

LOCATION:

Air Resources Board
Byron Sher Auditorium, Second Floor
1001 I Street
Sacramento, California 95814

PUBLIC MEETING AGENDA

October 21, 2010

This facility is accessible by public transit. For transit information, call (916) 321-BUSS, website: <http://www.sacrt.com>
(This facility is accessible to persons with disabilities.)

TO SUBMIT WRITTEN COMMENTS ON AN AGENDA ITEM IN ADVANCE OF THE MEETING GO TO: <http://www.arb.ca.gov/lispub/comm/bclist.php>

October 21, 2010

9:00 a.m.

DISCUSSION ITEMS:

Note: The following agenda items may be heard in a different order at the Board meeting.

Agenda Item #

10-9-1: Public Meeting to Hear a Staff Presentation on the Draft Planned Air Pollution Research, Fiscal Year 2010-2011

Staff will present the portfolio of proposed research projects for FY 2010-2011. Research has been selected to support the Board's decision-making, support effective implementation of our regulatory programs, and address knowledge gaps critical to the Board's mission.

10-9-4: Public Meeting to Hear the 2010 Legislative Update

ARB Legislative Director and staff will present a review of legislation from the recently concluded 2009-2010 legislative session.

10-8-3: Public Meeting to Update the Board on the Implementation of the AB 32 Scoping Plan

Staff will update the Board on implementation of the Scoping Plan measures and other climate change program activities.

10-9-5: Public Meeting to Hear an Informational Update on Recent Federal and ARB Activities to Support Development of More Stringent Greenhouse Gas Emission Standards for Model Year 2017-2025 Passenger Vehicles

Staff will report on the recent publication of a Technical Assessment Report, jointly prepared by ARB, U.S. EPA, and U.S. DOT, on greenhouse gas emission reduction standards for model year 2017-2025 passenger vehicles and the related federal Notice of Intent to conduct a rulemaking.

10-9-2: Public Hearing to Consider Proposed Amendments to the Airborne Toxic Control Measure for Stationary Compression Ignition Engines

Staff will propose amendments to the Airborne Toxic Control Measure for Stationary Compression Ignition Engines (ATCM) to more closely align the requirements in the ATCM with those in the federal Standards of Performance for Stationary Compression-Ignition Internal Combustion Engines that was promulgated on July 11, 2006, help clarify provisions in the ATCM, address new information, and remove provisions no longer needed.

10-9-3: Public Hearing to Consider Minor Amendments to the Periodic Smoke Inspection Program in Response to the Inclusion of Diesel Vehicles in Smog Check (Assembly Bill 1488, Mendoza 2007)

Staff will present to the Board minor amendments to the Periodic Smoke Inspection Program (PSIP) to mitigate the duplicative testing requirements resulting from the implementation of the statutory requirements of AB 1488 and the existing testing requirements of PSIP. This action will eliminate duplicative emissions tests thereby lowering administrative costs to affected California fleets with diesel vehicles.

CLOSED SESSION – LITIGATION

The Board will hold a closed session, as authorized by Government Code section 11126(e), to confer with, and receive advice from, its legal counsel regarding the following pending or potential litigation:

Pacific Merchant Shipping Association v. Goldstene, U.S. District Court (E.D. Cal Fresno), Case No. 2:09-CV-01151-MCE-EFB.

American Trucking Associations, et al. v. U.S. Environmental Protection Agency, et al., U.S. Court of Appeals, District of Columbia Circuit, Case No. 09-1090.

POET, LLC, et al. v. Goldstene, et al., Superior Court of California (Fresno County), Case No. 09CECG04850.

Rocky Mountain Farmers Union, et al. v. Goldstene, U.S. District Court (E.D. Cal. Fresno), Case No. 1:09-cv-02234-LJO-DLB.

National Petrochemical & Refiners Association, et al. v. Goldstene, et al., U.S. District Court (E.D. Cal. Fresno) Case No. 1:10-cv-00163-AWI-GSA.

OPPORTUNITY FOR MEMBERS OF THE BOARD TO COMMENT ON MATTERS OF INTEREST

Board members may identify matters they would like to have noticed for consideration at future meetings and comment on topics of interest; no formal action on these topics will be taken without further notice.

OPEN SESSION TO PROVIDE AN OPPORTUNITY FOR MEMBERS OF THE PUBLIC TO ADDRESS THE BOARD ON SUBJECT MATTERS WITHIN THE JURISDICTION OF THE BOARD

Although no formal Board action may be taken, the Board is allowing an opportunity to interested members of the public to address the Board on items of interest that are within the Board's jurisdiction, but do not specifically appear on the agenda. Each person will be allowed a maximum of three minutes to ensure that everyone has a chance to speak.

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IF YOU HAVE ANY QUESTIONS, PLEASE CONTACT THE CLERK OF THE BOARD:

OFFICE: (916) 322-5594

1001 I Street, Floor 23, Sacramento, California 95814

ARB Homepage: www.arb.ca.gov

SPECIAL ACCOMMODATION REQUEST

Special accommodation or language needs can be provided for any of the following:

- An interpreter to be available at the hearing;
- Documents made available in an alternate format (i.e., Braille, large print, etc.) or another language;
- A disability-related reasonable accommodation.

To request these special accommodations or language needs, please contact the Clerk of the Board at (916) 322-5594 or by facsimile at (916) 322-3928 as soon as possible, but no later than 10 business days before the scheduled Board hearing. TTY/TDD/Speech to Speech users may dial 711 for the California Relay Service.

Comodidad especial o necesidad de otro idioma puede ser proveído para alguna de las siguientes:

- Un intérprete que esté disponible en la audiencia;
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SMOKING IS NOT PERMITTED AT MEETINGS OF THE CALIFORNIA AIR RESOURCES BOARD

PUBLIC MEETING AGENDA

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October 21, 2010 at 9:00 a.m.

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CALIFORNIA AIR RESOURCES BOARD**NOTICE OF PUBLIC MEETING TO CONSIDER THE APPROVAL OF A DRAFT REPORT: PLANNED AIR POLLUTION RESEARCH, FISCAL YEAR 2010-2011**

The Air Resources Board (ARB or Board) will conduct a public meeting at the time and place noted below to consider a draft report, titled "Planned Air Pollution Research, Fiscal Year 2010-2011."

DATE: October 21, 2010

TIME: 9:00 a.m.

PLACE: California Environmental Protection Agency
Air Resources Board
Byron Sher Auditorium
1001 I Street
Sacramento, California 95814

This item may be considered at a one-day meeting of the Board, which will commence at 9:00 a.m., October 21, 2010. Please consult the agenda for the meeting, which will be available at least 10 days before October 21, 2010.

The California Health and Safety Code (HSC), Sections 39700 and 39703, established the Air Resources Board's research program. It directed the Board to coordinate and administer all air pollution research that is funded, to any extent, with State funds. To facilitate this process, HSC Section 39705 directs the Board to appoint a Research Screening Committee (RSC) to give advice and recommendations on all air pollution research projects proposed for funding.

The proposed research projects were selected from more than 150 research ideas that were submitted by the general public, business and academic communities, and ARB staff in response to ARB's public solicitation. All research ideas and technical evaluations were provided to the RSC for review and comment. The RSC met on September 9, 2010 to review and approve the final list of projects.

ARB staff will present a written draft report, Planned Air Pollution Research, Fiscal Year 2010-2011, at the meeting. The report describes projected funding allocations and proposed research projects, some recommended for funding and others recommended if funding becomes available. After the staff presentation and public testimony, the Board will vote on the draft plan.

Copies of the report may be obtained from ARB's Public Information Office, 1001 I Street, First Floor, Environmental Services Center, Sacramento, California, 95814, (916) 322-2990, on September 21, 2010. The report may also be obtained from ARB's website at <http://www.arb.ca.gov/research/apr/apr.htm>.

Interested members of the public may also present comments orally or in writing at the meeting and may be submitted by postal mail or by electronic submittal before the meeting. To be considered by the Board, written comments submissions not physically submitted at the meeting must be received **no later than 12:00 noon, October 20, 2010**, and addressed to the following:

Postal mail: Clerk of the Board, Air Resources Board
1001 I Street, Sacramento, California 95814

Electronic submittal: <http://www.arb.ca.gov/lispub/comm/bclist.php>

Please note that under the California Public Records Act (Government Code section 6250 et seq.), your written and oral comments, attachments, and associated contact information (e.g., your address, phone, email, etc.) become part of the public record and can be released to the public upon request. Additionally, this information may become available via Google, Yahoo, and any other search engines.

The Board requests, but does not require 20 copies of any written submission. Also, ARB requests that written and e-mail statements be filed at least 10 days prior to the meeting so that ARB staff and Board members have time to fully consider each comment. Further inquiries regarding this matter should be directed to Susan Fischer, Air Resources Engineer, (916) 324-0627, or Annmarie Rodgers, Manager of the Climate Action & Research Planning Section (916) 323-1517.

SPECIAL ACCOMMODATION REQUEST

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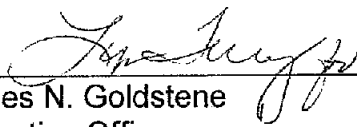
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CALIFORNIA AIR RESOURCES BOARD



James N. Goldstene
Executive Officer

Date: *Sept 15, 2010*

The energy challenge facing California is real. Every Californian needs to take immediate action to reduce energy consumption. For a list of simple ways you can reduce demand and cut your energy costs, see our website at www.arb.ca.gov.

California Environmental Protection Agency



PLANNED AIR POLLUTION RESEARCH

Fiscal Year 2010-2011

July 2010

The statements and conclusions in this paper are not necessarily those of the California Air Resources Board. The mention of commercial products, their source, or their use in connection with material reported is not to be construed as either actual or implied endorsement of such products. To obtain this document in an alternative format, please contact the Air Resources Board Disability Coordinator at (916) 323-4916 or 7-1-1 for the California Relay Service. This report is available for viewing or downloading from the Air Resources Board's Internet site at <http://www.arb.ca.gov/research/apr/apr.htm>.

Acknowledgments

This report was prepared with the assistance and support of managers and staff from the Research Division, Mobile Source Control Division, Monitoring and Laboratory Division, Planning and Technical Support Division, Office of Climate Change, and Stationary Source Division of the Air Resources Board. We would also like to acknowledge the members of the academic community, government agencies, private businesses, and the public who submitted research ideas.

Reviewed By:

Research Screening Committee

Harold Cota, Ph.D. (Chairman)
 Dan Costa, Ph.D.
 Iva Hertz-Picciotto, Ph.D.
 Steven Japar, Ph.D.
 Matthew Kahn, Ph.D.
 Charles Kolstad, Ph.D.
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External Reviewers and Collaborators

Bay Area Air Quality Management District
 California Department of Resources Recycling and Recovery
 California Department of Transportation
 California Energy Commission
 California Public Utilities Commission
 Coordinating Research Council
 Health Effects Institute
 National Oceanic and Atmospheric Administration
 New York State Energy Research and Development Authority
 Office of Environmental Health Hazard Assessment
 South Coast Air Quality Management District
 United States Environmental Protection Agency

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SUMMARY

This report presents the Air Resources Board's planned air pollution research for the fiscal year 2010-2011. Twenty-five projects that support the Air Resources Board's programs are recommended for funding. An additional four projects are offered for consideration, should additional resources become available. This research portfolio is organized by key policy and regulatory drivers: Health Effects and Exposure; Emissions Reductions; Climate Change, Energy Efficiency, and Conservation; Economic Analysis; and Technology Research and Development. Issues related to agriculture and environmental justices are integrated into several of these primary categories.

This annual plan proposes research in the areas listed above, with a significant effort to further inform health impacts of air pollution, develop technologies and behavioral change strategies to reduce emissions of greenhouse gases, improve emission inventories, characterize and assess the behavior of pollutants in the atmosphere, and reduce emissions of conventional air pollutants and their precursors. The total budget for projects recommended for funding is approximately \$6.5 million.

INTRODUCTION

The Air Resources Board (ARB or Board) sponsors a comprehensive program of research addressing the causes, effects, and possible solutions to air pollution problems in California. This research program also provides support for establishing ambient air quality standards. The Board's research program was established by the Legislature in 1971 (Health and Safety Code Sections 39700 et seq.) to develop a better understanding of air pollution in California, including air pollution's effects on health and the environment, atmospheric chemistry and transport of pollutants, and inventory and control of emissions. Several legislative mandates have expanded and further defined the scope of the program in recent years. For example, ARB's growing research interest in climate change issues is reflected by Assembly Bill 2991 (Nuñez, 2008), which expanded membership of ARB's Research Screening Committee to include two experts on climate change.

ARB's research portfolio comprises collaborative studies involving a variety of scientific disciplines and approaches. Some of these studies are long-term and build on unique data sets, while others address specific implementation or knowledge gaps as single modules. ARB funds niche projects that provide crucial input to California's air quality regulatory programs and may be unlikely to receive support from other funding agencies. In many cases, ARB technical staff play an active role in the research that extends far beyond contract management.

Objective of the Research Program. The goal of the research program is to provide timely scientific and technical information that will help the Board and local air pollution control districts to make sound policy decisions and effectively implement air pollution control programs in California. Specifically, this plan supports ARB's mission to protect public health based on a sound scientific understanding of health effects and exposures; continue developing and implementing strategies to reduce greenhouse gas emissions and energy consumption; develop effective strategies to safeguard health and welfare against adverse impacts of ambient air pollution; and support development of technologies and non-technological strategies that address multiple priorities related to air quality.

Process for Developing this Research Plan. Every year the Board sends out a public solicitation inviting and encouraging the public to contribute ideas for project consideration. Members of the public, the academic community, and ARB staff submit research ideas. To aid in the evaluation, the Board's Executive Officer has established interagency committees, led by ARB staff, to review research ideas. These interagency review teams comprised, in addition to ARB staff, experts from state agencies with related research priorities and responsibilities as well as experts from other state, air district, federal, and non-profit institutions with scientific research or regulatory authority in areas of policy relevance to ARB. In response to this year's solicitation, approximately 150 research ideas were submitted. Proposed projects were examined for relevance to regulatory questions facing the Board, scientific and technical merit, and opportunities to leverage State resources through co-funding. Proposals were modified as necessary to

support ARB's goals. Reviewers then prioritized candidate projects with regard to urgency, cost-effectiveness, and likelihood to succeed. The Board's scientific external review committee, the Research Screening Committee (RSC), which was established by Health and Safety Code Section 39705, reviews candidate projects. A list of projects recommended for funding, as well as projects to consider pending availability of resources is compiled based on discussions between interagency review committees, feedback from ARB's divisions, and comments from the RSC as well as an agricultural stakeholder outreach working group. This list of recommended projects is submitted to the Executive Research Review Committee, whose members are the Executive Officer, his three deputies, and the Chief of the Research Division. The Executive Research Review Committee reviews all of the proposed projects and modifies the draft list of projects recommended for funding based on ARB's most pressing policy and regulatory needs. Finally, the RSC reviews the selected projects and recommends the Plan to the Board.

Implementation of the Plan. The next step for research concepts approved in the plan is their development into full research projects. The submission and selection of an idea does not guarantee a resulting contract for the submitter. Rather, ARB is required to consider public California universities for expertise to execute these projects. If the universities do not possess the expertise, then a public solicitation is issued or a sole source contract is awarded. A list serve distributes updates on research activities. To subscribe to the list serve, please visit:

http://www.arb.ca.gov/listserv/listserv_ind.php?listname=research.

Research Budget. The twenty-five recommended projects total approximately \$6.5 million. An additional four projects totaling approximately \$1.3 million may be considered if additional resources become available. Allocations for the projects recommended for funding are distributed among key research areas as follows:

RESEARCH CATEGORY	BUDGET
Health Effects and Exposure	\$1,519,439
Emissions Reductions	\$2,853,000
Climate Change, Energy Efficiency & Conservation	\$1,315,000
Economic Analysis	\$480,000
Technology Research & Development	\$376,000
TOTAL	\$6,543,439

Interagency Coordination. The Research Division works with other California government agencies to ensure that projects are non-duplicative, to identify opportunities to leverage resources, and to maximize the utility of research results. To foster coordination, staff at different agencies share information and solicit input from other agencies at all stages of the research process, including proposal review, updates on research progress, and final reports. Furthermore, the Climate Action Team has

established a Research Subgroup to coordinate the State's climate change research. Starting in fall 2010, this Subgroup will hold annual meetings where State Agency research staff will display the products of research projects, summarize their on-going and planned research activities, and identify opportunities for collaboration. The CAT Research Working Group also maintains a database of State-funded climate change research. ARB, in collaboration with the California Council of Science and Technology, is compiling a database of climate change research in California's public and private universities, national laboratories, and State agencies. This publicly available tool is designed to help the State identify intellectual resources, in the form of principal investigators, ongoing or complete research, and databases, that can facilitate cost-effective attainment of climate change goals.

Project Co-Sponsorships. ARB is continually seeking co-funding opportunities and other ways to leverage the State's research dollars. This effort allows the ARB to be part of projects and studies that may otherwise lie beyond the state's fiscal reach. ARB has successfully worked with other research organizations and has participated in multi-million-dollar collaborations.

Summaries of Past Research. Projects completed since the beginning of 1989 are summarized in the Research Division's publication, *Air Pollution Research*, available at www.arb.ca.gov/research/apr/past/past.htm. Research Division's final reports are available at the same web site.

Organization of the Research Plan.

This research plan is organized according to key research categories that support the Board's mission: Health Effects and Exposure; Emissions Reductions; Climate Change, Energy Efficiency, and Conservation; Economic Analysis; and Technology Research and Development; with issues related to agriculture and environmental justice integrated into several of these primary categories. For each research area, an overview indicates primary policy drivers, links to ARB's mission, ongoing research efforts in the area, and research and knowledge gaps that need to be addressed. These contextual overviews are followed by the projects recommended for funding as well as those that may be considered if additional funds become available.

The proposed research projects are not intended to be exhaustive or exclusive. Unanticipated opportunities, unique or innovative study approaches, or urgency may lead to consideration of other projects.

OVERVIEWS OF RESEARCH AREAS

Health Effects and Exposure

Context

The health impacts of particulate matter (PM) air pollution have been confirmed by extensive studies conducted at many universities and institutions world-wide. The United States Environmental Protection Agency (U.S. EPA) recently released a comprehensive review of the scientific literature on the health and welfare impacts of particulate matter. That review included consideration of hundreds of epidemiological, toxicological and human exposure studies, and it concluded that there is a causal relationship between long-term PM_{2.5} exposure and mortality and for cardiovascular effects. The U.S. EPA further concluded that there is a likely causal relationship between long-term PM_{2.5} exposure and respiratory effects. Although the ARB has made considerable progress in reducing PM emissions from motor vehicles and other sources, and consequently reducing the level of adverse health effects of PM, the burden of PM exposure remains particularly acute, in part because California is home to two of the worst non-attainment areas in the U.S. with regard to federal 2006 PM_{2.5} standards.

Substantial progress has been made in understanding the mechanisms of PM toxicity, as well as the magnitude of the associated mortality risk. However, ARB must continue to improve its understanding of the specific components and sources of PM that are responsible for health burdens, as well as illuminate the mechanisms that cause adverse health impacts, particularly in vulnerable populations. This improved understanding will foster development of increasingly targeted and cost-effective regulations.

ARB's health and exposure research also targets indoor air quality because the indoor concentration of many air pollutants exceeds that of the outdoor levels, often elevating Californians' exposures to unhealthy levels of those pollutants. Previously, ARB's indoor air quality research focused on gaining a better understanding of indoor sources and exposures (especially for toxic air contaminants), the relationship between indoor and outdoor air pollution, and how building factors affect indoor pollutant concentrations and exposures. Current and planned research is focused on improved indoor source emission measurement techniques and the effectiveness of various mitigation approaches for reducing indoor concentrations and exposures. ARB's 2005 *Report to the Legislature: Indoor Air Quality in California* identified high priority indoor source categories requiring mitigation, including indoor air cleaning devices that emit large quantities of ozone, and building materials that produce high levels of formaldehyde and other volatile organic compounds (VOCs) indoors. ARB's pioneering research provided the key information that identified the need for recent regulation of these sources, but additional information is needed. For example, new technologies in indoor air cleaning devices require more sophisticated emissions measurement and mitigation techniques. Thus, a top priority is measuring pollutant emissions from indoor sources and investigating strategies for reducing individuals' levels of exposure to those pollutants.

Policy Drivers

- The Children's Environmental Health Protection Act (SB 25, Escutia, 1999)

- Reviewing and evaluating Ambient Air Quality Standards (Title 17 of the California Health & Safety Code, Section 39606)
- Diesel Risk Reduction Plan
- Regulation of Ozone Emissions from Indoor Air Cleaning Devices (California Health & Safety Code, Sections 41985 et seq.)

Research Themes

- *Particulate matter toxicity.* Public health risk from air pollution is dominated by exposure to PM. Much progress has been made over the last decade documenting the serious nature of the health risk from exposure to particles; now, research is needed to determine the relative toxicity of the components of the mixture of ambient particles. Furthermore, the biological mechanism of toxicity, which is just now coming to light, needs to be investigated. Research on the characteristics of particles, such as size, chemical composition, and interaction with other pollutants, are crucial in designing smarter, more targeted regulations, while providing adequate protection of public health and the environment.
- *Vulnerable populations.* As part of its mission, ARB investigates the health effects of air pollution in support of ambient air quality standards that are adopted to protect the health of all Californians, including sensitive sub-groups and those living in disadvantaged communities. Sensitive sub-groups of interest include children, the elderly, and those with chronic health conditions, such as asthma, cardiovascular and pulmonary disease.
- *Indoor air quality.* A top priority is measuring pollutant emissions from indoor sources and investigating strategies for reducing individuals' levels of exposure to those pollutants.

Recommended for Funding

Particulate Matter Toxicity

Season- and location-specific systemic health effects of ambient PM

Problem: A diverse and increasingly sophisticated body of epidemiologic evidence associates environmental particulate matter with asthma as well as cardiovascular morbidity and mortality, but less is known regarding the biological mechanisms as well as the specific PM components that are responsible for ill health. Most studies focus on urban particle sources and do not distinguish between regional differences in particle composition and potential pulmonary or systemic health outcomes. Stronger support for source-apportioned regulation depends on correlating source specific composition with health effects.

Objective: This project will use a mouse model to correlate PM composition, season, and location (urban versus rural) with biologic markers relevant to cardiovascular disease. Results will provide a biological link between epidemiologic studies and a principal health outcome of PM exposure, and will provide critical information on toxicity of PM from different sources that will help to inform future source-specific regulations.

Proposed funding level: \$266,298

Biological activity of near-freeway particulate and gases

Problem: Epidemiological studies have shown associations between exposure to near roadway air pollutants and mortality and other adverse health outcomes, and a large

number of in vitro and animal studies have shown that particulate matter has pro-oxidant activity relevant to the pathogenesis of these conditions. However, no study has examined how changes in the proximity to major roadways may impact the biological activity of particles. This project addresses that missing link and is an opportunity to identify the components of traffic-related pollutants potentially responsible for adverse health effects.

Objective: This proposed roadway gradient study will evaluate the seasonal and spatial variation in both gas and particle phase air pollutants. To link the physical/chemical characteristics of pollutants to biological activity, investigators will use state-of-the-art cellular assays to examine the role of chemical composition in determining the pro-oxidant, electrophilic, allergic, and inflammatory activity of ambient aerosols. Findings will promote our understanding of the causal relationship between exposure and health outcomes as well as clarify the spatial pattern of risk, and may guide development of regulatory and public health policy.

Proposed funding level: \$300,000

Vulnerable Populations

Risk of pediatric asthma morbidity from multipollutant exposures

Problem: Asthma morbidity has been associated with fluctuations in daily concentrations of ambient air pollution, most strikingly with traffic-related air pollutants. However, the combined importance of local exposure to traffic-related ultrafine particles and regional exposure to ozone, as well as organic components of PM_{2.5}, is largely unknown. This lack of information is due to the difficulty in estimating the exposure profiles of individuals at risk.

Objective: Investigators will use PM concentrations predicted by regional air quality models to study the relationship of asthma morbidity in over 7,500 children to exposure to primary organic aerosol (POA), which is directly emitted from sources, and secondary organic aerosol (SOA), which forms in the atmosphere from precursor emissions. The findings from this research will clarify the roles that components of complex urban air pollution play in producing adverse asthma outcomes in children.

Proposed funding level: \$285,000

Investigation of persistent immune effects of acute PM exposure during early life and development of a biomarker for lung function decline

Problem: Although epidemiological studies suggest that there are life-long impacts of childhood air pollution exposures, the biologic mechanisms that mediate reduced lung function growth are not fully understood, and the phenomenon is difficult to study due to a lack of minimally invasive biomarkers. In addition to compromising lung development, preliminary data suggest that childhood exposures to air pollution may alter immune system development. The relationship between lung function growth and immune system development may offer a minimally invasive means of monitoring impacts of childhood air pollution exposures.

Objective: The proposed study will investigate the impact of environmental air pollutant exposure on immune system development and lung function growth in a cohort of rhesus monkeys that were born at the California National Primate Research Center, just prior to significant PM exposure from the Trinity and Humboldt County wildfires in July 2008. These fires led to air pollution levels significantly above ambient air quality standards that lasted for several weeks, which coincided with a period of rapid lung

growth in the exposed animals. The similarities between humans and rhesus monkeys in lung and immune system growth and development coupled with the cohort's inadvertent exposure to high levels of air pollution during a critical developmental period provides a unique opportunity to probe the mechanisms by which air pollution influences lung and immune system growth and development in children. The endpoints to be studied require minimally invasive procedures, and include lung function tests and blood draws that will provide the information needed while not harming the subject animals.

Proposed funding level: \$268,141

Indoor Air Quality

Evaluation of secondary pollutant emissions from portable air cleaners

Problem: Although ARB is implementing a regulation to limit ozone emissions from portable indoor air cleaners such as electrostatic precipitators (ESPs), ionizers and ozone generators (OGs), some of these devices, including newer technology air cleaners designed to produce less ozone, may also cause the production of formaldehyde and other pollutants through their operation or from reaction of their emissions with other constituents of indoor air. Thus, the current regulation to limit ozone emissions from portable indoor air cleaners may not suffice to safeguard indoor air quality.

Objective: This research will evaluate the emission of indoor pollutants by devices commercialized as portable air cleaners in California, with emphasis on a new generation of equipment integrating several technologies that include photocatalytic oxidation. Both primary emissions and those formed by reaction in the indoor environment will be determined in realistic indoor conditions, to assess the potential for exposure and possible health risks. Results will help the State assist the public in making informed decisions when purchasing and using these devices, and may help determine whether such emissions require regulation.

Proposed funding level: \$400,000

Recommended if Additional Funding Available

Particulate Matter Toxicity

Toxicity of fresh and aged semi-volatile PM

Problem: Many Californians live in nonattainment areas for PM_{2.5}, and the contribution of aged pollution emissions from sources such as motor vehicles is significant to PM concentrations. However, less is known about the toxicity of aged emissions than is known for fresh tailpipe emissions. Within seconds of leaving the tailpipe, there are dramatic changes in gas-particle partitioning of semivolatile organic materials. These changes transform aerosol mass and chemical composition, but more importantly, they considerably alter the toxicity of the emissions.

Objective: The proposed two-phase research study will investigate the toxicity of fresh and aged motor vehicle emissions. This project will provide needed information on the atmospheric evolution of fresh vehicular emissions and their physico-chemical characteristics, transformation, and resulting toxicity. This knowledge will be vital in the development of cost-effective strategies to protect the public from toxic sources.

Proposed funding level: \$300,000

*Vulnerable Populations***Traffic-related pollution, DNA methylation and asthma in children living near sea ports**

Problem: Asthma has a strong genetic basis, and genetic variants contribute to increase asthma susceptibility to exposures from traffic-related pollution. A growing body of evidence also suggests an epigenetic component in asthma susceptibility: air pollution may alter gene expression through effects on DNA methylation.

Objective: The proposed study will use a novel approach to generate new data that will improve understanding of the linkages among traffic-related pollution, DNA methylation and asthma progression in children. Results will also shed light on the impact of reductions in traffic-related pollution in the vicinity of the part of Long Beach due to ARB's implementation of the Goods Movement Emission Reduction Program on asthma progression and important epigenetic influences on asthma progression.

Proposed funding level: \$550,000

*Indoor Air Quality***Zero-energy air purification materials to reduce the exposure of Californians to harmful air pollutants**

Problem: Ozone is both a health-damaging air pollutant and a driver of indoor chemistry that leads to the formation of oxidized reaction products, some of which are toxic or irritating. Indoor exposures are also responsible for 70% of cumulative exposure to a wide range of organic hazardous air pollutants (typically volatile organic compounds or VOCs). Indoor controls are a potential, but largely unexplored, strategy to reduce population exposures to ozone and its reaction products, as well as to organic hazardous air pollutants.

Objective: This study will explore the use of zero energy air purification building materials (e.g., wall materials) for substantially reducing population exposures to ozone, ozone reaction products, and organic hazardous air pollutants. If successful, this novel approach to exposure reduction could substantially reduce people's exposures from both indoor and outdoor emissions, when source controls do not exist or are insufficient to reduce pollutant levels below levels of health concern.

Proposed funding level: \$254,205

Emissions Reductions

Context

Over the past four decades, ARB's emissions reductions strategies have yielded many improvements in air quality. For example, since the 1970's, aggregate tailpipe emissions of CO from on-road vehicles have been reduced by nearly 90%, and emissions of NO_x have been reduced by nearly one-half, despite substantial population growth and a more than doubling of vehicle-miles-travelled. However, California's topography and meteorology, compounded by continued population growth and a warming climate, render it vulnerable to poor air quality. Much of the State still struggles to meet air quality standards for ozone and particulate matter (PM). Attaining air quality standards that protect public health rests on the best possible science to guide effective planning and implementation of emissions reductions strategies. In particular, meeting the U.S. EPA's current PM_{2.5} standards will require that the State's planning and implementation strategies are informed by accurate emissions inventories and partitioning models of primary PM as well as improved models of secondary aerosol formation processes and transport dynamics.

Policy Drivers

- Development of emission targets and State Implementation Plans for ozone.
- Development of emission targets and State Implementation Plans for PM.
- Improved inventory estimates of conventional air pollutants and greenhouse gases (GHG).

Research Themes

- *Agriculture*: Criteria pollutant and GHG emissions from several agricultural sources, such as VOC emissions from dairy silages and nitrous oxide from manure management, need to be developed or refined to support decision-making by the Board. Research projects will be crafted to support improvements to the inventory as well as identification and development of best practices for reducing emissions.
- *Vehicular emissions reductions*: Near-term emissions reductions with the current vehicle fleet are possible through improved operations and management. These strategies will complement existing rules requiring progressively cleaner heavy-duty diesel engines for the California fleet, and will reduce emissions of greenhouse gases as well as conserve energy.
- *Atmospheric chemistry*: Continued progress in reducing Californians' exposures to air pollution requires resolving the chemical and physical mechanisms responsible for transformation of emissions to ambient concentrations. Priority research gaps include investigation of atmospheric chemistry of particles, including mechanisms for formation of reactive oxygen species, aerosol partitioning and implications for PM concentrations, and quantifying the ammonia slip and eventual by-products associated with selective catalytic reduction for NO_x control;
- *Emissions inventory*: To optimize the development of cost-effective strategies for protecting public health, emissions inventories must be complete, up-to-date, and accurate. Current research needs include refinement of the emissions inventory associated with vehicular sulfate emissions, in-use tailpipe PM emissions, and organic aerosols; as well as improving ARB's source apportionment of the methane

emissions inventory. Due to its relatively short atmospheric lifetime coupled with strong climate forcing properties, ARB recognizes the potential for cost-effective, near-term, substantial climate benefits from reducing methane emissions.

- *Cal/Nex*: In the summer of 2010, a large-scale multi-agency field study was conducted in California to better understand the emissions, transport, and transformation of conventional and climate change air pollutants. To leverage the results of this field work for maximum policy benefit requires a timely analysis and synthesis of the very large dataset collected.

Recommended for Funding

Agriculture

Characterization and mitigation of volatile organic compound emissions from dairy silage sources

Problem: Dairies are a major source of volatile organic compound (VOC) emissions in California and published studies suggest dairy cow feed or silage is an important factor in these emissions. However, the impact of silage on the magnitude and nature of VOC emissions is not well understood.

Objectives: This project will: (1) characterize silage production and management practices in California dairies; (2) evaluate effects of different ensilage practices on VOC emissions; (3) determine the potential for producing VOC's (in particular alcohol and aldehydes) emissions from different silages; and (4) delineate "best practices" for reducing or preventing the generation of alcohols and aldehydes during the ensiling process and consequently reducing their emissions.

Proposed funding level: \$300,000

Developing, validating and implementing a process modeling system for California agriculture greenhouse gas inventories

Problem: Despite their significant contribution to livestock GHG emissions, nitrous oxide (N₂O) emissions were excluded from the California Climate Action Registry's (CCAR's) livestock project reporting protocol, which was developed to support manure management, one of ARB's AB32 Early Action measures. CCAR anticipates expanding the protocol to include GHG reductions beyond methane capture and destruction from biogas systems.

Objectives: Project objectives include: (1) expansion of existing field measurements of N₂O emissions from major sources in California's dairies, (2) further testing of UCD's Manure-DNDC model to quantify model uncertainties, (3) assessment using full process model versus detailed, regional/soil specific emission factors for estimating both baseline and project N₂O emissions from manure management, and (4) work with CCAR, ARB, Western United Dairymen, Sustainable Conservation, the San Joaquin Valley Air Pollution Control District, and an advisory panel to deliver an updated livestock reporting protocol.

Proposed funding level: \$300,000

Vehicular Emissions Reductions

Investigation of Combined Aerodynamic Modifications to Reduce Emissions from the Current Heavy Duty Fleet

Problem: ARB's recently adopted tractor-trailer GHG rule requires that new and existing long-haul box-type trailers, as well as the tractors that pull them, be equipped with U.S. EPA Smartway-approved aerodynamic technology. However, little work has been done to investigate and quantify the benefits from combinations of multiple devices used simultaneously..

Objective: The proposed research will develop an evaluation protocol as well as test aerodynamic devices in multiple combinations on multiple platforms for increased reductions of greenhouse gases from on-highway trucks. Research results research will support innovative GHG emissions reductions and fuel-saving strategies that could be implemented with California's current heavy duty fleet.

Proposed funding level: \$300,000

Atmospheric Chemistry

Probing the intrinsic ability of particles to generate reactive oxygen species

Problem: Oxidative stress caused by reactive oxygen species (ROS) is a leading hypothesis for the mechanism by which particulate pollution contributes to a range of illnesses, including asthma and cardiovascular mortality. ROS are generated within the body in response to inhalation of PM, but the "exogenous" ability of the particles themselves to generate ROS may also be important.

Objectives: This research will: (1) determine the strength of reactive oxygen species (ROS) production intrinsic in ambient particles, (2) probe sources and relative strengths of ROS production via (speciated) transition metals and quinones, (3) probe the balance between H_2O_2 and OH and the underlying mechanism(s) of ROS generation, and (4) clarify the sources of quinones in particles.

Proposed funding level: \$260,000

Understanding primary organic aerosol volatility at atmospherically realistic concentrations for SIP analysis

Problem: Details of primary organic aerosol partitioning must be understood to predict the benefits of emissions control programs contained in the SIP as well as the impact of climate change on atmospheric organic aerosol pollution. Recent emissions tests have determined that primary organic aerosol generated from combustion sources behaves like a series of semi-volatile compounds when particulate phase concentrations range between $100 \mu\text{g}/\text{m}^3$ and $10,000 \mu\text{g}/\text{m}^3$.

Objective: The study will identify the dominant partitioning mechanism for primary organic aerosol emitted from diesel-powered and gasoline-powered vehicles at atmospherically realistic concentrations in the ranging from 5 to $30 \mu\text{g}/\text{m}^3$. Results will provide input for regional airshed models that seek to predict changes to ambient organic aerosol concentrations in the presence of emissions control programs and/or climate change.

Proposed funding level: \$300,000