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**California Energy Commission
STAFF DRAFT REPORT**

**BENEFITS REPORT FOR THE
ALTERNATIVE AND RENEWABLE
FUEL AND VEHICLE TECHNOLOGY
PROGRAM**



CALIFORNIA
ENERGY COMMISSION

Edmund G. Brown, Jr., Governor

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PREFACE

Assembly Bill 118 (Núñez, Chapter 750, Statutes of 2007) created the Alternative and Renewable Fuel and Vehicle Technology Program. This statute, amended by Assembly Bill 109 (Núñez, Chapter 313, Statutes of 2008), authorizes the California Energy Commission to “develop and deploy innovative technologies that transform California’s fuel and vehicle types to help attain the state’s climate change policies.” The Energy Commission must accomplish this, in part, by funding projects that provide for “a measurable transition from the nearly exclusive use of petroleum fuels to a diverse portfolio of alternative fuels that meet petroleum reduction goals and alternative fuel use goals.”

Assembly Bill 109 also requires the Energy Commission to include an evaluation of the efforts funded by the Alternative and Renewable Fuel and Vehicle Technology Program as a part of the Energy Commission’s biennial Integrated Energy Policy Report. The evaluation must include a list of funded projects, their expected benefits and overall contributions toward promoting a transition to alternative fuels, key obstacles to meeting program goals, and recommendations for future actions. This report represents the first of such evaluations.

ABSTRACT

This report summarizes and evaluates the Alternative and Renewable Fuel and Vehicle Technology Program, as implemented by the California Energy Commission to date. The Energy Commission has prepared this report in support of the Integrated Energy Policy Report, in accordance with Assembly Bill 109 (Núñez, Chapter 313, Statutes of 2008). It includes a summary of the projects funded by the Program thus far, as well as the potential benefits of the fuels and vehicle types supported by those projects. The report relies upon a number of sources of information, including grant proposals, surveys of awardees, industry surveys, historic fuel and vehicle data, and proposed regulations. Since most of the funded projects have lead times for implementation, construction and operation, the projects are evaluated on a prospective basis. Key performance measurements will be measurable in future evaluative reports, once the projects have been in operation for an extended period of time.

Keywords: California Energy Commission, Alternative and Renewable Fuel and Vehicle Technology Program, alternative transportation fuels, electric drive, hydrogen, fuel cell vehicles, biofuels, biomethane, biodiesel, renewable diesel, diesel substitutes, ethanol, natural gas, propane, workforce training, clean jobs, program evaluation

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EXECUTIVE SUMMARY

In 2007, the Legislature passed Assembly Bill 118 (Nuñez, Chapter 750, Statutes of 2007), which created the Alternative and Renewable Fuel and Vehicle Technology Program (ARFVT Program) within the California Energy Commission. This program helps the state meet its goals in the transportation sector regarding greenhouse gas emission reductions, and other energy and economic goals. The transportation sector accounts for roughly 40 percent of California's greenhouse gas emissions, and depends on a single source (petroleum-based fuels) to meet more than 90 percent of its fuel demand. The Energy Commission administers the Alternative and Renewable Fuel and Vehicle Technology Program, providing funds and incentives for activities that will develop and deploy clean, efficient, and low-carbon alternative fuels and technologies.

The Legislature amended the statutes of Assembly Bill 118 in 2008 with Assembly Bill 109 (Nuñez, Chapter 313, Statutes of 2008). Among other changes, Assembly Bill 109 requires the Energy Commission to prepare "an evaluation of research, development, and deployment efforts funded by this chapter" every two years, in conjunction with the Energy Commission's Integrated Energy Policy Report. The evaluations must include a list of all funded projects, expected benefits from the projects, overall contributions of the projects toward a portfolio of clean fuels, and obstacles and recommendations. This *Benefits Report for the Alternative and Renewable Fuel and Vehicle Technology Program* represents the first of such evaluations.

To date, the Energy Commission has awarded \$197.4 million (with \$149.8 million under executed contracts) to 86 projects that will support the broader commercialization of clean, renewable fuels and advanced technology vehicles. The funding has supported a suite of fuel types, including electric drive, natural gas, propane, biomethane, ethanol, diesel substitutes, and hydrogen. The Energy Commission has funded activities at various points in each fuel's supply chain, considering the specific commercialization needs for these points. As a result, the funded projects include a broad range of projects, from feasibility studies for biofuel production projects, to pre-commercial demonstration of electric trucks, to deployment incentives for natural gas vehicles (Table ES-1). To date, the Energy Commission has leveraged approximately \$375.5 million in private, federal and other funds to further support these projects.

Table ES-1: Program Investments by Fuel Type and Activity

Fuel Type	Funding Activity	Amount (\$ millions)	# of Awards	Total (\$ millions)
[Electric Drive]	Charging Infrastructure	\$17.4	9.5	\$62.4
	Convert State Vehicles to Plug-in Hybrid Vehicles	\$0.6	1	
	Light-Duty Vehicle Rebates	\$2	1	
	Medium- and Heavy-Duty Vehicle Rebates	\$4	1	
	Medium- and Heavy-Duty Advanced Vehicle Demonstration	\$12.5	7	
	Manufacturing Facilities and Equipment	\$25.9	12	
Hydrogen	Public Fueling Stations	\$15.7	3	\$22.7
	Transit Project	\$3	1	
	Fuel Standards Development	\$4	1	
Natural Gas	Vehicle Deployment Incentives	\$23.1	3	\$30
	Medium- and Heavy-Duty Advanced Vehicle Demonstration	\$1.8	1	
	Fueling Infrastructure	\$5.1	7.5	
Propane	School Bus Incentives	\$1	1	\$1.3
	Non-Bus Vehicle Incentives	\$0.3	1	
Biofuels	Biomethane Production	\$35.3	9	\$64
	Diesel Substitutes Production	\$4.3	5	
	Advanced Ethanol and Gasoline Substitutes Production	\$5.4	3	
	Medium- and Heavy-Duty Advanced Vehicle Demonstration	\$2.7	1	
	Sustainability Research	\$1.5	1	
	California Ethanol Producers Incentive Program	\$6	1	
	E85 Fueling Stations	\$5	2	
	Upstream Biodiesel Infrastructure	\$3.9	3	
Workforce Training and Development	Workforce Training and Development	\$15	3	\$15
Program Support	Technical Assistance and Analysis	\$2	8	\$2
Total		\$197.4	86	\$197.4

Source: California Energy Commission.

The results of these investments will quickly become apparent in certain areas, such as alternative fuel vehicles and infrastructure. For example, the Energy Commission has funded an estimated 4,375 charging stations for electric drive vehicles. This represents about a 344 percent increase compared to 2009-2010 baseline levels. (Due in part to such measures, approximately 40 percent of all fully-electric Nissan Leafs and one-third of all plug-in hybrid electric Chevrolet Volts nationwide are now located in California.) Similarly, the funding of 85 E85 fueling stations

represents a 218 percent increase in the number of E85 fueling stations, and the funding of 11 hydrogen fueling stations represents a doubling of funded stations. The Energy Commission's incentives have increased the number of electric cars, electric trucks, and natural gas trucks by 3 percent, 11 percent, and 6 percent respectively.

The long term benefits are undetermined since the Energy Commission's investments are recent and many of the projects are still being constructed or demonstrated. This is particularly relevant for projects that focus on pre-commercial technologies and processes, since it may take additional years for the technologies and processes to reach commercial scale. This report assesses the benefits resulting from the fuels and vehicles supported by the Energy Commission's investments.

To estimate petroleum displacement, greenhouse gas emission reductions, and local air pollution reductions, the Energy Commission developed low case and high case scenarios to estimate the benefits associated with light-duty electric vehicles, light-duty fuel cell vehicles, medium- and heavy-duty natural gas trucks, and biofuel production. For light-duty electric vehicles, the low and high cases for petroleum displacement reflect estimates by the Plug-In Electric Vehicle Collaborative, including a scenario developed by the Air Resources Board for automakers to comply with the Zero Emission Vehicle regulation. The estimated petroleum displacement of light-duty fuel cell vehicles includes a high range based on automaker survey data and Air Resources Board regulatory estimates. The petroleum reduction low case from medium- and heavy-duty natural gas vehicles is based on an extrapolation of previous growth, while the high case also incorporates projects funded by the ARFVT Program that will expand the market for natural gas vehicles into the heaviest vehicle classes. Finally, petroleum reduction from biofuels is based solely on reported low case and high case estimates provided by the program's grant awardees.

Reductions in greenhouse gas emissions and air pollution rely on these low case and high case petroleum displacement estimates. The analysis calculates greenhouse gas emission reductions using carbon intensity values from the Air Resources Board's tables for the Low Carbon Fuel Standard. Local air pollution estimates are based on a consultant's previous report on transportation fuels' inputs, emissions, and impacts. Table ES-2 shows the anticipated petroleum displacement, greenhouse gas emission reductions (in carbon dioxide equivalents), and air pollution reductions associated with the fuels and technologies supported, in part, by the ARFVT Program.

Table ES-2: Summary of Anticipated Benefits by Supported Fuels and Technologies

	Petroleum Displacement (Million Gallons)	(Metric Tonnes)				
		GHG Reductions (CO₂e)	VOC	CO	NOx	PM10
Low Case	374.9	2,534,751	1,209.6	8,553	728.3	364.7
High Case	1,184.2	9,312,189	3,009	19,481	504.4	1,377

Source: California Energy Commission.

The Energy Commission has also set priorities to emphasize in-state economic development in implementing the ARFVT Program. Through agreements with other agencies, the Energy Commission has provided job training to more than 5,300 individuals. Additionally, according to surveys of grant awardees, these projects will result in more than 1,900 short-term jobs and nearly 3,500 long-term jobs. Recipients reported the highest numbers of jobs in the fields of manufacturing and construction, two of the fields hit hardest by the current recession.

In implementing the ARFVT Program, the Energy Commission has identified barriers to expediting disbursement of program funds. Changes to the number of applications received for project solicitations, and efforts to streamline projects' compliance with the California Environmental Quality Act, will reduce these challenges in the future.

The economic and environmental benefits resulting from the first round of ARFVT Program funding awards establish a good foundation and measurable progress toward achieving multiple state policy goals. Expected commercialization of the projects may take one to five years and varies in complexity. This supports a need to quantify ranges of potential success for the supported fuels and technologies. The ARFVT Program funding can help achieve a goal of sourcing 26 percent of California's total transportation fuel from alternative sources by 2022. By 2020, diesel and gasoline demand is expected to reach roughly 18 billion gallons per year; the ARFVT Program projects will support alternative fuels that can displace two to six percent of these 18 billion gallons by 2020. Additionally, fuels and technologies supported by ARFVT Program projects can also reduce greenhouse gas emissions, representing a one to four percent decrease in expected transportation (business as usual) emissions by 2020. Furthermore, the commercialization potential of California biofuel production plants funded by the ARFVT Program represents 15 percent to 77 percent of the capacity needed to achieve a *Bioenergy Action Plan* goal to produce 40 percent of expected California biofuel consumption from in-state sources by 2020.

The benefits also help fulfill or complement other state, regional and local laws, regulations and policy goals. Among many statewide programs, these include the Low Carbon Fuel Standard, Zero Emission Vehicle mandate, Clean Fuels Outlet regulations, local air district requirements and the Long Beach and Los Angeles Ports' Clean Air Action Plan.

CHAPTER 1:

Introduction

The California Legislature created the Alternative and Renewable Fuel and Vehicle Technology Program (ARFVT Program) in 2007 through Assembly Bill 118 (Núñez, Chapter 750, Statutes of 2007). The statute authorized the Energy Commission to develop and deploy alternative and renewable fuels and advanced transportation technologies to help attain the state's climate change policies. AB 118 also authorized the California Air Resources Board (ARB) to develop the Air Quality Improvement Program to support developing and deploying zero emission and reduced emission light duty vehicles and trucks.¹ The Energy Commission's ARFVT Program has a budget of about \$100 million annually, while the ARB's program has a budget of \$30 to \$40 million annually.

A primary goal of the ARFVT Program is to "...develop and deploy innovative technologies that transform California's fuel and vehicle types to help attain the state's climate change policies."² California's transportation sector represents a large and critical element of the state's economy and society, with more than 26 million registered vehicles and total annual fuel consumption of nearly 20 billion gallons. This sector accounts for nearly half of all energy consumed within the state and produces approximately 40 percent of the state's greenhouse gas (GHG) emissions.³ Petroleum-derived fuels account for 91 percent of all energy consumed within the transportation sector, and importing foreign-sourced petroleum is expected to increase, even under a "low-import" case.⁴ The shift from a petroleum-based transportation system to one featuring a suite of alternative, low carbon fuels and vehicles will take time. The ARFVT Program is just one of many regulatory and incentive tools the State of California is using to transition to a low carbon, sustainable transportation system.

Through the ARFVT Program, the Energy Commission provides incentives to develop and deploy clean, efficient, low-carbon alternative fuels and technologies projects that:

- Reduce California's use and dependence on petroleum transportation fuels and increase the use of alternative and renewable fuels and advanced vehicle technologies.
- Produce sustainable alternative and renewable low-carbon fuels in California.
- Expand alternative fueling infrastructure and fueling stations.

1 California Air Resources Board, *2010 Biennial Report to the Legislature on the AB 118 Air Quality Improvement Program*, January 2011, available at: <http://www.arb.ca.gov/research/apr/reports/january-2011-aqipprogram-report.pdf>

2 Health and Safety Code Section 44272(a)

3 California Energy Commission, *2007 Integrated Energy Policy Report*, CEC-100-2007-008-CMF.

4 California Energy Commission, *2009 Integrated Energy Policy Report*, CEC-100-2009-003-CMF.

- Improve the efficiency, performance and market viability of alternative light-, medium-, and heavy-duty vehicle technologies.
- Retrofit medium- and heavy-duty on-road and non-road vehicle fleets to alternative technologies or fuel use.
- Expand the alternative fueling infrastructure available to existing fleets, public transit, and transportation corridors.
- Establish workforce training programs and conduct public outreach on the benefits of alternative transportation fuels and vehicle technologies.

Program funding allocations for each funding cycle are determined by the Energy Commission through the *Investment Plans* in a public process that features a multi-stakeholder Advisory Committee and multiple public workshops. The Advisory Committee includes representatives from industry trade associations; academic institutes; non-governmental environmental; public health and alternative energy organizations; labor; and other State of California energy and environmental agencies.

The Legislature amended the Program statutes with Assembly Bill 109 (Núñez, Chapter 313, Statutes of 2008), that requires the Energy Commission to evaluate the efforts and benefits of the program every two years and report the findings in the biennial Integrated Energy Policy Report. This *Benefits Report* is the first evaluation, and includes:

- A list of projects funded by the Program.
- The expected benefits of the projects in terms of air quality, petroleum use reduction, greenhouse gas emissions reduction, technology advancement, and progress towards achieving these benefits.
- The overall contribution of the funded projects toward promoting a transition to a diverse portfolio of clean, alternative transportation fuels and reduced petroleum dependency in California.
- Key obstacles and challenges to meeting these goals identified through funded projects.
- Recommendations for future actions.

Report Structure

This *Benefits Report* is the first evaluation on the projects funded to date by the Program. It includes qualitative and quantitative estimates of reductions in petroleum use, greenhouse gas emissions and criteria emissions attributable to the Program, plus an estimate of the jobs created through project funding. While the Program has entered its fourth year of funding, this report focuses only on projects currently funded from the first three fiscal years (2008-09, 2009-2010, and 2010-2011).

Chapter 1 provides general, quantitative, program-level descriptions of the projects according to their primary fuel category and phase of commercialization. Chapter 2 describes advances in

select fueling infrastructure and vehicles between 2008, the baseline year for the Program, and 2011. Chapter 3 provides estimates of a range of total potential petroleum reductions, GHG emissions reductions, and urban air pollution reductions for each major fuel category – electric drive, natural gas, biofuels and hydrogen – between 2010 and 2020 that have been supported by ARFVT Program investments. The Energy Commission expects each project to be successful, and makes substantial and essential investments to achieve the successes. In most instances, the ARFVT Program accelerates progress in the development and use of alternative fuels and vehicles. The Energy Commission also acknowledges that other parties contribute investments (since most projects require comparable matching funds), and multiple sources are responsible for the benefits. These benefits are summarized in Table 1. Chapter 4 summarizes job creation and workforce training benefits to California that result from Program funding. The report concludes with a summary of the challenges to meeting Program goals, and recommendations for future actions. A full list of funded projects is provided in the Appendix.

Table 1: Summary of Anticipated Benefits for Fuels and Vehicles Supported by the ARFVT Program

	Low Case	High Case
Petroleum Fuel Displaced Per Year by 2020	375 Million Gallons	1.18 Billion Gallons
GHG Emission Reduction Per Year by 2020	2.5 Million Metric Tonnes	9.3 Million Metric Tonnes
Criteria Air Pollution Reduction Per Year by 2020	10,855 Metric Tonnes	24,371 Metric Tonnes
Non-ARFVT Program Funding Leveraged	\$375.5 Million	
Short-Term and Long-Term Jobs Created by Projects Funded by ARFVT Program	5,394	

Source: California Energy Commission.

CHAPTER 2:

Summary of Program Funding

The Energy Commission has developed and adopted three investment plans since 2008 that guide more than \$361 million in total awards for the first four fiscal years of the ARFVT Program. Using funds from this first investment plan (fiscal years 2008-09 and 2009-10), plus a portion of funds from the second investment plan (fiscal year 2010-2011), the Energy Commission funded 86 projects totaling \$197.4 million to date. Table 2 shows the amount of funding provided to date for each fuel type and major program category.

Table 2: Funding Allocations by Fuel Type and Category (In Millions)

Fuel Type	Funded to Date	Remaining From Second Investment Plan	Allocations from Third Investment Plan	Total
Electric Drive	\$62.4	\$9.9	\$26*	\$98.3*
Hydrogen	\$22.7	\$10.2	\$8.5	\$41.4
Natural Gas	\$30	\$3.1	\$20	\$53.1
Propane	\$1.3	\$2.4	\$4.5	\$8.2
Biofuels	\$64	\$21.9	\$29	\$114.9
Innovative Fuels and Technologies	-	\$6.3	\$3	\$9.3
Workforce Training and Development	\$15	\$8	\$6.5	\$22.3
Program Support	\$2	\$9.4	\$2.5	\$13.9
Total	\$197.4	\$64	\$100.0	\$361.4

Source: California Energy Commission.

*Includes \$8 million for demonstration of medium- and heavy-duty vehicles of all fuel types, and \$10 million for manufacturing facilities and equipment of all fuel types.

Currently only the projects for \$197.4 have been funded, and will be the focus of this first *Benefits Report for the ARFVT Program*. The specific funding activities for each of the fuel types and major program categories are provided in Table 3.

It is also important to distinguish Program investments in alternative fuels and vehicle technologies along a continuum between the research phase and the point at which new technologies are introduced into commercial markets. The ARFVT Program emphasizes projects in the demonstration and commercial deployment phases of technology development, but a number of vehicle and fuels projects in the feasibility and development phases have also been funded. Approximately 65 percent of Program investments to date (totaling \$128.9 million) have been allocated to commercial deployment and production projects, while pre-commercial demonstration, research and development, and other fuel support projects have received about 26 percent of Program funding. The remaining nine percent has gone toward clean transportation workforce development and other projects to support the ARFVT Program.

Table 3: Program Investments by Fuel Type and Activity

Fuel Type	Funding Activity	Amount (\$ millions)	# of Awards	Total (\$ millions)
Electric Drive	Charging Infrastructure	\$17.4	9.5	\$62.4
	Convert State Vehicles to Plug-in Hybrid Vehicles	\$0.6	1	
	Light-Duty Vehicle Rebates	\$2	1	
	Medium- and Heavy-Duty Vehicle Rebates	\$4	1	
	Medium- and Heavy-Duty Advanced Vehicle Demonstration	\$12.5	7	
	Manufacturing Facilities and Equipment	\$25.9	12	
Hydrogen	Public Fueling Stations	\$15.7	3	\$22.7
	Transit Project	\$3	1	
	Fuel Standards Development	\$4	1	
Natural Gas	Vehicle Deployment Incentives	\$23.1	3	\$30
	Medium- and Heavy-Duty Advanced Vehicle Demonstration	\$1.8	1	
	Fueling Infrastructure	\$5.1	7.5	
Propane	School Bus Incentives	\$1	1	\$1.3
	Non-Bus Vehicle Incentives	\$0.3	1	
Biofuels	Biomethane Production	\$35.3	9	\$64
	Diesel Substitutes Production	\$4.3	5	
	Advanced Ethanol and Gasoline Substitutes Production	\$5.4	3	
	Medium- and Heavy-Duty Advanced Vehicle Demonstration	\$2.7	1	
	Sustainability Research	\$1.5	1	
	California Ethanol Producers Incentive Program	\$6	1	
	E85 Fueling Stations	\$5	2	
	Upstream Biodiesel Infrastructure	\$3.9	3	
Workforce Training and Development	Workforce Training and Development	\$15	3	\$15
Program Support	Technical Assistance and Analysis	\$2	8	\$2
Total		\$197.4	86	\$197.4

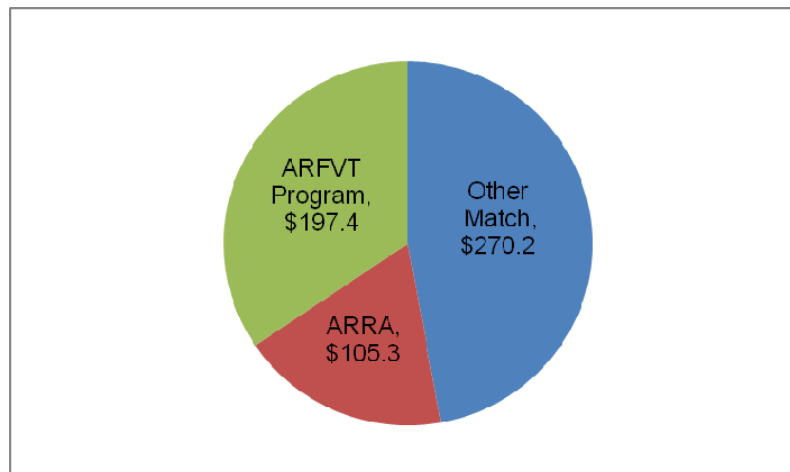
Source: California Energy Commission.

Table 4: Program Investments by Fuel Type and Commercialization Phase (in Millions)

	Commercial Deployment or Production	Pre-Commercial Demonstration	Development	Feasibility	Fuel Support	Total
Electric Drive	\$47.8	\$13.6	\$1	\$0	\$0	\$62.4
Biofuels	\$32.8	\$16.9	\$7.1	\$5.7	\$1.5	\$64
Natural Gas	\$28.3	\$1.8	\$0	\$0	\$0	\$30
Propane	\$1.3	\$0	\$0	\$0	\$0	\$1.3
Hydrogen	\$18.7	\$0	\$0	\$0	\$4.0	\$22.7
Workforce Development						\$15
Program Support						\$2
Totals	\$128.9	\$32.3	\$8.1	\$5.7	\$5.5	\$197.4

Source: California Energy Commission.

The AB 118 legislation directs the Energy Commission to leverage state public investments with private financing and other public funding sources (Figure 1). Outside contributions to the 86 projects funded are approximately \$375.5 million. So far, the largest public funds leveraged by the Program have been the federal dollars available through the American Reinvestment and Recovery Act (ARRA) of 2009. The ARFVT Program funded nine projects totaling \$36.5 million that received a total of \$105.3 in ARRA funding. California's Air Quality Management Districts (AQMDs) have also partnered in funding projects supported by the Program, especially the South Coast, Bay Area, San Diego and San Joaquin Valley AQMDs.

Figure 1: Project Funding Sources (In Millions)

Source: California Energy Commission.

CHAPTER 3:

Changes in Alternative Fueling Infrastructure and Vehicles, 2008-2011

As articulated in the ARFVT Program investment plans, the Energy Commission's strategy for allocating the ARFVT Program's funding has been to:

1. Help establish the infrastructure foundations for alternative vehicle fueling by focusing on electric drive, hydrogen, natural gas, and E85 retail fueling outlets and biodiesel wholesale fueling terminals. Early establishment of alternative fueling networks signals California's commitment to the long-term transition to alternative fueled and powered vehicles, which should in turn boost early market sales of alternative vehicles in California.
2. Accelerate shifts in medium and heavy duty truck fleets from diesel to natural gas fueling to leverage truck manufacturer's development of natural gas engines across multiple models, weight classes and duty cycles. Diesel-fueled trucks account for disproportionate amounts of fuel consumption, and GHG and criteria emissions. Program investments in this relatively small sector are being used to close the purchase pricing gap between diesel and natural gas-fueled trucks to demonstrate the commercial viability of alternative fueling for fleet applications.
3. Provide funding for feasibility studies, demonstrations and commercial production of biofuels in order to spur development of next generation biofuels suitable for California production.

The growth of key alternative fuel vehicle and infrastructure sectors are an early indicator that California's fuel and vehicle markets are shifting towards alternative and renewable fuels and advanced vehicle technologies. Although still in its early years, the ARFVT Program is playing an important role in accelerating this progress by meeting some of the initial strategic program goals (as indicated in Table 5). California now has the largest networks of electric vehicle charging systems and hydrogen fueling stations in the country.

Table 5: ARFVT Program Funding Impact on Alternative Fueling Stations and Alternative Vehicle Deployment in California

	Fuel Area	Existing 2009-2010 Baseline Levels	Additions from ARFVT Program Funding	Percent Increase
Alternative Fueling Infrastructure	Electric	1,270 charging stations	4,375 charging stations (public and residential) ⁵	344%
	E85	39 fueling stations	85 fueling stations	218%
	Natural Gas	443 fueling stations	20 stations	5%
	Hydrogen	6 public fueling stations ⁶ (plus 5 more under construction)	11 fueling stations	100%
Alternative Fuel Vehicles	Electric Cars	13,268	379	3%
	Electric Trucks	1,409	160	11%
	Natural Gas Trucks	13,995	898	6%

Source: Extrapolated from 2009 DMV data, plus actual deployment data. Electric truck and natural gas trucks extrapolated from 2009 data.

Public funding from the ARFVT Program and US Department of Energy's ARRA program will increase the number of electric charging stations more than three-fold in California from 1,270 in 2010 to nearly 5,645 in 2011. California has emerged as a national leader in advancing electric drive vehicles through its funding support for charging stations with 25 percent of the total nationwide.⁷ In just two years, the number of freeway legal plug-in electric vehicles has doubled in California to an estimated 13,268 vehicles. The ARB's Clean Vehicle Rebate Program (CVRP) has provided funding support in the form of vouchers of up to \$5,000 to help spur sales of 2,236 electric drive light duty passenger vehicles over the past two years. The ARFVT Program provided an additional \$2 million to CVRP, which helped fund 379 electric vehicles in 2011. There are now roughly 2,800 fully-electric Nissan Leafs and 1,300 plug-in hybrid electric Chevrolet Volts in California, roughly 40 percent and 33 percent respectively of these vehicles nationwide.

The Energy Commission also provided \$4 million in Program funds to the ARB's Air Quality Improvement Program Hybrid Truck and Bus Voucher Incentive Project in order to create incentive funding for 160 medium-duty electric trucks, primarily from Electric Vehicles International and Smith Electric Vehicles.

Public funding from the ARVFT Program and the Air Resources Board will double the number of commercially available retail hydrogen fueling stations in California to support the pending deployment of fuel cell vehicles. Program funding of \$15.7 million supports developing eight new hydrogen fueling stations and upgrading three existing stations. When completed, the Energy Commission-funded stations will account for 73 percent of the state's total hydrogen

5 Based on project estimates for all electric vehicle supply equipment funded with ARFVT Program or match funds.

6 Based on Energy Commission and ARB staff estimates. Public accessibility of these stations may vary.

7 U.S. Department of Energy, Oak Ridge National Laboratory, Transportation Energy Data Book, 30th Edition.

fueling capacity on a volumetric basis. The Energy Commission has also allocated an additional \$18.7 million for retail hydrogen stations for fiscal years 2010 to 2012. This public funding of hydrogen fueling stations makes California a national leader in its support of fuel cell vehicles.⁸

Similarly, ARFVT Program funding of E85 retail fueling stations has helped triple the number of stations for flex fueled vehicles that can operate on ethanol by adding 85 new stations to the existing fleet of 39.

Natural gas fueled-vehicles and fueling stations represent a more commercially established market than electric drive and fuel cell vehicles. Accordingly, the \$5.7 million in ARFVT Program funding allocated to natural gas fueling stations will add 20 stations to an existing fleet of 443 stations. On the vehicle side, the medium- and heavy-duty natural gas truck fleet totaled about 11,000 vehicles in 2009. To date, \$24.2 million in ARFVT Program funding has helped fleet operators add 898 natural gas-fueled trucks in California, increasing the number of such vehicles by over six percent. Demand for natural gas-fueled trucks in the medium duty and heavy duty vehicle classes is increasing rapidly as fleet operators realize the potential for fueling and operations savings and emissions reductions available by switching to this fuel and vehicle platform.

8 U.S. Department of Energy, Alternative Fuels and Advanced Vehicles Data Center, "Alternative Fueling Station Total Counts by State and Fuel Type," http://www.afdc.energy.gov/afdc/fuels/stations_counts.html.

CHAPTER 4:

Estimated Petroleum, GHG, and Air Pollution Reduction Benefits From ARFVT Program Investments

California's shift to a transportation system that is less dependent on petroleum fuels and more reliant on a suite of lower carbon alternative fuels and vehicles will take time and require substantial investments from the private and public sectors. This shift is being driven largely by state and federal policies and regulations that address air quality, energy security, and GHG emissions. The ARFVT Program investments to date of \$197.4 million will produce tangible benefits over time, but it is a modest investment compared to the billions of dollars that vehicle manufacturers and fuel producers are investing in next generation electric and fuel cell vehicles, natural gas-fueled trucks, and sustainable, low-carbon biofuels. Individual consumers and private and public fleet operators will need to make personal or business-related economic and environmental decisions as to when they will invest in alternative fuels and alternative fuel vehicles. However, ARFVT Program funds can be critical to spurring such investments.

Methods and Analytic Approach

The ARFVT Program is in its initial phase, and most of the funded projects have only begun their construction or implementation. Accordingly, the following series of analyses illustrate a low- and high-range of potential petroleum reduction and GHG emissions benefits resulting from initial ARFVT Program investments in electric drive, natural gas, biofuels, and fuel cell vehicles for the period from 2010 to 2020. The low-range scenarios are intended to illustrate challenging market and technology conditions and continued high initial incremental costs for emerging alternative fuels and vehicles when compared to petroleum-based fuels and vehicles. The high range scenarios are intended to illustrate optimal market conditions, a robust regulatory framework that obligates market participants to consume or fund low-carbon fuel and vehicles, higher costs for petroleum-based fuels, and continuing reductions in production and retail costs for alternative fuels and vehicles.

Estimates of petroleum displacement (and the accompanying alternative fuel use) for each fuel type are calculated first. The resulting GHG and urban air pollution reductions are subsequently calculated based on petroleum displacement. Carbon intensities used to calculate GHG emission reductions are based on data from the Low Carbon Fuel Standard (LCFS) when possible, but are adjusted as described when necessary.⁹ Criteria air pollutant reductions are based on a previous analysis provided by TIAX LLC of alternative fuel urban emissions, including volatile organic compounds (VOC), carbon monoxide (CO), oxides of nitrogen (NOx), and particulate matter of ten micron diameter (PM10).¹⁰

9 California Air Resources Board, "Proposed Changes to the LCFS Lookup Tables, As of February 24, 2011", http://www.arb.ca.gov/fuels/lcfs/010611lcfs_lutables.pdf

10 TIAX LLC. 2007. *Full Fuel Cycle Assessment: Well-to-Wheels Energy Inputs, Emissions, and Water Impacts*. California Energy Commission. CEC-600-2007-004-REV.

Data for the analyses comes directly from ARFVT Program awardees, vehicle manufacturer surveys, ARB staff, and published reports. The analyses for electric drive and fuel cell vehicles are based primarily on vehicle deployment forecasts and surveys developed by industry or third-party stakeholders. The analyses for biofuels are based primarily on information provided by Program awardees, regarding both their immediate expectations and their plans for expansion. The analysis for natural gas is based on a combination of these methods.

The Energy Commission cannot and does not claim exclusive responsibility for the full extent of the potential benefits in these technology categories. These analyses are intended to show how the range of investments from the ARFVT Program will contribute to the commercialization and market acceptance of next generation vehicles and fuels. The Energy Commission acknowledges that other parties are essential as partners, and the successes should also be partially attributed to and shared with them.

Electric Drive Vehicles – Estimated Benefits

The increased deployment of plug-in electric vehicles (PEVs) in California will improve air quality by reducing criteria pollutants, address climate change by reducing GHG emissions, advance energy security by reducing dependence on petroleum, and stimulate the California economy by providing a new industry and jobs. PEVs can help major vehicle manufacturers achieve ARB's Zero Emissions Vehicle (ZEV) regulation mandate and California's mandated GHG and petroleum reduction goals. The Energy Commission's \$62.4 million investments in PEVs has helped address many of the challenges to PEV deployment identified by industry, such as the need for early investments in fueling infrastructure, vehicle demonstrations, vehicle purchase incentives, and manufacturing. These investments will help enable the PEV market to overcome these challenges, and accelerate vehicle deployment. Some investments will result in immediate petroleum and GHG reduction benefits, while others will not be realized for many years. The Energy Commission's strategic goal is to provide a wide array of funding to help foster a dynamic market that will result in large numbers of electric vehicles being developed, manufactured and purchased by private and commercial consumers in California.

To estimate the potential range of petroleum and GHG reductions resulting from PEVs, high and low PEV deployment projections have been developed through 2020. These scenarios are based on the California Plug-in Electric Vehicle Collaborative's estimated range of 500,000 to 1,000,000 PEVs on the road in California.¹¹ The Collaborative developed this range with input from automakers, and in consideration of the ARB's ZEV regulation.¹² The 2020 high case is likely to reflect circumstances in which upfront PEV costs are lower, PEV batteries are cheaper, gasoline prices are higher, consumers are comfortable switching to new vehicle technologies,

11 California Plug-In Electric Vehicle Collaborative, "Taking Charge: Establishing California Leadership in the Plug-In Electric Vehicle Marketplace," http://www.evcollaborative.org/evcpev123/wp-content/uploads/2010/07/Taking_Charge_final2.pdf.

12 Based on phone conversation with Joshua Cunningham, Plug-in Electric Vehicle Collaborative, November 29, 2011.

and vehicle charging infrastructure is streamlined and readily available. Through the ARFVT Program, the Energy Commission has aggressively targeted its investments toward ensuring the latter, while also providing minor support toward reducing vehicle costs and improving battery technology and manufacturing. Accordingly, while future PEV populations are not directly attributable to the ARFVT Program's investments, the Program's investments will be critical to the vehicles' market success. ARFVT Program investments also support the growing investment of venture capital into California's PEV industry and related industries. According to Next 10, California benefited from roughly \$840 million in venture capital investment into PEVs and related industries in 2010. This represents approximately 60 percent of all venture capital investment into this area worldwide.¹³

For this analysis, the projected PEV population is separated into two categories: battery electric vehicles (BEVs) which rely entirely on batteries, and plug-in hybrid electric vehicles (PHEVs) which utilize both electricity and gasoline. The Plug-in Electric Vehicle Collaborative's scenarios do not distinguish between these vehicle types when projecting their range of PEVs. However, using the ARB's prediction of the likely compliance scenario for the ZEV mandate, the PEV population will consist of approximately 26 percent BEVs and 74 percent PHEVs by 2020.¹⁴

Figures 2 and 3 show the resulting high case and low case vehicle deployment for BEVs and PHEVs, based on the Plug-in Electric Collaborative's projections of vehicles and the ARB's expected split between BEVs and PHEVs. Three other trendlines are also shown for comparison. The ARB's estimated ZEV mandate compliance scenario is provided, along with a hypothetical scenario for BEVs and PHEVs developed by the ARB as part of the LCFS regulation.¹⁵ Both of these scenarios fall roughly between the low case and high case. The historic growth rate of conventional hybrid electric vehicles (such as the Prius) is also shown, as an example of the rate at which a different advanced technology has been accepted into the market.¹⁶

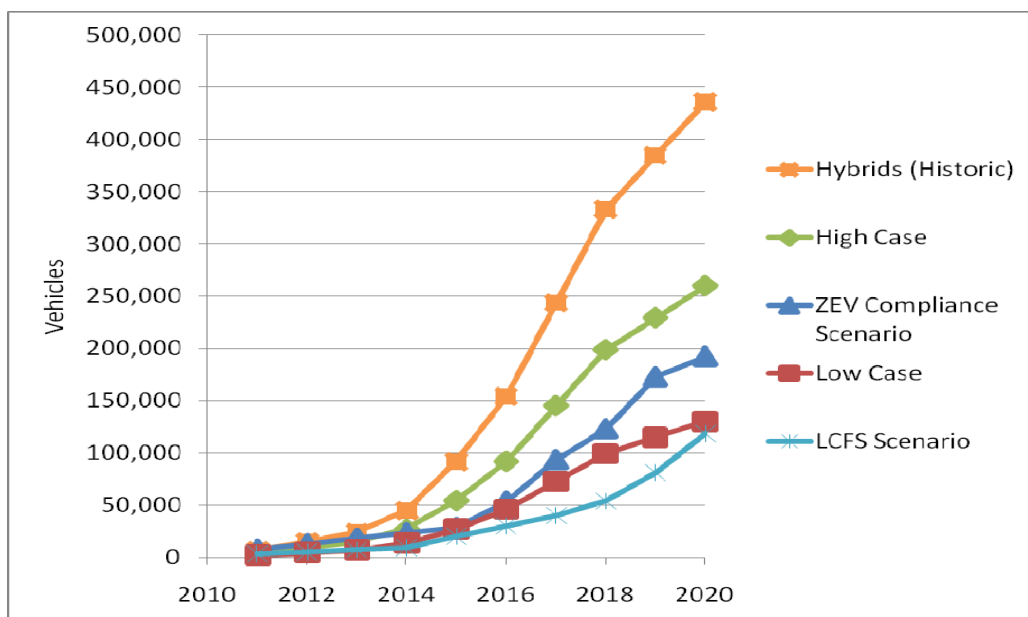
¹³ Next 10, *Powering Innovation: California is Leading the Shift to Electric Vehicles From R&D to Early Adoption*, December 2011, http://next10.org/next10/pdf/EV%20Report_2011_final.pdf.

¹⁴ Air Resources Board, "ZEV Regulation 2010: Staff Proposal," http://www.arb.ca.gov/msprog/zevprog/2011zevreg/11_16_10pres.pdf

¹⁵ Air Resources Board, "Summary of Draft Illustrative Scenarios," <http://www.arb.ca.gov/fuels/lcfs/workgroups/advisorypanel/20111117%20Summary%20of%20Illustrative%20Scenarios.pdf>

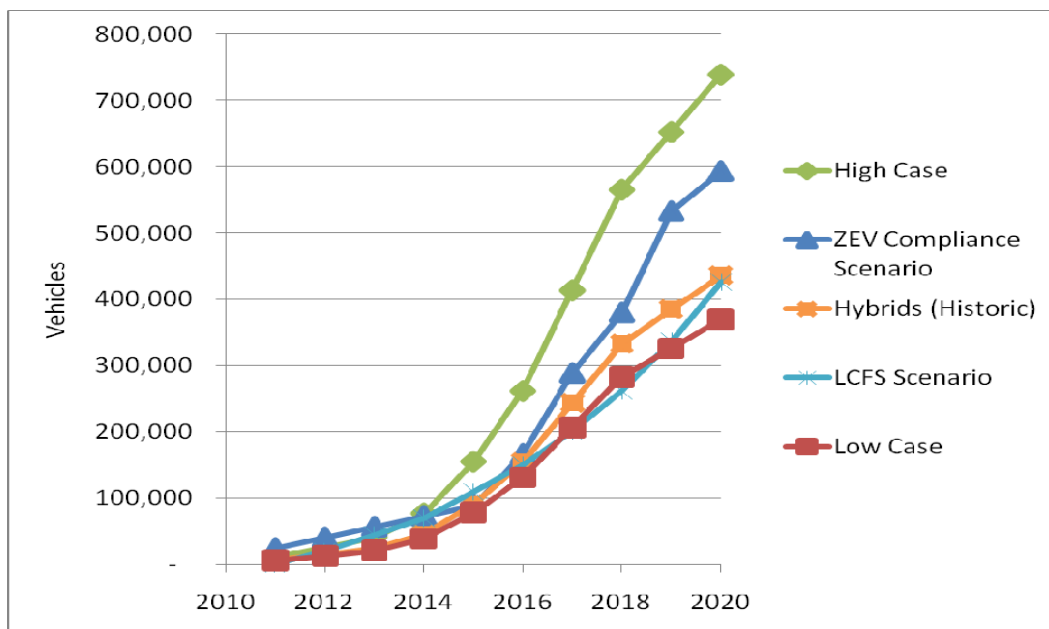
¹⁶ The Energy Commission has also conducted a separate analysis of consumer survey data, which suggested roughly 40,000 BEVs and 2.8 million PHEVs on the road by 2020. The analysis is included in the *Transportation Energy Forecasts and Analyses for the 2011 Integrated Energy Policy Report*. See Schremp, Gordon, Malachi Weng-Gutierrez, Ryan Eggers, Aniss Bahreinian, Jesse Gage, Ysbrand van der Werf, Gerald Zipay, Bob McBride, Laura Lawson, Gary Yowell. 2011. *Transportation Energy Forecasts and Analyses for the 2011 Integrated Energy Policy Report*. California Energy Commission. CEC-600-2011-007-SD.)

Figure 2: Estimated Light-Duty BEVs



Source: California Plug-in Electric Collaborative, California Air Resources Board, California Energy Commission.

Figure 3: Estimated Light-Duty PHEVs



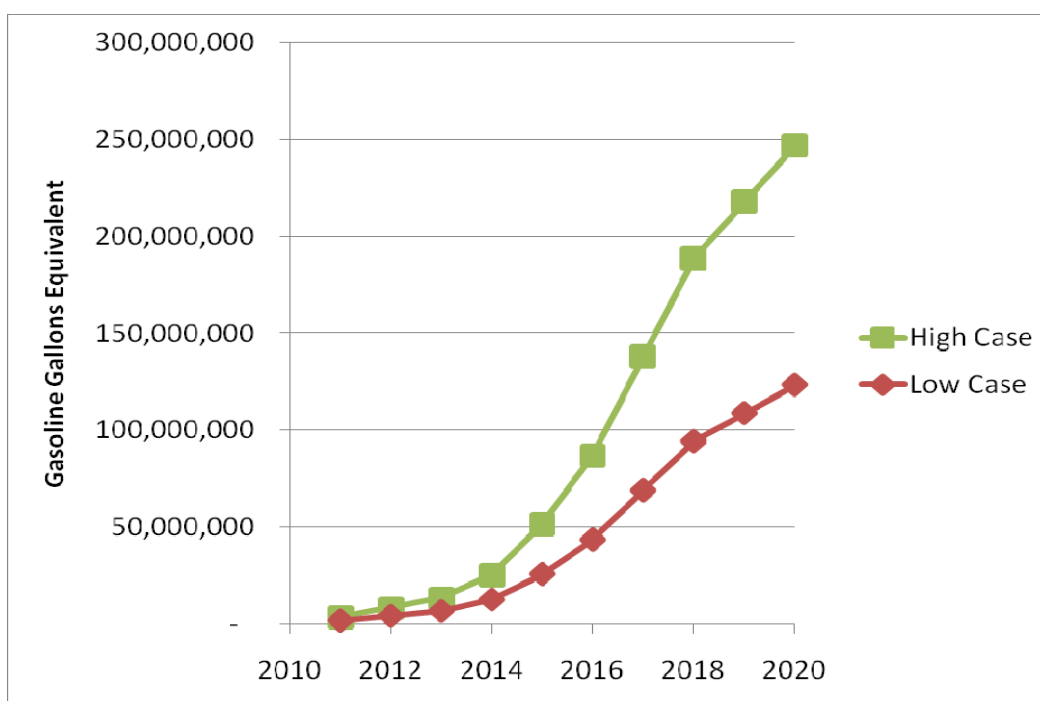
Source: California Plug-in Electric Collaborative, California Air Resources Board, California Energy Commission.

Based on BEV and PHEV deployment projections, it is possible to estimate the petroleum displacement from these vehicles. PHEVs are assumed to travel 12,000 miles per year, with roughly 36 percent of miles driven on electricity (without gasoline). Assuming a PHEV replaces a vehicle normally traveling 22 miles per gallon, this results in a petroleum displacement of 196 gallons of gasoline per year, per vehicle. In contrast, BEVs are assumed to drive 8,600 miles per

year (due to the lower vehicle range), and displace a vehicle that normally travels 22 miles per gallon. Thus, the estimated petroleum reduction for BEVs is 391 gallons per year, per vehicle.

Figure 4 shows the anticipated potential petroleum reductions resulting from all PEVs. By 2020, potential petroleum reduction benefits could range from a low case of 123.4 million gallons to a high case of 246.7 million gallons for the year 2020.

Figure 4: Annual Petroleum Displacement from PEVs (in Gasoline Gallons Equivalent)



Source: California Energy Commission.

Based on these estimates of petroleum displacement, the GHG emission and criteria pollution reductions for PEVs can be calculated. GHG emissions are based on the LCFS “marginal electricity mix” pathway, which equals 104.7 grams of carbon dioxide-equivalent per megajoule (gCO_{2e}/MJ), compared to 95.9 gCO_{2e}/MJ for California gasoline. An energy efficiency ratio of 2.6:1 was subsequently applied for the electric portions of BEVs and PHEVs, to account for the greater efficiency of the vehicle compared to a conventional light-duty engine. As a result, each gallon of gasoline displaced by electricity leads to a 58 percent reduction in GHG emission reductions. The resulting potential annual emission reductions in CO_{2e} and urban criteria pollutants by 2020 are shown in Table 6.

Table 6: Emission Reductions From Light-Duty PEVs by 2020

	Petroleum Reductions (Million Gallons)	(Metric Tonnes)				
		GHG (CO₂e)	VOC	CO	NOx	PM10
Low Case	123.4	795,371	947.1	7,788.3	670.3	320.2
High Case	246.7	1,590,742	1,894.2	15,576.6	1,340.6	640.4

Source: California Energy Commission.

To help PEVs reach these vehicle counts, the ARFVT Program has invested in a broad variety of activities to support the commercialization of both light-duty and medium- and heavy-duty PEVs. A summary of the number of these activities and the Program funding for these activities, sorted by project type, is presented in Table 7.

Table 7: Summary of ARFVT Program Investments in Electric Drive Technologies

Technology Type	Research, Development and Demonstration		Manufacturing		Deployment	
	Funding (in Millions)	# of Projects	Funding (in Millions)	# of Projects	Funding (in Millions)	# of Projects
Charging Infrastructure	-		\$1.1	1	\$17.4	9.5
Light-Duty PEVs	-		\$2.1	1	\$2.6	2
Medium- and Heavy-Duty PEVs	\$9.8	4	\$9.1	4	\$4	1
Medium- and Heavy-Duty Hybrid Electric Vehicles	\$1.9	2	-		-	
Medium- and Heavy-Duty Hydraulic Hybrid Vehicles	\$0.8	1	-		-	
Batteries	\$1	1	\$9.9	2	-	
Other Vehicle Components	-		\$2.8	3	-	
Total	\$13.5	8	\$24.9	11	\$24.0	12.5

Source: California Energy Commission.

Biofuels Production – Estimated Benefits

Increasing the use of low-carbon, sustainably-produced biofuels will help California achieve state and federal policy goals for GHG reduction, petroleum reduction and biofuel use. For air quality purposes, California requires approximately 1.6 billion gallons per year to satisfy the oxygenate blendstock requirements for reformulated gasoline. At present, corn-derived ethanol is the only biofuel commercially available at industrial scales to meet this need. Through the ARFVT Program, the Energy Commission is investing heavily in companies that are developing low-carbon biofuels from waste-based biomass resources or alternative feedstocks that reflect lower GHG emissions, lower environmental impacts, and better land-use choices. The U.S. Department of Energy's *Report on the First Quadrennial Technology Review* underscores the

importance of government funding in spurring advancements in low-carbon biofuels.¹⁷ Confirmed annual volumes of in-state, waste-based resources have the technical potential to be converted into 2.1 billion gallons of diesel gallon equivalent or 3.1 billion gallons of gasoline gallon equivalent each year.^{18,19}

The \$64 million allocated to biofuels production, fueling infrastructure, and related projects represent just over one third of total ARFVT Program awards for the initial funding years. Program funding for the development and production of biomethane, diesel substitutes, and gasoline substitutes (including advanced ethanol) totals \$44.9 million across 17 projects. All 17 projects in these categories use waste-based feedstocks, or alternative bioenergy crops to corn and soy. This analysis estimates the high and low ranges of biofuels production for the 17 ARFVT Program projects funded to date. The high and low estimates come directly from the successful grant proposals, as well as follow up surveys and interviews with each company or public agency. Low cases rely on the specific projects funded by the ARFVT Program. High cases rely on the expansion of the fuel conversion technology into further use in California. The difference between the two is likely to be affected by the success of the conversion technologies, the implementation of policies that support the production and use of low-carbon biofuels, and the market price of conventional petroleum fuels. New state and federal regulatory requirements, such as the LCFS, the Renewable Fuel Standard, and cap-and-trade systems, will ultimately determine the market viability of next-generation biofuels within California.

The ARFVT Program provided the majority of biofuel production funding, \$35.3 million, to advance the production of biomethane through nine projects. All of these biomethane production projects use waste streams such as woody biomass, agricultural or dairy residues, wastewater treatment plant residues, pre-landfill diverted municipal solid waste, or landfill gas. Biomethane from waste-based resources has the lowest carbon intensity value of any biofuel currently produced at commercial scale in California, about 85 percent below the petroleum baseline. Biomethane can be readily used in natural gas-fueled trucks, or as an input to the production of renewable hydrogen, renewable electricity, or other alternative fuels. As policies and regulations begin to incentivize lower carbon-intensity fuels, the incorporation of biomethane will further support the deployment of natural gas vehicles and fuel cell vehicles.

Estimates of annual fuel production from the nine biomethane projects funded by the ARFVT Program range from a low case of 100.7 million diesel gallons equivalent by 2020 to a high case

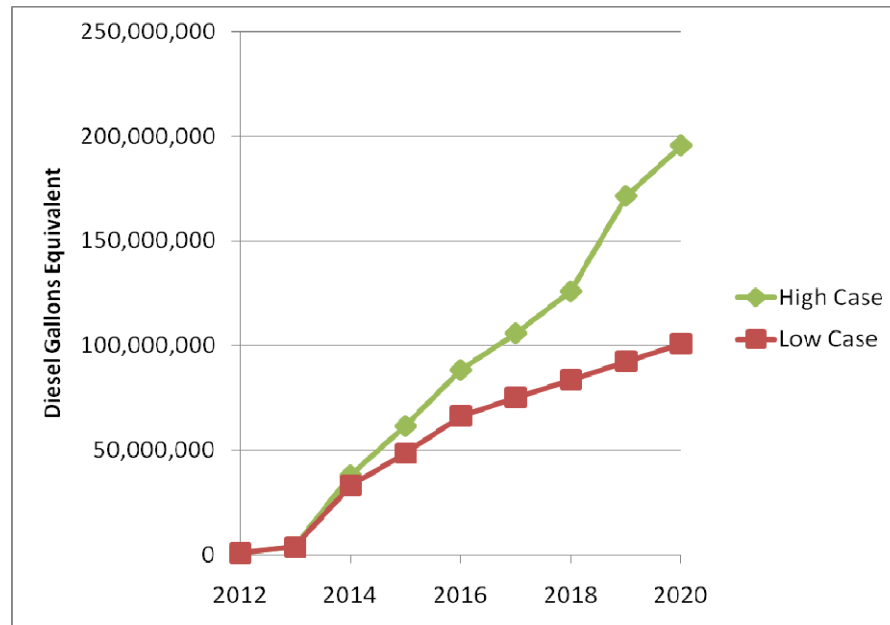
17 U.S. Department of Energy, *Report on the First Quadrennial Technology Review*, September 2011, http://energy.gov/sites/prod/files/QTR_report.pdf.

18 Smith, Charles, Miles Roberts, Jim McKinney. 2011. 2011-2012 Investment Plan for the Alternative and Renewable Fuel and Vehicle Technology Program Commission Report. California Energy Commission, Fuels and Transportation Division. Publication Number: CEC-600-2011-006-CMF. See Table 21.

19 Based on data from the California Biomass Collaborative at UC Davis, the Energy Commission estimates that biomass waste-based feedstocks in California have the potential to displace up to 3.1 billion gallons of gasoline per year, or 2.7 billion gallons of diesel fuel. Currently, California consumes about 16 billion gallons of gasoline and 4 billion gallons of diesel fuel annually.

of 195.5 million diesel gallons equivalent by 2020. The annual estimated growth of this production is shown in Figure 5.

Figure 5: Anticipated Biomethane Production From ARFVT Program Projects (in Diesel Gallons Equivalent)



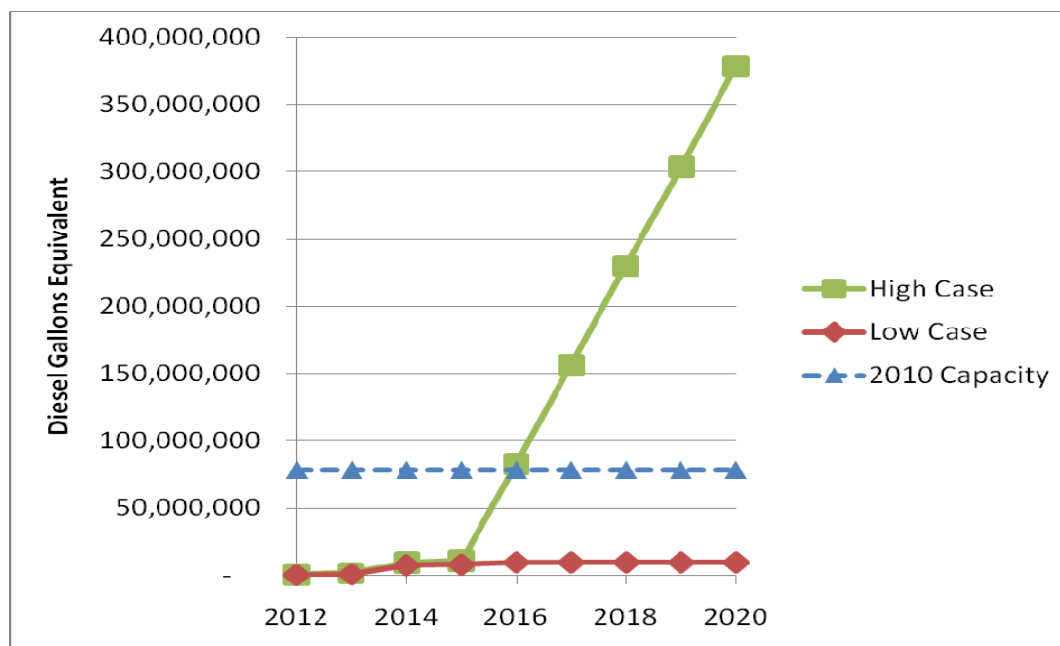
Source: California Energy Commission.

The ARFVT Program also made five awards totaling \$4.3 million to promote the production of diesel substitutes. These include four conversion technologies that will produce renewable diesel (or renewable oils that can be distilled into renewable diesel), which can directly displace conventional diesel in vehicles. The fifth project will produce biodiesel, which can be blended with conventional diesel at rates specified by vehicle manufacturers (often 5 – 40 percent). These five projects use a mix of waste-based feedstocks (such as dairy waste and fats, oils and greases) and algae to produce the fuel.

The low and high cases for these five awardees' fuel production are shown in Figure 6. The total fuel production from these projects (and the awardees' possible expansions) ranges from 9.4 million gallons to 378.1 million gallons of diesel gallons equivalent by 2020. This difference between the low case and high case is significantly greater than it is for biomethane production. There are several possible explanations for this, any of which might (or might not) apply to each funding recipient. The low case generally consists of the initial project funded by the ARFVT Program, which is typically a small-scale, pilot project. The high case is based on awardees' estimates of how their biofuel production technology could be expanded to utilize a greater share of specific waste streams. Additionally, as with other biofuel projects, the utilization of these projects will be heavily dependent on the relative price of conventional diesel and the implementation of functional carbon markets in California. The dramatic growth of diesel substitutes production following 2015 represents the reported shift of several funding recipients from precommercial work into commercial-scale production. For comparison, the in-state biodiesel production capacity in 2010 was approximately 78 million diesel gallons equivalent

per year, but less than 10 million gallons was actually produced.²⁰ The projects funded by the ARFVT Program represent additional production, beyond the existing capacity of 78 million gallons per year.

Figure 6: Anticipated Diesel Substitutes Production From ARFVT Program Projects (in Diesel Gallons Equivalent)



Source: California Energy Commission.

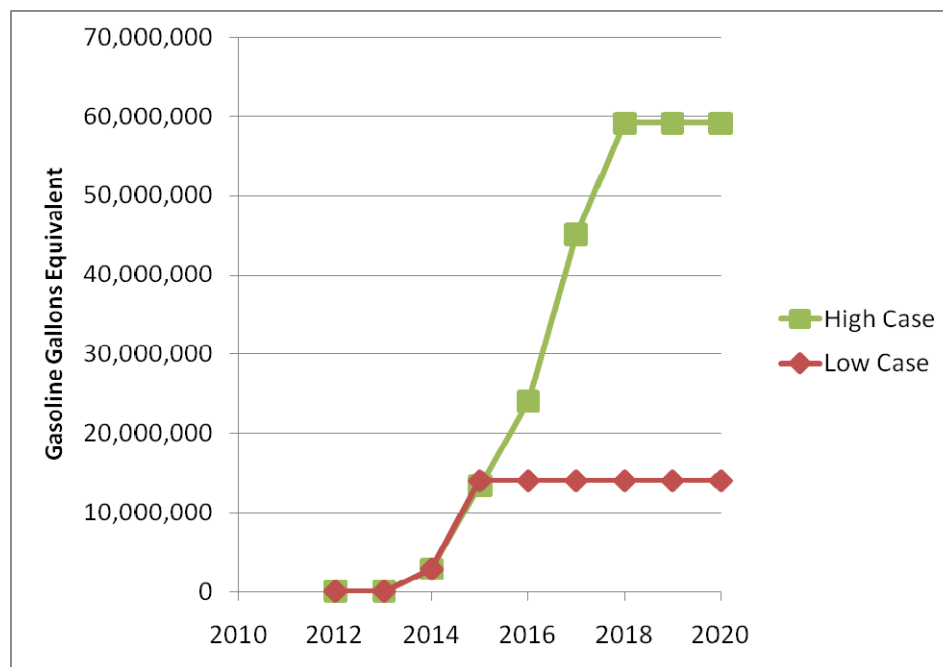
To further support the expansion of diesel substitutes, the Energy Commission has also provided \$3.9 million in ARFVT Program funding for biodiesel fuel infrastructure. Among these projects, one will be capable of blending and distributing up to 75 million gallons of biodiesel per year to the Northern California area. Depending on the market demand for biodiesel, as well as the relative infrastructure needs of renewable diesel, similar infrastructure investments may be necessary to meet state and federal biofuel and GHG emission reduction targets.

The ARFVT Program has provided \$5.4 million for three ethanol production projects. These investments include the state's first cellulosic ethanol pilot production facility using agricultural waste feedstocks, the first commercial feasibility evaluation of sweet sorghum as a potential bioenergy crop, and an important feasibility evaluation of sugar beets coupled with agricultural residues to produce a carbon neutral mix of ethanol and biomethane. Sweet sorghum and sugar beets have high potential as bioenergy crops in California because they can be grown on marginal or saline-contaminated soils, have low water requirements relative to corn, cotton or alfalfa, and have extremely low GHG scores of roughly 80-85 percent below the petroleum baseline.

²⁰ California Energy Commission, *2011-2012 Investment Plan for the Alternative and Renewable Fuel and Vehicle Technology Program*, Publication Number: CEC-600-2011-006-CMF.

Figure 7 shows the estimated low and high cases for ethanol production from these ethanol production projects. Much like the estimates for diesel substitutes production, there is a significant gap between the low case and high case. Again, this is partially attributable to both the small-scale nature of the initial projects (for the low case), and the possible expansion of the conversion technology to utilize a greater share of the particular feedstock (for the high case). By 2020, annual ethanol production from these projects is roughly 13.9 million gasoline gallons equivalent in the low case, and 59.2 million gasoline gallons equivalent in the high case. As with diesel substitutes production, the rapid growth of ethanol production following 2015 represents the shift of several funding recipients from precommercial work into commercial-scale production. In comparison, the in-state ethanol production capacity in 2010 was roughly 166 million gasoline gallons equivalent per year (with roughly 118 million gasoline gallons equivalent online.)

Figure 7: Anticipated Ethanol Production From ARFVT Program Projects (in Gasoline Gallons Equivalent)



Source: California Energy Commission.

To support existing in-state ethanol production facilities, the ARFVT Program provided \$6 million to establish the California Ethanol Producers Incentive Program (CEPIP). The CEPIP was designed to provide funds to support continued operation of the facilities when market conditions would otherwise have halted production. These funds would be repayable during favorable market conditions. Additionally, participants would be required to meet certain carbon reduction targets (whether by improving operational efficiency or by converting to a lower-carbon feedstock). However, markets proved very challenging for conventional corn-based ethanol, and the Energy Commission has decided to suspend additional funding for the CEPIP.

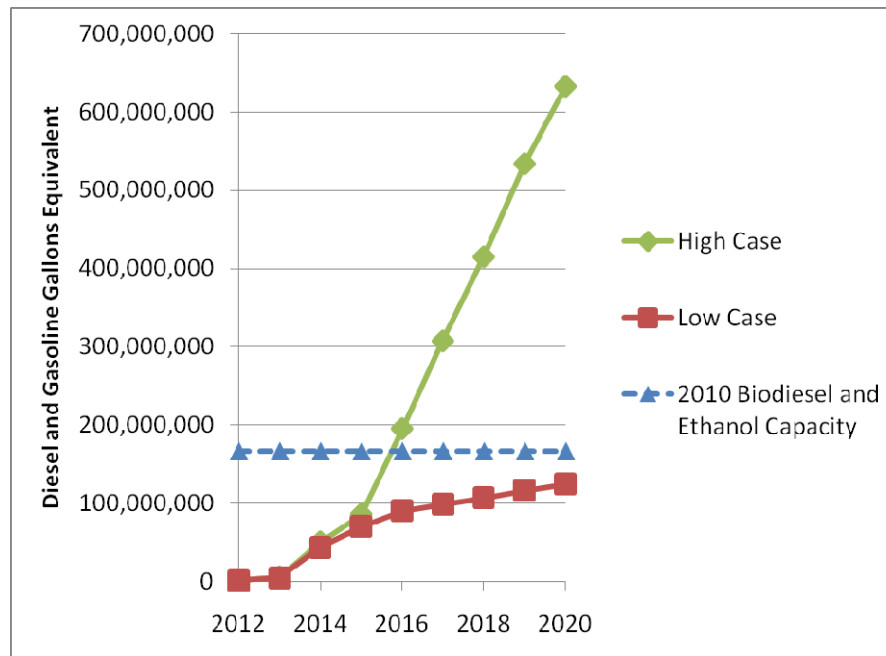
In its administration of the ARFVT Program, the Energy Commission will continue to prioritize the production of ethanol (and other biofuels) from non-conventional and waste-based feedstocks. In the future, state and federal policies and regulations will need to provide adequate market incentives to ensure the continued operation and expansion of new ethanol production projects funded under the ARFVT Program. Once a value is attached to carbon reductions, there will also be incentives for existing in-state ethanol producers to continue fuel production, while also reducing the carbon intensity of their product.

The in-state production of low-carbon, sustainably-derived ethanol will allow for a more desirable form of ethanol to be blended into California's gasoline supply. However, given a blending limit of roughly 10 percent (which might increase to 15 percent) of ethanol in gasoline, additional steps should be considered for the use of ethanol at higher rates. Toward this end, the Energy Commission has also provided \$5 million to support the installation of 85 additional E85 stations, which are capable of blending a fuel consisting of 85 percent ethanol and 15 percent gasoline.

The total estimated biofuel production from ARFVT Program projects is presented in Figure 8. This represents the sum of the biomethane, diesel substitutes, and ethanol production projects mentioned previously. To avoid the possibility of double-counting, it does not account for biofuel dispensed via the biofuel infrastructure projects funded by the ARFVT Program. By 2020, the low case represents the displacement of 124.1 million gallons of petroleum-based fuel, while the high case represents the displacement of 632.8 million gallons of petroleum-based fuel.²¹ Figure 8 also shows the 2010 capacity of in-state biodiesel and ethanol producers for comparison in diesel gallons equivalent and gasoline gallons equivalent, respectively. The projects funded by the ARFVT Program will represent additional capacity beyond the existing 2010 production capacity.

21 This measurement combines the gasoline gallons equivalent displaced by ethanol as well as the diesel gallons equivalent displaced by diesel substitutes and biomethane.

Figure 8: Anticipated Total Biofuel Production From ARFVT Program Projects



Source: California Energy Commission.

Based on these estimates of petroleum displacement, the GHG emission and criteria pollution reductions for biofuel production supported by the ARFVT Program can be calculated. GHG emissions are based on the LCFS pathways, with adjustments (when necessary) to reflect the actual mix feedstocks and fuel conversion processes. The carbon intensity assumptions are described in Table 8.

Table 8: Descriptions and Estimates of GHG Emissions for Biofuel Production Projects

Fuel	Description of GHG Emission Estimates	GHG Emission Estimates (gCO ₂ e/MJ)
Gasoline	(Displaced by ethanol)	95.9
Diesel	(Displaced by biomethane and diesel substitutes)	94.7
Biomethane	Based on LCFS values for landfill and dairy gas feedstocks.	12.0
Diesel Substitutes	Based on LCFS values for non-soy, waste-based feedstocks for biodiesel and renewable diesel.	15.0
Ethanol	Based on applicants' supplied values for agricultural waste feedstocks, domestic sugar beet feedstocks, and sweet sorghum.	25.0

Source: Air Resources Board Low Carbon Fuel Standard lookup tables; California Energy Commission.

Unlike electric drive projects, no energy efficiency ratio is applied for these projects, due to the similarity of engines using biofuel and engines using conventional fuel. The resulting annual emission reductions in CO₂e and urban criteria pollutants by 2020 are shown in Table 9.

Table 9: Annual Emission Reductions From Biofuel Production Projects by 2020

	Petroleum Reductions (Million Gallons)	(Metric Tonnes)				
		GHG (CO₂e)	VOC	CO	NOx	PM10
Low Case	124.1	1,326,694	94.3	94.5	-12.8	17.7
High Case	632.8	6,682,472	582.6	1,144.7	-1,092.8	631.8

Source: California Energy Commission.

Medium- and Heavy-Duty Natural Gas Vehicles – Estimated Benefits

The medium- and heavy-duty transportation sector represents a prime opportunity for the development and rollout of alternative fuel vehicles. The fleet of such trucks totaled about 916,000 in 2009, about 3 percent of the state's total vehicle fleet, yet they account for about 16 percent of total fuel consumption and GHG emissions. Natural gas vehicles are an attractive alternative to medium and heavy-duty fleet owners and operators, who have concerns with the cost of diesel fuel resulting from price volatility and the economic downturn, as well as compliance with air quality standards. Additionally, natural gas vehicles have been shown to have GHG reductions of between 11 and 16 percent compared to their diesel counterparts. If using waste-derived biomethane instead of conventional natural gas, however, these vehicles can achieve GHG reductions of roughly 85 percent below diesel counterparts.

The ARFVT Program's investments in new natural gas applications for medium- and heavy-duty vehicles has helped increase the number of natural gas-powered vehicles on the road and the growth rate of the overall vehicle population. The ARFVT Program has directed investments towards developing and deploying new natural gas vehicle technologies, addressing established business needs, and expanding California's current medium- and heavy-duty natural gas fleet. To date, the program has funded the deployment of 898 medium- and heavy-duty natural gas vehicles. In addition, the program has funded the development of technologies that will increase the availability of natural gas engines for specialized fleet applications, as well as fueling infrastructure to support these vehicles.

As of 2010, there were approximately 12,910 medium- and heavy-duty natural gas vehicles operating in California. The Energy Commission developed two scenarios for the rollout of medium- and heavy-duty natural gas vehicles in California through 2020. The low scenario represents a "business as usual" environment, which incorporates the 898 vehicles directly supported by the ARFVT Program, and the growth rate remains relatively steady.²² This is likely to reflect a scenario in which natural gas fuel prices are lower, but not significantly lower, than diesel prices, and natural gas vehicles are unable to significantly expand into heavy-duty uses.

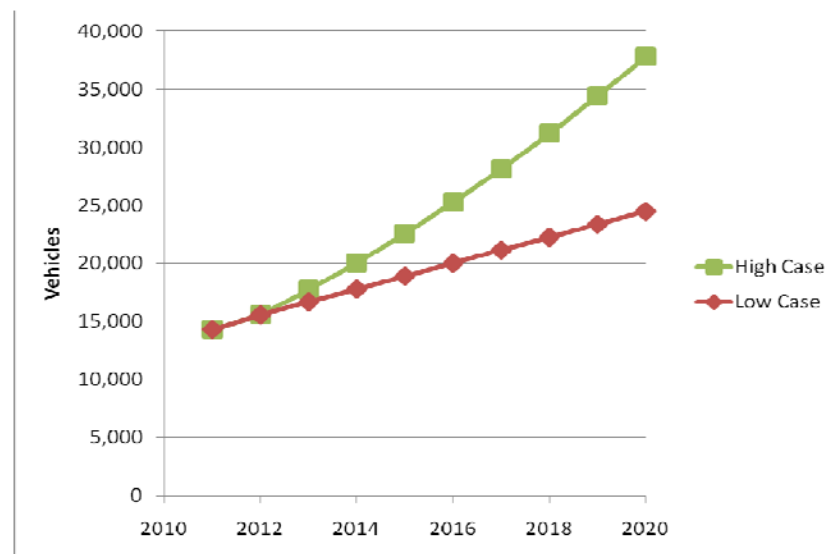
The high case assumes optimal market conditions for natural gas trucks, plus the expansion of natural gas vehicles into applications that were previously limited to diesel trucks. The ability of

²² Vehicle counts from Energy Commission analysis of Department of Motor Vehicle data.

medium- and heavy-duty natural gas vehicles to reach these populations will be dependent on comparative fuel prices, vehicle replacements necessitated by air quality regulations, technological advances in natural gas vehicles, fueling infrastructure access, and the ability of manufacturers to reach economies of scale. Through the ARFVT Program, the Energy Commission has focused its funding to support the latter three circumstances.

The high case is based on a combination of the low case plus the anticipated vehicle increases that were reported in survey responses and proposals from ARFVT Program awardees. Figure 9 compares the natural gas vehicle populations among medium- and heavy-duty trucks, for both the low case and high case.

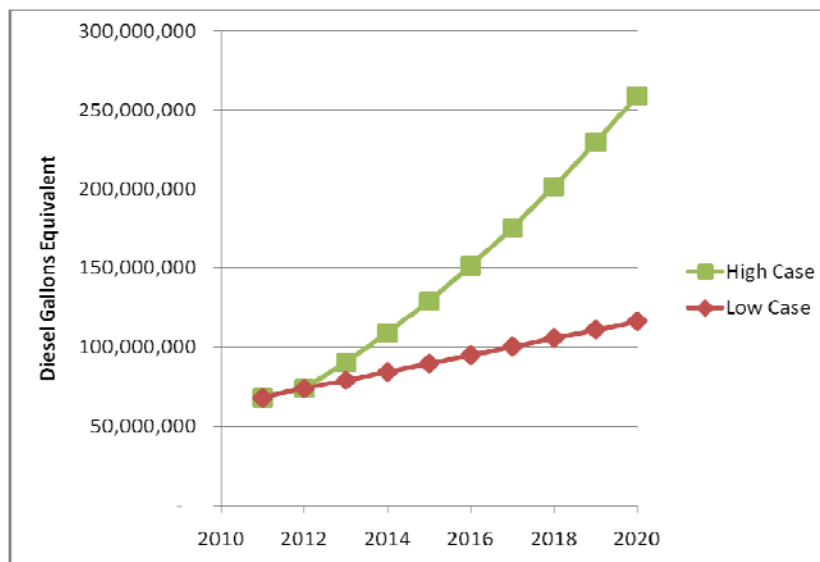
Figure 9: Anticipated Medium- and Heavy-Duty Natural Gas Vehicles



Source: California Energy Commission, Department of Motor Vehicles.

Each vehicle application will have a different duty cycle and associated usage and fuel consumption rate. As a result, the petroleum displaced by each medium- and heavy-duty natural gas vehicle is likely to vary more than in the light-duty vehicle sector. Under the low case, this analysis assumes that medium- and heavy-duty natural gas trucks displace an average 4,750 gallons of diesel per year, based on historic averages for existing natural gas trucks. The incremental increase of natural gas trucks under the high case assumes that natural gas trucks expand into heavier duty cycles, with these new trucks displacing roughly 10,750 gallons of diesel per year. The low case and high case for petroleum displacement by medium- and heavy-duty natural gas vehicles are presented in Figure 10.

Figure 10: Annual Petroleum Reductions from Medium- and Heavy-Duty Natural Gas Vehicles (in Diesel Gallons Equivalent)



Source: California Energy Commission.

As stated in Chapter 2, the ARFVT Program has also provided funding for an additional 19 compressed and liquefied natural gas fueling stations, bringing the statewide total to about 250. These stations will further support the deployment of additional medium- and heavy-duty natural gas vehicles within the state.

Based on these estimates of petroleum displacement, the GHG emission and criteria pollution reductions for medium- and heavy-duty NGVs can be calculated. GHG emissions are based on the LCFS pathways for compressed natural gas (67.7 gCO_{2e}/MJ) and liquefied natural gas (83.1 gCO_{2e}/MJ), and assume a 70 percent – 30 percent split between the two values (72.3 gCO_{2e}/MJ). As noted before, the carbon intensity for diesel is assumed to be 94.7 gCO_{2e}/MJ. An energy efficiency ratio of 1:1 was assumed, given the similar efficiencies between natural gas engines and diesel engines. Each gallon of diesel displaced by natural gas leads to a 24 percent reduction in GHG emission reductions. The resulting annual emission reductions in CO_{2e} and urban criteria pollutants by 2020 are shown in Table 10.

Table 10: Annual Emission Reductions From Medium- and Heavy-Duty Natural Gas Vehicles by 2020

	Petroleum Reductions (Million Gallons)	(Metric Tonnes)				
		GHG (CO _{2e})	VOC	CO	NOx	PM10
Low Case	116.4	349,093	84.5	-4.2	18.2	2.8
High Case	259.4	777,864	188.3	-9.3	40.5	6.2

Source: California Energy Commission.

Fuel Cell Vehicles – Estimated Benefits

Fuel cell vehicles, using hydrogen as fuel, are a prominent prospect for encouraging the deployment of alternative fuels. These vehicles emit no GHG emissions or air pollutants from the tailpipe, and have a significantly lower lifecycle carbon intensity than a comparable gasoline vehicle. Like other alternative fuel vehicles, they can also reduce dependence on foreign imports, as hydrogen can be derived from domestic sources of energy.

One major challenge to ensuring the deployment of these vehicles is the development of sufficient fueling infrastructure. To meet the needs of anticipated fuel cell vehicles, the ARFVT Program provided funding for 11 new and upgraded hydrogen fueling stations. The total cost per station ranged from \$2 million to \$3 million, a significant drop from the range of \$3 million to \$6 million per station just a few years earlier. All of these stations are located in regions identified by automakers as high-priority, early-adopter markets. Once installed in 2012, the eleven stations are expected to provide up to 2,160 kilograms per day (or 788,400 kilograms per year) of fueling capacity in critical regions of the state, or roughly 73 percent of the statewide public fueling capacity.

A low case and high case for FCV deployment can be derived from a combination of the ARB's ZEV regulation and automaker surveys. Under the low case, the cumulative number of FCVs increases to 30,200 by 2020. According to surveys of major automakers, the number of in-state FCVs will expand rapidly in the current decade, from roughly 250 in 2011 to more than 50,000 by 2017. Accordingly, the ARB has developed a scenario for the 2017-2020 period, based on automakers' compliance with the ZEV regulation, in which the total on-road number of light-duty FCVs within California will reach approximately 124,000 by 2020.²³

Table 11: Fuel Cell Vehicle Population Surveys

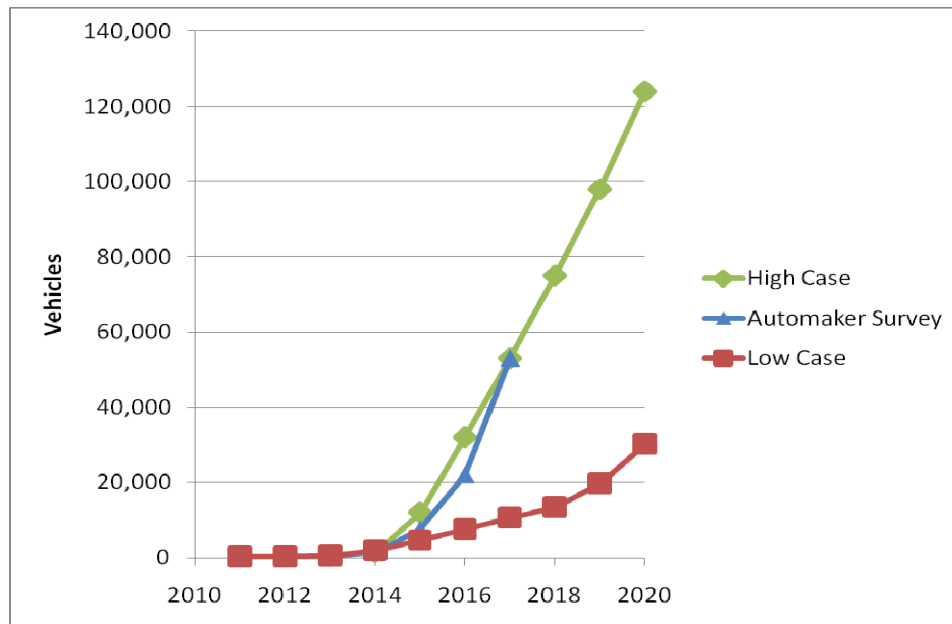
	2010	2011	2012	2013	2014	2015-2017
2009 Survey	192	330	495	769	1,839	47,800
2010 Survey	-	253	312	430	1,389	53,000

Source: Surveys of automakers conducted by the California Energy Commission and California Air Resources Board.

Figure 11 compares the fuel cell vehicle deployments for the high case and the low case. An additional trendline is added to represent the 2010 survey data from automakers. While the Energy Commission cannot claim sole responsibility for these vehicles entering the marketplace, their eventual deployment will be significantly dependent on the ARFVT Program's investments into hydrogen fueling infrastructure.

²³ ARB, *Staff Report: Initial Statement of Reasons, Advanced Clean Cars, 2012 Proposed Amendments to the Clean Fuels Outlet Regulation*. Released December 8, 2011.

Figure 11: Anticipated Light-Duty Fuel Cell Vehicles

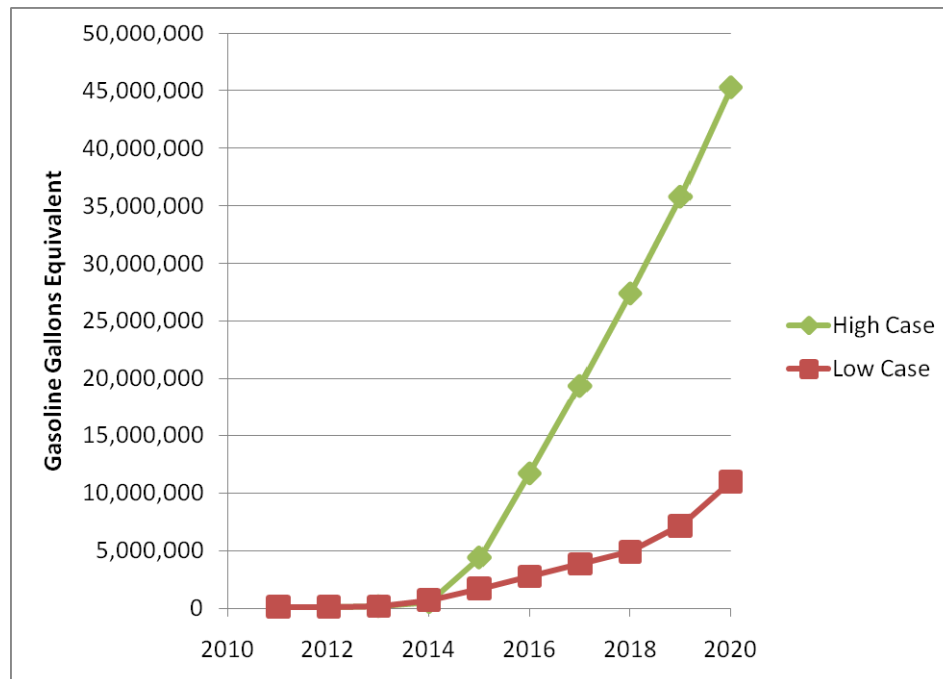


Source: California Energy Commission.

Sufficient fueling stations will be necessary to serve these vehicles. By providing fueling infrastructure early on, the Energy Commission's investments ensure that vehicle populations can continue to rise, to a point where private infrastructure suppliers can independently finance and construct additional stations to serve increasing numbers of vehicles. The Program's investments have played an important role in ensuring the availability of hydrogen fuel for early adopters of fuel cell vehicles. However, significant investments by automotive manufacturers and other agencies (including the Air Resources Board) have been necessary to bring fuel cell vehicles to this point. Further private investment, as well as regulatory support, will be necessary to expand the number of fuel cell vehicles and fueling stations to reach both the high and low scenarios for 2020.

Based on these vehicle estimates, it is also possible to calculate the estimated petroleum displacement from fuel cell vehicles. For this calculation, the Energy Commission assumes that each fuel cell vehicle uses approximately one kilogram of hydrogen per day, and that one kilogram of hydrogen roughly displaces one gallon of gasoline. Based on these assumptions, the number of gallons of gasoline displaced by hydrogen per day will roughly equal the number of fuel cell vehicles. Multiplying this number by 365 provides the approximate number of gallons of gasoline displaced by hydrogen per year. Figure 12 shows the resulting annual petroleum displacement of all fuel cell vehicles under the low case and high case scenarios.

Figure 12: Petroleum Displacement from Fuel Cell Vehicles (in Gasoline Gallons Equivalent)



Source: California Energy Commission.

Based on these estimates of petroleum displacement, the GHG emission and criteria pollution reductions for light-duty fuel cell vehicles can be calculated. GHG emissions are based on values submitted by the applicants, which reflect hydrogen produced via centralized reformation, with roughly 33-43 percent of this hydrogen being produced via renewable resources.²⁴ The weighted average of these projects equals 106.9 gCO_{2e}/MJ.²⁵ As stated earlier, the carbon intensity of California gasoline is approximately 95.9 gCO_{2e}/MJ. An energy efficiency ratio of 2.3:1 was subsequently applied, to account for the greater efficiency of fuel cell vehicles compared to conventional light-duty vehicles. As a result, each gallon of gasoline displaced by hydrogen in a fuel cell vehicle leads to a 52 percent reduction in GHG emission reductions. The resulting annual emission reductions in CO_{2e} and urban criteria pollutants by 2020 are shown in Table 12.

²⁴ The further growth of in-state biomethane from waste-based resources, when incorporated into the production of hydrogen, will further increase the renewable content of hydrogen, and further increase fuel cell vehicles' GHG emission reduction potential.

²⁵ This is roughly comparable to the estimates of carbon intensity provided by the LCFS look-up tables, which range from 98 to 142 gCO_{2e}/MJ.

Table 12: Emission Reductions From Light-Duty Fuel Cell Vehicles by 2020

	Petroleum Reductions (Million Gallons)	(Metric Tonnes)				
		GHG (CO₂e)	VOC	CO	NOx	PM10
Low Case	11.0	63,593	83.7	674.4	52.6	24.0
High Case	45.3	261,111	343.5	2,769.1	216.1	98.6

Source: California Energy Commission.

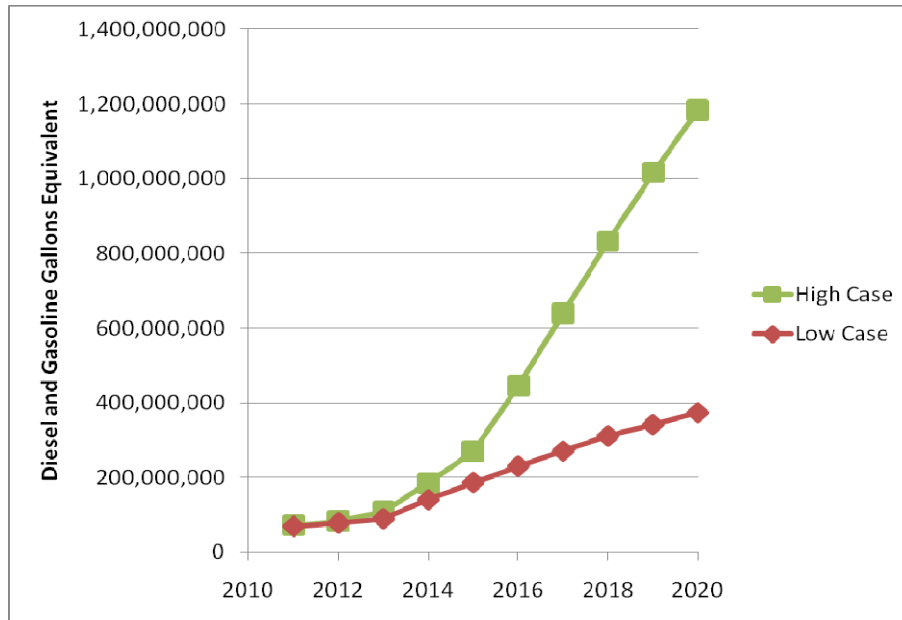
The Energy Commission has also made other investments to encourage the expansion of fuel cell vehicles and hydrogen fuel. Currently, there is no regulatory standard that allows hydrogen to be sold on a per-kilogram basis. Through the California Department of Food and Agriculture's Division of Measurement Standards, the ARFVT Program has provided \$4 million to establish retail fuel quality standards and per-unit retail standards for hydrogen. Additionally, the ARFVT Program has provided \$3 million to support a fuel cell bus demonstration project in the San Francisco Bay Area.

Summary of Total Estimated Benefits

The total estimated petroleum displacement associated with the fuels and vehicle technologies supported by the 86 ARFVT Program-funded projects could range from 374.9 million to 1.2 billion gallons per year by 2020. These estimates include reductions fostered by ARFVT Program investments in electric drive vehicles and charging infrastructure, biofuels production, natural gas-fueled vehicles and fueling stations, and hydrogen fueling stations for fuel cell vehicles. These estimated potential petroleum reduction benefits cannot be directly attributed to Program investment, but should be considered as the range of future benefits by a market influenced by ARFVT Program funding. To put these estimates in context, current petroleum fuel consumption in California totals roughly 18.8 billion gallons per year.

The annual petroleum reduction per year is shown in Figure 13. As shown, there is a significant acceleration in anticipated benefits after 2014 in the high case. This is attributable to the expansion of biofuel production projects funded by the ARFVT Program that move from precommercial projects into commercial-scale production, as expressed in the project proposals and surveys of awardees.

Figure 13: Annual Petroleum Displacement, 2011-2020



Source: California Energy Commission.

Looking forward to 2020, the low case estimate for annual petroleum displacement, GHG emission reductions, and reductions in criteria air pollutants are summarized in Table 13. This includes 374.9 million gallons of petroleum fuels displaced, 2.5 million metric tonnes of CO₂e GHG emissions reduced, and 10,855 metric tonnes of urban air pollutants reduced each year by 2020. Table 14 presents the high case, with 1.2 billion gallons of petroleum fuels displaced, 9.3 million metric tonnes of CO₂e GHG emissions reduced, and 24,371 metric tonnes of urban air pollutants reduced each year by 2020.

Table 13: Annual Petroleum Displacement, GHG Emission Reductions, and Criteria Emission Reductions by 2020 – Low Case

	Petroleum Displacement (Million Gallons)	(Metric Tonnes)				
		GHG Reductions (CO ₂ e)	VOC	CO	NO _x	PM ₁₀
Electric Vehicles	123.4	795,371	947.1	7,788.3	670.3	320.2
Biogas Production	100.7	1,111,214	73.1	-3.6	15.7	2.4
Biodiesel Production	9.4	100,403	9.8	20.5	-27.9	15.6
Ethanol Production	14.0	115,077	11.4	77.6	-0.6	-0.3
Natural Gas Vehicles	116.4	349,093	84.5	-4.2	18.2	2.8
Fuel Cell Vehicles	11.0	63,593	83.7	674.4	52.6	24.0
Total	374.9	2,534,751	1,209.6	8,553.0	728.3	364.7

Source: California Energy Commission.

Table 14: Annual Petroleum Displacement, GHG Emission Reductions, and Criteria Emission Reductions by 2020 – High Case

	Petroleum Displacement (Million Gallons)	(Metric Tonnes)				
		GHG Reductions (CO ₂ e)	VOC	CO	NO _x	PM ₁₀
Electric Vehicles	246.7	1,590,742	1,894.2	15,576.6	1,340.6	640.4
Biogas Production	195.5	2,157,323	141.9	-7.0	30.5	4.7
Biodiesel Production	378.1	4,038,539	392.5	823.5	-1,120.7	628.4
Ethanol Production	59.2	486,610	48.2	328.2	-2.6	-1.3
Natural Gas Vehicles	259.4	777,864	188.3	-9.3	40.5	6.2
Fuel Cell Vehicles	45.3	261,111	343.5	2,769.1	216.1	98.6
Total	1,184.2	9,312,189	3,009	19,481	504.4	1,377

Source: California Energy Commission.

These benefits are strong indicators of progress in attaining several of the state's policy goals for 2020. For example, the Energy Commission and ARB adopted a goal to increase alternative fuel and vehicle use equal to 26 percent of California's total onroad and offroad transportation fuel consumption by 2022.²⁶ By 2020, the Energy Commission anticipates gasoline and diesel fuel demand of approximately 14 billion gallons and 4 billion gallons, respectively.²⁷ The petroleum displacement from the fuels and technologies summarized in this report, ranging from 374.9 million gallons to 1.2 billion gallons, would represent roughly two to six percent of transportation fuels in 2020. This is a significant first step in achieving the state goal.

Similarly, the state has a goal of reducing GHG emissions to 1990 levels by 2020. According to the ARB's Scoping Plan for AB 32 (Núñez, Chapter 488, Statutes of 2006), the transportation

²⁶ *California Alternative Fuels Plan*, California Energy Commission and California Air Resources Board joint agency report, December 2007,

²⁷ Schremp et al. See the ranges between the "Low Petroleum Demand Scenario" and "High Petroleum Demand Scenario" for gasoline in Table 3 -5 and for diesel fuel in Table 3-7.

sector is expected to be responsible for 189.3 million metric tons of CO₂e GHG emissions by then.²⁸ If achieved, the range of 2.5 million metric tonnes to 9.3 million metric tonnes of CO₂e GHG emissions associated with the fuels and technologies discussed in this report would represent a one to four percent reduction from the ARB's business-as-usual case.

Finally, the state's Bioenergy Action Plan sets a target of meeting 40 percent of the state's biofuel demand (or roughly 820 million gasoline gallons equivalent) with in-state production by 2020.²⁹ The combined biofuel production estimates discussed in this report, ranging from 123 million gallons to 632 million gallons by 2020, represents a significant step toward fulfilling this goal.

28 ARB, *Supplement to the AB 32 Scoping Plan*

FED, http://www.arb.ca.gov/cc/scopingplan/document/final_supplement_to_sp_fed.pdf.

29 O'Neill, Garry, John Nuffer. 2011. *Draft 2011 Bioenergy Action Plan*. California Energy Commission, Efficiency and Renewables Division. Publication Number: CEC-300-2010-012-SD.

CHAPTER 5:

Workforce Training and Job Creation Benefits

Workforce Development and Training

Workforce development and training are critical elements in the Energy Commission's efforts to develop California's clean transportation market. A trained workforce is required to develop and respond to new technologies, improve efficiencies, minimize waste, and reduce the cost of production. A well-trained workforce will be critical to the industry's ability to manufacture low-emission vehicles and components, produce alternative fuels, build fueling infrastructure, service and maintain fleets and manufacturing equipment, and inform on-going innovation and refinement that will serve to increase the market acceptance of alternative fuels and new vehicle technologies.

The Energy Commission allocated \$15 million in program funding to support workforce development and training in the first investment plan for the ARFVT Program. The Energy Commission used the funds to establish interagency agreements with California's workforce training agencies, including the Employment Development Department (EDD) at \$4.5 million, the California Community Colleges Chancellor's Office (CCCCO) at \$4.5 million, and the Employment Training Panel (ETP) at \$6 million. The interagency agreements have been structured to fund alternative fuel and low-emission vehicle specific training, as a portion of the partner agency's broader workforce projects. The EDD and ETP interagency agreements deliver workforce training, while the EDD and CCCCCO interagency agreements provide workforce training development support activities, including surveying industry training needs, assessing existing training programs and resources, developing curriculum and training materials, instructor training, and regional industry cluster support planning grants.

To date, EDD and ETP have awarded 8 regional training grants, 4 regional industry cluster planning grants, and 12 direct employer training contracts to train more than 5,326 individuals. The grants and contracts awarded through the interagency agreements have also secured more than \$13 million in non-state matching funds.

Table 15: Workforce Training Delivery Data

Partner Agency	Allocations for Workforce Training Delivery (in Millions)	Match Contributions to Date (in Millions)	Trainees to be Trained	Businesses Assisted to Date	Municipalities Assisted to Date
ETP	\$5.4	\$5.8	4,327	78+	12+
EDD	\$3.8	\$7.5	999	36+	
Total	\$9.2	\$13.2	5,326	114+	12+

Source: California Energy Commission.

Jobs Creation Benefits

Since the projects funded by the ARFVT Program are almost entirely in the early stages of implementation, this summary represents projected job benefits. As projects come online, actual jobs data will be available in future reports.

The Energy Commission obtained projected jobs data through an electronic survey of its awardees, which was followed with telephone survey interviews. The survey respondents anticipate that they will create nearly 5,400 jobs to help implement their Program-funded projects. Respondents expect job creation throughout the market spectrum, but especially in manufacturing, construction, engineering, and operations and maintenance, as shown in Table 16. As defined in the survey, short-term jobs include jobs expected to last for 1 to 18 months, while long-term jobs include jobs that last 18 to 60 months

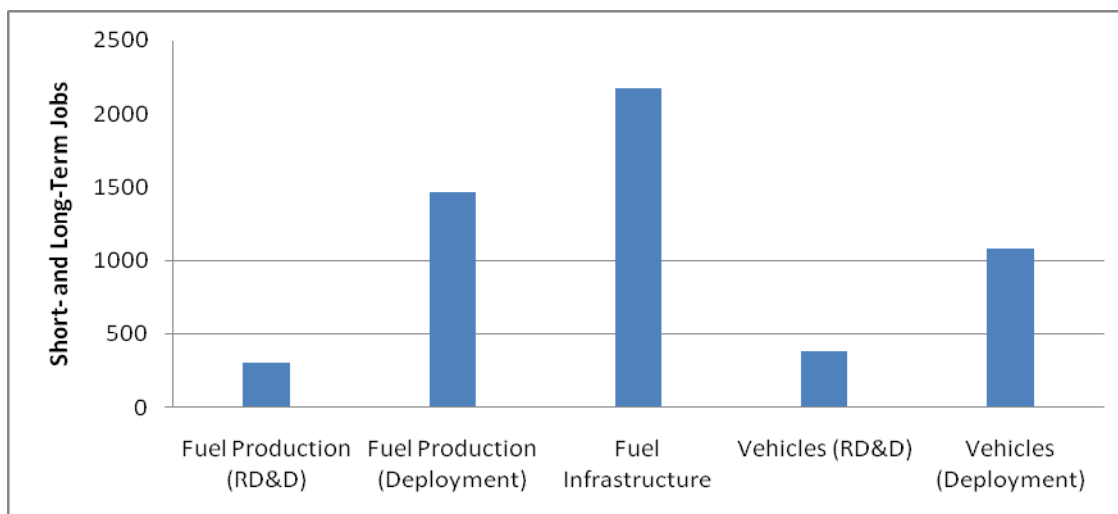
Table 16: Projected Job Creation by Type, As Reported By Recipients

	Manufacturing	Construction	Engineering	Operation and Maintenance	Other	Total
Short-Term	416	610	241	55	590	1,912
Long-Term	638	1306	384	410	744	3,482
Total	1,054	1,916	625	465	1,334	5,394

Source: California Energy Commission.

Respondents anticipate the highest numbers of jobs in manufacturing and construction, driven heavily by the construction of fuel production facilities and the production of batteries and components for the electric drive industry. Manufacturing and construction are universally recognized as two of California's most important industry sectors, and the hardest hit in the recent economic downturn. As such, the ARVFT Program's investment is a timely benefit to these vital industries. The number of jobs anticipated by survey respondents can also be sorted based on the commercialization phase of the technology involved in the project, when reported. This is shown in Figure 14.

Figure 14: Estimated Number of Jobs by Commercialization Phase



Source: California Energy Commission.

The economic benefit is compounded beyond the initial funding when the Program's investments promote additional outside investment, stimulate business expansion, and create new jobs. Using economic benefit multipliers, the Energy Commission's investment in 1,054 manufacturing jobs alone could actually create anywhere from 3,056 to 5,270 new jobs.³⁰

In addition to jobs data, survey respondents also provided information on the number of businesses involved in the implementation of their program-funded projects. The respondents estimated that over 800 California businesses would participate in the projects, with 568 of those businesses identified as small businesses (200 or less employees).

30 The Economic Policy Institute estimates that every direct manufacturing job supports an additional 2.9 indirect jobs in finance, transportation, supply chains, installers, and related businesses. The Alliance of American Manufacturing estimates that one manufacturing job supports four or five other jobs in the economy.

CHAPTER 6:

Key Challenges and Recommendations for Future Actions

In implementing the ARFVT Program, the Energy Commission identified several challenges to ensuring that funds are distributed and projects are completed in a timely manner. The Energy Commission has received comments from ARFVT Program awardees that are eager to begin work, but wait longer than expected for the final grant package. Recognizing this, the Energy Commission hosted a workshop in November 2010, incorporating input from the Energy Commission, the ARFVT Program's Advisory Committee, awardees, and other members of the public, with the goal of identifying the source and remedies for delays. The two major sources of delay are identified below, along with anticipated remedies.

Volume of Applications for ARFVT Program Funding

One symptom of the current tight capital markets and the challenges alternative fuel and vehicle technology developers face in raising financing is the strong interest in public funding such as ARFVT Program. The resulting high volume of applications for ARFVT Program funding created a challenge for the Energy Commission in the early years of the program. The concurrent start of ARFVT Program and the federal American Reinvestment and Recovery Act program resulted in a large number of applications that required technical review and administrative processing.

The Energy Commission's strategy in 2009 was to use the first year's ARFVT Program funding to match and leverage the \$3.4 billion in ARRA funding made available through six solicitations issued by three federal agencies. Commission staff reviewed 193 pre-proposals and 112 full proposals, requesting more than \$626 million from the ARFVT Program alone. Unfortunately, federal awards were made to only twelve California projects that had co-applied with the ARFVT Program.

The Energy Commission then released seven additional solicitations in late 2009 and early 2010. Staff reviewed 200 proposals requesting over \$568 million, and made 69 grant awards totaling roughly \$160 million. The high combined number of proposals and grants created a reviewing and processing challenge for Energy Commission program technical staff and support staff. On average, proposals took 40 to 80 days to review, before a notice of proposed award could be posted.

The Energy Commission has identified several possible solutions for reducing the impact of application review in implementation of the ARFVT Program. For projects that are sufficiently defined, the Energy Commission can automate the funding for small awards, as is the case for the recent deployment incentives provided for natural gas and propane trucks. In other cases, the Energy Commission will establish minimum performance or benefit requirements for proposals, which will reduce the number of proposals while retaining the most promising ones.

California Environmental Quality Act Compliance

The projects that the Energy Commission funds are subject to the California Environmental Quality Act (CEQA) (Public Resources Code § 2100 et seq.). This creates a statutory obligation for the Energy Commission to ensure that all ARFVT Program projects fully comply with CEQA prior to approving the project for grant funding. This statutory obligation has in turn created challenges for some grantees in terms of the sequencing of their projects.

Table 17 shows the level of CEQA review for the 71 grants from the first funding years. The Energy Commission usually acted as a “responsible agency” for CEQA purposes for projects that required discretionary local approvals, acting as a lead agency only when the project did not require any discretionary local approvals or was categorically exempt at the local level. Table 18 shows the median number of days for projects under each solicitation to complete CEQA compliance, from the day the Notice of Proposed Award was published.

Table 17: Level of CEQA Review by ARFVT Program Projects

Level of CEQA Approval	Number of Projects
Categorical Exemption ³¹	61
Negative Declaration	1
Mitigated Negative Declaration	6
Addendum to EIR	1
Certified FEIR	2

Source: California Energy Commission.

Table 18: Median Days for CEQA Compliance by Solicitation

Solicitation Description	Median Days for CEQA Compliance
Biomethane Production	321
Biofuel Production	65
Alternative Fuel Infrastructure	113.5
Hydrogen Fueling Infrastructure	71
Medium- and Heavy-Duty Advanced Vehicle Demonstration	25
Manufacturing	46
California Ethanol Producers Incentive Program	0
Buydown Incentives for Natural Gas and Propane Vehicles	0

Source: California Energy Commission.

CEQA compliance became a challenge for three types of grantees. The first was alternative fuel project developers who could not obtain financing to cross from the proof of concept phase into

31 The CEPIP and the buydown incentives for natural gas and propane vehicles, included here as two projects, were found not to be projects subject to CEQA review.

construction of pilot, demonstration, or commercial phase projects. Grants were offered to help these developers by funding final design, engineering, and site assessment information. However, some of these projects ventured beyond these feasibility studies into activities that would commit the Energy Commission to a definite course of action (such as site acquisition) or that would have a physical impact on the environment (such as constructing a facility). This caused delays as the Energy Commission had to work with the grantee to refine the grant to avoid physical impacts to the environment.

The second was five commercial scale biomethane production facilities whose projects required Mitigated Negative Declarations or Environmental Impact Reports (EIRs). For these projects, the time needed to prepare the environmental document was far longer than anticipated by the grantee, which created concerns for timely encumbrance of Energy Commission funds.

The third type of grantee was fueling infrastructure projects with several stations combined into a single project, which underestimated the difficulty in obtaining CEQA review of all the stations from the local lead agencies.

To improve the efficiency of its CEQA process, the Energy Commission has taken steps to:

1. Improve the information requirements for CEQA compliance in future solicitations;
2. Clarify the points at which CEQA may become an issue for a project; and
3. Pursue legislative relief through passage of AB 1314 (Wieckowski, Chapter 487, Statutes of 2011) to allow grantees to count funds expended from the date of the Notice of Proposed Awards as match, in an effort to create more flexible project schedules.

APPENDIX:

List of Projects Funded by the ARFVT Program

1. Electric Drive
 - a. Charging infrastructure awards (\$17,422,000)
 - b. Medium- and heavy-duty advanced vehicle awards (\$12,506,927)
 - c. Manufacturing awards (\$25,888,000)
 - d. Vehicle deployment incentives (\$6,612,500)
2. Natural Gas
 - a. Vehicle awards
 - i. Deployment projects (\$23,148,000)
 - ii. Demonstration projects (\$1,777,364)
 - b. Infrastructure awards (\$5,075,188)
3. Propane
 - a. Vehicle awards (\$1,342,000)
4. Biofuels
 - a. Production awards
 - i. Biomethane awards (\$35,318,080)
 - ii. Biodiesel awards (\$4,267,673)
 - iii. Advanced ethanol awards (\$5,363,538)
 - iv. California Ethanol Producers Incentive Program (\$6,000,000)
 - b. Infrastructure
 - i. Biodiesel awards (\$3,858,602)
 - ii. E85 awards (\$5,000,000)
 - c. Vehicle awards (\$2,712,140)
 - d. Sustainability research (\$1,500,000)
5. Hydrogen
 - a. Fueling infrastructure awards (\$18,718,934)
 - b. Fuel standards development (\$4,000,000)
6. Workforce Development Agreements
 - a. Interagency agreements (\$15,000,000)
7. Other Agreements
 - a. Technical assistance and analysis (\$1,721,385)
 - b. Sponsorships (\$264,475)

1. Electric Drive

a. Charging infrastructure awards (\$17,422,000)

Association of Bay Area Governments (ARV-10-032)

The Association of Bay Area Governments was awarded \$1,493,165 with more than \$2.7 million in total project match from local government, private industry, and the Bay Area Air Quality Management District. This project will install 423 charge points with Level 2 dual cordset capabilities and 18 fast chargers. The project has also helped to catalyze additional regional funding commitments of \$5 million for EV infrastructure from the Bay Area Air Quality Management District, and \$2.4 million from the Metropolitan Transportation Commission, which will fund an additional roll-out of more than 1,000 Level 2 charge stations and 50+ Fast Chargers. The project is the first stage in establishing the greater San Francisco Bay Area as the EV Capital of the United States by accelerating the deployment of EV-ready infrastructure and EV-friendly policies and incentives.

City of Reedley (ARV-10-004)

City of Reedley was awarded \$180,400 for the electric charging portion of a multi-alternative fuels infrastructure project. The infrastructure will be located at the Central Valley Transportation Center (CVTC). The CVTC will house, repair, and maintain a green fleet of vehicles. The facility will include a learning center and education center component to train current and future vehicle technicians on the latest technologies. The full project includes E85, Electric, B20 and CNG. Other users will be the City of Reedley, KCUSD, Dinuba USD, Parlier USD, and H&S Trucking. The electric infrastructure portion will be powered by solar panels. (The same agreement awarded City of Reedley funding for natural gas infrastructure. This is listed under the Natural Gas – Fueling Infrastructure section. Total anticipated project match is anticipated to be \$1,271,482.)

ClipperCreek, Inc. (ARV-10-001)

ClipperCreek, Inc. was awarded \$2,300,000 to update over 600 existing EV charging stations to the SAE-J1772 standard. While installing infrastructure with the new SAE-J1772 connector and communications protocol, ClipperCreek will ensure existing EV drivers are not stranded by leaving in-place Inductive and Avcon paddle infrastructure where it is being utilized by current EV drivers. Additionally, ClipperCreek will install meters, as directed by the local utility, so that the infrastructure usage can be monitored and eventually controlled (smart charging) by the local utility. Project match funds are expected to total approximately \$3,577,665.

Coulomb Technologies, Inc. (ARV-09-007)

Program funds of \$3,417,000, with match share of \$5,000,000 in federal ARRA funds will be used for the installation and upgrade of up to 1,290 Level 2 public electric vehicle charging stations in three metropolitan areas (Bay Area, Sacramento, and Los Angeles). Every station installed will have the ability for Smart Grid integration through demand response and utility monitoring that will enable utilities to measure and control charging. Including ARRA funds, total anticipated project match is expected to total approximately \$7,279,000.

Electric Transportation Electrification Corporation (ETEC)/Nissan (ARV-09-005)

Program funds of \$8,000,000 will be used for the installation of 2,300 Level 2 electric chargers and 30 DC fast charge electric charging stations in residential and commercial sites in the San Diego area. ETEC will support the introduction of 1,000 light-duty Nissan electric vehicles in the San Diego area. The chargers will support the eventual deployment of up to 5,000 vehicles. Match funding from the federal ARRA is \$39,350,000.

EV Connect and Los Angeles County Metropolitan Transportation Authority (ARV-10-006)

EV Connect and Los Angeles County Metropolitan Transportation Authority were awarded \$415,185 to upgrade and expand the Plug-In Electric Vehicle charge network at transit locations within the Los Angeles County Metropolitan Transit Authority service area. This will install 20 stations at five end-of-the-line parking lots of transit facilities. These are for cars, and four are upgrades. Anticipated project match funds total \$23,096.

Sacramento Municipal Utility District/Chrysler (ARV-10-041)

SMUD and the EV Sacramento Coalition (California Department of General Services, City of Sacramento, and California State University of Sacramento) will demonstrate 9 Chrysler PHEV vans and 11 Dodge PHEV pickups plus at least 35 charging stations. Program funds of \$100,000 will be used for data collection and analysis. Total anticipated match funding is \$300,054, including \$200,000 in ARRA funds.

Sacramento Municipal Utility District/General Motors (ARV-10-034)

SMUD and the EV Sacramento Coalition (California Department of General Services, Sacramento Metropolitan Air Quality Management District, and City of Sacramento) will demonstrate 34 Chevy Volt plug-in hybrid electric vehicles (PHEVs) and 206 electric recharging systems. Program funds of \$553,000 will be used for data collection and analysis. Total anticipated match funding is \$3,456,133, including \$2,100,000 in ARRA funds.

Southern California Regional Collaborative (ARV-10-045)

Southern California Regional Collaborative was awarded \$840,750 to install or upgrade at least 315 plug-in electric vehicle charge points in fleet operations and municipal sites. These chargers will support new and existing electric vehicles, and will be geographically distributed to ensure that some charging infrastructure is available across the broad area. The Collaborative consists of 23 public agency partners, including cities, counties, and universities in the greater Los Angeles area. Total anticipated match funding for this project is \$1,510,433.

University of California, Irvine (ARV-10-046)

University of California, Irvine was awarded \$122,500 to install plug-in electric vehicle charging for light-duty vehicles and shuttles on campus. This will include approximately 12 Level 2 chargers and two fast chargers for public access. Project partners estimate that this will displace upwards of 725,000 gallons of gasoline by 2020. The project team will provide up to \$1,687,500 in match funding.

b. Medium- and heavy-duty advanced vehicle awards (\$12,506,927)**Electric Vehicles International (ARV-09-017)**

Electric Vehicles International (EVI) was awarded \$2,569,367 to design, develop, and deploy a range-extended electric vehicle powertrain for medium-duty truck applications. EVI proposes to build 10 Range-extended LNG medium-duty pickup trucks. The applicant proposes to use Valence lithium-phosphate batteries for a 100-115 mile range. EVI will integrate the new powertrain into an industry standard pickup truck and will deploy prototypes for onsite testing with partners. Project match funding is anticipated to be \$2,834,771.

ISE Corporation (ARV-09-014)

ISE was awarded \$888,595 to produce a battery-electric 45-foot transit bus using the NABI "compobus" chassis for the Los Angeles Metropolitan Transportation Authority (LAMTA) Battery Electric Bus Program. ISE will install their electric drive system and lithium ion batteries in place of the engine and fuel storage tank. This is the first battery based technology to meet the 40+ ft. class transit bus requirements. This size class represents two thirds of the transit bus market. If this demonstration is successful, the LAMTA is expected to purchase 30 to 40 buses per year on average. The ARB and SCAQMD are financial supporters of the LAMTA's Battery Electric Bus Program. Total match funding was anticipated to be \$888,595. (Note: Subsequent to approval of this award, ISE Corporation filed for bankruptcy. Of the \$888,595 originally awarded, no funding had been provided by the Energy Commission.)

Kenworth Truck Company (ARV-09-012)

Kenworth and its partners were awarded \$1,458,735 and will demonstrate one truck with an advanced class 8 hybrid electric system and an intercooled recuperated (ICR) 350 kW microturbine. The ICR microturbine will be run on natural gas for this demonstration because of its low GHG potential, low cost, and distribution infrastructure. However, the microturbine will be capable of using any fuel including ethanol, LNG, hydrogen, and biodiesel. The system will initially be designed for class 8, but can be readily scaled to fit all class 6, 7, and 8 vehicles over a wide range of operation. Total match funding is anticipated to be \$1,603,325.

Motiv Power Systems Incorporated (ARV-09-015)

Motiv Power Systems, Inc. was awarded \$1,345,552, with equal match funding from the project team, to integrate Motiv's customizable electric-drive Power Control System into a prototype class 4 vehicle to demonstrate the viability and benefits of the system's 100-mile all-electric range. Motiv will install its system on a new shuttle bus chassis as a test platform to illustrate the large-scale applicability of the technology. This shuttle will operate along routes at campuses of Bauer Worldwide Transportation Inc.'s client companies, including Google, Cisco, Facebook, and Yahoo. Upon successful completion of the proposed project, Bauer will employ the vehicle technology in a large-scale roll-out of Motiv's electric-drive vehicle platform, which can be configured with different battery packs and with or without generators on board to meet the specific needs of medium- and heavy-duty vehicle fleets.

Parker Hannifin Corp. (ARV-09-011)

Parker Hannifin was awarded \$750,000 to design, develop, and deploy four hydraulic hybrid Class 6 Coca Cola delivery trucks. Hydraulic hybrids use hydraulic fluid in high pressure tanks to capture the braking energy of the moving vehicle and then reuse this energy at the next restart. These trucks may provide 40% better fuel economy over the conventional delivery trucks. Coca Cola Enterprises has the largest fleet of hybrid trucks currently deployed with 335 units in fleet operations as of January 1, 2010. The project team is providing matching funding totaling \$1.25 million.

South Coast Air Quality Management District (ARV-09-003)

Program funds of \$5,000,000 and \$27,994,490 of federal ARRA funds will be used to develop a fully integrated, production plug-in hybrid system for Class 2 – 5 vehicles. Total anticipated match for the project team is \$42,176,215. A demonstration fleet of 378 vehicles will be built in a production facility and delivered for nationwide testing in daily long-term

fleet use, with approximately 70 of these vehicles being used in California. Vehicles such as trucks, aerial lift utility trucks, work trucks, and shuttle busses will be used and support the commercialization of this technology. PHEV Applications for this project include: Ford F550 Utility “Trouble Trucks”, Ford F250 and F350 Trucks, Ford 450 and F550 work trucks with various body configurations, and, Ford F-series or E-series shuttle bus. The program will also include the development and installation of “smart” charging infrastructure to support the vehicles.

Terex (ARV-09-016)

Terex, in collaboration with Pacific Gas & Electric (PG&E) and CALSTART, was awarded \$494,678 to demonstrate the economic and environmental viability of its innovative new Hypower Hybrid system retrofitting 12 medium- and heavy-duty PG&E utility service vehicles. The Hypower Hybrid uses stored energy from the system's rechargeable batteries to provide power for aerial boom operation, cabin heating and air conditioning, and worksite lighting. This will virtually eliminate the need for chassis engine idling during these types of operation which typically exceed more than 4 hours per day for the average utility service vehicle. Total anticipated match funding is \$494,702.

c. Manufacturing awards (\$25,888,000)

Boulder Electric Vehicles (ARV-10-039)

Boulder Electric Vehicles (BEV) will design and locate a 20,000 square foot manufacturing facility in the Los Angeles region. BEV will mass produce medium- and heavy duty all electric drive, trucks and buses. BEV received \$3,000,000 in Program funding for its production project, and will provide an equal amount of match funding. BEV will incorporate low energy manufacturing processes that will be implemented into the design of the facility as well as use novel techniques for cycling the high voltage battery packs with a minimum current draw from the grid. The prototype will run at an average of 800 watt-hours per mile and have a 100-mile range per charge.

Coulomb Technologies, Inc. (ARV-10-012)

Coulomb Technologies Inc. was awarded \$1,102,985, with roughly equal match share, to develop and manufacture its Charge Point Communication Processor, which is designed for installation into existing electric chargers and into new chargers manufactured by other companies. Coulomb's project will culminate in hardware and software capability for a complete smart charger network. The network will be capable of remotely controlling the charging and discharging of batteries by creating a vehicle-to-grid network that can shift charging loads away from peak hours. In addition to load

leveling, the smart charge network will be capable of providing billing, wireless monitoring, and web and cell phone services for consumers.

Electric Vehicles International (ARV-10-011)

Electric Vehicles International (EVI) was awarded \$3,881,244, with a match share of \$7,226,076, to develop, test, and improve an automated, pilot, electric vehicle production process that will include on-site manufacture and assembly of battery packs, battery boxes, motors, motor controllers, drivetrains, and vehicle management units. This production process will automate manufacturing and assembly of the vehicles, and includes complete component manufacturing under one roof. By integrating on-site component manufacturing into the vehicle assembly process, EVI eliminates the additional costs associated with outside, standalone component manufacturers. This will reduce power system costs by 50 percent and vehicle costs by an estimated 30 percent.

Envia Systems (ARV-09-004)

Envia Systems was awarded \$1 million in Program funds and \$4,000,000 in federal ARRA funds, to develop high energy density lithium-ion batteries at its existing facility in Hayward. Current lithium-ion batteries for electric vehicles possess an energy density ranging from 100-200 watt-hours per kilogram. By developing advanced battery anodes, Envia expects to surpass 400 watt-hours per kilogram. This should, in turn, reduce the cost to produce each battery, resulting in a decreased cost for electric vehicles and/or increased electric range. Including ARRA funding, total anticipated match is expected to be \$4,422,332.

Green Vehicles (ARV-10-007)

Green Vehicles was awarded \$2,052,560, with project team match funds of \$2,878,611, to upgrade its existing facility in Salinas. The goal of the project is to validate vehicle, component, process, and equipment improvements before installing a 2,000 vehicle per year commercial production line for the Triac, Green Vehicle's three-wheeled battery-electric freeway commuter car. The improvements will be evaluated on a pilot assembly line that allows products and the processes by which they are created to be examined. The Triac is currently produced in low quantities at the Salinas facility as part of a commercial trial. Due to the use of proprietary software and controllers, lightweight vehicle construction, and a new, California based battery technology, Green Vehicles anticipates the Triac will be 40.3% more energy efficient than the Nissan Leaf. (Note: Green Vehicles has filed for bankruptcy. Only \$187,205 has been paid by the Energy Commission, prior to Green Vehicles' bankruptcy filing.)

Leyden Energy, Inc. (ARV-10-015)

Leyden Energy, Inc., a research, development, and manufacturing company based in Alameda County, was awarded \$2,962,743, with equal project team match funding, to establish a facility in Fremont to develop and test a new, advanced lithium ion battery technology, and design and verify a pilot production line that will be capable of producing 10 electric vehicle batteries each month by the end of the project. Leyden's patented technology makes its batteries tolerant of high temperatures and high levels of abuse, and flexible enough to incorporate all current lithium ion battery chemistries, which will allow integration of higher performing components as they develop. Leyden is striving to be cost-competitive with overseas battery manufacturers.

Mission Motors Company (ARV-10-021)

Mission Motors, a high performance electric motorcycle and electric powertrain technology company based in San Francisco, was awarded \$505,381 with project team match funds of \$623,502 to advance its battery module and motor control systems from the working prototype phase to a final product ready for commercial production. The manufacturing assembly lines that will be designed and validated during the course of the project will be capable of producing 30,000 battery packs and motor control systems per year by 2015. Mission Motors' electric powertrain's scalability allows the powertrain to be applied broadly; in cars, motorcycles, scooters, buses, and outdoor power equipment. Mission Motor has signed contracts or is developing strategic partnerships with large vehicle manufacturers or fleet owners in each of those areas.

Quallion (ARV-10-010)

Quallion, a California based Lithium-ion (Li-ion) battery manufacturer, was awarded \$6,914,072 with a match share from Quallion of \$6,950,265 to develop a pilot scale, automated manufacturing line capable of producing 10,000 1kWh Li-ion modules. The battery module for transportation is the single most expensive component in an electric vehicle, up to 50% of the purchase price. Quallion is automating the module building process to mass produce battery modules that can be produced with a lower price point and in large volumes making them less costly for use in transportation applications. Quallion is also designing a common base module structure to promote standardization in module size, module design, battery size, or battery design.

Quantum Fuel Systems Technologies Worldwide, Inc. (ARV-10-009)

Quantum was awarded \$1,371,679, with project team match share of \$1,676,453, to re-tool one of its facilities in Lake Forest, CA to manufacture and test a new combination inverter/charger for PHEV, HEV and EV

applications. Once operational, the facility will be able to produce 36,000 units each year. Quantum (co-founder of Fisker Automotive) developed the Q-Drive, a hybrid powertrain that will be used in the Fisker Karma and Sunset, a pair of highly anticipated plug-in hybrid luxury sedans. While Quantum anticipates supplying the Q-Drive to Fisker for up to 15,500 vehicles each year, it is developing a second generation Q-Drive designed around a new combination inverter/charger that will be more economical and targeted at a wider audience. In order to produce the new Q-Drive, Quantum will use Program funds to upgrade an existing facility with testing equipment, a pilot production line, and ultimately, a high volume production line.

TransPower (ARV-10-020)

TransPower, a California company, was awarded \$1 million with a team match share of \$1,606,074 to conduct a study and performance tests relating to the “Feasibility of a Vertically-Integrated Facility for Electric Truck Manufacturing” (VIFET). The VIFET project goal is to establish readiness to construct a new manufacturing facility for large Class 8 electric trucks in Southern California by January 2013. TransPower’s unique solution, to be studied and validated, is to co-locate the operations of at least four key companies in the electric truck supply chain, thereby enabling three stages of electric truck manufacturing to be performed and integrated cost-effectively. Those stages include: 1) Component manufacturing (advanced inverters and battery modules); 2) Integration of components into electric drive system “kits” customized for specific vehicle models and applications; and 3) Vehicle component kit installation into mass-produced Class 8 truck models. TransPower is targeting the port drayage market and working with PortTechLA to identify a location for the facility in the San Pedro port region.

Wrightspeed, Inc. (ARV-10-025)

Wrightspeed, Inc. will use \$1,197,064 in Program funds and \$1,523,531 in match funds to validate electric drive retrofit kits for use in Class 3 through Class 6 trucks, to ensure that the systems meet specified performance and efficiency levels. Wrightspeed’s Digital Drive System (DDS) electric drive retrofit kit replaces the entire drive system and includes a range extending micro-turbine powered generator. The Wrightspeed DDS uses electric-drive power for up to the first 40 miles per day before it switches over to a range-extending micro-turbine generator which will supply the necessary electrical energy to charge the batteries for extended driving range. Wrightspeed expects this project to validate that the DDS results in a 100 percent increase in fuel economy under mixed driving conditions, when compared with the same truck with a diesel engine.

Zero Motorcycles (ARV-10-013)

Zero Motorcycles, an electric vehicle company based in California, was awarded \$900,272 with project team match share of \$939,300 to design and bring to pilot production an advanced electric motor and integrated controller for use in next-generation electric vehicles including motorcycles, neighborhood electric vehicles, and all-terrain vehicles. The project team will develop a motor and integrated controller specifically for use in electric vehicles, and design cost-effective, scalable manufacturing processes that will allow the powertrains to be produced for less than \$450 each. Zero Motorcycles will benchmark currently available motors ranging from three to ten kilowatts to provide baseline performance requirements for the new design, develop a proof of concept motor and controller that exceeds those benchmarks, manufacture and test prototypes, and manufacture 30 powertrains on the pilot line.

d. Vehicle deployment incentives (\$6,612,500)**California Air Resources Board – Clean Vehicle Rebate Program (600-10-005)**

The Energy Commission provided \$2,000,000 to supplement the ARB's vehicle incentives under the CVRP. The CVRP provides incentives for freeway-capable plug-in electric vehicles, plug-in hybrid electric vehicles, and fuel cell vehicles. As manufacturers' options and consumer interest in these vehicles has increased, so has the need for vehicle incentives. The ARB initially allocated \$9,000,000 in Air Quality Improvement Program funds for this purpose; however, this is insufficient for near-term demand. The additional funding from the Energy Commission will provide incentives for 400 additional vehicles.

California Air Resources Board – Hybrid Truck and Bus Voucher Incentive Program (600-10-010)

The Energy Commission provided \$4,000,000 to supplement the ARB's vehicle incentives for the Hybrid Truck and Bus Voucher Incentive Program (HVIP). The HVIP provides incentives for medium-and heavy-duty vehicles that utilize hybrid technology, such as hybrid-electric or hybrid-hydraulic. The incentive amount available through the HVIP increases based on the vehicles' gross vehicle weight. Funding is also available for medium- and heavy-duty vehicles that operate strictly on electricity; however, the incentive amount for these vehicles is not proportional to their higher costs. The Energy Commission's funds will provide for a higher incentive for pure-electric vehicles, which will increase their immediate market viability.

Department of General Services (600-09-01)

The Energy Commission provided \$612,500 to the Department of General Services to retrofit 50 state-owned hybrid electric vehicles into plug-in hybrid electric vehicles as part of a pilot program.

2. Natural Gas

a. Vehicle awards

i. Deployment projects (\$23,148,000)

San Bernardino Associated Governments (ARV-09-001)

San Bernardino Associated Governments (SANBAG) was awarded \$9,308,000 to purchase and deploy 202 heavy-duty natural gas trucks. SANBAG has partnered on this project with Ryder Truck Transport Services, Inc. to purchase and deploy these trucks. The Department of Energy's ARRA funds will provide \$9,950,708 for the construction of two liquefied natural gas refueling stations and truck purchases. Total anticipated match funding is \$27,013,445.

South Coast Air Quality Management District (ARV-09-002)

South Coast Air Quality Management District (SCAQMD) was awarded \$5,142,000 in Program funds for 120 new Class 8 liquefied natural gas (LNG) drayage trucks through a regional buy down program. SCAQMD is partnering with the Ports of Long Beach and Los Angeles. Each LNG drayage truck displaces approximately 10,000 gallons of diesel fuel each year. The total anticipated match funding for this project is \$28,848,389.

Natural Gas Vehicle Buy-Down Program (Various under PON-10-604)

The Energy Commission is administering a vehicle buy-down program to support the deployment of natural gas vehicles. Buy-down incentives are based on vehicle weight. A total of \$10,190,000 is available for the deployment of light-, medium-, and heavy-duty natural gas vehicles. Major vehicle suppliers such as Peterbilt Motors, Ford, Kenworth, and Daimler have all placed reservations for these incentives. Funding for this program has been increased with the adoption of the 2011-12 Investment Plan. As of September 29, 2011, \$8,698,000 of the original total has been placed into reservations for 450 vehicles.

ii. Demonstration projects (\$1,777,364)

Gas Technology Institute (ARV-09-013)

The Gas Technology Institute, with Cummins Westport, was awarded \$1,777,364 to develop an advanced ISX11.9 G natural gas engine which will be a low-emission, high efficiency engine designed for the Class 8 market. Swift transportation, as a partner, will demonstrate one engine in a highway tractor for 12 months to accumulate approximately 2,000 miles per month while hauling loads up to 80,000 pounds gross vehicle weight. Total anticipated match funding for this project is \$3,622,636.

b. Infrastructure awards (\$5,075,188)

Border Valley Trading (ARV-10-042)

Border Valley Trading (BVT) was awarded \$500,000 to construct a public-access station in Palm Springs at a location central to both BVT and HayDay Farms (HDF) to provide LNG fuel for both BVT and HDV operations and for other regional fleets. This was needed after the owner of the LNG fueling component at the Sunline yard, used by BVT and HDF, closed the LNG facility In November 2008. This fueling station will allow both BVT and HDF to reliably fuel their respective 20 vehicle LNG fleets (40 vehicles total) and purchase additional LNG vehicles in the future. The total anticipated project match funding is expected to be \$2,127,698.

City of Lemoore (ARV-09-019)

The City of Lemoore was awarded \$200,000, with \$465,405 anticipated project match funding, to partner with Lemoore School District to develop a CNG fueling station. The station will be open to the public 24 hours a day and serve both the City and School District's vehicles. Both fast filling and slow filling options will be available at this station. The project is expected to displace over 55 thousand gallons of petroleum-based diesel fuel per year.

City of Reedley (ARV-10-004)

The City of Reedley was awarded \$300,000 to work collaboratively with Kings Canyon Unified School District to develop natural gas infrastructure at the Central Valley Transportation Center. The complete project will include a compressed natural gas fueling station, electric vehicle charging stations and a solar electric charging system that will supply electricity for the stations. (The same agreement awarded the City of Reedley funding for electric drive charging infrastructure. This is listed under the Electric Drive – Charging Infrastructure section. Project project match is expected to total \$1,271,482.)

Sacramento Regional Transit District (ARV-09-018)

The Sacramento Regional Transit District was awarded \$500,000 to install three 1,500 standard cubic feet per minute CNG dispensers at its bus maintenance facility to support 40 buses. There is a projected 150 percent increase in future transit service needs and these dispensers are needed to accommodate growth in bus services. The CNG buses supported by this station will displace over 2.6 million gallons of petroleum-based diesel fuel per year. The total anticipated match funding for the project is \$4,200,000.

San Diego Metropolitan Transit System (ARV-10-018)

The San Diego Metropolitan Transit System was awarded \$186,148 to install compressed natural gas fueling compressors at its South Bay Maintenance Facility to enable more rapid refueling of its bus fleet. Other match funding for the project is expected to total \$1,107,847. San Diego MTS will purchase and install larger, higher capacity fueling compressors that will more than double throughput from 1,900 to 5,520 standard cubic feet per minute. This increased capacity will support fleet expansion from 50 to 158 compressed natural gas buses with an additional 40 planned in the near future.

South Coast Air Quality Management District (ARV-10-054)

The South Coast Air Quality Management District was awarded \$2,600,000 to install 11 natural gas fueling stations throughout the South Coast Air Basin. The total anticipated project match is \$7,059,353.

South Coast Air Quality Management District (ARV-10-035)

The South Coast Air Quality Management District was awarded \$300,000 to partner with Earth Energy Fuels, Inc. to install a CNG fueling station at an existing gas station in Ontario, CA. The installation of this station will support the increasing demand in an area where fuel demand already exceeds availability. The installation of this station will displace approximately 375,000 gallons of petroleum in the first year. The total anticipated match funding for the project will be \$1,447,466.

USA Waste of California, Inc. (ARV-10-050)

USA Waste of California, Inc. was awarded \$489,040 in program funds. USA Waste's initial project, a CNG/LNG station located at the Bradley Landfill, has been delayed indefinitely due to permitting issues. USA waste has put together a substitute project using a comparable site at Corona. Current LNG fuel throughput at Corona is approximately

606,000 DGEs per year. With these upgrades, throughput is expected to rise to 902,000 DGEs. This is an increase of 296,000 DGEs per year. The total anticipated project match funding is \$489,043.

3. Propane

a. Vehicle awards (\$1,342,000)

Propane Bus Buy-Down Program (Various under PON-10-604)

The Energy Commission is administering a vehicle buy-down program to support the deployment of propane buses. Buy-down incentives are based on bus weight. A total of \$2,000,000 is available for the deployment of light- and medium-duty propane vehicles. Funding for this program has been increased with the adoption of the 2011-12 Investment Plan. As of September 29, 2011, \$1,000,000 of the original total has been placed into reservations for 50 buses.

Propane Non-Bus Vehicle Buy-Down Program (Various under PON-10-604)

The Energy Commission is administering a vehicle buy-down program to support the deployment of propane non-bus vehicles. Buy-down incentives are based on vehicle weight and purpose. A total of \$2,000,000 is available for the deployment of light- and medium-duty propane vehicles. Funding for this program has been increased with the adoption of the 2011-12 Investment Plan. As of September 29, 2011, \$342,000 of the original total has been placed into reservations for 57 vehicles.

4. Biofuels

a. Production awards

i. Biomethane awards (\$35,318,080)

Biostar Systems, LLC (PON-09-604)

Biostar Systems, LLC, was awarded \$3,372,314 with an equal match share to convert up to 141,000 gallons per day of combined animal and food waste into 240,000 cubic feet biogas or 148,000 cubic feet of pipeline quality biomethane at the Sonoma Valley County Sanitation District. Biomethane produced will be compressed and injected directly into an existing PG&E pipeline and used to fuel 33 of Sonoma County Transit fleet buses daily. The project is expected to reduce over 4,100 tons of CO₂ emissions annually.

City of San Jose (ARV-10-016)

The City of San Jose was awarded \$1,900,000 with a match of \$4,775,426 to demonstrate a gasification technology that uses recycled feedstocks such as urban wood waste, yard waste, and biosolids at the Santa Clara Water Pollution Control Plant in San Jose. The proposed facility will use gasification to produce biogas, which will undergo a proprietary methanation process to increase the biomethane content of the biogas. The project is estimated to produce 18.5 million standard cubic feet of compressed biomethane annually to displace 150,000 gallons of diesel.

Clean World Partners, LLC (ARV-10-026)

Clean World Partners, LLC was awarded \$1,315,800 with a match of \$1,448,569 to study the feasibility of, and then design, build, and manage a biomethane production facility to be located at the Sacramento Recycling and Transfer station in Sacramento, CA. This project is expected to produce 71,324,285 standard cubic feet (SCF) of compressed natural gas (CNG) from locally produced food and green waste, displacing 584,000 gallons of gasoline annually. Fuel produced from this project will be sold to the Yolo County Transit District CNG bus fleet, meeting over two-thirds of its annual demand.

CR&R Incorporated (ARV-10-052)

CR&R was awarded \$4,520,501 with a match of \$15,216,499 to process 50,000 tons per year of mixed municipal waste from the City of Los Angeles at CR&R's Perris Material Recovery and Transfer Station. The waste will be separated to produce a biologically rich feedstock for two-stage anaerobic digestion. The resultant biogas will be cleaned to pipeline quality. This process is expected to produce sufficient biomethane to displace the equivalent of 865,000 gallons of diesel per year. CR&R currently operates a fleet of roughly 100 liquefied natural gas trucks out of its San Juan Capistrano facility.

Eurisko Scientific (ARV-10-003)

Eurisko Scientific was awarded \$1,830,132 with a match share of \$1,870,825 to optimize and demonstrate that a patented additive process developed at Argonne National Labs can increase the productivity of anaerobic digestion up to five times and reduce the amount of CO₂ produced simultaneously. Clean Energy will transfer and distribute the biomethane produced for transportation use through their existing fueling facilities. An estimated 5,000 standard cubic feet of compressed biomethane (approx. 1250 GGE) can be produced per ton of wet waste material.

G4 Insights (ARV-10-023)

G4 Insights was awarded \$1,229,966 with a match of \$1,232,257 to test and refine their thermo-chemical process technology for converting forest biomass to pipeline quality biomethane for transportation end uses. The project will be located in Placer County, where G4 and Placer County will test the biomethane's performance in one of Placer County's CNG vehicles. They will also assess the feasibility of serving over 50 CNG vehicles operating in the county, including 12 CNG buses. If successful, G4's conversion technology could provide a cost-effective technology for converting woody biomass into transportation-grade biogas throughout the state.

High Mountain Fuels, LLC (ARV-10-051)

High Mountain Fuels was awarded \$11,020,419 with an equal match share to construct a bio-LNG fueling facility at the Simi-Valley Landfill in Ventura County. The proposed project will use pressure swing adsorption technology which will reduce greenhouse gas emissions for bio-LNG to 85 percent below the diesel baseline, rather than the 73 percent reduction for standard process LNG from landfill gas. The project is expected to produce about 750 million cubic feet of biomethane per year for 6 million gallons of LNG annually, displacing 3.43 million diesel gallons equivalent. The LNG produced will be used to fuel 500 waste hauling trucks.

Northstate Rendering (ARV-10-040)

Northstate Rendering was awarded \$5,456,150 in grant funding with a match share of \$5,740,950 to construct an anaerobic digestion facility in Oroville, CA that can accommodate animal and slaughterhouse remains. The facility will produce biomethane from rendering waste, which will be compressed and supplied to an on-location fueling station that feeds the CNG to a fleet of 14 trucks. The surplus biomethane will be injected into the gas pipeline at the facility to supply CNG fueling stations throughout California. The project is estimated to produce 54.1 million cubic feet of biomethane per year to displace 378,550 DGE and reduce 20,300 tons of CO2 emissions annually.

Pixley Biogas, LLC (ARV-10-053)

Pixley Biogas was awarded \$4,672,798 with a match share of \$4,810,802 to construct a biogas facility adjacent to the existing Calgren Renewable Fuels ethanol production facility in Pixley, CA. The biogas facility will use anaerobic digestion of cow manure from three local dairies to produce 266 mmBTU of biogas daily. The biogas produced will then be used to offset 13.1 percent (147,070 mmBTUs annually) of the total natural

gas consumption at the Calgren facility, which would cause an immediate drop of 5.74 percent in the GHG intensity of the ethanol produced on a Well-to-Wheels basis.

ii. Biodiesel awards (\$4,267,673)

Agricultural Waste Solutions, Inc. (ARV-10-043)

Agricultural Waste Solutions, Inc., in partnership with Scott Brothers Dairy Farms, was awarded \$658,220 of Program funds with a match share of \$1,014,537 to assemble, operate and test a modular, skid-mounted demonstration pilot plant for the conversion of dairy waste to renewable diesel. The project will use a proprietary solids separation process, combined with gasification of the solids and Fischer-Tropsch conversion of the resulting syngas to renewable diesel. At commercial scale, the technology could produce 6.8 million gallons of renewable diesel per year from the 35,000 dairy cows in Western Riverside County Agricultural Coalition. Each of the 3-5 commercial facilities needed to serve these 26 farms would result in 10 full time jobs for facility operation, in addition to stabilizing local on-farm employment.

Biodiesel Industries (ARV-10-024)

Biodiesel Industries was awarded \$886,815 and is contributing match share of \$1,573,526 to demonstrate an automated control system that includes a portable biodiesel production unit, an anaerobic digester, a microturbine, a greenhouse, and tanks for growing algae. Water and glycerin from biodiesel production will feed the digester. Biomethane from the digester will be burned in the microturbine to produce heat and power. Power from the microturbine will be used to produce biodiesel. Effluent from the digester will feed algae. Oil from the algae will be converted to biodiesel. The project will take place at the Naval Base Ventura County at Port Hueneme. In full production, the system could create 3 million gallons of biodiesel and create 58 permanent jobs.

California Polytechnic State University, San Luis Obispo (ARV-10-027)

Cal Poly San Luis Obispo was awarded \$250,000 and is contributing match share of \$442,000 to investigate algae oil production for biodiesel while treating wastewater. Cal Poly SLO will use its trademarked system to run experiments to optimize lipid production and effluent quality. The algae will be separated from the water using a simple, low-cost settling process. A full-scale system would use carbon dioxide from flue gas, so that the greenhouse gas contribution would be negative. A lifecycle analysis will evaluate total energy, carbon, and water use.

East Bay Municipal Utility District (ARV-10-022)

East Bay Municipal Utility District (EBMUD) was awarded \$1,000,000 and is contributing match share of \$1,574,834 to develop a process to convert fats, oil, and grease (FOG) to biodiesel at wastewater treatment plants. EBMUD will construct a FOG receiving station with two 30,000-gallon tanks, and will investigate, test, and demonstrate cost-effective methods to harvest brown grease from FOG and to reduce the sulfur content of the biodiesel oil. If successful, the technology will produce 300,000 gallons of biodiesel per year, which EBMUD would use in its diesel trucks.

Solazyme, Inc. (ARV-10-047)

Solazyme, Inc. was awarded \$1,472,638 with a match of \$2,745,935 to design and configure a pilot scale algal oil production facility in South San Francisco. The project will grow heterotrophic algae in fermentation equipment similar to corn ethanol facilities. The algae will be fed sugars from Imperial Valley sugarbeets or an equivalent California feedstock. The renewable oil will be refined into a drop-in renewable diesel and tested at an engine test facility.

iii. Advanced ethanol awards (\$5,363,538)**AE Advanced Fuels Keyes, Inc. (ARV-11-001)**

AE Advanced Fuels Keyes (which became Aemetis, Inc. in July 2011) was awarded \$1,875,528 with match of \$2,166,635 to design and construct a pre-commercial, one million gallon per year, cellulosic ethanol facility in Keyes (near Modesto). The project will also conduct feasibility studies to investigate the availability, cost of transport, and well-to-tank greenhouse gas emissions profile of available cellulosic feedstocks, such as wheat straw, corn stover, and sugarcane bagasse.

Great Valley Energy, LLC (ARV-10-017)

Great Valley Energy, LLC was awarded \$1,989,010 in Program funding with \$1,999,790 in match funding identified. The project will identify technologies and product markets to determine the feasibility of constructing a pilot facility that will produce ethanol and other products from sweet sorghum grown in the San Joaquin Valley. Sweet sorghum is an attractive feedstock as it has the potential to replace declining cotton production, can use abandoned saline soil lands for growth, has low water requirements, and has a lower greenhouse gas emissions than corn ethanol. Additionally, the project provides a positive economic business model and will benefit a distressed economic region. Great Valley Energy estimates the production of 5.4 million gallons of ethanol per year for a commercial scale facility.

Mendota Advanced Bioenergy Beet Cooperative (ARV-10-028)

The Mendota Advanced Bioenergy Beet Cooperative (MABBC) was awarded \$1,499,000 in Program funds with \$1,553,461 in match funding identified. This project integrates four different technologies in one facility to produce advanced ethanol, renewable biomethane, compost and fertilizer, and green e-electricity with sugar beets and almond prunings as primary feedstocks. The Advanced Bioenergy Center, Mendota projects to convert 840,000 tons per year of locally-sourced sugar beets, 80,000 tons of almond prunings and other agricultural waste, into 33.5 million gallons of advanced ethanol; 6.3 megawatts of certified clean electricity; 1.6 million standard cubic feet of renewable biomethane for conversion into compressed natural gas, and high-nutrient compost and liquid fertilizer. MABBC estimates that the project will produce 325 short term jobs, 50 permanent jobs, 160 agricultural jobs, and \$90 million in revenues per year.

iv. California Ethanol Producer Incentive Program (CEPIP) (600-09-017)

The Energy Commission has an inter-agreement with the California Alternative Energy and Advanced Transportation Financing Authority to authorize up to a total of \$6,000,000 to support production facilities that have a minimum production of 10 million gallons per year of ethanol per facility. Temporary financial assistance, pending funding availability, may be available during periods of difficult economic operating conditions and would be repayable under favorable market conditions. CEPIP requires compliance with Biorefinery Operational Enhancement Goals designed to reduce carbon intensity of the fuel it produces by at least 10 percent or displace at least 20 percent of its existing feedstock with alternative feedstock. The California Alternative Energy and Advanced Transportation Financing Authority retained \$196,620 to support administration of the CEPIP. The Energy Commission subsequently entered into agreements for the following ethanol producers to participate in the CEPIP, with maximum funding amounts listed in parentheses.

Calgren Renewable Fuels, LLC (ARV-10-033)

Calgren Renewable Fuels, LLC (\$2,000,000) has the maximum capacity to produce 58 million gallons of ethanol per year, and is operating at full capacity.

Pacific Ethanol Stockton, LLC (ARV-10-030)

Pacific Ethanol Stockton, LLC (\$2,000,000) has the maximum capacity to produce 40 million gallons of ethanol per year, and is operating at full capacity.

AE Advanced Fuels Keyes, Inc. (ARV-10-031)

AE Advanced Fuels Keyes, LLC (\$1,803,380) has the maximum capacity to produce 60 million gallons of ethanol per year, and is operating at full capacity.

b. Infrastructure awards

i. Biodiesel awards (\$3,858,602)

American Biodiesel, Inc, dba Community Fuels (ARV-10-037)

American Biodiesel, Inc, dba Community Fuels was awarded \$1,999,379 to build a biodiesel terminal within the Port of Stockton. The project team is also providing \$4,980,735 in match funding. The site is strategically located in close proximity to existing fuel distribution facilities, major trucking corridors, rail lines, and marine shipping and is projected to dispense up to 75 million gallons per year.

RTC Fuels, LLC (ARV-10-008)

RTC Fuels, LLC was awarded \$1,790,000 to develop two new biodiesel blending facilities. In Sacramento, RTC is partnering with InterState Oil Company at the former McClellan Air Force Base, where it will dispense up to one million biodiesel gallons annually. The second site will be in El Cajon in San Diego County. RTC will work with SoCo Group Inc. and will dispense up to 800,000 gallons annually. The project participants are providing a minimum of \$1,143,336 match funding.

Western States Oil Company (ARV-10-019)

Western States Oil Company was awarded \$69,223 to retrofit an existing premium gasoline retail tank and dispenser into a wholesale biodiesel tank and dispenser. The site is immediately adjacent to the Kinder Morgan Pipeline Terminal in San Jose. This site is projected to dispense 5.25 million gallons of locally produced biodiesel into the Bay Area market. The project participant is providing a minimum of \$186,650 match funding.

ii. E85 station awards (\$5,000,000)

Department of General Services (ARV-09-006)

The Department of General Services (DGS) in partnership with Propel was awarded \$4,000,000 to build 75 publicly accessible E85 stations throughout California. Propel Fuels has conducted an extensive market analysis to determine the best locations for these stations that takes into account census demographic data, alternative-fuel vehicle registration

data, socio-economic segmentation data, as well as traffic pattern analyses and customer intercept research. These stations are expected to displace 24,255,000 gallons of petroleum per year, and will reduce green house gas emissions by 187,000 metric tons annually. This project will create or retain over 450 jobs while creating opportunities in at least 18 of California's 42 Enterprise Zones. Program funding will be matched with \$19,071,787 in anticipated project match funding.

Propel Fuels, Inc. (ARV-10-002)

Propel Fuels, Inc., under its "California Low Carbon Fuel Infrastructure Investment Initiative," was awarded \$1,000,000 with \$2,009,222 in match funding identified. The project will fund construction of 10 publicly accessible E85 stations to displace 3,234,000 gallons of petroleum annually at existing gas stations. Locations were selected from data provided by the Department of General Services, Caltrans, and the United States Postal Service and provide the most visibility and accessibility with the highest concentration of flex fuel vehicles. E85 stations will be located in areas that will help meet economic, educational, and social equity objectives aligned with the enterprise zones, the California Conservation Corps, and a Clean Drive Program initiative.

c. Vehicle awards (\$2,712,140)

Cummins, Inc. (ARV-10-044)

Cummins, Inc. was awarded \$2,712,140 with an equal amount of match funding. Under this project, Cummins, Inc. will develop and demonstrate a medium-duty truck powertrain optimized to lower carbon emissions by 50 to 60 percent when compared to a model year 2010 ultra-low sulfur diesel fuel based powertrain. The primary elements of the system include a "downsized" engine optimized specifically for E85 and a dedicated hybrid drive system developed specifically for the system.

d. Sustainability research (\$1,500,000)

United States Forest Service - Pacific Southwest Research Station (600-10-006)

United States Forest Service will use \$1,500,000 in funding to investigate the sustainability of forest biomass for renewable biofuel production. This will include collecting field data from forest management activities, analysis of field data, case studies of biomass utilization activities, and decision tools for future projects.

5. Hydrogen

a. Fueling Infrastructure awards (\$18,718,934)

Alameda-Contra Costa Transit District (600-10-013)

Alameda-Contra Costa Transit District, an East Bay transit authority, was awarded \$3,000,000 to build a hydrogen fueling station for buses at their Oakland facility. This station will fuel a fleet of 12 (and eventually up to 24) fuel cell buses, shared among five bay area transit agencies. The station will allow a 30 kilogram fill (one bus) to be completed in 5 to 6 minutes, which will replicate the fueling process and speed of a standard diesel bus. The fueling station will support the transit service of the buses under regular service conditions. The total anticipated match funding for this project is \$11,573,618.

Air Products and Chemicals, Inc. (ARV-10-048)

Air Products and Chemicals, Inc. was awarded \$11,231,733 for the construction and expansion of eight hydrogen fueling stations in the Los Angeles area. This project will also incorporate \$4,592,178 in match funding from the project team. The six new stations (in Beverly Hills, Hawthorne, Hermosa Beach, North Irvine, Santa Monica and West LA) and two expanded stations (at UC Irvine and in Diamond Bar) are all located in regions that have been identified by major automakers as critical markets for the early deployment of fuel cell vehicles. The six new stations will be located on the premises of existing gasoline retail stations, which will both ensure a customary, retail-like fueling experience and promote the visibility of hydrogen as an alternative fuel. When operating at full capacity, these stations will be able to each dispense 180 kilograms of hydrogen per day. Due to a unique distribution model, these stations also possess a significantly lower cost per station than previous generations of fueling stations.

Airport Commission, City and County of San Francisco (ARV-10-036)

The San Francisco International Airport (SFO) was awarded \$567,003 to complete a hydrogen fueling station adjacent to the SFO. The Energy Commission's funding will support an expansion of the station's capabilities, and allow access to necessary utilities. Major automakers identified this station as the flagship for hydrogen fueling stations in the Bay Area. Using Linde technology, the station will have a maximum capacity of approximately 240 kilograms per day of hydrogen. The total anticipated match funding for this project is \$2,601,284.

Linde, LLC (ARV-10-038)

Linde, LLC was awarded \$3,920,198 for the construction of two new hydrogen fueling stations in West Sacramento and Laguna Niguel, with \$1,306,728 in project match funding. The new West Sacramento station will serve as the primary fueling station for the greater Sacramento area, including the headquarters of the California Fuel Cell Partnership. The new Laguna Niguel station will serve the adjacent Irvine area, which was identified by major automakers as one of the primary markets for early fuel cell vehicle deployment. Both of these stations will be located on the premises of existing gasoline retail stations, which will both ensure a customary, retail-like fueling experience and promote the visibility of hydrogen as an alternative fuel. At full capacity, these stations will be able to each provide approximately 240 kilograms per day of hydrogen, representing a significant increase over previous generations of fueling stations.

b. Fuel standards development (\$4,000,000)**California Department of Food and Agriculture (600-09-015)**

The Energy Commission provided \$4,000,000 to the California Department of Food and Agriculture, Division of Measurement Standards (DMS), for the development of critical standards and certifications for hydrogen and biodiesel fuels. The current lack of a “type approval” for hydrogen means that hydrogen cannot be sold on a per-unit basis. Unless addressed, this will remain a significant barrier to the commercialization of fuel cell vehicles. Additionally, DMS will research and develop fuel quality standards for both hydrogen and biodiesel blends. DMS will also conduct research to support standards that will allow biodiesel blends greater than 20 percent to be available in a retail setting.

6. Workforce Development Agreements**a. Interagency Agreements (\$15,000,000)****California Community Colleges Chancellor’s Office (600-08-009)**

Comprised of 72 districts and enrolling more than 209 million students, the California community colleges system is the largest higher education system in the country. The Program has provided \$4,500,000 to this agency to assess industry need and develop necessary courses, instructor training and course materials. This funding will be used to assess industry training needs and develop necessary courses, instructor training and course materials to support the alternative fuel and vehicle technology industry.

California Employment Development Department (600-08-008)

The Employment Development Department (EDD) delivers pre-paid training serving as one of the world's largest public employment service operations. The EDD provides a full range of educational activities, local employer services and referrals to other service agencies throughout their network of regional One-Stop Career Centers. The EDD will also work with the California Workforce Investment Board to assist workforce development associations through the planning processes necessary to bring regional industry, educational and workforce training practitioners together to compose strategies to advance the competitive positions of their targeted industry clusters. EDD was awarded \$4.5 million to advance the green transportation industry training needs.

California Employment Training Panel (600-09-016)

This agency provides financial assistance to California businesses to support customized worker training. They play an important role in California's workforce system by assisting businesses in providing lifelong learning opportunities, co-funding training for both incumbent and unemployed workers. The Energy Commission provided \$6 million for the development of training programs consistent with the needs of alternative and renewable fuels and vehicle technology industries. Based on allocations from recent investment plans, this agreement is expected to be supplemented with \$4.28 million in additional funding at a future business meeting.

7. Other Agreements

a. Technical Assistance and Analysis (\$1,721,385)

California Department of Transportation (600-10-008)

California Department of Transportation will use \$250,000 for Renewable and Alternative Fueled Vehicle Economy & Fuel Choice and CalTrans Household Travel Survey (CHTS) - On Board Diagnostic Devices.

ICF Incorporated, LLC (600-09-002)

ICF Incorporated, LLC used \$721,388 in Program funding to evaluate fuel infrastructure program investments, and market assessments.

ICF Consulting, LLC (600-08-007)

ICF Consulting, LLC used \$99,997 in Program funding (with \$100,000 in funding from the Energy Commission's Energy Resources Program Account) to develop program performance metrics, methodology and communication plan.

Tetra Tech Inc. (600-09-003)

Tetra Tech Inc. will use \$400,000 in technical assistance to assist in proposal evaluation and project troubleshooting.

The Regents of the University of California, Irvine Campus (600-10-002)

The Regents of the University of California will use \$250,000 annually for three years to enhance the Spatially and Temporally Resolved Energy and Environment Tool (STREET) model to expand its use from the South Coast Air Basin to multiple air basins/regions throughout California and permit an analysis of several emerging alternative vehicle and fuel options.

b. Sponsorships (\$318,350)

Bevilacqua-Knight, Inc. (600-09-007)

The Energy Commission provided \$209,525 to Bevilacqua-Knight, Inc. which is the administrator of the California Fuel Cell Partnership. This will provide the Energy Commission with a three-year membership to the California Fuel Cell Partnership.

Gladstein, Neandross & Associates, LLC (600-10-009)

Gladstein, Neandross & Associates, LLC used \$50,000 in a co-sponsorship of the inaugural Alternative Clean Transportation Expo 2011 National Conference held in Long Beach on May 4-6, 2011. This national conference highlights progress in alternative and renewable fuels and advanced vehicle technologies by providing participants the opportunity to share best practices, and by showcasing the projects, awardees and stakeholders of the Energy Commission's Alternative and Renewable Fuel and Vehicle Technology Program, as well as the Air Resources Board's Air Quality Improvement Program.

Platia Productions (P.O. 10-208)

Platia Productions used \$4,950 in a co-sponsorship of the City of Santa Monica's AltCar Expo held in Santa Monica, on October 1-2, 2010. The AltCar Expo introduces the latest technologies and innovations in alternative transportation and fuels, energy efficiency and renewable energy. Santa Monica is a "Green Power Community" known for its green innovation and leadership. For that reason and others, this is a well-attended event that attracts the big original equipment manufacturers, regional fleets interested in alternative fuels, and the public.