CALIFORNIA
ENERGY COMMISSION

Clean Transportation Program

FINAL PROJECT REPORT

Alameda County Industries, LLC, CNG Station Project

Prepared for: California Energy Commission

Prepared by: Clean Energy Fuels

Gavin Newsom, Governor

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Agreement Number: ARV-12-056

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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. The statute authorizes the California Energy Commission 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-12-605 to provide funding opportunities under the CTP for projects to support installation of new natural gas fueling infrastructure and upgrades to existing natural gas fueling infrastructure. In response to PON- 12-605, the recipient submitted an application which was proposed for funding in the CEC's notice of proposed awards March 18, 2013 and the agreement was executed as ARV-12-056 on December 31, 2014.

ABSTRACT

The most significant barrier to a natural gas refuse fleet conversion is the initial costs of on-site infrastructure. Refuse fleets are familiar with traditional petroleum sources of fuel and typically already have invested in on-site infrastructure to fuel their diesel fleet. When considering a compressed natural gas fleet conversion, a refuse company is forced to make massive capital investments into new trucks and also they must invest into a fueling solution that works for their fleet. Although the cost of compressed natural gas infrastructure has decreased over the years, it has not decreased enough to make it economically viable for a private refuse company to convert their entire fleet. For this reason, the California Energy Commission's investment into this project is vital to continue the growth of compressed natural gas adoption in the refuse industry. As more and more companies convert their fleets to compressed natural gas the market prices will continue to decrease and the economics of conversions will become more feasible. The objectives of this project are to remove the financial barriers to compressed natural gas fleet conversion by funding compressed natural gas infrastructure, increase compressed natural gas use in a California refuse fleet, promote compressed natural gas adoption in the refuse industry, provide a model that other refuse industries can replicate to accommodate fleet conversions to compressed natural gas. The goal of this project is to invest into alternative fuel infrastructure that will support a growing compressed natural gas fleet.

Keywords: Compressed natural gas

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EXECUTIVE SUMMARY

California Energy Commission (CEC) PON-12-605 provided Alameda County Industries, LLC funding to partially offset the cost to construct a compressed natural gas fueling station at 610 Aladdin Avenue, San Leandro, CA 94577. The project had 5 main tasks in order to complete the station construction and provide Data Collection & Analysis.

Alameda County Industries added 22 to their existing fleet of 18 compressed natural gas refuse trucks which were delivered in 2013. Recipient's existing diesel fleet was only a few years old, but rather than continue to operate their trucks using diesel (which they are permitted to), Alameda County Industries developed plans to deploy compressed natural gas trucks. The local area did not have a compressed natural gas station capable of fueling 40 compressed natural gas refuse trucks. In order for recipient to justify adding to their existing compressed natural gas fleet, they needed an onsite compressed natural gas station. The planned station was designed to fuel 36 compressed natural gas trucks each night after business hours. This station project made it possible for Alameda County to move forward with the 22 new compressed natural gas, bringing their compressed natural gas refuse fleet to 40 trucks. To support Alameda County's rapid compressed natural gas fleet expansion plans, a time-fill compressed natural gas station was constructed to fuel the fleet of trucks on-site.

The Alameda County compressed natural gas fueling station provides the necessary infrastructure to fuel their fleet of natural gas refuse trucks. Natural gas is the cleanest choice of alternative fuel available today – natural gas powered vehicles produce up to 23 percent fewer greenhouse gas (GHG) emissions than comparable diesel models, while meeting a demanding duty cycle. Using American-produced natural gas in vehicles is an abundant, stable and low-cost alternative to using diesel.

CHAPTER 1:
Project Background and Objectives

Alameda County's objective was to remove the financial barriers to compressed natural gas (CNG) fleet conversion by funding CNG infrastructure, increase CNG use in a California refuse fleet, promote CNG adoption in the refuse industry, provide a model that other refuse industries can replicate to accommodate fleet conversions to CNG. The new station is located at 577 Aladdin Avenue in San Leandro, CA on Alameda County Sanitation Property. The goal of this Agreement was to invest in alternative fuel infrastructure to support a growing CNG fleet.

Alameda County Industries, LLC (ACI) currently operates 18 CNG trucks. The purchase of 22 additional more than doubled the CNG volume of ACI's fleet. To support ACI's CNG fleet expansion efforts, the time-fill CNG station was needed in order to fuel the fleet of trucks on-site. The public CNG infrastructure in the area was limited and did not have the needed capacity to fuel these vehicles consistently on a daily basis.

The ACI CNG Station Project fully supports the funding goals of the Commission and the Natural Gas Infrastructure program. The project has advanced alternative energy development, significantly reduced GHG emissions and criteria pollutant emissions, and reduced petroleum usage in the transportation sector while increasing the use of clean fuels. The program's objectives have been accomplished by constructing a new CNG station at ACI's fleet base to support ACI's sustainable transportation initiatives, which involve deploying new CNG trucks and run on CNG. These trucks have been deployed strategically, paving the way for future expansion of their CNG fleet.

- Station Throughput - The station dispensed 101,950 gallons (GGE) of CNG in the last eight months.
- Fill Infrastructure Need - This station has made it economically possible for ACI to convert their existing fleet to CNG because the current public CNG infrastructure in the area is limited and does not have the required capacity to fuel existing and future refuse trucks consistently on a daily basis.
- Vehicle Population - ACI ordered 22 new CNG refuse trucks which were delivered in 2013. This brings their total CNG fleet to 40 Refuse Trucks.
- Emission Reductions - This station has provided real, surplus and quantifiable reductions of GHG and criteria pollutant emissions in one of the most polluted areas of California. In the first eight months, the project reduced an estimated 50,500 pounds of GHG and criteria pollutants.[1]
- Petroleum Displacement - The station has displaced an estimated 101,950 gallons of diesel in 8 months of operation and will displace 1,019,500 million gallons of diesel over the trucks' 10-year operating life.

[1] Emissions reduction calculated using the U.S. Department of Energy Clean Cities Area of Interest 4: Alternative Fuel and Advanced Technology Vehicles Pilot Program Emissions Benefit Tool. Based on projected fuel and vehicle usage Assumptions: 40 gallons per day, 40 HD Vehicles.

- California Job Creation - 14 jobs[2] have been created with the construction and opening of the station. Total Station Cost $1,595,700.

[2] Job benefits calculated utilizing the U.S. Department of Energy "Energy Efficiency and Conservation Block Grant Program Estimated Expected Benefits Calculator".

CHAPTER 2: Scope of Work

2.1 Scope of Work

ACI's scope of work under contract ARV-12-056 included the administration, site preparations, equipment installation, commission and operating natural gas (NG) fueling infrastructure, and date collection and analysis of this CNG fueling station. Clean Energy Fuels Corp. (CEF), was responsible for the tasks listed below to complete the CNG station project. Table 1 lists the description of each tasks and the completion date.

Table 1: Scope of Work

	Description	Date Completed
Task 1	Permits Issued	May 23, 2013
Task 2	Site Preparation	May 15, 2014
Task 3	Equipment Installation	June 1, 2014
Task 4	Commissioning Report	September 9, 2014
Task 5	Data Collection & Analysis	July 2014-February 2015

Source: CEF /ACI

Task 1: Administration/Permits Issued

- Administration
    - A "Kick Off" meeting was attended with the Contract Agreement Manager, the Grants Officer, and a representative of the Accounting Office in order to establish the lines of communication and procedures for this project.
    - Critical Project Meetings were scheduled to discuss the budget.
    - Final meeting was attended to closeout this project.
    - Monthly Progress Reports were submitted to show continued progress towards achieving the end result.
    - Final Report has been submitted.
- Permits were obtained in order for the work to be completed for this project.
- Subcontracts were executed in order to ensure quality products and to procure subcontractors. A draft of each subcontract was submitted to show the work under this agreement for review.

Task 2: Site Preparation

- Completed design work for proposed facility, completed necessary facility modifications and construction and prepared a site preparation report documenting the site is ready for equipment installation.

Task 3: Equipment Installation

- Procured and installed natural gas fueling infrastructure equipment. Prepared and submitted an Equipment Installation Report that summarizes the work performed.

Task 4: Commission and Operate Natural Gas Fueling Infrastructure

- Ran appropriate tests on installed equipment and troubleshoot any issues that have arisen. Began operating fueling facility for natural gas vehicles. Prepared and submitted commission report that summarizes the results of tests performed.

Task 5: Data Collection & Analysis

- Monthly volume reports were prepared from 7/14-2/15 and ACI 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.

2.1.1 Site Location

Figure 1 shows the site for the CNG fueling station in San Leandro, California.

Figure 1: 577 Aladdin Avenue, San Leandro, California 94577

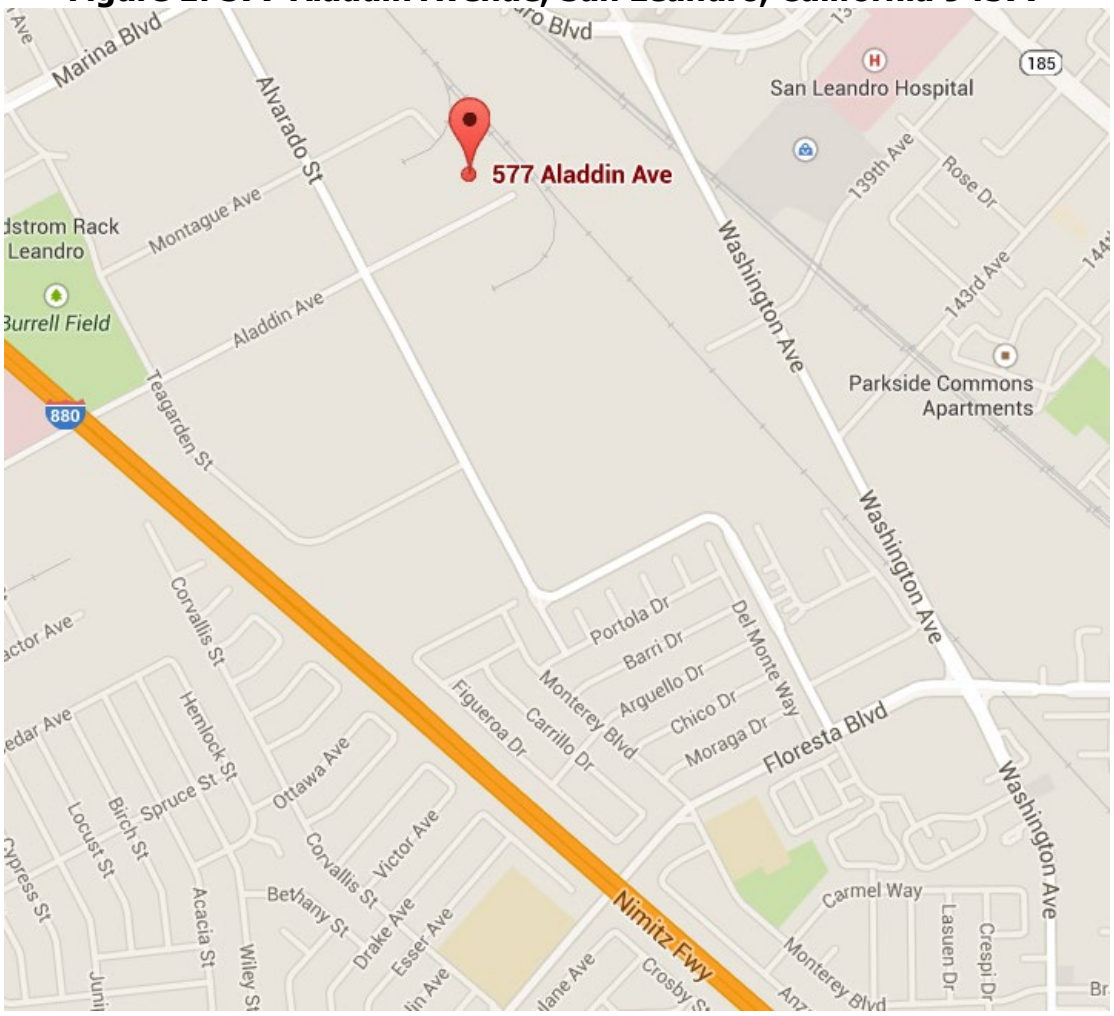

Photo Credit: CEF / ACI

Figure 2 shows the CNG equipment being installed at the site location

Figure 2: CNG Equipment Installed

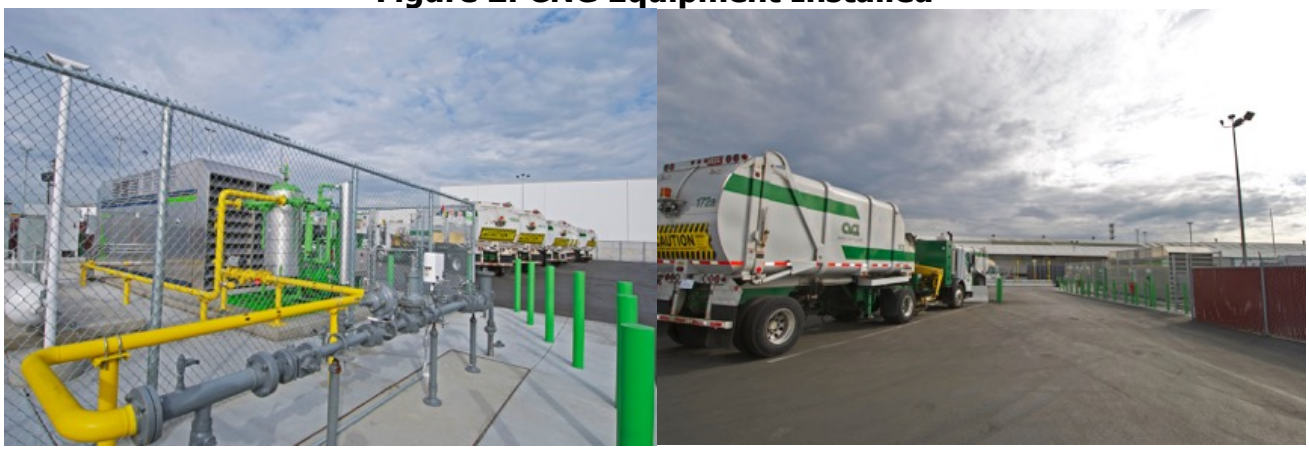

Photo Credit: CEF / ACI

Figure 3 shows the CNG station in use refueling the Refuse trucks.

Figure 3: Refuse Trucks Fueling

Photo Credit: CEF / ACI

2.2 Monthly Fuel Throughput

Approximately 40 ACI refuse trucks currently utilize the Alameda County CNG fueling station. The station has been operational since July 2014. Total fuel usage over the period of July 2014 through February 2015 (8 months) was approximately 101,950 gas gallon equivalent (GGE). On average, monthly throughput is approximately 12,700 CNG gallons. Table 2 shows the monthly CNG volume and the GGE by month.

Table 2: Monthly Fuel Throughput

Monthly CNG Volume	GGE
Jul-14	124.00
Aug-14	240.00
Sep-14	49.60
Oct-14	14,878.40
Nov-14	21,880.80

Monthly CNG Volume	GGE
Dec-14	22,148.80
Jan-15	21,271.20
Feb-15	21,358.00
(8) Total Throughput	101,950.40
Monthly Average	12,743.20

Source: CEF / ACI

2.2.1 Emission Reductions

Based on the average throughput of approximately 12,700 gallons of CNG per month consumed by the 40 CNG trucks, ACI is responsible for emission reduction benefits due to the Alameda County Station development. Based on the U.S. Department of Energy Clean Cities Area of Interest 4: Alternative Fuel and Advanced Technology Vehicles Pilot Program Emissions Reductions Tools for calculating criteria pollutant emission reductions, ACI can expect to achieve the following criteria pollutant reduction benefits based on initial deployments by using natural gas vehicles instead of diesel (See Table 3). These benefits will continue to increase over time as ACI acquires additional units. Figure 3 below shows the reduction of emissions for six different compounds measured in pounds.

Table 3: Bi-Annual Emission Reduction Calculation (Pounds)

Carbon Monoxide (CO)	Volatile Organic Compound (VOC)	Nitrogen Oxide (NOx)	Fine Particulate Matter (PM2.5)	Greenhouse Gas (GHG)	Total Emission Reductions (Criteria Pollutants & GHG)
2,561	284	13,288	171	34,224	50,528

Photo Credit: CEF / ACI

CHAPTER 3: Results

Clean Energy Fuels has completed construction of the private access CNG fueling station on Alameda County property at 577 Aladdin Avenue | San Leandro, CA 94577. The station is open, currently operational, and fueling Alameda County's large fleet of 40 CNG refuse trucks. The station was constructed according to plan with no major issues.

3.1 Problems

Initially, Clean Energy had expected to finish construction in March 2014. Due to subcontractor negotiations taking longer than expected, ACI requested a contract amendment for an additional 12 months to provide the time needed to construct and open the CNG Station.

3.1.1 Benefits

Natural gas is the cleanest choice of fuel available today for this market. Natural gas powered vehicles produce up to 23 percent fewer GHG emissions[3] than comparable diesel models[4]. This project will result in real, quantifiable emission reductions of pollutants that contribute to asthma and lung disease. In the first ten years of operation, this station will directly reduce over 687,700 million pounds of criteria pollutant and GHG[5].

3.2 Advancements in Science & Technology

Alameda County now has a better understanding of the operation and use of CNG for their refuse fleet in Northern California.

[3] "Detailed California-Modified GREET Pathway for Compressed Natural Gas (CNG) from North American Natural Gas" California Air Resources Board, January 12, 2009

[4] Detailed California-Modified GREET Pathway for California Reformulated Diesel Blended with Ethanol" California Air Resources Board, January 12, 2009.

[5] Emissions reduction calculated using the U.S. Department of Energy Clean Cities Area of Interest 4: Alternative Fuel and Advanced Technology Vehicles Pilot Program Emissions Benefit Tool. Based on projected fuel and vehicle usage Assumptions: 40 gallons per day, 40 HD Vehicles

CHAPTER 4: Conclusions

4.1 Benefits

The ACI CNG Station Project fully supports the funding goals of the Commission and the Natural Gas Infrastructure program. The project has advanced alternative energy development, significantly reducing GHG and criteria pollutant emissions, and reducing petroleum usage in the transportation sector while increasing the use of clean fuels. The program's objectives have been accomplished by constructing a new CNG station at ACI's fleet base to support ACI's sustainable transportation initiatives, which involve deploying new CNG trucks and repowering existing diesel trucks to run on CNG. These trucks have been deployed strategically, paving the way for future expansion of their CNG fleet.

4.1.1 Recommendations for Future Projects

ACI appreciates the CEC support of this natural gas project and strongly recommend the CEC continue to fund natural gas projects. We see the biggest future need for funding as natural gas vehicle funding support due to the high incremental cost of CNG vehicles. The incremental cost remains high however the natural gas advantage has a high pay off in the environment.

GLOSSARY

ALAMEDA COUNTY INDUSTRIES (ACI) - Alameda County Industries provides residential, commercial and industrial collection services for recyclables, organics, and garbage. We are the franchised hauling company for the cities of Alameda, San Leandro (excluding the Oro Loma Sanitary District) and Castro Valley Sanitary District.[6]

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.

CLEAN ENERGY FUELS CORP. (CEF) - is a provider of natural gas as an alternative fuel for vehicle fleets in the United States and Canada. The Company is engaged in supplying compressed natural gas (CNG), liquefied natural gas (LNG) and renewable natural gas (RNG) for light, medium and heavy-duty vehicles, and providing operation and maintenance (O&M) services for natural gas fueling stations.

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, hydrogen) and electricity.[7]

GREENHOUSE GASES (GHG) – Any gas that absorbs infra-red radiation in the atmosphere. Greenhouse gases include water vapor, carbon dioxide (CO2), methane (CH4), nitrous oxide (N2O), halogenated fluorocarbons (HCFCs), ozone (O3), perfluorinated carbons (PFCs), and hydrofluorocarbons (HFCs).

NATURAL GAS (NG) - A gaseous mixture of hydrocarbon compounds, the primary one being methane.[8]

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[6] Alameda county industries (https://www.alamedacountyindustries.com/)
[7] ARB glossary (https://www.arb.ca.gov/cc/inventory/faq/ghg_inventory_glossary.htm)
[8] US Energy Information Glossary (https://www.eia.gov/tools/glossary/index.php?id=alternative%20fuels)