CALIFORNIA ENERGY COMMISSION

CALIFORNIA NATURAL RESOURCES AGENCY

California Energy Commission

Clean Transportation Program

FINAL PROJECT REPORT

Residential EVSE Deployment Program in California- Multi-Unit Dwellings

Prepared for: California Energy Commission

Prepared by: AeroVironment, Inc.

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California Apartment Building Owners

AeroVironment wishes to acknowledge the apartment building owners who participated in this program. Volunteering their time and buildings for this effort made possible the expansion of electric vehicle charging infrastructure in multi-unit dwellings in San Diego, California.

Car2Go Car Sharing Program

AeroVironment wishes to acknowledge Car2Go for their efforts in assisting with site identification and integrating the electric vehicle charging apartment building venues with their business operations in San Diego, California.

PREFACE

Assembly Bill 118 (Núñez, Chapter 750, Statutes of 2007) created the Clean Transportation Program, formerly known as the Alternative and Renewable Fuel and Vehicle Technology Program (ARFVTP). The statute authorizes the California Energy Commission (CEC) to develop and deploy alternative and renewable fuels and advanced transportation technologies to help attain the state's climate change policies. Assembly Bill 8 (Perea, Chapter 401, Statutes of 2013) reauthorizes the Clean Transportation Program through January 1, 2024, and specifies that the CEC allocate up to $20 million per year (or up to 20 percent of each fiscal year's funds) in funding for hydrogen station development until at least 100 stations are operational.

The Clean Transportation Program has an annual budget of about $100 million and provides financial support for projects that:

- Reduce California's use and dependence on petroleum transportation fuels and increase the use of alternative and renewable fuels and advanced vehicle technologies.
- Produce sustainable alternative and renewable low-carbon fuels in California.
- Expand alternative fueling infrastructure and fueling stations.
- Improve the efficiency, performance and market viability of alternative light-, medium-, and heavy-duty vehicle technologies.
- Retrofit medium- and heavy-duty on-road and nonroad vehicle fleets to alternative technologies or fuel use.
- Expand the alternative fueling infrastructure available to existing fleets, public transit, and transportation corridors.
- Establish workforce-training programs and conduct public outreach on the benefits of alternative transportation fuels and vehicle technologies.

To be eligible for funding under the Clean Transportation Program, a project must be consistent with the CEC's annual Clean Transportation Program Investment Plan Update. The CEC issued PON-11-602 to provide funding opportunities under the ARFVT Program for alternative fuels infrastructure. In response to PON-11-602, the recipient submitted an application which was proposed for funding in the CEC's notice of proposed awards August 16, 2012 and the agreement was executed as ARV-12-017 on March 29, 2013.

ABSTRACT

In early 2013, the CEC awarded grant funding of $75,000 to AeroVironment, Inc. to supply and install level 2 Electric Vehicle Supply Equipment, also called charging stations, at each of two apartment buildings in San Diego for use by the apartment building tenants. Car2Go, an electric vehicle car-sharing program, contracted with the apartment building owners to allow Car2Go fleet customers to also use the stations. AeroVironment, Inc. sub-contracted with a local electrical contractor to perform the installation work. After an extensive search for apartment buildings that would be willing to participate and are qualified for the program, Electric Vehicle Supply Equipment installations began in June 2014 and ended in July 2014.

Governor Brown's Executive Order B-16-12 directs state government to support and facilitate the rapid commercialization of zero-emission vehicles in California, with a target of 1.5 million zero-emission vehicles on California roads by 2025. The order also requires that sufficient infrastructure be installed in the state to support 1 million zero-emission vehicles by 2020.

The primary goal of the project was to expand electric vehicle adoption in a particularly difficult sector for installation of electric vehicle infrastructure: multi-unit dwellings—in this case apartment buildings. Both apartment buildings chosen for the program were new constructions, which meant that there was no need to retrofit the infrastructure. The process was also expedited since approval for the installations was obtained from the building owners instead of the homeowner association.

The project exceeded its goals with the installation of seven Electric Vehicle Supply Equipment - five at The Point and two at Sofia Lofts. The project will result in an estimated greenhouse gas emissions reduction of 40 metric tons annually and displacement of approximately 6,500 gallons of gasoline annually. It also supports Car2Go's ride sharing program by expanding electric vehicle charging infrastructure in the City of San Diego.

Keywords: battery electric vehicle, electric vehicle supply equipment, zero emissions vehicle, multi-unit dwelling, greenhouse gases, electric vehicles

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EXECUTIVE SUMMARY

This report describes how AeroVironment, Inc. worked with Car2Go, an electric vehicle car sharing program to identify potential apartment buildings- Sofia Lofts and The Point, qualified them for the program, and supplied and installed level 2 electric vehicle supply equipment in their parking lots. In addition to the Daimler Smart Car electric vehicles that Car2Go uses for their fleet, the electric vehicle supply equipment installed under this program can charge a wide spectrum of plug-in electric vehicles (PEVs) that include: Nissan LEAF™, Chevy Volt, Toyota Prius plug-in hybrid, Ford Focus, Ford Fusion, Fiat 500e, Tesla Model S, and Honda Accord plug-in hybrid.

The seven new electric vehicle supply equipment supplied and installed through this project in June 2014, log approximately 3,000 charging events per year. The PEVs these electric vehicle supply equipment service log approximately 180,000 miles per year, which results in displacing an estimated 6,500 gallons of regular gasoline annually when compared to a 2013 sedan using regular unleaded fuel. This equates to an estimated annual greenhouse gas (GHG) emissions reduction of 40 metric tons.

The goals of this project are to expand electric vehicle charging infrastructure in multi-unit dwellings and to support Car2Go's car sharing program in San Diego. These were achieved with the installation of seven level 2 chargers at Sofia Lofts and at The Point. These chargers are available to the apartment residents and the members of Car2 Go.

This project demonstrates how electric vehicles can meet California's multi-unit dweller and car share fleet needs, thereby supporting widespread adoption. This project also assists the state to reduce its petroleum consumption and help to reduce GHG emissions.

CHAPTER 1: Objectives, Planning and Approach

1.1 Project Overview – Goals and Objectives

The purpose of the project is to promote adoption of electric vehicles (EVs) in the State of California and expand residential charging in the State. The Problem Statement for the project was:

"According to the Department of Motor Vehicles, California leads the nation with approximately 89,000 EVs on the road last year. But as more PEVs are introduced into the market, the demand for supporting EV charging infrastructure accessible to the public needs to be met. This plan requires installation of the necessary electric charging infrastructure to support electric vehicle charging."

Goals and Objectives

- Accelerate the commercialization of alternative vehicles and alternative/renewable fuels.
- EV adoption depends on the consumer and positive word-of-mouth relative to their experience. A primary project goal was to make the installation process of level 2 electric vehicle supply equipment (EVSE) process efficient and seamless.
- Reduce the use of petroleum fuels which will cut GHG emissions, helping the state achieve its public policy goals.

The degree of GHG emissions reduction attributable to EVs depends on the grid generation mix. As California has high renewables penetration and high natural gas components in its grid generation mix, it is the ideal environment which makes EVs effective at reducing GHG emissions from gasoline-powered vehicles. Through this program, consumer adoption of electric vehicles contributed to the reduction of GHG emissions in the San Diego area.

In 2006, California enacted Global Warming Solutions Act (Assembly Bill 32) to mitigate and reduce California's GHG emissions. In 2012, Governor Brown issued Executive Order B-16-12 ordering state agencies to begin transitioning their fleets away from internal combustion engines that depend on petroleum.[1] The ultimate goal is to use zero-emission vehicles (ZEVs) that use no petroleum- based fuel. This project accounted for an estimated annual displacement of 6,500 gallons of gasoline and the reduction of 40 metric tons of GHG emissions.

- Expand level 2 residential EV charging, specifically in multi-unit dwellings.
- One of the program goals was to provide cost effective EVSE installations while meeting CEC program requirements, including data reporting.

AeroVironment was awarded $75,000 to supply and install EVSE at each of two apartment buildings in San Diego, California. AeroVironment and its electrical subcontractor installed five EVSE at one apartment building (The Point) and two EVSE at the other apartment building (Sofia Lofts). Both apartment buildings serve as charging sites for the Car2Go car sharing

1 Executive Order B-16-12 https://www.ca.gov/archive/gov39/2012/03/23/news17472/index.html

program. At the time of installation, charging was free of charge for the tenants of the two apartments and planned to continue that way for the near future.

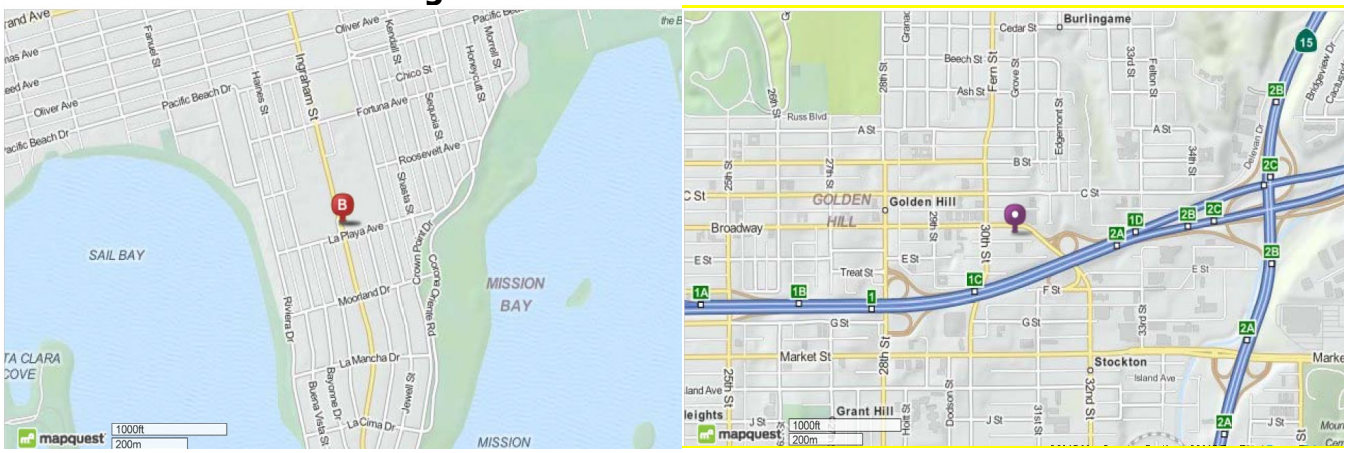
1.2 Project Planning and Approach

Car2Go is a subsidiary of Daimler AG providing car sharing services in European and North American cities. The company offers exclusively Smart Fortwo vehicles and features one-way point-to-point rentals. Users are charged by the minute, with hourly and daily rates available. The service forgoes the typical centralized rental office, and cars are user-accessed wherever parked via a downloadable smartphone app. In San Diego, the 400-vehicle fleet is all electric. Operations cover downtown San Diego, Mission Bay, Pacific Beach, and other areas, with expansion to the University of California San Diego campus planned for early 2015.

Project planning began during the preparation of the proposal in response to PON-12-602. The solicitation limited single application awards to $75,000, which allowed for a modest scope for supply and installation of level 2 EVSE at multi-unit dwellings—apartment buildings for this project. An additional constraint was the fleet application portion. AeroVironment worked with Car2Go to determine eligible apartments that could serve their territory in the San Diego area. After the award, AeroVironment and Car2Go investigated the proposed Cedar Shores and The Loft apartments. However, because of previous commitments to another EV charging program, these proposed sites did not work out. After a relatively long search, AeroVironment and Car2Go then identified and qualified The Point and Sofia Lofts as sites for the project.

The point is located at 3803 Ingraham Street, San Diego, CA 92109 and Sofia Lofts is located at 3051 Broadway, San Diego, CA 92102. Figure 1 below shows the location of the two sites.

Figure 1: The Point and Sofia Lofts



Source: Mapquest

Process

AeroVironment worked with the management of the two apartment buildings, acquired permits, and installed the EVSE over approximately a month beginning June 2014. Access control in the form of keypads were installed on the five EVSE at The Point for purposes of access control. Padlock access control was installed at Sofia Lofts.

AeroVironment used the following process:

- Request for Site Assessment
- Installer Confirmation
- Site Assessment Visit
- Order of Installation Services
- Permit Application (Permit costs were not eligible for funding under this grant. These were paid by the site hosts)
- Permit Receipt
- Installation Service
- Final Inspection

Typically, the process for getting approvals, permitting and installing EVSE for multi-unit dwellings is much more involved because Homeowner Associations (HOAs) and building owners add a layer of complexity. For this project, both apartments were new construction without HOAs which greatly simplified the internal approval process.

CHAPTER 2: Project Implementation

AeroVironment, Inc. installed the EVSE in June and July 2014, following the process listed in Chapter 1. Figures 2 through 4 shows pictures of the EVSE installations performed under this Project.

Figure 2: Single EVSE Installation at The Point

Source: AeroVironment

Figure 3: Four EVSEs at The Point

Source: AeroVironment

Figure 4: Dual EVSE Installation at Sofia Lofts

Source: AeroVironment

2.1 Data Gathering

The program required that site hosts participate in data collection by providing information on kilowatt hour (kWh) usage, and number and duration of charging sessions.

2.2 Number of Vehicles Fueled

The Car2Go network has more than 400 vehicles in San Diego. All are eligible to use the EVSE at the two apartment buildings. In addition, apartment building tenants who drive PEVs can use the EVSE for free. Sofia Lofts has 16 units (studio, one and two bedroom). The Point has 21 units (studio to two-bedroom). Six months after installation, none of the apartment renters is reported to drive an EV. However, the availability of EV charging infrastructure is expected to attract tenants who are EV owners.

2.3 Number of Days Vehicles were Fueled

Car2Go EVs charge daily at the seven EVSE, typically multiple sessions per day.

2.4 Number of Charging Events

Based on data gathered from AV's web portal, the number of annual charge events resulting from this project is approximately 3,000. This translates to approximately 53,000 kWh annual usage for the seven EVSE, or approximately 180,000 miles traveled.

2.5 Maximum Capacity of the New Fueling System

The level 2 EVSE installed under this project were rated at 30A 208/240 volts alternating current. The maximum capacity at 240 volts alternating current is 7.2 kilowatts (kW).

2.6 Gallons of Gasoline Displaced

The PEVs in this program will travel approximately 180,000 miles annually. According to the U.S. Department of Energy, this will result in annually displacing approximately 6,500 gallons of regular gasoline (when comparing a 2013 Nissan Leaf to a 2013 Chevrolet Impala using regular unleaded fuel).[2]

2.7 Emissions Reductions

Emissions reductions, as with gasoline displaced, were based on 180,000 annual PEV miles traveled. The Greenhouse Gases, Regulated Emissions, and Energy Use in Transportation (GREET) model was used to calculate GHG, non-methane hydrocarbons, oxides of nitrogen, non-methane hydrocarbons plus oxides of nitrogen, particulates, and formaldehyde.

The GREET software was developed by Argonne National Laboratory. This analysis used the GREET version 1-2014 using standard inputs for California grid mix and California reformulated gasoline (Table 1).

2 U.S. Department of Energy, Fuel Economy fueleconomy.gov

Emission Reduction Results

- GHG – 40 metric tons
- Non-methane hydrocarbons (VOCs) – 0.04 metric tons
- Oxides of nitrogen (NOx) – 0.04 metric tons
- Non-methane hydrocarbons plus oxides of nitrogen (VOCs and NOx – 0.08 metric tons
- Particulates (PM_{10} + $PM_{2.5}$) – 0.004 metric tons
- Formaldehyde – 0.006 metric tons

Table 1: GREET 1-2014 Emission Factors

	Electric Vehicle				Internal Combustion Vehicles (ICE) Vehicle, Cal. Gasoline			
	g/mile				g/mile			
Item	Feedstock	Fuel	Vehicle Operation	Total	Feedstock	Fuel	Vehicle Operation	Total
Total Energy	172	1,224	1,330	2,726	127	935	3,932	4,995
Fossil Fuels	169	948	1,030	2,147	121	854	3,670	4,645
Coal	2	126	136	264	3	19	0	22
Natural Gas	154	822	893	1,870	75	625	0	700
Petroleum	13	1	1	14	43	210	3,670	3,923
Water Consumption	0.01	1.18	0.00	1.20	0.07	0.19	0.00	0.25
CO2 (w/ C in VOC & CO)	11	130	0	141	-12	61	302	350
CH4	0.312	0.011	0.000	0.323	0.319	0.234	0.011	0.563
N2O	0.001	0.001	0.000	0.002	0.000	0.015	0.007	0.022
GHGs	21	131	0	152	-2	72	304	373
VOC: Total	0.017	0.005	0.000	0.022	0.012	0.108	0.170	0.290
CO: Total	0.042	0.060	0.000	0.102	0.026	0.072	2.866	2.963
NOx: Total	0.057	0.090	0.000	0.147	0.092	0.118	0.121	0.331
PM10: Total	0.003	0.011	0.018	0.032	0.006	0.013	0.026	0.044
PM2.5: Total	0.001	0.008	0.005	0.014	0.006	0.008	0.012	0.025
SOx: Total	0.022	0.088	0.000	0.110	0.045	0.105	0.005	0.154
BC Total	0.008	0.009	0.001	0.018	0.008	0.007	0.002	0.017
OC Total	0.000	0.002	0.001	0.003	0.002	0.002	0.006	0.010

Source: Argonne National Laboratory

Sample Calculation

- 1000 miles of EV travel equates to 152g/mi x 1000mi = 0.152 metric tons
- 1000 miles of ICE travel equates to 373g/mi x 1000 = 0.373 metric tons
- GHG reduction = 0.373-0.152 = 0.221 metric tons / 1000 miles

Formaldehyde Calculation

The GREET model does not list formaldehyde emissions. However, formaldehyde emissions were estimated using a factor of 20 percent of non-methane organic gases (or VOC) from the following study to calculate ICE vehicle portion:

- Well-to-Wheels Analysis of Advanced Fuel/Vehicle Systems — A North American Study of Energy Use, Greenhouse Gas Emissions, and Criteria Pollutant Emissions.
- Brinkman, N., M. Wang, T. Weber, and T. Darlington, May 2005.

- Formaldehyde for the EV portion is a subset of VOC. However, this is a small number relative to the ICE vehicle emissions. Thus, the VOC emissions were assumed to represent formaldehyde emissions.
- Formaldehyde = 0.29 x 0.2 (ICE) – 0.022 = 0.036g/mi.

2.8 Duty Cycle

Fleet EVs typically charge once a day, sometimes more often. In the case of the two apartment buildings, the EVSE have shown very high usage. For Sophia Lofts the usage is approximately nine hours per day for each EVSE. For The Point the usage is approximately 12 hours per day for each EVSE. Each EVSE has supported multiple Car2Go charging sessions per day. The kWh usage listed in Section 2.4 reflects Car2Go vehicle charging. As apartment residents begin to use the EVSE, the utilization will increase.

2.9 Jobs and Economic Development

EV and EVSE manufacturing creates jobs. The installations have, at the minimum, provided temporary jobs and have contributed to increasing revenues for companies engaged in the manufacture and installations of EVSE.

This project resulted in $18,510 or 38 percent of grant funding, to be paid to one in-state electrical contractor. This contractor is a small business.

Electrification of personal transportation can push job creation in a host of industries. More efficient cars require more sophisticated technology, which are designed and produced by adding workers to the auto industry. Many of these jobs would be in industrial sectors closely tied to auto manufacturing, advanced batteries, and research and development.

In the long run, drivers who switch to electric vehicles will have more disposable income to spend for housing, entertainment, and other services. This increased spending in other sectors will stimulate the economy and enhance job creation.

Electric vehicles in residences are generally charging late in the evening, overnight, and in the early morning, when there is excess generation capacity in the grid. A major portion of energy generated during this period comes from renewable sources, such as wind. This allows utilities to forego the use of power plants that are only needed to satisfy peak demand. Operating costs, and therefore utility rates, are reduced.

2.10 Renewable Energy at the Facility

Neither apartment building in this project has renewable energy sources installed.

2.11 Source of the Alternative Fuel

The electrical power for the charging stations was provided by California electrical utilities. Based on 2013 data from the US Energy Information Administration, in California, 60 percent of electricity generated comes from natural gas, 12 percent from hydroelectric, and 9 percent from nuclear. Wind and geothermal each account for 7 percent. Biomass and solar represent 3 percent and 2 percent, respectively.

2.12 Energy Efficiency Measures

Although, the project did not track energy efficiency measures at the apartment buildings, electric utility customers are now benefitting from rate plans to help them manage their EV energy costs. San Diego Gas and Electric has an electric vehicle time-of-use (EV-TOU) rate which has lower rates during off-peak hours, between midnight and 5 AM. EV-TOU rates encourage cutting down on daytime usage of electricity, when demand is at the highest.

CHAPTER 3: Assessment of Project Success

Electric vehicles produce less tailpipe emissions per mile than conventional vehicles, even taking into account power-plant emissions. These vehicles contribute to a cleaner commute and lower carbon footprint. Plug-in electric cars are more efficient and require less energy to run than internal combustion engine vehicles.

Electric vehicles contribute to energy independence. Most of the resources used to power our grid are locally-sourced, with approximately 20 percent of the power generated from renewable energy sources like wind and solar. When an EV driver fuels his vehicle, he is purchasing 100 percent American- made energy instead of the imported oil that powers most conventional vehicles today.

Electric cars lower the household's fuel expenses compared to gasoline. On average, electricity costs 25 percent to 50 percent the cost of a gasoline gallon equivalent. The household may save more by choosing an electric vehicle rate plan that gives lower rates for charging at night, when the costs of electricity are lower.

AeroVironment has installed seven level 2 EVSE at two apartment buildings in San Diego, California, for the use of Car2Go car share program customers and the apartment building tenants.

Aside from contributing to widening the network of EVSE infrastructure for Car2 Go and expanding level 2 EV charging in multi-unit dwellings, this project contributes to displacing an estimated 6,500 gallons of gasoline and reducing GHG emissions by an estimated 40 metric tons annually.

According to *Charged- Electric Vehicle Magazine (Charles Morris, October 28, 2013)*, the San Diego Union Tribune estimates that more than one-third of San Diego, CA residents live in multi-unit dwellings. It has been a challenge to site EV chargers in these residences due to reasons such as aging electrical infrastructure, stringent homeowner association rules, and metering issues. This project complements a host of other projects by federal and local governments to expand EV charging infrastructure for fleets and residences in the City of San Diego.

CHAPTER 4: Conclusions, and Recommendations

4.1 Conclusions

This project has achieved its goal of promoting the adoption of plug-in electric vehicles by expanding level 2 charging in the multi-unit dwelling and fleet vehicle sectors. It has contributed to the electrification of the transportation sector, reduced GHG emissions by approximately 40 metric tons annually, and displaced an estimated 6,500 gallons per year of gasoline. The project also contributed to small business job creation with 38 percent of grant funds going to a small business California electrical contractor. It has also provided a boost to car sharing programs, specifically Car2 Go, in the City of San Diego.

4.2 Recommendations

This project has achieved its goals. A primary project objective was to promote electric vehicle adoption by making level 2 charging available and making the process of procuring and installing an EVSE seamless and convenient. Additional funding for similar projects in multi-unit dwellings is highly recommended.

GLOSSARY

ASSEMBLY BILL (AB)—A proposed law, introduced during a session for consideration by the Legislature, and identified numerically in order of presentation; also, a reference that may include joint, concurrent resolutions, and constitutional amendments, by Assembly, the house of the California Legislature consisting of 80 members, elected from districts determined on the basis of population. Two Assembly districts are situated within each Senate district.

CALIFORNIA ENERGY COMMISSION (CEC)—The state agency established by the Warren-Alquist State Energy Resources Conservation and Development Act in 1974 (Public Resources Code, Sections 25000 et seq.) responsible for energy policy. The CEC's five major areas of responsibilities are:

1. Forecasting future statewide energy needs.
2. Licensing power plants sufficient to meet those needs.
3. Promoting energy conservation and efficiency measures.
4. Developing renewable and alternative energy resources, including providing assistance to develop clean transportation fuels.
5. Planning for and directing state response to energy emergencies.

Funding for the CEC's activities comes from the Energy Resources Program Account, Federal Petroleum Violation Escrow Account, and other sources.

ELECTRIC VEHICLE (EV)—A broad category that includes all vehicles that are fully powered by electricity or an electric motor.

ELECTRIC VEHICLE SUPPLY EQUIPMENT (EVSE)—Infrastructure designed to supply power to EVs. EVSE can charge a wide variety of EVs, including BEVs and PHEVs.

GREENHOUSE GAS (GHG)—Any gas that absorbs infrared radiation in the atmosphere. Greenhouse gases include water vapor, carbon dioxide (CO2), methane (CH4), nitrous oxide (NOx), halogenated fluorocarbons (HCFCs), ozone (O3), perfluorinated carbons (PFCs), and hydrofluorocarbons (HFCs).

GREENHOUSE GASES, REGULATED EMISSIONS, AND ENERGY USE IN TRANSPORTATION (GREET®)—A full lifecycle model sponsored by the Argonne National Laboratory (U.S. Department of Energy's Office of Energy Efficiency and Renewable Energy). GREET® fully evaluates energy and emission impacts of advanced and new transportation fuels, the fuel cycle from well to wheel, and the vehicle cycle through material recovery and vehicle disposal. It allows researchers and analysts to evaluate various vehicle and fuel combinations on a full fuel-cycle/vehicle-cycle basis.

HOMEOWNER ASSOCIATION (HOA)—A private association often formed by a real estate developer for the purpose of marketing, managing, and selling homes and lots in a residential subdivision.[3]

INTERNAL COMBUSTION ENGINE (ICE)—The ignition and combustion of the fuel occurs within the engine itself. The engine then partially converts the energy from the combustion to work.

KILOWATT (kW)—One thousand watts. A unit of measure of the amount of electricity needed to operate given equipment. On a hot summer afternoon, a typical home—with central air conditioning and other equipment in use—might have a demand of 4 kW each hour.

KILOWATT-HOUR (kWh)—The most commonly used unit of measure telling the amount of electricity consumed over time, means one kilowatt of electricity supplied for one hour. In 1989, a typical California household consumed 534 kWh in an average month.

NITROGEN OXIDES (OXIDES OF NITROGEN, NOx)—A general term pertaining to compounds of nitric oxide (NO), nitrogen dioxide (NO2), and other oxides of nitrogen. Nitrogen oxides are typically created during combustion processes and are major contributors to smog formation and acid deposition. NO2 is a criteria air pollutant and may result in numerous adverse health effects.

PARTICULATE MATTER (PM)—Unburned fuel particles that form smoke or soot and stick to lung tissue when inhaled. A chief component of exhaust emissions from heavy-duty diesel engines.

PLUG-IN ELECTRIC VEHICLE (PEV)—A general term for any car that runs at least partially on battery power and is recharged from the electricity grid. There are two different types of PEVs to choose from—pure battery electric and plug-in hybrid vehicles.

PLUG-IN HYBRID ELECTRIC VEHICLE (PHEV)—PHEVs are powered by an internal combustion engine and an electric motor that uses energy stored in a battery. The vehicle can be plugged in to an electric power source to charge the battery. Some can travel nearly 100 miles on electricity alone, and all can operate solely on gasoline (similar to a conventional hybrid).

TIME-OF-USE (TOU)—PG&E rate plans that can reduce expenses by shifting energy use to partial-peak or off-peak hours of the day. Rates during partial-peak and off-peak hours are lower than rates during peak hours.

VOLATILE ORGANIC COMPOUNDS (VOCs)—Carbon-containing compounds that evaporate into the air (with a few exceptions). VOCs contribute to the formation of smog and/or may themselves be toxic. VOCs often have an odor and some examples include gasoline, alcohol and the solvents used in paints.

ZERO EMISSION VEHICLE (ZEV)—Vehicles that produce no emissions from the on-board source of power (e.g., an electric vehicle).

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3 Homeowner Association Wikipedia https://en.wikipedia.org/wiki/Homeowner_association