CALIFORNIA ENERGY COMMISSION

CALIFORNIA NATURAL RESOURCES AGENCY

Clean Transportation Program

FINAL PROJECT REPORT

WOODLAND HILLS SMARTFUEL® HYDROGEN STATION

Prepared for: California Energy Commission

Prepared by: Air Products and Chemicals, Inc.

August 2023 | CEC-600-2023-037

California Energy Commission

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- The California Energy Commission
- The Governor's Office of Business and Economic Development (thanks to Tyson Eckerle for his efforts)
- South Coast Air Quality Management District

Air Products also acknowledges the efforts of its engineering and operations teams for their ongoing commitment to safety in the deployment of this hydrogen fueling station.

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-12-606 to expand the network of publicly accessible hydrogen fueling stations to serve the current population of fuel cell electric vehicles (FCEVs) and to accommodate the planned large-scale roll-out of FCVs commencing in 2015. In response to PON-12-606, the recipient submitted an application which was proposed for funding in the CEC's notice of proposed awards April 11, 2013 and the agreement was executed as ARV-12-059 on July 12, 2013.

ABSTRACT

Air Products and Chemicals, Inc. designed, engineered, permitted, constructed, and made operational a hydrogen refueling station at 5314 Topanga Canyon Blvd., Woodland Hills, California. The Woodland Hills SmartFuel® hydrogen station was approved for construction on April 14, 2015 and began public fueling in October of 2016. The station receives gaseous hydrogen delivered at elevated pressure from an Air Products production facility in southern California. The station is comprised of compression, cooling, and a two-hose dispenser with a customer payment interface are used to refill fuel cell electric vehicles.

Keywords: Woodland Hills, Air Products and Chemicals, Inc., fuel cell vehicles, hydrogen infrastructure, SmartFuel® hydrogen refueling station

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TABLE OF CONTENTS

LIST OF FIGURES

LIST OF TABLES

Page

EXECUTIVE SUMMARY

Hydrogen fuel cell electric vehicles and hydrogen refueling stations are expected to play key roles in California as the State transitions to lower-carbon and zero-emission vehicle technologies for light-duty passenger vehicles, transit buses, and truck transport fleets. Numerous government regulations and policy actions identify fuel cell electric vehicles as a vehicle technology that will be available to meet the California Air Resources Board's zero-emission vehicle regulation and the Governor's goal of 1.5 million zero-emission vehicles by 2025. More specific actions to bring fuel cell electric vehicles to California markets are specified in the Governor's Zero Emission Vehicle Action Plan.

Hydrogen fuel cell electric drive technology offers tremendous potential for the light-duty passenger vehicle market and medium- and heavy-duty truck and bus markets. Fuel cell electric vehicle passenger vehicles can drive more than 300 miles on a tank of hydrogen and can be refueled in 3 to 4 minutes the way gasoline passenger vehicles are fueled. They have zero tailpipe emissions, while the carbon footprint of these vehicles is nearly the same as plug-in electric vehicles. The technology can be readily scaled up for sport utility vehicles, family passenger vans, pickup trucks, urban package and beverage delivery trucks, and even heavy-duty trucks and buses. Most auto industry analysts and agencies view fuel cell electric drive technology as a complement to battery electric drive technologies rather than as a competing technology. Both battery and fuel cell electric vehicle technologies will be needed in California to achieve the zero-emission-vehicle deployment goals.

In contrast to battery electric and plug-in hybrid electric vehicles that can be charged at home, fuel cell electric vehicles require a new network of refueling stations that dispense pressurized hydrogen for consumer use. This has meant that the auto industry and station development industry have had to develop two new technologies in parallel: hydrogen refueling infrastructure and hydrogen fuel cell electric vehicles (FCEVs). Fuel cell electric vehicles cannot be widely marketed and sold to consumers without a minimum network of refueling stations available.

Assembly Bill 8 (AB 8, Perea, Chapter 401, Statutes of 2013) reauthorized the original Assembly Bill 118 funding program (Núñez, Chapter 750, Statutes of 2007) and created new legal requirements for the California Energy Commission's Alternative and Renewable Fuel and Vehicle Technology Program. The bill directs the CEC to allocate up to $20 million per year, or up to 20 percent of each fiscal year's available funding, to develop hydrogen refueling stations "until there are at least 100 publicly available hydrogen-fueling stations in operation in California" (Health and Safety Code 43018.9[e][1]).

The California Energy Commission contributed $1,252,746 of the total $1,927,302 budget to design, engineer, permit, construct, and make the Woodland Hills SmartFuel® hydrogen station operational.

The site selected for this project is 5314 Topanga Canyon Blvd., Woodland Hills, California (Los Angeles County). A hydrogen refueling station at this location will serve fuel cell electric

vehicles in the area. Air Products and Chemicals, Inc. (Air Products) accomplished this goal through the steps outlined below.

Air Products worked with the Woodland Hills gas station owner on a hydrogen fueling station at 11261 Santa Monica Blvd. in Los Angeles, so the parties were very familiar with the terms and conditions of the land lease agreement. Initially, Air Products prepared and executed the site memorandum of understanding on August 29, 2013. This allowed Air Products to proceed and obtain contemporaneous commitment on site design, permitting, and the terms of the station lease. Air Products and the landlord executed the lease on April 29, 2015.

Air Products developed the site configuration and design, and S. Gordin Structural Design and Engineering Services, Inc. performed the detailed engineering design. Initial structural and electrical design packages were completed on June 23, 2014.

Air Products submitted the permit application to the Los Angeles Department of Building and Safety on June 23, 2014. The Los Angeles County Fire Department requested a separate submittal with additional information, and this was provided in early July of 2014. The station equipment layout was approved by the Fire Department in October of 2014. The electrical design was changed by the Los Angeles Department of Water and Power on March 10, 2015. Following resubmittal of the updated design packages, the station design was approved on April 14, 2015.

Air Products provided the hydrogen refueling station equipment. Based upon their excellent safety record and prior experience with hydrogen station construction, Air Products selected Fueling and Service Technology, Inc. as the construction contractor on September 3, 2015. Construction began on October 12, 2015. Additional changes to the electrical design were identified by the Department of Water and Power during the construction phase. Following changes to the design, construction of the Woodland Hills SmartFuel® hydrogen station was completed on April 29, 2016.

The process of making the Woodland Hills SmartFuel® hydrogen station operational began on May 2, 2016, and was completed on August 16, 2016. The Hydrogen Station Equipment Performance Device was then brought to the Woodland Hills station to verify operation per the Society of Automotive Engineers Standard J2601. This testing was performed from August 16 to August 18, 2016. Approval of the hydrogen dispenser for retail operations by the California Department of Measurements and Standards was received on August 22, 2016. Following review of Hydrogen Station Equipment Performance data and other automaker testing which concluded in September, initial use of the Woodland Hills SmartFuel® hydrogen station by retail customers occurred in early October of 2016.

The Woodland Hills SmartFuel® hydrogen station can dispense 180 kilograms per day with daily deliveries. The station has the potential to contribute to the reduction of greater than 1,100 metric tons of GHG emissions and greater than 66,000 gallons of gasoline consumption annually.

CHAPTER 1:
Station Design and Construction

Project Timeline

This section highlights the most critical items related to the development of the Woodland Hills hydrogen station, provides detail on each, and states the timing required for each step for this site.

Site Acquisition (August 2013 – April 29, 2015)

Following the kick-off of Grant Agreement ARV-12-059, Air Products and Chemicals, Inc. (Air Products) prepared and executed the site memorandum of understanding on August 29, 2013. This allowed Air Products to proceed with site design and to negotiate the terms of the station lease with the gas station owner. Air Products worked with the same station owner on a hydrogen fueling station at 11261 Santa Monica Blvd. in Los Angeles, so the parties were very familiar with the terms and conditions of the land lease agreement.

Negotiations on the station lease concluded in October of 2014, and the parties agreed to execute the lease upon completion of the permitting process.

The station lease was then formally executed on April 29, 2015.

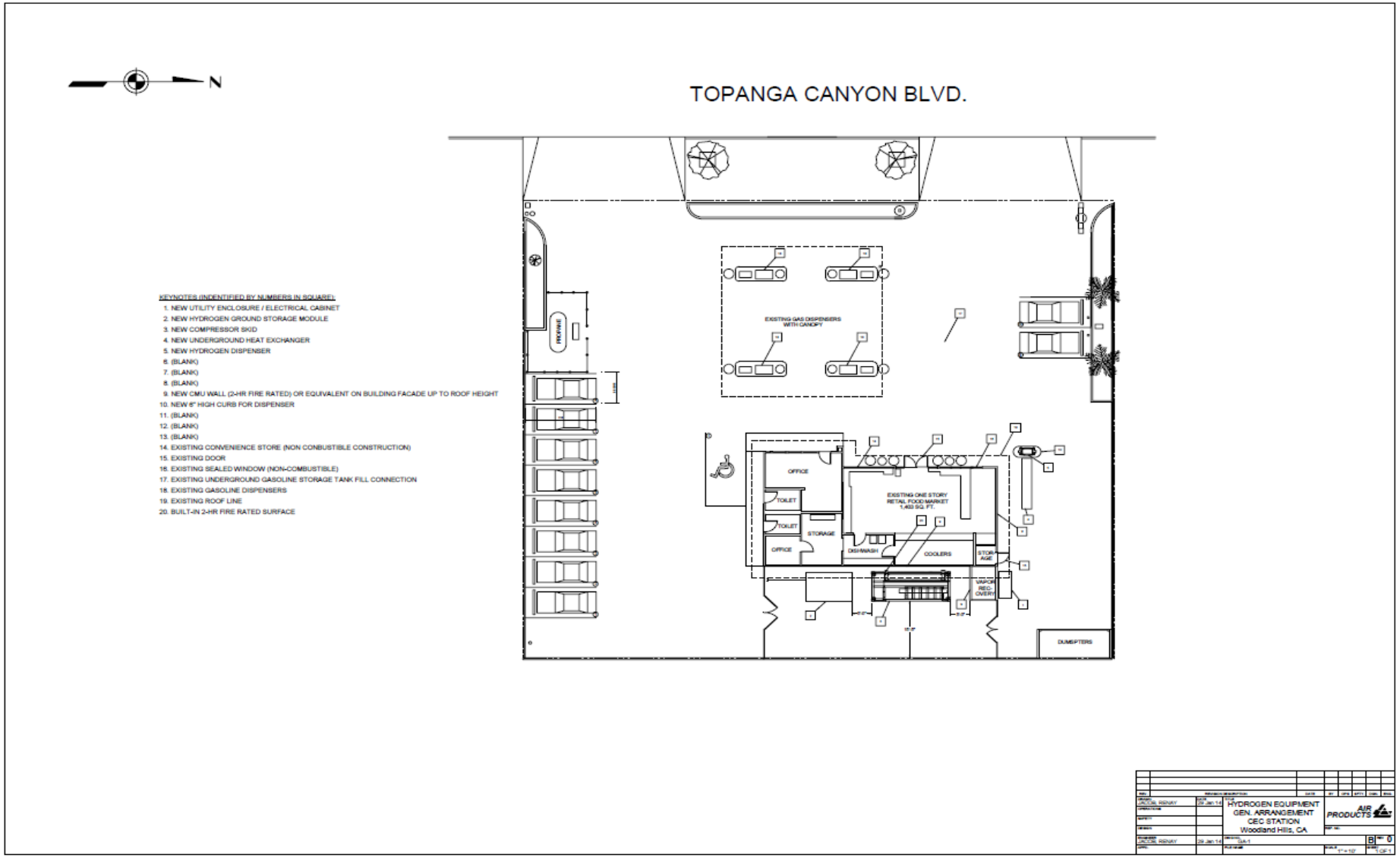
Site Design and Engineering (September 30, 2013 – June 23, 2014)

Air Products held preliminary discussions with S. Gordin Structural Design and Engineering Services, Inc. regarding the Woodland Hills station. The companies executed a subcontract for design engineering services on December 3, 2013, and an initial site visit took place on December 18, 2013.

Following this meeting, options for equipment layouts were prepared by the architect for review with the gas station owner. Figure 1 provides an initial equipment arrangement drawing. During this time, an introductory meeting was held at the station with a representative from the Los Angeles Department of Water and Power on February 18, 2014. Several iterations of equipment arrangement drawings were developed, and the gas station owner agreed that an existing propane tank could be relocated to facilitate the installation of the dispenser. The site plan was approved by the gas station owner on April 30, 2014, and Figure 2 provides the approved equipment arrangement drawing.

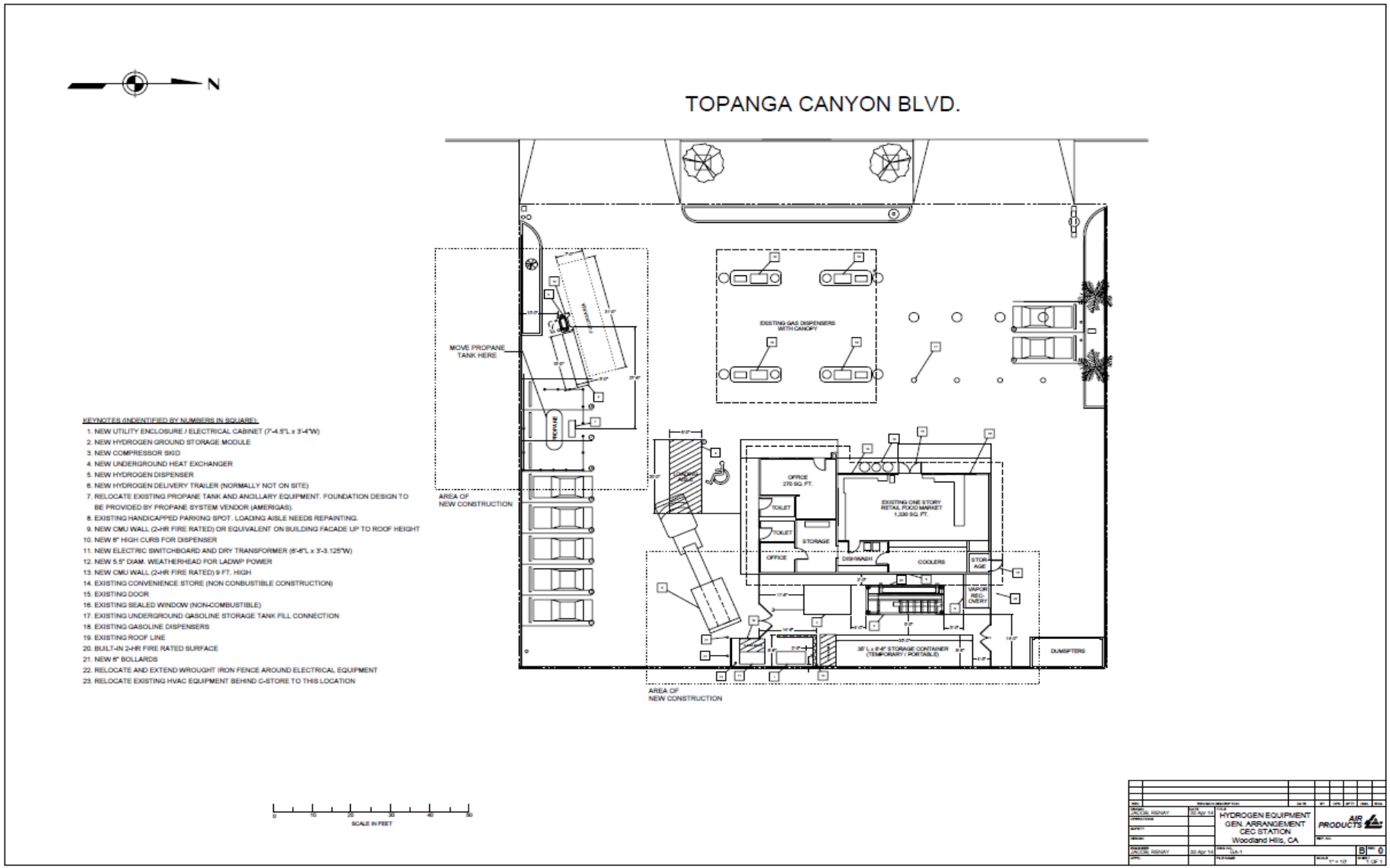
Structural and electrical designs were then initiated by S. Gordin Structural Design and Engineering Services, Inc, and initial packages were completed on June 23, 2014.

Figure 1: Woodland Hills SmartFuel® Hydrogen Station Initial Equipment Arrangement (January 29, 2014)



Source: Air Products and Chemicals, Inc.

Figure 2: Woodland Hills SmartFuel® Hydrogen Station Equipment Arrangement (April 30, 2014)



Source: Air Products and Chemicals, Inc.

Equipment Procurement (December 11, 2013 – April 2016)

In parallel with the site activities, Air Products began the equipment design and procurement activities for the SmartFuel® hydrogen station equipment. The internal kick-off meeting with the engineering and purchasing functions was held on December 11, 2013.

Major equipment began to arrive in mid-2014. Air Products decided to delay the purchase of the electric switchgear / metering panel for the station until we understood the specific requirements from the Los Angeles Department of Water and Power. As noted in the construction section, the Los Angeles Department of Water and Power changed electrical supply requirements which resulted in the purchase of a second, expanded electric switchgear.

Entitlement Process

The City of Los Angeles did not require a zoning review of the addition of hydrogen equipment to the gas station in Woodland Hills.

Permit Process (June 23, 2014 – April 14, 2015)

Air Products submitted the structural and electrical plans to the Los Angeles Department of Building and Safety on June 23, 2014. The Los Angeles Fire Department requested a separate submittal with additional information, and this was provided in early July of 2014.

Plan check comments from all departments but Los Angeles Fire Department were received on July 13, 2014. Updates to the electrical design were able to be made in the absence of the Los Angeles Fire Department comments, and these were resubmitted and approved by Los Angeles Department of Building and Safety on August 7, 2014.

Ongoing discussions with Los Angeles Fire Department continued during July and August of 2014, but the design team was unable to complete the revision to the structural comments without firm input. To accelerate the process, Air Products decided in September of 2014 to update the structural plans based on the information at hand at that time.

A major milestone was the approval of the station equipment layout by Los Angeles Fire Department in October of 2014.

As part of finalizing the overall design, a site visit was held with an electrical service representative from Los Angeles Department of Water and Power on December 4, 2014. At this meeting, the design of the electrical supply to the station was changed. Los Angeles Department of Water and Power provided additional details on January 14, 2015, and provided approved design plans on March 10, 2015. Air Products and S. Gordin Structural Design and Engineering Services, Inc. then were able to modify all the structural and electrical design drawings.

Following resubmittal of the updated design packages, Los Angeles Department of Building and Safety approved the station design on April 14, 2015.

Construction Process (October 12, 2015 – April 29, 2016)

Following a bid process, Air Products executed the construction subcontract to Fueling and Service Technology, Inc. on September 3, 2015. It has an excellent safety record and had prior experience in hydrogen station construction, including work performed for Air Products

under Grant Agreement ARV-10-048. Construction started on October 12, 2015, with hydrogen storage, compression, cooling, and dispensing equipment delivered to the site on December 10, 2015. Additional changes to the electrical design were identified by Los Angeles Department of Water and Power during the construction phase. Updated electrical plans were submitted in early January of 2016 and approved by Los Angeles Department of Building and Safety in late February of 2016. Completion of construction, as reflected by final sign-off of the site took place on April 29, 2016.

Making the Station Operational (May 2, 2016 – August 16, 2016)

Following the completion of construction, commissioning activities were undertaken by Air Products' engineering and operations staff. Initial equipment operation, hydrogen sampling, and test fills into an Air Products test tank were performed during this time.

Station Declared Operational (August 16, 2016 – September 20, 2016)

The Hydrogen Station Equipment Performance Device was brought to the Woodland Hills station to verify operation per the Society of Automotive Engineers standard J2601 "Fueling Protocols for Light Duty Gaseous Hydrogen Surface Vehicles". Testing was performed from August 16 to August 18, 2016. The results of the testing were reviewed by the Hydrogen Station Equipment Performance team led by the California Air Resources Board with the automakers on September 9, 2016. Notification that the Woodland Hills SmartFuel® station was ready for retail operation was provided by Air Products to the Governor's Office of Business and Economic Development on September 20, 2016.

In addition to the Hydrogen Station Equipment Performance testing, individual automakers performed their own tests during August and September of 2016.

Division of Measurement Standards Certification (August 22, 2016)

The California Department of Food and Agriculture's Division of Measurement Standards is responsible for enforcing California weights and measures laws and regulations and must certify any device used for metering the sale of commercial items within California. The permanent Division of Measurement Standards approval was received for the Woodland Hills SmartFuel® hydrogen station on August 22, 2016. Figure 3 provides a photograph of the dispenser with the Division of Measurement Standards stickers in place.

Figure 3: Woodland Hills SmartFuel® Dispenser following Division of Measurement Standards Certification (August 22, 2016)

Source: Air Products and Chemicals Inc.

Customer Usage (October 9, 2016 – Present)

The first public customer fueled at the Woodland Hills SmartFuel® station in early October of 2016, and the station has been used regularly since then. Dispensed volumes totaled 275 kilograms in October 2016, 292 kilograms in November 2016, and 248 kilograms in December 2016. A photograph of a Daimler FCEV fueling at the Woodland Hills SmartFuel® hydrogen station is provided in Figure 4.

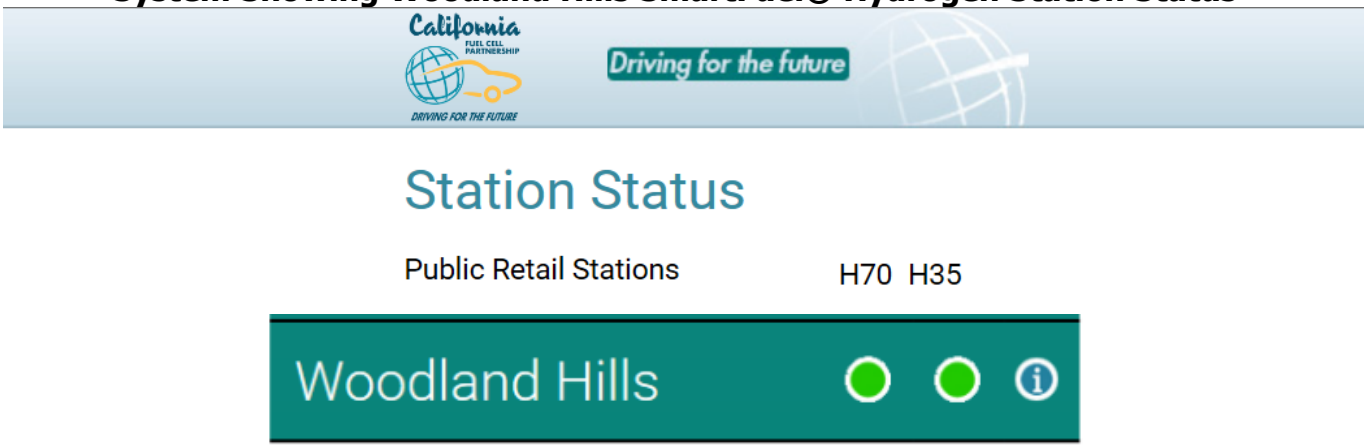
Figure 4: Woodland Hills SmartFuel® Dispenser

Source: Air Products and Chemicals Inc.

Station Online Status System Activated (October 5, 2016)

The California Fuel Cell Partnership Station Online Status System provides regularly updated station status information to fuel cell vehicle drivers. Air Products has provided California Fuel Cell Partnership station status information regarding its stations since the inception of Station Online Status System. The Woodland Hills station was added on October 5, 2016. A screenshot of the network that includes the Woodland Hills SmartFuel® hydrogen station is shown in Figure 5.

Figure 5: Screenshot of California Fuel Cell Partnership Station Online Status System Showing Woodland Hills SmartFuel® Hydrogen Station Status



Source: Air Products and Chemicals, Inc.

Environmental Impacts

Hydrogen is stored as a compressed gas in an above-ground tank concealed behind a wall at this station. Hydrogen is nontoxic, colorless, and odorless, so hydrogen station equipment is outfitted with appropriate sensors to provide immediate notification in case a leak occurs. No solid or liquid waste will be produced at this site.

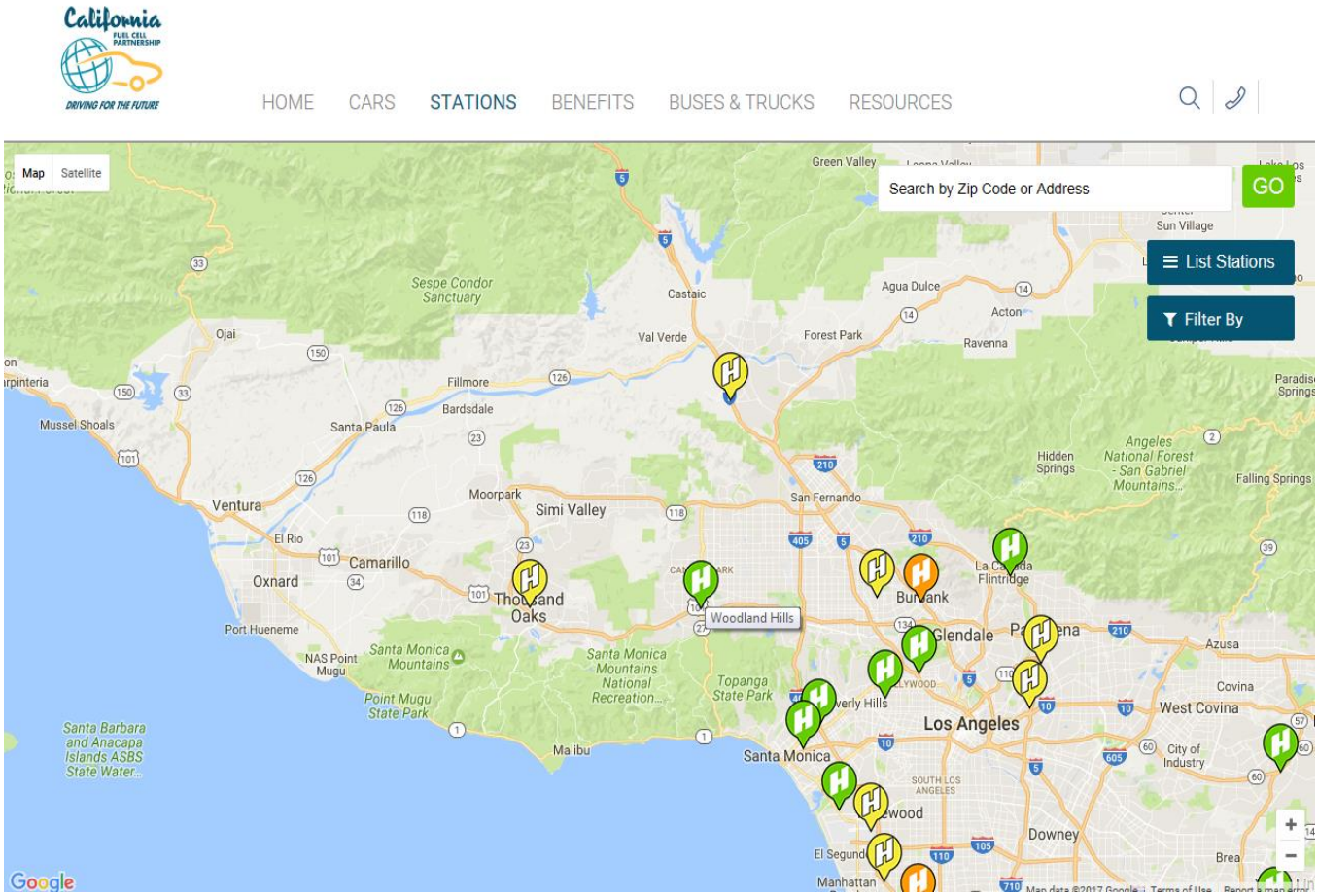
There was no additional landscaping added for the construction of the hydrogen refueling station, and, therefore, no additional irrigation water will be consumed.

In order to address noise concerns raised by neighbors adjacent to the gas station, the Woodland Hills SmartFuel® hydrogen station has been open for fueling during daytime hours until a noise mitigation program is implemented. Based on the results of a sound survey, sound reduction panels are being added and changes are being made to the operation of certain rotating equipment. Based on the results from this work, Air Products expects that the station will then operate 24 hours per day, 7 days per week.

Woodland Hills SmartFuel® Hydrogen Station in the Network

Figure 6 shows the location of the Woodland Hills SmartFuel® hydrogen station at 5314 Topanga Canyon Blvd. in relation to other stations in the Southern California network.

Figure 6: The Woodland Hills SmartFuel® Hydrogen Station

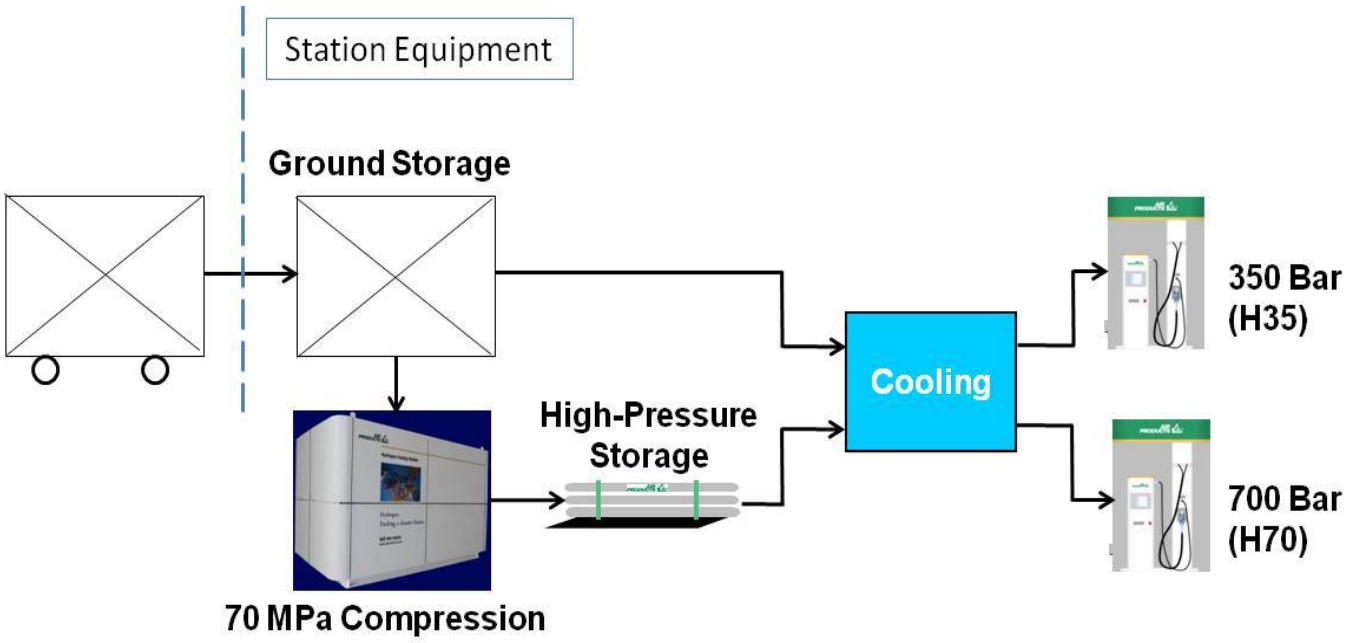


Source: Air Products and Chemicals, Inc. Map courtesy of California Fuel Cell Partnership.

Schematic Layout of the Woodland Hills SmartFuel® Hydrogen Station

As shown below, Figure 7 depicts an overview of the Woodland Hills SmartFuel® hydrogen station components. Hydrogen is produced by Air Products at a central fill system located in southern California, and the gas is delivered by a high-pressure tube trailer and pressure-transferred to a ground storage module at the station. Hydrogen is compressed as needed to fill the high-pressure storage tubes that are integral in providing a full fill to fuel cell vehicles that use the H70 nozzle. Gas is taken from storage and cooled based on the dispenser programming that meets the Society of Automotive Engineers J2601 fueling protocol; Air Products has patents which cover elements of the station operation and the dispensing process.

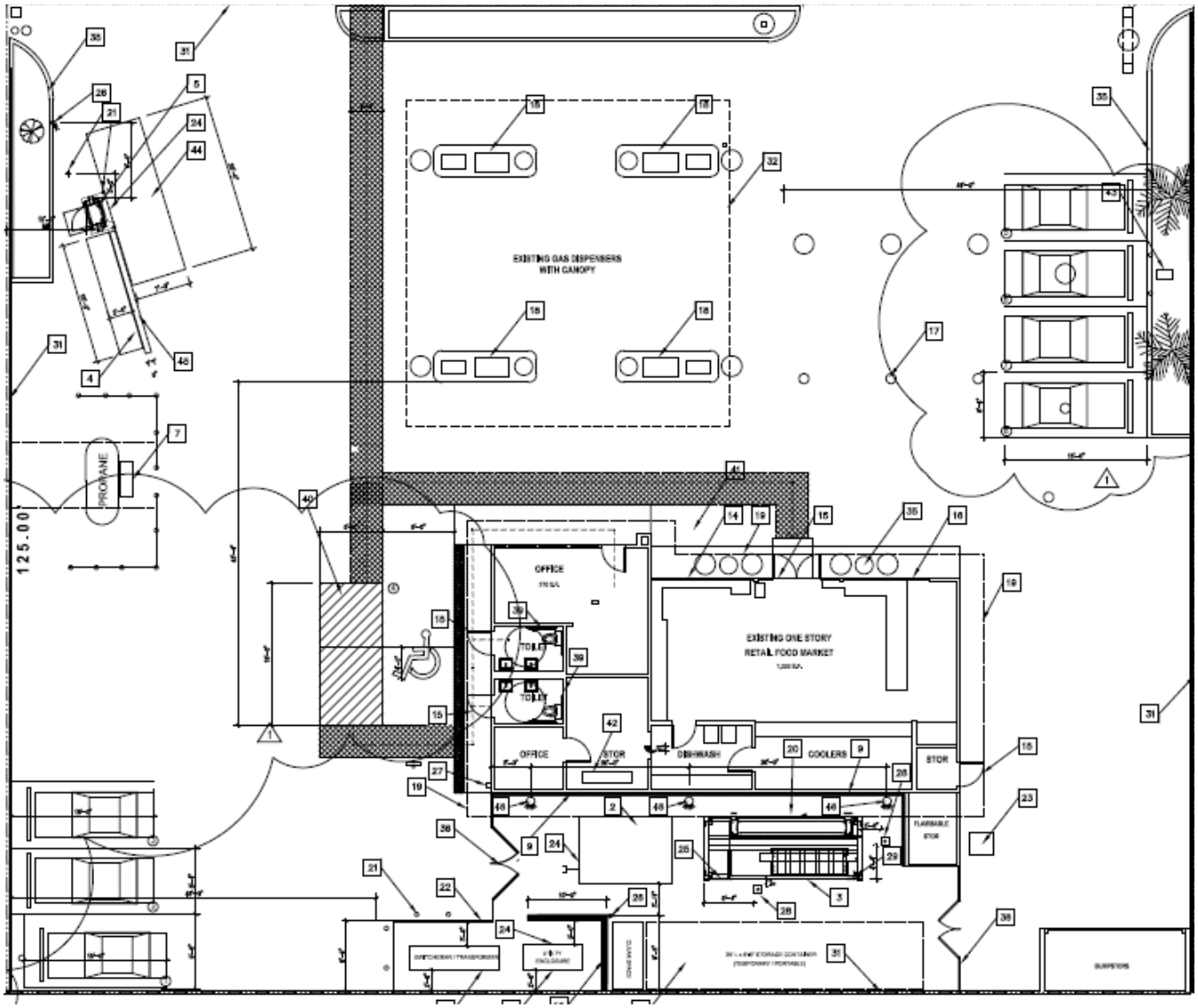
Figure 7: Schematic Depicting SmartFuel® Hydrogen Station Equipment



Source: Air Products and Chemicals, Inc.

Figure 8 shows a detailed view of the actual final, as-built configuration of the Woodland Hills SmartFuel® hydrogen station.

Figure 8: Final Woodland Hills SmartFuel® Hydrogen Station Layout



Source: Air Products and Chemicals, Inc.

Table 1 showcases the list of different subcontractors involved in the project along with the budget allocated.

Table 1: List of Subcontractors and Grant Agreement Budget

Subcontractors	**Budget**
Air Products and Chemicals, Inc., Allentown, PA H2 station equipment	$1,580,807
FASTECH, Buena Park, CA Construction	$315,395
S. Gordin Structural Design & Engineering Services, Inc., Carson City, NV Design and permitting services	$31,100
Total Budget	**$1,927,302**
California Energy Commission Grant	$1,252,746
Air Products Cost Share	$674,556
Total Energy Commission cost share	65%

CHAPTER 2:
Data Collection and Energy Analysis

The Woodland Hills SmartFuel® hydrogen refueling station is supplied by hydrogen generated via steam methane reformation that converts methane (CH_4) and water (H_2O) to hydrogen (H_2) and carbon dioxide (CO_2) and along with an equilibrium amount of carbon monoxide (CO):

Steam/Methane Reforming Reaction $CH_4 + H_2O + \text{Heat} \Leftrightarrow CO + 3H_2$

Water-Gas Shift Reaction $CO + H_2O \Leftrightarrow CO2 + H_2 + \text{Heat}$

Per California Senate Bill 1505 (Lowenthal, Chapter 877, Statutes of 2006) and PON-12-606, which funded this project, at least one-third of the hydrogen dispensed will be produced from renewable energy sources.

Hydrogen is supplied to the hydrogen fueling station from Air Products' hydrogen production facilities in Wilmington/Carson, California. Renewable biogas is being procured as feedstock for the facilities, resulting in delivered hydrogen product that meets the 33 percent renewable requirements.

Air Products has a contract for sourcing the renewable biogas that meets Public Resources Code Section 2574(b)(1); documentation is provided in Figure 9. Although California has a substantial amount of biogas, local supply cannot be injected into California pipelines under California Health and Safety Cost Section 25420. Air Products' biogas supply for this project is sourced outside California and transported to California with connection to a natural gas pipeline within the Western Electricity Coordinating Council region that delivers gas into California.

Figure 9: Documentation of Biogas Sources

Exhibit A
RB Supply Sources
Shell Energy North America (US), L.P.

Supply Source	Address	Pipeline/LDC	Receipt	Delivery
Greentree Landfill	635 Toby Road Kersey, PA 15846	National Fuels Gas TETCO NGPL EPNG Socal Gas FAR	Landfill meter Nat Fuel-Bristoria Tetco-Sweet Lake 3825 EPNG Jal 3083 Topock	Bristoria NGPL-Sweet Lake EPNG Jal 3083 Topock Socal Citygate
Imperial Landfill	11 Boggs Road Imperial, PA 15126	National Fuels Gas TETCO NGPL EPNG Socal Gas FAR	Landfill meter Nat Fuel-Bristoria Tetco-Sweet Lake 3825 EPNG Jal 3083 Topock	Bristoria NGPL-Sweet Lake EPNG Jal 3083 Topock Socal Citygate

SELF-GENERATION INCENTIVE PROGRAM
DIRECTED BIOGAS FUEL SUPPLIER
ATTESTATION

I, Shell Energy North America (US), L.P., hereby attest that Directed Biogas will be supplied to Air Products and Chemicals, Inc. by nomination and will comply with all applicable rules of the Self-Generation Incentive Program (SGIP) including but not limited to;

a) Contract will include term (minimum of 5 years), cost, amount of renewable fuel injected on a monthly basis for the length of the contract, address of renewable fuel facility, and facility address of Host Customer.

b) Documentation will be provided that shows that the third party gas provider can inject the renewable fuel into the natural gas pipeline.

c) The Renewable Fuel Supplier facility must produce fuel that meets the SGIP definition of renewable fuels.

d) The gas must be injected into a natural gas pipeline system that is either within the Western Electricity Coordinating Council (WECC) region or interconnected to a natural gas pipeline in the WECC region that delivers gas into California.

The undersigned understands that non-compliance to any SGIP requirements will be grounds for partial or complete incentive refund.

Shell Energy North America (US), L.P.

Signature: Edward E Beard

Name Printed: Edward Beard

Title: Vice President

Company Shell Energy North America (US), L.P.

Date: 3/21/2011

Source: Air Products and Chemicals, Inc.

Hydrogen is delivered to the Woodland Hills SmartFuel® hydrogen refueling station by a Department of Transportation-certified high-pressure delivery trailer.

For an analysis on greenhouse gas (GHG) emissions, the Greenhouse Gases, Regulated Emissions, and Energy Use in Transportation Model model for gaseous hydrogen has been appended with calculations to deliver compressed hydrogen gas with 33.3 percent renewable energy content from a large central hydrogen production facility to a cluster of fuel cell stations in Southern California. For the hydrogen supply pathway and hydrogen fueling station, the lifecycle emission of hydrogen energy supply is estimated at 75.2 grams of carbon dioxide equivalent (CO2e) per megajoule on a full well-to-wheels basis. CARB's Low Carbon Fuel Standard (LCFS) lifecycle emissions estimate for a similar pathway for compressed hydrogen from central reforming of natural gas (LCFS Pathway HYGN005) is 88.3 grams CO2e/MJ. In factoring in an Energy Efficiency Ratio of 2.5 for FCEV's established under CA LCFS the resulting emissions performance for FCEVs is 148 grams CO2e/mile. In comparison to a LCFS light-duty gasoline vehicle baseline, the hydrogen supply pathway results in a 62 percent reduction in WTW greenhouse emissions relative to California gasoline.

Relating to the Woodland Hills SmartFuel® hydrogen refueling station, this level of relative GHG reduction to the LCFS 2016 baseline for gasoline vehicles each FCEV deployed in the market will reduce GHG emissions by 4.3 metric tons per year. The station has the potential to contribute to the reduction of greater than 1,100 metric tons of GHG emissions and greater than 66,000 gallons of gasoline consumption annually. The long-term greenhouse gas and petroleum reduction that could be realized by widespread adoption of FCEVs in the marketplace is enormous.

CHAPTER 3:
Statement of Future Intent

Air Products has executed an initial 3-year lease with the landowner through 30 April 2018, with an option for a 3-year extension.

Data on the operation of the station will be collected and reported to the CEC throughout the term of operations and maintenance under Grant Agreement ARV-15-035.

As part of its ongoing support to hydrogen fueling stations in California, Air Products has a fully staffed operations department which can address station maintenance and emergency situations. Air Products utilizes a 24-hour Equipment Support Team to monitor for alarms from the hydrogen station (in addition to any local alarms at the point of use). Air Products employs technicians in the Los Angeles Basin area that are trained in the specialized requirements for hydrogen fueling stations.

CHAPTER 4:
Findings, Conclusions, and Recommendations

The following is a list of important findings from the Woodland Hills SmartFuel® hydrogen station project:

- Project kick-off can proceed more quickly when the opportunity exists to work with a gas station owner who has prior experience with hydrogen fueling stations.
- In order to shorten the time needed to permit a hydrogen fueling station, both the applicant and the various agencies responsible for review and approval must provide timely and complete responses to correspondence between the parties.
- The hydrogen station equipment at Woodland Hills has common components to other stations supplied by Air Products. This helps to increase the efficiency of the project management process.

GLOSSARY

AIR PRODUCTS AND CHEMICALS INCORPORATED (APCI or Air Products)—Provides industrial gases and related equipment to dozens of industries, including refining, chemical, metals, electronics, manufacturing, and food and beverage. Air Products is also the world's leading supplier of liquefied natural gas process technology and equipment.

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

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

Funding for the CEC's activities comes from the Energy Resources Program Account, Federal Petroleum Violation Escrow Account, and other sources.

CARBON DIOXIDE (CO_2)—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. CO_2 is the greenhouse gas whose concentration is being most affected directly by human activities. CO_2 also serves as the reference to compare all other greenhouse gases (see carbon dioxide equivalent).

CARBON DIOXIDE EQUIVALENT (CO_2e)—A metric used to compare emissions of various greenhouse gases. It is the mass of carbon dioxide that would produce the same estimated radiative forcing as a given mass of another greenhouse gas. Carbon dioxide equivalents are computed by multiplying the mass of the gas emitted by its global warming potential.

FUEL CELL ELECTRIC VEHICLE (FCEV)—A zero-emission vehicle that runs on compressed hydrogen fed into a fuel cell "stack" that produces electricity to power the vehicle.

GREENHOUSE GAS (GHG)—Any gas that absorbs infrared radiation in the atmosphere. Greenhouse gases include water vapor, carbon dioxide (CO_2), methane (CH_4), nitrous oxide (NO_x), halogenated fluorocarbons (HCFCs), ozone (O_3), per fluorinated carbons (PFCs), and hydrofluorocarbons (HFCs).

LOW CARBON FUEL STANDARD (LCFS)—A set of standards designed to encourage the use of cleaner low-carbon fuels in California, encourage the production of those fuels, and therefore reduce greenhouse gas emissions. The LCFS standards are expressed in terms of the carbon intensity of gasoline and diesel fuel and their respective substitutes. The LCFS is a key part of a comprehensive set of programs in California that aim cut greenhouse gas emissions and other smog-forming and toxic air pollutants by improving vehicle technology, reducing fuel consumption, and increasing transportation mobility options.