REVISED DRAFT REPORT ON THE JUNE 8, 2011 ADVISORY COUNCIL MEETING ON ULTRAFINE PARTICULES: SOURCES AND CHARACTERISTICS FOR DISCUSSION BY THE ADVISORY COUNCIL AT THE SEPTEMBER 14, 2011 MEETING

SUMMARY

The following presentations were made at the June 8, 2011 Advisory Council meeting on Ultrafine Particles: Sources and Characteristics:

1. ***Mobile Source Ultrafine Particle Emissions: Past, Present and Future*** by Barbara Zielinska, Ph.D., Research Professor, Desert Research Institute, Division of Atmospheric Sciences, Reno, Nevada and Director, Organic Analytical Laboratory, DRI. Dr. Zielinska has been working in the field of organic analysis for over 30 years. She has extensive experience in development of measurement methods for organic compounds in both gas and particle phases in ambient air. She has also developed analytical methods for identifying biologically active compounds in primary and secondary particulate organic matter, kinetics, and products of gas-phase reactions. She has published numerous articles on emissions sources of organics in the gas and particle phases, including leading edge work in diesel particulate matter emissions and secondary particle formation. She has served on the US EPA Clean Air Scientific Advisory Council (CASAC), which provides scientific guidance to Congress and she is currently a member of the CASAC Ambient Air Monitoring and Methods Subcommittee. She earned her M.Sc. in Chemistry at the Technical University of Lodz, Poland and her Ph.D. in Chemistry from the Polish Academy of Sciences.

2. ***Physical, Chemical and Toxicological Properties of Ambient Ultrafine Particles and their Sources*** by Anthony Wexler, Ph.D., Professor, Mechanical and Aerospace Engineering, Civil and Environmental Engineering and Land, Air and Water Resources, UC Davis and Director, Air Quality Research Center, Crocker Nuclear Laboratory and EPA's San Joaquin Valley Aerosol Health Effects Research Center, UC Davis. Dr. Wexler has worked on the atmospheric transport and transformation of airborne particles for over 20 years. Currently, he is investigating how early childhood exposure may lead to lung function decrements, where particles are deposited in airways, the thermodynamic properties of organic and inorganic compounds in the atmosphere, ion mobility spectrometry for aerosol chemical composition analysis, and source-oriented sampling of ambient particles. Dr. Wexler has developed new equipment for analyzing nanoparticles in air and has participated in multiple US EPA projects to measure air quality impacts in selected cities, including Pittsburgh, Pa., Houston, TX, and Fresno, CA. He earned his B.S. in Engineering Physics at UC Berkeley, an M.S. in Mechanical Engineering at the Massachusetts Institute of Technology, and Ph.D. in Mechanical Engineering at California Institute of Technology.

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DISCUSSION MEETING

At the July 13, 2011 meeting, the Council discussed the presentations, materials received at the June 8, 2011 meeting, and the draft report on that meeting. The revised draft report will be discussed and finalized at the September 14, 2100 meeting.

KEY POINTS

Dr. Barbara Zielinska

- New diesels (2007 and newer) with filters have such low mass PM emissions, i.e., 99% lower than the 1998 standard, as well as lower particle counts, that they over achieved the 2007 emissions standard. Diesels with retrofit traps also have low PM emissions. NO_x controls were also implemented in 2010 diesels.
- Old, un-retrofitted diesels emit 10 times as much PAH as gasoline engines.
- Gasoline engines that burn lubricating oil are gross polluters and are thus significant sources of UFP. UFP emissions attributable to lube oil include: the oil itself, oil additives (e.g., ZDDP, sulfur compounds), and PAHs. Changing lube oil frequently reduces the potential to emit PAHs from these vehicles.
- Standards or regulations should focus on emission magnitudes (i.e., numbers of UFP > 23 nm), as is the European approach, rather than on an Ambient Air Quality Standard (AAQS).
- Understanding the state (i.e., gas, liquid, solid) of the UFP is challenging, as ambient temperature affects the state, and particles are dynamic and change in state and size (i.e., grow or shrink) over time, space, and temperature.

Dr. Anthony Wexler

- Exposure of children to UFP and ozone is a concern, because their lungs are still developing. Rats exposed to ozone showed measureable and significant reductions in lung function, while those exposed only to PM did not show the same results. While we were not given the concentrations or the nature of the PM that the rats were exposed to, test ozone levels were 500 ppb, i.e., five times the AAQS.
- Exposure to UFP that occurs on freeways, in road tunnels, and near freeway is most important and potentially harmful to health because UFP count is markedly higher in these areas.
- Most lubricating oil comes out of tail pipes volatilized or as unburned and unhealthy semi-volatile organic carbon (OC).
- The methodology to trace the source of PM by elemental analysis and time sequence sampling that is used in field research studies is expensive and complicated.

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EMERGING ISSUES FROM THE ADVISORY COUNCIL

1. BAAQMD programs to remove old vehicles (both gasoline and diesel) via TFCA funds are effective in targeting significant PM sources. Targeting gross polluters (i.e., lube oil burners) also is efficient.

2. The state (i.e., gas, liquid, solid) of the UFP changes as it exits the tailpipe, migrates along the road way, and drifts away from the roadway. Ambient temperature affects the state, and particles are dynamic and change physical state and size (i.e., grow or shrink) over time, based on changes in the temperature, pressure and humidity.

3. UFP emissions standards (as particle counts) are preferable to AAQS (as concentration).

4. Observations show that ultrafine PM is significantly high near freeways relative to background. Potential health impacts of ultrafine PM on near-freeway receptors are expected to vary depending on factors such as the use of nearby facilities (e.g., long or short term exposures), sensitivity of receptors (e.g., young, old, asthmatics, sick), and environmental factors (e.g. prevailing winds). New development projects within this zone need to be monitored and reviewed closely, depending on the projected use of such facilities and on the use of the facility by sensitive populations. The Air District is working with the City/County of San Francisco and City of San Jose to develop Community Risk Reduction Plans that can serve as model policies for reducing exposure to ultrafine PM.

5. The Advisory Council would like to review the District's pending ambient monitoring for UFP in light of recent information provided to the Council. Questions include: How does the program integrate with the District's ongoing modeling on the 4 and 1 km grid-cell scales? Is the purpose of the monitoring to determine population exposure to UFP or to describe emission sources (i.e., freeways)? We noted in our May 11 report that the size distribution of particles emitted by diesel engines is affected by PM emissions control systems. Where significant diesel PM mass reductions have occurred in highly impacted areas, such as the Port of Oakland, studies are needed to evaluate potential increases of UFP concentrations and impacts on nearby residents. (*We asked the speakers their opinions on the issue. Both speakers said they had seen this study but it has not been repeatable and other studies refute it.*)

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ADVISORY COUNCIL RECOMMENDATIONS

The following Advisory Council recommendations to the Board are based on the above presentations and on subsequent discussions among Advisory Council members. These recommendations are made with the knowledge that further advances on measurements, physical state, and health effects will be made. We encourage the Air District to:

1. Continue efforts to remove or retrofit older diesel vehicles (via the TFCA program) and to remove grossly polluting, oil burning gasoline automobiles.

2. Request BAR to modify the SMOG check program to identify vehicles that are lube oil burners, so that they can be targeted for repair or removal.

3. Collaborate with BAR to develop recommendations on how to reduce UFP emissions from lube oil (re frequency change, synthetic or non-synthetic oil), and publicize this information on the Air District website and through other means.

4. Develop recommendations concerning the mitigation for existing sites and future location of schools, day care centers, athletic fields, and other places congregating children and other sensitive receptors within 300 meters of highways and major roadways. Impacts on the elderly (in homes, housing, and care facilities) need to also be considered. Meteorology (especially prevailing wind directions) needs to be considered. Explore potential mitigation measures for both future and existing near-roadway facilities.

5. Evaluate the potential unintended consequences concerning UFP issues, e.g., massive use of HVAC to reduce indoor UFP may result in increased greenhouse gas emissions from electric power plants. The amount of energy required to filter air to mitigate UFP should be determined separate from that needed for heating or cooling in order to affect policy.

6. Monitor the European standard for UFP and support, where appropriate, the development of an ultrafine particle standard for motor vehicle emissions in California which includes semi-volatile organics.

7. Develop list of short term and long term mitigation strategies to reduce near roadway traffic exposures in new developments, as well as among existing populations in high impact areas.

Note that the Advisory Council is interested in staying informed on the District's plans for UFP monitoring and modeling.

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GLOSSARY

AAQS: Ambient Air Quality Standards, set by the US EPA and California Air Resources Board.

BAR: Bureau of Automotive Repair, a state agency responsible for coordinating the state's vehicle emissions testing program.

EC: Elemental Carbon, a product of combustion of petroleum seen as black soot or smoke.

HVAC: Heating and Ventilation Air Conditioning, systems used to cool or warm air within buildings.

OC: Organic Carbon, a by-product of combustion of petroleum generally more reactive and toxic than elemental carbon. OC may be laced with other more toxic hydrocarbons.

DOC: Diesel Oxidation Catalyst, a device installed to destroy, by catalytic reaction,, PM generated by diesel engines, generally less efficient and less costly than DPFs.

DPF: Diesel Particulate Filter, a device installed on the exhaust systems of diesel engines to capture diesel engine generated PM, generally 90+ percent effective in reducing PM emissions.

PAHs: Poly Aromatic Hydrocarbons, highly toxic organic compounds.

PM: Particulate Matter with no size characterization.

PM2.5: Particulate Matter of a size less than or equal to 2.5 microns.

TFCA: Transportation Fund for Clean Air, a BAAQMD grant program used to replace, retrofit, or repair older, dirtier engines (usually diesel)

UFP: Ultra Fine Particulate matter in size less than 0.1 microns or 100 nanometers. This is considerably smaller than PM2.5.

ZDDP: an exotic zinc compound used in lubricating oil to enhance lubricating properties.

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