Application: _____

Exhibit No.: SDGE-_____

Witness: J.C. Martin _____

PREPARED TESTIMONY OF

J.C. MARTIN

ON BEHALF OF SAN DIEGO GAS & ELECTRIC COMPANY

CHAPTER 7

BEFORE THE PUBLIC UTILITIES COMMISSION
OF THE STATE OF CALIFORNIA

JANUARY 22, 2018

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PREPARED TESTIMONY OF
J.C. MARTIN
CHAPTER 7

I. INTRODUCTION

This chapter summarizes net emission reduction estimates for San Diego Gas & Electric Company's ("SDG&E") proposed Medium-Duty and Heavy-Duty Electric Vehicle Charging Infrastructure Program ("Program") and Vehicle to Grid ("V2G") Electric School Bus Pilot ("V2G Pilot"). The emission reduction estimates include greenhouse gas ("GHG") and several Criteria Pollutant emissions.[1] This chapter also describes the methodology used to estimate the Program and V2G Pilot related emission reductions.

SDG&E's program is designed to provide electric vehicle ("EV") charging infrastructure for approximately 3,100 medium-duty ("MD") and heavy-duty ("HD") EVs, including electric trucks, school buses, transit buses, forklifts, and transport refrigeration units ("TRUs"). The Program is described in detail in the direct testimony of Hannon J. Rasool (Chapter 2) and the V2G Pilot is described in detail in the direct testimony of David M. Goldgraben (Chapter 3).

My testimony supports the Commission's September 14, 2016 ruling requirement to describe project emission benefits and accounting methodology.[2] Reductions of GHG and local Criteria Pollutants are beneficial to public health and are policy objectives of Senate Bill ("SB") 350 transportation electrification programs.[3] All ratepayers benefit from GHG and Criteria

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[1] GHG examples include carbon dioxide ("CO_2"), methane, and nitrous oxide. Criteria Pollutant examples include nitrogen dioxide and particulate matter.

[2] Rulemaking 13-11-007, *Assigned Commissioner's Ruling Regarding the Filing of the Transportation Electrification Applications Pursuant to Senate Bill 350* (September 14, 2016) ("September 14, 2016 ACR"), Appendix A, p. A3.

[3] September 14, 2016 ACR, pp. 5-6, and Pub. Util. Code §740.12(a)(1).

Pollutant emission reductions. Reduced emissions result in, "reduced harm to climate, health and the economy."[4]

II. SUMMARY OF NET EMISSION REDUCTIONS FOR PROGRAM

The MD and HD EVs utilizing the Program's charging infrastructure are intended to displace vehicles burning fossil fuels. Displacing fossil-fueled vehicles with EVs results in reductions in hydrocarbon-related emissions, such as GHGs and Criteria Pollutants. However, EV charging results in electricity generation related emissions.[5] Net emission reductions reported in my testimony are calculated by subtracting EV charging related emissions from displaced fossil fuel emissions.

Net emission reductions in my testimony are on a Well-to-Wheels ("WtW") basis consistent with methodologies used by the California Air Resources Board ("CARB") Low Carbon Fuel Standard, 2016 Mobile Source Strategy, and Vision planning model.[6] Well-to-Wheels analysis scope is illustrated in Figure 7-1 below. The analysis includes both Tank-to-Wheels ("TtW") emissions resulting from vehicle operations as well as upstream Well-to-Tank ("WtT") emissions resulting from energy production processes which include fuel production, transportation, refining and delivery to the vehicle.

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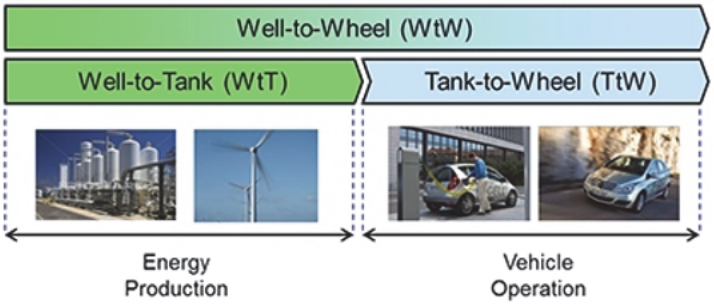
[4] America Lung Association in California, *Clean Air Future: Health and Climate Benefits of Zero Emission Vehicles* (2016), p. 9. Downloaded 11/13/2017: http://www.lung.org/local-content/california/documents/2016zeroemissions.pdf.

[5] Electricity-related emissions are generally lower than fossil fuel-related emissions for comparable vehicle operations (e.g., emissions per vehicle mile traveled or per hour of operation).

[6] Well to wheel ("WtW") emissions analysis considers the energy or emissions intensity of all stages of fuel production and final use of a fuel in a vehicle (i.e., the production, transport, and consumption of fuels in a vehicle). See also CARB, *Mobile Source Strategy* (May 2016), p. 157-160. Downloaded 12/4/2016: https://www.arb.ca.gov/planning/sip/2016sip/2016mobsrc.pdf.

Figure 7-1



Source: CARB (2017) Vision 2.1 Scenario Modeling System, p. 24[7]

For the purposes of this chapter, MD and HD vehicle classes are grouped based on Gross Vehicle Weight Rating ("GVWR") classes and off-road types:[8] GVWR classes are grouped into Class 2-3, Class 4-6, and Class 7-8. Transit buses and school buses are included in Class 7-8. These on-road vehicle types are mapped to groups based on the Emission Factors Model ("EMFAC") vehicle categories used by CARB. Off-road forklifts and TRUs are grouped in their own category.

Net emission reduction estimates for the Program are presented for both first-year and vehicle lifetime. Tables 7-1 and 7-2 below present the emission reductions estimates for each vehicle group and includes the number of vehicles in each group as well as the assumed displaced fossil fuel type used to estimate net emission reductions. Table 7-1 presents the first-year emission reductions estimates for the Program, totaling 42,709 Metric Tons ("MT") of Carbon Dioxide equivalent ("CO2e"), 25.6 MT Nitrox Oxides ("NOx"), and 4.3 MT of Particulate Matter up to 2.5 microns ("PM2.5"). Table 7-2 presents the lifetime emission

[7] Downloaded 11/1/2017: https://www.arb.ca.gov/planning/vision/docs/vision2.1_model_documentation_20170202.pdf.

[8] GVWR or gross vehicle weight rating, means the value specified by the manufacturer as the loaded weight of a single vehicle.

reduction estimates for the Program, totaling 476,552 MT CO2e, 327.9 MT NOx, and 50.5 MT PM2.5.

Table 7-1

Net Emission Reduction Estimates First-Year Well-to-Wheels Impacts					
			Annual Net Emission Reductions		
MD/HD Vehicle Group:	Vehicles (Count)	Displaced Fuel	CO2e (MT)	NOx (MT)	PM2.5 (MT)
Class 2-3	1,200	Diesel	5,512	0.6	0.2
Class 4-6	1,200	Diesel	18,793	4.5	0.2
Class 7-8 & Buses	450	DSL & CNG	15,177	16.8	3.9
Forklifts & TRUs	225	Diesel	3,227	3.6	
Grand Total	3,075		42,709	25.6	4.3

DSL = Diesel and CNG = Compressed Natural Gas
TRU = Transport Refrigeration Units

Table 7-2

Net Emission Reduction Estimates Lifetime Well-to-Wheels Impacts					
			Lifetime Net Emission Reductions		
MD/HD Vehicle Group:	Vehicles (Count)	Displaced Fuel	CO2e (MT)	NOx (MT)	PM2.5 (MT)
Class 2-3	1,200	Diesel	59,205	13.2	3.4
Class 4-6	1,200	Diesel	191,687	52.4	2.3
Class 7-8 & Buses	450	DSL & CNG	186,936	218.7	44.9
Forklifts & TRUs	225	Diesel	38,725	43.6	
Grand Total	3,075		476,552	327.9	50.5

DSL = Diesel and CNG = Compressed Natural Gas
TRU = Transport Refrigeration Units

III. SUMMARY OF NET EMISSION REDUCTIONS FOR V2G PILOT

The V2G Pilot, described in the direct testimony of David M. Goldgraben (Chapter 3), will add ten electric school buses to SDG&E's service territory with the capability of bi-directional power flow (i.e., charging from the grid and discharging to the grid). These electric school buses are assumed to have the same GHG emission reductions as the Program school buses on a per bus basis. Estimated GHG emission reductions for the ten V2G school buses are 174 MT CO2e for the first year, and 1,980 MT CO2e over the vehicle lifetime. These emission reductions are incremental to reductions reported in Tables 7.1 and 7.2.

IV. METHODOLOGY FOR NET EMISSION REDUCTIONS

This section describes the methodology used to estimate the GHG and Criteria Pollutant emission reductions summarized above. The methodology utilizes publicly available data from CARB, Argonne National Lab ("ANL"), and California Electric Transportation Coalition ("CalETC"). In general, on-road vehicle estimates use CARB's data for TtW emission estimates, and ANL's data for WtT emission estimates. Off-road vehicle (forklifts & TRUs) estimates use CalETC's data for WtW emission estimates.

The CARB Vision modules provide TtW emission estimates for the on-road vehicles included in the Program.[9] The data used for MD and HD vehicles are from the 2016 Vision 2.1 Heavy Duty Vehicle Expanded Zero Emission Scenario Release module. The data used for Transit Buses and School Buses are from the 2016 Vision 2.1 Passenger Vehicle Module. The Vision modules include vehicle model years from 1961 through 2051, however vehicles with model years earlier than 2029 were filtered out since few MD and HD EVs are included in

[9] More information on CARB's Vision modules are available at: (downloaded 12/12/2017) https://www.arb.ca.gov/planning/vision/downloads.htm#2016vision21lr.

earlier model years, and since it is assumed that EV purchases would likely displace a similar model year fossil fuel vehicle.

Data from the Vision modules were consolidated and summary data were created by vehicle groups and fuel types. Summary data includes Vehicle Miles Traveled ("VMT") per vehicle, miles per Gallon Gasoline Equivalent ("GGE"), and operating days per year. Summary data also include TtW emissions per GGE. Where summary data do not exist in the Vision modules for a vehicle group and/or fuel type, summary data from comparable vehicles and fuels are used. The summary data are used to estimate first-year and lifetime GGE consumption and TtW emissions for each vehicle group and fuel type.

The ANL GREET model is used to provide WtT emission estimates for each fuel type.[10] GREET fuel types used are low Sulphur diesel, reformulated gasoline, compressed natural gas ("CNG"), and electricity.[11] GREET WtT emission estimates were normalized to pounds per GGE and are combined with Vision TtW summary data to obtain total Well-to-Wheels emissions for each vehicle group and fuel type.

CARB Vision data was also used to estimate average vehicle lives. Average vehicle life is estimated to be twelve years for this analysis. This estimate is based on the 50% population survival period derived from Vision population data for model year vehicles 2025 and greater.

[10] GREET is the Greenhouse gases, Regulated Emissions, and Energy Use in Transportation model.

[11] SDG&E's 2016 power mix was modeled in the ANL GREET model using 43% eligible renewables, 42% natural gas, and 15% unspecified sources modeled as natural gas. See: Downloaded 11/15/2017: http://www.energy.ca.gov/pcl/labels/2016_labels/San_Diego_Gas_and_Electric.pdf.

Emission estimates for off-road forklifts and TRUs use CalETC data.[12] CalETC forklift and TRU data include assumptions on annual petroleum fuel use, annual emission rates, and Energy Economic Ratios ("EER"). The EERs are used to calculate the GGE for electric vehicles.

The net emission estimates in Tables 7-1 and 7-2 are calculated by subtracting the WtW emissions for electric fueled vehicles from the WtW emissions for the displaced petroleum fueled vehicles, resulting in net emissions reduction per vehicle. Per vehicle emission reductions are multiplied by the number of vehicles in each vehicle group to obtain the Program level emission reduction estimates.

V. CONCLUSION

SDG&E's proposed Medium-Duty and Heavy-Duty Electric Vehicle Charging Infrastructure Program and V2G Pilot provide GHG emission reductions and air quality improvements for all SDG&E ratepayers. This concludes my prepared direct testimony.

[12] CalETC, *California Transportation Electrification Assessment, Phase 1: Final Report* (September 2014) ("CalETC Report"). Downloaded 11/15/2017: http://www.caletc.com/wp-content/uploads/2016/08/CalETC_TEA_Phase_1-FINAL_Updated_092014.pdf.

VI. STATEMENT OF QUALIFICATIONS

My name is John C. Martin. My business address is 8306 Century Park Court, San Diego, California 92123. I am employed by SDG&E as Team Lead in Clean Transportation. I have over 24 years of energy industry experience. My current duties involve project and team management to support SDG&E's electric transportation efforts.

Prior duties have focused on costs and benefits associated with Vehicle-Grid Integration, Smart Metering, Home Area Networks, and conservation based information feedback. My prior electricity work experience includes demand response program and tariff development, electricity trading and scheduling, demand side management program evaluation, and load research of customer energy use. This work draws upon my broad experience in energy industries, including the oil trading, refining and marketing.

My EV driving experience began in 1997. I currently own and previously leased a plug-in hybrid EV since January 2013. I actively charge my vehicle at home, at my workplace, and at public facilities.

My education is in the general area of resource economics. I graduated from Cornell University with a master's degree in agricultural economics. My bachelor of science degree was granted by Purdue University in business and farm management.

I have previously testified before the California Public Utilities Commission.