



BAY AREA  
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MANAGEMENT  
DISTRICT

# Transboundary (International) Ozone Transport

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Board of Directors  
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# Presentation Overview

- Status of ozone in the Bay Area
- Pollution level in Asia, especially in China
- Federal effort to estimate international pollution transport
- Transport impacts in the western US
- Air District's effort to estimate local impacts
- Continuing collaboration among Federal, State and local agencies

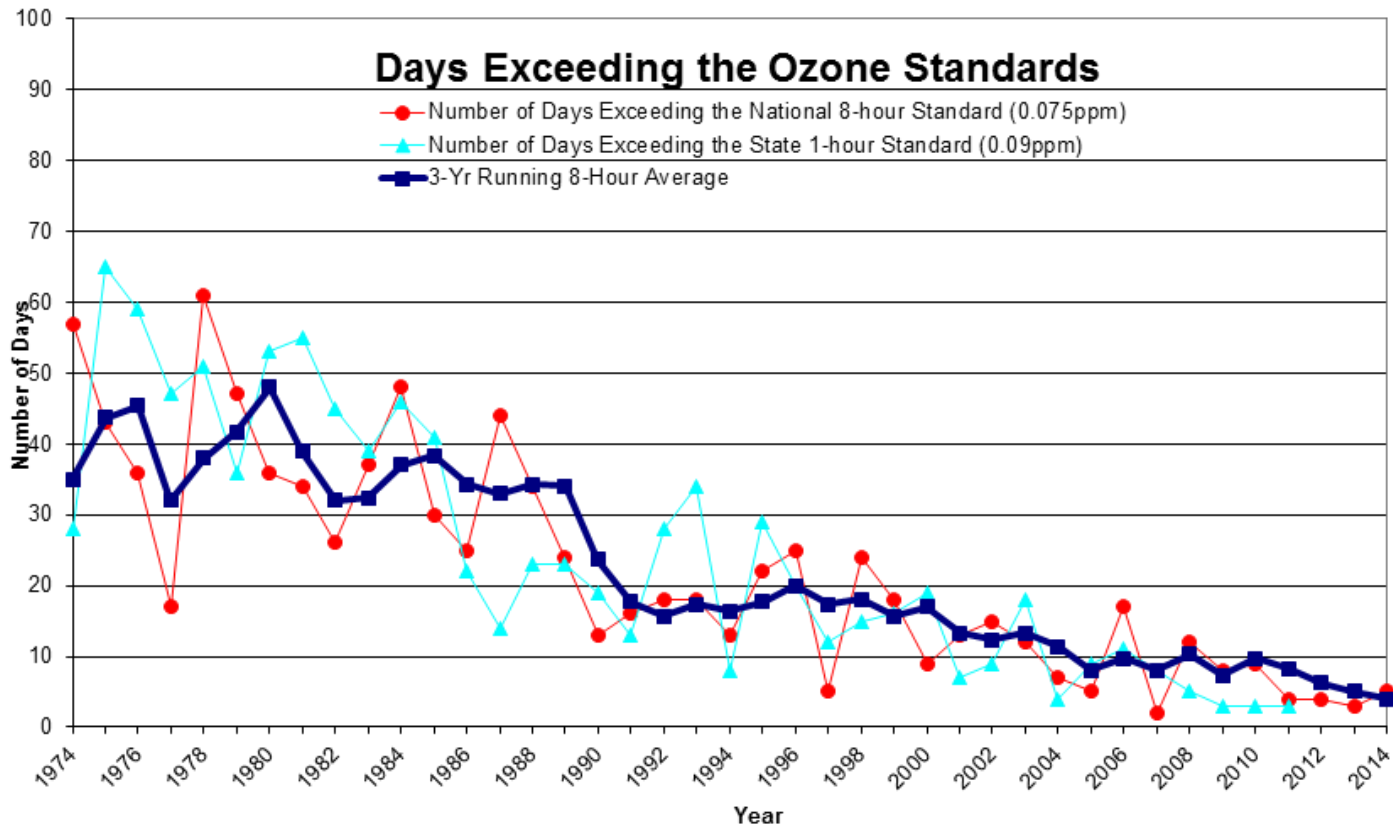


## Air District's Research and Modeling Program

- Study ozone, particulate matter (PM<sub>2.5</sub>), air toxics and ultrafine particulate matter (PM<sub>0.1</sub>)
- Chemically speciate emissions for modeling
- Study meteorological conditions impacting air quality
- Simulate pollutant and precursor concentrations
- Study pollutant response to changes in emissions; answer what-if questions
- Estimate exposure and health impacts of pollutants
- Provide technical support to Clean Air Plan updates
- Collaborate with EPA, NOAA, NASA, ARB, neighboring districts and research community



# Ozone Trend in the Bay Area





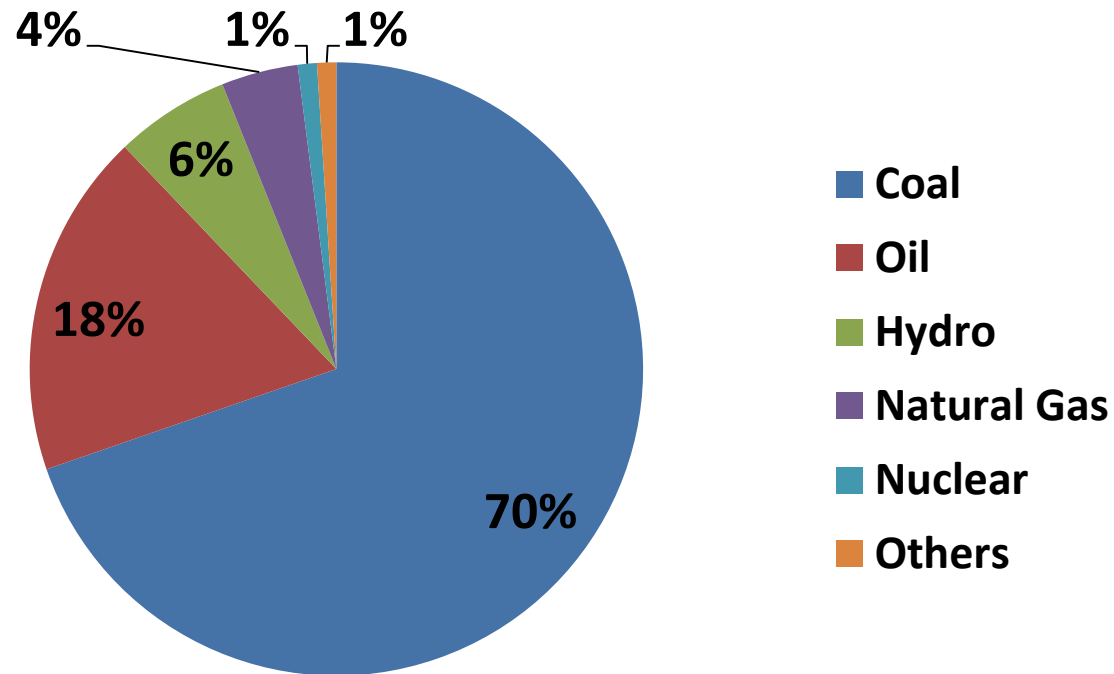
## Status of Ozone in the Bay Area

Year	National 8-Hour	State 1-Hour	State 8-Hour
2011	4	5	10
2012	4	3	8
2013	3	3	3
2014	5	3	10

**Days > 0.075 ppm 8-hour NAAQS: 4/30, 5/1, 5/14, 10/4, 10/5**



## Total Energy Consumption in China by Fuel Type, 2011



Energy consumption increased about 2.5 times from 1990 to 2010

Source: US Energy Information Administration



# Asian Pollution

- Pollution in Asia has increased in recent years
- High pollution levels and long pollution seasons
  - Ozone – spring, summer and fall
  - PM2.5 – fall, winter and spring
  - Dust – winter and spring (yellow dust – Mongolia)

Beijing air on a day after rain and  
on a smoggy day, 2005





# Federal Effort to Estimate Transport

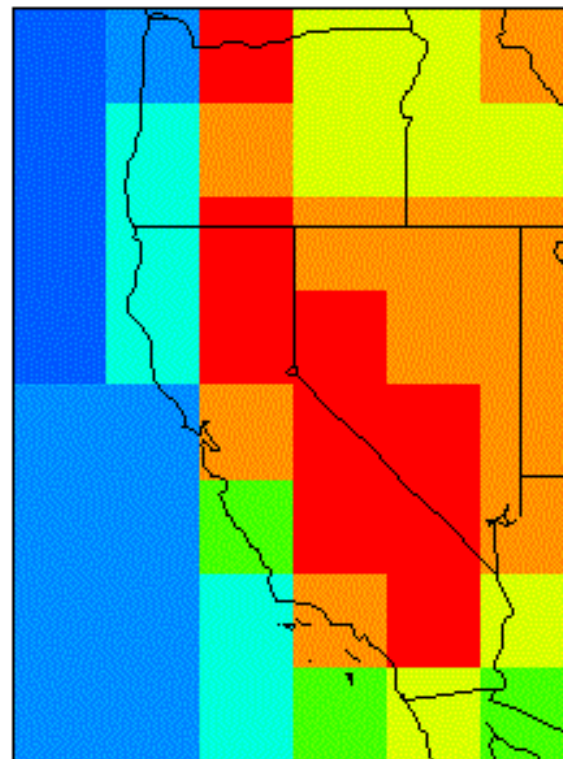
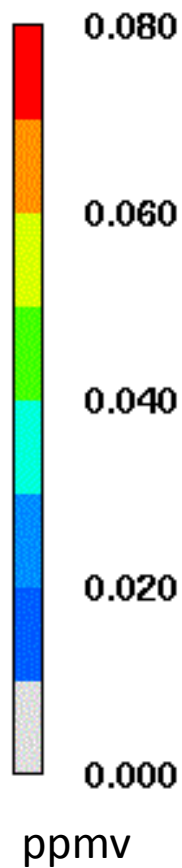
- NOAA, NASA, EPA and others launched a field campaign during the summer of 2010
  - Aircraft-based ozone measurements
  - Ozonesonde measurements, including measurements at Point Reyes and Point Sur
  - Ground-level ozone monitoring in the western US
  - Monitoring pollution transport via satellites
  - Data analysis
  - Global modeling with and without inclusion of anthropogenic emissions in Asia





# Global Model

- Conducted by NCAR
- Ozone, PM2.5 and precursors
- 200 km horizontal resolution
- Available every six hours

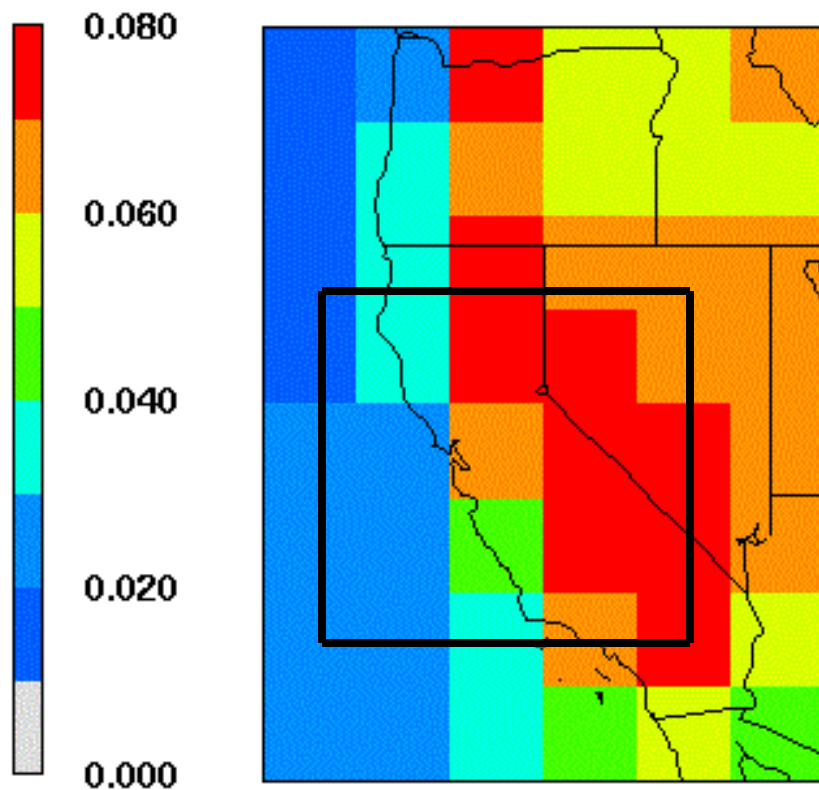


August 12, 2012



# Global Model

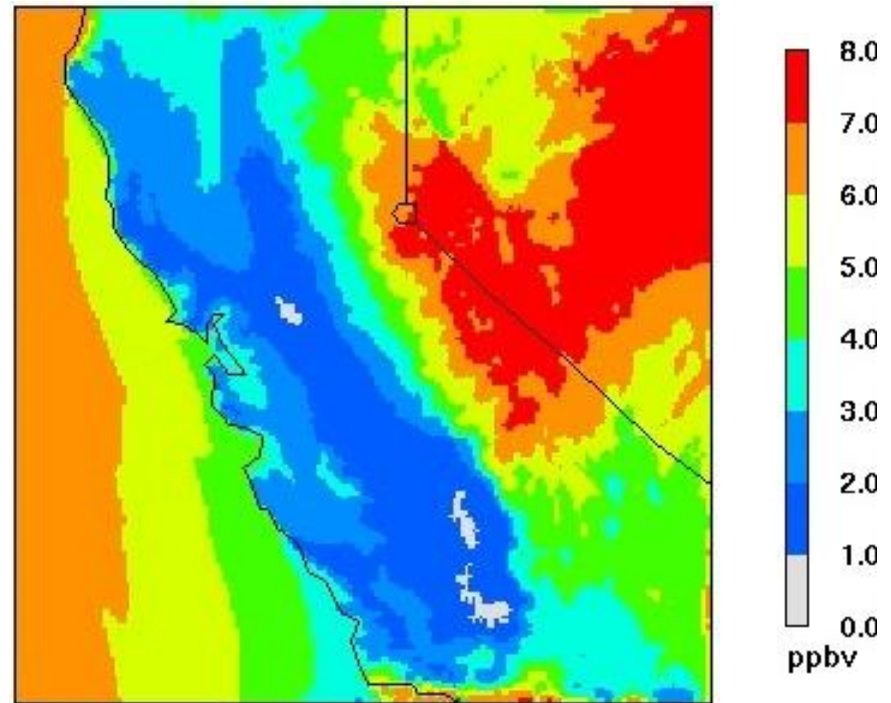
Provides incoming boundary  
pollution information to  
local models





# Air District's Effort to Estimate Transport

- Asian ozone transport was estimated for a 2-week period in August, 2012
- Ozone at the boundaries was obtained from NOAA's global simulations for two scenarios, with and without Asian anthropogenic emissions
- Two local simulations, using data from NOAA's scenarios, were conducted. The difference represents transported ozone

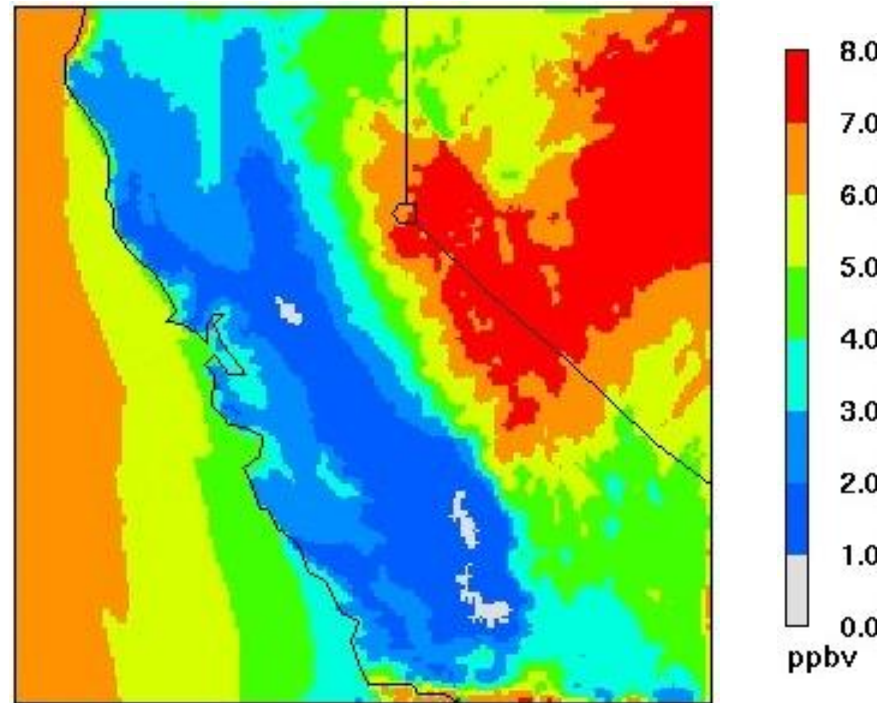


Example of ozone transport via the western boundary



# Air District's Effort to Estimate Transport

- International ozone transport takes place mostly in aloft layers of the atmosphere
- Transported ozone impacts higher elevations the most
- Cooler and cloudy air along the California coast brings ozone concentrations down at lower elevations

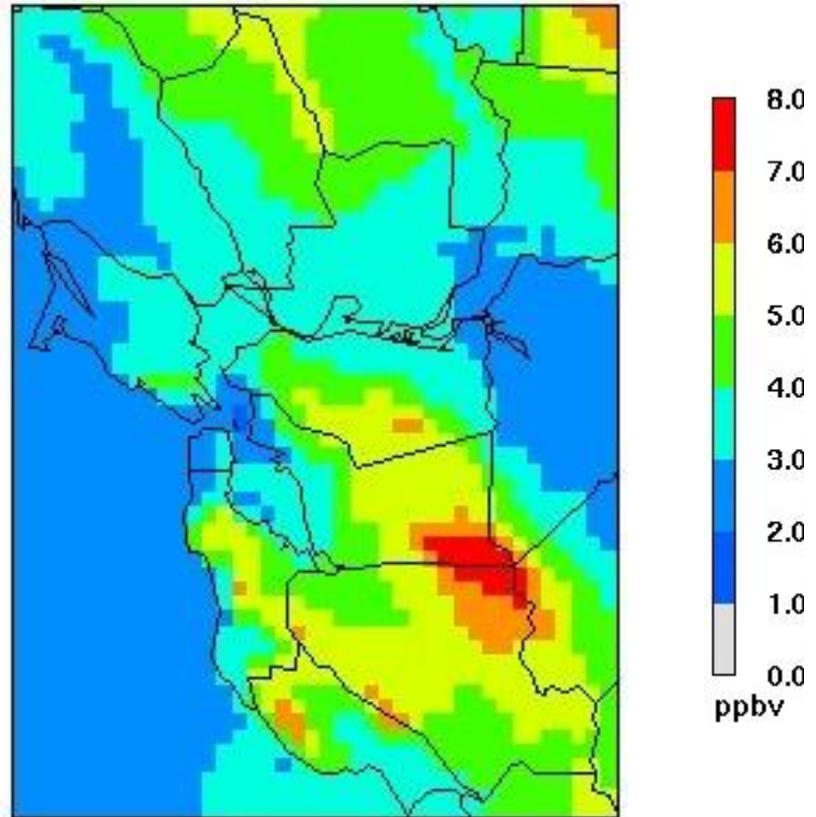


Example of ozone transport via the western boundary



# Air District's Effort to Estimate Transport

- International ozone transport impacts the Bay Area
- Locations of air monitoring stations are also impacted



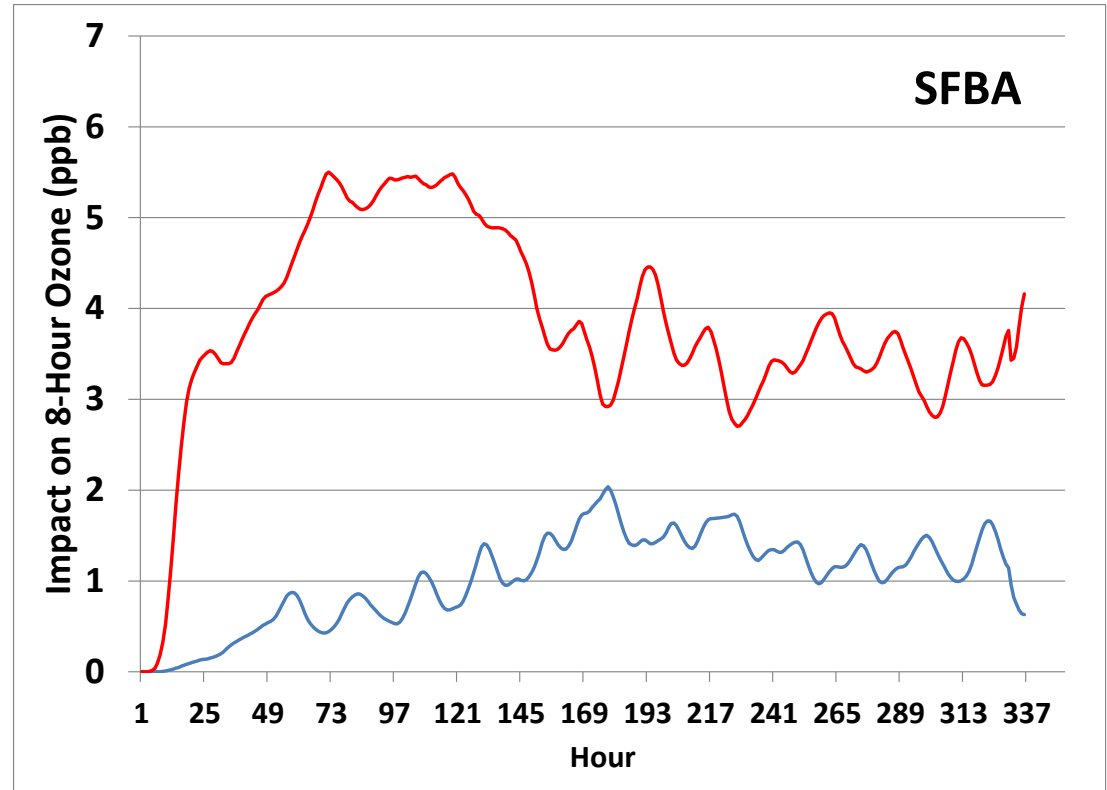
Example of ozone transport via the northern boundary; Bay Area close-up



# Air District's Effort to Estimate Transport

Estimated upper and lower bounds of transported ozone averaged across Bay Area air monitoring stations for 2 weeks

- Four transport scenarios were simulated
- Upper bound is as much as 5.5 ppb
- This amount is significant for the Bay Area; it could impact our attainment status





## Key Takeaway

- There is an ozone contribution from Asia
- It is relatively small, 2-5 ppb
- Spring season and higher elevations seem impacted the most
- We will continue with in-house research and collaborate with others



# Continuing Collaboration Among Federal, State and Local Agencies

- NOAA plans to work with State and local agencies to accommodate their needs for estimating ozone transport
- NASA plans to launch a new satellite in 2018 that will collect pollution data every 1-3 hours
- NASA has been funding the Air Quality Applied Science Team to help interpret satellite-based data for air agencies
- ARB plans to launch daily ozonesodes at two coastal locations in northern and central California during the summer of 2015
- Districts and Western Regional Air Partnership plan to collaborate and further study continental ozone transport
  - PM2.5 and dust transport is of interest





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# 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 Air 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

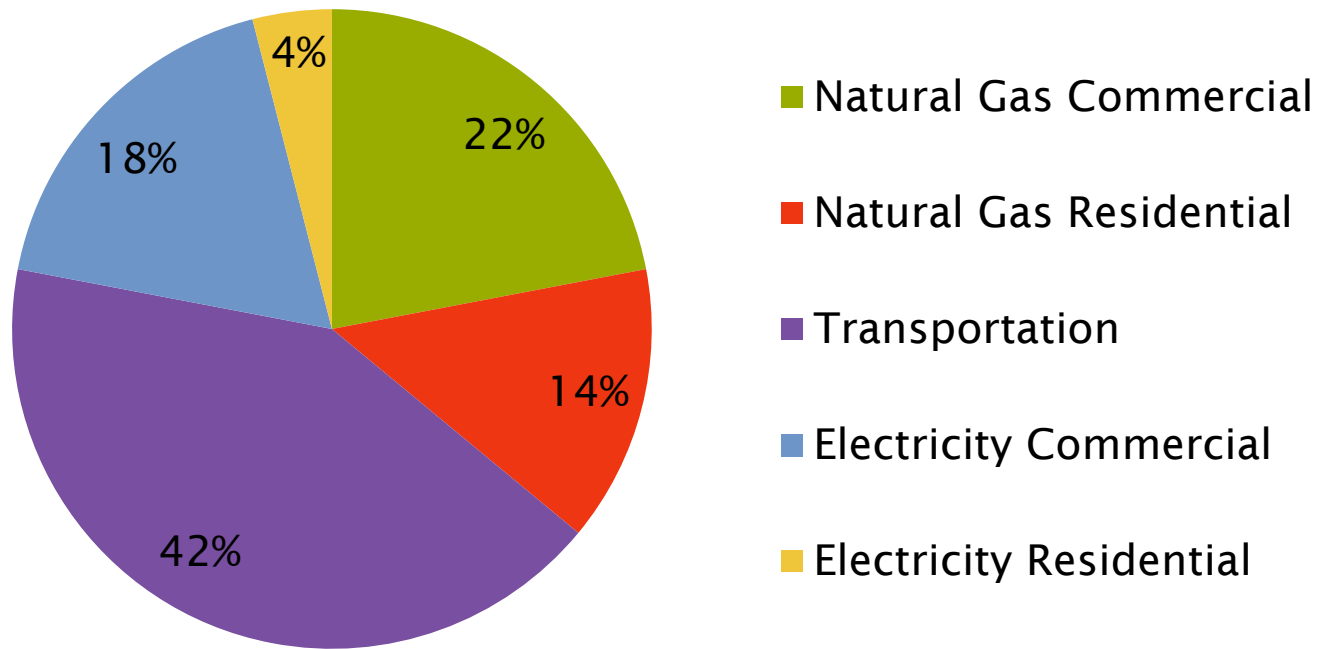
- **Efficiency**
  - Especially uses that cannot be easily electrified
- **Electrification**
  - All feasible fossil-fuel combustion uses
- **Decarbonization**
  - Electricity supply (e.g., renewables) and fossil fuels





# Energy Future: Where We Are – Bay Area

## Bay Area Energy Consumption (percent) in 2012



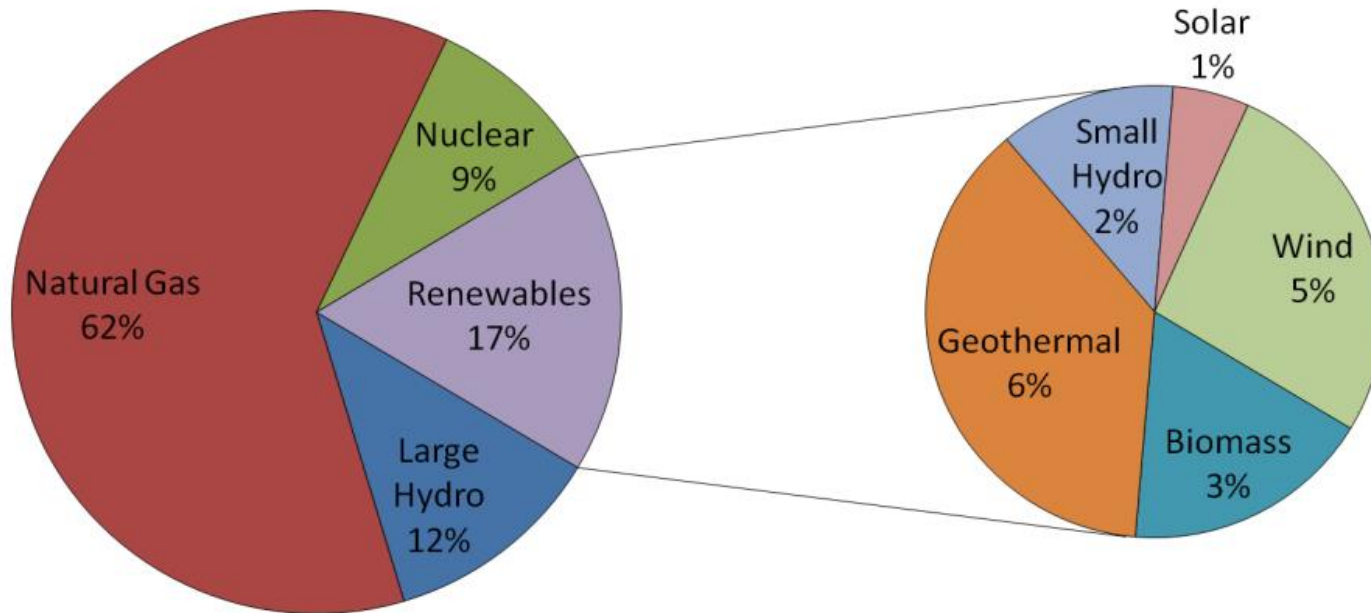
Source: California Energy Commission and Air Resources Board





# Energy Future: Where We Are - State

## CA In-State Electricity Generation in 2012

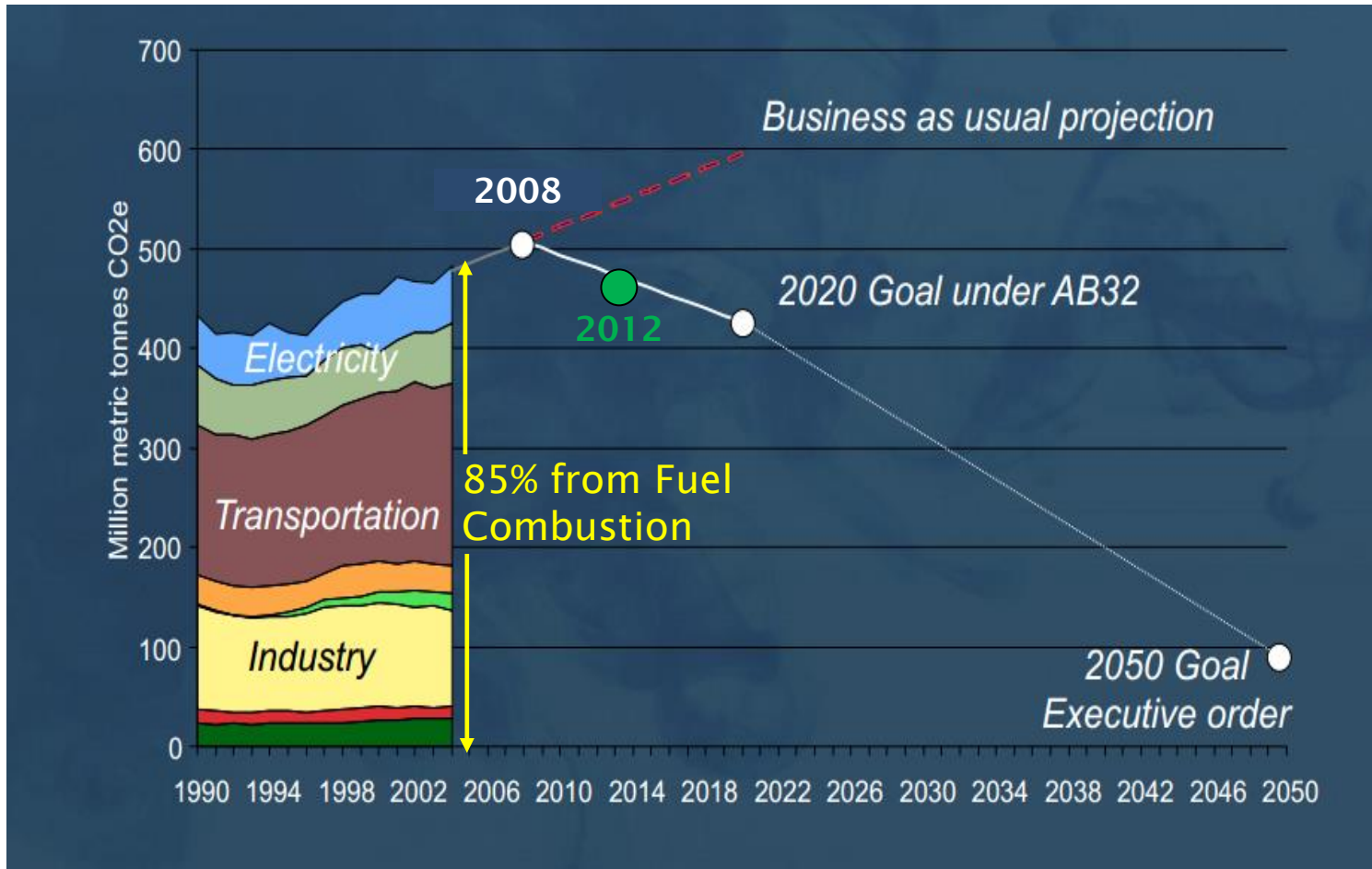


Sources: California Energy Commission, QFER and SB 1305 Reporting Requirements. In-state generation is reported generation from units 1 MW and larger.





# Energy Future: Where We Are Going

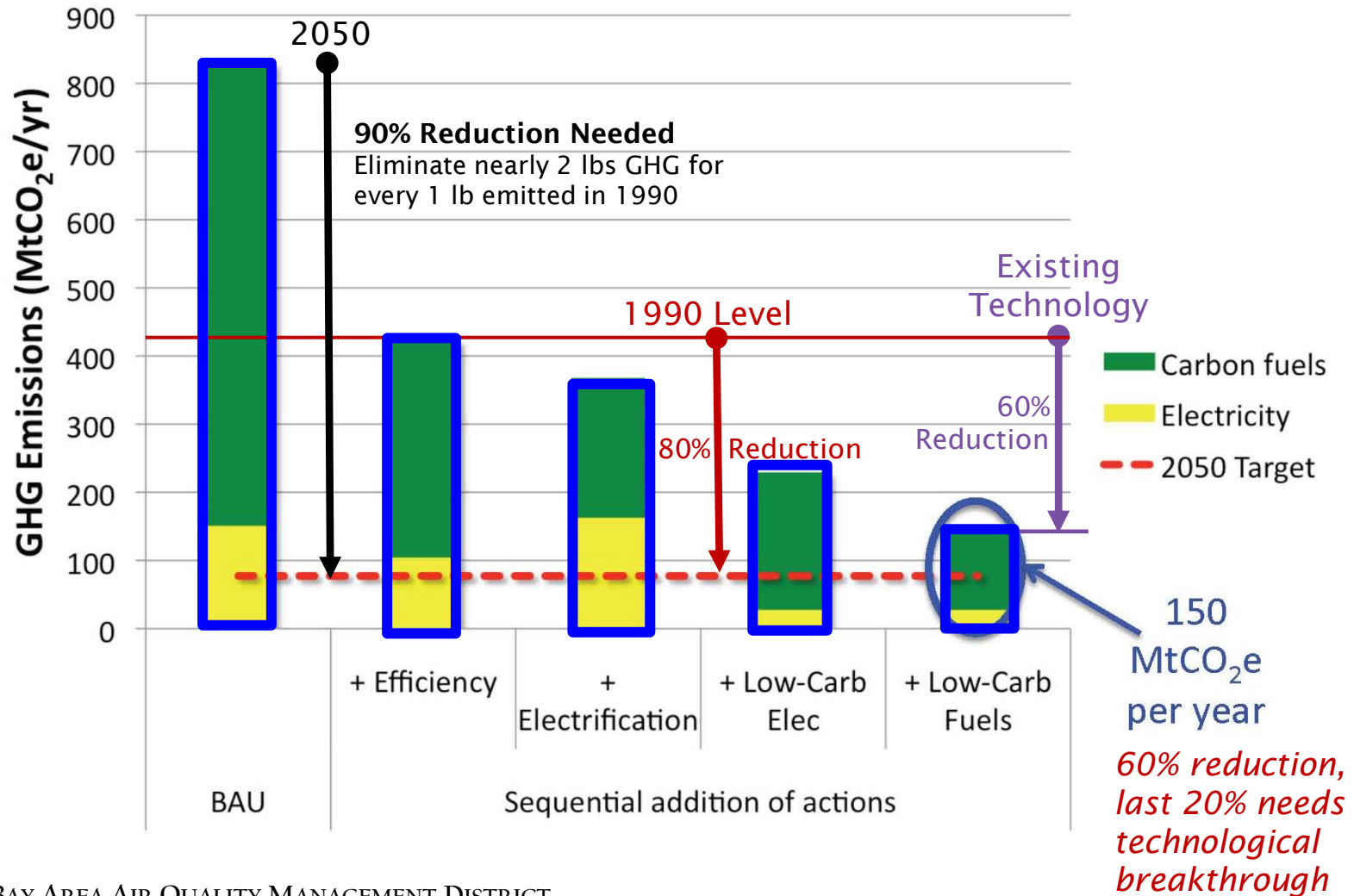


Source: Dr. Jim Williams, Energy and Environmental Economics, Feb. 2014





# 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*





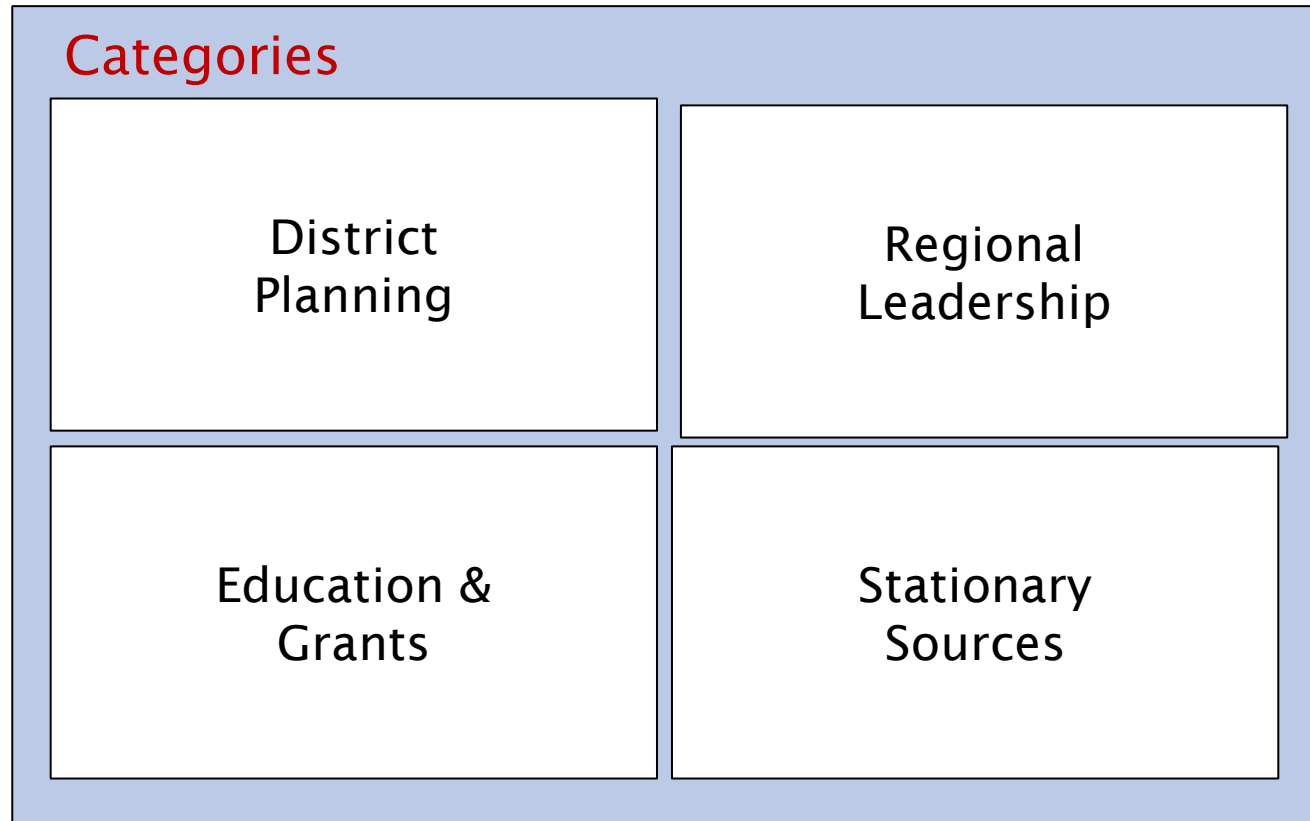
# Energy Future: Major Challenges

- **Energy storage**
  - Critical to renewables success, pumped storage most readily available now, batteries, hydrogen, and compressed air not ready yet
- **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
- **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 **Air 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 **Air District's clean air plans**
- Integrate **implications of future energy trends** into Air District's clean air and climate plans, modifying plans if necessary



Chevron oil refinery, Richmond, CA ([www.wtsp.com](http://www.wtsp.com))





# Recommendations: Regional Leadership

Collaborate with state, regional, and local agencies to **incorporate energy considerations** into Air 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

- **Integrate latest information on energy** behavior-oriented recommendations into Air 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: Grants

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





# Recommendations: Stationary Sources

- Integrate GHG emission reductions into new and existing **Air District's permitting rules**
- Explore ways to reduce GHG emissions from large numbers of **small stationary sources** of CO<sub>2</sub> (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)







# Thank You!

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