BAY AREA
AIR QUALITY
MANAGEMENT
DISTRICT

ADVISORY COUNCIL
REGULAR MEETING & RETREAT

WEDNESDAY
JANUARY 14, 2015
9:00 A.M.

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

AGENDA

CALL TO ORDER

1. **Opening Comments** — **Liza Lutzker, Chairperson**
   Roll Call — **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 Air 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.

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

   The Advisory Council will consider approving the draft minutes of the Advisory Council meeting of November 12, 2014.

RECOGNITION

4. **Recognition of Outgoing Advisory Council Members** — **Liza Lutzker, Chairperson**

   The Council will recognize outgoing Advisory Council members.

5. **Recognition of Outgoing Advisory Council Chairperson** **Liza Lutzker, Chairperson**

The Council will recognize outgoing Chairperson, Sam Altshuler, for his dedicated leadership, and service to air quality in the Bay Area.

RETREAT Staff/Phone (415) 749-

6. **Review and Discussion of 2014** **S. Tanrikulu, Advisory Council Liaison/4787**

The Council will discuss the Advisory Council meetings, presentations and reports for 2014 with Air District staff.

7. **Discussion of 2015** **S. Tanrikulu, Advisory Council Liaison/4787**

The Council will discuss the future meetings, presentations, reports, processes, and related matters and potential changes for 2015 with Air District staff.

PRESENTATION

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

A speaker will present materials on the mitigation of urban heat island effects by increasing areas covered with vegetation and trees.

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

DISCUSSION

9. **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."

AIR DISTRICT OVERVIEW

10. **Report of the Executive Officer/Air Pollution Control Officer** **J. Broadbent, Executive Officer/APCO/5073**

Mr. Broadbent will provide an update on pending and planned Air District activities, policies and initiatives

OTHER BUSINESS

11. **Chairperson's Report** **Liza Lutzker, Chairperson**

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

12. **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.

13. **Time and Place of Next Meeting**

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

14. **Adjournment**

The Advisory Council meeting shall be adjourned by the Chairperson.

CONTACT:

MANAGER, EXECUTIVE OPERATIONS **(415) 749-5016**
939 ELLIS STREET, SAN FRANCISCO, CA 94109 **FAX: (415) 928-8560**
mmartinez@baaqmd.gov **BAAQMD homepage:**
www.baaqmd.gov

- 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

JANUARY 2015

TYPE OF MEETING	DAY	DATE	TIME	ROOM
Board of Directors Regular Meeting *(Meets on the 1st & 3rd Wednesday of each Month)* - **CANCELLED**	**Wednesday**	**7**	**9:45 a.m.**	**Board Room**
Advisory Council Special Meeting/Retreat *(Meets on the 2nd Wednesday of each Month)*	**Wednesday**	**14**	**9:00 a.m.**	**Board Room**
Board of Directors Climate Protection Committee – *(Meets 3rd Thursday every other Month)*	**Thursday**	**15**	**9:30 a.m.**	**Board Room**
Board of Directors Executive Committee *(Meets on the 3rd Monday of each Month)* - **CANCELLED**	**Monday**	**19**	**9:30 a.m.**	**Board Room**
Board of Directors Special Meeting/Retreat *(Meets on the 1st & 3rd Wednesday of each Month)*	**Wednesday**	**21**	**9:45 a.m.**	**City of SSF Municipal Services Building – 33 Arroyo Drive, South San Francisco, CA 94080**
Board of Directors Mobile Source Committee *(Meets on the 4th Thursday of each Month)*	**Thursday**	**22**	**9:30 a.m.**	**Board Room**
Board of Directors Personnel Committee *(At the Call of the Chair)*	**Monday**	**26**	**9:30 a.m.**	**Board Room**
Board of Directors Budget & Finance Committee *(Meets on the 4th Wednesday of each Month)*	**Wednesday**	**28**	**9:30 a.m.**	**Board Room**

FEBRUARY 2015

TYPE OF MEETING	DAY	DATE	TIME	ROOM
Board of Directors Regular Meeting *(Meets on the 1st & 3rd Wednesday of each Month)*	**Wednesday**	**4**	**9:45 a.m.**	**Board Room**
Advisory Council Meeting *(Meets on the 2nd Wednesday of each Month)*	**Wednesday**	**11**	**9:00 a.m.**	**Board Room**
Board of Directors Executive Committee *(Meets on the 3rd Monday of each Month)*	**Monday**	**16**	**9:30 a.m.**	**Board Room**

FEBRUARY 2015

TYPE OF MEETING	DAY	DATE	TIME	ROOM
Board of Directors Regular Meeting *(Meets on the 1st & 3rd Wednesday of each Month)*	**Wednesday**	**18**	**9:45 a.m.**	**Board Room**
Board of Directors Budget & Finance Committee *(Meets on the 4th Wednesday of each Month)*	**Wednesday**	**25**	**9:30 a.m.**	**Board Room**
Board of Directors Mobile Source Committee *(Meets on the 4th Thursday of each Month)*	**Thursday**	**26**	**9:30 a.m.**	**Board Room**

MARCH 2015

TYPE OF MEETING	DAY	DATE	TIME	ROOM
Board of Directors Regular Meeting *(Meets on the 1st & 3rd Wednesday of each Month)*	**Wednesday**	**4**	**9:45 a.m.**	**Board Room**
Advisory Council Special Meeting *(Meets on the 2nd Wednesday of each Month)*	**Wednesday**	**11**	**9:00 a.m.**	**Board Room**
Board of Directors Executive Committee *(Meets on the 3rd Monday of each Month)*	**Monday**	**16**	**9:30 a.m.**	**Board Room**
Board of Directors Regular Meeting *(Meets on the 1st & 3rd Wednesday of each Month)*	**Wednesday**	**18**	**9:45 a.m.**	**Board Room**
Board of Directors Climate Protection Committee *– (Meets 3rd Thursday every other Month)*	**Thursday**	**19**	**9:30 a.m.**	**Board Room**
Board of Directors Budget & Finance Committee *(Meets on the 4th Wednesday of each Month)*	**Wednesday**	**25**	**9:30 a.m.**	**Board Room**
Board of Directors Mobile Source Committee *(Meets on the 4th Thursday of each Month)*	**Thursday**	**26**	**9:30 a.m.**	**Board Room**

AGENDA: 3

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 5, 2015

Re: Approval of the Minutes of the Advisory Council Meeting on November 12, 2014

RECOMMENDED ACTION

Approve the attached draft minutes of the regular meeting of the Advisory Council on November 12, 2014.

DISCUSSION

Attached for your review and approval are the draft minutes of Advisory Council meeting on November 12, 2014.

Respectfully submitted,

Jack P. Broadbent
Executive Officer/APCO

Prepared by: Sean Gallagher
Reviewed by: Maricela Martinez

Attachment: Draft Minutes of the Advisory Council Meeting of November 12, 2014

Draft Minutes – Advisory Council Regular Meeting of November 12, 2014

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

DRAFT MINUTES

Advisory Council Regular Meeting
Wednesday, November 12, 2014

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:

Chairperson Sam Altshuler called the meeting to order at 9:04 a.m.

Roll Call:

Present: Chairperson Sam Altshuler, P.E.; Vice-Chairperson Liza Lutzker, M.P.H.; Secretary Jessica Range, LEED A.P.; and Members Robert Bornstein, Ph.D., Harold Brazil, Jonathan Cherry, A.I.A., Heather Forshey, Stan Hayes, John Holtzclaw, Ph.D., Kraig Kurucz, Bruce Mast and Laura E. Tam.

Absent: Members Ana M. Alvarez, D.P.P.D., Benjamin Bolles, Jeffrey Bramlett, M.S., C.S.P. (resigned), Frank Imhof, Rick Marshall, P.E., P.L.S., SaraT L. Mayer, M.P.P., Timothy O'Connor, Esq., and Estes Al Phillips (resigned).

Also Present: None.

Opening Comments:

The Clerk made an announcement regarding careful use of microphones during public meetings.

2. PUBLIC COMMENT ON NON-AGENDA ITEMS:

Floyd Earl Smith, East Bay Community Action Program/350 Bay Area, addressed the Advisory Council (Council) in gratitude for the webcasting of select Council meetings and the sharing of the presentations; to issue an informal invitation to an upcoming conference in May/June 2015; to note highlights from the presentation of Daniel M. Kammen, Ph.D.; and to request the webcasting of all public meetings.

NOTED PRESENT: Member Mast was noted present at 9:09 a.m.

3. APPROVAL OF THE MINUTES OF THE COUNCIL MEETING ON OCTOBER 8, 2014

Council Comments: None.

Public Comments: No requests received.

Council Action:

Member Bornstein made a motion, seconded by Member Holtzclaw, to approve the minutes of the Council meeting on October 8, 2014; and the motion carried by the following vote of the Council:

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

1. Opening Comments (continued):

Jean Roggenkamp, Deputy Air Pollution Control Officer, addressed the Council regarding the term expirations of various Council members and potential reappointments and to announce the appointment of Saffet Tanrikulu, Research and Modeling Manager of the Planning, Rules and Research Division, as the successor Council Liaison to Eric Stevenson, Director of Technical Services.

The Council and staff discussed the timing of the Council's annual presentation to the Board of Directors (Board).

DISCUSSION

4. Discussion of Draft Report on the Council's Meeting on September 10, 2014

Council Comments:

The Council deliberated upon proposed revisions to the draft report on the Council meeting on September 10, 2014.

Public Comments: No requests received.

Council Action:

Member Holtzclaw made a motion, seconded by Member Hayes, to approve the draft report on the Council meeting on September 10, 2014, as amended at today's meeting and subject to grammatical changes by Member Bornstein; and the motion carried by the following vote of the Council:

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

OTHER BUSINESS

5. Selection of Slate of Officers for 2015 (Out of Order Agenda Item 9)

Council Comments: The Council discussed a Slate of Officers for 2015.

Public Comments: No requests received.

Council Action:

Member Hayes made a motion, seconded by Member Lutzker, to appoint Member Lutzker as Chairperson, Member Range as Vice-Chairperson and Member Cherry as Secretary; and the motion carried by the following vote of the Council:

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

6. Future Topics for the Current Council (Out of Order Agenda Item 10)

Council Comments:

The Council and staff discussed potential future topics and invited the submission of suggestions for further discussion at the next Council meeting.

Public Comments:

Mr. Smith addressed the Council regarding the lack of public access to the list of potential topics; the importance of making this decision deliberately; the need for stakeholder input in advance of a decision being made; to suggest carbon tax as an additional topic; and to suggest an expanded geographic area for the "Wind Energy Potential in Northern California" topic.

Council Comments (continued):

The Council and staff discussed the meeting schedule and its compatibility with the potential topics and participated in an anonymous written ballot to determine the most preferred future topics.

Council Action: None; receive and file.

7. Discussion of Senate Bill (SB) 1415

Jack Broadbent, Executive Officer/Air Pollution Control Officer (APCO), addressed the Council in gratitude for their efforts; to summarize the Council role over the years and the provisions of SB 1415, as analyzed and considered for implementation by staff and the Board; and to suggest that further updates will be delivered to the Council as matters progress.

Council Comments:

The Council and staff discussed the current transition plan; the weighting of technical expertise versus geographical representation and politics during the recruitment process for the future Council; the maximum number of members in the future Council; Council representation at the Board retreat in January 2015; how the future Council member qualifications will be developed into eligibility criteria; the form of the future Council's relationship with the Board and staff; the need for Council encouragement from the Board and staff until June 2015; the recommendation to develop an enhanced relationship between the Board and future Council; possible Board and staff survey of the strengths and weaknesses of the current Council; what problem the Council is working to resolve through this line of discussion; the potential growth of the Board as the Bay Area population increases; the multitude of subjects being brought to the Air District at this time; the value of strong, scientific input for the Board, staff and public and hope that the future Council can provide it; increased public awareness of Air District activities as a positive development; the troubled history of the Council and improvements in recent history; consideration of Council input in the creation of a Council transition plan and creation of the future Council; an update on the formation of an Air District community council and community engagement efforts generally; and the Air District invitation to four Council members to attend the Air & Waste Management Association's 108th Annual Conference & Exhibition on June 22-25, 2015 in Raleigh, North Carolina.

Public Comments: No requests received.

Council Action: None; receive and file.

8. Report of the Executive Officer/APCO

Mr. Broadbent summarized Air District rule-making and refinery-related staff work expected through year end; announced that changes to the Office of Environmental Health Hazard Assessment guidelines that will impact Air District operations are expected to be issued soon; announced the beginning of the Spare the Air winter season and potential changes to the wood smoke rule; explained the genesis behind and expectations for the California Air Pollution Control Officers Association's upcoming conference, My Air Quality: Using Sensors to Know What's in Your Air on Wednesday, November 19 in Northern California and on Friday, November 21, 2014 in Southern California.

Public Comments:

Mr. Smith addressed the Council in gratitude for Mr. Broadbent's comments about the importance of public involvement; to re-characterize comments made about refinery crude stocks and facility modernization projects; and to suggest the Council has a strong role in deciding how refinery operations will proceed.

Council Comments:

The Council and staff discussed potential changes to the wood smoke rule and recruitment updates regarding the Health and Science Officer and Community Engagement Manager at the Air District.

The Council recessed at 11:06 a.m.

The Council resumed at 11:16 a.m.

6. Future Topics for the Current Council (Out of Order Agenda Item 10 Continued)

Council Comments:

The Council and staff discussed the results of the anonymous written ballot to determine the most preferred future topics.

Public Comments: No requests received.

Council Action: The Council directed staff to agendize future topics, in descending order of popularity, based on speaker availability.

DISCUSSION (CONTINUED)

9. Discussion of Draft Report on the Council's Meeting on October 8, 2014 (Agenda Item 5)

Council Comments:

The Council deliberated upon proposed revisions to the draft report on the Council meeting on October 8, 2014.

Public Comments: No requests received.

Council Action: None; receive and file.

10. Discussion of Council Presentation to the Board (Agenda Item 6)

Council Comments:

The Council and staff discussed the Council presentation to the Board; potential schedules for future Council meetings, reports and presentations; the request for a review or evaluation of the Council by the Board and staff before June 2015; the need and potential topics for a Council retreat, as opposed to a regular meeting, in January 2015; the approach to and timing of the Council presentation to the Board; and possible public outreach by the Council regarding the substance of the final report before presenting to the Board.

Public Comments: No requests received.

Council Action: None; receive and file.

OTHER BUSINESS

11. Chairperson's Report: None.

12. Council Member Comments/Other Business:

Member Hayes thanked Chairperson Altshuler for his service as Chairperson and Mr. Stevenson for his service as Council Liaison.

13. Time and Place of Next Meeting:

Wednesday, January 14, 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 12:20 p.m.

Sean Gallagher
Clerk of the Boards

AGENDA: 6

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 5, 2015

Re: Review and Discussion of 2014

RECOMMENDED ACTION

None; receive and file.

DISCUSSION

The Council will discuss the Advisory Council meetings, presentations and reports for 2014 with Air District staff.

Respectfully submitted,

Jack P. Broadbent
Executive Officer/APCO

Prepared by: Sean Gallagher
Reviewed by: Maricela Martinez

AGENDA: 7

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 5, 2015

Re: Discussion of 2015

RECOMMENDED ACTION

None; receive and file.

DISCUSSION

The Council will discuss the future meetings, presentations, reports, processes, and related matters and potential changes for 2015 with Air District staff.

Respectfully submitted,

Jack P. Broadbent
Executive Officer/APCO

Prepared by: Sean Gallagher
Reviewed by: Maricela Martinez

BAY AREA
2010 CLEAN AIR PLAN

VOLUME II

Section E

Energy and Climate Measures

September 2010

Only two sections are included for the purpose of Advisory Council information:

ECM 3 - Urban Heat Island Mitigation

ECM 4 - Shade Tree Planting

The rest of the document can be downloaded from:
http://www.baaqmd.gov/Divisions/Planning-and-Research/Plans/Clean-Air-Plans.aspx

ECM 3 - Urban Heat Island Mitigation

Brief Summary:
The control measure includes regulatory and educational approaches to reduce the "urban heat island" (UHI) phenomenon by increasing the application of "cool roofing" and "cool paving" technologies.

Purpose:
The purpose of this control measure is to mitigate the urban heat island phenomenon. Reducing UHI effects can help to reduce ozone levels, as well as emissions of particulate matter (PM), air toxics and greenhouse gases related to energy consumption for air conditioning and cooling. In addition, it can help to offset temperature increases related to global warming.

Source Category Affected:
The sources of emissions affected by this control measure are primarily associated with electricity generation for buildings and evaporative emissions from automobiles.

Regulatory Context and Background:
As urban areas develop, natural, permeable surfaces and vegetation are replaced by impermeable structures and paved surfaces. This development transforms the area into a drier micro-environment, which absorbs, rather than reflects, the heat of the sun. Thus, urban heat islands are created, which can be up to 10^0 F hotter than natural background temperatures.
Factors that contribute to UHI formation include the following:

- Many man-made surfaces are composed of dark materials that absorb and store the sun's heat.
- Buildings, industrial processes, motor vehicles and people produce anthropogenic heat.
- Loss of trees and vegetation due to urbanization causes a reduction in cooling from evapo-transpiration.
- Urban structures can form canyons that reduce ventilation and trap heat.

Elevated temperatures caused by UHIs can accelerate the formation of ground level ozone, or smog, and can contribute to adverse health impacts, such as respiratory and heat-related ailments. Higher temperatures can also result in increased electricity use to cool buildings. Mitigation methods include increasing the reflectivity of built surfaces, such as roads, parking lots and rooftops, increasing tree-cover and natural vegetation (for shading and the cooling effect of evapo-transpiration), and increasing ventilation.

Cool Paving: On average, about 12% of an urban city's land area is devoted to parking lots. This number can be even higher in suburban communities.

Many parking lots are resurfaced every 5-10 years. The amount of parking lot construction and re-surfacing that occurs in the Bay Area provides a significant opportunity to increase albedo (reflectivity) while providing ancillary benefits such as an extended life of the paved surface and storm water benefits associated with use of porous paving.

The hottest pavements tend to be impermeable and dark in color, with solar reflectance values (albedo) under 25%. These pavements can heat to 150^{o}F or more on hot days. Utilizing cool paving techniques can reduce this temperature by 30^{o}F or more. There are two ways to make pavements cooler: 1) by increasing albedo, and 2) by increasing their ability to store and evaporate water.

Cool Roofs: Most existing flat roofs have an albedo (reflectivity) of only 10 to 20 percent of sunlight. These roofs absorb much of the remaining solar radiation and heat up the buildings they cover. Cool roofing technologies, such as lighter or more reflective paint, coatings, membranes, shingles or tiles, can increase a roof's albedo, on average, to about 50-60%. A 2000 study by Lawrence Berkeley National Laboratory revealed a 13-18% reduction in air conditioning-related electricity use in residential and commercial buildings in San Jose due to the application of cool roof strategies.

While cool roofing reduces the need for air conditioning during periods of heat, it can have an opposite impact during periods of cold by reflecting solar radiation away from the buildings, requiring an increase in heating during winter months. In most locations, the balance of these two effects results in a net reduction in energy use. However, in some locations, there may not be an energy reduction benefit from the application of cool roof technologies. Air District staff will continue to follow research efforts in this area.

Implementation Actions:
Control measure consists of the following components:

- Promote building code requirements for new construction or re-roofing/roofing upgrading for commercial and residential multi-family housing to meet specific "cool roof" standards.
- Include minimum "cool roof" standards for new commercial and residential multi-family housing construction and re-roofing or roofing upgrades in specified areas as mitigation measures under the District's CEQA Guidelines and ISR rule.
- Develop and promote adoption of a model zoning ordinance for "cool paving" standards to be met when existing parking lots undergo re-surfacing.
- Provide training for public works staff and private construction/paving companies on benefits of and how to meet new cool paving standards.
- Encourage construction of new and re-surfacing of existing parking lots and other paved surfaces to meet minimum reflective and permeable surface standards by including this as a mitigation measure under the District's CEQA Guidelines and ISR rule.
- Perform outreach to cities and counties to make them aware of the benefits of cool roofing and cool paving, and of new tools available.

- Provide training for building inspectors on benefits of and how to meet new cool roofing standards.

Emission Reductions:
Lawrence Berkeley National Laboratory's (LBNL) Heat Island Group conducted a study of the impacts that surface lightening of rooftops and pavement, combined with tree shading, might have on the Los Angeles air basin. The study found that the widespread application of these combined activities could achieve a decrease in ambient air temperature of 3°C. Half of this temperature reduction is due to albedo (roofs and pavement) and half to trees.

While no similar study has been conducted for the Bay Area, the results can be applied to similar temperature zones, such as San Jose and the Diablo Valley. This reduction in ambient air temperature would result in a reduction in electricity use to cool buildings. While no empirical studies have been conducted for the Bay Area, studies of individual buildings by LBNL, the Florida Solar Energy Center, and others have shown that energy savings on the order of 20% to 30% are commonly achieved with a cool roof surface.

Contra Costa County, Napa County, Santa Clara County and approximately half of Solano County are expected to be the most appropriate locations for applications of cool roofs in the Bay Area Air Quality Management District's jurisdiction due to their warmer temperatures and higher use of air conditioning. It is assumed that cool roofs in these counties would reduce air conditioning-related electricity use by 20%.

Emission reductions are in short tons/day (metric tons/day for CO2)

Source Category	MWh	CO2 (MT)	PM10	PM2.5	ROG	Nox	SO2	CO
Electricity	80	23	0.015	0.15	<0.01	0.03	0.02	0.03

Emission Reduction Methodology:
Factors for greenhouse gas emissions from electricity use are based solely on the amount of electricity used. Factors for criteria air pollutant emissions, on the other hand, are based not just on the amount of energy used, but also on the specific technology being utilized at the power plant. Therefore, it is far more complicated to develop an emissions factor for criteria pollutants, and the numbers in the table above should be treated as general estimations and not specific projections.

Coefficients to translate electricity use into CO2 emissions were taken from the California Climate Action Reserve General Reporting Protocol, version 3.1, using the most recently CCAR-approved coefficient for PG&E (for year 2007). Electricity coefficients for PM, ROG, NOx, SO2 and CO were derived by Air District staff based on regional averages of emissions factors from power plants in the region.

Estimations for electricity used for air conditioning in the selected counties was taken from the Energy Information Administration's (EIA) 2001 Residential Buildings Energy

Consumption Survey and the California Energy Commission's (CEC) 2006 California Commercial End-Use Survey. Data on energy consumption by county and by sector from the CEC's Energy Consumption Data Management System was used to estimate the amount of electricity used for air conditioning that occurred in these counties.

Exposure Reduction:
This measure would help reduce smog formation by reducing the ambient air temperature, particularly in areas that experience excessive heat. It would be especially effective in reducing population exposure in those areas of the Bay Area that experience higher daily ambient temperatures, like San Jose, Concord, and San Leandro/East Oakland.

Emission Reduction Trade-offs:
It is unlikely that this measure would increase any emissions appreciably. However, caution would have to be taken in compiling the technology specifications to ensure that products that could produce toxic emissions during their use are not recommended.

Cost:
Cool roofs deflect some desired heat gain during the winter. In general, though, cool roofs result in net energy savings, especially in areas where electricity prices are high.

Although costs will vary greatly depending on location and local circumstances, the cost premium for cool roofs versus conventional roofing materials ranges from zero to 5 or 10 cents per square foot for most products, or from 10–20 cents for a built-up roof with a cool coating used in place of smooth asphalt or aluminum coating.

A California study found that cool roofs provide an average yearly net savings of almost 50 cents per square foot. This number includes the price premium for cool roofing products and increased heating costs in the winter as well as summertime energy savings, savings from downsizing cooling equipment, and reduced labor and material costs over time due to the longer life of cool roofs compared with conventional roofs.

A 2007 study titled "California Rooftop Photovoltaic (PV) Resource Assessment and Growth Potential by County," conducted by Navigant Consulting for the CEC's PIER program provided estimated roof space for the residential and commercial sectors within the selected counties. An estimated cost of 10 cents per square foot was used to calculate the cost of applying cool roof technologies to this potential roof space. Assuming a cool roof penetration program rate of 10%, we estimated upfront capital cost of $7,600,637 for the residential sector and $2,311,504 for the commercial sector.

	Residential	Commercial	Total
Upfront Capital Costs	$7,600,637	$2,311,504	$9,912141
Annual Savings	$38,003,185	$11,557,521	$49,560,706
Net Annual Savings	$30,402,548	$9,246,017	$39,648,565

To estimate the electricity cost savings that would be achieved in the residential sector, we again reference the California Energy Commission's Energy Consumption Data Management System for the amount of expenditures in California for electric Air Conditioning in 2007. This was then scaled down based on the share of statewide electricity used by the selected counties, and reduced by 80% to arrive at the amount of electricity use that would be avoided by cool roofs. We largely used the same methodology for the commercial sector, except that we did not have actual expenditure data. Instead, we consulted the Energy Information Administration's Average Retail Price of Electricity to Ultimate Customers by End-Use Sector, by State report to find the average retail price of electricity. This was then applied to the scaled down air-conditioning electricity consumption data.

Co-Benefits:
Heat island mitigation measures bring a number of co-benefits to a community, including:

- improved air quality
- improved public health (lower risk of respiratory and heat-related ailments)
- energy savings
- financial savings through reduced energy usage
- green job creation (local suppliers/contractors for installing technologies)

Monitoring Mechanisms:
Monitoring and evaluating progress could include:

- Tracking how many cool roof building codes are adopted
- Measuring increases in square footage of cool roofs, both in new construction and existing buildings
- Measuring increases in square footage of cool parking lots

Issues / Impediments:
Advocating for building code requirements that include "cool roof" standards for re-roofing/roofing upgrades may raise concerns about a potential increase in up-front costs among some stakeholders, such as the construction and development industries or local governments. Similar requirements for "cool paving" may also raise concerns due to a lack of information on the availability and sourcing of these technologies and products. By promoting and encouraging adoption of these types of policies, the Air District will facilitate demonstration of the actual cost benefits of such policies and work toward overcoming these barriers.

Sources:

1) Cool Houston: A Plan for Cooling the Region (2004)
2) Heat Islands: Understanding and Mitigating Heat in Urban Areas; Gartland (2008)
3) California Energy Commission, http://www.energy.ca.gov/title24/coolroofs/
4) http://www.energy.ca.gov/title24/coolroofs/documents/QUESTIONS-ANSWERS_BUILDING-OWNERS.PDF
5) USEPA, http://www.epa.gov/heatisland/

6) Consumer Energy Center, http://www.consumerenergycenter.org/coolroof/faq.html#faqs-04
7) Cool Roof Rating Counsel, http://www.coolroofs.org/coolroofing.html; http://www.autolife.umd.umich.edu/Environment/E_Casestudy/E_casestudy2.htm; http://www.concretenetwork.com/pervious/environ_benefits.html
8) California Energy Commission. Energy Consumption Data Management System. Available online: http://ecdms.energy.ca.gov/elecbycounty.aspx
9) Energy Information Administration, 2001. Residential Buildings Energy Consumption Survey (RECS), Consumption and Expenditure Data Tables. Available online: http://www.eia.doe.gov/emeu/recs/recs2001_ce/2001tblce.html
10) California Energy Commission, March 2006. California Commercial End-Use Survey. Publication # CEC-400-2006-005, Table 8-2, p.153. Available online: http://www.energy.ca.gov/ceus/
11) Navigant Consulting, Inc. 2007. California Rooftop Photovoltaic (PV) Resource Assessment and Growth Potential by County, California Energy Commission, PIER Program. CEC-500-2007-048. Available online: https://norman.baaqmd.gov/exchweb/bin/redir.asp?URL=http://www.energy.ca.gov/2007publications/CEC-500-2007-048/CEC-500-2007-048.PDF
12) Energy Information Administration, November 2009. Average Retail Price of Electricity to Ultimate Customers by End-Use Sector, by State, Available online: http://www.eia.doe.gov/cneaf/electricity/epm/table5_6_b.html

ECM 4 - Shade Tree Planting

Brief Summary:
The control measure includes voluntary approaches to reduce the "urban heat island" phenomenon by increasing shading in urban and suburban communities through planting of (low VOC-emitting) trees and preservation of natural vegetation and ground cover.

Purpose:
The purpose of this control measure is to reduce ozone precursors, criteria pollutants (ozone, NO_2, PM10, SO_2) and greenhouse gases by mitigating the urban heat island phenomenon.

Source Category Affected:
The sources affected by this control measure include electricity generation as well as evaporative emissions from mobile sources.

Regulatory Context and Background:
As discussed in the Urban Heat Island control measure, due to their impermeable structures and paved surfaces, as well as a lack of vegetation, urban areas tend to absorb, rather than reflect, the sun's heat. These urban heat islands can be up to 10^0 F hotter than natural background temperatures. These elevated temperatures can accelerate the formation of ground level ozone, or smog. They can also result in increased electricity use to cool buildings. In addition, parked cars can release emissions from the vehicle's carburetor or fuel system. These "evaporative emissions" increase as ambient temperatures rise.

Planting trees through a comprehensive urban forestry program that includes goal-setting and ongoing management of the urban tree canopy can mitigate the urban heat island phenomenon and conserve energy use in three principal ways:

- Shading reduces the amount of the sun's energy absorbed and stored by built surfaces
- Transpiration converts moisture to water vapor and thus cools by using solar energy that would otherwise result in heating of the air
- Wind-speed reduction reduces the movement of outside air into interior spaces and conductive heat loss where thermal conductivity is relatively high (e.g., glass windows)

In addition, urban trees provide the following air quality and climate protection benefits:

- Absorbing gaseous pollutants (ozone, nitrogen oxides) through leaf surfaces
- Absorbing CO2 (carbon sequestration)
- Intercepting particulate matter (e.g., dust, ash, dirt, pollen, smoke)
- Reducing emissions (GHGs and criteria pollutants) from power generation by reducing energy consumption

- Releasing oxygen through photosynthesis
- Reduce evaporative emissions in parking lots
- Street trees also enhance conditions for pedestrians and cyclists, thus supporting alternatives to the automobile.

The Sacramento Municipal Utility District (SMUD) shade tree program has a goal to plant 500,000 trees in Sacramento. The tree planting program was found to produce net benefits from air conditioning savings. Three scenarios were assumed (base, highest, and lowest benefits) based on the SMUD program and a Best Available Control Technology cost analysis was performed to determine if shade trees planted in residential yards can be a cost effective means to improve air quality. Annual planting and maintenance costs, pollutant deposition, and biogenic hydrocarbon emissions were estimated over a 30-year period with existing models.

Some tree species emit volatile organic compounds (VOCs) which contribute to the formation of ground level ozone, particularly in hot weather. It is important for tree planting programs to carefully select the species to be planted, opting for low VOC-emitting species.

Implementation Actions:
Control measure consists of the following components:
- Include tree planting standards for new developments in specified areas as mitigation measures under the District's CEQA Guidelines and ISR rule
- Promote adoption of a model municipal tree planting ordinance, including tree planting in parking lots
- Provide information via outreach materials, presentations and workshops to local government planning and public works department staff on how to maximize air quality, GHG and public health benefits of municipal tree planting programs, including promoting the Bay-Friendly Landscape Guidelines
- Provide information on and encourage the use of low VOC-emitting tree species for new planting and, as appropriate, replanting
- Monitor the outcomes and findings of current tree planting programs, such as the Air District Climate Protection Grant to Urban ReLeaf for tree planting and air quality monitoring in West Oakland.

Emission Reductions:
Implementation actions #1 (include as mitigation options under CEQA and ISR) and #2 (promote municipal tree planting ordinances) are estimated to increase the Bay Area's tree canopy by 1% over the next 10 years, from the current 29% of land cover to 30%.

Increase in Canopy cover (%)	Canopy cover (%)	# of Trees	Increase in # of Trees
Baseline = 0	29	41,172,735	0
Ten year goal = 1	30	42,593,715	1,420,980

The table below illustrates the annual energy savings and emission reduction benefits of planting an average medium sized deciduous tree, in this case a Cherry Plum tree, in a residential neighborhood. Benefits are given for 1,420,980 ten year old trees (representing a 1% increase in existing tree canopy).

Emission reductions are in short tons/day (metric tons/day for CO2)

	MWh	CO2 (MT)	PM10	PM2.5	ROG	NOx	SO2	CO	BVOCs
Benefits for 1,420,980 trees	85,259	67.56	0.04	0.04	<0.01	0.07	0.062	0.09	-0.002

Emission Reduction Methodology:
Even low-voc trees will result in some release of biogenic VOC. This has been factored into the emission reduction estimates, and these emissions are listed as BVOCs in the table above.

The 1% target for increasing tree canopy is a more conservative, reduced target taken from the report, *"State of the Urban Forest: San Francisco Bay Area Progress Report"*, published by the Center for Urban Forest Research in 2007. This report examines a 3% increase in tree cover. Estimated energy savings were also taken from this report. In quantifying the emission reductions from this measure, coefficients to translate electricity into CO2 emissions were taken from the California Climate Action Reserve General Reporting Protocol, version 3.1. Electricity coefficients for PM, ROG, NOx, SO2 and CO were derived by Air District staff based on regional averages of emissions factors from power plants in the region.

Exposure Reduction:
This measure would reduce smog formation by reducing the ambient air temperature, particularly in areas that experience excessive heat. The measure would also reduce local air pollution by decreasing the accumulation of ozone precursors and PM due to the absorptive ability of trees.

Emission Reduction Trade-offs:
Caution must be taken in compiling the list of recommended species for planting to ensure that only low-VOC emitting trees are recommended. Planting deciduous trees ensures that there is no cooling dis-benefit in cooler months.

Cost:
According to the report, "*City of Berkeley, California Municipal Tree Resource Analysis"*, prepared by the Center for Urban Forest Research in 2005, the energy reduction benefits of the City of Berkeley's tree planting program are approximately $15 per tree. Applying these

benefits and costs to the Bay Area as a whole (and planting a total of 1,420,980 trees) creates the following results:

	Per Tree	Total(1)
Total benefits	$15	$21,314,700
Total costs	$65	$92,363,700
Net cost	$50	$71,049,000
Cost-benefit ratio	4.3	

1. This table represents the benefits and costs of planting 1,420,980 trees in the Bay Area.

In this analysis, benefits come from reduced net energy use due to shading.

Co-Benefits:
Tree planting brings a number of co-benefits to a community and the region.

Regional benefits:
- reduced urban heat island effect
- improved air quality
- improved public health (lower risk of respiratory and heat-related ailments)
- green job creation (tree planting and maintenance)

Local benefits:
- reduced energy use in buildings
- financial savings through reduced energy usage
- reduced storm water run-off
- increased community livability/quality of life
- enhanced bike and pedestrian environments
- increased property values

In the *"State of the Urban Forest: San Francisco Bay Area Progress Report"*, the Center for Urban Forest Research estimates that approximately 90% of the monetary benefits achieved by urban tree planting programs are due to increased property values.

Monitoring Mechanisms:
Monitoring and evaluating progress will be done by:
- Tracking local tree planting ordinances and tree planting programs

Issues/Impediments:
Due to the voluntary nature of this measure, significant impediments to implementation are not anticipated.

Sources:
1) *Cool Houston: A Plan for Cooling the Region* (2004)
2) *Heat Islands: Understanding and Mitigating Heat in Urban Areas*; Gartland (2008)

3) "Estimating Cost Effectiveness of Residential Yard Trees for Improving Air Quality in Sacramento, California, Using Existing Models," E. Gregory McPherson, Klaus I. Scott, James R. Simpson, USDA Forest Service, Pacific Southwest Research Station, Davis, CA, October 1997.
4) "City of Berkeley, California, Municipal Tree Resource Analysis," Scott E. Maco, E. Gregory McPherson, James R. Simpson, Paula J. Peper, Qingfu Xiao, USDA Forest Service, Pacific Southwest Research Station, Davis, CA, March 2005.
5) *"State of the Urban Forest: San Francisco Bay Area Progress Report,"* Jim Simpson, Greg McPherson, Chad Delany, Center for Urban Forest Research, USDA Forest Service, PSW Research Station, Davis, CA; June 20, 2005.
6) *"Actualizing microclimate and air quality benefits with parking lot tree shade ordinances,"* McPherson, E.G., J.R. Simpson and K.I. Scott. 2001.
7) *Parking Lot Shading Guidelines*, City of Davis Municipal Code, Section 40.25.100,
8) California Energy Commission, http://www.energy.ca.gov/title24/coolroofs/; http://www.energy.ca.gov/title24/coolroofs/documents/QUESTIONS-ANSWERS_BUILDING-OWNERS.PDF
9) USEPA, http://www.epa.gov/heatisland/
10) Consumer Energy Center, http://www.consumerenergycenter.org/coolroof/faq.html#faqs-04
11) Cool Roof Rating Counsel, http://www.coolroofs.org/coolroofing.html
12) http://www.autolife.umd.umich.edu/Environment/E_Casestudy/E_casestudy2.htm
13) http://www.concretenetwork.com/pervious/environ_benefits.html

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 5, 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.

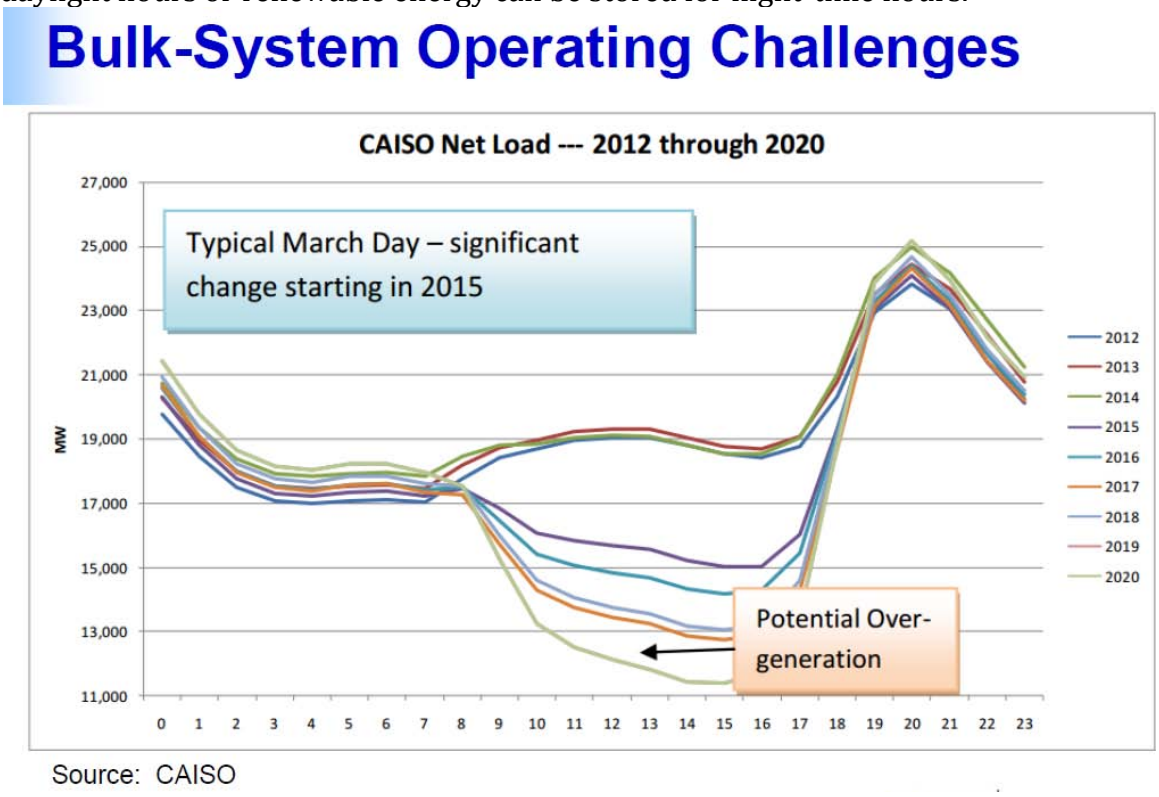
Assimilating the information together regarding the sources of renewable energy, grid reliability, the need for energy storage, and the necessity of back-up generation when renewable power is not available, it is apparent to the Advisory Council that the District needs to pay particular attention to 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.



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.

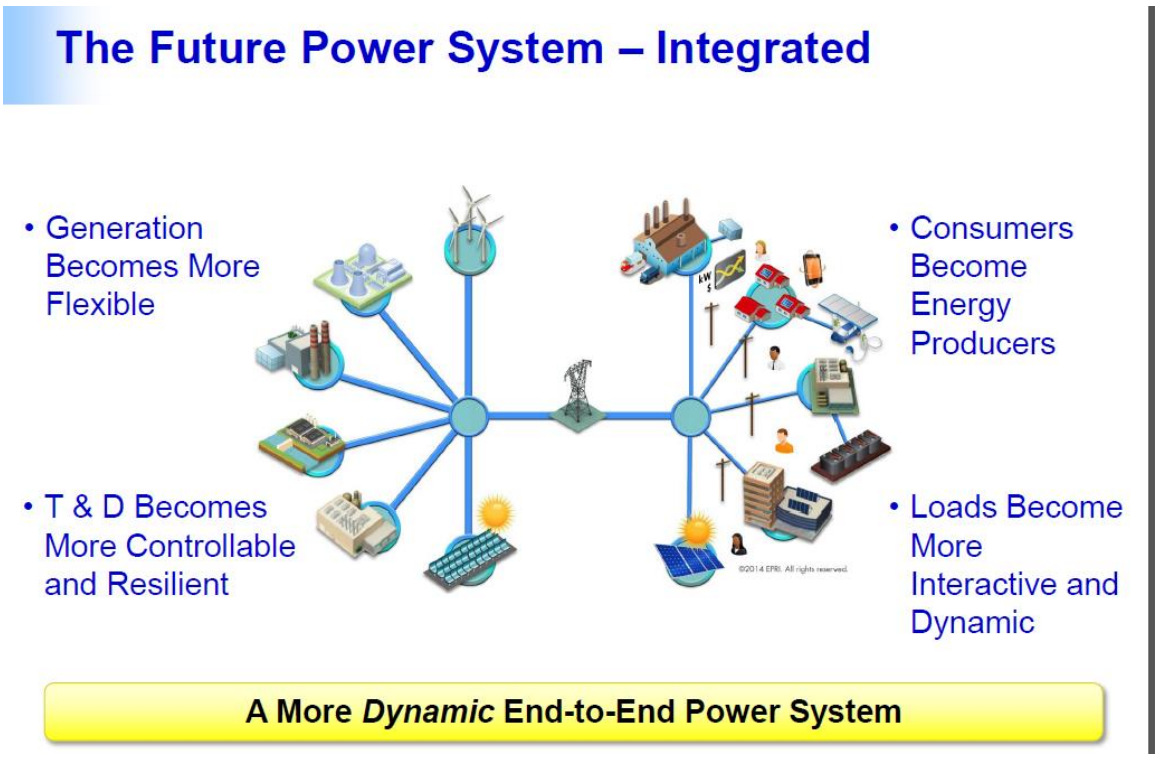
4. Within the last 4 years, new EVs have been added to the US fleet representing 5 GWh of storage capacity. It is unknown what kind of system storage benefit these batteries could offer if they were properly networked together. Such an approach is theoretically possible but would face significant technical, 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..



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

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[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*. Saarbrucken, 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