Bay Area Air Quality Management District
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APPROVED MINUTES

Advisory Council Regular Meeting
9:00 a.m., Wednesday, October 14, 2009

CALL TO ORDER

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

Roll Call: Chairperson Harold Brazil; Secretary Ken Blonski; Council Members, Jennifer Bard, Louise Bedsworth, Ph.D., Benjamin Bolles, Robert Bornstein, Ph.D., Emily Drennen, MPA, Stan Hayes, John Holtzclaw, Ph.D., Robert Huang, Ph.D., Karen Licavoli-Farnkopf, Jane Martin, Dr.Ph.H., Kendal Oku, Neal Osborne, Jonathan Ruel, Dorothy Vura-Weis, M.D., M.P.H.

Absent: Vice Chairperson Jeffrey Bramlett, Kraig Kurucz, M.S., Rosanna Lerma, Sarah Martin-Anderson, M.P.P.

Public Comment Period: There were no public comments.

Consent Calendar:

1. Approval of Minutes of the September 9, 2009 Advisory Council Meeting

Advisory Council Action: Member Holtzclaw made a motion to approve the minutes of September 9, 2009; Member Bard seconded the motion; unanimously carried without objection.

PRESENTATION: CALIFORNIA'S 2050 GHG EMISSION REDUCTION TARGET – ELECTRICITY GENERATION AND COMMERCIAL & RESIDENTIAL ENERGY SECTORS

2. California's 2050 GHG emission reduction target of 80% below 1990 levels – electricity generation and commercial & residential energy sectors.

A. GHG Emission Reduction Technologies for Electricity Generation and Demand Reduction
Hal LaFlash
Director of Renewable Energy, Policy and Planning, Pacific Gas and Electric Company

Mr. LaFlash, Pacific Gas and Electric Company (PG&E), said he believes electrification of many energy loads will be necessary to get to California's GHG targets. It can be

accomplished through electricity generation and the commercial and residential energy sector and by adding as many carbon-free resources to the generating portfolio as possible, which will take several enabling technologies, mainly energy storage.

Mr. LaFlash discussed five topic areas of the electric generation and demand reduction sectors: Utility-scale renewables, distributed renewables, demand response, enabling technologies and common needs among these areas.

Mr. LaFlash said it will take a diverse set of resources and not any one solution, and presented eligible resources in California such as geothermal, wind, bio-energy, solar photovoltaic (PV), solar thermal, solar/biomass, small hydro and wave technology. He presented a portfolio of diverse central-station and dispersed utility-scale solar technologies.

Enhanced Geothermal Systems (EGS) is an engineered process to fracture hot rock and circulate water. There is recent controversy due to tests done in Italy that caused earthquakes. Therefore, it must be carefully sited in California. The highest grade sites are in the western United States, but require drilling depths beyond one mile. He presented a map of areas 6.2 miles deep. There are a number of areas with very hot rock potential if going deep enough. The benefit of geothermal is that it is a base load resource that can give 24/7 electric generation.

Another resource in a longer term timeframe is wave power, which takes the up and down motion of waves and converts it into a rotary energy to power generation. There are several models being tested and he presented examples, stating there is an incredible amount of potential in the service area. On a megawatt basis, a huge amount of energy could be extracted if technology proves out.

Another ocean-based source of energy is off-shore wind. There are differences between the west coast and Europe designs such as the shallowness of coastlines and floating designs are still too expensive for wide-spread use. While California is the second largest producer of wind energy, it is only the 17th largest resource of wind energy on shore. For off-shore, California is probably one of the highest resources in the country.

A technology PG&E is starting to look at is biomethane. There are two forms; 1) biologically derived through anaerobic digestion; and 2) thermo-chemically derived by converting different forms of biomass into a substitute natural gas. Issues to be considered in a 2050 timeframe are: 1) how to reduce all of the commercial and residential use of natural gas, and 2) to the extent it cannot be reduced anymore, can some other form of renewable gas be substituted for it.

Regarding solar, PG&E has a contract for a space-based solar station which he briefly described as a 24/7 operation. If it works, it can produce some clean energy. Photovoltaics are where a lot of the progress is being made, and it is one where the biggest advances in technologies will occur between now and 2050. He presented a chart from the University of New South Wales, which depicts Area I as where the U.S. is now with silicon based solar cells. Area II is the new thin film technology which is less expensive and less efficient, and

Area III where third generation technologies are going, which are inexpensive and highly efficient.

He then presented an example of a triple-junction PV which is expensive but very efficient and uses different material to harvest different wavelengths of light. Nano materials and coatings are making progress to optimize band widths. Multi-Exciton Generation (MEG) PV is another technology which discharges one electron for every proton, which improves efficiency and produces less waste heat. Solar "Nantenna" will capture solar radiation and it acts as a nano version of a Radio Frequency Identification (RDIF) tag that harvests the electromagnetic force from the sun and converts it to electricity.

Mr. LaFlash noted that solar has multiple applications; utility scale and distributed applications, and PG&E expects to see Building Integrated Photovoltaics (BIPV). The state recently announced a goal to have net zero energy homes by 2020 and net zero energy businesses by 2030. To do this, a lot of power will need to be produced on site. Hopefully, one of the least expensive ways to do this is by building integration where you make solar part of the façade or roof. Examples of solar roofing were presented, as well as solar glazing, spandrel glass, and vision glass which integrate PV into shading by varying the density of the thin-film PV. He briefly discussed a pilot program for a smart air conditioning program where loads can be turned off via a switch or setting, with the program being connected to a pager network. As the technology is developed, the program can also work on appliances that do not need to run all the time, and PG&E believes there is potential to manage demand and peak generation. Mr. LaFlash further discussed demand response and storage, and noted that 95% of people did not even realize their air conditioner was triggered during testing.

To make all this happen, enabling technologies will be needed. Currently, the Smart Grid is moving nationwide, with California taking the lead. PG&E is putting in 10 million automated meters and he presented a curve of opportunities ranging from outage management, expanded customer demand response, grid asset management, grid level renewables integration, smart home, real time supply and distribution and management with distributed storage and plug-in vehicle integration. He presented a schematic of a typical home area network of things that could be done by having the ability to communicate, as well as an example of a vehicle smart charging pilot.

In looking at the 2020 aspects of 33% renewable scenario, Mr. LaFlash said the California Public Utilities Commission (CPUC) expects the majority of renewables to come from wind and solar, which are intermittent resources, so others are needed to make the tool work. Wind also occurs more at night in California and while not entirely reliable because of weather, solar more closely matches customer loads. He presented ancillary service needs projected for the year 2050 and various generation scenarios. The high renewables case forecasts that approximately 12,000 megawatts of energy storage would be needed to make it work. Right now they have 1,200 megawatts, so there is a need for much more energy storage.

Mr. LaFlash said there are a number of forms of storage, from high energy to high power, and those focused on by PG&E which are pump storage. He presented a compressed air energy project which would lower the amount of fuel needed to provide the same output to

one-third of what it is today, stating that it takes and compresses air at night using cheaper, off-peak abundant energy, puts it in an underground storage cavern and takes it out as needed to provide ancillary services. In this technology, there is still some amount of natural gas needed to reheat the air as it comes out of the ground. The third generation design actually harvests the compression heat, stores it in thermal storage and uses the waste heat in the daytime, which avoids natural gas entirely.

One common thing all of the areas need is funding. Mr. LaFlash presented a funding gap, stating that the development cycle of any new technology has an R&D sector that has been funded by the government to a large extent. Once technology is commercialized and sold, it can be funded by the standard project financing market. The challenge is getting from the R&D phase to the commercial phase. He said the new technologies will take grants and incentives to get going and having a financing program and market structure in place would be the best ways to make this happen.

Regarding implications of the greenhouse gas (GHG) reduction target for the District's regulatory and legislative agendas, it is clear that all technologies are needed, not any one should be chosen now, and he suggested creating the right incentive and market structure to help technologies along and let those determine which ones ultimately succeed.

Council Member Comments/Questions:

Ms. Drennen referred to installation of residential solar and asked Mr. LaFlash to discuss net metering and why PG&E is not supporting solar production as opposed to offsetting other use.

Mr. LaFlash explained that the law, as written, which just changed as a result of AB 920 (Huffman), said the Net Metering Program and California Solar Initiative Program were to meet customer's loads only and were not to be sold back to the utility. Excess generation goes into a homeowner's account which can be drawn on at any time with the theory being at the end of the year it is neutral. He said AB 920 was signed two days ago which allows people to generate an excess, but a pricing still must be determined by the CPUC. Their concern is that whatever benefits a solar customer receives through transmission and other features and does not pay for, others do have to pay, and they want to ensure this does not penalize the remaining customer base. He noted there is a net metering cap today at 2.5% and the bill pending would raise it to 5%.

Ms. Drennen said energy created by those who have excess capacity is green energy which tends to cost more in production. Therefore, a higher quality energy that meets goals for sustainability is needed, which she felt was not included in the equation. She also felt that green energy would reduce customers' need for peak production. Mr. LaFlash said this will be in the equation once pricing is determined.

Mr. Hayes said the electricity sector represents 20% of the GHG emissions for the state. He questioned whether Mr. LaFlash had a sense of the magnitude of reduction in GHG emissions are anticipated, given whatever technology is used. Mr. LaFlash said more than half of the 20% that the generation represents in the footprint today comes from out of state. He said there are a

handful of coal generators that locate in the state, but most generation comes from out of state by wire. Therefore, a big portion of this will be its impact—whether it will be subject to California rules or a federal cap and trade. Testing is being conducted on technology around carbon capture and sea sequestration and to the extent fossil plants will still need to operate; there will be technologies in place to capture the CO_2. He noted a hydrogen energy project in Kern County is underway now that the Department of Energy (DOE) funded for $20 million would capture the CO_2 from petroleum and put it in an enhanced oil recovery or in a saline aquifer structure. Although, he felt much of it will be the market signal given.

Mr. Hayes said the 2050 target is an 80% reduction from 1990 levels which is difficult. He did not know what was realistic to look at the electricity generation sector for and he questioned if the sector reduces levels by, for example, 10% or more.

Mr. LaFlash said it is basically an issue of money; if carbon capture and sea sequestration in it is in the $50/ton range to do this. If captured, the sector could produce a lot of results. For different, high renewable scenarios, it depends upon whether storage can be put in place or whether natural gas turbines must be run. Mr. Hayes said he found it interesting that the cost of generation is dependent upon the cost of carbon price, and Mr. LaFlash agreed, but he said they also did not know what breakthrough's occur between now and 2050, and he likened it to a "black swan" forecast and changes today as a result of the Internet.

Dr. Bornstein asked Mr. LaFlash to comment on how PG&E uses meteorological data; whether it is real time data, forecasted data, climate distribution, micro climate, and climate change distribution in the design of smart houses, and the interaction between smart houses and PG&E's central locations.

Mr. LaFlash said most of the work they do with meteorological data is more in the energy reduction side. They use it for forecasting hydrology, wind and are getting into solar. They have not used it on the building side itself; however, one of the demand response programs they are working on is thermal ice storage. If the forecast is for a hot day on the next day, one could charge an ice pack the day before with cheaper energy.

Dr. Bornstein said in looking at smaller scale changes, coastal areas do differently than inland areas which has implications for peak energy and low prediction in the future, where you may build power plants. He questioned if this was taken into consideration. Mr. LaFlash said they are looking at it from the load and generation standpoint because the models point thus far to probably having as much precipitation. But, most of what is coming in is rain and not snowfall, which changes their hydro-production dramatically, as they rely on snowpack as a form of storage. Mr. Brian Gitt added that a technology being used in a residential application is high efficiency irrigation controllers which track this data and which is dependent upon the weather.

Ms. Bard questioned the fast charging network in the Bay Area, stating there is a huge interest in accelerating Electric Vehicle (EV) infrastructure. She questioned how this ties into PG&E's concerns about peak energy load. She also questioned biomethane and the percentage of the region's GHG coming from natural gas power production and the percentage of resources

dedicated to biomethane, believing there is a large benefit of biomethane to overall power, as well as vehicle power.

Mr. LaFlash said PG&E has a Clean Air Transport group that works with the evolving electric vehicle market including those that are installing fast charging devices. They are trying to forecast where they will be and what impact they will have on the immediate grid. They hope to affect the overall generation impact somewhat by pricing. Currently, they have an electrical vehicle tariff which is a 5 cent off peak rate and a 30 cent on peak rate, and they encourage people to charge at night. The challenge is that electric vehicles are so efficient that a six times factor between peaks is not that big a price difference. They are also looking at neighborhoods in clusters of people who have hybrids and charging coming off the same transformer, which if not cooled at night, result in transformer failures.

Regarding biomethane, Mr. LaFlash said PG&E's buys biological biomethane. They have two contracts with dairies and dairy clusters to receive biogas into their pipeline, which can be burned just like any other natural gas. In this case, they buy the gas in the San Joaquin Valley, send it to their gateway power plant in the Antioch area and then route it. He said the greater volume they buy right now is coming from Texas, which is a benefit of a pipeline grid. They are also discussing the Mountain Pine Beetle wood in Canada, which can be converted into methane. He said the challenge on the biological front is that the dairies could use this system because their current methane affects ozone levels and GHG's. The goal is to harvest as much of this as possible, but the challenge has been numerous regulations with waste management, water quality and other impacts, which he briefly described.

Ms. Bard confirmed with Mr. LaFlash that approximately 20% of the State's carbon footprint comes from generation and about 10% comes from natural gas.

Dr. Vura-Weis questioned what other regulatory, funding or policy issues the Air District might be able to address. Mr. LaFlash said there are many regulatory issues slowing down putting renewables on line, but felt most were not within the Air District's purview but environmental permitting issues, habitat issues, large space issues for solar, coordination of regulations, time issues, as well as on the transmission side which is contingent upon where people live.

B. GHG Control Measures for Commercial and Residential Sectors
Brian Gitt
Principal, Bevilacqua-Knight, Inc.

Brian Gitt, Principal, Bevilacqua-Knight, Inc. discussed the presentation overview, stating he will specifically talk about the role of building and how goals can be met, recent legislation and regulatory initiatives, challenges, policy tools that government has at its disposal, and what it would take to make market transformation elements happen.

Mr. Gitt noted that the Governor's Executive Order S-3-05 was signed in 2005 and shortly after, AB 32 and the Draft Scoping Plan followed. He said the Draft Scoping Plan focuses on transportation, buildings, and renewable generation. The Bill has spurred tremendous activity throughout many other state agencies, and most tangible is the CPUC and their Strategic Plan.

He discussed the 13.2 million homes in California which will average a 40% reduction in energy use by 2020 and said the average household will spend about $15,000 to $20,000 to do this. Regarding GHG emissions, transportation leads at 38% in emissions, with buildings at 23%, and residential is double the impacts of commercial buildings. Mr. Gitt noted that 2/3 of all buildings in 2050 have already been built, there is +5 billion square feet of existing commercial space, and new construction rates forecasted at only 1% per year.

Given mandates driving goals, many legislative and regulatory initiatives are being or will be approved, which include: AB 32 and Scoping Plan, CPUC's Strategic Plan, local government CO_2 reduction goals, Green Building Standards Code, AB 811 (Levine) / Property Assessed Clean Energy (PACE) which helps homeowners finance energy projects and upgrades, HERS II which is a home energy rating system, and AB 758 (Skinner) which will require the California Energy Commission (CEC) to develop a comprehensive energy efficiency program for all existing residential and commercial buildings, and will require the California Public Utilities Commission (CPUC), by January 1, 2011, to authorize each electrical corporation to provide a targeted number of low- or no-cost energy efficiency audits each calendar year. There will be an unprecedented amount of development; a typical year for the CEC is $1-3 million, but they are receiving $226 million to put together various energy efficiency and renewable programs. Therefore, investments in infrastructure will be moving in the next 18-36 months that will reshape the way we live in our homes. Another major wave is the $3.1 billion over the next three years which will be spent across all sectors, and big changes will occur with how utilities are structured. Utilities will launch one of the largest home retrofit programs beginning in January 2010 and dramatic additional funding will go into future programs.

Regarding challenges, every house and building is different. Therefore, retrofitting each is dramatically different and creates complexity and knowledge that is needed by those doing the retrofits. There are huge differences in demographics and lifestyles, cultural barriers and behaviors and there are few trigger mechanisms to currently get into people's homes and buildings. The question is how to drive participation, create reasonable standards that move the market forward to accelerate the rate of programs, foster regional consistency and build in accountability. There are only a handful of Bay Area companies that have the knowledge, skills and expertise to do comprehensive whole house retrofits. Driving down material costs and quality assurance is needed and most importantly is consumer demand, as people will only pay for so much benefit.

Mr. Gitt discussed the following policy tools:

A. Voluntary:
    - Property Assessed Financing District (PACE)
    - Rebates and incentives
    - Education and Outreach
    - Technical Assistance
    - Easy, cheap permits
    - Emerging Technologies
B. Mandatory:

- Codes and standards
- Green Remodeling Requirements
- Mandatory HERS Audits
- Time of Sale Requirements
- Mandatory retrofits by date certain
- Carbon Surcharge on Energy

To get market transformation to happen, government policy, business capacity and consumer demand must be sequentially aligned. A carrots and sticks approach is needed to get to the 2050 goals and should start with a voluntary market based approach and engagement of the private sector to create jobs and bolster the local economy. Education, outreach and technical assistance is needed, as well. Over time, mandatory elements must then be phased in such as mandatory HERS audits, time of sale requirements, mandatory retrofits by date certain and carbon surcharge on energy.

Regarding business capacity, workforce development must occur to ensure consistent standards, contractor qualifications, training, testing and certification, field mentoring and quality assurance. Government will need to put into place resources, marketing tools, and technology advancements and lead referrals. To address consumer demand, education and outreach is needed, cost barriers must be removed, incentives must be bundled and bulk purchasing is needed to drive down costs, as well as regional programs to achieve economies of scale and centralized information for convenience.

Mr. Gitt said as the Air District is looking at initiatives to reduce carbon and CO_2 and coordination must occur between all entities to get to consistent program design and leverage collective funding.

In addressing how California's 2050 GHG reduction target could be accomplished, Mr. Gitt said a market transformation program is needed and not another rebate program. An entity is needed to look comprehensively at all elements; to harmonize them and put a market transformation program in place.

From a regulatory and legislative agenda standpoint, there are many things the Air District could support in Sacramento, especially as the CEC moves forward with AB 758 and has regulatory authority over existing buildings. The Air District could advocate to the CPUC about changing their cost effectiveness rules so deeper energy reductions are achieved.

Regarding the implications for the Air District's climate protection and grants and incentives programs, Mr. Gitt confirmed it was $60-$80 million a year and spent mostly on vehicles. He believed the Air District could influence the CPUC to use the right incentives. There are various research projects that need to occur to prove how deep energy reductions can happen and there is a lot of research needing to be done on the market transformation model and how we harmonize and bring all of the elements together. As a regional agency, the Air District has the potential to help bolster a region-wide campaign around consumer education, outreach, doing demonstration projects, supporting state legislation, institute test pilots, and proving technology works.

Council Member Comments/Questions:

Dr. Holtzclaw questioned BKi's background and confirmed they are currently designing and implementing emerging market transformation programs with local government. Mr. Gitt noted that his team was hired by Sonoma County to design out their community scale building retrofit program to deliver 13,000 retrofits in the next 36 months to help them achieve their 2015 GHG goals for the building sector. Their goal is to get 80% of their buildings a 30% reduction in energy use by 2015.

Dr. Holtzclaw referred to SB 375 and Mr. Gitt's recommendations for its implementation. He said we think of it as more addressing transportation and driving, but felt it also has strong implications for home building use and others, like mixed use neighborhoods, high density, more bike and transit, smaller homes, multi-family, commons walls, people use less energy, have smaller footprints and less furnishings, and less water use. He said if transit is extended in a sprawling area and you build Transit Oriented Development (TOD) around the transit stops, then you offer the additional housing as being more efficient. He hoped BKi could assist cities and counties in changing their zoning laws to encourage that kind of development.

Mr. Gitt said in his past role, he was Executive Director of Build It Green for five years and worked with over 200 local governments on green building policy and program design. Currently, their focus has been on existing buildings and retrofitting because there is a lot of momentum with the construction industry, and they are working with local governments on green building and zoning policies. Dr. Holtzclaw also cited second units as a way of increasing housing while not necessarily increasing the footprint.

Dr. Bedsworth said she works for the Public Policy Institute in California and they did a survey of local cities and counties last year and what they are doing on climate change. One of the biggest barriers she found from survey and follow-up interviews was finding funding to do basic planning, such as updating General Plans, building and zoning codes. She felt the problem is most likely more acute now, as city departments are somewhat decimated. With all of the money coming in for transformation strategy, she questioned how much of it was unrestricted so as to help local government update planning documents which may not directly cause an emission reduction or energy efficiency improvement but will get achieve towards a comprehensive strategy of the right framework to implement programs.

Mr. Gitt replied that none of the utility money is being dedicated for such work, as they have very strict cost effective rules and the savings that needs to be delivered. Stimulus money is not about energy reduction but about job creation and tangible goals need to be met for every dollar spent. For every dollar spent, 10 million metric BTU's need to be reduced. As an example, Los Angeles County is using about $500,000 out of their $15 million received in American Recovery and Reinvestment Act (ARRA) funds for their Climate Action Plan, which will encompass as many cities as possible. Mr. Gitt agreed it is a real challenge and some cities are creative, but there is not enough grant money to pay for all of it. There may be some surcharge, impact or fee based mechanisms that may be necessary to get the level of planning needed.

Ms. Drennen underscored Mr. Gitt's assessment of how consumers feel going through the process. She referred to socioeconomic factors, low income individuals and renters, stating that most programs are focused on homeowners, yet there is a huge rental population. She questioned if any thought has been given to work with low income individuals or the rental population so that they can also be part of the solution.

Mr. Gitt said there are a lot of weatherization funds for qualified low income individuals. The underserved segment is just above low income, or low/moderate income levels where they do not have resources, cannot qualify for financing themselves or for the low income subsidies. There are initiatives to change the definition of low income, but there will always be an underserved segment. He felt it is about bundling incentives as much as possible to drive down costs to allow more people to be able to afford it and make it easy. Regarding renters, the issue of split incentives is huge and must be solved; the reality is that renters are often paying utility bills yet the property owners are responsible for investing to making the upgrades. With issues of rent control and other barriers, they cannot get their investment back.

C. Prioritizing GHG Mitigation Alternatives by Cost-Effectiveness
Nic Lutsey
University of California, Davis (ITS-Davis STEPS Program)

Dr. Lutsey said he believes it has been an extremely exciting time in thinking about and moving forward with energy, climate mitigation change, leadership and moving forward with initiatives. He said his presentation will be based on his dissertation from a year ago, it will address issues relating to the Air District and decision-making that must be done on a local level. Both he and Dr. Sperling had been interested in supporting the State in their first GHG law. From a cost effectiveness perspective, the question is whether or not other measures are as cost effective. Therefore, they put into perspective what could be done with transportation and compare what was done in all of the other economic sectors, compare cost effectiveness, and have a comparable consistent metric to look across different sectors to determine what reductions can be achieved at a given cost.

He presented his outline and said the motivation for the research was that there was a bottoms-up effort for an emissions reduction goal. At that time, there were inspirational goals and now there is AB 32, GHG targets, emissions planning, inventories, action plans, new technologies, standards, the power sector, switching from fossil fuels to lower carbon fuels, carbon sequestration, building options with appliances, heating, lighting, and air conditioning. The question is how to put it altogether, how do we compare across sectors and which is adopted first to get to 2050 goals. He said this was the basis for the research and initial motivating questions.

The analytical tool to estimate those costs is supply curves or GHG abatement mitigation cost curves to effectively reduce GHG's. In looking at the cost of the new technology, amount of emission reduction ton and cost per ton, given the least cost measures, cost effectiveness can be reviewed, ranked from lowest to highest cost, and a cluster of technologies can then be put together which will provide a supply of reductions that are possible.

He presented a schematic on Slide 4 that illustrated the cumulative amount of emission reductions from putting together 7 measures. Each discreet step along that path is a certain cost per ton associated with it. There could be certain measures for efficiency, vehicles, power plants, agricultural sector, soil/carbon sequestration, and tons of options, but a consistent metric should be used to arrive at the cost per ton and then put them together to see what is achieved.

Dr. Lutsey said there are many options available; Compact Fluorescent (CFL) light bulbs, Light-Emitting Diode (LED) light bulbs, vehicle efficiency, low carbon biofuels, hydrogen, electric vehicles, options with building efficiencies, and as long as data can be gathered on what is the cost and GHG reduction, then they can be compared by taking the lowest cost per ton item until we either have all of the reductions we need or they just get so costly we do not want to pay for them. There are limited resources for any sort of public goal. He wanted to at least constrain his study to technology options only and not behavioral options. There will be a slight difference in what the findings mean for the U.S. versus a state basis. Regarding the timeframe, he looked at available, near-term technologies, or what we know today that are reasonable enough and that can be widespread available in the next 10 years. He then brings together all of the data, making sure all the numbers are kept straight, comparable and true to assumptions and constraints, and everything that defines the analysis. And, making sure that energy costs associated with the measures are consistent, the discount rate used for energy savings in the future is consistent and then it is brought altogether for a cost effectiveness curve.

Dr. Lutsey said within the method, cost effectiveness can be defined however one wants to define it. The easy-to-estimate costs are, relatively speaking, what the costs are of the new technology for a power plant, a vehicle, an efficient appliance. The next easiest is the energy savings from those different appliances, devices and vehicles. After that, somebody could make the analysis more inclusive by thinking about co-benefits and ancillary benefits, what are criteria air pollution benefits, what are benefits in water source pollution, and other areas that are outside the sphere of direct energy costs and direct costs of technology.

Dr. Lutsey said in looking at just light duty vehicles, we need what it will cost on a per vehicle basis for a given amount of efficiency improvement. There are plenty of studies and regulatory work done such that he has reasonable estimates for what it costs. For the Pavley GHG regulation in California, the number could be a 25% CO_2 reduction and it could cost $1,000 per vehicle. There is evidence to suggest that these numbers are correct and are the root analysis for coming up with a cost per ton. If there is a $1,000 up front cost for a vehicle that has a more efficient technology, you change little things about the vehicle incrementally and this would be the root for coming up with a cost per ton. The next step would be how much energy savings is associated with that vehicle efficiency over the life of that vehicle, and this would be encapsulated in the cost per ton metric for light duty vehicle efficiency.

Moving one step past that would be hybrid technology, which is relatively near term, available in California, and is 5% of vehicle sales in the U.S. There will most certainly be a higher percentage next year and higher in the next 10 years.

In looking at putting measures together, there is incremental efficiency, on-road efficiency and other measures not on the immediate first sale of the vehicle which might include the inflation of

tires or low rolling resistant tires. Going up to the third step, there are cellulose ethanol's or second generation biofuels. The fourth step are hybrid electric vehicles and in this case, the cost is higher at $3,000 per vehicle, which will continue to come down as more automakers have more suppliers that deal with the components.

Almost the same type of curve but with a different scale can be done for heavy duty trucks. There are similar efficient technologies with engines, transmissions, and tires which can bring about efficiencies that do pay back over the lifetime of the entire vehicle and not necessarily with the first owner of the vehicle. The last sector of trucks includes large vans, diesel contractor trucks. Class 7 and 8 trucks are larger, 40 ton 18-wheeler trucks.

Dr. Lutsey referred to building sector efficiency technologies, and said there can be more efficiency appliances and systems such as Energy Star appliances, Heaving, Ventilating and Air Conditioning (HVAC), lighting, distributed power, building shell issues by changing the windows and insulation to retain heat or cooling, and in the upper left of the graph on Slide 10, you get the discreet supply curve that states, at a given cost per ton, what kind of reduction do you get. The type of scale in reduction is similar to what you can get on a U.S. basis compared to light duty vehicles but the difference is that you have to hit on many, many different technologies. In the case of vehicle technology, one regulation hits all of the vehicles, and an energy star for a refrigerator is only a small wrung on the supply curve in this case. Dozens of other different levels must be hit to start to arrive at cumulative reductions that you would get to from 3-5 broad measures.

What does it mean for reductions over time with these technologies by 2020, 2030 and 2040? The business as usual plot is the highest, and each step coming down is a full widespread deployment of the whole portfolio of technologies. Each step is appliance, building shell efficiency, HVAC, lighting, etc. If you take a vertical slice at any one point, those are the reductions you get in any one year that have to be used in the supply curve "x" axis.

For GHG reduction within power generation, the analysis looks at the broadest scale possible for the U.S. In looking at big technology options; in moving into areas from shifting more coal to natural gas to nuclear, geothermal, wind, cleaner coal technologies, biomass, coal carbon, capture and storage (CCS), natural gas CCS and solar options, it is a matter of paying more each time you want to go further out. Willingness to pay for those is what dictates how far you want to go with emission reductions. He referred to the error bars and said the power industry can react accordingly, given a price signal.

Dr. Nutsey then presented a graph which brings together the different sectors of multi-sector GHG reduction. It looks at what is happening in light duty mitigation, what can be done in heavy duty trucks, power sector, agricultural areas, etc. Each one is a discreet horizontal step and when put together and there are some obvious conclusions—you need a lot of technology from a lot of different sectors to start adding up to the type of reductions needed for 2020-2035 goals.

For the focus of his dissertation, Dr. Nutsey said he was most interested in transportation measures and how they stacked up. There are efficiency measures that drop below the zero line cost per ton, which are "no regrets measures"; Energy savings over the lifetime of the use of that

technology with a discounted energy rate of 7% per year achieves energy savings that bring the cost per ton to zero. Almost entirely, that part of the region is made up of efficiency within vehicles and within homes. This is because of the way consumers purchase vehicles and different devices in our homes. These are the areas he would call low lying fruit--where there is a lot of GHG mitigation opportunity at low cost or less than zero cost because consumers value energy savings very different than we would from a grant societal perspective.

The middle part of the chart that goes from zero dollars per ton to about $50 per ton is mostly power sector options and it moves in a big way to lower carbon overall energy grid. More advanced technologies are seen above $50 per ton, such as solar panels and going beyond hybrid vehicles, and these have the most opportunity for cost reduction over time.

Regarding what this means for 2050 goals, analysis was entirely posing the question of, what near term technologies get us for the relatively near term 2025-2030 goals? A whole new slate of technologies is needed and/or new activity trends such as the way we travel, co-locate residences with businesses, where we work, how we move around, and not just hybrid vehicles. This would include electric vehicles, fuel cell vehicles, going further up with solar panels in larger scale implementation, wind turbines and others.

Broad Conclusions:

- Nearer term goals (e.g., 205% reduction from 1990 by 2020)
  - Push state/national leaders to pass comprehensive climate/energy legislation (sector specific standards, economy-wide GHG pricing)
  - Accommodate/push/incentivize your utility toward lower GHG sources
  - "Good housekeeping": City purchasing practices, contracting with industry technology leaders (vehicles, lighting, appliances, etc)
  - Outreach and incentives: promote low-GHG travel modes, reduce single occupancy vehicle (SOV) travel, low-GHG vehicle incentives (parking, purchasing, charging)

- Longer terms goals (e.g., 80% reduction from 1990 by 2050)
  - Same as near-term strategies above – and then some!
  - Advanced vehicle infrastructure:
    - Smart grid, EV fast-charging, hydrogen stations
    - Reduce barriers for long-term ultra-low-GHG mobility
  - Major long-term planning efforts:
    - Land use, transit, pricing, smart growth, zoning for vehicle miles traveled (VMT) reduction

Dr. Lutsey said he believes there are a lot of options and a lot of technology that is needed just to hit 2020 and 2030 goals. An entire study could be done in 2020, and there may be an entirely new list of technologies that hopefully do a better job at including behavioral and activity shifts. He felt this research does not scratch the surface of 2050 goals other than to point to the fact that we need a lot more than what we are really talking about today for technologies.

There are different limitations to the research such as no impact of price change effects, almost all data used is based on large scale aggregated U.S. levels, there is a lot of regional differences which would hugely change certain aspects, none of this applies that well for any given state, and others. What this means for deep climate stabilization goals is hard to say. In looking at an 80% and 50% goal, we look at what is needed. To make any problem tractable, we will need to get into all of the different sectors and determine what can actually be done, given the level of policy making. There are more vehicles in California. They are traveling more. There are more people here and this is the business as usual trend going up. Once a low carbon fuel standard is in place and implemented, the question is how far this gets us. With SB 375 evolving, we might be able to reduce our annual VMT which would bring us further down on the graph, but we still have a very long way to go and no where near an 80% or 50% goal.

Transportation is 38% of California's overall GHG emission and light duty is 75% of transportation within California. If we do not hit the light duty number there will be no chance of attaining the goal overall. The overriding conclusion has to be the overwhelming daunting-ness of the problem at hand to try and get anything close to the 80% and 50% goals. Needed are entirely new vehicles that are on different primary energy sources, an entirely new fleet of electric vehicles, hydrogen fuel cell vehicles, or predominantly fueled on energy sources that are renewable in some way that allow us to decouple from the current 96% petroleum system. Bio fuels can also buy time to help move us toward the bigger options that require electric vehicle infrastructure and hydrogen infrastructure. Undoubtedly, electric vehicles and hydrogen fuel cell vehicles are and will be higher cost per ton for the foreseeable future, but to hit 80% and 50% goals, it is hard to imagine doing it without getting onto an almost entirely decoupled fuel source.

Regarding what this means in the Bay Area, 2020 goals must be met because housing, appliances, and vehicle technology has to start to be turned over in the 2030 and 2040's if the use of energy by 2050 is anywhere close to the lower carbon vehicle and power grid and other sectors having lower GHG emissions. Everybody must push what can be done at the state and national levels for larger decisions to be made. In terms of the bigger technology changes, funds for infrastructure and EV planning is the role that the Air District can play so that competition can take off for different cities wanting to be the early adopters of EV vehicles and infrastructure. In terms of major long term planning efforts, SB 375 is pushing research on land use issues and what can be done to get VMT reductions, lower GHG emissions, and ingrained status quo ways of thinking about how we travel, locating residents near their work, and how cities can help make smart growth concepts a reality and be implemented on a much larger scale.

<u>Council Member Comments/Questions:</u>

Dr. Holtzclaw questioned technologies not covered, such as moving long distance freight from trucks to rail and electrifying rail. He said there are costs but at the same time, there is reduction in energy consumption and CO_2 emissions. Dr. Lutsey said in this case, it is a subfield in transportation that he is not well enough versed in, but it is definitely an area where research has happened, but has no idea what sort of energy savings, cost per ton, or reductions would yield.

Dr. Holtzclaw said if we change our zoning laws and encourage mixed use development, this is one way to decrease VMT and other CO_2 GHG generation. He has not seen this kind of analysis

but would like it done. Generally, because there are less infrastructure investments for compact construction, this should result in less cost and he wanted to see this included too; efficiency in community. Dr. Lutsey said the topic has come up within transportation on putting the pieces together. What happens with planners and civil engineers and what can be done with smart growth policies, and typically these are two fields that do not interact well within another. While it is unfortunate, there is good work that tries to put some cost per ton numbers on the demand side and smart growth side. He agreed that bringing all those pieces together is really the only true way to see what can be done in the transportation sector.

Dr. Holtzclaw said what has not been included in the analyses is that if you build a TOD out in an area that is already built up in sprawl, then you help the people who live in sprawl have a transit center surrounded by mixed use development and a parking garage structure so that people walk past supermarkets and child care centers going to/coming from home and work which reduces the number of trips.

Ms. Drennen questioned if Dr. Lutsey found any resources in terms of monetizing co-benefits such as cleaner water, public health, economic development, or standard of living and said it seems if you do cost per ton for one particular GHG reduction, it does not take into account any of the other co-benefits. Dr. Lutsey said when proposing the topic to his dissertation committee, the goal was to think of co-benefits and air quality benefits. The data you come by is sparse or is too specific to include on a U.S. basis in most cases. Because the numbers are so particular and different place to place, depending upon pollutant and air basin, it is almost impossible on a national study to include it. Whatever studies are out there, the numbers can be linked up with any sort of energy efficiency change that also causes GHG reductions. The method can easily accommodate as much data as you can find, and this is the benefit of the method; that it is a cost per ton. However, you do need to come up with a cost that somebody believes in enough, such as the costs in East Oakland coming from freight in the area and you would have to somehow put that into an air quality benefit.

Concluding Remarks:

Mr. LaFlash said he thinks Dr. Lutsey's study helps conclude his. When looking at the cost curve, there are renewals that are in good position and some that are not. The best planning way to do this is to look at the overall cost curve and say you want to reduce carbon at the most effective cost. He worked on the 2007 McKenzie study with similar conclusions; if you find a way to incentivize people to do those things which nominally pay for themselves without considering carbon; this is the first step to take. And, it's probably a place where the Air District could have some impact. PG&E is trying to reduce the costs of all of the technologies such that they will move themselves down the curve, but he thinks where progress will be seen on the curve is a snapshot of today's costs which hopefully can be improved upon.

Dr. Lutsey had no closing remarks.

Chair Brazil confirmed with Mr. LaFlash that the strongest recommendation is working on incentive programs to move technologies to the next phase. All have high costs and their biggest challenge is going from R&D to commercialization. He knows there is work going on with the

District with transportation technologies, and he suggested others like biomethane which has the potential to displace natural gas.

Dr. Holtzclaw said Mr. LaFlash talked about the net metering cap which has been at 2.5% and a bill pending in the legislature will raise it to 5%. There is a study pending by the CPUC that says what the impact is for ratepayers on net metering. He noted net metering is that which is used to bank on the utility and then take back another time of day or year. Therefore, whatever people are using on site itself is not included in it.

Mr. Blonski said in the early 1980's, there were a number of co-generation plants with agricultural waste and there are very few left. He represents open space and parks, manages over 100,000 acres and is doing a major vegetation removal program of Eucalyptus and Monterey Pine on about 17,000 acres, and spending millions of dollars doing this each year. One of the biggest issues is the cost of removing that vegetation and what to do with the biomass. He questioned if anyone was looking at producing ethanol from agricultural waste like slash and boles of trees.

Mr. LaFlash said there is a lot of work going on with cellulose ethanol using either bacteria, yeast, or thermo chemically. A company called Range Field is building a facility, but the challenge is that there are not many companies building in California. Range Field is a Colorado company funded by California venture capitalists building a facility in Georgia. There is a lot of research going on by UC Berkeley, Stanford and Cal Tech who have spun off synthetic biology companies that can make third generation biofuels out of agricultural waste products. The challenge of any application is the stability of the feed stock. If someone were to build a 20 year project, would they have feedstock every year to do this, and this is what happened to the original co-generation plants installed 25 years ago. They realized they overbuilt the supplies, but some of them have restarted as they found fuel sources.

Ms. Bard said Mr. Gitt mentioned he is working with Sonoma County on their green building program to get 200 homes per day energy efficient. There is discussion regarding green building requirements and the onus it would put on homeowners. She asked if analysis has been done for the individual side on what would be the best use of their dollar in terms of reducing GHG's. She said her second question relates to the importance of consistency and she asked if it was consistency of programs or standards, and referred to how Sonoma County is moving forward. She questioned what it would do to some of the early adopters in a consistency model.

Dr. Lutsey said he thought about what cost effectiveness means on an individual level. It is not a direct connection because it looks more on an institutional level like changing entire vehicle fleets over. But, this said, in the vehicle sector within light duty vehicles, the decision of buying the most efficient vehicle within any given class is something no one thinks about. This can be a 20%-30% difference that one individual can make. There is also the other question of buying one more vehicle; however, buying the best in class will always be the most "bang for buck" efficiency that someone can do. If you are still within the widespread, mainstream category of vehicles, appliances, or air conditioners, it is economies of scale that brings costs down.

Ms. Bard said that if you are asking people to invest in upgrading their homes, you want to be able to at least provide information as to whether it is the best use of money. For instance, in Sonoma County, there is a $700 audit that might be required, so there is a need for making that analysis available so people are feeling comfortable with their investment, and she believes it helps sell it to the public, as well.

Dr. Lutsey added that the only thing he could think of are studies done by concerned scientists when doing consumer handbooks, or other groups that talk about impacts, costs and ratings. He also noted the existence of a global warming survival handbook, which does a great job of having very nice, easy-to-understand options and talks about the overall impact in terms of everyday things we can do. However, he was skeptical that any analyst would devote time to such particular needs that would be different on a local level.

OTHER BUSINESS

4. **Council Member Comments/Other Business** – Chair Brazil said Dr. Bornstein would be the principal author of the Advisory Council recommendations, and he, Ben Bolles and Stan Hayes would work with Dr. Bornstein. If any other Advisory Council Members have any comments for the report, they need to provide them by October 21, 2009, with the goal of finishing the Report at the November meeting.

5. **Time and Place of Next Meeting:** 9:00 a.m. Wednesday, November 10, 2009, 939 Ellis Street, San Francisco, CA 94109

6. **Adjournment:** The meeting adjourned at 12:07 p.m.

/S/ Lisa Harper
Lisa Harper
Clerk of the Boards