



**CALIFORNIA
ENERGY COMMISSION**



**CALIFORNIA
NATURAL
RESOURCES
AGENCY**

Clean Transportation Program

FINAL PROJECT REPORT

Waste Management LNG/CNG Upgrade Project

**Upgrades to LNG/CNG Station in Corona,
California**

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Prepared by: Waste Management

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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-09-006 to provide funding opportunities under the Clean Transportation Program for projects that develop infrastructure necessary to store, distribute, and dispense electricity, E-85, Biomass-based diesel, and natural gas. In response to PON-09-006, the recipient submitted an application which was proposed for funding in the CEC's notice of proposed awards June 20, 2011 and the agreement was executed as ARV-10-050 on September 29, 2011.

ABSTRACT

An important aspect of natural gas vehicle deployment in California is the lack of supporting infrastructure. There is limited access to natural gas infrastructure between the Ports of Long Beach and Los Angeles and the warehousing facilities in the Inland Empire. This enormous barrier deters the adoption or expansion of natural gas advanced technologies by the many goods movement fleets that haul cargo along this heavily traveled Southern California route every day. As a result, Waste Management sought to successfully upgrade its existing limited public access Corona liquefied natural gas facility located near the intersection of I-15 and CA-91 to accommodate additional liquefied natural gas storage and to add compressed natural gas fueling.

The goal of the upgrades was to provide incentive for heavy-duty trucking fleets to adopt or expand use of natural gas advanced technologies; enable the accelerated replacement of heavy-duty diesel trucks with ultra-low-emission natural gas; further infuse the Southern California regional natural gas refueling infrastructure with locally produced, low-carbon liquefied to compressed natural gas; and create and strengthen the necessary web of liquefied natural gas/compressed natural gas infrastructure across the region and state. Waste Management's liquefied to compressed natural gas upgrade project supports a region-wide transition opportunity for heavy-duty fleets interested in alternative fuels, as well as allows for the reduction of diesel consumption and vehicle emissions in California.

Keywords: compressed natural gas, liquefied natural gas, liquefied to compressed natural gas

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EXECUTIVE SUMMARY

Under this grant agreement, Waste Management upgraded its liquefied natural gas station in the City of Corona in Riverside County. The upgrades allowed the site to provide compressed natural gas from liquefied natural gas. The compressed natural gas will be produced in addition to liquefied natural gas by adding storage tanks, vaporizers, and dispensers to provide compressed natural gas dispensing capabilities in addition to the current liquefied natural gas dispensing.

Waste Management operates more than 430 natural gas vehicles in Los Angeles County alone, and thus experienced a strong need for the infrastructure to fuel its vehicles. Waste Management's contractor, NorthStar, Inc., was responsible for the construction of the liquefied to compressed natural gas fueling facility upgrade, which became operational on October 1, 2011.

Waste Management's objective in constructing this station is to provide the additional necessary infrastructure needed 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. WM can achieve the reduction of more than 58 tons per year of nitrogen oxides, and 1.1 tons per year of particulate matter annually. 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 upgrade of this station. This project is also beneficial to those vehicles subject to the South Coast Air Quality Management District's Rule 1193, which requires public and private solid waste collection fleets having exclusive contracts with public entities and greater than 15 trucks to purchase or replace existing vehicles with alternative fuels.

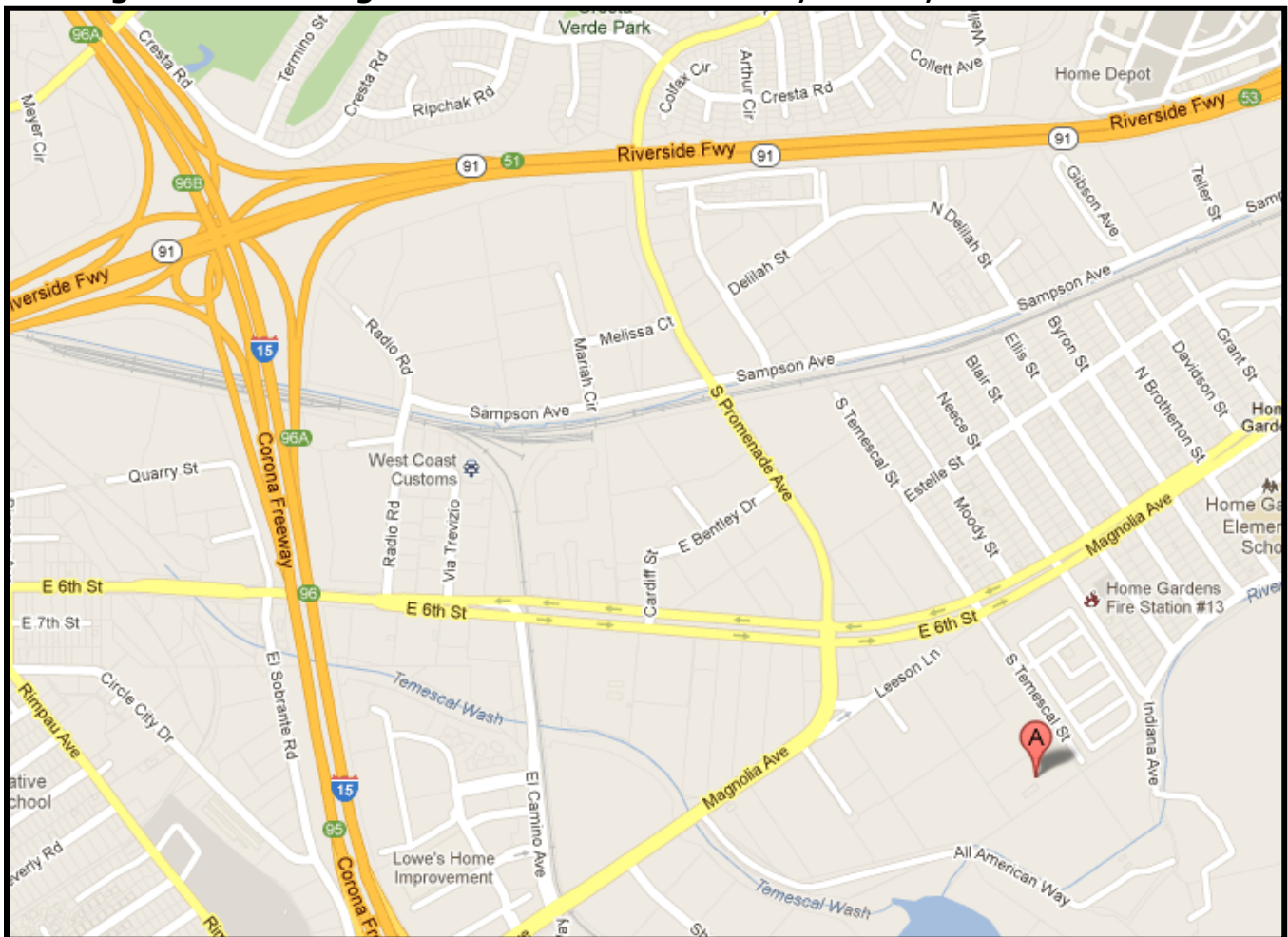
The successful installation of this fueling station will provide the necessary infrastructure to fuel natural gas vehicles operated by Waste Management. Natural gas is a clean, safe, and abundant fuel that is domestically produced, with 99 percent used in the United States coming from North America.

CHAPTER 1: Project Background and Objectives

Waste Management (WM) owns and maintains a facility for refuse collection vehicles in the city of Corona and has operated a liquefied natural gas (LNG) refueling station at the site since 2001. The facility is in the South Coast Air Basin, a non-attainment area for ozone and particulate matter pollutants and is located at the center of one of the region’s most heavily traveled highway and truck corridors, near the intersection of I-15 and CA-91. The station provides convenient LNG fueling for WM’s growing onsite fleet of approximately 95 vehicles. Figure 1 shows the address of the station, which is located at 800 S. Temescal Street, Corona, California 92879

Site Location

Figure 1: Refueling station: 800 S Temescal St., Corona, California 92879



Source: Waste Management via Online Google Maps

WM is actively pursuing the purchase of additional heavy-duty natural gas solid waste collection vehicles and became interested in expanding the station to provide greater LNG to

compressed natural gas (CNG) refueling capacity to accommodate CNG powered vehicles. The objective of this project was to reduce emissions from heavy-duty refuse collection vehicles by installing additional infrastructure to fuel extremely low-emission natural gas vehicles by increasing the LNG capacity and adding CNG fueling capability at the Corona station.

WM met the goals of this project with the installation of its Corona liquefied to compressed natural gas station upgrades 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.
- Enabling 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.
- Further infusing the Southern California regional natural gas refueling infrastructure with locally produced, ultra-low carbon liquefied to compressed natural gas fuel.
- 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.
- Creating and strengthening the necessary infrastructure of LNG/CNG fueling stations across the region and state, thereby supporting a region-wide transition opportunity for heavy-duty fleets interested in alternative fuels.

CHAPTER 2:

Scope of Work

WM's scope of work under contract ARV-10-050 included the installation, operation, and reporting of this upgraded liquefied to compressed natural gas refueling station. WM was responsible for constructing the liquefied to compressed natural gas refueling station with new equipment:

- Two liquefied to compressed natural gas station pump skids
- Odorant injection system
- Two 2-hose high-flow transit dispensers
- 16,300 LNG storage tank
- Four 40,000 standard cubic foot CNG storage vessels
- PCL control system
- Two high pressure heat exchangers
- Safety system
- 50 standard cubic foot per minute vapor compressor
- LNG boost pump
- Card-reader

All equipment meets all applicable 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 liquefied to compressed natural gas station upgrades in an orderly and efficient manner. WM completed the below technical tasks under this project:

Task 2: Finalize Specifications and Order LNG/CNG Station Equipment

WM finalized the station specifications, including electrical, plumbing, foundation, trenching, drainage, and signage. WM also ordered the LNG/CNG equipment for the station, including placing the order for all equipment and parts.

Task 3: Site Work, Equipment Placement, and Quality Insurance

WM performed construction activities at the site in preparation for the arrival of the equipment. WM also took delivery of all necessary equipment and supplies at the site.

Task 4: System Start-Up and Commissioning into Service

WM performed the start-up activities for the site, including the final commissioning of the site into service.

Task 5: Data Collection and Reporting

WM continues to collect and analyze data on the economic benefits and local impacts of the project, including the station throughput and associated project emission benefits.

Photographs

Figures 2 and 3 show the CNG Fueling Stations and its storage spheres and vaporizers.

Figure 2: Front View of Station Showing CNG Fueling Island



Source: Waste Management

Figure 3: Side View of Station Showing CNG Storage Spheres and Vaporizers



Source: Waste Management

Annual Fuel Throughput

Approximately 95 WM vehicles currently utilize the Corona liquefied to compressed natural gas station. The station has been operational since October 2011. Annual fuel usage from October 1, 2011 to October 1, 2012 was approximately 1,296,000 LNG gallons, or 748,000 diesel gallon equivalents. On average, as seen in Table 1, the monthly throughput is approximately 108,000 LNG gallons or 62,000 diesel gallon equivalents.

Table 1: Annual Fuel Throughput

	LNG Gallons	Diesel Gallon Equivalents
Monthly Average	108,000	62,000
Annual Average	1,296,000	748,000

Source: Waste Management

Emission Reductions

Based on the average throughput of approximately 1,300,000 gallons of LNG per year, or 748,000 diesel gallon equivalent per year, WM is responsible for the reduction of a high level of emission reduction benefits due to the Corona liquefied to compressed natural gas station

upgrades. Using the Carl Moyer Program Guidelines¹ (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 by using natural gas vehicles instead of diesel, which can be seen in Table 2.

Table 2: Emission Reduction Calculation

Criteria Pollutant Emission Reduction Calculation	Nitrogen Oxides	Particulate Matter
Baseline Emission Factor (gram/mile) 2006 Diesel	11.63	0.252
Reduced Emission Factor brake horse power- hour (gram/brake horse power- hour)	0.16	0.01
Conversion Factor (brake horse power- hour /mile)	2.90	2.90
Energy Consumption Factor gallon (brake horse power- hour /gallon)	18.50	18.50
Annual Fuel Consumption	747,577	747,577
Percent in Operation in California (1.0 = 100%)	1.0	1.0
(ton/907,200 gram)	0.00000110229277	0.00000110229277
Projected Baseline Emissions (tons/year)	61.14	1.325
Projected Reduced Emissions (tons/year)	2.44	0.152
Annual Emission Reductions (tons/year)	58.70	1.172

Source: Waste Management

As a result of the Corona liquefied to compressed natural gas station upgrade project, WM can achieve the reduction of more than 58 tons per year of nitrogen oxides, and 1.1 tons per year of particulate matter annually. Additionally, the project will contribute to the reduction of 2,245 tons of greenhouse gas emissions per year. Greenhouse gases were calculated according to fuel consumption, using emission factors from the Low Carbon Fuel Standard. For more information research can be done on the California Environmental Protection Agency's Air Resource Board Report *Carbon Intensity Lookup Table for Gasoline and Fuels that Substitute for Gasoline*².

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

² [California Environmental Protection Agency, Air Resources Board, "Carbon Intensity Lookup Table for Gasoline and Fuels that Substitute for Gasoline" December 2012](http://www.arb.ca.gov/fuels/lcfs/lu_tables_11282012.pdf)
(http://www.arb.ca.gov/fuels/lcfs/lu_tables_11282012.pdf)

CHAPTER 3:

Results

Results

WM has completed installation of an additional LNG storage vessel and a vaporizer to produce CNG. The station is open and currently operational, fueling WM's large fleet of regional LNG and CNG solid waste collection trucks. The modifications were completed according to plan and with no major issues.

Problems

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

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 Corona liquefied to compressed natural gas station upgrade project directly meets the goals of the AB 118 Clean Transportation 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 greenhouse gases, 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 CEC to displace petroleum with clean-burning natural gas and reduce greenhouse gas emissions from WM's existing fleet. The successful installation of this storage tank provides increased fueling capacity to fuel natural gas vehicles operated by WM. Natural gas is a clean, safe, and abundant fuel that is domestically produced, with 99 percent used in the United States coming from North America. 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 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 LNG and 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 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 Energy Commission's five major areas of responsibilities are:

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

Funding for the Commission'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.

LIQUEFIED NATURAL GAS (LNG) – Natural gas that has been condensed to a liquid, typically by cryogenically cooling the gas to minus 260 degrees Fahrenheit (below zero).

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

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