



**CALIFORNIA
ENERGY COMMISSION**



**CALIFORNIA
NATURAL
RESOURCES
AGENCY**

Clean Transportation Program

FINAL PROJECT REPORT

Waste Management Natural Gas Fueling Station

**Upgrades to Liquefied Natural Gas/Liquefied
Compressed Natural Gas Station in Baldwin
Park, California**

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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 10, 2011 and the agreement was executed as ARV-10-054 on June 20, 2012.

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 Baldwin Park liquefied natural gas facility located near the intersection of I-210, I-10, and I-605 to accommodate additional liquefied natural gas storage, and to add new liquefied to 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 compressed natural gas, and create and strengthen the necessary web of liquefied natural gas / liquefied compressed natural gas infrastructure across the region and state. Waste Management's liquefied natural gas/liquefied 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 Baldwin Park in Los Angeles County. The upgrades allowed the site to provide additional liquefied natural gas and compressed natural gas from liquefied natural gas (liquefied compressed 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.

WM operates more than 1,060 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 compressed natural gas fueling facility upgrade, which became operational in May 2012.

WM'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 (CO₂) and greenhouse gas (GHG) 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 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, Objectives, and Executive Summary

Project Background and Objectives

Waste Management (WM) owns and maintains a facility for refuse collection vehicles in the city of Baldwin Park and has operated a liquefied natural gas (LNG) refueling station at the site since 2003. The address of the station is 13940 Live Oak Avenue, Baldwin Park, CA 91706. 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 interstates 210, 10, and 605. The station provides convenient LNG fueling for WM's 75 heavy-duty natural gas solid waste collection trucks.

WM is currently pursuing an aggressive nationwide transition to natural gas fueling. As WM transitioned to natural gas vehicles, it became interested in expanding the station to provide greater LNG refueling capacity, and to accommodate compressed natural gas (CNG) powered vehicles. The objectives of this project were to reduce emissions from heavy-duty refuse collection vehicles by installing additional infrastructure to fuel extremely low emission natural gas vehicles and make LNG/CNG a commercially viable fueling option for local fleets. Commercial fleet drivers and owners of CNG-equipped vehicles can benefit from additional capacity at Waste Management's existing station.

WM met the goals of this project with the installation of its Baldwin Park LNG/CNG 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 CNG 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; and
- Creating and strengthening the necessary infrastructure of LNG and 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 South Coast Air Quality Management District contract #12854 (funded by CEC under #ARV-10-054) included the installation, operation, and reporting of this upgraded liquefied compressed natural gas (LCNG) refueling station. WM was responsible for constructing the LCNG refueling station with new equipment:

- One 16,300 LNG storage tank
- Two LCNG Pump Skids
- Odorant Injection System
- Two 2-hose high-flow transit dispensers
- Four CNG storage spheres
- Two high pressure vaporizers
- 50 standard cubic feet per minute Vapor compressors
- Safety system

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 LCNG upgrades in an orderly and efficient manner. WM completed the below technical tasks under this project:

Task 1: Station Construction

WM finalized the installation of the proposed equipment: LNG storage vessel, compressors, pumps, dispenser, and vaporizer. WM managed the installation and implementation of all equipment by all subcontractors. Additionally, WM successfully attained all required permits as stated in the contract.

Task 2: Station Commissioning

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

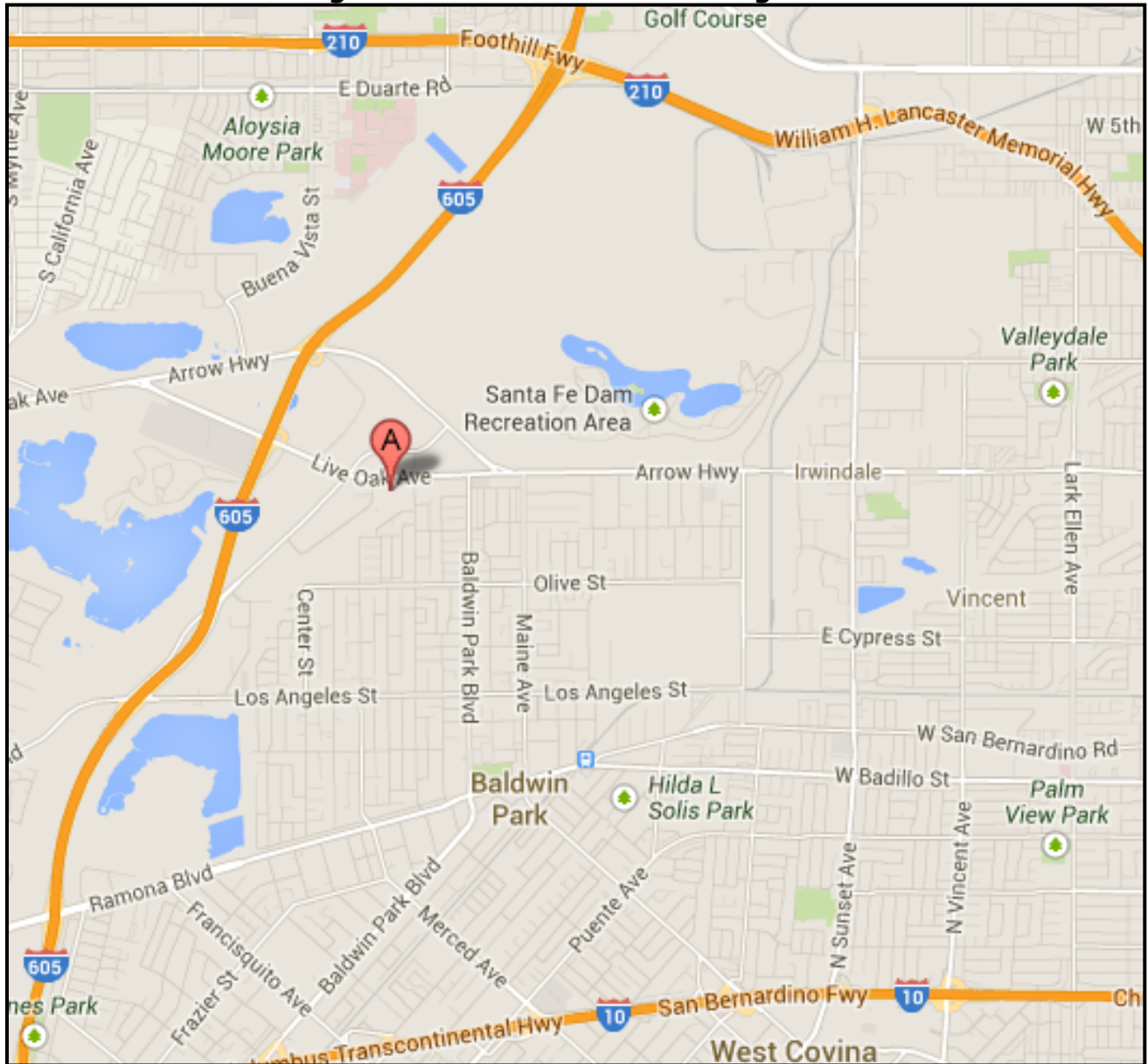
Task 3: Station Operation and Maintenance

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.

Site Location

Figure 1 below shows the location of the LNG fueling station located at 13940 Live Oak Ave, Baldwin Park, CA 91706.

Figure 1: Location of LNG Fueling Station



Source: Google Maps

Photographs

Figure 2 shows the side view of the upgrades to the LNG fueling station, two storage tanks and two high pressure vaporizers.

Figure 2: Side View of Storage Tanks and Vaporizers



Source: Waste Management

Annual Fuel Throughput

The Baldwin Park LCNG station became operational in May 2012. The station provides fueling to WM's fleet of 1,063 natural gas trucks in Southern California. Approximately 75 natural gas trucks utilize the Baldwin Park LCNG station as of July 2014. Specifically, the fleet is comprised of 23 LNG trucks and 52 CNG units. Previously, in 2011 before the upgrades, only 53 LNG vehicles were able to utilize the facility. Table 1 shows the amount of natural gas used by the WM fleet in volume.

Table 1: Fuel Utilized from May 2011 to June 2014

WM Fuel Use by Month - Baldwin Park (WM Vehicles Only)		
Month	LNG Gallons	CNG (DGE)
May-11	48,009	0
Jun-11	63,300	0
Jul-11	55,689	0
Aug-11	58,103	0
Sep-11	55,766	0
Oct-11	53,673	0
Nov-11	55,939	0
Dec-11	66,093	0
Jan-12	58,964	0
Feb-12	57,183	0
Mar-12	38,353	14,074
Apr-12	10,562	12,475
May-12	29,876	40,451
Jun-12	22,043	29,642
Jul-12	20,817	25,251
Aug-12	25,803	30,285
Sep-12	25,890	29,193
Oct-12	25,612	29,741
Nov-12	21,519	25,937
Dec-12	20,538	27,174
Jan-13	23,346	27,395
Feb-13	21,975	24,902
Mar-13	22,242	28,059
Apr-13	22,563	26,698
May-13	23,268	27,851
Jun-13	22,512	28,000
Jul-13	23,468	27,483
Aug-13	23,763	29,683
Sep-13	21,255	25,777
Oct-13	20,568	26,273
Nov-13	18,256	23,391
Dec-13	19,922	25,408
Jan-14	19,327	28,982
Feb-14	17,023	25,638
Mar-14	17,751	28,154
Apr-14	19,770	29,066
May-14	19,638	32,179
Jun-14	6,886	11,915
TOTAL	1,177,265	741,077

Source: Waste Management

As of June 2014, the average monthly fuel usage for the Baldwin Park LCNG station was approximately 30,981 LNG gallons and 26,467 diesel gallon equivalents of CNG. Table 2 below demonstrates fuel use by year, as well as the monthly averages. The average annual fuel use from 2012-2013 (the two full years during which the upgraded station has been operational) was approximately 310,149 LNG gallons and 292,572 diesel gallon equivalents of CNG.

Table 2: Fuel Throughput May 1, 2011 through June 15, 2014

WM Fuel Use by Year - Baldwin Park (WM Vehicles Only)		
Year	LNG Gallons	CNG (DGE)
2011 Total	456,572	0
2012 Total	357,160	264,223
2013 Total	263,138	320,920
2014 Total	100,395	155,934
Monthly Average	30,981	26,467

Source: Waste Management

In addition to WM’s own fuel use, WM has opened the Baldwin Park station to additional third-party fleets to help allow natural gas to become a commercially available fuel. There are several additional fleets currently using the LCNG station. These fleets include Southland Transit, Baldwin Park Unified School District, Allen Company, and Athens Disposal, and WM is open to additional third-party fleets who may be interested in using the station.

Emission Reductions

Based on the average throughput of approximately 310,149 LNG gallons and 292,572 diesel gallon equivalents of CNG, WM is responsible for a high level of emission reduction benefits due to the Baldwin Park LCNG 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 following criteria pollutant reduction benefits by using natural gas vehicles instead of diesel as shown in Table 3:

Table 3: Emission Reduction Calculation

Criteria Pollutant Emission Reduction Calculation	NOx	PM
Baseline Emission Factor (g/mi) 2006 Diesel	36.55	0.73

Source: Waste Management

As a result of the Baldwin Park LCNG station upgrade project, WM can achieve the reduction of more than 36 tons per year of nitrogen oxides (NOx), and 0.73 tons per year of particulate matter (PM) annually.

¹ California Environmental Protection Agency, Air Resources Board, June 2011 [Carl Moyer Program Guidelines](https://ww2.arb.ca.gov/sites/default/files/classic/msprog/moyer/guidelines/2011/2011cmp_guidelinesVER4.pdf)
https://ww2.arb.ca.gov/sites/default/files/classic/msprog/moyer/guidelines/2011/2011cmp_guidelinesVER4.pdf

CHAPTER 3:

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 LCNG solid waste collection trucks. Additionally, the station offers limited public access for other public and private fleets. 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

The Baldwin Park LNG/LCNG Infrastructure Expansion Project will provide solutions to the development and widespread use of natural gas as a transportation fuel. Public and private fleets will be encouraged to switch to natural gas as additional infrastructure is available due to both the environmental and cost-saving benefits.

Additionally, the Baldwin Park LCNG 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 GHGs, reducing petroleum use, and improving air quality in California. 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.

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 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 CO₂ 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 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 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 Energy Commission'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.

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.

CARBON DIOXIDE (CO₂)—A colorless, odorless, nonpoisonous gas that is a normal part of the air. Carbon dioxide is exhaled by humans and animals and is absorbed by green growing things and by the sea. CO₂ is the greenhouse gas whose concentration is being most affected directly by human activities. CO₂ also serves as the reference to compare all other greenhouse gases (see carbon dioxide equivalent).

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

LIQUID COMPRESSED NATURAL GAS (LCNG)—The volume of liquefied compressed natural gas is only around 1/600th of the volume of gaseous natural gas. This results in significant advantages where gas transportation is concerned in particular. Following liquefaction and transportation, the liquefied natural gas (LNG) is regasified (converted into CNG) with subsequent forwarding to grid gas companies via pipelines.

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.