Decarbonizing the San Diego Region Project

Technical Appendix

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1 Introduction

This report summarizes the methods, models/tools, activity level assumptions, and data sources used to estimate GHG reductions for programs and projects included in the San Diego-Chula Vista-Carlsbad Metropolitan Statistical Area (San Diego Region) CPRG Phase II Implementation Funding Proposal. For each program or project, the following information is Included: GHG Reduction Estimate Method, Models/Tools Used, Measure Implementation Assumptions, GHG Reduction Estimate Assumptions, Reference Case Scenario, Measure Specific Activity Data, and Cumulative GHG Reduction Estimates for 2025-2030 and 2025-2050.[1] GHG reductions included here are in carbon dioxide equivalent (CO_2e). Additional details, including annual emissions and those for CO_2, CH_4, and N_2O, are included in the Optional GHG Emission Reduction Calculations Spreadsheet (GHG Spreadsheet).

2 Common Assumptions

This section provides a summary of methods used for more than one program or project.

2.1 Vehicle Emission Rates

For measures related to transportation, California Air Resources Board's (CARB) EMFAC Model (EMFAC2021 v1.0.2) was used to derive vehicle miles driven per year, fuel/electricity use per vehicle, and emissions per vehicle mile (grams CO_2e/mile) of relevant vehicle classes to estimate GHG impacts.[2] Below are the different vehicle emission rates used:

- Annual average passenger vehicle emission rates are estimated based on (1) vehicle miles traveled (VMT) distribution of light-duty vehicle by vehicle category and (2) emission rate of each light-duty vehicle category;[3]
- Average annual transit bus emission rates are based on a model year 2027 transit bus during the useful life of the bus (15 years or 2027-2041); and,
- Annual average battery electric and plug-in hybrid vehicle emission rates are based on electric vehicle miles traveled (EVMT) and energy consumption per vehicle for each vehicle category and (2) the electric emission rates.

2.2 Electric Emission Rates

For most of the electricity-related programs and projects, we used annual average emission rates (AAER), which represent the total emissions divided by the total associated electricity. The average emission rate weighted by retail sales in 2021 was 472 lbs. CO_2e/MWh. This is based on data from the most recent Power Source Disclosure data.[4] To develop annual values, we assume that the ratio of GHG emissions intensity and percentage renewable remains constant as suppliers reach the statutory goal of 60% renewable electric supply by 2030 and 100% zero carbon by 2045. For CE-1.2 Solar and Storage on

[1] Based on guidance in the Phase II Notice of Funding Opportunity (NOFO) EPA-R-OAR-CPRGI-23-07.
[2] California Air Resources Board, EMFAC Model. The most recent version is EMFAC2021 v1.0.2. Available at https://ww2.arb.ca.gov/our-work/programs/msei/on-road-emfac. EMFAC is developed and used by CARB to assess emissions from on-road vehicles including cars, trucks, and buses in California, and to support CARB's regulatory and air quality planning efforts. US EPA approves EMFAC for use in State Implementation Plan and transportation conformity analyses.
[3] Passenger vehicles are referring to the vehicles covered by California Senate Bill 375, which set regional targets for GHG emission reductions from passenger vehicles. In EMFAC2021 v1.0.2, the passenger vehicle categories are LDA (passenger cars), LDT1 and LDT2 (light-duty trucks), and MDV (medium-duty trucks). https://ww2.arb.ca.gov/our-work/programs/sustainable-communities-program/regional-plan-targets
[4] California Energy Commission (CEC): Annual Power Content Labels for 2021. https://www.energy.ca.gov/programs-and-topics/programs/power-source-disclosure-program/power-content-label/annual-power-1

Residential Buildings, we used hourly short-run marginal emission rates (SRMER) generated from the CPUC Avoided Cost Calculator[5] through 2050.

2.3 Useful Life and Replacement

GHG reduction estimates assume implementation activity occurs between 2025 and 2029.[6] Reductions are assumed to occur during the useful life of the activity and no replacement is considered. For example, if the useful life of an electric vehicle is 10 years, reductions would be estimated for the 10 years a vehicle is assumed to be operational. In this case, the first vehicle would be put into operation in 2025 (and remain operational through 2034) and the last vehicle, put in operation in 2029, would still be operational in 2038. In this way, this measure would have GHG reductions from 2025 through 2038, a total of 13 years. Further, we do not assume that the vehicle would be replaced and continue to reduce emissions beyond this point. So, in this example, no emissions reductions for 2039-2050 would be included in the estimates presented here.

There are programs and projects with activities that have longer useful lives, including bike lanes and solar, that would continue to reduce emissions through the 2050 timeframe. Emissions for these projects would be included in the cumulative GHG reduction estimate for 2025-2050.

3 Regional Zero-Emission Light-Duty Vehicle Incentive Program

GHG reductions from this program are estimated using the net impact of a reduction in fossil fuel usage and an increase in electricity use to charge electric vehicles. Emissions impacts are calculated using emissions rates for electricity and miles driven described in Section 2 above.

Models/Tools Used – We used one model to generate inputs for a custom calculation using standard methods for GHG quantification.[7] The California Air Resources Board EMFAC2021 v1.0.2 Model was used to derive emissions per vehicle (grams CO_2e/mile) of relevant vehicle classes.[8]

Measure Implementation Assumptions – Based on program participation data for San Diego County from the California Clean Vehicle Rebate Program,[9] we assume that vehicle purchases would occur equally over a five-year implementation period from 2025 to 2029. The lifetime of an average battery electric vehicle (BEV) or plug-in hybrid electric vehicle (PHEV) is assumed to be 10 years. We assume that the life of an EV is the same as for an internal combustion engine (ICE) vehicle. Kelley Blue Book reports the average age of a vehicle is 12.5 years.[10] We assumed 10 years to account for used vehicles. Average purchase cost is assumed to be $65,000 for new and $31.000 for used vehicles.[11] We assume that 20% of vehicles in the program and about 46% of program funding would go to LiDACs. We assume differential incentive amounts of $2,000 per BEV and $1,000 per PHEV for the general market and $6,750 for BEV and $3,375 per PHEV for LiDAC participants. Cost of incentives, program administration,

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[5] 2021 CPUC Avoided Cost Calculator. Available at https://www.cpuc.ca.gov/industries-and-topics/electrical-energy/demand-side-management/energy-efficiency/idsm.

[6] One measure, Transit Incentives, has one year carryover of GHG reductions beyond the program duration. See Section 6.

[7] GHG quantification is based on methods summarized in the Regional Climate Action Planning Framework. Technical Appendices. See San Diego Association of Governments. Regional Climate Action Planning Framework -- TECHNICAL APPENDIX II Methods to Calculate GHG Emissions Impacts of CAP Measures, VERSION 1.1. NOVEMBER 2020. Available at https://www.sandag.org/-/media/SANDAG/Documents/ZIP/projects-and-programs/recap-and-technical-appendices.zip

[8] California Air Resources Board, EMFAC2021 v1.0.2 Model. Available at https://ww2.arb.ca.gov/our-work/programs/msei/on-road-emfac

[9] California Clean Vehicle Rebate Program website. Available at https://cleanvehiclerebate.org/en

[10] Kelley Blue Book. See https://www.kbb.com/car-advice/how-long-do-electric-cars-last/

[11] ICF Consulting proprietary EV Library.

marketing/outreach, and evaluation are included in the total EPA CPRG costs presented in the supplemental GHG Spreadsheet.

GHG Reduction Estimate Assumptions – Electric and vehicle emission rates used are described in Section 2 above. All values are provided in the supplemental Optional GHG Emission Reduction Calculations Spreadsheet.

Reference Case Scenario – The reference case is an ICE light-duty passenger vehicle, light-duty truck, or medium-duty vehicle. Emissions for reference vehicles are derived using the CARB EMFAC model described in Section 2 above.

Measure Specific Activity Data – Total participation is assumed to be 7,700 vehicles. This is lower than program participation data for San Diego County from the California Clean Vehicle Rebate Program (CVRP) in recent years.[12] We assume this same level of participation would occur between 2025 and 2029. We assume that 75% of incentives would go to BEVs[13] and that 50% of participants would purchase used vehicles. We assume the proportion of vehicles participating in the program are like that of the fleet and historic participation in the CVRP. As noted above relevant inputs vary by year, vehicle class, vehicle type (i.e., new vs. used), market type, and are provided in full in the supplemental GHG Spreadsheet.

2025-2030 Cumulative GHG Emissions Reduced – 6,026 MT CO_2e

2025-2050 Cumulative GHG Emissions Reduced – 15,276 MT CO_2e

4 Regional Zero-Emission Medium- and Heavy-Duty Vehicle Charging Infrastructure Program

The overall approach to estimate GHG reduction associated with the installation of medium- and heavy-duty electric vehicle chargers is to determine the VMT shift from gasoline to electricity per plug-in hybrid vehicle (PHEV) because of increased EV charging stations. Calculations followed the standard methods from the 2019 Final Sustainable Communities Strategy (SCS) Program and Evaluation Guidelines[14] and the Handbook for Analyzing GHG Emission Reductions, Assessing Climate Vulnerabilities, and Advancing Health and Equity.[15] We note that this approach does not adequately capture the impact from non-PHEVs and HDVs; therefore, we consider the GHG reductions as a minimum value and would expect higher GHG reductions from this program.

Models/Tools Used – We used one model to generate inputs for a custom calculation using standard methods for GHG quantification.[16] The California Air Resources Board EMFAC2021 v1.0.2 Model was used to derive emissions per vehicle (grams CO_2e/mile) of relevant vehicle classes.[17]

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[12] California Clean Vehicle Rebate Program website. Available at https://cleanvehiclerebate.org/en
[13] Ibid. Also, based on California Energy Commission, Light-Duty Vehicle Population in California. See https://www.energy.ca.gov/data-reports/energy-almanac/zero-emission-vehicle-and-infrastructure-statistics/light-duty-vehicle
[14] California Air Resources Board (CARB). (2019, November). Final Sustainable Communities Strategy Program and Evaluation Guidelines Appendices. Retrieved from https://ww2.arb.ca.gov/resources/documents/scs-evaluation-resources.
[15] California Air Pollution Control Officers Association. (n.d.). Handbook for Analyzing GHG Emission Reductions, Assessing Climate Vulnerabilities, and Advancing Health and Equity. Retrieved from https://www.caleemod.com/documents/handbook/ch_1/handbook_front.pdf.
[16] GHG quantification is based on methods summarized in the Regional Climate Action Planning Framework. Technical Appendices. See San Diego Association of Governments. Regional Climate Action Planning Framework -- TECHNICAL APPENDIX II Methods to Calculate GHG Emissions Impacts of CAP Measures, VERSION 1.1. NOVEMBER 2020. Available at https://www.sandag.org/-/media/SANDAG/Documents/ZIP/projects-and-programs/recap-and-technical-appendices.zip
[17] California Air Resources Board, EMFAC2021 v1.0.2 Model. Available at https://ww2.arb.ca.gov/our-work/programs/msei/on-road-emfac

Measure Implementation Assumptions – Based on program participation data for the San Diego Air Pollution Control District's (SDAPCD) Clean Air for All Program,[18] we assume that vehicle purchases would occur equally over a five-year implementation period from 2025 to 2029. The useful life of a charger assumed to be 10 years.[19] Based on program data, the average purchase cost for a similar project installing level 2 and DC fast chargers is assumed to be $118,000 per connector.[20] We assume that this program will fund about 50% of installed cost, consistent with the Clean Air for All Program data.

GHG Reduction Estimate Assumptions – We assume that vehicles increase PHEV miles in electric mode with the measure from 50% to 80%.[21] Annual GHG reductions are based on the equivalent of 2 vehicles per year per charger.[22] Analysis is based on emissions from medium-duty PHEVs, because EMFAC2021 does not include any heavy-duty PHEVs. EMFAC2021 was used to derive miles driven per EV per year, electricity requirements for EVs (kWh/mile), percentage of electric miles per PHEV, and emission rates for PHEVs and ICEs. Values vary by year and by vehicle class. Electric emission rates are described in Section 2 above. All values are provided in the supplemental GHG Spreadsheet.

Reference Case Scenario – The reference scenario is 50% of electric miles for a medium-duty PHEV.

Measure Specific Activity Data - We assumed installation of 200 level 2 and DC fast chargers during the implementation period 2025 to 2029.

2025-2030 Cumulative GHG Emissions Reduced – 941 MT CO_2e

2025-2050 Cumulative GHG Emissions Reduced – 2,251 MT CO_2e

5 Regional Active Transportation Program

GHG emissions reductions from this program are estimated based on annual VMT reduction from changes in transportation mode share due to new bicycle facilities (Class I and Class IV) and annual average passenger emission rate. Class I and Class IV are the two facilities types identified due to the infrastructure needs and the cost effectiveness ($/mile) considerations.

Models/Tools Used - Several models were used to generate inputs for a custom calculation using method described above, including CARB California Climate Investments Benefits Calculator Tools and Quantification Methodology, Active Transportation (December 15, 2022)[23] and SANDAG Transportation Forecast Information (ABM2+/2021 RP, Year 2025)[24] to determine VMT impact; and CARB EMFAC2021 v1.0.2[25] to determine vehicle emissions rates.

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[18] SDAPCD Clean Air for All Program. See https://www.sdapcd.org/content/sdapcd/grants/moyer.html. Program data provided by SDAPCD.

[19] Dominion Energy Level 2 Charging Program. Example of a rebate program requiring at least a 10-year useful life. See Dominion Energy https://www.dominionenergy.com/virginia/save-energy/electric-vehicles/charging-on-the-go/level-2-charging-program

[20] ICF Consulting proprietary EV Library.

[21] Smith, K., Earleywine, M., Wood, E., Neubauer, J., & Pesaran, A. (2012). Comparison of Plug-In Hybrid Electric Vehicle Battery Life Across Geographies and Drive Cycles. National Renewable Energy Laboratory.

[22] National Renewable Energy Laboratory and California Energy Commission. Electric Vehicle Infrastructure Projection Tool (EVI-Pro) Lite. Available at https://afdc.energy.gov/evi-pro-lite

[23] CARB California Climate Investments Benefits Calculator Tools and Quantification Methodology, Active Transportation. Available at https://ww2.arb.ca.gov/sites/default/files/auction-proceeds/sgc_ahsc_userguide_121522.pdf

[24] CARB EMFAC Model. Available https://experience.arcgis.com/experience/81b2daca1827470ca8beeb4708139f79/page/Main/

[25] https://arb.ca.gov/emfac/emissions-inventory/dd07a6ca4ed10aa7ada49fc3daf62ef502a3afc7

Measure Implementation Assumptions - Local jurisdictions have identified the new bicycle facilities that are ready for implementation in the 2025 to 2029, and on average, the new facilities are assumed to be open to public by 2028.

GHG Reduction Estimate Assumptions - Key assumptions include: Annual VMT reduction: (1) new facility type (i.e., Class I bicycle path and Class IV cycle track); (2) location of the facility (North San Diego County Coastal and San Diego South Bay); (3) first year facility will be open to user; (4) mileage of facility; (5) average daily traffic on road parallel to facility; (6) number of key destinations within 0.25 mile of facility; and (7) number of key destination within 0.5 mile of facility). Annual average passenger vehicle emission rates are described in Section 2 above. GHG reductions will occur from 2028 through 2050 based on useful life.

Reference Case Scenario – the facilities are not built; trips are made by an average passenger vehicle.

Measure Specific Activity Data - 5.2 miles of Class I (multi-use paths) and 5.1 miles of Class IV (cycle tracks)

2025-2030 Cumulative GHG Emissions Reduced – 3,673 MT CO_2e

2025-2050 Cumulative GHG Emissions Reduced – 25,107 MT CO_2e

6 Regional Transit Incentive Programs

6.1.1.1 Youth Opportunity Pass[26]

GHG emissions reductions from extending the Youth Opportunity Pass (YOP) pilot program are estimated based on annual VMT reduction from transit trips replacing passenger vehicle trips and the annual average passenger vehicle emission rate.

Models/Tools Used – Two models were used to generate inputs for the custom calculation using the general method described above: SANDAG Activity Based Model (ABM2+) to determine the VMT impact of the transit use and CARB EMFAC2021 v1.0.2[27] for vehicle emission rates.

Measure Implementation Assumptions – This existing program is assumed to be extended and funded from 2027 through 2029 at the same level of funding (adjusted with an inflation escalator) as in previous years.

GHG Reduction Estimate Assumptions – We assume that GHG reductions will occur from 2027 through 2029 and no GHG reduction will occur after 2029 (i.e., no program impact after 2029). Annual VMT reduction is estimated based on the FY2023 pilot program annual VMT reduction with an adjustment factor of 1/3 to account for new trips that would not have been made with a vehicle without the program.[28]Annual average passenger vehicle emission rates are described in Section 2 above.

Reference Case Scenario - No YOP program; trips are made by an average passenger vehicle.

[26] SANDAG Youth Opportunity Pass Program. Available at https://www.sandag.org/projects-and-programs/regional-initiatives/transit-equity-pilot/youth-opportunity-pass

[27] CARB EMFAC Model. Available https://arb.ca.gov/emfac/emissions-inventory/dd07a6ca4ed10aa7ada49fc3daf62ef502a3afc7

[28] The adjustment factor from SANDAG's Youth Opportunity Pass Pilot Program is used as a proxy. SANDAG: Youth Opportunity Pass Pilot Program: Comprehensive Program Report (December 2023). https://www.sandag.org/-/media/SANDAG/Documents/PDF/projects-and-programs/regional-initiatives/transit-equity-pilot/youth-opportunity-pass/yop-comprehensive-program-report.pdf

Measure Specific Activity Data – GHG reductions are based on 2 million additional annual trips including Metropolitan Transit System (MTS) and NCTD buses and light rail trips, and 7 million vehicle miles avoided, based on current program data.

2025-2030 Cumulative GHG Emissions Reduced – 6,186 MT CO_2e

2025-2050 Cumulative GHG Emissions Reduced – 6,186 MT CO_2e

6.1.1.2 Try Transit[29]

GHG emissions reductions from restarting Try Transit pilot program are estimated based on annual VMT reduction due to change in transportation mode share and annual average passenger vehicle emission rate.

Models/Tools Used – One model was used to generate inputs for the custom calculation using method described above: CARB EMFAC2021 v1.0.2 for vehicle emission rates.[30]

Measure Implementation Assumptions – This existing program is assumed to be restarted and funded from 2025 through 2029.

GHG Reduction Estimate Assumptions – We assume that GHG reductions will occur from 2025 (when program restarts) through 2030 and that no GHG reductions occur after 2030 (i.e., no program impact after one year). To account for future benefits beyond 2029, we assume that 36% of program impacts will carryover for one year based on program evaluation data.[31] Annual VMT reduction is estimated based on (1) 2025 through 2029 funding level, (2) current pilot program (FY 2022 Q3 – FY 2023 Q4) funding level and annual VMT reduction ($ per GHG avoided),[32] (3) an adjustment factor of 1/3 to account for new trips that would not have been made with a vehicle without the program (similar to the YOP program)[33], and (4) a one year carryover factor to account for pilot participants continuing using transit after the pilot.[34] Annual average passenger vehicle emission rates are described in Section 2 above.

Reference Case Scenario – No Try Transit pilot program; trips are made by an average passenger vehicle.

Measure Specific Activity Data – Participation and VMT impacts will be scaled up based on 2025-2029 funding level and pilot program data (338 participants per year on average, 222 Pronto Card (transit card) activated per year, and 90,000 vehicle miles avoided).[35]

2025-2030 Cumulative GHG Emissions Reduced – 746 MT CO_2e

2025-2050 Cumulative GHG Emissions Reduced – 746 MT CO_2e

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[29] SANDAG Try Transit. Available at https://www.sandag.org/projects-and-programs/regional-initiatives/sustainable-transportation-services/transit-services
[30] California Air Resources Board, EMFAC Model. Available https://experience.arcgis.com/experience/81b2daca1827470ca8beeb4708139f79/page/Main/
[31] SANDAG. Try Transit Program: Summary Report Quarter 3 Fiscal Year 2022 – Quarter 4 Fiscal Year 2023. Internal Program Evaluation.
[32] *Ibid*.
[33] The adjustment factor from SANDAG's Youth Opportunity Pass Pilot Program is used as a proxy. SANDAG: Youth Opportunity Pass Pilot Program: Comprehensive Program Report (December 2023). https://www.sandag.org/-/media/SANDAG/Documents/PDF/projects-and-programs/regional-initiatives/transit-equity-pilot/youth-opportunity-pass/yop-comprehensive-program-report.pdf FY2023 annual VMT reduction is based on (1) the difference between FY2023 and FY2019 boardings (with and without the program) and (2) estimated average trip distance for K-12 school trip purposes.
[34] SANDAG: Try Transit Program: Summary Report, Quarter 3 Fiscal Year 2022 - Quarter 4 Fiscal Year 2023.
[35] *Ibid*.

7 Bus Rapid Transit Project

GHG emissions reductions from implementing bus rapid transit (BRT) Route 277 are estimated based on emissions reduction from passenger vehicle miles avoided and emissions added due to new transit buses.

Models/Tools Used – Three models were used to generate inputs for a custom calculation using the general method described above: CARB Benefits Calculator Tool for the California State Transportation Agency (CalSTA) Transit and Intercity Rail Capital Program Calculator (October 18, 2019)[36] to estimate VMT impacts; SANDAG ABM2+ to estimate ridership and trip length;[37] and CARB EMFAC2021 v1.0.2 for vehicle emission rates.[38]

Measure Implementation Assumptions – Route 277 is identified in the 2022 San Vicente Comprehensive Multimodal Corridor Plan and draft 2025 Regional Plan and will be operational by 2027.

GHG Reduction Estimate Assumptions – GHG reductions will occur from 2027 and continue through 2041, based on the useful life of a transit bus. We assume that as the vehicle fleet gets cleaner, the GHG reduction from miles avoided will decrease. Annual average passenger vehicle miles and added miles due to new transit buses are estimated based on year 1 (2027) and year final (2041) annual ridership of the three routes and length of average trip of the three routes. Annual average passenger vehicle emission rates are described in Section 2 above.

Reference Case Scenario – No Route 277; trips are made by an average passenger vehicle.

Measure Specific Activity Data – To estimate GHG reductions, we assume 304,982 riders in first year, 355,559 riders in last year, 19,977,864 passenger miles avoided over 15 years, based on SANDAG ABM2+ outputs.[39]

2025-2030 Cumulative GHG Emissions Reduced – 1,546 MT CO_2e

2025-2050 Cumulative GHG Emissions Reduced – 5,345 MT CO_2e

8 Regional Building Electrification Program

GHG reductions from this program is estimated using the energy impacts of switching from natural gas water heaters, natural gas space heating, and traditional electric space cooling technology to heat pump technologies. GHG estimates are estimated using changes in energy use, the electricity emissions rate, and carbon content of natural gas.

Models/Tools Used – No models or tools are used. Custom calculations using standard methods for GHG quantification were used.[40]

Measure Implementation Assumptions – We assumed a total of 4,500 air-source heat pumps (ASHP) and 4,000 heat pump water heaters (HPWH) and installations and associated energy reductions would occur equally over a five-year implementation period from 2025 to 2029. Equipment useful life is assumed as

[36] https://ww2.arb.ca.gov/sites/default/files/auction-proceeds/calsta_tircp_finalqm_cycle4.pdf
[37] https://www.sandag.org/data-and-research/transportation-modeling
[38] https://arb.ca.gov/emfac/emissions-inventory/dd07a6ca4ed10aa7ada49fc3daf62ef502a3afc7
[39] https://www.sandag.org/data-and-research/transportation-modeling
[40] GHG quantification is based on methods summarized in the Regional Climate Action Planning Framework. Technical Appendices. See San Diego Association of Governments. Regional Climate Action Planning Framework -- TECHNICAL APPENDIX II Methods to Calculate GHG Emissions Impacts of CAP Measures, VERSION 1.1. NOVEMBER 2020. Available at https://www.sandag.org/-/media/SANDAG/Documents/ZIP/projects-and-programs/recap-and-technical-appendices.zip

15 years for ASHP and 10 years for HPWH.[41] Installation cost is assumed as $16,000 for ASHP and $5,500 for HPWH. We assume differential incentive amounts of $5,500 for ASHPs and $1,000 for HPWHs for the general market and $7,000 for ASHPs and $1,500 for HWPH for LiDAC participants. We assume that 25% of ASHPs and 50% of HPWH are installed in LiDACs. About 30% of program costs are assumed to be for LiDAC participants. Cost of incentives, program administration, marketing/outreach, and evaluation are included in the total EPA CPRG costs.

GHG Reduction Estimate Assumptions – Electric emission rates used are described in Section 2 above. The carbon content of methane used is 0.0054 MT CO_2e/therm.[42]

Reference Case Scenario – Reference case for HPWHs is natural gas tank water heater and for ASHPs the is natural gas for heating and electricity for cooling.[43]

Measure Specific Activity Data – An annual electricity increase of 1,507 kWh and a natural gas reduction of 195 therms for HPWHs and a 1,303 kWh increase and a 220 therms reduction for ASHP is used to estimate GHG emissions impacts. All energy impacts assume natural gas baseline where appropriate.

2025-2030 Cumulative GHG Emissions Reduced – 11,500 MT CO_2e

2025-2050 Cumulative GHG Emissions Reduced – 39,555 MT CO_2e

9 Regional Residential Solar and Storage Program

GHG reductions from solar and energy projects are estimated by (1) determining the amount of solar and battery energy used to serve building load, the amount solar and battery energy exported to the grid, and the amount energy imported from the grid, and (2) determining the emissions impacts using electric emissions rates. The proposes program would fund two types of residential projects in different markets. Storage only projects would be for the general market single family and multifamily buildings in LiDACs. Solar and storage projects would be for single-family LiDACs participants. To determine the energy ad GHG emissions implications of each project configuration, we first estimated the results for the solar and storage project, then estimated results for solar only. To estimate the impacts of the program, which would fund only the storage portion of projects for market rate participants and LiDAC multifamily, we subtracted the results from the solar only project. from the results from the solar and storage project. We analyzed hourly data for building load, solar generation, storage behavior, and short run marginal emission rates (SRMER).

Models/Tools Used – Several tools were used to generate inputs for a custom calculation using generally accepted methods. Building energy load shapes were derived using the California Energy Commission's (CEC) California Building Energy Code Compliance (CBECC) model.[44] Hourly short-run marginal emission rates (SRMER) are from the CPUC Avoided Cost Calculator.[45] PV production estimates are from the CBECC model and validated using the National Renewable Energy Laboratory (NREL) PVWatts calculator.[46]

[41] The California Electronic Technical Reference Manual (eTRM)is available online at https://www.caltf.org/etrm-overview
[42] The Climate Registry 2021 Default Emission Factors and Emissions Factors for Greenhouse Gas Inventories, U.S EPA April 2022.
[43] Based on project data from the Tech Clean California program. Data available at https://techcleanca.com/public-data/download-data/
[44] California Energy Commission. 2022 Energy Code Compliance Software. Available at https://www.energy.ca.gov/programs-and-topics/programs/building-energy-efficiency-standards/2022-building-energy-efficiency-1.
[45] 2021 CPUC Avoided Cost Calculator. Available at https://www.cpuc.ca.gov/industries-and-topics/electrical-energy/demand-side-management/energy-efficiency/idsm.
[46] National Renewable Energy Laboratory PV Watts Calculator. Available at https://pvwatts.nrel.gov/

Measure Implementation Assumptions – The estimates presented here assume that solar and energy storage equipment installations and associated energy reductions would occur equally over a five-year implementation period from 2025 to 2029. We expect a total of 8.569 projects: 5,088 market rate storage incentive only, 3,456 solar and storage incentive for LiDAC participants, and 25 storage-only projects in LiDAC multifamily buildings. We assumed a 25-year useful life for PV and 13-year-life for battery storage.[47] Based on data from the California Distributed Generation Statistics website for the San Diego region, we used a $4,500 per kW installation cost for solar and $1,300 per kWh for energy storage.[48]

GHG Reduction Estimate Assumptions – The average system sizes used are 7.3 kW-AC and 13.6 kWh battery. For PV generation, we assume that energy output declines by about 4% per year[49] and batteries by 0.01% per cycle.[50] We used hourly building energy load shapes (CEC CBECC Model) and hourly data on solar generation (PVWatts) and battery behavior are used to determine import, export, and self-consumption of solar and battery energy. Because GHG emissions impacts of energy storage are based on the differences in emission rates when charging and discharging, hourly analysis is used to estimate the emissions impact of adding energy storage to a PV project. We assume that batteries are charged using only solar generation (emissions free). The GHG emission rates used for this analysis are described in Section 2 above. All values are provided in the supplemental Optional GHG Emission Reduction Calculations Spreadsheet.

Reference Case Scenario - The reference scenario is business-as-usual energy consumption from the grid with no solar and energy storage.

Measure Specific Activity Data – Energy and emissions implications were calculated on an hourly basis and depend on building load, solar generation, and battery behavior. No general rate or factor was used. Details are provided in the supplemental Optional GHG Emission Reduction Calculations Spreadsheet.

2025-2030 Cumulative GHG Emissions Reduced – 8,976 MT CO_2e

2025-2050 Cumulative GHG Emissions Reduced – 27,925 MT CO_2e

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[47] Verdant. (2021, January). Net-Energy Metering 2.0 Lookback Study. Retrieved from https://www.cpuc.ca.gov/-/media/cpuc-website/divisions/energy-division/documents/net-energy-metering-nem/nemrevisit/nem-2_lookback_study.pdf.
[48] California Distributed Generation Statistics. See https://www.californiadgstats.ca.gov/downloads/
[49] PV degradation rate: Verdant NEM 2.0_Lookback_Study 2021, p. 63.
[50] Degradation rate provided by Unigrid battery company.