CALIFORNIA ENERGY COMMISSION

California Energy Commission

Clean Transportation Program

FINAL PROJECT REPORT

Sysco Riverside LNG Infrastructure Project

Develop Public Access LNG Station in Riverside, California

Prepared for: California Energy Commission

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PREFACE

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

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

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

To be eligible for funding under the Clean Transportation Program, a project must be consistent with the CEC's annual Clean Transportation Program Investment Plan Update. The CEC issued PON-11-602 to provide funding opportunities for projects that develop infrastructure necessary to store, distribute, and dispense electricity, E-85, Biomass-based diesel, 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-11-033 on August 1, 2012.

ABSTRACT

An important aspect of natural gas vehicle deployment in California is the lack of supporting infrastructure. There is limited access to natural gas infrastructure between the Ports of Long Beach and Los Angeles, and the warehousing facilities in the Inland Empire. This enormous barrier deters the adoption or expansion of natural gas advanced technologies by the many goods movement fleets that haul cargo along this heavily traveled Southern California route every day.

As a result, Sysco Riverside sought to develop a publicly accessible liquefied natural gas station along the 1-215 corridor in Riverside County to accommodate its expanding fleet of natural gas-powered goods movement vehicles, as well as to offer a refueling station for other natural gas truck users.

The goal of the station development was to provide an incentive for heavy-duty trucking fleets to adopt or expand use of natural gas advanced technologies, enable the accelerated replacement of heavy-duty diesel trucks with ultra-low-emission natural gas, further infuse the Southern California regional natural gas refueling infrastructure with locally produced, low-carbon, and create and strengthen the necessary web of infrastructure across the region and state. Sysco's station development project supports a region-wide transition opportunity for heavy-duty fleets interested in alternative fuels, as well as allows for the reduction of diesel consumption and vehicle emissions in California.

Keywords: Sysco Riverside (Sysco), liquefied natural gas (LNG), greenhouse gas (GHG), carbon dioxide (CO2), diesel gallon equivalents (DGE), nitrogen oxides (NOx),

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EXECUTIVE SUMMARY

Under this grant agreement, Sysco developed a publicly accessible liquefied natural gas station to fuel their expanding fleet of natural gas-powered goods movement vehicles in Riverside. The new station established natural gas fueling infrastructure to support its fleet and others operating along one of the busiest stretches of highway in the nation. At the time of application, Sysco operated 35 trucks.

This initial fleet was expected to grow to 125 liquefied natural gas trucks during the project life, thus creating a strong need for infrastructure to fuel its vehicles. Sysco' s contractor, Fullmer Construction, was responsible for the construction of the liquefied natural gas fueling station, which became operational in May 2013. Sysco' s objective in constructing this station is to provide the additional necessary infrastructure needed to make alternative fuels like natural gas a commercially available and preferable fueling option.

Natural gas contains less carbon than any other fossil fuel, and thus produces lower carbon dioxide and greenhouse gas emissions per year. In fact, natural gas vehicles produce up to 20-30 percent fewer greenhouse gas emissions than comparable diesel vehicles. Natural gas is typically less expensive than diesel, costing less energy per unit.

Sysco is quite familiar with the many benefits of natural gas, and as such it sought to provide these benefits to its own fleet and others in the development of this station. This project also complements existing air quality guidelines by deploying natural gas engines that are certified to the strict standard of 0.2 grams/boiler horsepower per-hour nitrogen oxides without the use of average, banking, and trading credits. Furthermore, the use of liquefied natural gas dispensed from the station complements the California Phase 3 Reformulated Gasoline Standard and diesel fuel regulations by achieving greater emission benefits than the goals of the standards.

Having a reliable, operationally feasible low-cost natural gas fuel at a convenient location provides additional economic incentives and fuel source security that can encourage fleets to make new purchases of natural gas-powered trucks. The successful installation of this fueling station will provide the necessary infrastructure to fuel natural gas vehicles operated by Sysco. Natural gas is a clean, safe, and abundant fuel that is domestically produced, with 99 percent used in the United States coming from North America.

CHAPTER 1:
Project Background and Objectives

Sysco' s objective to develop a public access LNG station was to support its own LNG vehicle operations, as well as to offer an LNG refueling station for other natural gas truck users along the 1-215 corridor in Riverside County. The station is located off the 1-215 on Meridian Parkway in Riverside, California. It will be located at the northeast comer of the property, in a very convenient location that will support a region-wide transition to low-emission natural gas-powered trucks.

Sysco utilizes enough fuel volume to justify a full station and sought to develop a public access fueling station to help facility other fleets in the region to also adopt natural gas vehicles aggressively into their own operations. According to the United States Department of Energy' s Alternative Fuels & Advanced Vehicles Data Center, there is currently only one other LNG fueling facility along the 1-215 in Riverside. This prevents the conversion to natural gas from diesel for other vehicles that travel in the area.

The average daily traffic along the 1-215 corridor is over 11,000 trips, with trucking and goods movement expected to grow. These projected increases in the volume of vehicles on the corridor present a clear picture as to the critical demand for natural gas refueling infrastructure that is quickly evolving along this major transportation artery.

The objective for this project was to target this niche market in hopes of shifting some of this petroleum demand to clean alternative fuels such as LNG. Sysco met the goals of this project with the development of its Riverside LNG station by:

- Supporting and bolstering the regional refueling infrastructure strategy being developed in Southern California through the development of a new publicly accessible station along a key goods movement corridor.
- Providing natural gas refueling for Sysco' s fleet.
- Providing for nearly 1.46 million gallons of LNG per year.
- Providing for the displacement of more than 812,500 gallons of annual diesel use with 100 percent domestically produced low-carbon LNG.
- Providing for the reduction of more than 2,400 metric tons of GNG emissions and more than 24 tons of NOx emission per year.
- Promoting regional growth in alternative fuel vehicle deployments and the replacement of heavy-duty diesel trucks.
- Enabling a cost-effectiveness as low as $0.39 per gallon of diesel displaced and $130.81 per metric ton of GHGs reduced.

CHAPTER 2:
Scope of Work

Sysco' s scope of work under contract ARV-11-033 included the construction, delivery of equipment, and operation/reporting of this public access LNG refueling station. Sysco was responsible for constructing the LNG refueling station with new equipment:

- Two above-ground horizontal LNG storage tanks (16,000-gallon capacity each).
- Two island mounded LNG dispensers.
- One offloading station and pump assembly.
- LNG pump skid.
- Two submersible LNG pumps.
- Panel for delivery tanker offloading into the LNG storage tanks.
- Saturation vaporizer.
- Vacuum-jacketed piping.
- Four flame detectors.
- Five gas sensors.
- Universal card reader.

All station components comply with Title 8, California Code of Regulations[1], National Fire Protection Association[2], and any other local, state, and federal codes as applicable. The station also included design, engineering, permitting, project management and purchasing. Sysco' s work included fire protection, fire detection, methane detection, and all necessary safety elements identified with hazardous operations process safety.

Technical Tasks

Sysco completed several technical tasks in order to complete the LNG refueling station development in an orderly and efficient manner. In particular, Sysco completed the below overall tasks under this project.

Design System - Engineering and Preconstruction

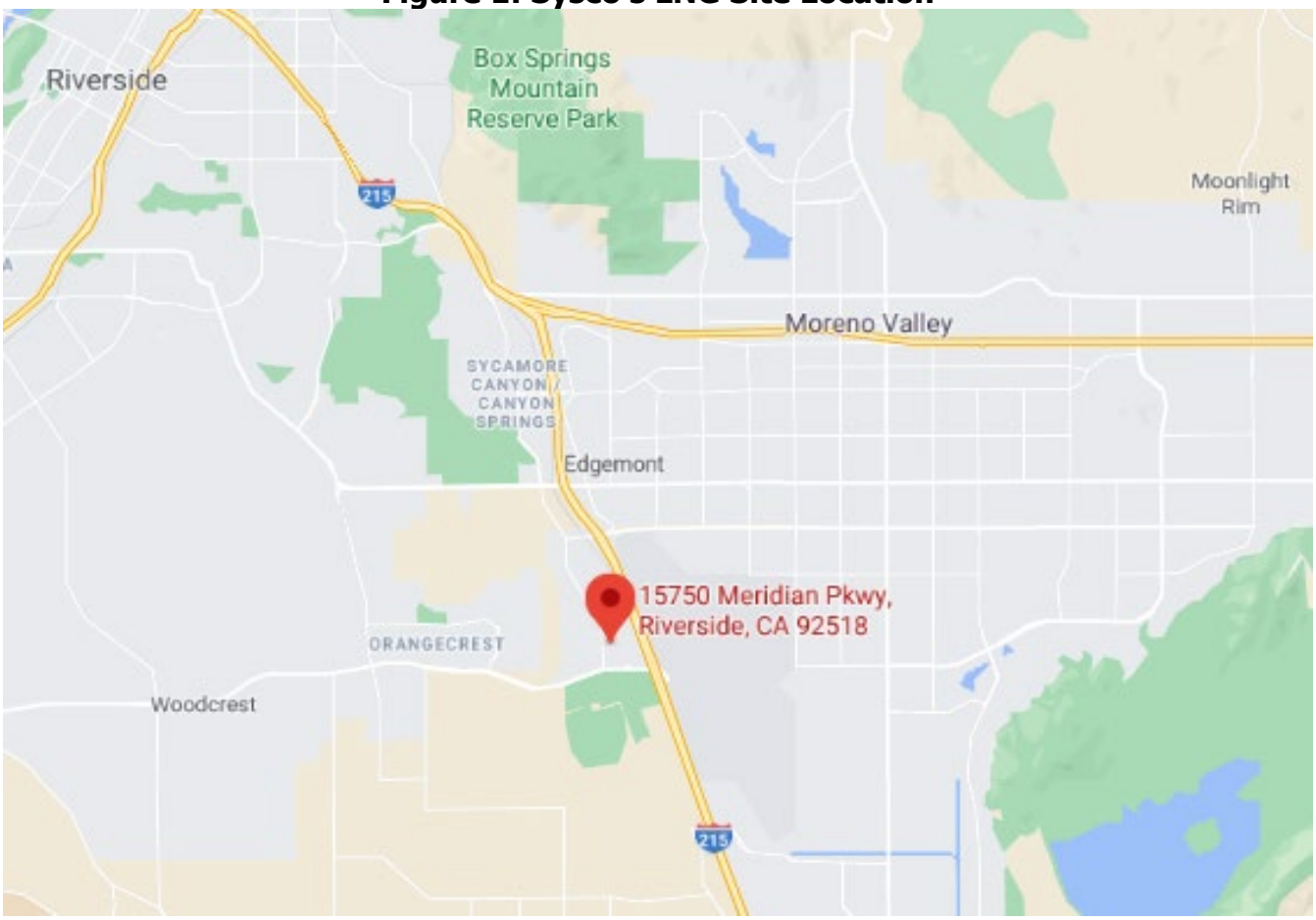
Sysco performed civil and architectural engineering, including design management services, and preconstruction planning. Sysco finalized the layout, engineering, and design of the station.

[1] State of California Department of Industrial Relations https://www.dir.ca.gov/samples/search/query.htm
[2] National Fire Protection Association https://www.nfpa.org

Site Location

Figure 1 below shows the location of Sysco's LNG site location in Riverside County.

Figure 1: Sysco's LNG Site Location



Source: Sysco Food Services of Los Angeles, Inc

Sysco performed construction activities at the site in accordance with the design specifications to prepare for the arrival of the equipment to the site. Sysco completed the site construction and improvements, which included completing the electrical and mechanical work, extending the natural gas line from the main to the equipment, and installing underground and aboveground piping and conduits to transport natural gas from the collection system on site to the plant.

Equipment Delivery and Installation

Sysco took delivery of all necessary equipment and supplies at the site. In Figure 2, on the next page, one of Sysco's LNG semi-trailers can be seen arriving at the station site. Within this task, the equipment, controls, and support infrastructure were installed in accordance with the system design specifications. The final installation of these LNG sites can be seen in Figures 3 and 4 on the next page.

Figure 2: One of Sysco's LNG Vehicles

Source: Sysco Food Services of Los Angeles, Inc

Source: Sysco Food Services of Los Angeles, Inc

Source: Sysco Food Services of Los Angeles, Inc

System Start-up and Commissioning into Service

Sysco started up the LNG fueling system and commissioned the system into operation. Sysco also created public awareness about the development of this infrastructure project using AB 118 funding[3]. In collaboration with key stakeholders, Sysco invited government officials and the media to the ribbon cutting ceremony. The flyer for the ribbon cutting ceremony can be seen in Figure 5 below.

Figure 5: Invitation to Ribbon Cutting Ceremony

Source: Sysco Food Services of Los Angeles, Inc

[3] California Legislation Information https://leginfo.legislature.ca.gov/faces

Data Collection and Analysis

Sysco collected and analyzed data on the economic benefits and local impacts of the project, including the station throughput and associated project emission benefits.

Monthly Fuel Throughput

Approximately 43 Sysco units and 2 other units (other private fleet trucks) currently utilize the Riverside LNG station. The station has been operational since June 2013. Total fuel usage over the period of July 2013 through March 2014 was approximately 334,687 LNG gallons, or 194,689 DGE. On average, monthly throughput is approximately 37,187 LNG gallons, or 21,632 DGE. This data can be seen in Table 1 below.

Table 1: Monthly Fuel Throughput at the Sysco LNG Station

Month	LNG	DGE
July 2013	27,701	16,114
August 2013	34,580	20,115
September 2013	38,197	22,219
October 2013	36,775	21,392
November 2013	37,777	21,975
December 2013	42,492	24,718
January 2014	42,492	24,718
February 2014	40,024	23,282
March 2014	40,756	23,708
Total Throughput	334,687	194,689
Monthly Average	37,187	21,632

Source: Sysco Food Services of Los Angeles, Inc

Emission Reductions

Based on the average throughput of approximately 37,187 gallons of LNG per month, or 21,632 DGE per month, Sysco is responsible for emission reduction benefits due to the Riverside LNG station development. Using the Carl Moyer Program Guidelines (Adopted April 2011)[4] methodology for calculating criteria pollutant emission reductions and using a baseline model year 2006-diesel on-road tractors, Sysco can expect to achieve the following criteria pollutant reduction benefits based on initial deployments by using natural gas vehicles instead of diesel. This data can be seen in Table 2 on the next page. These benefits will increase over time as Sysco deploys additional units.

[4] Carl Moyer Program Guidelines (2011) https://ww2.arb.ca.gov/guidelines-carl-moyer

Table 2: Emission Reduction Calculation

Criteria Pollutant Emission Reduction Calculation	NOx	Particulate Matter
Baseline Emission Factor (gallons/mile) 2006 Diesel	11.63	0.252
Reduced Emission Factor (gallons/boiler horsepower per hour)	0.16	0.01
Conversion Factor (boiler horsepower per hour/mile)	2.90	2.90
Energy Consumption Factor (boiler horsepower per hour/gallon)	18.50	18.50
Estimated Annual Fuel Consumption	259,584	259,584
Percentage in Operation in California (1.0 = 100 percent)	1.0	1.0
(ton/907,200 gallons)	0.00000110229277	0.00000110229277
Projected Baseline Emissions (tons/year)	21.23	0.460
Projected Reduced Emissions (tons/year)	0.85	0.053
Annual Emission Reductions (tons/year)	20.38	0.407

Source: Sysco Food Services of Los Angeles, Inc

Because of the Riverside LNG station development project, Sysco can achieve the reduction of more than 20 tons per year of NOx, and 0.4 tons per year of Particulate Matter. Additionally, the project will contribute to the reduction of approximately 779 tons of GNG emissions per year. GHGs were calculated according to fuel consumption, using emission factors from the Low Carbon Fuel Standard Table 6 Carbon Intensity Lookup Table for Gasoline and Fuels that Substitute for Gasoline[5].

[5] California Air Resource Board Look Up Table https://ww3.arb.ca.gov/regact/2009/lcfs09/lcfscombofinal.pdf

CHAPTER 3: Results

Results

Sysco completed the construction of its public-access LNG refueling station. The station is open and currently operational, fueling Sysco' s large fleet of regional LNG vehicles and other goods movement trucks traveling to and from distribution centers. The station construction was completed according to plan and with no major issues.

Problems

Initially, there were concerns that the station would present hazards to aircraft. The land use commission had jurisdiction, yet no familiarity with an LNG station project such as this. Yet Sysco has experience and good project partners, and the team identified the challenges and risks and developed corresponding solutions. Two potentially hazardous scenarios involving aircraft that were imagined were:

- An emergency landing on the site where the aircraft lands near the LNG equipment and ultimately impacts the equipment in some capacity.
- An emergency landing on the site where the aircraft lands directly on the LNG fuel storage tanks and equipment.

Sysco developed a briefing and a full presentation to review the hazards and discuss risk mitigations. Sysco described how the LNG station met all code and setback requirements, how the tanks have a low profile and robust construction and discussed LNG containment in the event of a spill.

Benefits

Sysco remains committed to reducing emissions and creating cleaner solutions, such as the construction of alternative fuel natural gas fueling stations for use by its fleet. The Riverside LNG Infrastructure Project directly meets the goals of the AB 118 Clean Transportation Program[6] by demonstrating a measurable and significant transition from the use of petroleum to use of a low-emission alternative fuel. Through a public-private investment between the CEC and Sysco, this project is curbing GHGs, reducing petroleum use, and improving air quality in California.

[6] California Legislation Information https://leginfo.legislature.ca.gov/faces

CHAPTER 4: Conclusions

Led by a prepared and seasoned team with a vast understanding of the technology, this project greatly assists the CEC to displace petroleum with clean-burning natural gas and reduce GHG emissions from Sysco's existing fleet. The successful construction of this LNG refueling station provides increased fueling capacity for natural gas vehicles operated by Sysco and other fleets. Natural gas is a clean, safe, and abundant fuel that is domestically produced, with 99 percent used in the United States coming from North America.

Natural gas contains less carbon than any other fossil fuel and thus produces lower CO2 and GHG emissions per year. In fact, natural gas vehicles produce 20-30 percent less than GNG emissions than comparable diesel vehicles. Sysco is quite familiar with the many benefits of natural gas, as the largest food-service marketing and distribution organization in North America. Sysco is dedicated to doing business in the most sustainable way possible.

Commercialization

This project will provide the additional necessary infrastructure needed in order to make alternative fuels like natural gas a commercially available and preferable fueling option. Sysco remains committed to reducing emissions and creating cleaner solutions, such as the construction of alternative fuel natural gas fueling stations for its fleet and others within the neighborhoods that Sysco' s employees work and live.

GLOSSARY

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

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.

CARBON DIOXIDE (CO2)—A colorless, odorless, nonpoisonous gas that is a normal part of the air. Carbon dioxide is exhaled by humans and animals and is absorbed by green growing things and by the sea. CO2 is the greenhouse gas whose concentration is being most affected directly by human activities. CO2 also serves as the reference to compare all other greenhouse gases (see carbon dioxide equivalent).

DIESEL GALLON EQUIVALENT (DGE)—The amount of alternative fuel it takes to equal the energy content of one liquid gallon of diesel fuel

GREENHOUSE GAS (GHG)—Any gas that absorbs infrared radiation in the atmosphere. Greenhouse gases include water vapor, carbon dioxide (CO2), methane (CH4), nitrous oxide (NOx), halogenated fluorocarbons (HCFCs), ozone (O3), per fluorinated carbons (PFCs), and hydrofluorocarbons (HFCs).

LIQUEFIED NATURAL GAS (LNG)—Natural gas that has been condensed to a liquid, typically by cryogenically cooling the gas to minus 260 degrees Fahrenheit (below zero).

NITROGEN OXIDES (OXIDES OF NITROGEN, NOx)—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.

SYSCO RIVERSIDE (Sysco)— Sysco Riverside's 400 local associates bring a wealth of experience and specialized skills to the table — from culinary experts and customer care professionals to warehouse and delivery specialists. We live, work, play and dine in our local community. This allows Sysco Riverside to be both personally involved in your business and professionally invested in your success.[7]

[7] SYSCO Riverside https://www.sysco.com/Contact/Contact/Our-Locations/Riverside