CALIFORNIA ENERGY COMMISSION

CALIFORNIA NATURAL RESOURCES AGENCY

Clean Transportation Program

FINAL PROJECT REPORT

Waste Management CNG Refueling Station Project

Public-Access CNG Fueling Station in Santa Maria, California

Prepared for: California Energy Commission

Prepared by: Waste Management

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California Energy Commission

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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 opportunities under the Clean Transportation Program for projects that 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 posted April, 2012 and the agreement was executed as ARV-12-009 on February 11, 2013.

ABSTRACT

Waste Management sought to develop a compressed natural gas fueling stations to support its existing and rapidly expanding private fleet of compressed natural gas-powered solid waste collection vehicles in the City of Santa Maria, as well as other local and regional goods movement fleets along the Highway 101 major transportation corridor. This critical infrastructure project provides solutions to overcome the significant refueling barrier that has hindered the development and widespread use of natural gas as a transportation fuel in the Santa Barbara region.

The project is located at 1850 W. Betteravia in Santa Maria, California, providing a convenient and affordable source of compressed natural gas fuel for the Waste Management fleet of heavy-duty refuse trucks that operate daily from this facility. The fueling station also provides a convenient source of fuel to other local goods movement and regional goods movement fleets that travel along the heavily trafficked Highway 101 transportation corridor that passes through the City of Santa Maria.

The goal of developing a compressed natural gas fueling station in the Santa Maria / Santa Barbara area near Highway 101 was to provide incentive for foods movement operators, municipal fleets, school districts, and water agencies to adopt or expand the use of their natural gas advanced technologies. Another goal was to enable the accelerated replacement of heavy-duty diesel trucks with clean-burning, ultra-low-emission natural gas trucks to stimulate the U.S. manufacturing base and economy and assist in the development of a more aggressive "green" automotive industry in the United States. A final goal of this project was to infuse further the Southern California regional natural gas refueling infrastructure with locally produced, ultra-low carbon compressed natural gas fuel.

Keywords: Energy Commission, compressed natural gas

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EXECUTIVE SUMMARY

Under this grant agreement, Waste Management developed 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 Santa Maria, as well as other local and regional goods movement fleets along the Highway 101 major transportation corridor. Waste Management now owns and operates a slow- and fast-fill compressed natural gas fueling station at its Health Sanitation Services Facility in Santa Barbara County. At this location, Waste Management supports and maintains a fleet of eleven residential and four commercial waste-hauling trucks that operate on natural gas and serve the City of Santa Maria and surrounding municipalities.

Waste Management's contractor, ET Environmental, was responsible for the construction of the compressed natural gas fueling station, which became operational in July 2013. Waste Management's objective in constructing this station is to provide the additional necessary infrastructure needed in order to make alternative fuels like natural gas a commercially available and preferable fueling option. Natural gas contains less carbon than any other fossil fuel, and thus produces lower carbon dioxide and greenhouse gas emissions per year. In fact, natural gas vehicles produce up to 20-30 percent fewer greenhouse gas emissions than comparable diesel vehicles. Natural gas is typically less expensive than diesel, costing less energy per unit. Waste Management is quite familiar with the many benefits of natural gas, and as such, it sought to provide these benefits to its own fleet and others in the development of this station.

CHAPTER 1:
Project Background and Objectives

Background

Waste Management (WM) sought to construct a public access compressed natural gas (CNG) station at its existing facility in Santa Maria to support its existing fleet of CNG refuse collection vehicles, as well as to support additional local and regional goods movement CNG vehicles along the major transportation corridor Highway 101. The station's location (shown in figure 1) is 1850 W. Betteravia in Santa Maria. WM plans to deploy 27 CNG waste collection vehicles by the end of 2015, yet at the time of project proposal, there was only one CNG station within a 25-mile radius of Santa Maria, and it was only privately accessible. There was a critical gap in fueling infrastructure and not enough convenient fueling to support WM's planned deployment of CNG vehicles. WM calculated that even without the number of local and regional vehicles that will use the station, WM would have enough private fueling volume to justify a full station.

Objectives

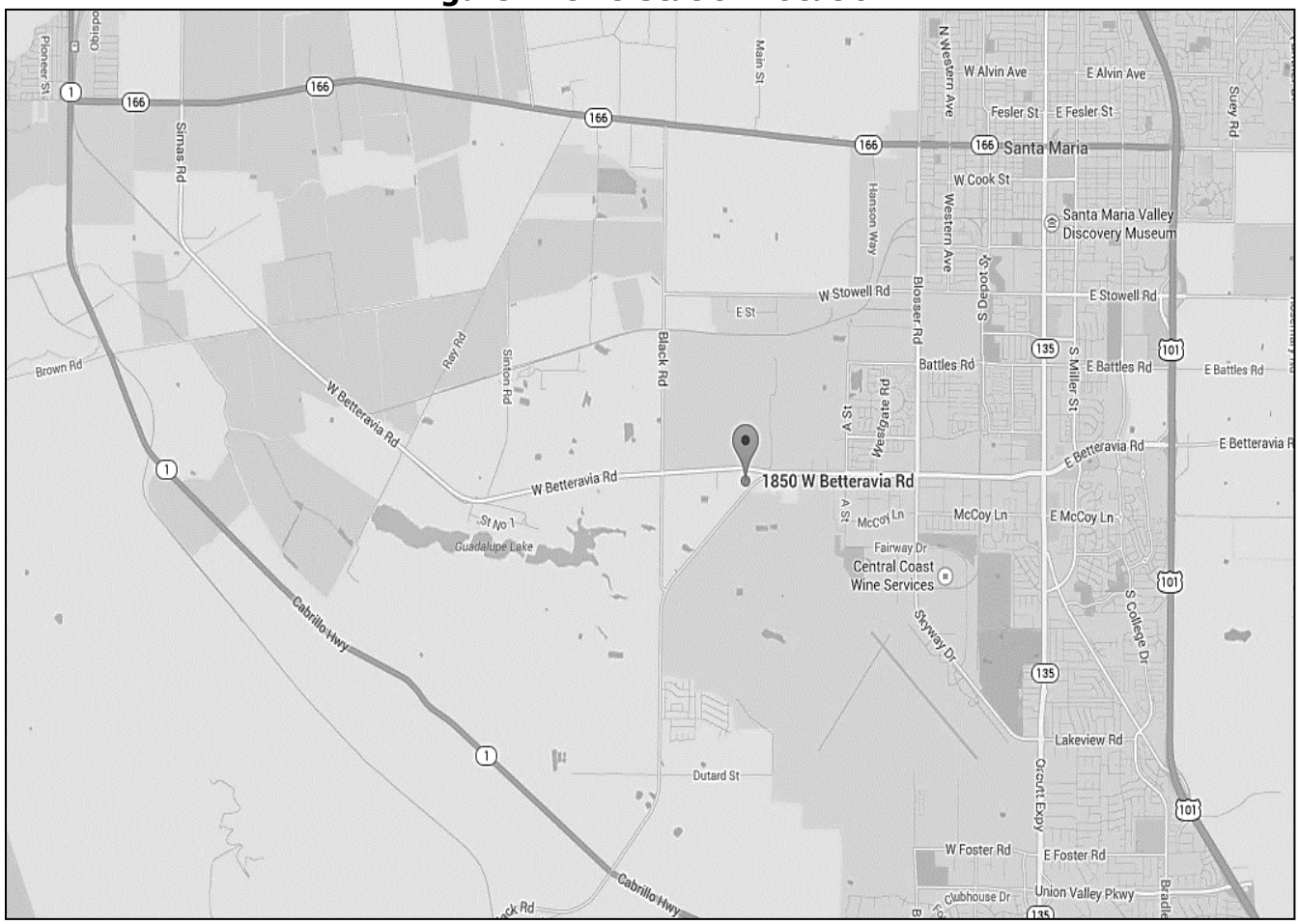
The objectives of developing the Santa Maria CNG station were to support fuel requirements of the existing and planned expansion of WM's CNG refuse collection and transfer trucks, in addition to other fleets in the region. Another objective of the project was to reduce greenhouse gas emissions from transportation activities in California.

Currently, WM's Santa Maria CNG station supports its fleet of eleven residential trucks and four commercial trucks, in addition to local, private fleets and retail customers. WM met the goals of this project with the development of a public access CNG fueling station by:

- Providing an incentive for goods movement operators, municipal fleets, school districts, and water agencies to adopt or expand the use of their natural gas advanced technologies;
- Providing for the annual displacement of thousands of gallons of diesel use with 100 percent domestically produced low-carbon natural gas;
- Serving as a model for other large-scale refuse collection companies or station operators on how to successfully implement advanced technology alternative fuel infrastructure programs in collaboration with state agencies;
- Promoting regional growth in alternative fuel vehicle deployments to stimulate the U.S. manufacturing economy and assist in the development of a more aggressive green automotive industry in the U.S.;
- Further infusing the Southern California regional natural gas refueling infrastructure with locally produced, ultra-low carbon CNG;
- Providing California with the ability to achieve its goals as outlined in the California Air Resources Board's Low Carbon Fuel Standard;
- Providing a clean, reliable, cost-efficient and domestically produced source of fuel for transportation and encourage market development for natural gas vehicles; and

- Creating and strengthening the necessary infrastructure of CNG fueling stations across the region and state, thereby supporting a region-wide transition opportunity for heavy-duty fleets interested in alternative fuels.

Figure 1: CNG Station Location



Source: Waste Management

CHAPTER 2:
Scope of Work

WM's scope of work under contract ARV-10-09 included the installation, operation, and reporting of the CNG fueling station. WM was responsible for constructing the CNG fueling station with new equipment:

- Portable Solution Trailer with Two Fast-fill Priority Hoses and Eight Time-Fill Posts
- 151 Horsepower Compressor
- Enclosure
- PLC Panel
- Buffer Storage
- Gas Dryer
- 20 CNG Stalls

Figure 2 is a photograph of the portable solution GNG trailer on site and figure 3 is of vehicle connected to the CNG delivery line located at one of the 20 fueling stalls. All equipment meets all American Petroleum Institute, American Society of Mechanical Engineers, International Society of Automation, American Gas Association, National Electric Code, and National Fire Protection Association requirements. The station also included the installation of utility tie-ins, start-up, debugging, and stabilizing the refueling station, along with design, engineering, permitting, project management, and purchasing. WM's work included fire protection, fire detection, methane detection, and all necessary safety elements identified with hazardous operations process safety.

Technical Tasks

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

Task 2: 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.

Task 3: Site Work and Civil Improvements

WM performed construction activities at the site in accordance with the design specifications to prepare for the arrival of the equipment. WM oversaw and managed site construction and electrical, mechanical, and civil improvements.

Task 4: CNG Equipment Procurement and Installation

WM ordered, took delivery of, and installed all necessary equipment and supplies at the side. The installation of equipment, controls, and support infrastructure were completed in accordance with the system design specifications. This work included installation of

underground and aboveground piping and conduits to transport gas on site to the plant and to provide necessary utilities and communication lines to the equipment locations. Finally, WM performed the start-up activities for the site.

Task 5: Station Start-Up and Commissioning

WM performed start-up of the system and equipment on-site and commissioned the system into operation.

Task 6: Data Collection and Analysis

WM collected, and continues to collect, operational data from the station. WM analyzes this data for the economic and environmental benefits of the project, such as station throughput and associated project emission benefits.

Annual Fuel Throughput

Approximately 15 WM units, in addition to other local private fleets, currently utilize the Santa Maria CNG station. The station has been operational since July 2013. The estimated annual fuel usage over the reporting period, July 1, 2013 – April 30, 2014, was approximately 175,000 diesel gallon equivalents (DGE). On average, monthly throughput (table 1) is approximately 14,500 DGE.

Emission Reductions

Based on the average throughput of approximately 175,000 DGE per year, WM is responsible for the emission reduction benefits due to the publicly accessible Santa Maria CNG station. Using the Carl Moyer Program Guidelines[1] (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 criteria pollutant reduction benefits presented in table 2 by using natural gas vehicles instead of diesel.

As a result of the Santa Maria CNG station, WM is able to achieve the reduction of more than 13 tons per year of nitrogen oxides (NOx), and 0.28 tons per year of particulate matter (PM). Additionally, the project will contribute to the reduction of 632 tonnes of greenhouse gas (GHG) emissions per year. GHGs were calculated according to fuel consumption, using emission factors from the low carbon fuel standard carbon intensity lookup table for gasoline and fuels that substitute for gasoline[2].

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[1] California Environmental Protection Agency, Air Resources Board, "Carl Moyer Program Guidelines" June 2011

https://ww2.arb.ca.gov/sites/default/files/classic/msprog/moyer/guidelines/2011/2011cmp_guidelinesVER4.pdf

[2] California Environmental Protection Agency, Air Resources Board, "Carbon Intensity Lookup Table for Gasoline and Fuels that Substitute for Gasoline" December 2012

https://ww2.arb.ca.gov/sites/default/files/classic/fuels/lcfs/ca-greet/lut.pdf

Figure 2: Portable Solution CNG Trailer

Source: Waste Management

Figure 3: CNG Filling Stall

Source: Waste Management

Table 1: Santa Maria CNG Station Fuel Throughput

	Retail GGEs*	Private Access GGEs	Total Site Throughput GGE (CFF/1.21)	Total Site Throughput DGE
July '13	0.00	2,859.5	2,859.5	3,261.1
August '13	0.00	8,139.7	8,139.7	9,282.7
September '13	0.00	8,749.6	8,749.6	9,978.3
October '13	2.31	12,234.9	12,237.2	13,955.7
November '13	9.42	12,274.1	12,283.5	14,008.4
December '13	72.56	13,083.6	13,156.2	15,003.7
January '14	316.68	13,132.9	13,449.6	15,338.3
February '14	640.58	11,495.0	12,135.5	13,839.7
March '14	642.24	12,247.8	12,890.1	14,700.2
April '14	595.33	12,593.9	13,189.3	15,041.4
Total Throughput for Reporting Period	2,279.1	106,811.0	109,090.1	124,409.5
Monthly Average (Nov. '13 - Apr. '14)	379.47	12,471.22	12,850.69	14,655.30
Estimated Annual Throughput	4,553.61	149,654.66	154,208.26	175,863.63

*** Gasoline Gallon Equivalent (GGE)**

Source: Waste Management

Table 2: Emission Reduction Calculation

Criteria Pollutant Emission Reduction Calculation	**NOx**	**PM**
Baseline Emission Factor (g/mi) 2006 Diesel	11.63	0.252
Baseline Emission Factor (g/mi) 2006 Diesel, w/o PM 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
Annual Fuel Consumption	175,864	175,864
Percent in Operation in CA (1.0 = 100%)	1.0	1.0
(ton/907,200 g)	0.00000110229277	0.00000110229277
Projected Baseline Emissions (tons/year)	14.38	0.312
Projected Reduced Emissions (tons/year)	0.57	0.036
Annual Emission Reductions (tons/year)	**13.81**	**0.276**
Emission Weighting for Cost Effectiveness Calculations	**1.00**	**20.00**
Weighted Emission Reductions	**13.81**	**5.52**

Source: Waste Management

CHAPTER 3:
Results

Results

WM has completed installation of a portable solution CNG trailer at its existing Health Sanitation Services Facility in Santa Maria. The station is open and currently operational, fueling WM's fleet of regional CNG waste collection vehicles and other local retail customers. The station development was completed according to plan and with no major issues.

Problems

No significant problems were encountered during the construction of the project.

Lessons Learned

WM originally projected that 245,700 gallons of diesel fuel would be displaced annually by this project by 2015. The estimated Year One throughput to date is 175, 964 DGE. WM's fleet size has grown somewhat more slowly than originally anticipated; that being said, WM anticipates that it will use these vehicles well beyond the March 2015 contract requirement, contributing to significant petroleum displacement and corresponding emission reductions for years to come.

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 Santa Maria CNG station project directly meets the goals of the AB 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.

CHAPTER 4:
Conclusions

Led by a prepared and seasoned team with a vast understanding of the technology, this project greatly assists the Energy Commission to displace petroleum with clean-burning natural gas and reduce GHG emissions from WM's existing fleet. 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. 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 necessary 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 that 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.

GASOLINE GALLON EQUIVALENT (GGE)—The amount of alternative fuel it takes to equal the energy content of one liquid gallon of gasoline. GGE allows consumers to compare the energy content of competing fuels against a commonly known fuel—gasoline. GGE also compares gasoline to fuels sold as a gas (natural gas, propane, and hydrogen) and electricity.

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).

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.

WASTE MANAGEMENT (WM)—An American waste management, comprehensive waste, and environmental services company.[3]

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[3] Waste Management Webpage https://www.wm.com/us/en/inside-wm/who-we-are