Bay Area Air Quality Management District
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APPROVED MINUTES

Advisory Council Regular Meeting
9:00 a.m., Wednesday, February 9, 2011

CALL TO ORDER

Opening Comment: Chairperson Bramlett called the meeting to order at 9:00 a.m.

Oath of Office: The Clerk gave the Oath of Office to new Advisory Council Members Jonathan Cherry, AIA and Peter Chamberlin.

Roll Call: Chairperson Ken Blonski, M.S., Vice Chairperson Stan Hayes, and Council Members Sam Altshuler, Jennifer Bard, Louise Bedsworth, Ph.D., Benjamin Bolles, Jeffrey Bramlett, M.S., Harold Brazil, Peter Chamberlin, Jonathan Cherry, AIA, Alexandra Desautels, John Holtzclaw, Ph.D., Kraig Kurucz, Gary Lucks, JD, CPEA, REA I, Liza Lutzker, Jane Martin, Dr.Ph.D., Kendall Oku, Jonathan Ruel, and Dorothy Vura-Weis, M.D., M.P.H.

Absent: Secretary Robert Bornstein, Ph.D.

Introduction of New Advisory Council Members – Chairperson Blonski introduced new Advisory Council Members:

A) Jonathan Cherry, under the *Architect* category, term of office effective January 1, 2011 through December 31, 2011; and

B) Peter Chamberlin, under the *Community Planning* category, term of office, effective January 1, 2011 through December 31, 2012.

Oath of Office - The Clerk of the Boards administered the Oath of Office to new Advisory Council Members Jonathan Cherry and Peter Chamberlin.

Public Comment Period - There were no public comments.

CONSENT CALENDAR

1. Approval of Minutes of the January 12, 2011 Advisory Council Meeting:

The following amendments to the minutes of January 12, 2011 were proposed:

Page 12; replace the word, “greek model” with “GREET model”.

Page 8; replace the phrase, “physics and chemistry” with “physical chemistry”.

Council Action: Member Hayes made a motion to approve the minutes of the January 12, 2011 Advisory Council Meeting, as amended; Member Holtzclaw seconded the motion; carried unanimously without objection.

OVERVIEW: HEALTH EFFECTS VALUES

A. Health Effects Values: Ambient Air Quality Standards, Cancer Potency Factors and Reference Exposure Levels

Melanie Marty, Ph.D.
Chief, Air Toxicology and Epidemiology Branch
Office of Environmental Health Hazard Assessment (OEHHA)
California Environmental Protection Agency (EPA)

Deputy APCO Jean Roggenkamp welcomed new Council Members and provided an overview of the Advisory Council’s focus on ultrafine particles, how their health effects are analyzed, and noted that the District currently has no authority to regulate them. She welcomed Melanie Marty, Ph.D., from the California Environmental Protection Agency’s Office of Environmental Health Hazard Assessment, who will provide an overview of health effects values.

Chairperson Blonski briefly addressed meeting protocols and stated Dr. Marty is amenable to addressing questions throughout her presentation.

Dr. Marty began her presentation with an overview of Ambient Air Quality Standards (AAQS). She said she will also discuss Reference Exposure Levels (RELs) for assessing hazard from exposure to chemicals with non-cancer toxicity, and cancer potency factors for assessing risk from exposure to carcinogens. She stated AAQS are numerical standards for common air pollutants called criteria air pollutants and include particulate matter (PM), ozone, NOx, SOx, and CO. They are widely distributed, have major health impacts, and federal standards have teeth while California state standards are goals. Standard setting does not include attainment designation, cost of controls, feasibility of controls, and implementation of controls. These are addressed by separate regulatory processes.

She outlined the federal review process and the standard review process in California, presented a comparison of the size of PM10 and PM2.5 to a human hair, and said standards for PM are based on air pollution epidemiology studies which are supported by mechanistic toxicity studies in animals. A typical statistical approach is a multiple regression analysis, which is a method to test hypothesis about an association between exposures and response. Attempts have been made to explain variation in some health endpoint due to variation in pollution exposure and controlling for other factors which may also influence the endpoint.

Dr. Marty presented PM mortality epidemiology studies and noted that consistent associations were found between daily average PM10 and PM2.5 and mortality in the elderly, and now several studies in infants. Most mortality studies show statistically significant associations of between 0.5 and 2% increments in daily mortality per 10 $\mu g/m^3$ and these are supported by other types of studies.

Dr. Marty reviewed the exposure and odds ratio of PM and myocardial infarction, presented a flow chart of potential mechanisms of action from PM exposure (Slide 11), discussed studies of long-term exposure and life expectancy, and mortality risks and long-term PM exposure in the Harvard Six-Cities Study and the American Cancer Society Cohort Study. She noted that long-term exposure studies are supported by results from short-term exposure studies linking PM to:

- Mortality
- Cardiovascular and respiratory hospitalization and emergency room visits
- Worsening of asthma
- Bronchitis
- Work loss, school absenteeism
- Respiratory symptoms
- Lung function decrements

Long-term exposure also affects morbidity in children:

- Increased risk of bronchitis and chronic cough in children related to long-term exposures to PM10;
- PM exposure during pregnancy may be related to low birth weight, prematurity, and birth defects;
- Over a 4-year period, PM10, PM2.5 coarse particles, acid vapors, and NO_2 were associated with reduced lung growth in Southern California Children's Health Study.
- A number of studies associating PM (and other air pollutants) with diagnosis of asthma.

Reduced PM exposures are linked with clear health improvements, and noted that PM10 and PM2.5 range of long-term mean concentrations observed in epidemiology studies showing highest levels in California and the east coast regions. Controlled human studies of 1 to 3 hours are the lowest concentrations showing effects of lung function decrements at 0.12 ppm, increased respiratory symptoms at 0.12 ppm, increased airway resistance at 0.18 ppm, and airway inflammation at 0.20 ppm. For multi-hour exposures (at 6.6 hour exposures), they saw lung function decrements at 0.08 ppm, increased respiratory symptoms at 0.08 ppm, increased airway reactivity at 0.08 ppm, and airway inflammation at 0.08 ppm, and no effects were reported at 0.04 ppm.

She presented data collected in studies with clean air, increasing levels of ozone and measurements of forced exploratory volume in one second of individuals over time which shows a very distinct response at 0.08 and much more at 0.12 ppm. She said some individuals are particularly responsive, and others are very non-responsive.

Regarding findings from animal studies, acute responses were very similar to humans. Fibrosis is seen with repeated injury-repair cycles in monkeys, and for altered airway architecture, if infant monkeys are exposed over a lifetime, they will end up with worse lung function than airway controls.

She presented findings from epidemiologic studies and associated ambient concentrations of ozone with respiratory hospital admissions, emergency room visits, and asthma exacerbation (children) school absences, onset of asthma, reduced lung function growth, and premature death.

Dr. Marty reviewed the basis for the 1-hour standard and 8-hour standard recommendations, stating there were large changes in symptoms at 0.08 ppm. The U.S. EPA is now reviewing the federal standard for ozone at 0.06 ppm and 0.07 ppm, and there is evidence for effects at lower levels and increased concern for subpopulations including children and asthma induction. In response to a question of Mr. Ruel, Dr. Marty clarified that the 1-hour and 8-hour standards are state standards. She stated there is generally far less data on toxic air contaminants health effects than the well-studied criteria air pollutants. Usually if they do have data, it is from occupational exposures, and the emphasis tends to be on the animal toxicology literature.

In dealing with toxics, she then presented the NAS (1983) framework for risk assessment and risk management, which starts with a hazard identification, they then look at all available data on the chemical, conduct a dose response assessment to characterize the relationship between exposure to the animals and the health outcome, and characterize exposure at the District level. They combine all information to do a risk characterization to help make a decision on whether or not to control sources of the chemical.

For airborne toxics, looking at non-cancer health effects, they have Reference Exposure Levels (RELs) which are used in risk assessment. Most toxicology data is either for drugs, food additives or pesticides because extensive testing is required by federal statutes. However, she indicated there are no requirements for testing of all of the 85,000 chemicals used today in commerce unless there is an academic interested in the chemical for some reason and they conduct testing.

She described REL development in hazard identification, REL exposure durations, REL development in identifying critical toxicological endpoint, point of departure and benchmark concentrations, applying any necessary time or dosimetric adjustments and they then divide this by uncertainty factors. Time adjustments are necessary and these are adjusted using Haber's Law which is used for longer term exposures. Regarding uncertainty factors, they try to account for animal to human extrapolation which is usually a factor of 10, and they account for differences amongst individuals according to size and life stage. Two subcategories for these variability levels are toxic kinetic differences which are the process of how one's body handles the chemical, metabolism, and excretion. The other subcategory is toxic dynamic differences and how the chemical interacts with cells and tissues. This varies by age and is hard to determine because of varying targets for chemicals in infants that do not exist in adults. She noted OEHHA has increased its uncertainty factors for prototype environmental chemicals, as there are identifiable deficiencies in data and no chronic toxicity data; only sub chronic. Examples of profound differences in toxicity by age at exposure are in part, due to toxic dynamics of methyl mercury and lead, and she reviewed infant neurological damage and measureable deficits in IQ through exposure.

Dr. Marty then reviewed the example of mercury as a REL. For a chronic REL, they have human worker data through inhalation. Critical effects were all neurobehavioral. An interspecies study was not needed because they had a human study. For interspecies, they used a 3 fold default for the kinetic side of the equation, but used a 10 fold default for the dynamic side of the equation because of concerns of neurodevelopmental toxicity in infants. They ended up with a REL of 0.03 micrograms per cubic meter.

Member Bard questioned and confirmed with Mr. Stevenson that the current REL is three times higher as compared to the older one used.

Dr. Marty then discussed quantitative cancer risk assessment, stating the other part of risk assessment for toxic air contaminants generally involves carcinogens. In assessing risk, they typically express its potency as risk per unit dose. It is generally viewed as linear and having no threshold. It is based on some chemical data but also radiation data where they cannot seem to see a threshold. They make a health protective assumption that there is no threshold and some finite risk with every increment in dose. The risk management side is based on keeping risk down to an acceptable or unavoidably low level at around 10 per million per lifetime exposure.

They have two different types of data for the carcinogen dose-response assessment: human epidemiology data for chemicals that are common occupational concerns and sometimes human and animal studies for which arsenic serves as an example. She said the dose is generally in the range for public health issues, particularly arsenic, but the timescale is very long to do the studies and often the exposure is based on remembering, or data on what that person's job was, how long they were in it, and it must be reconstructed.

For animal bioassays, OEHHA looks at national toxicology program bioassays which are controlled experiments under laboratory conditions. They usually have high doses, they are expensive, and it is not quick but faster than some of the epidemiological studies. But, public health can be protected by using the animal studies. One key problem recognized is that they bring in animals already close to maturity, expose them, and the juvenile, post natal and utero-exposure periods are missed. She said the two most common models used are linearized multistage model based on the Armitage-Doll model of cancer. The second is the benchmark method which is a mathematical function with a statistical analysis of which line fits the data points the best, which is the dose response slope line. For carcinogens that damage DNA directly or indirectly, the data support the assumption low dose linearity. OEHHA's policy is that if it is a genotoxic carcinogen or if they do not know the way it produces tumors, they assume low dose linearity. For both of these cases, the cancer potency factor is the estimated slope from the effective dose for 10% tumor response down to zero. Dr. Marty then presented a figure from a benchmark dose model as an example.

OEHHA must do interspecies extrapolation if using animal data and the convention is to assume it is scaled on the third quarter power of body weight, which is similar to how people scale chemotherapeutic agents. There are other issues such as study design where assumptions must be made about tumors increasing if that exposure had continued which is based on data indicating that cancer increases with the 3^{rd} power of age. Sometimes there are tumors in multiple organs and the site must be chosen, as well as multiple studies and determination of which has the most relevance. And, sometimes they take a geometric mean if they cannot choose one estimate over another.

She noted that infants and children are especially sensitive to some toxics. For carcinogens, sometimes there are different tumor sites in rodent models where they actually looked at exposure earlier in life rather later in life. Sometimes they get the same tumor site but higher incidents of tumors. Part of the reason is that there are differences in metabolism in life stage, but also cell growth which provides targets for chemicals that interact with DNA and multiple cells dividing. Stem cells keep a body in check so they do not become a cancer; however, sometimes

carcinogens will ruin that checking. There is also differentiation--a stem cell going to what it is going to be or a process by which it can be attacked by chemicals that may make the cell turn into a cancer cell. Therefore, early life exposure is an important issue.

From rodent studies, later stages of fetal development show high sensitivity to many carcinogens. The other issue is the shelf life effect. If an infant is exposed to asbestos today, that person has many more years for cancer to manifest. They have a broad distribution and chemical specific, and they used a factor of 10 to account for early life exposure in humans when doing risk assessment of carcinogens from third trimester to age two, which she presented from Slide 62. OEHHA's risk assessment guidelines now have a ten-fold waiting factor for aged exposure from the 3rd trimester to before 2 years of age, and three-fold from 2 to less than 16 years of age based on their analyses of available rodent data. For exposure after turning 16, it is just like an adult.

Adjustment of factors then applies to lifetime risk estimates using the standard potency values, and they also recognize that puberty is a time of growth and differentiation in the reproductive organs and mammo glands. So, if a carcinogen produces tumors in those organs puberty is then a pretty sensitive window in exposure; however, they have left this open for assessments to consider this factor. In characterizing risk, cancer risk is essentially exposure times your potency, so units of exposure are generally in concentration and units of exposure are generally inverse concentrations. The general equation is Risk = y $\mu g/m^3$ x z $(\mu g/m^{3)-1}$. In accounting for infants and children, exposures must be done by age grouping including breathing rates by age.

Dr. Marty concluded her presentation by stating the risk values considered are upper confidence limit estimates based on data. OEHHA believes they are pretty health protective, they do not predict risk for a specific individual due to not knowing individual risk factors, and are meant to be applied to a population. Risk estimates for multiple carcinogenic exposures are viewed as additive.

Chairperson Blonski noted that the panel will convene once all three speakers have provided their presentation, and Ms. Roggenkamp introduced the next presentation and speaker.

B. Air Quality Impact Analysis and Health Risk Assessment
Brian Bateman
Director, Engineering Division, BAAQMD

Director of Engineering Brian Bateman said the District uses health effect values very broadly in its planning processes, CEQA guidelines, and CARE program, but his presentation focuses on regulatory programs. For Air Districts, this is about stationary sources of pollution. The District has the authority to directly regulate stationary sources which are facilities both large and small. Stationary sources are broken down into two categories: 1) how the District addresses Toxic Air Contaminants (TACs) using Health Risk Assessment (HRA) and 2) Criteria air pollutants, or Air Quality Impact Analysis (AQIA). The procedures to address both of these have similarities and a few differences, but it is important to note that the use of these types of analyses in regulatory programs is to augment technology-based requirements. Rules and regulations focus on what the technology can do, how it can best reduce emissions, and there is not explicit consideration of hitting a certain target level.

The District then looks at the residual risk left over, which is where generally these tools are used in programs. For both HRA and AQIA these use a tool known as air dispersion modeling to estimate air concentrations. These are used to validate the model and background levels.

Mr. Bateman reviewed two regulatory programs using HRA; the first focusing on proposed projects which are new or modified sources of air pollution, and the second, existing facilities. The New Source Review Program focuses on new and modified projects and when addressed through HRA, the emissions evaluated are permitted or allowable under the permit. The actual emissions would be expected to be somewhat less than that.

There are two sets of requirements; the first is Toxics Best Available Control Technology (T-BACT). They look at very low levels of risk in terms of cancer and non-cancer. If risk from a source is greater than this they must control emissions with BACT. The next step is to look at the residual risk left over after controls are applied and see what the project risk is. It could be one or more sources that constitute a project, and there are then risk limits for cancer and non-cancer.

The second requirement is the Air Toxics Hot Spots (ATHS) Program which is a state program, and it applies to existing facilities based on actual emissions. The District has an inventory program which it updated every year. Facilities report data to the District in order to determine their Toxic Air Contaminants moving forward. There is a prioritization step first to screen out those very small and not worthy of a HRA, but those that are larger must do a HRA. This is then applied to those emissions.

Two requirements that come out of this were added into the program when it was amended in 1992: 1) public notification; and 2) requiring facilities to prepare a Risk Reduction Audit plan, which must be implemented over a period of time to reduce emissions to drop risk below those significance levels.

In order to prepare HRAs in a regulatory program, a standard methodology is needed. An evolution of HRA guidelines was adopted and used by California air districts, which began in 1987 and these have been expanded and revised over time, which he reviewed.

Mr. Bateman then provided an overview of how HRAs work, how TAC emission rates are calculated by taking emissions and applying air dispersion models to be able to estimate concentrations in the ambient air in various locations, and taking concentrations and estimating human exposures and health risks. He reviewed the regulatory HRA process, stating they look at both short- and long-term emission rates and various methods to estimate emissions, all of which are put together and expressed as an emission factor. They then do the air dispersion modeling on a site specific basis. He noted the "workhorse" model is AERMOD, which is a steady-state model and uses Gaussian plume dispersion.

He reviewed source inputs to the AERMOD, such as point, area and volume sources, stating emission rates can be varied in the model by the hour of the day, month, and season. Emission release parameters define the way in which emissions are released. For stack sources, dispersion is often times affected by local buildings or structures that can cause aerodynamic downwash turbulence. These go into a process that calculates all of the parameters the model takes in.

Mr. Bateman stated in terms of meteorological inputs, raw data is put into a meteorological pre-processor, called AERMET. These come from a variety of sources and include wind speed, air direction, and cloud cover. Upper air data is taken from balloon releases. Models also can use on-site meteorological data to better characterize the local meteorology. He noted surface characteristics can also affect dispersion, which he described. The District uses another pre-processor in the case of surface characteristics called AERSURFACE, which takes 24 different categories of land cover data from the USGS and calculates surface parameters and wind direction segments. Depending on the way wind is blown, it will apply the appropriate characteristics for the hour of meteorology. What comes out thereafter in the pre-processor is the model-ready data of hourly wind speed, wind direction, temperature, lateral and vertical turbulence.

The last type of input is receptor input. Receptors are placed at locations outside of a facility's boundaries where the public may be exposed to emitted TACs. This data goes into the pre-processor and the District gets model-ready inputs which are coordinates of receptor locations and terrain and height scale tells a model whether or not it can go over a hill or around it. From these air concentrations, the District estimates human exposures and risk using the Hotspots Analysis and Reporting Program (HARP) which encompasses guidelines OEHHA develops and applies those to modeling results. Determining exposure is how much in the air gets to a person's body over a period of time, and simplifying assumptions are used which calculate exposure based on a hypothetical individual assumed to stay in one place for a considerable amount of time. There are assumptions about body weight, breathing rate, and exposure duration applied. He noted the hazard index approach mentioned in Dr. Marty's presentation is used to add the risk for pollutants that affect the same part of the body.

Certain metrics are then applied to this which look at the maximum health risk to an individual in the population, or also looks at risk to a population which then integrates risk to each individual based on the density of the population within an area. He noted there are risk metrics for chronic and acute exposures, short- and long-term exposures, metrics based on the nature of the land use, residential, off-site workers, student risks, cancer and non-cancer risks, and chronic and acute non-cancer health risks which are expressed on a hazard index approach. He said the District has detailed land use database information at a land parcel level in order to do this.

Mr. Bateman reviewed Air Quality Impact Analysis (AQIA) which is similar to HRA in many ways. The federal pre-construction air permitting program, known as a Prevention of Significant Deterioration (PSD) program, has been delegated to the District by the EPA. The goal of the program is to ensure that new stationary sources or modified sources will not increase emissions that would interfere with the attainment or maintenance of National Ambient air Quality Standards (NAAQS) or cause an exceedance of a PSD increment. There is a technology component of this program that comes into effect before modeling is done, which is BACT. This is done in two steps--an initial analysis used to determine if the source would increase the ambient concentrations by more than Significant Impact Levels (SILs), and a full analysis if the impact of the source is above the SIL, which includes accounting for concentrations from other sources.

In conclusion, Mr. Bateman presented aerial map examples of results of analyses. He displayed an example of a facility installing a new back-up diesel generator which is a common source and maximum cancer risk to an individual. He then presented an example of a facility in Berkeley

which focuses on maximum cancer risk to individuals where zoning in the area is industrial. The City provided some exemptions for zoning for live/work status which the District has categorized using residential receptors. Impacts under residential are more regulated than commercial, and therefore, this facility was subject to public notification requirements for those exposed to over a 10 in a million risk level. He also presented the same facility where the metric was the chronic hazard index.

C. Multi-Pollutant Evaluation Method for Health Benefits of Control Measures
David Burch
Principal Environmental Planner, Planning and Research Division, BAAQMD
Dr. David Fairley
Statistician, Planning and Research Division, BAAQMD

Ms. Roggenkamp introduced Principal Environmental Planner, David Burch and Statistician, Dr. David Fairley, both of whom will discuss health from a regional planning perspective, how air quality in the region might be improved, and public health from a broader regional scale. They will also present new, innovative ways this has been done in the Clean Air Plan.

Principal Environmental Planner David Burch gave the staff presentation, stating the traditional approach to air quality planning is a one pollutant type approach which is dictated by state and federal guidelines. He said when the most recent plan was put together; staff did not want to simply attain the standards, but rather thought of the ultimate outcomes when trying to attain the standards. In particular, protecting public health and climate were identified as key outcomes for the plan. The legal impetus was that the District needed to do an update to its State Ozone Plan, but this served as a good opportunity to test multi-pollutant planning.

Pollutants identified were ozone and its precursors, primary and secondary particulate matter, focus on PM2.5, key air toxics including diesel PM and "Kyoto 6" greenhouse gases. They made protecting public health an explicit focus on the plan at the regional and local scale. They performed a health burden analysis where they looked at present air quality levels, concentrations, tried to analyze the impact on public health and compare this to what the impact was in past years. In putting together the control strategy, they wanted to ensure they considered not only emission reductions per se, but also how to maximize reductions in population exposure through the control strategy. Through that effort, they created a new category of control measures called Land Use and Local Impacts Measures, with the idea that, in work with regional partners to promote focused growth and infill development, it is done in such a way to protect people who live and work in those areas.

Mr. Burch discussed the multi-pollutant planning process which has been out for 6-7 years, and said the impetus for this came out of the National Research Council's 2004 recommendations that air quality planning needs to look at air quality outcomes to protect public health, climate and eco-systems. Their recommendations also talked about the rationale for multi-pollutant planning; that different pollutants share common emission sources, precursors, they interact together in the atmosphere, and many of the control strategies or measures will reduce more than a single pollutant.

He discussed the EPA's launch of several pilot projects throughout the country and said there are no adopted multi-pollutant plans through the SIP process at this point or requirements or

guidelines issued thus far. Therefore, the District had a lot of flexibility in putting the plan together and original thinking. While there is a good rationale for such planning, it is difficult. Pollutants differ in significant ways in terms of their scale, mass, range of health effects, and a key issue as far as trade-offs is how to compare the value of reducing pollutants one against another. To address this issue, staff developed a Multi-Pollutant Evaluation Method (MPEM) to help analyze potential control measures to capture benefits across pollutants, evaluate co-benefits, look at impacts of control measures on specific public health end points, and then quantify in monetary terms the health and climate protection benefits of the control measures.

The second use of the MPEM was for a regional health burden analysis, the findings of which he said he would discuss later in the presentation. He introduced Dr. Fairley who compiled the methodology.

Statistician, Dr. David Fairley, provided an overview of the MPEM, explaining that he considers various control measures and evaluates the emission reductions made from different pollutants to eventually identify the social and health benefits of reductions and/or their increases and dis-benefits. In spite of the fact there was significant detail that went into the methodology; staff had to make some serious simplifying assumptions. Dr. Fairley said a lot of information has been done by EPA and CARB as well as academic researchers, and District staff developed a customized analysis to basically randomize the entire process to get some sense of the overall uncertainty. He presented pollutants and effects considered, said they considered cancer causing toxics, and are including the changes in Kyoto 6 greenhouse gases. Other than greenhouse gases, there are many steps to the process. Rule developers tell them how much they think the rule will change the emissions of different pollutants. They also consider secondary pollutants. Once they have a sense of how much each of these emissions changes, they needed a way to estimate what change that will cause in concentration.

He said District staff work on three dimensional Bay Area air quality models which are grid based and take emissions and estimate concentrations. To provide a sense of how much concentrations will change for each key pollutant, staff ran available models reducing each of the precursor emissions by 10%. He presented a slide of benzene concentrations from 10% reduction in emissions and another slide showing the category, emitted pollutants and ambient pollutants. He pointed out that diesel PM is carbonaceous, which are things produced by burning and it comes in in two different places when considering health effects, but they actually modeled it just as other carbonaceous PM. For each of the concentrations, there are changes. They then take what they estimate to be the population, grid it, and overlay it on top of the change in concentration which gives them a change in exposure. They took this and arrived at an average for each county, which is a weighted population of exposure.

Dr. Fairley said the next step is health effect. The District is using the results of various studies, some of which were discussed by Dr. Marty such that a given change in the concentration of a pollutant results in a change in some health end point. These have been considered very beneficial by CARB, the EPA and others.

Dr. Fairley then presented health effects included in the MPEM, noting that in order not to double count diesel, the mortality effects include lung cancer and they excluded it. However, he said there is a fraction of people who get lung cancer who do not die from it, and this is why he added it in the cancer morbidity line.

With changes or fewer cases of health effects, to put it in quantitative dollar terms, the economists use the approach of "Willingness To Pay" where they use surveys to determine how much one would pay to, for example, avoid a heart attack or going to the ER for asthma. They also can look at the cost of treatment, but this does not take into account other quality of life factors. Therefore, it is preferable to look at willingness to pay if they can find it, and he used the BENMAP program in most cases to come up with dollar values. In putting it altogether, he starts at the risk function which is a change in the risk resulting from a change in the concentration. This is multiplied by the population and the instance rate which gives the incidents of so many hearts attacks per year by County. Multiplied by the risk function will be the change in instance from the change in emission. They take that change and multiple it by a cost per case, to arrive at an estimate of the dollar benefits. For greenhouse gas, they take the number of tons reduced and multiply by 28; however, they consider the entire range of serious things that could happen with global warming as well as ranges in cost.

Mr. Burch then discussed results the District found once this was applied, as well as limitations and enhancements they can make in moving forward. In putting together the Clean Air Plan (CAP), 55 control measures in 5 categories were identified in the 2010 Control Strategy:

- Stationary sources measures (18)
  - To reduce ROG, NOX, PM, CO2, methane
- Mobile sources measures (10)
- Transportation control measures (17)
- Land use & local impacts measures (6)
  - Goods movement, ISR, CEQA, local monitoring
- Energy & climate measures (4)
  - Energy efficiency, urban heat island, tree-planting

He displayed a slight on various pollutants or precursors reviewed in the plan and the aggregate emission reductions estimated from the 55 measures combined. He noted that estimates in ammonia, SO2, air toxics and GHGs were made as well. GHGs, NOx and VOCs, in terms of raw emission reductions, are the highest. They ran one ton of reductions in each of the pollutants to see what it would show, and this arrives at a very different outcome. Both diesel PM and other types of PM jump to the top and precursors or secondary formation like ammonia and SO2 were also very high. They then combine the results into a third chart where they take the raw emission reductions where NOx, GHGs and VOCs were the highest and multiply it by the weighting factor to get the weighted emission reductions. This results in PM dominating both in diesel PM2.5, other types of PM2.5 and precursors.

Mr. Burch then presented a slide of health burden past and present analysis and outcomes. He said that 7 of the key health end points were measured from the plan and the estimated number of cases staff believes is related to air pollution in the Bay Area. Staff then conducted a "then and now" exercise, from present 2008 back to 1970 for ozone and back to 1990 for PM and air toxics data. The take-away message from the slide is pretty dramatic reduction of 50%-60%, so improvements in air quality are providing tangible benefits in terms of health outcomes. Also interesting is that they have color-coated the relative contribution of pollutants, and what dominates this is PM.

To summarize findings, improved air quality is providing tangible health benefits in the region; better air quality has added ~6 months to average Bay Area life expectancy since 1990; air quality is generally good, but air pollution still has significant impacts on public health; PM2.5 is pollutant most harmful to public health; and it is important to reduce fine PM from all sources.

Mr. Burch said outcomes from the methodology are only as good as emission reduction estimates put in at the front end. Issues of the MPEM method include:

- Accurate emission reduction estimates are important
- Emission factors lacking for some pollutants or sources
- MPEM incorporates many assumptions
- Emission reductions from control measures are geographically allocated same as emissions inventory
- The methodology assumes that people are home & outside 24/7
- Ozone & PM modeling only from peak periods
- Valuation of health effects places great weight on reducing premature mortality

He stated the MPEM does not include:

- All health impacts
- AQ benefits beyond the Bay Area
- Economic benefits re: reduced property damage, enhanced tourism, property values
- Water quality, ecosystem benefits
- Benefits related to better transportation access, improve safety, travel time savings, reduced fuel consumption

Potential MPEM Enhancement might include:

More accurate:

- Base MPEM on full-year AQ modeling
- More accurate spatial distribution of emissions reductions
- Refined exposure estimates:
  1) Perform travel/activity survey of a sample of Bay Area residents
  2) Measure pollution in micro-environments (home, car, office, school, on-street, etc.); and

On a broader scope:

- More pollutants: acrolein, PAHs
- More health effects: e.g. toxics morbidity
- Ecosystem impacts: water, species, etc
- Include benefits re: mobility, safety, noise, reduced energy use, etc.
- Incorporate new info re: differential effects of PM2.5 components: e.g., wood smoke toxicity, ultra-fine particles

In conclusion, Mr. Burch said the MPEM provides a useful tool to:

- analyze potential trade-offs
- compare benefits to costs in evaluating potential control measures
- estimate dollar value of air quality improvements
- prioritize which pollutants are most important to reduce
- MPEM results are estimates; should be used with caution

Overall conclusions reveal:

- It makes sense to use multi-pollutant approach & to focus on health outcomes
- It is important to consider benefits, as well as costs, in evaluating control measures
- Improved air quality in Bay Area provides important public health benefits
- Despite great progress, air pollution still has significant impacts on public health
- PM is the pollutant most harmful to public health

DISCUSSION

3. Health Effects Values and Use in Air District Actions

Dr. Holtzclaw asked Dr. Marty if the Bay Area has been trying to incorporate some of the toxic analyses for chemicals the EU has been analyzing ahead of the U.S. Dr. Marty said the EU has their Reach Program and is trying to compile dossiers on chemicals used in commerce. There are some issues relating to their statutes and what they can share with them. One may have to go through the U.S. EPA to get some of it, although many dossiers are going to go up to the website and anyone will be able to access them.

Dr. Holtzclaw referred to the three-quarter power of interspecies extrapolation, and asked if it is the same power for other issues such as metabolism levels, amount of food required, and standard extrapolation formula. Dr. Marty said yes; it is actually for scaling dose and based on metabolic capability. OEHHA does not use this scaling factor when looking at exposure parameters because they have data available to develop distributions of exposure, such as intake rates for breathing, and food consumption. However, it is based on metabolic capability.

Dr. Holtzclaw said one of the analyses or efforts of the San Francisco Health Department and others is to figure out in new construction how to reduce the dosage, such as building up high and being above the pollution level or filtering air. He asked if this is taken into account in determining exposures. Dr. Fairley said no; they compare the average on a specific grid and assume that people are outside, and what Mr. Bateman's staff does is a lot closer to this.

Dr. Holtzclaw referred to Table 26 and suggested rounding off the numbers when reporting weighted values.

Mr. Altshuler offered accolades to Mr. Burch and his presentation in light of news regarding a judge slowing down the AB 32 process because the ARB did not include an EIR analysis of GHG emissions control strategy. He thinks this effort will go a long way in preventing this from occurring when a group might want to sue the District for not doing an EIR. Beyond this, he voiced concern with nitrates. He questioned how big a factor they are in driving some of the PM2.5 weighted cost effects. He expressed curiosity as to whether there is current or new information that would suggest that PM nitrates are as health impactful as some of the metals in PM2.5.

Dr. Fairley replied that ammonium nitrate represents about one third of the total Bay Area PM2.5.

Dr. Marty referred to whether nitrate is one of the more potent components of PM and said most of it focuses on the metals component, elemental carbon and organic carbon. But, it appears in

areas where nitrate is a predominant portion of the PM. She said there is still the same measureable impact, so it is hard to explain.

Dr. Bedsworth questioned the range seen in the cost per ton of GHGs. Mr. Burch said staff did a literature search and arrived at a meta study from Tol, who looked at 200 studies to determine the range of potential costs and impacts related to GHGs. He recalled the values were in the range of $10 up to 75 per ton and some outlying numbers, but most in that range. One issue has to do with the discount rate applied, as the effects from GHG emissions today may not be fully felt depending on the pollutant for more than 100 years as well as the way impacts are valued 100 years from now in terms of today's dollars.

Dr. Bedsworth said the plan did a nice job of quantifying benefits. She asked if this led to doing a straight cost benefit or cost effectiveness analysis, and how did the cost of the control measures in the plan compare to the benefits quantified? Mr. Burch stated that in addition to the analyses shared today, they did a traditional calculation as if doing a conventional ozone plan. Costs and benefits varied a lot depending on the control measure. Some had many benefits that outweighed the cost by 10 to 1. There were some measures that were much closer and it was interesting to make that comparison. He thinks it is easier to quantify the costs than benefits and because of doing this for the first time they did not want to make the comparison too directly because of concerns and limitations in the methodology. Comments from regulated industries revealed that they thought it made sense to do the analysis of benefits and use it to compare the relative benefits, but they were very uncomfortable with comparing the cost and benefits.

Dr. Bedsworth questioned if there were any statutory limitations for doing a more robust benefits analyses. Ms. Roggenkamp said no requirement exists to do what the District has done as well as no restriction. They had a lot of flexibility based on their best professional sense in what should be done to move forward; however, there is also no guidance as to what should be done, and she hopes this will help the air quality field move more in that direction.

Mr. Hayes referred to Slide 27; the dollar weighted CAP Emission Reductions. He noted there are various bars to reduce PM2.5 and questioned if those were contained in the "Other PM2.5" bar. Mr. Burch said these are direct emissions of PM and this is what is driving that. Mr. Hayes said he thinks this idea of doing a multi-pollutant approach is smart and cutting edge, and hoped for even more refinement to be made.

Mr. Hayes said the conclusion, which is reinforced by the health burden past and present slide, is that overwhelmingly, PM is the issue. He said there is a temptation if this is not understood and explained to see this as virtually the sole historical and current problem. He thinks the District has invested a lot of money and effort over the years on ozone and what is a very sophisticated toxics program. All continue to be important moving forward, and he wants to be sure that as people interpret this information they do not slip into the mindset that it is all about PM and the rest is not worth worrying about.

Mr. Hayes recognized that the Council's focus will be on ultrafine particles and referred to slide 11; PM – Potential Mechanisms of Action. The multi-pollutant analysis is obviously overwhelming and seems to be a major issue. Not every piece of PM seems to be created equal which leads to the probability that there is some PM that is more troublesome. In choosing and designing control measures, understanding which are the most dangerous becomes a huge issue

for the District. And, if ultrafine particles are the reasons, understanding that is an important outcome. He said slide 11 shows there is lung inflammatory reactions and particle uptake in blood as being the principal modes of action, and he asked for Dr. Marty's thoughts about where ultrafine particles fit into this process.

Dr. Marty said there is a fair amount of research trying to determine which components are more biologically active and the key characteristics of very, very fine particles that result in a biological response. Many think surface area available for interaction was cellular components is a key to ultrafine particles and nano particles and why there may be more toxicity associated with those. She said there is concern that they do cross the capillary membrane and then they are circulating. Therefore, you not only have pulmonary inflammation which may trigger a systemic cascade, but delivery of the ultrafine or nano particle to tissues throughout the body, which is a big factor. She said there are some rodent studies looking at manganese nano particles going from the olfactory nerve endings in the nasal cavity directly into the brain. There is concern about the size and the size making those ultrafine particles and nano particles more capable of crossing membranes and getting into tissues. However, there are lots of questions in terms of the mechanism and many questions in terms of the constituents, as well. Mr. Hayes said he thinks there will be a need to think through what the appropriate measures for exposure might be, and Dr. Marty agreed.

Ms. Bard echoed Mr. Hayes' comments about not abandoning ozone and particularly looking at the impacts of climate change on ozone, increases in ozone with increased heat, and impacts with transport of ozone to other areas. She asked Mr. Bateman that in hearing from Dr. Marty about the updated RHA, the ten-fold adjustment for infants and children and three-fold adjustment for ages 2-16, she asked if the numbers from Slides 13, 14 and 15 take into account adjustments. Mr. Bateman said specific examples are not; those were done before OEHHA made changes in the guidelines. But certainly now when HRAs are done for either the Hot Spots Program or Toxics New Source Review, staff uses the asensitivity factors in estimating lifetime cancer risk for residential exposures. He said it makes a significant difference using exposure assumptions they have right now, and OEHHA is in the process of revising those. Using the ones that exist now increases the cancer risk by a factor of 1.7 lifetime cancer risk.

Ms. Bard suggested the huge differential between the impacts on infants and children and adults be communicated throughout this process. She recognized that the District has grid level data and she asked how more specific staff can be in a neighborhood by neighborhood level, the ability to analyze these with respect to cancer risk, differential health impacts, and providing that information to the public. Mr. Bateman said whenever the District makes risk estimates they make some simplifying assumptions. Generally when making individual risk estimates for lifetime, they will use whatever OEHHA methodology is at that time. In the CARE program, they focused on residential risk. Within every grid they used assumptions that someone will essentially be born in that grid and spend their whole 70 year life there. It does not really look at the age distribution of the population in that area, but this could be a refinement to it through census data.

Dr. Martin questioned if the new research on ultrafine particles calls into the question the assumption of additivity used in the HRA models. She asked if this was conservative or might the multiple pollutants be synergistic in their effect. Dr. Marty said they know from some studies in animals for toxic chemicals, at low levels of exposure the assumption of additivity seems very

reasonable and it seems to hold water at environmental level of exposure. Beyond typical environmental levels and going to higher doses, other types of interactions will come into play, including synergism where it is more than the sum of the parts, and antagonism where it is less than the sum of the parts.

Mr. Lucks referred to framework in terms of regulations today and some of the science moving forward, and confirmed with Mr. Kendall that the Council will be talking about the sources of ultrafine particles in future meetings. Regarding the relationship in tying the threads together regarding the RELs and ambient air quality standards, he asked if the REL is the no exposure level and ambient air quality standard is premised on that, and whether there are other considerations politically otherwise to change that level. Dr. Marty said the ambient air quality standards have been set in California primarily on the recommendations of OEHHA based on health. The considerations of cost and technical feasibility come after the standard is set. The same thing is true at the federal level, although the politics are different and there is more pressure on them, so they have been less health protective than California has been for the ambient air quality standards. In terms of RELs, Dr. Marty said this is not really the "no effect" level but hopefully well below it. One of the reasons someone might ask is why use uncertainty factors when setting ambient air quality standards, and she said it is because there is so much human data with large sample sizes and lots of studies, and they have much less uncertainty when looking at those data to set a number. For RELs they are dealing with much less robust data and there is a lot more uncertainty, so the need for those uncertainty factors is considerably greater. This is why there is some historical difference in approach, as well. For ozone they are already pretty close to background for ambient air quality standards, and that issue comes into play.

Mr. Bramlett said eventually, the Council is going to be asked to make recommendations in this area. He asked what they would be remising in by not commenting on. Dr. Marty said for the multi-pollutant approach, the federal government and the world health organization are going in this direction, and it is critical that this District is out ahead of the rest of the pack. She said the air districts and the ARB do these control measures and focus on one pollutant they are controlling when in fact they are controlling a lot of pollutants, which does not get taken into consideration when people are arguing about control measures.

Ms. Lutzker referred to slide 14; the residential grid map and HRS for the Berkeley facility which is directly next to the freeway and other industrial facilities. She asked how cumulative effect is taken into account. Mr. Bateman said in the Hot Spots Program, it is specifically focused on the incremental health effects from the facilities' emissions, and this is established in the statute. In terms of cumulative impacts, the District has a monitoring site just within the boundaries of the map which measures pollutants from everything. Staff can take data from it and use a similar approach based on modeled concentrations from the facility, to estimate the cumulative risk from everything. They have a good understanding of the array of pollutants and what the cancer risk is in terms of air pathway exposure to those pollutants, non-cancer risk for toxics and comparisons to air quality standards for criteria air pollutants.

Dr. Vura-Weis said she especially appreciated seeing the rating of the effects of the different pollutants. She asked about whether the Council will be hearing more about sources of non-diesel PM2.5 and whether those are from stationary sources or other sources that the District either sets the regulation or enforces regulations. She thinks this will help the Council in how to

listen in future presentations, as well. Ms. Roggenkamp said staff will definitely be looking at different kinds of sources and this is one of the reasons the subject will be brought forward and discussed together with speakers.

Dr. Fairley added that the District does not know sources of ultrafine particles but does know sources of PM2.5 and direct emissions of carbonation are wood smoke, cooking, and fossil fuel combustion in general. He said diesel is less than half of the total of fossil fuels.

Ms. Bard said in looking at PM2.5, she had read on CARB's website that 16% is contribution of total PM from diesel, and she asked if this was correct. Dr. Fairley said yes, it is 5% to 10%.

Ms. Bard recognized the very localized exposures and particularly with highway exposures near sources. She asked if the Council will be looking at more specific measurements around wood smoke pollution point sources for residential, and measuring those emissions around a house or within a neighborhood. Ms. Roggenkamp said there are some plans to do more specific monitoring in neighborhoods where there is more wood burning.

Ms. Bard said the Clean Air Act requires a margin of safety when standards are set and she asked if how this was defined when looking at protective levels for OEHHA guidelines. Dr. Marty said both the federal and state statutes require an adequate margin of safety for the ambient air quality standard and this has never been defined. Because there is a copious amount of data in humans with large sample sizes, they are trying to incorporate a margin of safety where they are pretty sure there are health effects versus what is recommended for the standard. The federal government tries to do the same thing, as well. For RELs, they do not have an equivalent type of statutory language, but they are using uncertainty factors to account for all of the things they do not know, and they are generally are working with much less data when doing an REL.

Mr. Hayes said the spatial scale of the risk around the individual facilities is much finer than that resolution spatially in the modeling that was done. He questioned the grid squares for the work done in the multi-pollutant modeling. Dr. Fairly said some of it was 4 kilometers and some was 1 kilometer. Mr. Hayes referred to Slide 14 and in each receptor point where the model has calculated a risk one can see how quickly risk falls off when moving away from the particular facility. This is certainly true of a freeway, but if a house or apartment is right along the freeway, it could be seeing substantially more concentrations of risk than the average for that grid cell. He thinks it is important to keep this in mind, and that individual risk might be substantially higher than implied by the multi-pollutant modeling.

OTHER BUSINESS

9. Council Member Comments/Other Business:

The Advisory Council thanked all speakers.

Chairperson Blonski asked that members notify him of their interest in attendance to the Air and Waste Management Conference after the meeting.

Dr. Altshuler referred to ozone, and stated he had heard on the news that Livermore recorded a one hour .15, which was quite a bit higher than in previous years. Meanwhile, the Bay Bridge toll

collection policy has changed to end free carpool passes which he said has altered commute patterns. He questioned if there was any connection between the commute policy and the ozone measures in Livermore. Mr. Stevenson said the high level of ozone was likely caused by a fire on Mt. Diablo.

Ms. Bard announced that the Heart and Lung Association has worked hard to engage organizations from around the country to sign onto a letter to President Obama and Congress members to support the Clean Air Act. She stated the Association submitted a letter with 1,800 health professionals' support and they will alert people as they move forward.

10. Time and Place of Next Meeting - 9:00 a.m., Wednesday, March 9, 2011, 939 Ellis Street San Francisco, California 94109.

11. Adjournment - The meeting adjourned at 12:04 p.m.

/S/ Lisa Harper

Lisa Harper
Clerk of the Boards