California Energy Commission

LEAD COMMISSIONER REPORT

2015-2016 INVESTMENT PLAN UPDATE FOR THE ALTERNATIVE AND RENEWABLE FUEL AND VEHICLE TECHNOLOGY PROGRAM

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Edmund G. Brown Jr., Governor

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ABSTRACT

The *2015-2016 Investment Plan Update for the Alternative and Renewable Fuel and Vehicle Technology Program* guides the allocation of program funding for fiscal year 2015-2016. This *2015-2016 Investment Plan Update* covers the seventh year of the program and reflects laws, executive orders, and policies to reduce greenhouse gas emissions, petroleum dependence, and criteria emissions. It details how the Energy Commission, with input from stakeholders and the program Advisory Committee, determines the goal-driven priorities of the program, coupled with project opportunities for funding. These priorities are consistent with the overall goal of the program "to develop and deploy innovative technologies that transform California's fuel and vehicle types to help attain the state's climate change policies."

This *2015-2016 Investment Plan Update* establishes recommended funding allocations based on the identified needs and opportunities of a variety of alternative fuels and vehicle technologies. As an update, the *2015-2016 Investment Plan Update* relies on the narrative and analyses developed in previous investment plans, most recently the *2014-2015 Investment Plan Update.*

This Lead Commissioner Report version of the *2015-2016 Investment Plan Update* follows initial and revised staff drafts that were released in November 2014 and January 2015, respectively, with a public Advisory Committee workshop following each draft. The Lead Commissioner Report will be proposed for adoption at an Energy Commission business meeting in spring 2015.

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EXECUTIVE SUMMARY

California has adopted aggressive goals for reducing greenhouse gas emissions, including a near-term goal of reducing to 1990 levels by 2020 and a long-term goal of reducing to 80 percent below 1990 levels by 2050. Achieving these goals will require significant technological and market changes within the transportation sector, which accounts for more than a third of the state's greenhouse gas emissions. Related goals also exist for reducing criteria air pollution and increasing the prevalence of alternative fuels and vehicles. Most recently, in his second inaugural address, Governor Brown proposed three ambitious goals for reducing carbon pollution, including reducing today's petroleum use in cars and trucks by up to 50 percent within 15 years.

To help address these objectives, the California Legislature passed Assembly Bill 118 (Núñez, Chapter 750, Statutes of 2007). This legislation created the Alternative and Renewable Fuel and Vehicle Technology Program (ARFVTP), administered by the California Energy Commission. With funds collected from vehicle registration and smog fees, the ARFVTP provides up to $100 million per year for projects that will "transform California's fuel and vehicle types to help attain the state's climate change policies." The statute also calls for the Energy Commission to "develop and deploy technology and alternative and renewable fuels in the marketplace, without adopting any one preferred fuel or technology." Assembly Bill 8 (Perea, Chapter 401, Statutes of 2013) subsequently extended the collection of fees that support the ARFVTP through January 1, 2024.

As part of the ARFVTP, the Energy Commission prepares and adopts an annual investment plan update that identifies the funding priorities for the coming fiscal year. The funding allocations reflect the potential for each alternative fuels and vehicle technology to contribute to the goals of the program; the anticipated barriers and opportunities associated with each fuel or technology; the effect of other entities' investments, policies, programs, and statutes; and a portfolio-based approach that avoids adopting any preferred fuel or technology. This Lead Commissioner Report version of the *2015-2016 Investment Plan Update* follows initial and revised staff drafts that were released in November 2014 and January 2015, respectively, with a public Advisory Committee workshop following each draft. The Lead Commissioner Report will be proposed for adoption at an Energy Commission business meeting in spring 2015.

Context of the 2015-2016 Investment Plan Update

The *2015-2016 Investment Plan Update* builds on the analyses and recommendations contained in previously adopted investment plans and investment plan updates. Since the first investment plan, the Energy Commission has invested about $557 million in projects that will support alternative and renewable fuels and advanced vehicle technologies. These existing projects provide direct feedback on how the ARFVTP can maximize value in reducing near-term greenhouse gas emissions by 2020 while supporting the transformation of California's transportation sector toward fuels and technologies that can meet the more drastic emission reductions required by 2050. Projects funded by the ARFVTP are summarized in Table ES-1 and support a broad portfolio of fuel types, supply chain phases, and commercialization phases.

Table ES-1: Previous ARFVTP Awards as of 3-9-2015

Category	Funded Activity	Cumulative Awards to Date (in millions)*	# of Projects or Units
Alternative Fuel Production	Biomethane Production	$51.0	15 Projects
	Gasoline Substitutes Production	$27.3	12 Projects
	Diesel Substitutes Production	$56.7	18 Projects
Alternative Fuel Infrastructure	Electric Vehicle Charging Infrastructure	$38.3	9,369 Charging Stations
	Hydrogen Refueling Infrastructure	$85.3	48 Fueling Stations
	E85 Fueling Infrastructure	$14.6	161 Fueling Stations
	Upstream Biodiesel Infrastructure	$4.0	4 Infrastructure Sites
	Natural Gas Fueling Infrastructure	$16.1	59 Fueling Stations
Alternative Fuel and Advanced Technology Vehicles	Natural Gas Vehicle Deployment**	$64.6	4,470 Cars and Trucks
	Propane Vehicle Deployment**	$6.4	514 Trucks
	Light-Duty Electric Vehicle Deployment	$25.1	10,700 Cars
	Medium- and Heavy-Duty Electric Vehicle Deployment	$4.0	150 Trucks
	Medium- and Heavy-Duty Vehicle Technology Demonstration and Scale-Up	$58.7	31 Demonstrations
Related Needs and Opportunities	Manufacturing	$57.2	22 Manufacturing Projects
	Emerging Opportunities	†	†
	Workforce Training and Development	$25.2	55 Recipients
	Fuel Standards and Equipment Certification	$3.9	1 Project
	Sustainability Studies	$2.1	2 Projects
	Regional Alternative Fuel Readiness and Planning	$6.4	26 Regional Plans
	Centers for Alternative Fuels	$4.6	4 Centers
	Technical Assistance and Program Evaluation	$5.6	5 Agreements
Total		**$557.1**	

Source: California Energy Commission. *Includes all agreements that have been approved at an Energy Commission business meeting, or are expected for business meeting approval following a Notice of Proposed Award. For canceled and completed projects, includes only funding received from ARFVTP, which may be smaller than initial award. **Funding includes both completed and pending vehicle incentives, as well as encumbered funds for future incentives. †Previous awards have been reclassified by project type into other rows.

The funding recommendations in this draft are guided by, and complementary to, multiple energy policies and regulations, including the Low Carbon Fuel Standard administered by the California Air Resources Board (ARB), the federal Renewable Fuel Standard, and the Governor's *Zero-Emission Vehicle Action Plan.* The Low Carbon Fuel Standard provides a financial incentive based on gallons, kilowatt-hours, or therms to the producers and distributors of low-carbon alternative fuels based on the life-cycle carbon intensity of a fuel. Similarly, the federal Renewable Fuel Standard provides a direct incentive for the introduction of biofuels. Both complement the investments of the ARFVTP by creating market incentives for near-term GHG reductions and alternative fuel use, allowing the ARFVTP to focus more resources on longer-term market transformation goals. The *Zero-Emission Vehicle Action Plan*, for instance, articulates these market transformation goals as applicable for zero-emission vehicles. Governor Brown's Executive Order B-16-12 set a target of 1.5 million zero-emission vehicles on the road by 2025 and tasked various state agencies with specific actions needed to support this goal. For instance, the plan calls for developing infrastructure networks and community readiness plans for both plug-in electric vehicles and fuel cell electric vehicles, which have been priorities for the ARFVTP.

More recently, Greenhouse Gas Reduction Funds have also been allotted for low-carbon transportation projects. In fiscal year 2014-2015, for instance, the state budget allocated $200 million to the ARB for such projects. In its joint funding plan for both its Air Quality Improvement Program and its Greenhouse Gas Reduction Fund appropriation, the ARB allocated $222 million primarily toward deployment incentives for light-duty electric vehicles, pilot projects for deploying zero-emission trucks and buses, and advanced technology freight demonstration projects. Funding recommendations in this draft also take into consideration the availability of other funding programs for similar purposes to appropriately target ARFVTP funding that will maximize benefits for California. The Governor's January 2015 proposed budget for fiscal year 2015-2016 similarly contains $223 million for low-carbon transportation projects and the Air Quality Improvement Program. For 2015-2016, the ARB is initially exploring project allocations similar to those approved for fiscal year 2014-2015 while also accounting for new legislative requirements.

2015-2016 Investment Plan Update

Assembly Bill 1314 (Wieckowski, Chapter 487, Statutes of 2011) reduced the scope of the annual ARFVTP investment plan to an update. The update builds on the work of previous investment plans, while highlighting differences from those previous years. The resulting funding allocations are intended to reflect the unique technological and market hurdles for each of these fuels and technologies. These are discussed in detail in Chapters 3-6 of this revised staff draft, which describe the barriers and opportunities associated with alternative fuel production, alternative fuel distribution infrastructure, alternative fuel and advanced technology vehicles, and related activities that can accelerate progress in these areas. Table ES-2 outlines the funding allocations of the two most recent investment plan updates, in comparison to the proposed funding allocations for FY 2015-2016.

Table ES-2: Most Recent and Current Proposed Investment Plan Allocations (in millions)

Category	Funded Activity	2013-2014	2014-2015	2015-2016 (Proposed)
Alternative Fuel Production	Biofuel Production and Supply	$23	$20	$20
Alternative Fuel Infrastructure	Electric Charging Infrastructure	$7	$15	$17
	Hydrogen Refueling Infrastructure	$20	$20	$20
	Natural Gas Fueling Infrastructure	$1.5	$1.5	$5
Alternative Fuel and Advanced Technology Vehicles	Natural Gas Vehicle Incentives	$12	$10	$10
	Light-Duty Electric Vehicle Deployment	$5	$5	-
	Medium- and Heavy-Duty Vehicle Technology Demonstration and Scale-Up	$15	$15	$20*
Related Needs and Opportunities	Manufacturing	$5	$5	
	Emerging Opportunities	$4	$6	$3
	Workforce Training and Development Agreements	$2	$2.5	$3
	Regional Alternative Fuel Readiness and Planning	$3.5	-	$2
	Centers for Alternative Fuels and Advanced Vehicle Technology	$2	-	-
Total		**$100**	**$100**	**$100**

Source: California Energy Commission. *See the text of these respective sections for details on the proposal to combine these funding allocations.

As shown in Table ES-2, funding allocations for project types can change between fiscal years within the annual investment plan update. Table ES-3 summarizes the changes and justifications for changes between the previous FY 2014-2015 and FY 2015-2016 allocations.

Table ES-3: Funding Changes From FY 2014-2015 to FY 2015-2016

Funded Activity	2014-2015	2015-2016	Summary of Change
Electric Charging Infrastructure	$15 Million	$17 Million	This increase reflects the need to stay ahead of a steady acceleration of plug-in electric vehicle sales within the state.
Natural Gas Fueling Infrastructure	$1.5 Million	$5 Million	This increased allocation helps target a greater share of this program's air pollution reductions toward disadvantaged communities and vehicle duty cycles (such as school buses and municipal fleets), where zero-emission vehicles are not yet as available or practical.
Light-Duty Electric Vehicle Deployment	$5 Million	-	The availability of Greenhouse Gas Reduction Funds to supplement the Air Resources Board's Clean Vehicle Rebate Project eliminates the need for supplemental funding from this program.
Medium- and Heavy-Duty Vehicle Technology Demonstration and Scale-Up	$15 Million	$ 20 Million	Merging these categories will allow future recipients to have a smoother transition from small-scale demonstrations to ramping up for larger demonstrations and pilot projects.
Manufacturing	$5 Million		
Emerging Opportunities	$6 Million	$3 Million	A significant share of the previous year's funds is still available.
Workforce Training and Development Agreements	$2.5 Million	$3 Million	Based on the estimated demand for new training projects by the Energy Commission's agency partners.
Regional Alternative Fuel Readiness and Planning	-	$2 Million	There is increasing interest from local governments in developing and implementing local plans for zero-emission vehicles.

Source: California Energy Commission.

CHAPTER 1: Introduction

"We face an existential challenge with the changes in our climate. The time to act is now. The place to look is California."
– Governor Edmund G. Brown Jr.[1]

Since the passage of Assembly Bill 32 (Núñez, Chapter 488, Statutes of 2006), also known as the Global Warming Solutions Act of 2006, California has held a leading role in the pursuit of reduced greenhouse gas (GHG) emissions. With its passage, California established a goal of reducing GHG emissions to 1990 levels by 2020. In 2005, Executive Order S-3-05 also set a longer-term goal for reducing GHG emissions to 80 percent below 1990 levels by 2050.

In March 2014, the California Air Resources Board (ARB) updated its GHG inventory for California, indicating that the transportation sector was responsible for about 37 percent of all in-state GHG emissions as late as 2012. This makes it the largest emitting sector, even without accounting for transportation-related emissions associated with refineries or oil and gas extraction.[2] As Governor Brown acknowledged in his 2014 State of the State address, "In terms of greenhouse gases, our biggest challenge remains the amount of gasoline Californians use."[3]

Other aspects of the transportation sector similarly challenge California's future health and economic prosperity. In the American Lung Association's 2014 *State of the Air* report, California metropolitan areas represented the top five "Most Polluted Cities," with the worst pollution from both ozone and particle pollution (including Fresno-Madera, Visalia-Porterville-Hanford, Bakersfield, Los Angeles-Long Beach, Modesto-Merced and Sacramento-Roseville).[4] In the future, to meet federal Clean Air Act standards in two of California's most heavily polluted air basins, the transportation sector may need to reduce oxides of nitrogen (NO_X) by almost 90

1 Governor Edmund G Brown Jr., September 19, 2014. Comments ahead of United Nations Secretary-General's Climate Leadership Summit.

2 ARB, "California Greenhouse Gas Emission Inventory,"http://www.arb.ca.gov/cc/inventory/inventory_current.htm.

3 Governor Edmund G Brown Jr., State of the State Address, January 22, 2014. Available at http://gov.ca.gov/news.php?id=18373.

4 American Lung Association, *State of the Air 2014*, 2014. Available at http://www.stateoftheair.org/2014/assets/ALA-SOTA-2014-Full.pdf.

percent below 2010 levels by 2032.[5] These air quality impacts may be further exacerbated by drier, hotter weather caused by climate change.

California is also economically dependent on a single source of transportation fuel: petroleum. Californians rely on petroleum-derived gasoline and diesel for roughly 92 percent of their on-ground transportation energy. This is a slight decrease from previous years, owing to the steady growth of alternative fuels. Nevertheless, this continued reliance can create significant problems when the price of petroleum swings.

Table 1 summarizes California's major policy goals and milestones developed in response to these challenges.

Table 1: Greenhouse Gas, Fuel, and Air Quality Goals and Milestones

Policy Origin	Objectives	Goals and Milestones
AB 32	GHG Reduction	Reduce GHG emissions to 1990 levels by 2020
Executive Order S-3-05	GHG Reduction	Reduce GHG emissions to 80 percent below 1990 levels by 2050
Low Carbon Fuel Standard	GHG Reduction	Reduce carbon intensity of transportation fuels in California by 10 percent by 2020
State Alternative Fuels Plan	Petroleum Reduction	Reduce petroleum fuel use to 15 percent below 2003 levels by 2020**
Bioenergy Action Plan	In-State Biofuels Production	Produce in California 20 percent of biofuels used in state by 2010, 40 percent by 2020, and 75 percent by 2050
Energy Policy Act of 2005; Energy Independence and Security Act of 2007	Renewable Fuel Standard	36 billion gallons of renewable fuel by 2022 nationally
Clean Air Act	Air Quality	80 percent reduction in NO_x by 2023
California Air Resources Board's Zero-Emission Vehicle Mandate; California Executive Order B-16-2012	Increased Zero-Emission Vehicles	Infrastructure to accommodate 1 million electric vehicles by 2020 and 1.5 million electric vehicles by 2025 in California*

Source: California Energy Commission. *Senate Bill 1275 (De León, Chapter 530, Statutes of 2014) subsequently established a target of 1 million zero-emission and near-zero emission vehicles in California by 2023, as well as increasing access to such vehicles for disadvantaged, low-income, and moderate-income communities and consumers. **In his second inaugural address, Governor Brown also proposed a goal of reducing petroleum use in cars and trucks by up to 50 percent within 15 years.

To help address these objectives, the California Legislature passed Assembly Bill 118 (Núñez, Chapter 750, Statutes of 2007). This legislation created the Alternative and Renewable Fuel and Vehicle Technology Program (ARFVTP), administered by the California Energy Commission. With funds collected from vehicle registration and smog fees, the ARFVTP provides up to $100 million per year for projects that will "transform California's fuel and vehicle types to help attain the state's climate change policies." This program includes projects that:

5 California Air Resources Board, South Coast Air Quality Management District, San Joaquin Valley Unified Air Pollution Control District, *Vision for Clean Air: A Framework for Air Quality and Climate Planning – Public Review Draft*, June 27, 2012. Available at http://www.arb.ca.gov/planning/vision/docs/vision_for_clean_air_public_review_draft.pdf.

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

The statute also calls for the Energy Commission to "develop and deploy technology and alternative and renewable fuels in the marketplace, without adopting any one preferred fuel or technology."[6] Assembly Bill 8 (Perea, Chapter 401, Statutes of 2013) subsequently extended the collection of fees that support the ARFVTP through January 1, 2024.

As part of the ARFVTP, the Energy Commission prepares and adopts an annual investment plan update that identifies the funding priorities for the coming fiscal year. The funding allocations reflect the potential for each alternative fuels and vehicle technology to contribute to the goals of the program; the anticipated barriers and opportunities associated with each fuel or technology; the effect of other entities' investments, policies, programs, and statutes; and a portfolio-based approach that avoids adopting any preferred fuel or technology. The investment plan update also describes how the proposed allocations will complement existing public and private efforts, including related state programs.

The *2015-2016 Investment Plan Update* will be the seventh investment plan document in the history of the program and builds on the analyses and recommendations contained in these previously adopted investment plans and investment plan updates. This revised staff draft of the *2015-2016 Investment Plan Update* follows the release of an initial staff draft in November 2014 and a public Advisory Committee workshop that same month. Prior to the adoption of a final version at an Energy Commission business meeting, the Energy Commission plans to release a Lead Commissioner Report version. This process will also include at least one additional public workshop with the ARFVTP Advisory Committee, which includes representatives from fuel and technology industry groups, nongovernmental entities, and other state agencies. The Energy Commission also seeks comment on the *2015-2016 Investment Plan Update* from a public docket

6 California Health and Safety Code Section 44272(a).

and ongoing outreach.[7] State law requires the Energy Commission to submit a draft of the investment plan update to the Legislature concurrent with the Governor's budget in January and an adopted investment plan update concurrent with the Governor's revised budget in May.

Chapter 2 of this document provides an update on the Energy Commission's implementation of the ARFVTP to date, as well as a review of the most relevant programs, policies, and regulations that affect the allocations of this investment plan update. The subsequent contents are organized according to the traditional supply chain of alternative fuels. Chapter 3 addresses the barriers and opportunities associated with alternative fuel production and supply within California, Chapter 4 focuses on the distribution of that alternative fuel and associated refueling infrastructure, and Chapter 5 focuses on the vehicles that will use the alternative fuels and advanced technologies. Chapter 6 identifies related activities and investments that can expedite the development and deployment of alternative fuels and advanced technology vehicles. Finally, Chapter 7 summarizes the funding allocations proposed in this staff draft.

All allocations in this staff draft assume a complete $100 million appropriation for the ARFVTP, and the Energy Commission currently expects to be fully funded for fiscal year 2015-2016. However, in the event that less than $100 million is available, the Energy Commission may amend the allocations in this investment plan update after it is adopted in spring 2015. These allocations are also subject to change in future drafts of this investment plan and are not official until the investment plan has been officially approved at an Energy Commission business meeting. Future developments, including the potential availability of funding from the Greenhouse Gas Reduction Fund for these or related categories, may prompt a need for modifications to these allocations before business meeting approval.

7 The Energy Commission encourages written comments on the development of the *2015-2016 Investment Plan Update*. Please include your name or the name of your organization in the name of the attached file. Send your comments as either a Microsoft Word document or a Portable Document Format file (PDF) to docket@energy.ca.gov. In the subject line, please include the docket number 14-ALT-01.

CHAPTER 2:
Context of the *2015-2016 Investment Plan Update*

Implementation of the Alternative and Renewable Fuel and Vehicle Technology Program

Since the beginning of the ARFVTP, the Energy Commission has developed a consistent approach toward program implementation, summarized in Figure 1. An annual investment plan update determines the coming fiscal year's funding allocation for categories of projects and is adopted at an Energy Commission business meeting.[8] Funding allocations are initially proposed by Energy Commission staff based on the GHG emission reduction potential of alternative fuels and technologies (both near-term and long-term), identification of the primary market and/or technological barriers, evaluation of complementary funding or regulations, consideration of policy priorities, and a statutory directive to maintain a "portfolio-based approach." Prior to official adoption by the Energy Commission, the investment plan update is proposed and revised across several drafts and benefits from stakeholder input at public Advisory Committee workshops.

Each investment plan update identifies funding allocations for particular segments of the supply chain for alternative fuel or vehicle technologies. They typically do not, however, determine the specific focus of future funding solicitations. Based on these funding allocations, the Energy Commission subsequently issues a series of competitive solicitations, known as Program Opportunity Notices (PONs, usually designated as "PON-[Year]-XXX"). Each solicitation has a set of scoring criteria that reflect project selection preferences established by statute.[9] Cost-related scoring criteria are generally given more weight for commercially mature technologies. Priority is also given to projects that will benefit areas with poor air quality or economic disadvantage. Some solicitations are first-come, first-served and establish minimum requirements that must be achieved to be eligible for funding.

Energy Commission staff reviews, scores, and ranks the proposals for each solicitation using the evaluation criteria developed for that particular solicitation. Outside agencies and contractors may also provide technical assessments of the proposals. Based on the total scores of each application, the Energy Commission releases a Notice of Proposed Awards (NOPA) for each solicitation. The NOPA ranks each application by score and provides a proposed funding amount for each proposal in order of score until available funding has been depleted. For specialized agreements with certain partner agencies, such as the California Employment

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8 The most recently adopted investment plan update, covering fiscal year 2014-2015, was adopted at the April 22, 2014, Energy Commission Business Meeting. It is available at http://www.energy.ca.gov/2013-ALT-02/documents/.

9 These preference criteria are listed in Health and Safety Code Section 44272 (c) and (d).

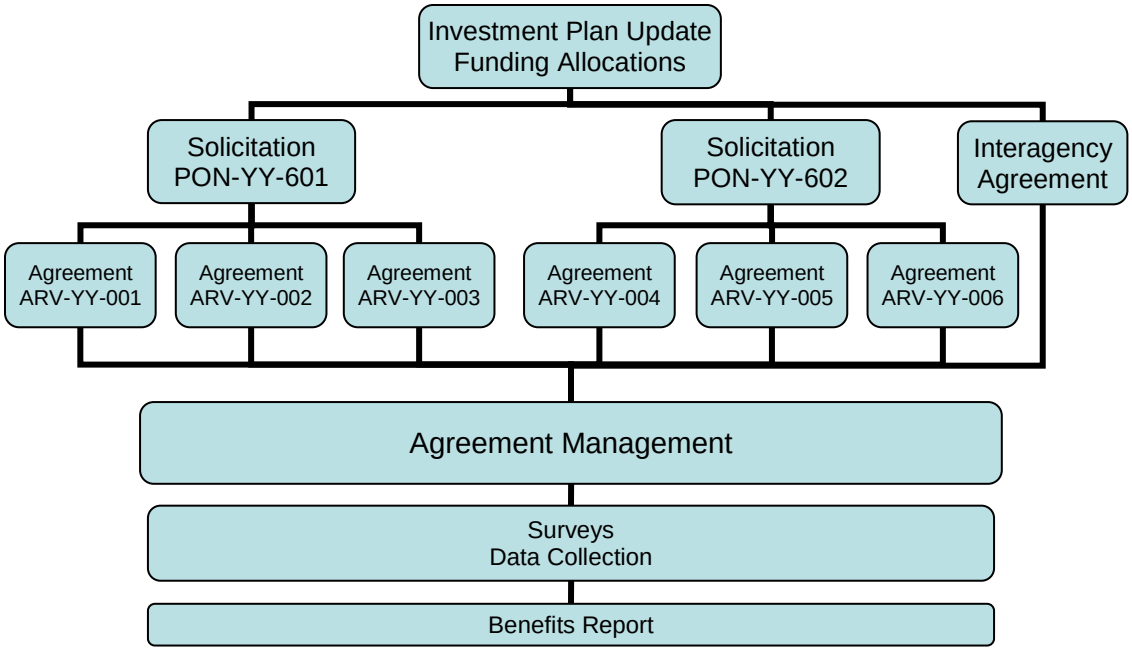
Training Panel, the University of California campuses, and the Division of Measurement Standards, the Energy Commission has the discretion to develop an interagency agreement without using the solicitation process.

Assembly Bill 8 added a "benefit-cost score" element to the process of selecting projects for ARFVTP funding. This addition factors into the scoring and selection of projects during the proposal review period of a solicitation. The benefit-cost score is defined as "…a project's expected or potential greenhouse gas emissions reduction per dollar awarded by the commission to the project." The new legislation requires the Energy Commission to rank applications for funding based on existing solicitation scoring criteria, with "additional preference to funding those projects with higher benefit-cost scores." In recent solicitations, this preference has been incorporated both as part of the general scoring criteria and as a potential tie-breaker in the event of proposals receiving equal scores.

Each funded application becomes an agreement (usually designated as "ARV-[Year]-XXX") once it has been executed by the Energy Commission and the original applicant. Energy Commission staff oversees the completion of these agreements according to the respective schedules, budgets, scopes of work, and terms and conditions of these agreements.

Data collection and project review are also key parts of ARFVTP implementation. The Energy Commission periodically surveys funding recipients on the anticipated results of their projects, with a broad array of questions relating to alternative fuel use, petroleum displacement, GHG emission reductions, and in-state economic benefits. The Energy Commission also continues to collect data from funding recipients after completion of a project, typically for six months. Information from all these efforts feeds into the development of a biennial ARFVTP benefits report, as well as other ARFVTP measurement, verification, and evaluation efforts.

Figure 1: Schematic of ARFVTP Implementation



Source: California Energy Commission.

In October 2014, Energy Commission staff held a series of public outreach workshops across the state on the ARFVTP and how organizations can participate in the program's grant solicitation process. In scheduling the workshops, staff focused specifically on economically disadvantaged and/or environmentally impacted parts of the state. In addition to general programmatic outreach, the Energy Commission has also previously sought comments on the development of funding solicitations prior to release. For example, in 2013, staff held presolicitation public workshops focused on hydrogen refueling stations, medium- and heavy-duty vehicle demonstration projects, biofuel production projects, and centers for alternative fuels.[10] Several entities have similarly provided comments for future funding solicitations during the development of the *2015-2016 Investment Plan Update*, which will be considered as staff develops the relevant solicitations.

Alternative Funding and Financing Mechanisms

The aforementioned competitive solicitation for grants has been the predominant funding mechanism for ARFVTP to date. However, as the Energy Commission gains experience implementing the ARFVTP, and alternative fuels and technologies advance in the marketplace,

10 Presentations, transcript, and recordings of on previous and upcoming ARFVTP funding solicitations are available at http://www.energy.ca.gov/altfuels/notices/index.html. Individuals wishing to receive information about future ARFVTP workshops are also encouraged to subscribe to the Altfuels list server located at http://www.energy.ca.gov/altfuels/.

the Energy Commission is also exploring alternative funding and financing mechanisms. Each of these mechanisms has respective strengths and weaknesses; the Energy Commission weighs these options ahead of developing the funding implementation strategy for each allocation. In general, the most important factor in considering the appropriate funding mechanism for an activity has been the relative technological and market maturity of the fuel or technology. The more mature a fuel or technology, the more appropriate it may be to use alternative mechanisms.

The most prominent funding mechanisms used for the ARFVTP by the Energy Commission to date are described below. At an April 2014 workshop on the development of the Energy Commission's *2014 Integrated Energy Policy Report*, multiple stakeholders encouraged ARFVTP staff to further explore these and other funding mechanisms.[11]

- Competitive Solicitation for Grants – This type of solicitation represents the most common funding mechanism for the ARFVTP to date. It is flexible, as project requirements and scoring criteria can be adapted for a broad variety of commercial and technological maturity levels. Competitive scoring across the scoring criteria allows for increased scrutiny on key issues for each project type. However, because of the amount of time and attention required to review each application (and oversee each subsequent award), this approach is more manageable when funding larger projects (typically at least several hundreds of thousands of dollars). The specific time window for applying under these solicitations, as well as the uncertainty of receiving an award, may also provide greater uncertainty for alternative fuel project investors.
- Competitive Solicitation for Federal Cost-Sharing – Similar to above, but with a specific emphasis on applications that can demonstrate federal cost-sharing opportunities. This solicitation can provide an additional economic benefit to the ARFVTP portfolio by encouraging federal investment within the state; however, it also more difficult to coordinate and plan, as federal solicitations come and go throughout the year.
- First-Come, First-Served – This type of funding mechanism has been used primarily for vehicle incentives by both the Energy Commission's ARFVTP and the ARB's Air Quality Improvement Program. Once eligibility requirements are established, the funding can be administered relatively quickly and can provide greater market certainty for a project type. However, without a method for evaluating the funding need for each project, these incentives may fund activities that would have already occurred without public investment. The first applicants in line for funding are likely to be those who are already the most interested in the activity.
- Production or Operation Incentives – To date, the Energy Commission has used these types of incentives for both in-state ethanol production and hydrogen refueling station operation and maintenance. The primary aim of these incentives is to provide greater

11 Presentations, transcript, and recording of this workshop are available at http://www.energy.ca.gov/2014_energypolicy/documents/#04232014.

market certainty, which allows for further outside investment. This funding typically requires commercial operation and would be poorly suited for projects focused more on technological research, development, or demonstration. It is also important that the ARFVTP seek options that limit such support to finite amounts of time or funding and avoid providing a perpetual subsidy without encouraging market expansion.

- Loan Loss Reserve/Loan Guarantees – While yet untested by the ARFVTP, these financing types may increase the opportunity to leverage private financing and transition alternative fuel and vehicle investments from public to private sources. At its March 2015 Business Meeting, the Energy Commission approved the development of a $2 million pilot financing program with the California Pollution Control Authority to administer a financing program for electric vehicle charging stations. This financing program will incentivize lenders to finance the acquisition and installation of electric vehicle charging stations by eligible small businesses in California. Other mechanisms such as loan guarantees might also be considered as technologies and markets mature. Similar considerations have also been proposed for commercial-scale biofuel production projects as they expand beyond the scope of reasonable ARFVTP grant sizes.

Program Outreach and Inclusion

The Energy Commission is committed to ensuring that a diverse range of applicants have the opportunity to participate in ARFVTP projects, including small businesses, women, minorities, and disabled veterans, and is similarly committed to increasing their ARFVTP participation rates. During legislative testimony and at other public forums, Commissioner Scott has reiterated her commitment of targeted outreach to these communities to ensure a broad and diverse range of applicants in the ARFVTP. The Energy Commission also seeks to increase the participation of disadvantaged and underrepresented communities from a diverse range of geographical regions while implementing the ARFVTP. This includes:

- Initiating and implementing an outreach plan to ensure that a diverse range of potential applicants know about, and understand how to participate in, ARFVTP activities, especially solicitations for projects.
- Targeting particular geographic regions within the state for certain program activities (for example, job training or workforce planning efforts in economically depressed communities).
- Including initiatives addressing transportation energy-related challenges and opportunities in economically depressed communities.
- Reaching out to women, minority, and disabled veteran groups, sharing information from the ARFVTP webpage and encouraging their presence and participation in ARFVTP workshops. These groups included:
    - All 35 local Air Districts
    - Legislative staff, to share with their constituents.

- The African American, Hispanic, and Asian chambers of commerce in California.
- The Association of Women in Water, Energy, and Environment.
- California Association of Black Lawyers.
- California Minority Counsel Program staff.
- Hispanic Bar Association of Orange County.
- National Association of Black Accountants.
- National Society of Black Engineers.
- Southern California Chapter of American Association of Blacks in Energy.
- Three Squares, Inc.

- Hosting five public outreach workshops around the state (Sacramento, Fresno, Oakland, Los Angeles and San Bernardino) in October 2014, explaining the ARFVTP application process and highlighting the Energy Commission's commitment to diversity in the ARFVTP.
- Distributing ARFVTP information at key expositions and conferences throughout the state.
- Developing and posting online "Grant Funding Opportunities 101," a presentation on how to apply for ARFVTP funding.[12]

In addition to the above actions, the Energy Commission has also provided preferences for projects located in or benefitting disadvantaged communities, as defined by the CalEnviroScreen 2.0 tool available online from California's Office of Environmental Health Hazard Assessment.[13] These preferences were used in recent solicitations, including:

- Centers for Alternative Fuels and Advanced Vehicle Technology (PON-13-605)
- Electric Vehicle Charging Infrastructure (PON-13-606)
- Pilot-Scale and Commercial-Scale Advanced Biofuels Production Facilities (PON-13-609)
- Advanced Vehicle Technology Manufacturing (PON-14-604)
- Medium-and Heavy-Duty Advanced Vehicle Technology Demonstration (PON-14-605)
- Centers for Alternative Fuels and Advanced Vehicle Technology in Central California (PON-14-606)

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12 California Energy Commission, "Grant Funding Opportunities 101: Alternative and Renewable Fuels and Vehicle Technology Program," October 2014. Available at http://www.energy.ca.gov/altfuels/notices/2014-10_workshops/ARFVTP_Solicitation_Grant_Tutorial.pdf.

13 Office of Environmental Health Hazard Assessment, "CalEnviroScreen 2.0," updated October 2014. Available at http://oehha.ca.gov/ej/ces2.html.

In the future, the Energy Commission plans to continue and enhance existing efforts and implement new activities to ensure that participation in the ARFVTP reflects the rich and diverse characteristics of California and its people. These plans include but are not limited to:

- Targeting particular geographic regions within California for a variety of program activities that will further the Energy Commission's outreach efforts, especially in Southern California and the Central Valley.
- Continuing to meet with small businesses, veteran, women, minority, and other interested groups to provide informational materials on partnering for success through the ARFVTP. The materials will also be available on the webpage.
- Continuing to hold pre-application and pre-bid workshops to explain requirements for grant and contract funding opportunities, answer questions, and encourage networking and partnering among potential applicants.

Summary of Program Funding

As of October 2014, the Energy Commission has issued or proposed roughly $557 million in ARFVTP funding across 462 agreements. These agreements are summarized by project type in Table 2 and support a broad portfolio of fuel types, supply chain phases, and commercialization phases. In most cases, projects are still in progress: production facilities are still being sited and constructed, infrastructure is still being installed, and vehicles are still being demonstrated or deployed. Major highlights of the ARFVTP funding portfolio to date include:

- 45 projects to promote the production of sustainable, low-carbon biofuels within California. Most will use waste-based feedstocks, which contribute to some of the lowest carbon-intensity pathways recognized under the Low Carbon Fuel Standard. Furthermore, 18 will expand biofuel production at commercial scale, allowing California to expand its biofuel production capacity by 88 million diesel-equivalent gallons per year.
- 9,369 installed and planned charging points for plug-in electric vehicles, including 5,127 residential charging points, 4,129 commercial and workplace charging points, and 113 direct current (DC) fast chargers.
- 48 new or upgraded hydrogen refueling stations that will help serve a nascent population of fuel cell electric vehicles, plus the development of retail fueling standards to enable hydrogen sales on a per-kilogram basis.
- 31 projects to demonstrate zero- and near-zero-emission advanced technologies and alternative fuels in a variety of medium- and heavy-duty vehicle applications.
- 4,470 natural gas vehicles now or soon-to-be in operation in a variety of applications, including roughly 2,600 medium- or heavy-duty trucks.

- 58 natural gas fueling stations to support a growing population of natural gas vehicles. These include at least five stations that will incorporate low-carbon biomethane into some, if not all, of the dispensed fuel.
- $24.5 million to fund nearly 10,700 incentives for all-electric and plug-in hybrid electric vehicles via the Air Resources Board's Clean Vehicle Rebate Project. An additional $24.5 million transferred from the ARFVTP fund to the Air Quality Improvement Program fund will likely cover an additional 12,400 vehicle incentives.
- 22 manufacturing projects that will support in-state economic growth while simultaneously reducing the supply-side barriers for alternative fuels and advanced technology vehicles, primarily in electric drive-related components and vehicles.
- Workforce training for 13,674 trainees and more than 600 businesses that will translate California's clean technology investments into sustained employment opportunities.
- 18 plug-in electric vehicle readiness planning grants to help regions plan for vehicle deployment, new charging infrastructure, and permit streamlining. Six other planning grants have also been issued for multiple alternative fuels, and one has been issued specifically for hydrogen in the early deployment area for fuel cell electric vehicles.

The details associated with each project type are discussed further in respective sections of this draft investment plan update. In addition, Table 3 outlines the funding allocations of the two most recent investment plan updates, in comparison to the funding allocations for fiscal year (FY) 2015-2016.

Table 2: Previous ARFVTP Awards as of 3-9-2015

Category	Funded Activity	Cumulative Awards to Date (in millions)*	# of Projects or Units
Alternative Fuel Production	Biomethane Production	$51.0	15 Projects
	Gasoline Substitutes Production	$27.3	12 Projects
	Diesel Substitutes Production	$56.7	18 Projects
Alternative Fuel Infrastructure	Electric Vehicle Charging Infrastructure	$38.3	9,369 Charging Stations
	Hydrogen Refueling Infrastructure	$85.3	48 Fueling Stations
	E85 Fueling Infrastructure	$14.6	161 Fueling Stations
	Upstream Biodiesel Infrastructure	$4.0	4 Infrastructure Sites
	Natural Gas Fueling Infrastructure	$16.1	59 Fueling Stations
Alternative Fuel and Advanced Technology Vehicles	Natural Gas Vehicle Deployment**	$64.6	4,470 Cars and Trucks
	Propane Vehicle Deployment**	$6.4	514 Trucks
	Light-Duty Electric Vehicle Deployment	$25.1	10,700 Cars
	Medium- and Heavy-Duty Electric Vehicle Deployment	$4.0	150 Trucks
	Medium- and Heavy-Duty Vehicle Technology Demonstration and Scale-Up	$58.7	31 Demonstrations
Related Needs and Opportunities	Manufacturing	$57.2	22 Manufacturing Projects
	Emerging Opportunities	†	†
	Workforce Training and Development	$25.2	55 Recipients
	Fuel Standards and Equipment Certification	$3.9	1 Project
	Sustainability Studies	$2.1	2 Projects
	Regional Alternative Fuel Readiness and Planning	$6.4	26 Regional Plans
	Centers for Alternative Fuels	$4.6	4 Centers
	Technical Assistance and Program Evaluation	$5.6	5 Agreements
Total		**$557.1**	

Source: California Energy Commission. *Includes all agreements that have been approved at an Energy Commission business meeting, or are expected for business meeting approval following a Notice of Proposed Award. For canceled and completed projects, includes only funding received from ARFVTP, which may be smaller than initial award. **Funding includes both completed and pending vehicle incentives, as well as encumbered funds for future incentives. †Previous awards have been reclassified by project type into other rows.

Table 3: Most Recent and Current Proposed Investment Plan Allocations (in millions)

Category	Funded Activity	2013-2014	2014-2015	2015-2016 (Proposed)
Alternative Fuel Production	Biofuel Production and Supply	$23	$20	$20
Alternative Fuel Infrastructure	Electric Charging Infrastructure	$7	$15	$17
	Hydrogen Refueling Infrastructure	$20	$20	$20
	Natural Gas Fueling Infrastructure	$1.5	$1.5	$5
Alternative Fuel and Advanced Technology Vehicles	Natural Gas Vehicle Incentives	$12	$10	$10
	Light-Duty Electric Vehicle Deployment	$5	$5	-
	Medium- and Heavy-Duty Vehicle Technology Demonstration and Scale-Up	$15	$15	$20*
Related Needs and Opportunities	Manufacturing	$5	$5	
	Emerging Opportunities	$4	$6	$3
	Workforce Training and Development Agreements	$2	$2.5	$3
	Regional Alternative Fuel Readiness and Planning	$3.5	-	$2
	Centers for Alternative Fuels and Advanced Vehicle Technology	$2	-	-
Total		**$100**	**$100**	**$100**

Source: California Energy Commission. *See the text of these respective sections for details on the proposal to combine these funding allocations.

ARFVTP Benefits and Evaluation

The Energy Commission periodically reviews and evaluates its implementation of the ARFVTP to improve program efficiency, identify future funding needs, and select higher-quality projects. Much of this can be done in-house by reviewing previous investment plans, reviewing funding solicitations, comparing past awards, visiting sites, surveying ARFVTP grantees, and performing other program analyses.

Benefit-Cost Assessments

AB 8 introduced a new element into the list of policy and scoring preferences for ARFVTP: the GHG benefit-cost score. This is defined as "…a project's expected or potential greenhouse gas emissions reduction per dollar awarded by the Commission to the project."[14] AB 8 also directs the Energy Commission to "give additional preference to funding those projects with higher benefit-cost scores."[15] Energy Commission staff interprets the new benefit-cost provision as a preference to be applied when evaluating proposals for similar types of projects during funding solicitations.[16]

At a June 12, 2014, workshop for the *2014 Integrated Energy Policy Report Update* (*2014 IEPR Update*), Energy Commission staff presented examples of how GHG benefit-cost scores might be estimated and received feedback from related agencies, academic institutions, and other stakeholders. Based on the analysis and comments provided at the workshop, Energy Commission staff will continue to incorporate benefit-cost measurement and scoring into the development of solicitations and the review of submitted proposals. The "benefit" is calculated as the amount of conventional fuel displaced per year by the resulting alternative fuel or technology, multiplied by the carbon intensity of that fuel or technology relative to conventional fuel. This results in an estimate of direct GHG reduction benefits from a proposed project. The "cost" is based on the requested ARFVTP funding amount. Dividing the "benefit" by the "cost" produces a benefit-cost ratio that staff uses as one among several scoring criteria in ranking similar proposals within a competitive solicitation.

Benefit-cost ratio is one of several project selection criteria established in statute and is accordingly just one of several criteria used to evaluate project applications. The benefit-cost ratio is given greater scoring weight in solicitations that focus on technologically mature and commercially established project types. Conversely, the benefit-cost ratio is given smaller weighting in solicitations that focus on precommercial or evolving technologies. In recent solicitations, this preference has also been incorporated both as part of the general scoring criteria and as a potential tie-breaker in the event of proposals receiving equal scores.

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14 Health and Safety Code, Sec. 44270.3(a).

15 CH&S Code 44272(d).

16 Charles Smith, California Energy Commission, staff presentation at the June 12, 2014, IEPR workshop.

The *2014 Draft Integrated Energy Policy Report Update* was released in November 2014 and incorporates comments on benefit-cost assessments from outside stakeholders at the aforementioned June 2014 workshop. Representatives from federal and state agencies, air quality agencies, environmental groups, and academia provided additional insights on how the ARFVTP might apply metrics and other assessments to its funding decisions. The draft is now available online for review and will be subsequently revised for possible adoption at a Commission business meeting in February 2014.[17]

National Renewable Energy Laboratory

The Energy Commission has also worked with the National Renewable Energy Laboratory (NREL) to develop an approach for quantifying the petroleum displacement, GHG reduction, and air quality benefits of projects funded by the ARFVTP. In June 2014, NREL issued a *Program Benefits Guidance* draft report on the potential benefits associated with 274 projects supported through $488 million in ARFVTP funding.[18] The *Program Benefits Guidance* document provides support for the *2014 IEPR Update*, which has a special focus on transportation. Since then, NREL has periodically provided updated benefits estimates based on new project information and most recently looked at 290 projects totaling $515 million in ARFVTP funding. Of these, 223 projects totaling $458 million were evaluated to determine benefits.

In reviewing ARFVTP benefits, NREL identified four relevant benefit categories, as summarized in Table 4. These categories range from benefits with relatively high levels of certainty about past trends and near-term projects to benefits with high levels of uncertainty regarding technological innovation and market transformation. The first category, Baseline Benefits, is a conceptual category that represents GHG reductions ***without*** ARFVTP projects. Since its report focused on benefits associated with ARFVTP, NREL focused on other categories within the report.

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17 California Energy Commission. 2014. *2014 Draft Integrated Energy Policy Report Update.* Publication Number: CEC-100-2014-001-D. Available at http://www.energy.ca.gov/2014publications/CEC-100-2014-001/CEC-100-2014-001-D.pdf.

18 Melaina, Marc, Ethan Warner, Yongling Sun, Emily Newes, and Adam Ragatz (National Renewable Energy Laboratory). 2013. *Program Benefits Guidance: Analysis of Benefits Associated With Projects and Technologies Supported by the Alternative and Renewable Fuel and Vehicle Technology Program.* California Energy Commission. Publication Number: CEC-600-2014-005-D. Available at http://www.energy.ca.gov/2014publications/CEC-600-2014-005/CEC-600-2014-005-D.pdf.

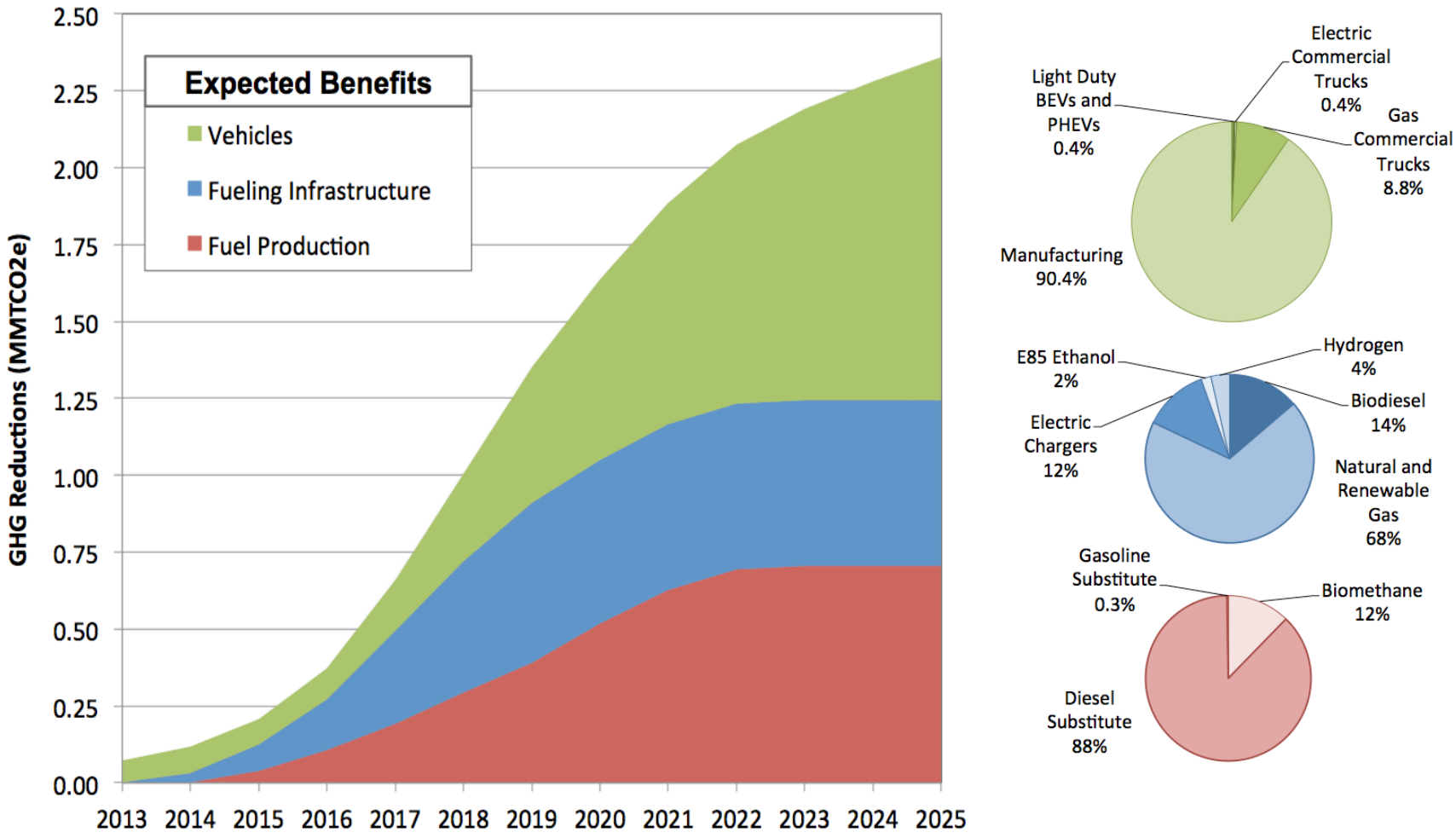
Table 4: Benefit Categories in NREL *Program Benefits Guidance*

Benefits Category	Description	Range of Certainty Levels
Baseline Benefits	Expected to accrue without support from ARFVTP.	Near-term; More certainty from direct benefits ↕ Long-term; Less certainty from innovation and transformation
Expected Benefits	Directly associated with vehicles and fuels deployed by projects receiving ARFVTP funds.	
Market Transformation Benefits	Accrued due to influence of ARFVTP projects on future market conditions to accelerate the adoption of new technologies.	
Required Carbon Market Growth Benefits	Projections of future market growth trends comparable to those needed for deep GHG reductions by 2050.	

Source: California Energy Commission, based on categories developed by NREL.

The second category, Expected Benefits, is defined as the benefits most likely to occur from ARFVTP projects being executed successfully, assuming a one-to-one substitution of existing fuel or technology with a new fuel or technology. Figure 2 summarizes the estimated GHG emission reductions from the Expected Benefits category through 2025.

Figure 2: Summary of GHG Emissions Reductions From the Expected Benefits of 223 Projects Through 2025



Source: NREL

The third category of benefits considered by NREL, Market Transformation Benefits, is based upon more hypothetical estimates of how ARFVTP-funded projects will contribute to reducing the barriers of ***future*** alternative fuel and technology deployments. Many of these benefits are therefore "second order" benefits that follow up on the successes of ARFVTP projects. Because of the greater uncertainty from this type of benefit, NREL incorporated a low and high range.

Table 5: Summary of GHG Emission and Petroleum Fuel Reduction Benefits Based on 223 Projects

Category	Project Class / Range	GHG Reductions (thousand tonnes CO2e)			Petroleum Reductions (million gallons)		
		2015	2020	2025	2015	2020	2025
Expected Benefits	Fueling Infrastructure	84.4	531.3	540.6	20	97.8	101.7
	Vehicles	85.1	585.4	1,113.1	20.9	60.5	141.2
	Fuel Production	39.9	519.7	705.1	3.6	36.4	65.6
	TOTAL	209.4	1,636.4	2,358.8	44.5	194.7	308.5
Market Transformation Benefits	Low Case	255.6	546.1	1,000.2	30.5	70.8	132.3
	High Case	470.6	1,847.5	2,944.1	66.6	250	384.6
Required Carbon Market Growth	Low Case	-	2,333	6,375	-	237.2	957.3
	High Case	-	6,397	15,189	-	665.4	1,959

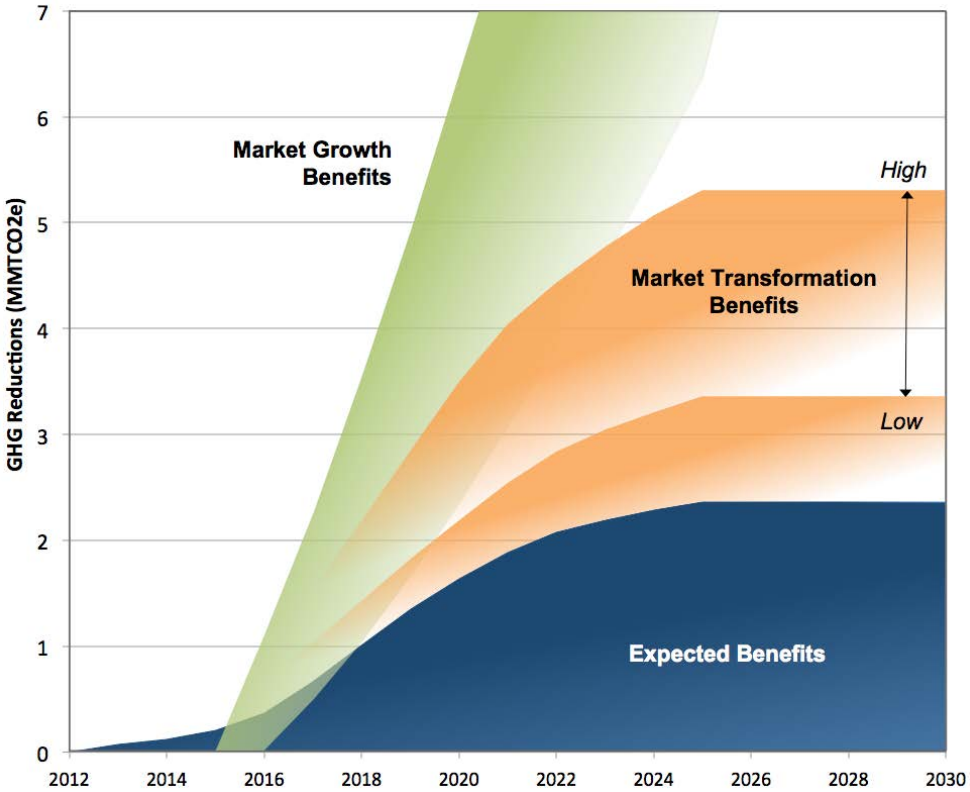
Source: NREL.

The estimates for Expected Benefits and Market Transformation Benefits are summarized in Table 5. Expected Benefits for all project classes by 2025 total about 2,358,800 metric tons of carbon dioxide equivalent (CO_2e). The range of Market Transformation Benefits by 2025 range from 1,000,200 metric tons CO_2e in the Low Case to 2,944,100 metric tons CO_2e in the High Case. Combining this range of benefits with the Expected Benefits category yields a GHG reduction range of 3.4 million metric tons of CO_2e ($MMTCO_2e$) to 5.3 $MMTCO_2e$ by 2025.

These categories can be compared against the fourth category, Required Market Growth Benefits. This category represents an approximate trajectory for how California will need to reduce GHG emissions to meet its 2050 goal. Total Expected Benefits and Market Transformation Benefits represent a significant contribution to overall efforts to reduce transportation-related GHG emissions; more than half of the roughly 7 $MMTCO_2e$ needed in the 2020 to 2025 time frame is indicated by Figure 3. Another comparative reference is that the high case GHG reduction estimate of 4.2 $MMTCO_2e$ would represent nearly one-third of the 15 $MMTCO_2e$ in transportation GHG emissions reductions projected for the Low Carbon Fuel Standard program in 2020.[19] The comparisons are shown in Figure 3, which depicts steady progress along this trajectory, but with a clear need for future investments as well.

19 ARB, *2014 LCFS Advisory Panel*, May 19, 2014. Available at http://www.arb.ca.gov/fuels/lcfs/workgroups/advisorypanel/051914advisorypanelpresentation.pdf.

Figure 3: GHG Reductions From Expected and Market Transformation Benefits in Comparison to Required Market Growth Benefits



Source: NREL

Related Policies and Programs

Air Quality Improvement Program

In addition to the ARFVTP, Assembly Bill 118 also created the Air Quality Improvement Program (AQIP) to be administered by the ARB. While the ARFVTP is focused primarily on achieving the state's GHG reduction goals within the transportation sector, the AQIP is primarily responsible for reducing air pollutants from the transportation sector. The two programs have worked in concert to maximize the benefits to the state and avoid duplication of efforts. For instance, the ARFVTP has invested in light-duty electric vehicle charging infrastructure, regional planning, and manufacturing projects, while the AQIP has provided deployment incentives for light-duty electric vehicles through the Clean Vehicle Rebate Project (CVRP). Similarly, the Energy Commission has supported the demonstration of early hybrid and electric truck and bus models, while the AQIP has provided deployment incentives for such vehicles through the Hybrid and Zero-Emission Truck and Bus Voucher Incentive Project (HVIP). The AQIP also provides grants for demonstration and testing of emission-reduction technologies, with projects addressing railroads, tugboats, and other applications. Finally, AQIP has also provided loans to assist fleets in modernizing their diesel trucks. Historical funding from the AQIP is summarized below.

Table 6: AQIP Historical Funding

Project Category	Funding Provided or Allocated Through June 2014 (in millions) [20]
Clean Vehicle Rebate Project	$123.8*
Hybrid and Zero-Emission Truck and Bus Voucher Incentive Project	$69.4**
Advanced Technology Demonstration	$6.3
Truck Loan Assistance Program	$54.0
Other Emission Reduction	$4.7
Total	**$258.2**

Source: ARB. *ARFVTP funding provided a total of $43.6 million to backfill CVRP needs. **ARFVTP funding provided $4 million in added incentives for electric truck deployment, before this activity had a permanent higher incentive under the HVIP guidelines.

As discussed in the AB 32/Greenhouse Gas Reduction Fund section below, the availability of new funding for FY 2014-2015 has led ARB to propose several changes and expansions to the activities funded under AQIP. These funds are also discussed in greater depth within the relevant sections of this investment plan update, as they pertain to several ARFVTP funding activities.

AB 32/Greenhouse Gas Reduction Fund

Assembly Bill 32, also known as the Global Warming Solutions Act of 2006, required the ARB to adopt a statewide GHG emission limit for 2020 equivalent to the statewide GHG emission levels in 1990. Executive Order S-3-05 also set an objective of reducing emissions to 80 percent below 1990 levels, which is consistent with an Intergovernmental Panel on Climate Change analysis of the emissions trajectory that would stabilize atmospheric GHG concentrations at 450 parts per million CO_2e and reduce the danger of catastrophic climate change.

As part of its regulation, the ARB developed a cap-and-trade program that set a limit on the amount of permissible GHG emissions from regulated sectors. Covered entities must then pay an allowance price for their GHG emissions from those sectors. Revenue from these payments goes into the Greenhouse Gas Reduction Fund (GGRF) and is appropriated by the Legislature each year in the annual Budget Act. For FY 2014-2015, the state Budget Act identified $832 million in proposed expenditures from the GGRF. Of this, $200 million was allocated to the ARB for "Low Carbon Transportation" projects.[21]

20 ARB, *Fiscal Year 2014-15 Funding Plan for the Air Quality Improvement Program and Low Carbon Transportation Greenhouse Gas Reduction Fund Investments*, May 23, 2014. Available at http://www.arb.ca.gov/msprog/aqip/fundplan/fy1415_funding_plan_aqip_ggrf_final.pdf.

21 Department of Finance, *Cap and Trade Expenditure Plan*, 2014. Available at http://www.ebudget.ca.gov/2014-15/pdf/Enacted/BudgetSummary/CapandTradeExpenditurePlan.pdf.

In its joint funding plan for both the AQIP and the Low Carbon Transportation portion of the GGRF appropriation, the ARB allocated a combined $222 million, summarized in Table 7.[22]

Table 7: FY 2014-2015 AQIP and Low Carbon Transportation GGRF Allocations

Project Category	AQIP Funding for FY 14-15 (in millions)	GGRF Funding for FY 14-15 (in millions)
Light-Duty Vehicle Projects		
Classic CVRP	$5	$111
Pilot Projects in Disadvantaged Communities	-	$9
Heavy-Duty Vehicle and Equipment Projects		
HVIP	$5	$5-$10
Zero-Emission Truck and Bus Pilots	-	$20-$25
Advanced Technology Freight Demonstrations	-	$50
Truck Loan Assistance Program	$10	-
Reserve for Revenue Uncertainty	$2	-
Total	**$22**	**$200**

Source: ARB.

The first five project categories listed in Table 7 have particular importance to the goals and strategies of the ARFVTP and are further discussed in the Light-Duty Electric Vehicle subsection and Medium- and Heavy-Duty Vehicle Technology Demonstration and Scale-Up subsection of this investment plan update. Based on initial funding considerations, ARB staff has proposed to provide similar levels of funding for these activities in FY 2015-2016 as well.[23]

Low Carbon Fuel Standard

The ARB adopted the Low Carbon Fuel Standard (LCFS) regulation in April 2009, with a goal of reducing the overall carbon intensity of fuel within the transportation sector by 10 percent by 2020. Since then, regulated parties have had to slowly reduce the carbon intensity of their fuel.

A "credit" under the LCFS is equivalent to the reduction of one metric ton of CO_2e, roughly equivalent to the amount of CO_2e released from the combustion of 100 gallons of gasoline. The cost of credits has ranged from a high near $80 in November 2013 to a low near $20 in early April 2014, and during the third quarter of 2014, the average price has been about $28. The price per credit is likely to rise should the ARB readopt the LCFS program with proposed amendments in

22 ARB, *Fiscal Year 2014-15 Funding Plan for the Air Quality Improvement Program and Low Carbon Transportation Greenhouse Gas Reduction Fund Investments*, May 23, 2014. Available at http://www.arb.ca.gov/msprog/aqip/fundplan/fy1415_funding_plan_aqip_ggrf_final.pdf.

23 ARB, "Air Quality Improvement Program (AQIP) & Low Carbon Transportation Investments: Second Public Workshop on the Fiscal Year (FY) 2015-2016 Funding Plan," January 23, 2015. Available at http://www.arb.ca.gov/msprog/aqip/fundplan/fundingplan_workshop_presentation_012315.pdf.

2015 (with an anticipated effective date of an amended LCFS of January 1, 2016), and compliance levels are no longer frozen by a court ruling. As of November 2014, there were 233 transportation fuel pathways available for use under the LCFS.[24] As of July, more than 155 parties have registered transactions under the LCFS, including oil refiners, biofuel producers, and electric and natural gas utilities.[25]

The LCFS has significance for the ARFVTP in several ways. Most important, the Energy Commission frequently relies on LCFS-derived carbon intensity numbers in numerous phases of ARFVTP implementation. This is due to the LCFS program life-cycle analysis of GHG emissions, the specificity to California, and the consistent method across multiple fuel pathways. The life-cycle GHG emission numbers are used in assessing the opportunities from different alternative fuels within the investment plan update, estimating the GHG reduction potential from applicants during solicitations, and analyzing ARFVTP benefits.

The LCFS also provides a direct financial incentive per gallon, kilowatt-hour, therm, or kilogram to the producers and distributors of low-carbon alternative fuels. At the most recent average price of $28 per credit, the LCFS value of an alternative fuel offering a 50 percent GHG emission reduction compared to gasoline would be roughly $0.17 per gasoline gallon equivalent (GGE).[26] This complements the investments of the ARFVTP by creating market incentives for near-term GHG reductions, allowing the ARFVTP to focus more resources on longer-term market transformation goals.

Renewable Fuel Standard

The federal Energy Policy Act of 2005 established the Renewable Fuel Standard Program (RFS), which was revised under the Energy Independence and Security Act of 2007 into the RFS2. The RFS2 mandates 36 billion gallons of renewable fuel to be blended into transportation fuels nationwide by 2022. Within this volume, the RFS2 also establishes four categories of renewable fuel, each with a target for 2022. These categories include cellulosic, biomass-based diesel, advanced biofuel, and total renewable fuels.

Renewable fuels are assigned renewable identification numbers (RINs) to track trading and record compliance with the RFS. The U.S. Environmental Protection Agency (U.S. EPA) establishes annual RIN requirements in consideration of the expected available volumes of

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24 Yeh, Sonia and Julie Witcover (2014) *Status Review of California's Low Carbon Fuel Standard*, July 2014 Issue. Institute of Transportation Studies, University of California, Davis, Research Report UCD-ITS-RR-14-09. Available at http://www.its.ucdavis.edu/research/publications/publication-detail/?pub_id=2253. The UC Davis Institute of Transportation Studies periodically reissues this review, which provides an overview of the LCFS, as well as a general indication of alternative fuel growth within the state.

25 Air Resources Board, "Parties Reporting Transactions in the LCFS Reporting Tool (as of July 18, 2014), http://www.arb.ca.gov/fuels/lcfs/regulatedpartiesreporting20140718.pdf.

26 Based on assumptions of $28 per MT of CO2e and 0.012 MT of CO2e per GGE.

renewable fuels. In November 2013, the U.S. EPA released proposed ranges for each fuel category for 2014, as shown in Table 8.[27] The proposed ranges for each fuel category for 2015 have yet to be released.

Table 8: Projected Available Fuel Volumes and Proposed RFS Percentage Standards for 2014

Category	Range of Volume*	Proposed Volume*	Required Percent of Fuels
Cellulosic Biofuel	8-30 million gallons	17 million gallons	0.01 percent
Biomass-Based Diesel	1.28 billion gallons	1.28 billion gallons	1.16 percent
Advanced Biofuel	2.0-2.51 billion gallons	2.20 billion gallons	1.33 percent
Total Renewable Fuels	15.00-15.52 billion gallons	15.21 billion gallons	9.20 percent

Source: U.S. EPA. *All volume is reported in ethanol-equivalent gallons, except for biomass-based diesel, which is in native gallons.

As with the LCFS, the RFS provides a per-gallon subsidy for alternative fuels that complements the goals of the ARFVTP by encouraging regulated parties (and credit-generating parties) to invest in the lowest-cost means of increasing alternative fuel use. The market value of these RINs changes over time but currently ranges from about $0.40 to $0.60 per RIN, with one RIN representing the energy content of a gallon of ethanol (or, in the case of the biomass-based diesel category, one native gallon). In summer 2014, the U.S. EPA also classified biomethane under the "Cellulosic Biofuel" category and thereby expanded the eligibility of biomethane from landfills, wastewater treatment facilities, agricultural digesters, and municipal solid waste digesters. This should further encourage the growth of biomethane production both within and outside California.

Executive Order on Zero-Emission Vehicles

On March 23, 2012, Governor Brown issued Executive Order B-16-12, which set a target of 1.5 million zero-emission vehicles on the road by 2025 and tasked various state agencies with specific actions needed to support this goal. The *ZEV Action Plan*, issued in February 2013, includes actions that apply directly to the funding categories of the ARFVTP.[28] For instance, the *ZEV Action Plan* calls for developing infrastructure networks and community readiness plans for both plug-in electric vehicles and fuel cell electric vehicles, which have been priorities in the ARFVTP. The *ZEV Action Plan* also highlights the importance of economic development that can result from growth of the ZEV sector, specifically calling on the need for public investment into workforce training and advanced technology manufacturing. Both of these have been captured in the ARFVTP annual investment plans since the inception of the program.

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27 U.S. EPA, "Regulatory Announcement – EPA Proposes 2014 Renewable Fuel Standards, 2015 Biomass-based Diesel Volume," November 2013. Available at http://www.epa.gov/otaq/fuels/renewablefuels/documents/420f13048.pdf.

28 Governor's Interagency Working Group on Zero-Emission Vehicles, *2013 ZEV Action Plan: A Roadmap Toward 1.5 Million Zero-Emission Vehicles on California Roadways by 2025*, February 2013. Available at http://opr.ca.gov/docs/Governor's_Office_ZEV_Action_Plan_(02-13).pdf.

In October 2013, the Governor's Office of Planning and Research followed up with the release of the *Zero-Emission Vehicles in California: Community Readiness Guidebook*. This guidebook helps local planning and permitting agencies familiarize themselves with ZEVs and support these vehicles in their communities. The guidebook includes an overview of ZEV technologies, specific suggestions for how these agencies can better prepare for ZEVs, as well as a collection of tools that can help streamline ZEV infrastructure permitting, prepare for increased electricity demand, and develop ZEV-friendly building codes.

Charge Ahead California Initiative

Senate Bill 1275 (De León, Chapter 530, Statutes of 2014) established the Charge Ahead California Initiative, administered by the ARB in consultation with the Energy Commission and related agencies. The new statute establishes a goal of 1 million zero-emission and near-zero-emission vehicles by January 1, 2023, as well as increased access to these vehicles by disadvantaged, low-income, and moderate-income communities and consumers. In implementing the initiative, the ARB must develop and update a special funding plan every three years through January 1, 2023, beginning with FY 2016-2017. The funding plan will include the estimated need for vehicle incentives and other incentive programs for the next two-year forecast period. The ARB must also adopt revisions to the Clean Vehicle Rebate Project to ensure that rebate levels can be phased down based on cumulative sales levels, eligibility is limited based on income, and other methods of incentives are considered.

CPUC Alternative-Fueled Vehicle Proceedings

The California Public Utilities Commission (CPUC) recently adopted rulemaking R.13-11-007, which permits utility ownership of electric vehicle charging stations (EVCS) on a case-specific basis. This rulemaking is expected to encourage the expansion of EVCS within the CPUC-regulated utility service territories. Since this rulemaking was adopted, the three major investor-owned utilities within the state have announced plans to introduce upwards of 60,000 new EVCS installations within their territories. This is described further in the Charging Infrastructure section. The Energy Commission has worked and will continue to work closely with other agencies to ensure the strategic deployment of EVCS and avoid redundant investments in infrastructure.

CHAPTER 3:
Alternative Fuel Production and Supply

Biofuel Production and Supply

Biofuels, defined here to include gasoline substitutes, diesel substitutes, and biomethane, represent the largest existing stock of alternative fuel in California's transportation sector.[29] Of the roughly 28.4 million vehicles on California's roads, more than 96 percent rely on gasoline or diesel for fuel.[30] Low-carbon biofuels that can directly displace the roughly 13 billion gallons of gasoline and 3.3 billion gallons of diesel used per year in California represent both an immediate and long-term opportunity to reduce GHG emissions and petroleum dependence. An illustrative scenario produced by ARB staff projects that gasoline substitutes, diesel substitutes, and biomethane will account for more than 80 percent of LCFS credits by 2020. One goal of the ARFVTP is to help build the capacity of California companies to produce economically competitive biofuels from waste-based and renewable feedstocks. In addition to the production of low-carbon fuels, ARFVTP investments in this area also provide employment benefits in economically disadvantaged regions of the state.

Ethanol is used primarily as a fuel additive with gasoline in concentrations of either 10 percent or 85 percent. California limits ethanol blends in conventional gasoline to 10 percent, although the U.S. Environmental Protection Agency does permit blends of up to 15 percent. Flex-fuel vehicles (FFVs) are capable of running on higher blends of up to 85 percent ethanol and 15 percent gasoline, referred to as E85. Nearly 1 million FFVs are registered in California, which, during 2013, used a total of 6.6 million gallons of E85. Although sales continue to increase as ARFVTP-funded fueling stations come on-line, E85 accounts for about 1 percent of the total fuel used by FFVs.[31]

With roughly 1 billion gasoline-equivalent gallons consumed in 2013, ethanol continues to be the largest volume alternative fuel used in California. The state has the capacity to produce nearly

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29 "Gasoline substitutes" refers to any liquid fuel that can directly displace gasoline in internal combustion engines, including ethanol and renewable drop-in gasoline substitutes. "Diesel substitutes" refers to any liquid fuel that can significantly displace diesel, including biodiesel, renewable diesel, and renewably derived dimethyl ether (assuming fuel system modifications). These definitions differ from similar terms used by ARB under the LCFS, which are broader and include fuels such as electricity, natural gas, and hydrogen.

30 Based on analysis from California Energy Commission Demand Analysis Office, with data from the California Department of Motor Vehicles.

31 Ibid. As initial ARFVTP E85 fueling station projects reach completion, staff will review market data and may consider reintroducing funding for E85 infrastructure. The Energy Commission encourages stakeholders with additional data on the relative demand for E85 fuel and E85 stations to submit comments to the docket.

220 million gallons of ethanol per year, using primarily corn or sorghum as a feedstock. While all four major in-state ethanol plants are operational, several have experienced notable idling periods in the past because of unfavorable economic conditions. In-state ethanol use has not substantially changed since 2011; however, the gross number of LCFS credits generated from ethanol increased almost 40 percent in 2013 compared to 2012 because of a substantial shift to lower-carbon-intensity ethanol. However, ethanol as a share of all LCFS credits fell from about 73 percent in 2012 to about 53 percent in 2013. This is a result of increased credits generated by other fuels, most notably renewable diesel and biodiesel.[32]

Renewable diesel was the most common diesel substitute used in California for 2013, supplanting biodiesel and increasing total volume more than tenfold to about 95 million gallons.[33] The majority of this increase is accounted for by overseas imports; however, additional in-state renewable diesel producers are expected to come on-line soon. Renewable diesel that meets the fuel specification requirements of American Society for Testing and Materials standard D975 is fungible, or interchangeable, with conventional diesel fuel and can be used in existing diesel engines and fuel infrastructure.

Biodiesel is another diesel substitute that, though not fully fungible with conventional diesel fuel, can be blended in a manner analogous to ethanol and gasoline. California has seven biodiesel production facilities, with a combined production capacity of 59 million gallons per year.[34] While there is no mandate for blending biodiesel with conventional diesel (as there is with ethanol and gasoline), a blend of up to 5 percent biodiesel can be used without special modifications to the vehicle. Blends of 20 percent biodiesel are also commercially available; however, this may not be compatible with all retail infrastructure and may interfere with vehicle warranty provisions. ARB's proposed Alternative Diesel Fuel Regulation addresses the potential for certain blends of biodiesel to increase NO_x under specific circumstances and in the absence of offsetting factors. The regulation includes in-use requirements for the use of biodiesel in certain diesel engines above a 5 percent blend level (B5) for low saturation biodiesel and a 10 percent blend level (B10) for high saturation biodiesel during ozone season and above B10 for all biodiesel in low-ozone season.[35] Both renewable diesel and biodiesel have very low carbon

32 California Air Resources Board. LCFS Quarterly Data. July 8, 2014. Accessed September 15, 2014. http://www.arb.ca.gov/fuels/lcfs/media_request_070714.xls.

33 Ibid.

34 U.S. Energy Information Administration, "Monthly Biodiesel Production Report" Table 4, May 2014. Available at http://www.eia.gov/biofuels/biodiesel/production/table4.xls.

35 California Air Resources Board. *Proposed Regulation on the Commercialization of Alternative Diesel Fuels – Staff Report: Initial Statement of Reasons*. January 2, 2015. Available at http://www.arb.ca.gov/regact/2015/adf2015/adf15isor.pdf.

intensities, accounting for 35 percent of LCFS credits from a combined total of about 174 million gallons of fuel in 2013.[36]

Terminal blending racks are typically used to store bulk volumes of nonfungible diesel substitutes and dispense blended fuels to trucks for delivery to retail, fleet, and farm customers. Though the Energy Commission has funded upstream biodiesel infrastructure projects, the LCFS regulation has encouraged the regulated fuel distributors to integrate larger shares of biodiesel into their upstream infrastructure without ARFVTP incentives. Several major oil terminals throughout the state have either converted or begun converting existing infrastructure to accommodate biodiesel blending. Given that private investment is supporting large-scale biodiesel blending, the Energy Commission is not proposing additional funding for diesel substitutes infrastructure in this investment plan update.

Biomethane represents another major opportunity for low-carbon biofuel production within California as a substitute for natural gas. According to the life-cycle analysis prepared for the LCFS, biomethane from landfill gas can reduce GHG emissions to 88 percent below diesel, and biomethane derived from high solids anaerobic digestion possesses negative carbon intensity roughly 115 percent below diesel.[37] Assembly Bill 341 (Chesbro, Statutes of 2011, Chapter 476) set a state goal of reducing, recycling, or composting 75 percent of solid waste by 2020. This goal should support prelandfill biomethane production by increasing the availability of organic waste feedstocks. The Energy Commission supports this target and may consider prioritizing prelandfill biomethane production in future solicitations over landfill gas projects, while still allowing landfill gas projects to compete.

Although the number of natural gas engines is currently much smaller than the number of gasoline or diesel engines, this number may increase as the comparative price of natural gas remains lower than gasoline or diesel. The Energy Commission also provides investments in natural gas vehicles and infrastructure to support and expand use of the fuel. While the low price of natural gas may open up a larger number of prospective consumers for natural gas vehicles, it may also be more difficult for biomethane producers to compete in the market against a lower-priced fuel. Higher LCFS credit values are expected to follow the higher compliance rates that should occur as the LCFS is readopted. This should help bridge the current gap between biogas production costs and price. Alternatively, biomethane can be used to generate renewable hydrogen.

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36 California Air Resources Board. LCFS Quarterly Data. July 8, 2014. Accessed September 15, 2014. http://www.arb.ca.gov/fuels/lcfs/media_request_070714.xls.

37 Carbon intensity of high solids anaerobic digestion based on staff paper. California Air Resources Board, *Proposed Low Carbon Fuel Standard Pathway for the Production of Biomethane From High Solids Anaerobic Digestion of Organic Wastes,* staff report, June 28, 2012. Available at http://www.arb.ca.gov/fuels/lcfs/2a2b/internal/hsad-rng-rpt-062812.pdf. Carbon intensity values for biomethane may be affected by data in forthcoming studies related to methane leakage (similar to natural gas); however, biomethane is still expected to represent a very low carbon intensity transportation fuel.

Table 9 summarizes the number of awards made for each of these fuel types by the ARFVTP to date. As used in the table, "qualifying proposals" means those receiving at least a passing score.

Table 9: Summary of Biofuel Production Awards to Date

Fuel Type	Qualifying Proposals Submitted	Funds Requested by Qualifying Projects (in millions)	Awards Made	Funds Awarded (in millions)
Gasoline Substitutes	18	$44.8	12	$27.3
Diesel Substitutes	44	$135.1	18	$56.7
Biomethane	37	$121.0	15	$51.0
Total	**99**	**$300.9**	**45**	**$135**

Source: California Energy Commission.

The carbon intensities of the above-mentioned biofuels can vary significantly, depending on the feedstocks and conversion processes used in production. Biofuels derived from waste-based feedstocks typically represent the lowest carbon intensities among all biofuels and often among all alternative fuels. The California Biomass Collaborative estimates that more than 2 billion gasoline gallons equivalent could be produced from in-state waste-based feedstocks.[38] Maximizing biofuel production from these lowest-carbon options represents a key opportunity to reduce near-term GHG emissions in conventional combustion engines. Low GHG emissions, as well as other sustainability considerations, have been a primary factor in determining ARFVTP funding for biofuel production projects.

Table 10 shows a selection of the commercial-scale projects by fuel type that either received or are proposed to receive ARFVTP funding. While the pathway used for these projects may not have the lowest carbon intensity, the technologies used are sufficiently developed to allow for considerable annual production.

38 UC Davis California Biomass Collaborative, "Resources and Facilities Database Update," September 3, 2014. Available at http://energy.ucdavis.edu/files/09-16-2014-08_Biomass_Resource-and-Facilities-Database-Update.pdf.

Table 10: GHG Emission Reduction Potential of Commercial-Scale ARFVTP Projects

Fuel Type	Pathway Descriptions	Average GHG Emission Reduction[39]	# of Projects	Range of Annual Capacity for Individual Projects (DGE or GGE)	Total Annual Capacity Increase
Biomethane	Food, green, yard, and mixed municipal waste	110%	5	394,000 – 2,870,000 DGE	6.0 Million DGE Per Year
Diesel Substitutes	Waste oils (various)	81%*	10	4,600,000 – 20,000,000 DGE	74.9 Million DGE Per Year
Gasoline Substitutes	Grain sorghum	31%	3	2,600,000 – 3,000,000 GGE	8.6 Million GGE Per Year

Source: California Energy Commission. *Several diesel substitute production projects will use a mixture of waste-based oils and conventional vegetable oils (for example, canola or soy).

Recent ARFVTP biofuel production solicitations have also funded precommercial projects. Though these projects do not yet produce as much fuel as the commercial-scale projects, these precommercial projects focus on pathways that have either a greater potential for production or lower carbon intensity. The ARFVTP funds these pilot and demonstration projects with the expectation that, after successful operations at this scale, the technology will be suitable for commercial use. While not producing the same immediate increase in annual production capacity as the previous commercial-scale projects, these precommercial projects are aimed at advanced new technologies and approaches that can be subsequently expanded into wider markets. Diesel substitute production technologies are quickly evolving and maturing, as seen in Table 10. However, the resulting fuels have a smaller market potential than gasoline substitutes. Next-generation gasoline substitutes, including cellulosic ethanol and drop-in renewable gasoline, are still needed to displace large volumes of gasoline. The ARFVTP previously invested in precommercial cellulosic ethanol projects, and several companies have announced the development of commercial-scale cellulosic ethanol plants nationwide. A sample of precommercial ARFVTP projects is shown in Table 11, including pathways and greenhouse gas emission reduction potential. The Energy Commission continues to track the progress of these ARFVTP projects, as well as out-of-state projects, to identify when and whether further investment is needed as new technologies, feedstocks, and production processes mature in the market.

39 Compared to California diesel (98.03g CO2e/MJ) for biomethane and diesel substitutes, and California gasoline (99.18g CO2e/MJ) for ethanol. All GHG emission reductions will vary depending on the specific feedstock and production process used by each project. Based on a mix of established LCFS values and applicants' LCFS-derived estimates.

Table 11: Sample of Precommercial ARFVTP Projects

Fuel Type	Pathway Description	Estimated GHG Emission Reduction[40]	# of Projects	Annual Capacity for Individual Projects (Diesel or Gasoline Gallon Equivalent)
Biomethane	Wastewater	88%	1	160,000
Diesel Substitutes	Algae	66%-122%	2	1,200 – 5,000
Diesel Substitutes	Green Waste	66%	1	365,000
Gasoline Substitutes	Woodchips and Switchgrass	76%	1	21,000
Gasoline Substitutes	Sugar Beets	82%	1	215,000

Source: California Energy Commission.

The most recently completed biofuel production funding solicitation, PON-13-609, was released in January 2014 and was eligible to both precommercial pilot and demonstration facilities, as well as commercial-scale facilities. Applicants were separated into funding categories for diesel substitutes, gasoline substitutes, and biomethane. PON-13-609 received qualified funding requests from 20 applicants totaling more than $76 million, illustrating a continued interest in and need for ARFVTP funding. Eleven projects were proposed for a total of $43.6 million in grants. The proposals received continued to show significant GHG reductions compared to conventional gasoline and diesel fuels. The subsequent biofuel production funding solicitation, PON-14-602, was released in October 2014 and focused on biofuel production projects in the early or precommercial technology development stage.

Past funding solicitations have taken various approaches to biofuel types, either combining all biofuel projects into one category or separating projects by fuel type. Upcoming solicitations may use the combined category approach when scoring applications to maximize cost-effectiveness per dollar of ARFVTP funding. As such, this investment plan will retain the single allocation for all biofuels as used in previous years to allow for greatest flexibility for funding solicitations.

Other state and federal program may also provide support and incentives to biofuel producers. For example, the California Department of Resources Recycling and Recovery's (CalRecycle) Organics Grant Program awarded $8.9 million to three biomethane-producing projects in 2014 and is expected to release a new cycle of grants in 2015. The Energy Commission will work with CalRecycle to ensure future funding awards are complementary rather than duplicative. In

40 Compared to California diesel (98.03g CO2e/MJ) for biomethane and diesel substitutes, and California gasoline (99.18g CO2e/MJ) for ethanol. All GHG emission reductions will vary depending on the specific feedstock and production process used by each project. Based on a mix of established LCFS values and applicants' LCFS-derived estimates.

addition, the LCFS and RFS requirements can support biofuel producers by creating markets for carbon credits and renewable fuels.

Some fuel types and pathways have shown minimal improvement in carbon intensity or cost-effectiveness in recent funding solicitations. These results may indicate that the technology or process has fully developed. The Energy Commission may evaluate biofuel types and production pathways to determine when state incentives are no longer necessary. To this end, incentives may be reduced or altered by placing a higher emphasis on using cost-effectiveness scoring criteria, requiring increased benefits from repeat applicants, or increasing the focus on commercial-scale projects. As the market for biofuels continues to develop, the Energy Commission may also consider alternative funding mechanisms, such as revolving loan or loan guarantee programs, which may be more suitable for large projects and developed industries. For FY 2015-2016, staff proposes to maintain the $20 million allocation for Biofuel Production and Supply from the previous fiscal year. This amount is anticipated to support funding of additional commercial-scale production projects, plus a small number of precommercial projects.

Summary of Proposed Alternative Fuel Production and Supply Allocations

Table 12: FY 2015-2016 Funding for Alternative Fuel Production and Supply

Biofuel Production and Supply *Relevant Policy Goals:* - GHG Reduction - Petroleum Reduction - In-State Biofuels Production - Low Carbon Fuel Standard	$20 Million	No funding allocation change relative to FY 2014-2015.
Total	**$20 Million**	

Source: California Energy Commission.

CHAPTER 4:
Alternative Fuel Infrastructure

Electric Charging Infrastructure

Providing a convenient and reliable network of electric vehicle charging stations remains a fundamental part of accelerating market growth and acceptance of plug-in electric vehicles (PEVs), which includes both all-electric battery electric vehicles (BEVs) and plug-in hybrid electric vehicles (PHEVs). Though improving in both cost and energy density, batteries continue to restrict the electric drive range of most BEVs and PHEVs when compared to gasoline- and diesel-fueled vehicles. Adequate public charging infrastructure is critical to allow PEVs to be a viable alternative to internal combustion vehicles and continue the rapid expansion of PEV ownership in California. Cumulative sales of modern PEVs have grown quickly in California, increasing from nearly 20,000 in October 2012, to 50,000 in October 2013, to 100,000 in September 2014. Californians also buy about 40 percent of all PEVs sold within the United States.[41] However, PEVs still account for less than 1 percent of the light-duty vehicles registered in California, indicating substantial opportunities for growth.

The Energy Commission has supported the rollout of PEVs by awarding nearly $40 million in ARFVTP funding for electric vehicle charging stations (EVCS). The most recent EVCS funding solicitation, PON-13-606, had such strong interest that funding was increased from $6 million to more than $13 million. Due in part to these investments, California possesses the largest network of nonresidential charging stations in the nation, accounting for about one out of every four public charging points.[42] ARFVTP investments have funded multiple categories of EVCS as detailed in Table 13.

Table 13: Charging Stations Funded by ARFVTP

	Residential	Multiunit Dwelling	Commercial	Workplace*	DC Fast Chargers	Total
Installed	3,596	94	2,693	210	9	**6,602**
Planned	1,437	-	1,019	207	104	**2,767**
Total	**5,033**	**94**	**3,712**	**417**	**113**	**9,369**

Source: California Energy Commission. Does not include projects that have yet to be approved at a Commission business meeting.
*An unspecified number of additional Workplace charging stations are included in the Commercial column, which were funded before Workplace was tracked separately.

41 California Plug-in Electric Vehicle Collaborative, "California Surpasses 100,000 Plug-in Car Sales," September 9, 2014. http://www.pevcollaborative.org/sites/all/themes/pev/files/7_July_2014_Dashboard_PEV_Sales_140805.pdf.

42 U.S. Department of Energy. "Alternative Fueling Station Counts by State." September 8, 2014. http://www.afdc.energy.gov/fuels/stations_counts.html.

PEV owners rely on residential charging for about 80 percent of their charging. Residential charging points account for more than half of the ARFVTP charging station awards, with the vast majority installed at detached single-family homes. According to a recent Center for Sustainable Energy survey, 88 percent of PEV owners reside in a detached single-family home; however, less than 60 percent of Californians live in this type of residence.[43] Multiunit dwellings, which account for nearly 40 percent of the state housing stock, have been historically underrepresented in ARFVTP funding. PEV sales have tended to be higher in more urbanized areas, where multiunit dwellings are more common as well. This creates a market barrier to higher PEV sales in areas with a known potential for growth. This lack of charging infrastructure may be caused by a lack of interest on the part of property owners or managers, given the relative complexity, higher installation costs, and uncertain business case compared to other types of locations. This was evident in PON-13-606, as only 2 of the 41 funded projects proposed installing EVCS at multiunit dwellings. PON-13-606 also limited awards under the multiunit dwelling categories to $50,000 for rental properties and $300,000 for owner-occupied properties, which may have been insufficient given the higher costs of these installations. Future EVCS funding programs may consider adjusting the requirements and incentives available to multiunit dwellings, such as increasing the maximum award amount or allowing demonstration projects or electrical infrastructure upgrades.

In addition to residential charging, publicly accessible charging stations are important to extend the range and improve the convenience of PEVs to increase adoption. Commercial charging, as identified in Table 13, includes stores, parking garages, universities, municipal governments, and other common, publicly accessible destinations. According to a recent Center for Sustainable Energy survey, PEV driver satisfaction in public charging infrastructure has improved but remains low, increasing from 17 percent in May 2012 to 29 percent as of May 2013.[44] This low satisfaction demonstrates a need for additional investment in publicly accessible charging stations to assure the reliability and feasibility of PEVs for potential owners. Possible causes of the low satisfaction include congestion at popular charging stations, as well as many areas of the state with few EVCS. The applications submitted in response to PON-13-606 demonstrated a continued need for funding to address these issues that may become more pressing as more PEVs are on the roads.

Workplace charging represents another priority in the ARFVTP portfolio of charging infrastructure, which was reinforced by numerous stakeholders' comments at an IEPR workshop on June 5, 2014.[45] When residents of multiunit dwellings are unable to charge at home, having a dedicated site to charge at work can serve as an alternative. If located far from home, workplace

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43 Center for Sustainable Energy. February 2014 Survey Report. September 8, 2014. http://energycenter.org/clean-vehicle-rebate-project/vehicle-owner-survey/feb-2014-survey.

44 Ibid.

45 The agenda, recording, and transcript for this workshop are available at http://www.energy.ca.gov/2014_energypolicy/documents/#06052014.

charging can also help BEV owners extend their range and PHEV owners increase their electric miles driven. However, the above-mentioned Center for Sustainable Energy survey also notes only 46 percent of respondents have access to workplace charging. While up from 37 percent in May 2013, there are still substantial opportunities for growth.[46]

A complete PEV charging network will also require fast chargers, which can fully recharge a BEV in 15 to 30 minutes (compared to several hours). When located along major interregional corridors, these chargers can enable long-distance travel by BEVs. Furthermore, these chargers can provide a quicker alternative to charging at destinations or at home, if needed. Fast chargers can also serve the needs of drivers without access to charging at home, such as those living in multiunit housing. To date, nine fast chargers have been installed with ARFVTP funding. An additional 104 fast chargers are planned using ARFVTP funding, and at least 200 fast chargers are expected by December 2016 as a result of a settlement with NRG Energy, Inc. Energy Commission staff coordinates with NRG Energy quarterly to review progress on the NRG eVgo charging network. Although many fast chargers are planned, actual fast charger deployment trails that of other types of EVCS. Future funding solicitations may increase the focus on fast chargers to resolve gaps in interregional charging infrastructure.

In the longer term, the *ZEV Action Plan* sets a goal of ZEV infrastructure that is able to support up to 1 million vehicles by 2020. While there is no single ratio for the number of chargers needed per PEV, the National Renewable Energy Laboratory developed the *California Statewide Plug-In Electric Vehicle Infrastructure Assessment* in May 2014 to provide recommendations on the numbers and types of chargers that will help achieve the *ZEV Action Plan* goal. The assessment investigated two scenarios, one focused on home-dominant charging and one focused on high public access charging. NREL staff used the assessment to extrapolate the number of additional Level 2 and DC fast chargers needed to meet the demand in 2017 and 2018, as shown in Table 14.

46 Ibid.

Table 14: Additional Charging Units Needed for 2017 and 2018

Scenario		Public and Private* Level 2	Estimated ARFVTP Cost ($ millions)	Public Fast Chargers	Estimated ARFVTP Cost ($ millions)
August 2014 (Projected and Planned)		7,800	-	172	-
Additional Need (Compared to August 2014 Baseline)	**2017** Home-Dominant	13,659	$20.5	-	-
	High Public Access	32,429	$48.6	289	$4.3
	2018 Home-Dominant	17,805	$26.7	18	$0.3
	High Public Access	40,239	$60.4	364	$5.5
Estimated incentive per unit**		Level 2: $1,500		DCFC: $15,000	

Source: National Renewable Energy Laboratory. *"Private" includes private workplace and fleet charging units, but not private residential charging units. **Includes equipment costs, but not necessarily installation costs, which can constitute the majority of costs for a full EVCS installation project.

The home-dominant and high public access scenarios can be respectively considered a low-end and high-end estimate of the number of nonresidential chargers required. The actual number of chargers required will be determined by consumer preference and market forces and is likely to fall somewhere between the two estimates. Moreover, not all of these charging units will necessarily require state funding. Nevertheless, a clear need for continued incentives is shown in the NREL data since projects receiving fiscal year 2015-2016 funding will not likely enter service until late 2016 or 2017.

As the market for PEVs becomes more developed, financing for electric vehicle charging stations will eventually need to shift from government incentives to private sector lending. However, electric vehicle chargers are a relatively new technology with uncertain long-term payoffs and risks. This uncertainty may reduce the willingness of lenders to fund EVCS with competitive terms. In an effort to validate the profitability and feasibility of financing EVCS, the Energy Commission approved demonstration-scale loan loss reserve project with the California Pollution Control Authority, which will be used by eligible lenders to reduce risk and increase options for financing in-state EVCS. The program provides 50 percent rebates of the loan loss reserve contribution to borrowers with a good track record of repayments. The program also offers increased contributions to the loan loss reserve for charging stations that are installed in disadvantaged communities or multi-unit dwellings. Other advanced financing mechanisms, such as loan guarantees, may also be considered as EVCS technologies and markets continue to mature.

Targeted efforts may also be needed to support the introduction of electric drive technology into the medium- and heavy-duty truck and bus sectors. Multiple technology providers and fleets have expressed challenges associated with setting up charging infrastructure to serve new PEV fleets. While the per-unit charging equipment costs may be similar to residential or public

chargers, installation costs are notably higher. If unaddressed, this could hinder larger-scale fleet adoptions of PEV commercial trucks.

Additional activities beyond those described here may be needed to ensure adequate charging infrastructure for all of California's future PEVs. Coordination of and support for the effective deployment of EVCS signage may also be necessary throughout the state. In addition, there may be future opportunities for the state to demonstrate the value of vehicle-to-grid technologies in expanding the business case for PEVs.

In December 2014, the CPUC adopted rulemaking R.13-11-007 which permits utility ownership of EVCS.[47] Previous rules had broadly prohibited utility ownership of EVCS; however, utilities may now apply for ownership approval from the CPUC on a case-specific basis. The Energy Commission will closely monitor developments related to this rulemaking and other EVCS projects to continue the strategic deployment of electric vehicle infrastructure under the ARFVTP. Table 15 summarizes the utility-owned electric vehicle infrastructure projects proposed by the utilities; however, they are still subject to change before being approved by the CPUC.

Table 15: Proposed Utility EVCS Investments

Investor-Owned Utility	Proposed # of EVCS	Proposed Type of Infrastructure and Location	Estimated Cost	Program Time Frame
Pacific Gas and Electric Company	25,000 L2 100 DCFC	EVCS at Commercial and Public Locations, including Multi-Unit Dwellings	$654 million	5 years
San Diego Gas & Electric Company	5,500	EVCS at Workplaces and Multi-Unit Dwellings	$103 million	4 – 5 years
Southern California Edison Company	30,000	Supporting infrastructure for customer-owned EVCS	$355 million	5 years

Source: Pacific Gas and Electric Company, San Diego Gas & Electric, and Southern California Edison.

Additional attention to previously underserved areas may also be needed. Future EVCS funding opportunities under the ARFVTP may provide preferential scoring to infrastructure placed in underserved or disadvantaged communities. The Energy Commission may solicit input during public workshops to determine how to best target projects in these communities.

In the interim, there is a visible need for additional charging infrastructure that can support both recent PEV sales and the broader marketability of PEVs in the future. For FY 2015-2016, the Energy Commission reserves $17 million in ARFVTP funding to support the expansion of charging infrastructure and related activities. This allocation is larger than in past fiscal years to keep pace with the rapid growth of PEVs in the state, meet the goals of the *ZEV Action Plan* as

47 California Public Utilities Commission, "CPUC Takes Steps to Encourage Expansion of Electric Vehicles," December 18, 2014 Available at http://docs.cpuc.ca.gov/PublishedDocs/Published/G000/M143/K627/143627882.PDF.

benchmarked by the *California Statewide Plug-In Electric Vehicle Infrastructure Assessment*, and possibly expand the types of EVCS incentives offered under the ARFVTP.

Hydrogen Refueling Infrastructure

Fuel cell electric vehicles (FCEVs), using hydrogen fuel, offer another opportunity for transportation with zero tailpipe emissions. Like electricity, hydrogen can be produced from a broad variety of pathways, including the use of renewable sources of energy. When produced with one-third renewable energy, the hydrogen for a passenger FCEV can reduce GHG emissions by 55 to 70 percent compared to gasoline for a conventional vehicle.[48] FCEVs can travel farther and be refueled more quickly than BEVs. Fuel cells enable electrification of a broad range of passenger vehicles, from mid-size sedans to SUVs, vans, and trucks. For this reason, FCEVs can complement BEVs in the marketplace by offering a portfolio of zero-emission vehicles to drivers who want or need a larger vehicle, more range, and/or faster refueling.

Several automakers have already announced their near- and long-term plans for launching FCEVs in early markets. Earlier this year, Hyundai became the first automaker in California to lease production model FCEVs to private customers. Toyota announced a production FCEV model to be released in 2015. Moreover, several teams of major automakers have entered into agreements to further develop FCEVs and related technologies in new or expanded partnerships.[49] Toyota and Honda have also offered loans to hydrogen refueling station provider First Element Fuel to support the construction of new hydrogen refueling stations within California.[50]

Hydrogen refueling stations are much less common than conventional gasoline stations or even other alternative fuel stations. As of March 2015, 11 hydrogen refueling stations in California were operational, including the first two stations funded by ARFVTP in West Sacramento and

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48 Based on a range of potential fuel pathways hydrogen established by the LCFS. This includes an energy economy ratio of for 2.5 FCEVs and a range of 76.1-110.2 grams CO2e/MJ for hydrogen with one-third renewable content. Sources: ARB's LCFS carbon intensity look-up tables (available at http://www.arb.ca.gov/fuels/lcfs/lu_tables_11282012.pdf) and LCFS Final Regulation Order (available at http://www.arb.ca.gov/fuels/lcfs/CleanFinalRegOrder112612.pdf).

49 *The New York Times*, "Three Automakers Combine Forces on Fuel-Cell Cars," January 28, 2013. Available at http://wheels.blogs.nytimes.com/2013/01/28/three-automakers-combine-forces-on-fuel-cell-cars/. AutoblogGreen, "Honda, GM Fuel-Cell Partnership Wants to Reduce Hydrogen Refueling Cost," February 26, 2014. Available at http://green.autoblog.com/2014/02/26/honda-gm-fuel-cell-partnership-reduce-hydrogen-refueling-costs/. Bloomberg, "Toyota Joins Hydrogen Station Funding Push in California," May 24, 2014. Available at http://www.bloomberg.com/news/articles/2014-05-01/california-awards-46-6-million-for-hydrogen-car-stations.

50 *Green Car Reports*, "Honda to Loan First Element $14 Million for Hydrogen Fueling Stations," November 19, 2014. Available at http://www.greencarreports.com/news/1095563_honda-to-loan-first-element-14-million-for-hydrogen-fueling-stations.

Diamond Bar. The limited demand for refueling by a relatively small number of FCEVs, combined with the capital costs of installing a new station, has limited the broader installation of new hydrogen stations. This, in turn, limited the marketability of FCEVs.

To resolve this dilemma, the *ZEV Action Plan* called for funding an early network of hydrogen refueling stations, and Assembly Bill 8 directed the Energy Commission to dedicate up to $20 million (or up to 20 percent) of available ARFVTP funds to an initial infrastructure of 100 stations. With this commitment, automakers are confident their customers will have access to fuel, enabling progress toward market launch of FCEVs. As shown in Table 16, the number of hydrogen refueling stations open to light-duty FCEV drivers will increase significantly with investments from the ARFVTP and support from related public agencies. Through the ARFVTP, the Energy Commission has thus far provided funding to install or upgrade 48 publicly available stations capable of light-duty vehicle refueling. By late 2015, the California network of operational hydrogen stations is projected to include up to 46 stations, with 4 additional stations scheduled to come on-line in the first quarter 2016, and the remaining 4 by second quarter 2016. This network of 51 to 54 stations will support the initial 6,600 vehicles projected for sale in California in the 2015-2017 time frame.

The most recent funding solicitation issued by the ARFVTP for hydrogen refueling stations was PON-13-607. The solicitation was released in November 2013, and awards were made for 28 stations in July 2014. The solicitation identified 42 priority areas for new stations and allowed for stations outside these areas. Of the 28 awarded stations, 27 are located inside or near one of the priority areas, and 1 station is outside the priority areas. In all, 57 proposals for new stations were received from 11 applicants; both numbers are noteworthy increases over participation rates of previous solicitations.

As under previous awards, the 28 stations will provide at least 33 percent of the hydrogen from renewable resources, and 6 of them will provide 100 percent of the hydrogen from renewable resources. On average, hydrogen refueling station networks funded by the ARFVTP are expected to dispense fuel with an average of roughly 38 percent renewable hydrogen content. The renewable hydrogen from these agreements is typically derived from either renewable electricity via electrolysis or biomethane via methane reformation.

Table 16: Publicly Available Hydrogen Refueling Stations

Solicitation/Agreement	ARFVTP Amount (in millions)	# of Stations	Cumulative Public Stations	Targeted Operation
Stations Funded by ARB, U.S. DOE, South Coast AQMD, Energy Commission, AC Transit	-	9	9*	Opened
ARFVTP PON-09-608	$15.1	8 new and 2 upgrades**	18	Jul 2014 - Nov 2015
ARFVTP PON-12-606	$12	7 new	25	Aug 2015 – Jan 2016
ARFVTP Agreement With South Coast AQMD	$6.7	3 upgrades**	26	Jun 2015 – Apr 2016
ARFVTP PON-13-607	$46.6	28 new	54	Oct 2015 – Jan 2016†

Source: California Energy Commission. *According to ARB's *Annual Evaluation of Fuel Cell Electric Vehicle Deployment and Hydrogen Fuel Station Network Development*, three demonstration stations listed here may close in the coming year. **Includes one upgraded station not previously counted in the "Cumulative Public Stations" column. †PON-13-607 offered higher ARFVTP funding share for stations completed by October 31, 2015.

In addition to funding for new or upgraded stations, the Energy Commission and related agencies have supported related projects that can accelerate the growth of FCEVs and hydrogen refueling infrastructure throughout the state. These are summarized in Table 17.

Table 17: Related Projects for Hydrogen Refueling

ARFVTP Project(s)	ARFVTP Amount (in millions)	Description
Agreement for Mobile Refueler	$1	Develop and deploy a mobile hydrogen refueler with storage, compression, and dispensing capabilities
Agreement with AC Transit	$3	Hydrogen refueling station (transit only)
Agreement With California Department of Food and Agriculture	$3.9*	Interagency agreement to develop regulations and test procedures for selling hydrogen on a per-kilogram basis
Agreement With California Department of Food and Agriculture	$0.1*	Provide staff to test equipment and perform type evaluations to test and certify light-duty vehicle hydrogen dispensers located in California
Agreement With UC Irvine	$1.9*	Enhancements to STREET model for identifying and assessing station locations
O&M Support	$1.8	Operations and maintenance funding up to $300,000 for new and existing stations
Agreement for Hydrogen Regional Readiness	$0.3	Statewide FCEV readiness activities, such as streamlining station permits, promoting FCEV interest, installation of signage

Source: California Energy Commission. *Funded by a mixture of ARFVTP funds and technical support funds.

Assembly Bill 8 requires the ARB to evaluate the need annually for additional publicly available hydrogen-fueling stations for the subsequent three years. This evaluation includes quantity of

fuel needed for the actual and projected number of hydrogen-fueled vehicles (based on DMV registrations and automaker projections), geographic areas where fuel will be needed, and station coverage. Based on this evaluation, ARB reports to the Energy Commission the number of stations, geographic areas where additional stations will be needed, and minimum operating standards, such as number of dispensers, filling protocols, and pressures.

The ARB issued the *Annual Evaluation of Fuel Cell Electric Vehicle Deployment and Hydrogen Fuel Station Network Development* in June 2014. Based on automaker responses, the annual evaluation indicates the number of hydrogen-fueled vehicles in California will increase from more than 100 this year to roughly 6,650 in 2017 and 18,465 in 2020. The annual evaluation also evaluates two primary factors regarding hydrogen refueling adequacy: capacity and coverage. Based on the number of stations funded previously, the report suggests that there will be sufficient capacity through 2017, but without further investment to expand the network of hydrogen refueling stations, California will fall short of demand beginning in 2018 and beyond. As noted in the annual evaluation, as well as the California Fuel Cell Partnership's *A California Road Map: The Commercialization of Hydrogen Fuel Cell Vehicles (Road Map)*, the initial network of hydrogen refueling stations must provide potential FCEV customers with convenient access to hydrogen refueling stations to optimize FCEV adoption. The annual evaluation presents the *Road Map* suggestion of 68 strategically placed stations as a preliminary goal for supporting automakers' initial launch of FCEVs, and the 100-station target as reflecting the needs of a transition toward a market-driven industry.[51] The next annual evaluation document will be prepared in June 2015.

The annual evaluation will also be complemented by a separate Energy Commission-ARB joint report that evaluates progress in establishing a hydrogen refueling network that provides refueling coverage and capacity for FCEVs. The first of these reports is due on or before December 31, 2015.[52] While the annual evaluation focuses on the incremental need for additional hydrogen stations in response to automaker plans, the progress report focuses on determining the cost and timing of the broader 100 station network and whether ARFVTP funding is still necessary toward this goal.

To maximize the utility of a small number of hydrogen stations, the ARB, Energy Commission, automakers, and other stakeholders have focused on developing early adopter clusters for initial FCEV deployment. This includes five clusters identified in the annual evaluation: Coastal/Southern Orange County, Torrance, West Los Angeles/Santa Monica, South San Francisco/Bay Area, and Berkeley. Other important regions, such as Sacramento, San Diego, and certain travel corridors, are also considered as part of an expanded network. The California Fuel Cell Partnership's road map targets a six-minute drive time proximity for early adopters, which

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51 Ibid. California Fuel Cell Partnership, *A California Road Map: The Commercialization of Hydrogen Fuel Cell Vehicles*, June 2012. Available at http://www.cafcp.org/sites/files/A%20California%20Road%20Map%20June%202012%20%28CaFCP%20technical%20version%29_1.pdf.

52 California Health and Safety Code Section 43018.9 (e) (6).

helps inform the target number of stations (and locations) within each cluster. Toward this end, the annual evaluation includes both a summary of existing and planned hydrogen refueling stations by cluster, along with a list of working recommendations (Table 18) for locations to cover in the Energy Commission's future hydrogen refueling infrastructure solicitations.

Table 18: Annual Evaluation Working Recommendations on Station Funding

Location	Purpose	Suggested Station Counts
Berkeley Cluster	Establish Market	2
South San Francisco/Bay Area Cluster	Coverage/Capacity	1
Coastal/South Orange County Cluster	Coverage/Capacity	1
West Los Angeles/Santa Monica Cluster	Coverage/Capacity	1
Torrance Cluster	Coverage/Capacity	2
San Diego Area	Coverage	1
Sacramento Area	Coverage	1
Expanded Network Areas	Coverage or Destination/Connector	1 or 2

Source: ARB, *Annual Evaluation of Fuel Cell Electric Vehicle Deployment and Hydrogen Fuel Station Network Development*, June 2014.

Based on previous average costs to the ARFVTP for the installation of new hydrogen refueling infrastructure (roughly $1.8 million–$2.1 million), the 10-11 total stations proposed in Table 18 warrant the allocation of the maximum $20 million allowed under Assembly Bill 8.

In addition to funding for infrastructure development, the Energy Commission recognizes the need for operation and maintenance (O&M) funding for the initial network of hydrogen refueling stations. This funding improves the business case of station developers who build and operate stations prior to the mass introduction of FCEVs, which will subsequently sustain the stations. In the previous solicitation, the Energy Commission offered up to $300,000 for three years' worth of O&M funding for each existing or planned station, once operational. As of December 2014, six stations have been eligible for this funding. However, this number will increase to about 50 as recently funded hydrogen refueling stations come on-line in the next few years.

This increase will be most notable during fiscal years 2015/2016, 2016/2017, and 2017/2018. Assuming all stations are completed as currently expected, and $100,000 per station is available each year for O&M support for the new stations, the ARFVTP might provide roughly $5 million to $6 million per year in O&M support in each of these three fiscal years.[53] This allocation could reduce the amount of funding available for new hydrogen station development by roughly 2-4 stations per fiscal year. In anticipation of fiscal year 2015/2016, the Energy Commission will

53 The amount of funding to be provided for O&M support for future stations is still under evaluation. To the extent that O&M costs are less than estimated, or station operators are able to recoup O&M costs from increasing retail sales, the amount may be reduced in the future.

continue discussions with ARB and stakeholders to ensure that all available funding for hydrogen refueling is used in the most effective manner for encouraging early FCEV adoption.

For FY 2015/2016, the Energy Commission proposes the maximum $20 million allocation permitted under Assembly Bill 8 for hydrogen refueling infrastructure. This funding will support a future solicitation for new hydrogen stations, as well as the O&M support of previously planned stations. The number of new stations funded under the solicitation will necessarily be fewer than the 28 stations and one mobile refueling project funded in the previous solicitation, since the latter used a total of $49.9 million of ARFVTP funding from over three previous investment plans. If the average Energy Commission share of station infrastructure development cost remains as estimated at $1.8 million to $2.1 million for each station, and one year's worth of O&M funding is needed for all of the stations operational in FY 2015/2016, then the Energy Commission estimates that the $20 million allocation will be able to fund the installation of roughly seven new stations.

Natural Gas Fueling Infrastructure

Natural gas vehicles in California depend on a mix of public and private fueling stations capable of dispensing compressed natural gas (CNG) and/or liquefied natural gas (LNG). California leads the United States in the number of CNG and LNG fueling stations, with more than 500 public or private CNG stations and roughly 45 public or private LNG stations.[54] Relative to most other alternative fuels, natural gas fueling is commercially mature and relies on an existing natural gas pipeline infrastructure throughout the state.[55]

The cost of a natural gas fueling station depends on many factors, including compressor size, storage size, and LNG or CNG dispensing capabilities. Costs generally range from $500,000 for smaller CNG-only stations to several million dollars for large combined LNG-CNG fueling stations. Based on this range of costs, the Energy Commission has previously offered up to $300,000 in ARFVTP funding to support CNG stations and up to $600,000 for stations dispensing LNG.

Particularly in the case of private stations for individual fleets, the costs of installing a natural gas fueling station can be built into the long-term savings on fuel that result from switching to natural gas vehicles. This is reflected in recent investment plans, with funding allocations for natural gas vehicles significantly higher than funding allocations for fueling infrastructure.

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54 Comments submitted by California Natural Gas Vehicle Coalition to Energy Commission docket 14-ALT-01, TN 74034. November 21, 2014.

55 Despite this comparative maturity, opportunities still exist to advance new technologies in natural gas fueling. Toward this end, the Energy Commission's Public Interest Energy Research Natural Gas program released PON-14-502, which offers awards up to $400,000 for projects that can improve the cost-effectiveness, efficiency, or public benefits of CNG fueling stations. More information is available at http://www.energy.ca.gov/contracts/PON-14-502/.

For this reason, the Energy Commission has also previously prioritized its ARFVTP natural gas fueling infrastructure funding toward entities that may not have access to the necessary capital for such long-term investments. As shown in Table 19, the Energy Commission proposed awards for 18 applicants in its most recent solicitation for natural gas fueling infrastructure projects, including 10 school districts and municipal governments. These 10 awards, totaling nearly $3 million, represented all of the qualifying applications received from school districts and municipal governments. In future solicitations, staff expects to focus exclusively on natural gas infrastructure funding for school districts and municipal governments, while possibly providing preference to projects that also offer public access.

Table 19: Natural Gas Fueling Infrastructure Awards From PON-12-605

Applicant Type	Projects Awarded Among Qualifying Proposals*	ARFVTP Funding (in millions)
School District	6 out of 6	$1.8
Municipality	4 out of 4	$1.2
Fuel Vendor	2 out of 2	$0.4
Municipal Solid Waste	5 out of 7	$2.0
Utility	1 out of 3	$0.3
Transit	0 out of 1	-
Towing	0 out of 1	-
Air District/Joint Power Authority	0 out of 2	-
Total	**18 out of 26**	**$5.7**

Source: California Energy Commission. *Indicates the number of project that received ARFVTP funding out of the number of projects that were eligible for funding.

Natural gas offers a modest 20 to 30 percent GHG reduction compared to gasoline and diesel and has been an early source of GHG reductions for ARFVTP investments. In the NREL benefits analysis of the ARFVTP, natural gas fueling infrastructure accounted for about two-thirds of the estimated near-term GHG reduction benefits under the fueling infrastructure category, despite a comparatively small ARFVTP investment of roughly $17 million. This result is due primarily to the high amount of fuel dispensed, as well as the small number of stations that are dispensing renewable natural gas. Natural gas also offers significant savings on fuel for high-mileage, low-mpg vehicles, as well as a path for reducing particulate matter and NO_x emissions from older vehicles (particularly school buses).

However, the potential for upstream methane leakage risks undermining some of these advantages. This issue is discussed in greater depth in the Natural Gas Vehicles section, although the same concerns apply to natural gas fueling infrastructure. Accordingly, the Energy Commission may also want to prioritize funding for natural gas fueling stations that can incorporate the use of biomethane as a means of lowering the overall carbon intensity of natural gas within the transportation sector. This can be done for ARFVTP natural gas fueling infrastructure awards in a way that cannot be as easily done for ARFVTP natural gas vehicle awards. For instance, the Energy Commission has previously awarded ARFVTP funding for five natural gas fueling stations that will incorporate biomethane into some, if not all, of the dispensed fuel. This significantly lowers the carbon intensity of the dispensed fuel.

In consideration of both of these priorities, staff proposes increasing the proposed funding allocation for this category relative to previous years' allocations. The proposed allocation of $5 million could fund the number of qualifying school district and municipal government proposals received in the last solicitation, while potentially reserving additional funds for natural gas fueling stations that specifically incorporate biomethane.

Summary of Proposed Alternative Fuel Infrastructure Allocations

Table 20: FY 2015-2016 Funding for Alternative Fuel Infrastructure

Electric Charging Infrastructure *Relevant Policy Goals:* - GHG Reduction - Petroleum Reduction - Low Carbon Fuel Standard - Air Quality - ZEV Mandate	$17 Million	Increased from $15 million in FY 2014-2015. This increase reflects the need to stay ahead of a steady acceleration of plug-in electric vehicle sales within the state.
Hydrogen Refueling Infrastructure *Relevant Policy Goals:* - GHG Reduction - Petroleum Reduction - Low Carbon Fuel Standard - Air Quality - ZEV Mandate	$20 Million	No funding allocation change relative to FY 2014-2015.
Natural Gas Fueling Infrastructure *Relevant Policy Goals:* - Petroleum Reduction - Air Quality - Low Carbon Fuel Standard - GHG Reduction (with incorporation of biomethane)	$5 Million	Increased from $1.5 million in FY 2014-2015. This increased allocation helps target a greater share of this program's air pollution reductions toward disadvantaged communities and vehicle duty cycles (such as school buses and municipal fleets), where zero-emission vehicles are not yet as available or practical.
Total	**$42 Million**	

Source: California Energy Commission.

CHAPTER 5:
Alternative Fuel and Advanced Technology Vehicles

Medium- and Heavy-Duty Vehicle Technology Demonstration and Scale-Up

Medium- and heavy-duty vehicles, defined here to mean vehicles with a gross vehicle weight rating (GVWR) above 10,000 lbs., represent a small share of California's registered vehicle stock: about 936,000 out of 28.4 million, or 3 percent.[56] However, because of the lower fuel efficiency and higher number of miles traveled per year, medium- and heavy-duty vehicles are also responsible for 30 percent of on-road GHG emissions.[57] For this reason, they represent a significant opportunity to reduce GHG emissions while focusing on a comparatively small number of vehicles.

Making this more challenging, the fuel and technology of a medium- or heavy-duty vehicle must be closely matched to the needs of the particular vehicle application. For example, a low-emission solution such as a hybrid electric system might be appropriate for urban delivery trucks with many stops and starts but will provide little benefit to long-haul trucks. Similarly, a battery electric system might be appropriate for a vehicle that can recharge all night but inappropriate for trucks that operate at irregular hours or have unpredictable travel routes. Providing the right solution for the right application is therefore a key element in reducing GHG emissions from this vehicle sector.

The Energy Commission has provided $58.7 million in ARFVTP funding for a wide variety of fuel and technology types that can be incorporated into California's trucks and buses. Table 21 summarizes the portfolio of advanced vehicle technology demonstration projects that the ARFVTP has supported in the medium- and heavy-duty vehicle sector. Financial support for demonstration and precommercial projects can lead to reduced costs for future generations of advanced technology vehicles. Furthermore, by demonstrating the feasibility and reliability of such technologies in the field, these projects can garner further interest from potential fleet adopters. The projects can also inform the development of future standards for truck emission reductions and fuel efficiency.[58]

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56 Based on analysis from California Energy Commission Demand Analysis Office, with data from California Department of Motor Vehicles.

57 ARB, "California Greenhouse Gas Inventory for 2000-2012 – by Category as Defined in the 2008 Scoping Plan," March 24, 2014. Available at http://www.arb.ca.gov/cc/inventory/data/tables/ghg_inventory_scopingplan_00-12_2014-03-24.pdf.

58 Through their jointly developed Heavy-Duty National Program, the U.S. Environmental Protection Agency and the National Highway Transportation Safety Administration have developed a five-year plan for reducing GHG emissions and improving fuel efficiency among medium- and heavy-duty vehicles for

Table 21: Demonstration Projects Supported by ARFVTP

Vehicle/Technology Type	# of Projects	# of Units	ARFVTP Funding (in millions)
Medium-Duty Hybrids, PHEVs and BEVs	8	164	$15.8
Heavy-Duty Hybrids, PHEVs and BEVs	6	14	$11.3
Electric Buses	4	17	$6.3
Natural Gas Trucks	4	5	$8.3
Fuel Cell Trucks and Buses	3	6	$4.5
Vehicle-to-Grid	3	TBD	$5.3
Off-Road Hybrids	2	2	$4.5
E85 Hybrids	1	1	$2.7
Total	**31**	**209+**	**$58.7**

Source: California Energy Commission.

While many previously funded demonstration projects are still in progress, several have already begun to move further along the commercialization continuum or even prove commercial viability. Stockton-based Electric Vehicles International (EVI), for example, has successfully demonstrated four Class 5 extended-range electric bucket trucks with Pacific Gas and Electric Co. (PG&E). In addition to offering 45 miles of all-electric driving range, the vehicles can provide electricity to outage areas during repairs. EVI will also supply electric drivetrains to demonstrate similarly sized fuel cell battery electric delivery vans for the United Parcel Service under a recent ARFVTP federal cost-sharing award.

The ARFVTP has also funded a series of Class 8 drayage trucks that can move shipping containers from the Ports of Los Angeles and Long Beach to warehouses and distribution centers in the northern and eastern parts of the Los Angeles region. TransPower of Poway (San Diego County) has produced a battery electric truck, while Volvo and Artisan are developing plug-in hybrid drayage tractors. Through the Emerging Opportunities investment plan category, the Energy Commission has provided $3 million toward the South Coast Air Quality Management District's (AQMD) demonstration of a catenary lines system. This system is intended to allow cargo trucks along the busy Interstate 710 corridor to use overhead lines to travel the corridor on electricity and then transition to conventional fuel once the overhead lines end. This busy corridor, though just 24 miles long, sees more than 40,000 truck trips per day.

The Energy Commission also released an ARFVTP solicitation focused on retrofitting used medium-duty trucks (between 10,001 and 26,000 pounds gross vehicle weight rating) with all-electric drive technology. This funding would demonstrate the feasibility of retrofitting trucks for electricity as a cost-effective way to increase market penetration of ZEV truck technologies. Three awardees were selected from among five applicants to receive a total of $4.8 million in

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model years 2014-2018. The next phase of standards, extending beyond model year 2018, is expected by March 2016.

ARFVTP funding. Two projects will demonstrate the repowering of Class 5 walk-in delivery vans; the third project will demonstrate the repowering and potential vehicle-to-grid integration of an all-electric Class 6 school bus.

The ARFVTP has also supported the demonstration of more near-term alternative fuel configurations of medium- and heavy-duty vehicles. Through both the ARFVTP and Public Interest Energy Research Natural Gas programs, the Energy Commission is partnering with South Coast AQMD to support development and demonstration of natural gas engines with NO_x emission levels that are 90 percent lower than 2010 engine emission certification standards. Other natural gas truck demonstration projects include new high-efficiency engines and plug-in hybrid technologies. ARFVTP funding has also supported the development and demonstration of an E85 hybrid truck with Cummins Inc.

Some of these projects can introduce alternative fuels and GHG emission reductions into vehicle applications, including long-haul applications. While the per-vehicle emission reductions from these project types may be smaller than those of ZEV technologies, they nevertheless provide an early market, cost-effective option for emission reductions when such advanced technologies are not currently practical. The Energy Commission may also consider opening ARFVTP funding for enabling technology development and demonstration projects (not necessarily related to propulsion), which can reduce emissions without requiring incorporation of alternative fuel systems.[59]

While the Energy Commission has focused its ARFVTP funding on demonstration projects, the HVIP administered by the ARB provides deployment incentives for hybrid, battery electric, and fuel cell trucks and buses. These two activities are regularly coordinated to ensure that applicants are not "double-dipping" into both funding sources, as well as to promote the ability of funding recipients to graduate from small-scale demonstration projects to full-scale deployment projects over time. Table 22 below summarizes the number and amount of awards provided by HVIP through June 2014. Parcel and beverage delivery trucks account for nearly two-thirds of vehicles provided with incentives, indicating a particular suitability for hybrid and zero-emission vehicle technologies in those applications.

Table 22: HVIP Deployment Incentives

Technology Type	# of Vehicles	Average HVIP Funding	Total HVIP Funding (in millions)
Hybrid Vehicles	1,338	$29,220	$39.1
Zero-Emission Vehicles	361	$34,814	$12.6*
Total	**1,699**	**$30,408**	**$51.7**

Source: ARB. *Includes $4 million in earlier ARFVTP funding targeted toward zero-emission vehicle incentives.

59 For example, the most recent solicitation for this category (PON-14-605) added funding eligibility for intelligent transportation system projects, which can reduce system-wide emissions without altering propulsion technology or fuel choice for vehicles.

More recently, the ARB adopted a funding plan for FY 2014-2015 that incorporated funding from both the traditional AQIP fund as well as a portion of the GGRF. This funding plan included up to $85 million for heavy-duty vehicle and equipment projects, including $10 million to $15 million in added HVIP incentives, $20 million to $25 million for zero-emission truck and bus pilot projects, and $50 million for advanced technology freight demonstrations. This funding for larger-scale projects will likely build upon previous small-scale ARFVTP demonstration projects. While it is uncertain whether similar funding levels can be anticipated for future fiscal years, Senate Bill 1204 (Lara, Statutes of 2014, Chapter 524) recently laid the groundwork for the California Clean Truck, Bus, and Off-Road Vehicle and Equipment Technology Program, to be funded by the GGRF and administered by the ARB in conjunction with the Energy Commission. The statute allows the new program to fund development, demonstration, precommercial pilot, and early commercial deployment of zero- and near-zero emission truck, bus, and off-road vehicle and equipment technologies.

This significant influx of new funds (both present and potential) will improve the ability of ARFVTP awardees to shift from initial vehicle demonstrations toward greater commercialization. The pilot and demonstration projects funded under GGRF will target a small number of medium- to large-scale projects. In comparison, ARFVTP-funded demonstration projects have traditionally focused on small numbers of vehicles per project, as reflected in Table 21. Accordingly, ARFVTP funding will be needed to support demonstration projects for advanced technologies that are not yet able to scale up to the larger projects funded under GGRF.

Unlike major automakers with broader access to private financing and larger federal programs (such as the Advanced Technology Vehicle Manufacturing loan program), these companies often seek Energy Commission support to bridge the span between initial capital funding for prototype development and revenue from early commercialization. However, unless paired with additional funding to expand manufacturing after successful demonstrations, companies may find themselves unable to advance from small demonstration activities funded by the ARFVTP and larger precommercial deployment activities funded by the ARB. For this reason, staff proposes to also merge the previous Manufacturing Facilities, Equipment, and Working Capital allocation into this category.

The broadened scope of the new allocation will provide applicants an opportunity to conduct small-scale demonstration projects, with the added ability to scale-up or retool manufacturing or assembly lines, as appropriate. Many of the ARFVTP previous manufacturing awards have gone toward companies that are also interested in vehicle demonstration projects, and vice-versa. By combining the scope of these allocations, prospective applicants will no longer need to time their projects around two separate solicitations. Funding could be open for projects seeking support for demonstration activities, manufacturing or scale-up activities, or both combined. To ensure that all activities under this broader category are reasonably represented, the Energy Commission might consider setting aside a minimum reserve of funding in future solicitations for each of the former activities. Several would-be applicants and outside stakeholders have previously indicated an interest in this option, and staff welcomes additional input. For this

draft, staff proposes an allocation of $20 million to this revised category. Relative to previous years, the $5 million increase for this activity is based on previous funding levels for the Manufacturing allocation.

Natural Gas Vehicles

Natural gas vehicles represent a readily available and economically competitive alternative to gasoline and diesel vehicles. As the economy gradually recovered at the end of the previous decade, national gasoline and diesel prices returned to previous highs, while the retail price of compressed natural gas (CNG) stabilized at lower levels. This was attributable primarily to large new supplies of natural gas within North America resulting from shale gas extraction.[60] In October 2014, the average price of CNG per diesel-gallon equivalent (DGE) in the West Coast states was roughly $2.69 compared to $3.90 per gallon of diesel, although the latter has fallen closer to $3.00 since then.[61] As a result of this price difference, vehicle and fleet owners are exploring the possibility of shifting from conventional fuels to CNG or liquefied natural gas (LNG). Moreover, prior to the 2010 diesel emission standards, natural gas trucks historically held an edge in reduced NO_x and other emissions. In some impacted air basins where fewer alternative fuel options exist, natural gas might remain the only viable alternative fuel option for long-haul heavy-duty trucks. Medium- and heavy-duty natural gas vehicles represent the largest number of alternative fuel vehicles in their class, with nearly 15,000 on California's roads; however, this is still less than 2 percent of all such vehicles. Furthermore, there are roughly 20,000 light-duty natural gas cars, trucks, and vans within the state.[62]

In response to growing supply and demand for natural gas, the Legislature passed Assembly Bill 1257 (Bocanegra, Statutes of 2013, Chapter 749), also referred to as the "Natural Gas Act." This law tasks the Energy Commission with developing a report to "identify strategies to maximize the benefits obtained from natural gas, including biomethane for purposes of this section, as an energy source, helping the state realize the environmental costs and benefits afforded by natural gas."[63] This includes the use of natural gas as a fuel within the transportation sector. The first of

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60 Jaffe, Amy, Rosa Dominguez. "The Shale Revolution and Natural Gas in Transportation." Presented at the Energy Commission's Lead Commissioner Workshop on Electric and Natural Gas Vehicles in California. June 23, 2014. Available at http://www.energy.ca.gov/2014_energypolicy/documents/#06232014.

61 U.S. Department of Energy, *Clean Cities Alternative Fuel Report*, October 2014. Available at http://www.afdc.energy.gov/uploads/publication/alternative_fuel_price_report_oct_2014.pdf.

62 Based on analysis from the California Energy Commission Demand Analysis Office, with data from the California Department of Motor Vehicles. Include all Class 3 through Class 8 vehicles (10,001 lbs gross vehicle weight and up). These numbers may slightly underrepresent actual natural gas vehicle numbers, as some aftermarket modifications to natural gas systems may not be included.

63 California Public Resources Code Section 25303.5(b).

these reports will be completed by November 1, 2015, and the report will be updated every four years thereafter.

The staff of the Energy Commission's Fuel and Transportation and Energy Assessments Divisions held a workshop on June 23, 2014, seeking initial comments on how natural gas and biomethane will affect the transportation sector, as well as development of the 2015 AB 1257 report in general. Stakeholders from academic institutions, engine suppliers, and public utilities shared expectations for an increasing share of heavy-duty trucks to use natural gas in the next two decades, the opportunity to significantly reduce the GHG emissions of natural gas trucks through the incorporation of biomethane, and the potential for advanced technology engines that can meet low-NO_x standards.[64]

Natural gas vehicles offer a modest greenhouse gas reduction compared to most conventional vehicles under the LCFS. The carbon intensity look-up tables established by the ARB for the LCFS suggest that CNG and LNG offer GHG emissions that are respectively 15-25 percent and 10-20 percent lower than diesel.[65] These life-cycle GHG emissions can be significantly reduced with the introduction of biomethane, which possesses some of the lowest carbon intensity values established by the LCFS. CNG from landfill gas and dairy digester biogas offers life-cycle GHG emission reductions of 85-90 percent compared to diesel, while biomethane derived from high solids anaerobic digestion can reduce life-cycle GHG emissions by upwards of 115 percent.[66] As part of a potential compliance scenario for achieving the goal of reducing GHG emissions by 10 percent by 2020, demand for natural gas could reach 600 million - 1,200 million DGE, with 250 million - 500 million DGE of this coming from biomethane. This scenario would require a large transition toward natural gas engines since the current demand for natural gas in the transportation sector is closer to 100 million DGE per year.[67]

More recently, the ARB has proposed to revisit the model used to establish carbon intensities under the LCFS. The potential switch from California Greenhouse Gases, Regulated Emissions, and Energy Use in Transportation Model (CA-GREET) 1.8b to CA-GREET 2.0 entails new carbon intensity numbers for numerous fuels, including natural gas. Due to updated estimates for methane leakage rates and other factors, the life-cycle GHG emissions for natural gas vehicles will almost certainly rise. This will be part of the readoption of the LCFS, expected to take effect in January 2016.

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64 Presentations, comments, and the transcript from this workshop are available at http://www.energy.ca.gov/2014_energypolicy/documents/#06232014.

65 Depending on a range of potential natural gas supply pathways, as well as a range of natural gas engine efficiencies relative to gasoline or diesel engines.

66 Based on LCFS lookup table from December 2012. Available at http://www.arb.ca.gov/fuels/lcfs/lu_tables_11282012.pdf.

67 ARB, "Low Carbon Fuel Standard Re-Adoption – Fuel Availability," September 25, 2014. Available at http://www.arb.ca.gov/fuels/lcfs/lcfs_meetings/092514_lcfs_fuels_availability_presenation_color.pdf.

Ongoing research into methane leakage will provide opportunities to further refine the GHG emission reduction potential of natural gas and biomethane, as well as the potential to identify and eliminate fugitive methane emissions in the future. The Environmental Defense Fund, for instance, is partnering with multiple universities, natural gas producers, and utilities to identify the extent of methane leakages throughout the natural gas supply chain.[68] Several of the resulting studies are expected in early 2015 and will inform the carbon intensity values under the LCFS.

Natural gas vehicles may also offer the opportunity for lower criteria pollution emissions. In December 2013, the ARB adopted an optional reduced NO_x emission standard for heavy-duty vehicles that can encourage engine manufacturers to demonstrate their emission reductions. Such standards include NO_x levels that are 50, 75, and 90 percent lower than the current 0.20 grams per brake horsepower-hour emission standard. The initial statement of reasons for the voluntary standard suggests that heavy-duty natural gas engines may be the primary initial technology for meeting the more aggressive 75 percent and 90 percent NO_x reduction targets.[69] Depending on the ability of natural gas engine manufacturers to demonstrate such reductions, this finding could further support market deployment of heavy-duty natural gas trucks.

To date, the ARFVTP has supported the deployment of 1,361 natural gas vehicles, as summarized in Table 23. Two large awards for natural gas vehicle deployment came from the ARFVTP cost-sharing of successful projects under the American Recovery and Reinvestment Act of 2009. After that, the Energy Commission released two solicitations (PON-10-604 and PON-11-603) that offered first-come, first-served buydown incentives for the sale of natural gas cars and trucks. Vehicle incentives were tailored to vehicle weight classes, to reflect the increasing incremental costs of natural gas vehicles as gross vehicle weight (GVW) increases. As a result, these investments have favored heavier-duty vehicle classes (both in terms of numbers and funding), which offer the largest per-vehicle opportunities for petroleum displacement.

In addition to these 1,361 vehicles, the Energy Commission issued a third solicitation (PON-13-610) for buydown incentives. For this solicitation, staff reconfigured vehicle incentive levels based on the estimated fuel displacement for each GVW class per ARFVTP dollar, as well as comparisons to other vehicle incentives. While still in progress, applicants under this solicitation have reserved more than $21 million for more than 3,100 natural gas vehicle incentives.[70]

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68 Environmental Defense Fund, "What Will It Take to Get Sustained Benefits From Natural Gas?" http://www.edf.org/methaneleakage.

69 Air Resources Board, *Staff Report: Initial Statement of Reasons for Proposed Rulemaking*, October 23, 2013. Available at http://www.arb.ca.gov/regact/2013/hdghg2013/hdghg2013isor.pdf.

70 This number reflects incentive reservations, which may or may not become fully used. In the event that a company does not use all of its reserved incentive funding, the remaining amount then becomes available for the next eligible company to reserve.

Table 23: ARFVTP Funding for Natural Gas Vehicle Deployment

Funding Agreement or Solicitation	Vehicle Type	# of Vehicles	ARFVTP Funding (in millions)
San Bernardino Associated Governments (ARV-09-001)	Heavy-duty trucks	202	$9.3
South Coast Air Quality Management District (ARV-09-002)	Heavy-duty drayage trucks	120	$5.1
Buydown Incentives PON-10-604 and PON-11-603 *(Reflects all approved incentives)*	Up to 8,500 GVW	245	$0.7
	8,501-14,000 GVW	137	$1.1
	14,001-26,000 GVW	211	$4.2
	26,001 GVW and up	446	$12.9
Buydown Incentives PON-13-610 (In Progress) *(Reflects approved reservations only, not claimed or approved incentives)*	Up to 8,500 GVW	1,616	$1.6
	8,501-16,000 GVW	628	$3.8
	16,001-26,000 GVW	314	$1.9
	26,001-33,000 GVW	0	$0
	33,001 GVW and up	551	$13.8
UC Irvine Agreement (Pending)	TBD	TBD	$10.2
Total		**4,470 (+ TBD)**	**$64.6**

Source: California Energy Commission.

The Energy Commission is administering the reservations and pending incentive claims in PON-13-610. In addition to this funding, the Energy Commission is pursuing an agreement with UC Irvine to provide an incentive directly to vehicle purchasers using additional available funds from previous investment plans.

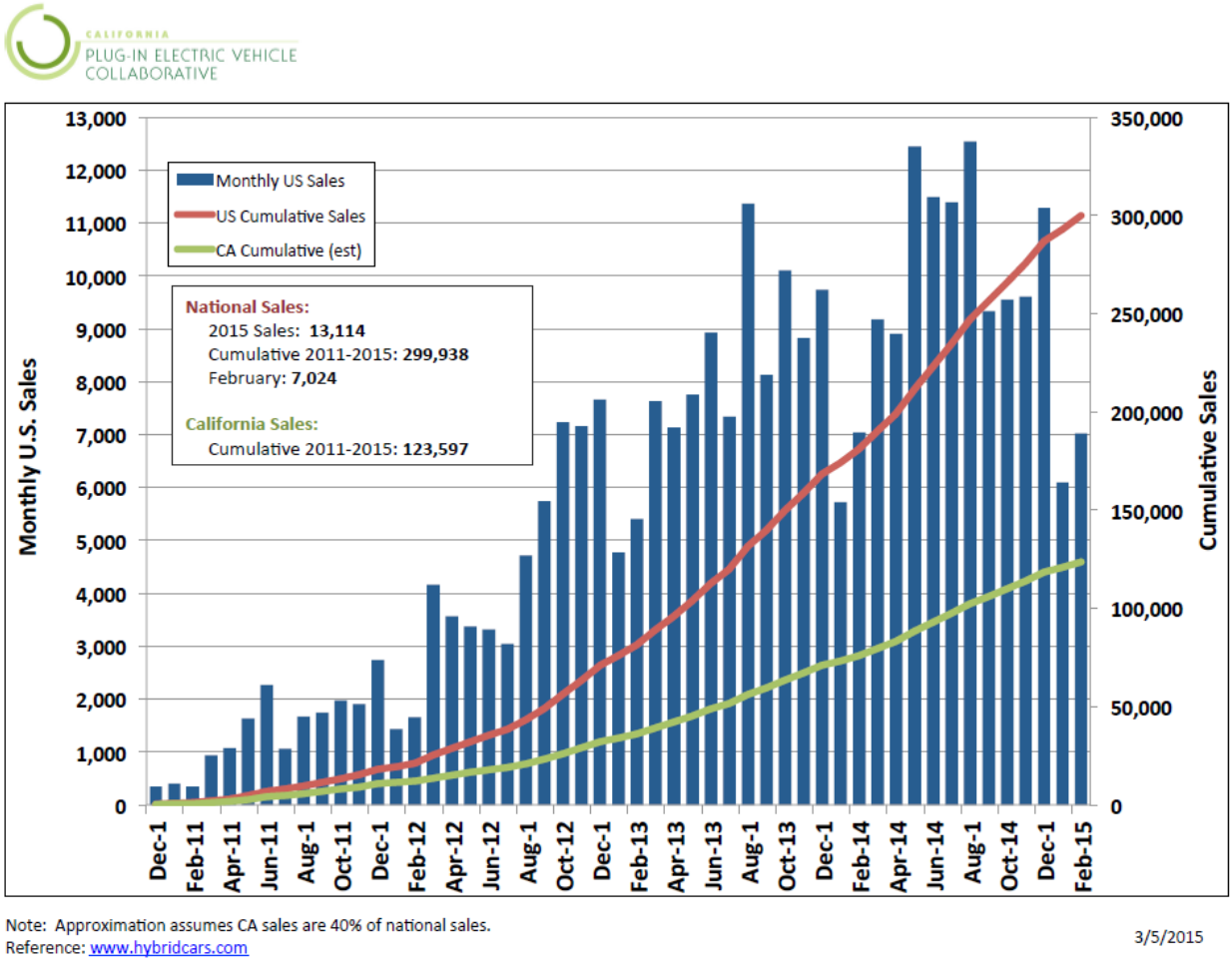
The incremental upfront costs for natural gas engines vary significantly by engine size and supplier but typically are in the tens of thousands of dollars. As a result, natural gas engines are most economical in vehicle applications where fuel costs constitute a higher share of overall vehicle costs, such as heavy-duty trucks that travel tens of thousands of miles per year. In such cases, the payback period for investing in a natural gas engine can be two years or less. Once the incremental cost difference is paid off, the truck owner can benefit from significant savings in fuel costs over the useful life of the truck and engine.

The long-term goal for ARFVTP vehicle incentives is to increase consumer familiarity and supplier production to a point where various natural gas vehicle types can grow in the market without further subsidy. In the longer term, these vehicles can also be paired with the increased production of biomethane for a lower carbon intensity, and with other advanced vehicle technologies (such as low-NO_x engines or hybrid-drive technology) to further lower all emissions. While continuing to monitor revisions to life-cycle GHG emissions, staff proposes a $10 million allocation for FY 2015-2016 to support natural gas vehicle deployment. In using these funds, staff will continue to seek opportunities for more efficient per-vehicle incentives that can affect the sales of more vehicles.

Light-Duty Electric Vehicles

The accelerating deployment of light-duty PEVs in California has been an early success in California's goal of reducing GHG and criteria pollution emissions. PEVs have become an increasingly common site on California's roadways in the past two years, especially in metropolitan areas. These include 19 models of full battery-electric vehicles and plug-in hybrid vehicles with varying levels of electric range, offered by almost every automobile manufacturer. Through February 2015, the number of PEVs sold in California has reached nearly 125,000, representing about 40 percent of national sales.[71]

Figure 4: California and National Sales of PEVs



Source: California Plug-in Electric Vehicle Collaborative.

71 California PEV Collaborative, "California Surpasses 100,000 Plug-in Car Sales," September 9, 2014. Available at http://www.pevcollaborative.org/sites/all/themes/pev/files/docs/140908_News%20Release_Final.pdf.

Despite this impressive beginning, there are still significant room and need for market expansion of PEVs. Nearly 27.5 million light-duty vehicles are registered within California, and recent annual sales have ranged from 1.2 million to 1.6 million. The *ZEV Action Plan* sets a target for 1.5 million ZEVs on California's roads by 2025. In the longer term, California will likely need to transition all of its light-duty fleet to ZEV technologies by 2040 to meet the 80 percent GHG reduction target for 2050.

To help sustain growth of both PEVs and FCEVs, the ARB administers the CVRP as part of the AQIP. The CVRP provides a first-come, first-served incentive to encourage the purchase or lease of light-duty BEVs, PHEVs, and FCEVs. To date, the CVRP has provided incentives for more than 93,000 BEVs and PHEVs, as well as several dozen FCEVs.[72] Current incentives include $2,500 for BEVs, $1,500 for PHEVs, and $5,000 for FCEVs. Based on the number of incentives provided over the past 12 months, current demand for incentives averages about $7.6 million per month for about 3,700 vehicles.[73] At this level, incentives over a 12-month period totaled about $91.7 million per year for about 44,000 vehicles. However, given the upward trend of PEV sales within California over the last four years, demand for incentives may exceed this amount.

For this reason, the ARB approved a funding plan for FY 2014-2015 that supports the CVRP using money from both the traditional AQIP fund as well as the GGRF. Between the two funding sources, the ARB allocated a total of $116 million to support the current CVRP, as well as an additional $9 million to initiate pilot projects that can support early PEV deployment in disadvantaged communities. Based on initial fund estimates for FY 2015-2016, ARB staff has proposed providing a similar amount of funding for CVRP as in FY 2014-2015.[74] To further ensure the sustainability of CVRP incentives, ARB staff continues to refine PEV market projections and review available research on the level of appropriate incentives. Incentive amounts were previously diminished to current levels in July 2012 in response to market demand. The passage of Senate Bill 1275 (De León, Chapter 530, Statutes of 2014) may entail further changes to the CVRP. Among other provisions, this bill will require the ARB to adopt revisions to the CVRP by June 30, 2015, pertaining to rebate levels, income eligibility, and consideration of other rebate methods.

The Energy Commission has also helped sustain CVRP incentives by providing supplemental funding in previous investment plans. The Energy Commission strongly supports the CVRP goal of getting more PEVs deployed within California and has provided a combined $24.5 million in

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72 Center for Sustainable Energy (2014). California Air Resources Board Clean Vehicle Rebate Project, Rebate Statistics. Data last updated February 19, 2015. Retrieved March 8, 2015, from http://energycenter.org/clean-vehicle-rebate-project/rebate-statistics.

73 Ibid. Based on incentives received from June 1, 2014, through August 31, 2014.

74 ARB, "Air Quality Improvement Program (AQIP) & Low Carbon Transportation Investments: Second Public Workshop on the Fiscal Year (FY) 2015-2016 Funding Plan," January 23, 2015. Available at http://www.arb.ca.gov/msprog/aqip/fundplan/fundingplan_workshop_presentation_012315.pdf.

previous investment plans to sustain the availability of the CVRP rebate. These transfers represent a mix of initial investment plan allocations and subsequent reallocations and are summarized in Table 24. This funding provided incentives for about 10,700 PEVs. In September 2013, the Legislature also approved the transfer of $24.55 million from the ARFVTP fund to the AQIP fund, which provided incentives for roughly 10,300 more.[75]

Table 24: ARFVTP Funding for CVRP

Fiscal Year	Amount (in millions)	Cumulative Total (in millions)
2009-2010 (Reallocations)	$2	$2
2012-2013	$4.5	$6.5
2012-2013 (Reallocations)	$8	$14.5
2013-2014	$5	$19.5
2014-2015	$5	$24.5
General Fund Repayment Transfer	$24.55	$49.05

Source: California Energy Commission.

Before the availability of GGRF support for CVRP, these funds from the Energy Commission were necessary to ensure that the incentives were reliably available for prospective PEV consumers. Given the availability of GGRF support for CVRP, the potential for adjusting incentive levels, and the increasingly small role of transferred funds from ARFVTP, staff does not propose additional funding for this category but will continue to work with ARB to support the deployment of BEVs, PHEVs, and FCEVs in the market through other complementary efforts.

75 Assembly Bill 101 (Committee on Budget, Chapter 354, Statutes of 2013). Senate Bill 359 (Corbett, Chapter 415, Statutes of 2013).

Summary of Proposed Alternative Fuel and Advanced Technology Vehicles Allocations

Table 25: FY 2015-2016 Funding for Alternative Fuel and Advanced Technology Vehicles

Medium- and Heavy-Duty Vehicle Technology Demonstration and Scale-Up *Relevant Policy Goals:* - GHG Reduction - Air Quality - Petroleum Reduction - Low Carbon Fuel Standard	$20 Million	No net funding allocation increase from FY 2014-2015; combines previous allocations of $15 million for Medium- and Heavy-Duty Vehicle Technology Demonstration category and $5 million for Manufacturing category. Merging these categories will allow future recipients to have a smoother transition from small-scale demonstrations to ramping up for larger demonstrations and pilot projects.
Natural Gas Vehicle Deployment *Relevant Policy Goals:* - Petroleum Reduction - Air Quality - Low Carbon Fuel Standard - GHG Reduction (with incorporation of biomethane)	$10 Million	No funding allocation change relative to FY 2014-2015.
Total	**$30 Million**	

Source: California Energy Commission.

CHAPTER 6:
Related Needs and Opportunities

Manufacturing

In addition to reducing GHG emissions, improving air quality, and reducing petroleum dependence, California's transition to alternative fuels and advanced technology vehicles can provide an opportunity for economic growth in related industries. California possesses a significant advantage in terms of technology innovation. According to the Next10 *2014 California Green Innovation Index,* California leads the nation in patent developments for battery technology and comes second to three states in the number of patents for hybrid/electric drive systems, fuel cell technology, and biofuel and biomass technologies. However, the same report finds that, since a peak in 2011, clean technology companies in California have experienced significant declines in financing through debt, venture capital, grants, and other funding mechanisms. In particular, the amount of venture capital invested statewide in clean transportation decreased from roughly $1 billion in 2012 to around $250 million in 2013. This decline mirrors a trend both nationally and worldwide.[76]

To help translate private investment into job growth, the Energy Commission has invested more than $57 million to date into 22 in-state manufacturing projects that support the goals of the ARFVTP. The Energy Commission most recently released solicitation PON-14-604, focused on advanced vehicle technology manufacturing. The solicitation proposed awards totaling $10 million for manufacturing facilities that produce complete vehicles and/or vehicle components. Projects were scored based on several criteria, with "Benefits" (including economic benefits and GHG reductions) and "Business Plan" (including technology, marketing, and financial information) each representing 30 percent of the overall score.

Existing ARFVTP awards for manufacturing projects are summarized in Table 26.

Table 26: Summary of Manufacturing Projects

Hardware Type	Number of Projects	ARFVTP Funding (in millions)	Match Funding (in millions)
Battery Systems*	4	$12.2	$16.2
Charging Equipment*	2	$1.9	$2.3
Electric Cars*	2	$10.2	$50.2
Electric Motorcycles	3	$3.7	$3.8
Electric Powertrains and Platforms	3	$6.0	$7.0
Electric Trucks and Buses	8	$23.2	$47.2
Total	**22**	**$57.2**	**$126.7**

Source: California Energy Commission. * Includes one canceled project; funding amount is limited to invoices that were paid before the project was canceled.

76 Next10, *2014 California Green Innovation Index*, May 2014. Available at http://greeninnovationindex.org/.

Notable previous examples of ARFVTP manufacturing agreements include the following:

- EVI produces light- and medium-duty battery-electric trucks, as well as electric powertrain systems and conversions for existing trucks. In 2010, the Energy Commission awarded EVI a $3.9 million grant to develop, test, and improve production processes at its Stockton (San Joaquin County) manufacturing facility. Through this project, EVI anticipates a 30 percent reduction in vehicle costs and the creation of an additional 375 jobs at commercial scale.
- TransPower produces battery-electric powertrain conversions for heavy-duty trucks. The Energy Commission awarded TransPower a $1 million grant in 2010 to study the feasibility of an electric truck manufacturing facility in Southern California. The grant also funded performance tests to validate that TransPower's electric vehicle components are ready for commercial-scale manufacturing. The project was successful and helped TransPower further its business and technology. TransPower has subsequently participated in several projects demonstrating its technology.
- Wrightspeed produces range-extended electric drive powertrain retrofit kits for medium-duty trucks. The Energy Commission awarded Wrightspeed a $5.8 million grant in 2012 to expand and improve its existing manufacturing facility in San Jose. When complete, the facility will be able to fully manufacture, assemble, integrate, and test the retrofit kits, which are expected to significantly improve fuel economy.
- Tesla Motors has made significant inroads over the past two years in expanding its capital. California continues to host the manufacturing of Tesla Motors' existing Model S sedan. With previous manufacturing funding from the ARFVTP, Tesla Motors will also reconfigure its manufacturing line in Fremont to produce its next product, the Model X crossover utility vehicle.
- Zero Motorcycles, a producer of electric motorcycles, received a $1.8 million grant from the Energy Commission in 2012 to improve its Scotts Valley (Santa Cruz County) manufacturing facility. The grant enabled Zero Motorcycles to quadruple production capacity and improve production workflow. The project is also expected to foster and contribute to the in-state electric vehicle component manufacturing industry.

In previous solicitations, funding to establish, expand, or upgrade manufacturing lines has been particularly beneficial for heavy-duty advanced technology vehicle developers. Unlike major automakers, which have broader access to private financing and larger federal programs (such as the Advanced Technology Vehicle Manufacturing loan program), these companies often seek Energy Commission support to advance from prototype development and demonstration into early commercialization and initial revenue streams. The ARFVTP already provides funding to support small-scale demonstration projects. However, unless paired with additional funding to expand manufacturing after successful demonstrations, companies may find themselves unable to advance from small demonstration activities funded by the ARFVTP and larger precommercial deployment activities funded by the ARB.

Staff is therefore proposing a revision to these two ARFVTP allocations that would combine them into one category with a broader scope. (See the previous "Medium- and Heavy-Duty Vehicle Technology Demonstration and Scale-Up" section.) Combining these allocations would allow staff greater flexibility in developing solicitations that combine both elements of vehicle technology demonstration and facility retooling. As currently structured, applicants seeking to pair these funding sources must compete in separate solicitations and acquire top scores in both. Staff encourages stakeholder feedback on this proposal.

Emerging Opportunities

The Emerging Opportunities allocation of the investment plan was created to withhold a small amount of funding for project types that were not anticipated during the development of that year's investment plan. This category also been used to provide matching funds for projects seeking federal funding.

To date, the Energy Commission has developed six agreements through this funding category. The first three rows in Table 27 are partnerships with other government agencies to develop advanced fuel production technologies, explore vehicle-to-grid capabilities, and demonstrate the integration of hybrid electric trucks with over-the-road charging. Each of these projects will contribute to the goals of the ARFVTP. The last three rows in Table 27 represent successful projects from solicitation PON-13-604, which focused specifically on federal cost-sharing projects. Federal solicitations are offered throughout each year in a variety of subjects related to the goals of the ARFVTP.

Table 27: Summary of ARFVTP Agreements From Emerging Opportunities Category

Primary Partners	Description	ARFVTP Funding (in millions)	Outside Funding (in millions)
California Institute of Technology; U.S. DOE	Develop methods to generate fuels directly from sunlight as part of U.S. DOE's Energy Innovation Hub program.	$5	Up to $122
Lawrence Berkeley National Laboratory; Concurrent Technologies Corporation; U.S. Department of Defense	Three projects to demonstrate the viability of an all-electric, nontactical vehicle fleet, integrate vehicle charging with local building loads, and explore the possibility of the vehicles participating in the California Independent System Operator's ancillary services markets.	$5.3	TBD
South Coast Air Quality Management District	Demonstrate the use of hybrid electric trucks with the ability to use an overhead electric line for charging and as a range extender.	$3	$10.5
Center for Transportation and the Environment	Develop and demonstrate fuel cell hybrid walk-in delivery vans. Expand to a limited deployment of 4 (out of 16) additional vehicles in Phase II.	$1.1	$3.4
CALSTART, Inc.	Develop and demonstrate a battery dominant fuel cell hybrid transit bus and compare operation against previous fuel cell bus generations.	$0.9	$7.6
The Regents of the University of California, Davis Campus	Establish a center for research on strategies for promoting alternative fuels and advanced vehicle technologies, increase system efficiency, and reduce single-occupant driving.	$1.1	$5.6

Source: California Energy Commission.

For FY 2015-2016, staff proposes a smaller funding amount of $3 million compared to $6 million in the previous year. As only $0.9 million was needed from FY 2014-2015 to fully fund passing projects under the last solicitation, there is still $5.1 million available from the $6 million allocation in the *2014-2015 Investment Plan Update.* The combined $8.1 million should be adequate to fund emerging opportunities as they are identified.

Workforce Training and Development

The Energy Commission continues to focus on California's present and future clean transportation workforce needs through the ARFVTP. The Energy Commission has three active interagency agreements for workforce training under the ARFVTP: the Employment Development Department (EDD) at $7.25 million, the Employment Training Panel (ETP) at $9.5 million, and the California Community Colleges Chancellor's Office (CCCCO) at $5.5 million.

The EDD agreement focuses on current and future green transportation workforce training needs. EDD, through the Labor Market Information Division, has delivered studies that inform the Energy Commission on potential workforce training opportunities for the ARFVTP. Moreover, the EDD agreement supports the California Workforce Investment Board (CWIB) and

its Regional Industry Clusters of Opportunity efforts in developing pathways to deliver clean transportation job training that addresses specific regional needs.

The ETP agreement focuses primarily on incumbent training across multiple businesses that include first responders, producers of alternative fuels, and manufacturers of advanced technology in transportation. ETP reaches out to organizations that would benefit from ARFVTP funding and invites their participation. ETP training contracts require employers to commit matching funds, along with proving retention of those employees on the 91st day after completion of their training, to receive ARFVTP funds.

The CCCCO agreement funds alternative fuel and advanced vehicle technology training and education through curriculum development, equipment purchases, and train-the-trainer and other approved activities for communities throughout California. The California Community Colleges continue to lead in the training of alternative fuels and advanced vehicle technologies in California by focusing on employer needs within each community and having those employers support new and existing training

Table 28: Workforce Training Funding

Partner Agency	Funded Training (in millions)	Match Contributions (in millions)	Trainees	Businesses Assisted	Municipalities Assisted
ETP	$7.00	$9.9	12,675	92+	14+
EDD	$7.25	$7.5	999	36+	-
CCCO	$5.50	N/A	N/A	480+	-
Total	**$19.75**	**$17.4**	**13,674**	**608+**	**14+**

Source: California Energy Commission. *The number of trainees includes completed, partially completed, and anticipated participants from approved contracts.

Examples of previous workforce training funding recipients:

- ETP/International Brotherhood of Electrical Workers-National Electrical Contractors Association California and Nevada Labor Management Cooperation Trust ($749,708) – To retrain 1,124 incumbent journeyman electricians throughout California in the Electric Vehicle Infrastructure Training Program, established to provide training and certification for the installation of residential and commercial (public) electric vehicle supply equipment. Training will address technical requirements, safety imperatives, and performance integrity of industry partners to ensure that the equipment is properly installed and maintained using the highest quality standards.
- ETP/Dana Thomas dba Industrial Modification & Repair (IMR) ($75,400) – To train 14 existing IMR workforce and new employees and to provide technology development in the rebuilding of hybrid electric vehicle batteries to meet the goals of the company and furnish the rising demand for these batteries. IMR plans to rebuild 200 HEV battery pack units in the first year and a projection of 1,000 units each year thereafter.
- CCCCO/Solano Community College ($200,000) – To enhance and develop hybrid technology courses through curriculum development, extensive equipment purchases,

and train-the-trainer support. In addition, a fully equipped mobile training system for hybrid technologies allows training to be delivered to business community partners and colleges at their own locations.

- ETP/Foothill-DeAnza Community College ($363,636) – To train 378 public and private fleets in alternative energy for technicians and supervisors, including workforce development in new fueling infrastructure, including biodiesel, ethanol, methanol, electricity, propane, CNG/LNG, and hydrogen.
- ETP/Calgren Renewable Fuels, LLC ($28,652) – To provide cross-training in at least two or three ethanol production processes to improve employee's level of expertise to 29 employees. Training will include the five general processes involved in ethanol production: cooking, fermentation, distillation and dehydration, quality control lab, and shipping and loading. Ethanol production staff will gain the knowledge needed to understand ethanol production from the raw material stage to the finished product.
- ETP/MV Public Transportation ($180,000) – To train 100 employees in a curriculum that spans maintenance skills and related occupational skills required to provide optimal service to customers and clients. Training topics include electrical skills, air systems, compressed natural gas, hybrid propulsion systems, Cummins CNG engine/fuel systems, and air conditioning and heating for alternately fueled transit vehicles. One of the three training locations—Visalia, Tulare County—is located in an area of high unemployment.
- CCCCO/Rio Hondo College ($50,000) – To develop the nation's second associates of science for electric vehicle/hybrid vehicle technician degree that is a direct pathway into a four-year degree offered at California State University, Los Angeles. There are 28 enrollees in a class that has 24 seats. In addition, an Advanced Hybrid/Electrical/Fuel-Cell course will have its first class of 20 students graduating in May 2015.
- ETP/Blue Sky ($59,280) – To train 19 employees to update manufacturing skills for yard laborers, operations/maintenance staff, refiners, and drivers in the processing and distribution of biodiesel products. Training courses include managing and servicing refining equipment, biofuel refining systems training, transporting biofuels, material management, supply chain, low-carbon process and products, feedstock titration, and biodiesel dispensing operations.
- ETP/California Labor Federation ($999,349) – To fund joint labor management training programs in public transit that provide advanced technology training for 1,352 bus and rail technicians and mechanics working with energy-efficient and green transportation vehicles and equipment. The transit partners on this project included Los Angeles County Metropolitan Transportation Authority and Amalgamated Transit Union, Local 1277; Santa Clara Valley Transportation Authority and Amalgamated Transit Union, Local 265; Sacramento Regional Transit District and the International Brotherhood of Electrical Workers, Local 1245; and the American Federation of State, County and Municipal Employees, Local 146.

Based on input received during workshops from partners in workforce delivery and private sector professionals, the Energy Commission will continue to expand workforce training opportunities for alternative fuels and advanced vehicle technologies. The Energy Commission will also continue to work with partner agencies to determine how ARFVTP funding can be implemented to maximize workforce and training needs. Based on expectations of needed funds from partner agencies in FY 2015-2016, Energy Commission staff proposes to reserve $3 million for workforce training and development projects.

Centers for Alternative Fuels and Advanced Vehicle Technologies

The Energy Commission has previously offered ARFVTP funding for centers that are dedicated to expanding the role of alternative fuels and advanced vehicle technologies within California. As described in the most recent solicitation for proposals in this category (PON-13-605), centers can provide several unique benefits, such as:

- Identifying opportunities to develop and demonstrate advanced technology vehicles.
- Providing a neutral site for companies to collaborate on technology demonstrations.
- Attracting the attention of fleet managers that might be interested in alternative fuels and advanced vehicles.
- Integrating vehicle technology development with workforce training.
- Supporting and promoting local and regional alternative fuel vehicles, which may include demonstration, maintenance and/or technical training/educational services associated with multiple alternative fuels, fueling systems, and/or vehicle technologies.
- Providing a central location for local and regional planning for development and deployment of alternative fuels, fueling infrastructure, or alternative-fueled vehicles.

To date, the Energy Commission has funded four such centers, three of which were funded under solicitation PON-13-605. Each of these three funded centers, two in Northern California and one in Southern California, will address a mixture of the above goals. While each project is unique, common activities include working with local fleet managers to understand the opportunities for converting their fleets to alternative fuels, providing technical information and training to a variety of local officials, and providing venues for showcasing new vehicle technologies.

A fourth center was funded under PON-13-604, using funding from previous Emerging Opportunities allocations. This center, cofunded as part of a larger U.S. Department of Transportation project under the University Transportation Centers Program, will research strategies that can promote new vehicle and fuel technologies, and subsequently conduct outreach to inform future decision-making. Among other subjects, this research will include

technologies pertaining to intelligent transportation systems, which Assembly Bill 8 recently added to the list of eligible projects under ARFVTP.[77] These awards are summarized in Table 29.

Table 29: Centers for Alternative Fuels and Advanced Vehicle Technology Awards

Recipient	Title of Project	ARFVTP Funding (in millions)	Outside Match Funding (in millions)
The Regents of the University of California, Berkeley Campus	Northern California Center for Alternative Transportation Fuels and Advanced Vehicle Technologies	$1.6	$1.6
Economic Development Corporation of Los Angeles County	California Alternative Fuel and Advanced Vehicle Technology Center	$1.6	$1.6
carbonBLU	NORCAL Alternative Fuels and Advanced Vehicle Technology Center	$0.4	TBD
The Regents of the University of California, Davis Campus	National Center for Sustainable Transportation – Emerging Technologies Project	$1.1*	$5.6
	Total	**$4.7****	**$8.8**

Source: California Energy Commission. *This project was submitted under a solicitation for federal cost-sharing projects and was therefore funded from previous Emerging Opportunities allocations. All other projects were funded from previous Centers for Alternative Fuels allocations. **Lower due to rounding.

These projects represent the first funding awards to support centers that the ARFVTP has funded. Until more details and results emerge from the projects funded under this solicitation, the Energy Commission does not plan on providing additional funding for this category in the investment plan.

Regional Readiness

In addition to funding for alternative fuel infrastructure and vehicles, the Energy Commission has provided funding for regions to prepare for and expedite deployment. Using comparatively small amounts of funding, the Energy Commission can help regions identify and implement policies and practices that reduce the barriers to expanding alternative fuel vehicles, particularly PEVs, into the market. These include, but are not limited to:

- Streamlining of permitting and inspection processes to promote installations.
- Updating building codes, zoning, and parking.
- Training, education, and outreach.

77 Generally, the term "intelligent transportation systems" refers to the integration of transportation systems with information technology to increase transportation system efficiency.

- Setting regional priorities for charging and refueling locations

With these goals in mind, the Energy Commission released an initial solicitation for PEV regional readiness planning in 2011. Funding recipients from this solicitation included combinations of local planning entities, air districts, government associations, and nongovernmental organizations. The awardees covered 40 counties and all major metropolitan areas. All of these awards, including three major metropolitan areas, have been completed. The Energy Commission continues to play a role in overseeing and coordinating these plans.

The California PEV Collaborative subsequently received a $1 million award from the U.S. Department of Energy to develop a statewide, multiregional approach for planning and implementing charging infrastructure. The PEV Collaborative has developed multiple materials for regions to use in developing their own plans, including resources on multiunit dwelling charging and workplace charging.

A second solicitation in this area was released in August 2013. Unlike the previous solicitation, this one was open to multiple alternative fuel types. Proposals were accepted on a first-come, first-served basis through April 2014, with eight successful applications submitted. These successful applications included the first planning award for hydrogen refueling, which will cover early FCEV adopter markets identified by automakers throughout the state.

In September 2014, the Energy Commission released PON-14-603, its third solicitation in this area. Funding in this solicitation was divided into three categories pertaining to PEVs and FCEVs. The first category focuses on implementation activities identified in previous regional PEV planning awards, such as implementing improvements to EVCS installation processes, installation of local EVCS signage, hosting PEV awareness events, and/or local government code adoption and training. The second category provides for the development of regional PEV readiness plans in areas where no such plans have yet been developed. The third category allows funding for FCEV readiness activities, such as streamlining the permitting process for hydrogen stations, promoting interest in FCEV adoption, installation of local hydrogen refueling signage, and the identification of preferred sites for future hydrogen stations. The results of PON 14-603 were released and revised in January 2015, with 8 successful applications submitted.

The results of all three regional readiness solicitations are summarized in Table 30.

Table 30: Regional Alternative Fuel Readiness Planning and Implementation Awards

Status	Fuel Type	Number and Location of Regional Awards	ARFVTP Funding (in millions)
Proposed for Award	Electricity – Implementation	3 Regions *(Corona, San Joaquin Valley, San Francisco)*	$0.9
	Hydrogen – Planning	2 Regions *(Santa Barbara Tri-County, San Francisco)*	$0.4
In-Progress*	Electricity – Planning	1 Region *(Davis)*	$0.2
	Electricity – Implementation	3 Regions *(North Coast, San Diego, South Bay)*	$0.8
	Hydrogen – Planning	1 Agreement *(Statewide - Early FCEV markets)*	$0.3
	Other/Multiple Fuels – Planning	6 Regions *(Northwest California, San Diego, Monterey Bay, Central Coast, San Mateo, San Francisco)*	$1.8
Completed	Electricity – Planning	10 Regions *(Bay Area, Coachella Valley, Monterey Bay, San Diego, Sacramento, Southern California, Ventura, North Coast, San Joaquin Valley, Shasta)*	$2
	Total	**26 Agreements**	**$6.4**

Source: California Energy Commission. *Includes proposed awards that have not yet been approved at an Energy Commission business meeting.

In PON-14-603, twice as many applications were submitted for other regions and activities that could not be funded due to timing limitations. The Energy Commission subsequently revised and reissued the previous solicitation as PON-14-607, with $1 million available from previous fiscal years' funds. However, based on recent experience, this amount is not expected to fully fund anticipated awards.

In previous staff drafts of the *2015-2016 Investment Plan Update*, further interest in new regional readiness grants was uncertain, and staff proposed to shift ARFVTP funding for this category toward charging infrastructure instead. However, given the expanded interest and variety of these planning awards, as well as the potential availability of non-ARFVTP funding for charging infrastructure (from some utilities and automakers), the Energy Commission now proposes to allocate an additional $2 million for regional readiness in FY 2015-2016.

Summary of Proposed Related Needs and Opportunities Allocations

Table 31: FY 2015-2016 Funding for Related Needs and Opportunities

Emerging Opportunities *Relevant Policy Goals:* - GHG Reduction	$3 Million	Decreased from $6 million in FY 2014-2015. A significant share of the previous year's funds is still available.
Workforce Training and Development *Relevant Policy Goals:* - GHG Reduction	$3 Million	Increased from $2.5 million in FY 2014-2015. Based on the estimated demand for new training projects by the Energy Commission's agency partners.
Regional Readiness *Relevant Policy Goals:* GHG Reduction	$2 Million	Increased from $0 in FY 2014-2015. There is increasing interest from local governments in developing and implementing local plans for zero-emission vehicles.
Total	**$8 Million**	

Source: California Energy Commission.

CHAPTER 7:
Summary of Proposed Funding Allocations

Proposed funding allocations for FY 2015-2016 are summarized in Table 32. These allocations are subject to change and are not official until the investment plan has been officially approved at an Energy Commission business meeting. Future developments, including the potential availability of GGRF allocations for these or related categories, may prompt a need for modifications to these allocations before business meeting approval. For specific details on each allocation, please see the relevant section of the preceding chapters.

Table 32: Summary of Proposed Funding Allocations for FY 2015-2016

Category	Funded Activity	Proposed Funding Allocation
Alternative Fuel Production	Biofuel Production and Supply	$20 Million
Alternative Fuel Infrastructure	Electric Charging Infrastructure	$17 Million
	Hydrogen Refueling Infrastructure	$20 Million
	Natural Gas Fueling Infrastructure	$5 Million
Alternative Fuel and Advanced Technology Vehicles	Natural Gas Vehicle Incentives	$10 Million
	Medium- and Heavy-Duty Advanced Vehicle Technology Demonstration and Scale-Up	$20 Million*
Related Needs and Opportunities	Manufacturing	
	Emerging Opportunities	$3 Million
	Workforce Training and Development	$3 Million
	Regional Readiness	$2 Million
	Total Available	**$100 million**

Source: California Energy Commission. *See the text of these respective sections for details on the proposal to combine these funding allocations.

LIST OF ACRONYMS

AB	Assembly bill
AQIP	Air Quality Improvement Program
AQMD	Air Quality Management District
ARB	Air Resources Board
ARFVTP	Alternative and Renewable Fuel and Vehicle Technology Program
BEV	battery electric vehicle
CA-GREET	California Greenhouse Gases, Regulated Emissions, and Energy Use in Transportation Model
CalRecycle	California Department of Resources Recycling and Recovery
CCCCO	California Community Colleges Chancellor's Office
CNG	compressed natural gas
CO_2e	carbon dioxide-equivalent
CPUC	California Public Utilities Commission
CVRP	Clean Vehicle Rebate Project
DC	direct current
DGE	diesel gallon-equivalent
EDD	Employment Development Department
ETP	Employment Training Panel
EVCS	electric vehicle charging station
EVI	Electric Vehicles International
FCEV	fuel cell electric vehicle
FY	fiscal year
GGE	gasoline gallon-equivalent
GGRF	Greenhouse Gas Reduction Fund
gCO_2e/MJ	grams of carbon dioxide-equivalent per megajoule
GVW	gross vehicle weight
GVWR	gross vehicle weight rating
GHG	greenhouse gas
HVIP	Hybrid and Zero-Emission Truck and Bus Voucher Incentive Project
IEPR	*Integrated Energy Policy Report*
ITS	intelligent transportation systems
LCFS	Low Carbon Fuel Standard
LNG	liquefied natural gas
MJ	megajoule
$MMTCO_2e$	million metric tons of carbon dioxide-equivalent
NO_x	oxides of nitrogen
NOPA	Notice of Proposed Award
NREL	National Renewable Energy Laboratory
O&M	operations and maintenance
PG&E	Pacific Gas and Electric Co.
PEV	plug-in electric vehicle

PHEV	plug-in hybrid electric vehicle
PON	Program Opportunity Notice
RFS	Renewable Fuel Standard
RIN	renewable identification number
U.S. DOE	United States Department of Energy
U.S. EPA	United States Environmental Protection Agency
ZEV	zero-emission vehicle