



BAY AREA
AIR QUALITY
MANAGEMENT
DISTRICT

ADVISORY COUNCIL REGULAR MEETING

WEDNESDAY
FEBRUARY 11, 2015
9:00 A.M.

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

AGENDA

CALL TO ORDER

1. **Opening Comments**
Roll Call

Liza Lutzker, Chairperson
Clerk

The Chairperson shall call the meeting to order and make opening comments. The Clerk of the Boards shall take roll of the Advisory Council members.

2. **PUBLIC COMMENT ON NON-AGENDA MATTERS**

Pursuant to Government Code Section 54954.3, the public has the opportunity to speak on any agenda item. All agendas for Advisory Council meetings are posted at the District, 939 Ellis Street, San Francisco, California 94109 at least 72 hours before a meeting. At the beginning of the meeting, an opportunity is also provided for the public to speak on any subject within the Advisory Council's purview. Speakers are limited to three minutes each.

Staff/Phone (415) 749-

3. **APPROVAL OF THE MINUTES OF THE ADVISORY COUNCIL REGULAR MEETING
AND RETREAT OF JANUARY 14, 2015**

Clerk of the Boards/5073

The Advisory Council will consider approving the draft minutes of the Advisory Council Regular Meeting and Retreat of January 14, 2015.

PRESENTATION

- 4. Urban Heat Island Effects on Energy Use, Climate, Air Pollution, Greenhouse Gases (GHGs) and Health** **S. Tanrikulu, Advisory Council Liaison/4787**

A speaker from the City College of New York will present materials on urban heat island.

Urban Heat Island

Jorge E. Gonzalez, Professor
The City College of New York
140 Convent Avenue
New York, NY

DISCUSSION

- 5. Discussion of Draft Report on the Advisory Council's Meeting on October 8, 2014** **S. Tanrikulu, Advisory Council Liaison/4787**

The Advisory Council will discuss, finalize and consider approval of the draft report on the October 8, 2014 meeting on "Energy Storage and Smart Grid Technologies and Their Relationship to the 2050 Greenhouse Gas Goals."

- 6. Discussion of Advisory Council Presentation to the Board of Directors** **S. Tanrikulu, Advisory Council Liaison/4787**

The Advisory Council will discuss presenting a summary of the Advisory Council's 2014 and 2015 activities to the Board of Directors.

OTHER BUSINESS

- 7. Chairperson's Report** **Liza Lutzker, Chairperson**

The Chairperson will provide the Advisory Council a report of recent and upcoming activities.

- 8. Advisory Council Member Comments/Other Business**

Advisory Council members may make a brief announcement, provide a reference to staff about factual information or ask questions about subsequent meetings.

- 9. Time and Place of Next Meeting**

March 11, 2015 at 9:00 a.m. at 939 Ellis Street, San Francisco, California 94109.

- 10. Adjournment**

The Advisory Council meeting shall be adjourned by the Chairperson.

CONTACT:

MANAGER, EXECUTIVE OPERATIONS
939 ELLIS STREET, SAN FRANCISCO, CA 94109
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- To submit written comments on an agenda item in advance of the meeting. Please note that all correspondence must be addressed to the “Members of the Advisory Council” and received at least 24 hours prior, excluding weekends and holidays, in order to be presented at that Council meeting. Any correspondence received after that time will be presented to the Council at the following meeting.
- To request, in advance of the meeting, to be placed on the list to testify on an agenda item.
- To request special accommodations for those persons with disabilities notification to the Clerk’s Office should be given in a timely manner, so that arrangements can be made accordingly.

Any writing relating to an open session item on this Agenda that is distributed to all, or a majority of all, members of the body to which this Agenda relates shall be made available at the District’s offices at 939 Ellis Street, San Francisco, CA 94109, at the time such writing is made available to all, or a majority of all, members of that body.

BAY AREA AIR QUALITY MANAGEMENT DISTRICT
939 ELLIS STREET, SAN FRANCISCO, CALIFORNIA 94109
FOR QUESTIONS PLEASE CALL (415) 749-5016 or (415) 749-4941

EXECUTIVE OFFICE:
MONTHLY CALENDAR OF AIR DISTRICT MEETINGS

FEBRUARY 2015

<u>TYPE OF MEETING</u>	<u>DAY</u>	<u>DATE</u>	<u>TIME</u>	<u>ROOM</u>
Board of Directors Regular Meeting <i>(Meets on the 1st & 3rd Wednesday of each Month)</i> - CANCELLED	Wednesday	4	9:45 a.m.	Board Room
Advisory Council Regular Meeting <i>(Meets on the 2nd Wednesday of each Month)</i>	Wednesday	11	9:00 a.m.	Board Room
Board of Directors Executive Committee <i>(Meets on the 3rd Monday of each Month)</i> - CANCELLED	Monday	16	9:30 a.m.	Board Room
Board of Directors Stationary Source Committee <i>(Meets on the 3rd Monday of each Month)</i> - CANCELLED	Monday	16	10:30 a.m.	Board Room
Board of Directors Personnel Committee <i>(At the Call of the Chair)</i>	Wednesday	18	9:00 a.m.	Board Room
Board of Directors Regular Meeting <i>(Meets on the 1st & 3rd Wednesday of each Month)</i>	Wednesday	18	9:45 a.m.	Board Room
Board of Directors Budget & Finance Committee <i>(Meets on the 4th Wednesday of each Month)</i>	Wednesday	25	9:30 a.m.	Board Room
Board of Directors Mobile Source Committee <i>(Meets on the 4th Thursday of each Month)</i>	Thursday	26	9:30 a.m.	Board Room

MARCH 2015

<u>TYPE OF MEETING</u>	<u>DAY</u>	<u>DATE</u>	<u>TIME</u>	<u>ROOM</u>
Board of Directors Regular Meeting <i>(Meets on the 1st & 3rd Wednesday of each Month)</i>	Wednesday	4	9:45 a.m.	Board Room
Advisory Council Regular Meeting <i>(Meets on the 2nd Wednesday of each Month)</i>	Wednesday	11	9:00 a.m.	Board Room
Board of Directors Executive Committee <i>(Meets on the 3rd Monday of each Month)</i>	Monday	16	9:30 a.m.	Board Room
Board of Directors Stationary Source Committee <i>(Meets on the 3rd Monday of each Month)</i>	Monday	16	10:30 a.m.	Board Room
Board of Directors Regular Meeting <i>(Meets on the 1st & 3rd Wednesday of each Month)</i>	Wednesday	18	9:45 a.m.	Board Room
Board of Directors Climate Protection Committee <i>(Meets on the 3rd Thursday of Every Other Month)</i>	Thursday	19	9:30 a.m.	Board Room

MARCH 2015

<u>TYPE OF MEETING</u>	<u>DAY</u>	<u>DATE</u>	<u>TIME</u>	<u>ROOM</u>
Board of Directors Budget & Finance Committee <i>(Meets on the 4th Wednesday of each Month)</i>	Wednesday	25	9:30 a.m.	Board Room
Board of Directors Mobile Source Committee <i>(Meets on the 4th Thursday of each Month)</i>	Thursday	26	9:30 a.m.	Board Room

APRIL 2015

<u>TYPE OF MEETING</u>	<u>DAY</u>	<u>DATE</u>	<u>TIME</u>	<u>ROOM</u>
Board of Directors Regular Meeting <i>(Meets on the 1st & 3rd Wednesday of each Month)</i>	Wednesday	1	9:45 a.m.	Board Room
Advisory Council Regular Meeting <i>(Meets on the 2nd Wednesday of each Month)</i>	Wednesday	8	9:00 a.m.	Board Room
Board of Directors Regular Meeting <i>(Meets on the 1st & 3rd Wednesday of each Month)</i>	Wednesday	15	9:45 a.m.	Board Room
Board of Directors Executive Committee <i>(Meets on the 3rd Monday of each Month)</i>	Monday	20	9:30 a.m.	Board Room
Board of Directors Stationary Source Committee <i>(Meets on the 3rd Monday of each Month)</i>	Monday	20	10:30 a.m.	Board Room
Board of Directors Budget & Finance Committee <i>(Meets on the 4th Wednesday of each Month)</i>	Wednesday	22	9:30 a.m.	Board Room
Board of Directors Mobile Source Committee <i>(Meets on the 4th Thursday of each Month)</i>	Thursday	23	9:30 a.m.	Board Room

SG – 1/29/15 (9:55 a.m.)

BAY AREA AIR QUALITY MANAGEMENT DISTRICT

Memorandum

To: Chairperson Liza Lutzker and Members
of the Advisory Council

From: Jack P. Broadbent
Executive Officer/Air Pollution Control Officer

Date: January 28, 2015

Re: Approval of the Minutes of the Advisory Council Regular Meeting and Retreat of
January 14, 2015

RECOMMENDED ACTION

Approve the attached draft minutes of the regular meeting and retreat of the Advisory Council of January 14, 2015.

DISCUSSION

Attached for your review and approval are the draft minutes of the Advisory Council regular meeting and retreat of January 14, 2015.

Respectfully submitted,

Jack P. Broadbent
Executive Officer/APCO

Prepared by: Sean Gallagher
Reviewed by: Maricela Martinez

Attachment: Draft Minutes of the Advisory Council Regular Meeting and Retreat of
January 14, 2015

Draft Minutes – Advisory Council Regular Meeting & Retreat of January 14, 2015

Bay Area Air Quality Management District
939 Ellis Street
San Francisco, CA 94109
(415) 749-5073

DRAFT MINUTES

Advisory Council Regular Meeting & Retreat
Wednesday, January 14, 2015

Note: An audio recording of the meeting is available on the website of the Bay Area Air Quality Management District at <http://www.baaqmd.gov/The-Air-District/Board-of-Directors/Advisory-Council/Agendas-and-Minutes.aspx>.

1. CALL TO ORDER

Vice-Chairperson Jessica Range called the meeting to order at 9:07 a.m.

Opening Comments: None

Roll Call:

Present: Chairperson Liza Lutzker, M.P.H.; Vice-Chairperson Jessica Range, LEED A.P.; Secretary Jonathan Cherry, A.I.A.; and Members Sam Altshuler, P.E., Robert Bornstein, Ph.D., Stan Hayes, Frank Imhof, Kraig Kurucz, Rick Marshall, P.E., P.L.S., Bruce Mast, SaraT L. Mayer, M.P.P., Timothy O'Connor, Esq., and Laura E. Tam.

Absent: Members Ana M. Alvarez, D.P.P.D., and Harold Brazil.

Also Present: None.

2. PUBLIC COMMENT ON NON-AGENDA MATTERS: No requests received.

3. APPROVAL OF THE MINUTES OF THE ADVISORY COUNCIL (COUNCIL) MEETING ON NOVEMBER 12, 2014

Council Comments: None.

RECOGNITION

4. Recognition of Outgoing Council Members

Vice-Chairperson Range recognized outgoing Council Members Benjamin Bolles, Jeffrey Bramlett, Heather Forshey and former Member Estes Al Phillips, all in absentia, for their service on the Council.

Vice-Chairperson Range recognized outgoing Council Member John Holtzclaw, Ph.D., for his service on the Council. Dr. Holtzclaw addressed the Council in gratitude.

Council Comments:

Member Hayes expressed his gratitude for Dr. Holtzclaw’s contribution to the Council.

Public Comments: No requests received.

Council Action: None.

5. Recognition of Outgoing Council Chairperson

Vice-Chairperson Range recognized outgoing Chairperson Altshuler for his dedicated leadership and service to air quality in the Bay Area.

Council Comments:

Member Hayes expressed his gratitude for Member Altshuler’s contribution as Council Chairperson.

Public Comments: None.

Council Action: None.

RETREAT

6. Review and Discussion of 2014 AND

7. Discussion of 2015

Jean Roggenkamp, Deputy Air Pollution Control Officer, introduced the topic and Saffet Tanrikulu, Research and Modeling Manager of the Planning, Rules and Research Division, who gave the staff presentation, *Council Regular Meeting and Retreat*, including review of 2014 and discussion of 2015, a sample albedo map of San Francisco and the California Energy Commission’s (CEC’s) building climate zone map.

NOTED PRESENT: Member Marshall was noted present at 9:23 a.m. and Chairperson Lutzker was noted present at 9:27 a.m.

The Council and staff discussed, at slide 5, *Discussion of 2015 (cont.)*, *Discussion on Possible Mitigation Strategies*, if and how solar panel roofs mitigate as effectively as cool roofs; the nature of sensible heat flux and the various forms of solar heating; and additional details about the energy dynamic in the “urban with increase cool roofs and pavements” example.

Dr. Tanrikulu continued the presentation.

The Council and staff discussed, at slide 6, *Discussion of 2015 (cont.)*, the counterintuitive nature of the numbers provided and what types of modeling the data are used for; if the chart means that San Francisco and Oakland do not have the same heat island issues as other urban areas and whether the differences can be attributed to the measurements being taken at their respective airports; the possibility that a greater degree of urban foliage may be contributing to the difference; what size monitoring network is necessary to obtain these measurements; the applicability of these figures to Council work; how the national urban average was established and what it means in comparison to the Bowen ratio provided for individual cities; whether tree density can be increased to positive effect; information and technology available to determine how much foliage exists relative to urban development and the direct measurement of temperatures; the types of modeling available in this field; how individual emissions will impact different areas with varying Bowen ratios and what that means for air quality monitoring; and the definition of “urban” in this chart.

NOTED PRESENT: Member Imhof was noted present at 9:39 a.m.

Dr. Tanrikulu continued the presentation.

The Council and staff discussed, at slide 7, *Discussion of 2015 (cont.)*, the significant impact that results from the small difference between the albedo of urban and rural areas and what the meaning of “cool roof.”

Dr. Tanrikulu continued the presentation.

The Council and staff discussed, at slide 8, *A Sample Albedo Map of San Francisco*, the exclusion of road measurements on the map.

Dr. Tanrikulu continued the presentation.

The Council and staff discussed, at slide 9, *CEC’s Building Climate Zone Map*, what the various zones are based upon; the applicability of the map; heat generation from roadways and automobiles as having important, but perhaps unrecognized, impacts; the nature of anthropogenic heat; and how these climate zones were established.

Dr. Tanrikulu concluded the presentation.

Council Comments:

The Council and staff discussed report formatting and membership in the report writing work group for the upcoming presentation; the lack of webcasting for today’s meeting; and when and on what topic the next speaker should present.

Public Comments: No requests received.

Council Action: None.

PRESENTATION

8. Urban Heat Island Effects on Energy Use, Climate, Air Pollution, Greenhouse Gases (GHGs) and Health

Dr. Tanrikulu introduced John Melvin and provided a brief description of his background.

John Melvin, State Urban Forester
Urban Forestry Advisor Staff
California Department of Forestry and Fire Protection (CAL FIRE)
Sacramento, California

Mr. Melvin gave a presentation entitled *BAAQMD [Bay Area Air Quality Management District] Urban Forestry Overview* (a copy of which is available on the website of the Bay Area Air Quality Management District at <http://www.baaqmd.gov/The-Air-District/Board-of-Directors/Advisory-Council/Agendas-and-Minutes.aspx>).

Council Comments:

The Council, staff and Mr. Melvin discussed whether any information exists regarding the effect of trees on the Bowen ratio and similar dynamics, including whether specific types of plants or landscape designs change the result; possible recommendations regarding tree types with multiple benefits; carbon sequestration capabilities of various tree types; urban pollen sources, the impact of pollen in urban environments, recent trends in the planting of male and female trees, and the potential exacerbation of pre-existing asthma from urban pollen; the importance of considering tree species in urban planting as each has a distinct impact for those suffering from asthma; how CAL FIRE is involved in community planning; the complexity of the impact of urban trees on air quality, including but not limited to arrangement, tree type, and variable heat island effects; whether CAL FIRE grants require the maintenance of and check-ups on trees planted; the mortality rate of young trees and long-term benefits of early investment in tree health; CAL FIRE's opinion relative to the carbon accounting in the California Air Resources Board's new protocols; whether and how varying types of trees and their usual pruning result in variable GHG sequestration capabilities; issues and trends relative to constructing new buildings around existing trees; the declining canopy in San Francisco resulting from the ease of planting and difficulty of successful maintenance programs; cities that are planting and maintaining trees well; whether it is recommended for cities to establish dedicated funds for landscape maintenance; Palo Alto, Menlo Park and Atherton as emerging models for tree maintenance in the Bay Area; if any efforts are being made to plant and maintain trees for residents who are willing to host, but unable to maintain, trees on their property; what factors are taken into account for calculations of the benefit of urban forestry; additional information regarding the studies listed on slide 23, *Bay Area Specific Information*, and which websites have published each; concerns and differences of opinion regarding trees and water usage; opinions relative to municipal requirements for minimum clearance between trees and buildings; the skewing of urban canopy figures by large parks; and the viability of trees and bushes in planters, such as in bike lane dividers, and their benefits and challenges compared with trees planted in the ground.

Public Comments: No requests received.

Council Action: None; receive and file.

AIR DISTRICT OVERVIEW

9. Report of the Executive Officer/Air Pollution Control Officer (APCO) (Out of Order Agenda Item 10)

Jack Broadbent, Executive Officer/APCO, gave the staff presentation *Air District Overview Council Special Meeting / Retreat*, including key 2015 initiatives and key 2015 policy initiatives.

Mr. Broadbent presented a summary of the Winter Spare the Air Season to date.

Council Comments:

The Council and staff discussed the trend of exceedences of the federal ozone standard and staff opinions relative to expected adjustments to the standard; the Bay Area ambient air quality in comparison to the background level; whether source apportionment information exists that is more recent than several years ago, which attributed up to 40% of particulate matter levels to wood smoke; whether the new Air District headquarters are 375 Beale Street will become the Milton Feldstein Building; the air quality impact of back-up generators and rulemaking plans relative to the same; possible updates to the Clean Air Plan; recent media coverage citing air quality experts that are not Air District employees and who are, perhaps erroneously, attributing nearly all of the winter air quality problems to wood smoke; progress on the community engagement program and plan; and a possible transition plan for the Council.

Public Comments: No requests received.

Council Action: None; receive and file.

3. APPROVAL OF THE MINUTES OF THE COUNCIL MEETING ON NOVEMBER 12, 2014 (CONTINUED)

Public Comments: No requests received.

Council Action:

Member Kurucz made a motion, seconded by Member Hayes, to approve the minutes of the Council meeting on November 12, 2014; and the motion carried by the following vote of the Council:

AYES:	Altshuler, Bornstein, Cherry, Hayes, Kurucz, Lutzker, Marshall, Mast, Range and Tam.
NOES:	None.
ABSTAIN:	Imhof.
ABSENT:	Alvarez, Brazil, Mayer and O'Connor.

DISCUSSION

10. Discussion of Draft Report on the Council's Meeting on October 8, 2014 (Agenda Item 9)

The Council postponed this item to a future meeting date.

The Council and staff discussed the form and timing of Council reports and presentations to the Board of Directors (Board); the advisability of initially delivering the Council's 2014 reports to the Board without an accompanying presentation; the desire among some Council members to deliver more than one presentation to the Board and its committees between now and May 2015; which Council members will prepare the Council summary of 2014 reports; and which Council members will present to the Board.

OTHER BUSINESS

11. Chairperson's Report

Chairperson Lutzker thanked the outgoing Council members and Chair for their service.

12. Council Member Comments/Other Business

Chairperson Lutzker provided a summary of the air sensor workshop on November 19, 2014, hosted by the California Air Pollution Control Officers Association.

Member Bornstein commented on the value and importance of continued collaboration between the Air District and the South Coast Air Quality Management District (SCAQMD). Member Bornstein and staff discussed how the SCAQMD modelling compares to that of the Air District.

Member Altshuler announced the availability of a phone application that senses noise levels.

Member Kurucz noted recent news reports regarding increases in average temperatures.

13. Time and Place of Next Meeting:

Wednesday, February 11, 2015, Bay Area Air Quality Management District Headquarters, 939 Ellis Street, San Francisco, CA 94109 at 9:00 a.m.

14. Adjournment: The meeting adjourned at 12:27 p.m.

Sean Gallagher
Clerk of the Boards

BAY AREA AIR QUALITY MANAGEMENT DISTRICT

Memorandum

To: Chairperson Liza Lutzker and Members
of the Advisory Council

From: Jack P. Broadbent
Executive Officer/Air Pollution Control Officer

Date: January 28, 2015

Re: Discussion of Draft Report on the Advisory Council's Meeting on October 8, 2014

The draft report of the October 8, 2014, Advisory Council Meeting on *Energy Storage and Smart Grid Technologies and Their Relationship to the 2050 Greenhouse Gas Goals* will be discussed, finalized and considered for approval.

Respectfully submitted,

Jack P. Broadbent
Executive Officer/APCO

Prepared by: Sean Gallagher
Reviewed by: Maricela Martinez

Attachment: Draft Report of the Advisory Council's Meeting on October 8, 2014

EXECUTIVE SUMMARY

This report summarizes activities of the Advisory Council during October 2014, consolidating a presentation received, and subsequent discussion and consideration by Council members. It is the intent of the Council to continue study of this topic during the early portion of 2015. As more information is received and evaluated by the Council, conclusions and recommendations are expected to evolve and will be documented in future reports.

The following presentation was made at the October 8, 2014 Advisory Council meeting:

The Integrated Grid: Energy Storage and Smart Grid Technologies and their Relationship to 2050 GHG Goals

Haresh Kamath

Program Manager

EPRI, Electric Power Research Institute, Palo Alto, CA

A video recording of this presentation and the Council's discussion is available at: http://baaqmd.granicus.com/MediaPlayer.php?publish_id=ee8a8cdd-4f30-11e4-bf9a-00219b9a9d7d

EPRI states that its mission is to conduct research, development, and demonstration on key issues facing the electricity sector on behalf of their funding members, energy stakeholders, and society. EPRI does not advocate any particular position, but provides information about the effects of policy decision systems as it relates to the electric utility industry. EPRI receives funding from electric utilities as well as other sources.

Building on other presentations to the Council in 2014 focusing on energy conservation and renewable sources of energy, the October meeting focused on energy storage and integrated electric transmission systems, aka smart electric grids.

Assimilating the information together regarding the sources of renewable energy, grid reliability, the need for energy storage, and the necessity of back-up generation when renewable power is not available, it is apparent to the Advisory Council that the District needs to pay particular attention to the role of existing and future back up generation facilities located within the Bay Area as they may play a larger role in supporting the electric grid as more and more sources of renewable electricity come on line. To that end, the Council recommends that the Air District:

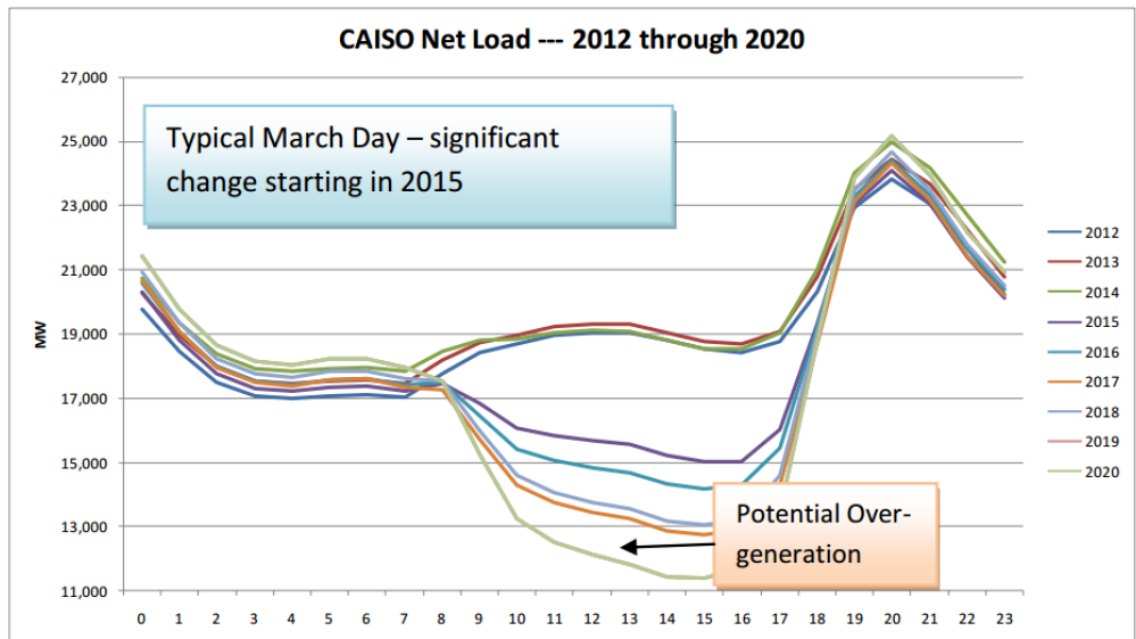
1. work with other key stake holders (PG&E, CPUC, ARB, CEC, etc.) to strategically evaluate network reliability and the network of Back-up Generators (BUGs) to see if we are optimally positioned and coordinated for the future.
2. evaluate the permitting process for BUGs, amending as necessary, to ensure that it is consistent with air quality and climate change goals and criteria.

BACKGROUND

Managing the Electric Energy Flow in CA

1. Energy storage (primarily electricity in concept) is key as we head towards an electric system that is increasingly powered by renewable sources of electricity. Solar and wind power are notable in their inability to provide power 24/7 due to their inherent nature of dependence on variable sun and wind patterns from one hour to the next as well as day or month. Hydro power is variable depending on the season and previous winter's precipitation.
2. The duck curve (below), a graph of net electric load (the load after variable renewable generation is accounted for), graphically shows the potential problem of misaligned renewable energy supply and peak energy demand. Peak generation occurs mid-afternoon but peak demand occurs at the end of each day between 1800 and 2300 hours: after the sun goes down and the wind speeds decrease. Evening and night loads are served primarily by fossil fueled generators. After a certain point, adding more renewables to the generation mix no longer reduces GHGs unless demand can be shifted to daylight hours or renewable energy can be stored for night-time hours.

Bulk-System Operating Challenges



Source: CAISO

3. Energy storage using advancements in lithium ion batteries technology is being applied to the grid, but it is early in its development. Batteries, however, are likely to continue to be expensive, inefficient, and relatively short-lived.

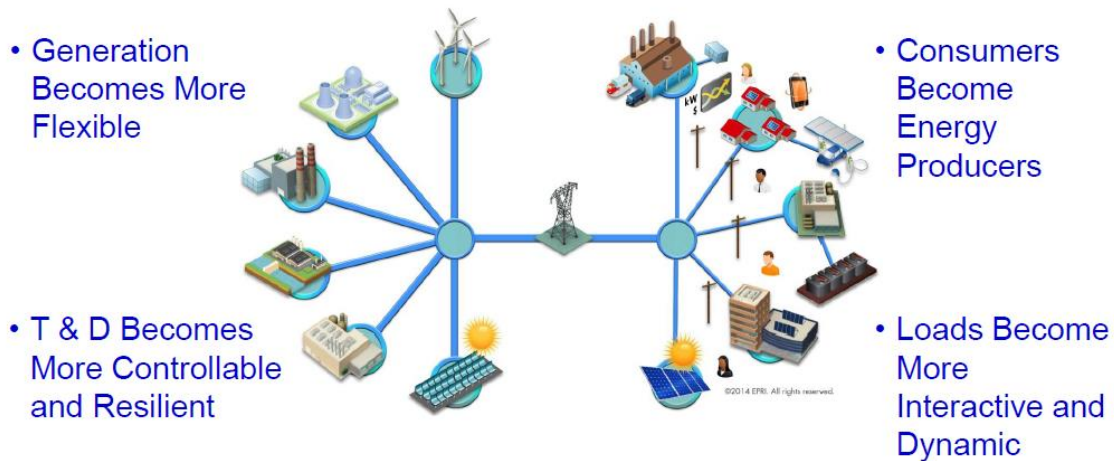
4. Within the last 4 years, new EVs have been added to the US fleet representing 5 GWh of storage capacity. It is unknown what kind of system storage benefit these batteries could offer if they were properly networked together. Such an approach is theoretically possible but would face significant technical, economic and regulatory hurdles.
5. California has set a goal of adding storage capacity equivalent to 2% of grid capacity by 2020 (1325MW); California already has 1.5% storage; Europe already has 5% and Japan has 10-15%.
6. Pumped storage is relatively efficient, and can scale to increase capacity, but has environmental issues. New opportunities are also limited: "All the good locations have been taken." However, as the value of storage increases, developers may consider new sites that were previously considered economically unfeasible. PG&E has a large pumped storage power plant (Helms Power Plant) east of Fresno. Pumped storage is the single largest storage technology currently in use by a wide margin.
7. Compressed air has been explored as an energy storage mechanism but has not been fully developed. Underground caverns in California from depleted natural gas fields are being considered. Germany and Alabama have 400 MW demonstrated energy storage using compressed air.
8. Energy can be stored by making hydrogen from excess renewable electricity, however significant challenges exist (low conversion efficiency, 25%). Hydrogen is a huge opportunity for use as storage, but is not ready now.
9. Thermal storage combined with concentrated solar thermal generation and the use of flywheels are other energy storage concepts that may emerge as viable.
10. More advanced solutions to bulk energy storage are projected to be two decades away. While research into advanced storage continues, storage implementation is likely to be dominated by present-day technologies at least for the next ten years and are likely to be most effective at smaller scales.
11. Demand response management and energy conservation may offset some storage capacity needs.

Integrated Transmission Systems/Smart Grids

1. Highly reliable, stable voltage, stable frequency (60 cycles), affordable, and safe access of the public electricity is critical today in our ever increasing digital world. An electric transmission and distribution system plays a critical role in managing these attributes and is essential in connecting sources of electricity to the end users. Historically, a small number of large remote power plants provided electricity to users throughout the state. With the production of electricity at many small sources (distributed generation), often operating intermittently when the sun shines or the wind blows, new challenges emerge that change how the grid operates. Think of the grid as "just in time delivery of electricity" and the unique challenges that it creates

- for power production and transmission. Grids are not currently designed to have electricity flow "backwards" as it will exist with renewable sources of electricity in the future (e.g., homeowner roof top PV arrays feeding power into the grid during the day while drawing power from the grid in the evenings). The grid will have to be modified to operate in the future as an increasing number of sources go on line.
2. The current interconnected grid provides a number of essential services even to consumers with distributed generation sources, including power reliability, start up power, energy efficiency, voltage quality, and energy transactions. We need to move to an integrated grid that allows distributed generation to enhance grid operation for everyone, by providing the additional services of resiliency, voltage support, emissions reductions, loss reduction, demand response, and distribution optimization.
 3. 0-36 GW of electric capacity variation occurs in Germany's renewable energy sources (primarily solar and wind). They run coal plants to fill voids, which has resulted in greater CO₂ emissions. It is presently unknown how variable California's renewable energy portfolio is. Natural gas use in power plants is the default scenario followed by energy storage is the backup mechanism projected for California
 4. Demand response allows utilities to meet peak electrical demand by influencing or managing the demand of electricity by customers. For example, some customers willingly curtail electric usage (e.g., cut off air conditioners) during times of high electric demand. Perhaps future charging of electrical vehicles will be controlled to occur after evening peak loads or during the day through workplace charging, if solar power is abundant enough to allow low-cost charging approaches.
 5. Zero energy homes, while not consuming more energy than they produce on an annual basis, must still be connected to the grid in order to receive electricity when electric demand exceeds the home's ability to provide power (the sun isn't shining). The grid must be designed to still handle peak power demands though less and less electricity comes from central generation on an annual basis as more zero energy homes are built.
 6. The single biggest challenge to integrated grid? Changing the industry mind set of utility executives and regulators. Other industries have undergone similar cultural shifts; for example, the break-up of the AT&T monopoly in 1982 led to a telecom industry transform that has introduced radical and unforeseen changes to business models, particularly in the last 5-10 years..

The Future Power System – Integrated



A More *Dynamic* End-to-End Power System

Renewable Power and Distributed Power

1. Distributed generation refers to generation of electricity at localized sites. Distributed Energy Resources (DER) includes such things as home and business owned solar panels, fuel cells, back-up generators, storage facilities, etc. Fuel cells at customer locations are 50% efficient, but they are expensive. Combined heat and power allocates waste heat from distributed generation plants to space heating, water heating, and industrial processes requiring heat, thereby improving overall energy efficiency to 80-90%.
2. Solar PV costs have dropped dramatically to the point that they are cheaper than installation of conventional large fossil fueled power plants when normalized on a \$/kW of unit production capacity. This metric is a little deceptive in that a fossil power plant can produce power 8760 hours each year while solar and wind have more limited hours of operation. However, the energy for solar and wind power plants is free while the energy for fossil fuel is costly and escalating with inflation. That there are operations and maintenance costs associated with all power plants.
3. Utility scale solar power plants produce more power than the aggregate sum of all domestic solar panels.
4. A renaissance of natural gas usage with its low cost is occurring with its abundance of supply. Combined cycle power plants are 50+% efficient, less transmission line loss.
5. For now, natural gas is the fuel of choice for power plants in the US, filling the void when renewable power is not available.

Reconciling with other speakers

1. The key take away from Haresh Kamath is that significant storage capacity or reserve generation capability (likely to be powered by fossil fuels though it could be nuclear or hydro) are needed to support an electric grid powered entirely by renewable power (WWS). Load curtailment is another option to help stabilize the grid. When over-production from renewable sources occurs, storage capacity is needed for the excess energy. Other speakers earlier in 2014 did not address this. Currently, we have only 1.5% storage capacity with another 2% mandated by 2020 in California.
2. The concept of doing all that is possible to meet the 2050 goals, as discussed by Jim Williams and Jane Long, is consistent with the presentation by Haresh Kamath.

KEY EMERGING ISSUES RELEVANT TO THE BAY AREA

1. Grids are not currently designed to have electricity flow "backwards" as it will exist with renewable sources of electricity in the future (e.g., homeowner roof top PV arrays feeding power into the grid during the day while drawing power from the grid in the evenings). The grid will have to be modified to operate in the future as an increasing number of sources go on line.
2. Managing the load and making it match the renewable resource is critical to maintain electric grid reliability. Even with a home solar system, there is a need to be connected to the grid for reasons of electric reliability and stability, as well as to provide "start-up power" for such things as large appliances.
3. Embedded in the customer charges for electricity are the cost of the energy to produce the electricity, the cost of the power plants and its maintenance, and the cost of the transmission and distribution system. The latter two costs are fixed costs that are spread among all customers. As the usage of utility-generated electricity drops with the introduction of renewable power, the PUC and the utility will need to develop a system to recover fixed costs through adjustment in electric rates. The utility's capacity to meet peak demand must still be large, even though it will be operated at a lower capacity during most hours. The more that energy generation is distributed to the edges of the grid (such as with home solar), the less energy is being transmitted by the grid. This means a smaller and smaller base over which to spread the costs associated with operating and maintaining the grid itself. Kamath referred to this concept as "stranded assets", a common term in the utility industry. Thus, economic and equity challenges exist in the transition to a renewable grid.
4. Integrated grids have changed over the last 5 years, and will experience seminal changes within the next 10 years.
5. Voltage variation (e.g., due to passing clouds) is an issue with solar power; it is currently happening in grids supported by solar plants.
6. Germany has a "feed in tariff" where providers of renewable power are paid for new electric capacity added to the grid. The large number of solar arrays

- has resulted in voltage swings on the grid as solar energy is affected by passing clouds. To avoid such swings, a more flexible grid will be needed.
7. Germany experiences 0-36 GW of electric capacity variation due to their aggressive use of renewable energy sources (primarily solar and wind). This is cause for concern for the Bay Area when a similar shift to renewable occurs. Germany runs coal-fired plants to fill voids, which has resulted in greater CO2 emissions. It is presently unknown how variable California's renewable energy portfolio is. Natural gas use in power plants is the default scenario projected for California to fill the supply-demand gap unless significant energy storage mechanisms are developed.
 8. The permitted 7000 MW of back up generation (running on diesel fuel) within the Bay Area may be called upon more often in the future to support the grid and is cause for concern. Carbon sequestration of back up, fossil fueled power plants may be an option to reduce their carbon footprints.
 9. Energy storage and demand response work together to reduce the impact of power shortages during periods when renewable power is unavailable. All grid services need to be valued in the electric rate making process, including power quality, reliability, capacity, etc. Costs must be equitably allocated as the grid transforms. These issues remain under the review and domain of the CPUC. Efficiency measures should be considered a resource.
 10. There is a tradeoff between reliability and cost of electricity.
 11. Carbon capture and storage needs to be considered for use in gas power plants providing back-up power to fill voids.
 12. Having diverse sources of electricity is desirable. However we need more options than WWS unless large-scale storage and demand response options are available. Renewable power needs a complementary energy source that is low carbon. Coal and gas currently fill that void in different grids, but they are high carbon unless equipped with carbon sequestration.
 13. All eyes are on California on how we address storage and use of renewables.

RECOMMENDATIONS

In this report, the Council recommends that the Air District:

1. conduct an evaluation of benefits and costs associated with energy generation, distribution, transmission and use while considering air quality and climate change benefits.
2. consult and coordinate with relevant agencies and other stakeholders involved in energy-related planning (distributed generation and back-up generators) to ensure that the utilities and CPUC include these new electric resources in their planning process, e.g.,
 - Public agencies (e.g., CPUC, CEC, DOE, ARB, EPA)
 - Private sector (e.g., PG&E, refineries, other)
3. evaluate the permitting process for BUGs, amending as necessary, to ensure that it is consistent with air quality and climate change goals and criteria.

4. track the European experience with Feed-in Tariffs and their renewable power grids.
5. further evaluate carbon sequestration for power plants including power plants burning renewable fuels (waste, and biomass).
6. promote energy efficiency measures as a resource for the grid.
7. promote distributed generation power plants in combination with waste heat capture and use (i.e., Combined Heat and Power).

Acronyms:

Compressed air Energy Storage (CAES): Excess power from renewable electricity is used to compress air which is stored in underground reservoir (depleted gas field or natural caverns). The compressed air is then withdrawn and used to drive power plant turbines when electricity is in demand.

Demand Response: Changes in electric usage by end-use customers from their normal consumption patterns in response to changes in the price of electricity over time, or to incentive payments designed to induce lower electricity use at times of high wholesale market prices or when system reliability is jeopardized.¹

Duck curve: A graphic that utility companies use to illustrate concerns about mismatched renewable generation and demand (i.e., lack of availability of solar energy during high use early evening hours).

Feed in Tariff: A feed-in tariff drives renewable energy market growth by providing developers long-term purchase agreements for the sale of electricity generated from renewable energy sources.² These purchase agreements typically offer a specified price for every kilowatt-hour (kWh) of electricity produced and are structured with contracts ranging from 10 -25 years.³

Integrated Grid and Smart grid: an electric grid that collates many diverse and perhaps small sources of electricity into a functional grid capable of providing reliable, stable, cost effective, and safe electricity.

Load: The amount of electric power delivered or required over a given period at a constant rate.

Stranded Assets: a concept relating to being able to capture the cost, through rate making, of power plants and transmission lines when distributed generation and energy conservation reduce the sale of electricity produced by the utility. The current configuration of the electric utility is designed to provide power 24/7, 365 days a year. This allows fixed costs of assets to be spread out over the year. With

¹ Federal Energy Regulatory Commission, <http://www.ferc.gov/industries/electric/indus-act/demand-response/dr-potential.asp>, accessed Oct. 24, 2014

² Menanteau, P.; Finon, D.; Lamy, M. (2003). "Prices versus quantities: choosing policies for promoting the development of renewable energy." *Energy Policy*, (31, 8); pp. 799–812. As cited in *A Policy-maker's Guide to Feed-in Tariff Policy Design (NREL)*, <http://www.nrel.gov/docs/fy10osti/44849.pdf>, accessed Oct. 24, 2014

³ Klein, A. (2008). *Feed-in Tariff Designs: Options to Support Electricity Generation from Renewable Energy Sources*. Saarbrücken, Germany: VDM Verlage De. Muller Aktiengesellschaft & Co. KG. As cited in *A Policy-maker's Guide to Feed-in Tariff Policy Design (NREL)*, <http://www.nrel.gov/docs/fy10osti/44849.pdf>, accessed Oct. 24, 2014

energy conservation and distributed generation, there is less opportunity for the utility to recover its cost of generation and transmission assets.

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WWS: Wind, water, solar power

Zero Energy Homes: homes designed to produce enough electricity to meet their annual needs though the homes still need to be connected to the grid to ensure that electricity is available 24/7. Key is the concept that the solar panels of these homes provide extra electricity to the grid and that the homes are built to use energy efficiently