# Appendix U11

## San Diego Regional Alternative Fuel Readiness Plan

**Appendix U11 Contents**

San Diego Regional

# ALTERNATIVE FUEL READINESS PLAN

Addressing the Barriers to Alternative Fuel Deployment


February 2016

SAN DIEGO REGIONAL CLEAN CITIES COALITION

SANDAG

Center for Sustainable Energy

# Acknowledgements

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# 1. Executive Summary

The San Diego Regional Alternative Fuel Readiness Plan (Readiness Plan) was developed to accelerate the deployment of alternative fuel vehicles (AFV) and alternative fuel infrastructure (AFI) in the San Diego region by identifying regional barriers and developing resources to overcome them. This Readiness Plan expands upon previous plug-in electric vehicle (PEV) planning efforts to include all alternative fuels.

The state has established aggressive goals and targets for greenhouse gas (GHG) emissions reductions and adoption of AFV and AFI is essential in helping the region meet these, and other local and federal goals. Through Refuel: San Diego Regional Alternative Coordinating Council (Refuel San Diego), local government, public agencies, academia, fuel industry, vehicle manufacturers, and other interested stakeholders convened to discuss challenges and best practices in the deployment of AFV and AFI, offer peer-to-peer information exchange, and help inform this Readiness Plan.

A Regional Alternative Fuel Assessment (Assessment) was prepared as part of Refuel San Diego project, to identify available alternative fuel training, infrastructure, policy, and funding gaps in the region within different sectors. The Assessment helped inform the development of regionally consistent and accepted resources in the form of Sector-Specific Alternative Fuel Toolkits (Alternative Fuel Toolkits). The standalone Alternative Fuel Toolkits include audience-specific information about each of the different fuel types and how they are used, and include tools for determining costs, available funding opportunities, and why they are relevant to each of the following sectors:

- Alternative Fuels for Consumers
- Alternative Fuels for Public Agencies
- Alternative Fuels for Fleets
- Alternative Fuels for First Responders
- Alternative Fuels for Fuel Marketers and Retailers

Table 1-1 names and describes each barrier to AFV and AFI deployment identified by Refuel San Diego. It also highlights how the barrier was addressed through the Alternative Fuel Toolkits, within this Readiness Plan, or through Plug-in SD, which is the implementation project for the San Diego Regional Plug-in Electric Vehicle (PEV) Readiness Plan (January 2014).

**Table 1-1: Refuel San Diego Barriers and Recommended Resources**

| Barrier | Description | Refuel Tools and Resources |
|---|---|---|
| **Lack of public knowledge on alternative fuels** | Lack of knowledge and misconceptions about alternative fuels, and advanced vehicle technology. | Alternative Fuels for Consumers Toolkit |
| **Training and education for municipal staff** | Lack of training and education about alternative fuels, and advanced vehicle technology and how to plan for and service | Alternative Fuels for Public Agencies Toolkit<br>Alternative Fuels for Fleets |

| Barrier | Description | Refuel Tools and Resources |
|---|---|---|
| | them. | Toolkit |
| **Training and education for emergency personnel and transportation fleet staff** | Lack of safety and technical training for AFV and AFI. | Alternative Fuels for First Responders Toolkit |
| **Time-of-use (TOU) utility rates/grid integration** | Discourage PEV charging during high-cost peak hours and support of TOU pricing to ensure grid reliability. High demand charges impact utility bills and expensive metering options to access TOU rates. | Plug-in SD |
| **Station development: codes and permitting** | Need for increased guidance on alternative fuel station installation processes, and how city staff and station developers can work together to ease the station deployment process. | Alternative Fuels for Public Agencies Toolkit |
| **Station development: site assessment** | Station developers encounter site specific challenges to installations, including right of way and easement issues. Station locations should consider fleet routes. | Alternative Fuels for Public Agencies Toolkit |
| **Access to public alternative fuel stations** | Lack of AFV adoption due to limited fueling infrastructure within proximity to fleets and the public. Lack of station access for heavy-duty vehicles. | Alternative Fuels for Public Agencies Toolkit<br>Alternative Fuels for Fleets Toolkit<br>Alternative Fuel Marketers and Retailers Toolkit |
| **Electric vehicle charging stations (EVCS) at multi-unit dwellings (MuDs)** | Lack of knowledge by MuD property owners and residents about the installation of EVCS. Coordinate with Home Owners Associations to identify and find solutions to unique building challenges. | Plug-in SD |
| **Workplace charging** | Lack of understanding regarding benefits and approaches to workplace charging. | Plug-in SD |
| **Infrastructure costs** | Need justification/incentives due to lack of capital for higher station construction and operation costs. | Recommendation 3<br>Alternative Fuel Toolkits - all |
| **Selecting appropriate AFVs** | Advise municipal staff and businesses on identifying alternative fuels that will meet fleet needs. | Alternative Fuels for Public Agencies Toolkit<br>Alternative Fuels for Fleets Toolkit |
| **Procuring and financing AFVs** | Initial higher costs of AFVs are a barrier to adoption; more information about incentives for procuring AFVs. | Alternative Fuel Toolkits - all |

| Barrier | Description | Refuel Tools and Resources |
|---|---|---|
| **Converting conventional vehicles to an alternative fuel** | Lack of understanding about conversion regulations, conversion kits, or companies that provide conversion services. | Alternative Fuels for Fleets Toolkit |
| **AFV technology** | Lack of comfort with emerging AFV technology is a barrier causing consumers to delay investment until there is confidence in reliability. | Alternative Fuels for Consumers Toolkit |

Although the Alternative Fuel Toolkits offer resources to address the barriers identified by Refuel San Diego, continued efforts are needed to ensure that the region can support greater deployment of AFVs. This Readiness Plan includes recommendations to further the growth of alternative fuel vehicles and infrastructure and could help establish the San Diego region as one of the most comprehensive zero emissions infrastructure network in the country.

**Recommendations:**

1. Continue to emphasize alternative fuels as a key strategy in the region's GHG reduction efforts.
2. Continue to align alternative fuel policies across all local agencies in support of regional air quality attainment and other goals.
3. Seek new funding sources for alternative fuel and infrastructure deployment.
4. Enhance education and outreach efforts to promote awareness of alternative fuel options.
5. Accelerate market growth through workforce development, training, and local entrepreneurship.

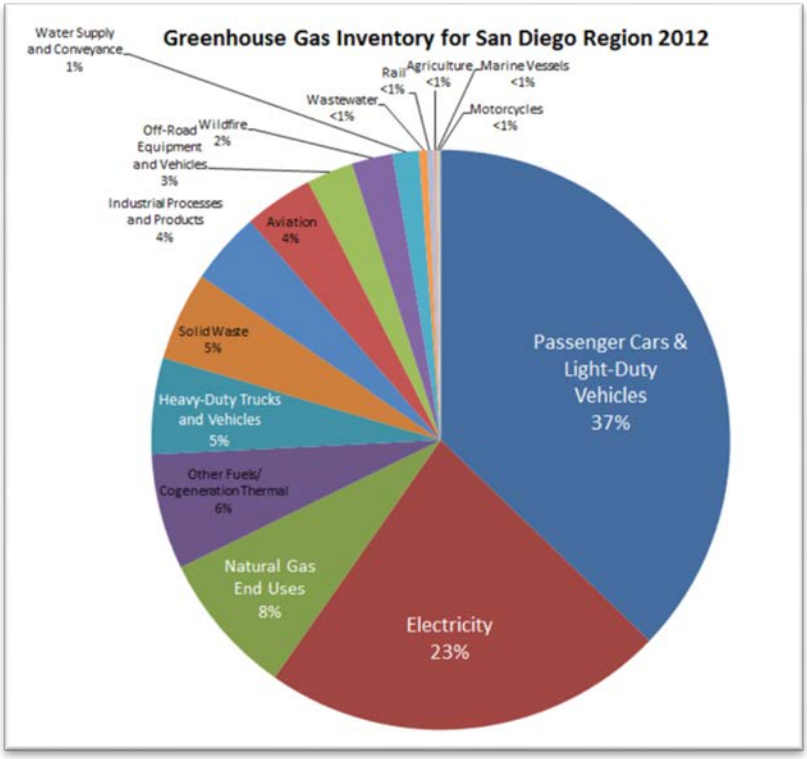
Implementation of this Readiness Plan can help increase the awareness, accessibility, and use of alternative fuels throughout the region while reducing GHG emissions and helping the state achieve its alternative fuel vehicle goals.

# 2. Introduction

The San Diego region has a long history planning for alternative fuels as a means for reducing local reliance on petroleum imports, improving air quality, and providing more fuel choices to consumers. These reasons remain important but the greenhouse gas emissions (GHG) reduction benefits of alternative fuels have prompted state, regional, and local governments to take more direct and immediate action to ensure their market growth. California's Global Warming Solutions Act (Assembly Bill [AB] 32, Chapter 488, Statutes of 2006) established a goal to reduce statewide emissions to 1990 levels by the year 2020. As federal, state, regional, and local governments adopt more GHG reduction goals through Climate Action Plans (CAP) and other sustainability policies, a variety of measures for mitigating future emissions and achieving these goals are needed.

*On-road transportation accounts for 42 percent of GHG emissions in the San Diego region.*

On-road transportation is a major contributor to urban air pollution, GHG emissions, and total energy use. It accounts for 42 percent of the San Diego region's GHG emissions,[1] providing a large opportunity for reducing emissions, improving air quality, and shifting reliance on oil to cleaner and more abundant fuel sources. State and local policies and programs have helped foster the current alternative fuel market and continue to drive industry growth. This San Diego Regional Alternative Fuel Readiness Plan (Readiness Plan) is a direct result of these efforts and builds upon broad goals to develop recommendations for ongoing local actions. It reviews the current state of alternative fuels in the region and provides methods to increase the deployment of alternative fuels.




The primary alternative transportation fuels currently available and addressed in the Readiness Plan are biodiesel, electricity, ethanol, hydrogen, natural gas, and propane autogas. Alternative fuels are used in a variety of applications ranging from light-duty passenger cars to

[1] San Diego Association of Governments (SANDAG). 2015. "San Diego Forward: The Regional Plan." http://www.sdforward.com/

heavy-duty trucks, as well as off-road equipment. As part of the Refuel San Diego project, Alternative Fuel Toolkits have been created to highlight the applications of each fuel, tailored for different audiences, and intended to address some of the barriers that inhibit growth in the alternative fuel market.

## Policy Background

**State Policy**

In addition to AB 32, California has adopted numerous policies to address the use of alternative fuels as a means to reduce GHG emissions, petroleum dependence, and improve energy security with in-state fuel production. Table 2-1 identifies many of the key strategies enacted in California. Legislation and executive orders have created goals aimed at lowering the carbon content of fuels (S-01-07 Low Carbon Fuel Standard), increasing the efficiency of vehicles (AB 1493 [Pavley, 2007]), and expanding local production of biofuels (S-06-06).

Funding for the implementation of state transportation goals and requirements was created by the California Legislature with AB 118 (Núñez, Chapter 750, Statutes of 2007) and extended by AB 8 (Perea, Chapter 401, Statutes of 2013). AB 118 created the Alternative and Renewable Fuel and Vehicle Technology Program (ARFVTP), administered by the California Energy Commission (Energy Commission) to allocate funding to achieve energy goals associated with the transportation sector. AB 118 also established the Air Quality Improvement Program (AQIP), administered by the Air Resources Board to funding vehicle deployments and other projects with immediate air quality benefits.

**Table 2-1: Alternative Fuel Oriented Strategies for California**

| Strategy Origin | Year | Objectives | Goals and Milestones |
|---|---|---|---|
| **AB 1493 (Pavley regulations)** | 2002 | GHG Reduction | 17 percent reduction in climate change emissions from light-duty fleet by 2020 and 25 percent overall reduction by 2030. |
| **Petroleum Reduction and Alternative Fuel Goals (*Reducing California's Petroleum Dependence*)**[1] | 2003 | Petroleum Reduction | This document was developed In response to AB 2076 (Shelley). It set goals to reduce petroleum fuel use to 15 percent below 2003 levels by 2020, and recommended the State adopt a goal of 20 percent nonpetroleum fuel use in the year 2020. |
| **AB 1007 (*State Alternative Fuels Plan*)** | 2005 | GHG Reduction | Develop and adopt a plan that sets increased alternative fuel use goals for years 2012, 2017, and 2022. |
| **Energy Policy Act of 2005; Energy Independence and Security Act of 2007** | 2005 | Renewable Fuel Standard | 36 billion gallons of renewable fuel used in the U.S. by 2022. |

[1] Reducing California's Petroleum Dependence, an Energy Commission and ARB, joint agency report, August 2003, publication #P600-03-005F.

| Strategy Origin | Year | Objectives | Goals and Milestones |
|---|---|---|---|
| **Executive Order S-3-05** | 2005 | GHG Reduction | By 2010, reduce GHG emissions to 2000 levels; by 2020, reduce GHG emissions to 1990 levels; by 2050, reduce GHG emissions to 80 percent below 1990 levels. |
| **AB 32 (Global Warming Solutions Act)** | 2006 | GHG Reduction | Reduce GHG emissions to 1990 levels by 2020. |
| **Executive Order S-06-06 (*Bioenergy Action Plan*)** | 2006 | In-State Biofuels Production | Produce in California 20 percent of biofuels used in state by 2010, 40 percent by 2020, and 75 percent by 2050. |
| **Low Carbon Fuel Standard** | 2007 | GHG Reduction | 10 percent reduction in carbon intensity of transportation fuels in California by 2020. |
| **Executive Order B-16-2012** | 2012 | ZEV Mandate | Accommodate 1 million zero-emission vehicles by 2020 and 1.5 million by 2025. |
| **Governor Brown Inaugural Address 2015** | 2015 | Petroleum Reduction | Reduce petroleum use in cars and trucks by up to 50 percent within the next 15 years (2030). |
| **Executive Order B-30-15** | 2015 | GHG Reduction | Reduce GHG emissions to 40 percent below 1990 levels by 2030. |

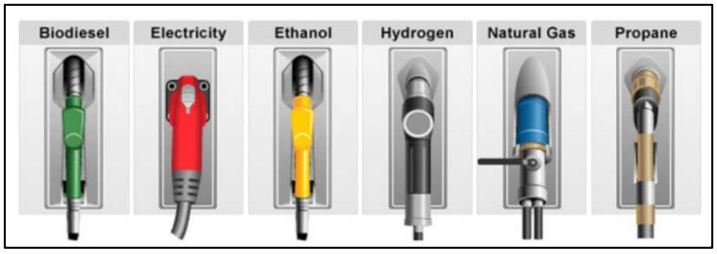
**Regional and Local Policy**

The State of California recognizes the critical role that regional and local governments play in meeting statewide GHG reduction targets. With the transportation sector representing the largest source of the region's GHG emissions, the SANDAG Sustainable Communities Strategy and Regional Energy Strategy both call for SANDAG to undertake coordinated regional planning for electric vehicle charging and alternative fueling infrastructure. Locally, alternative fuel vehicles (AFV) and alternative fuel infrastructure (AFI) are playing a larger role in CAPs as a way to meet adopted GHG reduction targets. More than half of the jurisdictions in the San Diego region have prepared or are developing CAPs. These jurisdictions are moving toward CAP implementation, including how to advance alternative fuels in their communities. The SANDAG Climate Change Mitigation and Adaptation White Paper details local CAP and alternative fuel activities further and is included in San Diego Forward: The Regional Plan.

## Refuel San Diego Project

The San Diego region was awarded funding by the Energy Commission to expand on previous regional plug-in electric vehicle (PEV) planning efforts to address all alternative fuels. Led by the San Diego Association of Governments (SANDAG), and in partnership with the San Diego Regional Clean Cities Coalition (SDRCCC), and the San Diego Air Pollution Control District (SDAPCD), the region developed this project concept – Refuel San Diego – to bring awareness to the barriers

refuel




San Diego Regional Alternative Fuel Coordinating Council

impeding increased alternative fuel use in the region, and to create Alternative Fuel Toolkits to address those barriers. Additionally, the comprehensive alternative fuel readiness plan was developed with expertise and input of the San Diego Regional Alternative Fuel Coordinating Council or Refuel San Diego. Refuel San Diego is a regional partnership made up of diverse stakeholders from local and regional public agencies, industry, fleet managers, and other interested parties. Appendix A and B contain the Refuel San Diego member list and meeting schedule, respectively.

## Composition of the Project

The Refuel San Diego project leverages previous alternative fuel planning efforts to bring together stakeholders and advance alternative fuel deployment in the region. The Center for Sustainable Energy (CSE) serves as the SDRCCC Program Coordinator, and with SANDAG, helped to execute the project. The components of an alternative fuel barriers table, alternative fuel assessment, and Alternative Fuel Toolkits contribute to the development of this Readiness Plan for the San Diego region.

Alongside Refuel San Diego quarterly meetings, subcommittee meetings were held to focus on one fuel type and discuss it exclusively. The subcommittees were made up of regional stakeholders that have either had experience using the specific alternative fuel of topic, alternative fuel providers, or parties who were interested in learning more about the fuel in general. The subcommittees were instrumental in providing insight into real world challenges associated with using each fuel and providing the building blocks of information required to go into the Alternative Fuel Toolkits. These Alternative Fuel Toolkits will play a role in ongoing outreach after the Readiness Plan adoption.

As a culmination of the efforts of Refuel San Diego, this Readiness Plan identifies immediate needs as well as long-term planning objectives to prepare the San Diego region for the increased use of alternative transportation fuels. It also discusses past efforts in the San Diego region, captures existing conditions and current activities surrounding alternative fuel deployment, describes opportunities to continue increasing adoption into the future, and identifies additional challenges that need to be addressed to achieve stated goals.

This Readiness Plan ends with recommendations for a regional approach to encourage alternative fuel use. Strong regional support for alternative fuels can communicate to the market that the San Diego region is committed to, and seeks to attract, investment in AFV and AFI.

# 3. Existing Conditions

## Regional Planning for Alternative Fuels

The San Diego region has a long history of planning for alternative fuels through collaboration and coordination with stakeholders. The 1994 San Diego Association of Governments (SANDAG) Regional Energy Plan included alternative fuels, providing information and measures that regional stakeholders could undertake to reduce inefficient petroleum use. The San Diego Regional Clean Cities Coalition (SDRCCC) was formed in 1996 to advance petroleum reduction policies and projects. In response to state petroleum reduction and climate change goals, and in an effort to offer more fuel choices to local consumers, SANDAG prepared the Alternative Fuel Vehicle and Infrastructure Report in 2009 (2009 Report). The 2009 Report presented recommendations to accelerate the deployment of alternative fuels in the San Diego region, provided an overview of California's clean transportation policies, and identified alternative fuels and associated infrastructure in the region.

As the 2009 Report was being finalized, both San Diego Gas and Electric (SDG&E) and SANDAG entered into Memorandums of Understanding (MOUs) with Nissan North America to support making the San Diego region one of the first plug-in ready regions in the nation. Local outreach events were held and the San Diego region was selected to be one of the first five metropolitan areas in the United States for the introduction of plug-in electric vehicles (PEV) through the EV Project.

The Center for Sustainable Energy (CSE) conducted the first baseline assessment of the PEV landscape in San Diego, funded by a U.S. Department of Energy (DOE) grant in 2012. This baseline assessment included the results of surveys given to local governments to determine whether their existing permit processes and building codes supported PEV growth.

In 2012, the California Energy Commission (Energy Commission) awarded SANDAG funding to plan for the growth of PEVs in the San Diego region. This funding established the PEV coordinating council, named the San Diego Regional Plug-in Electric Vehicle Infrastructure (REVI) working group, to develop the San Diego Regional Plug-in Electric Vehicle Readiness Plan (PEV Readiness Plan). The PEV Readiness Plan includes fact sheets, resources, best practices, and other pertinent guidance documents for use by planners and other local government officials to support the growth of PEVs in their jurisdiction. Cities in the San Diego Region such at Chula Vista and National City have implemented recommendations from the PEV Readiness Plan.

The Refuel San Diego project included developing an existing conditions report and an alternative fuel assessment. These documents acted as updates to the 2009 Report with information on the current state of alternative fuel penetration within the San Diego region as well as the understanding of alternative fuels amongst local stakeholders.

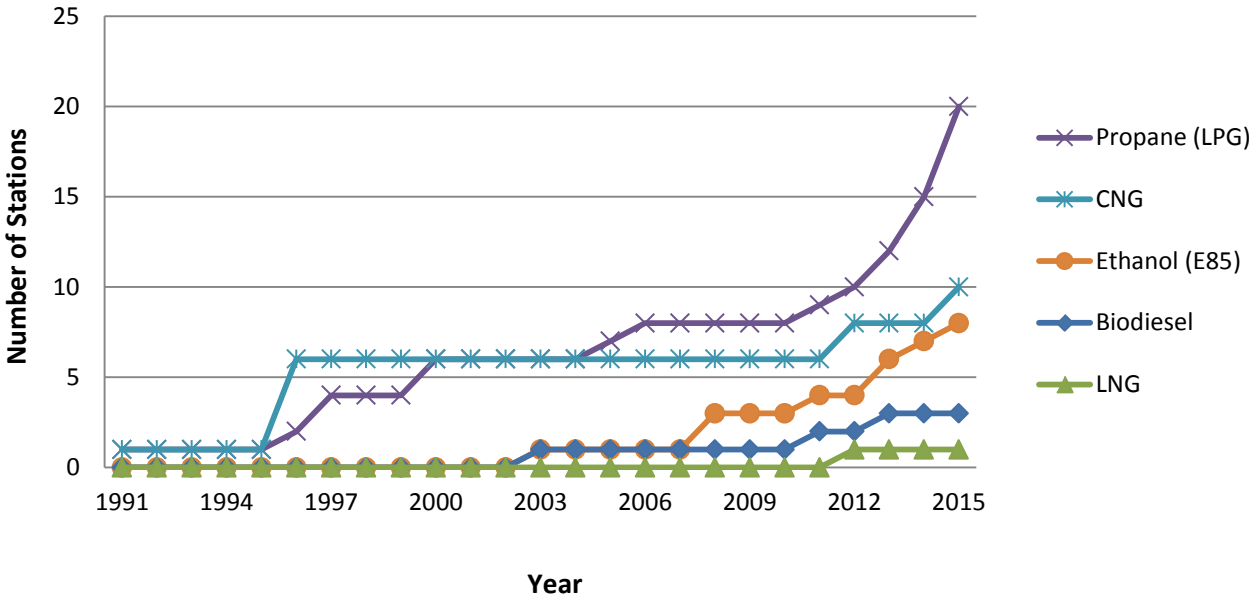
## Infrastructure

The San Diego region has about 40 public alternative fuel stations (excluding electric vehicle charging stations, EVCS), compared to more than 1,000 gasoline stations. A strategic approach to locating more stations could help accelerate alternative fuel vehicle (AFV) adoption in the region.

Extensive efforts have been made to increase the availability of EVCS for PEVs. Availability has increased rapidly since their introduction in 2010, with over 600 public charging ports currently available in the San Diego region. That said, in order for the region to be ready for the amount of PEVs the state is projecting by 2025, the San Diego region would need up to 4,200 public Level 2, 190 public Level 1, and 138 public DC fast charging ports. The Energy Commission estimates that this number could support the region's share of California's 1.5 million zero emission vehicle (ZEV) goal.[1,2]

Other alternative fuels have seen slow but steady infrastructure growth in the region over a longer timeframe. Figure 3-1, below, shows the growth of public alternative fuel infrastructure (AFI) in the region (excluding EVCS). More information on currently available and pending AFI is available in Section 4: Alternative Fuel Infrastructure Investment and Coverage.

**Figure 3-1: San Diego County Public Alternative Fuel Infrastructure Growth, 1991-2015**



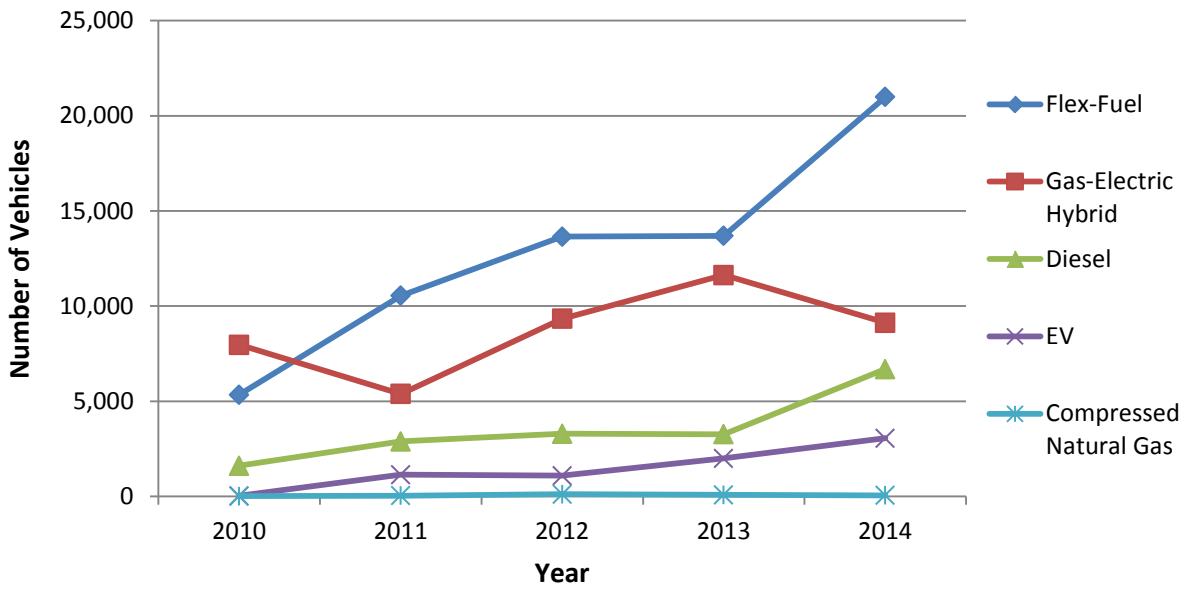

[1] Melaina, Marc, Michael Helwig. (National Renewable Energy Laboratory). 2014. California Statewide Plug-In Electric Vehicle Infrastructure Assessment. California Energy Commission. Publication Number: CEC-600-2014-003.
[2] This is in a "high public access" scenario in which most charging would occur outside of the home. These numbers exclude workplace charging.

## Number of Vehicles

In 2014, there were close to 2.3 million light-duty vehicles in San Diego County and nearly 60,000 heavy-duty vehicles.[3] Statewide, there were 26 million light-, medium-, and heavy-duty vehicles. The region accounts for nearly 9 percent of the state's total vehicle population. The number of vehicles in the region is growing at a rate of approximately one percent per year.

From 2010 to 2014, the region's light-duty AFV market was predominantly led by sales of vehicles capable of running on alternative fuels and a conventional fossil fuel, such as flex-fuel vehicles, hybrids, and diesel vehicles. Approximately 80 percent of the region's new light-duty vehicle sales continue to be for traditional gasoline vehicles. In the second quarter of 2015, PEVs accounted for roughly 2.5 percent of new light-duty vehicle sales in San Diego County.[4,5] Figure 3-2 shows the growth of new light-duty alternative fuel vehicle sales in San Diego County. Figure 3-2 excludes propane autogas vehicles as there are no factory-produced, light-duty autogas vehicles. Public databases are unable to identify vehicles with 3rd party fuel systems.

**Figure 3-2: New Alternative Fuel Light-Duty Vehicle Sales San Diego County, 2010-2014**




[3] Light-duty vehicle refers to vehicles whose Gross Vehicle Weight Rating (GVWR) does not exceed 14,000 pounds. It includes trucks and passenger vehicles.

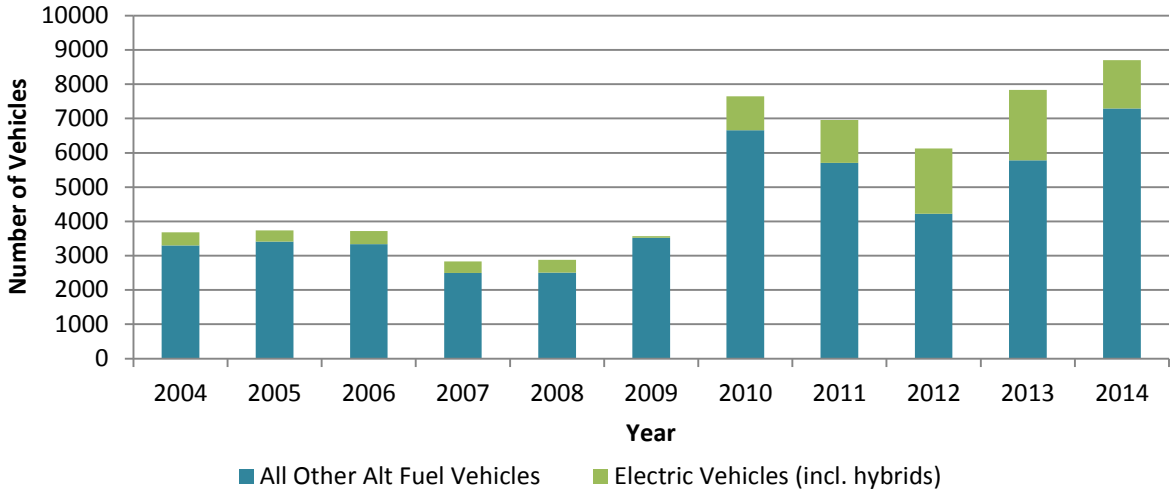
[4] Auto Outlook, Inc. *California Auto Outlook*. Exton, PA: Auto Outlook, Inc. on behalf of the California New Car Dealers Association, August 2015. Web. October 25, 2015. (Data Source: IHS Automotive)

[5] Center for Sustainable Energy (2015). California Air Resources Board Clean Vehicle Rebate Project, Rebate Statistics. Data last updated October 25, 2015. Retrieved October 25, 2015, from https://cleanvehiclerebate.org/rebate-statistics.

## Alternative Fuel Use in Local Fleets

Since 2004, the SDRCCC has maintained regional data on the use of alternative fuels and the deployment of AFV in local fleets. Figure 3-3 depicts AFV growth deployed by SDRCCC stakeholders[6] in the region. Several public and private fleets have served to demonstrate successful large-scale deployments. For example, CNG has been used extensively by local refuse haulers and transit agencies such as the San Diego Metropolitan Transit System (MTS). The San Diego car2go car sharing fleet has operated several hundred PEVs while also giving customers the opportunity to have hands-on experience with electric vehicle technology. Additional fleet deployments are discussed in the private funding portion of this Section.

**Figure 3-3: Number of Alternative Fuel Vehicles Reported by SDRCCC Stakeholders**




## Alternative Fuel Investments

**California Energy Commission Funding**

As established by AB 118 (Núñez, Chapter 750, Statutes of 2007) and extended by AB 8 (Perea, Chapter 401, Statutes of 2013), the Energy Commission is responsible for managing the Alternative and Renewable Fuel and Vehicle Technology Program (ARFVTP). This program provides grants to develop and deploy advanced transportation technologies and alternative and renewable fuels that will help the state achieve its climate goals. The Energy Commission has an annual program budget of approximately $100 million through 2024 to support such projects.

[6] These numbers do not provide a complete representation of all fleets in San Diego County. All information provided by fleets is voluntary and therefore the data may be incomplete. SDRCCC stakeholders are fleets and organizations that have participated in Clean Cities events or are in regular communication with the Coalition, and have provided the Coalition with fleet data in its annual fleet questionnaire. National fleets using alternative fuels locally are excluded from this data as they are tracked at the federal level.

Statewide, ARFVTP has funded over 460 clean transportation projects and invested over $557 million in infrastructure and advanced transportation technologies.[7] Primary investments have been in electric drive, biofuels, natural gas, and hydrogen technologies as well as workforce development and market development programs. These investments have supported growth in alternative fuel vehicles, fuel production, and infrastructure.

Table 3-1 shows ARFVTP investments for projects in the San Diego region since 2011. The variety of projects is one measure of the region's overall commitment to advancing alternative fuel technology.

**Table 3-1: ARFVTP Funding: Awards Given to Projects in San Diego Region**

| PON[8] # | Program Area | Date Released | Amount Awarded to Local Entity |
|---|---|---|---|
| **10-602** | Regional Plans to Support Plug-In Electric Vehicle Readiness | 05/12/2011 | $ 200,000 |
| **11-601** | Biofuels Production Facilities | 01/11/2012 | $3,153,657 |
| **11-602** | Alternative Fuels Infrastructure: Electric, Natural Gas, Propane, E85 & Diesel Substitutes Terminals | 02/08/2012 | $1,737,234 |
| **12-605** | Natural Gas Fueling Infrastructure | 11/29/2012 | $ 897,471 |
| **13-603** | Alternative Fuel Readiness Plans | 08/12/2013 | $ 300,000 |
| **13-605** | Centers for Alternative Fuels and Advanced Vehicle Technology | 08/23/2013 | $ 272,263 |
| **13-606** | Electric Vehicle Charging Infrastructure | 11/08/2013 | $1,122,855 |
| **13-607** | Hydrogen Refueling Infrastructure | 11/22/2013 | $1,451,000 |
| **14-603** | Zero Emission Vehicle (ZEV) Readiness | 09/09/2014 | $ 300,000 |
| **14-604** | Advanced Vehicle Technology Manufacturing | 09/05/2014 | $2,999,880 |
| **14-602** | Biofuels Early and Pre-Commercial Technology Development | 10/27/2014 | $ 305,624 |
| **14-505** | Advancing Clean Energy from Biogas, Biomethane, and Natural Gas | 12/10/2014 | $1,000,000 |
| **14-605** | Medium- and Heavy-Duty Advanced Vehicle Technology Demonstration | 12/19/2014 | $6,884,812 |
| **14-608** | Natural Gas Fueling Infrastructure | 03/18/2015 | $ 250,000 |
| | | | **$20,874,796** |

Over $20 million in grant funds have been awarded to public agencies, private companies, research institutions, and other entities in the San Diego region to complete advanced vehicle technology

[7] http://www.energy.ca.gov/drive/
[8] PON: Program Opportunity Notice

projects. Table 3-2 shows anticipated project categories for fiscal year (FY) 2015-2016, which will supplement currently open solicitations.[8]

**Table 3-2: Proposed FY 2015-2016 ARFVTP Statewide Funding**

| | |
|---|---|
| Biofuel Production and Supply | **$20 million** |
| Electric Charging Infrastructure | **$17 million** |
| Hydrogen Refueling Infrastructure | **$20 million** |
| Natural Gas Fueling Infrastructure | **$5 million** |
| Natural Gas Vehicle Incentives | **$10 million** |
| Regional Alternative Fuel Readiness and Planning | **$2 million** |

In addition to the ARFVTP, AB 118 also established the ARB Air Quality Improvement Program (AQIP). This program funds clean vehicle and equipment projects, including the Clean Vehicle Rebate Project (CVRP), Hybrid and Zero-Emission Truck and Bus Voucher Incentive Project (HVIP), and advanced technology demonstration projects. Annual funding for AQIP projects is generally $20 million to $25 million. For FY 2015-2016, AQIP will benefit from an additional $200 million from the Greenhouse Gas Reduction Fund (GGRF) derived from the state Cap-and-Trade Program.

**U.S. Department of Energy Funding**

A number of federal alternative fuel efforts have benefitted the San Diego region including the Clean Cities program, the EV Project, and PEV community readiness. The Department of Energy (DOE) created the Clean Cities program as a result of the 1992 Energy Policy Act (EPAct), requiring certain vehicle fleets to acquire AFVs. Local Clean Cities Coalitions were formed to provide EPAct-regulated fleets with resources to help them abide by the act. Since then, Clean Cities has evolved to help both fleets and consumers reduce their petroleum use. The SDRCCC has been working with the community for almost 20 years.

The EV Project was a large-scale effort funded by the DOE to increase the deployment of PEV charging stations across the nation. The DOE provided more than $100 million dollars to establish EVCS in ten major metropolitan areas including San Diego. In support of the EV project, the San Diego region formed an advisory group, developed an infrastructure roll-out plan, and performed a regional mapping project

[8] Smith, Charles, Jacob Orenberg. 2015. 2015-2016 Investment Plan Update for the Alternative and Renewable Fuel and Vehicle Technology Program. California Energy Commission, Fuels and Transportation Division. Publication Number: CEC-600-2014 -009-CMF.

to identify the most optimal sites for locating EVCS. The EV Project contributed to the installation of over 1,400 residential and public Level 2 chargers in the region.[9]

In 2011, the DOE issued 16 funding awards for PEV community readiness projects, totaling $8.5 million. California received $1 million to produce an assessment of community readiness for PEVs. CSE received a portion of this award on behalf of the San Diego region to conduct surveys among local jurisdictions and assess barriers to the deployment of PEV infrastructure.

**Private Funding**

In addition to government funding, private investments in AFI and AFVs play an essential role in largescale deployment of alternative fuels. Nissan, the manufacturer of the all-electric LEAF vehicle, has supported workplace charging station deployment. Two of the company's programs, Workplace Initiative and EV Advantage, provided employers with financial support for installing a charging station at their place of business if they allowed Nissan to host "ride and drives" at their facility. Through the EV Advantage program, Nissan contributed $10,000 toward workplace DC fast charger installations.

Investments in infrastructure also came from the energy company NRG. As part of a settlement agreement with the state, NRG is tasked to subsidize the installation of a minimum of 200 public DC fast chargers – 110 in the Los Angeles region, 55 in the San Francisco Bay Area, 15 in the San Joaquin Valley, and 20 in San Diego County.[10] Since 2012, 16 public fast chargers have been installed in the region.

In 2011, the San Diego International Airport partnered with SDRCCC, CSE, and SANDAG on a $1 million award from the reformulated gasoline settlement fund to launch the San Diego Airport Vehicle Rebate Project (AVRP). This program supported the San Diego International Airport's goal to transition its ground transportation providers to cleaner vehicles. The project combined vehicle funding with extensive education and outreach to ground transportation providers and drivers. The AVRP led to the conversion of 181 conventional gasoline vehicles to hybrids and alternative fuel vehicles. Even after the exhaustion of program funds, vehicle conversions have continued as taxi owners have recognized the economic benefits of hybrids. In early 2015, the SDAPCD approved $360,000 to fund the conversion of 33 of the remaining conventional airport taxi cabs to alternative fuels.

More private fleet investment will be needed to increase the deployment of alternative fuels. However, this investment is already beginning in certain sectors. The waste and recycling sector has seen significant movement toward natural gas, with the majority of new vehicle deployments being natural gas. Waste Management was an early mover, deploying 125 natural gas trucks in the early 2000's in support of clean air goals. As the economic benefits of natural gas became clear, many other regional waste haulers have converted all or part of their fleet including EDCO, Republic Services, and Tayman

[9] The Electric Transportation Engineering Corporation. 2013. *Q2 2013 Report: The EV Project*. http://www.theevproject.com/cms-assets/documents/127233-901153.q2-2013-rpt.pdf.

[10] California Energy Commission. 2012. "CPUC Files Settlement That Will Bring Electric Vehicle Charging Infrastructure to California's Diverse Communities."
http://docs.cpuc.ca.gov/PUBLISHED/NEWS_RELEASE/165145.htm.

Industries. The City of San Diego is planning to convert their waste collection fleet to natural gas. EDCO has included public fueling at two of their locations.

Continued private investment and public-private partnerships are essential for wide scale deployment of alternative fuels. Public agencies can support private contributions by providing a regulatory framework that encourages these investments, and by providing education and outreach to highlight the successes and local benefits.

# 4. Alternative Fuel Infrastructure Investment and Coverage

Alternative fuel infrastructure (AFI) is necessary to expand and accelerate the deployment of alternative fuel vehicles (AFV). This section provides an overview of the current condition of AFI in the San Diego region, estimates the increase in coverage needed for each fuel to become a reliable transportation option for more consumers and businesses, and makes suggestions for future infrastructure planning through geographic information systems (GIS) mapping and statistical analysis. AFI includes electric vehicle charging stations (EVCS), natural gas stations, hydrogen stations, and multi-fuel stations that sell biodiesel, ethanol (E85), propane autogas, and gasoline.

At a minimum, most consumers or businesses need at least one station nearby to begin to consider adopting a new fuel technology. The National Renewable Energy Laboratory (NREL)'s *Geography of Existing and Potential Alternative Fuel Markets in the United States* (2014) notes that proximity to an alternative fuel station is the most important prerequisite for market growth. Table 4-1 below identifies the percentage of residences and businesses in the region that are currently in the vicinity of alternative fuel stations using a radius of 2.5 miles. This distance is based on the NREL research showing that a most refueling happens within a five minute travel range from home or work and a relative unwillingness of drivers to travel out of their way to refuel. Table 4-1 also displays an estimated percentage of infrastructure coverage necessary for the region to meet our fair share of state petroleum reduction and alternative fuel targets and to enable more widespread adoption of AFV, referred to as the "Targeted Coverage" percentage.

**Table 4-1: Current and Targeted Alternative Fuel Infrastructure Coverage for San Diego County (January 2016)**

| Fuel | Audience | Current Coverage | Targeted Coverage |
|---|---|---|---|
| **Biodiesel** | Business | 13% | 50% |
| **Biodiesel** | Resident | 10% | 40% |
| **Electricity - DCFC** | Business | 62% | 75% |
| **Electricity - DCFC** | Resident | 45% | 70% |
| **Ethanol** | Business | 42% | 60% |
| **Ethanol** | Resident | 29% | 60% |
| **Hydrogen** | Business | 2% | 30% |
| **Hydrogen** | Resident | 2% | 30% |
| **CNG** | Business Only | 44% | 70% |
| **Propane Autogas** | Business Only | 50% | 65% |

The targeted coverage is based on the goal to provide fueling access to the majority of businesses and residents in the region. The target levels were informed by industry consultations and other relevant stakeholder contributions from Refuel San Diego. Some fuels require more or less coverage due to their range of operation between fueling events, the traffic capacity of stations, and the level of adoption. The GIS analysis to find optimal station locations is based on their proximity to business and residential sites. Maps were developed to show the existing (current and planned) stations as well as potential stations that would bring the total coverage up to the targeted level for each fuel type. Each fuel has maps for residences and businesses within 2.5 miles of a station. Natural gas and propane autogas are assumed to be business-only fuels as very few passenger vehicle options are available.

*NREL considers proximity to an alternative fuel station as the most important prerequisite for market growth.*

## Infrastructure Investment for Regional Readiness

Based on the analysis in this section, two scenarios – a low case and high case – were developed to estimate the level of investment necessary for the San Diego region to be considered ready to support the large-scale influx of vehicles run on each alternative fuel. The low case estimates how many stations would be necessary to reach the targeted coverage of residential and business sites using a 2.5 mile radius. The high case envisions a scenario where AFI is ubiquitous throughout the region, with redundancies in fueling infrastructure similar to gasoline stations.

The high case scenario is supported by projections from multiple sources including the Energy Commission's Statewide PEV Infrastructure Assessment, industry reports, and other state or national plans, resources, and best practices. For both types of electric vehicle charging stations (EVCS) analyzed, the high and low cases were derived from the Energy Commission's Statewide PEV Infrastructure Assessment (CEC-600-2014-003). Using approximate station costs, Table 4-2 estimates the costs to build out this comprehensive fueling infrastructure for the region.

**Table 4-2: Infrastructure Investment Needs to Support Widespread AFV Adoption in the Region**

| Additional Stations Needed | | | Cost Per Station | Investment Costs (in millions) | |
|---|---|---|---|---|---|
| Fuel Type | Low Case | High Case | | Low Case | High Case |
| Biodiesel | 11 | 25 | $300,000 | $3.30 | $7.50 |
| DC Fast Chargers | 15 | 104 | $60,000 | $0.90 | $6.24 |
| L2 EVCS | 1,140 | 3,540 | $5,000 | $5.70 | $17.70 |
| Ethanol | 5 | 22 | $300,000 | $1.50 | $6.60 |
| Hydrogen | 9 | 20 | $2,000,000 | $18.00 | $40.00 |
| CNG | 9 | 30 | $1,200,000 | $10.80 | $36.00 |
| Propane Autogas | 5 | 10 | $50,000 | $0.25 | $0.50 |
| | | | **Total Cost:** | **$40.45** | **$114.54** |

With a total investment of between $40 and $115 million, the region could support the widespread adoption of alternative fuel vehicles. These costs would need to be shared among state and federal funding, local government support, and private funding by fleets and fuel marketers. Infrastructure costs are based on average costs provided by the US DOE AFDC. These costs include permitting, equipment, and installation for a public access site. Estimates do not include the cost of site acquisition and assume installation on appropriately zoned sites. Actual installations costs may be higher or lower, depending on site specific characteristics. Installations costs may decline in the future as more sites are developed and designs are standardized.

While the analysis identifies specific locations, station deployment should also consider local land use, vehicle travel characteristics, and other factors. Co-locating alternative fuel stations at existing service stations or locating multiple alternative fuels at a single site can be a cost effective strategy, with lower costs for site acquisition and the ability to attract incentive funding from multiple sources. With sufficient vehicle deployment, stations should generate a surplus in their continued operations, allowing owners to expand capacity and build more stations to satisfy market demands. Each alternative fuel is addressed individually next.

## Biodiesel

Excluding hydrogen, biodiesel remains the least accessible fuel in San Diego County today. With three public stations selling high-level blends, biodiesel infrastructure provides access for only 13 percent of businesses and 10 percent of residences within a 2.5 mile radius. Like many fuels, biodiesel provides a better return on investment (ROI) as volume increases; however, it is used by many fleets and some public stations in low-level blends. Two of these stations sell a high-blend level renewable diesel and one sells a B20 blend.

**Table 4-3: Biodiesel Infrastructure Coverage for Sites in San Diego County (January 2016)***

| Site Type | % of Sites Covered | Targeted coverage | Additional Stations Needed |
|---|---|---|---|
| **Residence Sites** | 10% | 40% | 11 |
| **Business Sites** | 13% | 50% | 4 |

*Accounts for open and planned stations.

**Figure 4-1: San Diego County Biodiesel Infrastructure: Coverage for Residences within 2.5 Miles**

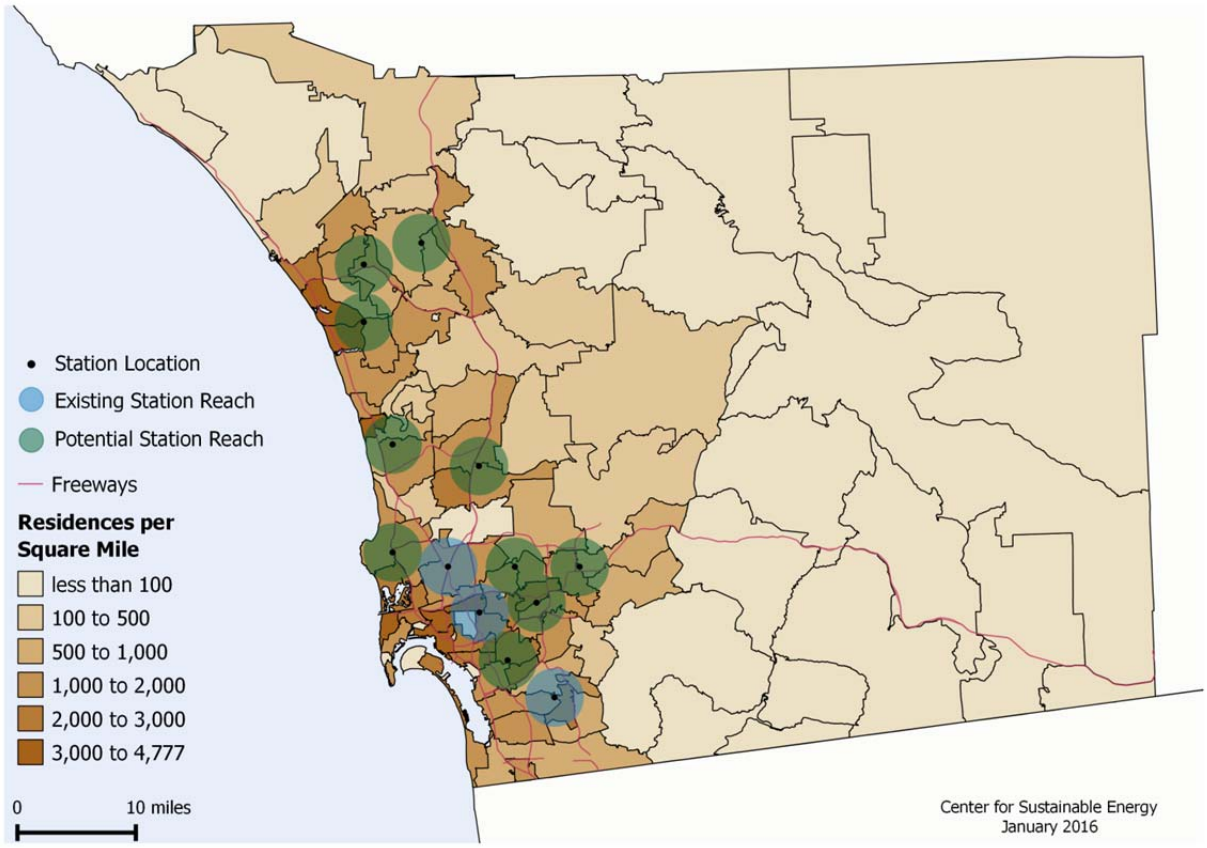
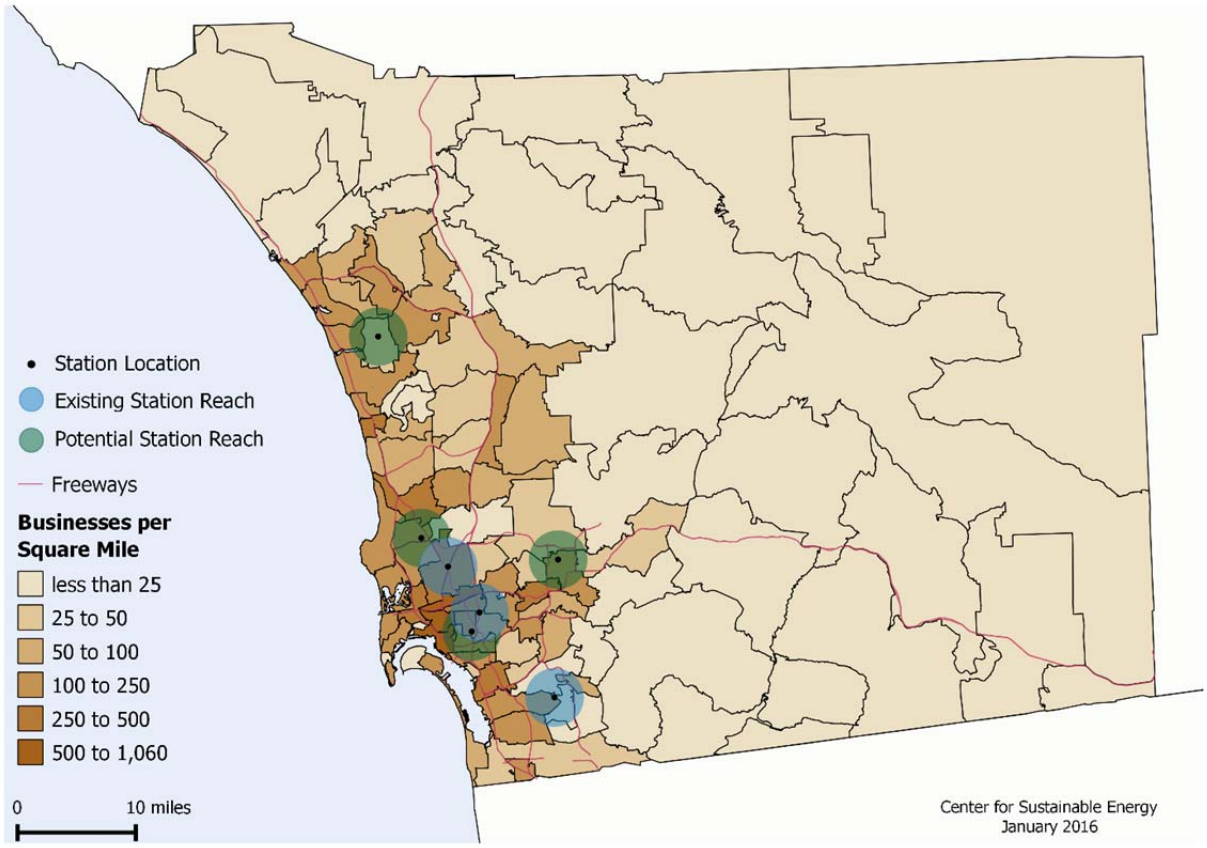


**Figure 4-2: San Diego County Biodiesel Infrastructure: Coverage for Businesses within 2.5 Miles**




Close to a dozen biodiesel stations are needed to provide adequate residential coverage. A much smaller number of stations would significantly improve business coverage. The region also has a small number of stations that primarily serve Class 8 trucks. If biodiesel was integrated into these stations it could lead to a large increase in access to fueling. Renewable diesel can be used in standard diesel infrastructure with no additional permitting requirements. Biodiesel can be permitted when the equipment has documented compatibility. Converting in use infrastructure is a cost effective opportunity to increase bio/renewable diesel fueling.

## Electricity

There are two primary categories of publicly available EVCS, Level 2 (L2) and direct current fast chargers (DCFC). The power output for L2 equipment varies by device and the vehicle's onboard charger, so an hour of charging can provide between 8 and 30 miles of driving range. DCFCs have the ability to charge a PEV to approximately 80 percent capacity in under 30 minutes. Not all PEVs are compatible with DCFC but most newer all-electric models are equipped to take advantage of the quicker charging DCFC provides. While DCFCs can be used more like traditional gas pumps, L2 stations need to be located at destinations with long dwell times such as workplaces and recreation sites. Because of this unique characteristic of L2 fueling, targeted coverage percentages are not an appropriate gauge to address need. Accordingly, coverage maps were not created for L2 stations.

Table 4-4 displays the number of business and residential sites covered by DC fast chargers. The following maps show the current coverage of DC fast chargers as well as where infrastructure is needed to reach the targeted coverage.

**Table 4-4: Electricity (DCFC) Infrastructure Coverage for Sites in San Diego County (January 2016)***

| Site Type | % of Sites Covered | Targeted Coverage | Additional Stations Needed |
|---|---|---|---|
| **All Residence Sites** | 44% | 70% | 11 |
| **All Business Sites** | 62% | 75% | 5 |

*Accounts for open and planned stations

**Figure 4-3: San Diego County Electricity (DCFC) Infrastructure: Coverage for Residences within 2.5 Miles**

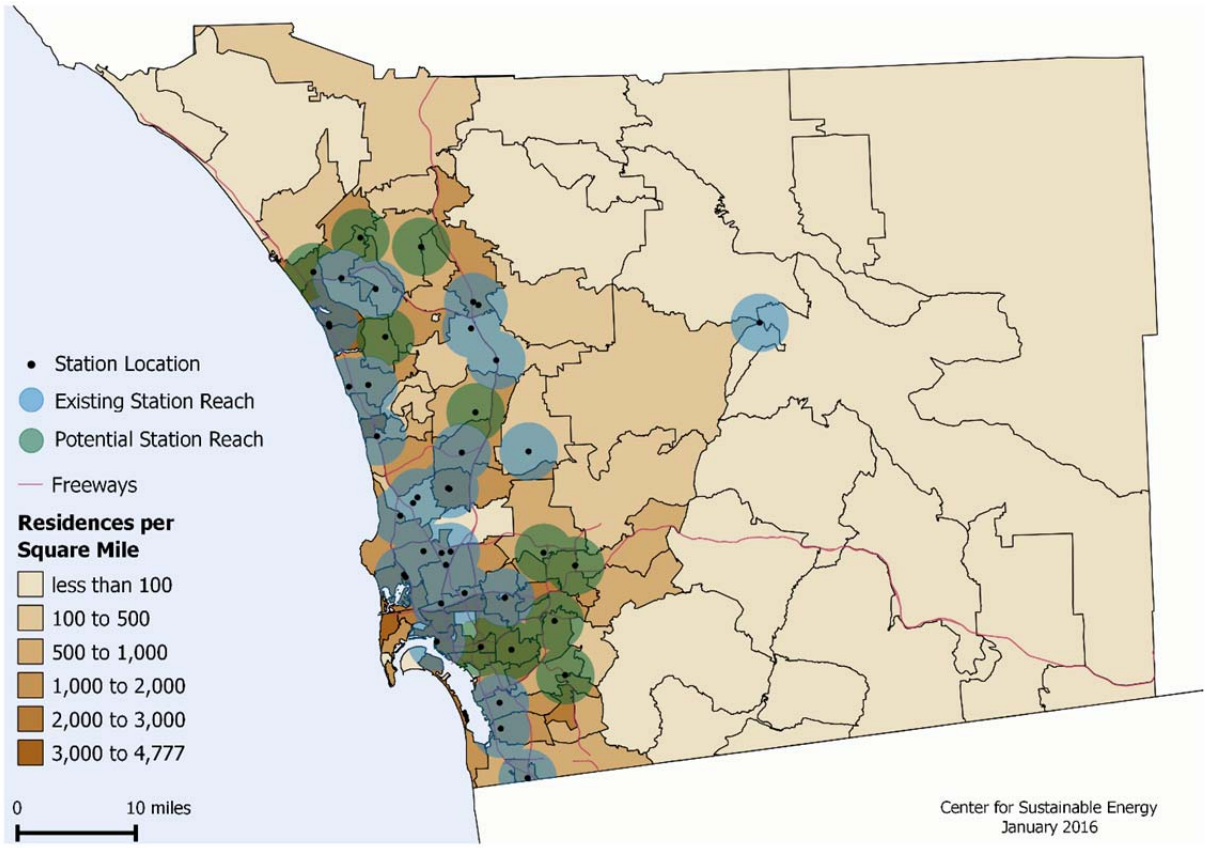
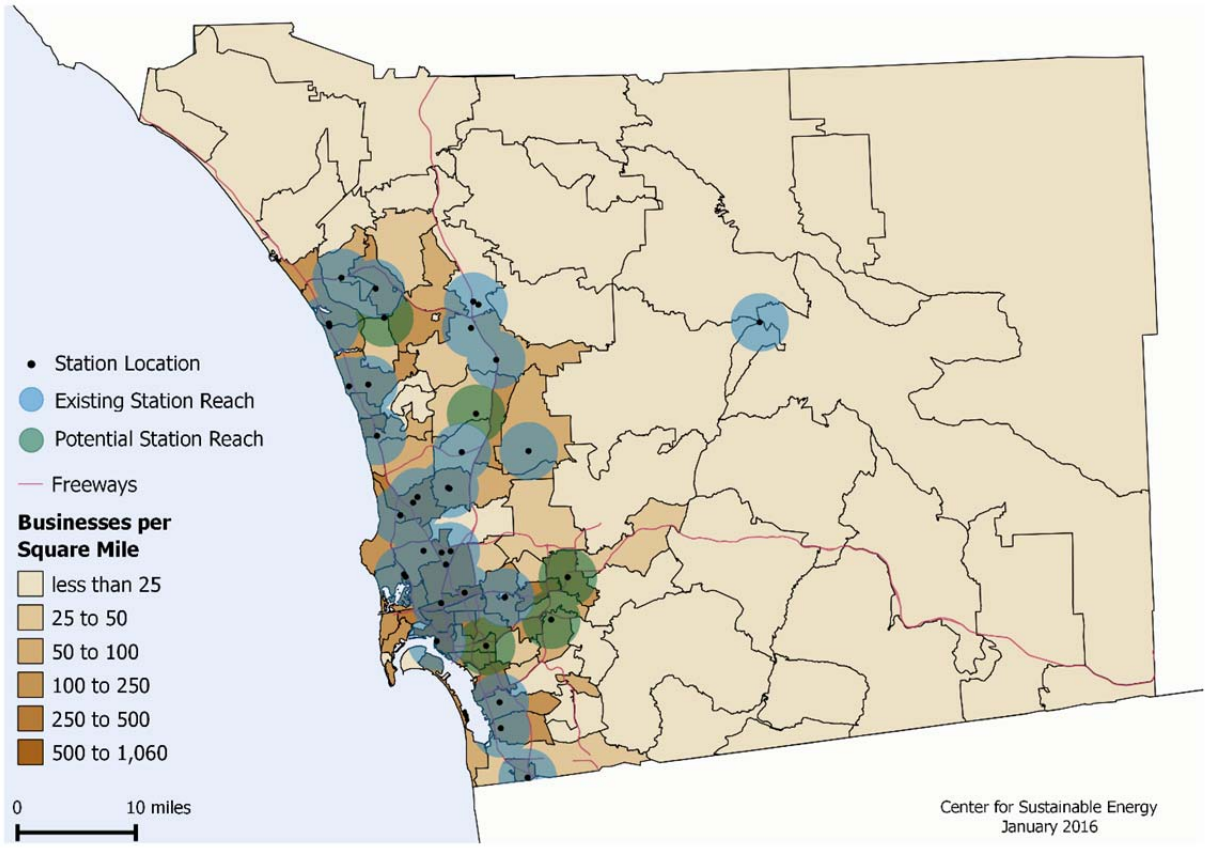


**Figure 4-4: San Diego County Electricity (DCFC) Infrastructure: Coverage for Businesses within 2.5 Miles**




DCFC expansion should be based on the increasing utilization of current infrastructure, as well as filling in gaps near major transportation corridors. Anecdotal observations show that existing DCFC infrastructure is already well utilized. Increasing the number of chargers on an existing site can help increase capacity, although power supply issues may preclude the inclusion of additional chargers on some existing sites. More detailed utilization studies are required to demonstrate the need for extensive L2 expansion is needed.

## Ethanol (E85)

As of January 2016, there are nine E85 stations open to the public in San Diego County, with two more planned. These stations are within 2.5 miles of 42 percent of all business sites and 29 percent of all residences shown in Table 4-5 below.

E85 can be used in a wide range of vehicles and these cars have the benefit of being able to use gasoline as well, thus reducing anxiety over the lack of fueling stations. A study found that E85 was often not being used in flex fuel vehicles because fueling stations were not readily available. With more readily available fueling infrastructure, fleets may deploy more flex fuel vehicles capable of running on E85 and fuel them more often with E85 rather than conventional gasoline. As seen in Table 4-5, the addition of a relatively small number of E85 stations could have a broad impact on fuel access and use.

**Table 4-5: Ethanol (E85) Infrastructure Coverage for Sites in San Diego County (January 2016)***

| Site Type | % of Sites Covered | Targeted Coverage | Additional Stations Needed |
|---|---|---|---|
| **Residence Sites** | 29% | 60% | 5 |
| **Business Sites** | 42% | 60% | 4 |

*Accounts for open and planned stations

**Figure 4-5: San Diego County Ethanol (E85) Infrastructure: Coverage for Residences within 2.5 Miles**

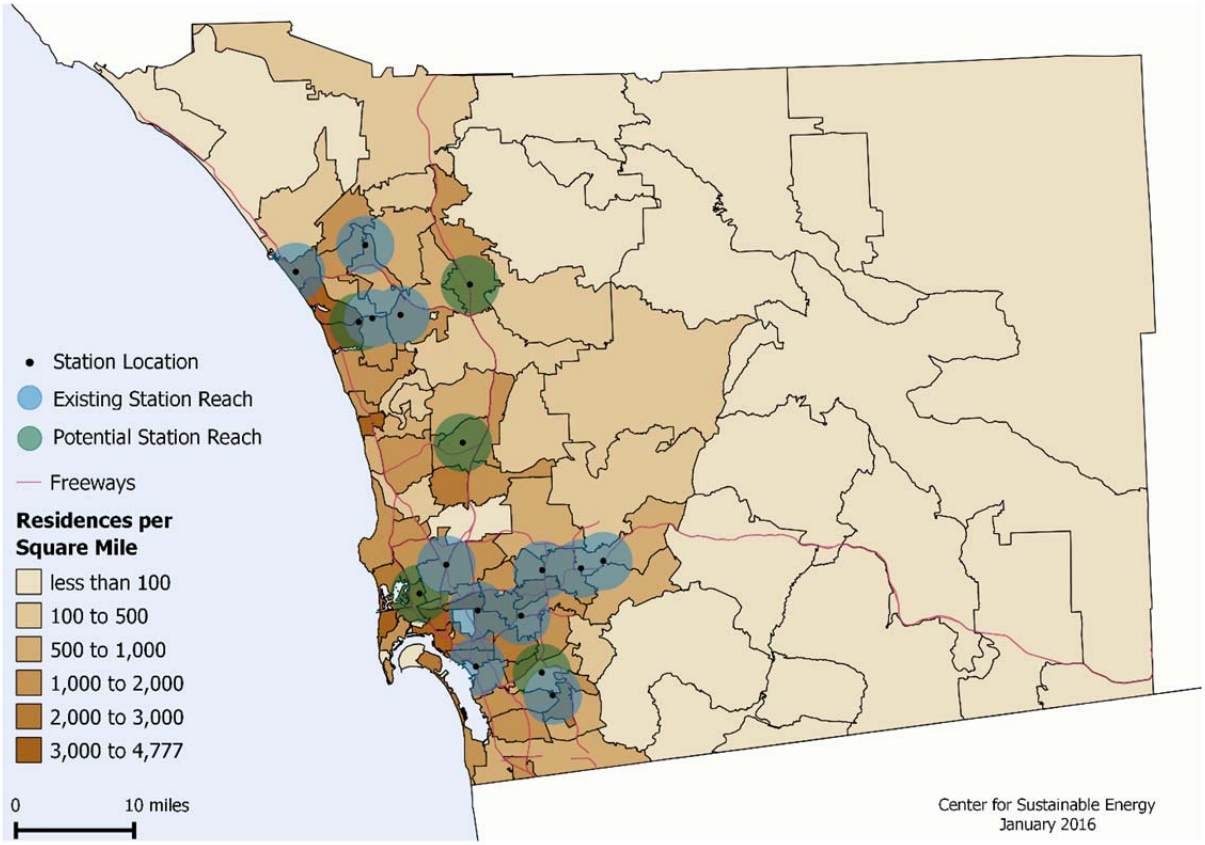
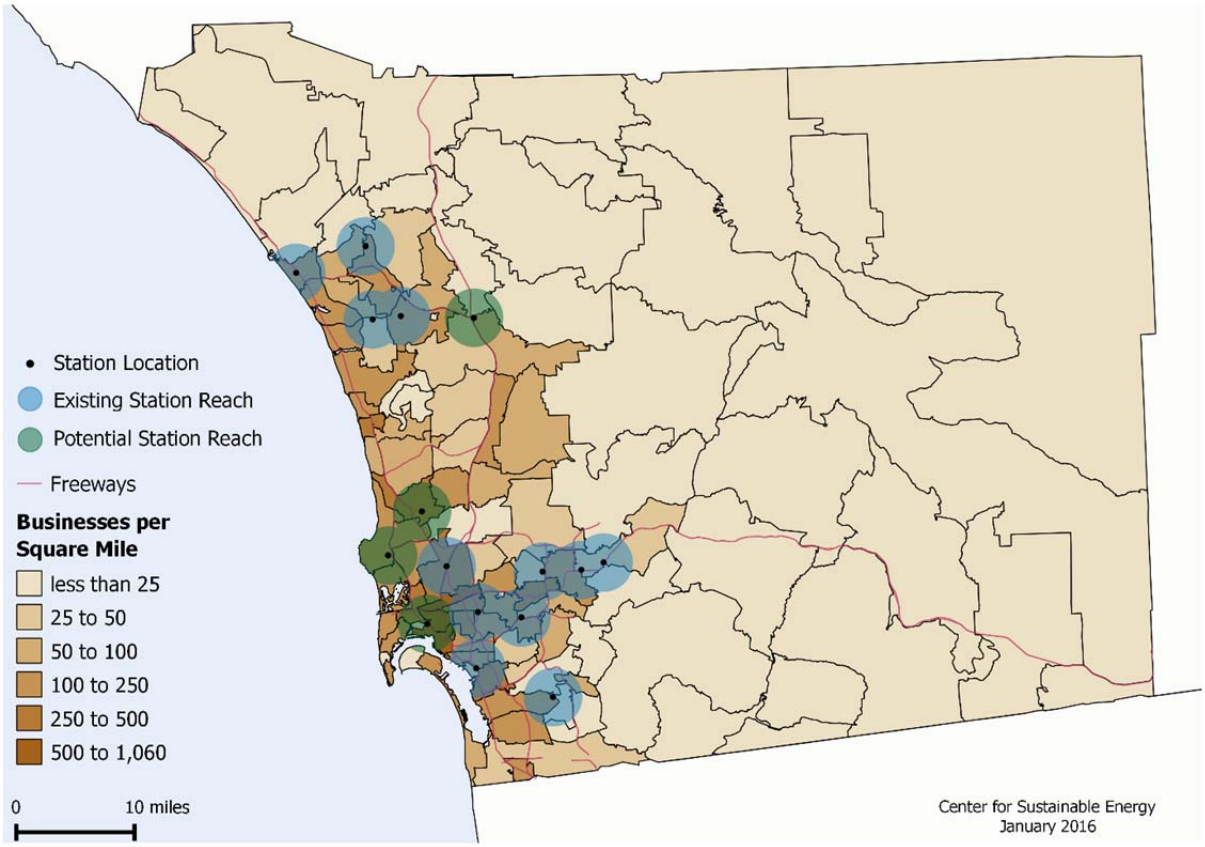


**Figure 4-6: San Diego County Ethanol (E85) Infrastructure: Coverage for Businesses within 2.5 Miles**




## Hydrogen

Over the long term, hydrogen is expected to play a large role in the state's transportation fuel mix. Although the San Diego region has been home to some hydrogen demonstrations, mass market vehicles are only now entering the market in California. The region's first hydrogen station is expected to be operational in early 2016. The station will primarily serve as a "connector station" for trips from the greater Los Angeles region. This single station covers a very small number of residents and businesses and is insufficient for automakers to sell hydrogen vehicles in the San Diego region yet.

*Two to three hydrogen stations are necessary for automakers to sell hydrogen vehicles in the San Diego region.*

Hydrogen automakers recommend an initial state investment of two to three stations to launch the hydrogen fuel cell electric vehicle market in the San Diego region. This analysis shows that even more stations would be needed to provide a moderate level of coverage in the region. Until hydrogen infrastructure costs decline, public funding will remain the primary source for funding station installations.

**Table 4-6: Planned Hydrogen Infrastructure Coverage for Sites in San Diego County (January 2016)**

| Site Type | % of Sites Covered | Targeted Coverage | Additional Stations Needed |
|---|---|---|---|
| **Residence Sites** | 2% | 30% | 9 |
| **Business Sites** | 2% | 30% | 5 |

**Figure 4-7: San Diego County Hydrogen Infrastructure: Coverage for Residences within 2.5 Miles**

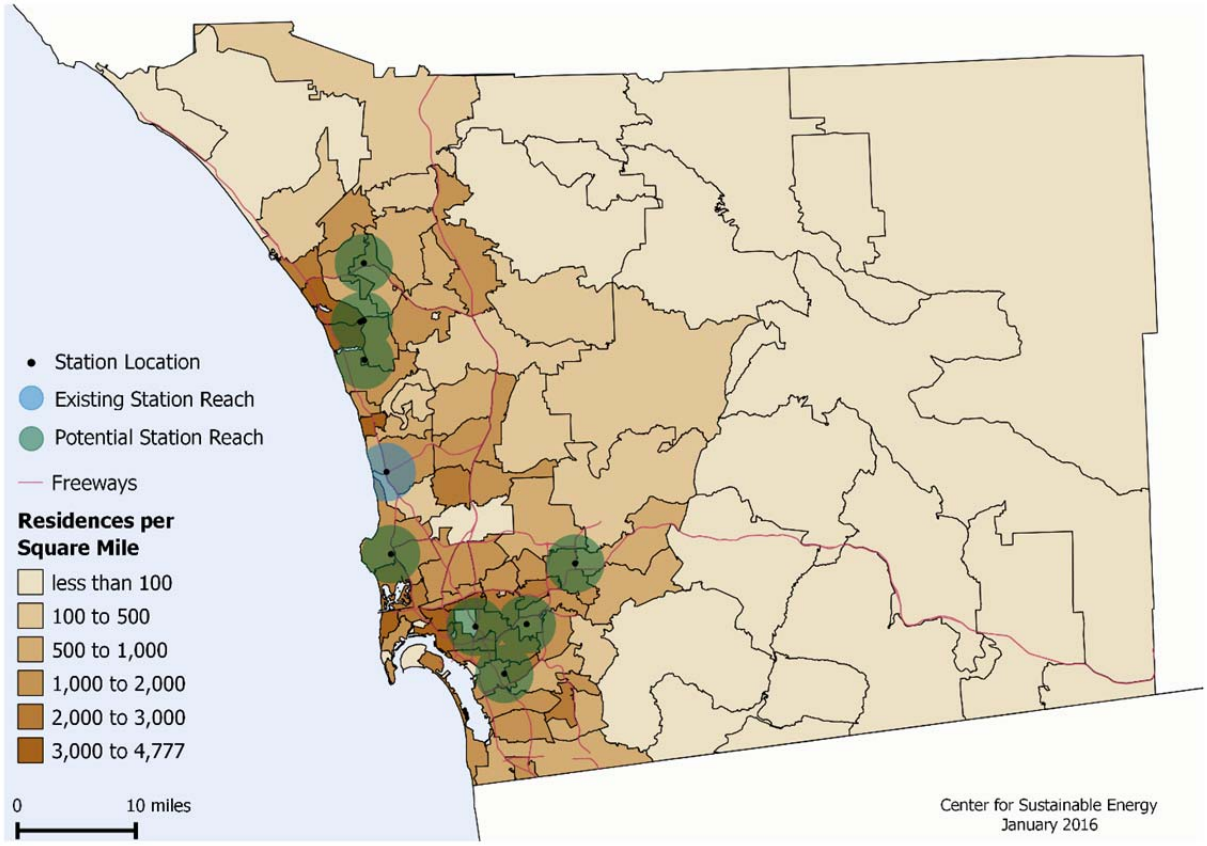
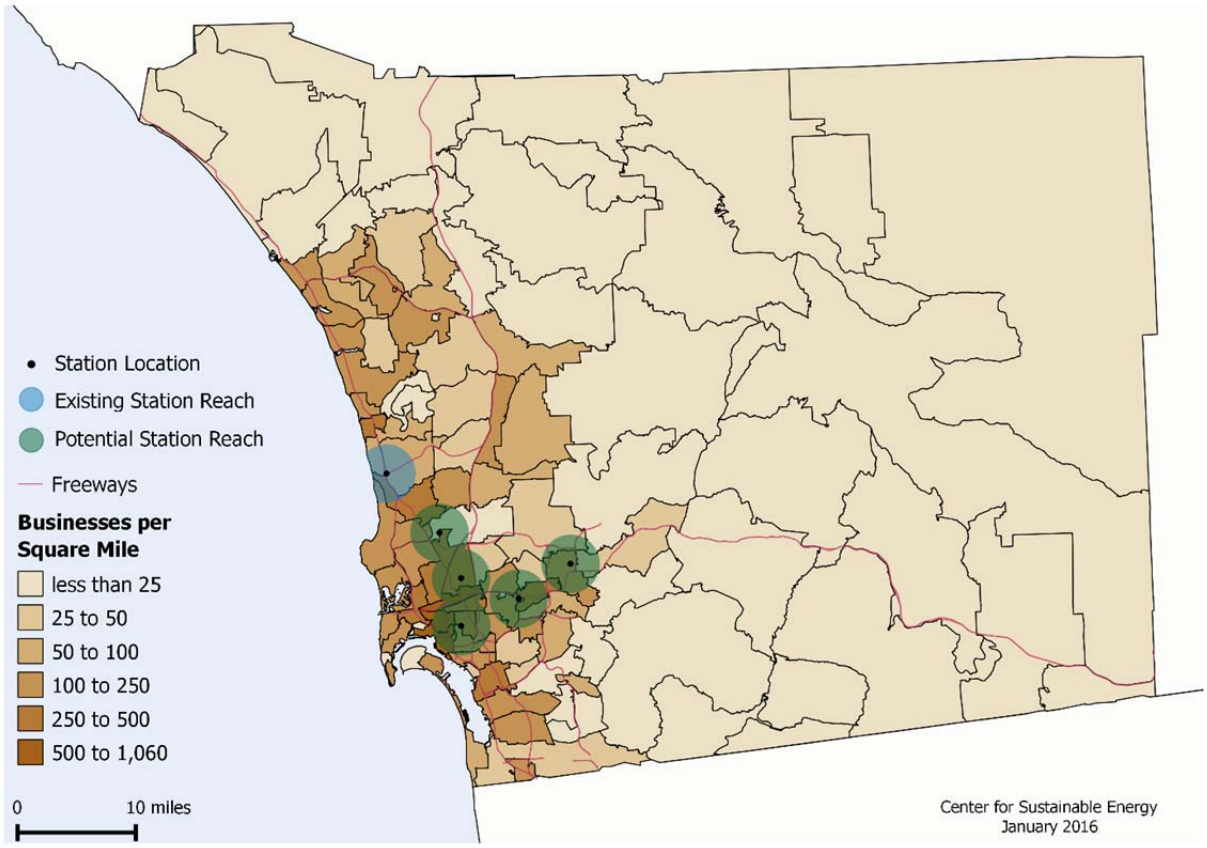


**Figure 4-8: San Diego County Hydrogen Infrastructure: Coverage for Businesses within 2.5 Miles**




The mapping results show that stations clustered in central San Diego can serve the most businesses, however stations in the north coastal corridor would serve more residents. The coastal corridor may be more in line with the demographic factors that automakers are targeting for hydrogen fuel cell vehicle deployment. The number of stations identified in this analysis exceeds current regional targets set by the state. However, these stations would allow automakers to accelerate their deployment plan for the region by providing a robust network in the region.

## Natural Gas

Natural Gas is already used by many refuse trucks and public transit fleets in the region, although often at private stations. In addition to conventional natural gas, the region is supplied with renewable natural gas—a clean and low carbon natural gas alternative derived from the anaerobic digestion of organic matter (usually waste at landfills or wastewater treatment plants).

The natural gas vehicle market is forecast to triple in size by 2035, a growth rate of nearly 5.6 percent per year. Renewable natural gas used in ultra-low NOx engines is the most feasible path for heavy duty trucks to approach zero emissions in the near future. To facilitate this growing vehicle demand, the San Diego region will need a robust network of strategically located natural gas fueling infrastructure.

There are currently 11 public compressed natural gas (CNG) stations in San Diego County. Table 4-7 shows that 44 percent of businesses are within 2.5 miles of a CNG station. A higher percentage of businesses are within 5 miles. However, not all stations are accessible to Class 8 tractor-trailers and some stations do not have sufficient compressor capacity to handle a substantial increase in the volume of fuel dispensed.

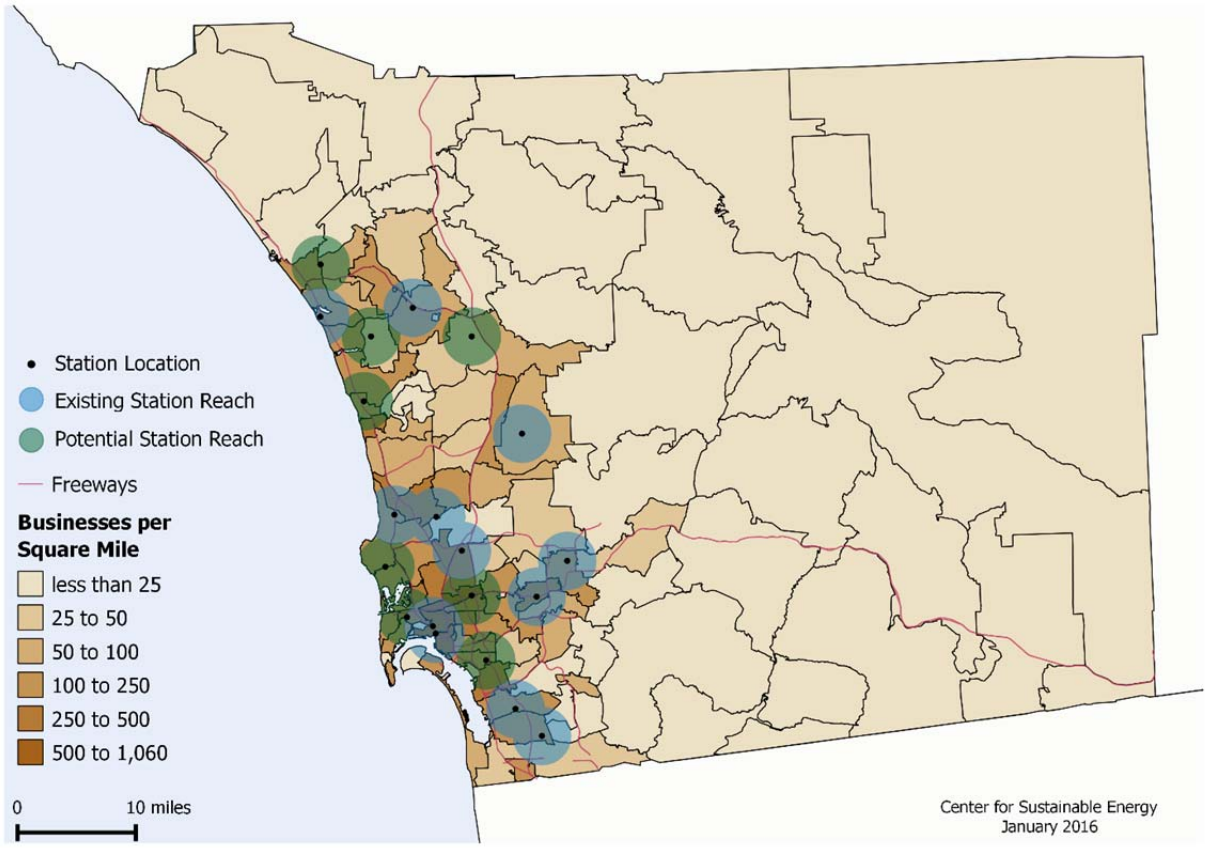
There is less demand for natural gas passenger vehicles because the economic and environmental case for natural gas fuel and vehicles are much better for medium and heavy duty vehicles. Therefore, this analysis focused on the coverage of CNG infrastructure in relation to businesses. There is only one liquefied natural gas station in San Diego County. It is located close to the Mexican border in Otay Mesa, San Diego and serves a very low percentage of businesses and residences in San Diego County. However this station does support long-haul trucks headed from the border to major logistics centers in the Inland Empire.

**Table 4-7: Natural Gas (CNG) Infrastructure Coverage for Businesses in San Diego County (January 2016)***

| Site Type | % of Sites Covered | Targeted Coverage | Additional Stations Needed |
|---|---|---|---|
| **All Business Sites** | 44% | 70% | 9 |

*Accounts for open and planned stations

**Figure 4-9: San Diego County Compressed Natural Gas (CNG) Infrastructure: Coverage for Businesses within 2.5 Miles**




Logistical and economic challenges exist for CNG station construction. A sufficient level of throughput is needed to fully amortize the capital costs, ongoing operations, and maintenance. Currently, many station sites are selected with the cooperation of a local business acquiring CNG vehicles. However, few businesses have large enough fleets to support a station on their own, so greater support may be needed for network growth in comparison to other fuels.

The natural gas industry identified that at least 10 percent of total fuel stations should have CNG fueling available in order to support a robust market.[1] Although this target exceeds the modeled target coverage, 30 stations could serve more than 10 percent of the regions heavy duty vehicle fleet if properly sized and located.

[1] America's Natural Gas Alliance. *U.S. and Canadian Natural Gas Vehicle Market Analysis: Compressed Natural Gas Infrastructure* Final Report. www.anga.us/media/content/F7D3861D-9ADE-7964-0C27B6F29D0A662B/files/11_1803_anga_module5_cng_dd10.pdf

## Propane Autogas

Aside from electricity, propane autogas — also known as liquefied petroleum gas (LPG) — is the most established alternative fuel infrastructure in the region. Excluding private stations, 22 public stations are available to fuel propane vehicles throughout San Diego County. These 22 stations are within 2.5 miles of 50 percent of all business sites. However, some stations would need to be upgraded if a larger volume of propane autogas fueling was to occur.

Current public infrastructure covers a significant number of businesses and consumers in San Diego County. Light- and medium-duty fleets are the primary consumers of propane autogas. Additional fueling stations in locations with potential demand could prove an incentive for more fleet managers to switch from diesel fuel. Additional fueling infrastructure and upgrades for existing propane autogas infrastructure could be installed at low cost, and propane autogas fuel providers are motivated to develop infrastructure for a potential customer with sufficient volume.

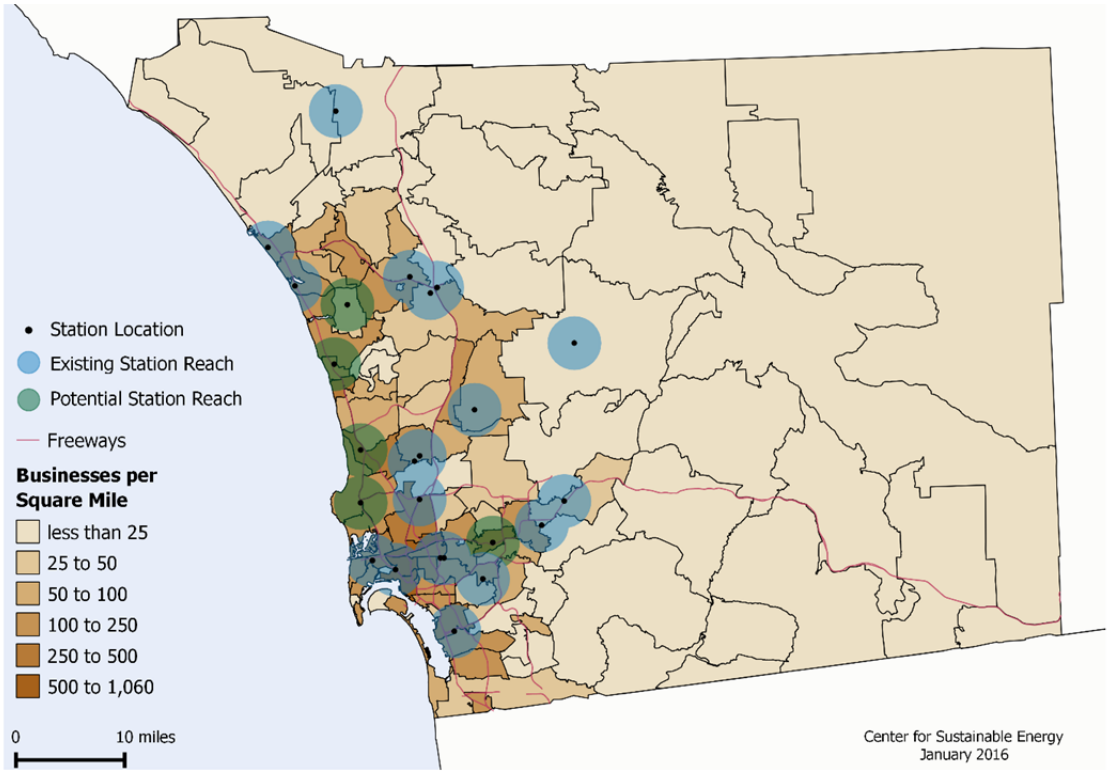
Presently, public infrastructure in the region appears close to providing adequate coverage. The low cost and ease of infrastructure construction lends itself to a relatively quick ROI, making private stations attractive to fleets that want the convenience of onsite fueling.

**Table 4-8: Propane Autogas Infrastructure Coverage for Businesses in San Diego County (January 2016)***

| Site Type | % of Sites Covered* | Targeted Coverage | Additional Stations Needed |
|---|---|---|---|
| **All Business Sites** | 50% | 65% | 5 |

*Accounts for open and planned stations

**Figure 4-10: San Diego County Propane Autogas Infrastructure: Coverage for Businesses within 2.5 Miles**



## About the GIS Method

The algorithm used searches for station locations that would add service to the (approximately) greatest number of residences or businesses. This is achieved by first creating circles with a given radius around each business (or residence). It would be prohibitively time consuming to check each point in space and so a square grid is created over the entire space and each square is checked to see how many circles it intersects. Smaller grids are then created within the grids with the maximum number of intersecting circles. Once a sufficiently small square area of maximum coverage has been found (50m X 50m) the centroid is used as a station location and the true number of intersects is found.

Further analysis using factors such as travel patterns, demographics, and business types could be used to provide more detail on station locations. Additional market analysis is needed to inform investment in individual sites; however this analysis illustrates the magnitude of regional investment that is required.

# 5. Current and Ongoing Efforts

There are several programs that actively support planning for and the deployment of alternative fuel vehicles (AFVs) and alternative fuel infrastructure (AFI) in the San Diego region. Although not an exhaustive list, this section describes many of these efforts.

## San Diego Forward: The Regional Plan

San Diego Forward: The Regional Plan (Regional Plan) combines the big-picture vision for how the San Diego region will grow over the next 35 years with an implementation program to help make that vision a reality. On October 9, 2015, the San Diego Association of Governments (SANDAG) Board of Directors adopted the Regional Plan, its Sustainable Communities Strategy (SCS), and Environmental Impact Report (EIR). The Regional Plan calls for the following actions to accelerate the deployment of alternative fuels in the region:

- *Near-Term Action*: Complete a follow-up study to detail strategies to reduce greenhouse gas (GHG) emissions by expanding the use of alternative fuels across the region.
- *Continuing Action*: Promote the use of alternative fuels and zero-emission vehicles (ZEV), while ensuring that adequate supporting infrastructure is available.

The EIR identifies measures to reduce the significant environmental impacts of the Regional Plan. Multiple measures directly address alternative fuels or suggest consideration of alternative fuels as a means to mitigate GHG emissions. EIR mitigation measures include:

- Adopt a Plan for Transportation Fuels that Reduce GHG Emissions [GHG-4D]
- Fund Electric Vehicle Charging Infrastructure [GHG-4C]
- Allocate Competitive Grant Funding to Projects that Reduce GHG Emissions [GHG-4A]
- Adopt a Detailed Regional Mobility Hub Implementation Plan to Reduce GHG Emissions [GHG-4B]
- Assist in the Preparation of Climate Action Plans and Other Measures to Reduce GHG Emissions [GHG-4E]
- Implement Measures to Reduce GHG Emissions from Transportation Projects [GHG-4F]
- Implement Measures to Reduce GHG Emissions from Development Projects [GHG-4G]

The Regional Plan estimates that by 2025, 15.4 percent of new car sales will be ZEV or plug-in hybrid electric vehicles. In order to support these vehicles, SANDAG has dedicated $30 million toward a regional charger program to begin in 2020.

## Plug-in SD

In 2015, SANDAG received California Energy Commission funding to implement the recommendations of the San Diego Regional Plug-In Electric Vehicle Readiness Plan and support plug-in electric vehicle (PEV) adoption and electric vehicle charging station

(EVCS) deployment throughout the region. SANDAG has partnered with the Center for Sustainable Energy (CSE) to implement this effort, called "Plug-in SD." Plug-In SD's goal is to provide guidance to local stakeholders through a combination of resources, outreach, and training to ensure that the San Diego region is PEV ready. The program will support the development of resources such as permitting, inspection and installation checklists, best practice reports, and PEV awareness marketing materials. Direct technical assistance is available to local stakeholders through an "EV Expert" who offers expertise on electric vehicle charging in the region and is available to address specific concerns.

## Car Share Pilot

In October 2015, the California Air Resources Board (ARB) awarded SANDAG a $300,000 grant to fund the Innovative Mobility Options for Disadvantaged Communities Pilot Project. The City of San Diego and car2go have partnered with SANDAG to expand the City's car share service into Barrio Logan and Logan Heights, two disadvantaged neighborhoods. These neighborhoods experience heavy traffic congestion and associated air pollution from daily commutes of 9,000 employees and 30,000 military personnel driving to locations directly adjacent to them. The car2go fleet is comprised of 400 all electric vehicles which could be used by commuters and local residents. The project plans to site EVCS in the community, provide dedicated parking spaces for car share vehicles, and offer car share membership subsidies for residents and incentives for new participants.

## Advanced Transportation Center

The Los Angeles County Economic Development Corporation and CSE have established the Southern California Advanced Transportation Center (Center). The Center serves as a central clearinghouse for public information and supports stakeholder coordination to advance the adoption of alternative fuels and advanced vehicle technologies. The Center provides a framework for stakeholder coordination through regular communications, events, and technical support to alternative fuel market participants. The Center includes physicals locations in San Diego and Los Angeles in addition to an online presence.

## San Diego Regional Clean Cities Coalition

The San Diego Regional Clean Cities Coalition (SDRCCC) has been active in the San Diego community since 1996. Clean Cities is a national Department of Energy program created as a result of the Energy Policy Act of 1992. SDRCCC is dedicated to reducing the San Diego region's dependence on conventional, petroleum-based fuels. The SDRCCC has been active in education and outreach to the general public and technical assistance for fleets interested in adopting alternative fuel and advanced technology vehicles. In 2015, the SDRCCC hosted five Coalition-led events. These events are primarily targeted at fleet managers in the region, but several events have also been designed for consumers. These events, and other outreach activities, engage new sectors in the San Diego region while continuing to educate the community on alternative fuels and provide information on alternative fuel technology or vehicle developments. The SDRCCC plans to utilize the Alternative Fuel Toolkits developed as part of this process to support its continued outreach efforts.

## San Diego Gas & Electric® Vehicle-Grid Integration Pilot

In April 2014, San Diego Gas & Electric (SDG&E) submitted an application to the California Public Utilities Commission (PUC) to implement a pilot program for electric vehicle-grid integration (VGI). Under this pilot program, SDG&E proposes to contract with third-parties to install, operate, and maintain charging stations to SDG&E's specifications for VGI. Charging stations in this pilot will primarily be installed at workplaces and multi-unit dwellings such as apartments. In the first four years of the project as proposed, SDG&E estimates it will install up to 3,500 charging stations. The proceeding, still ongoing as of January 2016, can be followed on the SDG&E and PUC websites.

## Center for Sustainable Energy

The Clean Vehicle Rebate Project (CVRP) is funded by ARB and administered statewide by the Center for Sustainable Energy (CSE). CVRP provides rebates of up to $5,000 for the purchase or lease of zero-emission and plug-in hybrid light-duty vehicles, encouraging the diffusion of technologies that provide immediate air pollution emission reductions. As of January 2016, CVRP has issued more than $275 million in clean vehicle incentives. The CSE team also facilitates outreach events throughout California, conducts ongoing surveys of CVRP recipients to determine driving and charging habits of PEV owners, and develops PEV adoption data tools to provide key information to industry stakeholders.

## Trainings

Community colleges and other educational institutions in the San Diego region have held specialized trainings over the past five years to better prepare for alternative fuels. Trainings include technical training on biodiesel and natural gas, hybrid vehicle technology, and first responder trainings for emergency personnel and tow truck drivers.

For example, the San Diego Miramar College Advanced Transportation Technology and Energy (ATTE) Center offers technical education, training, and resources to allow its students to work with advanced fuel technologies. ATTE offers training regularly throughout the year and can schedule special trainings when an organization adopts new technologies.

Another regularly occurring alternative fuel training is the Electric Vehicle Infrastructure Training Program (EVITP), a training and certification opportunity for electricians who wish to learn how to install EVCS. The San Diego Electrical Training Trust, a partnership of the International Brotherhood of Electrical Workers Local 569, the San Diego Chapter of National Electrical Contractors Association, and Cuyamaca College have offered EVITP since November 2011 and has offered the course three to four times per year since its inception.

# 6. Addressing Alternative Fuel Barriers

There are many barriers to greater deployment of alternative fuels. Refuel: San Diego Regional Alternative Fuel Coordinating Council (Refuel San Diego) identified a number of alternative fuel barriers facing the San Diego region, which are listed in the Executive Summary and detailed below. These barriers were developed through a collaborative process including Refuel San Diego and subcommittee meetings, and consultation with industry experts. Many barriers were initially identified in work performed by the San Diego Regional Clean Cities Coalition (SDRCCC), San Diego Regional Electric Vehicle Infrastructure (REVI) working group, and other alternative fuel deployment efforts. The barriers can be categorized into those related to education, vehicles, and infrastructure.

Alternative Fuel Toolkits were developed to address each barrier and meet the needs of specific audiences: consumers, public agency and municipal staff, fleet professionals, first responders including emergency personnel, and fuel vendors. While the Alternative Fuel Toolkits offer information and resources, continued action and outreach will be needed to overcome these barriers. This section describes each barrier by category and related action items and resources included in the Alternative Fuel Toolkits.

**Table 6-1: Education Barriers**

| Lack of Public Knowledge on Alternative Fuels | |
|---|---|
| **Many members of the general public are unaware that alternative fuels are available, or have misconceptions about their use. Numerous sources provide information on alternative fuels, but continued effort is needed to disseminate the information and help consumers make informed decisions about alternative fuels. Outreach resources also must be updated frequently to reflect new developments in the rapidly evolving alternative fuels market.** | |
| **Pertains to** | All fuels |
| **Action Items** | Support municipalities in promoting alternative fuel vehicle (AFV) awareness to the public as well as increase their own baseline understanding of AFVs. |
| **What the Alternative Fuel Toolkit Provides** | The Alternative Fuels Toolkits for Fleets, Public Agencies, and Consumers all contain a general introduction to each fuel. The introductions cover details on how each fuel is made, what vehicles can use the fuel, and web-based resources with additional information. |
| **Continued Effort Needed** | The SDRCCC will continue to support outreach to fleets. Dealerships can be engaged as a key source of information on consumer vehicle purchases and the San Diego Association of Governments (SANDAG) Regional Energy Working Group (EWG) can serve as a forum for continued outreach to local government agencies and interested stakeholders. |

| Training and Education for Municipal Staff | |
|---|---|
| **Cities can play a lead role in promoting alternative fuel adoption. Municipal staff can ensure that city policies and activities support and encourage alternative fuel use. While many cities have incorporated language supporting alternative fuel use into a climate action plan or sustainability goal, actually implementing new policies and deploying new technologies can be challenging.** | |
| **Pertains to** | All fuels |
| **Action Items** | Support fleet managers and municipal staff in integrating AFVs and promoting alternative fuel-friendly policies. |
| **What the Alternative Fuel Toolkit Provides** | The Alternative Fuels for Public Agencies Toolkit provides relevant state policies that motivate greater AFV adoption, sample municipal policies that support the growth of AFVs, and guidance on codes and standards for permitting staff, including newer technology, such as hydrogen. |
| **Continued Effort Needed** | The SDRCCC will continue to provide updated information on successful implementation policies and offer forums for information sharing. Plug-in SD includes funding to support electric vehicle and infrastructure information throughout the region, but additional resources are needed to assist local governments with adopting and implementing measures related to other alternative fuels. The EWG can serve as a forum for outreach on potential training needs and opportunities. |

| Training and Education for Emergency Personnel and Transportation Fleet Staff | |
|---|---|
| **Emergency personnel including first responders, in addition to transportation fleet staff, should receive ongoing training on how to address alternative fuels as each fuel is different and has unique characteristics. Emergency personnel must know how to safely address incidents involving AFVs and Alternative Fuel Infrastructure (AFI). Transportation fleet staff should be trained to operate and maintain AFVs and AFI to reduce financial and operational risks.** | |
| **Pertains to** | All fuels |
| **Action Items** | Inform emergency personnel and transportation fleet staff of available training opportunities related to AFVs and AFI. |
| **What the Alternative Fuel Toolkit Provides** | The Alternative Fuels for First Responders Toolkit provides contacts for training facilities within and near San Diego County, information on responding to an incident in which an alternative fuel is present, and information on potential hazards unique to individual alternative fuels. The Alternative Fuels for Fleets Toolkit provides guidance on the availability of alternative fuel fleet vehicles, what local fleets are using, and where to obtain more information. |

| | |
|---|---|
| **Continued Effort Needed** | As technologies evolve and AFVs and AFI become more common, training programs will need to expand and evolve as well. Methods for continued information-sharing should be identified and utilized to provide ongoing information to these unique stakeholders. The SDRCCC can provide some technical assistance to local fleet staff to determine which alternative fuels, vehicles, and infrastructure could benefit them. The SDRCCC will continue to explore training opportunities and provide local resources when possible to share with first responders. Additional resources will be needed to ensure regular education and training opportunities are available. |

| **Time-of-Use Utility Rates/Grid Integration** | |
|---|---|
| **Access to the most affordable fueling possible is important for increasing deployment of alternative fuels. Utility rates can significantly affect the value proposition of these fuels. Electric vehicle charging during a period of lower grid demand can both optimize grid use and provide lower cost fuel to the end user. As plug-in electric vehicle (PEV) numbers grow, the impacts to the grid must be managed. Time-of-use (TOU) rates and vehicle-grid integration (VGI) projects are in their infancy and must be closely monitored to ensure they become a benefit, not a barrier, to further PEV growth. Natural gas fueling stations use compressors to fill vehicle tanks which are large users of electricity and the cost to produce natural gas fuel can be impacted by TOU rates depending on when they are used.** | |
| **Pertains to** | Electricity and natural gas |
| **Action Items** | Help AFV users to understand how vehicles integrate with the electricity grid and provide general information about time-of-use PEV charging and minimizing utility charges from natural gas station operation. |
| **What the Alternative Fuel Toolkit Provides** | The Alternative Fuels for Consumers Toolkit provides information on San Diego Gas & Electric (SDG&E) TOU rates, impacts vehicle charging can have on the grid, and links to the SDG&E website for additional information. |
| **Continued Effort Needed** | Plug-in SD provides additional resources on PEV charging. The state is expected to approve a VGI pilot program with SDG&E in 2016, which Plug-in SD will coordinate with on outreach to businesses and multi-unit dwellings (MuDs) to maximize end user exposure to PEVs and TOU rates. The SDRCCC will continue to work with natural gas suppliers on ways to optimize electricity use to reduce cost impacts at stations. The SDRCCC also will provide outreach and information about both electricity and natural gas integration. The EWG can serve as a forum to share information with local public agencies and other interested stakeholders. |

**Table 6-2: Infrastructure Barriers**

| Station Development: Codes and Permitting | |
|---|---|
| **Codes and standards exist for the location, installation, and maintenance of all AFI, including hydrogen. These regulations and requirements are not widely known, especially when the infrastructure has not previously been sited in the host jurisdiction.** | |
| **Pertains to** | All fuels |
| **Action Items** | Reduce the frequency of permit problems by documenting and addressing issues that have routinely occurred when stations are being installed (e.g., when a propane station is built, screens surrounding the propane tanks are often required). Increase local jurisdiction awareness of codes and standards relevant to alternative fuel stations. |
| **What the Alternative Fuel Toolkit Provides** | The Alternative Fuels Toolkits for Public Agencies and for Fleets include fuel-specific codes and standards, policies and laws, and permitting best practices to help jurisdictions facilitate station installations. The Alternative Fuel Toolkits also provide installation case studies and station installation processes identified as relevant to the region as discussed by Refuel San Diego. |
| **Continued Effort Needed** | California ZEV goals require an increase in the already high volume of charging station installations; therefore, further effort will be given to streamline permitting through Plug-in SD. Additional funding would advance the Refuel San Diego effort and allow for implementation of this Readiness Plan. Other fuel types can continue to be addressed with technical support of SDRCCC and information sharing through venues such as the EWG. |
| **Station Development: Site Assessment** | |
| **More alternative fuel stations are needed for all fuel types. Jurisdictions that want to advance alternative fuels may not know how or where to prioritize station sites, thus causing challenges for station developers and local fleets interested in utilizing AFVs. Jurisdictions can support station developers by sharing information on station sites they would consider optimal based on local land uses and the transportation network. This could help ensure that stations are sited in locations where they will have adequate use to be economically sustainable.** | |
| **Pertains to** | All fuels |
| **Action Items** | Provide solutions and guidance for municipal staff and other fleets on optimal locations for AFI. |
| **What the Alternative Fuel Toolkit Provides** | The Alternative Fuels for Public Agencies Toolkit details site assessments for electric vehicle charging stations (EVCS). Section 4 of this Readiness Plan, AFI Investment and Coverage, includes information on where additional AFI are most needed for each alternative fuel across the San Diego region. |

| | |
|---|---|
| **Continued Effort Needed** | Site assessment efforts for fuels other than electricity could be supported by SDRCCC in connecting potential fleet users to private station developers. A regional "Alternative Fuel Expert," similar to the "EV Expert" with Plug-in SD, could help with site assessments and implementation of this Readiness Plan, if funding was available. The EWG can serve as one forum for disseminating this information. |

| **Access to Public Alternative Fuel Stations** | |
|---|---|
| **Publicly available AFI in the region is limited in quantity, which can make access and affordability challenging. Increased numbers of fueling stations, greater access to them, and more AFVs to make them economically viable are needed to enable greater adoption of alternative fuels. Increased station utilization numbers would boost support for the construction of additional stations.** | |
| **Pertains to** | Biodiesel, ethanol, hydrogen, natural gas, and propane autogas |
| **Action Items** | Develop ways for fuel providers and local jurisdictions to increase awareness of public alternative fuel station locations. |
| **What the Alternative Fuel Toolkit Provides** | The Alternative Fuel Marketers and Retailers Toolkit includes an outreach guide to promote existing alternative fuel stations. Section 4: AFI Investment and Coverage (of this Readiness Plan) includes maps of where public fueling infrastructure is located and where potential new stations could be installed. |
| **Continued Effort Needed** | The SDRCCC will continue to facilitate introductions among potential users of alternative fuels, station developers, and property owners. Station developers, fuel providers, and the SDRCCC will continue to promote use of existing stations. |

| **Electric Vehicle Charging Stations at Multi-unit Dwellings** | |
|---|---|
| **Home charging is a necessity for most PEV drivers. Multi-unit dwellings (MuDs) account for about 40 percent of the region's housing stock and are forecasted to become even more predominant. Additional effort is needed to ensure MuD residents can easily access charging stations.** | |
| **Pertains to** | Electricity |
| **Action Items** | Conduct targeted outreach to property management associations, home owners associations, and similar entities, as well as MuD residents in order to reduce the complexities of charging at MuDs. Gather and share resources to help facilitate charging installations at MuDs. |
| **What the Alternative Fuel Toolkit Provides** | The Alternative Fuels for Consumers Toolkit includes resources on PEV charging at MuDs. |

| | |
|---|---|
| **Continued Effort Needed** | Plug-in SD will provide an "EV expert" to directly assist MuD communities with questions about PEV charging. SDG&E's proposed VGI pilot may provide additional opportunities for collaboration with Plug-in SD and the SDRCCC on outreach to this audience. |

| Workplace Charging |
|---|

**Workplace charging is second only to home charging in its ability to enable PEV adoption and increase in electric vehicle miles traveled, but workplace charging installations have not kept up with demand. More workplace charging is needed to support state goals for electric vehicle deployment.**

| | |
|---|---|
| **Pertains to** | Electricity |
| **Action Items** | Increase targeted outreach to employers, business associations, and similar entities on the demand for workplace charging. Provide information on the complexities of charging at workplaces, guidance on charging station considerations specific to workplaces, and resources to help facilitate installations. |
| **What the Alternative Fuel Toolkit Provides** | The Alternative Fuels Toolkits for Public Agencies and for Fuel Marketers and Retailers provide basic information, considerations, and guidelines for installing workplace charging. |
| **Continued Effort Needed** | Plug-in SD will conduct workplace outreach to promote PEVs and answer questions about charging. The "EV Expert" will be available to address technical questions and document solutions to common challenges. SDG&E's proposed VGI pilot may provide additional opportunities for collaboration with Plug-in SD and the SDRCCC on outreach to this audience. |

| Infrastructure Costs |
|---|

**AFI installations can be costly. Some infrastructure grants are available, but capital costs are still a barrier. Greater understanding of financing options, ownership models, and early identification of potential sites can help address this barrier.**

| | |
|---|---|
| **Pertains to** | All fuels |
| **Action Items** | Provide public agencies and fleets with tools for evaluating and overcoming infrastructure costs. |
| **What the Alternative Fuel Toolkit Provides** | The Alternative Fuels Toolkits for Public Agencies, for Fleets, and for Fuel Marketers and Retailers each address infrastructure cost considerations for their specific audience. Included are best practices, a listing of Energy Commission infrastructure grant recipients, ownership models for charging stations, and a compilation of workplace charging calculators. Resources to evaluate infrastructure installation payback and infrastructure installation case studies are also included. Additionally, the Alternative Fuels for Consumers Toolkit has a cost savings calculator and other resources for potential buyers of home chargers. |

| | |
|---|---|
| **Continued Effort Needed** | The San Diego region should position itself to compete for additional grant funding for alternative fuel readiness plan implementation, station installation, and other efforts to expand the knowledge and use of alternative fuels. The SDRCCC, San Diego Air Pollution Control District, and the EWG will help to disseminate information on available resources and grant programs. The region should continue to work to ensure that existing AFI is fully utilized. |

**Table 6-3: Vehicle Barriers**

| Selecting Appropriate Alternative Fuel Vehicles | |
|---|---|
| **Not all alternative fuels are appropriate for every application. Tools and information, including case studies, are needed to assist fleets and consumers when selecting the appropriate vehicle to meet their needs.** | |
| **Pertains to** | All fuels |
| **Action Items** | Help fleet staff and businesses choose the most appropriate alternative fuel vehicles for their needs. |
| **What the Alternative Fuel Toolkit Provides** | The Alternative Fuels for Fleets Toolkit includes a compilation of vehicle cost calculators, total cost of ownership calculators, and case studies of fleets using specific types of AFVs. |
| **Continued Effort Needed** | The SDRCCC will maintain current links to cost calculators and other resources. They also will update regional case studies and offer trainings on current and future resources and technologies. |
| **Procuring and Financing Alternative Fuel Vehicles** | |
| **AFVs may not be available through the same dealer channels as conventional vehicles. Higher vehicle costs put a strain on budgets, even when fuel savings will make up the cost over the life of the vehicle.** | |
| **Pertains to** | Biodiesel, electricity, ethanol, natural gas, and propane autogas |
| **Action Items** | Assist fleets with understanding the costs of AFVs and provide guidance on procurement and financing. |
| **What the Alternative Fuel Toolkit Provides** | The Alternative Fuels Toolkits for Public Agencies and for Fleets include information on incentives available for AFVs, provide support for leveraging existing or future joint procurement opportunities in government contracts, best practices, and identify methods for financing vehicle purchases. |
| **Continued Effort Needed** | The SDRCCC will continue to provide a forum for fleets to discuss and coordinate procurement. The EWG may be a space to share successes and challenges with other local interested stakeholders. |

| Converting Conventional Vehicles to an Alternative Fuel | |
|---|---|
| **Many alternative fuels require the purchase of a new vehicle, but biodiesel (B20) and ethanol (E85) can be used in most conventional diesel and/or flex-fuel vehicles with no modification. Conversion kits exist for switching from gasoline to propane autogas or natural gas as well as enabling dual-fuel operation, but California's complex regulations governing these conversions discourage their deployment.** | |
| **Pertains to** | Biodiesel, ethanol, natural gas, and propane autogas |
| **Action Items** | Provide guidance to public agencies and fleets on how to safely and lawfully convert conventional vehicles to use alternative fuels. |
| **What the Alternative Fuel Toolkit Provides** | The Alternative Fuels for Fleets Toolkit includes guidance on California Air Resources Board-approved conversion kits for propane and natural gas, and information on other fuels. |
| **Continued Effort Needed** | The SDRCCC should continue to promote fuel switching in capable vehicles (biodiesel and flex-fuel) and quantify the petroleum and GHG savings for fleets from switching to alternative fuels. Aggregate demand for vehicle conversion kits to support the certification process of those vehicles. |
| **Alternative Fuel Vehicle Technology** | |
| **Public awareness and acceptance of alternatives to gasoline and diesel is low. For widespread acceptance of AFV technology, a variety of concurrent efforts is needed: more AFVs must be seen on the roads, more stations need to provide and advertise alternative fuels, and dealerships need to provide information on the AFVs they carry and advertise them. Alternative fuels in public fleets and local support for more fuel choices will help reduce consumer anxiety about investing in AFVs.** | |
| **Pertains to** | All fuels |
| **Action Items** | Provide insight into the up-and-coming technology and emerging fuels. |
| **What the Alternative Fuel Toolkit Provides** | The Alternative Fuels Toolkits for Consumers, for Public Agencies, and for Fleets include information on each alternative fuel and the state's goals for dramatic increases in zero emission and partial zero emission vehicles. Section 7: Future of Fuels – Technology Assessment provides additional insight into each fuel's market readiness and upcoming developments. |
| **Continued Effort Needed** | The SDRCCC will continue to provide technical assistance to public and private fleets and host educational workshops on AFV technology. The EWG will provide a forum for discussion of state, regional, and local alternative fuel and petroleum reduction goals, progress on achieving the goals, and regional needs to accelerate the deployment of AFVs and AFI. Additional efforts could be made to connect potential fleet users with manufacturers to provide input on the direction of future technology developments. |

# 7. Future of Fuels – Technology Assessment

The alternative fuel market is rapidly evolving as technology improves and new vehicles become available. Several interlacing variables influence the development and economics of alternative fuels, such as state policy and funding, technology advancements, conventional fuel prices, and shifting customer preferences. At this time, there is no "silver bullet;" no one fuel that will satisfy all end-uses. Therefore it is crucial to understand the benefits, limitations and future outlook of each fuel to make informed decisions matching a fuel with an application. This section describes the market-readiness of each alternative fuel based on a number of factors and highlights specific needs for continued support.

**Table 7-1: Biodiesel**

| Biodiesel | |
|---|---|
| **Biodiesel, and more recently, renewable diesel, can be used in existing diesel vehicles and fueling stations while offering substantial greenhouse gas (GHG) benefits depending on the feedstock from which they are produced.** | |
| **GHG Reductions** | High – Using biodiesel in place of conventional diesel reduces lifecycle carbon emissions, which vary by fuel blend and concentration. Renewable diesel can be used in very high blends. Used cooking oil and other waste fats can be used to produce fuels with more than 75 percent fewer GHG emissions than conventional petroleum fuel production. |
| **Air Quality Benefits** | Low – Biodiesel has criteria pollutant emissions equivalent to conventional diesel for vehicle models 2010 or newer due to mandated advancements in conventional emissions controls. Biodiesel can reduce toxic air pollutants in older on-road vehicles. |
| **Current Status** | Biodiesel vehicle technology is established and can replace petroleum diesel fuel in compression-ignition engines. Nearly 80 percent of Original Equipment Manufacturers (OEMs) have approved blends up to B20 (20 percent biodiesel) in diesel vehicles and the use of B100 (100 percent biodiesel) in some off-road applications. Renewable diesel can be used in 100 percent blends in all diesel vehicles.<br>Locally, New Leaf biofuels recently expanded production with support from the Energy Commission, but production and distribution still may not be sufficient to meet the projected fuel demand for the heavy-duty (HD) sector. Only three fueling stations are currently operating in San Diego County. |
| **Future Needs** | More in-state production is needed, with more sustainable feedstocks at scale to meet the projected demand. Ongoing research aims to gain approval for the use of B20 in all on-road diesel vehicles.<br>Streamlined regulations allowing biodiesel use in conventional diesel infrastructure would facilitate an easier transition. Additional stations are needed in the northern and inland areas of San Diego County to expand access to fleets in those areas. |

**Table 7-2: Electricity**

| Electricity | |
|---|---|
| **The light-duty (LD), plug-in electric vehicle (PEV) market launched in 2010 and expands each year. A growing number of models are available from major OEMs. Charging infrastructure is located throughout much of the County, but the number and type of electric vehicle charging stations (EVCS) fall well below the number needed if the state's target is to be achieved.** | |
| **GHG Reductions** | High – In lifecycle analyses of PEVs, emissions reductions depend on the energy source used to charge the battery. A vehicle charged on California's average grid electricity mix generates 65 percent fewer emissions than a conventional vehicle. |
| **Air Quality Benefits** | High – PEVs produce zero tailpipe emissions and thus have the potential to completely eliminate criteria pollutants from automobiles. |
| **Current Status** | LD technology is currently available with a growing number of models on the market. Medium-duty (MD) and HD trucks are not as readily accessible.<br>HD truck efficiency has remained relatively stagnant over time. As the cost of batteries declines and sales increase, more progress can be made in the HD market. Development of range extenders – supplementary combustion engines or fuel cells which allow the vehicle to travel an extended distance before refueling – has showed promise for heavier vehicles like refuse trucks used for stop-and-go driving, but seems unlikely to work for long-haul trucks.<br>Electricity is a ubiquitous fuel source, but there are still significant costs and complexities associated with installation of EVCS. Currently, 77 percent of residences are within 2.5 miles of some type of charging infrastructure. |
| **Future Needs** | Improvements in battery technology should provide longer range and lower vehicle prices, which will accelerate adoption.<br>Advances in vehicle technology to increase range and cargo capacity are needed to allow for more wide-spread commercial adoption.<br>Significant strides must be made to increase charging access at workplaces and multi-unit dwellings (MuDs) to broaden the consumer ownership pool.<br>Additional DC fast charging stations, especially in high-traffic corridors such as along Interstate 8 and Interstate 15 freeways, would help alleviate range anxiety as a barrier to PEV adoption. |

**Table 7-3: Ethanol**

| Ethanol | |
|---|---|
| **Corn-based ethanol plays a major role in the state's gasoline supply. Lower carbon ethanol production from diverse feedstocks is a growing portion of the mix.** | |
| **GHG Reductions** | High – The use of E85 (85 percent ethanol) has the potential to reduce emissions by up to 80 percent compared to gasoline. Corn-based ethanol offers slight GHG reductions. Ethanol produced from new feedstocks, including cellulosic ethanol, requires less fossil fuel energy to produce and has no land use impacts, thus lowering lifecycle emissions. |
| **Air Quality Benefits** | Medium – Corn-based ethanol produces criteria pollutant emissions similar to conventional gasoline, but new feedstocks may offer improved air quality benefits. |
| **Current Status** | Ethanol is already used in regular gasoline, comprising about 10 percent of every gallon.<br>"Flex fuel" vehicles can run on higher ethanol blends and are widely available in light to medium applications (cars, vans, pickup trucks, SUVs). Ethanol-capable engines for MD and HD applications are currently in the demonstration phase.<br>Locally, a number of entities, including the University of California, San Diego, Venter Institute, and other private biotech firms, are researching and developing future ethanol blends from advanced feedstocks such as algae.<br>Ethanol infrastructure is limited in the region. Nine stations in San Diego County currently offer E85. |
| **Future Needs** | More in-state production of ethanol is needed, especially of low-carbon cellulosic fuel made from feedstocks like wood chips or crop residue.<br>Blender pumps that can provide multiple ethanol blends would facilitate greater infrastructure deployment and serve more customers.<br>Three additional ethanol stations are currently in development which will increase ethanol distribution in the region, but more infrastructure is needed in North San Diego County coastal areas to extend access to more than half of the County's business sites. |

**Table 7-4: Hydrogen**

| Hydrogen | |
|---|---|
| **Hydrogen has great potential emissions reduction and operational benefits for all vehicle classes, but the market is still in the early phases of development.** | |
| **GHG Reductions** | High – Emissions associated with the production of hydrogen fuel are significantly lower than those associated with the production of petroleum fuels, depending on the production method used to generate the hydrogen. Conventional methods can reduce emissions by up to 50 percent, but production using renewable energy can provide much greater reductions. California Senate Bill 1505 requires that at least 33 percent of the energy used to produce hydrogen fuel come from renewable sources. |
| **Air Quality Benefits** | High – No harmful pollutants are emitted from a hydrogen vehicle itself. The production of hydrogen may produce emissions that affect air quality depending on the method and energy source. |
| **Current Status** | The first significant wave of LD hydrogen vehicles is hitting the road in targeted regions now, with San Diego expected to experience deployment by 2020.<br>Fuel cell technology has been successfully demonstrated in transit buses and the market is growing.<br>One hydrogen fueling station is expected to open in San Diego in 2016 and will connect with the more developed infrastructure in the Los Angeles region. The closest public station is currently in San Juan Capistrano. The California Fuel Cell Partnership aims to bring three additional stations to San Diego by 2020. |
| **Future Needs** | Hydrogen vehicle deployments will require adequate infrastructure that can support both consumers and fleet users with high reliability and accessibility.<br>More sustainable fuel production methods, and increased availability of hydrogen fueling infrastructure, will improve the case for vehicle adoption.<br>Continued support is needed for pre-commercial demonstrations in new applications, specifically those that can be centrally fueled, operated and maintained.<br>Incentives and regulations to support the transition of MD and HD vehicles to zero-emissions technologies should continue.<br>Early-adopting consumers, public agencies, and entrepreneurial private fleets appreciate the operational flexibility and range of hydrogen fuel cell vehicles, but costs will need to come down significantly for wider adoption. Continued public support will be necessary to grow the nascent market. |

**Table 7-5: Natural Gas**

| Natural Gas | |
|---|---|
| **Natural gas is well established as a low-emission transportation fuel in the HD vehicle sector and has been used in buses, refuse trucks, and other vehicles in the region for more than two decades. Renewable natural gas sourced from landfills, wastewater treatment plants, or other biological sources is growing in availability and offers substantial GHG reductions.** | |
| **GHG Reductions** | High – Renewable natural gas offers up to 80 percent reduction in GHG emissions, conventional natural gas offers more modest reductions of up to approximately 10 percent. Methane leaks can negate GHG benefits if not prevented. |
| **Air Quality Benefits** | High – Natural gas engines emit no particulate matter and the newest technology can provide up to 90 percent reduction in NOx emissions compared to the latest diesel engines. |
| **Current Status** | Natural gas engine technology is well developed for HD vehicles and in the majority of refuse trucks and urban transit buses. Ultra-low NOx natural gas engines for MD trucks will go into commercial production in 2016 and large-scale production is expected by 2020.<br>There are no technological barriers to greater deployment in natural gas MD/HD markets. However, infrastructure in the region is somewhat limited. Less than half of business sites in San Diego County are within 2.5 miles of one of the 11 CNG fueling stations in the region. |
| **Future Needs** | Natural gas fueling infrastructure requires significant capital costs. Lower capital and fuel costs will facilitate greater adoption. Construction of additional fueling stations will allow for more widespread adoption.<br>The ARB requirements for natural gas engine certifications can add to the cost and complexity of running vehicles on natural gas.<br>An increased use of renewable natural gas could improve overall lifecycle emissions benefits. More local sources of renewable natural gas could be developed, such as anaerobic digesters.<br>Because of the major up-front investment and ongoing maintenance costs of natural gas infrastructure, public-private partnerships and efforts to aggregate fleet demand in a given area may be needed to accelerate the build out of new stations to fill gaps in public access throughout the County. |

**Table 7-6: Propane Autogas**

| Propane Autogas | |
|---|---|
| **Propane autogas is produced domestically as a byproduct of petroleum and natural gas production. As a vehicle fuel, it provides modest emissions benefits and significant economic benefits.** | |
| **GHG Reductions** | Low – Propane burns slightly cleaner than gasoline due to its lower carbon content, producing approximately 10 percent fewer GHG emissions. Renewable propane offers the potential for greater GHG emissions reductions. |
| **Air Quality Benefits** | Medium – Compared to conventional diesel and gasoline, propane autogas vehicles can provide modest reductions of several pollutants including nearly 30 percent fewer emissions of volatile organic compounds.<br>High – Non-road carbureted vehicles such as landscaping equipment and forklifts offer more air quality benefits. |
| **Current Status** | Liquid propane injection engine technology is mature, with some efforts in HD vehicles for propane-powered operation.<br>Dedicated propane autogas and bi-fuel vehicles are available in some fleet applications such as school buses and shuttles.<br>Propane autogas infrastructure is relatively inexpensive and easy to deploy. |
| **Future Needs** | More widespread vehicle deployment may help justify manufacturer investments in engine development and certification.<br>Europe has developed plants to produce renewable propane. Domestic production of renewable propane would improve propane emissions benefits and availability.<br>Many fleets have built their own private infrastructure to support deployments but additional public stations, especially along the Interstate 5 corridor, would help to expand access. |

# 8. Recommendations for Future Readiness

This section provides recommendations that identify immediate actions and long-term planning objectives to further prepare the San Diego region for the deployment of alternative fuel vehicles (AFV) and supporting infrastructure. The recommendations highlighted within this Readiness Plan are intended to help increase the awareness, accessibility, and use of alternative fuels while reducing greenhouse gas emissions (GHG).

**Table 8-1: Refuel San Diego Regional Plan Recommendations**

| **Recommendation 1:** | **Continue to emphasize alternative fuels as a key strategy in the Region's GHG reduction efforts.** |
|---|---|
| Increasing the deployment of alternative fuels and reducing reliance on petroleum is a key strategy in federal, state, regional, and local efforts to reduce GHG emissions. While emissions reduction goals and alternative fuel policies are often set at the state and regional level, ultimately action is required at the local level. Several jurisdictions in the San Diego region are preparing climate action plans (CAPs) or other GHG reduction strategies. Efforts should be made to ensure that alternative fuel use plays a significant role in these policies. The following actions further efforts to achieve regional and local GHG reductions through the increased use of alternative fuels. | *Local CAPs have goals to convert fleets to clean fuels as transportation is the largest source of GHG emissions.* |
| **Lead Stakeholders:** | • SANDAG and other regional planning agencies<br>• San Diego Regional Clean Cities Coalition (SDRCCC)<br>• Local jurisdictions and public agencies |
| **Strategy 1.1** | **Pursue alternative fuel infrastructure (AFI) deployment that supports future vehicle adoption anticipated by state and federal policy.** |
| **Actions:** | • **1.1.1:** Estimate future infrastructure needs and associated costs.<br>• **1.1.2:** Identify key geographic areas for siting types of AFI, incorporating air quality and environmental equity considerations.<br>• **1.1.3:** Implement construction measures through construction bid specifications to incorporate the use of AFVs and equipment in transportation and development projects.<br>• **1.1.4:** Incorporate infrastructure electrification, electric vehicle charging stations (EVCS), and other alternative fuel opportunities into project design, especially projects that include commuter parking areas. |
| **Strategy 1.2** | **Include alternative fuel deployment actions in local CAPs.** |
| **Actions:** | • **1.2.1:** Estimate GHG reductions from anticipated alternative fuel deployment.<br>• **1.2.2:** Adopt formal policies to replace government fleet vehicles with AFVs and preferred vendor policies for contracted private fleets.<br>• **1.2.3:** Streamline the permitting process for alternative fuel stations.<br>• **1.2.4:** Increase the availability of AFI. |

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| **Strategy 1.3** | **Continue to track progress in AFV and AFI deployments as well as associated GHG reductions.** |
| **Actions:** | • **1.3.1:** Aggregate data from agencies implementing alternative fuel programs, such as the Air Resources Board (ARB) Clean Vehicle Rebate Program (CVRP), and the SDRCCC, to track vehicle and infrastructure deployment numbers.<br>• **1.3.2:** Calculate emissions reductions associated with various alternative fuel deployment initiatives to assess effectiveness and inform future planning efforts.<br>• **1.3.3:** Track AFV clusters and sector growth to anticipate future demand for AFI.<br>• **1.3.4:** Calculate the environmental and economic costs of not taking action to promote the transition to alternative fuels. |

## Recommendation 2: Continue to align alternative fuel policies across all local agencies in support of regional air quality attainment and other goals.

Coordination and consistent approaches to alternative fuel policies by regional and local agencies support sustained growth in alternative fuel production, availability, and use. Harmonization and regularity among regional plans such as San Diego Forward: The Regional Plan, municipal general plans, energy roadmaps, climate action plans, and other efforts is critical for successful implementation.

*The Regional Plan, local CAPs, and Energy Roadmaps, incorporate clean fuel measures that improve air quality and reduce petroleum dependence.*

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| **Lead Stakeholders:** | • SDRCCC<br>• SANDAG and other regional planning agencies<br>• Local jurisdictions and public agencies<br>• San Diego County Air Pollution Control District (SD APCD) |
| **Strategy 2.1** | **Align mandates, grants, and incentive programs with AFV deployment goals and recommendations.** |
| **Actions:** | • **2.1.1:** Coordinate with other agencies to amplify outreach efforts around incentive programs and provide consistent messaging.<br>• **2.1.2:** Collaborate with alternative fuel industry partners to prioritize air quality improvements via deployment of alternative fuel investments.<br>• **2.1.3:** Align programs and deployment goals with efforts to improve air quality in disadvantaged communities and provide social, economic, and environmental benefits in those areas. |

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| **Strategy 2.2** | **Foster information-sharing among public agencies and private companies deploying AFVs.** |
| **Actions:** | • **2.2.1:** Communicate successes and lessons learned to help avoid reoccurring barriers and reduce duplication of efforts.<br>• **2.2.2:** Capitalize on opportunities for cross-agency and public-private partnerships to achieve economies of scale through shared responsibility.<br>• **2.2.3:** Support cooperative public-private and/or multi-agency procurement opportunities for vehicles, infrastructure and fuel. |
| **Strategy 2.3** | **Continue to aggregate information on successes and challenges in local deployment efforts.** |
| **Actions:** | • **2.3.1:** Identify successful local efforts that can be scaled up for greater effect.<br>• **2.3.2:** Identify gaps in training and access to information in order to rectify the problem. |

## Recommendation 3: Seek new funding sources for alternative fuel vehicle and infrastructure deployment.

Local, state and federal entities continue to provide funding opportunities to support growth in the alternative fuels market. For example, local entities in the San Diego region have received more than $20 million in state funding through the Alternative and Renewable Fuel and Vehicle Technology Program (ARFVTP). However, scaling up infrastructure networks for several alternative fuels will require additional funding streams. It is estimated that between $40 million and $115 million in additional funding would be needed if the region were to build out a robust AFI network to accommodate the number of alternative fuel vehicles expected under current state policy. Hydrogen alternative fuel technology is new and will require the most initial capital to spark the market. Funding for vehicle deployment also supports private investment in infrastructure. The following actions support continuing investment in the fuel supply infrastructure and fueling stations.

*The San Diego region has won awards exceeding $20 million, but more public investment is needed to build out infrastructure and grow the market for clean fuels.*

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| **Lead Stakeholders:** | • Local jurisdictions and public agencies<br>• Alternative fuel producers and suppliers<br>• SD APCD<br>• SANDAG<br>• SDRCCC |

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|---|---|
| **Strategy 3.1** | **Capitalize on opportunities for public-private partnerships.** |
| **Actions:** | • **3.1.1:** Enhance and promote public investments in alternative fuel markets such as regulatory and land use policies, property ownership, and potential match funding.<br>• **3.1.2:** Solicit private contributions such as capital, technology expertise, and equipment.<br>• **3.1.3:** Enhance channels for communication through organizations such as Cleantech San Diego and the Southern California Advanced Transportation Center. |
| **Strategy 3.2** | **Continue to monitor state and federal funding opportunities to position the region for maximum benefit.** |
| **Actions:** | • **3.2.1:** Monitor trends in funding programs to understand state and federal priorities and position the region for more competitive and successful grant applications.<br>• **3.2.2:** Ready the region for hydrogen station deployment grants which are anticipated to become the next wave of state ARFVTP funding. The region needs at least three hydrogen fueling stations before car manufacturers will consider selling hydrogen fuel cell vehicles in the region.<br>• **3.2.3:** Continue to provide a forum for regional stakeholders to exchange information regarding upcoming funding opportunities and form project teams.<br>• **3.2.4:** Support implementation of the SANDAG Regional Charger Program beginning by 2020, which will facilitate the installation of publically available EVCS leveraging approximately $30 million in federal Congestion Management and Air Quality Improvement Program funds. |

## Recommendation 4: Enhance education and outreach efforts to promote awareness of alternative fuel options.

Awareness and understanding of alternative fuels available on the market is critical to their successful adoption. Outreach must be calibrated to reach distinct players in the regional alternative fuel landscape such as government agencies, private businesses, and consumers. Significant existing programs and resources can be leveraged to bring education to each audience.

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|---|---|
| **Lead Stakeholders:** | • SDRCCC<br>• Local alternative fuel industry vendors<br>• Local jurisdictions and public agencies |

*The Clean Cities Coalition performs outreach on alternative fuels to the community and to local fleet managers.*

| | |
|---|---|
| **Strategy 4.1** | **Disseminate the Alternative Fuel Toolkits developed through Refuel San Diego.** |
| **Actions:** | • **4.1.1:** Assist local governments in using the Alternative Fuels for Public Agencies toolkit to understand financing options, review case studies, and gain familiarity with each fuel type.<br>• **4.1.2:** Distribute the relevant Alternative Fuel Toolkits to fleet managers, first responders, fuel providers, consumers, and other key stakeholders throughout the region.<br>• **4.1.3:** Update available resources with new information, uses, and applications for alternative fuel types as they become widely available to maximize these fuels and build public awareness on fuel benefits.<br>• **4.1.4:** Leverage Plug-in SD, the pending SDG&E Vehicle-Grid Integration Pilot, and other programs to spread awareness of electric vehicles, time-of-use rates, and grid integration issues. |
| **Strategy 4.2** | **Strengthen existing relationships and create new partnerships to disseminate alternative fuel-related materials.** |
| **Actions:** | • **4.2.1:** Establish outreach opportunities through local dealerships leveraging programs such as Plug-In SD. Use dealer input to inform future programs for light- and heavy-duty vehicles.<br>• **4.2.2:** Leverage SDRCCC outreach, resources, and continued support for regional working group coordination.<br>• **4.2.3:** Continue to provide a forum as a means to share lessons learned and successes for potential duplication.<br>• **4.2.4:** Partner with local community based organizations in disadvantaged communities to share information on alternative fuels and funding programs.<br>• **4.2.5:** Support ride-and-drives and other opportunities to provide hands-on experience with alternative fuel vehicles. |
| **Strategy 4.3** | **Continue to provide support to local public and private fleets interested in alternative fuels.** |
| **Actions:** | • **4.3.1:** Assist fleets with understanding the upfront and lifecycle costs of AFVs and provide guidance on procurement and financing of AFVs leveraging the Alternative Fuels for Fleets Toolkit.<br>• **4.3.2:** Provide resources and guidance materials on how to safely and lawfully convert conventional vehicles to use alternative fuels.<br>• **4.3.3:** Ensure the most current resources are available to help fleet staff and businesses choose the most appropriate AFV for their needs.<br>• **4.3.4:** Support the development of programs that can provide environmental and economic analyses of fleet options to better inform fleet staff and advance alternative fuel deployment |

| Recommendation 5: | Accelerate market growth through workforce development, training, and local entrepreneurship. |
|---|---|

Ongoing research and development around fuel production should be supported. Local trade professionals should have access to local training opportunities to be comfortable with monitoring, maintaining, and repairing alternative fuel technologies. A reliable, local workforce to provide infrastructure and vehicle support will provide assurances to potential users that they will not be left with stranded assets.

*The San Diego region is home to a growing clean-tech sector. Several companies are developing next generation fuel and vehicle technologies.*

| | |
|---|---|
| **Lead Stakeholders:** | • SDRCCC<br>• Local jurisdictions and public agencies<br>• Private sector business associations<br>• Local alternative fuel industry vendors<br>• Community colleges and vocational programs |
| **Strategy 5.1** | Provide training to ensure the local workforce is prepared to operate and maintain AFVs and AFI. |
| **Actions:** | • **5.1.1:** Continue to support community colleges and other educational institutions in delivering alternative fuels training programs for first responders and fleet technicians such as Cuyamaca College's Automotive Technology Program, Miramar College's Advanced Transportation Technology Program, Palomar College's Diesel Mechanic Technology Program, and IBEW/NECA Electric Vehicle Infrastructure Training Program.<br>• **5.1.2:** Leverage existing, successful, training programs and industry associations such as the Municipal Equipment Maintenance Association and CSU Los Angeles, to support and expand local workforce programs. |
| **Strategy 5.2** | **Support local companies engaged in the alternative fuel industry and regional research institutions.** |
| **Actions:** | • **5.2.1:** Offer new opportunities for existing companies to collaborate on public-private partnerships, funding applications, and outreach programs.<br>• **5.2.2:** Increase communication with private sector institutions such as chambers of commerce, technology incubators, and industry associations on needs in the alternative fuel market.<br>• **5.2.3:** Pursue strategies to aggregate local demand for alternative fuels to incentivize market growth such as a regional public fleet procurement consortium.<br>• **5.2.4:** Work with local universities to expand transportation research. Support commercialization of new technologies. |

# Conclusion

Alternative fuels have come a long way and within the San Diego Region they continue to gain greater traction; however, there is more that needs to be done if the region is to help the state achieve their aggressive goals for zero emissions vehicle adoption and petroleum reduction. It will require the development of new and emerging fuels, vehicle and fuel production technology advances, and manufacturing cost reductions of vehicles, engines, and component parts to continue to advance the market.

Strong regional support for alternative fuels can communicate to the market that the San Diego region is committed to, and seeks to attract, investment in AFV and AFI. The San Diego region should continue to work together to ensure that the alternative fuel market can grow and thrive, while helping to reduce GHG emissions, improving air quality, and supporting a growing workforce and clean-tech economy.

# Appendix A: San Diego Regional Alternative Fuels Coordinating Council Member List

**REFUEL: SAN DIEGO REGIONAL ALTERNATIVE FUELS COORDINATING COUNCIL**

| REPRESENTATION | | NAME | MEMBER/ALTERNATE |
|---|---|---|---|
| South County Subregion | City of Chula Vista | Barbara Locci | Member |
| | | Lynn France | Alternate |
| North County Coastal Subregion | City of Carlsbad | Mike Grim | Member |
| | City of Oceanside | Mo Lahsaie | Alternate |
| North County Inland Subregion | City of Escondido | Jeff Wyner | Member |
| East County Subregion | City of Santee | Kathy Valverde | Member |
| City of San Diego | | Jacques Chirazi | Member |
| County of San Diego | | Susan Freed | Member |
| San Diego Association of Governments | | Anna Lowe, Co-Chair | Member |
| | | Susan Freedman | Alternate |
| San Diego Regional Airport Authority | | Paul Manasjan | Member |
| | | Brendan Reed | Alternate |
| Caltrans, District 11 | | Chris Schmidt, Chair | Member |
| Unified Port District of San Diego | | Michelle White | Member |
| | | Kellie Carlson | Alternate |
| San Diego Gas & Electric | | Randy Schimka | Member |
| | | Greg Haddow | Alternate |
| Center for Sustainable Energy | | Colin Santulli | Member |
| University of California, San Diego | | Jim Ruby | Member |
| Miramar College, ATTE Program | | Greg Newhouse | Member |
| San Diego County Air Pollution Control District | | Nick Cormier | Member |
| **ADVISORY MEMBERS** | | | |
| City of Coronado | | Bill Cecil | Advisory |
| City of Del Mar | | Kristen Crane | Advisory |
| City of El Cajon | | Matt Lyer | Advisory |
| City of Encinitas | | Bryce Wilson | Advisory |
| City of Imperial Beach | | Chris Helmer | Advisory |
| City of La Mesa | | Howard Lee | Advisory |
| City of Lemon Grove | | Mike James | Advisory |
| City of National City | | Ray Pe | Advisory |

**REFUEL: SAN DIEGO REGIONAL ALTERNATIVE FUELS COORDINATING COUNCIL**

| ADVISORY MEMBERS | | |
|---|---|---|
| City of Poway | Eric Heidemann | Advisory |
| City of San Marcos | Lisa Fowler | Advisory |
| City of Vista | Lyn Dedmon | Advisory |
| Metropolitan Transit System | Sharon Cooney | Advisory |
| North County Transit District | Vacant | Advisory |
| Department of Defense/Military | David Powell | Advisory |
| San Diego Regional Clean Cities Coalition | Kevin Wood | Advisory |
| Energy Policy Initiatives Center | Nilmini Silva-Send | Advisory |
| University of San Diego | Michael Catanzaro | Advisory |
| San Diego Regional Chamber of Commerce | Mike Evans | Advisory |
| CleanTECH San Diego | Jason Anderson | Advisory |

# Appendix B: Refuel San Diego: Regional Meeting and Outreach Schedule

## Refuel San Diego Quarterly Meetings

Quarterly meetings are held to help streamline and address collective alternative fuel barriers to adoption. Refuel San Diego meetings provided a forum for information sharing across jurisdictions and provided an opportunity to disseminate best practices.

| Quarterly Meeting Schedule | | |
|---|---|---|
| 2014 | October | 10/16/2014 |
| | November | |
| | December | |
| 2015 | January | 1/15/2015 |
| | February | |
| | March | |
| | April | 4/16/2015 |
| | May | |
| | June | |
| | July | 7/15/2015 |
| | August | |
| | September | |
| | October | 10/15/2015 |
| | November | |
| | December | |
| 2016 | January | 1/21/2016 |
| | February | |
| | March | |

# Refuel San Diego Subcommittee Meetings

In addition to the Refuel San Diego quarterly meetings, subcommittee meetings were held to focus on a single fuel type exclusively. The subcommittees were made up of regional stakeholders with experience using the specific alternative fuel, providers of the specific alternative fuel, and parties who were interested in learning more about the specific fuel.

| **Subcommittee Meeting Schedule** | | | | | |
|---|---|---|---|---|---|
| **Year** | **Electricity** | **Natural Gas** | **Propane** | **Biofuel** | **Hydrogen** |
| 2014 | | | | | |
| | 11/19/2014 | | | | |
| | | | | | |
| 2015 | | | 1/8/2015 | | 1/12/2015 |
| | | | | 2/26/15 | |
| | 3/12/15 | | | | |
| | | 4/22/15 | | | 4/2/15* |
| | | | | | |
| | | **6/11/2015**** | | | |
| | | | | **7/9/2015** | |
| | **8/28/2015** | | | | |
| | | | | | **9/15/2015** |
| | | | | | |
| | | | | | |
| | | | | | |

*Refuel as a collaborator

**Joint propane/natural gas subcommittee meeting

**Bolded** meeting dates indicate toolkit outline presentation and discussion

# Refuel San Diego Toolkit and Readiness Plan Outreach

Outreach for toolkits outside of Refuel San Diego quarterly and subcommittee meetings consisted of in-person meetings to review resources. Individual email communications with local governments, providing clarification and relaying links to resources also took place.

A public workshop for comments and feedback on the San Diego Regional Alternative Fuels Readiness Plan will be held prior to acceptance of the final plan in addition to acceptance by the SANDAG Board of Directors.

| **Subcommittee Meeting Schedule** | | | | | |
|---|---|---|---|---|---|
| **Year** | **Electricity** | **Natural Gas** | **Propane** | **Biofuel** | **Hydrogen** |
| 2014 | | | | | |
| | 11/19/2014 | | | | |
| | | | | | |
| 2015 | | | 1/8/2015 | | 1/12/2015 |
| | | | | 2/26/15 | |
| | 3/12/15 | | | | |
| | | 4/22/15 | | | 4/2/15* |
| | | | | | |
| | | **6/11/2015** | | | |
| | | | | **7/9/2015** | |
| | **8/28/2015** | | | | |
| | | | | | **9/15/2015** |
| | | | | | |
| | | | | | |
| | | | | | |

**Refuel training - NOT toolkit outreach

# Appendix C: San Diego Regional Alternative Fuel Assessment

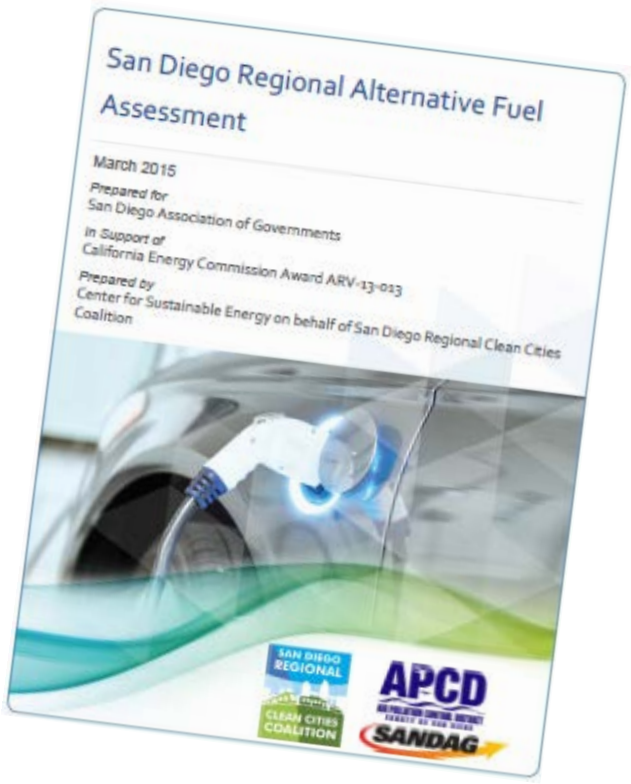
The San Diego Regional Alternative Fuel Readiness Assessment (Assessment) provides an overview of the state of alternative fuels in the San Diego region at the onset of Refuel San Diego, highlighting the region's notable progress in the adoption of alternative fuels, equating to a small portion of the region's overall total fuel use. Light-duty flex-fuel vehicles, and plug-in electric vehicles (PEVs), in particular, have been growing steadily in number; however, 80 percent of the region's light-duty vehicles use conventional gasoline.

Also described in the Assessment is how the San Diego region has benefitted from over $9 million in State investment, in terms of grants and vehicle rebates, for alternative fuel projects. However, even with such growth, the alternative fuel infrastructure in the region is limited in number. Placement of the infrastructure is such that it covers a large portion of the regions business and residents. The Assessment concludes with gaps, outlining the needs of public agencies and fleet managers for more information on the technical and economic aspects of fuels to integrate these alternatives into their plans and operations.

## Topics Covered

The Assessment provides a benchmark with which to evaluate the role of alternative fuels, identify the needs of local public agencies and fleet managers, and to help prioritize the efforts of Refuel San Diego for the San Diego region. The following topics are included in the Assessment:

- Past regional efforts with alternative fuel planning
- State and municipal strategies
- Codes and standards
- Infrastructure
- Vehicles
- Incentives
- Investments
- Training
- Education & Outreach



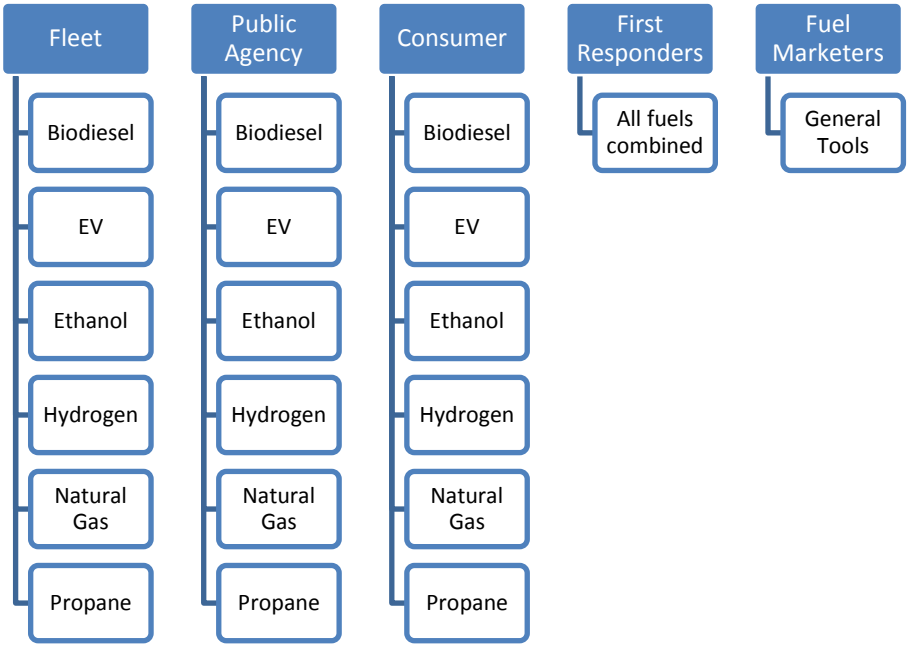
# Appendix D: Regional Alternative Fuel Toolkits

## Alternative Fuel Toolkits Background


**Why Create Alternative Fuel Toolkits?**

- The Alternative Fuel Toolkits were created for five different sectors: (1) fleet; (2) public agency; (3) consumer; (4) first responder; and (5) fuel marketer and retail.
- The goal was to create greater awareness and understanding of alternative fuel vehicles and to address existing barriers to adoption and deployment.
- The Alternative Fuel Toolkits provide actionable information that each audience can use to address alternative fuels.

**General Alternative Fuel Toolkit Composition**



The Alternative Fuel Toolkits were updated in advance of the January 14, 2016, public workshop on the draft Readiness Plan and Alternative Fuel Toolkits. They may be refined based on feedback from the public workshop and final Refuel San Diego meeting; the web addresses will remain the same for each. Current versions are available for download on the San Diego Regional Clean Cities Coalition website:

- Draft Alternative Fuels for Consumers Toolkit: http://www.sdcleancities.org/wp-content/uploads/2016/01/Alt-Fuels-Toolkit-Consumers.pdf
- Draft Alternative Fuels for First Responders Toolkit: http://www.sdcleancities.org/wp-content/uploads/2016/01/Alt-Fuels-Toolkit-First-Responders.pdf
- Draft Alternative Fuels for Fleets Toolkit: http://www.sdcleancities.org/wp-content/uploads/2016/01/Alt-Fuels-Toolkit-Fleets.pdf
- Draft Alternative Fuels for Fuel Marketers and Retailers Toolkit: http://www.sdcleancities.org/wp-content/uploads/2016/01/Alt-Fuels-Toolkit-Fuel-Marketer.pdf
- Draft Alternative Fuels for Public Agencies Toolkit: http://www.sdcleancities.org/wp-content/uploads/2016/01/Alt-Fuels-Toolkit-Public-Agencies.pdf

These Alternative Fuel Toolkits are a component of the over-arching San Diego Regional Alternative Fuel Readiness Plan, in which the current state of the San Diego regional alternative fuel landscape is analyzed and recommendations are provided to address barriers to alternative fuel adoption and deployment.

# Appendix E: Glossary of Abbreviations

| Terms and Acronyms | Description |
|---|---|
| AB | Assembly Bill |
| AFDC | U.S. Department of Energy's Alternative Fuel Data Center. Can be accessed online at www.afdc.energy.gov. |
| AFI | Alternative Fuel Infrastructure |
| AFV | Alternative Fuel Vehicle |
| ANSI | American National Standards Institute |
| AQIP | California Air Resources Board's Air Quality Improvement Program. It funds clean vehicle and equipment projects, such as the Clean Vehicle Rebate Project) as a result of AB 8. |
| ARB or CARB | California Air Resources Board |
| ARFVTP | The Alternative and Renewable Fuel and Vehicle Technology Program. It is funded as part of AB 118 and provides grants to deploy and develop advanced transportation technologies and alternative and renewable fuels that will help the state achieve its climate change mitigation goals. |
| ASTM | American Society for Testing and Materials |
| ATTE | California Community College's Advanced Transportation Technology and Energy Program. San Diego Miramar College hosts the local ATTE center. |
| AVRP | San Diego Airport Vehicle Rebate Project |
| BEV | Battery electric vehicle. This is a vehicle fueled entirely by electricity stored in the onboard battery. These vehicles often produce zero tailpipe emissions while operating. A battery electric vehicle is a type of plug-in electric vehicle. |
| Biodiesel | A renewable fuel that is manufactured from vegetable oils, animal fats, or recycled restaurant grease. It can be used in diesel vehicles to a certain extent. |
| Biofuel | Any renewable fuel that is manufactured from biological materials. Examples of biofuels are ethanol and biodiesel. Renewable natural gas biogas gas. |
| CAFE standards | Corporate Average Fuel Economy standards set increasingly higher fuel economy standards for automobiles in each model year. |
| CALGreen | California Green Building standards; otherwise known as Part 11 of Title 24, California Code of Regulations. |
| CAP | Climate Action Plan. This is a document that usually sets strategies forth for a jurisdiction to reduce its greenhouse gas emissions. |

| Terms and Acronyms | Description |
|---|---|
| Cap and Trade Program | Market approach to curb carbon emissions by setting a 'cap' on the amount of emissions an economy can emit each year. Emission allowances are traded among entities to meet their allocated limits. Since 2012, the California legislature and governor appropriate proceeds from the sale of State-owned emission allowances to fund projects that support the State's climate goals as detailed in AB 32. |
| Carl Moyer Voucher Incentive Program | Provides funding for equipment replacement, engine repowers, engine retrofits, and new purchases. |
| CGA | Compressed Gas Association |
| Charging station | A piece of equipment that is designed to supply energy to electric vehicles. |
| Charging level | Standardized indicators of electrical force at which an electric vehicle's battery is charged. Common charger levels are Level 1 (120v), AC Level 2 (208-240v), and a DC Fast Charge. |
| CNCDA | California New Car Dealers Association |
| CNG | Compressed natural gas. Most vehicles use natural gas in its compressed form. See Natural Gas. |
| CPUC | California Public Utilities Commission |
| CSE | Center for Sustainable Energy |
| CVRP | California Air Resource Board's Clean Vehicle Rebate Project. It provides up to $5,000 for the purchase or lease of a zero-emission vehicle in the state. |
| DMV | Department of Motor Vehicles |
| DOE | U.S. Department of Energy |
| DOT | U.S. Department of Transportation |
| EMFAC | On-Road Vehicle Emissions Factors Model. It is a modeling tool created by the California Air Resources Board, which allows for the estimation of emissions from on-road vehicles. |
| Energy Commission | California Energy Commission |
| Ethanol/E85 | A renewable fuel derived from corn and other plant materials. Almost all U.S. gasoline contains some ethanol. E85 is a high level blend of ethanol that is used in flex-fuel vehicles. |
| EVCS | Electric vehicle charging station. This is the equipment that provides electricity in order to recharge an electric vehicle. *See* EVSE. |
| EVITP | Electric Vehicle Infrastructure Training Program. This is a curriculum that trains electrical contractors on how to install EV charging stations to code. |

| Terms and Acronyms | Description |
|---|---|
| EVSE | Electric vehicle supply equipment. This includes the charging station itself and all components required for the installation and use of an electric vehicle charging station. Often, EVSE is used interchangeably with EVCS. |
| Flex-Fuel | Types of vehicles that can operate on gasoline or ethanol blends up to E85. |
| GGE | Gasoline gallon equivalent. The amount of alternative fuel it takes to equal the energy content of one liquid gallon of gasoline. Using this measure helps comparisons among various fuels. |
| GGRF | Greenhouse Gas Reduction Fund. In California, proceeds from the cap-and-trade program are included in this greenhouse gas reduction fund, whose monies support projects that reduce GHG emissions in the State. |
| GHG | Greenhouse gas |
| HOA | Homeowners Association |
| HVIP | The ARB Hybrid and Zero-Emission Truck and Bus Voucher Incentive Project. This program provides funding for the procurement of a low-carbon hybrid or electric truck or bus. Vouchers range from $8,000 to $45,000. |
| Hydrogen Fuel Cell Vehicle | An alternative fuel vehicle in which hydrogen is reacted in a fuel cell to produce electricity in order to power a vehicle. |
| IBEW | International Brotherhood of Electrical Workers |
| ICC | International Code Council |
| ICE | Internal combustion engine. An engine which solely uses petroleum-based fuel to power a vehicle. |
| IEPR | Integrated Energy Policy Report. It provides updated strategies every other year for how California can reduce its GHG emissions while satisfying its energy needs. |
| IOU | Investor owned utility |
| LCFS | Low Carbon Fuel Standard. Requires a 10 percent reduction in carbon intensity of transportation fuels in California by 2020. |
| LNG | Liquefied natural gas. Natural gas is liquefied by being purified and condensed by intense cooling. Typically, LNG fuel systems are used with heavy-duty vehicles. *See* Natural Gas. |
| LPG | Liquefied petroleum autogas. See Propane. |
| MuD | Multi-unit dwelling or Multi-family dwelling unit. |
| Natural Gas | An alternative fuel that is a hydrocarbon gas, primarily made up of methane. Comes in a compressed (*see* CNG) or liquefied (*see* LNG) form. |

| Terms and Acronyms | Description |
|---|---|
| NEC | National Electrical Code |
| NFPA | National Fire Protection Association |
| NREL | National Renewable Energy Laboratory |
| OEM | Original Equipment Manufacturer |
| PEV | Plug-in electric vehicle. Any motor vehicle for on-road use that is capable of operating only on the power of a battery. |
| PEVC | California Plug-in Electric Vehicle Collaborative |
| PHEV | Plug-in hybrid electric vehicle. A type of plug-in electric vehicle that is fueled by both an onboard battery and a gasoline-powered internal combustion engine. |
| PM | Particulate Matter |
| Propane | An alternative fuel that is produced domestically and burns clean. It is produced as part of natural gas processing. Also known as propane autogas or liquefied petroleum autogas. |
| Refuel San Diego | The San Diego Regional Alternative Fuel Coordinating Council |
| REVI | The San Diego Regional Electric Vehicle Infrastructure working group. This group aided in the development of the San Diego Regional Plug-in Electric Vehicle Readiness Plan (2014). |
| SAE | Society of Automotive Engineers |
| SANDAG | San Diego Association of Governments |
| SCR | Selective Catalytic Reduction. Used to reduce emissions in diesel engines. |
| SD APCD | San Diego Air Pollution Control District |
| SDG&E | San Diego Gas and Electric |
| SDRCCC | San Diego Regional Clean Cities Coalition |
| STI | Steel Tank Institute |
| TOU | Time-of-use. An electricity billing method with rates based upon the time of electricity usage during the day. |
| UL | Underwriters Laboratory |
| VDECS | Verified Diesel Emission Control Strategy (essentially, a retrofit) |
| VMT | Vehicle miles traveled |
| ZEV | Zero-emission vehicle. A vehicle that emits no tailpipe pollutants from the onboard source of power. |