Air Resources Board

Mary D. Nichols, Chair
1001 I Street • P.O. Box 2815
Sacramento, California 95812 • www.arb.ca.gov

Matthew Rodriquez
Secretary for
Environmental Protection

Edmund G. Brown Jr.
Governor

August 15, 2016

Dear UC/CSU Researchers:

The California Air Resources Board (ARB or Board) is soliciting draft research proposals from California public universities and colleges for the project described in the enclosed solicitation.

If you are interested in submitting a draft proposal for the research project described in this solicitation, please send an email that indicates your intent to submit a proposal and identifies the tasks to which you plan to respond, to Seungju Yoon by August 31, 2016. Draft proposals will then be due no later than October 3, 2016. Applicants should submit their draft proposal via email to Seungju Yoon (seungju.yoon@arb.ca.gov).

Guidelines for developing your draft proposal are included in this solicitation package. The amount of money allocated for this project is $500,000. Projects that provide co-funding or other leveraging will be evaluated more favorably. Proposals for methods other than those suggested in the scope of work will be considered, provided that the research objectives are met. The tasks in this scope of work are also very diverse, so proposals will be considered that address a subset of the tasks, but teams that bring together the multidisciplinary expertise to address all tasks into a unified proposal will be evaluated more favorably.

We expect to select a proposal by mid-October. A final proposal incorporating comments by ARB staff will be needed by December 1, 2016, for further review and refinement by the Board's Research Screening Committee, and a final decision by the Board to meet our target of executed contract(s) by February, 2017.

Prospective investigators are encouraged to contact Seungju Yoon at (916) 324-5606 or seungju.yoon@arb.ca.gov for any clarification on these topics.

Sincerely,

Jorn Herner, Ph.D.
Acting Chief, Research Division

Enclosure
cc: See next page

cc: John Collins, Research Division
Sarah Pittiglio, Research Division
Annalisa Schilla, Research Division
Seungju Yoon, Research Division

CALIFORNIA AIR RESOURCES BOARD FISCAL YEAR 2016-17 ANNUAL RESEARCH PLAN

SOLICITATION OF DRAFT RESEARCH PROPOSALS FROM CALIFORNIA PUBLIC UNIVERSITIES AND COLLEGES

Pathways Towards a Near-Zero Heavy Duty Sector

I. Objective

Determine the costs, greenhouse gas (GHG), air toxic, and criteria pollutant emissions, and impacts to disadvantaged communities from multiple advanced technology scenarios in the heavy duty sector. Multiple long-term scenarios will be developed that maximize emissions reductions through the use of alternative fuels, connected and automated technology, and other advanced heavy duty vehicle technologies. The best policies and economic mechanisms to encourage zero and near-zero pathways will be identified through an analysis of potential barriers to the use of advanced technologies.

II. Background

Transitioning to biofuels can result in reduced GHG emissions, but does not reduce engine criteria pollutant emissions in all cases. Recent research suggests that biorefineries to produce biofuels may also have larger criteria pollutant footprints than the fossil fuels they would replace. Given these constraints on the production of biofuels in a State with ambitious GHG and criteria pollutant reduction plans, a holistic approach to assessing which alternative fuel and energy sources can be generated in the future is needed. This proposed research will focus on the heavy duty sector, with the assumption that the majority of other sectors can be electrified. A more accurate assessment of the best uses of California's feedstocks for the production of biofuels would help inform the best heavy duty fleet choices in the long-term.

Since additional criteria pollutant reduction strategies will be needed to meet SIP requirements, even with the use of alternative fuels, additional NO_X reduction strategies need to be considered. Recent developments in the literature have shown that intelligent technologies, such as vehicle automation and connections between vehicles, as well as connections between vehicles and transportation infrastructure, is beginning to show promise for practical application in the real world with benefits to fuel efficiency. This technology also has the potential to reduce criteria pollutant emissions in busy freight corridors, where disadvantaged communities are often located. The extent to which the application of these technologies can improve fuel efficiency and air quality needs to be explored, as well as the policies to ensure that the deployment of advanced technology vehicles and fuels allows the State to meet both air quality and climate goals without any unintended negative consequences.

III. Scope of Work

Task 1 - Determine the best use of renewable feedstocks in California.

Long-term scenarios on the best uses of renewable feedstocks are needed to inform investments and policy development that ensure that California will achieve its climate and air quality goals. In order to develop these scenarios, data is needed to inform

current modeling efforts at the Air Resources Board (ARB). ARB staff have developed the California Biofuel Allocation Model (CA-BAM), which is a multi-region optimization model that makes use of probability distributions to estimate plausible fuel supply situations. The model uses national feedstock supply curves, conversion costs, and yields that come from values and distributions presented in the literature. National supplies of biofuels are allocated to California based on costs, and include the impacts of subsidies (LCFS credits, RIN credits, and other regional and national policies). Researchers will work with staff at ARB to provide the latest lifecycle analyses (LCA) and costs for a suite of alternative biomass to fuel pathways, including renewable natural gas, renewable diesel, renewable hydrogen, electricity, and dimethyl ether (DME).

However, the primary focus of the task is to review the literature and perform analyses to determine the resource potential, costs, conversion yields, and viable pathways for power-to-gas technologies for the production of natural gas, and hydrogen. Additional consideration should be made to incorporate the demand and marginal costs for comparable technologies that provide competitive grid services in competition with power-to-gas technologies, including direct use of biomass for electricity generation, and to identify the factors that influence the demand for these services. Documentation of any state or regional policies that support biofuel production, beyond what is already in the Alternative Fuel Data Center policy database, would also be informative.

Vehicle to grid integration and associated fuel demand should also be considered to account for changing demands for vehicles and fuels by sector. This analysis should take into account that traditional consumer purchasing decisions and fuel demand may not be driven by stock turnover, VMT, and efficiency in the future

This task will also require the researchers to work in coordination with concurrent research funded by the California Energy Commission (CEC), who are developing scenarios of the electrical grid, in order to assess the potential for using California's biomass resources for electricity generation. Data gaps will also be identified to guide future research.

Task 2– Quantify the potential reductions in the emission of GHGs and criteria pollutants through the use of a broad range of connected and automated technologies and efficiency upgrades in the heavy duty sector.

Subtask 2a – Literature review. Compile information on costs, barriers to use and potential GHG and criteria pollutant reductions from the use of a broad range of connected and automated technologies (CAV) and efficiency upgrades, as well as anticipated changes to future demand on the heavy-duty sector fleet mix and activity due to other market and technology trends, which are relevant to California's heavy duty fleet. The review will identify technologies that will be available both in the near- and long-term. The researchers will work with ARB staff to determine the list of technologies that will be included in the study. This work will also draw on recent work funded by ARB on efficiency upgrades, to quantify their projected benefits in projected fleet mixes. In addition to the literature review, the study would benefit from interviews with

stakeholders investing in CAV technologies and staff at state and federal agencies that are currently researching the topic.

Subtask 2b – Identify potential unintended consequences that could be caused by the use of CAV technologies in the heavy-duty sector could have on California's disadvantaged communities (DACs). DACs will be identified with the use of CalEnvironScreen. For example, real-time alternate route information could direct truck traffic through DAC instead of nearby truck routes in order to avoid traffic, thereby increasing the exposure to pollutants in these communities. This sub-task should include a brief literature review of any documented impacts on DACs and suggested strategies to reduce potential impacts on DACs.

Task 3 – Create multiple long-term heavy duty fleet mix scenarios.

This analysis will incorporate information from task 1 and 2 to examine the appropriate heavy duty fleet mixes that will allow California to meet its long-term climate and air quality goals, as well as support achievement of the broader sustainability goals for California's freight transport system embodied within the Vision and Guiding Principles identified in the California Sustainable Freight Action Plan and Mobile Source Strategy. The study should include the use of diesel, electric, hydrogen, and liquid and compressed natural gas vehicles in multiple size classes, and to the extent possible, marine, rail, and aviation fuel needs. The researchers will work with staff at ARB to either use or augment ARB's existing Vision scenario tool framework. Scenarios could also be created using additional models in order to compare the results with outputs from the Vision model in order to identify strengths and weaknesses within the models. To the extent possible, given the limitations in the literature, the model projections should consider changes in consumer demand, improvements in vehicle efficiency, and the impacts of the availability and costs of fueling and transportation infrastructure. The use of North American Industry Classification System (NAICS) codes should also be considered to link the fleet projection models with the REMI economic model to determine the economic impacts to different industries and counties, which could help inform task 2b.

Task 4 – Develop a guidance document for fleets transitioning to alternative fuels

Consult with published reports, peer-reviewed literature, fleet managers, and researchers (including contractors of multiple pilot studies funded by the state to demonstrate the zero-emission heavy-duty technologies), and other relevant experts to identify challenges, costs, barriers, and tradeoffs, and potential solutions to overcome barriers, associated with investing in low carbon fuels and advanced technology. This should include timeframes for technology diffusion within fleets, and discounting decisions applied to fuel costs versus capital costs. Information from task 2 will inform the potential to improve efficiencies and emission from the use of CAV technologies. The results of the literature review and interviews should be distilled so that they can easily be used as guidance for fleets that are considering transitioning to alternative vehicles and/or fuels, or that have already begun that transition.

Task 5 – Provide guidance on overcoming barriers to implementing zero and near-zero emission heavy duty pathways

This task will identify how State policies (e.g., incentives and pricing) can support the use of zero and near-zero emission, heavy duty vehicles, infrastructure and fuels, as well as promote the responsible use of CAV technologies, to achieve the State's long-term climate and air quality goals, as well as the broader sustainability goals for California's freight transport system. This analysis will be duplicated for multiple scenarios that will be developed for task 3. The analyses will consider costs and potential barriers to implementing the scenarios and strategies to overcome them. Cost analyses will consider the influence of LCFS and RIN credits in the market

IV. **Deliverables**

- Quarterly progress reports and conference calls;
- Draft final report;
- Peer-reviewed publication(s), as appropriate;
- Final report and research seminar in Sacramento;
- All data and analyses generated through the course of this project;
- Additional deliverables to be determined in consultation with ARB staff.

V. **Timeline**

It is anticipated this project will be completed in 42 months from the start date. This schedule allows 36 months for the completion of all work through delivery of a draft final report; the last 6 months are for ARB review of the draft final report and the delivery of a revised final report and data files to ARB. The estimated budget for this project is $500,000.