BAY AREA
AIR QUALITY
MANAGEMENT
DISTRICT

ADVISORY COUNCIL MEETING

WEDNESDAY
JUNE 13, 2012
9:00 A.M.

7TH FLOOR BOARD ROOM
939 ELLIS STREET
SAN FRANCISCO, CA 94109

AGENDA

CALL TO ORDER

Opening Comments — Stan Hayes, Chairperson
Roll Call — Clerk

PUBLIC COMMENT PERIOD

Public Comment on Non-Agenda Items, Pursuant to Government Code Section 54954.3. *The public has the opportunity to speak on any agenda item. All agendas for Advisory Council meetings are posted at the District, 939 Ellis Street, San Francisco, at least 72 hours before a meeting. At the beginning of the meeting, an opportunity is also provided for the public to speak on any subject within the Council's purview. Speakers are limited to three minutes each.*

CONSENT CALENDAR

1. Approval of Minutes of the May 9, 2012 Advisory Council meeting.

DISCUSSION

2. Discussion of draft report on the Advisory Council's May 9, 2012 meeting.

The Advisory Council will discuss the draft report on the May 9, 2012 meeting on Ultrafine Particles: Exposure and Assessment with Air District staff.

OTHER BUSINESS

3. Council Member Comments/Other Business
Council Members may make a brief announcement, provide a reference to staff about factual information, or ask questions about subsequent meetings.

4. Time and Place of Next Meeting

   Wednesday, July 11, 2012, at 9:00 a.m. at 939 Ellis Street, San Francisco, CA 94109.

5. Adjournment

CONTACT EXECUTIVE OFFICE - 939 ELLIS STREET SF, CA 94109

(415) 749-5130
FAX: (415) 928-8560
BAAQMD homepage:
www.baaqmd.gov

- To submit written comments on an agenda item in advance of the meeting.
- To request, in advance of the meeting, to be placed on the list to testify on an agenda item.
- To request special accommodations for those persons with disabilities notification to the Clerk's Office should be given in a timely manner, so that arrangements can be made accordingly.
- Any writing relating to an open session item on this Agenda that is distributed to all, or a majority of all, members of the body to which this Agenda relates shall be made available at the District's offices at 939 Ellis Street, San Francisco, CA 94109, at the time such writing is made available to all, or a majority of all, members of that body. Such writing(s) may also be posted on the District's website (www.baaqmd.gov) at that time.

BAY AREA AIR QUALITY MANAGEMENT DISTRICT
939 ELLIS STREET, SAN FRANCISCO, CALIFORNIA 94109
(415) 771-6000

EXECUTIVE OFFICE:
MONTHLY CALENDAR OF DISTRICT MEETINGS

JUNE 2012

TYPE OF MEETING	DAY	DATE	TIME	ROOM
Board of Directors Regular Meeting *(Meets 1st & 3rd Wednesday of each Month)*	**Wednesday**	**6**	**9:45 a.m.**	**Board Room**
Advisory Council Regular Meeting *(Meets 2nd Wednesday each Month)*	**Wednesday**	**13**	**9:00 a.m.**	**Board Room**
Board of Directors Executive Committee *(Meets 3rd Monday of each Month* **- CANCELLED**	**Monday**	**18**	**9:30 a.m.**	**4th Floor Conf. Room**
Board of Directors Regular Meeting *(Meets 1st & 3rd Wednesday of each Month* **- CANCELLED**	**Wednesday**	**20**	**9:45 a.m.**	**Board Room**
Board of Directors Public Outreach Committee *(Meets Quarterly at the Call of the Chair)* **- CANCELLED**	**Thursday**	**21**	**9:30 a.m.**	**4th Floor Conf. Room**
Board of Directors Budget & Finance Committee *(Meets the 4th Wednesday Each Month)*- **CANCELLED**	**Wednesday**	**27**	**9:30 a.m.**	**4th Floor Conf. Room**
Board of Directors Mobile Source Committee *(Meets 4th Thursday each Month)*	**Thursday**	**28**	**9:30 a.m.**	**4th Floor Conf. Room**

JULY 2012

TYPE OF MEETING	DAY	DATE	TIME	ROOM
Board of Directors Regular Meeting *(Meets 1st & 3rd Wednesday of each Month)* **- CANCELLED**	**Wednesday**	**4**	**9:45 a.m.**	**Board Room**
Advisory Council Regular Meeting *(Meets 2nd Wednesday each Month)*	**Wednesday**	**11**	**9:00 a.m.**	**Board Room**
Special Meeting of the Board of Directors *(Meets 1st & 3rd Wednesday of each Month)*	**Wednesday**	**11**	**1:30 p.m.**	**Meeting Location:** **ConocoPhillips** **1380 San Pablo Avenue** **Rodeo, CA 94572** **Tour Location:** **ConocoPhillips** **1380 San Pablo Avenue** **Rodeo, CA 94572**

July 2012 Calendar Continued on Next Page

JULY 2012

TYPE OF MEETING	DAY	DATE	TIME	ROOM
Board of Directors Executive Committee *(Meets 3rd Monday of each Month)*- **CANCELLED**	**Monday**	**16**	**9:30 a.m.**	**4th Floor Conf. Room**
Board of Directors Stationary Source Committee *(Meets the 3rd Monday Every Other Month)*	**Monday**	**16**	**10:30 a.m.**	**4th Floor Conf. Room**
Board of Directors Regular Meeting *(Meets 1st & 3rd Wednesday of each Month)* **- CANCELLED**	**Wednesday**	**18**	**9:45 a.m.**	**Board Room**
Board of Directors Public Outreach Committee *(Meets Quarterly at the Call of the Chair)*	**Thursday**	**19**	**9:30 a.m.**	**4th Floor Conf. Room**
Board of Directors Personnel Committee ***(Meets at the Call of the Chair)***	**Monday**	**23**	**9:30 a.m.**	**4th Floor Conf. Room**
Board of Directors Budget & Finance Committee *(Meets the 4th Wednesday Each Month)*- **CANCELLED**	**Wednesday**	**25**	**9:30 a.m.**	**4th Floor Conf. Room**
Board of Directors Mobile Source Committee *(Meets 4th Thursday each Month)*	**Thursday**	**26**	**9:30 a.m.**	**4th Floor Conf. Room**

AUGUST 2012

TYPE OF MEETING	DAY	DATE	TIME	ROOM
Board of Directors Regular Meeting *(Meets 1st & 3rd Wednesday of each Month)*	**Wednesday**	**1**	**9:45 a.m.**	**Board Room**
Board of Directors Regular Meeting *(Meets 1st & 3rd Wednesday of each Month)*	**Wednesday**	**15**	**9:45 a.m.**	**Board Room**
Board of Directors Executive Committee *(Meets 3rd Monday of each Month* **- CANCELLED**	**Monday**	**20**	**9:30 a.m.**	**4th Floor Conf. Room**
Board of Directors Budget & Finance Committee *(Meets the 4th Wednesday Each Month)*	**Wednesday**	**22**	**9:30 a.m.**	**4th Floor Conf. Room**
Board of Directors Mobile Source Committee *(Meets 4th Thursday each Month)*	**Thursday**	**23**	**9:30 a.m.**	**4th Floor Conf. Room**

BAY AREA AIR QUALITY MANAGEMENT DISTRICT
Memorandum

To: Chairperson Stan Hayes and
Members of the Advisory Council

From: Jack P. Broadbent
Executive Officer/APCO

Date: May 29, 2012

Re: Advisory Council's Draft Meeting Minutes of May 9, 2012

RECOMMENDED ACTION:

Approve attached draft minutes of the Regular Advisory Council's meeting of May 9, 2012.

DISCUSSION

Attached for your review and approval are the draft minutes of the May 9, 2012 Advisory Council meeting.

Respectfully submitted,

Jack P. Broadbent
Executive Officer/APCO

Prepared by: Sean Gallagher
Reviewed by: Jennifer C. Cooper

Attachment

AGENDA: 1

Bay Area Air Quality Management District
939 Ellis Street
San Francisco, CA 94109
(415) 749-5000

DRAFT MINUTES

Advisory Council Regular Meeting
9:00 a.m., Wednesday, May 9, 2012

CALL TO ORDER – ROLL CALL

Chairperson Stan Hayes called the meeting to order at 9:08 a.m. and introduced new Member Kathryn Lyddan. Member Lyddan made introductory remarks to the Council.

Present:	Chairperson Stan Hayes; Vice Chairperson Robert Bornstein, Ph.D.; Secretary Sam Altshuler, P.E.; and Council Members Jennifer Bard, Benjamin Bolles, Jeffrey Bramlett, Harold Brazil, Jonathan Cherry, John Holtzclaw, Ph.D., Gary Lucks, J.D., Kathryn Lyddan, Jane Martin, Dr.P.H., Estes Al Phillips, Jessica Range, Dorothy Vura-Weis, M.D., M.P.H., and Murray Wood.
Absent:	Council Members Louise Bedsworth, Ph.D., Kraig Kurucz and Liza Lutzker.
Also Present:	None.

PUBLIC COMMENT PERIOD

None.

CONSENT CALENDAR

1. Approval of Minutes of the April 11, 2012, Advisory Council Regular Meeting

Member Bornstein made a motion to approve the minutes of April 11, 2012. Member Holtzclaw seconded the motion; unanimously approved without objection with Member Altshuler abstaining.

RECOGNITION

2. Recognition of Outgoing Advisory Council Member

Chairperson Hayes, on behalf of the Council, recognized former member Kenneth Blonski and presented a token of appreciation for his service. Chief Blonski addressed the Council.

PRESENTATION: ULTRAFINE PARTICLES

3. Ultrafine Particles: Exposure Assessment

A. Indoor Exposure to Particles from Cooking, Cleaning and Smoking
Lynn M. Hildemann, Ph.D., Associate Professor
Civil and Environmental Engineering
Stanford University

Jean Roggenkamp, Deputy Air Pollution Control Officer, introduced Lynn M. Hildemann, Ph.D., Associate Professor, Civil and Environmental Engineering, Stanford University, and provided a brief description of her background.

Dr. Hildemann gave a presentation entitled, "Indoor Exposure to Particles from Cooking, Cleaning and Smoking" (a copy of which is available on the website of the Bay Area Air Quality Management District at http://www.baaqmd.gov), with supplemental comments from and discussion with the Council as follows:

Dr. Hildemann mentioned, regarding slide 14, Oct 19 am Cooking Bacon, the peak marked "??" occurred prior to cooking bacon but after the burner was turned on and that initially it was thought to be emissions from residue accumulated while in storage until it was repeated in later experiments on the same burner.

Dr. Hildemann noted, regarding slide 16, a table regarding source and source emission rate, that the bacon is normalized for one strip rather than a typical portion, that the measurements are lower bound because the measurement device is incapable of detecting all ultrafine particulate matter (UFP) and fresh emissions will likely have much higher UFP compared with later emissions that coagulate and avoid categorization as UFP, and when reviewing the emission rate per minute, one should note that the sources listed take different amounts of time to cook.

Dr. Hildemann added, regarding slide 19, Average Exposures to Second-Hand Smoke (SHS) (ug/m^3 $PM_{2.5}$), that the results for test subject VAB were attributed to how the air in the room was drifting.

Council Comments:

Member Holtzclaw asked what the source of ozone (O_3) was in the cleaning product equation. Dr. Hildemann responded that it is mostly penetration from outdoors. Member Holtzclaw asked if cleaning products might be a source. Dr. Hildemann responded that there is some potential for the indoor generation of O_3, such as photocopiers or a now banned Sharper Image product, but it is mostly from outdoors. Member Holtzclaw replied that distance from a source makes a notably significant difference.

Member Bornstein noted the presence of Dr. Wayne Ott in the presentation photographs and the pre-cooking peak in emissions is an interesting potential topic for future research. Dr. Hildemann

responded that it would be interesting to quantify emissions from the burner. Member Bornstein asked if the rooms were ventilated. Dr. Hildemann responded that during cooking the ventilation was constant with small variances that were factored in. Member Bornstein asked if the overhead vent was on. Dr. Hildemann responded that it was not, as it has been her experience that most people do not use the fan because of the noise level. Member Bolles suggested that most residences in San Francisco do not have the vent at all and those that do often vent back into the room.

Member Vura-Weis asked if the introductions of O_3 were at levels similar to typical indoor conditions. Dr. Hildemann responded that she did not conduct the experiment in question but was informed that correlation was the goal, not recreating a typical environment. William W. Nazaroff, Ph.D., Daniel Tellep Distinguished Professor, Energy, Civil Infrastructure and Climate, Civil and Environmental Engineering, University of California, Berkeley, interjected that he too has worked on this topic and suggested that indoor levels are generally one-third of outdoor ambient levels and are levels fully capable of generating the exampled nucleation events. Member Vura-Weis asked if the information in the graphs is probably typical to what is found in people's homes. Dr. Hildemann responded that there is certainly the potential but the magnitude will vary based on a number of factors such as cleaning product volume used, time of day and so on. Member Vura-Weis asked if the gas dryer results would be similar to, if not greater than, those for a gas stove. Dr. Hildemann responded that it is an interesting question and that she has not conducted experiments but, theoretically, the result would be the same under similar conditions.

Member Phillips asked for Dr. Hildemann's recommendation as it stems from the study. Dr. Hildemann responded that this is a tricky question relative to combustion sources because we all cook but otherwise suggested opening windows and leaving the kitchen after cooking and to not purchase scented cleaning products. Member Phillips said that one can move away from a cigarette smoker to reduce exposure but asked what can be done to limit exposure to other sources. Dr. Hildemann replied that there are limited options and that she is wary of recommending modifications to cleaner additives as the resulting additive may also be reactive while the product is marketed as having removed the targeted additives.

Member Altshuler stated that it is important for someone to quantify the O_3 concentration necessary to get the reported reactions. Dr. Hildemann responded that Dr. Nazaroff has done some work in the area. Member Altshuler asked, regarding slide 18, Real-time $PM_{2.5}$ Data from Scripted Activity, if the data is accurate. Dr. Hildemann responded that the data is from 5-second measurements. Member Altshuler replied that these are huge numbers. Dr. Hildemann agreed and shared her surprise with the result. Member Altshuler asked if a beta monitor was used. Dr. Hildemann responded that it was a laser particle counter. Member Altshuler replied that the device would not provide micrograms per cubic meter. Dr. Hildemann responded that this particular device does and was calibrated with filter-based samples to make sure the scaling factor is correct. Member Altshuler expressed his lack of confidence in the approach. Dr. Hildemann agreed that the typical scaling factor is inadequate and was amended so as to achieve very good agreement between the methods.

Member Altshuler suggested that the source of pre-cooking emissions may be the cast iron pan, and its embedded oils, as it heats. Dr. Hildemann responded that no pan was on the burner at the time of the emission peak.

Member Bard expressed her appreciation for the recommendation to consider a low particulate matter (PM) count to be indicative of a high UFP count and asked for any additional thoughts on the issue and for details about the factors in the traffic/cigarette comparison. Dr. Hildemann responded that all of the track/cigarette experiments were conducted on major roadways with 3,000 to 5,000 cars traveled per hour and bench locations that varied within a few meters of the roadway. Member Bard asked how the results for traffic emissions are so high in one slide and virtually non-existent in many of the others. Dr. Hildemann responded that the varied results seem to be tied to the volume of heavy-duty diesel trucks and the wind pattern.

Member Bolles asked what terpene and limonene are. Dr. Hildemann responded that they are chemicals and limonene is a natural extract from the fruit. Dr. Nazaroff interjected that limonene is a terpene principally extracted from orange peel and terpenes are used in cleaning products and air fresheners as scenting agents but also for their solvent properties. Member Bolles asked if terpenes are themselves a problem or if it is that which they attach to. Dr. Nazaroff responded that extremely high levels of terpene exposure may pose a hazard but ordinarily it is the reaction, exampled formaldehyde as a problematic byproduct of the reaction, and mentioned as an aside that not all UFP are equal in terms of their potential for harm in that solvent UFP is minimally harmful compared to substantially insoluble UFP but that further studies are recommended.

Member Lucks noted the water polluting potential of cigarette butts as they leach nicotine into the environment, noting that smoking is not just an air quality issue.

Public Comments: None.

B. Toward Understanding Ultrafine Exposures in Indoor Environments
William W. Nazaroff, Ph.D., Daniel Tellep Distinguished Professor
Energy, Civil Infrastructure and Climate
Civil and Environmental Engineering
University of California, Berkeley

Ms. Roggenkamp introduced Dr. Nazaroff and provided a brief description of his background. Dr. Nazaroff noted that his last visit to the Air District was more than 30 years prior as a student visiting the very same board room and that he is a former classmate of Dr. Hildemann.

Dr. Nazaroff gave a presentation entitled, "Toward Understanding Ultrafine Particle Exposures in Indoor Environments" (a copy of which is available on the website of the Bay Area Air Quality Management District at http://www.baaqmd.gov), with supplemental comments from and discussion with the Council as follows:

Dr. Nazaroff noted, regarding slide 6, Facilitating technology: Water-based Condensation Particle Counter (WCPC), the device used has a measurement minimum of 6 nm, instead of the 10 nm for the device used by Dr. Hildemann, and doesn't do size-resolved measurements, only total number concentration. Dr. Nazaroff added that neither device is capturing information on UFP said to be as small as 2 nm.

Dr. Nazaroff added, regarding slide 8, QA/QC: Overview, that WCPC is a very reliable instrument.

Dr. Nazaroff noted, regarding slide 15, Particle number (PN) in relation to copollutant data: Nitric oxide (NO) at H6, the toaster oven resulted in an emission peak despite being a non-combustion device and questioned whether residual food matter or an unknown aspect of the high temperature device was the cause. Dr. Nazaroff cited a study in Germany that used brand new, high temperature devices to yield high particle count readings and concluded there may a good argument for release at high temperatures as a result of only operating the device.

Dr. Nazaroff noted, regarding slide 16, Occupancy time-series data at H6, the study was set up to rely on the occupants as little as possible in the hopes of getting high compliance and the research team did daily checks to be sure that the diary data were as accurate as possible.

Dr. Nazaroff noted, regarding slide 17, Indoor proportion of outdoor particles at H6, the readings were taken when evidence suggests that indoor sources were not affecting the concentration, the intention being to show the concentration by penetration from outdoors alone.

Dr. Nazaroff noted, regarding slide 18, Characterizing indoor PN sources at H6, the difference between the data provided and that presented by Dr. Hildemann and suggested the not too drastic difference could be attributable to stronger sources or the differing measuring capacities of the devices used by each study.

Dr. Nazaroff suggested, in reference to slide 20, All houses: Relationship of PN in to PN out, that one cannot determine indoor exposure by measuring outdoor levels or, at the very least, cannot do so very well.

Dr. Nazaroff noted, regarding slide 22, Indoor proportion of outdoor particles (*f*), H1 has a very good particle filter in its HVAC system.

Dr. Nazaroff noted, regarding slide 24, Episodic emissions characterization, the results are consistent with, but somewhat higher than, Dr. Hildemann's results.

Dr. Nazaroff added, regarding slide 32, S1: PN peak from mopping (manipulation), that the manipulation phase of the experiments was not nearly as productive as hoped or as the observational monitoring phase was.

Dr. Nazaroff noted, regarding slide 33, Summary for classrooms: PN levels, that he attributed the penetration of a higher concentration while the students were present to the facts that the windows in the subject classrooms were generally open during the afternoon hours and outside sources generate more emissions during those same hours.

Dr. Nazaroff noted, regarding slide 34, Indoor proportion of outdoor particles (*f*), S3 and S5 both had ineffective filters and suggested that identifying and using the appropriate filters can help with the health of our children.

Dr. Nazaroff added, regarding slide 35, Summary for classrooms: PN exposure rates, that the higher numbers for teachers was attributed to their being present in the classroom longer.

<u>Council Comments:</u>

Member Holtzclaw said the Council previously concluded $PM_{2.5}$ is a good indicator of UFP and asked for the perspective of presenters. Dr. Nazaroff responded that data seem to suggest that it is not a good indicator; that $PM_{2.5}$ mass concentration measurements will not tell you anything meaningful about UFP concentrations and the data may actually be anti-correlated; that $PM_{2.5}$ dominate measurements such that UFP do not contribute measurably to number or mass concentration; that days with high $PM_{2.5}$ levels typically appear hazy and coincide with conditions that do not favor the formation or long-term persistence of UFP; and finally shared the expectation, typically borne out by evidence, that the two tend to be high at opposite times or days. Dr. Hildemann agreed, noted the data regarding cigarette smoke which shows a correlation is a unique exception, and suggested there is no way to guess at UFP concentrations in a highly variable environment with high $PM_{2.5}$ levels.

Member Holtzclaw asked if the implications of wood smoke and cigarette smoke are similar. Dr. Hildemann responded that there is no data yet but predicted it is not similar in that wood smoke is extraordinarily dirty and generates large numbers of particles per unit burned, cigarette smoking involves much higher combustion temperatures and better air penetration to the fuel, and speculated that UFP is lower for wood smoke. Dr. Nazaroff stated his disagreement with Dr. Hildemann, that he had experimented with cigarettes but not wood, that a key indicator is whether smoke is visible or not with visible smoke generally being composed of particles larger than a tenth of a micrometer that will contribute more $PM_{2.5}$ than UFP; suggested that wood-burning fireplaces do not burn in a way that is very complete but still there are times when very little visible smoke emits which suggests that large amounts of UFP are being generated; noted the difference in the cigarette smoke during those times when it is smoldering versus puffed; and concluded that wood smoke could be an important source of UFP exposure. Dr. Hildemann suggested that one consider the speed by which the emissions are cooled and diluted as determining how much time is available for the particles to diffuse and condense and determining, in turn, how quickly nucleation will occur; noted that smoke in a fireplace has a finite time in the chimney with gradual cooling; and said cigarette smoke is immediately and rapidly cooled leading to higher saturation levels and, therefore, is more likely to condense. Dr. Nazaroff recalled his work with smokeless ashtrays and their general ineffectiveness, with measurements lending them the nickname "smoke spreaders" because of their tendency to disburse smoke, leading to higher concentrations of UFP because no plume of particles persist for UFP to attach to. Dr. Hildemann stated there is a complex combination of factors that should take into account cooling and nearby condensation opportunities.

Public Comments: None.

PANEL DISCUSSION

4. Ultrafine Particles: Exposure Assessment

Chairperson Hayes read a list of issues and questions to frame the panel discussion, including the regulation of ozone and PM, how UFP impacts the Air District's work to develop and implement control programs regarding $PM_{2.5}$, whether or not the controls in place for $PM_{2.5}$ or ozone have the intended effect in respect to UFP, what are the high exposure sources relative to personal exposure to PM, and how does it all fit together in working to adopt the best plan to deal with all of the various emissions sources.

Dr. Hildemann asked if the Air District is looking at UFP very broadly. Chairperson Hayes responded that the Air District's look is broader yet in that it should not be isolated to UFP alone and keeping that in mind, asked what the take-home message is for the Air District from the two presentations.

Dr. Nazaroff expressed his appreciation for being invited to present on this topic because government agencies generally regulate outdoor air and their interest in air quality seems to stop around the vent intake, commended the Air District for its forward thinking engagement of this issue, and explained his lack of an immediate answer to his having previously adopted a presumption that his work will be put to use in good time without his having to exhaust himself with trying to communicate the relevance. Dr. Nazaroff suggested that the message for the Air District depends on how it views its role or responsibility; noted the value of a good/not-good practices informational campaign; stated that the school environment has a lot of problems, with exposure to outdoor pollutants in classrooms being one of them, and that filtration is a tempting solution that exists in an environment of limited funding; suggested that messages regarding the risks of combustion sources be tied to cigarette smoke as the latter is a commonly accepted health risk; and recommended the use of range hoods and improvements in their manufacture. Dr. Nazaroff exampled an apartment building in China whose range fans shared a common exhaust duct where emissions would escape from one residence to another, an issue that was easily fixed with the advent of improved technology. Dr. Nazaroff added that products with scenting agents should not be used in proximity to high concentrations of ozone, asked for greater protections for our children in schools, and urged greater distance between people and their combustion byproducts.

Dr. Hildemann stated that the average adult in California spends 89% of their time indoors so if reducing exposure is the goal then addressing indoor levels is an important factor; consideration should be made regarding UFP not all being the same from a health standpoint if one considers solubility versus insolubility; urged efforts beyond avoiding cleaners with certain additives and O_3 to suggesting changes in behavior such as cleaning during morning and night hours when O_3 levels are generally lower; and suggested opening the windows and going outside after cleaning. Dr. Nazaroff recalled a cleaning products study showing paper towels used for cleaning that are placed in interior trash bins continue to emit, suggesting that immediately storing used cleaning materials outdoors and keeping in mind that "a little is good, so more is therefore better" is not the case with cleaning products.

Member Bramlett asked Dr. Nazaroff if the presence and use of range hoods was noted in the studies. Dr. Nazaroff responded that he didn't remember that detail but recalled another study by Lawrence Berkeley National Laboratory showing range hood use may decrease exposure by as much as 50% and that better capture, exhaust systems, and fans would increase the capture rates.

Member Bramlett recalled the presentation stated most classrooms are fully ventilated by HVAC and asked if the study included recirculation/fresh air rates and whether it did or would have an impact on the results. Dr. Nazaroff apologized for his mischaracterization if any, stated that only two classrooms were mechanically ventilated and four were ventilated by door and window use, and added that the two with mechanical ventilation were not part of big building systems but rather shared their system with only three or four other rooms with moderately high exchange rates and very low-grade particle filters, one of which was improperly installed. Dr. Hildemann

noted that the ventilation rate has little effect if a subject is close to a source, the important difference between natural and mechanical ventilation systems beyond the filter is to what extent vertical mixing is promoted as another way of getting dilution in an indoor environment, and that mechanical systems often promote more vertical mixing than natural ventilation.

Dr. Vura-Weis asked for clarification whether the proportion in Dr. Nazaroff's presentation is indoor-to-outdoor or indoor-to-total. Dr. Nazaroff responded, referencing slide 17, Indoor proportion of outdoor particles at H6, that the data is meant to reveal indoor levels as a direct ratio to outdoor levels, the significance being the belief that outdoor sources are penetrating and persisting indoors in a reliable and measurable way before factoring in indoor sources.

Dr. Vura-Weis stated that the Council is trying to determine what's important to look to – mass, particle number or composition – and that the issue seems to remain outstanding. Dr. Nazaroff said that evidence thus far suggests mass matters because there are adverse health effects associated with elevated levels, that particle number is still an unknown but some early studies reveal health problems based on particle numbers independent of mass, that it may turn out that exposure to peaks in levels may matter more than the average levels, and there is a great deal of work needed on the chemical composition front but that it seems to matter along with everything else for $PM_{2.5}$. Dr. Nazaroff questioned the value of exercises to parse the characteristics out, suggested that, from a policy standpoint, $PM_{2.5}$ mass is a better indicator but the chemical composition of UFP might be more important, keeping in mind that direct toxicity is largely a non-issue, because of its low mass, but inflammatory responses are important due to the triggered cascade effect and the dangers of insoluble UFP, as it has a propensity to move through membranes and cause disruptions.

Chairperson Hayes noted his surprise at the similarity in the average levels of UFP and their similarity to the figures relative to $PM_{2.5}$. Dr. Nazaroff responded that is generally correct in mechanically ventilated commercial buildings but in residences the $PM_{2.5}$ ratio is generally higher, in the range of 70 or 80%.

Member Brazil asked if the households in Dr. Nazaroff's study were cooking essentially the same foods. Dr. Nazaroff responded that they were the foods the householders planned independently, which were noted, but the diversity was too great to include in the study. Member Brazil inquired about the proximity of the school locations to roadways and other outdoor emissions sources. Dr. Nazaroff responded that the school identities are protected under the permission process but can be found in an area from Richmond to Fremont in ordinary spaces that are neither too close to nor distant from moderately travelled roadways. Member Brazil asked if the schools were randomly chosen. Dr. Nazaroff responded that the selection was primarily driven by the ability to establish school participation and with so few sites and so many independent variables preventing reliability from a statistical point of view, it may be better to think of the experiment as six case studies.

Member Bornstein asked if the presenters would consider working together to which Dr. Hildemann responded in the negative, adding that their collaborative work is behind them. Member Bornstein asked if measurements of $PM_{2.5}$ are useful to work related to UFP, if the continued expenditure of resources by regulatory agencies to gather information relative to outdoor levels is useful and what is the recommendation to agencies in general about spending resources on UFP measurements or if agencies should wait for further developments. Dr.

Hildemann responded that spatial and temporal heterogeneity of UFP concentrations is the biggest challenge and the difficulty, from an agency's standpoint, is the question of what measurements should be taken to represent once obtained.

Member Bard asked if the presenters would recommend that the Air District expand its authority to regulating SHS and asked that they clarify their statements on wood smoke. Dr. Hildemann responded that studies on exposure in proximity to SHS in the outdoor environment and, that although persistence is not an issue, exposure levels can be comparable to what the presentation shows for an indoor environment and from that standpoint, yes, SHS can be a significant source of exposure in the outdoor environment. Dr. Nazaroff noted his lack of expertise on policy or regulatory management of these issues but stated that SHS is definitely a significant source of exposure, not just as particles but in the form of hazardous air pollutants regulated by both the state and federal governments. Dr. Nazaroff noted a paper he co-published which found that average exposure to a smoker contributes more to one's overall exposure to hazardous air pollutants than living in a polluted urban environment and is completely unattended to by air quality regulations, so one could make the case for increased regulation. Drs. Hildemann and Nazaroff agreed they really don't know the answer to the wood smoke question and would appreciate an opportunity to research it further as there are too many factors and too little work done. Dr. Hildemann noted, from personal experience, that wood smoke from a neighbor's chimney in the right conditions could be a real issue. Dr. Nazaroff added that there is plenty of evidence that wood smoke is a major contributor to the PM mass concentration levels encountered in an urban environment so he would not be surprised if it is important for UFP.

Member Martin noted the substantial occupational health hazards, namely for janitorial staff, indicated in the studies presented and asked how the results of Dr. Nazaroff's research routinely make their way to occupational health agencies or labor unions. Dr. Nazaroff repeated his earlier statement about it not being his agenda to push the application of his work, noted that occupational studies indicated that asthma incidence is second highest among those employed in the cleaning field, but whether for dust or cleaning products is unknown, and noted a National Public Radio piece regarding maintenance workers in Boston that made a connection to his work but there is a long way to go before his work is translated into action.

Member Altshuler stated that the Council has been looking at PM for 18 months but have yet to engage indoor exposure until today and the presentations were very valuable. Member Altshuler suggested that valuable recommendations can be made in the area of kitchen design improvements, including having and using a kitchen fan that does not utilize a down draft, filter replacement, avoidance of recirculating fans, and the need to implement oven ventilation, and then asked if the presenters have any additional recommendations. Dr. Nazaroff stated his agreement and suggested opening windows when cooking, regardless of range hood use, and for those with a high incidence of asthma and respiratory impairment, it would be wise to take steps to limit exposure as much as possible.

Member Altshuler cited a wood smoke study by Eric Stevenson, Director of Technical Services, that measured wood smoke particles at 200 nm, concluding there is not much evidence of UFP being present.

Chairperson Hayes thanked Drs. Hildemann and Nazaroff and explained the Council process from this point forward.

OTHER BUSINESS

5. Council Member Comments/Other Business

Chairperson Hayes and Gary Kendall, Advisory Council Liaison, asked for additional volunteers for the Council work group and listed Members Altshuler, Bramlett, Cherry, Range and Wood, with Member Cherry as the lead author, and asked that input be forwarded to the work group as soon as possible, with a final deadline of June 6, 2012.

Chairperson Hayes noted the imminent resignation of Member Bedsworth from the Council and read Member Bedsworth's resignation letter.

Member Bornstein asked what seat will be vacated with Member Bedsworth's resignation to which Mr. Kendall responded transportation.

Member Bard cited a recently issued report by the American Lung Association and invited the Council to attend a planning committee meeting at the Metropolitan Transportation Commission (MTC) regarding the sustainable communities strategy and greenhouse gas goals. Ms. Roggenkamp noted the Council's role as advisors to the Board of Directors and staff as not including the duty to represent the Air District, otherwise welcomed Member use of data gleaned from work done with the Air District, and reported that the Board of Directors has discussed the state of the sustainable communities strategy with staff from MTC and the Association of Bay Area Governments in an effort to address perceived concerns.

6. **Time and Place of Next Meeting:** Wednesday, June 13, 2012, Bay Area Air Quality Management District Office, 939 Ellis Street, San Francisco, CA 94109 at 9:00 a.m.

7. **Adjournment:** The meeting adjourned at 12:22 p.m.

Sean Gallagher
Clerk of the Boards

BAY AREA AIR QUALITY MANAGEMENT DISTRICT
Memorandum

To: Chairperson Hayes and Members
of the Advisory Council

From: Jack P. Broadbent
Executive Officer/APCO

Date: June 4, 2012

Re: Discussion of Draft Report on the Advisory Council's May 9, 2012 Meeting on Ultrafine Particles: Exposure Assessment

The attached draft report on the May 9, 2012, Advisory Council Meeting on Ultrafine Particles: Exposure Assessment was prepared by Advisory Council members Jonathan Cherry, Jessica Range, Murray Wood, Sam Altshuler, and Jeffrey Bramlett. The draft report will be discussed by the Advisory Council at its June 13, 2012 meeting.

Respectfully submitted,

Jack P. Broadbent
Executive Officer/APCO

Prepared by: Sean Gallagher
Reviewed by: Jennifer C. Cooper

Attachment

AGENDA: 2A

DRAFT REPORT ON THE MAY 9, 2012 ADVISORY COUNCIL MEETING ON ULTRAFINE PARTICULES: EXPOSURE ASSESSMENT FOR DISCUSSION BY THE ADVISORY COUNCIL AT THE JUNE 13, 2012 MEETING

SUMMARY

The following presentations were made at the May 9, 2012 Advisory Council meeting on Ultrafine Particles: Exposure Assessment:

1. ***Indoor Exposure to Particles from Cooking, Cleaning and Smoking*** by Lynn M. Hildemann, Ph.D. Dr. Hildemann is an Associate Professor at Stanford University in the Environmental Engineering and Science Program of the Department of Civil and Environmental Engineering Department. Professor Hildemann research interests include atmospheric chemistry, characterization of source emissions, dispersion modeling, and indoor air pollutants. She is currently studying the sources, chemistry and fate of organic pollutants, with a focus on aerosols. Major areas of research include investigating the sources and size distributions of indoor particulate matter (including allergens), and characterizing the uptake of water by organic aerosols. She has published more than 30 articles on her research.

2. ***Toward Understanding Ultrafine Particle Exposures in Indoor Environments*** by William W. Nazaroff, Ph.D. Dr. Nazaroff is a Professor of Engineering in the Department of Civil and Environmental Engineering at the University of California, Berkeley. Professor Nazaroff's research group studies the physics and chemistry of air pollutants in proximity to people, especially in indoor environments, in the domain of exposure science, stressing the development and application of methods to better understand mechanistically the relationship between emission sources and human exposure to pollutants. Professor Nazaroff presently serves as editor-in-chief of Indoor Air, as president of the American Association for Aerosol Research (AAAR), as president of the Academy of Fellows in the International Society of Indoor Air Quality and Climate (ISIAQ), and as a member of the California Environmental Protection Agency's Scientific Review Panel on Toxic Air Contaminants. He has published 130+ articles on his research.

DISCUSSION MEETING

At the June 13, 2012 meeting, the Council discussed the presentations and the materials received at the May 9, 2012 meeting, and the draft report on that meeting.

KEY POINTS

Dr. Lynn M. Hildemann

- Dr. Hildemann presented study results on three aspects of indoor air quality that she posed as the **greatest risks of exposure** to indoor Ultrafine Particles (UFPs; See Glossary for all acronyms): scented cleaning products, combustion sources, and proximity of human receptors to sources.

- Three **"ingredients" for high UFP exposures** are: The presence of gaseous pollutants (from combustion or chemical reactions) that want to condense, low ambient PM2.5 concentrations (so gases will form UFP rather than condensing on larger PM), and fresh UFP emissions that have not yet coagulated with larger PM.

- **Scented cleaning products**: Products containing citrus-scented limonene or other terpenes (often pine-scented) can chemically react in the presence of moderate ozone levels (from the outdoors) to form UFP. If used, these products should be used during off-ozone peaks (morning or evening), and windows should be opened and rooms vacated afterwards.

- **Indoor combustion sources** studied were clothes dryers, cigarette smoking, and cooking:

    - Clothes dryers can contribute to indoor UFP levels due to imperfect venting, especially at startup. These elevated UFP levels can persist in air for a couple hours.
    - In a study of casino air quality, particle number concentrations of UFP were more than 3 times greater in indoor smoking areas than outdoors. UFP concentrations in nonsmoking areas indoors varied greatly based on the extent to which the location was influenced by outdoor air or drift from adjoining rooms.
    - In studies of cooking various foods on an electric cooktop, UFP number concentrations were detected at levels up to 10 times greater than the ambient indoor air. UFP emissions from some foods were comparable to emissions from cigarette smoking. The hot cooktop itself when turned on generated initial UFP levels almost as high as the food. In the absence of a range hood, elevated UFP levels from food persisted for an hour or more.

- UFP exposure levels are generally correlated with **proximity to the source,** but microenvironmental factors can influence exposure levels:
    - **Air circulation patterns** in an indoor environment affect dilution levels and can have a greater effect than distance. (For example, a nonsmoker can have nearly the same exposure as a smoker, depending on position and air circulation.) In general, mechanical ventilation systems tend to more effectively promote vertical mixing and dilution of indoor air than simply opening windows.
    - In outdoor studies **comparing cigarette smoke exposure to motor vehicle emissions exposure**, subjects on the sidewalk of an arterial road within 1.5m of a smoker were exposed to much greater UFP levels while a cigarette was being smoked than from the background UFP generated by traffic. This effect decreased with distance from the smoker and can be affected by the presence of truck traffic and wind direction.

Dr. William W. Nazaroff

- Dr. Nazaroff presented results of two studies that characterized indoor UFP and co-pollutant levels in small convenience samples of typical East Bay **homes and schools**.

- Studies involved intensive monitoring and occupant surveys to characterize indoor air quality and also **quantify exposure of occupants** based on time and duration of occupancy.

- Study in non-smoking **homes** (Note: Small sample; Broad extrapolation not warranted)

    - A variety of indoor sources contributed to UFP levels, with both gas and electric cooking appliances (stoves and ovens) contributing UFPs in all cases. Other sources (though not contributing in all cases) included gas clothes dryers, gas furnaces, toasters or toaster ovens, irons, incense, and candles.
    - Approximately half the UFPs contained in outdoor air managed to enter homes. Over the course of the day and night, these outdoor-origin particles contributed ~30% of the average study resident's indoor exposure to UFPs, with the remaining 70% of daily indoor UFP exposure associated with indoor sources. The vast majority of these indoor sources were associated with peak events that occurred when the residents were at home and awake (i.e. cooking or other activities under residents' control).
    - In some cases, particle counts were actually higher upstairs away from sources, because of tendency for warm air to rise in the home.

- Study in **schools** (Note: Small sample; Broad extrapolation not warranted)

- Compared to homes, which have more indoor sources of UFP, there was not as strong a correlation of indoor occupancy to high UFP exposure (exceptions in study: cooking pancakes, mopping).
- During outdoor peak UFP periods, there was some reduction in particle counts within classrooms compared to the outside, but UFP counts in the classroom during occupied periods generally tended to fluctuate along with outdoor UFP counts. (Classroom windows tended to be open when the rooms were occupied.)
- When doors were closed and HVAC off, an average of 38% of the UFPs contained in outdoor air managed to enter the classroom. When doors/windows were open and/or HVAC on, an average of 60% of the UFPs contained in outdoor air managed to enter the classroom.
- There are other air quality issues at schools besides PM counts, but this suggests an opportunity for effective air filtration and ventilation techniques, as well as greater attention to custodial practices, to help improve air for kids at school. A more detailed cost-effectiveness evaluation of air filtration should be performed.

- Note by Advisory Council: The studies did not follow the occupants in their activities out of the home or school, so it is not possible to know how in-home or in-school exposures compared to exposure levels in other locations throughout the rest of the day (including in transit or outdoors). However, Dr. Nazaroff stated that indoor exposures tend to be the greatest concern because people tend to be indoors for most of the day.

EMERGING ISSUES FROM THE ADVISORY COUNCIL

1. It is likely that **much of a typical person's total UFP exposure occurs indoors**, since that is where most people spend their time and indoor concentrations of UFP in residential settings can in some cases be significantly higher than outdoors. (According to Dr. Hildemann, the average Californian spends 89% of their time indoors.)

2. The **apportionment of indoor and outdoor sources** of indoor UFPs can be highly variable depending on factors such as location, building type, building ventilation system, and occupant behavior.

3. In terms of **health impacts**, not all UFPs are created equal. Although science is still evolving and there is not yet enough data, it has been suggested that insoluble particles may be a greater health concern than highly soluble UFPs.

4. Similar to UFPs in outdoor environments, indoor UFPs can exhibit high **spatial and temporal variability** due to microenvironmental factors, presenting challenges to the use of traditional measurement techniques.

5. Despite these uncertainties, and although we cannot totally eliminate UFP exposure, it is possible to **mitigate exposure** from both indoor and outdoor sources through a combination of source reduction, managing proximity to sources, and effective ventilation and air filtration to reduce both ambient and episodic UFP levels.

ADVISORY COUNCIL RECOMMENDATIONS

The following Advisory Council recommendations to the Board are based on the above presentations and subsequent discussions among Advisory Council members. The Air District should:

1. Encourage **further research** on indoor UFP exposures and health effects that considers issues such as:
    a. Better define the health risks from different types of UFPs as well as different exposure levels (e.g. episodic exposures vs. average exposures).
    b. Use of a total exposure methodology (considering duration and peak levels of exposure) can help identify priorities for mitigation and public education, and help integrate research on indoor UFP exposure with research on outdoor UFP exposure. Attention should be given to existing research on occupational exposures (e.g. cleaning products) as well as exposures expected from different types of commute patterns (car, bike, mass transit).
    c. How do seasonal air quality variations associated with wood smoke and ozone affect indoor exposures to UFPs?

2. Work with regional partners to determine what types of **ventilation and filtration methods** are most effective at removing UFPs in different building types, while being energy efficient and cost effective in the Bay Area climate.
    a. The Air District should work with regional planning and public health agencies to provide uniform guidance so that those involved with designing, building, and maintaining buildings are aware of **best practices** in reducing occupant exposure to UFPs (through ventilation, high MERV value or HEPA filtration, building siting, custodial practices, etc.).
    b. Prioritize adoption of best practices for ventilation and filtration in **schools**, including the possibility of **financial incentives**.

3. Integrate information on indoor UFP sources into the Air District's **Public Education and Outreach** efforts. Concepts for integration may include awareness about individuals' ability to control their personal exposure to UFPs in the home, as well as the potential to reduce or mitigate exposures in schools, the workplace, and outdoors:
    a. Citrus and pine scented products can react with ozone in the air to form UFPs as well as formaldehyde; Encourage the use of unscented cleaning products and urge those with any degree of respiratory impairment to

avoid use of cleaning products and air fresheners with **limonene or other terpene** scenting agents; Educate those with occupational exposures to cleaning products (including domestic workers) about these ingredients; Use the right amount of cleaning products, open windows, and try to leave the room afterwards; If using such products, disposing of damp paper towels outside could cut exposure in half; Avoid using these products mid-day or other times when ozone levels are high, but be aware that even moderate ozone levels can cause these chemical reactions.

b. Build on existing awareness about the health effects of cigarette smoke to give advice about **good cooking and ventilation practices**: Turn on the ventilation hood when the stove or oven are in use; Limit the time that children with asthma or adults with lung or heart disease spend in the kitchen while cooking, and ventilate and vacate the kitchen for a while after cooking; Encourage the adoption of quieter stove hood fans and avoid use of recirculating fans; Educate the public about high UFP levels from older stoves or ovens with pilot lights.

c. **Living with a smoker** can expose you to levels of PM2.5 that exceed the AAQS. Smoking can contribute significantly to indoor or outdoor UFP concentrations.

GLOSSARY

AAQS: Ambient Air Quality Standard

HEPA: High-Efficiency Particulate Arresting

HVAC: Heating, Ventilation, and Air-Conditioning

MERV: Minimum Efficiency Reporting Value

Micrometer, or micron: One millionth of a meter; used as measure of particle diameter

nm: nanometer: One billionth of a meter; used as measure of particle diameter

PM: Particulate matter, typically PM smaller than 10 or 2.5 microns; largest $PM_{2.5}$ is 25 times larger than diameter of the largest UFP

UFP: Ultra Fine Particulate, smaller than 100 nm