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Clean Transportation Program

FINAL PROJECT REPORT

Fullerton Joint Union High School District Compressed Natural Gas Fueling Infrastructure

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FJUHSD would also like to acknowledge its board of trustees for the support of the compressed natural gas (CNG) fueling infrastructure project. The CNG project is one that will generate revenue to invest in the classroom where students learn moral and civic values, compassion and empathy, honesty, perseverance, respect, and responsibility.

The tireless work of the FJUHSD Board of Trustees and Superintendent listed below, fosters a belief that every student can succeed.

- Marilyn Buchi, Board President
- Robert Singer, Ph.D., Clerk
- Andy Montoya, Board Member
- Robert Hathaway, Board Member
- Joanne Fawley, Board Member
- Krista McAtee, Student Board Member
- Scott Scambray, Ed.D., Superintendent

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-14-608 to California K-12 public school district and other public entities in California. In response to PON-14-608, the recipient submitted an application that was proposed for funding in the CEC's notice of proposed awards August 12, 2015, and the agreement was executed as ARV-16-003 on September 15, 2016.

ABSTRACT

To use alternative and renewable fuel options more effectively and minimize exposure to global crude oil market instability, the Fullerton Joint Union High School District built and upgraded the compressed natural gas (CNG) infrastructure to accommodate current and future need for cleaner air fuels in the school bus fleet. The California Energy Commission Grant Proposal PON-14-608 was instrumental in providing necessary funding to complete the infrastructure project and add a public fueling station for fuel. The project was completed in December 2017.

The enhancements to the facility lay the foundation for a long-term policy to minimize the vulnerability of the school district to dramatic swings in petroleum prices, improve air quality, reduce the dependency on petroleum fuel products, and minimize the exposure to the possibility of unsustainable crude oil prices over the next 10 to 15 years.

The Fullerton Joint Union High School district awarded the project to TOMCO, LLC and included two 200-horsepower compressors enclosed with electrical panels, three storage vessels, two public dispensers, and 15 time-fill posts.

The station is providing the compressed natural gas for all district vehicles equipped to operate on compressed natural gas fuel. The station also provides CNT for natural gas vehicles owned/operated by the public, and for other nearby school districts, municipalities, and waste management companies that operate natural gas vehicles.

Keywords: Fullerton Joint Union High School District, compressed natural gas, La Habra

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EXECUTIVE SUMMARY

This project provided the Fullerton Joint Union High School District (Orange County) with necessary upgrades to the compressed natural gas (CNG) infrastructure to meet the current and ongoing fueling needs of the expanding fleet of natural gas vehicles. In addition, the district proposed the addition of a public compressed natural gas fueling station to meet the industry and community needs of a refueling station in La Habra.

At the time the project was initiated, the district had 19 CNG buses with plans of adding six to eight more buses through the South Coast Air Quality Management district grant program. In addition, the district will look at the cost/benefit analysis of replacing the service vehicles (white fleet) as vehicle replacement plans warrant. The district allows other local fleets, including the La Habra City School District, to use the refueling of unleaded and diesel vehicles during limited hours.

With CEC funding, Fullerton Joint Union High School District was able to move forward immediately with the construction of the CNG fueling infrastructure project. The district contracted TOMCO, LLC to be the lead agent for the design, engineering, construction, and commissioning of the compressed natural gas infrastructure project. Design and construction started August 17, 2016, and was completed in November 2017.

In addition to public fueling and additional fueling posts, a key component of the project was the relocation of the existing compressor system equipment away from the street to the back corner of the property for safety purposes for the equipment, as well as maintenance personnel.

The project objective was to complete a CNG infrastructure expansion, add a public fueling station, and upgrade the existing facility to accommodate additional time-fill and fast-fill capabilities for district vehicles. The project demolished the existing compressed natural gas compressor system as it was undersized, unreliable, and near the street. The proposed improvements added 15 dual-nozzle, time-fill dispensers for the district's buses, two additional fast-fill dispensers, and four public fast-fill dispensers. The proposed two 200-horsepower compressors have a design capacity to accommodate current and future CNG capacity and use three new compressed natural gas storage vessels.

The project team anticipates that the project, with the additional fill posts, equipment, and storage capacity, will vastly improve the CNG fueling efficiency for the district's current and future compressed natural gas bus fleet, the surrounding municipalities that have CNG vehicle fleets, and the added ability to provide fuel for the public's privately owned compressed natural gas vehicles.

CHAPTER 1:

Project, Purpose, and Approach

Introduction

The following board-adopted goals of the Fullerton Joint Union High School District (FJUHSD) guide the decisions, which affect the staff and students at its high schools:

- High-quality programs of sufficient breadth and depth will be provided so that students upon graduation will have reached or surpassed district achievement standards and will have a satisfactory level of knowledge and skills to continue their formal education or enter a productive occupation or both.
- Students will meet district standards in attendance and personal behavior.
- Adequate and secure physical facilities, grounds, and equipment will be provided and satisfactorily maintained.
- Sound management of district resources will be provided.
- There will be effective internal and external communications.
- Students, staff, parents, and other community members will be properly recognized for their outstanding accomplishments and contributions to the district.
- Parents, staff, and students will be satisfied with the support, the quality, and the characteristics of the schools and school district.

The FJUHSD was organized in 1893 and serves grades nine to twelve. It serves a 50-square-mile area that includes the elementary districts of Buena Park, Fullerton, La Habra, and Lowell Joint. Six four-year comprehensive high schools are operated by the district: Buena Park, Fullerton, La Habra, Sonora, Sunny Hills, and Troy. La Vista High School, a continuation high school, and La Sierra High School, an alternative high school, also serve FJUHSD students. A comprehensive summer school program is offered each year. FJUHSD's school year consists of 180 instructional days of 372 minutes each.

Background

FJUHSD's existing facility provided the necessary fueling needs for the current compressed natural gas (CNG) bus fleet. However, as the use of CNG buses became more prevalent, it became clear that the infrastructure was not designed to meet the increasing needs of the expanding CNG bus fleet. The existing infrastructure had reached the end of economical serviceability and needed to be upgraded, rebuilt, or replaced, or a combination.

The existing CNG infrastructure did not have sufficient capacity to support the district CNG vehicle fleet efficiently and needed to be expanded. Moreover, the existing infrastructure would not support additional CNG vehicles. The compressor began to fail regularly, leaving the district without the ability to fuel its own buses.

As discussions began related to upgrading and improving the CNG infrastructure, the CEC offered an opportunity to add a public fueling component to the project.

Existing Facility and Fleet

The existing CNG refueling station included six time-fill and one fast-fill dispensers used by the district to refuel the fleet at night. The existing compressor was undersized for FJUHSD's growing CNG fleet. In addition, the single air compressor afforded no redundancy and was unreliable. Furthermore, the existing equipment was sitting open, near the street, uncovered, and reaching the end of serviceable life.

FJUHSD's highway fleet consisted of the following vehicles:

- 24 diesel buses
- 37 gasoline buses
- 19 CNG buses
- 44 white-fleet maintenance vehicles (gasoline)
- Six campus vans (gasoline)
- 13 district vans (gasoline)
- Four agriculture pickup trucks (gasoline)
- Two facilities program sedans (gasoline)

Over the past 10- plus years, the district has been converting its diesel bus fleet to CNG. More requirements are being placed on transit operators to replace diesel buses with alternative-fueled buses. Specifically, the South Coast Air Quality Management district (SCAQMD) Rule 1195 (adopted 2001) requires operators with fleets of 15 or more school buses to replace buses with alternative-fueled buses; alternative fuel means any of the following that has been certified by California Air Resources Board:

- Compressed natural gas
- Liquefied natural gas
- Propane
- Methanol
- Electricity
- Fuel cell
- Other nondiesel fuels

Some years ago, the district decided to meet this requirement by installing CNG fueling equipment and began replacing diesel powered buses with CNG-powered buses. Fortunately, the district was able to take advantage of several funding grants allowing the acquisition of CNG-powered buses at about 10 percent to 15 percent of the retail cost of a new CNG bus. As resources permitted and grant monies were received, old diesel buses were retired. Additional buses are converted as resources permit.

The project team anticipated that that the district would begin converting its white fleet maintenance vehicles and district vans to CNG as well, when the CNG infrastructure project was complete.

As previously stated, the existing CNG infrastructure did not have sufficient capacity to support the current district's CNG vehicle fleet efficiently and would not support adding any additional

CNG vehicles. The district needed to replace, upgrade, and expand its existing CNG infrastructure to convert additional vehicles to CNG. While the district had no choice with respect to purchasing CNG buses since this is mandated by the SCAQMD, the district had not yet purchased any other types of CNG vehicles but planned to do so once new infrastructure was installed.

There are no other public CNG facilities within La Habra and only one in the FJUHSD attendance area. The nearest facility is in neighboring Fullerton, about five miles away. Refueling in Fullerton is extremely inconvenient when taking into consideration the lead times required to refuel vehicles while remaining consistent with established student transportation schedules.

Project Objective

The project objective was to complete CNG infrastructure upgrades at the existing facility to accommodate additional time-fill capabilities for district buses and to construct a public CNG fueling station. The district expects to achieve the following objectives:

1. Replace and expand the existing CNG infrastructure to meet FJUHSD's projected needs over the next 10 plus years and to include both slow-fill and fast-fill dispensers
2. Achieve an overall cost savings and air pollution reduction for district vehicle operations by converting vehicles from diesel and unleaded gasoline to CNG
3. Comply with the SCAQMD Rule 1195, which requires operators with fleets of 15 or more school buses to replace buses with alternative-fuel buses
4. Conveniently service local municipalities and school districts that are fueling diesel and unleaded gasoline vehicles at the district transportation center
5. Service local municipalities and school districts by providing easy access to CNG as they convert their vehicle fleets from diesel and unleaded to CNG
6. Construct a public access CNG fueling station for use by the community at large in order to generate revenue and support FJUHSD's general fund

Goals of the Agreement

This agreement sought to provide FJUHSD with a new CNG facility that enables reliable CNG fueling for the CNG bus fleet, additional district CNG vehicles, the La Habra City School District CNG bus fleet, and to publicly vend CNG fuel. The internal project team, along with the selected project consultants and contractors, all had individual and collective experiences implementing recent CNG refueling infrastructure projects, concise and organized business practices, and effective project management that ensured the successful completion of the planned effort in the most cost-effective and -efficient manner.

Technical Scope of Work

Table 1 shows the general natural gas and electrical supply parameters used by the design team for this project.

Table 1: General Project Data

Type of Gas	Natural Gas
Dew point of gas	At least 10° F below the minimum design ambient temperature
Gas input temperature	60° F
Gas density	0.65 - 0.85 kg/Sm3
Electrical requirement	Three phase AC.
Voltage	460 volts, + / - 5%
Frequency	60 hertz
Dispenser supply (if applicable)	120 V, +/- 5%
Frequency	60 hertz

Source: FJUHSD Staff

The overall scope of work included:

1. Installation of CNG compressor packages, dryer, 15 time-fill post, two fast-fill dispensers, bus wash station, liquid fuel dispenser, canopy, and all relatable mechanical, civil and electrical equipment, parts, and labor.
2. Relocate the primary equipment serving time-fill and fast-fill stations, including compressors, priority panel, control panel and dryer, within a fenced enclosure at the back of the new facility.
3. Electrical shut off stations to be installed per electrical drawings.
4. Existing parking lot to be slurry coated and restriped.
5. Relocate existing light pole, install new head and install two new light poles/heads.
6. Installation of bus wash and storm water system.

The initial scope included the following new equipment and facility upgrades:

1. One three-vessel CNG storage assembly (one wide by three high) seamless pressure vessel to American Society of Mechanical Engineers Unfired Pressure Vessels Code Section VIII, Division 1, Appendix 22, safety factor three to one for dry gas, non-corrosive service. Design temperature -40° Fahrenheit to +200° Fahrenheit. Vessel material is SA372 Grade J, Class 70. (Figure 1)
 - a. Vessel size: 20" OD x 1.303" MW x 23' 0" Long
 - b. Design pressure: 5,500 pounds per square inch gauge

- c. Assembly water volume: 102.6 cubic feet
- d. Assembly capacity: 36,621 standard cubic feet CNG at 5,000 pounds per square inch gauge
- e. Assembly weight: about 21,770 pounds

Figure 1: Vessel Installation



Source: FJUHSD Staff

- 2. One natural gas dryer American Society of Mechanical Engineers U stamped 200 megawatt peak at -20° Fahrenheit to 400° Fahrenheit (Figure 2)
 - a. Desiccant Charge: 1,500 lbs.
 - b. Weight: 7,350 pounds with desiccant installed
 - c. Area Classification: National Electrical Manufacturers Association 4/7, Class 1, Division 2, Group D

Figure 2: Natural Gas Dryer



Source: FJUHSD staff

- 3. Two 200-horsepower natural gas compressors enclosed with electrical panels (Figure 3), nonlubricated cylinders, liquid-cooled cylinders, blowdown unloading system

- a. Interstage safety valves, interstage water/gas tube exchangers, pressure monitoring transmitters

Figure 3: Compressors



Source: FJUHSD staff

4. 15 time-fill post assemblies the American National Standards Institute/CSA Group NGV1-certified (Figure 4)
 - a. Service pressure: 3,000 or 3,600 psi
 - b. Temperature: -40° Fahrenheit to +185° Fahrenheit
 - c. Flow rate: 2,100 standard cubic feet per minute

Figure 4: Time-Fill Posts



Source: FJUHS staff

5. Two CNG Dispensers (Figure 5)

- a. Dual hose with safety relief valves, micromotion, pressure gauge, master reset, vent valve, air purge pressure switch, vibration switch
- b. Card reader in dispenser with PPU/volume display, media display, receipt printer, keypad, on/off nozzle holster, manual shut-off valve

Figure 5: CNG Dispensers



Source: FJUHS staff

Local utilities and municipalities were partners through the permitting, entitlement, and inspection phases, including Southern California Edison, Southern California Gas Company, and La Habra.

Also, a mitigated negative declaration was filed after commissioning a California Environmental Quality Act (CEQA) study.

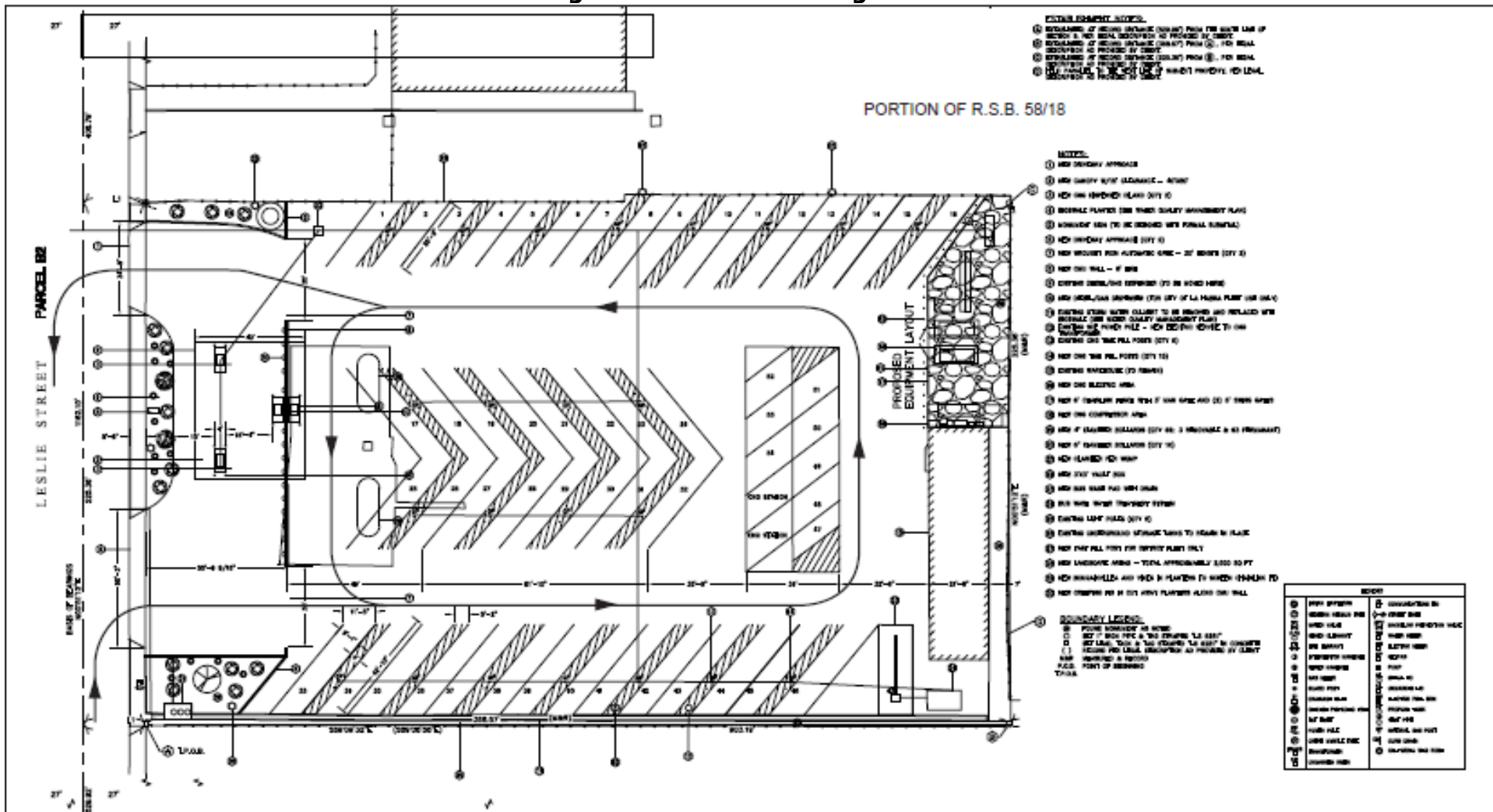
The CEQA initial study was prepared to identify the potential effects on the environment from the construction and operation of the proposed CNG fueling station project and evaluate the significance of those effects. Based on the environmental analysis, it was determined that the project would have no impacts or less-than-significant environmental impacts on the following resources:

- Aesthetics
- Agriculture and forestry resources
- Air quality
- Biological resources
- Geology and soil
- Greenhouse gas emissions
- Hazards and hazardous materials
- Hydrology and water quality
- Land use and planning
- Mineral resources
- Population and housing
- Public services
- Noise
- Recreation
- Utilities and service systems

Changes to Facility Access

As shown in Figure 6, access to the CNG site would be provided via two modified driveway approaches, and the public fueling station would be separated from the time-fill station and bus yard by an eight-foot-high concrete masonry wall and two wrought-iron rolling gates. The southern driveway from S. Leslie Street would provide access to the public fueling station and the district transportation center beyond the gate. Vehicles would enter from this southern driveway to access the one-way loop to the time-fill post and the bus yard beyond the gate before exiting to the northern driveway. The proposed project would eliminate 24 parking spaces from the CNG site to accommodate additional time-fill posts, and the district would create 13 or 14 additional parking spaces at the district maintenance and operations site by closing or relocating the north driveway and reconfiguring the existing internal circulation.

Figure 6: Bus-Yard Configuration



Source: PlaceWorks Mitigated Negative Declaration and Initial Study, April 2016

Estimated Annual Throughput

The annual throughput prior to the CNG fueling station upgrade was 50,608 gas gallon equivalents. The initial estimated annual throughput of the new system in support of the total number of CNG buses and public fueling that will use the facility on both time-fill and fast-fill stations is 75,912 gas gallon equivalents.

CHAPTER 2:

Project Activities and Results

Project Activities

The project objective was to replace, upgrade, and expand the existing CNG infrastructure and construct a public CNG fueling station. In 2015, FJUHSD began exploring options for the replacement and relocation of the existing CNG infrastructure, including the compressor and refueling equipment. At the same time, FJUHSD discussed the possibility of developing a public CNG fueling station, since no station existed in La Habra. In April 2015, information regarding FJUHSD's CNG facility was formally presented to the district's board of trustees.

In June 2015, a request for qualifications and proposal for CNG infrastructure design and installation services (Request for Qualifications and Proposal Number 2014/15-32) was authorized by the board of trustees as an opportunity to competitively select a vendor to provide the requisite services (GC §4217.10 *et seq.*). Notices were sent to 11 identified vendors with CNG experience July 15, 2015. A job conference and walk-through was conducted July 20, 2015. The response deadline was July 30, 2015.

In June 2015, an agreement was awarded to PlaceWorks, Inc., for consulting services to perform the required CEQA analysis.

In addition, FJUHSD applied for and was awarded a \$500,000 grant from the CEC for the construction of the CNG fueling infrastructure project.

In August 2015, an independent contractor/special services agreement was awarded to TOMCO, LLC for the design phase (phase one) of the CNG project (Government Code [GC] §4217.10 *et seq.* and GC §53060).

In November 2015, an update on the CNG project was provided to the board of trustees. At that time approval was secured to increase the scope of the project to include expanded conditional use permit processing, stormwater retention/treatment design services, additional traffic/parking analysis, the addition of a combined gas and diesel dispenser, offsite street improvements, water quality management construction, and electrical service relocation.

In May 2016, the board of trustees approved Resolution 2015/16 #54 adopting a mitigated negative declaration and authorized the filing of a notice of determination with the Orange County Clerk and State Office of Planning and Research and formally approved the CNG project.

In June 2016, the La Habra Planning Commission approved the conditional use permit and design review to construct the CNG service station at 1050 South Leslie Street, La Habra, California.

In July 2016, TOMCO, LLC submitted project plans to La Habra.

In August 2016, the FJUHSD Board of Trustees considered and approved the energy services and construction contract.

It was estimated that the project cost would be roughly \$2.4 million, of which, \$750,000 was attributable to the addition of the public fueling station. Without the CEC grant, the public fueling station component would not have been part of the project.

Station Design Intent

The long-term design intent of this project is to provide adequate time-fill capacity for FJUHSD vehicles that operate on CNG, maintain a fast-fill capacity, and provide a public CNG fueling station to the La Habra community. The intent of the project was to relocate the existing infrastructure, address sizing and selection of new equipment, and provide equipment layouts and site amenities. The upgrades and fueling station include the following attributes, which reflect the upgrades to the CNG equipment and components, as well as some ancillary services and design elements to provide for future facility expansion, if needed:

- Two new 200-horsepower compressors to serve as the base load compressor and allow future fleet expansion and redundancy
- Addition of a three-vessel CNG storage assembly and dryer (pictured above in Figure 1)
- Installation of 15 dual-hose time-fill dispensers located between bus parking spaces at the bus yard
- Two new CNG dispensers, each with dual-hose capabilities and card readers for unmanned public fueling
- Seismic design criteria for station structural design.

Compressor sizing and storage sizing are calculated based on both components working together. The three-vessel storage assembly holds 36,621 standard cubic feet of CNG at 5,000 pounds per square inch gauge (psig). The size of the compressor and storage was determined based on current demand and potential future demand based on additional district CNG vehicles and public fueling capacity.

Figure 7, Figure 8, and Figure 9 show project a concrete pour, preparation for underground plumbing, and equipment delivery.

Figure 7: Concrete Pour



Source: FJUHSD staff

Figure 8: Underground Plumbing



Source: FJUHSD staff

Figure 9: Equipment Delivery



Source: FJUHSD staff

Project Results

The project was completed in December 2017. Once the station was commissioned, FJUHSD began collecting monthly fuel usage data and recording them per the terms of the grant agreement. The district currently uses Comdata's Petroleader software as the fuel management system, and CNG usage data were provided using data from this system in addition to utility bill information received from Southern California Gas Company. The only natural gas service on-site is dedicated to the refueling of CNG buses, district CNG vehicles, and the public CNG fueling station.

Table 2 below captures the monthly fuel consumption and environmental impacts reported by FJUHSD from December 2017 through May 2018. The estimated annual throughput of the newly upgraded CNG facility was 75,912 gas gallon equivalents. The total throughput for the first six months of the commissioning of the station was 13,037 gas gallon equivalents.

Table 2: Monthly Fuel Consumption and Greenhouse Gas Impacts

	Dec. 2017	Jan. 2018	Feb. 2018	March 2018	April 2018	May 2018
Therms Documented by Utility Bills	4,870	5,197	5,283	6,249	8,620	9,161
Kilo-British Thermal Units	487,000	519,700	528,300	624,900	862,000	916,100
Megajoules	513,821	548,322	557,396	659,316	909,475	966,554
Natural Gas Sold (gas gallon equivalents)	952.55	1,229.77	1,161.88	1,514.63	2,136.61	2,379.45
Non-District Vehicles Fueled per Month	70	77	96	142	201	226
Days per Month Vehicles Were Fueled	24	26	26	31	30	31
Average Miles Traveled per Bus by Odometer Reading	537.55	605.65	616.10	695.35	1,045.35	1036.10
Gallons of Diesel Fuel Displaced GDE	3,512.11	3,747.93	3,809.95	4,506.60	6,216.50	6,606.66
Greenhouse Gas Emissions Avoided (pounds/CO₂ equivalent)	17,829.8	19,026.9	19,341.8	22,878.5	31,559.1	33,539.8

Source: FJUHSD staff

Assumptions and Conversion Factors

The project team used the following conversion factors in calculating the environmental impacts noted above (greenhouse gas emissions avoided):

- Estimate of natural gas dispensed; convert therms into kilo-British thermal units Us (one therm = 100 kilo-British thermal units)
- CNG dispensed was converted into megajoules (MJ) by using $1 \text{ MJ} = 0.9478 \text{ Btu}$
- Diesel gallon equivalents displaced was calculated by dividing MJ of CNG fuel dispensed by megajoules per gallon of diesel (146.3 MJ/diesel gallon).

For greenhouse gas emissions avoided:

- Multiplied the megajoules of CNG dispensed by differential between CNG and diesel carbon intensity: 15.74 grams CO₂ equivalent per MJ. Then converted the grams figure into pounds of carbon dioxide equivalent.

CHAPTER 3:

Project Assessment

Project Goals

- Upgrade the CNG infrastructure.
- Expand fueling capacity for additional CNG buses to be added to FJUHSD’s fleet.
- Construct a public CNG fueling facility.

The completed CNG infrastructure upgrade and fueling station project were successful in helping the district achieve these goals.

Project Success

Since the CNG infrastructure and equipment were upgraded and moved to the back corner of the property (Figure 10), district buses have been fueled more efficiently. The newly upgraded equipment provides much needed capacity for fueling and will allow the district to continue the expansion of the CNG bus fleet and will accommodate additional district CNG vehicles going forward.

Figure 10: Complete CNG Infrastructure



Source: FJUHSD staff

An additional benefit of the upgraded fueling facility is that all of FJUHSD’s CNG buses are refueled in the existing parking space. This has resulted in a savings in labor costs for the district since buses do not have to be moved constantly to access the limited dispensers.

In addition to the benefit to the district fleet, the public fueling station (Figure 11) continues to provide a convenient fueling station. As mentioned, there was no CNG fueling station in the La Habra area. In the first full year of operation, the public facility vended more than 25,000 gas gallon equivalents to nondistrict vehicles. As the station exposure increases, the amount of CNG fuel vended to the public increases, thereby decreasing emissions in the local area.

Figure 11: Public Access CNG Station



Source: FJUHS staff

Determining fuel efficiency of CNG buses is an important component in measuring the success of the project. The following tables account for the monthly mileage of FJUHS's CNG fleet. The miles per diesel gallon equivalent are calculated using an average of 5 miles per gallon for diesel buses based on FJUHS's current diesel bus fleet. Tables 3 through 9 summarize data collected for the project. During the six-month period from December 2017 through May 2018, the facility displaced about 28,400 diesel gallon equivalents of CNG across 87,677 miles of service. This displacement equates to about 5 miles per gallon in fuel efficiency. The total mileage for each CNG bus during the December 2017 through May 2018 data collection period is listed in Table 3. Tables 4 through 9 show the monthly mileage data for each bus during the data collection period.

Table 3: Total Mileage by Bus (December 2017–May 2018)

Bus Number:	Total Mileage
1	7,077
2	5,325
3	10,195
4	7,374
6	6,361
7	2,008
9	6,345
21	3,190
23	3,182
28	3,022
29	1,281
30	3,171
31	2,114
32	613
33	6,321
34	8,988
35	3,099
36	4,358
37	1,490
38	2,163
TOTAL:	87,677

Source: FJUHSD staff

Table 4: Data for December 2017

Bus #	Mileage Beginning	Mileage End	Mileage Total	Days Schools in Session
1	48,460	49,539	1,079	15
2	50,645	51,606	96	15
3	51,635	52,631	996	15
4	49,175	50,210	1,035	15
6	43,169	44,134	965	15
7	160,770	161,576	806	15
9	47,775	48,747	972	15
21	6,051	6,699	648	15
23	146,452	146,483	31	15
28	96,973	96,998	25	15
29	115,536	115,608	72	15
30	105,614	105614	0	15
31	112,733	112,733	0	15
32	118,295	118,308	13	15
33	126,611	127,182	571	15
34	120,409	121,258	848	15
35	92,052	92,389	337	15
36	114,193	115,616	1,423	15
37	132,491	132,983	492	15
38	114,470	114,812	342	15

Source: FJUHSD staff

Table 5: Data for January 2018

Bus #	Mileage Beginning	Mileage End	Mileage Total	Days Schools in Session
1	49,539	50,671	1,132	17
2	51,606	52,483	877	17
3	52,631	54,222	1,591	17
4	50,210	51,433	1,223	17
6	44,134	45,063	929	17
7	161,576	161,576	0	17
9	48,747	49,872	1,125	17
21	6,699	7,040	341	17
23	146,483	146,769	286	17
28	96,998	97,294	296	17
29	115,608	115,816	208	17
30	105614	106,261	647	17
31	112,733	113,037	304	17
32	118,308	118,523	215	17
33	127,182	128,195	1,013	17
34	121,258	122,201	943	17
35	92,389	92,905	516	17
36	115,616	115,649	33	17
37	132,983	132,983	0	17
38	114,812	115,246	434	17

Source: FJUHSD staff

Table 6: Data for February 2018

Bus #	Mileage Beginning	Mileage End	Mileage Total	Days Schools in Session
1	50,671	51,864	1,193	18
2	52,483	53,452	969	18
3	54,222	56,198	1,976	18
4	51,433	52,655	1,222	18
6	45,063	45,922	859	18
7	161,576	161,576	0	18
9	49,872	51,026	1,154	18
21	7,040	7,282	242	18
23	146,769	147,013	244	18
28	97,294	98,318	1,024	18
29	115,816	116,052	236	18
30	106,261	106,388	117	18
31	113,037	113,165	128	18
32	118,523	118,589	66	18
33	128,195	128,963	768	18
34	122,201	123,766	1,565	18
35	92,905	93,296	391	18
36	115,649	115,649	0	18
37	132,983	132,983	0	18
38	115,246	115,414	168	18

Source: FJUHSD staff

Table 7: Data for March 2018

Bus #	Mileage Beginning	Mileage End	Mileage Total	Days Schools in Session
1	51,864	52,897	1,033	16
2	53,452	54,341	889	16
3	56,198	57,767	1,569	16
4	52,655	53,643	988	16
6	45,922	46,935	1,013	16
7	161,576	162,417	841	16
9	51,026	52,044	1,018	16
21	7,282	7,773	491	16
23	147,013	147,452	439	16
28	98,318	99,128	810	16
29	116,052	116,252	200	16
30	106,388	106,468	80	16
31	113,165	114,001	836	16
32	118,589	118,857	268	16
33	128,963	129,901	1,062	16
34	123,766	125,322	1,556	16
35	93,296	93,661	365	16
36	115,649	115,649	0	16
37	132,983	132,983	0	16
38	115,414	115,863	449	16

Source: FJUHSD staff

Table 8: Data for April 2018

Bus #	Mileage Beginning	Mileage End	Mileage Total	Days Schools in Session
1	52,897	54,155	1,258	21
2	54,341	55,146	805	21
3	57,767	59,853	2,086	21
4	53,643	55,112	1,469	21
6	46,935	48,052	1,117	21
7	162,417	162,670	253	21
9	52,044	53,529	1,428	21
21	7,773	8,473	700	21
23	147,452	148,508	1,056	21
28	99,128	100,070	942	21
29	116,252	116,765	513	21
30	106,468	107,136	668	21
31	114,001	114,881	880	21
32	118,857	118,857	0	21
33	129,901	131,334	1,433	21
34	125,322	127,656	2,334	21
35	93,661	94,360	699	21
36	115,649	117,296	1,647	21
37	132,983	134,000	1,017	21
38	115,863	116,465	602	21

Source: FJUHSD staff

Table 9: Data for May 2018

Bus #	Mileage Beginning	Mileage End	Mileage Total	Days Schools in Session
1	54,155	55,537	1,382	22
2	55,146	56,835	1,689	22
3	59,853	61,830	1,977	22
4	55,112	56,549	1,437	22
6	48,052	49,512	1,460	22
7	162,670	163,350	680	22
9	53,529	54,307	778	22
21	8,473	9,416	943	22
23	148,508	149,567	1,149	22
28	100,070	100,070	0	22
29	116,765	116,887	122	22
30	107,136	108,931	1,795	22
31	114,881	114,974	93	22
32	118,857	118,928	71	22
33	131,334	132,808	1,474	22
34	127,656	129,756	2,100	22
35	94,360	95,300	940	22
36	117,296	119,145	1,849	22
37	134,000	134,480	480	22
38	116,465	116,768	303	22

Source: FJUHSD staff

CHAPTER 4:

Project Conclusions

The CNG project provided many learning opportunities. Since FJUHSD did not have an in-house facilities and construction team at the time of project commencement, there were unforeseen delays that may have been addressed if the district had waited for the new internal facilities and construction department to be built. The district began the CNG project during the time when the first general obligation bond projects were being programmed.

Coordination with all municipalities, public utilities, and civil engineers early in the process is important. The entitlement process took longer than anticipated as did CEQA and soils testing. A better understanding of the time frames associated with these areas would have resulted in better time estimates for the project. Also, since the project incorporated a bus wash facility on the grounds, a water quality management plan was necessary. Although this plan did not add significant time, it was an added expense to the project.

For the district mechanics to service the CNG vehicles, it was recommended that the service garage install a proper methane detection system. Since several district buses were funded through the SCAQMD, the district was able to use grant funds to offset some of the garage upgrades.

Advertising the CNG station has been a challenge. There are regulations for signage on city and county streets, and with limited funding, the school district could not invest many resources into getting the word out about the station. The existence of the public fueling facility advertising has been through word of mouth (CNG users telling other CNG users), individual discussions (FJUHSD employees speaking directly with CNG drivers who do not fuel at the public station), informative discussions with local school districts, and the use of CNG-specific mobile applications and websites. The FJUHSD CNG fueling station is listed on popular CNG fueling apps such as cngnow.com, cngprices.com, and the California Department of General Services' Alternative Fuels Vehicle Program. Recently, FJUHSD began accepting the WEX Inc. fleet card, which will likely boost exposure significantly, since it is an industry standard fleet card with its own fuel finder mobile application.

Understanding the potential use of the public CNG facility was key to sizing the equipment appropriately. When the district initially began the project, the intent was to oversize the equipment for current demand so that no future expansion would be necessary to accommodate an increased CNG fleet as well as public CNG fueling. FJUHSD is now in a position to consider CNG vehicles throughout the fleet as a method for reducing fueling costs and reducing emissions. The public side of this project would not have been possible without the grant funding from the CEC.

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 seven major responsibility areas 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.

CALIFORNIA ENVIRONMENTAL QUALITY ACT (CEQA) — Enacted in 1970 and amended through 1983, established state policy to maintain a high-quality environment in California and set up regulations to inhibit degradation of the environment.

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.

FULLERTON JOINT UNION HIGH SCHOOL DISTRICT (FJUHSD) — A school district founded in 1893 in a school district in Orange County, California, that serves a 50-square-mile area which includes the cities of Fullerton, La Habra, La Habra Heights, and small sections of Anaheim, Buena Park, Brea, Placentia, Whittier, and Whittier's unincorporated community East Whittier. There are about 16,299 students in the union high school district.¹

MEGAJoule (MJ) — A joule is a unit of work or energy equal to the amount of work done when the point of application of force of 1 newton is displaced 1 meter in the direction of the force. It takes 1,055 joules to equal a British thermal unit. It takes about 1 million joules to make a pot of coffee. A megajoule itself totals 1 million joules.

POUNDS PER SQUARE INCH GAUGE (PSIG) — The pressure relative to atmosphere.

SOUTH COAST AIR QUALITY MANAGEMENT DISTRICT (SCAQMD) — The air pollution control agency for all of Orange County and the urban portions of Los Angeles, Riverside and San Bernardino Counties. This area of 10,740 square miles is home to more than 17 million people — about half the population of the whole state of California. It is the second most populated urban area in the United States and one of the smoggiest. Its mission is to clean the air and protect the health of all residents in the South Coast Air District through practical and innovative strategies.

THERM — One hundred thousand (100,000) British thermal units (1 therm = 100,000 Btu).

¹ [FJUHSD Website: https://www.fjuhsd.org/](https://www.fjuhsd.org/).

