Northwest California

Alternative Fuels Readiness Plan

REDWOOD COAST ENERGY AUTHORITY

SCHATZ ENERGY RESEARCH CENTER

MCOG

NORTH COAST UNIFIED AIR QUALITY MANAGEMENT DISTRICT

SISKIYOU COUNTY ECONOMIC DEVELOPMENT

The California Energy Commission provided the funding for this project through its Alternative and Renewable Fuel and Vehicle Technology Program, which issued solicitation PON-13-603 to provide funding opportunities for projects that will help prepare California for the increased use of alternative fuels and vehicles.

PROJECT TEAM

The Redwood Coast Energy Authority was formed in 2003 to develop and implement sustainable energy initiatives that reduce energy demand, increase energy efficiency, and advance the use of clean, efficient, and renewable resources available in the region. The Energy Authority is a local government joint powers agency representing all incorporated cities in Humboldt County, the County of Humboldt, and the Humboldt Bay Municipal Water District.

The Mendocino Council of Governments is the regional transportation planning agency for the County of Mendocino and its four incorporated cities. In addition to supporting projects within its five member jurisdictions, the Mendocino Council of Governments helps support transportation activities of the Mendocino Transit Authority, North Coast Railroad Authority, local airports, state highways, and others. Projects involve planning, capital improvements, rehabilitation and maintenance, public transit fleet replacement, and intermodal transit facilities.

The North Coast Unified Air Quality Management District is a regional environmental regulatory agency with jurisdiction over Humboldt, Del Norte, and Trinity counties. The District's primary responsibility is controlling air pollution from stationary sources, though their efforts also address mobile sources and vehicles. They are committed to achieving and maintaining healthful air quality throughout their tri-county jurisdiction. The District is one of thirty-five local air districts in California and enforces local, state, and federal air quality regulations.

The Schatz Energy Research Center at Humboldt State University was founded in 1989 with a mission to promote the use of clean and renewable energy resources. The Center has been involved in extensive research, planning, design, and analysis activities for the development and implementation of sustainable energy systems.

The Siskiyou County Economic Development Council is a non-profit 501(c)4 corporation designed to promote the overall economic development of Siskiyou County. Governed by a thirteen-member Board of Directors, the Siskiyou County Economic Development Council functions as a clearinghouse for countywide efforts aimed at improving the local economic base and generating increased permanent employment opportunities. The SCEDC develops strategies that will result in the constructive, balanced economic growth of the region.

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CURRENT STATUS

Introduction

Funded by the California Energy Commission, the Northwest California Alternative Fuels Readiness Project was launched to develop strategies for the deployment of alternative fuel infrastructure and identify activities to encourage the adoption of alternative fuel vehicles in rural northwest California.

The State of California has set ambitious goals for reducing greenhouse gas emissions through the adoption of a low carbon fuel standard and the promotion of renewable and alternative fuels for transportation. The purpose of this project is to assess the opportunity for low carbon fuel commercialization and adoption in the local context of the Northwest Region and to integrate these local nuances into a strategic planning and outreach effort that effectively enhances the uptake of alternative fuels in the region.

The goal of the project was to create a coordinated effort throughout the Northwest Region that supports the successful introduction of alternative fuel vehicles, wise and effective deployment of alternative fuel infrastructure, and the development of a robust market for alternative fuels. This was accomplished by conducting a strategic assessment of the barriers to and opportunities for regional adoption of alternative fuels, and by developing a targeted outreach program in the region designed to promote alternative fuels and surmount the most critical barriers.

Mission Statement:

The Northwest California region will take the most efficient approach to meet its regional contribution to reduce greenhouse gas emissions by increasing the adoption of clean low-carbon transportation fuels, and establishing a key set of actions to accomplish this goal.

The key drivers and priorities for the Northwest California Alternative Fuels Readiness Project include:

Health: Reduced air pollutants in the region.
Economic: Increased development and jobs, improved fuel economy, and reduced vehicle operation and maintenance costs.
Energy Security: Reduced price volatility and less dependency on foreign oil sources.
Environmental Community: Increased environmental consciousness in our region that will attract tourism, businesses, and residents.
Alignment with State and National Goals: Assist in meeting greenhouse gas emissions reduction goals and municipal fleet goals.

For the purposes of this Readiness Plan, the Northwest California Region consists of the five contiguous counties on California's northwest coast: Del Norte, Siskiyou, Humboldt, Trinity, and Mendocino. At 18,715 square miles, the region encompasses over 11% of California. However the largest city in the region, Eureka, has a population of only 27,000. As a rural area, the Northwest faces unique alternative fuel adoption issues as compared to more metropolitan areas of the country. All of the counties in the Northwest Region have individually undertaken some level of planning effort to prepare for the adoption of electric vehicles. This Readiness Plan presents results of region-wide coordination in the broader arena of alternative fuels.

Business as Usual

A snapshot of the current status of alternative fuels in the Northwest Region is presented in the following sections which outline relevant legislation, state and regional planning documents, infrastructure, and stakeholders. A business-as-usual scenario predicts how alternative fuels adoption would be expected to proceed in the region under the current conditions and without additional action.

The following tables show the expected population of vehicles and quantity of fuel consumed under a business-as-usual scenario. Existing vehicles are those vehicles that are model years 2015 or older. New vehicles are model years 2016 through 2020, and are expected to be purchased new between now and 2020. Business-as-usual is defined as the 2020 vehicle mix and population for the region that is forecasted by the EMF AC2011 vehicle emissions model developed and maintained by the California Air Resources Board (CARB). The numbers in the tables below were taken directly from the EMF AC2011 model using the default settings. Note also that "passenger vehicles" refers to the LDA vehicle class in the EMFAC2011 model. These are sedans and hatchbacks, and other similar smaller vehicles.

Table 1: Business-as-usual vehicle miles traveled, quantity of gasoline and diesel consumed, and vehicle population for passenger vehicles for the year 2020.

Region	Total VMT (miles/day)		Gallons Fuel Consumed (1000 gallons/day)		Vehicle Population (Vehicles)			
	Diesel	*Gas*	*Diesel*	*Gas*	*Diesel – New*	*Diesel – Existing*	*Gas – New*	*Gas – Existing*
Del Norte	1,921	297,572	0.1284	24.86	16	39	2,802	5,157
Humboldt	21,216	1,710,272	1.392	133.5	173	433	16,032	29,498
Mendocino	17,353	1,190,458	1.125	93.24	141	351	11,128	20,476
Siskiyou	4,417	500,701	0.2945	45.73	39	99	5,133	9,444
Trinity	1,396	1,444,444	0.0901	14.42	11	28	1,355	2,494

Source: SERC, 2015

Table 2: Business-as-usual vehicle miles traveled, quantity of gasoline and diesel consumed, and vehicle population for all vehicles other than passenger vehicles for the year 2020.

Region	Total VMT (miles/day)		Gallons Fuel Consumed (1000 gallons/day)		Vehicle Population (Vehicles)			
	Diesel	*Gas*	*Diesel*	*Gas*	*Diesel – New*	*Diesel – Existing*	*Gas – New*	*Gas – Existing*
Del Norte	115,242	687,831	8.7427	46.2246	724	2,205	6,336	14,906
Humboldt	884,475	3,643,434	92.4769	228.6236	4,424	13,472	33,501	78,814
Mendocino	903,035	2,838,535	113.7063	180.3293	3,736	11,378	26,085	61,368
Siskiyou	999,056	1,567,419	147.5318	113.8346	2,917	8,884	14,942	35,152
Trinity	223,516	489,880	31.5270	37.7318	781	2,379	4,565	10,741

Source: SERC, 2015

Federal, State, and Local Legislation

There are several Federal and State mandates and regulations requiring governments to take an active role in building the alternative transportation marketplace. The State of California has set ambitious goals for reducing greenhouse gas emissions through the adoption of a low carbon fuel standard and the promotion of renewable and alternative fuels for transportation. Local governments have begun planning efforts to address these mandates and regulations, as well as identify and codify their own relevant goals. Infrastructure and markets necessary to achieve federal and state goals must be developed in a manner that recognizes local and regional nuances, as well as the context-dependent strengths and weaknesses of different fuel pathways.

The Energy Policy Act (EPAct) of 1992 (Public Law 102-486) was passed by Congress to address the country's increasing dependence on petroleum. The act mandated that an increasing percentage of new vehicles purchased by government fleets be alternative fuel vehicles, and developed a renewable fuel standard.

Executive Order 13693 guides planning for federal sustainability in the next decade, and specifically addresses fleet and vehicle efficiency. By the end of 2020, PEVs and ZEVs shall make up 20 percent of all new agency passenger vehicle acquisitions, and 50 percent by 2026. Agencies will also plan for appropriate charging or refueling infrastructure, and ancillary services, to accommodate the fleet composition.

Corporate Average Fuel Economy (CAFE) standards were enacted by Congress in 1975 with the purpose of reducing energy consumption by increasing vehicle fuel economy. Standards are set by the National Highway Traffic Safety Administration (NHTSA) for five year periods; final standards have been set for light-duty vehicles, model years 2017 to 2021 and non-final standards for years 2022 to 2025. Standards for medium and heavy-duty vehicles, model years 2018 to 2027 have been proposed.

California Assembly Bill 32, the California Global Warming Solutions Act of 2006, requires reducing greenhouse gas emissions to 1990 levels by the year 2020, and 80% below 1990 levels by 2050. This is approximately 15 percent below emissions expected under a "business as usual" scenario. AB 32 requires a Scoping Plan, to be updated every 5 years, that lays out strategies to reduce GHG emissions based on the latest science and technologies. The California Air Resources Board (CARB), which is a department within the California Environmental Protection Agency that oversees air quality, was charged with developing the Scoping Plan and subsequent updates. They have implemented several initiatives over the years to reduce GHGs across multiple sectors, including the Low Carbon Fuel Standard Program, Zero Emission Vehicle (ZEV) Program, and an Emissions Trading Program (Cap-and-Trade).

California Senate Bill 375, the Sustainable Communities and Climate Protection Act of 2008, requires metropolitan planning organizations (MPO) to prepare a sustainable communities strategy as part of regional transportation planning that would include measures to meet regional GHG reduction targets. Regional targets are set by the Air Resources Board and periodically updated as needed.

California Senate Bill 350 mainly commits the state to more renewable energy and increased energy efficiency. However it also addresses alternative transportation by tasking electric utilities with investing in electric vehicle charging infrastructure.

Existing Planning Documents

Among the myriad planning and regulatory documents that guide future development within the Northwest Region, many contain content relevant to alternative fuels readiness planning. Existing regulatory and planning documents provides an overview of the range of goals in the region, helps to identify potential stakeholders, and provides a starting place for determining which individual strategies may work best to meet petroleum reduction goals. Below are selected elements of local regulatory documents that contain language relevant to alternative transportation fuels.

Del Norte County

Current General Plan: Criteria pollutant emissions reduction goals.

Humboldt County

General Plan Update (not yet adopted as of February 2016):

> Energy Element: E-P4: "...Support the development and implementation of Electric Vehicle (EV) charging stations and other alternative fueling infrastructure."
>
> Energy Element: E-P5: “Recognize the Redwood Coast Energy Authority (RCEA) as the regional energy authority, which will foster, coordinate, and facilitate countywide strategic energy planning, implementation and education through a Comprehensive Action Plan for Energy."

Comprehensive Action Plan for Energy (CAPE):

> "Vehicle Fleets: Encourage local government and private fleets to maximize the use of high-efficiency vehicles and alternative fuels."
>
> "Alternative Fuels: Encourage when appropriate the use of alternative fuels that will reduce greenhouse gas emissions, which may include hydrogen, biodiesel, ethanol and natural gas."
>
> "Biofuels Development: Promote the use of waste oils and other biomass sources for biofuels production. Focus on waste oils and other biomass that are not already being used for other purposes, and explore potential opportunities and issues of new technologies for biofuels production from local resources."

Humboldt County Association of Governments Regional Transportation Plan (VROOM): Support the transition to alternative fuels for transit fleet (Policy PT-11).

City of Arcata Climate Action Plan: Green the City Fleet (Goal C7).

City of Blue Lake Climate Action Plan:

Goal LG.3: Purchase alternative fuel and/or hybrid vehicles to replace current fleet vehicles.

Goal LG. 4: Incentivize green commuting by city employees.

Goal AT1.a: Public education and promotion of low-carbon transportation options, including alternative fuels.

Goal AT3.a: Support the installation of EV charging stations.

Mendocino County

General Plan:

Policy RM-45: Encourage the use of alternative fuels, energy sources and advanced technologies that result in fewer airborne pollutants.

Policy DE-161: The County will demonstrate leadership in the implementation of programs encouraging the use of alternative modes of transportation by its employees, as well as the use of alternative fuels. Example programs may include:

- Preferential carpool parking and other ridesharing incentives;
- Flexible working hours or telecommuting where consistent with job duties and customer service needs;
- A purchasing program that favors hybrid, electric, or other energy-efficient vehicles;
- Properly matching trips to the most efficient vehicle to minimize fuel expenditures;
- Encouraging pedestrian/bicycle trips between County facilities where distances and physical ability permit;
- Assisting in the development of demonstration projects for alternative fuel technologies such as ethanol, hydrogen, and electricity;
- Secure bicycle parking; and
- Transit incentives.

City of Ukiah General Plan:

Goal EG-2: Improve the efficiency of energy use within the private transportation system.

Policy EG-2.1: Encourage the use of alternatively powered vehicles.

Goal EG-3: Improve the efficiency of energy use within the City's and County's vehicle fleet.

Policy EG-3.1: The City and County shall serve as models for programs to operate fleet vehicles at maximum fuel efficiency.

Goal OC-37: Support programs that reduce PM10 emissions.

City of Ukiah Climate Action Plan:

Action TL-3.1a: Participate in City-wide marketing efforts for Clean Air Days, Bike-to-Work Days, Sunday Streets/Car-Free Sundays, etc.

Action TL-3.1b: Consider setting aside funding and/or pursuing grant funding to replace the City fleet vehicles with additional electric, hybrid-electric, and alternative fuel vehicles.

City of Fort Bragg Climate Action Plan:

Goal 3: Expand transportation alternatives by encouraging an alternative fueling station, coordinating with the Regional Blueprint Planning effort to improve transportation choices and reduce GHGs.

Siskiyou County

General Plan:

Energy Element: "Shifting to cost effective alternative fuels."

Energy Element: "Commercialization of alternative fueled/powered vehicles."

Energy Element: "Transportation fuels can be diversified through the introduction of alternative fuels such as methanol and electric-powered vehicles. There is also a need for a local contingency plan in the event outside supplies are disrupted, e.g. gasoline shortage as a result of an international oil crisis."

Energy Element: Improving the efficiency of the transportation sector (intended meaning is reducing the number of Single Occupancy trips, but could also be extrapolated to mean increased vehicle efficiency).

Energy Element: "The County Planning Department shall maintain and distribute basic reference information and referrals for persons interested in energy efficient land-use and transportation techniques."

Energy Element - Implementation Measure N: "In recognition of new federal legislation requiring federal government purchase of clean-fuel vehicles, and inasmuch as the Forest Service operates the largest public vehicle fleet in the County, the County shall seek a joint clean-fuel demonstration project with the Forest Service to create the basis for wider availability of clean fuels in the County."

Strategic Plan:

> F-6 Strategy: Help develop County policy with regard to climate change and greenhouse gases. Assist in the development of database to help inform County action relative to AB 32, such as carbon sequestration and greenhouse gas emissions from wildfires.

Trinity County

General Plan – Circulation Element:

> Goal 3: Maintain and upgrade the existing transportation system to prevent costly deterioration, to ensure that efficiency of the system does not decline, to maintain air quality and conserve energy, and to increase mobility and reduce travel time within Trinity County and adjacent regions.

City of Weaverville Community Plan:

> Goal 7 of Transportation Section: To maintain the high air quality in the Weaverville basin while expanding the transportation network.

Existing State and Regional Planning Documents

There are numerous state and regional planning documents that are relevant to alternative fuels planning, including:

- Multi-State ZEV Action Plan: http://www.dem.ri.gov/zevplanmou.pdf
- California ZEV Action Plan: https://www.opr.ca.gov/s_zero-emissionvehicles.php
- North Coast Plug-In Electric Vehicle Readiness Plan: http://www.redwoodenergy.org/index.php/transportation/ev-readiness-planning
- Upstate Plug-In Electric Vehicle Readiness Plan: http://www.siskiyoucounty.org/pev/
- Mendocino County Regional Transportation Plan: http://www.mendocinocog.org/pdf/2010%20RTP/2010%20Final%20RTP%20Part%201.pdf
- Mendocino County Zero Emission Vehicle (ZEV) Regional Readiness Plan: http://www.mendocinocog.org/reports_projects.shtml
- Feasibility Report for Plug-in Electrical Vehicle Charging Stations (Phase 2 of the Mendocino County ZEV Regional Readiness Plan): http://www.mendocinocog.org/reports_projects.shtml
- RePower Humboldt Readiness Plan: http://www.redwoodenergy.org/index.php/renewable-energy/repower-humboldt

Currently Available Fuels and Vehicles

Alternative Fuels

Alternative fuels are typically defined as fuels other than gasoline and diesel. One of the more common drivers towards the use of alternative fuels is to reduce greenhouse gas emissions. Fuels that offer lower lifecycle greenhouse gas emissions compared with gasoline or diesel are also referred to as low-carbon fuels. However, reduction in greenhouse gas emissions is not the sole reason to consider alternative fuels. Additional reasons include:

- Considering alternative fuels due to their potential to offer cheaper operating costs.
- Sourcing domestically produced fuels for increased energy security and/or to invest in local economies.
- Reducing criteria air pollutants in order to improve air quality and general public health.
- Reducing challenges associated with fuel price volatility.
- Addressing social justice concerns, particularly those associated with foreign fossil fuel sources.
- Addressing other environmental concerns such as water quality and land use impacts.

Following are introductory descriptions of the multiple commercially available alternative transportation fuels.

Biodiesel (B20 and up): A type of biofuel that has similar properties to petroleum diesel that can be made from vegetable, fish, and algal oils, as well as waste cooking oil and animal fat. Advantages of biodiesel include that it is domestically produced from non-petroleum, renewable resources; it can be used in most diesel engines, especially new ones; it produces less air pollutants (other than nitrogen oxides); is biodegradable; and is non-toxic. Some disadvantages include that many blends are not yet approved to use by many auto makers; results in lower fuel economy and power; is currently more expensive than petroleum diesels; high concentration (B100) is generally not suitable for use in low temperatures; may have some impact on engine durability; and can produce increased nitrogen oxide emissions in some circumstances.

Electricity: Used to power electric motors, which are the most energy efficient vehicle option available. It produces zero tailpipe emissions, and has the potential to produce zero operating emissions if it comes from a renewable source. Additional advantages to electricity include high performance and the lowest fuel cost per mile. Some disadvantages with currently available vehicles and technology include a shorter driving range and long recharge time compared with liquid and gaseous fuel vehicle options.

Ethanol, Methanol, and other alcohols: Ethanol is combustible fuel produced from non-petroleum, renewable resources. It produces lower emissions of some air pollutants and is resistant to engine knock because of its higher octane. The advantage of ethanol is that blends of up to 15% can be used in newer (2001 and later) conventional ICE vehicles, and in fact all gasoline sold in California is a 10% blend. Flex-fuel vehicles can use blends above 15%, and are comparable in cost to gasoline vehicles. A disadvantage of ethanol is that it has lower energy content than gasoline resulting in lower fuel economy in currently available flex-fuel vehicles.

Hydrogen: Hydrogen can be produced from almost any existing energy source, but currently almost all hydrogen is produced from fossil fuels mainly for the production of ammonia, oil refining, and other industrial uses. Benefits of hydrogen include the ability to produce it using a renewable energy source.

Natural Gas and Renewable Natural Gas: Natural gas can be sourced either from fossil fuel wells or from the controlled decomposition of biomass such as from wastewater treatment or landfills. Fossil fuel-sourced natural gas is domestically produced, relatively cheap petroleum fuel that produces fewer emissions of some criteria pollutants. Disadvantages of fossil fuel-sourced natural gas include the fact that it is non-renewable, and its use potentially results in higher greenhouse gas emissions from leakage of methane during fuel production.

Renewable natural gas sourced from the controlled decomposition of biomass, however, offers a significant reduction in lifecycle greenhouse gas emissions compared with fossil fuels. Lower criteria pollutants than those seen with fossil fuel-sourced natural gas, is also a major benefit. The cost to produce renewable natural gas is generally more expensive as of the time of this report, but work is being done to make this fuel commercially competitive.

Propane (a.k.a. Autogas): Also known as Liquified Petroleum Gas (LPG), propane is a domestically produced fuel from oil and natural gas wells that produces reduced emissions of some criteria pollutants. Disadvantages include that it is non-renewable and that there are not many vehicles available that use it.

Renewable Diesel: A broad category of diesel that includes biodiesel, hydrogenation-derived renewable diesel (HDRD), as well as emerging technologies including biomass-to-liquid using cellulosic feedstock. Most commonly refers to HDRD, which is made from the same types of oils and animal tallow as biodiesel. HDRD is produced domestically as well as imported from non-petroleum, renewable resources. Advantages of HDRD include that it can be used in all existing diesel engines with no blend wall limit, and many manufacturers approve its use. It produces less air pollutants, and meets the ASTM D975 standard, which is the same standard for petroleum diesel. The only main concern is supply availability as there are currently only two approved bulk suppliers for California.

Regional Fueling Infrastructure

Table 3: Number of existing publically accessible locations offering low carbon fuels.

	Gas and Diesel[a]	Public EV Charging Stations		Biofuels			Hydrogen
		Level 2 (J1772)	Level 3 (J1772 & CHAdeMO)	Ethanol	Biodiesel	Renewable Diesel	
Del Norte	14	---	---	---	---	---	---
Humboldt	87	18	---	---	1	---	1
Mendocino	60	9	---	---	3	---	---
Siskiyou	45	1	---	---	---	---	---
Trinity	15	---	---	---	---	---	---

a: Estimated number of fueling stations taken from 2012 survey data collected by the California Energy Commission. Data available at http://energyalmanac.ca.gov/gasoline/retail_fuel_outlet_survey/reporting_stations.html

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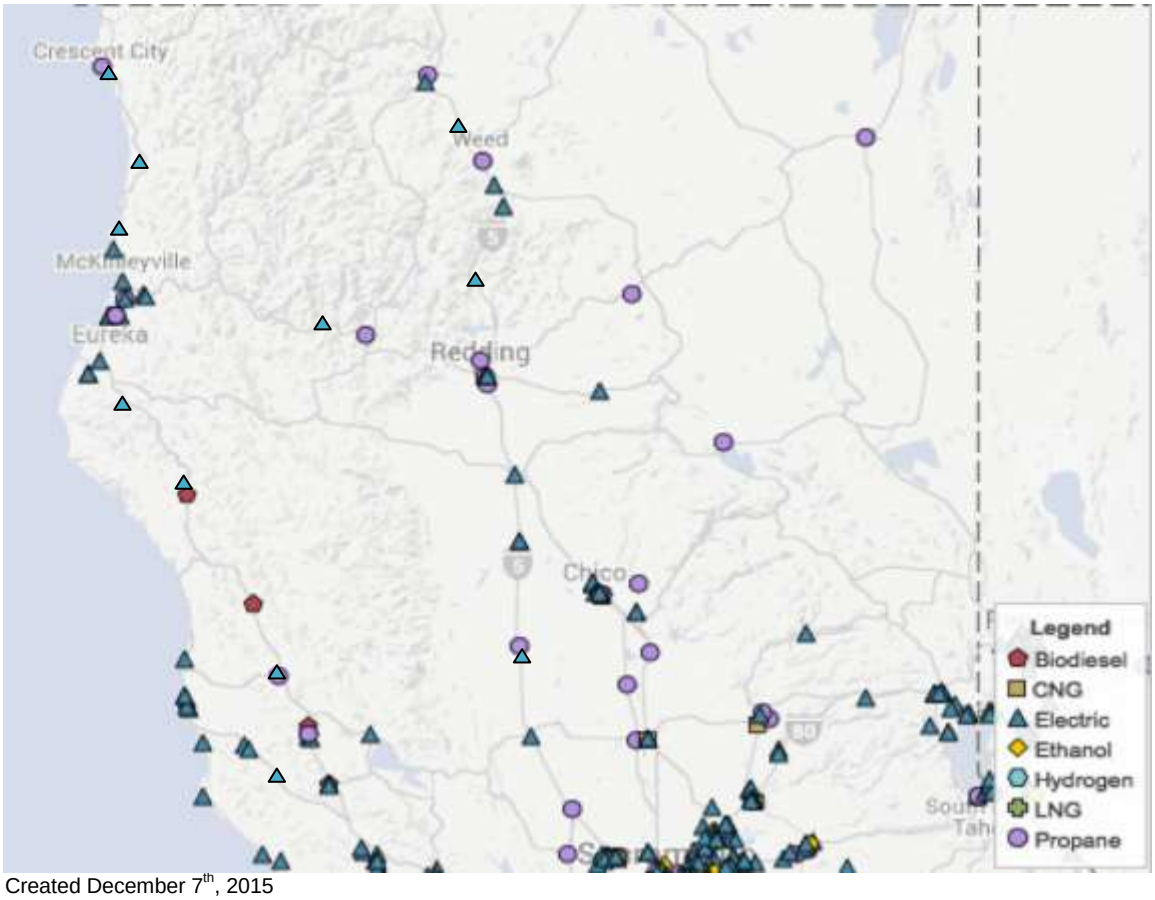
Source: SERC, 201

Figure 1: Map of existing and near-term planned alternative fuel stations in the local region.



Created December 7th, 2015
Source: http://www.afdc.energy.gov/locator/stations/

Alternative Fuel Vehicles

An alternative fuel vehicle is a dedicated, flexible fuel, or multi-fuel vehicle designed to operate on at least one alternative fuel. All current vehicles have an Internal Combustion Engine (ICE), an electric motor, or both, that power the transmission. There are already a significant number of commercially available alternative fuel vehicles that may be available to stakeholders and the general public.

Multi-Fuel Vehicle Technologies

HEV: A hybrid electric vehicle (HEV) has both an ICE that utilizes combustible fuel, and an electric motor powered by electricity stored in onboard batteries. Since an electric motor is more efficient than a gasoline-powered motor, the combination of the two makes the HEV more efficient than a gasoline-only powered vehicle. The gasoline motor recharges the battery, and regenerative breaking is also utilized to recharge the battery.

There are two subsets of HEVs that are even more efficient:

PHEV: A plug-in hybrid electric vehicle (PHEV) has a bigger battery than an HEV, providing more all-electric miles, and has a plug enabling the vehicle to connect to an electricity source and recharge the battery.

ER-PHEV: An extended range plug-in hybrid electric vehicle (ER-PHEV) has an even bigger battery than a PHEV, providing many more all-electric miles. Common ER-PHEVs only use the ICE as an onboard generator that charges the battery. In other words the ICE does not directly power the vehicle.

Multi-Fuel ICE: A multi-fuel ICE vehicle is equipped with two separate fuel tanks to provide fuel flexibility. It may use a domestic fuel source, such as natural gas or propane, and/or a non-petroleum fuel source, for increased efficiency or to offset petroleum consumption. Most multi-fuel vehicles also have a gasoline or diesel fuel tank. Both tanks are able to power the IC engine.

Dedicated-Fuel Vehicle Technologies

BEV: A battery electric vehicle (BEV) has only an electric motor and a substantially bigger battery than a hybrid since it is the single source of power to the transmission. It plugs in to an electricity source to recharge its battery, and also utilizes regenerative breaking.

CNG and Propane: Compressed natural gas (CNG) and propane (Autogas) vehicles have an IC engine designed to combust a gaseous fuel rather than a liquid fuel.

FCHV: A fuel cell hybrid vehicle (FCHV) has an electric motor that is powered by electricity generated by an onboard hydrogen fuel cell stack, which also charges an onboard battery that also provides power to the motor. The fuel cell stack utilizes hydrogen gas stored in a refillable tank. The design is exactly the same as a HEV except with a fuel cell stack rather than an ICE. The motivation for using a fuel cell rather than an ICE is that fuel cells are much more efficient than ICEs at converting their fuel into power to drive the vehicle.

FCEV: A fuel cell electric vehicle (FCEV) operates similar to a FCHV, except the hydrogen fuel cell stack charges the battery only, which is the sole power source for the electric motor. This is the same design as most ER-PHEVs except with a fuel cell stack rather than an ICE.

Flexible Fuel Vehicle Technologies

Typically flexible fuel vehicles, as opposed to multi-fuel vehicles, operate on liquid fuels. A flexible fuel vehicle has an ICE that typically utilizes liquefied biofuels in combination with petroleum fuel. The biofuel is blended with petroleum fuel in the vehicle's one fuel tank, thereby offsetting petroleum consumption. These vehicles are often referred to as "Flex-Fuel" vehicles because the engine is designed to utilize a wide range of blends of both fuels. The most common flex-fuel vehicle runs a blend of gasoline and ethanol, and typically the term "Flex-Fuel" refers to these vehicles.

Table **4** and Figure 2 show the number of known 2015 vehicle models available by fuel type.

Table **4** also shows the number of available gasoline and diesel 2015 models available for comparison.

Table 4: Number of currently existing publically accessible gasoline and petroleum diesel vehicles, and estimated 2020 volume consumed of these fuels for all five Counties.

	Number of Vehicle Models Available in the U.S. (Model Year 2015)		Gallons of Fuel Consumed (million gallons)[d]
	Light Duty[a,b]	Heavy Duty[c]	
Gasoline (All / Max E-10 / Max E-15)[e]	386 / 249 / 137	? / ? / ?	128 / 128 / 0
Diesel (All / Max B-5 / Max B-20)[f]	39 / 38 / 1	? / ? / 16	42 / ? / ?
BEV and PHEV	27	18	?
HEV[g]	46	21	N/A
H_2	3	7	?
Flex-Fuel	84	19	?
CNG	17	67	?
Propane	10	27	?

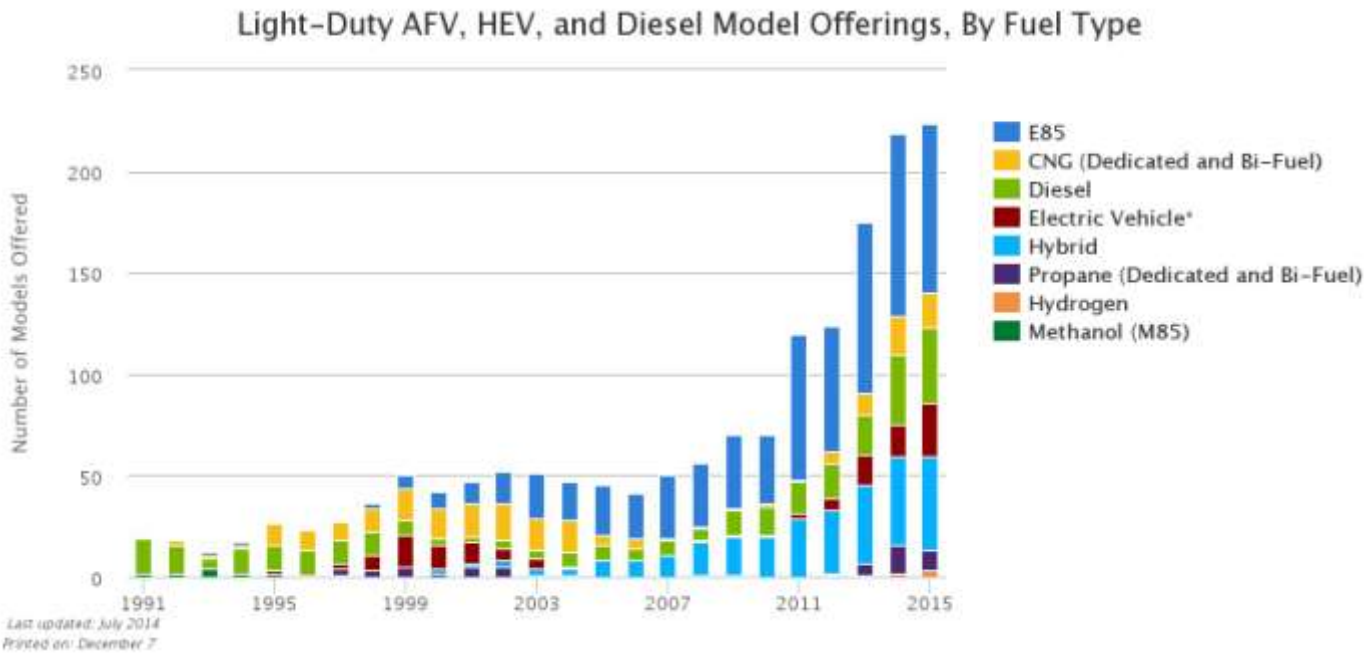
a: Data on diesel and alternative fuels from http://www.afdc.energy.gov/data/10303
b: Data on gasoline and E-15 Compatible vehicles from https://www.fueleconomy.gov/feg/download.shtml. Count ignores variations on a model such as manual vs. automatic transmission, or baseline vs. top-of-the-line.
c: Data obtained from http://www.afdc.energy.gov/vehicles/search/ and https://www.fueleconomy.gov/feg/download.shtml
d: Data for the year 2012, and obtained from http://energyalmanac.ca.gov/gasoline/retail_fuel_outlet_survey/retail_gasoline_sales_by_county.html
e: Note that the federal Environmental Protection Agency approves the use of E-15 in all vehicle model years 2001 and later. However, many auto manufacturers do not explicitly approve the use of E-15.
f: There likely may be additional heavy-duty vehicles approved for B-20. The best way to determine this is to reference both vehicle and engine manufacturers rather than solely vehicle manufacturers. For a list of OEMs that support B-20 see http://biodiesel.org/using-biodiesel/oem-information/oem-statement-summary-chart.
g: For light duty vehicles, HEV means hybrid electric gasoline or diesel. For heavy-duty vehicles, HEV means hybrid diesel. Heavy duty HEVs that run other fuels are included under that fuel type.

Source: SERC, 2015

The number of available models is expected to continue to rise. For light duty vehicles, hybrid and flex-fuel vehicles are an established and readily available technology while the electric and compressed natural gas vehicle sectors are growing quickly. For heavy duty vehicles, exact numbers are not known yet there are numerous biodiesel and compressed natural gas options,

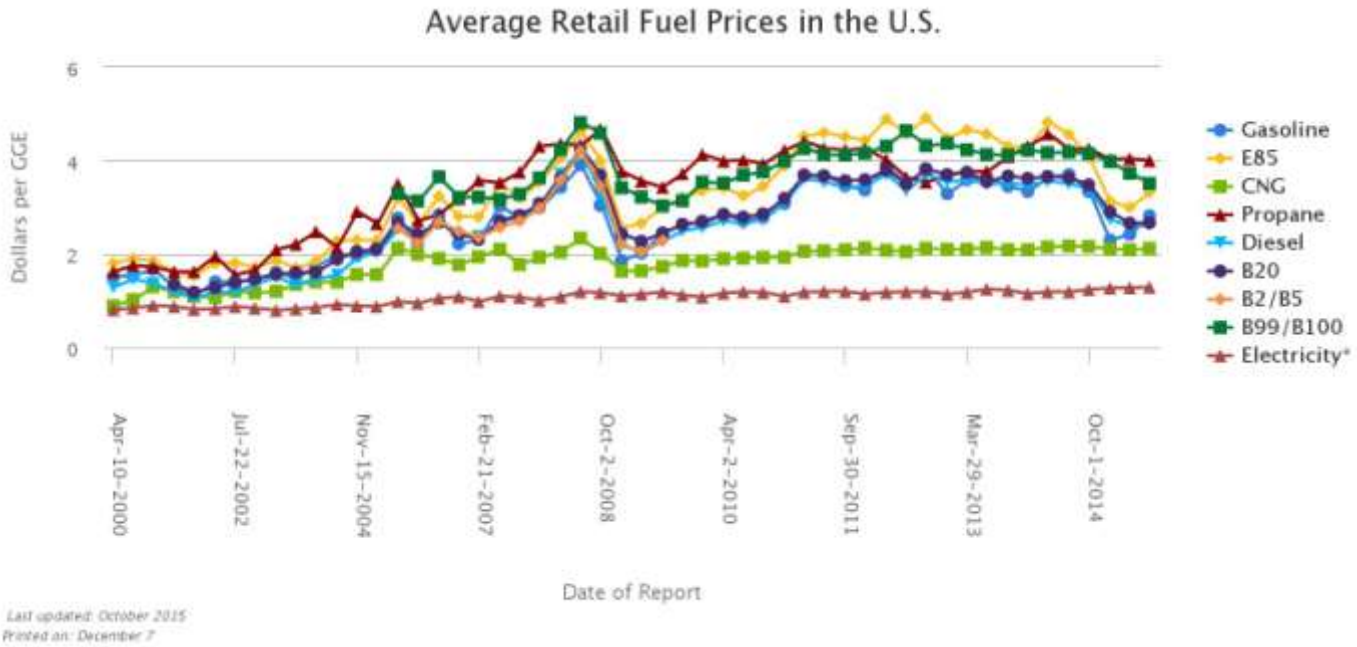
while the hybrid electric, hybrid hydraulic, and pure electric vehicle sectors are growing. Hybrid and bi-fuel retrofit and modification kits are also becoming increasingly available.

Figure 2: Total number of commercially available light-duty alternative fuel vehicles.



Source: http://www.afdc.energy.gov/data/10303

Figure 3: Transportation fuel prices, averaged across the U.S., on a gallons of gasoline equivalent (GGE) basis.



*Electric prices are reduced by a factor of 3.4 because electric motors are 3.4 times more efficient than internal combustion engines.
**Propane prices reflect the weighted average of "primary" and "secondary" stations.

Source: http://www.afdc.energy.gov/data/10326

Stakeholders

The Northwest Region is home to many committed key players integral to the successful implementation of the Readiness Plan. Key stakeholders are broadly categorized into five main groups: government agencies, fuel distributors, vehicle fleets, supporting services, and the general public.

Government Agencies

There are multiple government agencies throughout the region that have a vested interest in alternative fuels planning, including:

- Transportation planning agencies (MPOs, RTPAs, tribal)
- Air Quality Management Districts
- Planning and permitting departments
- Community development, economic development, and public health agencies
- Special districts (energy authorities and transit authorities)

Representatives of these agencies formed the project's Strategic Plan Working Group and met to discuss the preferred focus and trajectory of this project to best meet the unique and varying needs of the region. The group crafted the mission statement and outlined the strategic plan accordingly, and offered feedback throughout its development.

Fleets

Opportunity for quick and widespread adoption of alternative fuels and vehicles exists within vehicle fleet operations due to their representative scale. Additionally, several mandates exist that will require agencies and fleet operators to become familiar with alternative fuel and vehicle options. The U.S. and state governments have placed a great deal of responsibility for meeting petroleum fuel reduction goals on fleets, although have limited the reach to federal and state agencies. However local government and private fleets can certainly benefit from the information put forth in response to these mandates, and will continue to be important stakeholders in determining opportunities and barriers that exist in those sectors.

The EPAct requires 75% of new light-duty vehicle acquisitions by covered federal fleets be alternative fuel vehicles. Executive Order 13693 requires federal agencies with 20 vehicles or more to ensure that by 2025, 50% of their light-duty vehicle acquisitions are zero-emission vehicles or plug-in hybrid electric vehicles (https://federalfleets.energy.gov/). Certain state governments are subject to similar EPAct requirements. In California, the purchase or lease of alternative fuel vehicles is encouraged for state offices, agencies, and departments. Any vehicle that the state owns or leases that can run on alternative fuel must operate on that fuel if it's available.

The state has also set goals to reduce or displace fleet petroleum use. Additionally, the agencies responsible must work with other agencies to incentivize state employee use of alternative fuels. This may be by providing electric vehicle charging, reduced-cost parking, or other programs. The State Agency Low Carbon Fuel Use Requirement will be in effect starting January of 2017 at which time at least 3% of bulk transportation fuel purchased by the state must be very low carbon fuels, defined as having no greater than 40% of the carbon intensity of the closest comparable petroleum fuel.

Case Study: Mendocino Fleet Impact Analysis

An analysis was completed that looked at potential impacts of converting a portion of fleet vehicles in Mendocino County to a low-carbon fuels mix. Establishing a baseline demand for alternative fuels and fuel infrastructure would allow for alternative fuels to be made available for the general public. In addition to interviewing public agency fleet managers as part of stakeholder engagement, interviews were conducted with private fleet operators for this analysis. Fleet size, vehicle mix, and annual miles travelled were gathered. The analysis considered fuels currently on the market and anticipated to increase in availability over the next 5 years. Data used to complete the model include: vehicle fuel economies, annual miles traveled by vehicle type, fuel emissions profiles, fuel energy densities, and engine efficiency ratios. Results of the analysis were compared to key regional targets for number of alternative fuel vehicles, fuel reduction, and greenhouse gas emissions reductions.

Results of the analysis indicate that fleet conversions can have a high impact on the regional emissions reduction targets, as well as help to provide a solid threshold of demand for renewable diesel, biodiesel, and ethanol (E85) fuels. The greatest air emissions reductions can be achieved through light-duty fleet vehicle conversions to electric vehicle or plug-in hybrid electric vehicle technologies. Fueling Mendocino police car fleets with E85 would alone provide nearly 1/3 of the demand needed to meet the AFRP E85 2020 fuel targets. Replacing diesel fuel with drop-in fuels such as biodiesel and renewable diesel for heavy-duty vehicle fleets represents an immediate opportunity to reduce GHG emissions while avoiding the incremental cost of purchasing a new vehicle. The potential demand far exceeds the AFRP target. Overall, converting approximately half (41%) of the Mendocino fleet vehicles to alternative fuels over the next five years would achieve 25% of the AFRP 2020 regional greenhouse gas emissions targets. Recommendations coming out of the fleet analysis include:

- Establish policy that sets maximum vehicle age restrictions for public agency fleets
- Maintain contact with public and private fleets to keep them up to date on local AFRP plans and how it will impact them in the near-long-term and long-term.
- Use AF vehicles in public fleets to demonstrate the efficacy of alternative fuel vehicles in different applications and across vehicle types to provide private fleet operators with an advanced understanding about AF technologies.

Achieving regional targets can be facilitated by incentives and mandates requiring early fleet uptake. Early adoption in fleet application can help to provide a baseline demand for alternative fuels, support the development of infrastructure, and increase the alternative fuel vehicle offerings at local dealerships.

Although Mendocino County fleet vehicle conversion to low-carbon fuels could accelerate the proliferation and use of alternative fuels regionally, the roll-out of the 2008 Bus and Truck Rule PM emissions reductions mandate resulted in a residual fleet operator resistance to being the “guinea pig” for state-mandated early adoption of low emissions technologies. Fortunately, use

of drop-in biofuels provides the region and fleet operators with a low carbon fuel solution that will not require a new vehicle purchase or modifications. By establishing an overall Mendocino County fleet mix of low-carbon drop-in biofuels for heavy duty vehicles and EV / PHEV use for light duty vehicles, the county can maximize emissions reductions and increase the diversity of fuels available locally.

Fuel Distributors

Fuel distributors in the North Coast Region mainly consist of companies who transport motor vehicle fuels between production or import facilities and a retail outlet, or sell, offer for sale, or supply motor vehicle fuel to motor vehicle fuel retailers. Some distributors may also refine, blend, or otherwise produce motor vehicle fuels, as well as own and operate retail locations. Fuel distributors are integral to achieving the long-term goals of this project. They have a key role in determining the accessibility of currently available alternative fuels and the adoption of new technologies as they become available.

The Fuel Distributors Working Group consists of fuel distributors and project partners. The workgroup discussed challenges and opportunities related to brining alternative fuels to market in the North Coast Region. This included the key role and business activities of local fuel distributors in achieving long-term goals of the project as well as supply and demand of alternative fuels in the region.

Supporting Services

In 2015 the Training Materials Working Group was formed for this project. The project team attempted to recruit members with the goal of attaining broad geographic and industry representation. Ultimately, stakeholder availability was the key driver that led to the formation of the workgroup. The group included:

- Firefighters
- Law enforcement
- Ambulance services
- Roadside assistance
- County Office of Emergency Services
- Fueling Station Owners and Distributors
- Fleet Owners and Managers
- Dealerships
- Auto-repair shops
- Community colleges

Extensive interviews were conducted across the project region throughout 2014 and 2015 and included multiple stakeholder groups. The majority of interviews were conducted over the phone, but there were many in-person and email-based interviews as well. Although the Training Materials Working Group was intended to be the focus group that provides insight and guidance regarding training needs and material availability, significantly more interviews were conducted with stakeholders who were not originally selected to be members of the working group; the results of which added to the findings in this assessment. Interviews were conducted by: Juliette P. Bohn Consulting, Schatz Energy Research Center, and the Local Government Coalition CivicSpark program.

General Public

The public includes key groups such as consumers that buy alternative fuels and alternative fuel vehicles, business owners concerned with the economy, as well as voters that elect representatives who decide on policies and regulations. They are a key stakeholder group that doesn't often have a formal voice beyond rulemaking and elections. This project focused on inviting a broad number of stakeholders to participate in strategic planning, and recognize that including the public is crucial in meeting long-term goals of the project.

Two dual-head electric vehicle charging stations at the Blue Lake Rancheria, Blue Lake, CA.

LOOKING FORWARD

In addressing the mission of taking the most efficient approach to reducing greenhouse gas emissions from the transportation sector, this plan focuses on developing a least-cost path to fostering a local vehicle and fuel market that meets the Low Carbon Fuel Standard (LCFS) goal of reducing the carbon intensity of the total mix of all fuels by 10% by 2020. This approach was chosen because the LCFS approach provides an established and quantifiable framework and target that aligns with state goals and regulations. However, this is only one of many possible pathways the region can pursue to accomplish the mission proposed here, and should be considered as a tool for guiding stakeholders rather than a proposed regulation or mandate for the region.

It is worth keeping in mind that the incremental cost of the proposed mix of fuels and vehicles is significantly influenced by market fuel prices and advancements in technology which are constantly changing. Any regional policies that are based on the estimates in this plan should be flexible enough to allow the mix of different fuels and vehicles consumed by the community to change substantially from those presented here. As such, the values shown in the following sections are very rough estimates intended to help provide regional stakeholders a sense of the potential impact from these changes to the transportation sector, and should not be considered a hard target.

Modeling the Mix of Fuels and Vehicles Through 2020 that Meet the Low Carbon Fuel Standard with the Lowest Incremental Societal Cost

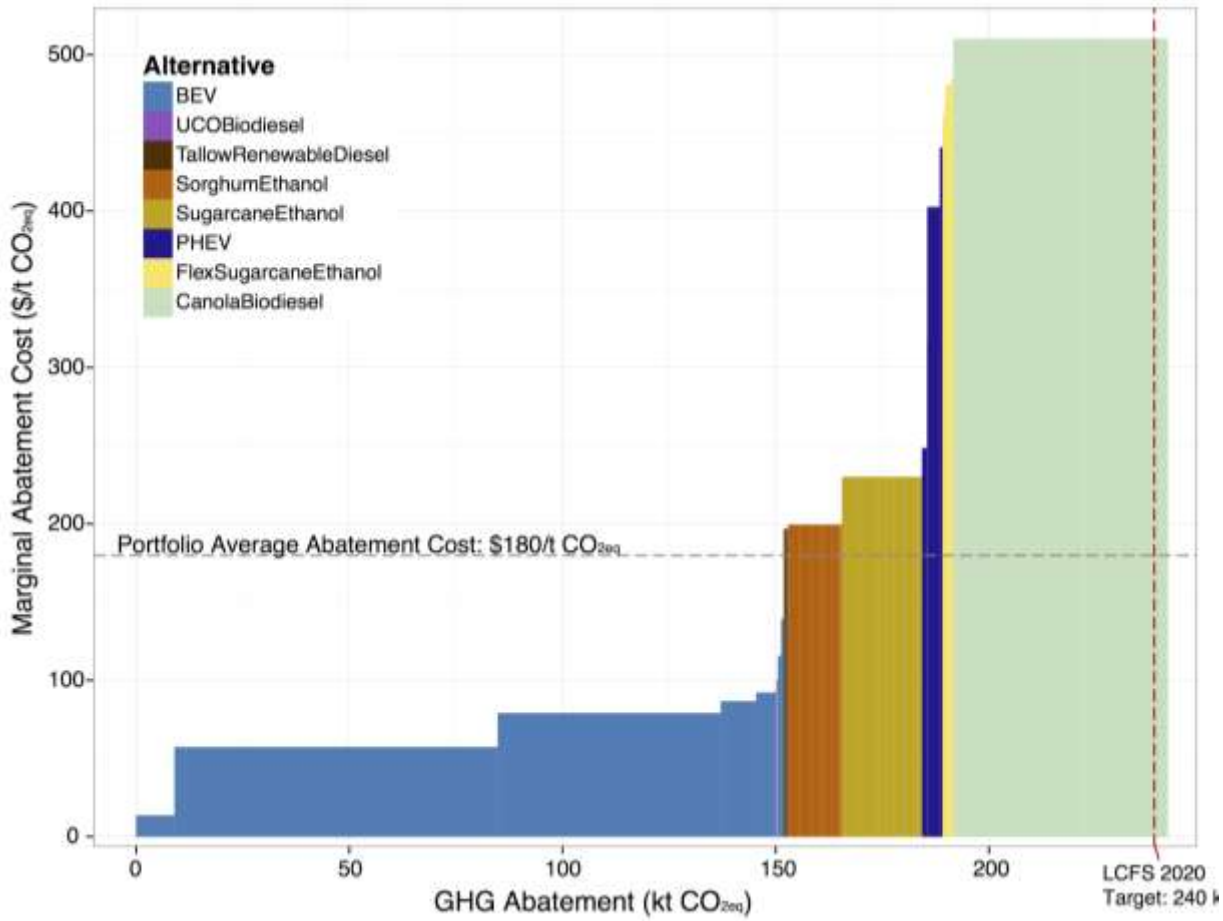
A modeling effort was undertaken to identify a potential lowest incremental societal cost mix of fuels and vehicles needed to meet the State LCFS target of a 10% reduction in the carbon intensity across all transportation fuels combined by the year 2020. The results of this effort are shown in Figure 1 below. The vertical axis represents the marginal (or incremental) cost above business as usual per tonne of reduced carbon dioxide equivalent emissions ($MTCO2_2e$). The horizontal axis represents the cumulative total reduced carbon dioxide equivalent emissions as each different fuel and/or technology is adopted in the region.

The average marginal cost of implementing this fuel mix portfolio is $180 per metric ton of offset carbon dioxide equivalent emissions, in 2014 dollars. The marginal cost considers the total lifecycle cost to society for each fuel and technology, which includes estimates of incremental:

- Vehicle cost
- Fuel infrastructure cost
- Fuel cost, which embodies the cost of distribution

The total incremental cost of achieving this fuel mix portfolio is estimated to be $43 million, representing a 4% increase above the total cost of business as usual of an estimated $1.16 billion per year across the five-County region.

Figure 1: Estimated lowest incremental societal cost low carbon fuel portfolio for the region, and associated marginal cost (in 2014 U.S. dollars per metric ton of offset carbon dioxide equivalent) and total offset emissions (in metric kilotons of offset carbon dioxide equivalent).



Source: SERC, 2015

A Note about Fuels Not Recommended by the Modeling Results

The modeling effort used to make fuel mix recommendations for the region over the next five years required reliable and defensible data on lifecycle greenhouse gas emissions and incremental costs of vehicles, fuel, and infrastructure. Data was available for most commercially viable alternative fuels, but not all.

Furthermore, this document makes recommendations for changes in the fuel mix of the transportation sector over a relatively short time span of five years. It is expected that technology and costs will change significantly over the next five years, opening doors for some fuels and closing them for others. The lifecycle emissions and economics of fuels have changed significantly for some fuels, and will continue to do so.

Natural Gas: Natural gas was considered in the modeling effort. Since this analysis focused on reducing greenhouse gas emissions, compressed natural gas did not result in sufficient enough reductions in GHGs to be competitive with other fuels on a basis of incremental cost per ton of avoided CO_2e. There is additional concern around natural gas leaks occurring in extraction and transport. Renewable natural gas is an appealing alternative with significant potential to reduce lifecycle greenhouse gas emissions. However there was insufficient cost data to compare with other fuels.

Hydrogen: Hydrogen is an increasingly viable option with zero tail pipe emissions and the potential to offer significant reductions in lifecycle greenhouse gas emissions depending on the hydrogen production method. The incremental vehicle cost is competitive with other technologies. However, the fuel station cost is substantially higher which causes this technology to be too expensive relative to other options on a basis of incremental cost per ton of avoided CO_2e.

Quantity of Vehicles Needed

The estimated total number of existing and new vehicles needed to meet the fuel portfolio shown in Figure 1 is shown in overwhelmingly the largest quantity of low carbon fuel vehicles anticipated. Although the upfront capital cost is currently relatively high for electric vehicles, the low cost of fuel and fueling infrastructure results in EVs demanding the lowest total incremental societal cost.

Table 5. Electric light duty vehicles are overwhelmingly the largest quantity of low carbon fuel vehicles anticipated. Although the upfront capital cost is currently relatively high for electric vehicles, the low cost of fuel and fueling infrastructure results in EVs demanding the lowest total incremental societal cost.

Table 5: Number of new and existing on-road vehicles running low carbon fuels by 2020.

	Light Duty						Heavy Duty	
	BEV[a]	PHEV[a]	E15[b]	E85[a]	B20 / RD[b]	H_2[a,c]	E15[b]	B20 / RD[b]
Del Norte	600	---	100	50	---	20	200	100
Humboldt	10,000	400	600	150	50	70	1,100	600
Mendocino	6,900	100	450	100	50	70	850	500
Siskiyou + I-5	1,000	---	200	50	---	20	500	350
Trinity	900	100	100	---	---	20	150	100
Total	**19,400**	**600**	**1,500**	**350**	**100**	**200**	**2,800**	**1,650**
% of All On-Road Vehicles in 2020[d]	**17% of LDVs**						**2.7% of HDVs**	

a: Represents number of new vehicles sold between 2015 and 2020
b: Represents both new vehicles sold between 2015 and 2020, and existing vehicles on the road in 2020 that are capable of running E15 (for gasoline vehicles) or B20 (for diesel vehicles). Columns labeled B20 / RD represent the fact that diesel vehicles could run either B20 or renewable diesel (RD)
c: Hydrogen vehicles (FCEVs) were modeled, yet are not expected to be cost competitive by 2020 such that they do not contribute to a low cost scenario. However, state policies are paving the way for FCEVs, and other modeling efforts predict a limited presence of FCEVs in the region. Therefore they are included to acknowledge this possibility. The distribution of hydrogen vehicles is a guesstimate based on NREL's modeling estimate of 200 FCEVs on the North Coast and 300 FCEVs in Upstate. Because the Ukiah and Eureka areas are the largest population density centers in the region it is assumed these cities will see the highest number of vehicles. For the remaining 300 vehicles predicted by NREL, it is assumed that Shasta and Sonoma counties will receive the majority of the remaining vehicles.
d: Percentage based on a total estimated vehicle population in 2020 of 130,100 LDVs and 164,300 HDVs, obtained from the EMFAC2014 model.

Source: SERC, 2015

Quantity of Low Carbon Fuels Needed

The total gallons of fossil fuel to be offset annually by 2020 in order to meet the LCFS target are estimated to be:

- Gasoline: ~17 million gallons per year
- Diesel: ~4 million gallons per year

The proposed mix and quantity of low carbon fuels needed to offset the quantity of gasoline and diesel is shown in Table 6. There are numerous different combinations of low carbon fuels and vehicles that can meet the LCFS target, some having a higher incremental cost than others. The mix of fuels and vehicle technology types in Figure 1 shows what is believed to be a low cost scenario that the region could reasonably implement by 2020. The estimated quantity of fuels this mix represents is shown in Table 6.

Table 6: Estimated quantities of low carbon fuels needed to meet LCFS by 2020.

	Electricity[a] *End-use MWh/year*	**Liquid Fuels** *Unblended Gallons / year*			H_2[e] *kg / year*
		E15[b]	E85[c]	B20 / RD[d]	
Del Norte	3,800	34,000	19,700	19,600	7,300
Humboldt	66,600	165,000	125,100	208,300	25,600
Mendocino	44,900	126,100	57,100	256,700	25,600
Siskiyou	7,000	37,600	46,600	61,600	7,300
I-5	200	38,400	1,200	218,500	
Trinity	8,600	24,000	0	41,400	7,300
Total	**131,100**	**425,100**	**249,700**	**806,100**	**73,100**

a: End use MWh estimated by converting total gallons of gasoline and diesel offset to MWh, then reducing by a factor of 3.4 to account for the increased efficiency of electric vehicles.
b: Unblended gallons of E15 means quantity of pure ethanol required to make E15. Recognizing that gasoline currently sold contains 10% ethanol as mandated by the state, the quantity of additional ethanol that would need to be imported is 30% of the gallons shown here.
c: Unblended gallons of E85 means quantity of pure ethanol required to make E85. Recognizing that gasoline currently sold contains 10% ethanol as mandated by the state, the quantity of additional ethanol that would need to be imported is 88% of the gallons shown here.
d: RD stands for Renewable Diesel. Project modeling efforts assumed the availability of RD would be very constrained thereby assuming biodiesel would be the primary replacement for the diesel engine sector. However, renewable diesel is gaining significant traction such that the goal of a 10% reduction in carbon intensity could be achieved using renewable diesel as well.
e: Quantity of hydrogen consumed estimated by assuming 1kg per vehicle per day for the number of vehicles listed in overwhelmingly the largest quantity of low carbon fuel vehicles anticipated. Although the upfront capital cost is currently relatively high for electric vehicles, the low cost of fuel and fueling infrastructure results in EVs demanding the lowest total incremental societal cost.

Table 5.

Source: SERC, 2015

Fueling Infrastructure Needs

Based on the estimated quantities of low carbon fuels as shown in Table 6 the number of fueling stations needed in the region are estimated in Table 7. The figures here represent a best estimate based on estimated fuel throughput for different fueling stations and the estimated fuel demand of each vehicle. The actual infrastructure needed can vary substantially because of variables such as location, station design, and the density of alternative vehicles near the stations.

Table 7: Estimated number of fueling stations needed to meet LCFS by 2020.

	Electricity *Number of charging stations*			**Liquid Fuels** *Number of stations with new infrastructure that supplies a throughput of 74,000 gallons per year*			**H_2**[f] *Number of stations with a throughput greater than 70kg per day*
	Home[a]	Public L2[b]	Public L3[b]	E15[c]	E85[d]	B20 / RD[e]	
Del Norte	600	9	1	0	1	1	1
Humboldt	10,400	157	19	0	2	3	1
Mendocino	7,000	106	13	0	1	4	1
Siskiyou	1,000	15	2	0	1	1	1
I-5				0	1	3	
Trinity	1,000	15	2	0	0	1	1
Total	**20,000**	**303**	**36**	**0**	**6**	**13**	**5**

a: The number of home charging stations is assumed to be equal to the numbed of BEVs and PHEVs.
b: Number of EV charging stations estimated based on the following factors derived from modeling efforts for Humboldt and Siskiyou counties: 0.015129 L2 stations per vehicle, and 0.0017923 L3 stations per vehicle.
c: It is assumed that E15 can be sold in existing tanks that currently sell E10. Therefore, no new infrastructure is needed. However, existing pumps and tanks would likely have to be dedicated to the sale of E15 since many on-road vehicles cannot utilize E15.
d: The assumed throughput of a liquid biofuel station of 74,000 gallons per year was taken from an NREL report[1] as a recommended benchmark for assessing the business case for an E85 station. It is worth noting that the average throughput for gasoline stations in Del Norte, Humboldt, and Trinity counties is roughly 600,000 gallons per year. However, it is likely that E85 will be sold at an existing gas station that will also sell gasoline.
e: While B20 and RD are not interchangeable, either fuel could accomplish LCFS goals. The throughput of a station is assumed to be equivalent to that of an E85 station as discussed above.
f: Number of hydrogen stations based on the assumption of an average station size of 180 kg/day based on the size of stations currently funded by the California Energy Commission under PON-13-607. A statewide report conducted by the University of California, Irvine under grant CEC-600-2015-005 estimates the demand for the Sonoma/Napa/Lake Tahoe regions to be 55kg per day. Currently, the smallest commercial stations in California are 74 kg/day. Stations anywhere in this size are assumed to be sufficient to serve the expected small vehicle population in 2020.

Source: SERC, 2015

Support Industry Needs

While alternative fuel vehicles and fuel supply are the primary components needed to forge a low carbon transportation market, it is just as important to enable the numerous industries that support the auto industry. These include government planning and inspection agencies, first responders, dealerships, maintenance and repair businesses, towing and salvage businesses, fleet operators, and fuel distributors.

Zoning, Codes, and Permitting

Information about low-carbon fuels permitting challenges was gathered to identify strategies to reduce permitting barriers in order to encourage low-carbon fuels deployment in the Northwest California region. To accomplish this goal, interviews were conducted with regional permitting and planning departments, low-carbon fuels providers, as well as California, Oregon, and Utah communities that have established low-carbon fuels deployment programs through the U.S. Department of Energy Clean Cities Coalition program.

Key findings from this research are:

[1] C. Johnson and M. Melendez. E85 Retail Business Case: Why and When to Sell E85. NREL/TP-540-41590, December, 2007.

1.) There are many pathways for a community to streamline the permitting process in order to encourage the adoption of low-carbon fuels without reducing protections for environmental health and safety.

2.) Collaboration between city / county planning and permitting staff, public safety agencies, fuels providers and community stakeholders can lead to increased awareness and understanding of existing codes and regulations for low-carbon fuels.

3.) Modernized land use codes and low-carbon fuels-specific permitting requirements can provide fleet operators and fuels distributors with opportunities to help accelerate the development of a thriving low-carbon fuels market.

Some of the recommended approaches for overcoming permitting barriers for developing low-carbon fuel infrastructure can be undertaken by a local coalition of agency representatives, low-carbon fuel facility developers and other entities with the mission of accelerating the development of a low-carbon fuels market in the region. Other actions such as procedural and code changes will need to be executed by agencies with broader authority such as City Councils, Boards of Supervisors and local permitting and planning departments. Some actions, if undertaken at the state level could eliminate the need for developing new local permitting policies.

Training

An assessment of the availability of both safety and non-safety training materials for relevant stakeholders, including first responders, fleet managers, emergency planning offices, fuel distributors, dealerships, and towing and auto repair shops. Training materials and resources were found by performing a literature review and surveying stakeholders about training on AFs and AFVs. A list of existing training materials and services was generated, with particular emphasis on freely available resources. Stakeholders were chosen based on their potential engagement with AFs and AFVs. For each county the project team attempted to survey at least two entities from each relevant stakeholder category.

The key results are:

1. Sufficient materials and resources were found for training technicians as well as code and permitting officials. Sufficient materials are available to educate key decision makers and the general public regarding the basics of AFs and AFVs.

2. Many free safety-training materials on AFs are available. In addition, there is an official 16-hour course through the National Fire Academy that is recognized by the state and local fire departments. However, there are challenges with existing materials that need be addressed through the proper state agencies. Furthermore, mandated training for alternative fuels and vehicles do not exist for all other safety and first responder groups.

3. Firefighters are the most likely to encounter alternative fuels and vehicles in an emergency situation, and some have had training in the past on AFs, in particular with electric vehicles (EVs), but considerably more training is needed. All other first responder and safety stakeholder groups have received little-to-no training on AFs.

4. There is a need for non-safety training across all relevant stakeholder groups, particularly automotive mechanics, in the region. Non-safety training refers to training planning and permitting agencies on their role regarding alternative fuel adoption, training auto mechanics on vehicle repair, training sales staff at dealerships on vehicle differences and required

behavior changes specifically for electric vehicles, and training relevant to other stakeholder groups that support the transportation sector.

Metrics for Estimating Required Funding and Allocation

From a full portfolio perspective, total estimated amortized incremental cost above business as usual is $43 million between 2015 and 2020 for the baseline scenario described in Section 0. On a per-vehicle basis, this cost is roughly $1,600 per alternative fuel vehicle[2], across all fuel and vehicle types modeled[3]. This estimate can be useful for assessing the cumulative cost performance of all activities supporting and encouraging and alternative fuels market. This incremental cost includes the amortized cost of the fueling infrastructure, quantity of fuel sold, and vehicles.

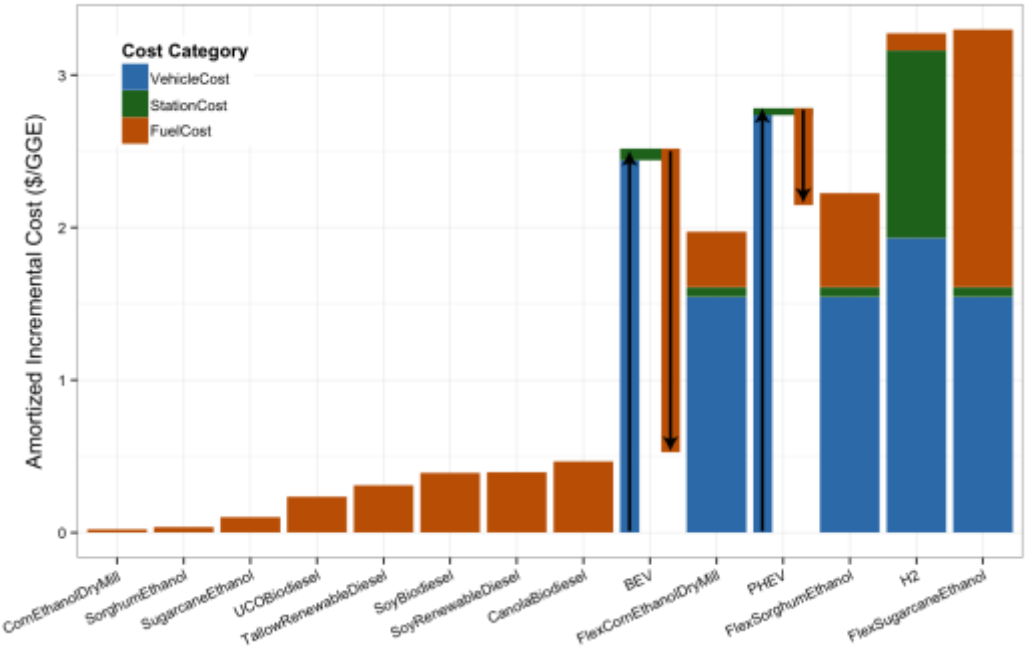
Because the incremental cost varies widely across fuel types, it is also useful to look at the total incremental cost for each fuel type since different technologies and fuels require different amounts of subsidies and incentives to move them forward in the market. These costs are shown in Figure 2 and elaborated on in **Error! Reference source not found.**, and can be used to assess the relative funding required to move each technology and fuel forward in the region.

[2] Estimated by taking the total combined incremental cost of $43 million divided by the total number of vehicles running alternative fuels as shown in overwhelmingly the largest quantity of low carbon fuel vehicles anticipated. Although the upfront capital cost is currently relatively high for electric vehicles, the low cost of fuel and fueling infrastructure results in EVs demanding the lowest total incremental societal cost.

Table 5.

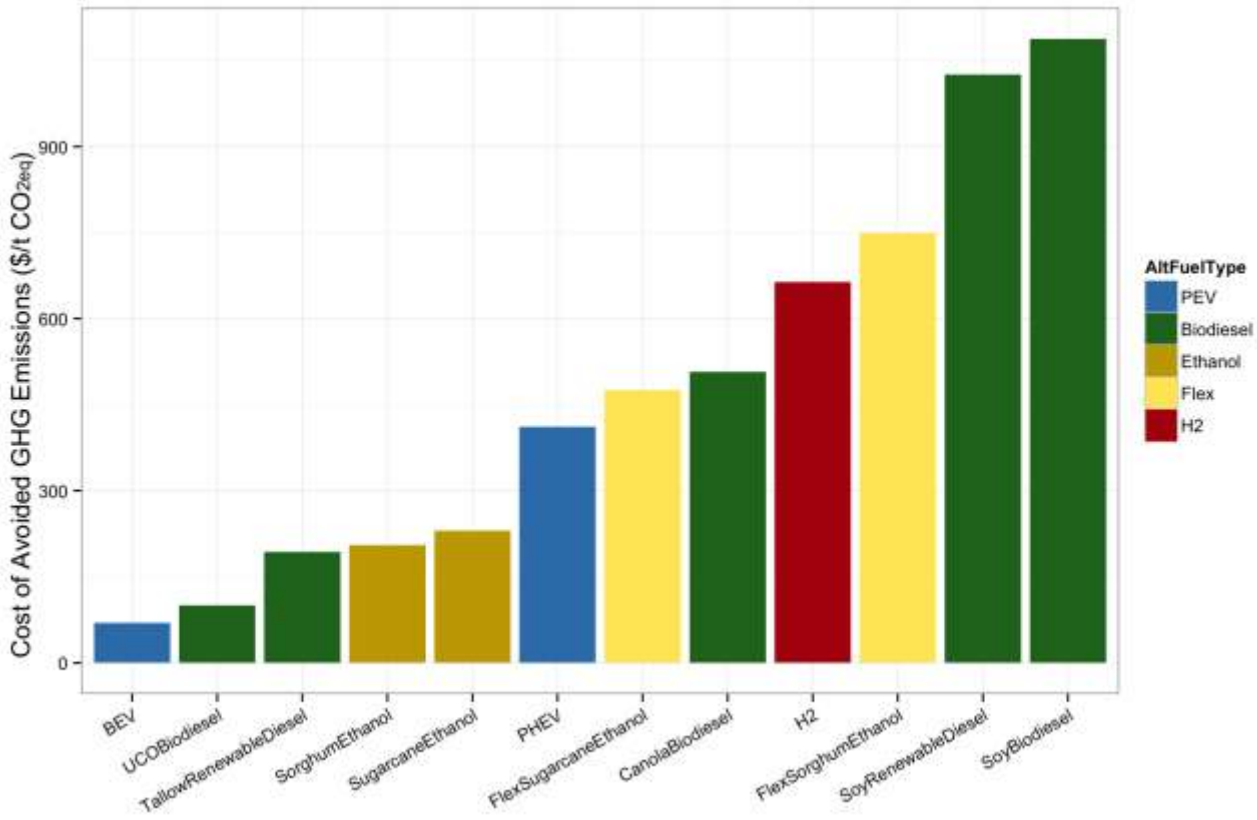
[3] Note that hydrogen is not modeled in the baseline scenario due to the high cost of infrastructure. Therefore, this cost does not assume investment in hydrogen.

Figure 2: Amortized incremental cost of alternative fuel pathways over conventional fuels. Units are dollars per gallon of gasoline equivalent (GGE). BEVs and PHEVs have negative incremental fuel costs.



Source: SERC, 2015

Figure 3: Average marginal abatement cost of alternative fuel pathways.



Source: SERC, 2015

Potential Barriers to Success

Identifying existing and potential barriers is critical for identifying next steps. Barriers may be technical, social, or economic. Some are common across several alternative fuel vehicle types (e.g., higher initial costs), while others are specific to only one vehicle or fuel type (e.g., limited range and charge time for BEVs).

The following sections identify a set of barriers, which are organized into the following categories:

- Vehicles - These include barriers that inhibit the penetration of alternative fuel vehicles into the market. This category includes both technical and consumer acceptance factors as well as vehicle availability.
- Infrastructure - A lack of fueling infrastructure can pose a barrier to vehicle penetration. In this section, we identify barriers that inhibit alternative fuel infrastructure deployment, and potential solutions to address these barriers.
- Fuels - The fuels themselves can also present barriers. In this section we identify fuel-related barriers and solutions.

In the following paragraphs, each barrier is described briefly and the types of AFVs to which it applies are identified in parenthesis (i.e., BEV, PHEV, FCEV, flex-fuel/biofuel). Note that where the term PEV is used, this applies to both BEVs and PHEVs. Following each description is a list of recommendations to overcome the identified barriers; the recommendations are listed by alphanumeric identifiers corresponding to the recommendations listed in Section 0.

Barriers to the Uptake of Low Carbon Fuel Vehicles

B1. *Higher capital cost (PEV, FCEV, flex-fuel):* Most alternative fuel vehicles command a higher up-front cost than a comparable conventional ICE vehicle.

Rebates and tax credits that directly reduce the incremental cost have been effective in addressing this issue. Financing incentives such as loan guarantees and/or preferential loan rates can incentivize buyers as can, free or preferential parking, and reduced registration/smog fees. Another option is to facilitate a robust used vehicle market by incentivizing dealerships to bring vehicles from areas that have a larger pool of used alternative vehicles. Educate consumers on the cost savings of operating PEVs.

Recommendations: A1, A3, A4, A8, A11

B2. *Limited range (BEV):* Limited driving range can be a real or perceived barrier for potential BEV drivers, as most BEVs cannot be driven long distances without recharging. Currently, battery all-electric vehicles typically achieve an 80 to 100 mile range on a full charge, with the one current exception being the Tesla Model S, which gets an EPA rated 265 miles per charge with the premium battery package. Other manufacturers such as Nissan and Chevrolet are claiming to release vehicles with a 200-mile range by 2017. Cold weather conditions can exacerbate this problem, because battery capacity can decrease by 25 to 50% in freezing weather conditions.

Two key approaches to overcoming range limitations for electric vehicles are 1) provide an extensive public charging network, including DC fast chargers, and 2) improve battery performance and/or thermal management systems to reduce battery range limitations. Local governments can really only significantly influence the first approach, but can lobby state and federal agencies to continue and/or increase funding for battery R&D.

Recommendations: A14, A15, A16, A17, A18, A19, A20, A21, A22, A23, A39, A43, A44, A45

B3. *Limited product offerings (PEV, FCEV, biofuel):* The variety of alternative fuel vehicles available on the market today is relatively limited, covering only a small subset of the wide range of end-use activities that vehicles serve. For example, there are no battery all-electric light duty trucks offered. For many categories this barrier will diminish as market share grows and additional vehicle models are offered.

This barrier can be addressed by encouraging or requiring manufacturers to offer more alternative fuel vehicle product offerings. In addition, local governments, business, and fleets can incentivize vehicle manufacturers by working collaboratively together to actively voice consumer demand for a wide range of alternative fuel vehicles.

Recommendations: A10

B4. *Long charging times (PEV)*: The time required to charge electric vehicle batteries is long in comparison to the time required to refuel vehicles that utilize liquid or gaseous fuels (e.g., conventional gasoline and diesel, biofuel, natural gas, propane, and hydrogen powered vehicles). Typical charging times for an all-electric passenger vehicle might be 4 to 5 hours with Level 2 charging or about 30 minutes with DC fast charging. This can present a barrier to consumers accustomed to a fueling time of 3 to 5 minutes. However, this barrier may be more a matter of perception and habit rather than an actual physical constraint. For example, many drivers are accustomed to filling their gasoline tanks once every week or two. Electric vehicle owners typically recharge at home each night, and this daily recharge is often sufficient to cover their daily driving needs (the 2009 National Household Transportation Survey estimated that the average daily vehicle miles traveled per driver is less than 30 miles)[4]. Furthermore, many fleet vehicles spend a significant time at "home base," presenting an opportunity to spend that time recharging for the next day's use.

This barrier can be overcome by providing a robust network of public DC fast chargers that allow rapid charging, as well as public and workplace Level 2 chargers that allow charging during the day while vehicles are parked. There is also a need to educate consumers about the various charging options that can provide them sufficient range to cover their daily driving needs, emphasizing that these vehicles require a change in habit and perception.

Recommendations: A14, A15, A16, A17, A18, A19, A20, A21, A22, A39, A45, A64

B5. *Risk aversion, market inertia, and lack of awareness (PEV, FCEV, biofuel):* Social factors can inhibit the deployment of a new technology, such as alternative fuel vehicles, into an existing market. These include potential customers being unfamiliar with the technology, uncertain about its costs and benefits, unaware of its market status and availability, unaware of available incentives, averse to risk, and thwarted by personal and/or market inertia. Succinctly put, conventional vehicles can be difficult to unseat; consumers know their attributes and are accustomed to buying, driving, and fueling these vehicles.

Alternative fuel vehicles, on the other hand, may have many different operational characteristics with which drivers must become familiar. For example, with PEVs some of the operational differences include: cheaper electricity costs relative to gasoline costs, use of a home re-fueling process, a need to understand battery charge states and how they relate to remaining driving range, knowledge of recharging times, using different types of re-fueling infrastructure, and locating/accessing public charging stations.

In the case of smaller, rural private fleet operators, a key social barrier to the uptake of alternative fuel vehicles is the residual frustration and distrust stemming from the implementation of the 2008 California Air Resources Board (CARB) Truck and Bus Regulation. Designed to reduce diesel particulate matter emissions, this regulation required fleet managers to either purchase newer vehicles with cleaner-burning engines or retrofit existing trucks with diesel particulate filters (DPFs) to delay new vehicle purchase. Fleet operators with retrofitted DPFs experienced engine issues resulting in vehicle towing costs, operational downtime, and repair expenses. CARB staff

[4] http://nhts.ornl.gov/2009/pub/stt.pdf

investigated this issue and found that two-thirds of the DPF problems were associated with upstream engine failures due to component durability issues or inadequate maintenance.[5] The remaining third of DPF issues were not attributable to any other cause. CARB also found that subsequent engine models (i.e., newer trucks) had fewer durability problems and were not subject to the downtime issues associated with the retrofitted DPFs. While CARB does provide financial fleet modernization assistance to encourage the purchase of new vehicles, fleet operators surveyed in the Northwestern California region reported that they were not able to access the funds needed due to the low prioritization of funding for operators in the high attainment (clean) air basins. In some cases this has placed rural operators at a further disadvantage relative to their competition.

These experiences with the 2008 state-led emissions reductions efforts have created a barrier to alternative fuel vehicle penetration in the small to medium private fleet operators in that they are reticent to be the state's early adopters for new AFV technologies. Among the fleet operators surveyed, there is a general sense that emissions reduction efforts will be costly, create uncertain maintenance issues, and that any funds allocated to assist with a transition to new vehicle technologies will be targeted at higher population centers and areas of low attainment for air emissions.

Public fleet operators and large fleet operators are more willing to consider adoption of AFVs into their fleets. However, these fleet operators are either skeptical or unaware of AFVs that are suitable for their specific vocations (i.e., police cars, garbage trucks, fire trucks etc.), and can meet performance requirements for their operational needs (e.g., ability to haul heavy loads up hills, drive on uneven and flooded unpaved roads, or accelerate quickly). Further, local agency budgets are tightly constrained and without knowledge of, or access to incentives, the incremental cost of the AFV replacement vehicle becomes the less economically feasible option.

Effective marketing, education, and outreach activities are critical to inform and encourage consumers. This is especially important to help overcome many of the actual and perceived barriers associated with alternative fuel vehicles. Demonstrations, case studies, and interactive events can be effective in helping to overcome many social barriers.

Recommendations: A6, A12, A20, A24, A25, A26, A27, A31, A32, A43, A56, A63, A64, A65, A66, A67, A68, A69

B6. *Information gap at the primary point of sale* (PEV, FCEV, biofuel): Barriers can also occur at various points in the supply chain, such as with sales personnel. For example, some auto dealers have been reluctant to aggressively market PEVs, citing a greater time commitment required to sell them and lower profit margins compared to conventional vehicles with internal combustion engines[6]. A survey of over 2,000 PEV buyers in California in December 2013 showed the vast majority was "dissatisfied" with their purchase experience[7]. According to a study by the National Research Council, "Dealerships are independent franchises that are not owned or operated by the

[5] http://www.arb.ca.gov/msprog/onrdiesel/documents/DPFEval.pdf

[6] http://electrificationcoalition.org/sites/default/files/EC_State_of_PEV_Market_Final_1.pdf

[7] EV Owner Demographics & Diffusion Survey. 2014: Center for Sustainable Energy.

automobile manufacturers. Training and educating dealership personnel -- salespersons, mechanics, financial specialists, and managers -- entail substantial costs to a franchise. Given those costs, many dealerships do not appear to be fully prepared to explain PEVs and educate customers about them. As a result, there appears to be an information gap at the primary point of sales."[8] In addition, many dealerships have only one or two PEVs on the lot at any given time, making immediate purchase of a vehicle more difficult. Rural customers also may lack confidence in local dealerships' expertise with service and support of these vehicles, so may choose to accept the costs of obtaining service at a more distant dealership that has more current training.

Incentives targeted to franchise dealerships might help overcome these barriers. They could be in the form of monetary awards and local publicity benefits (i.e., part of a public awareness campaign, green business campaign, etc.). A dealership education and training campaign could also help overcome some of these barriers. Ride and drive events can also support commission-based salespersons in the extra work to educate and inform the buying public about new vehicle technologies. Vehicle buyers guides can also help assist sales staff.

Recommendations: A3, A11, A23, A56, A63, A64, A65, A66, A68, A69

B7. *Road usage charges* (PEV): Currently the funding to develop and maintain roads and highways relies heavily on gasoline and diesel taxes. Individuals who drive more fuel-efficient vehicles tend to pay less in gasoline taxes, and electric vehicle drivers don't pay any. This is currently a de-facto subsidy to PEV drivers, although a very indirect one that is generally not readily obvious to the vehicle owners.

A number of states have adopted fees for EV drivers, and many others are considering legislation to close this loophole. This may be politically difficult if it appears to be a tax targeted at alternative fuels. Both California and Oregon are experimenting with mileage-based road user fees. These types of use-based fees would be more equitable for all drivers, but may reduce an incentive for PEV drivers. Something in this vein will probably need to be phased-in, as alternative fuel vehicles become a larger share of the transportation market.

Recommendations: A32

Barriers to Infrastructure Development

B8. *Lack of public fueling infrastructure (PEV, FCEV, biofuel):* The lack of public infrastructure is in part due to the classic "chicken-or-the-egg" conundrum. Fuel providers will not deploy fueling infrastructure if there are not enough vehicles to utilize it, and consumers will not buy alternative fuel vehicles if they can't refuel them. For fuel providers, this results in an unviable business model, at least for the early years of fueling station operation. With regard to electric vehicle charging infrastructure, the National Research Council Study found that "publicly accessible charging infrastructure provides several important benefits, such as extending the electric range of all PEVs, relieving range concerns of BEV owners, and providing increased visibility of both PHEVs and BEVs. However, the high cost of installing public charging stations and the little revenue obtained from providing electricity present challenges for developing

[8] National Research Council (2013), Overcoming Barriers to Electric-Vehicle Deployment: Interim Report

sustainable business models."[9] Similarly, infrastructure development costs for other fuels such as hydrogen and biofuels can be so high that it makes it difficult for fuel distributors to obtain a reasonable return on investment even if there is sufficient demand to utilize the station.

According to some regional fuel distributors, the key element needed to establish a regional alternative fuel market is demand. They indicate that they would need evidence of significant demand for alternative fuels before they would be willing to sell them, as they have made unsuccessful forays into AF sales in the past. While fleet applications could be a good arena for jump-starting demand, fuel providers indicated that there is not enough demand from fleets alone to support the investment required for AF infrastructure.

Many fuels require new storage and distribution infrastructure, which increases operation costs, making it more difficult to generate a profit. Also, there are often unintended consequences associated with fuel switching (e.g., higher criteria emissions, material compatibility problems, etc.), and this adds early adopter risk to the distributor of AFs.

Local fuel distributors will supply fuel if there is demand and reasonable financial risk. They prefer to serve an existing market rather than take the risk of kick starting the market. They recommend that state fleets should have their own AF stations (and offer public access to the nascent market) before private fuel distributors are to be involved and that state fleets can be used as the "guinea pigs" for testing the viability of new fuels.

A number of approaches can be used to address this barrier, including:

- Incentivize landowners, retailers, and public agencies to offer host sites for installing EV charging infrastructure, including incentives for the installation of workplace electric vehicle charging.
- Consider the formation of a non-profit regional fueling station model where stations that don't get a lot of use but are critical to enable public use of AF vehicles are subsidized with revenues from heavily used stations. . This is the model proposed in the Mendocino County ZEV Regional Readiness Plan.
- Encourage installation of EV chargers as a green building attribute.
- Provide recognition for government agencies and businesses providing public access to fueling infrastructure (e.g., a "green business" designation).
- Develop strategic partnerships between economic development agencies, vehicle dealerships and fuel distributors to help build infrastructure and build demand for vehicles.
- Develop economic zoning incentives for alternative fuel facilities.
- Advocate for public funds to be spent in a geographically and economically equitable way to enable AF market development in areas that are less attractive to early market investors.
- Facilitate streamlined permitting and government review processes for fueling infrastructure.

[9] NRC(2015). Overcoming barriers to deployment of plug-in electric vehicles. http://www.nap.edu/catalog/21725/overcoming-barriers-to-deployment-of-plug-in-electric-vehicles

- Subsidize micrositing efforts to identify ideal locations and interested site hosts, and encouraging local, state, and federal fleets to take the risk of early adoption to kick-start the AF market. Furthermore, identify and conduct micro-siting analyses at candidate locations, and inventory existing utility infrastructure, such as at idle industrial sites, which can be repurposed for DC fast charging stations.
- Directly subsidize new infrastructure equipment.
- Encourage innovative new business models such as the one used by Propel Fuel's Clean Fuel Points program, which allows existing fuel stations to host a new fuel with minimized associated risk.

Recommendations: A14, A15, A16, A17, A18, A19, A20, A21, A22, A24, A25, A43, A44, A45, A57, A70

B9. *Barriers to residential charging infrastructure (PEV):* The main barriers to widespread adoption of single family residential charging for PEVs appears to be the cost and effort of installing wiring and equipment, including upgrades to electric service panels in some cases. Permitting requirements can be an additional hurdle. Residential charging can also be problematic for rental properties and for the multi-family residential sector where the benefits of EV charging are often not realized by the same entity that bears the cost of installing the charging infrastructure.

This barrier can be addressed by providing rebates/incentives for the installation of residential chargers, including the charger purchase and installation as a package deal as part of the vehicle purchase, providing incentives for charger installation in multi-family settings, and streamlining permitting requirements for charging infrastructure. Rebates could also be offered to help buy down the cost of residential panel upgrades to allow higher- powered electric vehicle charging stations (EVCS) at home.

Recommendations: A17, A18, A23, A24, A27, A39, A44, A57

B10. *Zoning/permitting barriers for alternative fuel stations (PEV, FCEV, biofuel):* Biofuel dispensing facilities will typically be added to existing gasoline stations and uses the same or similar equipment. Therefore, zoning and permitting for biofuels should not be much different than for existing gasoline stations. Hydrogen fuel poses additional zoning and permitting challenges, as it has unique physical characteristics (it is a gas, is dispensed at up to 10,000 psig, and has different flammability characteristics) and is less well understood by the general public.

Electric vehicle charging infrastructure can be installed anywhere there are adequate electric services, and for the most part can be treated like any other large electrical appliance. However, DC fast charging stations have large, and variable, electric power demands and therefore require larger capacity electrical services. Permitting for EV charging stations is still relatively new, but has not proven to be a significant barrier in the region. EV charging stations are usually considered to be an auxiliary use and do not require special zoning approval. However, for larger EV charging station installations (i.e., numerous chargers), it is possible that a conditional use permit may be required.

To address the zoning and permitting barriers alternative fuel proponents should work with planning, zoning and permitting officials to make sure they are well informed about the various alternative fueling facilities and how they can fit into the existing regulatory

landscape. Efforts should include encouraging best practices among planning, zoning and permitting officials, and conducting education and outreach to fuel distributors to inform them of potential challenges.

Recommendations: A17, A34, A35, A36, A37, A38, A39, A40, A41, A42, A43, A45, A70

B11. *Lack of standardization in public charging infrastructure (PEV):* A lack of standardization of PEV charging infrastructure can present difficulties for PEV drivers. Examples of this lack of standardization include: multiple plug types for DC fast chargers, various payment methods, and charger access restrictions (such as charging network membership requirements). Standardization and consistency throughout the public charging network will tend to lead to a better user experience. To promote charging infrastructure standardization, PEV advocates should plan for and coordinate the installation and management of local charging networks to achieve regional consistency.

Recommendations: A15, A21, A25, A42

B12. *Lack of fuel production and distribution infrastructure (FCEV, biofuel):* In addition to a lack of alternative fuel retail providers in the Northwest California region, there is also a lack of local alternative fuel producers. According to the National Renewable Energy Laboratory's "transatlas,"[10] there are no ethanol plants in the Northwest California region and there are very few if any small biodiesel plants. Also, there are no commercial scale hydrogen production facilities in the region. This can affect the availability and cost of alternative fuels in the region.

To address this barrier, stakeholders can reach out to fuel providers/distributors and work collaboratively to develop markets and supply chains. Note that local distributors feel that alternative fuel supplies that are available in the San Francisco Bay Area could be integrated into our region provided there was sufficient demand for the fuels. Incentives that encourage the local production of transportation fuels within the region could also be helpful in addressing this issue.

Recommendations: A28, A29, A67

Challenges Associated with Low Carbon Fuels

B13. *Blend wall (biofuel):* A blend wall is a maximum percentage of ethanol that can be blended into gasoline per EPA regulation. This limit to ethanol content of fuels results from a political debate hinging on the design characteristics of vehicles as well as the interests of both biofuel and petroleum industries.

Increasing the percentage of biofuels in conventional/biofuel blends, such as ethanol in gasoline or biodiesel in petroleum diesel, could be a low cost approach to increasing the penetration of low-carbon biofuels, and thereby could reduce greenhouse gas emissions and lessen our dependence on petroleum fuels. For example, the Mendocino Alcohol Fuel Group is conducting research and testing on the viability of increasing the blend of ethanol in conventional gasoline engines. However, ethanol cannot at present be legally blended beyond 10% with gasoline unless it is separately labeled, stored and dispensed.

[10] http://maps.nrel.gov/transatlas

Biodiesel cannot be blended beyond 5% with conventional diesel without being separately labeled and handled. As of the writing of this report, most vehicles on the road are not approved by their manufacturers to accept higher percentage blends without modification.

One approach to overcoming this barrier would be to provide incentives reducing the added cost of separate labeling, storage and handling of higher biofuel blends. Furthermore, incentives could be targeted at vehicle manufacturers, encouraging them to design their conventional vehicles to allow higher biofuel blends.

Recommendations: A31, A33, A68, A69

B14. *Feedstock price volatility (biofuel)*: Supply risk of biofuels can be significant and can adversely affect both producer and consumer welfare[11]. The yield and price volatilities of biofuel feedstocks affect the availability of raw materials for biofuels production, which in turn impacts biofuel supply and cost. Adding biofuels to the current petroleum-based energy sector may initially lower supply risk by diversifying the fuel mix. However, in a scaled up scenario, biofuels could increase overall transportation energy supply risk as these agricultural supply variations are compounded with the existing volatility in oil prices driven by geopolitical and economic fluctuations.

To address this risk, policies should be designed to mitigate the impact of biofuel feedstock supply risks. Major biofuel firms should be encouraged to use several risk management strategies, including: more resilient production technologies, feedstock crop diversification, feedstock geographical diversification, storage technologies, and financial contracts. Public policy can play a role in a producers' risk management strategies by funding R&D to develop higher yield and more resilient feedstock crops, as well as by incentivizing crop and geographical diversification of feedstock, and by facilitating risk sharing with the fossil fuel sector. Public policy can also reduce the impact of fuel supply volatility by enabling consumers to shift their purchasing patterns between biofuels and fossil fuels. This may require supporting the development and deployment of flex-fuel vehicles, increasing biofuel blend walls, or requiring adjustments to the formulation of targets for the share of biofuels in the total fuel portfolio[12].

Recommendations: A29, A30, A33, A67, A69

B15. *Public perception (biofuel)*: First generation biofuels are made from sugar crops (sugarcane, sugarbeet), starch crops (corn), oilseed crops (soybean, rapeseed, palm oil), and animal fats. While it was originally thought that there would be significant environmental gains by using these fuels made from domestic biomaterials, careful analysis has shown that some first generation biofuels may not offer much in the way of environmental benefits, as they can compete with food crops, harming food security and indirectly causing GHG emissions through land use change. Because of this, biofuels in general have acquired somewhat of a tarnished name. However, some first generation biofuels, as well as second-generation cellulosic biofuels can offer substantial environmental benefits. In order for these biofuels to achieve substantial market share

[11] Ghoddusi, Hamed and Roy, Mandira and Trancik, Jessika E., Biofuels Supply Risk and Price Volatility (December 20, 2014). Available at SSRN: http://ssrn.com/abstract=2540274

[12] http://www.afdc.energy.gov/uploads/publication/ethanol_handbook.pdf

they may need to overcome some of these market-spoiling issues associated with first generation fuels.

This barrier can be addressed via an education and outreach campaign targeted to policy makers and advocacy groups that acknowledges the shortcomings of some first generation biofuels and points out the benefits of other first and second-generation biofuels. Getting buy-in from key environmental organizations would be particularly helpful. Efforts could include use of a product certification and marketing campaign for biofuel products that have been shown to result in lower greenhouse gas emissions and to avoid other adverse impacts (e.g., competition for food and land). One strong example of such a scheme is the Roundtable on Sustainable Biomaterials certification.

Recommendations: A29, A30, A31, A32, A33, A67, A68, A69

B16. *MPG reduction (biofuel):* Ethanol contains approximately 30% less energy than gasoline per unit volume, so vehicle fuel economy of E85 can be reduced by about 25%, depending on gasoline formulation and vehicle characteristics. Biodiesel contains 8% less energy per gallon than typical No. 2 diesel in the United States. The lower energy content per gallon in liquid biofuels will result in reduced vehicle range and increased fuel consumption.

Education and marketing campaigns should acknowledge these shortcomings associated with biofuels while making a strong case for their overall benefits. Incentives that subsidize biofuels in the short term to bring the price per mile on par with petroleum fuels could help address the issue of increased fuel use.

Recommendations: A5, A56, A64, A68, A69

B17. *Pure and blended biofuel property issues (biofuel):* There are numerous fuel-related issues associated with some biofuels, all of which become more problematic for higher proportion biofuel blends.

- Biodiesel: The freeze point of biodiesel is significantly higher than that of petroleum diesel, and when it begins to gel it can clog filters and prohibit effective pumping. Most biodiesel blends have adequate storage stability for normal use, but if the fuel will be stored for more than a few months a stability additive is recommended. Also, biodiesel is generally more susceptible to microbial degradation than petroleum diesel. Storage and handling procedures for B100 are very different from those for B20 and lower biodiesel blends. B100 is a solvent that can loosen varnish and sediments in fuel tanks and fueling systems, and it is incompatible with some hose, gasket, pipe, and tank materials[13].
- Ethanol: Ethanol is hygroscopic (i.e., attracts water). A small amount of water is soluble in E85, but at higher concentrations, the gasoline portion will separate from the ethanol/water mixture. The separated ethanol can cause corrosion of some soft metals and can degrade some plastic and rubber materials. Ethanol acts like a cleaning agent and can mobilize sludge in fuel storage and dispensing systems. Cross-contamination between fuel types can also cause issues. For example, fuel haulers conventionally practice “switch hauling” where the same tank is used for

[13] http://www.nrel.gov/transportation/pdfs/43672.pdf

delivering different fuels. In the case of ultra low sulfur diesel (ULSD), studies show that "Cross contamination of diesel tanks with small amounts of ethyl gasoline was leading to bacterial contamination (specifically, a kind of bacteria called Acetobacter) of the fuel tanks, leading to acid production and subsequent tank corrosion."[14]

Proper storage, dispensing and use of biofuels are critical to ensure that fuel related problems are not experienced. This will require proper education and training for fuel providers, fleet operators, and others using or providing biofuels. Biofuel users/providers must practice proper operation and maintenance procedures, adhere to fuel quality standards (e.g., ASTM), perform quality assurance procedures (e.g., periodic fuel testing), ensure proper material compatibility in vehicular, storage, and fueling system equipment, and provide adequate labeling and signage to help ensure that various biofuel blends are only used with compatible vehicular and fuel storage/supply systems.

Recommendations: A52, A54, A55, A57, A68, A69

B18. *Lack of carbon intensity accountability (PEV, FCEV, biofuel):* Petroleum-based fuels have a long history of externalized societal costs, which sustains an artificially low price point for this encumbant fuel. Emerging vehicle technologies also present challenges for legislation that relies on petroleum-based fees, such as the Highway Trust Fund. The switch to low carbon fuels presents an opportunity to create a universal costing system for transportation fuels.

Recommendations: A29, A32, A67

Barriers to Educating and Facilitating Support Services

B19. *Lack of vehicle maintenance support (PEV, FCEV, biofuel):* A lack of trained mechanics can be a barrier to the uptake of alternative fuel vehicles. Vehicle manufacturers and associated dealers are, in general, providing adequately trained mechanics at their dealerships. However, many consumers prefer to frequent their local independent mechanic. In addition, fleet operators typically have their own in-house mechanics. This presents a need to train independent mechanics so they can work on PEVs, FCEVs, and biofuel vehicles. This can be addressed by promoting alternative fuel vehicle maintenance and repair trainings for independent mechanics, especially through existing training channels.

Recommendations: A58, A59, A60, A61, A62

B20. *Lack of safety and first responder training (PEV, FCEV, biofuel):* Fire, police, ambulance, and other first responders need to receive regular training regarding safety issues related to alternative fuel vehicles they are likely to encounter. Currently there are some limited training options available to different groups, with firefighters having the most developed course available through the National Fire Academy. However, there are numerous challenges including:

- Hours-based training mandates pose difficult challenges particularly for volunteer departments. Topic-based requirements would make it easier for departments to cater to

[14] http://www.bellperformance.com/bell-performs-blog/ultra-low-sulphur-diesel-problems-corrosion-in-systems-storing-and-dispensing

the training needs of different departments, and also make it easier to add topics to the training curriculum.

- Bringing people to locations where training is happening can be a challenge, again particularly with volunteer departments and with departments in rural areas. Time availability, including backfilling for employees away on training, wage compensation, and travel expenses pose a significant barrier.
- There isn't consistency across first responder groups regarding the sources of training information.
- Train-the-trainer and hands-on training events are lacking in the area.
- Currently there is no training curriculum developed for first responders that has a focus on fueling equipment and infrastructure.
- The labeling of equipment is not standardized across manufacturers. Coloring high voltage cable orange is an example of an existing standardization, but there is more work that can be done to assist first responders in the field.

Recommendations: A46, A47, A48, A49, A50, A51, A52, A53, A54, A55

B21. *Lack of towing and salvage training (PEV, FCEV, biofuel)*: towing and salvage companies are a critical part of the automotive support industry. However, these companies are often overlooked when considering safety and vehicle requirements. Towing companies assisting stranded alternative fuel vehicles will need to know where the local fueling stations are, which dealerships and mechanics service the vehicles, specific details of how electric and hydrogen vehicles behave when they run low or out of fuel, and any unique safety considerations when towing or hauling these vehicles.

In addition, salvage companies need to be educated on many of the safety issues that first responders are trained on. Wrecking and salvaging vehicles requires knowledge of specific safety issues, and this information must also be conveyed to this industry.

Recommendations: A58, A59, A60, A61, A62

B22. *Lack of standardization of proprietary vehicle software (PEV, FCEV, biofuel):* Computers have become increasingly important in vehicles, with microprocessors controlling numerous processes including sophisticated engine controls, on-board diagnostic sensors, cabin climate control, theft deterrence systems, safety features such as traction and braking control, complicated transmission systems, and many other technological advancements. These computer systems all require software to operate them.

A lack in standardization of software development has resulted in numerous challenges including:

- Difficulty interpreting on-board diagnostic codes from engine and powertrain control modules. Although the current OBD-II standard is widely used, significant manufacturer discretion is allowed. This often means that different diagnostic equipment is required for different vehicle makes in order to fully interpret all diagnostic signals provided by the on-board diagnostic equipment. This is proving to be an increasingly significant barrier for independent automotive mechanics and fleet operators.

- Proprietary theft deterrence systems are increasing in complexity without standardization. When these systems fail specialized equipment is often required to

address the problem. Often only dealerships have access to this equipment particularly in rural areas like this region making it difficult or impossible for local mechanics or roadside assistance to assist stranded drivers.

Recommendations: A13, A61, A62

COMMITMENT TO ACTION

Agencies with authority to execute the recommendations are noted in parenthesis following each posited solution. The following notation is used to identify the agencies and parties who can adjust procedures or amend codes to streamline the permitting process for alternative fuel infrastructure:

S = State of California departments and agencies,

L = Local government, such as planning and permitting departments, City Councils and Boards of Supervisors,

C = Coalition of local agencies, AF developers, and non-profit entities supporting the efficient development of alternative fuels in the region.

Market Development Actions, Funding Mechanisms and Incentive Programs

The following are proposed recommendations to promote deployment of alternative fuels in the Northwest region of California. Funding mechanisms and incentives are heavily emphasized, with a focus on actions that regional stakeholders can take. These actions and incentives include those aimed at increasing purchases of alternative fuel vehicles, increasing installation of alternative fueling infrastructure, and increasing availability of the alternative fuels themselves.

It should be noted that many incentives should be structured to phase out over time as the alternative transportation fuel market matures. Incentives should be tied to program success metrics, and planned incentive reductions tied to these metrics. This ensures a more productive use of public funds and helps to avoid creating a market that is dependent on incentive programs[15].

Vehicles:

A1. Work with local and State financing entities to create, or to increase access to, AF vehicle financing incentives such as loan guarantees or preferential rates for AFV loans (S, L, C). **Barriers addressed: B1**

A2. Provide financial assistance to overcome the incremental cost increase in replacing fleet vehicles with AFV technologies. Ensure that assistance is available to all regions and fleet sizes throughout the state that will be required to comply with new low-carbon emissions standards.

[15] The recommendations discussed here are adapted from the 8-State ZEV action plan, the CA Governor's Draft ZEV plan, and the NRC "overcoming barriers to PEV deployment" report as well as research specific to the five county region.

Barriers addressed: B1

A3. Create incentives for used vehicle dealers to source used AFVs from the SF Bay Area where economic and demographic circumstances have led to a larger pool of such vehicles on the market (S, L, C).

Barriers addressed: B1, B6

A4. Provide perquisites such as free or convenient parking for AFVs in publically owned lots and/or metered spots. Provide access to HOV lanes where appropriate for AFVs. Also, collaborate with other jurisdictions to enable reciprocity in those perks (S, L).

Barriers addressed: B1, B5

A5. Consider subsidizing alternative fuel costs. For example, businesses could provide free electric vehicle charging for customers. Subsidies for other fuels could be provided at comparable subsidy levels to encourage a range of alternative fuels (S, L).

A6. **Barriers addressed: B16**

A7. Work actively to transition publicly owned fleets to AFVs as defined in Executive Order B-16-2012. State agencies have been active in this regard, targeting a 25% ZEV share of light duty vehicle purchases by 2020. Local agencies should follow suit; this will stimulate the local market for the vehicles and their fuels as well as increasing their visibility and familiarity in local communities. State funds, many of which are earmarked for economically disadvantaged communities, should be leveraged to bring down the cost associated with these purchases (S, L, C).

Barriers addressed: B5

A8. Initiate AFV phase-in for heavy-duty vehicles (e.g., >14,00lbs. GVWR) in the large and public fleets first to prove efficacy of alternative fuels in different applications and across fleet vehicle types. Then, performance data, reduced fuel costs, and emissions control compliance advantages can be communicated to smaller fleet operators.

Barriers addressed: B5

A9. Vehicle purchase incentives are currently after purchase rebates and tax breaks. Point-of-sale incentives have been found to be more effective and are recommended. In addition, income eligibility guidelines that can help improve the cost effectiveness of incentive programs are also recommended (S, L).

Barriers addressed: B1, B6

A10. Advocate for manufactures to offer a greater variety of vehicle types. One potential approach could be to collaboratively work with local governments, businesses, and fleets to identify needs, and voice a possible commitment of purchase should the vehicles become available (S, L, C).

Barriers addressed: B3

A11. Replace “least first-cost” procurement policies in public fleets with language that allows price flexibility, price preferences, life cycle costing, or other approach that considers benefits beyond initial price (S, L).

Barriers addressed: B1, B6

A12. Implement a “buy local” requirement, contingent on vehicle availability, for public fleets to encourage local dealerships to increase the availability of AFVs and relevant maintenance services (S, L).

Barriers addressed: B5

A13. Engage auto manufacturers in an effort to improve on existing on-board diagnostic code standards, and begin discussion around ways to address challenges associated with proprietary on-board software and the increased automation of vehicles (S).

Barriers addressed: B22

Fuel Distribution Infrastructure:

The majority of infrastructure-related recommendations are associated with EVCS. This is because the process of charging an EV deviates significantly from the traditional “gas station” model such that there are larger ranges of issues that need to be addressed to facilitate a robust EV market. The remaining recommendations that do not specifically address EVs are applicable across all AFs including electricity.

A14. Advocate for government funding for AF fueling infrastructure in Northwest California. Given the low population density and economic circumstances in the region, private markets may not provide for this infrastructure. However, its presence in the region would provide a public good, both to local residents and to others who may want to travel to Northwest CA, warranting government investment (L, C).

Barriers addressed: B2, B4, B8

A15. Collaborate with local electric utilities, local EVCS installers, and private companies to standardize the end-use customer interaction with EVCSs installed for public use, focusing on consistent payment methods and charger access (S, L, C).

Barriers addressed: B2, B4, B8, B11

A16. To ensure adequate geographic coverage, subsidize critically located but underutilized fueling stations (S, L).

Barriers addressed: B2, B4, B8

A17. Remove barriers to creation of AF infrastructure through fast-tracked permitting, consistent codes and standards, and waiver of key fees. Collaborate regionally on development of model permitting and zoning process to ease deployment of AF infrastructure. Seek support from state agencies, notably the Governor’s office. See Section 0 for more permitting and zoning actions (S, L).

Barriers addressed: B2, B4, B8, B9, B14

A18. Promote installation of EV charging infrastructure at targeted, high-impact locations where drivers spend significant time parked away from home (examples include workplaces and public transportation hubs) and in multi-family settings (L, C).

Barriers addressed: B2, B4, B8, B9

A19. Create incentives for businesses to install AF infrastructure, and lead by example by installing such equipment at public agency offices. For example, provide recognition as a

"green business" for businesses incorporating alternative transportation fuels into their operations (S, L, C).

Barriers addressed: B2, B4, B8

A20. Mandate that EVCS be installed at any significant new parking lot development, requiring at least one charger per set number of new parking stalls. Provide technical and/or procurement support to enable this. Mandating EVCS be available at multi-unit dwellings greatly expands the potential market for EVs. See Section 0 for more permitting and zoning actions (S, L).

Barriers addressed: B2, B4, B5, B8

A21. Collaborate intra- and inter-regionally on the installation of AF fueling infrastructure along major highway corridors, facilitating both intra- and inter-regional travel (L, C).

Barriers addressed: B2, B4, B8, B11

A22. Incentivize local public and private fleets to host fueling infrastructure that is accessible by the public (S, L, C).

Barriers addressed: B2, B4, B8

A23. Encourage PEV dealerships to offer package deals to single-family homeowners that include the installation of a residential PEV charger (S, L, C).

Barriers addressed: B2, B6, B9

A24. Offer incentives that help offset the cost of new AF equipment or the conversion of existing equipment to support AFs (S, L, C).

Barriers addressed: B5, B8, B9

A25. Mandate that any AF infrastructure built with public funds to be accessible to the public and be built to be compatible with as many vehicle types as possible. In the case of EVCS, require that it be built on the OCPP 2.0 standard. Encourage the same level of accessibility for privately funded AF infrastructure through incentives such as fast-tracked permitting and fee waivers. See Section 0 for more permitting and zoning actions (S, L).

Barriers addressed: B5, B8, B11

A26. Develop highly visible AF infrastructure markings and signage. An example is the Washington State requirement that EVCS spaces be identified with green pavement markings. Ensure that the presence of AF supply infrastructure is clearly marked along nearby traffic corridors. This involves collaboration among entities from local agencies to CalTrans and the Federal Highway Administration on development of consistent symbols and signage protocols to ensure driver awareness. Similar protocols would help make this infrastructure visible to the general public (S, L).

Barriers addressed: B5

Fuels:

A27. Where utilities are operated by local government entities, offer TOU pricing or other attractive EV rate schedules (L).

Barriers addressed: B5, B9

A28. Explore the possibility of localized production and distribution of alternative fuels and encourage feasible options through incentives, subsidies, or other mechanisms (S, L, C).

Barriers addressed: B12

A29. Establish a service that assists fuel sellers in claiming emissions credits from alternative fuel sales. This may incentivize an increase in AF availability as this additional funding stream could alleviate the potential additional costs or risks associated with providing alternative fuels. Consider also leveraging tools that assist fuel sellers and buyers in assessing additional social and environmental impacts and benefits of fuel feedstock sources. (S, L, C).

Barriers addressed: B12, B14, B15, B18

A30. Encourage biofuel policies that can mitigate feedstock supply risks (S, L).

Barriers addressed:B14, B15

A31. Encourage the use of renewable diesel fuels that have no blend wall limit thereby eliminating fuel compatibility issues with exiting diesel vehicles, equipment, and infrastructure (S, L, C).

Barriers addressed: B5, B13, B15

A32. Remove the unintended incentive for alternative fuel drivers associated with road usage fees that are not collected from fuels used to fuel AFVs. For example, work towards replacing the existing gas tax with a carbon tax, such as The Gas Tax Replacement Act of 2015 (H.R. 309), that can help bring all fuels, including petroleum based fuels, onto a level pricing playing field by internalizing environmental impacts. Note that attention should be paid to California's Road Usage Charge pilot program when considering this option (S, L).

Barriers addressed: B5, B7, B15, B18

A33. Actively support State and Federal efforts that address blend wall issues (S, L, C).

Barriers addressed: B13, B14, B15

Permitting and Zoning Changes

Amending zoning codes and streamlining the local permitting process presents an opportunity to proactively support and accelerate the deployment and use of alternative fuels. Permitting approaches should include all alternative fuels, all known alternative fuel use applications (e.g., both on-road and off-road), and be revisited periodically to include new technologies as they come online.

Streamline Permitting Processes

A34. Document, centralize, and make publically accessible the details about the permitting procedures for alternative fueling infrastructure for all jurisdictions in the region (C).

a. Address all agency questions so that they are comfortable with the technology before they even see an application (C).
b. Go to CalFire and ask what concerns they have well in advance (C)
c. Provide on-line and in-office resources explaining the process for permitting each type of alternative fuel dispensing or charging infrastructure at each individual city or county branch office (L).

d. Train planning and permitting department staff about the permitting process so they can explain it clearly to any entity seeking a permit (L).

Barriers addressed: B10

A35. Form a Uniform Code Committee where members of nearby cities and counties develop permitting and inspection guidelines intended to enhance regional consistency in application and enforcement of existing codes (L, C).

a. Encourage planning and permitting staff to contact their peers in neighboring cities with AF stations to see how they handled permitting (L).
b. Include input from transit agencies, fleet operators, utilities, planning departments and fuels providers (C).
c. Adopt clear local ordinances, permits, and procedures to minimize administrative burdens (L).
d. Standardize permitting and inspection fees for AF infrastructure (L).
e. Provide clearinghouse of permit process information and where to go to get more information (C).

Barriers addressed: B10

A36. Create template for local governments on existing codes and standards for permitting and inspection of AF infrastructure (S, C).

a. Provide standard forms that request all pieces of information that will be required by the different agencies with permitting oversight (S, L).
b. Establish reasonable permitting fees; the cost of the permit should cover the time necessary to issue the permit (including necessary plan checks), as well as the time to inspect the installation (L).

Barriers addressed: B10

A37. Leverage existing codes when drafting codes specific to alternative fuel stations (S, L, C).

a. All alternative fuel regulations, codes, and jurisdictions with enforcement authority in the state of California are listed in the “Cal/EPA Fuels Guidance Document, Version 1.0” (2011). This document contains information specific to every type of alternative fuel, contacts for each agency with oversight, and provides standards and requirements for fuel use, labeling, dispensing, vapor recovery and other aspects of AF use.
b. The most commonly used codes pertaining to AF infrastructure are:
    i. The California Building Standards Code, Title 24, California Code of Regulations (CCR),
    ii. Title 24, CCR, California Fire Code Chapter 43,
    iii. The National Fire Protection Association (NFPA) 52 Vehicular Gaseous Fuel Systems Code,
    iv. NFPA 70 National Electrical Code,
    v. NFPA 30A code for Motor Fuel Dispensing Facilities and Repair Garages,
    vi. NFPA 57, 59A codes for Liquefied Natural Gas Vehicular Fuel Systems,
    vii. NFPA 50A, 50B codes for Hydrogen Fuel,
    viii. The International Fire Code, and

ix. Health and Safety codes.

Barriers addressed: B10

A38. Make online and over-the-counter permitting available for basic AF installations and upgrades (L).

a. Establish a unique permit for installing each type of alternative fuel infrastructure; this will allow AF providers and fueling station developers to know exactly what is required to complete the permit process (L).

Barriers addressed: B10

A39. Consider the following recommendations for streamlining the permitting process of EV charging stations:

a. List EV charging as a permitted use across a broad range of zoning classifications. If a zoning review is triggered, consider EV charging infrastructure as an "accessory" to another permitted use whenever possible.

b. Allow for new EV charging infrastructure to be added to existing building permit / viewed as an additional "common utility" to existing permitted building (L).

c. Avoid requiring an electrician to be present during an EV charging infrastructure inspection (L).

d. Allow electricians to self-certify their installations using a standard checklist for inspecting EV charging installations (L).

e. Create an "EV charging station permit" even if it is the same permit needed to install a washing machine in garage, and put this permit application on the city or agency website (L).

f. Consider "bulk sticker" permitting for EV charging infrastructure with random inspection process (L).

Barriers addressed: B2, B4, B9, B10

A40. Allow for on-line or over-the-counter permits where applicable. This approach allows contractors to purchase permits online and follow the same inspection procedures as a regular permit.

Barriers addressed: B10

A41. Consider passing policy to wave requirements for other improvements for AF infrastructure upgrades at existing fueling facilities (L).

Barriers addressed: B10

A42. Develop fueling facility design standards (such as compressor noise abatement requirements) for gaseous fuels (S, L).

Barriers addressed: B10, B11

Land-Use and Zoning Recommendations

A43. Develop and/or amend codes that provide specific requirements for all types of alternative fueling stations (L).

a. Start with the most common AF fueling / charging applications (L).

b. Allow for flexibility in the zoning code; eliminate the need for new building permits for straightforward AF infrastructure (e.g., re-purposing an underground fuel tank to E-85 or Biodiesel) (L).
c. Allow flexibility in parking space requirements when the facility owner installs AF fueling / charging infrastructure (e.g., decrease the number of parking spaces required for a facility or increase the amount of retail space allowable per parking space) (L).

Barriers addressed: B2, B5, B8, B10

A44. Require new construction permits to have EV charging conduit and/or pre-wiring installed in all structures, meeting or exceeding CA building code. Even if EVCS isn't being installed at the outset, ensuring that necessary wiring, conduit and panel capacity are in place from the outset removes a barrier to later installation of chargers (S, L).

Barriers addressed: B2, B4, B8, B9

A45. Make sure there is sufficient land zoned to allow for new alternative fuel supply stations to be developed (L). For example, amend zoning codes to explicitly:
a. Allow alternative fueling infrastructure at existing gas stations, truck stops and corporation yards as these sites are already designed for large fuel truck ingress, egress, and turn-around, and already have ADA compliant features (L).
b. Encourage alternative fuel dispensing / charging equipment at existing gas station locations within one mile of any major transportation corridors (L).
c. Allow alternative fueling infrastructure in certain commercial and/or industrial zoned properties (L).
d. Allow compressed natural gas fueling stations where there is a viable gas supply line running along the property; permitting at these sites is more straightforward as natural gas is already there (L).

Barriers addressed: B2, B4, B8, B10

Safety, First Responder and Auto Support Industry Training

The following recommendations are categorized separately for first responder stakeholders, auto support industry stakeholders, and the general public.

Safety and First Responders

A46. Actively engage with first responder training material development organizations to encourage the creation and mandating of time-scalable alternative vehicle and fuel courses that can be implemented in a range of scenarios (for example from a one hour "awareness" course to a full 16 hour "train-a-trainer" course) (S).
a. Material development organizations include California Specialized Training Institute (CSTI), Peace Officer Standards and Training (POST), California Training Officers Association (CTOA), California State Fire Training, and National Fire Academy. Mandates through these organizations will increase level of local training.

Barriers addressed: B20

A47. Explore the potential for incorporating alternative fuel training material into existing mandated first responder courses by creating focus tracts where different personnel can

take the same course but with a different focus depending on an agency, department, or first responder's needs (S).

Barriers addressed: B20

A48. Identify an agency, State or local, that is capable of centralizing training material resources across all safety and first responder stakeholder groups (S, L).

Barriers addressed: B20

A49. Work with local OES chapters to coordinate and channel funding for training across safety and first responder stakeholder groups (S, L).

Barriers addressed: B20

A50. Treat alternative fuels trainings as "Perishable Skills" training in the near term since safety and first responder teams will likely not use many of the skills in the field in the near future. Encourage or require refresher courses when appropriate or needed (S, L).

Barriers addressed: B20

A51. Develop mechanism for first responders to easily identify different types of AF vehicles (L, C). For example, require a sticker or other identifying feature on alternative fuel vehicles.

Barriers addressed: B20

A52. Educate building officials and Fire Marshalls about the changes that are required for maintenance facilities that work on low-carbon fueled fleets – especially compressed gas vehicle maintenance. For example, address venting, doors, safety and sensor requirements (L, C).

Barriers addressed: B17, B20

A53. Communicate with all regulatory and safety agencies early in the permitting process of alternative fuel stations to address concerns and questions. Address all agency questions and concerns with supporting documentation and examples from other projects (L, C).

Barriers addressed: B20

A54. Train fire personnel to do inspections on alternative fuel storage and dispensing equipment; invite fire inspectors from a jurisdiction that already has the relevant infrastructure to participate in training and answer questions.

Barriers addressed: B17, B20

A55. Train safety and first responder stakeholder groups on safe fueling procedures for different types of low-carbon fuels.

Barriers addressed: B17, B20

Auto Support Industry Stakeholders

A56. Earmark and/or search for funding that provides training to dealership sales staff that addresses information gaps at the point of sale (S, L, C).

Barriers addressed: B5, B6, B16

A57. Promote trainings for contractors for AF station installations. Work with State and local officials to earmark funding to support these trainings (S, L, C).

Barriers addressed: B8, B9, B17

A58. Promote alternative fuel vehicle trainings for independent mechanics, towing companies, and salvage companies, perhaps through local community colleges, local auto parts suppliers, or private training companies or vocational centers (S, L, C).

Barriers addressed: B19, B21

A59. Bolster the training alternative fuel training capacity of local Community College Automotive Technology programs by funding the following:

a. Certification of instructors in existing automotive technology departments that results in their ability to offer certified courses on alternative fuel vehicles (S).
    i. Ensure that certification meets any accreditation requirements of the College. For example, Automotive Service Excellence (ASE) is a common certification pathway, and is required for a program to be accredited by the National Automotive Technicians Education Foundation (NATEF).
b. Integration of alternative fuel vehicle information into existing courses (S).
c. Development of separate courses devoted to alternative fuels when the level of demand is appropriate (S).

Barriers addressed: B19, B21

A60. Work with training and employment programs, such as the California Employment Development Department or the Siskiyou Training and Employment Program, to fill the gaps in local training needs (S, L, C).

Barriers addressed: B19, B21

A61. Explore ways to encourage auto manufacturers to offer trainings on their alternative fuel vehicles in the local region as trainings straight from the manufacturer are preferred by many industry groups (S, C).

Barriers addressed: B19, B21, B22

A62. Explore ways to create a local lending library of tools and technical manuals needed by mechanics. Cost is often the primary barrier to obtaining the necessary equipment and information for newer vehicles. This service could be useful to dealerships, independent auto mechanics, roadside assistance and salvage companies, and community colleges (S, C).

Barriers addressed: B19, B21, B22

Outreach and Promotion

The following recommendations relate to marketing, education, and outreach efforts targeted and key stakeholders as well as the general public.

A63. Promote the availability and marketing of AFVs regionally through outreach to and collaboration with dealerships. Collaborate with dealers in conducting outreach to the community through environmental and automotive events (S, L, C).

Barriers addressed: B5, B6

A64. Conduct and coordinate extensive AFV outreach and education campaigns in local communities throughout the region (S, L, C).

Barriers addressed: B4, B5, B6, B16

A65. Highlight dealerships that have taken innovative action or have had unusual success in promoting AFVs. Recognize them locally through local media or events and nominate them for statewide recognition. A contest for AFV sales over a season or a year might stimulate participation of dealers as well as media interest (S, L, C).

Barriers addressed: B5, B6

A66. Reach out to fleet owners/managers to encourage their uptake of AFVs through training, incentive programs, support and recognition. Encourage collaboration between dealers, fleet operators, and fueling infrastructure providers (S, L, C).

Barriers addressed: B5, B6

A67. Develop a biofuel education and outreach campaign that distinguishes the differences between first second generation biofuels, and promotes the benefits of second-generation biofuels. Consider the encouraging uptake of a biofuel certification program that distinguishes and promotes environmentally and socially responsible biofuels (S, L, C).

Barriers addressed: B5, B12, B14, B15, B18

A68. Facilitate biofuel trainings for fuel providers, fleet operators, and others using or providing biofuels that clearly addresses the proper storage, dispensing and use of biofuels (S, L, C).

Barriers addressed: B5, B6, B13, B15, B16, B17

A69. Develop a sustained education campaign that informs all sectors of the AF market about blend wall issues, and the do's and don'ts with flex-fuel vehicles and high percentage ethanol blends (S, L, C).

Barriers addressed: B5, B6, B13, B14, B15, B16, B17

A70. Employ the "Ladder of Engagement" at all city / county planning departments (L).

a. The basic level of engagement is awareness of existing AFs brochures and permitting information fact sheets; make sure all counter staff informed about alternative fuels information available (L, C).
b. The second level of engagement is to increase AF friendliness; create a dedicated permit form and a dedicated person(s) on staff that can answer questions (L).
c. The third level of engagement is to dedicate city staff time to go after prime installation sites and partners. The goal of this effort it so identify and market to owners of sites that are in AF-appropriate zones or already have appropriate use permits for AF infrastructure installations (e.g., gas stations, truck tops, corporation yards etc.) (L, C).
d. The fourth level of engagement is to partner on pilot programs, grant applications, and promotion activities to accelerate the deployment and use of alternative fuels (L, C).

Barriers addressed: B8, B10


Zero Emission

NEXT STEP: ESTABLISH A CLEAN CITIES COALITION

The project team identified the opportunity to leverage the framework and resources of the U.S. Department of Energy's Clean Cities Program[16] to move forward with alternative fuels readiness efforts in the region. The Clean Cities Program advances the nation's economic, environmental, and energy security by supporting local actions to reduce petroleum use in transportation. Clean Cities Coalitions:

- Provide a framework for businesses and governments to work together as a coalition to enhance markets.
- Coordinate activities, identify mutual interests, develop regional economic opportunities, and improve air quality.

The Clean Cities Program mission aligns well with the goals of the Northwest California Alternative Fuels Readiness Project, and the tools and support available through Clean Cities will add significant impact and effectiveness to regional efforts to accelerate the use of alternative fuels. To that end this readiness plan has been structured to both capture the strategic planning outcomes of the Northwest California Alternative Fuels Readiness, and meet the requirements of a regional Clean Cities Program Plan to allow designation as an official U.S. DOE Clean Cities Coalition. The Program Plan also sets the direction the Coalition will take during the next three years.

A draft of the Program Plan will be finalized and submitted for DOE review upon appointing a Coalition Coordinator. The DOE indicates that receiving official designation as a Clean Cities coalition is a multiyear process, with the following requirements:

- A clear organizational structure;
- An active network of stakeholders who meet regularly and have defined roles;
- A coordinator to lead the coalition;
- Reliable funding for the coordinator position;
- Specific, attainable goals and a strategic plan for achieving them;
- Strong partnerships with air-quality officials, energy officials, and other decision makers who control resources and help guide policy.

[16] https://cleancities.energy.gov/

Coalition Structure

The Clean City Coalition structure includes a Steering Committee, Working Groups, and a Coordinator.

Steering Committee

The Steering Committee will be comprised of a group of volunteer or elected stakeholders and will ensure that Coalition members cooperate in completing the shared vision and goals. The Steering Committee will also ensure that mechanisms are in place to get things done, and ensure equality in decision-making amongst competing interests. It will be the responsibility of the Steering Committee to:

- Write a Vision Statement for the Program Plan;
- Secure funding and formalize operations;
- Champion projects and communicate needs.

Working Groups

Coalition Working Groups are small groups of stakeholders that focus on specific initiatives to achieve important Coalition goals. Current working group initiatives are to assess the current marketplace, set goals and associated action steps, engage stakeholders, and develop training materials. Results and accomplishments to date are reported in the preceding sections.

Current Working Groups and their areas of focus:

- Strategic Planning: Legislation, vehicles and fleets, communication and outreach;
- Training Material: Education and training;
- Fuel Distribution: Alternative fuels and infrastructure;

Future Working Groups may include topics such as fundraising, idling reduction, media and Public Relations, and coalition membership.

Coordinator

The Clean Cities Coordinator is responsible for organizing the Coalition's activities and day-to-day operations. The Coalition stakeholders are responsible for choosing a host organization or hiring someone from the outside to take on a full-time or part-time role.

The DOE observes that coordinators often emerge from the original group of stakeholders, and in other cases the role is hired. Coordinators may be an employee in local government, non-profit, or the business sector. The most effective coalitions have dedicated full-time coordinators.

Stakeholders

Stakeholders are the key partners in the Coalition and are representatives of public, private, nonprofit, and academic sectors. On February 26, 2016 a network of regional stakeholders[17] hosted the North State Clean Cities Symposium in Eureka, CA, with simulcast to Redding and Ukiah. Attendees included representatives from Del Norte, Humboldt, Mendocino, Trinity, Shasta, and Siskiyou counties. The goals of the symposium were to:

- Identify a lead coalition to maintain momentum in current activities;
- Discuss what a Clean Cities coalition is and what it can do for our region;
- Receive an overview of local efforts to reduce petroleum use.

The overall participant consensus was positive, and various agencies showed a willingness to engage as stakeholders if a viable coordinator was identified. RCEA and SERC took an action to evaluate a viable coordinator role.

Given their ongoing leadership and mission focus to assess and promote alternative fuels in the North State region, RCEA and SERC plan to propose a partnership for the coordinator role. This provides both local government and technical capacity for the leadership role, and supports a long-standing partnership between the two agencies on regional efficiency and clean energy initiatives. The agencies are currently defining this model and will present it to the symposium participants in the spring of 2016, followed by a solicitation for stakeholder participation.

Goals, Action Steps, and Commitments

Proposed goals for a Northwest California Clean Cities Coalition would include:

- Goal 1: Increase the number of AFVs and hybrid-electric vehicles on the road each year. Pay particular attention to those classes of vehicles that can have the greatest impact on petroleum displacement.
- Goal 2: Increase the number of alternative fuel refueling or recharging stations in operation in the region.
- Goal 3: Recruit new stakeholders. Include specific fleets and stakeholders to be recruited, i.e., private fleets and local government fleets, and the recruitment strategy.
- Goal 4: Develop and promote incentives to increase the use of alternative fuels and vehicles and idle reduction technologies in the coalition area.
- Goal 5: Communicate to policymakers, fuel distributors, fleet managers, and the public. Include specific outreach activities, target audiences, and anticipated outcomes.
- Goal 6: Identify funding opportunities.
- Goal 7: Encourage efficient driving and maintenance practices, particularly from fleets.

[17] The collaborating bodies were RCEA, SERC, Mendocino Council of Governments, Northcoast Unified Air Quality Management District, and the Siskiyou Economic Development Council.

Note that meeting a goal of reduced emissions from the transportation sector can also be achieved through reduced VMT. A 10% reduction in fuel carbon intensity cannot be achieved this way, but a general 10% reduction from the transportation sector is possible. Furthermore, achieving a 10% reduction through reduced VMT could possibly be cheaper, in the same way that energy efficiency is considered the low hanging fruit for reduced electricity consumption. Reduced VMT likely does have a considerable upfront cost since significant VMT reduction will likely require political and social momentum for extensive changes in land use planning and zoning.

Monitoring Program

Progress toward achieving the Coalition's goals will be monitored by first determining anticipated outcomes and milestones, and then establishing metrics for measuring successes. Collaboration among the Stakeholders through the Working Groups will ensure that outcomes adequately and reasonably reflect the intentions of the goals, and can be divided into measureable and actionable items.

Outreach and education efforts will be tracked similarly by establishing metrics such as:

- Recording impressions during outreach events and presentations;
- Engagement time;
- Collateral distribution;
- Website analytics ;
- Requests for information.

Other examples of metrics include:

- Fleet analyses completed;
- Stakeholder commitments;
- Rulemaking outcomes ;
- Increased fuel or vehicle availability;
- Greenhouse gas emissions inventories.

Stakeholder Commitments

Forecasted commitments for the next 3 years:

Commitment	**Description**
Conduct Alternative Fuels Local Marketplace Survey (See the Clean Cities Designation Guide[18] for more details on key commitments).	Conduct a comprehensive stakeholder survey to assess the local marketplace to demonstrate a healthy regional market for AF and petroleum reduction. Document the number and type of AFVs and hybrids, the amount of alternative fuels used and produced, idle reduction technologies employed, and fuel economy measures taken.
Set goals and develop action steps.	Identify share of overall Clean Cities petroleum reduction goals and set local goals to meet target, currently projected at a 17% annual displacement of petroleum.
Prepare a draft 3-year strategic program plan.	Following results of stakeholder survey, create a strategic program plan to introduce the coalition, provide details of various roles and commitments, describe governance, discuss activities, and set 3-year goals.
Finalize the program plan with the DOE.	Work with the DOE to negotiate, revise, and finalize the program plan, which
Sign Stakeholder Memorandum of Understanding (MOU).	Once the DOE grants official designation, Stakeholders will formalize their Clean Cities program commitment by signing an MOU with each other.
Implement the program plan.	Maintain program participation through regular stakeholder meetings, launch of working groups, and engagement with other coalitions, DOE and their partners.
Respond to DOE data requests.	The DOE will issue periodic requests for data as they compile and track national metrics. This includes an annual Clean Cities questionnaire, and quarterly Alternative Fuels price reports.
Re-designate coalition after initial 3-year term.	Following successful program implementation, Stakeholders reviews commitments, goals and action steps, renews the MOU, and presents to the DOE.

In addition to the above Stakeholder commitments, the coalition will also need to:

[18] https://cleancities.energy.gov/files/pdfs/designation_guide.pdf

- Plan to sustain, expand, and diversify coalition membership:
    - Encourage stakeholder retention and active membership
    - Survey members on a regular basis for feedback and active participation
    - Evaluate and address gaps in membership – plan to ensure the coalition is well-rounded, with members from state and local governments, regional organizations, private sector fleets, nonprofits, and so on.
- Develop a Coordinator succession plan.
- Develop and manage operations, maintain records, conduct audits, and so on.
- Create a 3-year plan for Coordinator training and skill building.

Funding and Sustainability

Funding the Coordinator position and Coalition activities and initiatives to sustain efforts for three to five years and beyond may come from several avenues. Other Coalitions in California have opted to become non-profit organizations run entirely by volunteers; recruit sustaining partners; solicit sponsorships; or be incorporated into local government departments. The type of available Federal and State funding that has been identified will require the organization to be part of or in partnership with a local government agency. A local government agency will have the option of pursuing both public and private sector partnerships and donations as well.

Current Funding

RCEA and SERC have multiple active programs that align well with Clean Cities Program goals and can provide initial funding to launch a coalition. Some additional work will be required to achieve specific DOE goals and reporting requirements, which can be funded through RCEA general funds in a limited capacity.

Plug-in Electric Vehicle Readiness Plan Implementation
$361,250 - California Energy Commission, Alternative and Renewable Fuel and Vehicle Technology Program

California Assembly Bill 118 created the Alternative and Renewable Fuel and Vehicle Technology Program (ARFVT Program). The statute authorizes the California Energy Commission to develop and deploy alternative and renewable fuels and advanced transportation technologies to help attain the state's climate change policies. The Energy Commission has an annual program budget of about $100 million and provides financial support for projects that expand alternative fuel infrastructure, establish workforce training programs, conduct public education and promotion, and create technology centers, among other things. After completing the North Coast Plug-in Electric Vehicle Readiness Plan, RCEA received follow-up funding to implement measures to encourage PEV adoption, streamline permitting and inspection, and conduct public outreach and education.

Regional Charging Network Planning and Construction
$370,142 – California Energy Commission, ARFVT Program

The North Coast Electric Vehicle Charging Network project is implementing phase 1 of the regional public charging infrastructure requirements identified by the North Coast PEV

Readiness Plan. This project installed nine of the highest priority PEV charging sites as a first phase of establishing publically accessible electric vehicle charging network under a locally managed, public-agency owner/operator model with RCEA serving as the network administrator. In addition to infrastructure funding, the CEC has awarded RCEA a grant to implement other components of the North Coast PEV Plan, including public outreach, streamlining local government permitting and installation processes, as well as siting and design for phase 2 of infrastructure installations.

North Coast and Upstate Fuel Cell Vehicle Readiness Project
$187,000 – California Energy Commission, ARFVT Program

Fuel Cell Electric Vehicles (FCEVs) are a critical long-term solution for sustainable transportation objectives of rural communities due to community dependence on passenger vehicles as a result of intra-regional travel distances between communities, limited public transit services, and a lack of infrastructure for alternative transportation. The Fuel Cell EV Readiness Project builds upon the efforts of the Northwest California Alternative Fuels Readiness Project to create a coordinated effort throughout the region. The project will support the successful introduction of FCEVs, plan for the wise and effective deployment of hydrogen fueling infrastructure, and help catalyze a robust regional market for FCEVs. The project team will be working with regional stakeholders to develop a regional hydrogen infrastructure plan, promote FCEVs across the region, promote the incorporation of FCEVs into municipal fleets, and identify and evaluate sites for future hydrogen fueling stations.

Climate/Energy Planning
$50,000 - Redwood Coast Energy Watch, Strategic Energy Resources

RCEA partners with one of our regional utilities, Pacific Gas and Electric Company, to implement energy efficiency programs annually through the Redwood Coast Energy Watch program. The Energy Watch program also provides a range of planning and technical assistance to local governments and tribes with a focus on the nexus of climate and energy. With the passage of California Senate Bill 350, requiring electric utilities to invest in EV charging infrastructure and support EV adoption, there will likely be additional focus on electrifying the transportation sector in the near future, and working with local government partners to implement state goals.

Regional Analysis and Planning
$50,000 – North Coast Resource Partnership / Strategic Growth Council

RCEA, SERC, and others have been chosen to be part of a team of consultants, providing technical and planning assistance in several areas, including energy independence, climate change mitigation, GHG accounting, and model policy development, to support the development of a regional strategic plan. These areas will include broader transportation planning and policy development for the region, as well as identifying specific projects and programs to support locally-defined goals and objectives in collaboration with stakeholders. The work is being completed in phases and will culminate in strategies to enhance the economic, environmental, and community vitality of the region.

Near-Term Funding

California Energy Commission
RCEA is looking to secure additional grants for the implementation of PEV readiness planning specifically related to level 2 and level 3 electric vehicle charging. The Northwest California

region includes several key transportation corridors including Highway 101 and Interstate 5. These two corridors carry the vast majority of road travel between California and the greater northwest United States, and the California Energy Commission (CEC) is methodically releasing grant funds to build out charging infrastructure along major and interregional corridors.

For example, a CEC Grant Funding Opportunity[19] is currently open for Level 3 electric vehicle charging, which includes $1.05 million for the Highway 101 corridor from south of the Oregon border to Garberville, California, and $875,000 from Leggett to north of Santa Rosa. These chargers effectively fill the gap on the Electric Vehicle Highway between the San Francisco Bay Area and Oregon. This grant solicitation is expected to be awarded in the summer of 2016. In a report issued August 2015[20], it is worth noting that the North Coast Air District saw a 104% increase in rebates issued to PHEVs and ZEVs from the previous study year, ranking fourth out of 24 air districts, with Mendocino County ranking third. RCEA is eager to continue this adoption pace and maximize the value and benefits of CEC funded projects within our region.

Other Available Funding Opportunities

Caltrans, Sustainable Transportation Planning Grants
Caltrans provides funding for projects that focus on Strategic Partnerships, transportation planning, and studies of interregional significance in partnership with Caltrans. RCEA is in ongoing dialog with Caltrans District 1, based in Eureka CA, to seek collaborative opportunities to promote and advance sustainable transportation in our overlapping territories.

North Coast Resource Partnership / Strategic Growth Council, Continued Regional Analysis and Planning

Contracts for specific scopes of work related to energy independence, climate change mitigation, and model policy development will continue to be awarded to support the development of a regional strategic plan.

The California Cap and Trade program is a potential source of extensive funding in the transportation sector. As outlined in 2015-16 May revision of the Cap and Trade Expenditure Plan[21], the Governor's Executive Order B-30-15 established a GHG reduction target of 40% below 1990 levels by 2030. One of the Administrative policies to achieve this target is to "Reduce petroleum use in cars and trucks by up to 50 percent." The May Revision further states that "increased proceeds result in a total of $1.6 billion for clean transportation, mass transit and sustainable community development." The most realistic investment category for us to pursue is "Low Carbon Transportation", managed by the Air Resource Board. It will take time for these relatively new funding streams to propagate through the state, but may prove to be an essential recurring source of funds.

Local Laws and Incentives that Promote AFVs

Clean Vehicle Rebate Program
California offers rebates of up to $2,500 for the purchase of new battery electric and plug-in

[19] http://www.energy.ca.gov/contracts/GFO-15-603/

[20] http://www.energy.ca.gov/renewables/tracking_progress/documents/electric_vehicle.pdf

[21] http://www.ebudget.ca.gov/2015-16/pdf/Revised/BudgetSummary/CapandTradeExpenditurePlan.pdf

hybrid electric vehicles, neighborhood electric vehicles, and zero-emission motorcycles, and rebates of $5,000 for hydrogen fuel cell vehicles.

Financing Programs
There are also publically-backed financing programs for the installation of electric vehicle charging equipment at small businesses and multi-family residences in California. Additionally, Property Assessed Clean Energy (PACE) financing allows property owners to finance the purchase and installation of EVSE through a special tax assessment on their property.

Utility Discounts
Pacific Gas and Electric Company offers electric vehicle rate plans that are based on time-of-use and not tiered. This allows EV owners to add electricity usage at their homes without paying higher rates associated with the increased use.

High Occupancy Vehicle (HOV) Lane Exemptions
The Department of Motor Vehicles allows single-use of HOV lanes by qualifying alternative fuel vehicles, including battery electric, hydrogen fuel cell, and compressed natural gas vehicles.

Insurance Discounts
There are insurance providers that offer discounts on auto insurance policies for California drivers of alternative fuel vehicles.

Outreach and Education

The goal of the Coalition's outreach and education activities is to communicate the benefits of alternative fuels and vehicles to key demographics so that they will engage with Coalition initiatives.

Outreach Strategy

The overall outreach strategy involves four main steps:

Elicit Positive Reactions: Create and/or gather materials and tools that are visually appealing, easy to understand and use, impressive, and accurate. Present them in a way that motivates recipients to act, such as relaying a high probability of future satisfaction, easy to implement next steps, or a big payoff.

Educate to Change Attitudes: Address popular myths, provide outside and unbiased resources, and update information to reflect the latest science. Use this information to engage recipients to be champions for their organizations, thereby increasing their knowledge and skills through educating others.

Assist in Changing Behaviors: Decision-makers will be able to use the new information and consider alternative fuel options, change practices, and/or initiate new policies to guide future practices. The Coalition will be a resource to facilitate actions.

Publicize Results: Ultimately, long term changes and community-level impacts of the Coalition's efforts will include new policies to promote increased adoption of alternative fuels, more local alternative fuels choices, fleet adoption, and reduced greenhouse gas emissions. Publicizing these accomplishments will attract new stakeholders, reinvigorate efforts, and begin the four-step process all over again.

Target Audiences

The Coalition's target audience includes:

Fleet Managers: High-priority decisions makers and fleet operators in all sectors.

Fuel Distributors: This group includes combustible fuel distributors, as well as electric utilities and vehicle charging networks.

Dealerships: Vehicle sales representatives.

Government Agencies: Including councils and committees affecting policy decisions.

General Public: This audience includes consumers, business owners, academic institutions, and non-governmental organizations.

Support Services: Emergency services/first responders and auto industry services.

Outreach and Education Avenues

- Presentations
- Website
- Newsletter
- Working Groups
- Industry Meetings, Conferences
- Tabling, Radio, PSAs, Earned Media (news stories)

Acronyms

Alameda-Contra Costa Transit District (AC Transit)

Alternative Fuel (AF)

Alternative Fuel Vehicle (AFV)

Alternative and Renewable Fuels and Vehicle Technology Program (ARFVTP)

American Society for Testing and Materials (ASTM)

Americans with Disabilities Act (ADA)

Assembly Bill (AB)

Automotive Service Excellence (ASE)

Battery Electric Vehicle (BEV)

California Air Resources Board (CARB)

California Code of Regulations (CCR)

California Energy Commission (CEC)

California Environmental Quality Act (CEQA)

California Global Warming Solutions Act (CGWSA)

California Specialized Training Institute (CSTI)

California Training Officers Association (CTOA)

Circulation Element (CE)

Climate Action Plan (CAP)

Commission Agreement Manager (CAM)

Community Action Plan (CAP)

Community Plan (CP)

Community Services District (CSD)

Comprehensive Action Plan for Energy (CAPE)

Compressed Natural Gas (CNG)

Corporate Average Fuel Economy (CAFE)

County Planning Department (CPD)

Del Norte Local Transportation Commission (DNLTC)

Department of Transportation (DOT)

Diesel Particulate Filter (DPF)

Direct Current (DC)

Electric Vehicle (EV)

Electric Vehicle Charging Station (EVCS)

Emergency Medical Services (EMS)

Employment Training Panel (ETP)

Energy Element (EE)

Energy Policy Act (EPAct)

Extended Range Plug-In Hybrid Electric Vehicle (ER-PHEV)

First Responder Operations (FRO)

Fuel Cell Electric Vehicle (FCEV)

Fuel Cell Hybrid Vehicle (FCHV)

Gallons of Gasoline Equivalent (GGE)

General Plan (GP)

Greenhouse gas (GHG)

Gross Vehicle Weight Rating (GVWR)

Hazardous Materials (HAZMAT)

Heavy-Duty Vehicle (HDV)

High-Occupancy Vehicle (HOV)

Humboldt County Association of Governments (HCAOG)

Humboldt Transit Authority (HTA)

Hybrid Electric Vehicle (HEV)

Hydrogen/Natural Gas Blends (HCNG)

Hydrogenation-Derived Renewable Diesel (HDRD)

Internal Combustion Engine (ICE)

Light-Duty Vehicle (LDV)

Liquified Petroleum Gas (LPG)

Local Government Commission (LGC)

Low-Emission Vehicle (LEV)

Low Carbon Fuel Standard (LCFS)

Megajoule (MJ)

Memorandum of Understanding (MOU)

Mendocino Council of Governments (MCOG)

Metropolitan Planning Organizations (MPO)

Miles per Gallon (MPG)

National Automotive Parts Association (NAPA)

National Automotive Technicians Education Foundation (NATEF)

National Fire Academy (NFA)

National Fire Protection Association (NFPA)

National Highway Traffic Safety Administration (NHTSA)

National Renewable Energy Laboratory (NREL)

North Coast Unified Air Quality Management District (NCUAQMD)

Office of Emergency Services (OES)

On-Board Diagnostics (OBD)

Open Charge Point Protocol (OCPP)

Original Equipment Manufacturer (OEM)

Plug-In Electric Vehicle (PEV)

Plug-In Hybrid Electric Vehicle (PHEV)

Police Officers Standards and Training (POST)

Program Opportunity Notice (PON)

Property Assessed Clean Energy (PACE)

Redwood Coast Energy Authority (RCEA)

Regional Blueprint Planning (RBP)

Regional Readiness Plan (RRP)

Regional Transportation Plan (RTP)

Renewable Diesel (RD)

Schatz Energy Research Center (SERC)

Senate Bill (SB)

Siskiyou County Economic Development Council (SEDC)

Social Science Research Network (SSRN)

Strategic Plan (SP)

Sustainable Communities and Climate Protection Act (SCCPA)

Time-Of-Use (TOU)

Training Materials Working Group (TMWG)

Ultra Low Sulfur Diesel (ULSD)

United States Department of Energy (U.S. DOE)

United States Environmental Protection Agency (U.S. EPA)

Vehicle Miles Traveled (VMT)

Washington State Department of Transportation (WSDOT)

Zero Emission Vehicle (ZEV)

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