BOARD MEETING DATE: October 3, 2014 AGENDA NO. 4

TITLE: Execute Contracts to Conduct PEV Smart Grid, Heavy-Duty Truck Innovative Transportation System and Secondary Organic Aerosol Formation Studies

SYNOPSIS: University of California Riverside (UCR) CE-CERT continues to expand their programs focused on transportation emissions, their measurement and mitigation. Based on the relevance and potential to address SCAQMD's priorities to reduce NO_x and PM emissions from transportation sources, the following projects are recommended for award related to plug-in vehicle grid impacts, heavy-duty vehicle transportation communication and passenger vehicle aerosol measurement. This action is to execute contracts with UCR CE-CERT to: 1) evaluate PEV utilization in a smart grid; 2) develop an innovative transportation routing system for heavy-duty trucks; 3) quantify ozone and secondary organic aerosol (SOA) formation from gasoline and diesel components; and 4) evaluate the SOA formation potential from gasoline direct injection vehicles; in a total amount not to exceed $475,000 from the Clean Fuels Fund (31).

COMMITTEE: Technology, September 19, 2014; Recommended for Approval

RECOMMENDED ACTIONS:
Authorize the Chairman to execute contracts with UCR CE-CERT for the following projects from the Clean Fuels Fund (31):

1. Evaluate PEV utilization through advanced charging strategies in a smart grid system in an amount not to exceed $170,000;
2. Develop an innovative transportation routing system for heavy-duty trucks in an amount not to exceed $80,000;
3. Quantify the formation of ozone and SOA from gasoline and diesel components in an amount not to exceed $75,000; and

4. Evaluate the SOA formation potential from light-duty gasoline direct injection (GDI) vehicles in an amount not to exceed $150,000.

Barry R. Wallerstein, D.Env.
Executive Officer

MMM:BC

Background

UCR CE-CERT, as a recognized leader in environmental education and research, conducts a broad program of interdisciplinary basic and applied research to improve the understanding of the environment and develop future environmental technologies. Since its establishment in 1992, CE-CERT has successfully collaborated with SCAQMD in over two dozen projects, totaling more than $5 million in research dollars for the advancement of alternative fuel technologies and protection of air quality and public health in our region. CE-CERT recently submitted proposals for various projects ranging from development of innovative transportation routing systems for heavy-duty trucks to ozone and SOA formation studies. Upon review, staff has selected four projects for award recommendations as proposed below based on their relevance and potential to address the SCAQMD's priorities to reduce NO_x and PM emissions from transportation sources in the South Coast Air Basin (Basin).

Proposal

This action is to execute contracts with CE-CERT for the following four projects to: 1) evaluate PEV utilization through advanced charging strategies in a smart grid system; 2) develop an innovative transportation routing system for heavy-duty trucks; 3) quantify the formation of ozone and SOA from gasoline and diesel components; and 4) evaluate the SOA formation potential from light-duty GDI vehicles.

<u>PEV Utilization in Smart Grid</u>

With foundational support from the SCAQMD, CE-CERT has recently developed a smart grid testbed called the Sustainable Integrated Grid Initiative (SIGI) consisting of four MW of photovoltaics, two MWh of battery storage and a variety of vehicle charging stations. The proposed project is to demonstrate and evaluate advanced PEV charging technologies and associated vehicle activities in the SIGI environment in order to analyze their impact on the electrical distribution network and overall power grid. CE-CERT will implement and test vehicle to grid (V2G) communication protocols and demonstrate V2G charging events and detail efficiencies and operational constraints. CE-CERT will also utilize on-board telematics to characterize vehicle use and associated charging implications for PEVs in V2G activities. In addition, the project will incorporate Level 3 fast chargers to evaluate vehicle utilization, driver range/usage dynamics and power implications. In addition, the overall methods and strategies to

incorporate renewable energy and energy storage to mitigate negative impacts of PEV charging events will be evaluated and quantified in this project.

Innovative Transportation Routing System

The objective of this project is to develop a new set of routing algorithms specifically designed to minimize NO_x emissions and fuel consumption for heavy-duty trucks. Most existing navigation systems are based on minimizing total miles traveled. However, fuel consumption and emissions are not necessarily minimized by distance, particularly in congestion and areas that have significant changes in road grade. The proposed routing algorithms will build upon previous research in eco-routing algorithms for light-duty vehicles by integrating the navigation technology with compiled energy and emissions data as well as utilization of sophisticated models for heavy-duty trucks. CE-CERT will implement the new routing algorithms to develop a software application designed to recommend truck routes with minimum impact on NO_x emissions and fuel consumption to truck drivers. The new application will then be field tested to evaluate its effectiveness and determine potential NO_x emissions reduction in the Basin.

Ozone and SOA Formation from Gasoline and Diesel

Low Vapor Pressure (LVP) compounds are often unaccounted for in air models and emission inventories because of their low volatility. However, recent studies indicate that some LVP components of gasoline and diesel are also reactive and may play a significant role in the formation of ozone and $PM_{2.5}$ including SOA. Building on the CARB-funded research program for an LVP compounds study, CE-CERT proposes to evaluate the evaporation characteristics as well as to quantify ozone and SOA formation potential from the LVP compounds in gasoline and diesel. Whole gasoline and diesel mixtures will be oxidized inside a large Teflon chamber, leading to the formation of SOA. Measurements of SOA production will be used to evaluate the performance of SOA formation estimation tools. This will lead to more accurate predictions of SOA formation from specific LVP precursors. In addition, CE-CERT will investigate the chemical composition of SOA from gasoline and diesel vapors using mass spectrometry.

SOA Formation from GDI Vehicles

Studies have shown that motor vehicles, especially gasoline-powered vehicles, represent a large source of SOA formation in the atmosphere. SOA constitutes a significant component of suspended fine particulate matter that impacts visibility, climate and public health. GDI vehicles are known for higher fuel efficiency and power output but PM emissions profile is not well understood, especially on SOA formation potential. As manufacturers introduce more GDI models in the market to meet new fuel economy standards, it is important to understand the SOA potential from these vehicles as it could lead to further impact on the ambient PM concentration in our region. This project proposes to investigate the physical and chemical composition of aerosols from GDI vehicles using a mobile environmental chamber that has been designed and constructed

to characterize secondary emissions. The results of this study will provide valuable information on primary and secondary particulate emissions including SOA from in-use GDI vehicles and help to facilitate a discussion on potential mitigation strategies.

Benefits to SCAQMD

The proposed projects are relevant to the SCAQMD's priorities to reduce NO_x and PM emissions from transportation sources in order to achieve federal ambient air quality standards and protect public health. Sufficient funding for the proposed projects is included in the *Technology Advancement Office Clean Fuels Program 2014 Plan Update* under the categories of "Electric/Hybrid Technologies & Infrastructure" and "Fuels/Emission Studies."

The PEV utilization study will help to characterize and quantify impacts and benefits of V2G charging strategies on the power distribution system. Successful utilization of PEVs in the load management will lead to reductions in NO_x and PM emissions from utilities. Also, given that heavy-duty diesel trucks are one of the largest NO_x sources in the Basin, an innovative heavy-duty truck transportation routing system could provide a significant contribution in reductions of NO_x and PM as well as fuel consumption for heavy-duty trucks operating in our region.

Both SOA formation studies will enhance our ability to model the formation of SOA from unburned gasoline and diesel as well as GDI vehicles, helping to close the gap between atmospheric measurements and model predictions of PM concentrations. Models equipped with these SOA formation processes could then be used to help formulate science-based policy for the reduction of ambient PM concentrations.

Sole Source Justification

Section VIII.B.2 of the Procurement Policy and Procedure identifies provisions under which a sole source award may be justified. This request for sole source awards is made under provision B.2.d: other circumstances exist which in the determination of the Executive Officer require such waiver in the best interest of the SCAQMD. Specifically, these circumstances are B.2.d.(1): project involving cost sharing by multiple sponsors and B.2.d.(8): research and development efforts with educational institutions or nonprofit organizations.

UCR is an educational institution and CE-CERT is their research center with multidisciplinary resources to engage in diverse environmental and transportation research programs including advanced vehicle technologies and systems; emission measurements, analyses and controls; atmospheric measurements and modeling; and renewable energy. CE-CERT will provide cost-share from either internal sources or other public agencies and institutions for the proposed projects, including $100,000 from Riverside Public Utilities to cost share the PEV utilization study at the SIGI smartgrid testbed. CE-CERT is also leveraging $450,000 from CARB for a related

research program on LVP compounds for the proposed project to quantify ozone and SOA formation from gasoline and diesel components.

Resource Impacts
The total estimated cost for the proposed projects is $1,180,000 and SCAQMD's total proposed cost-share shall not exceed $475,000 from the Clean Fuels Fund (31) as summarized below:

Proposed Projects	SCAQMD Funding *(requested)*	Cost Share	Project Cost
PEV Utilization in Smart Grid	$170,000	$100,000	$270,000
Innovative Transportation Routing System	$80,000	$80,000	$160,000
SOA Formation from Gasoline and Diesel	$75,000	$450,000	$525,000
SOA Formation from GDI Vehicles	$150,000	$75,000	$225,000
Total	$475,000	$705,000	$1,180,000

Sufficient funds are available in the Clean Fuels Fund (31) for this proposed project. The Clean Fuels Fund (31) is established as a special revenue fund resulting from the state-mandated Cleans Fuels Program. The Clean Fuels Program, under Health and Safety Code Sections 40448.5 and 40512 and Vehicle Code Section 9250.11, establishes mechanisms to collect revenues from mobile sources to support projects to increase the utilization of clean fuels, including the development of the necessary advanced enabling technologies. Funds collected from motor vehicles are restricted, by statute, to be used for projects and program activities related to mobile sources that support the objectives of the Clean Fuels Program.