PROPOSED

State of California
AIR RESOURCES BOARD

The Optimal Route for a Clean Heavy-Duty Sector in California

RESEARCH PROPOSAL

Resolution 17-1

February 16, 2017

Agenda Item No.: 17-2-1

WHEREAS, the Air Resources Board has been directed to carry out an effective research program in conjunction with its efforts to combat air pollution, pursuant to Health and Safety Code sections 39700 through 39705;

WHEREAS, Research Proposal Number 2804-286, entitled, "The Optimal Route for a Clean Heavy-Duty Sector in California," has been submitted by the University of California, Irvine for a total amount not to exceed $500,000;

WHEREAS, the Research Division staff has reviewed Research Proposal Number 2804-286 and finds that in accordance with Health and Safety Code section 39701, the results of this study will assess the economics, feasibility, barriers, emission rates, and fuel economies of fleet mixes comprised of alternative heavy-duty vehicle technologies and fuels in California to identify strategies that can maximize environmental and health benefits while maintaining economic competitiveness, particularly in disadvantaged communities; and

WHEREAS, in accordance with Health and Safety Code section 39705, the Research Screening Committee has reviewed and recommends funding the Research Proposal.

NOW, THEREFORE BE IT RESOLVED, that the Air Resources Board, pursuant to the authority granted by Health and Safety Code section 39700 through 39705, hereby accepts the recommendations of the Research Screening Committee and Research Division staff and approves the Research Proposal.

BE IT FURTHER RESOLVED, that the Executive Officer is hereby authorized to initiate administrative procedures and execute all necessary documents and contracts for the Research Proposal as further described in Attachment A, in an amount not to exceed $500,000.

ATTACHMENT A

"The Optimal Route for a Clean Heavy-Duty Sector in California"

Background

Though freight transport represents a critical economic engine in the State, emissions from heavy-duty vehicles (HDV) contribute significantly to regional atmospheric pollutant burdens and climate change concerns impacting the public health of California citizens. Therefore, the transformation of the HDV sector towards the use of alternative fuels and advanced technologies represents a major opportunity to reduce environmental impacts without impeding this vital sector of the State's economy. Alternative propulsion methods and fuels being considered to displace conventional diesel internal combustion engines and associated emissions include advanced low-emitting compressed natural gas (CNG) engines, hydrogen in fuel cell electric vehicles, and electricity in battery electric vehicles. Furthermore, the use of connected and/or automated vehicle strategies (CAV) could improve efficiency and reduce emissions, but may have more complex impacts than those for CAV in the LDV sector that require a thorough analysis of the costs and benefits. A key determinant of overall impacts includes the supply chain utilized to produce and distribute selected alternative fuels. For instance, the use of power-to-gas strategies to produce very low carbon gaseous fuels, and vehicle-to-grid services represent important pathways that can complement the use of renewable power generation in California. Additionally, State biomass and biogas resources can serve as feedstock in the production of a range of low, or even net-negative carbon fuels. However, the optimal pathways forward to achieve a sustainable and economically competitive HDV sector are currently uncertain. For example, it is unclear how the State can best utilize biomass resources to attain reductions in pollutant emissions leading to improvements in health-damaging air pollutants such as ozone and PM2.5. In addition, a better understanding is needed of the technical, economic, and emission aspects of power-to-gas strategies. These questions can best be addressed by assessing the economic, greenhouse gas (GHG), and air quality impacts of future HDV emission mitigation strategies to better understand how California can develop and implement policy measures to address potential barriers to the deployment of zero and near-zero HDV pathways.

Objective

The goal of this work is to assess the economics, feasibility, barriers, emission rates, and fuel economies of fleet mixes comprised of alternative HDV technologies and fuels in California to identify strategies that can maximize environmental and health benefits while maintaining economic competitiveness, particularly in disadvantaged communities.

Methods

The project will develop a suite of future scenarios that will consider the implementation of various technologies and fuels in the heavy-duty sector. Once the scenarios are established, modeling tools will be employed to determine the economic and environmental impacts of pathways forward for HDV technologies and fuels defined by the impacts on costs, energy consumption, emissions of GHG and criteria pollutants, and resulting air quality impacts on ozone and PM2.5.

Interactions and impacts from the electricity sector, including integration of renewable resources, power-to-gas, vehicle-to-grid, and other fuel pathways, and other associated metrics will be estimated from modeling of the California electric grid through use of the Holistic Grid Resource Integration and Deployment (HiGRID) model. The Preferred Combination Assessment (PCA) model assesses the environmental impacts (i.e., criteria pollutant emissions, greenhouse gas emissions, energy consumption, and water consumption) associated with various combinations of hydrogen production, delivery, and utilization strategies as part of an integrated fuel supply chain. Outputs from the HiGRID and PCA model will be used as inputs to fuel and vehicle mix modeling done by ARB staff using the California Biofuel Assessment Model and the Vision Model, respectively. Choices of resource utilization and fuel availability will be considered to better understand how fuel and technology pathways can provide improvements in primary and secondary pollutant concentrations.

Expected Results
The results of the study will be used in the development of a guidance document for policymakers and stakeholders recommending optimal pathways forward for fleet transitions to zero and near-zero technologies and fuels. Results will also serve as a scientific foundation for policies and economic mechanisms encouraging the adoption of alternative technologies and fuels.

Significance to the Board
This study will provide economically viable pathways for the application of advanced technologies in the heavy-duty sector to improve air quality and reduce greenhouse gas emission. The results will help guide policy development and the use of incentive funds to ensure that the deployment of advanced technology vehicles and fuels allows the State to meet its air quality and climate goals while avoiding or minimizing unintended negative consequences.

Contractor:
University of California, Irvine (UCI)

Contract Period:
36 Months

Principal Investigator (PI):
Scott Samuelsen, Ph.D.

Contract Amount:
$500,000

Basis for Indirect Cost Rate:
The State and the UC system have agreed to a twenty five percent indirect cost rate.

Past Experience with this Principal Investigator:
Dr. Samuelsen is widely published and a leading expert on clean-technology research and has led several successful projects for the State in the past.

Prior Research Division Funding to Scott Samuelsen, Ph.D.:
Dr. Scott Samuelsen has been the principal investigator for three previous contracts with ARB. The first contract led to the enhancement of the Truck Activity Monitoring System by providing appropriate vehicle count data. The second contract supported the California Stationary Fuel Cell Collaborative by conducting a fuel cell industry survey, developing a brochure for the collaborative, a database on fuel cell installations, and a web site to address market, regulatory and market issues, as well as other support activities. The study also reviewed costs for installing fuel cells compared to other technologies such as wind power, solar power, micro turbines and other distributed generation technologies in California. The third contract addressed the challenge of reducing NO_X emissions while maintaining high efficiency for industrial, natural gas-fired burner applications. This was accomplished by laboratory testing of a model burner with multiple active control strategies, and measuring the release of air toxics during these tests to ensure that hazardous air pollutants were not increased as a result of low-NO_X operation. The results provided burner manufacturers with input for practical applications and demonstrations based on the project results.

Prior Research Division Funding to the University of California, Irvine:

Year	2016	2015	2014
Funding	$ 0	$629,977	$ 0

B U D G E T   S U M M A R Y

Contractor: University of California, Irvine

The Optimal Route for a Clean Heavy-Duty Sector in California

DIRECT COSTS AND BENEFITS			
1.	Labor and Employee Fringe Benefits	$ 363,003	
2.	Subcontractors	$ 45,000	
3.	Equipment	$ 0	
4.	Travel and Subsistence	$ 4,500	
5.	Electronic Data Processing	$ 0	
6.	Reproduction/Publication	$ 0	
7.	Mail and Phone	$ 0	
8.	Supplies	$ 4,950	
9.	Analyses	$ 0	
10.	Miscellaneous	$ 4,383	
	Total Direct Costs		$ 421,836
INDIRECT COSTS			
1.	Overhead	$ 78,164	
2.	General and Administrative Expenses	$ 0	
3.	Other Indirect Costs	$ 0	
4.	Fee or Profit	$ 0	
	Total Indirect Costs		$ 78,164
TOTAL PROJECT COSTS			**$ 500,000**

ATTACHMENT 1

SUBCONTRACTORS' BUDGET SUMMARY

Subcontractor: Empowered Energy

Description of subcontractor's responsibility: The subcontractors will use the REMI economic model to determine the economic impacts of multiple long-term heavy-duty fleet mix scenarios on different industries and counties.

DIRECT COSTS AND BENEFITS			
1.	Labor and Employee Fringe Benefits	$ 40,185	
2.	Subcontractors	$ 0	
3.	Equipment	$ 0	
4.	Travel and Subsistence	$ 4,815	
5.	Electronic Data Processing	$ 0	
6.	Reproduction/Publication	$ 0	
7.	Mail and Phone	$ 0	
8.	Supplies	$ 0	
9.	Analyses	$ 0	
10.	Miscellaneous	$ 0	
	Total Direct Costs		$ 45,000
INDIRECT COSTS			
1.	Overhead	$ 0	
2.	General and Administrative Expenses	$ 0	
3.	Other Indirect Costs	$ 0	
4.	Fee or Profit	$ 0	
	Total Indirect Costs		$ 0
TOTAL PROJECT COSTS			**$ 45,000**