

EXECUTIVE SUMMARY

Transportation fuel is one of the top three energy use sectors in the United States, accounting for two-thirds of the 20 million barrels of crude oil consumed daily. Of that, the United States imports about half from foreign sources. In California, the transportation sector represents roughly half of all energy consumed and is more than 90 percent dependent on petroleum. Despite the current economic turmoil, Californians still consume more than 50 million combined gallons of gasoline and diesel each day.

California's dependence on petroleum-derived fuels poses a number of significant challenges. The state's transportation sector contributes about 40 percent of the state's greenhouse gas emissions, the largest amount from any sector. Fuel prices are forecasted to increase from 35 to 50 percent by 2015, slowing California's economic recovery. Given our nation's dependence on foreign sources of crude oil, petroleum dependence also comes with national security risks.

California has and will continue to dramatically affect the direction of the nation's transportation sector as it leads with landmark state regulations and incentives to decrease petroleum use and greenhouse gas emissions. The *State Alternative Fuels Plan* of 2007 (Assembly Bill 1007, Pavley, Chapter 371, Statutes of 2005), jointly developed and adopted by the California Energy Commission and the California Air Resources Board, presented strategies to increase alternative and non-petroleum fuel use for transportation. The *State Alternative Fuels Plan* set goals to reduce petroleum dependence by 15 percent by 2020 and increase alternative fuels use to 26 percent of all fuel consumed by 2022. The alternative fuels proposed in the plan could achieve these goals and reduce greenhouse gases by 15 percent to 20 percent in the coming decade. Other California regulations include the Global Warming Solutions Act of 2006 (Assembly Bill 32, Núñez, Chapter 488, Statutes of 2006), the Low Carbon Fuel Standard, the Zero Emission Vehicle regulations, the *Bioenergy Action Plan*, the Renewables Portfolio Standard and the *San Pedro Bay Ports Clean Air Action Plan*.

The Alternative and Renewable Fuel and Vehicle Technology Program, created by Assembly Bill 118 (Núñez, Chapter 750, Statutes of 2007), is crucial in helping meet the state's climate change and energy policies. Through 2014, the Energy Commission is providing incentives up to \$100 million annually, leveraging public and private investment to develop and deploy clean, efficient, and low-carbon alternative fuels and technologies. The program also provides a foundation for sustainable development and use of transportation energy and an economic stimulus creating California jobs and businesses by encouraging the invention and production of future transportation technologies and services. Assembly Bill 118 also provides up to \$50 million per year for the Air Quality Improvement Program, administered by the Air Resources Board, which complements the Energy Commission's program in providing alternative fuel vehicle incentives.

Each year the Energy Commission prepares an investment plan to determine the program funding priorities and opportunities, and describe how this funding will be used to support other public and private investments. The Energy Commission adopted the first investment plan, combining a total of \$176 million in funds from fiscal years 2008-2009 and 2009-2010 at the April 22, 2009, Business Meeting. The second investment plan, for fiscal year 2010-2011 (\$100 million), was adopted at the August 11, 2010, Business Meeting. The Committee 2011-2012

Investment Plan for the Alternative and Renewable Fuel and Vehicle Technology Program is the proposed funding guide for fiscal year 2011-2012 (\$100 million).

Summary of Program Funding

Since the first investment plan, the Energy Commission has invested \$189 million in alternative and renewable vehicle technology, fuel and infrastructure. The first Investment Plan (a combination of fiscal years 2008-2009 and 2009-2010) allocated \$175.5 million to projects. In response to public solicitations, the Energy Commission received requests for funds totaling more than \$1.2 billion. To provide further funding for worthy projects, the Energy Commission also used \$14.6 million of the second Investment Plan (fiscal year 2010-2011) to augment solicitations that had an oversubscription of passing proposals. (Table ES-1)

Among other solicitations, the Energy Commission used funds from the first Investment Plan to help California entities successfully compete for funding under the federal American Recovery and Reinvestment Act (ARRA) committing \$36.5 million to California projects. These projects were awarded about \$105.3 million in ARRA funds and also include \$113.3 million in private funds. These funds are being used to:

- Install 2,860 new electric vehicle charging sites.
- Demonstrate and deploy more than 700 medium- and heavy-duty natural gas and hybrid-electric trucks.
- Develop high-energy-density lithium-ion batteries.
- Provide public outreach to promote deploying heavy-duty natural gas vehicles.
- Establish 75 new E85 fueling stations, capable of selling a blend of 85 percent ethanol and 15 percent gasoline.

The second Investment Plan projected \$108 million for project and activity funding, based on estimated vehicle registrations, vessel registrations, identification plates, and smog abatement fees. Californians, however, registered fewer vehicles in 2009 than was originally estimated; as a result, only \$86.4 million was available for fiscal year 2010-2011. As mentioned, \$14.6 million was used to augment funding for oversubscribed solicitations. This leaves approximately \$71.8 million remaining from the second Investment Plan for new projects. This funding, in conjunction with \$100 million from this third Investment Plan, will be released for new solicitations and agreements. (Table ES-2)

Table ES-1: Funding Awarded to Date (in Millions)

Category	Funded Activity	Initial Awards 2008-09 / 2009-10 (First Investment Plan)	Augmented Awards 2010-11 (Second Investment Plan)	Total Award
ARRA	Cost-Sharing for Federal Projects	\$36.5	-	\$36.5
Electric Drive	Charging Infrastructure	\$3.2	\$2.4	\$5.6
	Convert State Vehicles to Plug-in Hybrid Vehicles	\$0.6	-	\$0.6
	Light-Duty Vehicle Rebates	\$2.0	-	\$2.0
	Medium- and Heavy-Duty Vehicle Rebates	\$4.0	-	\$4.0
	Medium- and Heavy-Duty Advance Vehicle Demonstrations	\$10.0	\$2.0	\$12.0
	Manufacturing Facilities and Equipment	\$19.0	\$5.9	\$24.9
Hydrogen	Public Fueling Stations	\$15.7	-	\$15.7
	Transit Project	\$3.0	-	\$3.0
	Fuel Standards Development	\$4.0	-	\$4.0
Natural Gas	Fueling Infrastructure	\$5.1	-	\$5.1
Propane	School Bus Incentives*	\$2.0	-	\$2.0
Biofuels	Biomethane Production	\$35.1	\$0.2	\$35.3
	Diesel Substitutes Production	\$2.8	\$1.5	\$4.3
	Advanced Ethanol and Gasoline Substitutes Production	\$3.5	\$1.9	\$5.4
	California Ethanol Producers Incentive Program	\$6.0	-	\$6.0
	E85 Fueling Stations	\$1.0	-	\$1.0
	Upstream Biodiesel Infrastructure	\$3.9	-	\$3.9
Workforce Agreements	Workforce Training and Development	\$15.0	\$0.8	\$15.8
Other Agreements	Sustainability Research	\$1.5	-	\$1.5
	Technical Assistance and Analysis	\$1.6	-	\$1.6
Total		\$175.5	\$14.6	\$190.2

Source: California Energy Commission

* Solicitation is currently underway.

Table ES-2: Future Funding Solicitations and Agreements (in Millions)

Category	Funded Activity	Funds Remaining From Second Investment Plan 2010-11	Proposed Allocations From Third Investment Plan 2011-12	Total Future Funding
Electric Drive	Plug-in Electric Vehicle Regional Readiness Plans*	\$1.0	\$1.0	\$2.0
	Charging Infrastructure	-	\$7.0	\$7.0
	Medium- and Heavy-Duty Advance Vehicle Demonstrations**	\$8.9	\$8.0	\$16.9
	Manufacturing Facilities and Equipment**	-	\$10.0	\$10.0
Hydrogen	Fueling Infrastructure	\$10.2	\$8.5	\$18.7
Natural Gas	Fueling Infrastructure	\$1.6	\$8.0	\$9.6
	Light-, Medium- and Heavy-Duty Vehicles*	\$10.2	\$12.0	\$22.2
Propane	Light- and Medium-Duty Vehicles*	\$2.4	-	\$2.4
	Light-Duty Vehicles	-	\$1.0	\$1.0
	Medium- and Heavy-Duty Vehicles	-	\$3.0	\$3.0
	Fueling Infrastructure	-	\$0.5	\$0.5
Biofuels	Biomethane Production	\$5.3	\$8.0	\$13.3
	Diesel Substitutes Production	\$3.9	\$8.0	\$11.9
	Advanced Ethanol and Gasoline Substitutes Production	\$4.5	\$8.0	\$12.5
	E85 Fueling Stations	\$5.1	\$5.0	\$10.1
	Upstream Biodiesel Infrastructure	\$3.1	-	\$3.1
Innovative Technologies	Innovative Technologies, Advanced Fuels and Federal Cost-Sharing	\$6.3	\$3.0	\$9.3
Workforce Agreements	Workforce Training and Development	-	\$6.5	\$6.5
Other Agreements	Sustainability Studies	\$2.0	\$0.5	\$2.5
	Marketing, Education and Outreach	\$2.0	-	\$2.0
	Technical Assistance and Analysis	\$3.7	\$2.0	\$5.7
	Measurement, Verification and Evaluation	\$1.7	-	\$1.7
Total		\$71.8	\$100.0	\$171.8

Source: California Energy Commission.

*Solicitation is currently underway using funds from the second Investment Plan. Funds from the third Investment Plan may be used to supplement this solicitation.

**Funding eligibility for these activities has been expanded beyond strictly electric drive technologies.

2011-2012 Investment Plan

To ensure a more comprehensive approach to the investment plan, the Energy Commission has restructured the analysis and reorganized the contents of the plan. More emphasis is given to the upstream fuel issues, such as feedstocks and fuel conversion processes. This is reflected in the biofuels section, which includes a detailed analysis of some of the more developed and promising feedstocks. The Energy Commission is also developing a similarly detailed analysis of biofuel conversion processes encouraging advanced pathways for biofuels (and other fuel types) that rely on lower carbon feedstocks and more efficient conversion processes.

The Energy Commission has also reshaped the investment plan's approach to medium- and heavy-duty vehicles. Previously, these vehicles were discussed in each fuel section. For the *2011-2012 Investment Plan*, the Energy Commission developed a separate medium- and heavy-duty section for a more detailed analysis of the opportunities and barriers for incorporating alternative fuels and advanced technologies for these types of vehicles.

2011-2012 Investment Plan Funding Priorities

The third investment plan has benefited from the Energy Commission's recent experience in reviewing and funding previous projects. This process has provided useful technical and market information and guidance for future solicitations and agreements. The program is currently oversubscribed in most funding areas, receiving more than 300 project proposals since the first investment plan. Potential greenhouse gas and petroleum use reductions are substantial, and the leveraged amount of public, stakeholder, and venture capital is unprecedented.

The Energy Commission continues providing funding to accelerate developing and marketing clean, efficient low-carbon technologies that reduce greenhouse gas emissions and petroleum dependence, and increase alternative and renewable fuel use and in-state biofuels production. Achieving these policy objectives requires a portfolio of fuels and vehicle technologies including electric drive and fuel cell vehicles, low-carbon biofuels, natural gas and propane vehicles, and improved vehicle efficiency.

The Energy Commission evaluated funding priorities based on an identified portfolio of fuels and technologies, to reflect a broad set of short-, medium- and long-term opportunities. To ensure the maximum value for the state's funding, the plan evaluates existing public and private funding that is already developing and deploying alternative fuels and vehicle technologies, and assesses where gaps exist and funding is required. Funding required for workforce training, sustainability studies, standards and certification, public education and outreach, and analytical support is also considered.

This investment plan recognizes the necessity to leverage existing federal, state, and local funding and stakeholder investments. Auto manufacturers, utilities, other stakeholders, and federal and local governments are investing in alternative fuel and advanced vehicle technologies. The Energy Commission will leverage these investments to accelerate the introduction and use of these fuels and technologies.

The Energy Commission has relied on stakeholder input, contracted research, and other agreements to help develop the *2011-2012 Investment Plan*. The *2011-2012 Investment Plan* also relies on:

- Program funds that have been awarded to date.
- American Recovery and Reinvestment Act of 2009 funds awarded to successful California project applicants.
- The effects of existing and anticipated regulations, including the Low-Carbon Fuel Standard, the *Bioenergy Action Plan*, the Zero Emission Vehicle regulation modifications, the Clean Fuels Outlets regulations, the Renewable Fuel Standard, the National Greenhouse Gas and Corporate Average Fuel Economy Standards for Vehicles, the Renewables Portfolio Standard, and the Clean Air Action Plan.

2011-2012 Investment Plan Allocations

The allocations in the investment plan are based on possible alternative and renewable fuel increases and advanced vehicle technology deployment, petroleum displacement, potential greenhouse gas reductions, the level of current public and private funding, and input from stakeholders. These allocations provide funding for demonstration and deployment opportunities in the short, mid- and long term to meet program goals (Table ES-3). For example, funding is being provided immediately to establish electric drive infrastructure for electric vehicles being deployed in 2011 to 2013—the near term. Funding for improved biofuel production methods will provide alternative vehicle fuels in subsequent years, and funding for hydrogen infrastructure will help to meet petroleum and greenhouse gas reduction goals as commercial fuel cell vehicles are introduced beginning in 2015. The *2011-2012 Investment Plan* also supports commercializing alternative fuels and vehicle technologies by funding market and program development activities.

Table ES-3: Funding Allocation Summary for FY 2011-2012

	Project/Activity	Funding Allocation for FY (2011-2012)
Plug-In Electric Vehicles	Plug-In Electric Vehicle Readiness	\$1 Million
	Charging Infrastructure	\$7 Million
	Subtotal	\$8 Million
Hydrogen	Fueling Infrastructure	\$8.5 Million
	Subtotal	\$8.5 Million
Natural Gas	Fueling Infrastructure	\$8 Million
	Subtotal	\$8 Million
Propane	Light-Duty Vehicle Incentives	\$1 Million
	Fueling Infrastructure	\$.5 Million
	Subtotal	\$1.5 Million
Gasoline Substitutes	Advanced Ethanol and Gasoline Substitute Production Plants	\$8 Million
	E85 Fueling Infrastructure	\$5 Million
	Subtotal	\$13 Million
Diesel Substitutes	Advanced Diesel Substitute Production Plants	\$8 Million
	Subtotal	\$8 Million
Biomethane	Pre-Landfill Biomethane Production	\$8 Million
	Subtotal	\$8 Million
Medium- and Heavy-Duty Vehicles	Deployment Incentives for Natural Gas Vehicles	\$12 Million
	Deployment Incentives for Propane Vehicles	\$3 Million
	Develop and Demonstrate Advanced Technology Medium- and Heavy-Duty Vehicles	\$8 Million
	Subtotal	\$23 Million
Innovative Technologies, Advanced Fuels, and Federal Cost-Sharing	Innovative Technologies, Advanced Fuels, and Federal Cost-Sharing	\$3 Million
	Subtotal	\$3 Million
Manufacturing	Manufacturing Facilities and Equipment	\$10 Million
	Subtotal	\$10 Million
Workforce Training and Development	Workforce Training and Development Agreements	\$6.5 Million
	Subtotal	\$6.5 Million
Market and Program Development	Sustainability Studies	\$.5 Million
	Technical Assistance and Analysis	\$2 Million
	Subtotal	\$2.5 Million
	Total	\$100 Million

Source: California Energy Commission

Plug-In Electric Vehicles (\$8 Million)

Sales of in-state plug-in electric vehicles are expected to increase rapidly over the next 2-3 years, as major automakers begin offering fully electric and plug-in hybrid electric vehicles. Based on automaker survey data, the combined number of these vehicles is expected to surpass 20,000 by 2012. To ensure the continued deployment of these vehicles, the Energy Commission is

providing \$1 million to support regional readiness planning of plug-in electric vehicles, and \$7 million for charging infrastructure. This funding will potentially support a broad variety of charging installations and related activities, including residential chargers, workplace commercial and public chargers, and fast chargers that can fully charge a vehicle in minutes (rather than hours). These activities will be coordinated with the Air Resources Board, the California Public Utilities Commission, and the recently established California Plug-In Electric Vehicle Collaborative Council.

Hydrogen (\$8.5 Million)

Hydrogen vehicles, predominantly fuel cell vehicles, are expected to expand rapidly in California during this decade, and the Energy Commission wants to ensure sufficient fueling infrastructure to support these vehicles. An updated survey of major automakers suggests that, despite a drop in anticipated vehicles before 2015, the number of vehicles expected after 2015 will be in the tens of thousands. Before 2015, anticipated hydrogen fueling stations should be able to provide significant coverage for the expected number of vehicles. For fiscal year 2011-2012, the Energy Commission will provide \$8.5 million to address high-priority gaps in fueling infrastructure and funding for transit demonstration opportunities that use fuel cell vehicle technology. This funding may be combined with the funds from fiscal year 2010-2011 into a single solicitation.

Natural Gas (\$8 Million)

Natural gas will play a growing role in the state's transportation sector, in response to greenhouse gas emission reduction targets, volatile oil prices, and air quality standards. Significant opportunities remain for expanding medium- and heavy-duty natural gas vehicles in a variety of applications, and are discussed in greater detail in this section of the investment plan.

A modest network of fueling infrastructure already exists for natural gas vehicles. Many of these stations, however, require upgrades, and increases in natural gas vehicles will only happen when concerns about mileage range and fleet fueling operations are resolved. The Energy Commission is allocating \$8 million to support installing new natural gas fueling infrastructure and upgrades to existing infrastructure. An expanded natural gas fueling infrastructure also creates additional opportunities to incorporate biomethane from anaerobically digested waste-based biomass feedstocks into California's transportation fueling infrastructure.

The Energy Commission will also continue to support the deployment and expanded offerings of light-duty natural gas vehicles through vehicle incentives. Funding for these incentives will draw from the \$12 million allocated to similar incentives for medium- and heavy-duty natural gas vehicles.

Propane (\$1.5 Million)

Propane, like natural gas, offers the potential for immediately reducing greenhouse gas emissions, petroleum dependence, and fuel costs for light- and medium-duty vehicles. Propane produced by renewable methods will further reduce greenhouse gas emissions from propane-fueled vehicles. Propane has been the preferred alternative fuel for rural communities and school districts that do not have access to an alternative fuel, since propane fueling

infrastructure is readily available and affordable. The Energy Commission is allocating \$1 million specifically for light-duty propane vehicle deployment and \$500,000 to expand the propane infrastructure in Northern California. Further allocations for medium- and heavy-duty propane vehicles are discussed in the Medium- and Heavy-Duty Vehicles section of the investment plan.

Biofuels (\$29 Million)

There is a broad variety of feedstocks available for renewable biofuels. California possesses a significant volume of waste-based feedstocks, which offer a particularly excellent opportunity to expand low-carbon fuels production. The annual potential from California's waste-based feedstocks is estimated to be more than 2.6 billion diesel gallon-equivalents. The Energy Commission will invest in abundant, waste-based feedstocks and maximize the variety of fuel conversion processes that use these feedstocks. The investment plan focuses on three biofuel end uses: gasoline substitutes, diesel substitutes, and biomethane.

Gasoline Substitutes (\$13 Million)

Ethanol and other drop-in gasoline substitutes offer a significant opportunity for reducing greenhouse gas emissions and petroleum use. The state's Low Carbon Fuel Standard and *Bioenergy Action Plan* and the federal Renewable Fuel Standard rely heavily on biofuels (including ethanol) to meet their targets. The Energy Commission is providing \$8 million to expand in-state production of low-carbon ethanol and other gasoline substitutes from sustainable feedstocks. This funding is intended to develop new facilities that can produce a low-carbon fuel.

An additional \$5 million will be provided to expand E85 (85 percent ethanol and 15 percent gasoline) dispensers and retail outlets. Given the relatively modest marginal cost of flex-fuel vehicles, the Energy Commission is not proposing vehicle funding for this fuel category.

Diesel Substitutes (\$8 Million)

Diesel substitutes, such as biodiesel and renewable diesel, also offer an immediate opportunity to significantly reduce California's greenhouse gas emissions and petroleum dependence. The same policy drivers that will accelerate ethanol and gasoline substitutes will also accelerate diesel substitutes. To accelerate the in-state production of diesel substitutes, the Energy Commission will provide \$8 million to expand and support California's diesel substitute production plants.

Biomethane (\$8 Million)

Producing and using in-state biomethane will further advance state policy in the transportation sector. Biomethane, when produced from waste-based resources or byproducts, possesses one of the lowest carbon intensities of any existing fuel. Additionally, biomethane can reduce lifecycle greenhouse gas emissions in a broad variety of fuel pathways, from natural gas to hydrogen to ethanol. Anaerobic digestion from a variety of waste-based feedstocks, such as wastewater treatment plants and food-processing facilities, is proving to be a robust and cost-effective technology for creating very-low-carbon transportation fuels that can be readily incorporated into natural gas vehicles and fueling systems. For these reasons, the Energy

Commission is allocating \$8 million to develop pre-landfill biomethane production for the transportation sector.

Medium- and Heavy-Duty Vehicles (\$23 Million)

Medium- and heavy-duty vehicles are a significant component of California's transportation sector, accounting for a combined 16 percent of the state's petroleum consumption and greenhouse gas emissions within the transportation sector. Yet, these vehicles represent fewer than 4 percent of the in-state vehicle population. Given the high amount of petroleum use per vehicle (compared to passenger vehicles), these vehicles offer an excellent opportunity to expand alternative fuel use, reduce petroleum dependence, and reduce greenhouse gas emissions. The Energy Commission is allocating \$12 million in deployment incentives for on-road and off-road medium- and heavy-duty natural gas vehicles, and \$3 million for propane vehicles.

Advanced technologies, such as battery electric applications, hybrid hydraulics, and fuel cell technology, can also be incorporated into medium- and heavy-duty vehicles. However, compared to passenger vehicles, medium- and heavy-duty vehicles serve a broader variety of purposes. The early use of advanced technologies may be limited to certain niche applications. Some vehicle suppliers have already begun incorporating a variety of advanced vehicle technologies. To expand the use of these technologies, the Energy Commission will provide \$8 million to demonstrate advanced technologies in the medium- and heavy-duty sector.

Innovative Technologies and Advanced Fuels (\$3 Million)

In addition to the previous fuel and technology categories, the Energy Commission is interested in providing funding for other types of projects that can help the state meet its greenhouse gas emission reduction and alternative fuel use goals. This could include, among other things, projects to improve engine efficiencies, develop high-productivity biomass feedstocks (such as algae), and create lightweight vehicle materials for multiple vehicle platforms. To ensure adequate funding for these opportunities, the Energy Commission is reserving \$3 million for innovative technologies and advanced fuels. This funding will also be reserved for cost-sharing opportunities from highly leveraged federal solicitations.

Manufacturing (\$10 Million)

Given the amount of venture capital invested in California's clean transportation sector, the state has the potential to develop and attract new opportunities for manufacturing alternative fuel vehicles and components. The Energy Commission has already made substantial investments in manufacturing. These successful projects will attract customers and production orders and will soon require greater manufacturing capacity. State support can help ensure that these commercial-scale manufacturing plants are located in California, benefitting California with jobs, environmental benefits, and tax revenue. The *2011-2012 Investment Plan* will allocate \$10 million to fund projects that establish commercial-scale clean transportation manufacturing facilities in California.

Workforce Training and Development (\$6.5 Million)

Workforce training and development is critical in California's efforts to develop a clean transportation energy market. Skilled workers are needed to manufacture low-emissions vehicles and components, produce alternative fuels, build fueling infrastructure, service and

maintain fleets and equipment, and inform ongoing innovation and refinement to increase market acceptance. Training is required to respond to new technology, improve efficiencies, minimize waste, and reduce the cost of production. As the Energy Commission funds alternative fuel and low-emission vehicle projects, it is critical that funds are allocated to help develop a skilled workforce to implement and sustain those projects. The *2011-2012 Investment Plan* allocates \$6.5 million for this purpose.

Market and Program Development (\$2.5 Million)

The Energy Commission is also allocating funding for nonfuel categories to ensure the success of this program. The Energy Commission is providing \$500,000 for sustainability studies to support commercializing renewable fuels and minimizing negative environmental impacts. Existing efforts in marketing and program outreach will continue using previous years' funds and do not require additional funding at this time. The Energy Commission will provide \$2 million for technical assistance and environmental, market, and technology analysis. This work will help the program focus on funding priorities and identifying preferred opportunities for future funding. This category may also provide funding for a variety of analytical needs to support alternative fuels and advanced vehicle technologies. Finally, the Energy Commission will rely on previous years' allocations for the measurement, verification, and evaluation of the program's activities.