



**CALIFORNIA  
ENERGY COMMISSION**



Clean Transportation Program

## **FINAL PROJECT REPORT**

# **Waste Management CNG Refueling Station Project**

**Private CNG Fueling Station in Oceanside,  
California**

**Prepared for: California Energy Commission**

**Prepared by: Waste Management**



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# California Energy Commission

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## **DISCLAIMER**

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## PREFACE

Assembly Bill 118 (Núñez, Chapter 750, Statutes of 2007) created the Clean Transportation Program. 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 that helps develop infrastructure necessary to store, distribute, and dispense electricity, E-85, propane, diesel substitutes, and natural gas. In response to PON-11-602, the recipient submitted an application which was proposed for funding in the CEC's notice of proposed awards April 24, 2011 and the agreement was executed as ARV-12-060 on June 30, 2013.



## ABSTRACT

The Oceanside Compressed Natural Gas Station is the ultimate example of a project that provides an efficient, proven, and necessary step in transitioning California's heavy-duty transportation market away from petroleum-based fuels to clean-burning natural gas. Natural gas allows the heavy-duty operational requirements and high-fuel demands of California fleets to be met using a fuel supply that is plentiful, sourced domestically, low-carbon, and that provides exceptional long-term cost savings.

Waste Management currently operates 26 compressed natural gas trucks out of its Oceanside facility. There were not enough convenient compressed natural gas fueling locations available to support the vehicles serving Oceanside and Camp Pendleton. The only public compressed natural gas station within a 20-mile radius of the Waste Management facility was located 4.5 miles away at the San Diego Gas & Electric Power Plant. Additional public compressed natural gas stations within a 25-mile radius were more than 23 miles away in Temecula, Poway, and the City of San Diego.

Waste Management's ultimate goal is for its entire fleet at Oceanside to operate on clean-burning natural gas. In keeping with these plans, Waste Management signed an agreement with the City of Oceanside confirming a 10-year commitment to using natural gas vehicles. Because of these plans, Waste Management was in critical and immediate need of compressed natural gas fueling at this location. The Oceanside compressed natural gas Station Project included construction of 28 time-fill stalls, two fast-fill dispensers, and priority fueling for vehicles that receive maintenance overnight. Waste Management selected ET Environmental as the fueling station development contractor, and it is now fully operational.

**Keywords:** Compressed natural gas, Waste Management, natural gas fueling station

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## **EXECUTIVE SUMMARY**

Waste Management of California, Inc. received grant support from the California Energy Commission in the amount of \$300,000 to develop a compressed natural gas fueling station to support its existing and rapidly expanding private fleet of compressed natural gas-powered solid waste collection vehicles in the City of Oceanside. With support from the Energy Commission, Waste Management constructed, owns, and now operates the compressed natural gas fueling station at its Fleet Maintenance and Administration Facility in North County San Diego. At this location, Waste Management supports and maintains a fleet of 89 trash-hauling trucks serving Oceanside and Camp Pendleton. With the new station in operation, Waste Management plans to replace 42 trucks, or approximately 50 percent, of the overall fleet with compressed natural gas.

Waste Management has made a long-term commitment to convert its fleet vehicles to natural gas nationwide and has constructed dozens of such stations in California and throughout the country. Furthering its dedication to the alternative fuel, the company finalized a 10-year hauling agreement with the City of Oceanside that includes commitment to use compressed natural gas refuse collection vehicles at its facilities. Before, the four compressed natural gas trucks that Waste Management operated at this site were forced to fuel at the only other local public station nearly five miles away. Fueling was not available to Waste Management's vehicles without planning unnecessary trips outside of the fleet's normal solid waste collection routes, adding significant cost and inconvenience. Upon completion, the project has started to greatly assist the Energy Commission to displace petroleum usage and reduce greenhouse gas emissions from Waste Management's existing diesel fleet.

The station's compressed natural gas equipment area is located within the existing fleet operations at Waste Management's Oceanside site. It includes two fast-fill dispensers, 28 slow-fill stalls, as well as priority fueling for those vehicles that receive maintenance overnight and are prevented from slow-fill fueling. It required two compressed natural gas compressors, along with underground storage, for a total flowrate capacity of approximately 3.8 diesel gallon equivalents per minute. Waste Management collaborated with ET Environmental on the Oceanside fueling station project; it has collaborated with ET Environmental on the majority of its other successful compressed natural gas projects across California, including stations and upgrade projects in the cities of San Gabriel, Corona, and Long Beach, and others.

Waste Management received final building permit approval in April of 2015; equipment was ordered in June, and construction started in November of 2015. Upon successful delivery of equipment in January of 2016, construction neared completion in February, and station operations commenced on March 3, 2016. The total cost for this project was \$2.3 million, of which Waste Management provided 86.7 percent in match share.



# **CHAPTER 1:**

## **Project Background and Objectives**

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### **Project Background**

Waste Management of California, Inc's (WM) need for onsite compressed natural gas (CNG) fueling has been a huge limiting factor as it seeks to convert to natural gas operations in Oceanside. As a result, WM chose to install a large-scale CNG fueling station with an aggressive timeline. WM selected to complete the project at its 3.7 acre leased property at 2141 Oceanside Boulevard in the City of Oceanside in northern San Diego County. This fleet maintenance and administration facility was already an existing facility that supports and maintains trash-hauling trucks serving Oceanside and Camp Pendleton. It was a fully developed site providing residential trash disposal, recycling, and green waste services, zoned for general industrial use.

### **Project Objectives**

The Oceanside CNG Station Project has significant economic impacts in the immediate and long-term future that benefit both the local economy and the State of California. Waste Management directly invested \$1,958,692.47 in equipment, construction, site improvements, and contractor labor to develop its new CNG station, thereby injecting immediate capital into the local economy. The Energy Commission provided WM with \$300,000 to develop a CNG fueling station to support its existing and rapidly expanding private fleet of CNG powered solid waste collection vehicles in the City of Oceanside. With support from the Energy Commission, WM constructed, owns, and now operates the CNG fueling station at its Fleet Maintenance and Administration Facility in North County San Diego. Following station commissioning, the project also contributes ongoing fuel tax revenues from WM's proprietary fuel use, as well as ongoing investment in the highly skilled green jobs necessary to support the advanced technology vehicle and station operations, and California's overall transition into a market-leading clean technology economy. At the time the grant application was prepared, WM's goals for the project were to:

- Provide for the annual displacement of over 382,200 gallons of diesel use with 100 percent domestically produced low-carbon natural gas.
- Provide for the displacement of 1,010,100 gallons of diesel use from 2013 through 2015 with 100 percent domestically produced low-carbon natural gas.
- Provide for the annual reduction of more than 1,373 metric tons of greenhouse gas (GHG) emissions, more than 29.69 tons of nitrogen oxide emissions, and 0.588 tons of Particulate Matter
- Provide for the reduction of more than 3,628 metric tons of GHG emissions from 2013 to 2015.
- Complete these goals at a cost-effectiveness as low as \$0.2970 per gallon of diesel fuel displaced and \$82.69 per metric ton of GHGs reduced.

- Serve as a model for other large-scale refuse or station operators on how to successfully implement advanced technology alternative fuel infrastructure programs in collaboration with state agencies.
- Promote regional growth in alternative fuel vehicle deployments and the replacement of heavy-duty diesel trucks.

# CHAPTER 2:

## Scope of Work

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### Scope of Work

WM's scope of work under agreement number ARV-12-060 included the installation, operation, and reporting of the new CNG fueling station. New equipment procured and installed for this project included:

- Two Compressors
- 28 CNG Slow-Fill Stalls
- Two Fast-Fill Dispensers
- One Priority-Fill Post
- Ground Storage
- Gas Dryer
- Pressure Logic Control Panel
- Card Reader

The CNG fueling station conveys natural gas from the public utility pipeline to an on-site equipment compound where the gas is compressed and then distributed to WM's solid waste collection vehicles overnight. The compressed gas is buffered in steel storage containers and routed via piping and hoses to fuel the entire CNG fleet. A new natural gas line owned and operated by San Diego Gas & Electric was extended from Oceanside Boulevard to the southern portion of the project site where the new CNG fueling facilities are located. The new gas line extends southward from Oceanside Boulevard beneath Industry Street. The line was routed westward from the Industry Street cul-de-sac to the new CNG equipment compound. New additional electric power services via an underground conduit were also added from Industry Street to the project site to provide adequate power to the CNG equipment.

### Technical Tasks

WM completed several technical tasks to complete the CNG station development in an orderly and efficient manner. WM completed the below technical tasks under this project:

#### Engineering and Preconstruction

WM performed civil and architectural engineering, including design management services and preconstruction planning. WM finalized the station layout, engineering, and design. WM provided design management services and preconstruction planning services and submitted the final station design to the Commission Agreement Manager in November of 2014. WM received the final building approval from the City of Oceanside in April of 2015.

## **CNG Equipment Procurement**

WM ordered equipment and supplies for the site in June of 2015, with a committed delivery date in January of 2016. The installation of equipment, controls, and support infrastructure were completed in accordance with the system design specifications. WM and ET Environmental provided quality assurance checks on key components of the system as part of the station commissioning steps prior to start-up. The large-scale station is being designed with a flow capacity of 500 standard cubic feet per minute, or approximately 3.8 diesel gallon equivalents (DGEs) per minute. The Oceanside CNG station will include hoses to fill up to 56 vehicles at a time via slow-fill, with two additional fast-fill dispensers and a priority fueling post. WM's current two CNG vehicles operate an average of 5 days per week, or 260 days per year, and they use approximately 35 DGE per day.

## **Site Work, Civil Improvements, and Installation**

WM oversaw and managed site construction, which included both electrical and mechanical work. WM installed underground and aboveground piping to transport gas to the site and to provide necessary utilities and communication lines to the equipment locations. Site work started in November 2015 and continued through February 2016.

## **Station Start-Up and Commissioning**

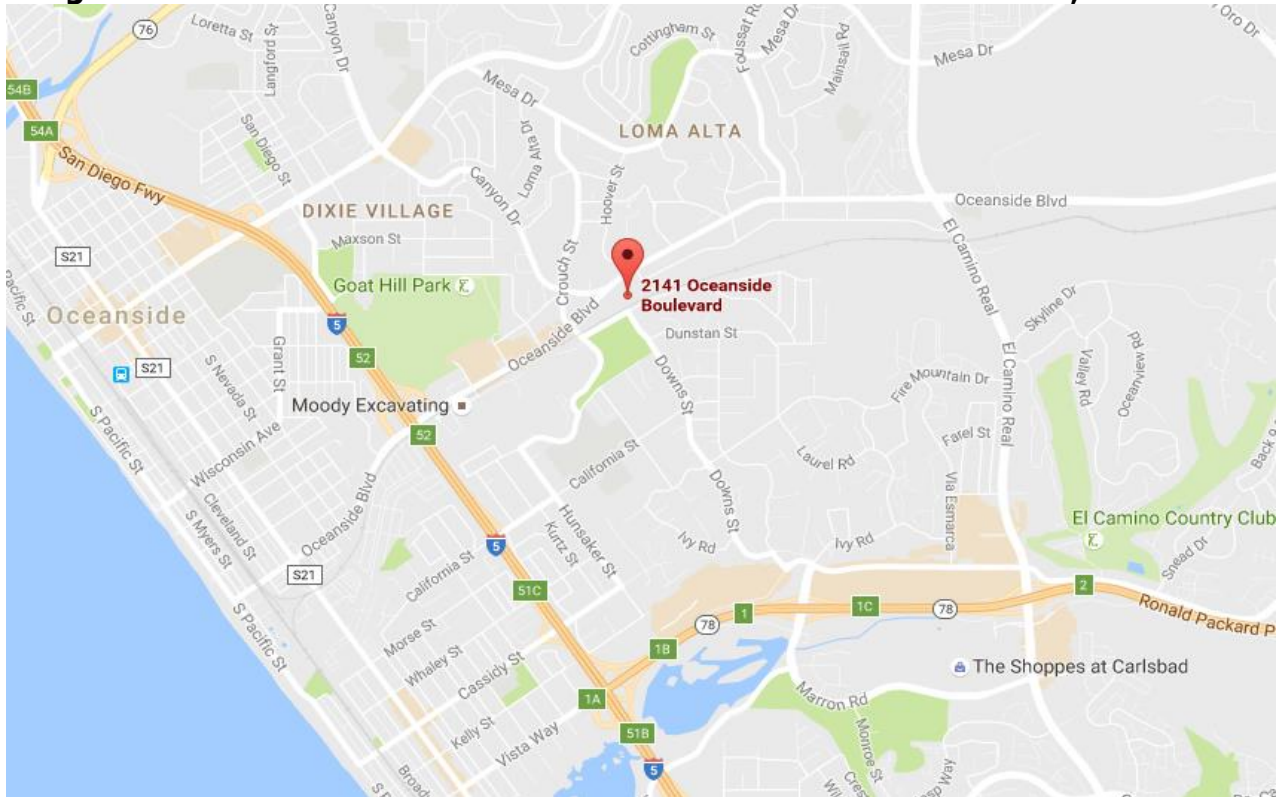
WM installed a back-office system for communications, management, and customer relations as well as held a training session to topics including safety, maintenance, ordering replacements parts, and warranty. Construction was complete in early March, and the commissioning of the new station commenced on March 3, 2016. WM performed start-up of the system and equipment on-site and commissioned the system into operation.

## **Data Collection and Analysis**

Since commissioning in March 2016, WM has collected and continues to collect operational data from the station. WM analyzes the data for the economic and environmental benefits of the project, such as station throughput and associated project emission benefits.

Figure 1 below shows the site location of the CNG station on a map. Figures 2 and 3 show photos of the CNG compound and time fill line.

**Figure 1. CNG Station Location: 2141 Oceanside Blvd. Oceanside, CA 92054**



Source: Google Map

**Figure 2. Completed CNG Compound**



Photo Credit: ET Environmental, Weekly Job Status Report #12, February 2016

**Figure 3. Completed Time Fill Line**



Photo Credit: ET Environmental, Weekly Job Status Report #12, February 2016

**Annual Fuel Throughput**

Approximately 26 WM units utilize the Oceanside CNG station since it became operational in March 2016. The estimated annual fuel usage over the reporting period, March 15, 2016 – September 15, 2016, was approximately 108,373 DGE. On average, monthly throughput is approximately 15,482 DGE as shown in Table 1 below.

**Table 1. Oceanside CNG Station Fuel Throughput**

	<b>Total Site Throughput (DGE)</b>
March 2016	11763.62
April 2016	15899.76
May 2016	19768.55
June 2016	15372.92
July 2016	19831.45
August 2016	16922.00
September 2016	8814.853
Total for Reporting Period	108373.2
Monthly Average (March 2016 – September 2016)	15481.88
Estimated Annual Throughput	185782.5

Source: Waste Management Renewable Identification Numbers (RINs) Report, 2016



## Emission Reductions

Based on the average throughput of approximately 185,782 DGE per year, WM is responsible for all of the emission reduction benefits of the Oceanside CNG station. Using the Carl Moyer Program Guidelines<sup>1</sup>(Adopted April 2011) methodology for calculating criteria pollutant emission reductions and using a baseline model year 2006 diesel refuse collection vehicle, WM can expect to achieve the following criteria pollutant reduction benefits by using natural gas vehicles instead of diesel. Table 2 below lists the emission reductions as part of this criteria.

**Table 2. Emission Reduction Calculation**

<b>Criteria Pollutant Emission Reduction Calculation</b>	<b>Nitrogen Oxide</b>	<b>Particulate Matter</b>
Baseline Emission Factor (g/mi) 2006 Diesel	11.63	0.252
Baseline Emission Factor (g/mi) 2006 Diesel, w/o Particulate Matter Retrofit	11.63	0.252
Reduced Emission Factor (g/bhp-hr)	0.16	0.01
Conversion Factor (bhp-hr/mi)	2.90	2.90
Energy Consumption Factor (bhp-hr/ga)	18.50	18.50
Estimated Annual Fuel Consumption (DGE)	185,783	185,783
Percent in Operation in CA (1.0 = 100 percent)	1.0	1.0
(ton/907,200 g)	0.00000110229277	0.00000110229277
Projected Baseline Emissions (tons/year)	15.21	0.33
Projected Reduced Emissions (tons/year)	0.76	0.038
Annual Emission Reductions (tons/year)	14.45	0.29
Emission Weighting for Cost Effectiveness Calculations	1.00	1.00
Weighted Emission Reductions	14.45	0.29

Source: California Environmental Protection Agency, Air Resources Board, "Carl Moyer Program Guidelines" June 2011

By displacing diesel fuel at the Oceanside CNG station, WM can achieve the reduction of more than 14.45 tons per year of nitrogen oxides, and 0.29 tons per year of PM. Additionally, the project will contribute to the reduction of 667 tons of greenhouse gas (GHG) emissions per year. GHGs were calculated according to fuel consumption, using emission factors from the

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<sup>1</sup> California Environmental Protection Agency, Air Resources Board, "[Carl Moyer Program Guidelines](http://www.arb.ca.gov/msprog/moyer/guidelines/2011gl/2011cmpgl_3_27_13.pdf)" June 2011 (http://www.arb.ca.gov/msprog/moyer/guidelines/2011gl/2011cmpgl\_3\_27\_13.pdf)

2015 Low Carbon Fuel Standard Regulations Table 7: Tier 2 Lookup Table for diesel and fuels that substitute for diesel.<sup>2</sup>

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<sup>2</sup> California Environmental Protection Agency, Air Resources Board, "[Low Carbon Fuel Standard Regulation](https://www.arb.ca.gov/regact/2015/lcfs2015/lcfsfinalregorder.pdf)" 2015 (https://www.arb.ca.gov/regact/2015/lcfs2015/lcfsfinalregorder.pdf)

# CHAPTER 3:

## Results

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### Results

The station has been open and operational since March 2016, fueling WM’s regional fleet of CNG waste collection vehicles. Since commissioning, over 100,000 DGEs have been replaced with cleaner burning fuel. Table 3 below provides more information about the CNG station and the vehicles it supports. Twenty-Six waste collection vehicles currently utilize the Oceanside Station. On average, they operate 10 hours per day, and 5.5 days of the week.

The Oceanside Station has a maximum fueling capacity of 204 DGE/hr. This flow rate assumes that two compressors are running at 18 psi  $[(237 \text{ cfm} \times 2)/(139 \text{ CNG scf/DGE}] \times (60 \text{ min/hour})$ . The required power of 360 amps/3 Phase 480 VAC also assumes that two compressors are running and does not include start up power need. The project has provided operational benefits for WM and air quality benefits for the surrounding area through the reduction of over 667 tons of GHGs.

**Table 3. Station and Vehicle Data Within First Year of Operations**

Number of vehicles at site	26
Number of operating days/week	5.5
Number of operating hours/day	10
Number of loads/day	3
Maximum capacity of new fueling system	204 DGE/hour
Electricity required to power CNG compression equipment	360 amps
Current and planned use of renewable energy at the facility	None
Energy efficiency measures exceeding Title 24 standards	None

Source: ET Environmental and Waste Management personnel, January 2017

### Problems

In January of 2016, WM and the Energy Commission executed an amendment which allowed for an extension of agreement ARV-12-060 for a period of nine (9) months to December 31, 2016. As part of the Mitigated Negative Declaration submitted by WM, WM agreed to the curtailment of construction during the period from February 1 to August 31 to protect the habitat and nesting habits of two special-status birds. The agreed to curtailment resulted in a delay in the project. In addition, the City of Oceanside requested an analysis of related to floodplain management at the site. In April 2015 Federal Emergency Management Agency approved the floodplain analysis (Letter of Map Revision/Conditional Letter of Map Revision), following which the City of Oceanside issued the building permit to WM.

## **Lessons Learned**

WM originally projected that 382,200 gallons of diesel fuel would be displaced annually by this project by the end of 2015. Construction was not complete on the station until March of 2016, and the throughput through September 2016 was 108,373 DGE or approximately 185,800 DGE on an annualized basis. As the CNG fleet size increases, volumes will move toward the original estimate of 382,000 DGE but at this time there is not a definitive schedule with respect to fleet additions. The design and equipment follow WM's proven standards for CNG stations and hence there are no particular lessons learned. The environmental issues were not originally anticipated by WM and lead to some significant delays in the project schedule.

## **Benefits**

WM remains committed to reducing emissions and creating cleaner solutions, such as the construction of alternative fuel natural gas fueling stations for use by its fleet. The Oceanside CNG station project directly meets the goals of the Assembly Bill 118 Alternative and Renewable Fuel and Vehicle Technology Program by demonstrating a measurable and significant transition from the use of petroleum to use of a low-emission alternative fuel. This project is curbing GHGs, reducing petroleum use, and improving air quality in California. The location of the site at 2141 Oceanside Blvd. has a CalEnviroScreen 2.0 score of 41-45 percent; a higher percentage indicates a higher burden for pollution and population characteristics such as exposure to diesel particulate matter and unemployment rates. The site falls in a census tract with a diesel particulate matter score in the 62<sup>nd</sup> percentile and traffic density score in the 88<sup>th</sup> percentile. The site does not fall within a designated disadvantaged community. There are no Disadvantaged communities in the immediate area, but the use of cleaner-burning CNG trucks will help mitigate diesel emissions and sustain high air quality for local residents.

# **CHAPTER 4:**

## **Conclusions**

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### **Conclusions**

The successful installation of this CNG station provides much needed fueling infrastructure to provide WM's fleet and other local fleets with natural gas. Natural gas is a clean, safe, abundant, and domestically produced fuel. Natural gas contains less carbon than any other fossil fuel and thus produces lower carbon dioxide and GHG emissions per year. In fact, natural gas vehicles produce 20-30 percent less than greenhouse gas emissions than comparable diesel vehicles. WM is quite familiar with the many benefits of natural gas, with the largest fleet of heavy-duty natural gas trucks in California and throughout North America. These benefits include new, more efficient, and quieter vehicles, and the potential for lower costs for CNG operators. WM is dedicated to doing business in the most sustainable way possible, as well as offering its customers more ways to live green via the air quality benefits of CNG.

### **Commercialization**

This project will provide the additional infrastructure needed to make alternative fuels like, natural gas, a commercially available and preferable fueling option. WM remains committed to reducing emissions and creating cleaner solutions, such as the construction of alternative fuel natural gas fueling stations for its fleet and others within the neighborhoods where WM's employees work and live.

# GLOSSARY

**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.

**COMPRESSED NATURAL GAS (CNG)**—Natural gas that has been compressed under high pressure, typically between 2,000 and 3,600 pounds per square inch, held in a container. The gas expands when released for use as a fuel.

**DIESEL GALLON EQUIVALENT (DGE)**—The amount of alternative fuel it takes to equal the energy content of one liquid gallon of diesel gasoline.

**GREENHOUSE GAS (GHG)**—Any gas that absorbs infrared radiation in the atmosphere. Greenhouse gases include water vapor, carbon dioxide (CO<sub>2</sub>), methane (CH<sub>4</sub>), nitrous oxide (NO<sub>x</sub>), halogenated fluorocarbons (HCFCs), ozone (O<sub>3</sub>), perfluorinated carbons (PFCs), and hydrofluorocarbons (HFCs).

**WASTE MANAGEMENT OF CALIFORNIA, INC. (WM)**— an American waste management, comprehensive waste, and environmental services company in North America. Founded in 1968, the company is headquartered in the First City Tower in Houston, Texas.