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ENERGY COMMISSION**



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Clean Transportation Program

FINAL PROJECT REPORT

Compressed Natural Gas Facility

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- Timothy Nelligan, Go Natural Gas, CEO
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PREFACE

Assembly Bill 118 (Núñez, Chapter 750, Statutes of 2007) created the Clean Transportation Program. The statute authorizes the California Energy Commission (CEC) to develop and deploy alternative and renewable fuels and advanced transportation technologies to help attain the state's climate change policies. Assembly Bill 8 (Perea, Chapter 401, Statutes of 2013) reauthorizes the Clean Transportation Program through January 1, 2024, and specifies that the CEC allocate up to \$20 million per year (or up to 20 percent of each fiscal year's funds) in funding for hydrogen station development until at least 100 stations are operational.

The Clean Transportation Program has an annual budget of about \$100 million and provides financial support for projects that:

- Reduce California's use and dependence on petroleum transportation fuels and increase the use of alternative and renewable fuels and advanced vehicle technologies.
- Produce sustainable alternative and renewable low-carbon fuels in California.
- Expand alternative fueling infrastructure and fueling stations.
- Improve the efficiency, performance, and market viability of alternative light-, medium-, and heavy-duty vehicle technologies.
- Retrofit medium- and heavy-duty on-road and nonroad vehicle fleets to alternative technologies or fuel use.
- Expand the alternative fueling infrastructure available to existing fleets, public transit, and transportation corridors.
- Establish workforce-training programs and conduct public outreach on the benefits of alternative transportation fuels and vehicle technologies.

To be eligible for funding under the Clean Transportation Program, a project must be consistent with the CEC's annual Clean Transportation Program Investment Plan Update. The CEC issued Program Opportunity Notice (PON) PON-12-605 to provide funding opportunities for projects to support installation of new natural gas infrastructure and upgrades to existing natural gas infrastructures. 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-12-045 on June 20, 2013.

ABSTRACT

The immediate impact to the Murrieta Valley Unified School District is the fuel cost savings that will be accrued over time. These savings can be applied to the compressed natural gas fleet replacement program thereby ensuring continuation of the district's home to school transportation program in the years ahead. Another important aspect of Murrieta Valley Unified School District's newly constructed compressed natural gas fueling station is that it enhances the compressed natural gas vehicle deployment in California by becoming an integral part in the development of a contiguous network of school district infrastructures forming a viable compressed natural gas refueling network that enables school districts to extend the field trip range of their buses. To this end, Murrieta Valley Unified School District has included two fast fill fueling positions that will be made available to school buses of districts from other regions destined for or transiting through Murrieta, California. Agreements have been formalized with two neighboring school districts that allow for mutual assistance in the event of fueling emergencies resulting from compressed natural gas equipment casualties. Finally, this fueling infrastructure will enable the district to continue its home to school transportation.

Key words include: Murrieta Valley Unified School District, Compressed natural gas fueling network, CNG time fill fueling, Limited fast fill capability, Assembly Bill (AB), Senate Bill (SB).

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EXECUTIVE SUMMARY

Introduction

On March 16, 2006, the South Coast Air Quality Management District mandated through rule 1195 that public school bus fleets must purchase new school buses fueled by an alternative clean fuel such as compressed natural gas, propane or ultra-low emission gasoline when replacing existing heavy duty diesel school buses. At that time only pre-1987 manufactured school buses qualified for replacement under grants offered by South Coast Air Quality Management District. The Murrieta Valley Unified School District was unable to participate because its oldest bus was manufactured in 1987. This bus age restriction remained in place until 2012, when the South Coast Air Quality Management District changed the qualifying threshold to pre-1994.

Meanwhile the Murrieta Valley Unified School District could not afford alternative fuel school bus replacements because its transportation program was among one of the lowest state funded programs in California with its state funding calculation frozen at \$86,000 in 1982 when the Murrieta Valley Unified School District had one elementary school and two school buses. This funding level continued for more than three decades while many school districts in California continued to receive state transportation funding in the millions of dollars each year.

Despite these obstacles, Murrieta Valley Unified School District remained committed to providing adequate home to school transportation for students residing in district boundaries, which encompass 100 square miles of mountainous terrain and 150 miles of flatland. To this end, Murrieta Valley Unified School District's administration envisioned replacement of its aging heavy-duty diesel engine buses with clean burning alternative fuel buses powered by self-produced compressed natural gas from its own fueling infrastructure. Because of the paucity of funds described above, this could only be accomplished with outside financial assistance which was pursued with vigor over a two-year period. The district's focus during this period was to transition into Compressed Natural Gas as outlined in the following synopsis.

Goals, Objectives, and Outcomes

Goal: To complete phase one of the Murrieta Valley Unified School District compressed natural gas infrastructure to time fill 19 regular education and special education school buses funded by the South Coast Air Quality Management District, Mobile Source Pollution Reduction Committee and co-funded by Murrieta Valley Unified School District.

Outcome: Prior to commissioning of the infrastructure on August 28, 2013, compressed natural gas buses were successfully fueled daily during the test phase of the fueling system.

- **Objective #1:** Provide time-fill fueling for up to 19 compressed natural gas buses, the first increment of which to be delivered in July 2013.
 - **Outcome:** PON-12-605 was the final critical piece of the financial package needed for constructing phase one of the compressed natural gas refueling infrastructure. With buses arriving prior to the start of the fall 2013 semester of school, it was imperative the district complete the infrastructure before the start

of school. PON-12-605 facilitated acceleration of construction that commenced on June 6, 2013 and completed on August 28, 2013.

- Objective #2: Provide 31 time-fill posts to accommodate the 19 funded natural gas school buses and additional vehicles to be acquired as funding becomes available.
 - Outcome: The finished infrastructure includes 16 time-fill posts capable of fueling 32 vehicles simultaneously. Construction cost of the infrastructure totaled \$1.4 million leaving a balance of \$657,000 for acquisition of four compressed natural gas special education buses under the Mobile Source Pollution Reduction Committee's Buy Down Program instead of the nine regular education buses previously anticipated. The four buses were delivered in April 2014. In August, the South Coast Air Quality Management District was expected to release a new alternative fuel bus program to replace heavy duty diesel school buses 1993 and older. Murrieta Valley Unified School District has 10 buses that qualify for replacement under this criterion and will be petitioned for replacement. If awarded, this will bring to 24 the number of compressed natural gas buses in the Murrieta Valley Unified School District active fleet.
- Objective #3: Provide fast-fill posts to accommodate neighboring school districts that have agreed to use the new compressed natural gas fueling facility in time of need.
 - Outcome: Mutual assistance agreements with these districts are in place to provide bus fueling during periods of inoperability resulting from equipment casualties.
- Objective #4: Save money that can be reinvested into additional compressed natural gas vehicles and infrastructure as well as classroom education.
 - Outcome: Converting the district's buses to compressed natural gas and fueling on site will allow the district to take advantage of the significant savings between the cost of diesel at the pump (\$3.55 per gallon according to the U.S. Energy Information Agency) and the cost of compressed natural gas at the pump (\$2.77 per diesel gallon equivalent at Downs Energy in Temecula). The district initially projected that its fueling station would produce compressed natural gas at a cost of \$1.15 per diesel gallon equivalent. The actual cost of throughput over the first six months of operation was \$1.03 (inclusive of electrical cost) and will drop to \$.53 per diesel gallon equivalent once the \$.50 federal rebate for 2013 is received.

Conclusions

The completion of phase one of the compressed natural gas fueling infrastructure and arrival of 10 new compressed natural gas school buses to replace an equal number of gross polluting heavy duty diesel buses became the cornerstone for the continuation of Murrieta Valley Unified School District's home to school transportation program. This occurred at a time when discontinuation of home to school transportation was rampant among California schools. Murrieta Valley Unified School District was especially vulnerable since state transportation funding for the district had been frozen more than 30 years ago leaving the district with no

alternative except to fund transportation with general fund monies that would otherwise be earmarked for classroom purposes.

Public Benefits

Continued infrastructure expansion funding assistance from both California Energy Commission and Mobile Source Pollution Reduction Committee as well as funding assistance from the South Coast Air Quality Management District to replace the remainder of diesel school buses with compressed natural gas will enable Murrieta Valley Unified School District to ultimately remove tons of particulate matter and nitrogen oxides from the atmosphere as part of a statewide movement to clean California's air.

CHAPTER 1:

1.1 Project Background

Murrieta Valley Unified School District (MVUSD) is in the South Coast Air Quality Management District (SCAQMD) of southwest Riverside County where clean energy is mandated in accordance with Air Quality Management District (AQMD) Rule 1195. Home to school transportation is essential because of demographics and geography. The school district has more than 23,000 students spread over 100 miles of mountainous terrain and 150 miles of flatland. Its 19 schools include four high schools, four middle schools and 11 elementary sites with exceptionally large student populations made necessary by an extremely rapid population growth in a very short period. The district maintains a fleet of 29 diesel regular education buses and 21 special needs buses, six of which are diesel and 15 are ultra-low emission vehicle gas powered. The fleet of 50 buses transports approximately 2,000 students daily and conducts over 1,100 field trips annually.

MVUSD's 24-year-old diesel bus fleet is well beyond the California average of 14 years because of a freeze to state transportation funding over the past three decades. During this time MVUSD received \$86,000 annually to operate a transportation system costing \$3 1/2 million a year. In fact, MVUSD ranks as one of the lowest funded districts in California because the state funding calculation was frozen in 1982 when MVUSD had only one school and two school buses. Since then, transportation has been funded with general fund monies that otherwise would be earmarked for the classroom.

Despite these obstacles, MVUSD remained committed to providing home to school transportation for students residing outside the non-busing zones in both the mountainous and flatland regions of the district. As testimony to this commitment and desire to reduce driver, student and community exposure to potentially health threatening pollution caused by an aged fleet of heavy duty diesel engine school buses, the District's Board of Trustees approved \$2 million to invest in SCAQMD's AB 923 Low Emission School Bus Program replacement of pre-1994 school buses and Mobile Source Pollution Reduction Committee (MSRC) funding opportunities for construction of compressed natural gas (CNG) fueling infrastructures.

Since these programs were not yet made public, MVUSD speculated on the following: (1) an award of 20 CNG buses under AB 923, (2) the fueling infrastructure cost to be \$1 million, and (3) having a balance of \$1 million to purchase nine regular and special education CNG buses. This plan would have enabled MVUSD to replace its entire heavy-duty fleet of buses as outlined in Figure 1.

Figure 1: MVUSD Fleet Conversion Financial Proposal dated February 16, 2012

Proposed Fleet Composition:

- Regular education fleet of 26 CNG transit buses
- Special education fleet consisting of 3 CNG transit buses, 1 diesel transit bus, 7 diesel cutaways, 10 ULEV gas cutaways and 3 vans
- Slow fuel CNG station

Proposed Operating Budget		
Regular Ed Transit Bus Replacement	\$4,550,000	(26 X \$175,000)
Special Ed Transit Bus Replacement	\$570,000	(3 X \$190,000)
Fueling Station	1,000,000	
Totals	\$6,120,000	
AQMD and MSRC Available Funding		
19 RegEd & 1 SpEd Bus--AQMD AB 923	\$3,200,000	(20 X \$160,000)
7 RegEd & 2 SpEd Buses--MSRC	\$405,000	(9 X \$45,000)
Fueling Station Infrastructure Funds-- (AQMD)	280,000	(20 X \$14,000)
Fueling Station Infrastructure Funds -- (MSRC)	250,000	(25% of \$1,000,000)
Cost to AQMD/MSRC	\$4,135,000	
Cost to the District	\$1,985,000	

Source: Murrieta Valley Unified School District

On March 2, 2012, the MSRC issued program announcement 2012-10 for new and expanded refueling facilities in the SCAQMD and awarded MVUSD \$244,000 toward construction of a CNG fueling infrastructure. On April 6, the SCAQMD issued program announcement #2012-15 for replacement of pre-1994 school buses and approved a 10-bus award to MVUSD totaling \$1,755,000. In November 2012, the CEC issued PON-12-605 for natural gas fueling infrastructure assistance and awarded MVUSD \$300,000 in March of 2013. MUVSD's investment and partnership funding by the CEC, SCAQMD and MSRC is outlined in Figure 2.

Figure 2: Revised MVUSD Investment and Partnership Funding for CNG

MVUSD	\$2,000,000.00	CNG Investment for Infrastructure & School Bus Replacement
AQMD	\$1,755,000.00	AB 923 Award for 10 CNG Buses
MSRC	\$124,000.00	*Buy Down Differential for 4 CNG Buses
MSRC	243,000.00	Fueling Infrastructure Award
AQMD	140,000.00	AB-923 Matching Fund Award
CEC	300,000.00	Fueling Infrastructure Award
TOTAL:	\$4,562,000.00	
*Buses delivered in April, 2014		

Source: Murrieta Valley Unified School District

Once funding for the infrastructure was approved by both CEC and MSRC, the district conducted a satisfaction survey with school districts in Riverside County that had constructed CNG fueling systems within the past 10 years and discovered all had experienced excessive problems related to extreme heat conditions in this high desert region. Further investigation revealed it was necessary to insulate compressors, especially those used extensively in southwest Riverside County, since they had a history of releasing oil into the natural gas compression process when ambient temperatures reached 80-plus degrees for sustained periods of time. This necessitated shutting down the system to prevent oil from contaminating the bus fuel sensor systems. Extensive repairs followed.

Go Natural Gas, the contractor that designed and built MVUSD's CNG infrastructure, installed dual 77 SCFM Gardner Denver compressors enclosed in an insulated structure and cooled with a large capacity fan. System startup began in the hottest season of the year with temperatures exceeding 100 degrees for sustained periods with no difficulty. Although MVUSD was not awarded the 20 CNG buses petitioned for in the PA 2012-15 program announcement by SCAQMD, the combination of MVUSD's initial investment and partnership funding outlined above enabled the district to complete phase one of the MVUSD compressed natural gas infrastructure capable of fueling 32 regular and special education CNG buses.

CHAPTER 2:

2.1 Project Approach

Phase one's infrastructure scope of work under grant award number ARV-12-045 included administration, contractor selection through competitive bidding, engineering, and permitting, site preparation, equipment procurement, installation, commissioning, data collection and warranting of all work and equipment for a period of five years.

The alternative fuel infrastructure specifications include:

A. CNG Fueling Station consisting of:

- One Gas Dryer
- Two 77-SCFM Compressors
- Time-fill dispensers to accommodate 32 vehicles including two fast-fill assemblies
- Two time-fill dispensers can be converted to fast fill through isolation
- Emergency Generator

B. Maintenance Facility Modifications:

- Gas Detection and Alarm Systems
- Alarm Triggered Exhaust Fans
- Explosion Proof Heaters
- Remote Controlled Four Post Bus Lift

All equipment meets American Petroleum Institute, American Society of Mechanical Engineers, International Society of Automation, American Gas Association, National Electric Code, and National Fire Protection Association requirements.

Administrative planning for the infrastructure project was two years in the making during which time the Murrieta Valley Unified School District Board of Education approved \$2,000,000 in co-funding toward a proposed joint effort with the SCAQMD to obtain grant funding for CNG buses and construction of a CNG fueling station. In February 2012, the district entered into contract with consulting engineer, Leland Burke, President of Environmental Vehicle Services, to prepare a CNG refueling Facility Design Proposal in anticipation of the MSRC PA 2012-10. After submitting the application, the district was awarded \$244,000 by the MSRC for construction assistance of the CNG Infrastructure. This was followed by a \$1.8 million award from SCAQMD for 10 CNG buses on November 2, 2012. In November 2012, a California Environmental Quality Act study was conducted and concluded with a mitigated negative declaration posted by the County of Riverside Clerk on November 13, 2012. On June 20, 2013, a \$300,000 CNG infrastructure award agreement with the CEC was executed with funding from PON-12-605. This became the final piece of the financial package for phase one of the CNG fueling infrastructure to service the vehicles already on order. At the conclusion of the bid process, Go Natural Gas, Inc. was selected to modify the bus maintenance facility to accommodate repair of CNG buses and to design, build, maintain and warrant the fueling facility for a period of five years. The alternative fuel infrastructure specifications include:

- Electrical: All panels enlarged to support anticipated CNG production needs through to conversion of entire school bus fleet.
- Underground: Conduit is oversized to accommodate enlarging electrical capacity without the need to retrench.
- Fueling posts: All posts are designed to fuel two buses simultaneously and are laid out to facilitate pull-through fueling and parking. Future positions have been identified for ease in connecting with existing high-pressure service lines and pull-through operations.
- Equipment pad: Capable of accommodating additional compression equipment necessary to handle the doubling of CNG production capacity in the future.
- Dryer: Existing PSB dryer capacity can accommodate double the current CNG volume.
- Compression equipment: Existing two compressors are manufactured by Gardner Denver and enclosed by a well-insulated structure complete with sufficiently sized cooling fans designed to enable the compressors to withstand intense high desert heat conditions frequently experienced in southwestern Riverside County.
- Shop upgrade: Includes methane detection, alarm and exhaust system that enables maintenance to be completed indoors on a 24/7 basis thereby allowing maintenance to continue during inclement weather and night shift operations should a second shift be required to accommodate fleet growth.
- Emergency generator: Has sufficient capacity to sustain CNG fueling operations to include completion of the phase two infrastructure expansion.
- Fast-fill: One, two or more fueling dispensers can be isolated for fast-fill operation through shut off valves strategically located throughout the system to accommodate variable fueling needs. The red handle shown in the attached picture isolates a single dispenser.
- System warranty: Infrastructure is designed, built, and warranted with a five-year 100 percent maintenance and warranty agreement by the general contractor, Go Natural Gas.

2.2 Data Collection and Analysis

The project was commissioned on August 28, 2013, after successful completion of all testing and has since been operating trouble free without interruption. The following is the six-month throughput usage and operational data from the station along with an analysis of the economic and environmental impacts:

Throughput:

- The station fueled 8 transit style regular education CNG buses and 2 transit style special needs CNG buses during this data collection period that included 105 school days.
- School buses are fueled an average of 220 days per calendar year.

- The fueling station consists of dual 77 SCFM compressors for a maximum capacity of 154 SCFM.
- A total of 16,611 gallons of diesel fuel was displaced by CNG buses with near identical mileage.

Expected Air Emissions Reduction:

- Non-methane hydrocarbon reduction= 80 percent
- Nitrogen oxides (NOx) reduction= 50 percent (drop of .604 lb. /gal to .302 lb. /gal per epa.gov)
- Particulate matter (PM) 95 percent (virtually no PM emissions from CNG combustion)
- Formaldehyde/volatile organic compounds 55 percent (drop from .049 lb. /gal to .022 per gal)

2.3 Economic Impact

The economic impact resulting from this nine-week fueling station construction project include:

- Total value of project= \$1.65 million
 - \$1 million= equipment parts and supplies
 - \$650,000= labor and infrastructure
 - \$21,000 spent on food, lodging, clothing, and amenities
- Renewable Energy Projects:
 - In 2013 the district constructed solar installations at 21 sites resulting in an annual savings of \$1 million.
- Natural Gas Source:
 - Natural gas used by the CNG fueling system is provided by the So Cal Gas Company.
- Alternative Fuel Expansion Projects:
 - Future expansion of the CNG fueling system is anticipated in 2018 and will increase the fueling capacity from 32 to 50 fueling positions and enhance our current limited modified fast fill capability as follows:
 - 9 additional fueling posts
 - 1, 154 SCFM compressor
 - 1, fast fill storage tank Cost estimate: \$750,000
 - Carbon intensity of natural gas delivered by pipeline to California and compressed by the district is approximately 67.70 gCO₂e/MJ and 94-71 gCO₂e/MJ for current CNG fleet per www.arb.ca.gov. This represents an approximate carbon intensity drop of 28 percent
- Project Performance and Accomplishments:
 - The fueling system has not experienced down time since date of commissioning. CNG fuel was projected to cost \$1.15 per diesel gallon equivalent. Actual diesel gallon equivalent cost was \$1.03 during the first six months of operation. A

- federal rebate of \$.50 per diesel gallon equivalent has been authorized for 2013 and the district is now in the application process. Upon rebate receipt the district cost per diesel gallon equivalent will drop to \$.53.
- Fuel cost comparison over a six-month period of operation between 10 diesel and CNG buses with identical mileage is:
 - Diesel: \$49,000
 - CNG \$8,000 (inclusive of federal rebates)

2.4 Fleet Life Cycle

The life cycle of the current diesel fleet is 24 years and the life cycle of CNG buses is projected to be 20 years making replacement more cost effective than the ever-increasing maintenance and repair costs beyond the 20-year mark. Cost factors include:

- Mandated replacement of CNG fuel tanks in 20th year of service: \$25,000
- Probable engine replacement: \$30,000
- Probable transmission replacement: \$10,000
- Probable differential replacement: \$3,000

CHAPTER 3:

3.1 Project Outcomes

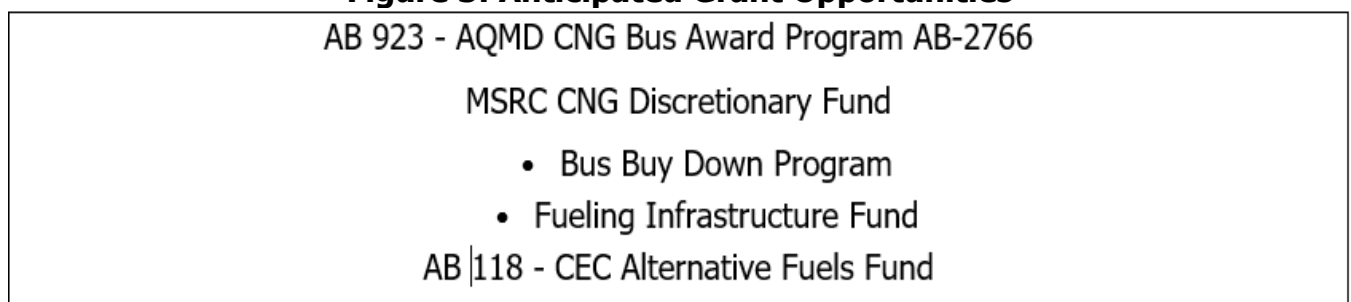
MVUSD was the first to construct a CNG fueling facility in Murrieta, due in large part by the widespread backing of local, state, and federal elected officials whose support helped the district transition into CNG and become a major contributor and community leader in Murrieta’s quest to improve the air quality of the city and southwest Riverside County. This in turn enabled the district to become the beneficiary of efforts by three major agencies — CEC, SCAQMD and MSRC — committed to promote and facilitate the use of alternative fuels in California. In 2012, the district actively partnered with these agencies in the promotion of SB 1445, to extend AB 923 school bus replacement program until 2023. The bill, sponsored by former State Senator Christine Kehoe of the 39th District, failed passage by two votes. In 2013, the district once again supported extension of the bus replacement and alternative fuel bills AB-8, AB 118, and SB-11. This time AB-8 and AB-118 passed both houses extending bus replacement and alternative fuels funding through 2023.

The recent 10-year extension of current CNG legislative bills that funded school bus replacement and construction of alternative fueling systems enables MVUSD to forecast, with some assurance, a year-by-year expansion into CNG in the upcoming decade between 2014 through 2023. This transition plan includes ongoing reliance on bus replacement and fueling infrastructure construction grants offered by CEC, MSRC and SCAQMD. It also enables the acquisition of CNG buses through the MSRC Buy Down Program that provides financial assistance to CNG school bus fleet expansion efforts. The first increment of four buses purchased under the MSRC Buy Down Program were delivered in April 2014.

With completion of the fueling infrastructure and delivery of the first 10 CNG buses in 2013, phase one of the district’s transition into CNG is complete. The focus now is on phase two, the acquisition of additional CNG buses to be fueled by an already completed 32 bus fueling system and the possible expansion of the fueling system being considered to take place in 2018.

Part one of phase two is to capitalize on forthcoming grants anticipated to be administered by CEC, SCAQMD and MSRC during the 10-year cycle authorized by the California Legislature in 2013. The grant programs are listed in figure 3.

Figure 3: Anticipated Grant Opportunities



Source: Murrieta Valley School District

Since this plan is prepared in advance of established parameters for upcoming grant programs authorized by recent legislative action, projections necessarily contain some assumptions.

AB 923 Low Emission School Bus Program Replacement Funding

The most recent AB 923 program announcement by SCAQMD was issued on April 6, 2012, with applications due by July 6, 2012. The SCAQMD Board met to consider approval of the school bus replacement awards on November 2, 2012, with awarded buses delivered in July 2013.

AB 2766 Buy Down Fleet Expansion Funding

This program differs from AB 923 in that it supports fleet expansion efforts by discounting outright purchases of CNG buses by school districts. The program is administered annually by MSRC and does not require turn in of diesel buses for crushing for a school district to qualify for an award. MSRC currently discounts each co-op bid price for CNG Type D Transit Buses by varying amounts each year. The discount for CY 2014 bus awards is \$31,000.

MVUSD has applied and was granted an award of four special needs buses costing the district net total of \$657,000. The buses were delivered in April 2014.

Assuming future grant cycles will be administered on a like timetable, the district will apply for AB 923 awards to continue its heavy-duty fleet CNG conversion program as follows:

Figure 4: AB 923 & 2766 Projections

2013	2014	2015	2017	2019	2021
*10	**4	*10	*3	*4	*4
		*AB-923	**2766 Buy Down		

Source: Murrieta Valley Unified School District

AB 118 Alternative and Renewable Vehicle and Technology Funding

This bill authorizes the CEC to develop and deploy alternative and renewable fuels and advanced transportation technologies to help attain the state’s climate change policies. To this end, it seeks to fund projects that establish infrastructures necessary to store, distribute and dispense alternative fuels and was the program that provided \$300,000 in grant funding to help finance the phase one MVUSD infrastructure project just completed.

MVUSD anticipates exceeding the capacity of the current fueling system by 2017 with the potential acquisition of CNG white fleet vans and trucks in addition to CNG buses. This will require expanding the system by as many as 18 additional fueling positions. At that time MVUSD anticipates applying for infrastructure expansion funding from both AB 118 and MSRC 2766.

3.2 Goals and Objectives

Goal: To complete phase one of the MVUSD compressed natural gas infrastructure to time

fill up to 19 regular education and special education school buses funded by the SCAQMD and MSRC and co-funded by MVUSD.

Objectives: Project objectives were to:

1. Provide time-fill fueling for up to 19 funded natural gas school buses. The first vehicles were scheduled to arrive in July 2013.
2. Provide 31-time fill posts to accommodate the 19 funded natural gas school buses and additional vehicles to be acquired as funding becomes available.
3. Provide quasi-fast fill posts to accommodate neighboring school districts that have agreed to use the new CNG fueling.
4. Save money that can be reinvested into CNG vehicles and infrastructure.

The 19 funded natural gas school buses in objective #1 was based on the purchase of nine buses under the MSRC Buy Down Program listed in Figure 1 instead of the four purchased. The change was necessitated by optional enhancement modifications to the infrastructure and acquisition of higher cost special needs buses.

Despite the reduction in the initial number of CNG buses, the district was confident in its ability to obtain future CNG bus grant awards to justify an infrastructure with a 31-bus fueling capacity. To this end, the district will be applying for another SCAQMD award of 10 more CNG buses in 2014 bringing the total CNG fleet to 24 buses. Recent discussions with SCAQMD officials revealed there are currently 800 pre-1994 heavy duty diesel engine school buses in the SCAQMD basin. It is projected this figure will drop to 100 in three to four years which will likely trigger a manufacture date threshold change to include post 1994 heavy diesel buses. If the threshold change remains consistent with past changes (seven-year increments) it will enable all of MVUSD's remaining heavy duty diesel buses to qualify for grant replacement.

The quasi-fast fill assembly positions enable MVUSD to help neighboring districts to fill their buses in time of need and to provide refueling services to school districts outside the round-trip range of field trips to southwest Riverside County. This can be accomplished by segmenting the number of buses to be fueled at any given time according to the amount of time needed to complete the fueling operation. The amount of time it takes to fill a bus can range from 20-30 minutes to fill one or two buses to six or seven hours to fuel the entire fleet of 31 buses.

CHAPTER 4:

4.1 Observations

MVUSD's initial strategy was to convince agencies offering funding assistance toward alternative fuel initiatives that Murrieta was serious about CNG and was willing to make an "up front" financial commitment and that a partnership with Murrieta would be economically feasible for all parties concerned. As testimony to this commitment, the MVUSD Board of Education approved \$2 million as seed money to invest in CNG. The result of this strategy is summarized in Figure 2 of this report.

Once funding for the infrastructure was approved by both CEC and MSRC, the district conducted a satisfaction survey with school districts in Riverside County that had constructed CNG fueling systems within the past 10 years and discovered the following common concerns:

- K-rail: K-rail between fueling posts was commonly used. In these instances, the high pressure CNG lines were attached to the top of the k-rails lined between fueling posts. The main reason for using k-rail was to reduce the cost of trenching. While cost savings were significant and essential in some cases because of the paucity of available district funds, k-rail creates three problems: (1) buses must be backed up to either enter or leave respective fueling positions, (2) heat factor caused by the CNG lines being exposed to the sun throughout the day and (3) ease with which exposed CNG lines can be damaged.
 - Resolution: All utilities associated with compression and distribution of CNG are located underground and encased with oversized conduit to facilitate replacement if necessary. This design is especially significant from an operational perspective since fueling and parking is enhanced by pull through positions.
- Compressors: Compressor problems were mostly related to extreme heat experienced in this high desert region. A common condition was oil from the compressor leaking into the fueling system during periods when ambient temperatures reached 80-plus degrees for extended periods of time. This necessitated shutting down the system to prevent oil from contaminating the bus fuel sensor systems. Quick remedies were infrequent absent those supported by contractual maintenance obligations.
 - Resolution: Because MVUSD lacked in-house CNG expertise, the district obtained the services of an independent consulting engineer who was neither on the payroll of a contractor or equipment manufacturer nor received compensation for using a specified equipment brand. Following due diligence, the district selected a qualified independent engineer to meet the following goals:
 - Meet the district's needs both now and in the future.
 - Comply with the district's budgetary and scheduling constraints.
 - Design specifications to maximize ease of operation, reliability, and safety, and to minimize construction and operating costs.
 - Advise the district during contractor bid selection and contract negotiations.

The services of a consulting engineer were invaluable to the district and are considered essential, if not critical, to any organization without in-depth staff expertise in the operation and maintenance of CNG equipment. Thus, MVUSD required its contract awardee to be responsible for 100 percent warranty and maintenance of all equipment and work performed for a period of five years, to commence at the completion of a 30-day trouble free performance period following commissioning of the infrastructure system. This was made an essential function to insure (1) acquisition of quality equipment and materials, and (2) quality work performance. This project was awarded to Go Natural Gas, the only bidder responding to the maintenance and warranty specification.

4.2 Additional Projects

As discussed in Chapter 3, SCAQMD officials recently informed the district there is a dwindling number of pre-1994 heavy duty buses currently in service in the South Coast Air Basin and that in 3-4 years the number could be as low as 100-150. This likely will trigger a grant threshold change to 1994 and newer thus qualifying all remaining MVUSD heavy duty diesel buses for grant replacements. At that time, the district will have outgrown its current fueling station capacity. Hence, in the 2017-2018 timeframe the district anticipates it will once again petition both CEC and MSRC for piggyback grant funding assistance to expand the current fueling system to accommodate up to 15 additional CNG replacement buses.

4.3 End Goal

MVUSD's success cannot be totally measured at this time even though the goal of the project was to complete phase one of the CNG infrastructure.

The CNG buses are manufactured to have a life expectancy of 20 years. MVUSD's end goal is to acquire and operate a school bus fleet that is 100 percent CNG and sustained by a self-financed fleet replacement program funded by fuel cost savings and ridership fees.

Figure 5 is the recently approved school bus replacement investment schedule beginning in fiscal year 2014 and maturing with an annual investment of \$275,000 each year beginning in FY 2014-15.

Figure 5: School Bus Replacement Investment Plan

<u>Fiscal Year</u>	<u>Annual Amount</u>	<u>Cumulative Total</u>
14-15	\$25K	\$25K
15-16	\$50K	\$75K
16-17	\$75K	\$150K
17-18	\$100K	\$250K
18-19	\$125K	\$375K
19-20	\$150K	\$525K
20-21	\$175K	\$700K
21-22	\$200K	\$900K
22-23	\$225K	\$1.1M
23-24	\$250K	\$1.4M
24-25	\$275K	\$1.6 M
25-41	(Approximately \$275K each year)	\$6.3 M

Source: Murrieta Valley Unified School District

This is a perpetual fund to be created in FY 14-15 with an initial investment of \$25,000 with incremental annual increases of \$25,000 for 11 years. Each year thereafter, the annual investment will be \$275,000. This bus replacement fund will be the final critical financial link that enables the district to sustain its home to school transportation program once grant funding is no longer available. The funding stream for the investment plan originates from bus rider fees that currently total \$280,000.

The fund is also a contingency plan that allows the district to track costs and adjust investment levels accordingly to ensure funds are sufficient to acquire replacement buses beginning in 2033 when the CNG 20-year life cycle dictates.

In summary, the partnership created between the MVUSD, CEC, SCAQMD, and MSRC not only benefits the community of Murrieta, it contributes to the ongoing statewide effort to remove PM and NOx from California's atmosphere. Murrieta is a school district that is committed to clean energy and doing its part to help California attain its climate change goals.

GLOSSARY

AIR QUALITY MANAGEMENT DISTRICT (AQMD)—Air districts issue permits and monitor new and modified sources of air pollutants to ensure compliance with national, state, and local emission standards and to ensure that emissions from such sources will not interfere with the attainment and maintenance of ambient air quality standards adopted by the California Air Resources Board (ARB) and the U.S. Environmental Protection Agency (U.S. EPA).

CALIFORNIA ENERGY COMMISSION (CEC)—The state agency established by the Warren-Alquist State Energy Resources Conservation and Development Act in 1974 (Public Resources Code, Sections 25000 et seq.) responsible for energy policy. The Energy Commission's five major areas of responsibilities are:

1. Forecasting future statewide energy needs
2. Licensing power plants sufficient to meet those needs
3. Promoting energy conservation and efficiency measures
4. Developing renewable and alternative energy resources, including providing assistance to develop clean transportation fuels
5. Planning for and directing state response to energy emergencies.

COMPRESSED NATURAL GAS (CNG)—Natural gas that has been compressed under high pressure, typically between 2,000 and 3,600 pounds per square inch, held in a container. The gas expands when released for use as a fuel.

MOBILE SOURCE AIR POLLUTION REDUCTION REVIEW COMMITTEE (MSRC)—A committee comprised of one representative from each of the following agencies:

- South Coast District (South Coast Air Quality Management District - SCAQMD)
- Southern California Association of Governments (SCAG)
- San Bernardino County Transportation Authority (SBCTA)
- Los Angeles County Metropolitan Transportation Authority (LACMTA)
- Orange County Transportation Authority (OCTA)
- Riverside County Transportation Commission (RCTC)
- State Board (ARB)
- A regional rideshare agency selected by the other members of the MSRC committee

All member appointments and alternates are made by the respective appointing authority. The authorized appointing authority may reappoint or fill a vacancy by giving notice in writing to the MSRC Chairperson.

Murrieta Valley Unified School District (MVUSD)—Serves 23,400 students in kindergarten through grade 12. It has 11 elementary schools, four middle schools, three high schools, one alternative education school, and one adult/community education program. It is located in Murrieta, California on the southwestern edge of Riverside, California.

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.

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 over 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.