



**CALIFORNIA
ENERGY COMMISSION**



California Energy Commission
Clean Transportation Program

FINAL PROJECT REPORT

Bonita Unified School District Compressed Natural Gas Fueling Station Project

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Gavin Newsom, Governor

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Anne Sparks

Primary Author

Bonita Unified School District

115 West Allen Avenue

San Dimas, CA 91773

(909) 971-8200

[Company Website](http://www.do.busd.k12.ca.us) (www.do.busd.k12.ca.us)

Agreement Number: ARV-12-042

Thanh Lopez

Commission Agreement Manager

Elizabeth John

Office Manager

ADVANCED FUELS AND VEHICLE TECHNOLOGIES OFFICE

John P. Butler, II

Deputy Director

FUELS AND TRANSPORTATION

Drew Bohan

Executive Director

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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 (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 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 April 24, 2012 and the agreement was executed as ARV-12-042 on July 8, 2013.

ABSTRACT

Bonita Unified School district applied for funding under the California Energy Commission's Clean Transportation Program to construct a compressed natural gas fueling station for its bus fleet. The school district is committed to greening its fleet of 24 school buses and has purchased 11 natural gas buses. Without a fueling station on site, the school district has to travel to several different fueling stations over 10 miles away that are also used by waste hauling and transit requiring long, causing costly waits. This project will ensure adequate, cost-effective fueling with equipment that is reliable, easy to maintain, efficient, and will meet the school district's future interest in increasing its capacity to replace the remaining diesel buses to natural gas. Bonita Unified School District is committed to continue to use compressed natural gas and improving local and regional air quality.

Keywords: California Energy Commission, Bonita Unified School District, compressed natural gas, CNG fueling station, natural gas infrastructure, natural gas bus fleets

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EXECUTIVE SUMMARY

The objective of the Bonita Unified School District compressed natural gas (CNG) fueling station upgrade project was to install a new compressed natural gas fueling station that can meet the current and future compressed natural gas fueling needs of the school district.

Bonita Unified School District has been successful in receiving South Coast Air Quality Management District grant funding for new natural gas buses. The school district was successful in procuring additional natural gas buses after the start of the compressed natural gas station project.

The California Energy Commission issued solicitation PON-11-602 for "Alternative Fuels Infrastructure Deployment: Electricity, Natural Gas, Propane, E85 and Diesel Substitutes" to provide funding opportunities under the Clean Transportation Program for projects which develop infrastructure necessary to store, distribute, and dispense electricity, E-85, propane, diesel substitutes, and natural gas. In response to PON-11-602, Bonita Unified School District submitted an application, which was proposed for funding in the California Energy Commission's Notice of Proposed Awards April 24, 2012, and the grant agreement was executed as ARV-12-042 on July 8, 2013.

With California Energy Commission funding, Bonita Unified School District was able to move forward immediately with the installation of the compressed natural gas fueling station project.

Natural Gas Vehicle Institute was contracted by Bonita Unified School District to provide compressed natural gas fueling station consulting services. The design process started in April 2014 and the construction of the fueling station was completed in early 2016. Construction was completed by Allsup Corporation. The compressed natural gas fueling station was built with 7 fueling posts, a natural gas dryer, and compressors allowing the school district to fuel its 13 natural gas school buses and anticipate the growth of its natural gas bus fleet. Growth of the natural gas bus fleet will be dependent on available grants.

Since the completion of the compressed natural gas fueling station, it has enabled Bonita Unified School District to fuel its compressed natural gas bus fleet on-site, instead of travelling to nearby fueling stations, effectively reducing operation costs.

CHAPTER 1:

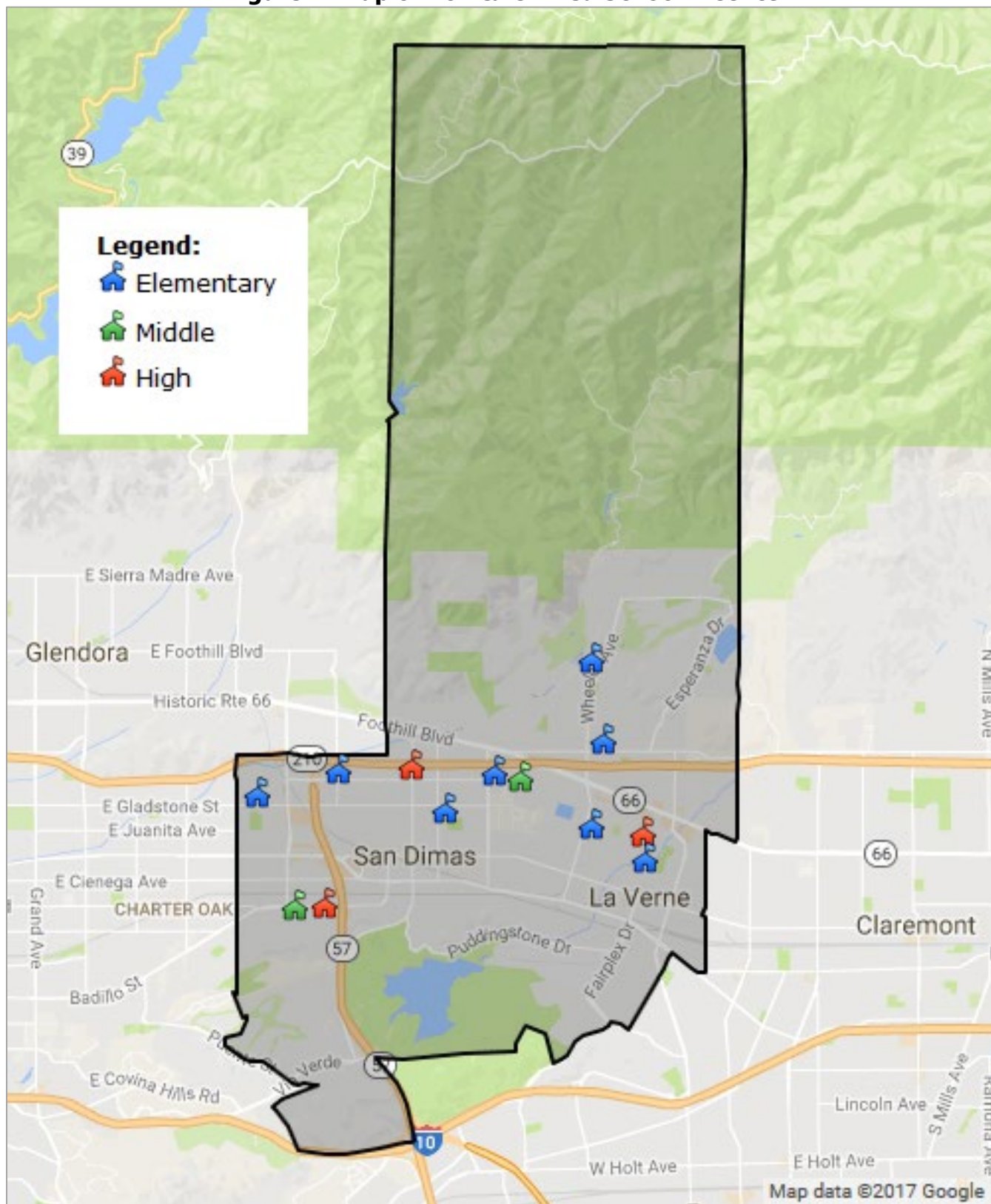
Introduction

1.1 Background

Bonita Unified School District (BUSD) lies 35 miles east of the City of Los Angeles in the East San Gabriel Valley. Made up of the cities of La Verne and San Dimas, the district borders the foothills of the San Gabriel Mountains on the north and U.S. Highway 10 on the south.

The District operates eight elementary schools (kindergarten to fifth grade), two middle schools (grades six-eight), and two comprehensive high schools (grades nine-twelve). BUSD also includes the Ed Jones Educational Center, which includes a continuation high school, and alternative (independent study/home schooling) school for grades K-12, and the Adult Education Program. BUSD also runs a regular Pre-School program, which is housed at Allen Avenue and Grace Miller Elementary School, and a Special Education pre-school class at Shull Elementary. See Figure 1 below for a map of the District boundaries.

Figure 1: Map of Bonita Unified School District



Source: Bonita Unified School District's [My School Locator Tool](http://locator.decisioninsite.com/?StudyID=85004) (<http://locator.decisioninsite.com/?StudyID=85004>).

1.2 South Coast Air Quality Management District Efforts

Mobile source emissions are major contributors to the potential cancer risk from air pollution. Long-term epidemiological studies of school age children conducted by University of Southern

California and University of California, Los Angeles indicate that nitrogen oxides and particulate matter have much greater impacts on limiting lung growth in children than believed in the past. These include exhaust emissions from high emitting diesel-fueled school buses that contain smog forming pollutants and air toxics harmful to school children. As a result, South Coast Air Quality Management District adopted *Rule 1195 – Clean On-Road School Buses*.¹ This rule requires public schools and private operators with more than 15 or more school buses to purchase or lease cleaner school buses that better protect school age children.

South Coast Air Quality Management District has also adopted the *Lower-Emission School Bus Incentive Program*.² There are thousands of older school buses on the road that have remained in service primarily because school districts lack funds to replace them. Using state, federal and its own matching funds, South Coast Air Quality Management District has provided substantial incentives to public school districts to purchase new very clean natural gas buses and low-emitting diesel buses. In turn, these districts have to retire an equivalent number of the oldest, highest-polluting buses in their fleets: first, pre-1987 buses and then pre-1994 buses.

South Coast Air Quality Management District has provided further incentives to both school districts and private operators to install particulate trap filters that eliminate 85 percent or more of particulates in diesel exhaust. School buses eligible for particulate traps are 1994 and newer diesel buses that must use low-sulfur diesel fuel, with 15 ppm or lower sulfur content. South Coast Air Quality Management District has awarded particulate matter traps to retrofit nearly 3,400 diesel buses.

As of 2016, South Coast Air Quality Management District has awarded nearly \$300 million to replace nearly 1,600 pre-1994 school buses with clean alternative school buses having the latest safety features. 90 percent of these new school buses have been the large size CNG Type D buses, and the remainder 10 percent were propane powered Type C buses. These awards also included particulate matter traps, to retrofit nearly 3,400 diesel buses, particulate matter traps that reduce toxic fine particulate exhaust by over 85 percent.

1.3 BUSD Bus Fleet

In 2011, BUSD had 5 CNG buses. By 2012, the District was able to add 6 additional CNG buses to the school district's fleet, bringing the total to 11 CNG buses. 10 of the buses are full sized 78-passenger transit CNG buses and one mid-size 36-passenger CNG bus used for special education students.

In March 2015, South Coast Air Quality Management District issued a program announcement to solicit applications for replacement of pre-1994 school buses with new alternative fuel buses and retrofit of 1994 and newer school buses with particulate traps. BUSD was approved an

¹ South Coast Air Quality Management District. [Rule 1195](http://www.aqmd.gov/docs/default-source/rule-book/reg-xi/rule-1195.pdf?sfvrsn=4). (<http://www.aqmd.gov/docs/default-source/rule-book/reg-xi/rule-1195.pdf?sfvrsn=4>).

² South Coast Air Quality Management District. [Lower Emission School Bus Funding Criteria](http://www.aqmd.gov/home/programs/business/lower-emission-school-bus-funding-criteria). (<http://www.aqmd.gov/home/programs/business/lower-emission-school-bus-funding-criteria>).

award to replace one pre-1994 diesel school buses with a CNG bus from the Carl Moyer Program Assembly Bill 923 Fund.³

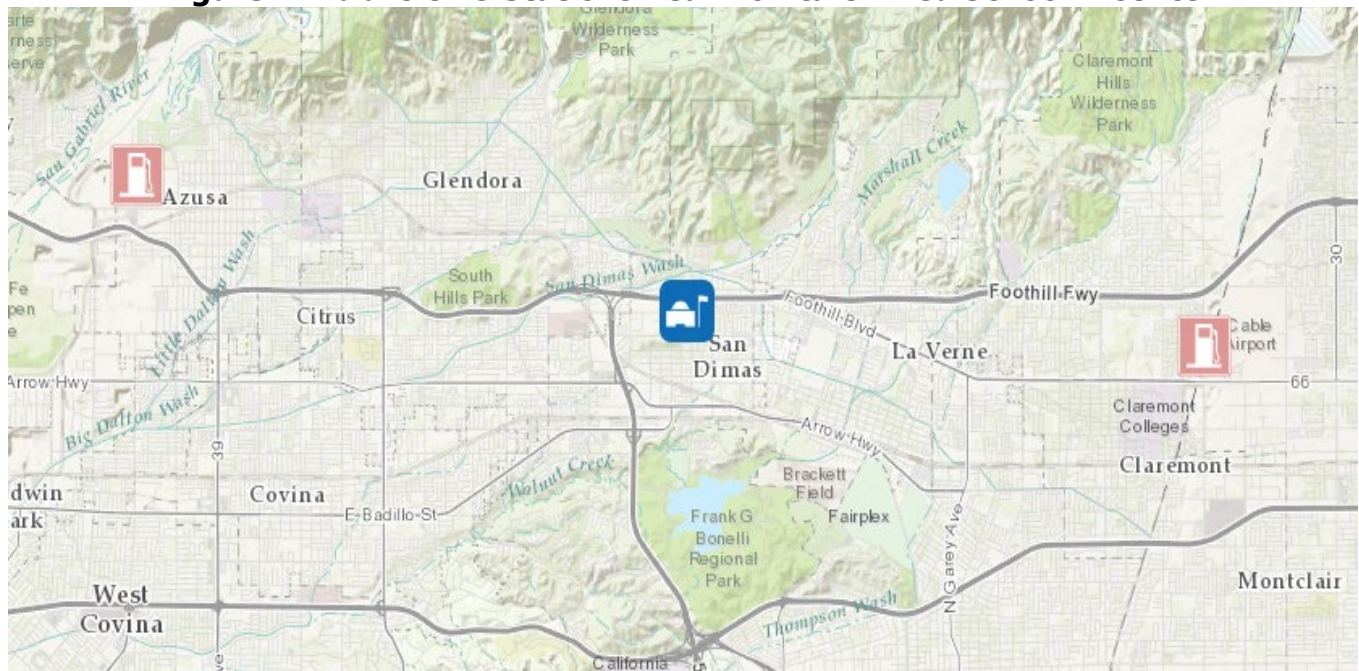
The school district plans to replace additional existing diesel buses with CNG buses in the future as funding becomes available.

1.4 Initial Situation

BUSD's fleet of 24 buses transports approximately 900 students daily from home to school. In addition, the fleet provides many extracurricular trips annually.

BUSD had no on-site fueling capability and fueled its buses by driving to two public fueling stations: The City of Claremont's CNG fueling station and Southern California Gas Company CNG station in Azusa. These are the closest public stations in the vicinity of the school district, each station at least 9 miles away (see Figure 2).

Figure 2: Public CNG Stations near Bonita Unified School District



Source: Bonita Unified School District.

Each of the 11 large buses had the capacity for 62 to 62 diesel gallon equivalents. Daily fuel use in the BUSD is approximately 18 diesel gallon equivalents. The buses travel to the public fueling station every other day. Travelling 18 miles round trip to the public station takes employee time and adds nearly 1,500 vehicle miles travelled per bus per year or 16,000 miles for the entire fleet of CNG buses.

Under budget constraints on school districts statewide, BUSD identified two ways to reduce operating costs: 1) replacing diesel buses with CNG buses for fuel cost savings; and 2) constructing an on-site fueling station.

³ California Air Resources Board. [Assembly Bill 923: New Funding for the Expanded Carl Moyer Program](https://www.arb.ca.gov/msprog/moyer/ab923/ab923.htm). (<https://www.arb.ca.gov/msprog/moyer/ab923/ab923.htm>).

In early 2012, the California Energy Commission issued solicitation program opportunity notice PON-11-602 for "Alternative Fuels Infrastructure Deployment: Electricity, Natural Gas, Propane, E85 and Diesel Substitutes" to provide funding opportunities under the Alternative and Renewable Fuel and Vehicle Technology Program for projects which develop infrastructure necessary to store, distribute, and dispense electricity, E-85, propane, diesel substitutes, and natural gas. In response to PON-11-602, BUSD submitted an application, which was proposed for funding in the California Energy Commission's Notice of Proposed Awards April 24, 2012, and the grant agreement was executed as ARV-12-042 on July 8, 2013.

With California Energy Commission funding, BUSD was able to move forward immediately with the installation of the compressed natural gas fueling station project.

Once the CNG fueling station upgrade project is complete, the District will have the opportunity to reduce both nitrous oxide and carbon dioxide emissions by replacing older diesel vehicles and offer a fueling source for neighboring school districts.

1.5 Project Goals

The goal of the project was to construct an on-site, state-of-the-art CNG fueling system with both time-fill and fast-fill capability such that each bus has its own fueling hose that will meet the current and near future CNG fueling needs of BUSD.

CHAPTER 2:

Project Approach

The objective of this project was constructing a new CNG fueling station with seven fueling posts with dual hoses owned by BUSD. In March 2012 BUSD applied for and was awarded a \$300,000 grant from the California Energy Commission to construct a new CNG fueling station.

The school district performed all normal purchasing practices to contract for the CNG fueling station as well as project management to oversee the construction and reporting associated with the project.

2.1 System Design and Specifications

In November 2013, BUSD met with representatives from Southern California Gas Company to discuss the cost and timeframe for the installation of the District's CNG fueling station.

In March 2014, Southern California Gas Company and its representatives presented a Tariff Proposal (to plan, design, construct, operate and maintain the CNG fueling station) to the school district that was attractive, but well out of the BUSD's project budget range. After internal discussions, the school district decided to hire a consultant and open its CNG fueling station project to outside bidders.

In April 2014, the Board of Education approved an agreement between BUSD and Natural Gas Vehicle Institute, a consulting firm to help the BUSD move the project to completion. Its services would include:

- Initial site visit and evaluation of the CNG fueling station location
- Developing a list of costs, expenses and revenues expected for the project
- Correspond with the district to obtain necessary estimates and cost figures
- Calculate, develop and present payback period findings
- Accurate equipment sizing
- Development of fueling station equipment specifications
- Assistance with the development of a Request for Proposals
- Development of bid criteria

Natural Gas Vehicle Institute would also assist with the pre-bid conference, bid evaluation, provide a list of recommended bidders and attend equipment commissioning and start up.

2.2 Project Equipment

Table 1 provides a list of the equipment that was installed for this project.

Table 1: Equipment List

Quantity	Equipment	Specifications
2	Compressor	ANGI compressor package NG300E (Duplex)
1	Dryer	Regenerative gas dryer
7	Time-fill post assemblies	Dual-hose time-fill post assemblies

Source: Allsup Corporation.

2.3 Subcontractors for Project

The following subcontractors were used for this project:

- Southern California Gas Company
PO Box 2007, Monterey Park, California 91754
- Natural Gas Vehicle Institute
3120 S. Durango Drive, Suite 304, Las Vegas, Nevada 89117
- Allsup Corporation
1868-K West 11th Street, Upland, California 91786

2.4 Site Preparation, Construction and Installation

In order to obtain the most cost-effective pricing, BUSD released a call for bids prior to entering into an agreement for services. A notice to contractors was published and BUSD held a pre-bid conference in February 2015. The general contents and requirements of the Design/Build CNG fueling stations were reviewed during the job walk portion of the pre-bid conference with the building contractors.

Two contractors submitted bids for the project. After reviewing all documents and discussing both bids, BUSD recommended entering into an agreement with Allsup Corporation. In May 2015, the Bonita School Board approved an agreement between BUSD and Allsup to furnish all labor, materials, and complete all work required installing the equipment for the CNG fueling station project.

Allsup Corporation began construction in August 2015. Allsup Corporation began with the layout of underground conduit and saw cutting for the gas and electrical underground, demolishing asphalt, and construction of the concrete pad for equipment, and construction of time-fill stations.

There was a slight delay in starting the construction process due to the submitting Southern California Gas Company project requirements in June 2015. BUSD submitted the Form 5, Meter Set Assemblies Size/Load Profile, but final approval and meter installation from Southern California Gas Company was completed in October 2015. Without information regarding the size and final location of the gas line, construction was stopped until the meter installation was completed. Figures 3, 4, and 5 show the project in different stages of completion.

Figure 3: Equipment Delivery



Source: Bonita Unified School District.

Figure 4: Regenerative Dryer and Compressor Packages



Source: Bonita Unified School District.

Figure 5: Project Construction



Source: Bonita Unified School District.

CHAPTER 3:

Project Outcome

The objective of this project was to install a new CNG station owned by BUSD.

3.1 Observations and Conclusions

This project was a success in that the BUSD station now has the ability to produce 70 gasoline gas equivalents per hour and fuel all of its CNG buses at once overnight.

In 2012, BUSD had 10 CNG school buses. Through the course of the project, the school district replaced 3 diesel buses with CNG school buses, bringing the total CNG bus fleet to 13 CNG buses. The intent of the school district with successful project implementation is to eventually replace additional diesel buses with future available funding.

3.2 CNG Usage

Bonita currently fuels 13 CNG buses with its new CNG fueling station on-site. Table 2 details the CNG usage for the bus fleet.

Table 2: CNG Usage for BUSD

Year	CNG Bus Fleet	Diesel gallon equivalents/bus/day	Diesel gallon equivalents/bus/year	Total diesel gallon equivalents all buses/year
2012	10	18	3,600	36,000
2016	13	18	3,600	46,800

Source: Bonita Unified School District.

On average, the CNG station is operating 20 days a month. The CNG station also operates during summer and winter breaks.

Since the start-up of the CNG fueling station, the station has not experienced any issues.

3.2.1 Greenhouse Gas Emissions Reductions

To provide an estimate of greenhouse gas emission reductions, the following assumptions were used:

- Carbon dioxide emissions from a gallon of diesel = $2,778 \text{ grams} \times 0.99 \times (44 / 12) = 10,084 \text{ grams} = 10.1 \text{ kilogram} / \text{gallon} = 22.2 \text{ pounds} / \text{gallon}$
- One diesel gallon equals about 135 standard cubic feet of gas, or 1.35 therms.

Based on these assumptions, Table 3 calculates the emissions reductions for 10 CNG buses in BUSD's fleet in 2012 to 13 CNG buses in 2016.

Table 3: GHG Reductions

# of CNG Buses	Diesel Gallon Equivalents	Greenhouse Gas Reductions (tons)
10	39,600	440
13	46,800	520

Source: Bonita Unified School District

3.2.2 Estimated Emissions Reductions from On-Site Fueling

Without an on-site CNG fueling station, BUSD would have to fuel its buses by driving to two public fueling stations: The City of Claremont's CNG fueling station and Southern California Gas Company's CNG station in Azusa. These are the closest public stations in the vicinity of the school district, each station at least 9 miles away.

By constructing an on-site CNG fueling station, the district is able to reduce 41.6 tons of carbon dioxide equivalents annually, by not having to travel 18 miles biweekly to the nearest CNG fueling station to refuel its bus fleet (Table 4).

Table 4: Emissions Reductions for Refueling Trips Only

Refueling Trips miles	18
Miles per Gallon	5
CNG Fuel used (diesel gallon equivalents / trip)	3.6
Number of CNG Buses	13
Operating Days per Year	200
Operating Weeks per Year	40
Number of Refueling Trips per Week	2
Annual Fuel expense reduction (\$2.50 / gallon)	\$9,360
Annual refueling trips mileage	18,720
Annual refueling trip fleet diesel gallon equivalents	3,744
Carbon dioxide emissions at 22.2 pounds per gallon	83,116.8
Tons carbon dioxide equivalents reduced annually	41.6

Source: Bonita Unified School District, Clean Fuel Connection, Inc.

3.2.3 Estimated Cost Savings of Staff Time

Fueling the current bus fleet off-site would have required additional staff time and wages. As the buses are required to fuel every other day to ensure route availability; this was not optimal to expend 1-labor hour per bus to refuel and adding an additional 18,720 miles just for refueling. Additionally, fueling at a public site only offers fast-fill, so there is a loss of pound-force per square inch in transit, the buses get a “hot fill” which does not equate to a “full-fill” as is capable with the slow-fill process.

By constructing a new CNG fueling station on-site, BUSD is able to save \$19,500 (see Table 5) in staff labor annually.

Table 5: Estimated Labor Reductions from On-Site Fueling

Round trip mileage to refuel	18
Duration of one refueling trip (hour)	1
Number of drivers/bus	1
CNG buses in operating	13
Operating weeks per year	40
Refueling trips per week	2.5
Annual driver hours for refueling trips only	1300
Average hourly wage including fringe benefits	15
Refueling wages avoided annually	\$19,500

Source: Bonita Unified School District, Clean Fuel Connection, Inc.

GLOSSARY

BONITA UNIFIED SCHOOL DISTRICT (BUSD)—A school district in Los Angeles County, California serving the communities of San Dimas, La Verne, and part of Glendora. There are 14 school in the Bonita Unified School District from grades K-12.⁴

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.

⁴ [BUSD's website](http://do.bonita.k12.ca.us/). (<http://do.bonita.k12.ca.us/>).