State of California
AIR RESOURCES BOARD

RESEARCH PROPOSAL

Resolution 12-45

December 6, 2012

Agenda Item No.: 12-9-4

WHEREAS, the Air Resources Board (ARB or 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, a research proposal, number 2753-275, entitled "Advanced Plug-in Electric Vehicle Travel and Charging Behavior" has been submitted by the University of California, Davis;

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

> Proposal Number 2753-275, entitled "Advanced Plug-in Electric Vehicle Travel and Charging Behavior," submitted by the University of California, Davis, for a total amount not to exceed $650,000.

WHEREAS, the Research Division staff has reviewed Proposal Number 2753-275 and finds that in accordance with Health and Safety Code section 39701, this research will allow the Board to evaluate the potential environmental benefits of different plug-in electric vehicles (PEV) types in a comprehensive and systematic manner. Detailed charging data will improve upstream electricity emissions estimates while operations and travel data collected on all vehicles will also help to refine estimates of emissions inventories and consumer benefits. Additionally, a better understanding of PEV household travel behavior will help inform whether additional public or workplace charging infrastructure may increase off-board electricity sources as well as improve forecasts of travel demand as PEV shares grow. The combined vehicle and survey data will also enhance the Board's understanding of the emerging PEV market and its potential contribution to achieve air quality and climate stabilization goals. Research Division staff recommends this proposal for approval.

NOW, THEREFORE, BE IT RESOLVED that the Air Resources Board, pursuant to the authority granted by Health and Safety Code section 39703, hereby accepts the recommendations of the Research Screening Committee and Research Division staff and approves the following:

> Proposal Number 2753-275, entitled "Advanced Plug-in Electric Vehicle Travel and Charging Behavior," submitted by the University of California, Davis, for a total amount not to exceed $650,000.

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 effort proposed herein, and as described in Attachment A, in an amount not to exceed $650,000.

I hereby certify that the above is a true and correct copy of Resolution 12-45, as adopted by the Air Resources Board.

Tracy Jensen

Tracy Jensen, Clerk of the Board

ATTACHMENT A

"Advanced Plug-in Electric Vehicle Travel and Charging Behavior"

Background

During its January 2012 meeting, ARB resolved to study consumers' actual usage of plug-in electric vehicles (PEVs) and report back to the Board by 2016. Consumer usage and charging habits of PEV owners remain ambiguous due to limited data availability and the diversity of PEV attributes. However, these behaviors will have significant implications for statewide emissions, energy consumption, and electrical grid management based on the total vehicle miles traveled using off-board electricity sources (eVMT). As PEVs are expected to become an increasing share of the light-duty fleet, understanding these behaviors will be important for appropriately projecting fleet emissions and estimating consumer impacts as well as efficiently planning future resources.

Objective

The objective of this research project is to collect and analyze longitudinal and spatial in-use vehicle data from households that own PEVs. A wide array of data will be collected from all vehicles within the households – both PEV and non-PEV – in order to improve emissions estimates at the vehicle, household, and fleet levels. The data will also be used to inform potential demand on the electrical grid as well as the need for potential future supporting infrastructure.

Methods

The primary data collection method will be through instrumentation with a customized data logging device connected through the on-board diagnostics port that captures vehicle location, operations, and charging data transmitted to a server via a cellular network. Approximately 115 households will be recruited to participate, owning an estimated 300 PEV and non-PEV vehicles total. Data will be collected from all vehicles within the household for 12 months, with the entire data collection period spanning over two years. Given the large volume of data generated from this project, the data will be processed using database software and geographic information systems (GIS).

The in-use vehicle data will be supplemented with two surveys of the participating households. As part of the recruitment effort, the first survey will be administered to all eligible households to gather data on household characteristics, charger availability, important destinations, and expectations about their PEVs. The results of this survey will be used to select households along the various dimensions of interest: PEV technology type, access to workplace charging, geographic diversity, annual miles traveled, etc. The exit survey will be conducted at the conclusion of the household's data collection period to provide context for interpreting the vehicle data and capture relevant changes to the household (e.g. change in workplace location or household structure) and reflections on their experiences with the vehicle and charging infrastructure.

Expected Results
Overall, this project will allow the researchers to describe the current state of PEV household vehicle use dynamics, their charging behavior, the interaction between charging infrastructure and eVMT, strategies for increasing eVMT, and the need for additional public charging infrastructure. More specifically, this research will produce total and household shares of eVMT for different PEV types, a spatial model of vehicle activity territory, charging/refueling profiles for vehicles and households, and a host of travel activity and in-use vehicle operations data that will be provided to ARB.

Significance to the Board
This research will allow the Board to evaluate the potential environmental benefits of different PEV types in a comprehensive and systematic manner. Detailed charging data will improve upstream electricity emissions estimates while operations and travel data collected on all vehicles will also help to refine estimates of emissions inventories and consumer benefits. Additionally, a better understanding of PEV household travel behavior will help inform whether additional public or workplace charging infrastructure may increase eVMT as well as improve forecasts of travel demand as PEV shares grow. The combined vehicle and survey data will also enhance the Board's understanding of the emerging PEV market and its potential contribution to achieve air quality and climate stabilization goals.

Contractor:
University of California, Davis

Contract Period:
44 months

Principal Investigator (PI):
Thomas Turrentine, Ph.D.

Contract Amount:
$650,000

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

Past Experience with this Principal Investigator:
Dr. Thomas Turrentine is the director of the Plug-in Hybrid and Electric Vehicle Center at the University of California, Davis' Institute of Transportation Studies. He is listed as a co-Principal Investigator on the concurrently proposed research project on new car buyers' valuation of zero-emission vehicles. Previously, he was a PI on a consumer study of converted plug-in hybrid vehicles through a Mobile Source Control Division contract for $1.8M completed in 2010.

Prior Research Division Funding to University of California, Davis:

Year	2012	2011	2010
Funding	$ 4,949,363	$ 1,394,560	$ 508,267

BUDGET SUMMARY

Contractor: University of California, Davis

"Advanced Plug-in Electric Vehicle Travel and Charging Behavior"

DIRECT COSTS AND BENEFITS			
1.	Labor and Employee Fringe Benefits	$ 228,814	
2.	Subcontractors	$ 0	
3.	Equipment	$ 0	
4.	Travel and Subsistence	$ 9,681	
5.	Electronic Data Processing	$ 53,155	
6.	Reproduction/Publication	$ 345	
7.	Mail and Phone	$ 2,760	
8.	Supplies	$ 150,000[1]	
9.	Analyses	$ 0	
10.	Miscellaneous	$ 150,141[2]	
	Total Direct Costs		$ 594,896
INDIRECT COSTS			
1.	Overhead	$ 55,104	
2.	General and Administrative Expenses	$ 0	
3.	Other Indirect Costs	$ 0	
4.	Fee or Profit	$ 0	
	Total Indirect Costs		$ 55,104
TOTAL PROJECT COSTS			**$ 650,000**

[1] This project requires procurement of a customized, programmable logging device in order to monitor the necessary parameters of plug-in electric vehicles, such as battery state of charge and electric motor speed. The supplies cost is estimated using preliminary vendor quotes for 150 logging devices at a unit hardware cost of $1000. Formal vendor quotes following contract approval will determine the final hardware costs.

[2] About one-third of the miscellaneous costs are for household participant incentives. Given the detailed data collected over a long period of time, households will likely require some incentive payment for installation of logging devices and completion of surveys. Another one-third of miscellaneous costs can be attributed to logger programming and testing. Plug-in electric vehicles are not required to output standard signals, and therefore require purchase of databases from auto manufacturers, additional engineering, and vehicle testing. The remaining third is dedicated mainly to graduate student in-state fees which is required by university policies when hiring graduate student personnel.