

**STATE OF CALIFORNIA
AIR RESOURCES BOARD**

**MEETING OF THE
RESEARCH SCREENING
COMMITTEE**

**July 17, 2014
10:00 a.m.**

**Air Resources Board
Research Division
Cal/EPA Building
1001 I Street
Sacramento, CA 95814
(916) 445-0753**

**State of California
AIR RESOURCES BOARD**

**Research Screening Committee Meeting
Cal/EPA Headquarters Building
1001 I Street
Conference Room 710, 7th Floor
Sacramento, California 95814
(916) 445-0753**

**July 17, 2014
10:00 a.m.**

AGENDA

- | | |
|--|---------|
| I. Approval of Minutes of Previous Meeting: | iii-vii |
| March 28, 2014 meeting | |
| II. Discussion of New Research Projects: | |
| 1) "Characterization of PM2.5 Episodes in the San Joaquin Valley Based on Data Collected During the NASA DISCOVER-AQ Study in the Winter of 2013," \$200,000, University of California, Davis, Proposal No. 2778-280 | 1 |
| 2) "The Dynamics of Plug-in Electric Vehicles in the Secondary Market and their Implications for Vehicle Demand, Durability, and Emissions," University of California, Davis, \$300,000, Proposal No. 2779-280 | 7 |

**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**

**May 30, 2014
9:00 a.m.**

MINUTES

RSC Members in Attendance via teleconference

Harold Cota
Forman Williams
Steven Japar
Suzanne Paulson
Rashid Shaikhu
Alan Vette
Philip Fine
Yifang Zhu
William Eisenstein

The Research Screening Committee (RSC or Committee) convened the meeting at 9:02 a.m. The minutes of the March 28, 2014 meeting were approved.

I. New Research Projects

- 1) "Association Between Long-Term Ultrafine Particulate Matter Exposure and Premature Death," University of California, Davis, \$849,115, Proposal No. 2775-279

The Committee mentioned the possibility of temporal discordance between the ultrafine particulate matter (UFP) results, using 24-hour averages, versus the epidemiological analysis, which would use monthly averages. This much longer time scale for the epidemiological analysis may be problematic. Thus, the Committee asks that the principal investigator (PI) address the possible consequences of the different time scales.

One question asked during the meeting was whether it would be preferable to focus on a single region, such as Southern California, rather than to model UFP levels for the entire state. Staff responded that this would be too limiting, and that the PI had already agreed to model specific population centers within the state,

including the Los Angeles area, at a finer resolution of 1 km, while covering the rest of the state at 4 km resolution. The Committee mentioned a newly published article that showed particle number concentrations from the Los Angeles International Airport may be comparable in magnitude to freeway traffic emissions (Hudda et al., 2014, "Emissions from an International Airport Increase Particle Number Concentrations 4-fold at 10 km Downwind," Environmental Science & Technology). They asked that the PI consider the implications of this study for the current project.

Motion: Move to accept the proposal, subject to inclusion of revisions based on comments from staff and the Committee.

The Committee approved the proposal. Forman Williams abstained from voting.

- 2) "Behavioral and CNS Pathology Associated with Ultrafine Particle Exposure in an a-Syn Transgenic Mouse Model of Parkinson' Disease," University of California, Los Angeles, \$500,000, Proposal No. 2776-2798

The Committee commented that the proposal was somewhat lacking in detail, but overall felt that the researchers' responses had provided helpful clarification. Additionally, the Committee was pleased by the researchers' decision to increase the sample size, from 12 animals to 16 animals per treatment group, in response to Committee comments received prior to the meeting.

Committee members also felt that the proposal wording should be amended to say that exposures could include particles up to 180 nm in diameter, otherwise known as "quasi-ultrafines."

Motion: Move to accept the proposal, subject to inclusion of revisions based on comments from staff and the Committee.

The Committee approved the proposal. Forman Williams abstained from voting.

- 3) "Ozone in the Lower Atmosphere and its Contribution to High Ozone Concentrations at Ground-Level in the Southern San Joaquin Valley," University of California, Davis, \$300,021, Proposal No. 2777-279

Staff provided the Committee with updated budget numbers (total of \$300,022 with \$183,472 to the prime and \$116,550 to the sub-contractor). Staff informed the Committee of comments since the agenda book was prepared, including expressed support from the San Joaquin Valley Air Pollution Control District. The Committee was satisfied with the written responses to its pre-meeting comments. A concern was raised regarding the intensive operations (12 flights in 3 days) and whether a back-up aircraft would be available should mechanical difficulties occur. Staff noted that, because an aircraft needs to be modified to accommodate the sampling lines and any aircraft modifications would require approval by the Federal Aviation Administration, no back-up plane would be readily available. Staff did not consider this a major concern because the

sampling campaign is episodic in nature and any maintenance/repair complications would not be a problem unless they would last more than 2-3 weeks. Several Committee members expressed support for the project.

Motion: Move to accept the proposal, subject to inclusion of revisions based on comments from staff and the Committee.

The Committee approved the proposal. Philip Fine was not present for this item.

- 4) "Characterization of PM2.5 Episodes in the San Joaquin Valley Based on Data Collected During the NASA DISCOVER-AQ Study in the Winter of 2013," \$200,000, University of California, Davis, Proposal No. 2778-279

The Committee was supportive of the proposal but requested further details to be included in the proposal. Several suggestions were given including: incorporation of the responses (with additional technical details) to Professor Yifang's questions into the technical plan section; a request for a justification for the scope of work; addition of further detail for both the scope of work (specific tasks and time breakdown) and the specific types of data analyses to be carried out, and the addition of a sentence describing any potential overlap between this project and Principal Investigator Ian Faloon's project in the San Joaquin Valley, "Quantifying the Origins of Residual Layer Ozone and its Contribution to Surface Exceedances in the Southern San Joaquin Valley."

Motion: Tabled.

The Committee tabled the proposal. Philip Fine was not present for this item.

- 5) "The Dynamics of Plug-in Electric Vehicles in the Secondary Market and their Implications for Vehicle Demand, Durability, and Emissions," University of California, Davis, \$300,000, Proposal No. 2779-279

Staff informed the Committee that they would like the researchers to provide an additional description of survey methods and justification for new car buyer survey, and that a change to ARB policy may prevent sharing the Department of Motor Vehicles' (DMV) data with researchers for the purposes of survey recruitment. Staff suggested that if DMV data cannot be used, the project should instead focus on the economic modeling portion of the proposal.

One Committee member provided written comments suggesting this research should study both new and used plug-in vehicle (PEV) buyers and used hybrid electric vehicle (HEV) buyers to understand how well these vehicles substitute for each other and to examine what we know about the market for used HEVs. They also advised staff to eliminate the new car buyer survey and the interviews with used buyers, and to expand the economic modeling portion to include HEVs.

Another Committee member was concerned about the lack of detail on the

surveys. They thought it was difficult to tell if the new and used car buyer surveys would use the same survey instrument, that the outreach effort to get responses needs to be substantially strengthened, and that the survey needs to be pre-tested. They also pointed out that there doesn't appear to be an effort to survey non-PEV buyers. Staff noted that ARB is funding another survey of new car buyers that will provide a useful comparison. The Committee member also said that data-sharing arrangements for the economic modeling portion of the contract should be clearer to address concerns that data may not be available. A third Committee member thought that it was unclear what the Committee was approving, with all the questions on DMV data, data for economic modeling, etc. and said it was better to delay.

Motion: Tabled.

The Committee tabled the proposal. Philip Fine was not present for this item.

- 6) "Potential to Build Current Natural Gas Infrastructure to Accommodate the Future Conversion to Near-Zero Transportation Technology," University of California, Davis, \$250,000, Proposal No. 2780-279

Staff informed the Committee that the start date for the project was changed to October 2014. The Committee was supportive of the project but requested information about contacts with industry for this project. The Committee also questioned the qualifications of the PI, given that Amy Jaffe does not have a Ph.D. Staff confirmed that the research team has ample expertise in natural gas policies, infrastructure and economics.

Motion: Move to accept the proposal, subject to inclusion of revisions based on comments from staff and the Committee.

The Committee approved the proposal. Steven Japar was not present for this item. Suzanne Paulson abstained from voting.

- 7) "The Development of Lifecycle Data for Hydrogen Fuel Production and Delivery," University of California, Davis, \$250,000, Proposal No. 2781-279

Staff informed the Committee that the start date for the project was changed to October 2014. The Committee commented that the proposal was brief and requested more details on all of the tasks. Staff is currently following up with the researchers to provide more information on methods and goals for each task. The Committee also wanted to know if the gas turbine industry would be interested in the results and if they are involved in the project. Staff is currently looking into the researcher's communication with the gas turbine industry and will provide a written comment to the Committee. The Committee wanted to know if there was a connection between this proposal and the proposal on natural gas infrastructure. Staff reported that both projects support the goals of the low carbon fuel standard but have different objectives. Finally, the Committee requested that the proposal include page numbers. Staff will ensure that the final

version of the proposal will include page numbers.

Motion: Move to accept the proposal, subject to inclusion of revisions based on comments from staff and the Committee.

The Committee approved the proposal. Steven Japar was not present for this item. Rashid Shaikhu abstained from voting.

The meeting adjourned at 10:53 a.m.

DISCUSSION OF A NEW RESEARCH PROJECT

ITEM NO.: II.1

DATE: July 17, 2014

PROPOSAL NO.: 2778-280

STAFF EVALUATION OF A RESEARCH PROPOSAL

TITLE: Characterization of PM_{2.5} Episodes in the San Joaquin Valley Based on Data Collected During the NASA DISCOVER-AQ Study in the Winter of 2013

CONTRACTOR: University of California, Davis

PRINCIPAL INVESTIGATOR: Christopher D. Cappa, Ph.D.

CONTRACT TYPE: Interagency Agreement

TOTAL AMOUNT: \$200,000

CONTRACT TERM: 30 Months

For further information, please contact Dr. Eileen McCauley at (916) 323-1534.

I. SUMMARY

Although substantial progress has been made in improving the air quality in the San Joaquin Valley (SJV), wintertime PM_{2.5} air pollution in the Valley continues to be the worst in the State. Models used in air quality planning for the region are inconsistent in their ability to predict PM_{2.5} concentrations, which suggests a gap in understanding and in the overall conceptual model for PM_{2.5} formation in the SJV. National Aeronautics and Space Administration (NASA) chose the SJV for one of its Deriving Information on Surface conditions from Column and Vertically Resolved Observations Relevant to Air Quality (DISCOVER-AQ) campaigns – a \$30 million NASA study to improve the ability of satellites to measure surface air quality. This measurement program created an extensive set of vertically resolved aircraft measurements of PM_{2.5} and important gaseous species for the SJV in January/February 2013. The aircraft measurements were complemented by a network of ground sites at which basic information on PM_{2.5} concentrations was collected and a ground “supersite” at ARB’s Fresno-Garland monitoring station which provided more detailed measurements of PM_{2.5} composition and properties. The objective of this project is to conduct advanced analysis of aircraft

and supersite measurements made during Discover-AQ with the goal of improving the conceptual model of the origin, evolution, and spatial distribution of PM_{2.5} in the SJV. Comparison of the data analysis results with ARB's modeling will help identify strengths and weaknesses in ARB's conceptual model of PM episode formation in the SJV. The enhanced understanding of PM_{2.5} formation in the SJV will be of immediate value for developing air quality attainment strategies. The proposal has been revised in accordance with requests by the RSC for further details (these are discussed in Staff Comments).

II. TECHNICAL SUMMARY

Objective

The proposed research has several objectives:

- 1) Investigate how the PM composition, gas-phase species, and meteorological fields vary with altitude and time of day over several sites in the SJV during DISCOVER-AQ. This analysis will provide insights into how extended PM episodes at the surface are connected to processes occurring aloft.
- 2) Provide a detailed characterization of physical and chemical properties of PM_{2.5} at the Fresno-Garland supersite during the DISCOVER-AQ study. The focus of this work will be on diurnal particle properties and in linking characteristics and differences in ground level behavior with the evolution of the vertical profile.
- 3) Improve and update the conceptual model for PM_{2.5} formation in the SJV in winter months. The investigators will work with ARB staff in refining the photochemical modeling of the study period, with an emphasis on the two PM episodes, based on results from the above analyses.

Background

The current numerical and conceptual models for PM formation in the SJV owe much of their development to the California Regional Particulate Air Quality Study (CRPAQS), which took place between December 1999 and February 2001. This study provided a broad suite of PM and gas-phase measurements from state-of-the-art (at the time) instruments located throughout the SJV. The measurements demonstrated that much of the PM_{2.5} in the SJV during winter is composed of ammonium nitrate (NH₄NO₃) or organic aerosol (OA). The spatial distribution indicated a more regional source for

NH_4NO_3 and an urban source for OA. Measurements from a 90 m tower suggested that NH_4NO_3 formed aloft at night could explain some of the homogeneity of particulate nitrate in the Valley; though it was also concluded that daytime surface formation of HNO_3 is important. Processes occurring above 90 meters could not be investigated, which limited the development of the current conceptual model for PM formation, especially in understanding the vertical distribution of pollutants in the SJV, how it evolves during the day, and impact on ground level PM.

The NASA DISCOVER-AQ campaign in the SJV during January/February 2013 was designed to help improve the ability of satellites to quantitatively measure surface air quality and produced an extensive set of surface and aloft (aircraft) ambient data. A surface supersite - Fresno-Garland - contained state-of-the-art real-time aerosol instruments, including a High-Resolution Aerosol Mass Spectrometer (HR-AMS), Particle-into-Liquid-Sampler (PILS) coupled with an ion chromatograph (for inorganic ions and water-soluble organic carbon), two scanning mobility particle sizers (SMPS), a cavity ringdown spectrometer, and a single particle soot photometer. Aloft measurements were taken from NASA's P3-B aircraft, which contained a suite of instrumentation for particle and gas-phase species. The P3-B flew throughout the SJV in a fixed pattern that was repeated three times each day, making low-altitude spirals over six ground sites. Atmospheric conditions during the campaign were optimal for the study of air quality: two episodes occurred in which $\text{PM}_{2.5}$ concentrations reached high levels and then dissipated. These buildups were regional in extent, and exceeded the United States Environmental Protection Agency $\text{PM}_{2.5}$ standard at many locations.

Proposal Summary

The main focus of the proposed research is on advanced analysis of the surface and airborne measurements of PM made during the DISCOVER-AQ campaign, with an emphasis on the two PM episodes. Using the unique set of air pollution and meteorological measurements from surface sites and the P3-B aircraft, the researchers will investigate the relative importance of different factors that contributed to the extended PM episodes in the SJV during the Discover-AQ; these include primary emissions (e.g. motor vehicles, wood burning), physical processes (e.g. stagnation), and chemical processes (e.g. fog chemistry). The extent to which mixing of PM, or PM

precursors, formed aloft influences surface PM concentrations will be explored using the temporal evolution of vertical PM_{2.5} distributions. Measurements of particle composition, or surrogates of composition, will be used to identify the sources of aloft PM. Ground-based measurements, especially HR-AMS measurements from the Fresno-Garland supersite, will be used to understand diurnal patterns of particle composition and to assess the extent to which aloft aerosol is related to surface PM_{2.5} properties and concentrations. These studies will be guided by five key hypotheses, which were developed through analysis of historical data and a preliminary examination of the DISCOVER-AQ data: H₁) Particulate nitrate is formed primarily aloft at night, and transported downwards to the surface in the late morning, which leads to an increase in the surface concentration of nitrate and of PM_{2.5}; H₂) Gas-phase precursors, such as HNO₃, are formed aloft at night and transported to the surface during the day, where they are mixed with air that has an overabundance of NH₃, which leads to rapid formation of particulate nitrate and increases in surface level PM_{2.5}; H₃) Photochemical production of HNO₃ at the surface contributes to surface particulate concentrations during daytime; H₄) Much of the organic aerosol is derived from primary emissions, but there is also formation of secondary organic aerosol that impacts ground level concentrations; H₅) One reason for the sometimes poor model/measurement agreement in terms of surface PM_{2.5} concentrations is insufficient model resolution in the vertical distributions of PM and gas-phase species. Based on these results, the researchers will update, refine and test the conceptual and numerical models for PM_{2.5} formation in the SJV.

III. STAFF COMMENTS

At the May 30 RSC meeting, the Committee was supportive of the proposal, but requested that additional details be presented in a revised proposal. In particular, the RSC asked for further background on the overall DISCOVER-AQ project (origins of data sets and the types of analyses NASA will perform), specifics on the data analysis/modeling that is being done as part of the project by ARB's staff in the Air Quality Planning and Science Division (AQPSD), and a discussion of effort/time needed for different tasks (justification for 30 months of work).

ARB staff believes the revised proposal adequately addresses all questions raised by the RSC. Several additional paragraphs and two figures were added in response: Section 3.3 includes further details about the DISCOVER-AQ project, data sets and types of analyses carried out by NASA and other groups; Section 5.1 (+ Fig. 6) contains a description of how a combination of ground and aircraft measurements will be used to understand the spatial and temporal distribution of PM_{2.5}; Section 5.1.3 (+ Fig. 9) expands the description of how AMS data will be processed and used along with aircraft measurements; Section 5.2 provides additional details about modeling work - specific days, region, models, inventory, boundary conditions; and Section 9 expands the Project Work Plan with the amounts of time/effort required for different tasks.

ARB staff from AQPS and Research Divisions reviewed this proposal and has helped strengthen some tasks to better address ARB's modeling efforts. The project should significantly improve our understanding of the composition, sources and processing of aerosols in the SJV and provide a better model for PM_{2.5} formation in the SJV. The proposal is well written and staff's only request was the addition of a list of explicit deliverables.

Dr. Chris Cappa has an extensive background in aerosol measurements and is currently co-investigator of an ARB project: "Improving Chemical Mechanisms for Ozone and Secondary Organic Carbon: SAPRC14." Staff is confident that Dr. Cappa's work would provide new and important information about primary and secondary PM_{2.5} sources and processing in the SJV, which is critically needed in the development of optimal air pollution mitigation strategies. Additionally, this project would represent a significant leveraging of resources and datasets: the extensive DISCOVER-AQ dataset in the SJV was acquired under NASA sponsorship.

IV. STAFF RECOMMENDATION

Staff recommends the Research Screening Committee approve this proposal for a total amount not to exceed \$200,000, subject to any changes and additions specified by the Committee.

DISCUSSION OF A NEW RESEARCH PROJECT

ITEM NO.: II.2

DATE: July 17, 2014

PROPOSAL NO.: 2779-280

STAFF EVALUATION OF A RESEARCH PROPOSAL

TITLE: The Dynamics of Plug-in Electric Vehicles in the Secondary Market and Their Implications for Vehicle Demand, Durability, and Emissions

CONTRACTOR: University of California, Davis

PRINCIPAL INVESTIGATORS: Gil Tal, Ph.D.
David Rapson, Ph.D.
Thomas Turrentine, Ph.D.

CONTRACT TYPE: Interagency Agreement

TOTAL AMOUNT: \$300,000

CONTRACT TERM: 30 Months

For further information, please contact Annmarie Rodgers at (916) 323-1517.

I. SUMMARY

Plug-in electric vehicles are expected to play a major role in achieving the greenhouse gas and criteria pollutant reductions required by California's Low Emission Vehicle (LEV III) program, the California Global Warming Solutions Act of 2006 (AB 32), and increasingly stringent National Ambient Air Quality Standards. This project will characterize the dynamics of the secondary market for plug-in electric vehicles (PEVs) in California to improve estimates of the emission benefits of PEVs and projections of the overall emissions from the light-duty fleet. Researchers will employ surveys, and an economic model to evaluate the impact of factors such as battery life, energy prices, infrastructure availability, attributes and prices of new vehicle offerings, and economic conditions, on the demand and prices of used PEVs and on their usage. Results will inform future decisions by ARB policymakers on the treatment of PEVs by various ARB programs, such as incentives, durability requirements, or vehicle crediting.

II. TECHNICAL SUMMARY

Objective

This project will characterize the dynamics of PEVs in the secondary market to understand the longer term emission implications from an increasing market share. The results of this study will be useful to refine long term projections of emissions benefits from PEVs, and to inform future decisions by ARB policymakers, beginning in 2016, on the treatment of these vehicles by various ARB programs, such as incentives, durability requirements, or vehicle crediting.

Background

While manufacturer compliance with ARB's Zero Emission Vehicle (ZEV) program is based on new vehicles sales, the expected emission benefits will require that these vehicles, including PEVs, remain in the fleet past the first owner. PEV sales over the past three years are approaching a total of 85,000 in California and many early consumers have been opting to lease rather than purchase these vehicles – either in response to competitive lease offers, uncertainty about current technology, and/or expectations for future developments – which will accelerate the development of a large secondary market of PEVs. This market began developing in late 2013, and initiating new research in these early stages will allow for comprehensive monitoring of its development process.

An earlier draft of this research proposal was reviewed by the Committee at the May 30, 2014 RSC meeting, and the project was tabled for several reasons. Questions relating to ARB policy on sharing of DMV data have since been resolved, and this project will be able to use addresses from the DMV database to recruit used PEV buyers for the survey. There is also greater certainty about acquisition of the datasets for the econometric analysis; ARB and UC Davis are in the process of negotiating a non-disclosure agreement with Manheim for auction data (free of charge), and ARB has committed at least \$50,000 toward the purchase of data from Experian, which based on current quotes will provide at least two calendar years of transaction-level data on PEVs and hybrids, and their close substitutes that will serve as a comparison group. The Committee also asked for pre-testing of the used PEV buyer survey, and for the inclusion of incentives to encourage higher response rates. The researchers have

included pre-testing in this version of the proposal, and intend to do follow-up mailings and offer incentives if response to the initial survey mailing is low. The Committee also requested that the new buyer survey and interviews be dropped from this project, although they thought that ensuring comparability between the used buyer survey and other surveys of new PEV buyers would be useful, and that hybrid vehicles be added to the econometric analysis. All of these changes are incorporated into this revised proposal.

Proposal Summary

This study will estimate the potential longer-term emissions benefits of PEVs by examining the early stages of the market for used PEVs. The investigators will conduct both qualitatively rich and quantitatively rigorous analyses of vehicle and market data on PEVs. Data sources will include comprehensive vehicle ownership/lessee databases, dealership inventory and sales data, commercially-sourced market and pricing data, and surveys of used PEV buyers.

Data analysis will include evaluation of factors such as battery life, energy prices, infrastructure availability, attributes and prices of new vehicle offerings, and economic conditions, on the demand and prices of used PEVs and on their usage. This research project will employ an econometric model to examine the statewide market for used PEVs, including the factors that are related to price variation of used PEVs (e.g., HOV sticker, state and federal incentives, mileage, battery life, etc.), the demand for used PEVs (including regional variations within California and out-of-state, and the role of charging infrastructure), and the relationship between the primary and secondary PEV markets. This project will also employ surveys to characterize used PEV buyers (socioeconomic and demographic characteristics, household fleets, etc.), their purchase motivations (value placed on vehicle attributes, incentives, charging access, etc.), and how they are using and charging their vehicles. The analysis will also evaluate whether the secondary market is expanding access to advanced clean cars, such as PEVs, to a wider array of consumers than the new PEV market. Additionally, the study will explore the variety of reasons that PEVs are entering the used market in order to gauge consumer acceptance of this class of technology.

III. STAFF COMMENTS

ARB staff (from Research and Emissions Compliance, Automotive Regulation, and Science Divisions) reviewed and provided comments on this proposal. It is necessary to begin this project in the next few months in order to obtain results that can be used in the Advanced Clean Cars program's Midterm Review Technical Assessment Report, which is due November, 2017. As part of the Midterm Review, ARB staff will use the findings of this study to help address concerns raised by auto manufacturers at the initial rulemaking regarding the demand for used PEVs, and to inform decisions about the future of incentive programs for PEV purchases and regulatory requirements for battery warranties.

The research team is highly qualified to conduct this project, with multiple Ph.D.'s and expertise spanning engineering, economics, and other social sciences. The team has extensive experience studying vehicle purchasing behavior and alternative fuel vehicles through survey and economic modeling, which they will apply to studying the secondary market for plug-in vehicles in this project.

IV. STAFF RECOMMENDATION

Staff recommends the Research Screening Committee approve this proposal for a total amount not to exceed \$300,000, subject to inclusion of any changes and additions specified by the Committee.