California's Air Pollution and Climate Change Policies

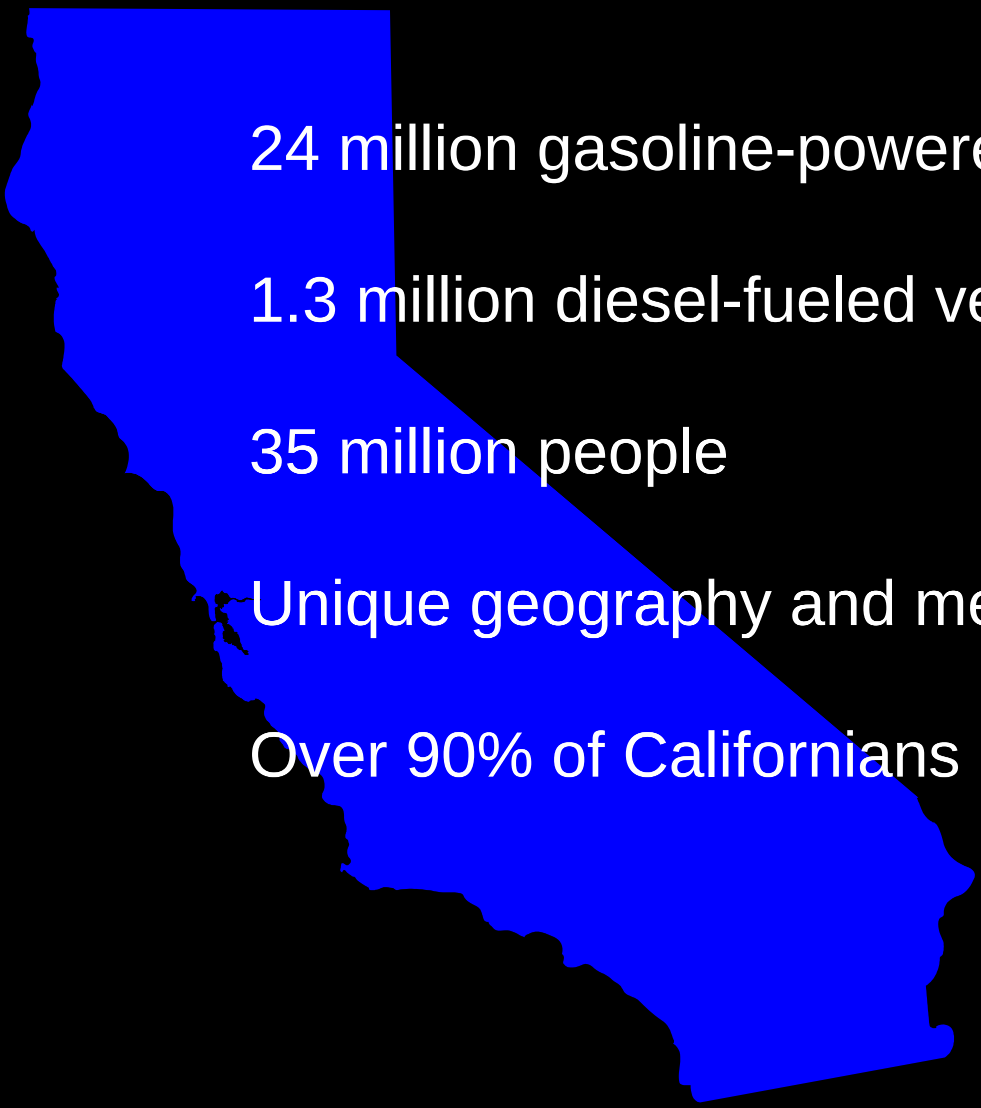
Bart Croes, Chief
Research Division

California Air Resources Board

California Environmental Protection Agency

Control policy drivers ...

California’s Air Quality Problem



24 million gasoline-powered vehicles

1.3 million diesel-fueled vehicles and engines

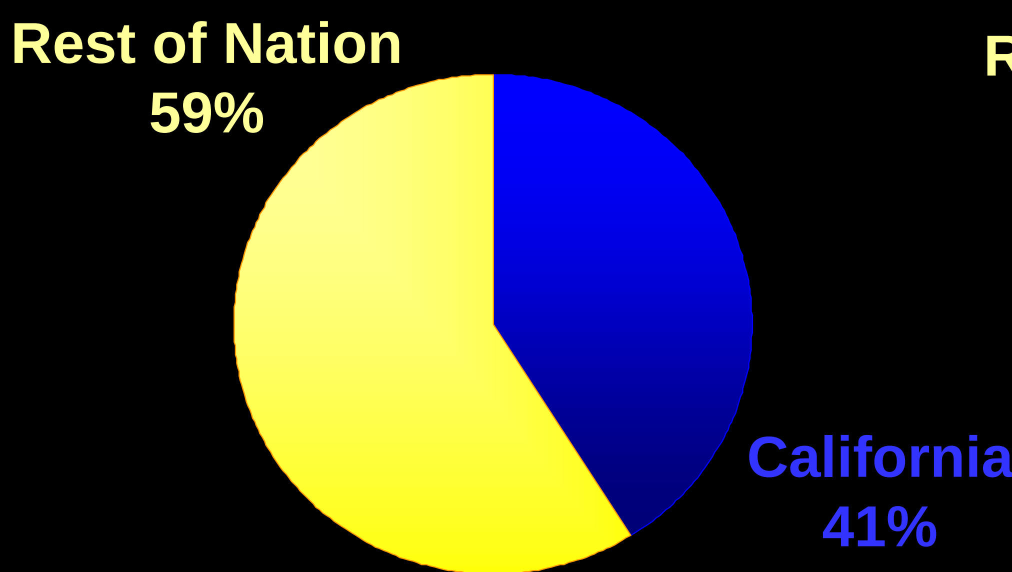
35 million people

Unique geography and meteorology confine air pollutants

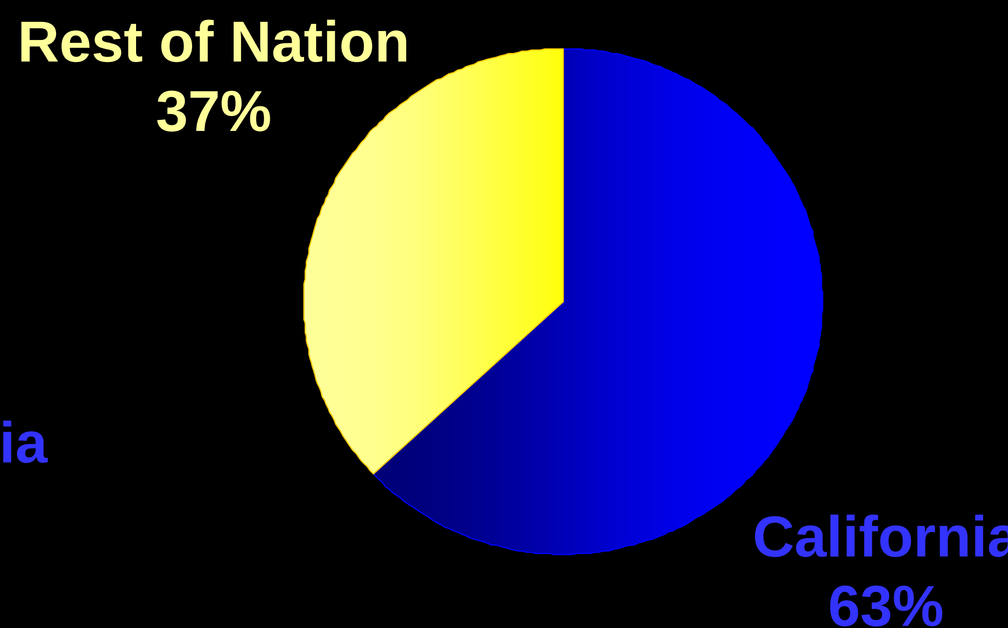
Over 90% of Californians breath unhealthy air

California's Disproportionate Air Pollution Exposure

8-Hour Ozone
(NAAQS = 160 µg/m^3)



Annual PM2.5
(NAAQS = 15 µg/m^3)



Population-weighted and minus national ambient air quality standard (NAAQS), based on 2000-2002 data

Air Pollution and Premature Death

California Estimates

Pollutant	Averaging Time	Increased Risk in All-Cause Mortality (per 10 μg/m^3) [e]	Threshold or Background (μg/m^3)	Average Annual Exposure (μg/m^3) [d]	Annual Deaths [e]
PM2.5	Annual	10% [a]	2.5 to 7	13.5	13,000 to 22,000
PM10	24-hour	0.25% [b]	5	22.3	1000
Ozone	8-hour	0.27% [c]	80	130	1500

[a] Median value from "An expert judgment assessment of the concentration-response relationship between PM2.5 exposure and mortality", Industrial Economics, Inc. (2006)

[b] "Revised analysis of time-series studies of air pollution and health", HEI Special Report, p.21 (2003)

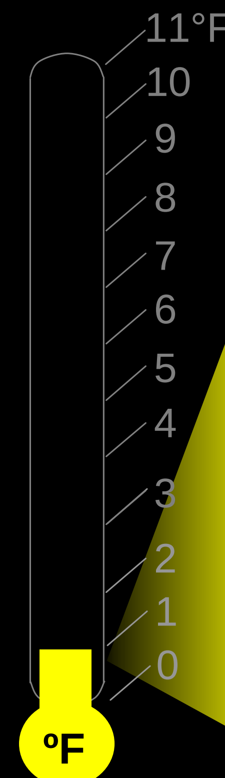
[c] Ostro, Tran and Levy "The health benefits of reduced tropospheric ozone in California", *JAWMA* (2006)

[d] 2003-2005 air quality data, population-weighted

[e] At least a factor of two uncertainty

California Climate Impacts

over the past 100 years



0.7ºF (0.4°C) higher temperatures

7 inch sea level rise

12% decrease in fraction of runoff between April and July

snowmelt and spring blooms advanced 2 days/decade since 1955

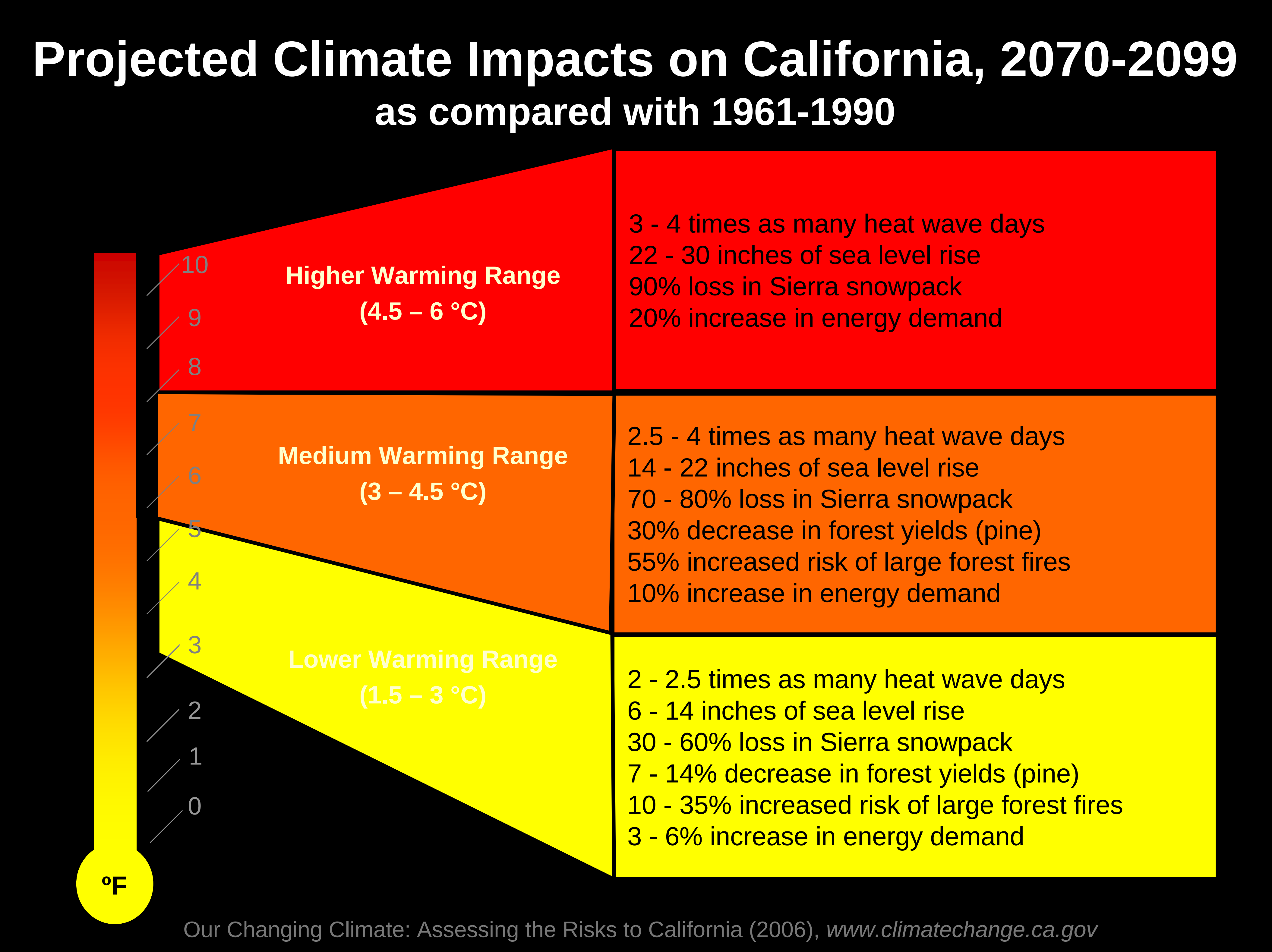
Cal/EPA-OEHHA, “Environmental Protection Indicators for California” (2002)
www.oehha.ca.gov/multimedia/epic/Epicreport.html

Lyell Glacier

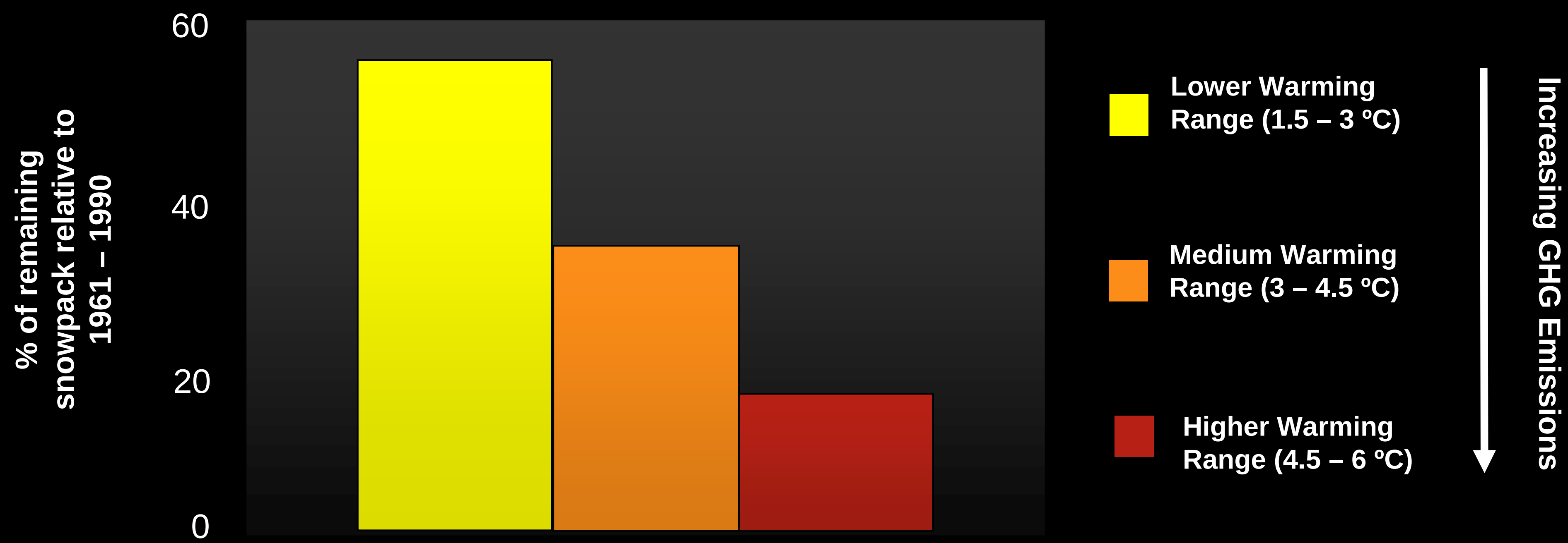
Yosemite National Park

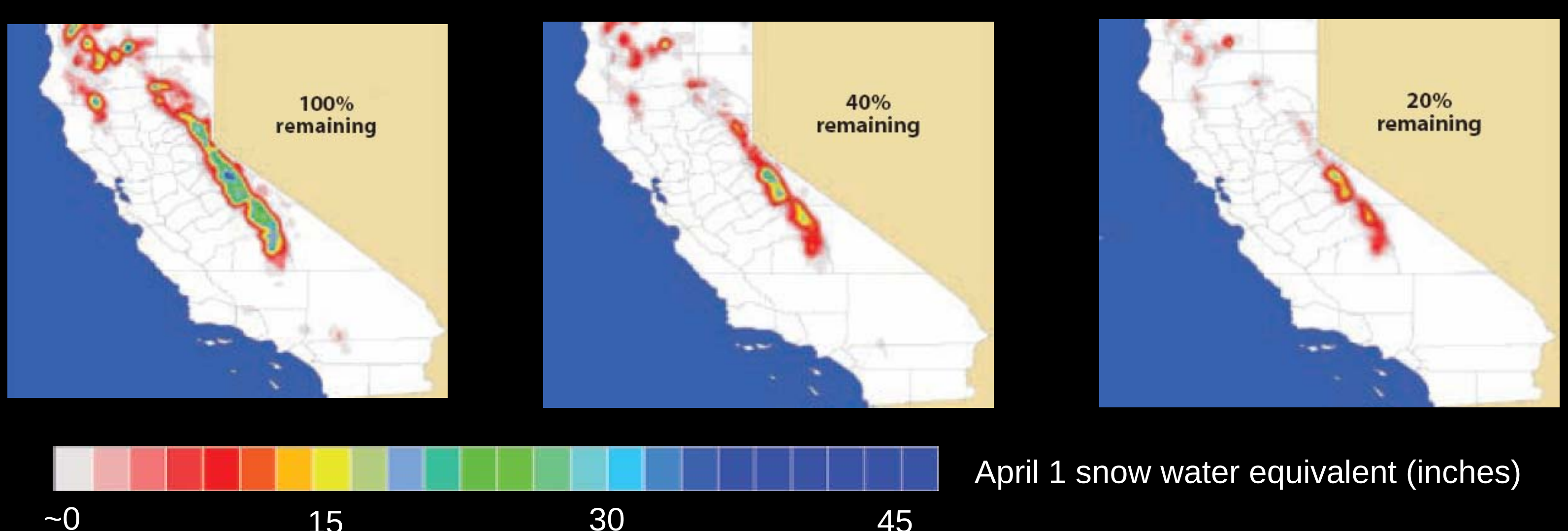
1903

2003


Projected Climate Impacts on California, 2070-2099
as compared with 1961-1990
Higher Warming Range
(4.5 – 6 °C)
3 - 4 times as many heat wave days
22 - 30 inches of sea level rise
90% loss in Sierra snowpack
20% increase in energy demand
Medium Warming Range
(3 – 4.5 °C)
2.5 - 4 times as many heat wave days
14 - 22 inches of sea level rise
70 - 80% loss in Sierra snowpack
30% decrease in forest yields (pine)
55% increased risk of large forest fires
10% increase in energy demand
Lower Warming Range
(1.5 – 3 °C)
2 - 2.5 times as many heat wave days
6 - 14 inches of sea level rise
30 - 60% loss in Sierra snowpack
7 - 14% decrease in forest yields (pine)
10 - 35% increased risk of large forest fires
3 - 6% increase in energy demand
10
9
8
7
6
5
4
3
2
1
0
ºF
Our Changing Climate: Assessing the Risks to California (2006), www.climatechange.ca.gov

Decrease in Sierra Nevada Snowpack

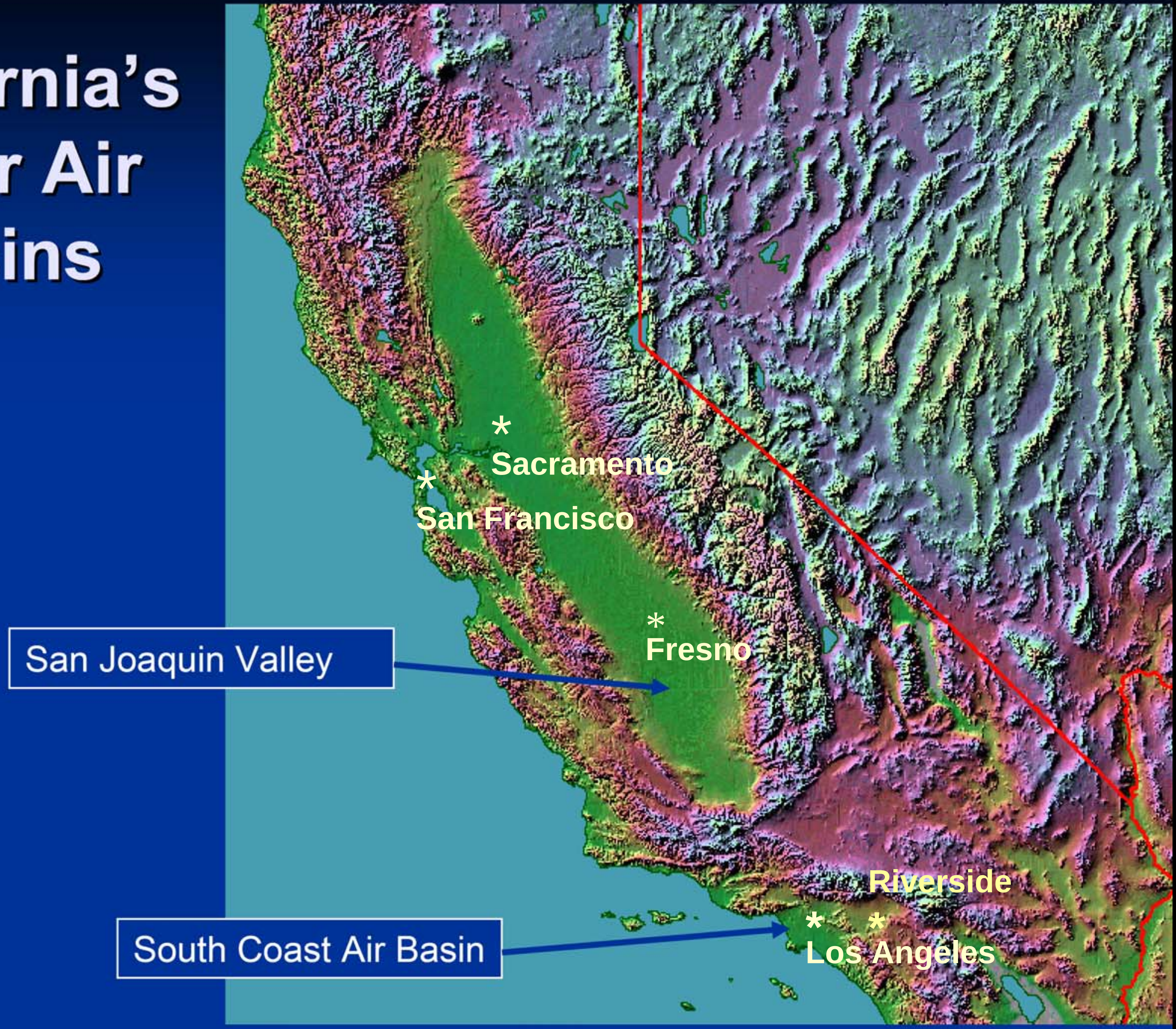




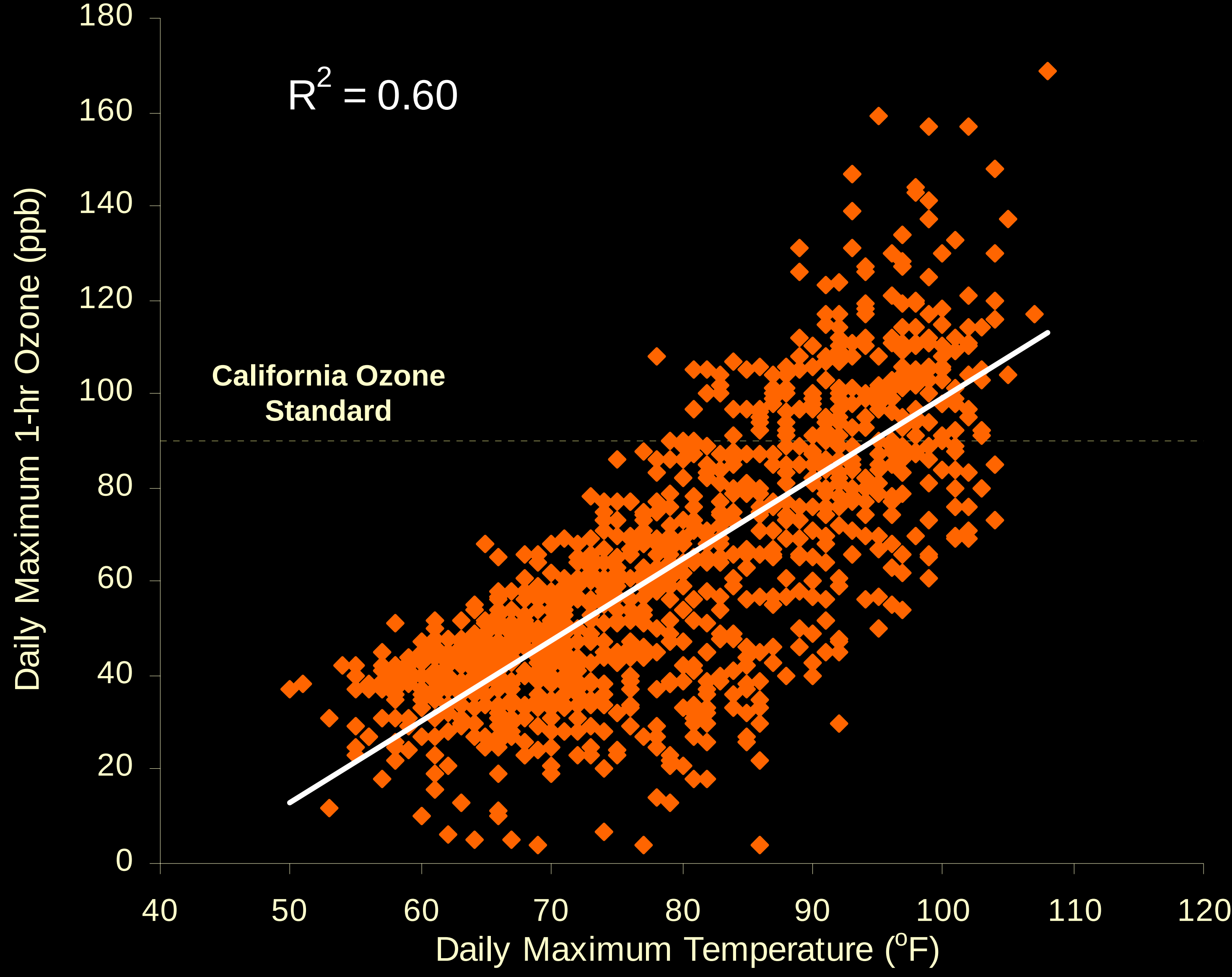
Our Changing Climate: Assessing the Risks to California (2006), *www.climatechange.ca.gov*

Implications of Climate Change for Air Quality

California's Major Air Basins

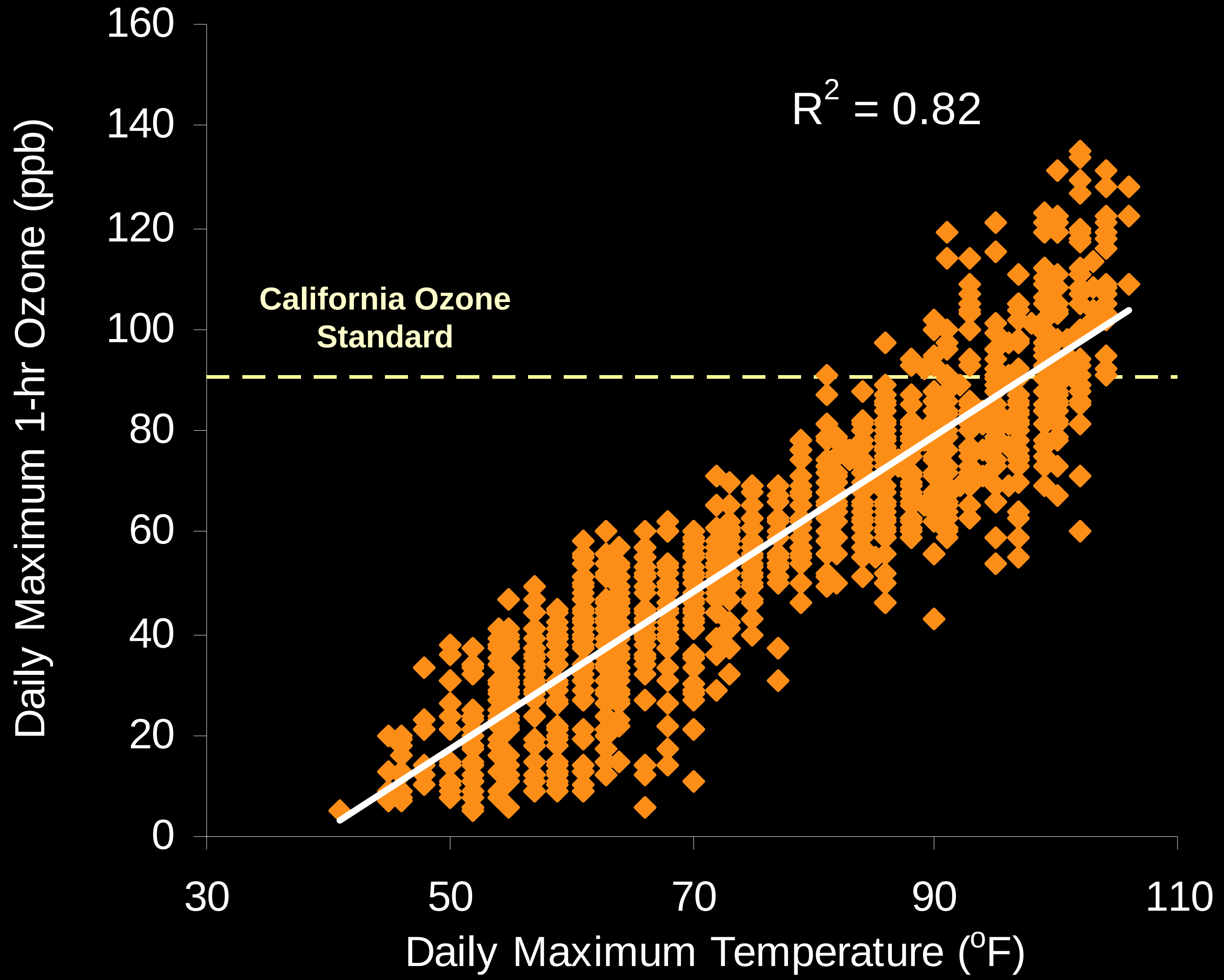


Ozone versus Temperature
Riverside, 2003-2005



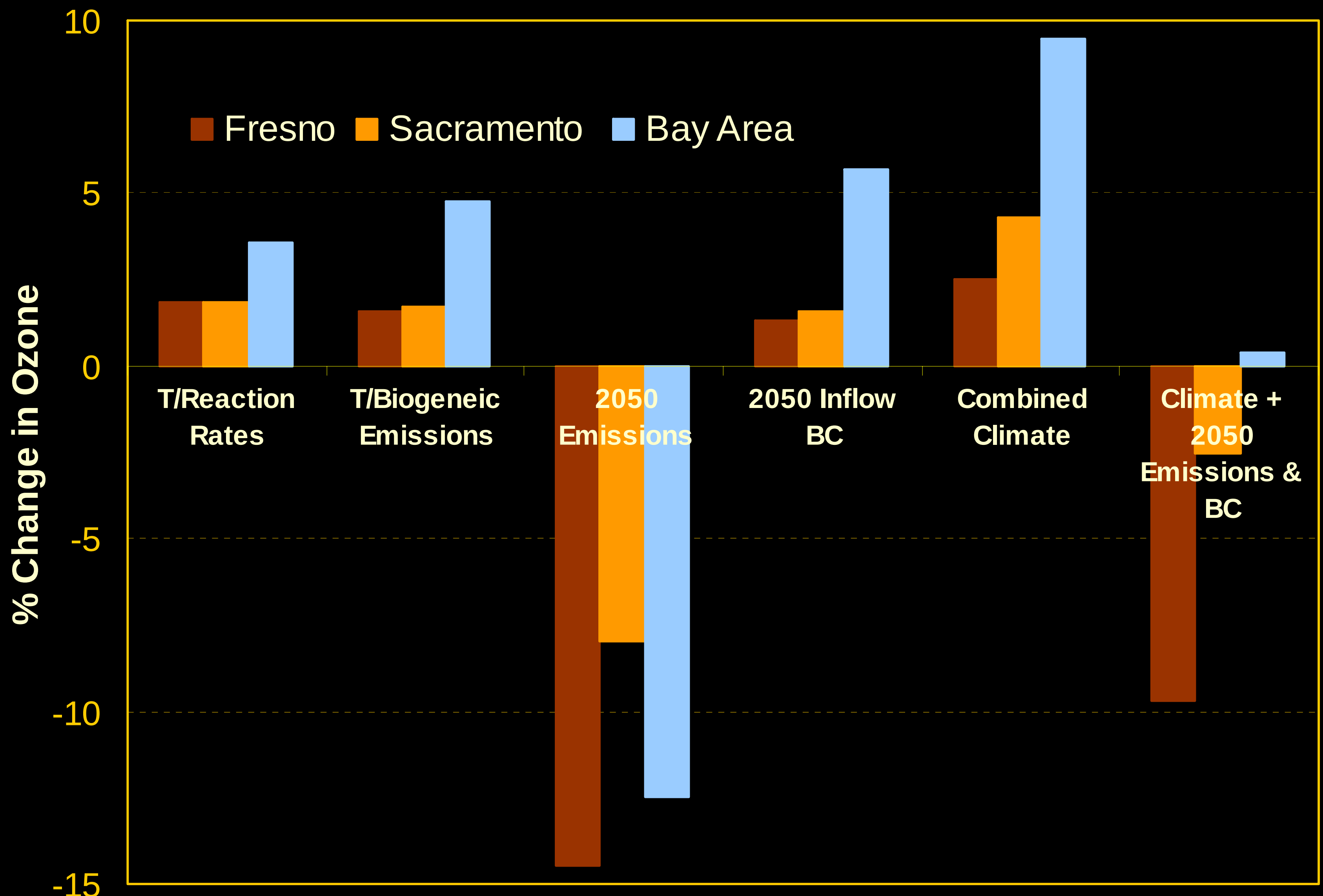
Ozone versus Temperature

Fresno, 2003-2005



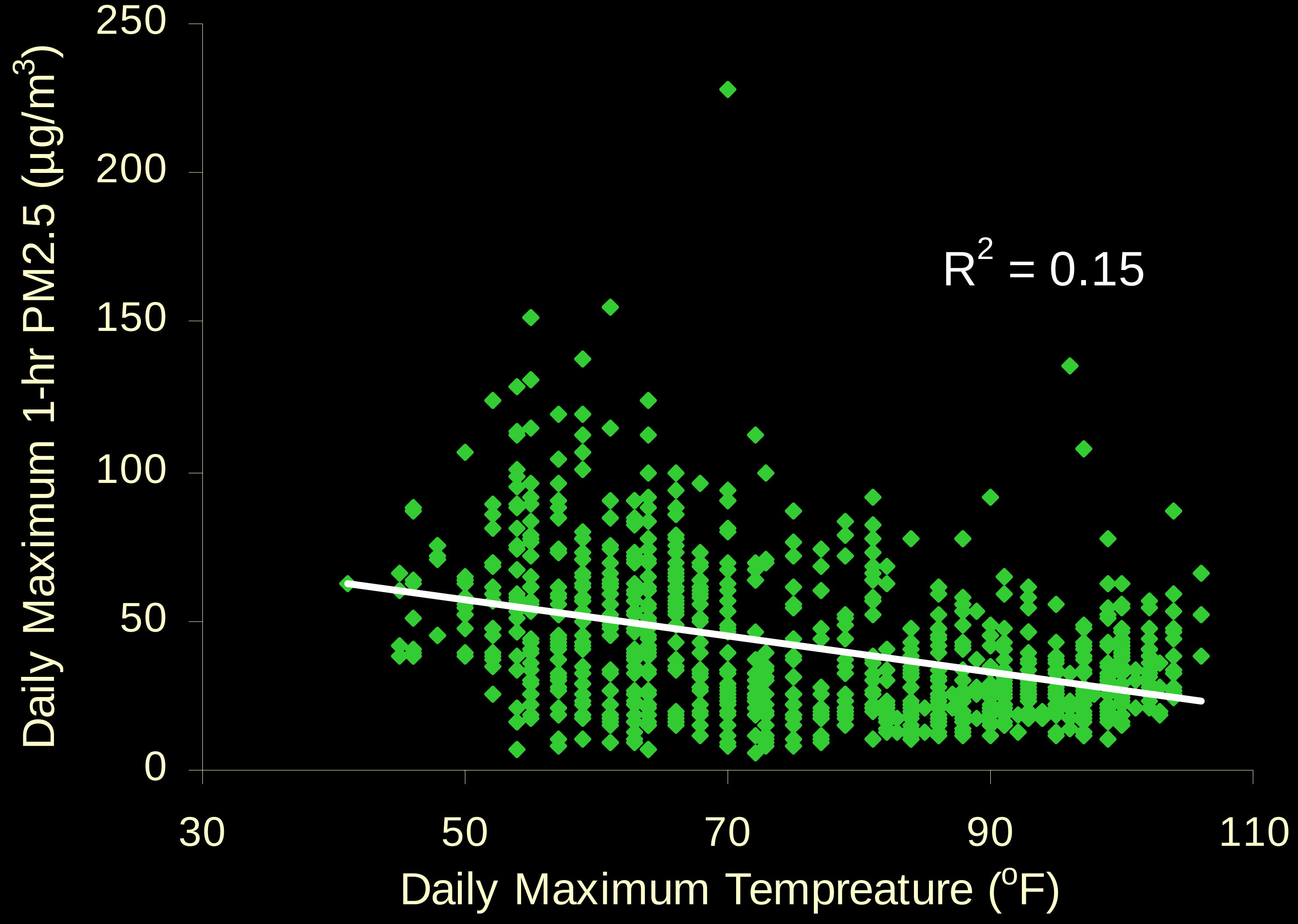
Projected Climate Impact on Ozone, 2050

Central California



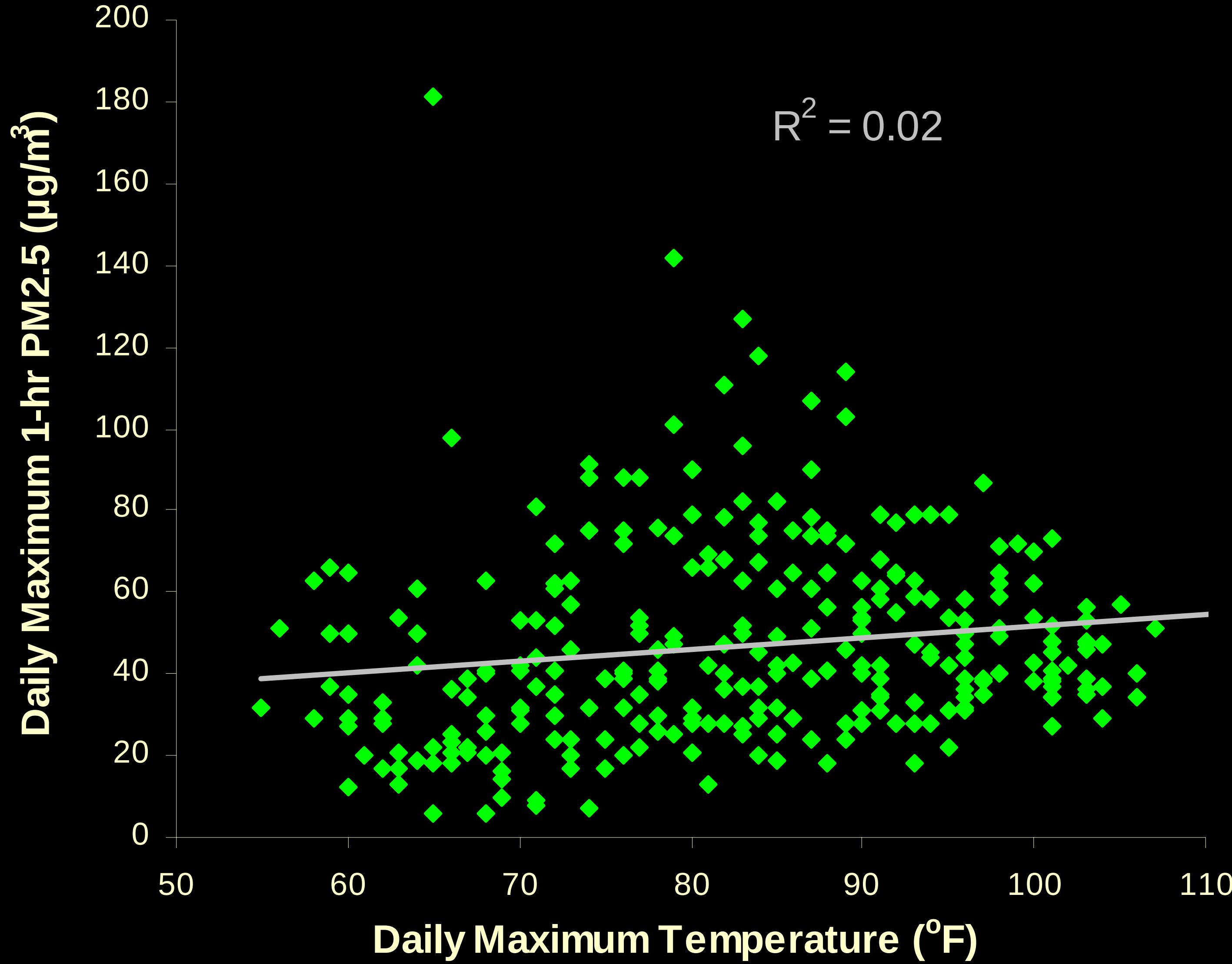
Steiner et al., “Influence of future climate and emissions on regional air quality in California”, *JGR* (2006)

PM2.5 versus Temperature
Fresno, 2003-2005



PM2.5 versus Temperature

Riverside, 2006



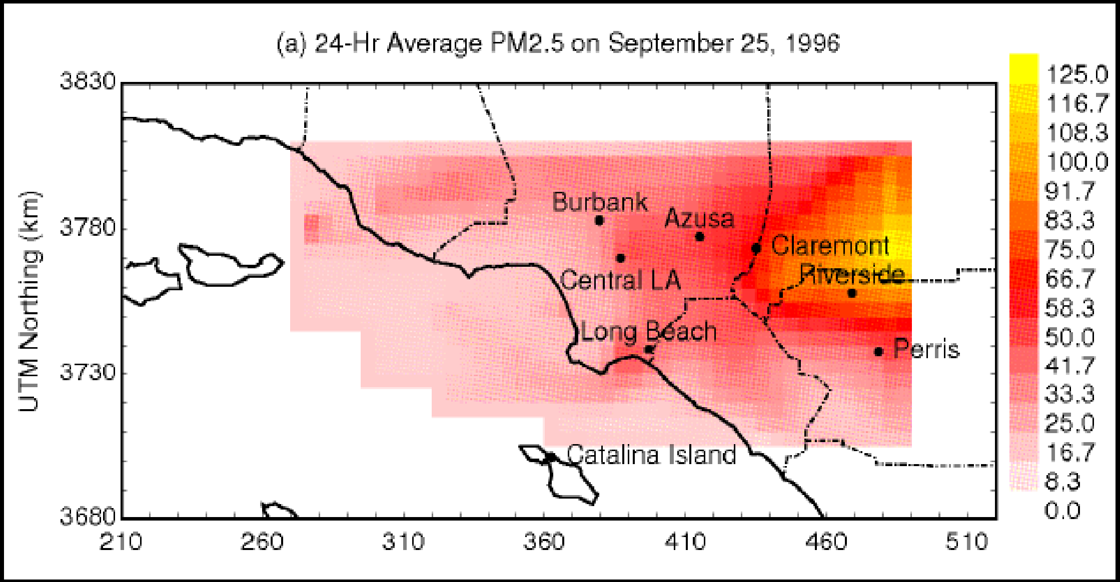
PM2.5 Response to Climate
South Coast Air Basin

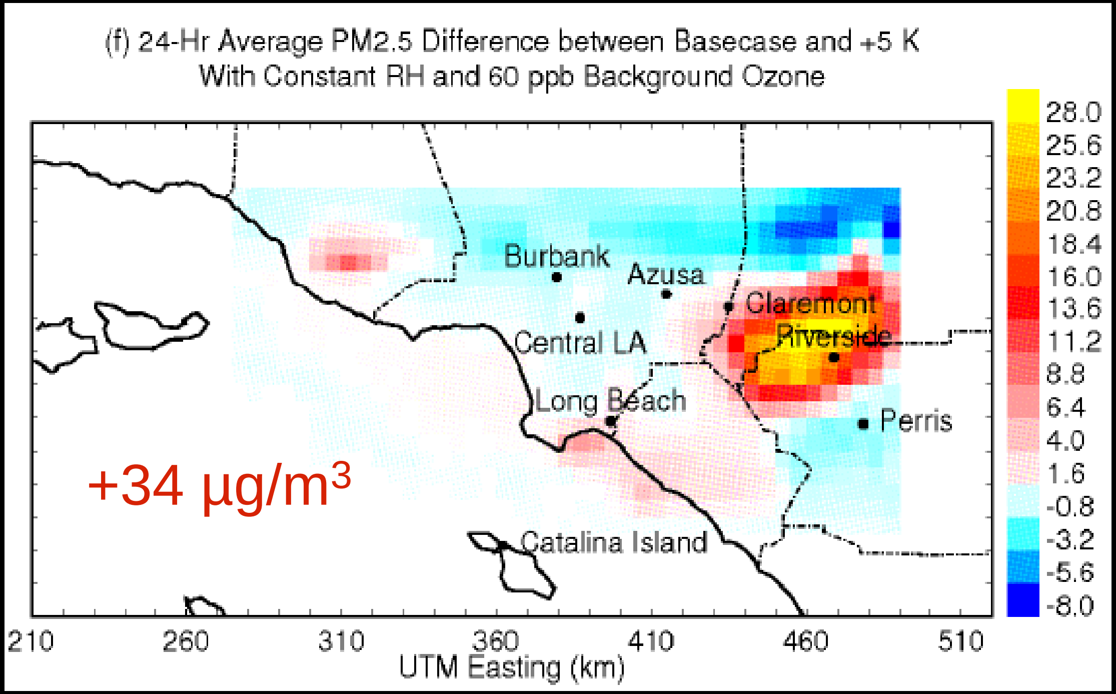
Base-case episode features
September 25, 1996
Elevated temperature inversion
Cool nights, warm days

Sensitivity study
1. Increase background ozone to 60 ppb
2. Increase temperature by +5˚C, constant RH
3. Does not account for future controls or the effect of temperature on emissions.

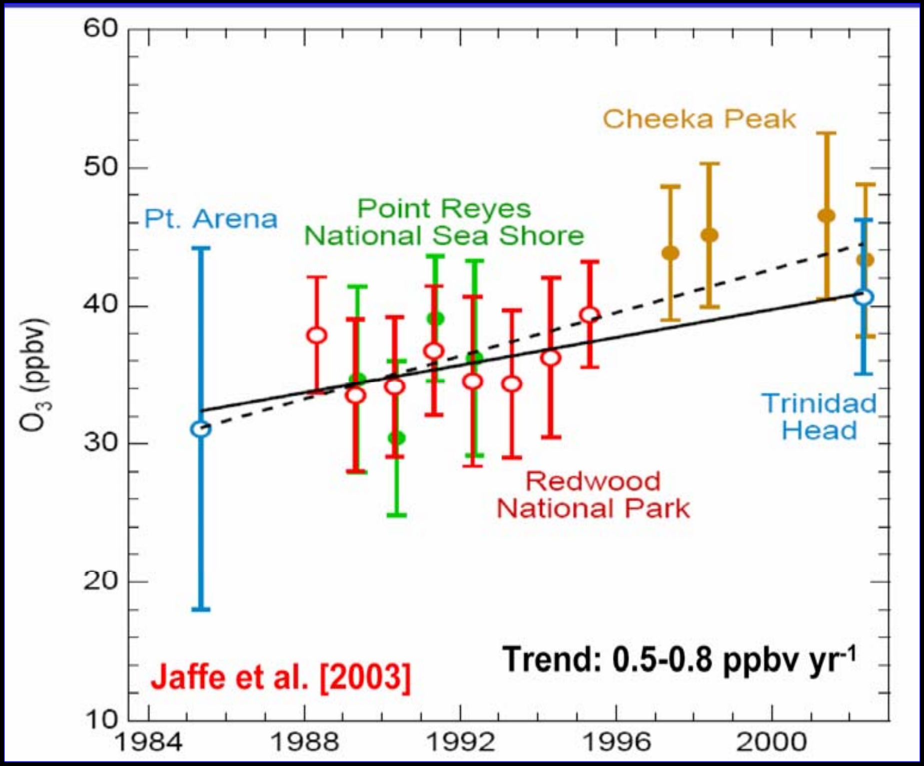
Results
+30 μg/m³ (~25%) increase in daily peak PM2.5

Kleeman and Cayan (2006)

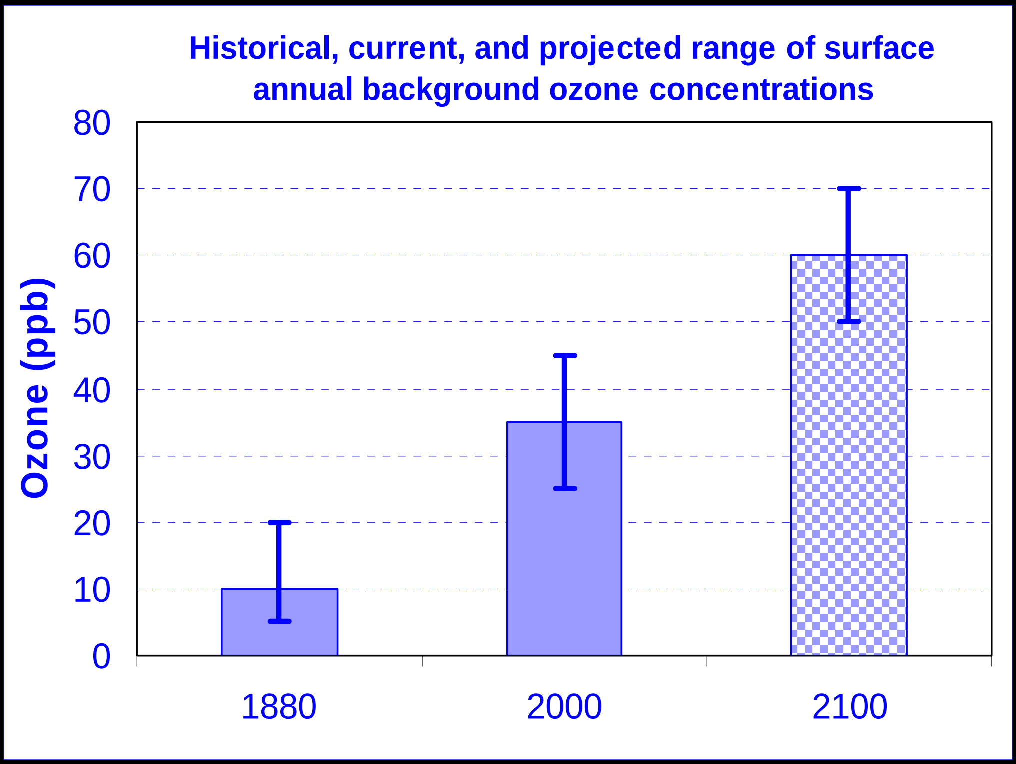




Increase in Background Ozone



Observed trends in background ozone levels in California (Jaffe et al., 2003)

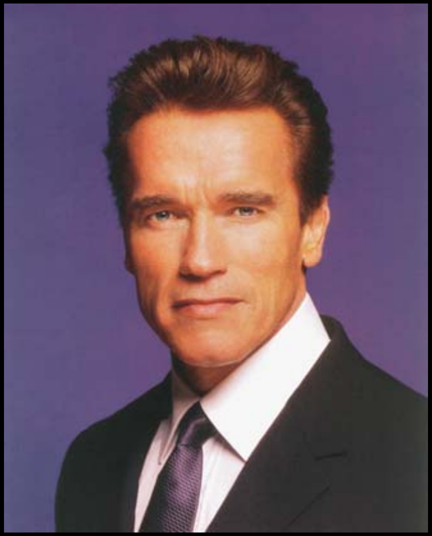


Background ozone levels in the Northern Hemisphere (Vingarzan et al., 2004)

Policy response ...

Governor Schwarzenegger's Environmental Targets

50% improvement in air quality from 2003 to 2010



Diesel Engines

75% below 2000 levels by 2010, 85% below by 2020
Replace or retrofit every diesel engine in California

Goods Movement

2001 emission levels by 2010
Diesel PM risk 85% below 2000 by 2020

Greenhouse Gases

By 2010, reduce to 2000 levels (60 MMT, 11% below BAU)
By 2012, cap and trade market linked with EU-ETS and RGGI
By 2020, reduce to 1990 levels (174 MMT, 30% below BAU)
By 2050, reduce to 80% below 1990 levels

Hydrogen Highway

Green Government Buildings

California Global Warming Solutions Act of 2006 (Assembly Bill 32)

Sept 2006
- AB 32 signed into legislation
- Air Resources Board charged with monitoring and regulating sources of greenhouse gases in order to reduce emissions

2007
- Publish list of early actions in June

2008
- Inventory baseline and reporting

2009
- Publish market and regulatory scoping plan

2010
- Reduce GHG emissions to 2000 levels
- Adopt enforceable early action regulations

2011
- GHG limits and measures adopted

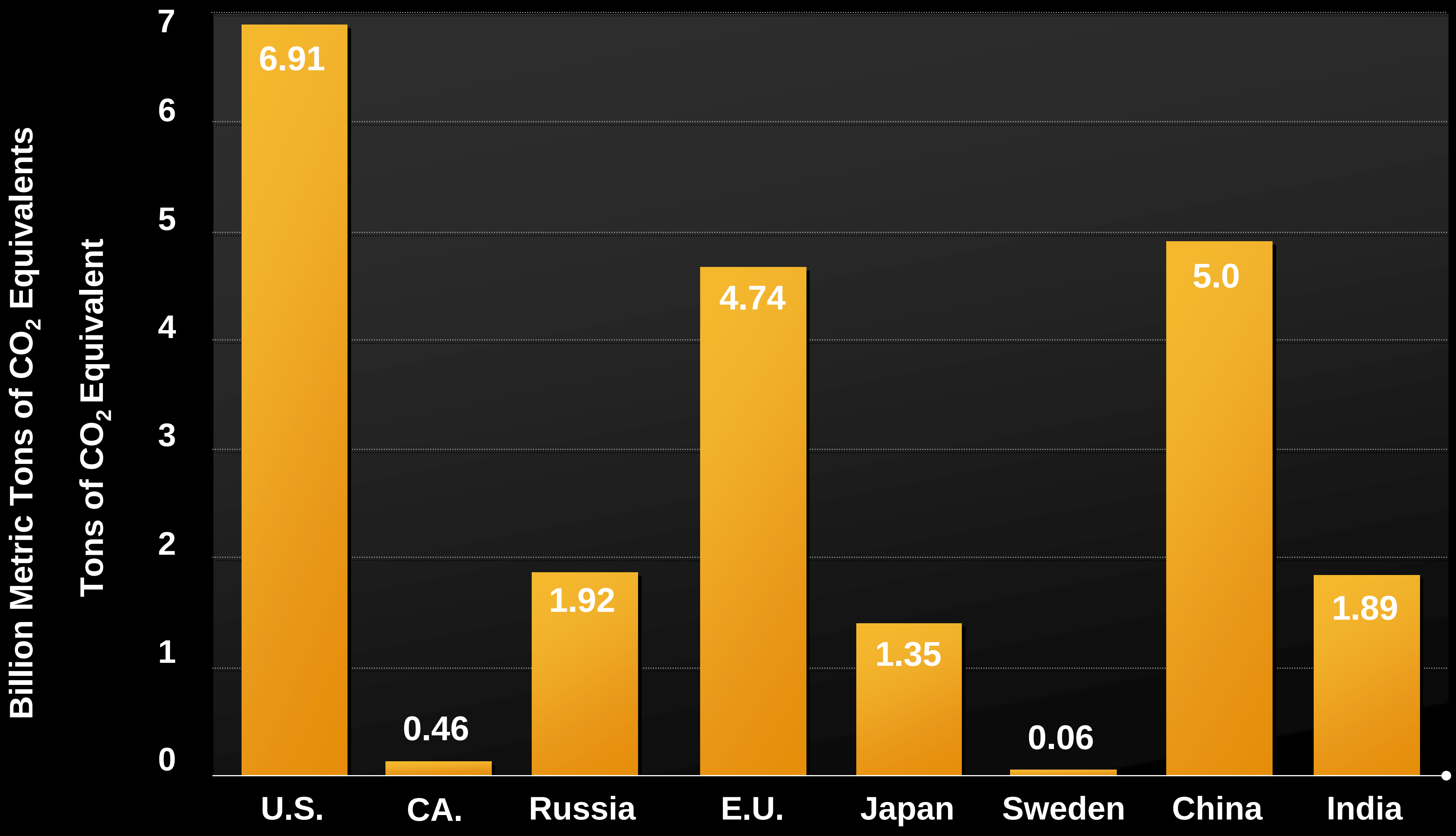
2012
- GHG limits and measures operative

2020
- Reduce GHG emissions to 1990 levels

2050
- Reduce GHG emissions to 80% of 1990 levels

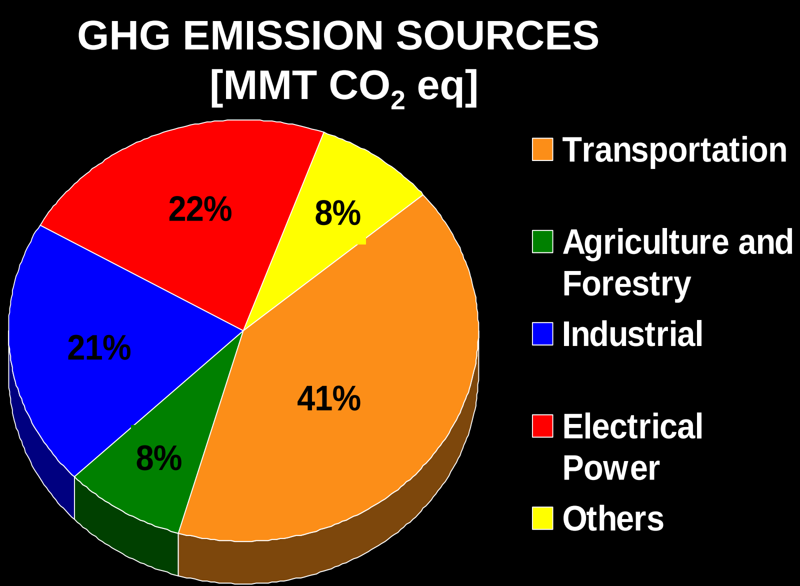
Air Resources Board

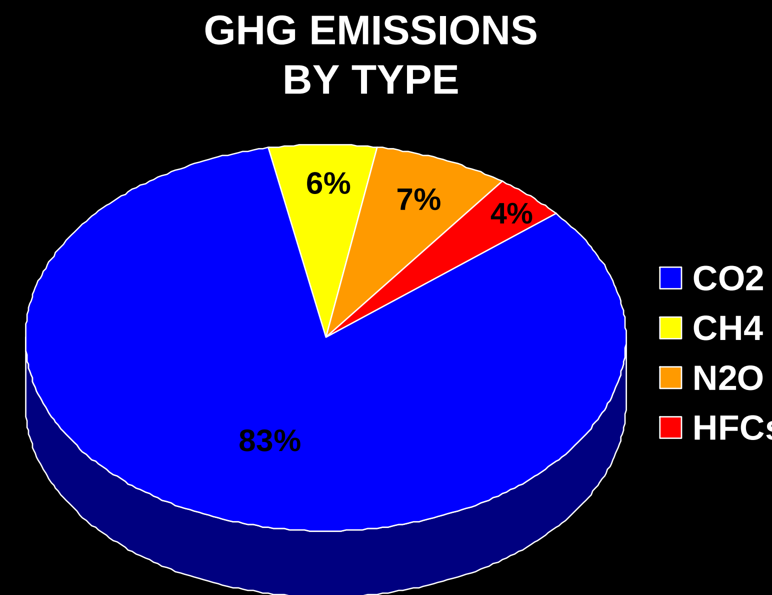
GHG Emissions Per Country / Region



Climate Analysis indicators Tool (CAIT US Version 1.0, CAIT version 4.0), World Resources Institute, 2007 (data is for 2001-2002 and includes CO_2, CH_4, N_2O, HFCs, PFCs, and SF_6 emissions for countries and CO_2, CH_4, N_2O, and F-gases for CA)

California Greenhouse Gas Emissions





CO_2, N_2O

CO_2, CH_4, N_2O

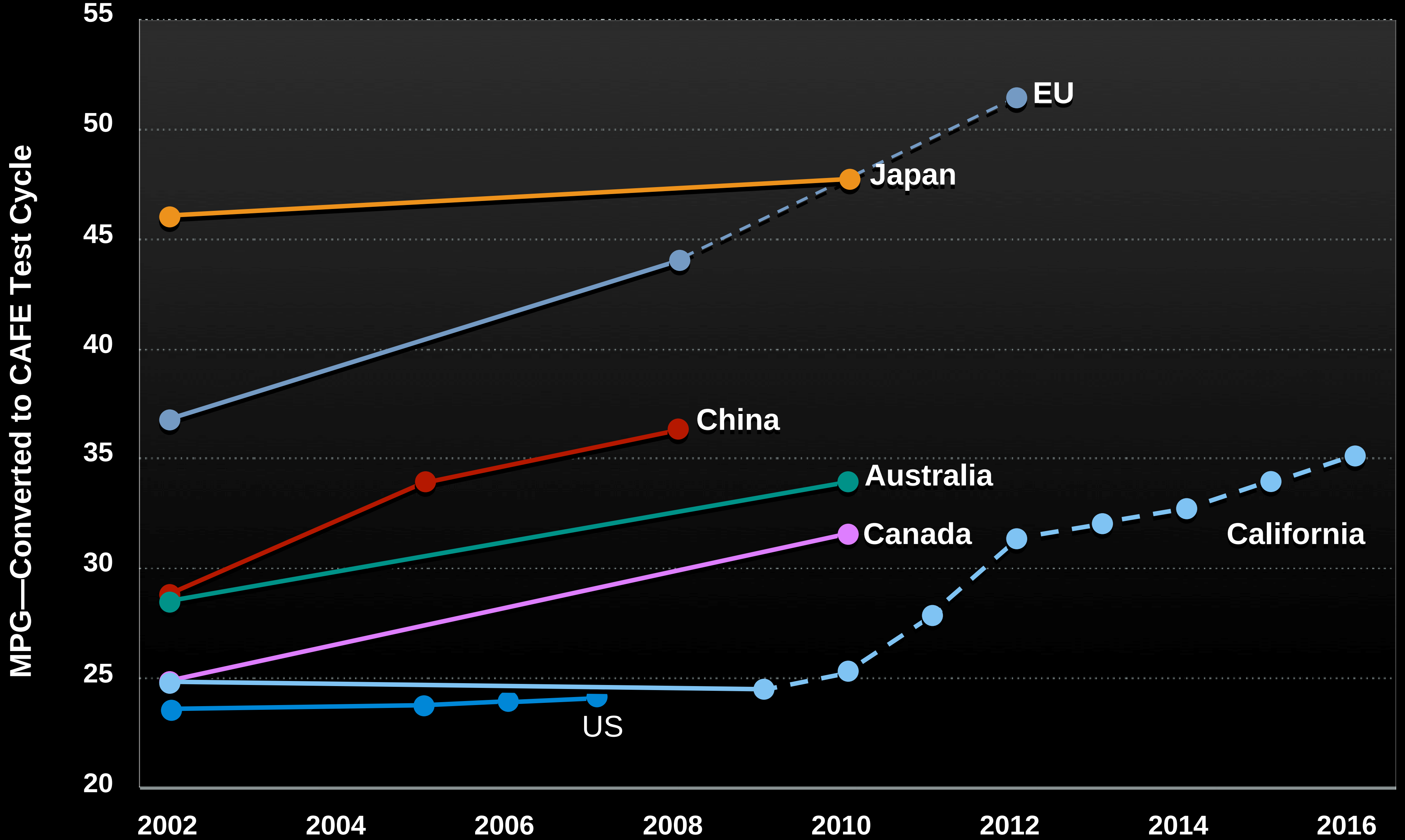
CO_2

CO_2

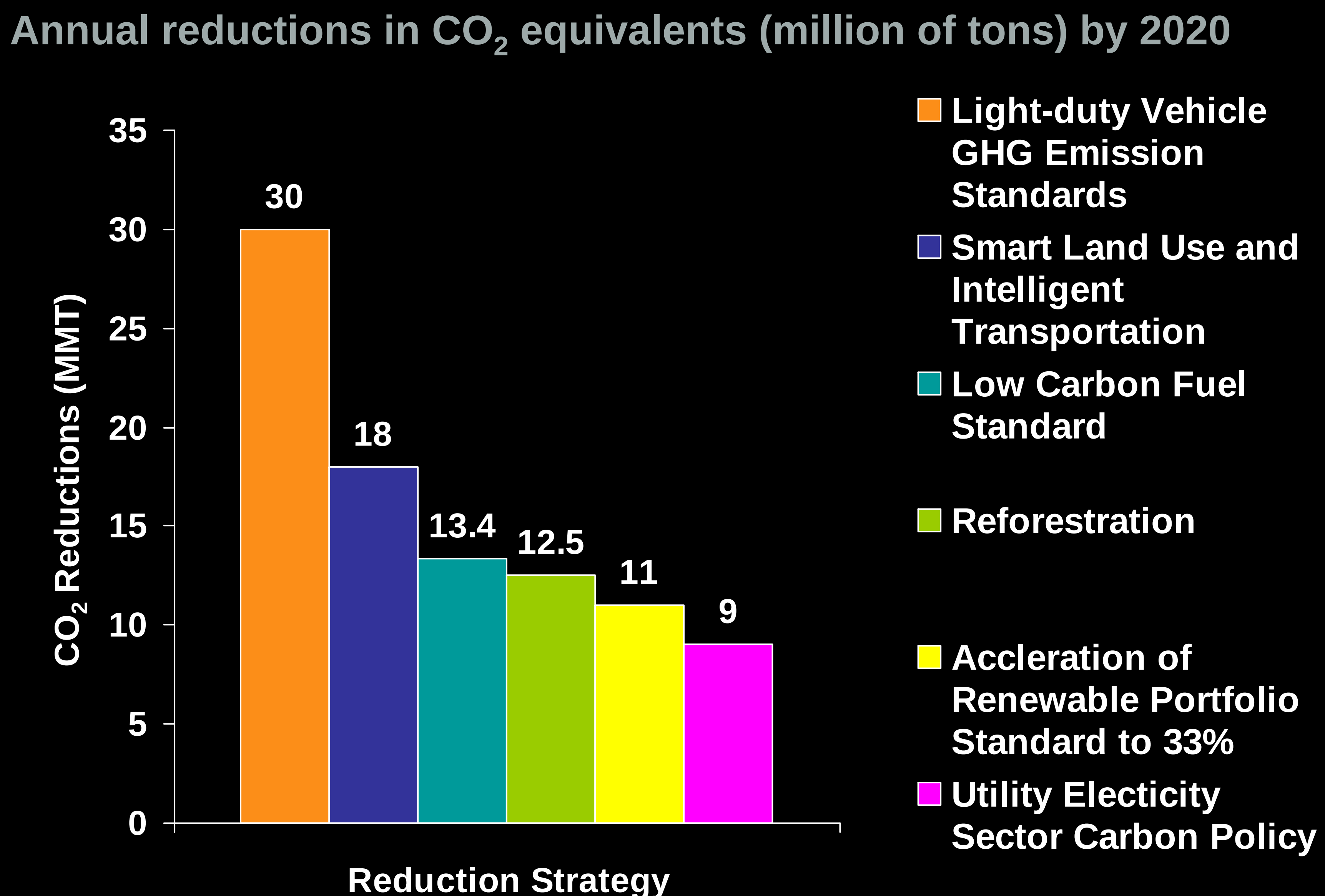
HFCs

CEC, "Inventory of California Greenhouse Gas Emissions and Sinks: 1990-2004" (2006)
www.climatechange.ca.gov/policies/greenhouse_gas_inventory/index.html

Comparison of Fuel Economy and GHG Emissions Standards Around the World

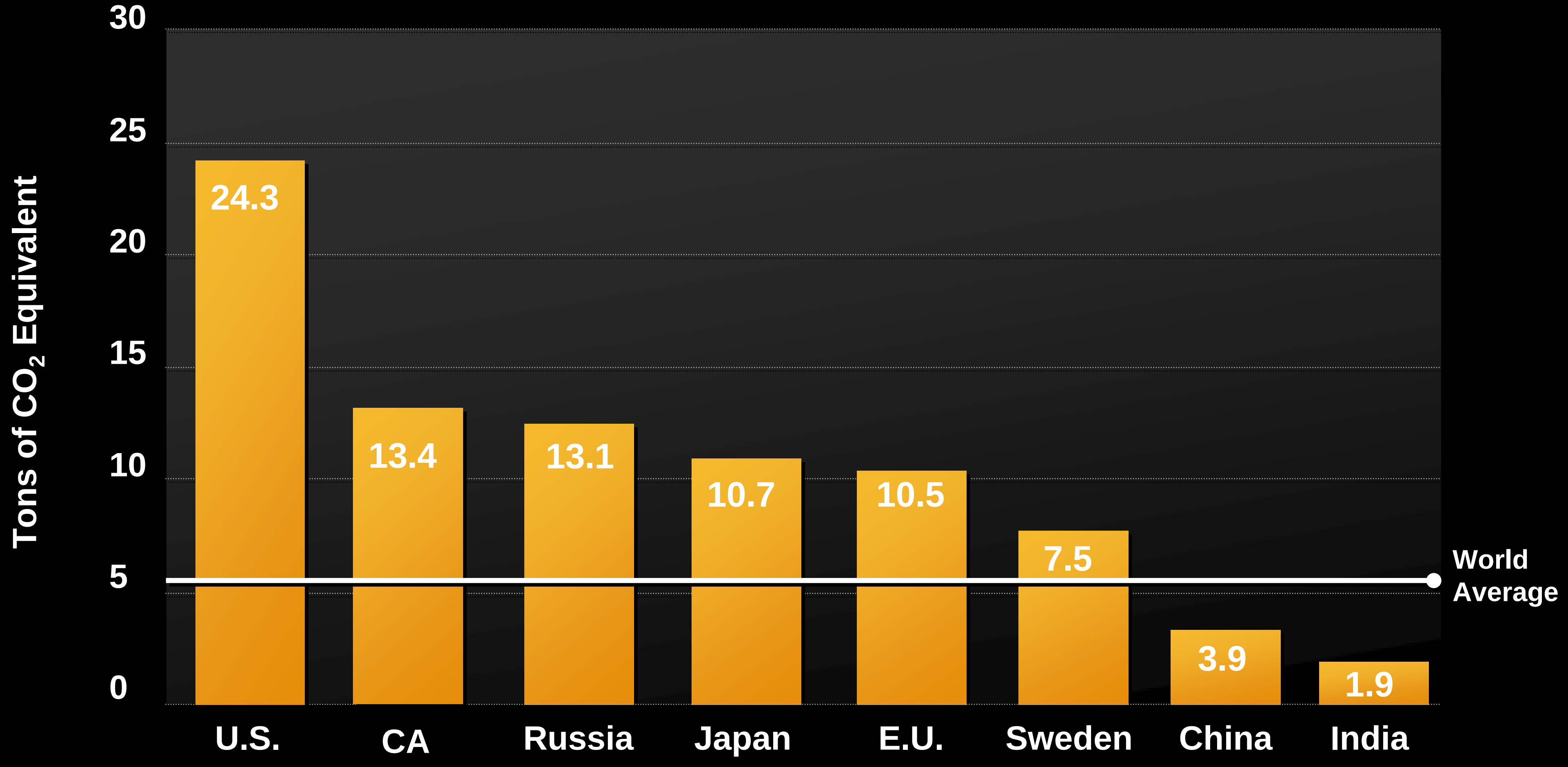


Current GHG Reduction Strategies



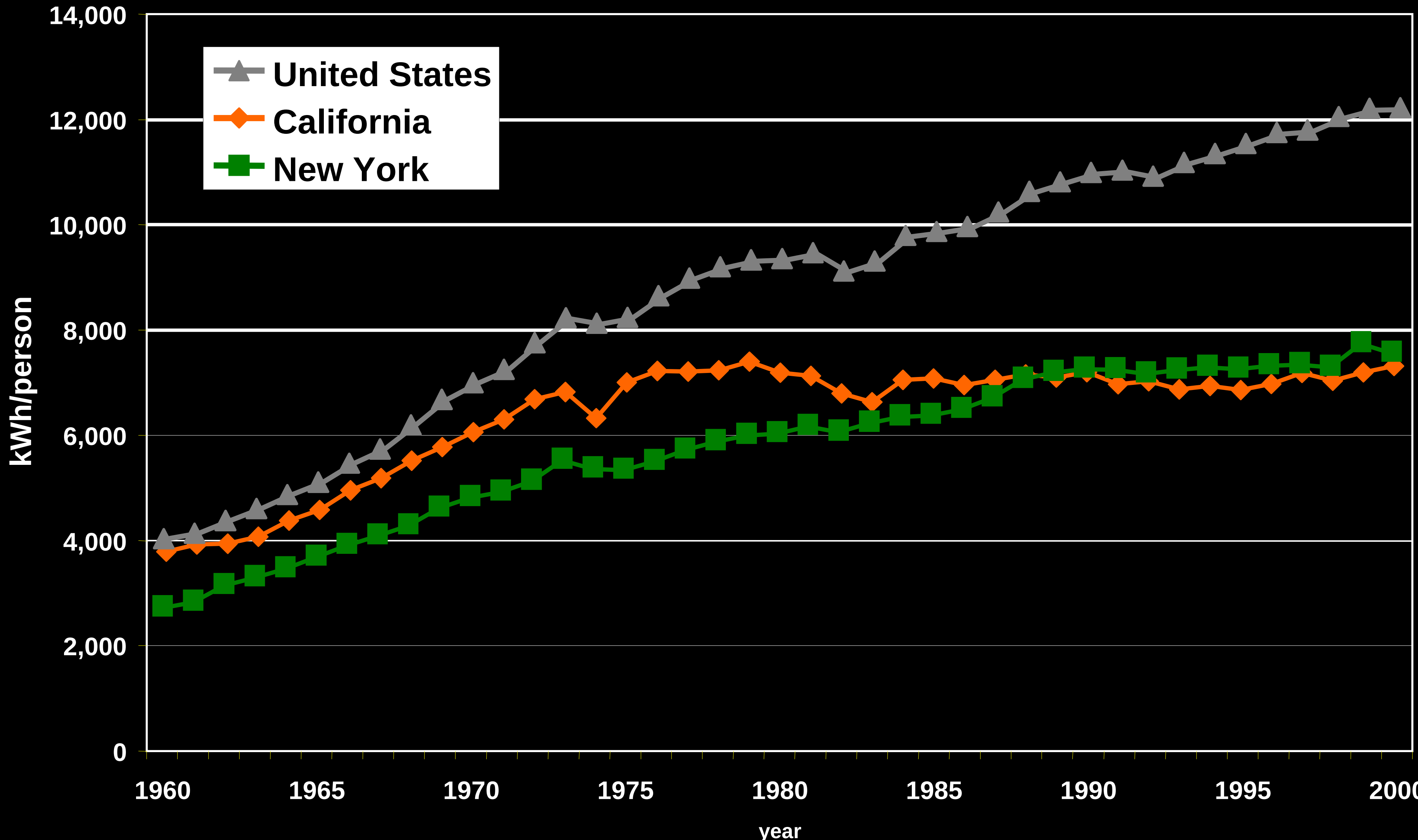
2006 Climate Action Team Report to the Governor and Legislature
climatechange.ca.gov/climate_action_team/reports/index.html

GHG Emissions Per Person



Climate Analysis indicators Tool (CAIT US Version 1.0, CAIT version 4.0), World Resources Institute, 2007 (data is for 2001-2002 and includes CO_2, CH_4, N_2O, HFCs, PFCs, and SF_6 emissions for countries and CO_2, CH_4, N_2O, and F-gases for CA)

Per Capita Electricity Consumption



www.eia.doe.gov/emeu/states/sep_use/total/csv/use_csv

Summary

Public health is the most important policy consideration – especially premature deaths due to PM2.5

California already affected by climate change – future warming threatens water supply and agriculture

Climate change makes ozone standards more difficult to attain – impact on PM2.5 and PM10 is unclear

Greenhouse gas reduction policies

- Adopted: light-duty vehicle standards, energy efficiency measures
- Jan. 1, 2010: low carbon fuel standard, other early actions
- Jan. 1, 2012: cap and trade market, other regulations