



California Energy Commission Research and Development for Transportation



Matt Fung, California Energy Commission
October 20, 2015



Policy Drivers

The following legislation and policy guide the ERDD Transportation subject area on meeting California's challenges:

Senate Bill 1250: *Enabled Natural Gas Research funds to be used for advanced transportation technologies that:*

- *Reduce air pollution and GHG emissions beyond applicable standards.*
- *Benefit electricity and natural gas ratepayers.*

State Alternative Fuels Plan: *Presents strategies and actions California must take to increase the use of alternative transportation fuels.*

ZEV Mandate: *Requiring automakers to produce a combination of zero emission and partial zero emission vehicles to meet air quality goals.*

Assembly Bill 32: *Calls for approximately 36% of the state's 2020 GHG reduction targets to come from the transportation sector.*



Goals

The goals of transportation-related projects are to:

- *Reduce carbon emissions*
- *Decrease reliance on fossil fuels*
- *Improve infrastructure capacity, reliability, and sustainability*
- *Improve air quality*
- *Increase the use of transportation renewable fuels*



Research Topic Areas

Transportation Topic Areas include:

- Plug-In Electric Vehicles
- Natural Gas Vehicles
- Energy Efficient Vehicle Components
- Renewable Transportation Fuel**

**** *Transportation fuels research limited to
Renewable Natural Gas***



General Approach

- Develop research initiatives consistent with California's energy and environmental policies and market need
 - ❑ Use stakeholder developed Research Roadmaps to identify and prioritize research opportunities
 - ❑ Participate in discussions with investor-owned utilities, government agencies, and stakeholders
- Conduct annual NGV Technology Forums
 - ❑ Communication and exchange of high-priority needs of natural gas vehicle end users
- Conduct Public Workshops
 - ❑ Scoping and Pre-bid
- Competitive Solicitations



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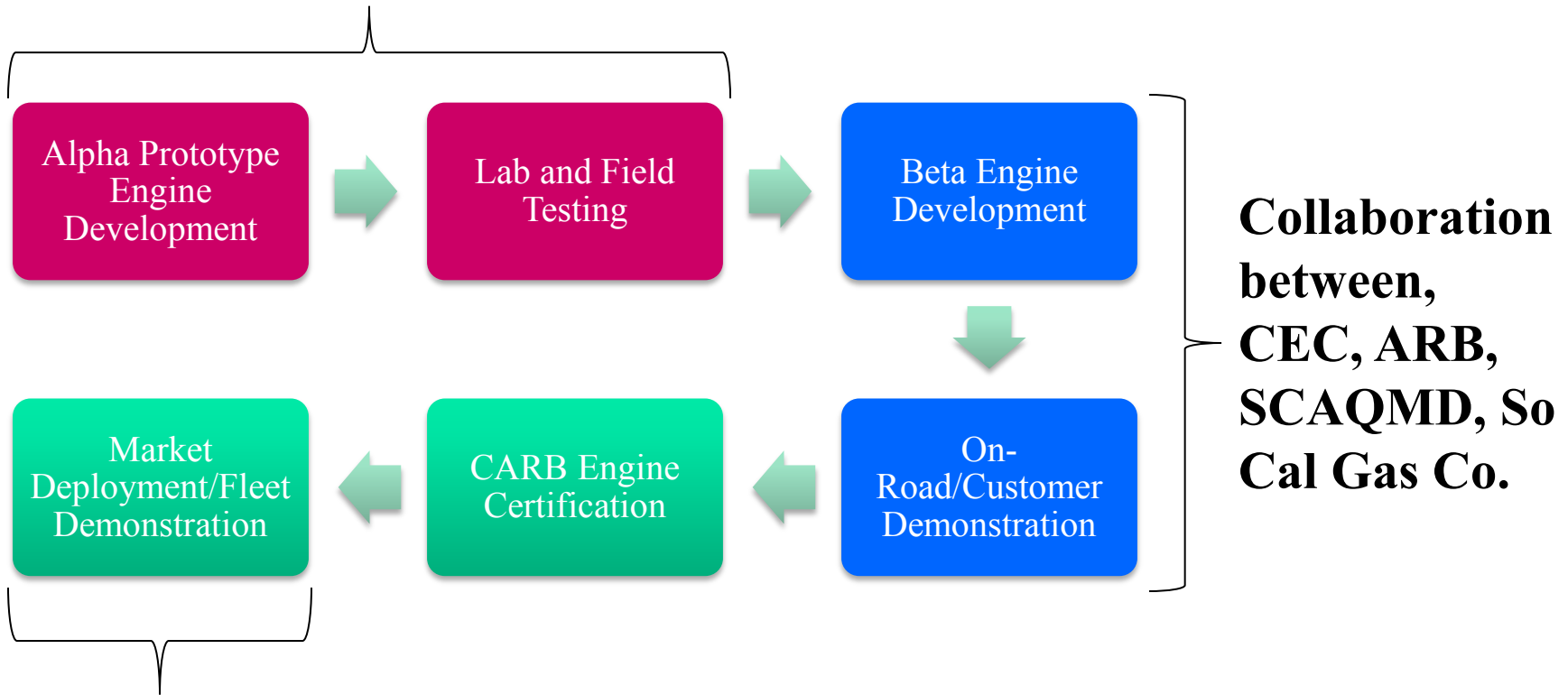
U.S. DEPARTMENT OF
ENERGY





Natural Gas Technology Development Process

CEC Research & Development



ARFVT-P



R&D Initiatives

Research Topic	Initiative	Projects
<ul style="list-style-type: none">Natural Gas Vehicle	<ul style="list-style-type: none">Engine DevelopmentChassis IntegrationVehicle DemonstrationAdvanced HybridizationOn-Board Storage	<ul style="list-style-type: none">NG Engine Development of low NOx, CWI 8.9L and Cummins15L (AB118, RDD, & SCAQMD funded)New CWI 6.7L Spark Ignited Stoichiometric NG EngineNG Hybridization - Class 4 to 8 vehicles with Transpower, Efficient Drivetrains Inc., and GTI/US HybridAdvanced NG adsorption on-board storage tank technology for light-duty vehicles



R&D Initiatives

Research Topic	Initiative	Projects
<ul style="list-style-type: none"> Energy Efficient Vehicle Components 	<ul style="list-style-type: none"> Advanced efficient truck technologies and systems Advanced Engine Ignition 	<ul style="list-style-type: none"> Completed California Hybrid, Efficient, and Advanced Truck Research Center project with CALSTART Pre-Chamber Advanced Plasma Ignition High Frequency Ignition (Corona)
<ul style="list-style-type: none"> Renewable Transportation Fuel 	<ul style="list-style-type: none"> Renewable Natural Gas Production Waste-to-energy technology Landfill gas purification 	<ul style="list-style-type: none"> RNG Production projects focusing on co-products and co-benefits Steam Hydrogasification technology development Landfill Gas production process for LNG Transportation Fuel



Project Successes

- **Purpose:** Development, integration, and demonstration of the 11.9 liter, heavy-duty stoichiometric spark-ignited natural gas engine with performance and emission attributes suitable for Class 8 regional haul and vocational truck applications.
- **Contractor:** NREL
- **Partners:** Cummins Westport, Inc.
- **PIER Funds:** \$4.25M with \$13.1M in match share
- **Results:** Successfully met the project objectives: criteria emission pollutants lower than CARB 2010, 400 HP & 1350 ft-lbs torque, and about 25% reduction in GHG emissions over current Class 8 engines. **The Cummins Westport ISX12 G natural gas engine entered the commercial market in late 2013.**
- **Rate Payer Benefits:** Approximately 97,500,000 gallons of diesel and 13 MMT of CO₂e can be displaced per year based on 10% market penetration.





Project Successes

- **Purpose:** To improve the operating fuel efficiency and power output of natural gas engines by incorporating advanced direct injection technology leading to lower incremental cost of natural gas vehicles.
- **Contractor:** Volvo Technology North America
- **Partners:** Westport Innovations Inc.
- **PIER Funds:** \$999,970 with \$390,259 in match share
- **Results:** The results from this project show a 6% fuel efficiency improvement over comparable diesel engines, and 22 to 30% reduction in GHGs (up to 90% with RNG).
- **Rate Payer Benefits:** Project results show the potential to further lower fuel consumption and decrease engine emissions for heavy-duty natural gas engines. Reduced emissions from heavy-duty vehicles improves air quality, particularly for communities heavily impacted by emissions from heavy-duty vehicles.





Current Natural Gas Solicitation

- **Title:** Natural Gas Engine Integration and Demonstration for Medium-Duty Vehicles (GFO-15-503)
- **Research:** Research and Development to integrate natural gas engines for medium-duty vehicle applications. On-road demonstration will assess emission and performance benefits associated with medium-duty natural gas engines. Will support emission reduction, reduced fuel consumption and improved engine performance goals.
- **Funding Amount:** \$2,000,000 (\$1,000,000 max/project)
- **Proposed Timeline:**
 - Solicitation Release: September 3, 2015
 - **Deadline to Submit Applications: November 3, 2015**
 - Business Meeting: May 2016
- <http://www.energy.ca.gov/contracts/pier.html#GFO-15-503>



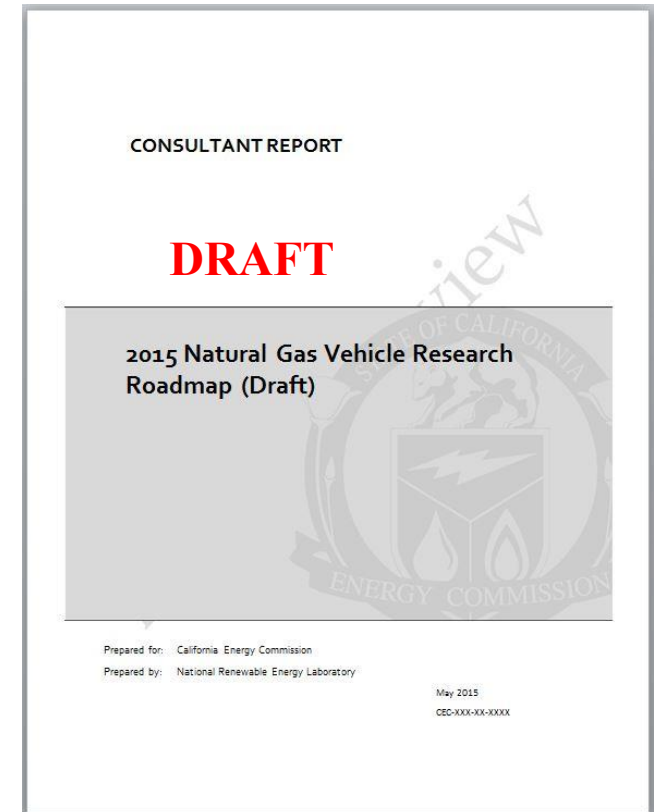
Upcoming Natural Gas Solicitation

- **Title:** Off-Road Natural Gas Engine Development and Demonstration
- **Research:** Natural gas engine research, development, and demonstration that integrate advanced natural gas technologies in off-road applications to reduce petroleum and improve air quality.
- **Funding Amount:** \$4,400,000 (\$1,100,000 max/project)
- **Proposed Timeline:**
 - Scoping Workshop: Early 2016
 - Solicitation Release: Spring 2016
 - Deadline to Submit Applications: Spring 2016
 - Business Meeting: Fall 2016



2015 Natural Gas Vehicle Research Roadmap

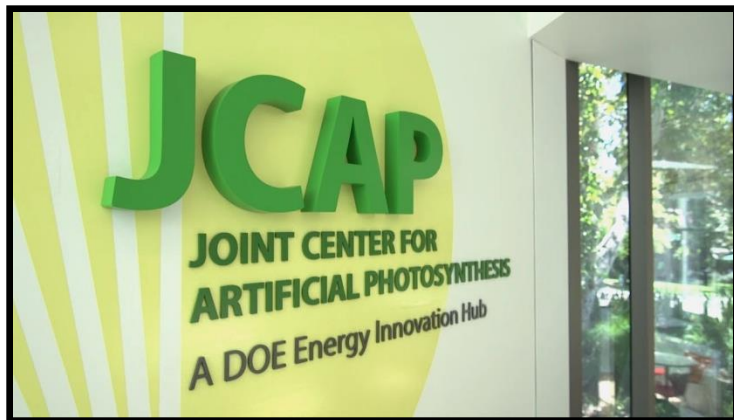
- 2015 Natural Gas Vehicle Research Roadmap (NGVRR) initiatives focus on:
 - Range, Storage, and Infrastructure
 - Vehicle and Engine Performance and Availability
 - Emission and Environmental Performance
 - Analysis and Information Sharing
- Stakeholders have reviewed and commented on the NGVRR.
 - U.S. DOE, CARB, CEC AB118 Program, Port of LA, GM, Cummins, Westport, and SCAQMD
- Research initiatives will be presented at the NGVTF and a future public workshop.





Special Projects

- Clean Energy Measures for California Ports (Tech Support)
- Military Base Vehicle-to-Grid Demonstration (ARFVT-P)
- Artificial Photosynthesis Liquid Fuels Production (ARFVT-P)





California Energy Commission

Natural Gas Vehicle Trends and Funding Opportunities

2015 Natural Gas Vehicle Technology Forum

Tim Olson, California Energy Commission

October 20, 2015



California and Federal Initiatives Related to Natural Gas/Biomethane Transportation Energy

California Government Initiatives

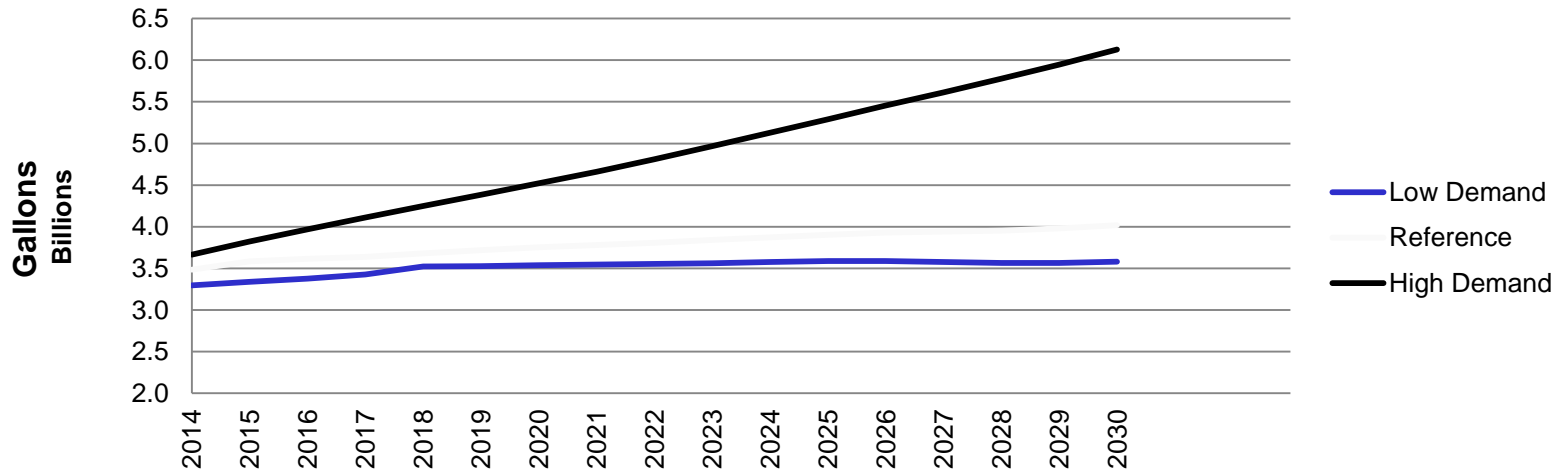
Global Warming Act (2006)	Reduce greenhouse gas emissions to 1990 levels by 2020 and 80% below 1190 levels by 2050
Low Carbon Fuel Standard (2007)	Reduce carbon intensity of transportation fuels sold in California by 10% by 2020
Petroleum Reduction and Alternative Fuel Goals (2003) and Alternative Fuels Plan (2007), R&D Roadmaps	Reduce petroleum use to 15% below 2003 levels by 2020. Increase alternative fuel use to 9% of California’s fuel consumption by 2012, 11% by 2017, and 26% by 2022. Governor Office direction (2015) to reduce petroleum use by up to 50% by 2030
SB 1257 Natural Gas Challenges/Opportunities	Identifies strategies to maximize the benefits obtained from natural gas, including biomethane, as an energy source in IEPR
Funding Incentives (AB 118, AB 8, Carl Moyer, Prop1B, CEC R&D)	Energy Commission, ARB and local air districts provide RD&D funding and financial incentives to vehicle, infrastructure and fuel production projects that reduce greenhouse gas emissions and air pollutants and increase the use of alternative fuels
75 % Diversion of Waste From Landfills by 2020	Statute requires diversion of waste (and organic material) from landfills by 2020
CPUC Biomethane Pipeline Ruling	Establish standards for energy value and clean-up of contaminants for injection of biomethane in natural gas pipelines
CPUC Natural Gas Compressor Tariff	Allows Southern California Gas Company to impose tariff to cover investment costs in natural gas compressors

Federal Government Initiatives

Renewable Fuels Standard	Requires annual specified levels of renewable fuels, including biomethane, as transportation fuel displacements of diesel and gasoline
National Ambient Air Quality Standards	Sets standards for tailpipe air pollutant emissions for vehicles by 2023

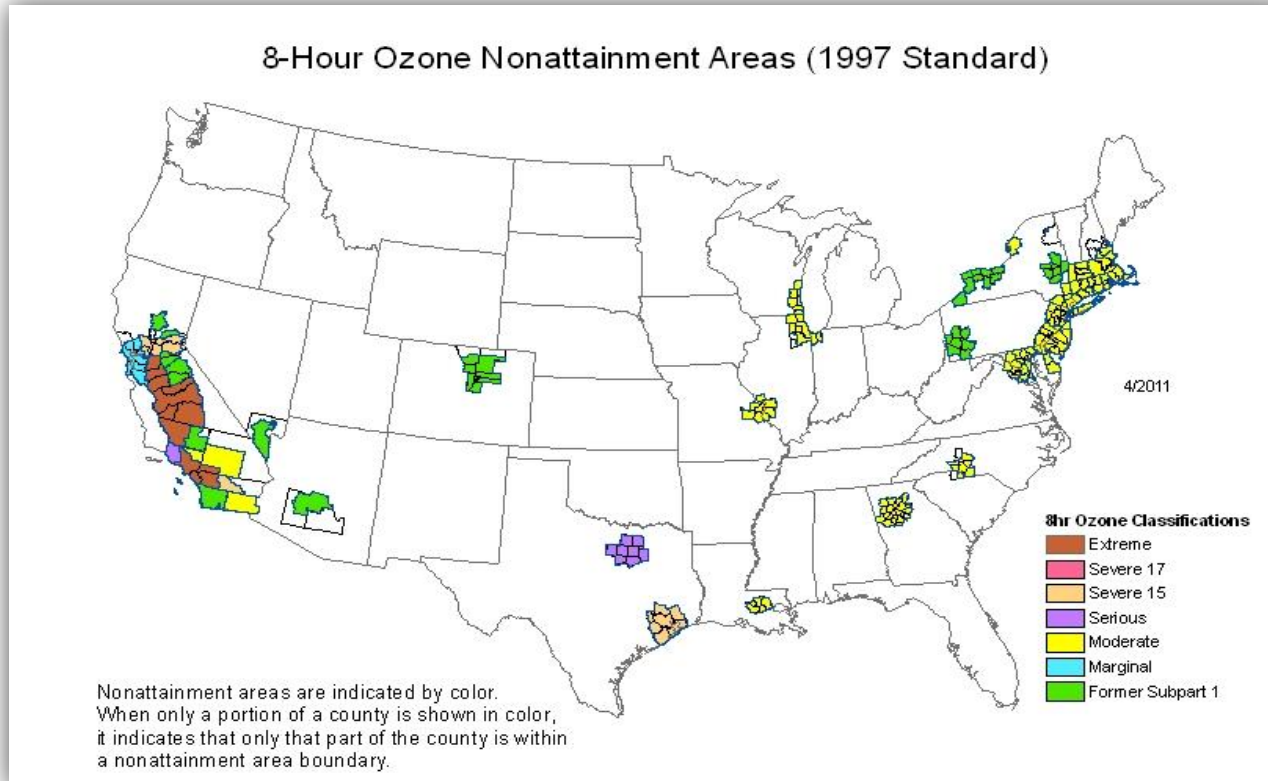


California Diesel Demand



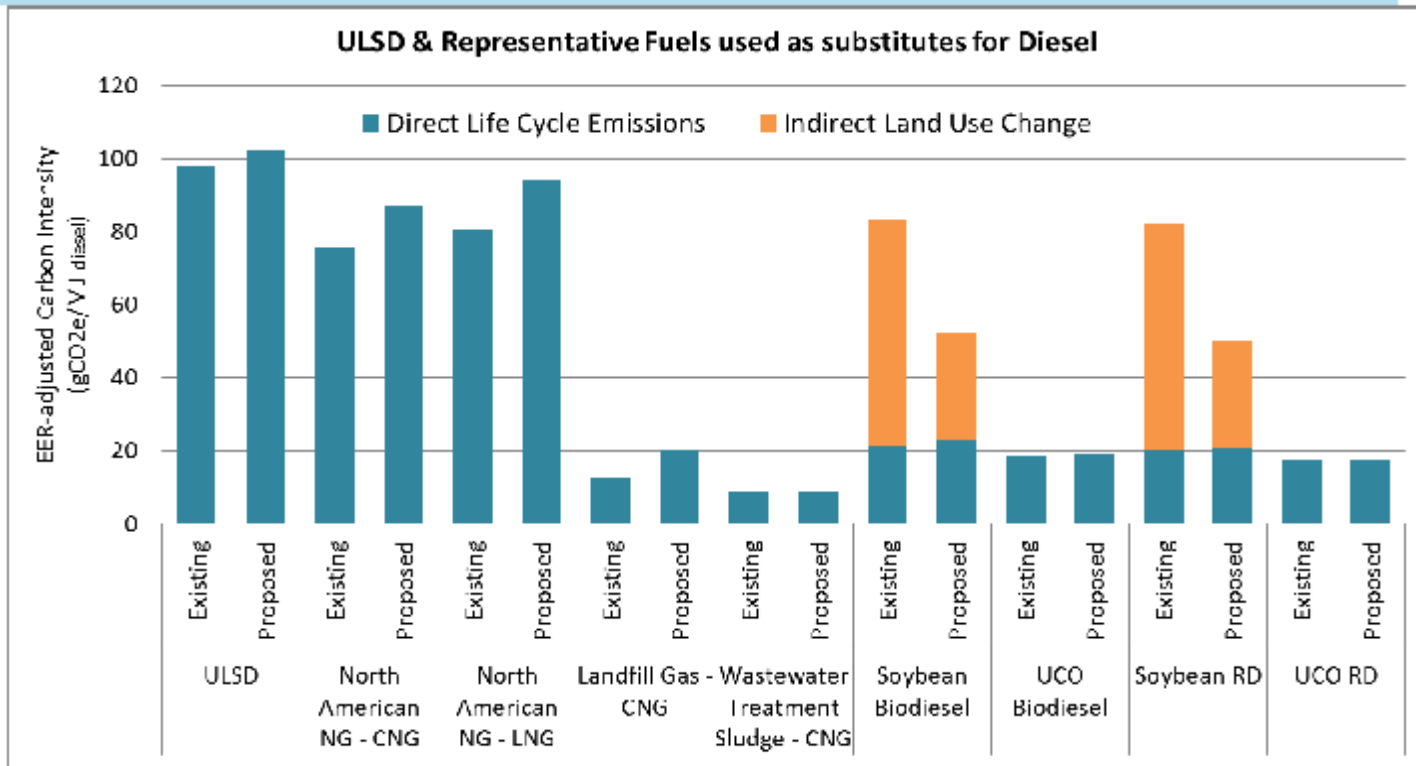


Eighteen of California's fifty-eight counties failed the ozone clean air test in the American Lung Association State of the Air 2011 report





Representative CIs for Diesel Substitutes





California Mobile Source Incentive Programs

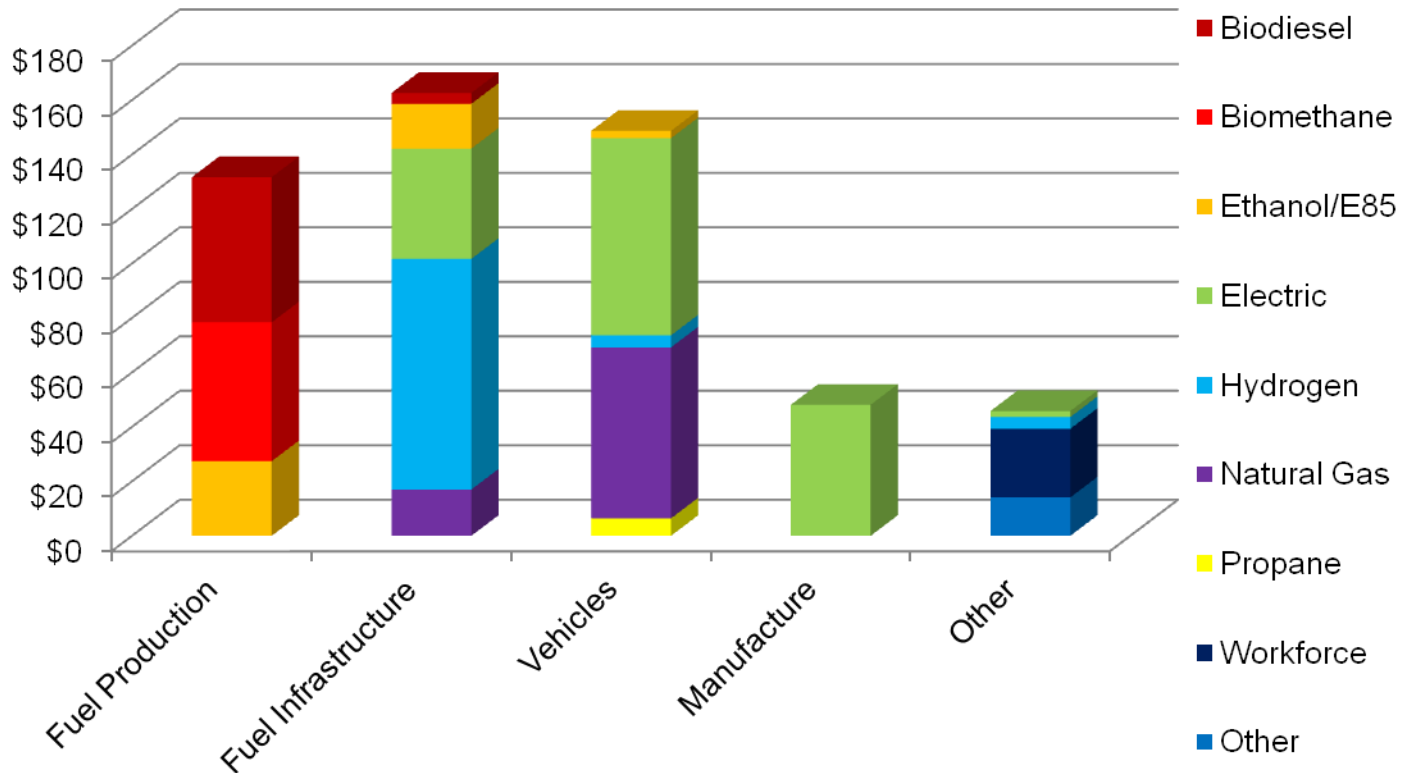
CARB Carl Moyer Near-term Local Priorities Diesel Risk Reduction Local SIP NOx, ROG, & PM	Districts AB 923 Near-term Local Priorities Diesel Risk Reduction Local SIP NOx, ROG, & PM	CEC ARFVTP Long-term Statewide Priorities Infrastructure Fuels Energy Research GHGs	BAR EFMP Near-term Local Priorities Car Scrap Criteria & GHG	CARB LCT Long-term Statewide Priorities Advanced Technology GHGs	CARB AQIP Long-term Statewide Priorities Advanced Technology Criteria, Toxics, & GHG
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	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024
CARB Carl Moyer	\$69M/yr									\$48M/yr
Air Districts AB 923	\$50M/yr									?
CARB AQIP	\$25M/yr									?
CARB Low Carbon Transportation	\$200M	\$350M*	?	?	?	?	?	?	?	?
CEC ARFVTP	\$100M/yr									?
BAR EFMP	\$35M/yr									?
CARB GMERP/Prop 1B	\$240M									

*FY15-16 CARB LCT funding as proposed by Governor's Office



California Energy Commission Alternative Fuel Incentive Funding Encumbered





ARFVTP Truck Sector-Related Funding About 30 Percent of Total Program Funding

Technology	Funding (\$ Millions)	No. of Vehicles, Fueling Stations or Projects
Commercial Natural Gas Trucks	54.3	2,735 Trucks
Natural Gas Infrastructure	16.7	60 Stations
Commercial Propane Trucks	6.4	514 Trucks
Commercial ZEV Trucks (Class 6 package delivery)	4.0	160 Trucks
Advanced Technology Truck Demonstration or Manufacturing	89.7	42 Projects
Total Funding	171.1	



Funding Allocations for FY 15-16

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
	Regional Planning and Readiness		\$2 Million
	Workforce Training and Development	\$3 Million	
	Total Available	\$100 Million	



Natural Gas Truck Incentive Levels

GVW (lbs.)	Incentive Amount
Up to 8,500	\$1,000
8,501–16,000	\$6,000
16,001–26,000	\$11,000
26,001–33,000	\$20,000
33,001 & Greater	\$25,000

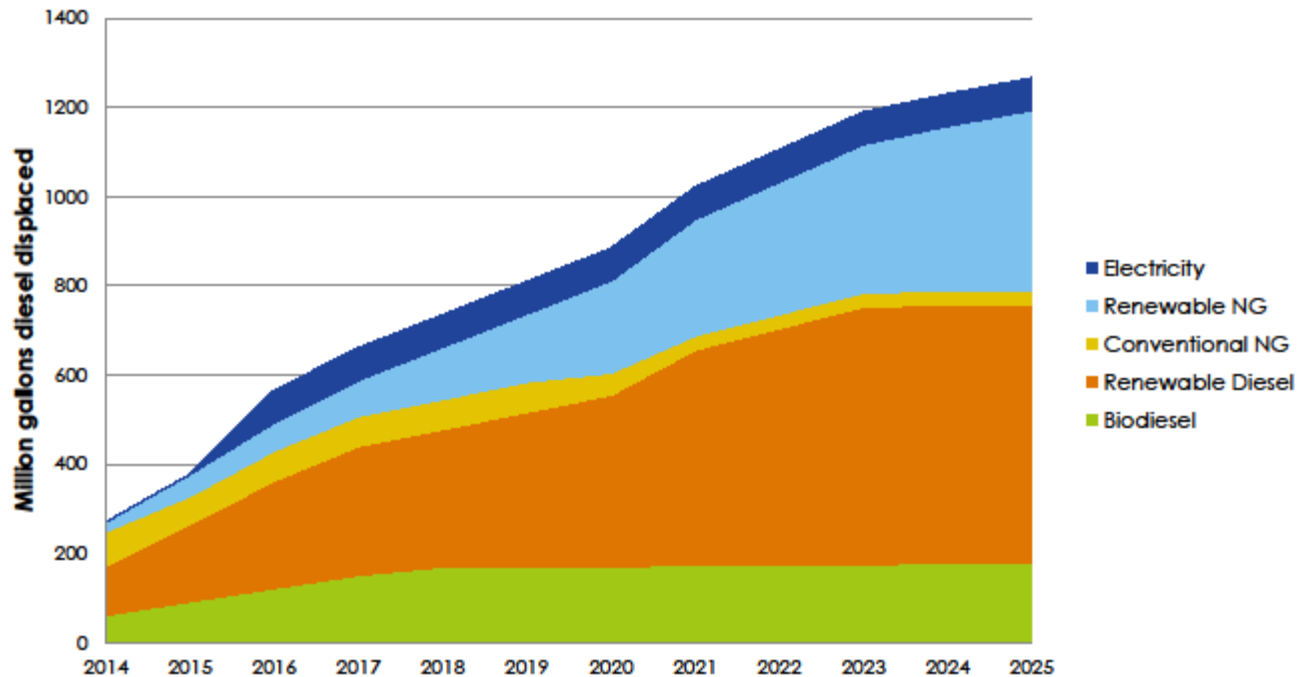


Natural Gas Vehicle Investment Program Re-Configured August 7, 2015

	Prior Solicitations	New Solicitations
Administration	California Energy Commission	Institute of Transportation Studies, Irvine
Applicant	OEM/dealer	Vehicle Purchaser
Incentive payments	Incentives paid to OEM/dealers following sale of vehicle	Incentives paid to vehicle purchaser following delivery and registration of vehicle
Reporting	By OEM/dealer	End-user reporting
Other		Research component



Illustrative Compliance Scenario: Diesel Displacement





Natural Gas/Biomethane Transportation Trends

- ❑ Fuel Price Advantage Compared to Diesel
 - \$0.50 to \$0.60/per gallon
- ❑ Established Fueling System Network
 - Over 500 Fueling Stations Operating in CA
- ❑ Low Nox 8.9 Liter Natural Gas Engine Certified at 0.01 g/bhp-hr - Provides Option to Meet NAAQS 2023 Standard
- ❑ Business Model Progress For Renewable Natural Gas Plants - Low Carbon Fuel Option
- ❑ Biomethane Injection into Natural Gas Pipeline
- ❑ Mitigate Methane Emissions



Thank You!

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