State of California
AIR RESOURCES BOARD

Research Screening Committee Meeting
Cal/EPA Headquarters Building
1001 I Street
Conference Room 510
Sacramento, California 95814
(916) 445-0753

September 15, 2016
9:00 a.m.

ADVANCE AGENDA

I. Approval of Minutes of Previous Meeting:

March 18, 2016 meeting

II. Discussion of New Research Projects:

1) "Measurement of In-Use Emissions and Fuel Consumption from Vocational Heavy-Duty Vehicles with Conventional and Alternative Engine and Fuel Technologies in Southern California," South Coast Air Quality Management District," $150,000, Proposal No. 2800-285

Current heavy-duty engine emission standards have reduced both oxides of nitrogen (NO_X) and particulate matter (PM) emissions significantly in the South Coast Air Basin (SoCAB). However, it is projected that heavy-duty vehicles (HDV) will still be a dominant source of those emissions in the SoCAB and there is a need of additional reduction in NO_X emissions to meet National Ambient Air Quality Standards (NAAQS) for ambient PM and Ozone. Understanding the impact of conventional and alternative engine and fuel technologies on in-use emissions and fuel use is critical for developing State Implementation Plans (SIP) as well as for understanding the effectiveness of potential rules to further lower emission standards for HDVs.

The South Coast Air Quality Management District (AQMD), California Energy Commission (CEC), Southern California Gas Company (SoCal Gas), and California Air Resources Board (ARB or Board) jointly developed a research plan for collecting in-use vehicle activity, emissions, and fuel use data from up to 200 HDVs in various vocation types including goods movement, transit bus, school bus, refuse, and local delivery and for developing effective strategies to achieve the NAAQS requirements in the region. ARB will participate in this project as a co-funding organization.

Our current research investigations characterizing HDV activity profiles by vocation and quantifying the potential greenhouse gas (GHG) benefits of aerodynamic features on HDV use only onboard diagnostic (OBD) data and do not include measurements of in-use emissions and fuel use due in part to limited resources. We will use the findings

from the proposed research work to expand our understanding of vocational use of HDVs and to develop effective strategies for achieving the federal ambient air quality standards and the state GHG reduction goals. Due to the complexity and extent of field testing involved in this research project, the technical review committee consisting of staff from all of the co-funding organizations selected research proposals submitted by two bidders: University of California, Riverside (UCR) and West Virginia University (WVU). The total amount of funding will not exceed $1,625,000 for each proposal. Staff will supervise and coordinate this research project through scheduled and unscheduled technical review committee meetings.

2) "Emerging Technology Zero Emission Vehicle Household Travel and Refueling Behavior," $650,000, University of California, Davis, Proposal No. 2801-285

   Zero emission vehicles (ZEV) are anticipated to become an increasing share of new light duty vehicle sales; however, their environmental benefits will vary depending on consumer usage and refueling behavior. This project's objective is to collect and analyze in use vehicle data from emerging clean vehicle technologies in a household context to improve estimates of emission profiles and consumer benefits. Specifically, the travel and refueling behavior from 82 households that own or lease a Toyota Prius Prime, Chrysler Pacifica, Chevrolet Bolt, or the Toyota Mirai will be analyzed. This project will result in a comprehensive and highly resolved dataset of vehicle and recharging/refueling parameters that allows for characterization of the current state of ZEV household travel, capturing an early stage of the market when vehicle range and body styles are rapidly expanding. This information can help regulators and policymakers to adjust treatment of ZEVs in regulatory or incentive programs, appropriately plan for possible grid impacts from ZEV charging, and evaluate the benefits of public electric vehicle charging and hydrogen refueling infrastructure investments. Lastly, this research can also continue to improve our understanding of how general vehicle operations and travel behavior may affect emissions.

3) "Carbon Dioxide Monitoring and Source Attribution in Los Angeles," $250,000, Caltech, Proposal No. 2802-285

   Carbon dioxide (CO_2) is the greenhouse gas (GHG) most frequently identified as the dominant cause of global warming. In order to fully understand the role of anthropogenic CO_2 emissions in climate change, and to track mitigation efforts, we must understand the spatial and the temporal distribution of their sources. Measurements of radiocarbon (Δ14C) have been identified as an effective way to distinguish ambient CO_2 contributions from fossil fuel combustion and from the biosphere. Integrating the stable carbon isotopic (δ13C) composition of ambient CO_2 into the analysis allows further discrimination between gasoline and natural gas combustion within the fossil fuel component. Measurements of CO_2, together with Δ14C and δ13C, have been ongoing at Pasadena and Palo Verdes in Los Angeles, California since 2006 and 2009, respectively. This project is proposing the continuation of measurements at the two stations through the end of 2020, which will allow for an independent evaluation of ARB's emissions estimates and projections for the program duration of Assembly Bill 32 ((AB 32), the California Global Warming Solutions Act of 2006) from 2006-2020. By extending the measurement time series through 2020, the State will be able to track the long-term

progress of industrial and transportation-related mitigation measures using the fossil fuel combustion signature of CO_2 through the trend observed in the megacity of Los Angeles. Having the ability to perform source attribution of CO_2 is necessary for future mitigation plans and policy-making and will play an integral part in evaluating the GHG emission reduction efforts under AB 32. The results from this project will also provide important information for the Megacities Carbon Project, which aims to provide scientifically robust capabilities to measure multi-year emission trends of carbon based gaseous emissions attributed to individual megacities and selected major sectors. The findings summarized in this project will provide information for future GHG programs.

4) "Improving the CalEnviroScreen score at the US-Mexico border," San Diego State, $150,000, Proposal No. 2803-285

The California Environmental Protection Agency (Cal/EPA) has developed two screening tools to assess the vulnerability of California communities. One, the Environmental Justice Screening Method (EJSM), was developed by academic researchers under contract with ARB. The second, CalEnviroScreen, was developed by the Office of Environmental Health Hazard Assessment to assist with identifying communities that are eligible for funding for environmental and economic improvement projects under Senate Bill 535. Both screening tools combine data on measures of environmental quality and toxic substance emissions with metrics of community socio-economic characteristics to evaluate the level of vulnerability in each community in California. Both screening tools lack an important component: neither adequately captures how California communities on the U.S. Mexico border are impacted by emissions sources located on the Mexico side of the border. The objective of this proposal is to characterize the locations and types of emission sources located in the area of Mexico immediately adjacent to California. It is not intended to provide a comprehensive characterization of emissions sources, but rather that it will be an initial step that provides a foundation for future work.

lll. Discussion of Draft Final Reports:

1) "The Feasibility of Renewable Natural Gas as a Large-Scale, Low-Carbon Substitute," University of California, Davis, $330,934, Contract No. 13-307

California will need high volumes of alternative low carbon fuels to be able to meet its climate change goals. In order to support these goals, this study investigated the technological and commercial feasibility of producing large quantities of renewable natural gas fuels for use in California. The study's results indicate that there are substantial sources of renewable natural gas (RNG) in California that are commercially competitive with existing fossil fuel-based transportation fuels because carbon externalities are taken into consideration in the California market through existing programs such as the Low Carbon Fuel Standard (LCFS) and the U.S. Renewable Fuels Standard (RFS). At current credit prices including California's LCFS and the U.S. federal Renewable Identification Number (RIN) credits, up to 82 billion cubic feet per year (bcf/y) of RNG supply could be attractive for private investment at competitive rate of return in developing RNG sources from landfill, dairy, municipal solid waste and waste-water sites combined. We find that the LCFS credit of $120 per metric tonne of CO2, if taken alone, enables economically viable production of up to 14 bcf RNG transportation fuel over the

study period, which begins in 2013 and extends into the 2020s, 6.3 bcf from landfill, 1.5 bcf from waste-water treatment, 1.75 bcf from municipal solid waste, and 4.3 bcf from dairy. If current carbon credit prices persist into the future for programs like the LCFS, a substantial portion of natural gas consumption in the transportation sector can be satisfied by RNG. The analysis also shows that increasing tipping fees for municipal solid waste can influence private investment in RNG. Finally, the study investigates the impact of California's quality standards for RNG and distance to central distribution systems on the level of investment in certain kinds of RNG. These results support the implementation of the Low Carbon Fuel Standard, Short-lived Climate Pollutant Strategy, and incentive programs by providing insight into feasible methods to maximize the production of RNG via the most cost-effective pathways, thereby providing practical means to meet the State's long term climate goals.

2) "The Future of Drop-In Fuels: Life-Cycle Cost and Environmental Impacts of Bio-Based Hydrocarbon Fuel Pathways," University of California, Berkeley, $400,000, Contract No. 13-308

Biofuels that can serve as a one-to-one replacement for gasoline or diesel, or achieve higher-level blends without modifications to existing fueling infrastructure and engines, are known as "drop-in fuels," and offer an opportunity to accelerate the deployment of low carbon liquid fuels. In order to achieve California's climate and air quality goals, California will need high volumes of alternative fuels, such as drop-in fuels, that have low GHG emissions. In order to support these goals, the objective of this project was to review the research related to drop-in fuel production, evaluate potential pathways from well-to-pump (excluding tailpipe combustion emissions) based on their expected costs and environmental performance, and model potential pathways to scaling up drop-in fuel production in the state. The study's results indicate that pathways are the most promising routes for the production of drop-in fuels in the near and mid-term if GHG and air quality goals are to be simultaneously met in California. Bio-based hydrocarbon fuels have the potential to have lower life-cycle GHG emissions relative to comparable first generation fuels, such as ethanol or biodiesel, because truck and rail transportation can be partially eliminated in favor of energy efficient pipelines. The criteria air pollutant emissions may also not be higher than those for conventional fuels. The researchers also found that pyrolysis, Fischer Tropsch, and methanol-to-gasoline routes can be scaled up using waste biomass in California to reach as high as 58 percent displacement of in-state diesel use and 8 percent of in-state gasoline use. These results support the implementation of the Low Carbon Fuel Standard, the Sustainable Freight Strategy, and incentive programs by providing insight into the most ideal and feasible pathways for California to meet its long-term climate and air quality goals.

3) "Measuring Real-World Emissions from the On-Road Passenger Car Fleet," University of Denver, $75,000, Contract No. 12-303

Carbon Monoxide (CO), Hydrocarbon (HC), Nitric Oxide (NO), Nitrogen Dioxide (NO_2), and Ammonia (NH_3) emissions from motor vehicles are important sources that contribute to urban air pollution. This contract extends a nine-year record of on-road emission measurements using remote sensing device (RSD) systems at a west Los Angeles location with two additional data collection campaigns in the spring of 2013 and 2015.

The contractor collected 27,247 (2013) and 22,124 (2015) emission measurements of CO, carbon dioxide (CO_2), HC, NO, NH_3 and NO_2 from light- and medium-duty vehicles. Fuel-based mass emission rates of those pollutants were calculated. The results show that, between 1999 and 2015, fleet emissions have decreased by 82 percent for CO, 81 percent for HC, and 71 percent for NO. These decreases have happened despite the fact that fleet average age has increased by two years as a result of the decreased vehicle sales during the 2008-2009 recession. Over the same period of time, the 99th percentile emission rates have dropped by 67 percent for CO, 74 percent for HC, and 36 percent for NO. There are concerns however, that the reductions in the 99th percentiles may be leveling out which could also stall future fleet average emissions reductions. These data sets were also used to document that 2009 and newer Volkswagen and Audi diesel vehicles had excessive on-road NO and NO_2 emissions.

4) "Examining Factors that Influence Zero Emission Vehicles Sales in California," University of California, Los Angeles, $302,993, Contract No. 13-303

ARB's Zero-Emission Vehicle (ZEV) program and Clean Vehicle Rebate Project (CVRP) aim to accelerate consumer adoption of plug-in electric vehicles (PEV) to help meet long-term California greenhouse gas (GHG) and criteria pollutant emission reduction goals. To better understand consumer demand for PEVs, this study provides information about the emerging PEV market and the factors that influence PEV sales to California residents. The study assembles and analyzes geocoded PEV market data, socioeconomic and demographic indicators as well as stated-preference data from a UCLA survey of new car buyers, to explore a range of hypotheses about factors that may influence future sales of battery electric vehicles (BEVs) and plug-in hybrid vehicles (PHEVs) in California. The study team found that PEV sales are positively associated with household income, gasoline prices and proximity to high-occupancy vehicle (HOV) lanes. Survey data analysis yielded estimates of consumers' valuations of PEV technologies and their impact on incentive programs designed to induce PEV sales. Incentive policy options that may enhance program effectiveness are identified. Results for analyses of other potential determinants of PEV sales, such as access to public charging facilities or the introduction of new PEV models, were inconclusive.