



**CALIFORNIA
ENERGY COMMISSION**



California Energy Commission
Clean Transportation Program

FINAL PROJECT REPORT

Replacement and Upgrade of Existing CNG Fueling Station

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Prepared by: Upland Unified School District

Gavin Newsom, Governor

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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 Clean Transportation Program for projects to support installation of new natural gas fueling infrastructure and upgrades to existing natural gas fueling 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 February 25, 2014 and the agreement was executed as ARV-12-037 on May 5, 2014.

ABSTRACT

California Energy Commission's Alternative and Renewable Fuel and Vehicle Technology Program awarded the Upland Unified School District \$278,889 to replace and upgrade its compressed natural gas fueling system. This final project report documents the planning, budget, specifications, and initial throughput for the upgraded fueling station.

Keywords: California Energy Commission, Upland Unified School District, Clean Transportation Program, natural gas fueling station, compressed natural gas.

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EXECUTIVE SUMMARY

The Upland Unified School District, in an effort to support California air quality and climate change goals, has committed to converting its fleet of school buses and other vehicles to those using compressed natural gas. The district purchased its original compressed natural gas fueling infrastructure in 2005; however, due to frequent system failures it was determined that the equipment had since reached the end of the serviceable life. The district applied for and was awarded a \$278,889.00 grant from the California Energy Commission's Clean Transportation Program to replace the existing, out-of-date fueling equipment with new, state-of-the-art infrastructure to increase station reliability and throughput.

The new infrastructure includes a compressed natural gas dryer to remove water from the natural gas before it is compressed, two compressors to compress the natural gas, a valve panel time-fill control to determine the priority and sequence of flow of compressed natural gas from the compressor to the dispensers, a fast-fill dispenser to rapidly fill a vehicle, and five time-fill dispensers to slowly fill vehicles that are not going to be used for several hours. These improvements allow the district to fuel vehicles at a rate of 75 cubic feet per minute.

Furthermore, the district estimates that the new equipment will displace nearly 27,500 gallons of diesel per year, reducing carbon dioxide (CO₂) emissions by nearly 170,000 pounds, oxides of nitrogen (NO_x) by nearly 35,600 pounds, and particulate matter (PM₁₀ and PM_{2.5}) by nearly 24,300 pounds.

CHAPTER 1:

Problem Statement

The Inland Empire region of Southern California has such poor air quality that it consistently ranks in the top five in nationwide “most polluted” studies. The Upland Unified School District (district) in Upland, California, is at the western end of San Bernardino County and has worked aggressively to reduce air pollution in the Inland Empire by replacing diesel-powered buses with those that are powered by compressed natural gas (CNG). The district has 9 CNG-powered buses and 15 diesel-powered buses. The existing compressor and associated fueling equipment are 10 years old and need replacement due to constant use and age. District officials determined that the equipment was economically beyond repair. The constant failure of the compressors over the years had a negative impact on the district’s transportation program and the increasing demand for clean fuel and improved air quality was quickly outstripping the district’s ability to meet that demand. The California Energy Commission grant was necessary to continue providing CNG for the district’s transportation fleet.

Goal of the Agreement

This project sought to replace the existing, out-of-date CNG infrastructure with new, state-of-the-art equipment and expand the plumbing of the gas lines so that the station will be able to provide reliable CNG that can meet existing fueling needs of the district and meet the possible future fleet expansion fueling needs. The district currently has nine CNG buses and intends to increase the CNG fleet to 15 buses. The increase in CNG-powered vehicles will continue to reduce greenhouse gas emissions and decrease diesel particulate matter emissions beyond what the district has already accomplished with its nine CNG buses.

CHAPTER 2:

Project Planning, Approach, and Process

The district, in compliance with Government Code Section 4217.12 that details a public agency's means to fulfill energy needs, developed specifications for the project, created the bid proposal, conducted inspections, and provided technical expertise in CNG and CNG facilities. The district formally announced that it would start accepting bids on January 13, 2015, for contractors to partner with the district in its proposal for the Energy Commission's Clean Transportation Program funding solicitation PON-11-602 ("Compressed Natural Gas Fueling Infrastructure"). The bid was for the procurement and installation of new CNG infrastructure and was awarded to Allsup Corporation of Upland, California.

The project started June 15, 2015, with the replacement of the old compressor equipment with a new compressor. Once the compressor was stationed, installation of new wiring and piping began immediately. Re-piping, electrical wiring, and startup were completed on June 22, 2015, with minor adjustments needed once the equipment ran.

New Fueling Infrastructure

The district left in place its current CNG storage tank. It did not need replacing and has a capacity of 36,000 cubic feet at 14,500 psi. The new equipment selected was a duplex compressor unit manufactured by ANGI (Figure 1). It has two 50-horsepower compressors (model NG50E) that are capable of producing 75 standard cubic feet per minute, a Xebec desiccant-style low pressure CNG dryer, an ANGI time-fill control panel with remote communication, and two Tulsa Gas Technologies dual-hose post time-fill dispensers (Figure 2). The new equipment can fill the district's fleet of nine CNG buses in six hours and will be able to continue that performance when the district makes its planned future purchase of six more CNG-powered buses, bringing the total to 15 CNG buses. The new gas dryer (Figure 3) and the new compressors are also more energy efficient. Those pieces of equipment saved the district nearly \$2,863.00 in electricity and natural gas costs over the six-month period of data collection when compared to the six months prior to the installation of the new equipment. The new Bauer priority panel (Figure 4) is rated for a higher psi; therefore, it is able to handle the increased capacity of the new compressor.

The new fast-fill dispenser was delivered August 7, 2015. Installation began August 12, 2015, and was completed August 14, 2015. On September 3, 2015, subcontractor Fuel Solutions began inspecting the new CNG fueling infrastructure and, after Allsup addressed the required corrections, signed off on project completion on December 8, 2015.

Figure 1: New Compressors



Photo Credit: Upland Unified School District

Figure 2: New Fast Fill Dispenser

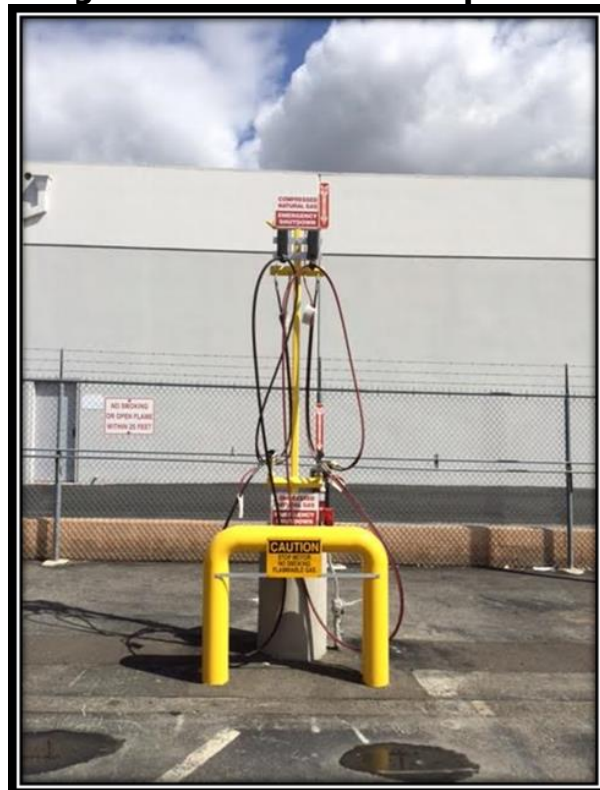


Photo Credit: Upland Unified School District

Figure 3: New Gas Dryer



Photo Credit: Upland Unified School District

Figure 4: New Priority Panel

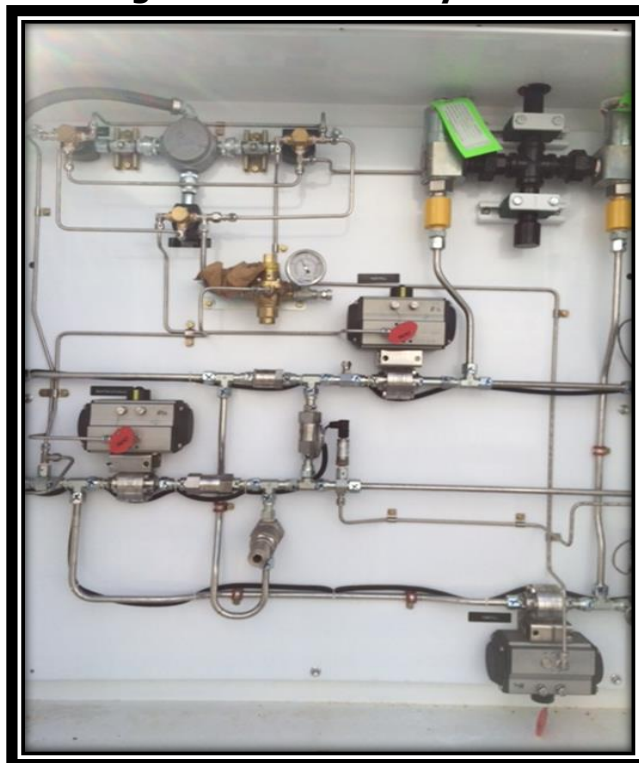


Photo Credit: Upland Unified School District

Economic Benefits

This project occurred using a local company (Allsup, Inc.) in an economically disadvantaged area of the state and supported around 10 temporary construction jobs for about four months.

CHAPTER 3:

Number of Vehicles Fueled, Station Usage, and Benefits

The station was in operation most of the time since its construction. Over a six-month period, there were only two inoperative days, the result of fine-tuning of the new compressor.

The District has nine CNG school buses that conduct slow fills overnight and fast fills during the day. As the calculations show on Table 1, it is estimated that a single school bus consumes an average of 5.5 miles per gasoline gallons equivalent (GGE), and that all nine of the school buses combined travel nearly 2,600 miles per year. This project represents an estimated annual displacement of about 470 GGE of gross polluting diesel fuel, 1,785 pounds of PM2.5, a half a pound of NO_x, and 349,270 pounds of CO₂. As the district continues to replace its remaining petroleum-fueled buses with CNG-fueled buses, the emissions produced by Upland Unified School District will continue to decrease.

Table 1: Monthly Data Collection

	Aug 2015	Sep 2015	Oct 2015	Nov 2015	Dec 2015	Jan 2016
Therms, as documented by utility bills	1,116	3,621	3,990	2,525	2,309	3,005
Gasoline Gallons Equivalent (calculated at 10 CNG Therms = 8.32 GGEs, per CEC's Energy Almanac)	929	3,013	3,320	2,101	1,921	2,500
Miles traveled by combined 9 CNG vehicles (at approximately 5.5 GGE per mile)	169	548	604	382	349	546
Number of days vehicles driven	21	21	22	21	14	20
Particulate Matter (PM2.5) in pounds displaced by combined 9 CNG vehicles (measured at 15 pounds per day)	315	315	330	315	210	300
Oxides of Nitrogen (NOx) in pounds displaced by combined 9 CNG vehicles (measured at 22 pounds. per day)	462	462	484	462	308	440

Source: Upland Unified School District

CHAPTER 4:

Conclusions

By using CNG school buses instead of diesel engines (Figure 5), the district has had a significant decrease in greenhouse gas emissions and particulate matter. This project, funded by Clean Transportation Program Grant Agreement ARV-12-037, has achieved its goals. The primary objective was to replace the existing CNG fueling infrastructure built in 2005, and this replacement will allow the district to add more CNG vehicles to its fleet, continuing the trend of reducing its carbon footprint in the Inland Empire.

Figure 5: CNG Buses Connected to New Fuel Station



Photo Credit: Upland Unified School District

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.

CARBON DIOXIDE (CO₂) - A colorless, odorless, non-poisonous 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).

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.

GASOLINE GALLON EQUIVALENT (GGE) - is 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.

NITROGEN OXIDES (OXIDES OF NITROGEN, NO_x) – 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.