

MEETING THE CLIMATE CHANGE CHALLENGE

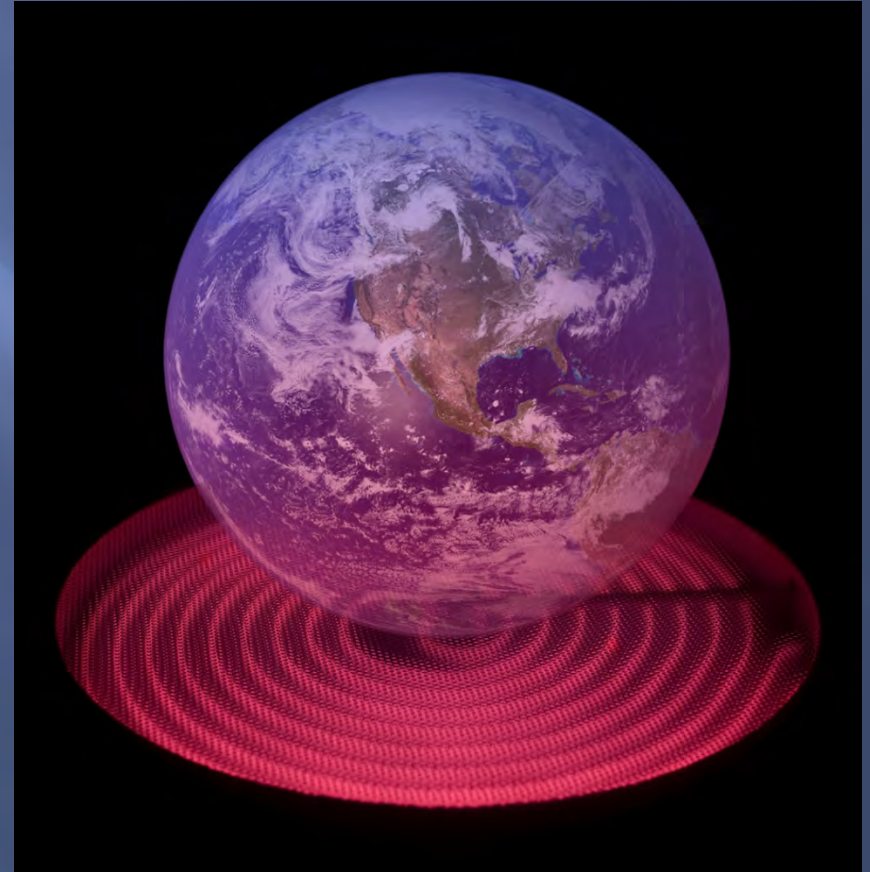
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November 13, 2009

Presentation Outline

- ▣ **What is climate change ?**
- ▣ **Drivers for renewable energy**
 - **State**
 - **National**
- ▣ **Terra-Gen Power**
 - **Geothermal**
 - **Wind**
 - **Solar**

Climate Change

- “Greenhouse “gas emissions affect the climate by accumulating and trapping heat within the earth's atmosphere.
- “Greenhouse “gases
 - Carbon dioxide
 - Methane
 - Nitrous oxide
 - Hydrofluorocarbons
 - Perfluorocarbons
 - Fluorinated gases – sulfur hexafluoride, nitrogen trifluoride and hydrofluorinated ethers.
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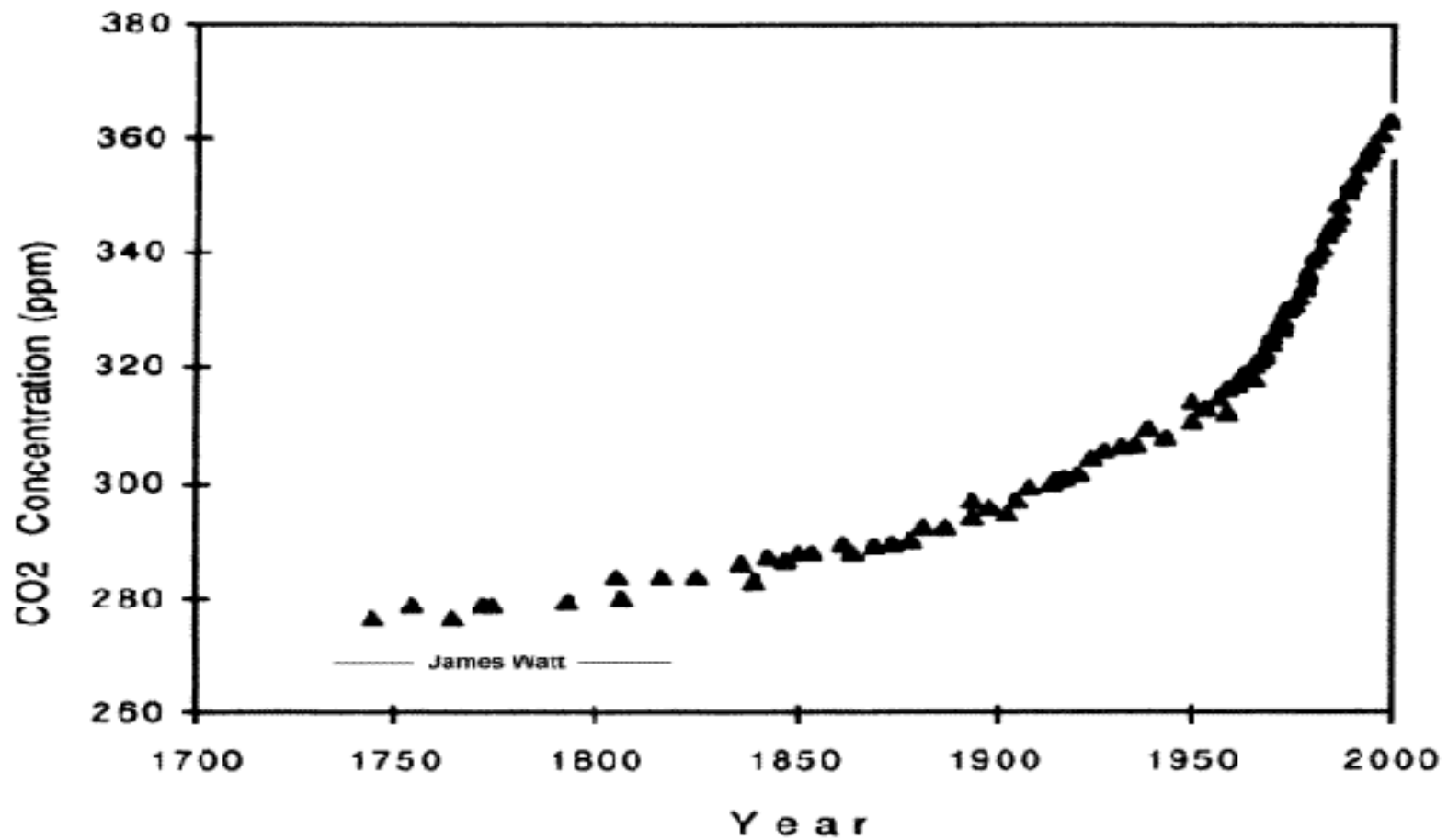


Climate Change

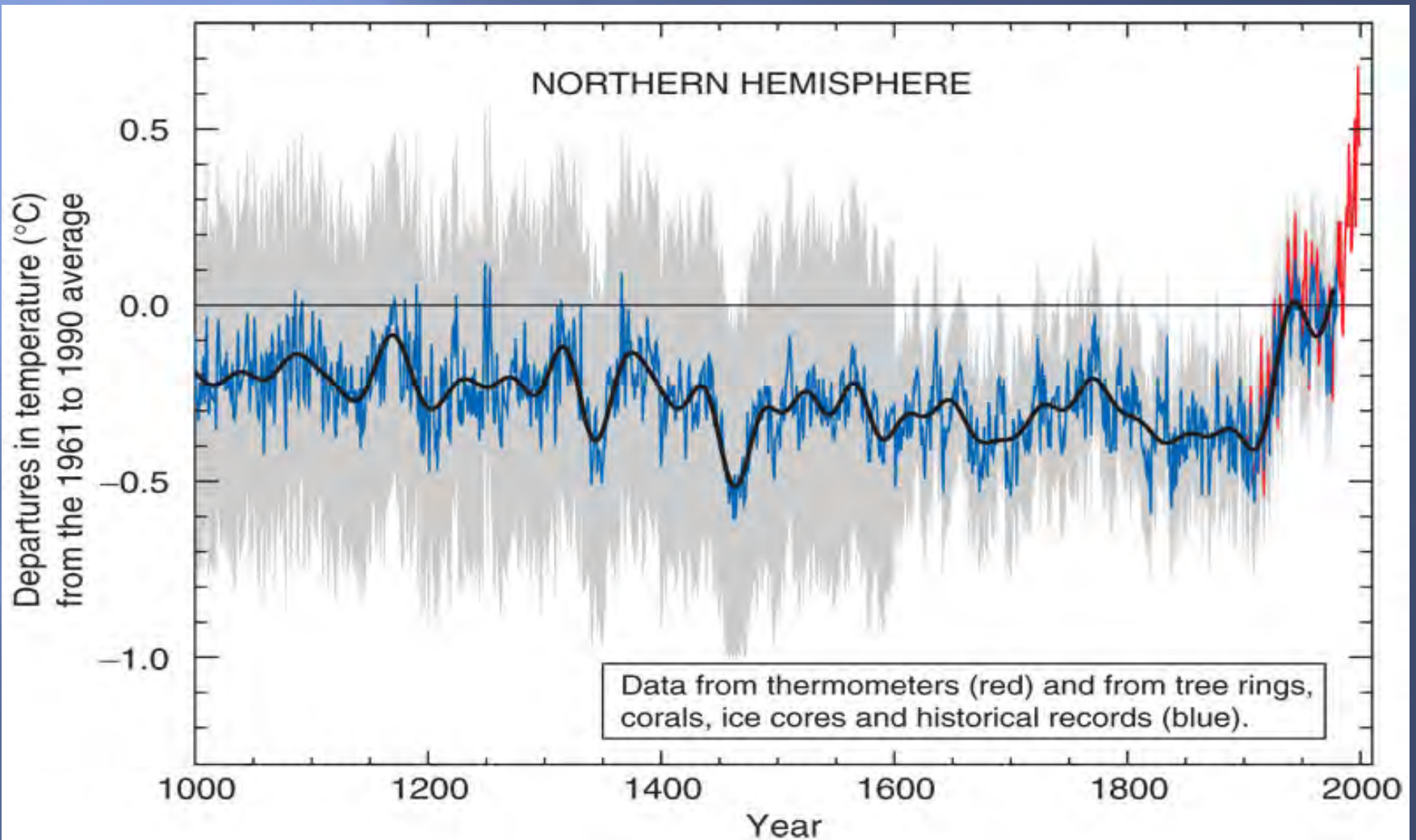


- ▣ CO₂ is the major GHG
- ▣ CO₂ results from burning carbon-based material - particularly fossil fuels (coal, oil, natural gas)

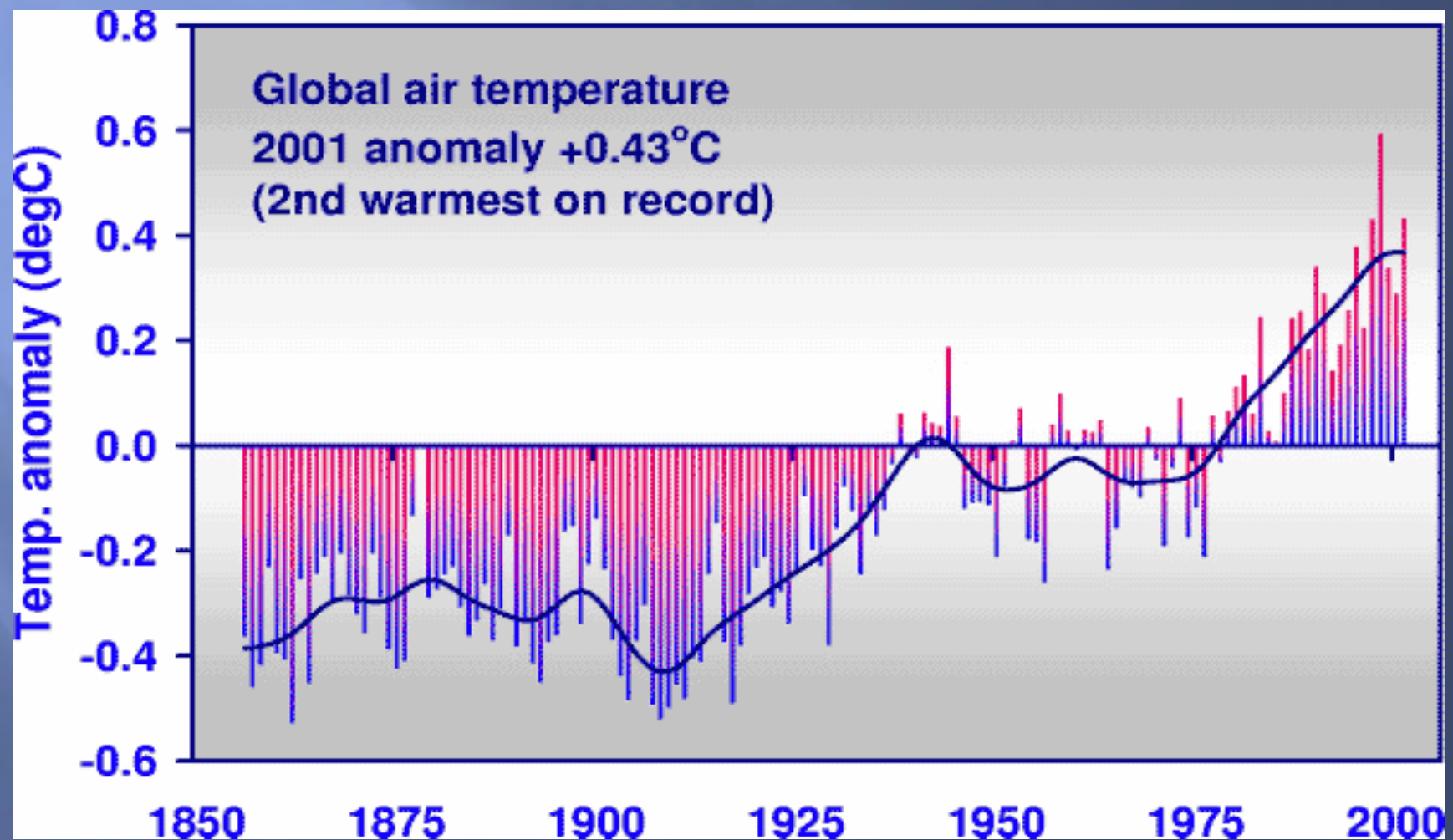
CO₂ Concentrations



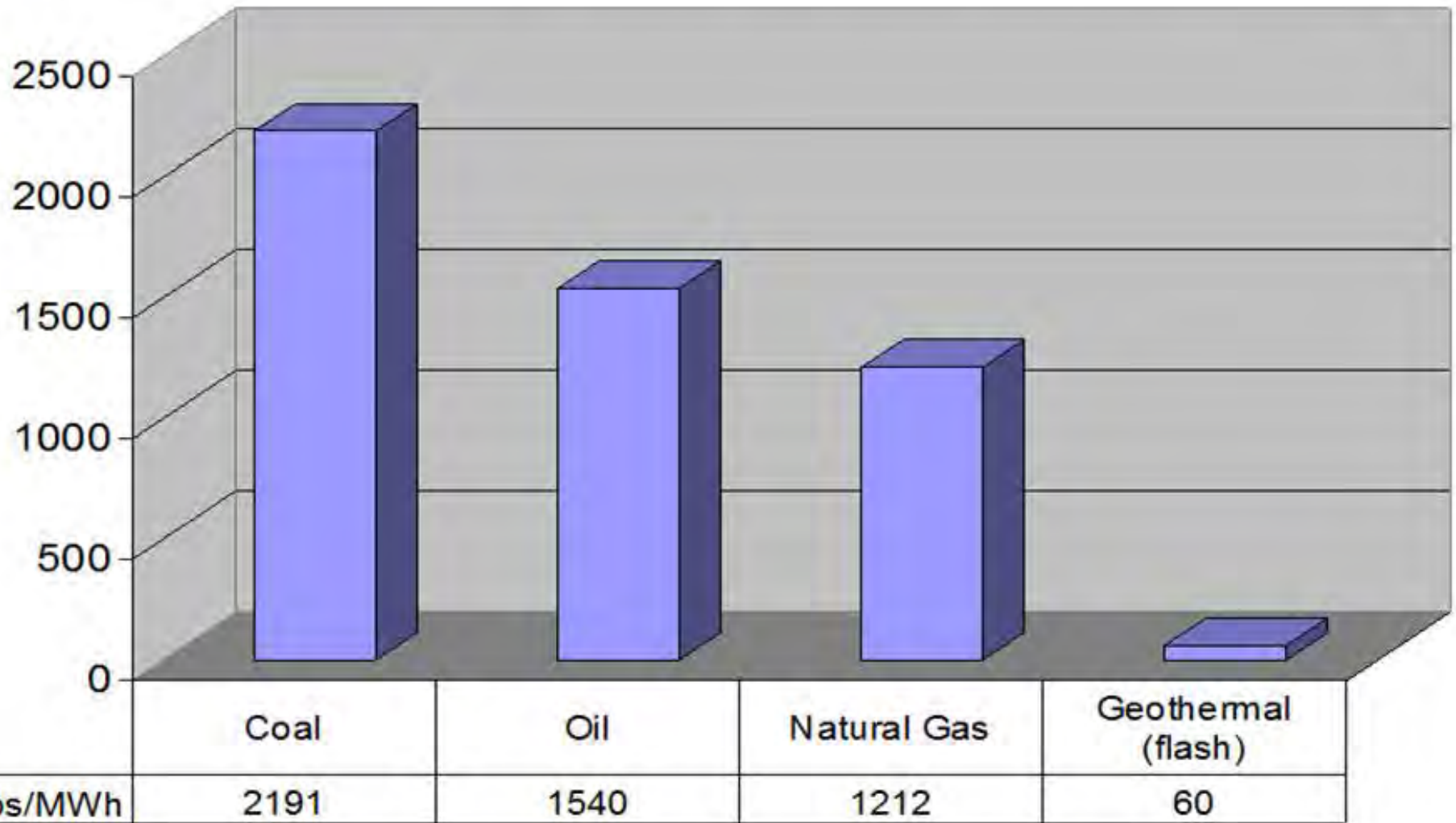
“Hockey Stick” Diagram



Temperature Rise



Carbon Dioxide Comparison



Source: Average emissions rates in the United States from oil-fired generation from EPA *Clean Energy Impacts* (2005); coal and natural gas: Platt's Research and Consulting, based on data from EPA's Continuous Monitoring System (2003); geothermal: DOE data (2000).

Renewable Energy Drivers – State

- ▣ 31 states have climate action plans in place or under development
- ▣ California is the leader in developing climate change regulations



California

- ▣ Second largest GHG emitter in the nation
- 473 million tons CO₂e in 2004
- ▣ BAU projection 512 million tons CO₂e by 2020
- ▣ Fifteenth largest GHG emitter in the world



Renewable Energy Drivers – California

- ▣ **California Global Warming Solutions Act (AB 32) passed in 2006**
 - **Requires reduction of GHG emissions to 1990 levels (30% reduction) by 2020 and 80% reduction by 2050**
 - ▣ **Electric sector required to reduce emissions by 40%**
 - **Cap and trade program to be in place by 1/1/12**
 - ▣ **Affects facilities that emit 25,000 metric tons or more of CO2 equivalent per year**

Renewable Energy Drivers – California

- ▣ **California Air Resources Board developing expansive Renewable Electricity Standard (RES)**
 - **Implements Governor Schwarzenegger's 9/15/09 Executive Order**
 - **Goal: to achieve a 20% renewable standard by 2013 and 33% by 2020**
 - **Applies to all electric utilities**
 - **Effective 1/1/12**
 - **Penalties up to \$75,000/day for noncompliance**

Renewable Energy Drivers – Nevada

- ▣ **Mandatory GHG reporting began 7/31/09**
- ▣ **Renewable energy generation exempt**
- ▣ **No exemptions for low emitters**

Renewable Energy Drivers - National

- ▣ EPA proposed first comprehensive national GHG reporting regulations on 9/22/09
 - Covers 85% of nation's emissions and 10,000 facilities
 - Includes facilities that emit 25,000 metric tons or more of CO₂ equivalent per year
 - Begins 1/1/10
- ▣ Initial step ultimately leading to GHG emission reductions

Renewable Energy Drivers – National

- ▣ EPA proposed first GHG emission permitting program on 9/30/09
 - Requires new power plants, factories and oil refiners to obtain GHG permits
 - Applies to facilities emitting 25,000 metric tons or more of CO₂ per year
- ▣ Requires new facilities and existing ones undergoing modification to use BACT
 - EPA has yet to define BACT

Renewable Energy Drivers - National

- ▣ **Waxman-Markey Energy and Climate Change bill (H.R. 2454) passed in June - 1437 pages!**
 - Establishes a GHG emissions cap: 17% reduction from 2005 levels by 2020, 42% by 2030 and 83% by 2050
 - Establishes a national 12% renewable energy standard by 2020
- ▣ **Kerry-Boxer bill drafted in Senate**
 - Requires 20% reduction from 2005 levels

Terra-Gen Power

ASSETS

- ▣ Owns and operates 20 renewable energy projects in California, Nevada, Montana, Wyoming, Colorado and Texas generating 831 MW
- ▣ Portfolio
 - 5 geothermal plants- 387 MW
 - 13 wind plants - 364 MW
 - 2 solar plants - 80 MW

PROFILE

- ▣ SCE's largest renewable energy provider
- ▣ 100% owned by ArcLight Capital Partners, a Boston-based \$6.8 billion energy investment firm
- ▣ Pursuing growth

What is a Megawatt?

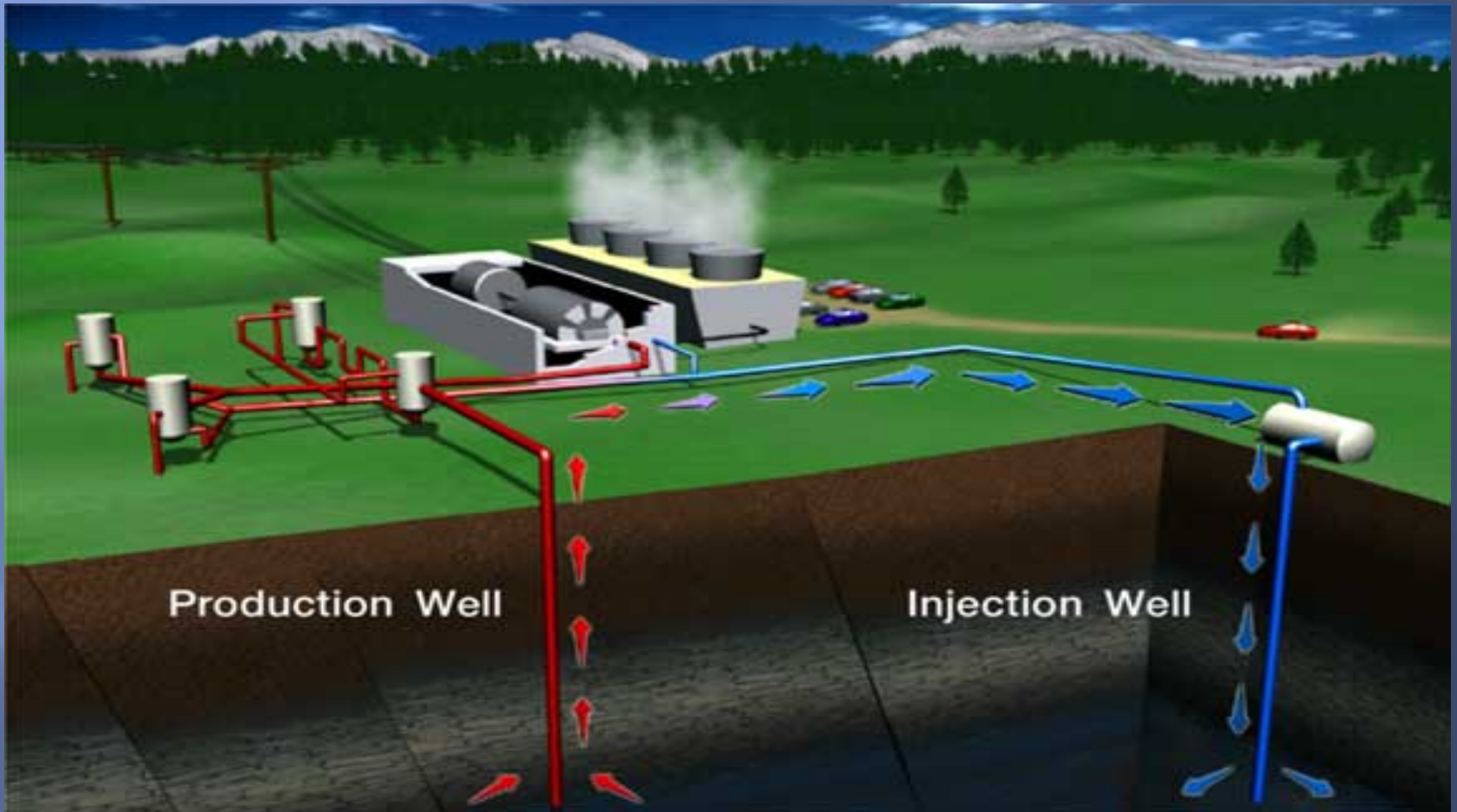
- ▣ **Watt – unit of power or energy per unit of time**
- ▣ **1 megawatt (MW) = 1,000,000 watts or 1,000 kilowatts (kW)**
- ▣ **A typical home uses energy at a rate of 1 kW (1,000 watts)**
- ▣ **1 MW is enough electricity to supply 1000 homes**



Coso Geothermal Plant Inyokern, California



Geothermal Process

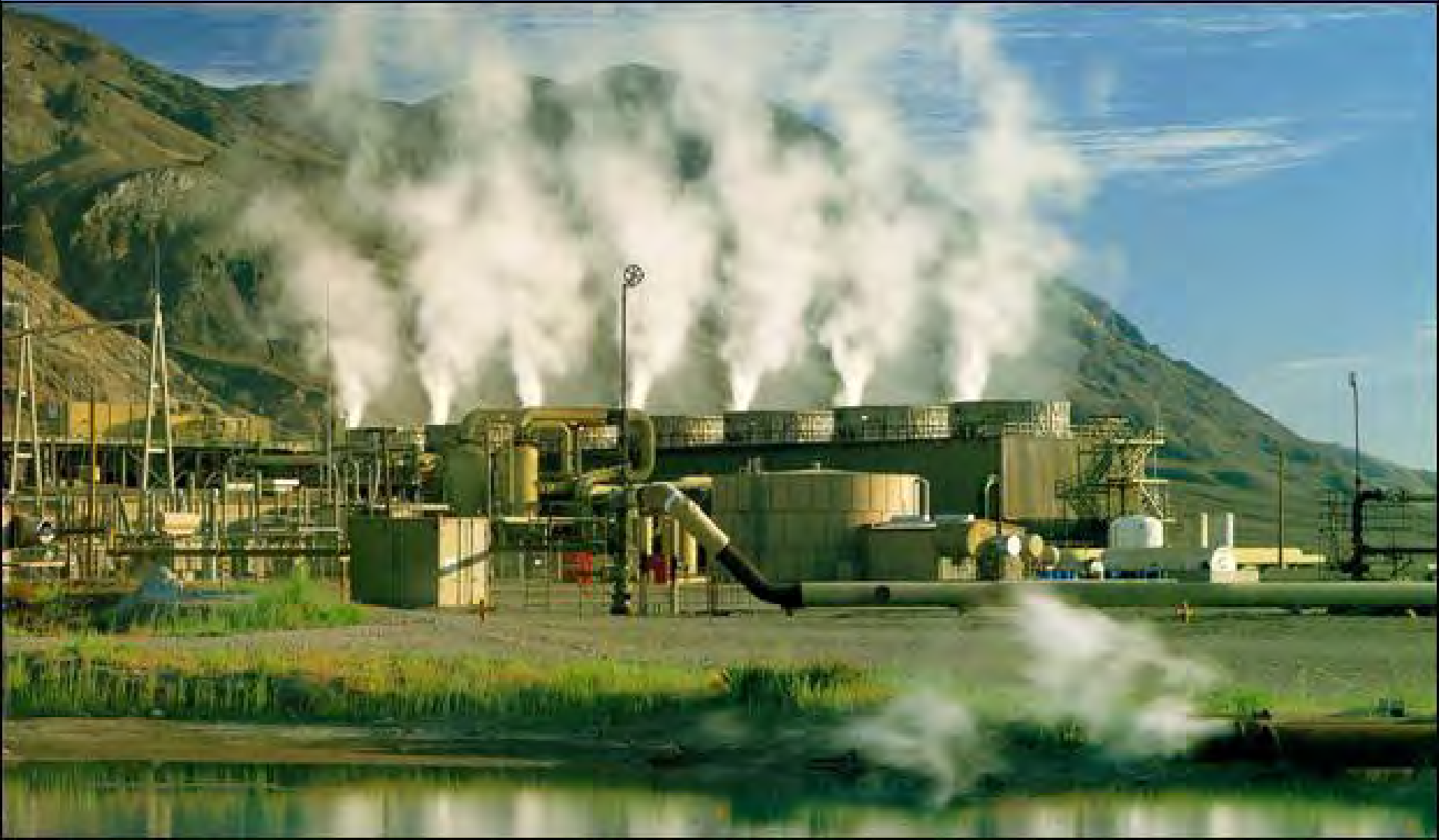


Coso Geothermal Power Plant

- ▣ **Base load plant**
- ▣ **Produced more than 40 million MWH since operations began in 1988**
- ▣ **Avoided about 30 million tons of CO₂ as compared with coal-fired generation**



Dixie Valley Geothermal Power Plant, Northern Nevada



Beowawe Geothermal Power Plant, Northern Nevada



Wind Projects

- ▣ 13 wind projects generating 364 MW
- ▣ Tehachapi, California - 730 turbines
 - Tallest towers 80 meters high
 - Intermittent operations - best wind in spring and fall
- ▣ Smaller projects in Wyoming, Colorado and Texas



Solar Electric Generating Station (SEGS) VIII & IX



- ▣ 2 solar projects generating 80 MW
- ▣ Solar collectors with curved (parabolic) reflectors capture and concentrate sunlight
- ▣ Heats synthetic oil (therminol) which heats water to create steam
- ▣ Steam pumped to onsite turbine-generator
- ▣ Steam condensed & reused

The Future

- ▣ Geothermal
 - Increasing production at existing geothermal plants in California and Nevada
 - Obtaining new Nevada leaseholds
 - Permitting new exploration and production wells in California and Nevada



The Future



- ▣ **Wind**
 - Fastest growing part of the company
 - Beginning construction of Alta I Wind Project in 2010 - 150 MW
 - Alta II Project - 590 MW
 - Alta Wind Energy Center - 3100 MW
- ▣ **Solar** - \$450 million solar facility planned near San Angelo, Texas in 2011

The Future

- \$787 billion Recovery Act passed February 2009
- \$338 million awarded 10/29/09 through DOE's Geothermal Technologies Program
- We received \$18 million in grants for 3 Nevada projects
 - Engineered geothermal systems demonstrations - \$14 million
 - Energy from nonconventional low temperature resources - \$4 million



Questions?

