



BAY AREA
AIR QUALITY
MANAGEMENT
DISTRICT

ADVISORY COUNCIL REGULAR MEETING

WEDNESDAY
APRIL 8, 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 MARCH 11, 2015**

Clerk of the Boards/5073

The Advisory Council will consider approving the draft minutes of the Advisory Council Regular Meeting of March 11, 2015.

DISCUSSION

4. DISCUSSION OF DRAFT REPORT ON THE ADVISORY COUNCIL'S MEETINGS ON JANUARY 14, 2015, FEBRUARY 11, 2015, AND MARCH 11, 2015

S. Tanrikulu, Advisory Council Liaison/4787

The Advisory Council will discuss the draft report on the January 14, 2015, February 11, 2015, and March 11, 2015 meetings on "Urban Heat Island Effects on Energy Use, Climate, Air Pollution, Greenhouse Gases and Health."

5. DISCUSSION OF ADVISORY COUNCIL PRESENTATION TO THE BOARD OF DIRECTORS

S. Tanrikulu, Advisory Council Liaison/4787

The Advisory Council will discuss, finalize and consider approval of a presentation summarizing the Advisory Council's 2014 activities to the Board of Directors.

OTHER BUSINESS

6. Chairperson's Report

Liza Lutzker, Chairperson

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

7. 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.

8. Time and Place of Next Meeting

Wednesday, May 13, 2015 at 9:00 a.m. at 939 Ellis Street, San Francisco, California 94109.

9. Adjournment

The Advisory Council meeting shall be adjourned by the Chairperson.

CONTACT:

MANAGER, EXECUTIVE OPERATIONS
939 ELLIS STREET, SAN FRANCISCO, CA 94109
mmartinez@baaqmd.gov

(415) 749-5016
FAX: (415) 928-8560
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

APRIL 2015

<u>TYPE OF MEETING</u>	<u>DAY</u>	<u>DATE</u>	<u>TIME</u>	<u>ROOM</u>
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 Ad Hoc Building Committee <i>(At the Call of the Chair)</i>	Wednesday	15	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) - CANCELLED</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

MAY 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	6	9:45 a.m.	Board Room
Advisory Council Regular Meeting <i>(Meets on the 2nd Wednesday of each Month)</i>	Wednesday	13	9:00 a.m.	Board Room
Board of Directors Executive Committee <i>(Meets on the 3rd Monday of each Month)</i>	Monday	18	9:30 a.m.	Board Room
Board of Directors Stationary Source Committee <i>(Meets on the 3rd Monday of each Month)</i>	Monday	18	10:30 a.m.	Board Room
Board of Directors Regular Meeting <i>(Meets on the 1st & 3rd Wednesday of each Month)</i>	Wednesday	20	9:45 a.m.	Board Room

MAY 2015

<u>TYPE OF MEETING</u>	<u>DAY</u>	<u>DATE</u>	<u>TIME</u>	<u>ROOM</u>
Board of Directors Climate Protection Committee <i>(Meets on the 3rd Thursday of Every Other Month)</i>	Thursday	21	9:30 a.m.	Board Room
Board of Directors Budget & Finance Committee <i>(Meets on the 4th Wednesday of each Month)</i>	Wednesday	27	9:30 a.m.	Board Room
Board of Directors Mobile Source Committee <i>(Meets on the 4th Thursday of each Month)</i>	Thursday	28	9:30 a.m.	Board Room

JUNE 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	3	9:45 a.m.	Board Room
Advisory Council Regular Meeting <i>(Meets on the 2nd Wednesday of each Month)</i>	Wednesday	10	9:00 a.m.	Board Room
Board of Directors Executive Committee <i>(Meets on the 3rd Monday of each Month)</i>	Monday	15	9:30 a.m.	Board Room
Board of Directors Stationary Source Committee <i>(Meets on the 3rd Monday of each Month)</i>	Monday	15	10:30 a.m.	Board Room
Board of Directors Regular Meeting <i>(Meets on the 1st & 3rd Wednesday of each Month)</i>	Wednesday	17	9:45 a.m.	Board Room
Board of Directors Budget & Finance Committee <i>(Meets on the 4th Wednesday of each Month)</i>	Wednesday	24	9:30 a.m.	Board Room
Board of Directors Mobile Source Committee <i>(Meets on the 4th Thursday of each Month)</i>	Thursday	25	9:30 a.m.	Board Room

SG – 3/30/15 (11:30 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: March 25, 2015

Re: Approval of the Minutes of March 11, 2015

RECOMMENDED ACTION

Approve the attached draft minutes of the regular meeting of the Advisory Council of March 11, 2015.

DISCUSSION

Attached for your review and approval are the draft minutes of the Advisory Council regular meeting of March 11, 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 of March 11, 2015

Draft Minutes – Advisory Council Regular Meeting of March 11, 2015

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

DRAFT MINUTES

Advisory Council Regular Meeting
Wednesday, March 11, 2015

Note: Audio and video recordings of the meeting are 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 Liza Lutzker called the meeting to order at 9:04 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., Harold Brazil, Stan Hayes, Frank Imhof, Kraig Kurucz, Rick Marshall, P.E., P.L.S., Bruce Mast, Sara T. L. Mayer, M.P.P., and Timothy O'Connor, Esq.

Absent: Members Ana M. Alvarez, D.P.P.D., and Laura E. Tam.

Also Present: None.

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

3. APPROVAL OF THE MINUTES OF FEBRUARY 11, 2015

Advisory Council (Council) Comments: None.

Public Comments: No requests received.

Council Action:

Chairperson Lutzker made a motion, seconded by Member Cherry, to approve the minutes of the Council meeting of February 11, 2015; and the motion carried by the following vote of the Council:

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

PRESENTATION

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

The Council discussed the composition of the report writing work group and the draft report.

NOTED PRESENT: Member Marshall was noted present at 9:07 a.m.

The Council and staff discussed potential presentations to the Board of Directors (Board) and its committees.

DISCUSSION

5. Discussion of Council Presentation to the Board

Council Comments:

The Council and staff deliberated upon proposed revisions to the draft presentation to the Board on Council activities in 2014 and discussed the availability of staff to assist with the preparation of the presentation.

PRESENTATION (CONTINUED)

4. Urban Heat Island Effects on Energy Use, Climate, Air Pollution, GHGs and Health (continued)

Saffet Tanrikulu, Research and Modeling Manager of the Planning and Climate Protection Division, introduced:

Ronnen Levinson, Ph.D.
Staff Scientist
Urban Heat Island Group
Lawrence Berkeley National Laboratory (LBNL)
Berkeley, CA

Dr. Levinson gave a presentation entitled *Urban Heat Island Effects on Energy Use, Climate, Air Pollution, and GHGs* (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>).

The Council and Dr. Levinson discussed, at slide 12, *Average roof albedo*, whether and how roof pitch impacts albedo.

Dr. Levinson continued the presentation.

At slide 13, *Let's go to the Oscars with AlbedoMap.LBL.gov*, Dr. Levinson played back a video, *Albedo Map Dolby Theater*, examining the features available at the same website.

Dr. Levinson continued the presentation.

The Council and Dr. Levinson discussed, at slide 14, *Mesoscale climate models predict air temperature reductions of up to 1° C*, the substitution of an alternate slide identifying the map on the right as “year-2000” not “present-day” emissions; details about the data that generated the models and the implications of the models; H. Taha’s continued presence on Dr. Levinson’s team; and details of related modeling work.

Dr. Levinson continued the presentation.

NOTED PRESENT: Member O’Connor was noted present at 9:57 a.m.

The Council and Dr. Levinson discussed, at slide 17, *2013 Title 24 prescribes cool roofs for all nonres buildings, some res buildings*, what is meant by “aging.”

Dr. Levinson continued the presentation.

The Council and Dr. Levinson discussed, at slide 18, *PG&E [Pacific Gas & Electric] formerly offered rebates for exceeding T24 cool roof requirements*, the ratio of steep-slope roofs to the total number; the definition of “multifamily residential;” and the cost of cool roofing at installation or natural life-cycle replacement.

Dr. Levinson continued the presentation.

The Council and Dr. Levinson discussed, at slide 20, *Fluorescent cool dark pigments reflect NIR [Near-Infrared] light and re-emit absorbed visible light as NIR*, “PPG” as a reference to a manufacturer of coatings.

Dr. Levinson continued the presentation.

The Council and Dr. Levinson discussed, at slide 21, *Ruby-pigmented coatings offer high Effective Solar Reflectance (ESR) in non-white colors*, the nature of the interest in non-white colors; the albedo implications of white and non-white colors as they age and become dirty; and the climate change impacts of near and thermal infrared coatings.

Dr. Levinson continued the presentation.

The Council and Dr. Levinson discussed, at slide 22, *Cool colored synthetic limestone granules can capture CO₂ [carbon dioxide], raise asphalt shingle albedo*, what is displayed in the photographs.

Dr. Levinson continued the presentation.

The Council and Dr. Levinson discussed, at slide 30, *LBNL laboratory aging method quickly predicts 3-year-aged roof albedo, thermal emittance*, the applicability of the aging method in the solar energy field and what the U.S. Cool Roof Rating Council approval means relative to Title 24 standards.

Dr. Levinson continued the presentation.

The Council and Dr. Levinson discussed, at slide 32, *A cool tile roof in Fresno, CA saved both cooling and heating energy in a single-family home*, the cost savings as being lower than expected by some Council members and why that might be; additional details relative to annual power-plant emission savings; thermal mass roof variations in different climates; and air conditioning.

Dr. Levinson continued the presentation.

The Council and Dr. Levinson discussed, at slide 33, *California's schools are growing cooler with reflective roofs and schoolyards*, whether schoolyard coatings are similar to that used on roofs and the ramifications of installations of new turf materials.

Dr. Levinson concluded the presentation.

Council Comments:

The Council, staff and Dr. Levinson discussed the numbers provided on slide 32, *A cool tile roof in Fresno, CA saved both cooling and heating energy in a single-family home*, relative to annual power-plant emission savings; whether these data are the result of a simulation; which locales and technologies are most appropriate for the Bay Area to focus its efforts on relative to urban heat islands and why; photovoltaic (PV) surfaces as not truly cool roofs; advisability of PV residential rebates to encourage installation; average conversion rates for PV and chances of improvement in the near future; the state of research on PV-cool roof combinations; compatibility of radiant barriers and cool roofs; reflectivity and cooling limitations on a global scale; whether an economic analysis of the net benefits of solar and cool roofs exists and the conclusion; and what roof solution Dr. Levinson and Member Altshuler would install tomorrow for a residence in Pleasanton, California.

Public Comments: No requests received.

Council Action: None; receive and file.

DISCUSSION (CONTINUED)

5. Discussion of Council Presentation to the Board (continued)

Council Comments:

Draft Minutes – Advisory Council Regular Meeting of March 11, 2015

The Council and staff further deliberated upon proposed revisions to the draft presentation to the Board on Council activities in 2014 and invited staff input as soon as possible.

Public Comments: No requests received.

Council Action: None; receive and file.

OTHER BUSINESS

6. **Chairperson’s Report**: None.
7. **Council Member Comments / Other Business**: None.
8. **Time and Place of Next Meeting**

Wednesday, April 8, 2015, Bay Area Air Quality Management District Headquarters, 939 Ellis Street, San Francisco, CA 94109 at 9:00 a.m.

9. **Adjournment**: The meeting adjourned at 12:44 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: March 30, 2015

Re: Discussion of Draft Report on the Advisory Council's Meetings on January 14,
February 11, and March 11, 2015

The draft report of the January 14, February 11, and March 11, 2015, Advisory Council Meetings on Urban Heat Island Effects on Energy Use, Climate, Air Pollution, Greenhouse Gas and Health will be discussed.

Respectfully submitted,

Jack P. Broadbent
Executive Officer/APCO

Prepared by: Saffet Tanrikulu
Reviewed by: Jean Roggenkamp

Attachment: Draft Report of the Advisory Council's Meetings on January 14, February 11
and March 11, 2015

EXECUTIVE SUMMARY

This report summarizes activities of the Advisory Council during January-May 2015, consolidating 3 presentations received, and subsequent discussion and consideration by Council members during this period.

The following presentation was made at the January 14, 2015 Advisory Council meeting:

BAAQMD [Bay Area Air Quality Management District] Urban Forestry Overview by John Melvin, State Urban Forester, California Department of Forestry and Fire Protection (CAL FIRE), Sacramento, CA

An audio recording of this presentations and the Council’s discussion can be reviewed at <http://75616d429db7e15d2a6a-9e30cedb57e7d60eeae8665296278a13.r83.cf2.rackcdn.com/AC%20011415.MP3>

The following presentation was made at the February 11, 2015 Advisory Council meeting:

The Urban Heat Island In Coastal/Urban Environments by Jorge E. Gonzalez, PhD, NOAA CREST Professor, The City College of New York (in absetnia). Presentation given by Member Bob Bornstein, PhD, Professor of Meteorology, San Jose State University, on behalf of Professor Gonzalez.

An audio recording of this presentations and the Council’s discussion can be reviewed at <http://75616d429db7e15d2a6a-9e30cedb57e7d60eeae8665296278a13.r83.cf2.rackcdn.com/AC%20021115.MP3>

The following presentation was made at the January 14, 2015 Advisory Council meeting:

Urban Heat Island Effects on Energy Use, Climate, Air Pollution, and Greenhouse Gases by Ronnen Levinson, PhD, Staff Scientist, Heat Island Group, Lawrence Berkeley National Laboratory, Berkeley, CA

An video recording of this presentations and the Council’s discussion can be reviewed at http://baaqmd.granicus.com/MediaPlayer.php?publish_id=db060b7b-c83c-11e4-b5ce-00219ba2f017

[INSERT SUMMARY HERE]

Some of the recommendations contained in this report are for the Air District to: [INSERT SELECT RECOMMENDATIONS HERE]

BACKGROUND

Member Bob Bornstein, PhD standing in for Jorge E. Gonzalez, PhD, NOAA CREST Professor, The City College of New York

1. An “Urban Heat Island” (UHI) is a relative term: it compares the temperatures of the urban area to those of the surrounding area. The same city may be both an UHI and not an UHI (i.e., urban cool island), depending on where the comparison surrounding area is.
2. The nature of the UHI effect varies greatly by city, and also by time of day and season and by prevailing meteorological conditions, such as wind speed and direction. Roofs tend to be the hottest part of urban areas during the day, while roads are the hottest part at night.
3. An UHI extends from the earth’s surface up to about 300-400 meters.
4. Some of the UHI effect is about city getting hotter, but most of it is about not being able to cool down at night
5. There are 5 factors that contribute to the UHI effect in urban areas:
 - a. Lower levels of vegetation (less shading from trees and less evapotranspiration from all vegetation to “suck up” heat energy)
 - b. More dark surfaces (lower albedo/solar reflectance)
 - c. Geometry of tall buildings traps outgoing heat energy at night
 - d. Air pollution affects how much solar radiation reaches and leaves urban areas, though this relationship is complicated
 - e. Anthropogenic heat sources (e.g., cars, air conditioning, industry)
6. **High urban temperatures** lead to 5 types of problems:
 - a. Increased ozone due to increased emission of precursors and accelerated rate of photochemical formation reactions (in general, a 1°C temperature increase results in a 2ppb ozone increase)
 - b. Increased heat-related illness (including heat stress, cardiovascular disease, stroke, renal failure, and diabetes)
 - c. Increased energy use due to increased demand for air conditioning
 - d. Increased emission of non-ozone pollutants associated with increased energy production
 - e. Contribution to global warming
7. Some urban cooling strategies include urban greening, increasing the albedo of building and construction materials, smart urban planning (e.g, land use planning, ventilation, shading, etc.), and increasing energy efficiency/decreasing energy use (to reduce anthropogenic heat). Models run for certain cities (i.e., Sacramento and Houston) confirm the success of these approaches.
8. Surface temperatures can be remotely sensed. For high-resolution images, this is accomplished using aircraft sensors, though these types of data are not routinely collected in the way that lower-resolution satellite data are.
9. When considering the long-term spatial variation in the UHI effect, it will be important to take into account modeling results indicating that many geographies in the Bay Area, especially coastal areas, will actually be expected to cool, and not warm as climate change proceeds. The expected magnitude and rate of coastal

cooling needs to be better understood to determine if it constitutes an important consideration in crafting long-term urban cooling strategies.

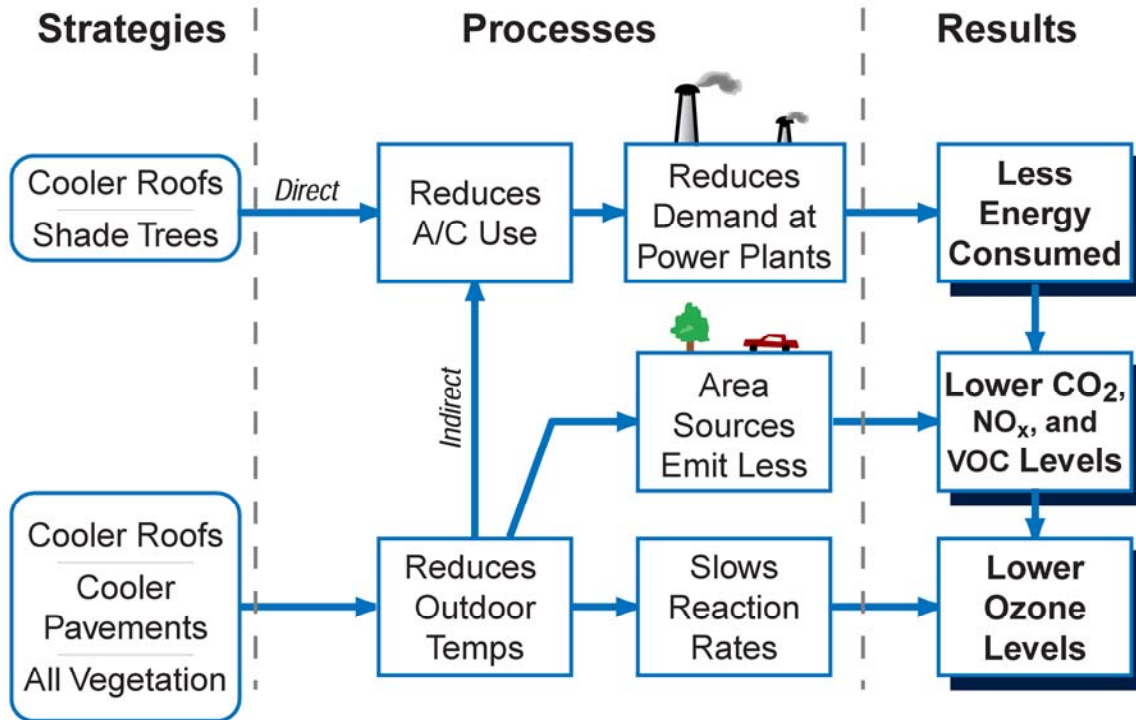
Ronnen Levinson PhD Staff Scientist, Lawrence Berkeley National Laboratory, Heat Island Group

Note: Dr. Levinson’s presentation was primarily concerned with the daytime summer UHI effect and did not touch upon the (important) aspect of the UHI effect relating to lack of nighttime cooling.

Urban Cooling Strategies Background

1. There are 4 urban cooling strategies: (1) cooler roofs (including reflective and vegetation roofs), (2) cooler pavements, (3) shade trees, and (4) all vegetation (see Figure 1). These strategies have the ultimate effect of lowering energy use, reducing pollutant emission, and reducing secondary pollutant formation. (Note that a benefit not called out in Figure 1 is a reduction in heat-related illness.)

Figure 1. Cool Strategies and their Results



2. There is currently working being done on a 5th “cool strategy”: cooler walls.

Roof Albedos

3. Albedo, also known as Solar Reflectance (SR), measures the fraction or percentage of incident sunlight reflected by a surface. Also relevant is Thermal Emittance (TE), which is a measure of a surface’s efficiency of emitting thermal radiation (or heat) versus absorbing that heat. A helpful example to distinguish between SR and TE is

white painted vs. unpainted metal: both have high albedos (or SRs), but the unpainted metal will have much lower TE (it will feel hot to the touch).

4. The Heat Island Group at Lawrence Berkeley National Laboratory (LBNL) has mapped the average albedo of every roof in 7 California cities. In no city did the mean albedo exceed 20%, which is a typical gray reflectance. Both San Francisco and San Jose had a mean albedo of 18%.
5. The most common type of roofing for residential buildings is asphalt shingle, which typically has a low albedo, around 5%. White roofs (which are now required on all large industrial buildings per Title 24), have an albedo around 80% when brand new, but the albedo drops to 55-65% after about 3 years of use (the roof material simply gets dirty). After 3 years of use, the albedo stabilizes and stays relatively constant for the remaining life of the roof.
6. While white roofs have high albedos, American preference remains for darker roof colors on residential buildings. Several strategies are being developed to increase albedo while keeping roofing material relatively dark in color. Three possible strategies for California are:
 - a. Using coatings that absorb light in the visible spectrum but that reflect light in the near infrared (NIR) and also fluoresce. One such coating is created by using ruby (Cr_2O_3) pigments. While this approach is highly effective (it creates visibly dark tiles with 60% albedo), it is expensive to manufacture and install at this time.
 - b. A less expensive approach is to create a modified asphalt shingle using a white synthetic "rock" (limestone, or CaCO_3) that is mixed with a pigment during formation to lie atop the asphalt. By virtue of being combined with the limestone during synthesis, the colored coating gives the shingle a dark look. At the same time, the whiteness of the limestone is opaque enough to protect the underlying asphalt, but is reflective enough to boost albedo to 30-40%. An ancillary benefit of these tiles is that they also can capture CO_2 .
 - c. A third approach is a vegetation roof, or a "green roof". Although vegetation is not very reflective, it is cool due to evapotranspiration and high thermal emittance (TE). However, green roofs are often expensive, high maintenance, and too heavy for the sub-roof structure of many homes in California.

Effects of Changing Roof and Pavement Albedo

7. A climate model of the Bay Area by H. Taha (2013) predicts that by increasing all roof albedos by 25-55% and all pavement albedos by 22-27%, temperatures can be reduced up to 1°C and ozone can be lowered by 2ppb. These changes in albedos are achievable with current technology, especially in the case of roofs.
8. Two side-by-side homes were built with similar construction in Fresno, but with different roof types: one used older style asphalt shingles, and the other used new, high-albedo tile roof. The new roof used less energy for cooling (as well as for heating). The annual cost savings was \$170/year, which is about 25% of the cooling energy costs. Additionally, the high albedo roof resulted in an estimated annual power-plant emission savings of 307kg CO_2 , 117g NO_x and 8.7g SO_2 (though this assumes some power is being generated at non-California power plants).

9. Numerous California schools are effectively using cool color coatings on top of their paved schoolyards to make play more comfortable for the school children in warm climates. This technique is especially important in areas using a year-round school calendar.

Title 24 Requirements and Related Incentives

10. Title 24 energy standards address the energy efficiency of new (and altered) buildings. Title 24 standards impose requirements for roofs on residential and non-residential buildings that vary by climate zone (see California Climate Zone map at: http://www.energy.ca.gov/maps/renewable/building_climate_zones.html).
 - a. All non-residential buildings (regardless of climate zone) must meet certain cool roof standards. These are stringent standards for the majority of non-residential buildings, requiring a roofing material with a minimum albedo of 63% (unless the roof is highly sloped, in which case the minimum prescribed albedo is 20%).
 - b. Residential buildings are held to a much lower standard under Title 24 and the regulations are specific to climate zone. Although some residential roofs are held to the 63% minimum albedo requirement, these are limited to the two hottest California climate zones, neither of which is in the Bay Area. The 20% minimum albedo requirement is also limited by: (a) climate zone – only a small part of the Bay Area is covered in this requirement (Contra Costa, Alameda, and Santa Clara counties, east of the Berkeley Hills and along the 680 corridor), and (b) roof slope – only highly sloped roofs are covered by this requirement.
11. Prior to 2015, PG&E offered rebates for multi-family (5+ unit) residential dwellings of 10-20 cents per square foot for newly purchased roofing products. These rebates exceeded Title 24 requirements for residential buildings and covered climate zones not covered under Title 24 (including more Bay Area geographies). These rebates have now expired. [PG&E's current strategy is to encourage local governments to adopt local requirements for cool roofs that exceed state energy standards.](#)
12. To meet Title 24 requirements for roof materials, products must be “aged” over three years of “natural exposure” to determine their relevant albedo and thermal reflectance values. Thus, it takes 3 years to bring a material to market. However, LBNL has developed a laboratory process that simulates the aging process, allowing the materials to “age by 3 years” in less than 3 days for about \$16,000. The US Cool Roof Green Rating Council has approved this laboratory method as an interim rating process for Title 24 Standards for new construction. This means that, during 3 years of waiting for “true” test results, these lab results can stand in as enough evidence of a roofing material meeting the appropriate standards, thus allowing for new cool roofing material to be brought to market faster.

On Cool Roofs and Solar Photovoltaic (PV)

13. Typically PV absorbs 60-70% of solar radiation (this includes the 5-15 % conversion to electricity) and reflects about 25% of solar radiation. Note that this solar reflectance, or albedo, exceeds any Title 24 residential requirements that might apply to the Bay Area.

14. While 25% is not terrible, there is a “cooling penalty” associated with PV because roof albedo without the PV could be higher. However, this cooling penalty is negligible compared to the benefits of clean power generation, so PV is a good strategy and should not be thrown out in favor of cool roofs.
15. It is possible for solar PV and cool roofs to co-exist. Either the panels can sit atop a high-albedo roof, or there could be a flexible, high-albedo roofing material that is white that has built-in PV panels (this is called “building integrated photovoltaic”).

Local Action on Urban Cooling

16. From an energy and air pollution perspective, urban cooling strategies will be most important in areas that: (a) have a real summer, (b) use air conditioning, and (c) have an air pollution (or precursor) issue.
17. Actions are already being taken by governments in California. At the state level, this includes cool pavement legislation (AB 296) and stricter cool roof requirements in the 2013 revision of Title 24. Some local jurisdictions are putting into place requirements and practices that are more stringent than the State. However, not all local jurisdictions considering these actions need to worry about the UHI effect (because they do not meeting any of the 3 considerations laid out in #17 above).
18. There are resources that exist to help local governments create cool communities and develop the best policies around UHI effect. These include CoolCalifornia.org and CoolRoofToolkit.org.

John Melvin, State Urban Forester, CAL FIRE

Trees as an Urban Cooling Strategy in the Bay Area

1. The canopy cover in the Bay Area ranges widely (14% in SF, 15% in San Jose), but is often driven by large open spaces (e.g., Golden Gate Park), rather than trees interspersed in inhabited areas. For reference, the average national urban forest canopy cover is 21%; Portland’s cover is 42%, New York City’s is 24%, Sacramento’s is 27%, and Chicago’s is 17%.
2. Currently, most cities (including San Francisco) have a declining canopy, as they lose more trees annually than are planted.
3. Urban forests cool urban areas in 2 ways. First, the evapotranspiration of the plants increases moisture in the air to “suck” heat out of the air. Second, the tree canopy itself provides shade to directly decrease ground surface temperature.
4. Not only do trees reduce temperature, they also reduce the length of time that heat is present throughout the day.

Other Benefits of Urban Forests

5. Urban forests have multiple benefits including GHG storage, improved air quality (through deposition of PM on leaves), storm-water capture, water quality improvement, increased property values, and reduced energy use.
6. The annual benefits of the Bay Area’s urban forest are estimated to be \$5.1 billion/year. Further, a 3% increase in the Bay Area’s urban canopy is projected to increase annual benefits by an additional \$475 million.

Considerations in Choosing Trees to Plant

7. Despite the multiple long-term benefits of increasing urban forests, the short-term costs and ongoing maintenance often make it difficult for local jurisdictions to decide to plant more trees. However, the right tree, planted at the right site, if well-established in its first 5 years, will cost less to maintain than other already-established tree plantings.
8. Health and air quality considerations for choosing species of trees to plant include a species' carbon sequestration capacity, level of VOC emissions, pollen allergenicity, size and density of canopy for providing shade (UHI reduction), and leaf surface areas for collecting PM. Other considerations include a species' water requirements, stormwater capture capacity, fruit and flower debris, maintenance requirements, and sidewalk damaging potential.
9. While it is important to analyze individual tree species' characteristics when selecting trees for an urban forest, perhaps more important for the urban forest ecosystem health is to select a wide diversity of trees.
10. Tools exist and technical assistance is available to help jurisdictions choose the appropriate trees/mix of trees to plant given siting and other goals. Example tools include http://www.fs.fed.us/psw/publications/documents/psw_gtr228/psw_gtr228.pdf, <http://selectree.calpoly.edu/>, and <http://www.fs.usda.gov/ccrc/tools/cufr-tree-carbon-calculator-ctcc>.
11. Planting of urban trees requires a lot of "buy-in" from the community. CalFIRE provides funding for initial planting and establishment, but additional maintenance is necessary and community members need better education on the financial benefits of urban trees (increased property values, etc.).

Urban Forestry Opportunities and Resources

12. CalFIRE provides funding for a number of Urban Forestry grants (tree planting and other green infrastructure such as vegetated swales and green roofs) to help to reduce GHGs. These grants are restricted to projects that are either in or directly serve urban disadvantaged communities (as defined by SB 535/CalEnviroScreen). These grants have some funding built in to encourage ongoing tree maintenance.
13. San Francisco, along with other cities in California and throughout the US has mapped their urban forest.
14. Sacramento and Pasadena are two cities to look up to for great urban forestry work. Each has used trees to improve the local environment and reduce cooling costs. In Sacramento, SAC MUD supports the planting and care of trees.
15. The US Forest Service Tree Guide for Northern Coastal Communities is an excellent resource that quantifies the benefits and costs of planting trees on a per-tree basis, taking into account location and whether trees are publically or privately owned.

Emerging Issues

UHI EFFECT

1. In order to better evaluate the need for urban cooling efforts in the Bay Area, the Air District needs to gain a clearer understanding of the temporal (seasonal and

diurnal) and spatial (across and within Bay Area cities and surrounding areas) variation in the UHI effect. Important questions include:

- a. What is the relationship between temperature increase and ozone formation? Is the relationship linear or non-linear and how does it vary spatio-temporally in the Bay Area?
 - b. Both atmospheric mixing and ozone formation are influenced by increases in temperature. How do these two temperature-dependent processes interact to affect air pollution exposure, and how does this interaction vary spatio-temporally in the Bay Area?
2. Urban cooling strategies will be most helpful in hot areas. In areas with lower summer temperatures (and lower winter temperatures), focusing on urban cooling could actually increase winter energy use.
 3. While localized temperature increases are most relevant for local pollution and heat; consideration of ozone transport downwind from areas with increased localized temperatures needs to be considered. In the Bay Area, high ozone areas are not over “urban” areas, but are rather over the cities of San Martin, Livermore, and Concord.
 4. In addition to high daytime temperatures, the UHI effect is characterized by a lack of nighttime cooling, and the inability for a person’s body to cool overnight is a significant driver of heat-related illness. Urban cooling strategies that promote better nighttime cooling are increased vegetation, cool pavement technologies, and better urban planning, while cool roofs are a less important strategy when targeting high nighttime temperatures.
 5. Not all populations are at equal health risk from heat. Factors such as socioeconomic vulnerability, social isolation, air conditioning ownership, and underlying co-morbidities put certain populations at higher risk of suffering from heat-related illness.
 6. While focusing urban cooling efforts in areas with high use of air conditioning is important for reduction of energy consumption and anthropogenic heat, it may actually be more important to focus on neighborhoods with high temperatures but low air conditioning ownership to better mitigate the effects of heat-related illness on vulnerable populations.
 7. A cost-benefit analysis of urban cooling strategies compared to alternative air quality strategies needs to be further evaluated. While UHI research has shown that the urban cooling strategies enumerated above can produce a measurable reduction in average urban temperatures, an associated improvement in local air quality, and related co-benefits, it remains to be determined whether the investment required to achieve those benefits via urban cooling represents the most cost-effective pathway to achieving those benefits.
 8. There is a need to better understand whether and how US EPA will give regional air districts ozone reduction credits for lowering UHI.

COOL ROOFS

1. Roof albedos are easier to increase than pavement albedos because (a) pavement choice is more governed by other factors dictating suitability (currently, 90% of

surfaces are asphalt concrete), and (b) roads get dirtier faster than roofs, so albedo will decrease faster. Cool walls are also an area that needs more work.

2. It never makes economic sense to replace a roof only for the purposes of increasing albedo. However, since the average lifespan of a roof is 20 years, about 5% of roofs are replaced annually. Creating requirements or incentives that get people to install cool roofs at time of replacement (in geographically appropriate areas) is important.
3. Asphalt shingle roofing is cheap (both materials and installation). Therefore, the best approach for mass adoption of cool roofs is to make high quality and high albedo asphalt shingles.
4. Cool roofs and PV are not mutually exclusive strategies. The Air District should continue to stay abreast of advances in rooftop PV and cool roof materials.

TREES

1. Trees have numerous air quality benefits to offer, and certain tree species may be more beneficial than others with respect to air quality benefits. Trees with large, dense canopies can provide shade and mitigate the UHI. Trees with high leaf surface areas (such as conifers) can collect PM and may be particularly useful in near-roadway settings. All trees, to varying degrees, have the ability to sequester carbon.
2. The public and local governments often fail to recognize that the long-term benefits of urban trees generally outweigh the short-term costs.
3. Large trees may shade solar panels, so trees may need to be cut in order to install solar. However, solar does not provide as many desirable air quality and ecological co-benefits that come with trees. As tree planting and rooftop solar both increase, the strategy of planting trees in urban areas must be balanced with the ability to have unshaded rooftops available solar panels, though large, healthy, established trees should not be cut down in order to install solar.
4. There are disparities in the percent canopy cover across the Bay Area – more disadvantaged neighborhoods have less canopy cover. Priority should be given to planting trees in areas that will get the most immediate benefit from tree planting.

Recommendations

While further research is required to quantify the geographical variation in air quality benefits from urban cooling measures, urban forests and photovoltaic systems offer important co-benefits regardless of geography. Likewise, cool roofs offer important co-benefits for buildings with significant cooling loads. These co-benefits provide grounds for the Air District to take initial steps in promoting these measures, pending further research into air quality impacts. Specifically, the Advisory Council recommends:

1. Provide technical support to local governments to include air quality criteria into their street tree selection processes. Criteria should include adsorption of CO₂ and other pollutants, VOC emissions, potential for PM capture, and allergenicity.
2. Collaborate with PG&E to encourage local governments with warmer climates to incorporate cool roof requirements into their local building codes. The Air District can add value to this effort by highlighting the associated air quality benefits.
3. Communicate the benefits of urban cooling measures as part of geographically-targeted public education campaigns

4. Conduct modeling studies to quantify the spatial and temporal variation in current and projected temperatures and levels of ozone in the Bay Area, as well as the air quality and other health benefits that could accrue from various urban cooling measures. Include Bay Area-specific heat vulnerability assessments in the analysis. Apply the results to prioritize (1) urban cooling strategies versus alternative methods of improving air quality, and (2) Bay Area communities that would benefit from more aggressive adoption of targeted measures.
5. Based on prioritization results from Recommendation #4, explore options for promoting more aggressive adoption of urban cooling measures in high priority communities, including targeted grant-making, education, and regulatory options.
6. Provide technical support to the California Energy Commission to incorporate quantified air quality benefits in cool roof cost-benefit analysis leading up to the 2019 building energy standards update. Inclusion of more comprehensive benefits will support the adoption of more rigorous standards. This effort may require collaboration with the Air Resources Board and/or other regional Air Districts.

Glossary

Albedo

Allergenicity

Evapotranspiration

LBNL: Lawrence Berkeley National Laboratory

PV: Photovoltaic solar panels (used to convert solar radiation to electricity)

Solar Radiation

Solar Reflectance (SR)

Thermal Emittance (TE)

Title 24

UHI: Urban Heat Island

VOC: Volatile Organic Compound

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: March 30, 2015

Re: Discussion of the Advisory Council Presentation to the Board of Directors

The draft presentation summarizing the Advisory Council's 2014 activities to the Board of Directors will be discussed, finalized and considered for approval.

Respectfully submitted,

Jack P. Broadbent
Executive Officer/APCO

Prepared by: Saffet Tanrikulu
Reviewed by: Jean Roggenkamp

Attachment: Draft Presentation of the Advisory Council's 2014 Activities



BAY AREA
AIR QUALITY
MANAGEMENT
DISTRICT

Exploring Bay Area Energy Future as Part of Climate Protection Strategy

2014 Efforts of
Advisory Council

Prepared for the
Board of Directors
2015



Advisory Council 2014 Activities

- Objective
 - Explore **Bay Area's energy future**, investigating technical issues related to District's Climate Protection Program
 - #10 in 10-Point Climate Action Work Program
- 10 regular **meetings**
- 6 expert **speakers**
 - Universities, national laboratory, CA Energy Commission, EPRI
- 4 **reports**





Advisory Council: Topics and Speakers

Bay Area Energy Future

- **Mark Jacobson**, Professor, Stanford (100% wind, water, solar pathway)
- **Jim Williams**, PhD, E3 (all available measures pathway)
- **Jane C.S. Long**, PhD, LLNL/EDF (action plan, feasibility, all available measures pathway)
- **Emilio Camacho**, Esq., CA Energy Commission (innovation)
- **Daniel Kammen**, Professor, UC Berkeley (Bay Area energy and climate opportunities)
- **Haresh Kamath**, EPRI (energy storage and integrated smart grid)





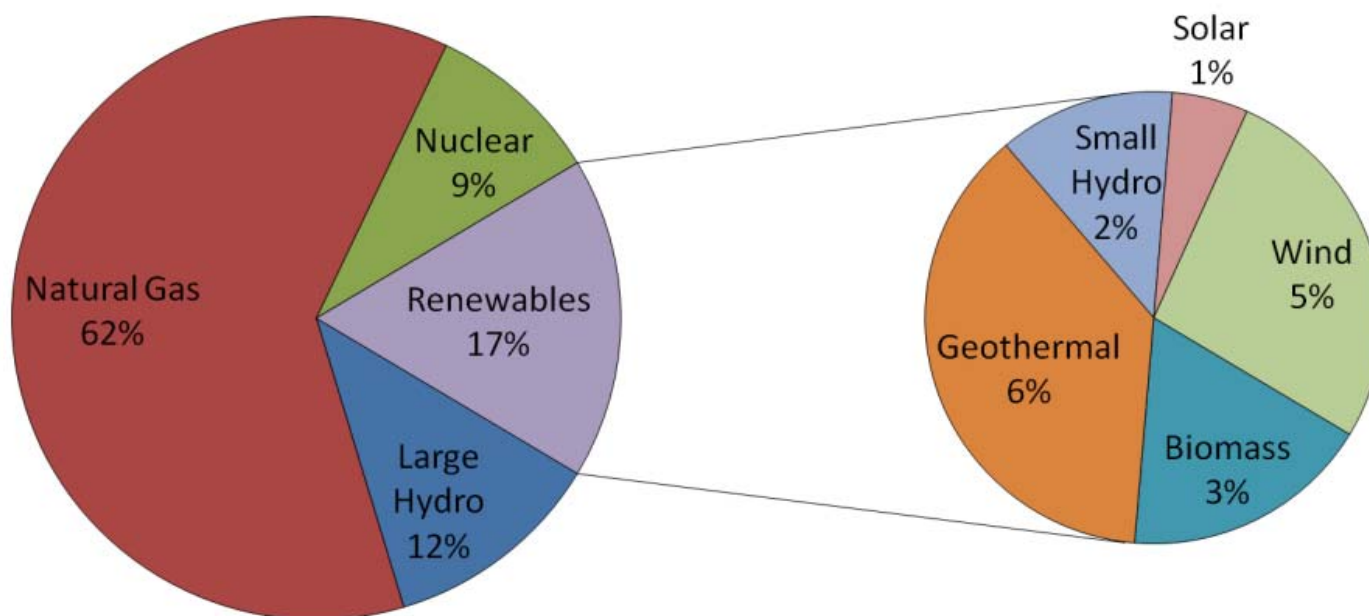
Energy Future: Big Picture

- **Efficiency**
 - Especially uses that cannot be easily electrified
- **Electrification**
 - All feasible fossil-fuel combustion uses
- **Decarbonization**
 - Electricity supply (e.g., renewables) and fossil fuels



Energy Future: Where We Are

CA In-State Electricity Generation in 2012

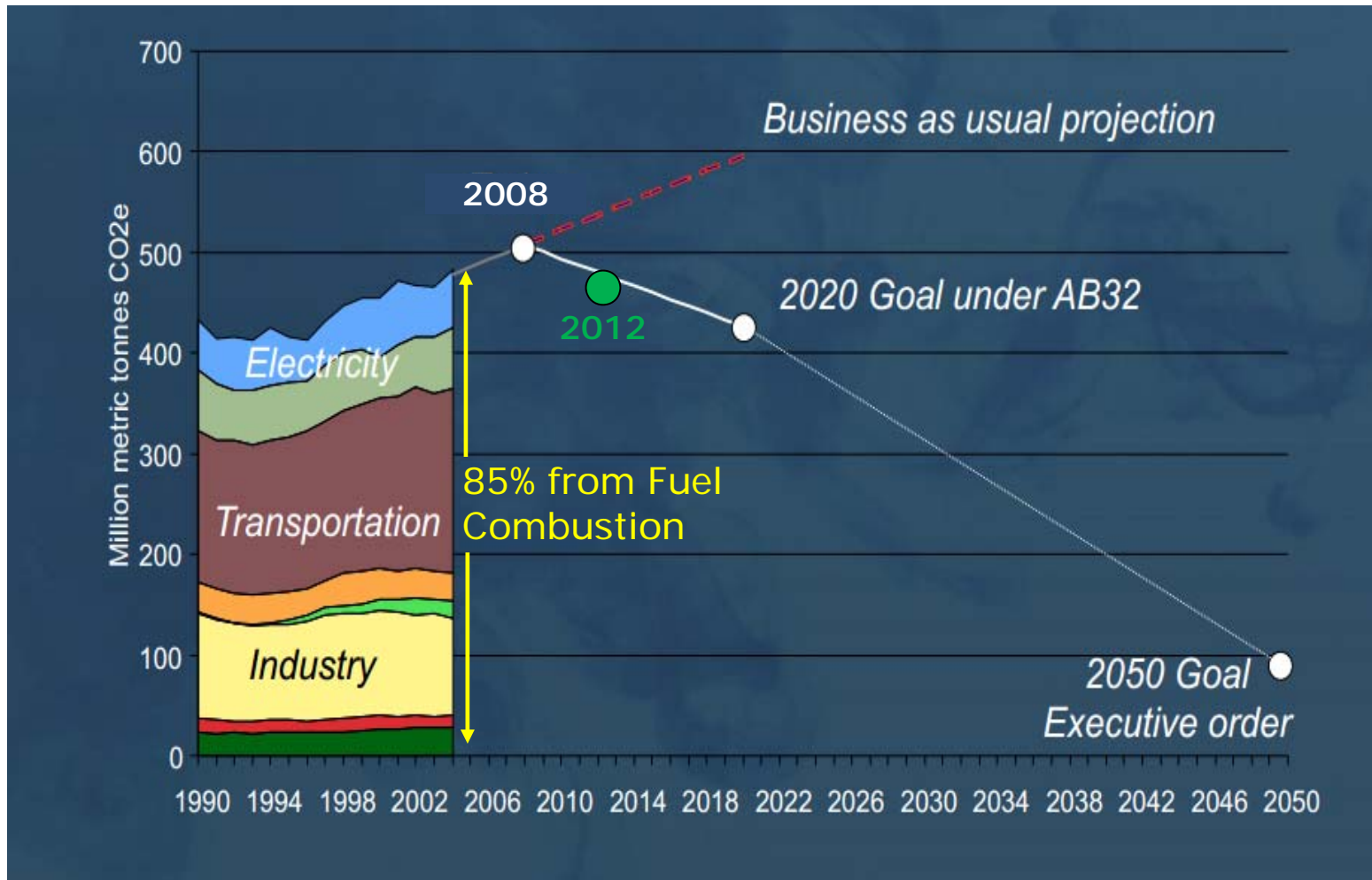


Sources: California Energy Commission, QFER and SB 1305 Reporting Requirements. In-state generation is reported generation from units 1 MW and larger.



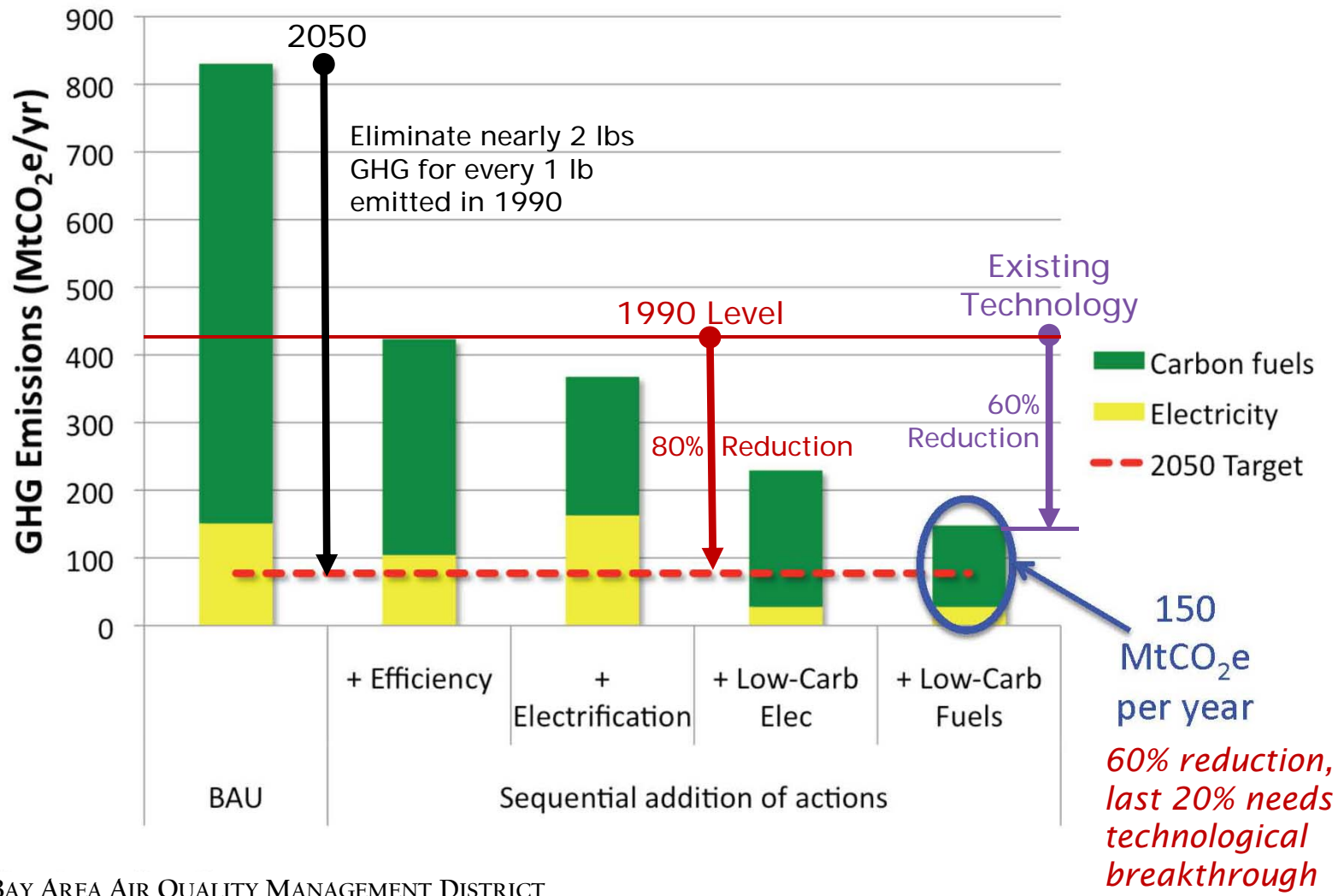


Energy Future: Where We Are Going





Energy Future: How We Can Get There





Energy Future: Two Points on Spectrum

1. 100% Wind, Water, and Solar

- All renewables including energy conservation and efficiency gains
- Maximizes air quality and climate benefits with no air emissions

Issues: Technical challenges, large number, permitting, variability, grid reliability

2. All Available Measures

- All possibilities, including wind, water, solar plus biofuels, carbon capture, energy storage, and nuclear
- 60% reduction in carbon doable with known technologies; remaining 20% reduction challenging

Issues: Technical challenges, negative side effects, use of fossil fuels for back up power with associated emissions, public acceptance





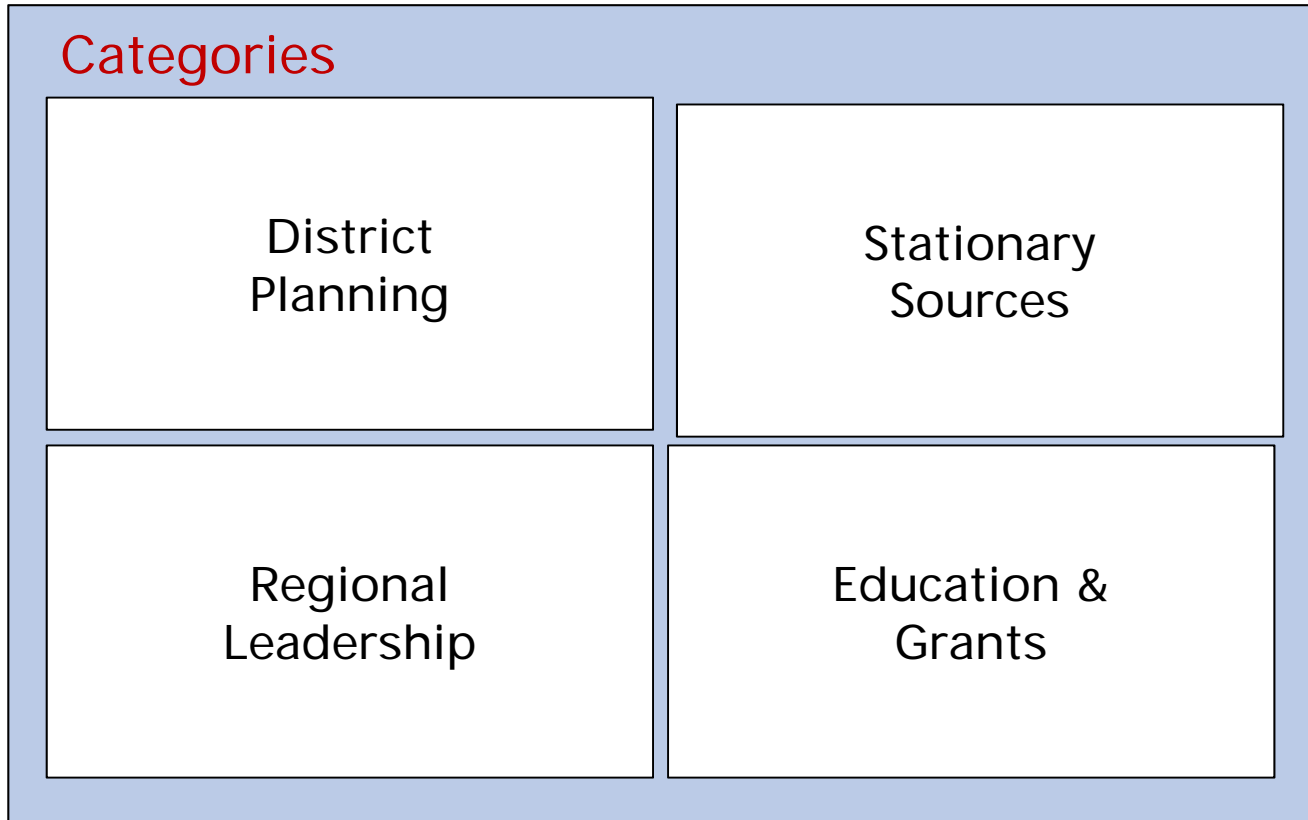
Energy Future: Major Challenges

- **Energy storage**
 - Critical to renewables success, pumped storage most readily available now, batteries, hydrogen, and compressed air not ready yet (several decades away)
- **Grid reliability & load balancing**
 - Integrated “smart” grid, demand management
- **Carbon pricing**
 - Needed for market-based solutions
- **Environmental & social equity**
 - Energy costs and availability, land use
- **Air quality and climate tradeoffs**
- **Political leadership**
 - Many difficult decisions, cost, reliability, public acceptance





Recommendations





Recommendations: District Planning

Continue **multi-pollutant approach** to reduce GHG emissions, limit unintended consequences, negative effects from other airborne pollutants

- Identify **District's most appropriate role** vis-à-vis Bay Area energy future
- Conduct study to project how Bay Area future energy trends may impact or complement **District's clean air plans**
- Integrate **implications of future energy trends** into District's clean air and climate plans, modifying plans if necessary





Recommendations: Stationary Sources

- Integrate GHG emission reductions into new **District's permitting rules** and review past rules for consistency
- Explore ways to reduce GHG emissions from large numbers of **small stationary sources** of CO₂ (furnaces, boilers, water heaters)
- Evaluate proliferation and potential use of **backup generators** (understand significant growth in number and look for opportunities to use energy storage devices instead)





Recommendations: Regional Leadership

Collaborate with state, regional, and local agencies to **incorporate energy considerations** into District's Regional Climate Action Strategy

- **Consult and coordinate** with relevant agencies and stakeholders in energy-related planning
 - State and federal agencies
 - ARB, CEC, CPUC, EPA, DOE, ISO
 - Regional and local agencies:
 - MTC, ABAG, Publicly Owned Utilities
 - Private sector
 - EPRI, PG&E, refineries, other





Recommendations: Education & Grants

- **Integrate latest information on energy** behavior-oriented recommendations into District's public education and outreach efforts
- **Concepts** could include:
 - Greater efficiency for appliances, cost savings
 - Energy audits/upgrades to residences, offices
 - Electric vehicles
 - Public transit





Recommendations: Education & Grants

- **Integrate future energy-related criteria** into grant proposal evaluation and selection
- **Expand incentives** to encourage/support more desirable energy sources and behavior





Thank You!

- We appreciate your time and interest
- Questions or comments?





Presentation

- Topics and speakers
- Energy future
 - Where we are, where we are going, how we get there
- Recommendations
 - Planning, Stationary Sources, Regional Leadership, Education & Grants



2014 Charge from Board for the Advisory Council

- Explore the Bay Area Energy Future as a part of Climate Protection Strategy and evaluate air quality, health and climate impacts





Summary Recommendations

- Air and GHG Emissions
- Planning
- Communications
- Grants





Recommendations: Integration into District Planning

- Given mission to achieve clean air and climate protection, identify **District's most appropriate role** vis-à-vis Bay Area energy future
- Conduct emission inventory-based study to project how Bay Area future energy trends may impact or complement **District's clean air plans**
- Integrate **implications of future energy trends** into District's clean air and climate plans, modifying those plans if necessary



Recommendations: Coordination with Other Agencies

- **Consult and coordinate** with relevant agencies and other stakeholders involved in energy-related planning
 - State and federal agencies
 - ARB, CEC, CPUC, EPA, DOE, ISO
 - Regional and local agencies:
 - MTC, ABAG, Publicly Owned Utilities
 - Private sector
 - EPRI, PG&E, refineries, other



Recommendations: Stationary Sources

- Integrate GHG emission reductions into new District's permitting rules while reviewing past rules for consistency
- Explore ways to reduce GHG emissions from large numbers of small stationary sources of CO₂ (furnaces, boilers, water heaters)
- Evaluate proliferation and potential use of backup generators (understand significant growth in number and look for opportunities to use energy storage devices instead)





Recommendations: Regional Leadership

Collaborate with state, regional, and local agencies to develop **regional GHG action** plan

- **Consult and coordinate** with relevant agencies and stakeholders in energy-related planning
 - State and federal agencies
 - ARB, CEC, CPUC, EPA, DOE, ISO
 - Regional and local agencies:
 - MTC, ABAG, Publicly Owned Utilities
 - Private sector
 - EPRI, PG&E, refineries, other





Recommendations: Education & Grants

Build public support for GHG policies through **education**, including:

- Energy efficiency (e.g., codes, financing, retrofits)
- Electrification
- Energy use (e.g., choice of supply, rates, reliability)
- Energy generation (e.g., distributed energy, on-site renewable, CCS)
- Planning (e.g., zoning, density, infill)
- Transit and goods movement
- Climate change adaptation
- Carbon sequestration





Recommendations: Education & Grants

Identify new funding sources to expand **grant program** to stationary sources

Prioritize the following:

- Electrification and related infrastructure
- Low-Carbon, clean-energy backup emergency power systems
- Energy efficiency in buildings, appliances, and processes
- Further VMT reductions through 'smarter" vehicles and technologies that optimize operations

Global Grants

