



California  
Energy Commission  
Research & Development

# Natural Gas Research Program Transportation Research Area

Energy Research and Development Division

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February 21, 2018





# Introduction and General Approach

- ▶ Identify research gaps through:
  - ▶ Discussion with public stakeholders, other government agencies, etc.
  - ▶ Roadmaps
  - ▶ Public meetings with industry and trade associations
  - ▶ Research ideas submitted by the public
- ▶ Develop annual budget plans with proposed research initiatives that address technology gaps and policy drivers.
- ▶ Develop and release competitive solicitations.
- ▶ Select research projects based on program priorities, policy directives, and clear benefits to CA ratepayers.



# Policy Drivers

**SB 1250:** Establishes a public goods utilities surcharge to support public interest R&D for transportation technologies that reduce air pollution and GHG emissions beyond applicable standards.

**EO B-32-15:** Sustainable Freight Action Plan. Improve freight system efficiency by 25%, deploy 100,000 zero-emission-capable freight vehicles, and maximize near-zero freight vehicles powered by renewables by 2030.

**2016 Mobile Source Strategy:** Reduce emissions from the heavy-duty sector with cleaner combustion engines, renewable fuels, and zero-emission technology to meet GHG reduction targets and attain federal health-based air quality standards for ozone and PM.

**Low Carbon Fuels Standard:** Reduce the life-cycle carbon intensity of California's transportation fuel pool by transitioning to low carbon fuels.

**AB 118 and AB 8:** Alternative and Renewable Fuels and Vehicle Technology Program. Increase deployment of vehicles and infrastructure to expand use of alternative and renewable fuels in CA.

**SB1383:** Short-Lived Climate Pollutant Reduction Strategy: Recommends actions to reduce SLCP pollutants from sources such as dairies, organics disposal, and WWTPs.

**SB 32:** Reduce GHG emissions to 40% below 1990 levels by 2030.



# Goals of the Transportation Research Area

- ▶ Increase freight efficiency and competitiveness
- ▶ Reduce carbon emissions and increase the use of renewable fuels in the transportation sector
- ▶ Improve air quality
- ▶ Improve natural gas fueling infrastructure capabilities



# Current Portfolio

- ▶ **Near-Zero Emission Natural Gas Engine Development**
  - ▶ Commercialized three heavy-duty natural gas engines certified to CARB's optional low NOx standards.
- ▶ **Natural Gas Fueling Infrastructure Improvements**
  - ▶ Improving fast-fill CNG dispenser technology to improve storage tank utilization and vehicle range.
- ▶ **In-Use Emissions and Fuel Usage Study**
  - ▶ Conducting real-world tests to characterize actual natural gas vehicle emissions and fuel usage.
- ▶ **Natural Gas Hybrid-Electric Vehicles**
  - ▶ Improving fuel efficiency and air quality benefits of natural gas vehicles by optimizing integration of advanced hybrid powertrains.
- ▶ **Advanced Combustion Research**
  - ▶ Developing advanced ignition systems that can extend the dilution tolerance of natural gas engines. Improve engine efficiency to close efficiency gap with diesel while maintaining near-zero emissions.
- ▶ **Natural Gas in Off-Road Applications**
  - ▶ Adapting low emission on-road natural gas engine technology to off-road vehicles.

# Program Highlights

## 12-Liter Engine to Provide Near-Zero Option for Class 8 Trucks

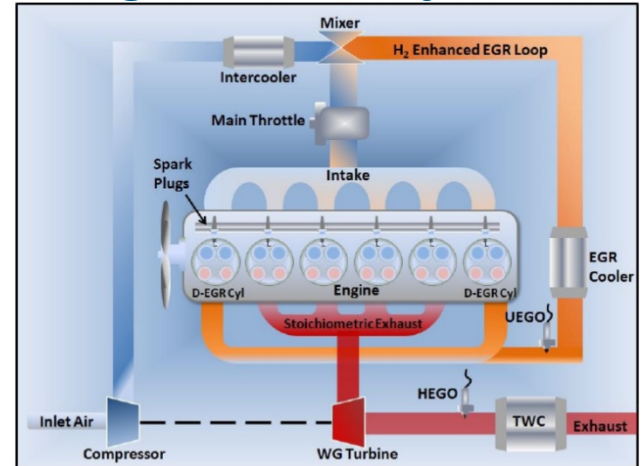
- ▶ **Recipient:** South Coast Air Quality Management District
- ▶ **Partners:** Cummins Westport, Inc., Southern California Gas Company, Clean Energy Fuels
- ▶ **R&D Funds:** \$1,000,000
- ▶ **Technology and Accomplishments:**
  - ▶ CARB certified at 0.02 g/bhp-hr NO<sub>x</sub>. Engine is in production.
  - ▶ Enhanced after-treatment, improved controls, closed crankcase ventilation, and improved fuel system.
- ▶ **Market Potential:** Support near-zero emission fleet adoption targets in SPB Ports Clean Air Action Plan (13-20% of the drayage fleet by 2021).
- ▶ **Benefits:** Improve air quality in California's densest freight corridors by reducing NO<sub>x</sub> emissions by 90%. Improve GHG benefits of natural gas vehicles by reducing methane emissions.



# Program Highlights

## Dedicated EGR to Improve Natural Gas Engine Efficiency

- ▶ **Recipient:** Southwest Research Institute
- ▶ **Partners:** Southern California Gas Company, Woodward, Honeywell
- ▶ **R&D Funds:** \$891,580
- ▶ **Technology and Accomplishments:**
  - ▶ Dedicate 2 cylinders to produce entirety of exhaust gas for EGR loop.
  - ▶ Run dedicated cylinders rich to produce H<sub>2</sub> and CO to improve knock resistance and burn rates.
  - ▶ Develop optimized turbo and use high-energy ignition to maximize efficiency benefits.
- ▶ **Market Potential:** Develop pathway to increase efficiency of stoichiometric natural gas engines by 10% while maintaining near-zero emissions.
- ▶ **Benefits:** Improve competitiveness of heavy-duty natural gas engines by closing efficiency gap with diesel engines.





# FY2018-19 Budget Plan Update

- ▶ Budget Plan will be sent to CPUC for approval in March.
- ▶ \$4,000,000 to support two natural gas-related transportation research initiatives.
- ▶ **Develop High Efficiency, Low Emission, Production-Ready Natural Gas Engines for Long Haul Applications**
  - ▶ Targets gap in engine availability above 12L.
  - ▶ Aim for near-term optional low NOx and OBD certification for commercial viability.
- ▶ **Research Natural Gas Compression Ignition to Achieve Comparable Performance to Diesel**
  - ▶ Targets efficiency and performance gap between natural gas engines and diesel.
  - ▶ Aim to develop innovative, pre-commercial technologies that can meet future efficiency goals without compromising emissions.





# Proposed Natural Gas R&D Program Expansion

- ▶ **Motivated** by new mandates and goals to dramatically reduce GHGs, improve freight sustainability, and address major infrastructure failures and natural events.
- ▶ **Increase available funding** for NG-related transportation research from \$3-4M annually to **\$29.5M** triennially.
- ▶ **Expanded scope** may cover high-horsepower off-road RD&D, strategic deployment of heavy-duty NGVs with RNG, etc.
- ▶ **Small grants and cost share programs** to provide proof-of-concept funding and leverage other funding opportunities from federal, state, and local government.
- ▶ **Triennial planning:**
  - ▶ Establish long-term research goals and provide larger and more impactful funding opportunities.
  - ▶ Increase preparation time for researchers to better response to funding opportunities.



# Proposed Natural Gas R&D Program Expansion

Research Area	Amount	% Total
Natural Gas IOUs	\$42,000,000	20%
Building Energy Efficiency	\$19,000,000	9%
Industrial, Ag, Water Efficiency	\$29,500,000	14%
Renewable Energy and Adv Gen	\$19,000,000	9%
Natural Gas Infrastructure Safety	\$20,000,000	9%
Environmental Related Research	\$19,000,000	9%
Transportation Related Research	\$29,500,000	14%
Natural Gas Small Grants	\$5,500,000	3%
Natural Gas Federal Cost-Share	\$5,500,000	3%
Program Administration*	\$21,000,000	10%
<b>Total Program Budget (Triennial)</b>	<b>\$210,000,000</b>	

\*Includes IOU and Energy Commission Administration



# Proposed Natural Gas R&D Program Expansion

- ▶ **Public workshop** held on January 25 and received comments from stakeholders. Link to slides:  
[http://www.energy.ca.gov/research/notices/2018-01-25\\_workshop/](http://www.energy.ca.gov/research/notices/2018-01-25_workshop/)
- ▶ **Open docket** titled “Research Idea Exchange” for commenters at our e-filing page. Link to docket:  
<https://efiling.energy.ca.gov/EComment/EComment.aspx?docketnumber=19-ERDD-01>
- ▶ **Next steps:**
  - ▶ Get stakeholder feedback on expanded program scope.
  - ▶ Host additional workshops.
  - ▶ Submit formal request to CPUC in Q2 2018.



# Closing Comments/Questions

**Follow the Natural Gas Research Program's  
funding opportunities here:**

<http://www.energy.ca.gov/contracts/pier.html>

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