 30 inmate buses by 2035, and 68 inmate buses by 2045.

Modeling Approach

GHG emissions reductions associated with electrification of County passenger fleet vehicles were calculated for Measure T7. The total number of County fleet passenger vehicles was provided by the County's Internal Services Department (ISD).[39] Total VMT for these vehicles were estimated based on an annual average VMT per vehicle from the Alternative Fuels Data Center.[40] This average VMT value was then multiplied by the number of vehicles to estimate the total annual VMT for County fleet passenger vehicles. The baseline (Adjusted BAU) e-VMT was estimated based on the number of electric vehicle purchases in fiscal year 2019–20 as a percentage of total passenger fleet vehicles from the County's Annual Clean Fuel Sustainability Report. e-VMT under implementation of Measure T6 was estimated using the total passenger fleet vehicle VMT and electric vehicle fleet goals specific to the County fleet (35 percent by 2030, 60 percent by 2035,

[39] County of Los Angeles Internal Services Department. 2021. *Annual Clean Fuel Sustainability Report*.
[40] Alternative Fuels Data Center. 2020. Annual Average VMT per Vehicle. February 2020. Available: https://afdc.energy.gov/data/10309. Accessed November 2021.

and 100 percent by 2045). GHG emissions for electrified passenger fleet vehicles with implementation of Measure T6 were then calculated by multiplying total VMT by adjusted VMT-weighted emission factors from EMFAC2021 using the same method as discussed above for the Countywide fleet, scaled to match the light-duty fleet electrification performance objectives of this measure. These emissions were subtracted from the Adjusted BAU forecast GHG emissions for the County passenger vehicle fleet in order to estimate GHG emissions reductions for Measure T7 for county light-duty fleet vehicles. Only the portion of GHG emissions reductions for county fleet vehicles that exceed the ZEV goals of Measure T6 were included in Measure T7, to avoid double-counting the effects of Measure T6 on the county-owned fleet.

The Measure T7 calculations use Adjusted BAU fuel use and GHG emissions from public transit buses as a baseline. Measure T7 assumes a 100 percent electrification rate of all County fleet buses by 2030. To calculate GHG emissions reductions associated with Measure T7, fuel use from diesel, gasoline, and compressed natural gas under the Adjusted BAU forecast was converted to electricity using specific energy effectiveness ratios (EERs) by fuel type and conversion factors from gallons to British thermal units (Btu) and Btu to electricity use.[41,42] The EERs account for the change in vehicle energy efficiency when substituting one fuel for another. GHG emissions associated with implementation of Measure T7 were calculated using the same participation rates and emission factors implemented under Measure ES2, as discussed below. GHG emissions after implementation of Measure T7 were then subtracted from the Adjusted BAU GHG emissions to estimate the emissions reductions from Measure T7.

Measure T7 also includes electrification of the County's inmate bus fleet. The total number of inmate buses in the County's fleet (88) was provided by the Los Angeles County Sheriff's Department.[43] Annual VMT for the County's inmate bus fleet was estimated based on an annual average VMT value of 12,000 per bus from the Alternative Fuels Data Center.[44] The average inmate bus VMT was then multiplied by the total number of inmate buses to estimate the total annual VMT for inmate buses. The baseline e-VMT was assumed to be zero given that the Sheriff's Department does not currently operate any electric inmate buses. e-VMT from implementation of Measure T7 was determined using data provided by the Los Angeles County Sheriff's Department on planned electrification of the inmate bus fleet: 15 buses electrified by 2030, 30 buses electrified by 2035, and 68 buses electrified by 2045.[45] GHG emissions associated with the electrification of inmate buses under Measure T7 were calculated using weighted average bus emission factors from EMFAC2021 multiplied by the annual diesel VMT and e-VMT; these emissions were then subtracted from the GHG emissions in the Adjusted BAU forecast to determine emissions reductions.

41 Navius Research. 2018. *Analysis of Energy Effectiveness Ratios for Light- and Heavy-Duty Vehicles.* November 6, 2018. Available: https://www.naviusresearch.com/wp-content/uploads/2018/11/BC-EER-Review-Final-Report-2018-11-06.pdf. Accessed November 2021.

42 Alternative Fuels Data Center. 2021. Fuel Properties. January 2021. Available: https://afdc.energy.gov/fuels/properties. Accessed November 2021.

43 County of Los Angeles Internal Services Department. 2021. *Annual Clean Fuel Sustainability Report*.

44 Alternative Fuels Data Center. 2020. Annual Average VMT per Vehicle. February 2020. Available: https://afdc.energy.gov/data/10309. Accessed November 2021.

45 Los Angeles County Sheriff's Department email correspondence (2021).

Assumptions

- The County passenger fleet vehicle annual average VMT per vehicle value of 11,467 remains constant through 2045.
- Complete electrification of the transit bus fleet by 2030.
- CPA and SCE emission factors for electricity are the same as those reported in section B.1 below.
- CPA participation rates after implementation of Measure ES2.
- EERs applied to each non-electric fuel type to convert to electricity.
- The County inmate bus fleet vehicle annual average VMT per bus value of 12,000 remains constant through 2045.

References

- County of Los Angeles Internal Services Department, Annual Clean Fuel Sustainability Report, 2021.
- Navius Research, Analysis of Energy Effectiveness Ratios for Light- and Heavy-Duty Vehicles
  Link: https://www.naviusresearch.com/wp-content/uploads/2018/11/BC-EER-Review-Final-Report-2018-11-06.pdf.
- Alternative Fuels Data Center, Fuel Properties.
  Link: https://afdc.energy.gov/fuels/properties. Accessed November 2021.
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  Link: https://afdc.energy.gov/data/10309.
- Los Angeles County Sheriff's Department email correspondence (2021)
- SCE Emission Factors
  Link: https://www.edison.com/content/dam/eix/documents/sustainability/eix-esg-pilot-quantitative-section-sce.pdf
- CPA Emission factors
  Link: (account required for download): https://cris4.org/(S(rtuopf12t5k5ymsx3rurxtg4))/frmLILogin.aspx
- CPA Member Status Report, July 28, 2021

MEASURE T8: ACCELERATE FREIGHT DECARBONIZATION

Table B-13: Measure T8 GHG Reductions

YEAR	GHG REDUCTIONS ($MTCO_2E$)
2030	86,168
2035	103,528
2045	176,638

Abbreviations: GHG = greenhouse gas;
$MTCO_2e$ = metric tons of carbon dioxide equivalent.

Description

Incentivize and implement freight decarbonization technologies, specifically focusing on charging infrastructure.

Performance Objectives

The goal of this measure is to achieve a total market share of ZEVs for medium- and heavy-duty vehicles of 40 percent by 2030, 60 percent by 2035, and 90 percent by 2045; transition 50 percent of medium- and heavy-duty vehicles in the County-owned fleet to ZEVs by 2030, 70 percent by 2035, and 95 percent by 2045; ensure that 100 percent of the drayage truck fleet is ZEV by 2035; ensure that 100 percent of sales of medium- and heavy-duty trucks are ZEV by

2045; require that all new warehouse loading docks have EVCS by 2030; and require that all existing warehouse loading docks have EVCS by 2030.

Modeling Approach

The Measure T8 calculations use Adjusted BAU GHG emissions from medium- and heavy-duty trucks as a baseline. To calculate the portion of the medium- and heavy-duty truck fleet that are ZEVs under Measure T8, the truck electrification performance goals for each future year were applied to the total vehicle population and Countywide VMT outputs of the applicable EMFAC2021 model medium- and heavy-duty vehicle types (LHDT1, LHDT2, MHDT, HHDT, and MH). The remaining non-ZEV population and Countywide VMT by fuel type (diesel, gasoline, and natural gas) was distributed proportionally for each vehicle type based on Countywide fuel type distribution data from EMFAC2021. The adjusted ZEV population and VMT values with implementation of Measure T8 were then factored back into the VMT-weighted emission factor calculations used for the Adjusted BAU forecast (see section B.2 above) to calculate new fleetwide vehicle emission rates under Measure T8. The recalculated weighted emission factors for trucks were then applied to the total medium- and heavy-duty truck VMT by year to estimate GHG emissions with implementation of the Measure T8.

The e-VMT were then calculated for the Adjusted BAU forecast and for the scenario with implementation of Measure T8 by multiplying the total medium- and heavy-duty truck VMT for each year by the electric vehicle share under each scenario.[46] The e-VMT was then multiplied by electricity factors (kWh/mile) derived from EMFAC2021 to determine the total electricity consumption from electric vehicles. GHG emissions associated with this electricity use were estimated using the same participation rates and emission factors implemented under Measure ES2, as described below. Total GHG emissions reductions from Measure T8 were calculated by subtracting GHG emissions associated with Measure T8 implementation for medium- and heavy-duty trucks and electric vehicle charging from GHG emissions under the Adjusted BAU forecast for medium- and heavy-duty trucks and electric vehicle charging.

GHG emissions reductions associated with electrification of the County's medium- and heavy-duty fleet vehicles were also calculated for Measure T8. The total number of County fleet medium- and heavy-duty trucks was provided by ISD.[47] Total VMT for these vehicles were estimated based on an annual average VMT per truck from the Alternative Fuels Data Center.[48] This average VMT value was then multiplied by the number of trucks to estimate the total annual VMT for the County's medium- and heavy-duty fleet vehicles. The baseline (Adjusted BAU) e-VMT was estimated based on the number of electric truck purchases in fiscal year 2019–20 as a percentage of total medium- and heavy-duty fleet vehicles from the County's Annual Clean Fuel Sustainability Report. e-VMT under implementation of Measure T8 was estimated using the total medium- and heavy-duty fleet vehicle VMT and electric truck fleet goals specific to the County fleet (60 percent by 2030, 80 percent by 2035, and 95 percent by 2045). GHG emissions for electrified medium- and heavy-duty fleet vehicles with implementation of Measure T8 were then calculated by multiplying total VMT by adjusted VMT-weighted emission factors from EMFAC2011 using the same method as discussed above for the Countywide fleet. These

[46] California Air Resources Board. 2021. EMFAC2021 Model. Version v1.0.1. Available: https://arb.ca.gov/emfac/emissions-inventory/4c9f04282a1f85d62a27721058b5a3bb6fd22fb9. Accessed October 2021.

[47] County of Los Angeles Internal Services Department. 2021. *Annual Clean Fuel Sustainability Report*.

[48] Alternative Fuels Data Center. 2020. Annual Average VMT per Vehicle. February 2020. Available: https://afdc.energy.gov/data/10309. Accessed November 2021.

emissions were subtracted from the Adjusted BAU forecast GHG emissions for the County's medium- and heavy-duty vehicle fleet to estimate GHG emissions reductions for Measure T8 for County fleet vehicles.

Assumptions

- Increased electric vehicle adoption displaces all other vehicle types (diesel, gasoline, natural gas) and VMT is redistributed proportional to the fuel type's share of total population and VMT.
- The County's medium- and heavy-duty fleet vehicle population remains constant through 2045.
- The County's medium- and heavy-duty fleet vehicle annual average VMT per vehicle value of 16,326 remains constant through 2045.
- CPA and SCE emission factors for electricity are the same as those reported in section B.1 above.
- CPA participation rates after implementation of Measure ES2.

Data Sources

- EMFAC2021 Model, v1.0.1
  Link: https://arb.ca.gov/emfac/emissions-inventory/4c9f04282a1f85d62a27721058b5a3bb6fd22fb9
- County of Los Angeles Internal Services Department, Annual Clean Fuel Sustainability Report, 2021
- Alternative Fuels Data Center, Annual Average VMT per Vehicle
  Link: https://afdc.energy.gov/data/10309.
- SCE Emission Factors
  Link: https://www.edison.com/content/dam/eix/documents/sustainability/eix-esg-pilot-quantitative-section-sce.pdf
- CPA Emission factors
  Link: (account required for download): https://cris4.org/(S(rtuopf12t5k5ymsx3rurxtg4))/frmLILogin.aspx
- CPA Member Status Report, July 28, 2021

MEASURE T9: EXPAND USE OF ZERO-EMISSION TECHNOLOGIES FOR OFF-ROAD VEHICLES AND EQUIPMENT

Table B-14: Measure T9 GHG Reductions

YEAR	GHG REDUCTIONS ($MTCO_2E$)
2030	8,373
2035	21,819
2045	44,964

Abbreviations: GHG = greenhouse gas;
$MTCO_2e$ = metric tons of carbon dioxide equivalent.

Description

Prohibit the use of gas- and diesel-powered small (≤25 horsepower) off-road equipment and increase the use of zero-emission and near-zero-emission construction, agriculture, and manufacturing equipment.

Performance Objectives

The goal of this measure is to increase the total amount of off-road fleet and equipment in unincorporated Los Angeles County that are ZEVs to 20 percent by 2030, 50 percent by 2035, and 95 percent by 2045; and to increase the fleetwide percentage of construction, agriculture, and manufacturing equipment in unincorporated Los Angeles County that are ZEVs to 50 percent by 2030, 75 percent by 2035, and 100 percent by 2045.

Modeling Approach

The Measure T9 calculations use Adjusted BAU off-road vehicle fuel consumption and GHG emissions as a baseline for estimating GHG emissions reductions. Measure T9 aims to electrify unincorporated Los Angeles County's off-road vehicles and equipment by an increasing percentage in each future year. To calculate GHG emissions reductions associated with Measure T9, fuel use from diesel, gasoline, and compressed natural gas under the Adjusted BAU forecast was multiplied by electrification rates by target year and then converted to electricity using specific EERs by fuel type and conversion factors from gallons to Btu and Btu to electricity use.[49,50] GHG emissions from electricity under Measure T9 were calculated using the same participation rates and emission factors implemented under Measure ES2, as discussed below. Diesel, gasoline, and natural gas GHG emissions were calculated using emission factors derived from CARB's OFFROAD2017 ORION model.[51] GHG emissions after implementation of Measure T9 were then subtracted from the Adjusted BAU GHG emissions to estimate the emissions reductions from Measure T9.

Assumptions

- Natural gas-fueled equipment is not displaced by electric equipment.
- CPA and SCE emission factors for electricity are the same as those reported in section B.1 below.
- CPA participation rates after implementation of Measure ES2.
- EERs applied to each non-electric fuel type to convert to electricity.

References

- CARB OFFROAD ORION Model
  Link: https://arb.ca.gov/emfac/
- Navius Research, Analysis of Energy Effectiveness Ratios for Light- and Heavy-Duty Vehicles
  Link: https://www.naviusresearch.com/wp-content/uploads/2018/11/BC-EER-Review-Final-Report-2018-11-06.pdf.
- Alternative Fuels Data Center, Fuel Properties.
  Link: https://afdc.energy.gov/fuels/properties. Accessed November 2021.
- SCE Emission Factors
  Link: https://www.edison.com/content/dam/eix/documents/sustainability/eix-esg-pilot-quantitative-section-sce.pdf
- CPA Emission factors
  Link: (account required for download): https://cris4.org/(S(rtuopf12t5k5ymsx3rurxtg4))/frmLILogin.aspx
- CPA Member Status Report, July 28, 2021

Building Energy and Water

Building Energy and Water Measure Order of Implementation

To avoid double counting GHG emissions reductions for measures that reduce emissions in building energy and water, these measures account for overlapping effects. For example, Measure ES2 (Procure Zero Carbon Electricity) is implemented first and includes electricity emission factors and CPA participation rates that are applied through the remaining building

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49 Navius Research. 2018. *Analysis of Energy Effectiveness Ratios for Light- and Heavy-Duty Vehicles*. November 6, 2018. Available: https://www.naviusresearch.com/wp-content/uploads/2018/11/BC-EER-Review-Final-Report-2018-11-06.pdf. Accessed November 2021.

50 Alternative Fuels Data Center. 2021. Fuel Properties. January 2021. Available: https://afdc.energy.gov/fuels/properties. Accessed November 2021.

51 California Air Resources Board. 2018. OFFROAD ORION. Available: https://ww2.arb.ca.gov/our-work/programs/mobile-source-emissions-inventory/msei-modeling-tools. Accessed January 2021.

energy and water measures. Further, each measure's baseline activity data (i.e., electricity and natural gas consumption) are affected by the ordering of the measures. For example, grid electricity savings from solar production under Measure ES3 (Increase Renewable Energy Production) are subtracted from the adjusted BAU electricity activity data for the relevant building sector and the resulting electricity usage is used as the new "baseline" activity data for the next measure, Measure E4 (Improve Energy Efficiency of Existing Buildings). After Measure E4 is implemented, the new "baseline" activity data are recalculated and used as the new "baseline" total electricity usage for Measure E1 (Transition Existing Buildings to All-Electric). For calculation purposes, measures were assumed to be implemented in the following order:

1. Measure ES2: Procure Zero Carbon Electricity
2. Measure ES3: Increase Renewable Energy Production
3. Measure E4: Improve Energy Efficiency of Existing Buildings
4. Measure E1: Transition Existing Buildings to All-Electric
5. Measure E2: Standardize All-Electric New Development
6. Measure E5: Increase Use of Recycled Water and Gray Water Systems

Note that Measure E2 (Standardize All-Electric New Development) is independent of the other measures because it exclusively applies to new development and therefore does not use the same baseline activity data as the other measures.

Strategy 5: Decarbonize Buildings

MEASURE E1: TRANSITION EXISTING BUILDINGS TO ALL-ELECTRIC

Table B-16: Measure E1 GHG Reductions

YEAR	GHG REDUCTIONS ($MTCO_2E$)
2030	176,072
2035	280,988
2045	477,221

Abbreviations: GHG = greenhouse gas;
$MTCO_2e$ = metric tons of carbon dioxide equivalent.

Description

As the carbon intensity of grid-supplied electricity decreases, decarbonization must be combined with building electrification, shifting more load toward cleaner sources. This measure aims to electrify existing buildings. Biomethane is another preferred alternative to fossil natural gas; however, the existing opportunities for widespread use of biomethane are limited.

Performance Objectives

The goal of Measure E1 is to electrify 25 percent of all existing residential buildings by 2030, 40 percent by 2035, and 80 percent by 2045; to electricity 15 percent of all existing nonresidential buildings by 2030, 25 percent by 2035, and 60 percent by 2045; and to require Zero Net Energy (ZNE) for 50 percent of all major renovations by 2030, 75 percent by 2035, and 100 percent by 2045. Measure E1 has several additional performance goals, including adopting building performance standards and reach code(s), adopting a ZNE ordinance, electrify County facilities to the maximum extent feasible, retrofit affordable housing units for efficiency, decarbonization, and resilience, and to ensure low-income households do not experience rent increases as result of first cost.

Modeling Approach

The performance objectives were derived using SCE's Pathway to 2045 Whitepaper electrification targets, as stated in Table 1 of the whitepaper's appendices. Targets are identified for the space and water heating end uses for both residential and commercial buildings. Using data from the 2012 Commercial Buildings Energy Consumption Survey (CBECS) and the 2015 Residential Energy Consumption Survey (RECS), these end use electrification targets were adjusted to overall residential and nonresidential natural gas consumption for buildings in the "Mixed-dry/Hot-dry" climate region as defined by the U.S. Energy Information Administration (which includes Los Angeles County).[52]

The Measure E1 calculations use the activity data (electricity and natural gas) and GHG emissions for existing residential and nonresidential land uses after implementation of Measure ES2 (Procure Zero Carbon Electricity) as a baseline. The baseline year for existing development is assumed to be 2023 because this is the earliest date that the 2045 CAP could be adopted and go into effect. In other words, Measure E1 would apply to the built environment through the end of 2022. Electricity emissions before implementation of Measure E1 were calculated using the same participation rates and emission factors implemented under Measure ES2. To calculate the reduction in natural gas use and increase in electricity use under Measure E1, natural gas use in applicable buildings was converted to electricity use by multiplying the number of therms consumed by the electrification percentage for each building type (residential and nonresidential) for each target year, and then converting the displaced natural gas to electricity using a standard conversion factor of 29.3 kWh per therm.[53] GHG emissions after implementation of Measure E1 were then calculated using the same participation rates and emission factors implemented under Measure E1 and subtracted from the post-ES2 emissions to estimate the GHG reductions produced by Measure E1.

Assumptions

- Performance goals are based on SCE's Pathway to 2045 Whitepaper electrification goals for residential and commercial space and water heating, adjusted to average end use profiles for natural gas energy consumption in residential and commercial buildings in the "Mixed-dry/Hot-dry" climate region; the 2045 performance goals were further adjusted to help unincorporated Los Angeles County achieve its 2045 emissions reduction target.
- CPA and SCE emission factors for electricity are the same as those reported in section B.1 above.
- CPA participation rates after implementation of Measure ES2.
- There is no efficiency loss when converting natural gas to electricity.
- Existing development represents emissions and activity data in 2023.

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[52] For example, the SCE Pathway targets are 36 percent electric commercial space heating and 7 percent electric commercial water heating by 2035; in the Mixed-dry/Hot-dry climate region, space heating represents 35 percent of total commercial natural gas use and water heating represents 31 percent of total commercial natural gas use; the calculation for the total commercial building electrification target is 36 percent * 35 percent + 7 percent * 31 percent = 15 percent.

[53] UC Irvine Physics and Astronomy. 2021. Energy Units and Conversions. Available: https://www.physics.uci.edu/~silverma/units.html. Accessed November 2021.

Data Sources

- SCE Emission Factors
  Link: https://www.edison.com/content/dam/eix/documents/sustainability/eix-esg-pilot-quantitative-section-sce.pdf
- CPA Emission factors
  Link: (account required for download): https://cris4.org/(S(rtuopf12t5k5ymsx3rurxtg4))/frmLILogin.aspx
- CPA Member Status Report, July 28, 2021
- Southern California Edison, Pathway 2045 Appendices, Table 1
  Link: https://www.edison.com/home/our-perspective/pathway-2045.html
- U.S. Energy Information Administration, 2012 Commercial Buildings Energy Consumption Survey (CBECS), Table E7
  Link: https://www.eia.gov/consumption/commercial/data/2012/index.php?view=consumption#e1-e11
- U.S. Energy Information Administration, 2015 Residential Energy Consumption Survey (RECS), Table CE4.5
  Link: https://www.eia.gov/consumption/residential/data/2015/index.php?view=consumption#undefined
- UC Irvine Physics and Astronomy, Energy Units and Conversions
  Link: https://www.physics.uci.edu/~silverma/units.html
- Climate Registry
  Link: https://www.theclimateregistry.org/wp-content/uploads/2018/06/The-Climate-Registry-2018-Default-Emission-Factor-Document.pdf (the 2018 document was the latest available at the time the inventories were prepared)

MEASURE E2: STANDARDIZE ALL-ELECTRIC NEW DEVELOPMENT

Table B-17: Measure E2 GHG Reductions

YEAR	GHG REDUCTIONS ($MTCO_2E$)
2030	7,452
2035	12,588
2045	22,639

Abbreviations: GHG = greenhouse gas;
$MTCO_2e$ = metric tons of carbon dioxide equivalent.

Description

This measure aims to electrify all new buildings.

Performance Objectives

The goal of Measure E2 is to start to electrify all applicable new residential and nonresidential buildings by2030 and that most new development will be ZNE by 2030. For modeling purposes, the goal is to electrify 90 percent of new residential buildings (single-family and multifamily) by 2030, 95 percent by 2035, and 100 percent by 2045; and to electrify 90 percent of new nonresidential buildings (except large industry and food service) by 2030, 95 percent by 2035, and 100 percent by 2045. Measure E2 also has the performance goals that 90 percent of new residential buildings will be ZNE by 2030 and 90 percent of new nonresidential buildings (except large industry) will be ZNE by 2030.

Modeling Approach

The Measure E2 calculations use Adjusted BAU activity data (electricity and natural gas) and GHG emissions after implementation of Measure ES2 for new residential and nonresidential land uses as a baseline. New residential and nonresidential energy use was calculated by multiplying the new building square footage[54] by the EUI for each land use type (single-family residential, multifamily residential, commercial, and manufacturing/industrial). GHG emissions for new development were then calculated using the same participation rates and emission factors implemented under Measure ES2. To calculate the reduction in natural gas use and increase in electricity use under Measure E2, natural gas use in applicable buildings was converted to electricity use by multiplying the number of therms consumed by the electrification percentage for each building type (residential and nonresidential) for each target year and then converting the displaced natural gas to electricity using a standard conversion factor of 29.3 kWh per therm.[55] GHG emissions after implementation of Measure E2 were then calculated using the same participation rates and emission factors implemented under Measure ES2 and subtracted from the post-ES2 emissions to estimate the GHG reductions produced by Measure E2. Electrification of new development starts in 2025 and emissions reductions in each of the target years are calculated as cumulative reductions; for example, total annual GHG emissions reductions in 2030 account for all new building electrification for the years 2025 through 2030.

Assumptions

- CPA and SCE emission factors for electricity are the same as those reported in Section B.1 above.
- CPA participation rates after implementation of Measure ES2.
- There is no efficiency loss when converting natural gas to electricity.
- Electrification of new development begins in 2025.
- Annual GHG emissions reductions for each target year (2030, 2035, and 2045) reflect all buildings electrified in all previous years (e.g., all buildings electrified from 2025–2030 contribute to annual emissions reductions in 2030).

Data Sources

- SCE Emission Factors
  Link: https://www.edison.com/content/dam/eix/documents/sustainability/eix-esg-pilot-quantitative-section-sce.pdf
- CPA Emission factors
  Link: (account required for download): https://cris4.org/(S(rtuopf12t5k5ymsx3rurxtg4))/frmLILogin.aspx
- CPA Member Status Report, July 28, 2021
- UCLA analysis of County of Los Angeles Parcel Assessor's Data
  Provided by UCLA Institute of Environmental Studies
- UC Irvine Physics and Astronomy, Energy Units and Conversions
  Link: https://www.physics.uci.edu/~silverma/units.html
- Climate Registry
  Link: https://www.theclimateregistry.org/wp-content/uploads/2018/06/The-Climate-Registry-2018-Default-Emission-Factor-Document.pdf (the 2018 document was the latest available at the time the inventories were prepared)

[54] UCLA Institute of Environmental Studies. 2018. Analysis of County of Los Angeles Parcel Assessor's Data.
[55] UC Irvine Physics and Astronomy. 2021. Energy Units and Conversions. Available: https://www.physics.uci.edu/~silverma/units.html. Accessed November 2021.

Strategy 6: Improve Energy Efficiency of Existing Buildings

MEASURE E4: IMPROVE ENERGY EFFICIENCY OF EXISTING BUILDINGS

Table B-19: Measure E4 GHG Reductions

YEAR	GHG REDUCTIONS ($MTCO_2E$)
2030	22,274
2035	41,255
2045	203,455

Abbreviations: GHG = greenhouse gas;
$MTCO_2e$ = metric tons of carbon dioxide equivalent.

Description

Retrofit existing building stock to reduce overall County energy use.

Performance Objectives

The goal of Measure E4 is to improve the energy efficiency of existing residential and nonresidential buildings by reducing the energy use intensity (EUI) of existing buildings in unincorporated Los Angeles County below 2015 levels as follows: 20 percent for residential, 15 percent for industrial, and 25 percent for commercial by 2030; 25 percent for residential. 25 percent for industrial, and 35 percent for commercial by 2035; and 50 percent for residential, 50 percent for industrial, and 50 percent for commercial by 2045.

Modeling Approach

The Measure E4 calculations use the activity data (electricity and natural gas) and GHG emissions for existing residential and nonresidential land uses after implementation of Measure ES2 (Procure Zero Carbon Electricity) and Measure ES3 (Increase Renewable Energy Production) as a baseline. The baseline year for existing development is assumed to be 2023 because that is the earliest date that the 2045 CAP could be adopted and go into effect. In other words, Measure E4 would apply to the built environment through the end of 2022. This new “baseline” energy use was then multiplied by an assumed eligibility rate (i.e., the portion of buildings eligible for retrofits [based on building vintage, incentives available, income level, etc.]) and then by the participation rate (i.e., the portion of eligible residential and nonessential buildings actually performing a retrofit) to determine the total building energy usage subject to energy retrofits under Measure E4. Electricity and natural gas savings resulting from implementation of Measure E4 were then calculated by multiplying these energy usage values (electricity and natural gas) by the percent improvement in EUI for each target year under Measure E4 implementation. Electricity and natural gas emissions before implementation of Measure E4 were calculated using the same participation rates and emission factors implemented under Measure ES2 and Measure ES3. GHG emissions after implementation of Measure E4 were then calculated using the same participation rates and emission factors implemented under Measure ES2 and Measure ES3 and subtracted from the post-ES3 emissions to estimate the GHG reductions produced by Measure E4. GHG emissions for natural gas savings were calculated using the emission factors of 0.00531 $MTCO_2e$ per therm for residential and commercial buildings and 0.00532 $MTCO_2e$ per therm for industrial buildings.

Assumptions

- CPA and SCE emission factors for electricity are the same as those reported in section B.1 above.
- CPA participation rates after implementation of Measure ES2.
- Existing building stock represents the built environment through the year 2023.
- The energy efficiency eligibility rate is 25 percent for both residential and nonpresidential buildings in 2030 and 2035 and 50 percent for both residential and nonpresidential buildings in 2045.
- The participation rate for eligible buildings is 40 percent in 2030, 60 percent in 2035, and 90 percent in 2045. When applied to the percentage of buildings that are eligible for a retrofit, 10 percent of buildings are retrofit by 2030, 15 percent of buildings are retrofit by 2035, and 45 percent of buildings are retrofit by 2045.
- The reduction in EUI is based on 2015 average County EUI values.

Data Sources

- SCE Emission Factors
  Link: https://www.edison.com/content/dam/eix/documents/sustainability/eix-esg-pilot-quantitative-section-sce.pdf
- CPA Emission factors
  Link: (account required for download): https://cris4.org/(S(rtuopf12t5k5ymsx3rurxtg4))/frmLILogin.aspx
- CPA Member Status Report, July 28, 2021
- Climate Registry
  Link: https://www.theclimateregistry.org/wp-content/uploads/2018/06/The-Climate-Registry-2018-Default-Emission-Factor-Document.pdf (the 2018 document was the latest available at the time the inventories were prepared)

Strategy 7: Conserve Water

MEASURE E6: REDUCE INDOOR AND OUTDOOR WATER CONSUMPTION

Table B-20: Measure E6 GHG Reductions

YEAR	GHG REDUCTIONS ($MTCO_2E$)
2030	10,575
2035	15,122
2045	11,764

Abbreviations: GHG = greenhouse gas;
$MTCO_2e$ = metric tons of carbon dioxide equivalent.

Description

Reducing indoor and outdoor water consumption is essential as the state experiences longer and more severe droughts. Not only will water conservation improve regional resiliency, but it will also reduce GHG emissions through the reduction of energy consumption associated with processing, treatment, and the conveyance of water and wastewater.

Performance Objectives

The goal of Measure E6 is to reduce water use to less than 110 gallons per capita per day (GPCD) by 2030, less than 100 GPCD by 2035, and less than 75 GPCD by 2045.

Modeling Approach

Water use and the associated energy use (electricity and natural gas) to distribute and treat water supplied to unincorporated Los Angeles County were estimated for both the Adjusted BAU forecast scenario and the Measure E6 implementation scenario. Metropolitan Water District of

Southern California's (MWD's) historical water use was used as a proxy for unincorporated Los Angeles County.[56] Water use in gallons per capita per day (GPCD) under the Adjusted BAU forecast was projected for each future year using unincorporated Los Angeles County's population and MWD's 2019 per capita water use (121 GPCD), which was then converted to acre-feet per year (AF/yr). Water use associated with the implementation of Measure E9 was estimated using the target GPCD (listed above) and population, which was then converted to AF/yr.

The electricity and natural gas use resulting from each of the water use scenarios (Adjusted BAU and Measure E9 implementation) was estimated for both residential and nonresidential land uses. Energy intensity factors from The Pacific Institute's *The Future of California's Water-Energy-Climate* Nexus report were used to estimate the energy use associated with the treatment, distribution, end-use, and collection of water in the region, as well as the treatment of the resulting wastewater.[57] Data from the Los Angeles County Waterworks Districts 2020 Urban Water Management Plan were used to get the following regionally specific information, which was then applied to each water use scenario: the ratio of total water demand met by locally pumped groundwater (31 percent), the ratio of total water used that is collected as wastewater (59 percent), the ratio of collected wastewater that goes through secondary treatment (100 percent), and the water used by residential versus nonresidential land uses (76 percent and 24 percent, respectively).[58,59] Averages were used to estimate the amount of residential water that is heated versus nonresidential water that is heated.[60,61]

To estimate the GHG reductions associated with Measure E6, GHG emissions associated with following two scenarios were quantified and the difference between the two was taken: implementation of Measures ES2, E1, E2, and ES3 and implementation of Measures ES2, E1, E2, ES3, and E6. In each scenario, water use was assigned to existing or new development using forecasted residential and nonresidential land use percentages. To account for implementation of Measure E1, the appropriate percentage of natural gas use associated with water use in existing development was converted to electricity use. For example, 25 percent of residential natural gas use (therms) associated with water use in existing development was converted to kWh and added to existing residential development's electricity use associated with water. The electricity use resulting from implementation of Measure E1 (electricity use associated with water use in existing residential and nonresidential development) was then multiplied by emission factors which accounted for Measures ES2 and ES3; i.e., the percentage of electricity supplied by solar and the participation rate in each tier of CPA electricity. The natural gas use resulting from implementation of Measure E1 was multiplied by standard emission factors associated with each land use type. To account for implementation of Measure E2, all natural gas use associated with water use in new development was converted to electricity and added to new development's electricity use associated with water. The combined electricity use resulting from implementation of Measure E2 was then multiplied by emission factors which accounted for

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56 Metropolitan Water District of Southern California. 2021. *2020 Urban Water Management Plan*. June 2021. Available: https://www.mwdh2o.com/media/21641/2020-urban-water-management-plan-june-2021.pdf. Accessed November 2021.

57 The Pacific Institute. 2021. *The Future of California's Water-Energy-Climate Nexus*. September 2021. Available: https://pacinst.org/wp-content/uploads/2021/09/Water-Energy-Report_Sept-2021.pdf. Accessed November 2021.

58 Los Angeles County Waterworks Districts. 2021. *2020 Urban Water Management Plans*. October 2021. Available: https://dpw.lacounty.gov/wwd/web/Publications/WMP.aspx. Accessed November 2021.

59 California Department of Water Resources. 2022. Water Use Efficiency Data Portal. Available: https://wuedata.water.ca.gov/default.asp. Accessed November 2021.

60 Water Research Foundation. 2016. *Residential End Uses of Water,* Version 2, Executive Report. April 2016. Available: https://www.circleofblue.org/wp-content/uploads/2016/04/WRF_REU2016.pdf. Accessed November 2021.

61 Yudelson, 2010. Available: http://greenbuildconsult.com/pdfs/GreenWater.pdf. Accessed November 2021.

Measures ES2 and ES3; i.e., the percentage of electricity supplied by solar and the participation rate in each tier of CPA electricity. Emissions associated with existing development were then summed with emissions associated with new development for each scenario.

Assumptions

- Unincorporated Los Angeles County's water use profile is equivalent to that of MWD.
- The County falls within the South Coast and South Lahontan water regions, thus energy intensity factors for each region were averaged.
- The County's water use profile can be represented by Los Angeles County Waterworks Districts data.
- No efficiency losses result from natural gas conversion to electricity (Measure E1).
- 33 percent of residential indoor water use is heated and 22 percent of nonresidential indoor water use is heated.
- CPA and SCE emission factors for electricity are the same as those reported in Section B.1 above.
- CPA participation rates after implementation of Measure ES2.

Sources

- SCAG Population Projections
  Link: http://gisdata.scag.ca.gov/Pages/SocioEconomicLibrary.aspx?keyword=Forecasting
- MWD 2020 Urban Water Management Plan
  Link: https://www.mwdh2o.com/media/21641/2020-urban-water-management-plan-june-2021.pdf
- Los Angeles County Waterworks Districts 2020 Urban Water Management Plan
  Link: https://dpw.lacounty.gov/wwd/web/Publications/WMP.aspx
- Water Use Efficiency Data (WUEdata) Portal
  Link: https://wuedata.water.ca.gov/uwmp_export_2020.asp
- Water-Energy-Climate Nexus Report
  Link: https://pacinst.org/wp-content/uploads/2021/09/Water-Energy-Report_Sept-2021.pdf
- Residential End Uses of Water Report
  Link: https://www.circleofblue.org/wp-content/uploads/2016/04/WRF_REU2016.pdf
- SCE Emission Factors
  Link: https://www.edison.com/content/dam/eix/documents/sustainability/eix-esg-pilot-quantitative-section-sce.pdf
- CPA Emission factors
  Link: (account required for download): https://cris4.org/(S(rtuopf12t5k5ymsx3rurxtg4))/frmLILogin.aspx

Waste

Strategy 8: Minimize Waste and Recover Energy and Materials from the Waste Stream

MEASURE W1: INSTITUTIONALIZE SUSTAINABLE WASTE SYSTEMS AND PRACTICES

Table B-21: Measure W1 GHG Reductions

YEAR	GHG REDUCTIONS ($MTCO_2E$)
2030	154,514
2035	248,362
2045	342,934

Abbreviations: GHG = greenhouse gas;
$MTCO_2e$ = metric tons of carbon dioxide equivalent.

Description

Undertake actions that result in sustainable waste systems Countywide. Responsible and sustainable waste practices are learned behaviors, which the County can facilitate through outreach, education, and mandates. Increase diversion of recyclable materials and organics from landfills through ordinances, service improvements, education and outreach, and promotion of product stewardship and markets for material reuse. An increased diversion rate indirectly reduces the demand for virgin materials, which reduces the life-cycle carbon intensity of any resulting products. Through action taken at the County level, waste-conscious habits and thoughtful consumption can become the default.

Performance Objectives

The goal of Measure W1 is to increase the total unincorporated Los Angeles County waste diversion rate to 85 percent by 2030, 90 percent by 2035, and 95 percent by 2045.

Modeling Approach

Target waste disposal in units of tons per capita per year were estimated for each future year using the BAU annual waste generation rate per capita (3.0 tons per person per year in 2030 and 3.1 tons per person per year in 2035 and 2045), the BAU average diversion rates (75 percent for 2030, 2035, and 2045), and the target diversion rates (85 percent in 2030, 90 percent in 2035, and 95 percent in 2045). These target disposal rates were then converted to total reduction in landfilled waste in tons, compared to the BAU landfilled waste tonnages, using forecasted population. A ratio of BAU waste disposal and BAU emissions to targeted waste disposal was then used to estimate the emissions associated with waste disposal once Measure W1 has been implemented. To estimate reductions associated with new development versus existing development, a ratio of incremental population growth to total population in each of the target years was used.

Assumptions

- The BAU solid waste disposal rates are 3.0 tons per person per year in 2030 and 3.1 tons per person per year in 2035 and 2045.
- The BAU solid waste diversion rate is 75 percent in 2030, 2035, and 2045.
- Solid waste diversion rate and organics diversion rate are assumed to remain constant at 75 percent and 38 percent, respectively.
- For each ton of solid waste not placed in a landfill, 0.44 $MTCO_2e$ is saved (based on the Adjusted BAU forecast for the waste sector; see Appendix A).

Sources

- CARB FOD Model
  Link: https://ww2.arb.ca.gov/resources/documents/landfill-methane-emissions-tool
- CalRecycle SWIS Reports
  Link: https://www2.calrecycle.ca.gov/SolidWaste/Site/Search
- LADPW SWIMS Reports
  Link: https://dpw.lacounty.gov/epd/swims/OnlineServices/reports.aspx
- CalRecycle Landfill Gas Master
  Link: https://www2.calrecycle.ca.gov/PublicNotices/Documents/1642
- SCAG Population Projections
  Link: http://gisdata.scag.ca.gov/Pages/SocioEconomicLibrary.aspx?keyword=Forecasting

Agriculture, Forestry, and Other Land Use

Strategy 9: Conserve and Connect Wildlands and Working Lands

MEASURE A1: CONSERVE FORESTS, WOODLANDS, SHRUBLANDS, GRASSLANDS, DESERT, AND OTHER CARBON-SEQUESTERING WILDLANDS AND WORKING LANDS

Table B-22: Measure A1 GHG Reductions

YEAR	GHG REDUCTIONS ($MTCO_2E$)
2030	8,953
2035	17,906
2045	26,858

Abbreviations: GHG = greenhouse gas;
$MTCO_2e$ = metric tons of carbon dioxide equivalent.

Description

Preserve, conserve, and restore agricultural lands, working lands, rangelands, forest lands, wetlands, and other wildlands in unincorporated Los Angeles County.

Performance Objectives

The goal of Measure A1 is to reduce the amount of natural land converted for urban uses 25 percent below current (2018) levels by 2030, 50 percent by 2035, and 75 percent by 2045; this is equivalent to conserving natural lands that would have otherwise been converted for urbanized uses by 53 hectares annually by 2030, 106 hectares annually by 2035, and 159 hectares annually by 2045.

Modeling Approach

The Adjusted BAU forecast assumes that 212 hectares of forest land are converted to a new land use each year, which releases carbon stored in the removed biomass. GHG emissions reductions from Measure A1 were calculated by decreasing the amount of forest land conversion in each future year and multiplying by an emission factor for land conversion. For each hectare of natural land converted to other uses, a one-time emission of 169 $MTCO_2e$ per hectare would occur (see Appendix A for discussion).[62] The number of hectares saved from conversion under Measure A1 for each future year was multiplied by the one-time emission rate of 169 $MTCO_2e$ to calculate GHG emissions reductions for this measure.

Assumptions

- 212 hectares of natural land is converted annually in the Adjusted BAU forecast.
- For each hectare of natural land saved from conversion, avoided emissions would be 169 $MTCO_2e$.

References

- NASS, 2021. CropScape.
  Link: https://nassgeodata.gmu.edu/CropScape/

[62] NASS. 2021. CropScape. Available: https://nassgeodata.gmu.edu/CropScape/. Accessed January 2021.

Strategy 10: Sequester Carbon and Implement Sustainable Agriculture

MEASURE A3: EXPAND UNINCORPORATED LOS ANGELES COUNTY'S TREE CANOPY AND GREEN SPACES

Table B-23: Measure A3 GHG Reductions

YEAR	GHG REDUCTIONS ($MTCO_2E$)
2030	4,602
2035	7,080
2045	10,310

Abbreviations: GHG = greenhouse gas;
$MTCO_2e$ = metric tons of carbon dioxide equivalent.

Description

Create an Urban Forest Management Plan to plant trees, increase unincorporated Los Angeles County's tree canopy cover, add green space, and convert impervious surfaces.

Performance Objectives

The goal of Measure A3 is to plant 130,000 total new trees by 2030, plant 200,000 total new trees by 2035, and plant 270,000 total new trees by 2045.

Modeling Approach

The performance goals for Measure A3 were developed using the following steps:

1. Unincorporated Los Angeles County's current urban tree canopy cover is estimated to be 10.7 percent based on the Tree People 2016 LA Tree Canopy Report. Estimates by land use type are 13 percent residential, 9 percent commercial, 4 percent industrial, and 10 percent for public/semi-public, mixed use, specific plan, and other land use types.
2. The current urban area estimate is 158,889 acres from Table 6.1 of the General Plan Land Use Element for the categories above.
3. Applying the canopy cover of 10.7 percent to the total urban area acreage yields 16,943 acres of tree canopy.
4. The goal is to increase urban tree canopy cover 10 percent by 2030, 15 percent by 2035, and 20 percent by 2045. This yields an additional 1,694 new acres of tree canopy coverage by 2030, 2,542 acres by 2035, and 3,389 acres by 2045.
5. According to a 2015 study, one acre of tree canopy coverage has approximately 80.5 trees.
6. This yields 136,394 total new trees planted by 2030, 204,591 total new trees planted by 2035, and 272,788 total new trees planted by 2045 (rounded to the nearest 10,000).

Measure A3 GHG emissions reductions were calculated using assumptions from CALEEMod.[63] The calculations assume a carbon sequestration rate per tree planted (from CalEEMod) and an

[63] California Air Pollution Control Officers Association. 2021. *CalEEMod v 2020.4.0 User's Guide*, Appendix A Calculation Details. May 2021. Available: http://www.aqmd.gov/docs/default-source/caleemod/user-guide-2021/appendix-a2020-4-0.pdf?sfvrsn=6. Accessed November 2021.

active growing period of 20 years for each tree, after which the tree no longer stores additional carbon. The calculation also assumes a total number of trees planted for each target year, based on the performance objectives above. The number of trees planted each year was then multiplied by the growing period and sequestration rate to estimate the overall GHG reductions from Measure A3 for each target year.

Assumptions

- Tree growing period of 20 years.
- The carbon sequestration rate remains constant for each year for each tree planted.
- The carbon sequestration rate is the average rate for all species classes included in CalEEMod.

References

- California Air Pollution Control Officers Association, CalEEMod v2020.4.0 User's Guide, Appendix A Calculation Details
  Link: http://www.aqmd.gov/docs/default-source/caleemod/user-guide-2021/appendix-a2020-4-0.pdf?sfvrsn=6
- Tree People, Los Angeles County Tree Canopy Assessment
  Link: https://www.treepeople.org/wp-content/uploads/2020/08/Tree-Canopy-LA-2016-Final-Report.pdf
- Lund, H. G., 2015, Canopy Cover, Trees per Acre, Crown Width, and Tree Spacing
  Link: https://www.researchgate.net/publication/288335361_Canopy_Cover_Trees_per_Acre_Crown_Width_and_Tree_Spacing

B.3 Attachment A: Fehr & Peers Modeling Analysis

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Memorandum

Date: February 22, 2023

To: Brian Schuster, Breanna Sewell, Renee Longman, and Jeff Caton, ESA

From: Ali Kothawala, Miguel Nunez, and Sarah Brandenberg, Fehr & Peers

Subject: LA County 2045 Climate Action Plan Update - VMT Technical Memorandum

LA21-3290

Introduction

Purpose of transportation analysis in Climate Action Plan Quantification

The Draft 2045 LA County Climate Action Plan (CAP) actions and targets are informed by a robust data and analysis process. Data was collected for each of the topic areas and analyzed to help inform and develop actions and targets, and create meaningful, measurable, and trackable indicators. Land use and transportation actions that help reduce VMT include bike, ped, and transit improvements, transportation demand management programs, and land use design and density.

This current effort is applying and quantifying estimated benefits of CAP strategies for VMT reductions using a state-of-the-practice approach from the California Air Pollution Control Officers Association (CAPCOA) GHG Handbook

The purpose of this technical memorandum is to present the methodology and assumptions applied for quantifying estimated VMT reductions of selected transportation demand management (TDM) strategies contained in the CAP. The project team developed a list of various TDM strategies as part of the CAP, the strategies were narrowed based on applicability and available data, and the corresponding VMT reductions were estimated using the CAPCOA GHG Reductions Handbook[1] (December 2021).

[1] *Handbook for Analyzing Greenhouse Gas Emission Reductions, Assessing Climate Vulnerabilities, and Advancing Health and Equity, California Air Pollution Control Officers Association*, December 2021. Last accessed January 3, 2022, at http://www.airquality.org/air-quality-health/climate-change/ghg-handbook-caleemod

VMT from Prior CAP Effort

F&P developed an inventory of the VMT and GHG emitted in Los Angeles County in support of the previous Los Angeles County Sustainability Plan (OurCounty). The VMT and emissions analysis for the OurCounty utilized data inputs and outputs from the SCAG regional travel demand model. Emissions were calculated through use of the EMFAC model. The current update to the CAP builds off prior efforts and Buro Happold used the OurCounty VMT projections as the basis for providing forecasts for the year 2045.

VMT Reductions Approach

CAPCOA Overview

TDM strategies have been determined to be among the most effective for reducing VMT. TDM strategies are reductions available from certain types of project site modifications, programming, and operational changes. The effectiveness of identified TDM strategies builds on research documented in the 2010 California Air Pollution Control Officers Association (CAPCOA) publication, *Quantifying Greenhouse Gas Mitigation Measures* (CAPCOA, 2010). The 2010 CAPCOA GHG Handbook was recently updated and the final version was published in December 2021. The CAPCOA Handbook contains detailed equations to apply these TDM reductions given the land use type and built environment context. The Handbook provides a percentage range (minimum-maximum) on the expected VMT reduction for each individual TDM strategy. In addition, some TDM strategies have complementary benefits reducing VMT, and need to be considered in combination, and not individually.

Data Sources (land use, transit, and bike facilities)

In order to apply the appropriate VMT percent reduction for each TDM strategy listed below, certain inputs are required that describe the land use type, built environment context, and characteristics of the TDM strategy. The inputs were provided to Fehr &Peers by LA County staff, and where information was not available, assumptions were made based on the default values provided in the CAPCOA Handbook.

- **Land Use**:
  - Increase residential/job density
  - Provide transit-oriented development (TOD) near high-quality transit areas (HQTA)

  - *Data sources*: LA County provided F&P a GIS shapefile layer showing the 2029 Housing Element Rezone Areas. F&P used a major transit stop[2] GIS layer that was developed as part of the LA County SB 743 VMT Tool released in late 2020.

- **Transit service**:
  - Increase transit service hours
  - Provide treatments to enhance existing transit routes
  - Improve county shuttle system
  - *Data sources* : LA Metro NextGen Plan[3] and LA Metro LRTP[4]

- **Bike Facilities**:
  - Increase the number of bikeway miles
  - *Data sources*: Los Angeles County Bike Master Plan 2012.[5]

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[2] *"Major transit stop" is defined as 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 interval of 15 minutes or less during the morning and afternoon peak commute periods (CA Public Resource Code, § 21064.3).*

[3] *LA Metro NextGen Bus Plan, Los Angeles Metropolitan Transportation Authority, October 2020. Last accessed on January 03, 2022, at https://www.metro.net/about/plans/nextgen-bus-plan/*

[4] *2020 Long Range Transportation Plan, Los Angeles Metropolitan Transportation Authority, Mar 2020. Last accessed on January 03, 2022, at https://www.metro.net/about/plans/long-range-transportation-plan/*

[5] *Bicycle Master Plan, County of Los Angeles Public Works, March 2012. Last accessed January 3, 2022, at https://pw.lacounty.gov/tpp/bike/docs/bmp/FINAL%20Bicycle%20Master%20Plan.pdf*

Applying VMT reductions

Data Sources and Quantifying VMT Reductions with CAPCOA

To quantify VMT reductions, appropriate equations were used based on factsheets in the CAPCOA handbook. Using the data obtained from sources identified in the previous section as inputs, percent reductions in VMT were estimated. However, not all reductions can be applied to all or total VMT. VMT resulting from light-duty vehicles is often categorized by trip purpose. Different VMT measures based on their nature and scope of application may apply either to one or more categories of the total combined light-duty vehicle VMT. For example, commuter subsidies are most likely to reduce home-based work VMT for employees and less likely to reduce VMT for retail patrons. In a similar vein, VMT reduction benefits accrue based on the geographic extent and context in which the strategy is applied. For instance, providing bicycle, pedestrian, and transit infrastructure will likely have more benefit in an urban than rural area. Not all measures will have a countywide effect. After identifying data sources, VMT reduction strategies, and the scope of each reduction, the VMT reduction estimates were finalized.

To estimate VMT reductions, implementing actions in the Draft GHG Reduction Measures Recommendations Memo (June 16, 2021) were first screened to identify actions whose reduction can be quantified. While most actions can be quantified, the level of detail needed to provide a detailed VMT estimate was not available; therefore, five quantifiable actions across the three categories were used for the CAP's VMT reduction estimate. This is not to say that the screened-out actions hold little or no GHG reduction potential. Like Supporting or Non-Quantified Reduction Measures enlisted in the Handbook, non-quantified VMT reduction actions although not quantitatively evaluated "may achieve emissions reductions and co-benefits on their own or may enhance the ability of quantified measures to attain expanded reduction and co-benefits." Table 1 summarizes the final list of quantifiable measures and implementing actions under each strategy and corresponding information such as the applicable CAPCOA strategy maximum VMT reduction that can be claimed under the strategy, data inputs required to quantify the benefit, assumptions made where needed, the equation used to estimate VMT reduction, and scope of application for geography and trip purpose.

Table 1. Quantifiable GHG Reduction Measures and corresponding VMT Reduction Category and Scope

Description	Tracking Metrics	Applicable 2021 CAPCOA Strategy & VMT Reduction Range	CAPCOA User Inputs	F&P Input Assumptions	% GHG Reduction Quantification	VMT Category & Geographic Scope to which Reduction is Applied to
Strategy 2: Increase densities and diversity of destinations with an emphasis near transit						
Measure T1: Increase Density Near High-Quality Transit Areas						
Increasing residential density, particularly near transit and affordable housing, is shown to reduce VMT.	Number and percent of increase in DUs in HQTAs, Specific Plans, or Area Plans	T-1 – Increase Residential Density. Up to 30% GHG emissions from VMT, depending on project DU per acre	Project DU per acre & typical DU per acre	Densities range from 20 DU per acre to 50 to 70 DU per acre. 9.1 DU/acre for typical density	20 du/acre : (20-9.1) /9.1 x -0.22 = <u>-26.4% reduction</u>	Home-Based VMT in TOD Areas
Implementing Actions						
T1.2 – Incentivize and prioritize development within	• Increase in DUs within HQTA • DU per acre Change in number of jobs and housing in non- HQTAs	T-3 – Provide Transit-Oriented Development	(B) Transit & (D) auto mode share in surrounding City, and (C) Ratio of transit mode share for TOD	27% measure maximum (B x C) & 85% auto mode share based on 2012 CHTS (D)	27% / -85% = <u>-31.8% reduction (use maximum 31%)</u>	Total VMT in TOD Areas

Description	Tracking Metrics	Applicable 2021 CAPCOA Strategy & VMT Reduction Range	CAPCOA User Inputs	F&P Input Assumptions	% GHG Reduction Quantification	VMT Category & Geographic Scope to which Reduction is Applied to
(HQTA)[6], while ensuring inclusion of vital public amenities such as parks and active transportation infrastructure.		(TOD)[7]. Up to 31% of GHG emissions from project VMT.	area with measure compared to existing transit mode share in surrounding city			
Measure T2: Develop Land Use Plans Addressing Jobs/Housing Balance & Increase Mixed Use						
Increasing density and diversity of destinations can help reduce single occupancy	Change in number of jobs and housing in non-HQTAs	T-2 – Increase Job Density. Up to 30% GHG emissions from VMT, depending on project jobs per acre	Job density of typical development = 145 jobs per acre, & Elasticity of VMT with respect	Project job density = 300 jobs per acre	(300-145)/145 x -0.07 = <u>-7.5% reduction</u>	This strategy overlaps with the TOD strategy above where we assume 31% Total VMT

[6] High Quality Transit Areas: Areas within one half mile of a corridor with fixed route bus service with service intervals no longer than 15 minutes during peak commute hours.

[7] To be considered TOD, a development must be within a 10-minute walk (0.5 mile) of a high frequency transit station (rail, or bus with headways less than 15 minutes)

Description	Tracking Metrics	Applicable 2021 CAPCOA Strategy & VMT Reduction Range	CAPCOA User Inputs	F&P Input Assumptions	% GHG Reduction Quantification	VMT Category & Geographic Scope to which Reduction is Applied to
trips, the number of trips, and trip lengths			to job density = -0.07			Reduction at TOD sites. No reduction here.
<u>Strategy 3: Reduce single-occupancy vehicle trips</u>						
Measure T3: Expand Bicycle & Pedestrian Network to Serve Residential, Employment, & Recreational Trips						
Travel options that serve a variety of land uses and trip purposes can help shift some trips away from single-occupancy vehicles.	T-17 – Provide Pedestrian Network Improvement. Up to 6.4% GHG emissions from vehicle travel, depending on length of existing and planned facilities T-19 – Expand Bikeway Network.	• Miles of bikeway type • Miles of transit routes • Headways				
Implementing Actions						
T3.2 – Create a more connected and	• Miles of bikeway type	T-19 – Expand Bikeway Network. Up to 0.5% GHG emissions from	Miles of existing & planned bikeways	LA County Bike Plan proposes significant	<u>-0.5%</u> Maximum Reduction	Total VMT Countywide

Description	Tracking Metrics	Applicable 2021 CAPCOA Strategy & VMT Reduction Range	CAPCOA User Inputs	F&P Input Assumptions	% GHG Reduction Quantification	VMT Category & Geographic Scope to which Reduction is Applied to
safer bikeway network by expanding bikeway facilities and deploying protected and separated lanes.	• Additional employees or residents served • Number of cities collaborated with to inform key areas for bicycle infrastructure expansion Number of funding sources identified or % of funding secured	vehicle travel, depending on length of existing and planned facilities		increases in bikeway miles. This analysis applies a 300% increase in bikeway miles by 2035. The maximum possible reduction of 0.5% is estimated based on the extent of network improvements outlined in the 2012 Bike Plan		(unincorporated areas)
Measure T4: Encourage Transit, Active Transportation, & Alternative Modes of Transportation						
Implementing Actions						
T4.1 – Expand and improve frequency of	• Size of area served	T-24 – Extend Transit Network Coverage or Hours. Up to 4.6% of	Total transit service hours	Assume transit mode share of 4.6% per 2012	-1 x (1.12M-560K)/560K x 4.6% x 0.7 x 57.8% x 1 = -1.9% Reduction	Total VMT Countywide

Description	Tracking Metrics	Applicable 2021 CAPCOA Strategy & VMT Reduction Range	CAPCOA User Inputs	F&P Input Assumptions	% GHG Reduction Quantification	VMT Category & Geographic Scope to which Reduction is Applied to
existing network of County shuttles and explore new mobility services, such as micro transit[8], in unincorporated County areas.	• Number of employees and residents served • Service frequency and headways	GHG emissions from vehicle travel, depending on increase in transit service hours or miles and the transit mode share in the community.	before & after expansion	CHTS; Assume 560,000 existing transit service hours in unincorporated county & 1.12 million after expansion based on Metro NextGen		(unincorporated areas)
T4.2 – Collaborate with Metro and other transit providers to install bus-only lanes and	• Increase in headways or frequencies • Increase in headways	T-26 – Implement Transit-Supportive Roadway Improvements. Up to 0.6% GHG emissions from vehicle travel, depending on the	Percent of transit routes that receive treatments	Assume transit mode share of 4.6% per 2012 CHTS, 85% for auto; Assume major transit	-1 x (100% x -10 x -0.4 x 4.6% x 57.8%) / 85% = <u>-12.5% Reduction</u> (use maximum <u>-0.6%</u>)	Total VMT in TOD Areas/HQTA Stops

[8] Micro transit is public or private multi-passenger transportation services that serve passengers using dynamically generated routes; they provide transit-like service on a smaller, more flexible scale.

Description	Tracking Metrics	Applicable 2021 CAPCOA Strategy & VMT Reduction Range	CAPCOA User Inputs	F&P Input Assumptions	% GHG Reduction Quantification	VMT Category & Geographic Scope to which Reduction is Applied to
signal prioritization along major thoroughfares, and work with transit agencies and neighboring jurisdictions to plan and install full bus rapid transit infrastructure along priority corridors, as appropriate.	• Increase in residents/employees served • Travel time reliability • Creation of new HQTAs	percent of transit routes that receive improvements.		thoroughfares in unincorporated county will receive treatments such as bus only lanes and/or signal prioritization		

CAPCOA Analysis and Findings

VMT is calculated at the transportation analysis zone (TAZ) level. TAZs are comparable in size and shape to census tracts or block groups depending on the travel demand model used and level of modeling detail. Once the percent VMT reductions were determined, based on the geographic scope and VMT category of each implementation action, the appropriate VMT was aggregated across the county or specific geographic sub areas, such as the TAZs within which transit enhancements would take place. Actions T3.2 and T4.1 were applied countywide. For the remaining actions, only the VMT generated in TAZs whose geographic area overlapped with the location of the infrastructure or land use strategy were included. Percent reductions were then applied to appropriate VMT sub-totals to obtain the VMT reduction estimates. The sum of these reductions was then subtracted from total light-duty vehicle VMT to estimate adjusted daily VMT. This adjusted daily VMT was then projected to obtain VMT reductions and adjusted totals in each analysis year (2030, 2035, and 2045). Table 2 shows reductions for each quantifiable implementation action for the analysis years.

Based on the methodology outlined in the CAPCOA Handbook, when determining the overall VMT reduction, the VMT reduction is separately calculated for each of the individual strategies should be dampened, or diminished, according to a multiplicative formula to account for the fact that some of the strategies may be redundant or applicable to the same populations. The multiplicative equation to accomplish this adjustment is as follows:

Overall % VMT Reduction = 1-(1-A)*(1-B)*(1-C)*(1-D) …

where A, B, C, D … = individual mitigation strategy reduction percentages

For example, if two strategies were proposed with corresponding VMT reductions of 20% and 10%, the equation would be [1-(1-20%)*(1-10%)] or [1-(80%*90%)], which equates to a 28% reduction rather than the 30% reduction that would otherwise be seen with a direct sum. Therefore, the overall VMT reduction was calculated as a dampened, or diminished, total according to the equation above, which produces a conservative overall estimate.

A = 1.38%; B = 1.97%; C = 0.15%; D = 0.57%; E = 0.01%

Overall % VMT Reduction = 1-(1-0.0138)*(1-0.0197)*(1-0.0015)*(1-0.0057) *(1-0.0001) = 4.03%

Based on the application of VMT reductions and dampening factor, the reduction of 4.03% would result in a total adjusted total daily VMT of 18,798,031 VMT in 2035, for example.

Table 2. VMT Reductions per Quantifiable Implementation Action for Analysis Years 2030, 2035, and 2045

				Daily VMT Reduction			
Reduction Category	**Reduction Percent**	**VMT Applied to**	**Geography Applied to**	**2030**	**2035**	**2045**	**Reduction as a share of Total County VMT**
M1T1 Increase Residential Density in HQTAs	26.4	Home-based VMT	TAZs intersecting TODs	267,982	269,689	273,103	1.38%
T1.2 Incentivizing and Promoting HQTAs	31	Total VMT	TAZs intersecting TODs	383,838	386,283	391,172	1.97%
T3.2 Pedestrian and Bikeway Network Improvements	0.5	Total VMT	Unincorporated County	0	29,133	29,502	0.15%
T4.1 County Shuttles	1.9	Total VMT	Unincorporated County	110,005	110,706	112,107	0.57%
T4.2 Bus-only and signal prioritization	0.6	Total VMT	TAZs intersecting TODs	2,303	2,318	2,347	0.01%
			Subtotal for VMT Reductions	764,128	798,128	808,231	
			Total Daily VMT (Pre-VMT reductions)	19,442,787	19,596,159	19,902,905	4%
			Total Daily VMT (Post-VMT reductions)	18,678,659	18,798,031	19,094,674	

5. Conclusion

The estimated benefits of CAP strategies for VMT reductions were quantified using a state-of-the-practice approach from the California Air Pollution Control Officers Association (CAPCOA) GHG Handbook. GHG reduction measures and Implementing actions were first screened to identify those that can be quantified. Using travel demand forecasting results from the SCAG regional travel demand model, County VMT data were used, based on trip purpose and geography, to estimate benefits from CAP actions.

While several strategies have significant reduction potential of up to 30%, like those that involve increasing residential density, the measures are applied to a portion of the unincorporated county and therefore accrue a net reduction of less than 2% countywide. When accounting for a combined effect, the effectiveness of each measure could be dampened by the existence of a similar overlapping measure. By estimating VMT that more closely reflects the travel to be likely affected by a certain measure, possibilities of overlaps have been minimized. Even then, a dampening factor was applied above to show the total reduction estimate that accounts for dampening arrives at a similar VMT reduction estimate. This analysis will support the analysis and quantification of benefits from the CAP for Los Angeles County and its residents.

LA COUNTY CAP VMT REDUCTION ESTIMATE SUMMARY

revised 2/22/23

				2030		2035		2045	
Reduction Category	**Reduction%**	**VMT Applied to**	**Geography Applied to**	**Daily VMT Reduction**	**Adjusted Total Daily VMT**	**Daily VMT Reduction**	**Adjusted Total Daily VMT**	**Daily VMT Reduction**	**Adjusted Total Daily VMT**
Residential Density	26.4	HBVMT	TAZs intersecting TODs	267,982	18,678,659	269,689	18,798,031	273,103	19,094,674
HQTA	31	LMV OD VMT	TAZs intersecting TODs	383,838		386,283		391,172	
Pedestrian and Bikeway Network Improvements	0.5	LMV OD VMT	Unicorporated County	-		29,133		29,502	
County Shuttles	1.9	LMV OD VMT	Unicorporated County	110,005		110,706		112,107	
Bus-only and signal prioritization	0.6	LMV OD VMT	TAZs intersecting TODs	2,303		2,318		2,347	

Unincorporated LA County Pre-VMT Reductions

PA (OD) VMT	LMV	HDT	All
2016	18,343,532	669,811	19,013,343
2030	18,676,608	766,179	19,442,787
2035	18,795,563	800,596	19,596,159
2045	19,033,475	869,430	19,902,905

Unincorporated LA County WITH VMT Reductions

PA (OD) VMT	LMV	HDT	All
2030	17,912,480	766,179	18,678,659
2035	17,997,435	800,596	18,798,031
2045	18,225,244	869,430	19,094,674

% Reduction

2030	4%
2035	4%
2045	4%