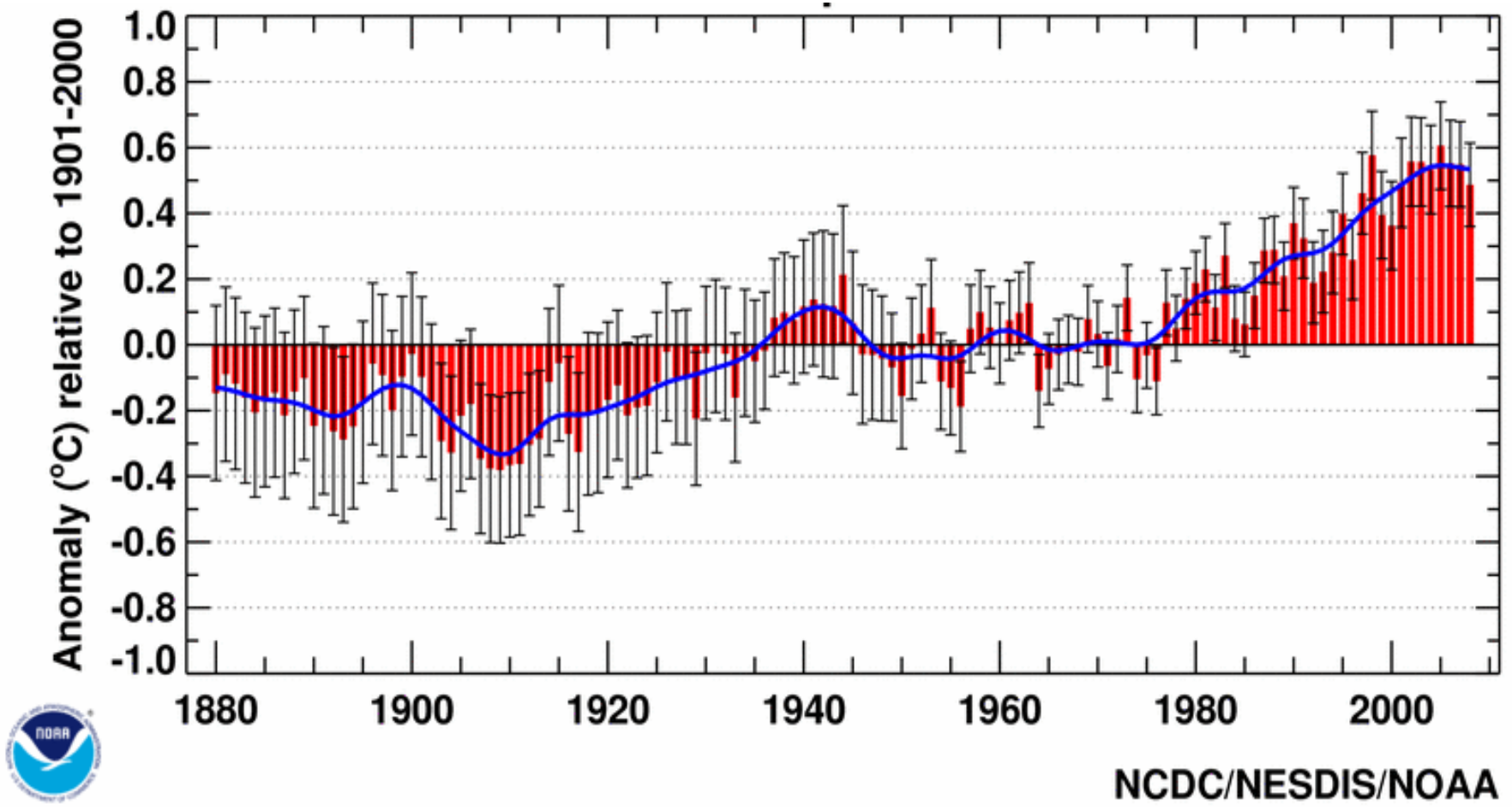
# The Case for Carbon Capture and Sequestration

CSLF Stakeholders Forum

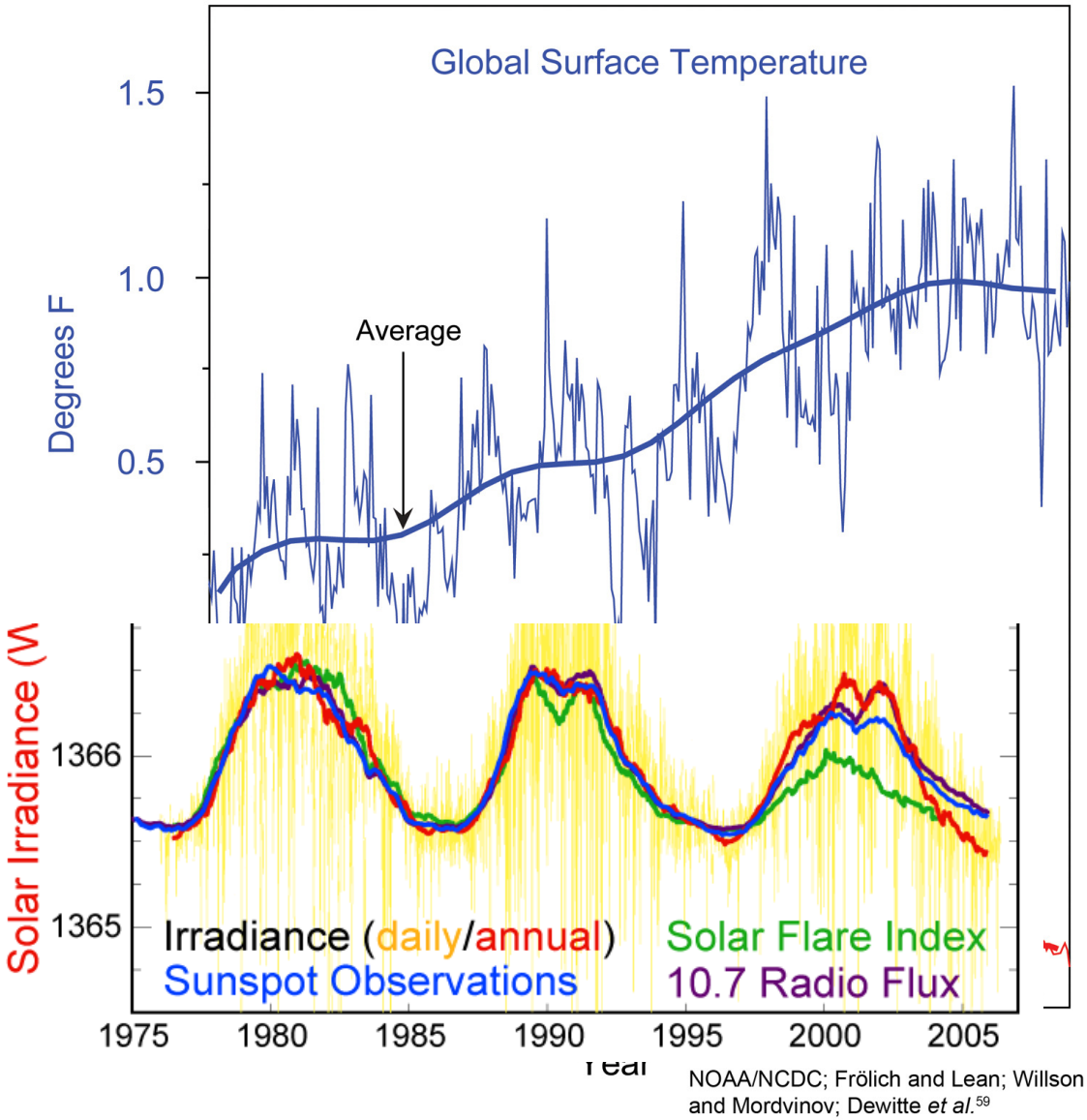
London

October 12, 2009

# Temperature Record (1850 – 2008)



# Can the recent changes be due to natural variations?

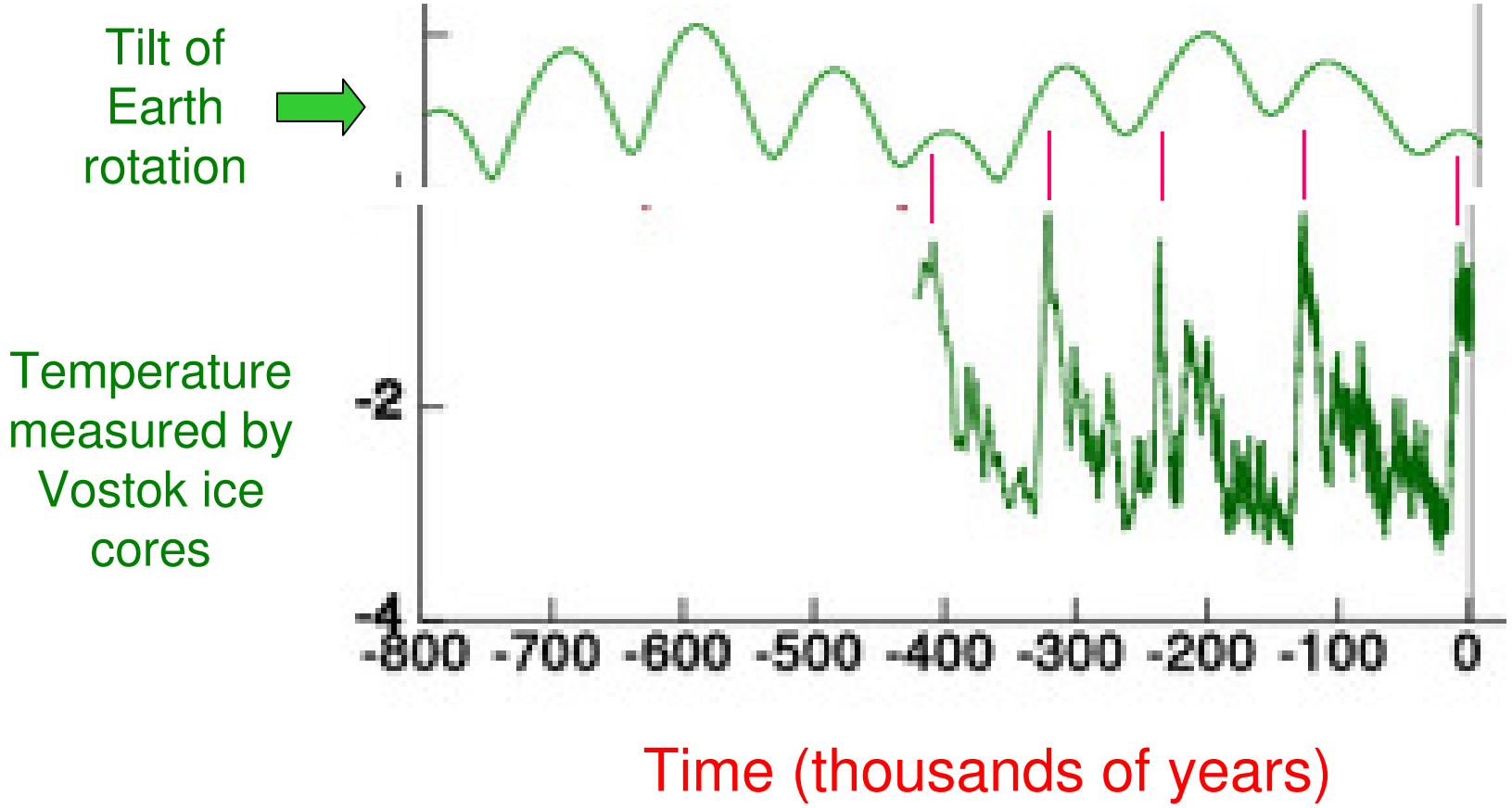



NOAA/NCDC; Frölich and Lean; Willson and Mordvinov; Dewitte *et al.*[59]

## Satellite Data (since 1978):

Solar Energy reaching the earth follows a 11 year cycle, but no net increase over 30 years.

# The periodicity may be due to astronomical changes in the Earth orbit (Milankovich Cycles)



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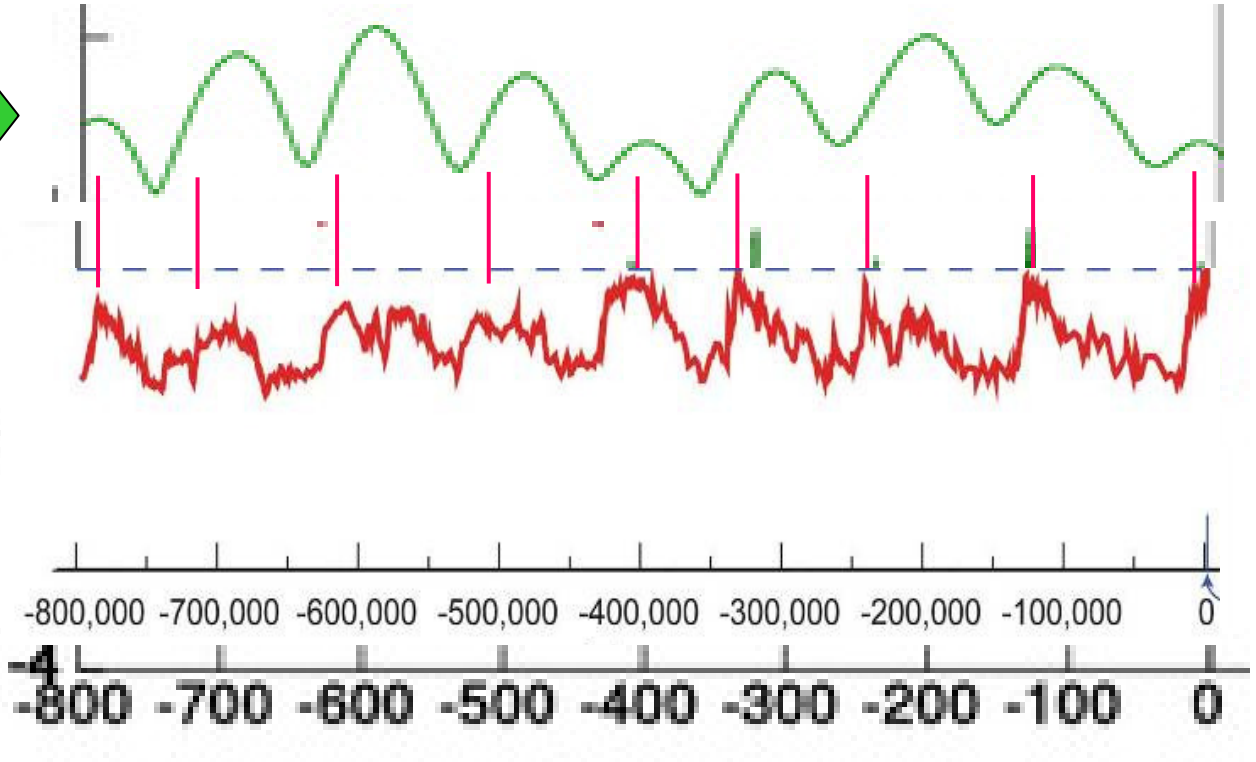
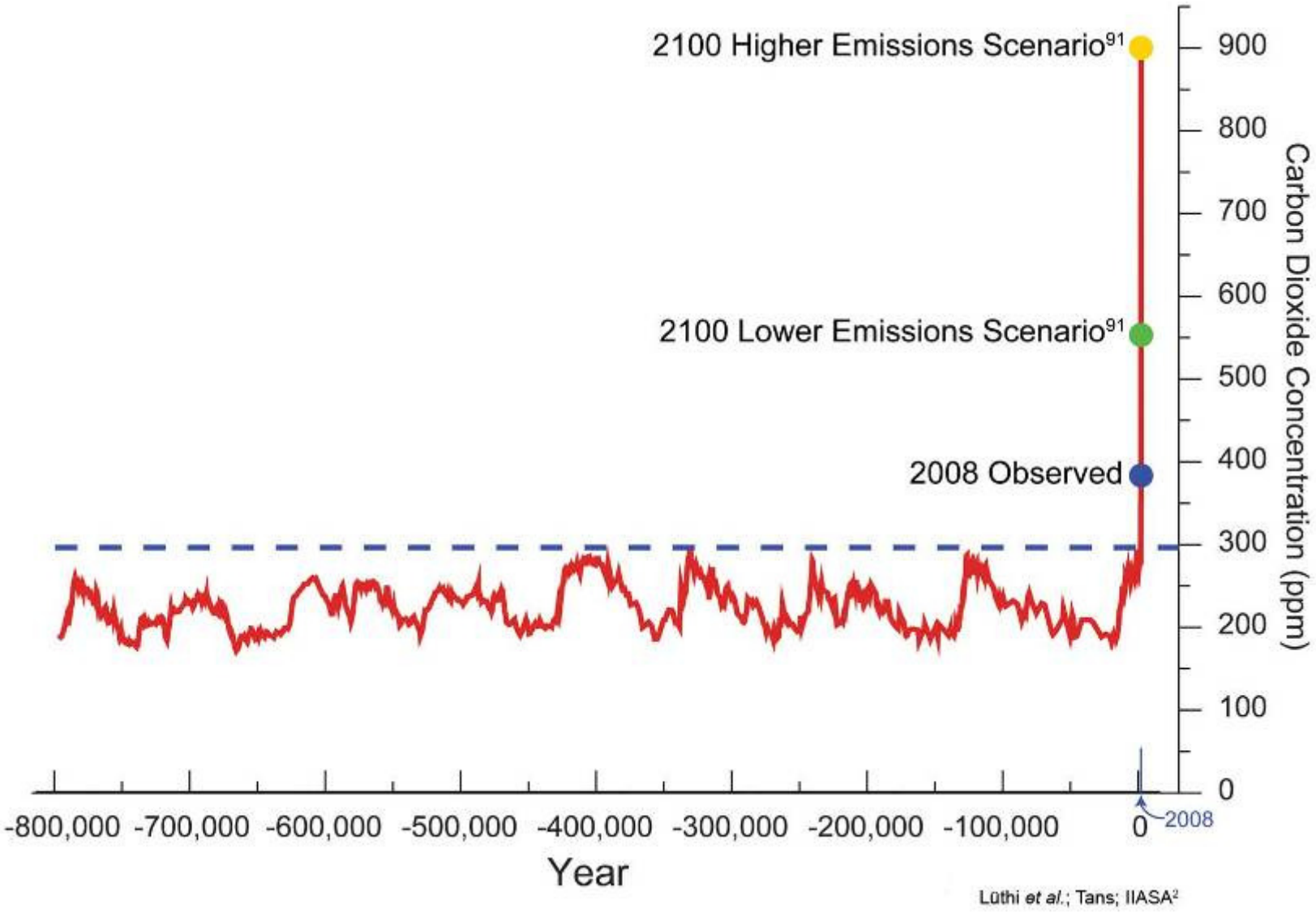
Tilt of Earth rotation



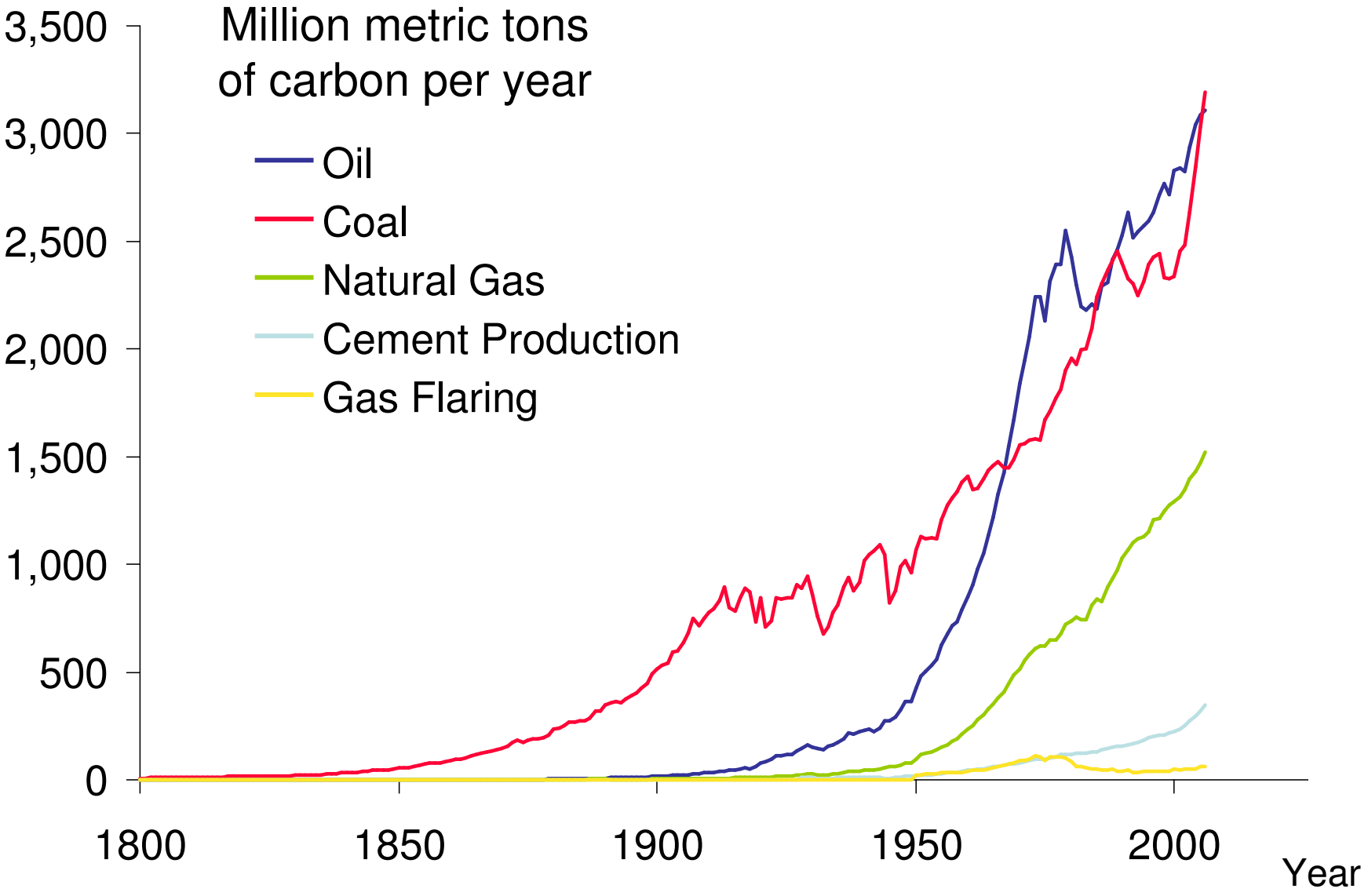

Temperature measured by Vostok ice cores

Time (thousands of years)

# Carbon Dioxide Concentration during the past 800,000 years

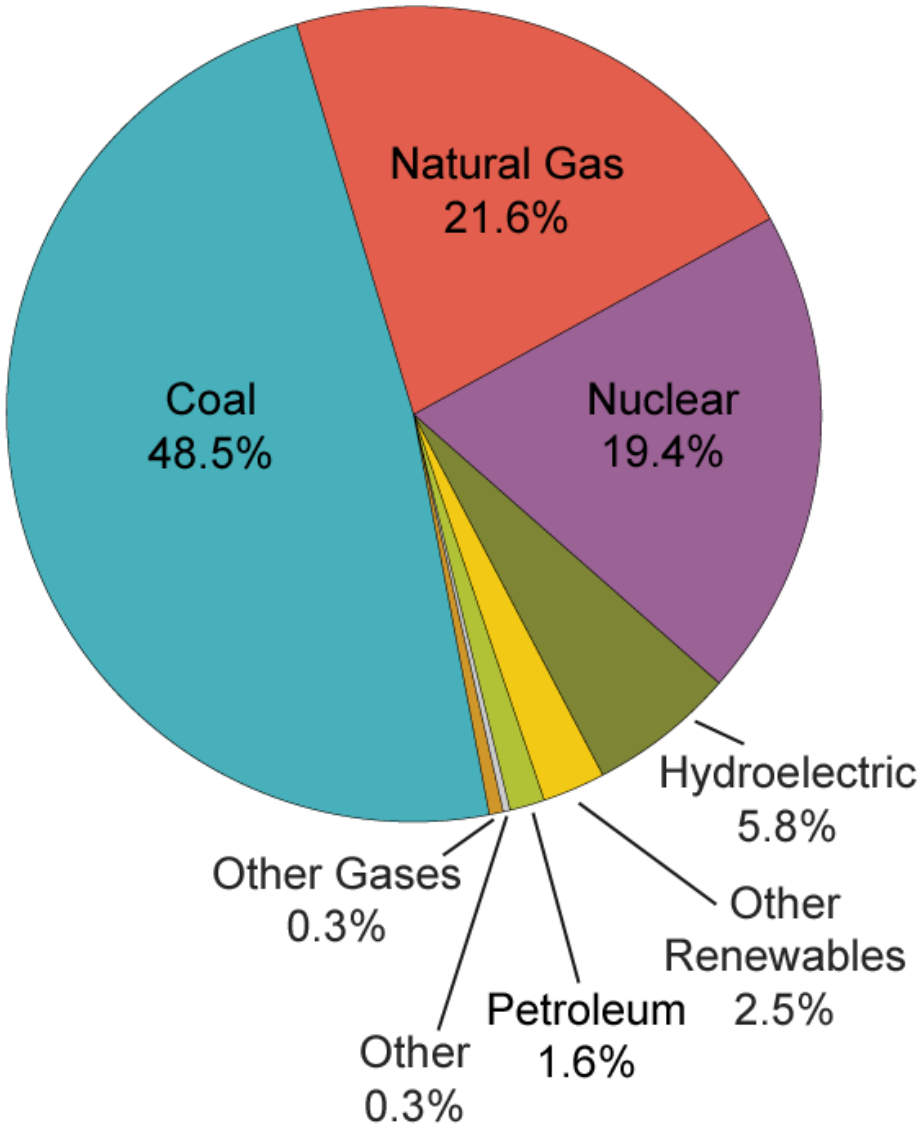


# Coal is 40% of Global Fossil Carbon Emissions



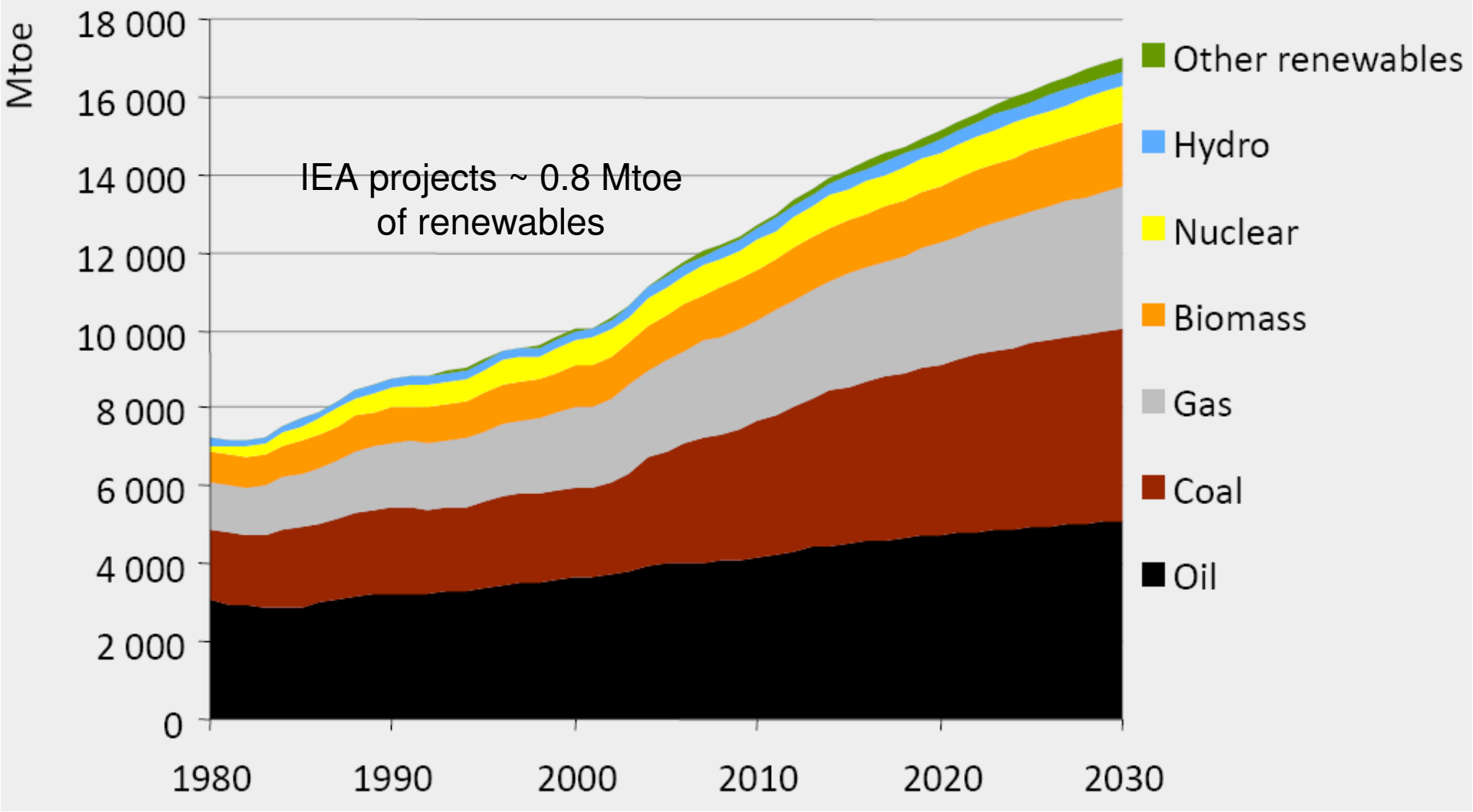

Source: Carbon Dioxide Information Analysis Center, DOE Oak Ridge National Laboratory

# Coal provides roughly half of U.S. electricity



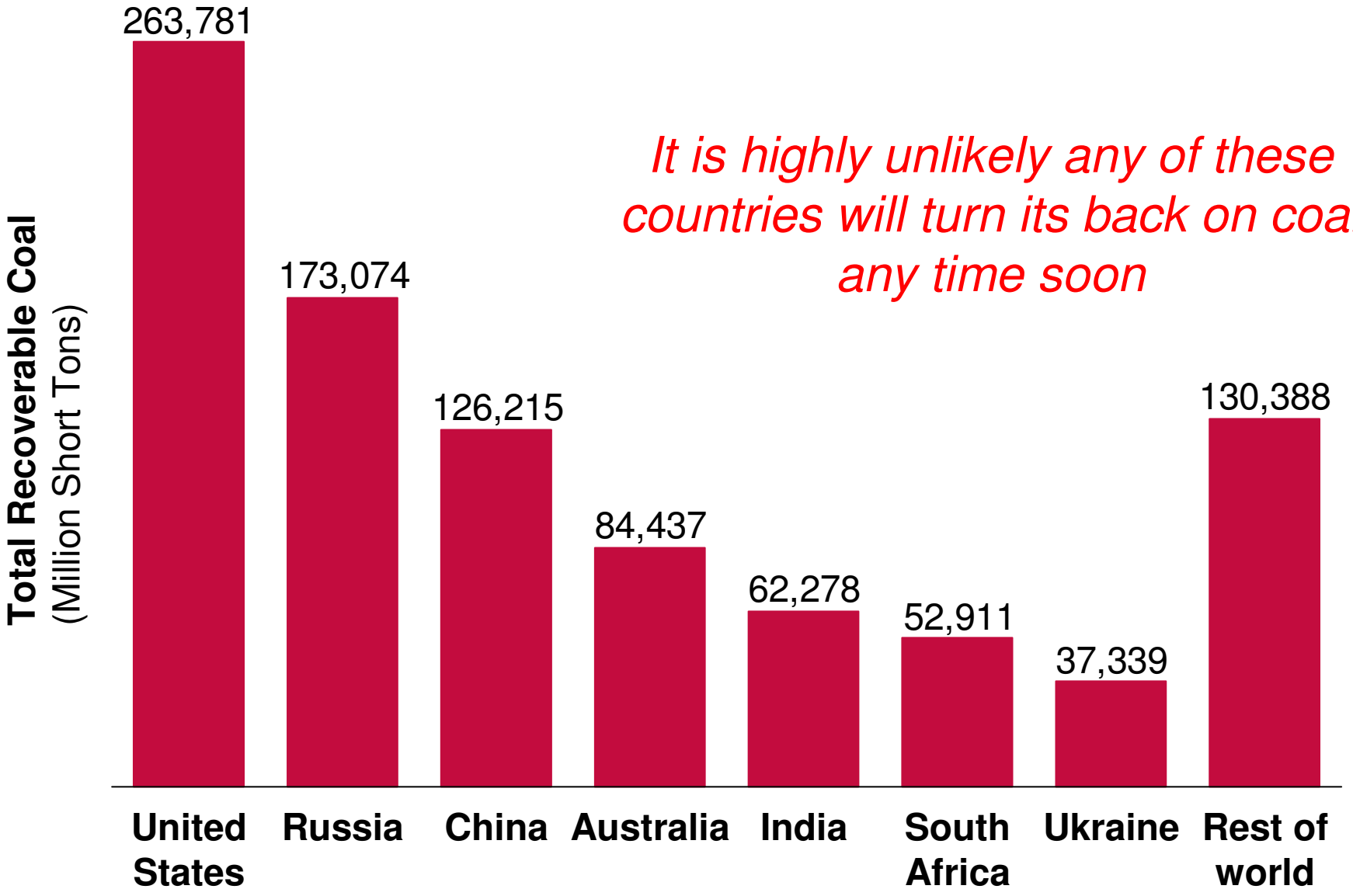

Source: EIA, Form EIA-923, “Power Plant Operations Report” and predecessor forms

# IEA: Coal will be more than 1/3 of projected increase in world energy demand



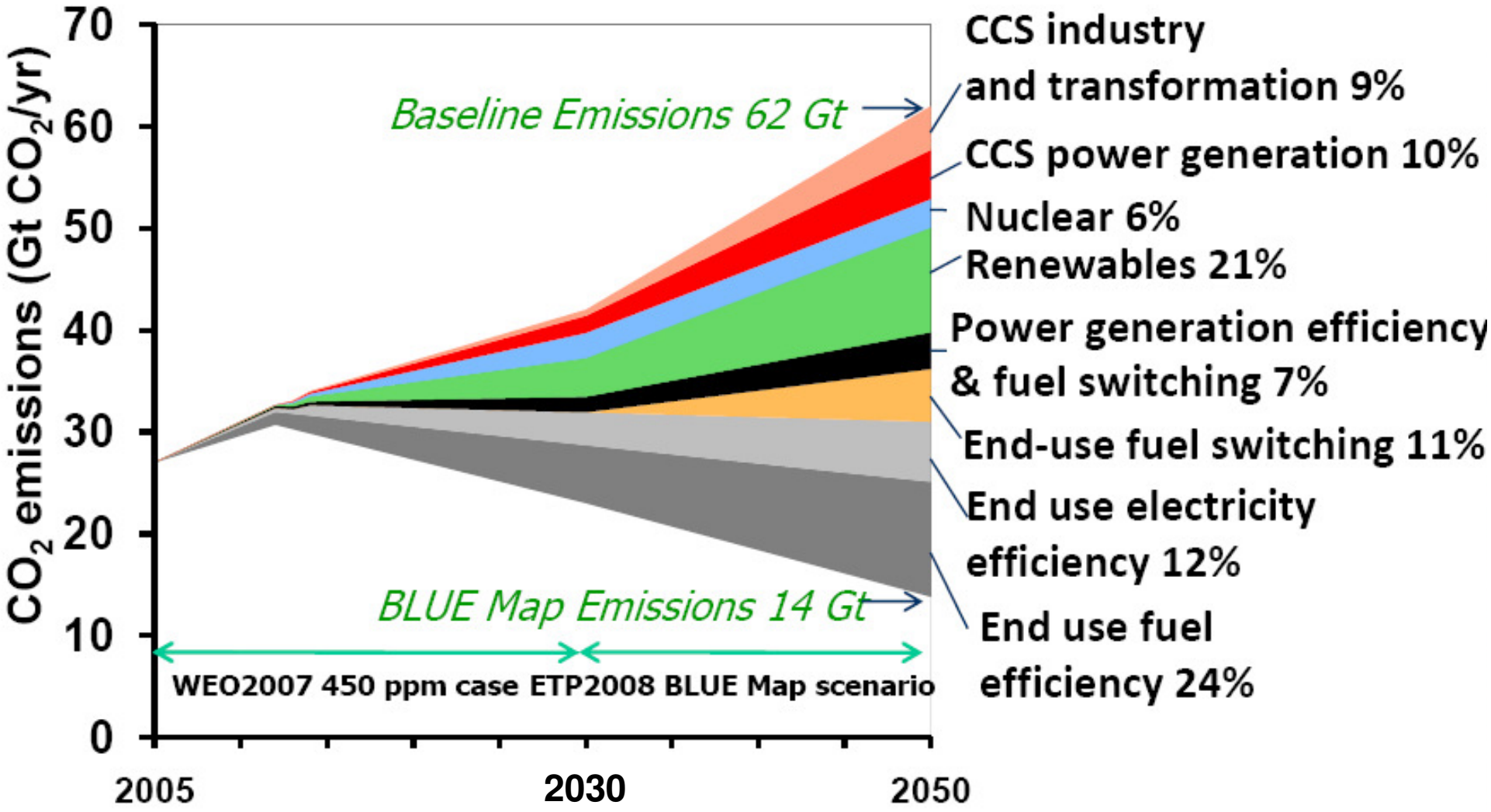

IEA: World Energy Outlook 2008

# US, China, Russia, Australia, and India have 3/4 of the world's known coal reserves




*It is highly unlikely any of these countries will turn its back on coal any time soon*

# CCS is a part of any realistic CO2 abatement scenario

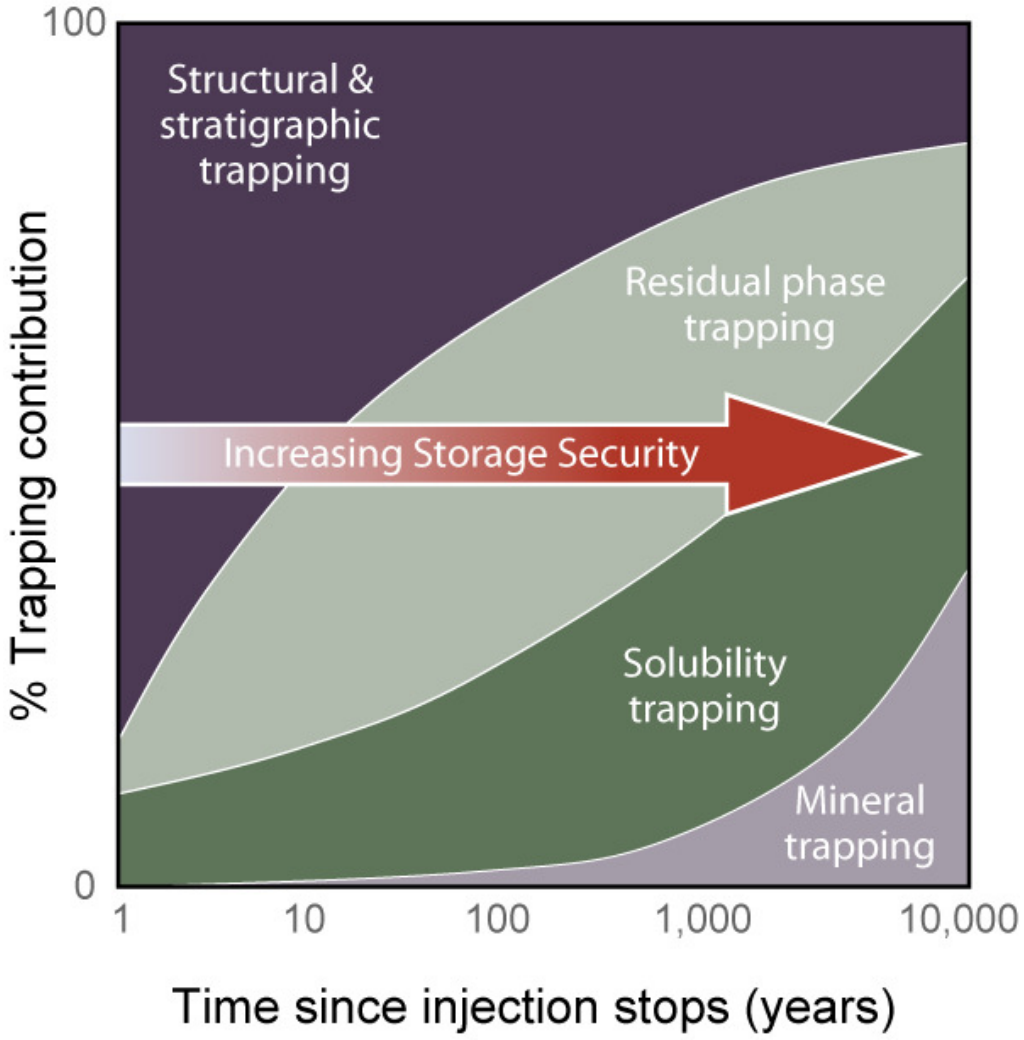



IEA: Energy Technology Perspectives 2008

# Temporal Evolution of Trapping

6 billion metric tonnes of coal is used each year, producing 18 billion tonnes of $CO_2$.

At geological storage densities of $CO_2$, underground sequestration will require a storage volume of 30,000 $km^3$ per year.



# The United States is committed to developing CCS technologies through international collaborations and domestic investments

The Department of Energy is
funding $4 billion in cost share for
CCS projects

Industry is putting up billions more

**We can and must begin commercial deployment of CCS in 8 – 10 years**

# President Obama's economic Recovery Act included $3.4 billion for CCS

- $800 million for the Clean Coal Power Initiative

- $1.5 billion for a range of industrial carbon capture and energy efficiency improvement projects

- $1.0 billion for fossil energy research and development programs (FutureGen)

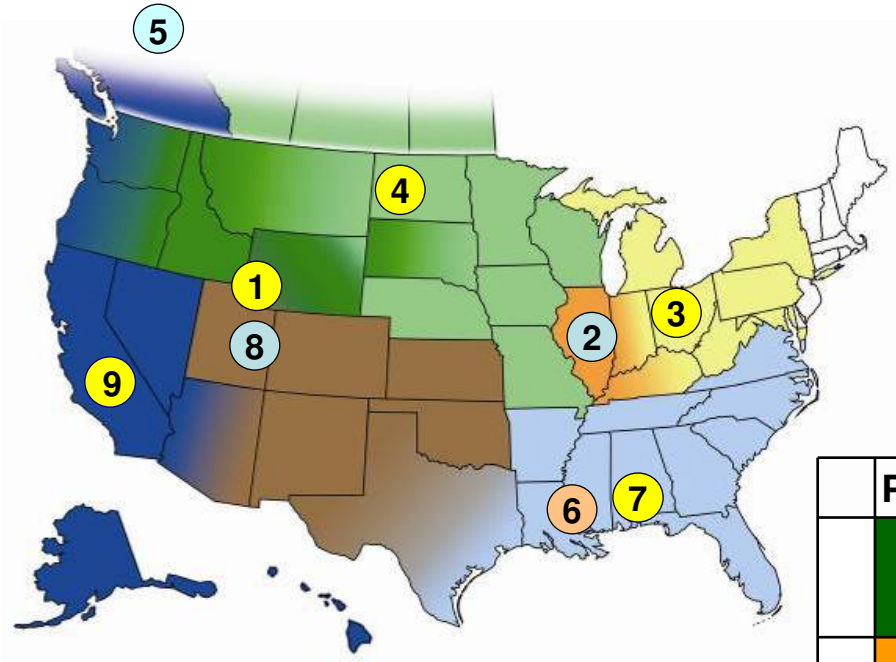
- $50 million for site characterization of geologic formations

- $20 million for geologic CO2 sequestration training and research grants

# Additional U.S. investments in CCS R&D

- **In 2010, we are investing over $400 M in CCS-Clean Coal R&D aimed at:**
  - **cost and energy penalty reductions**
  - **to develop the science measurement and verification technology to enable safe, long-term effective geologic storage.**
- **We are investing more than $500M over 10 years in research and modeling of geologic CO2 storage.**

# U.S. testing storage in 9 geologic formations




- ***Nine large-volume tests***
- ***Injections initiated 2009 – 2011***

2009 Injection Scheduled
2010 Injection Scheduled
2011 Injection Scheduled

| | Partnership | Geologic Province | Type |
|---|---|---|---|
| | Big Sky | Triassic Nugget Sandstone / Moxa Arch | Saline |
| | MGSC | Deep Mt. Simon Sandstone | Saline |
| | MRCSP | Shallow Mt. Simon Sandstone | Saline |
| | PCOR | Williston Basin Carbonates | Oil Bearing |
| | | Devonian Age Carbonate Rock | Saline |
| | SECARB | Lower Tuscaloosa Formation Massive Sand Unit | Saline |
| | SWP | Regional Jurassic & Older Formations | Saline |
| | WESTCARB | Central Valley | Saline |

# We are strongly pursuing international collaborations

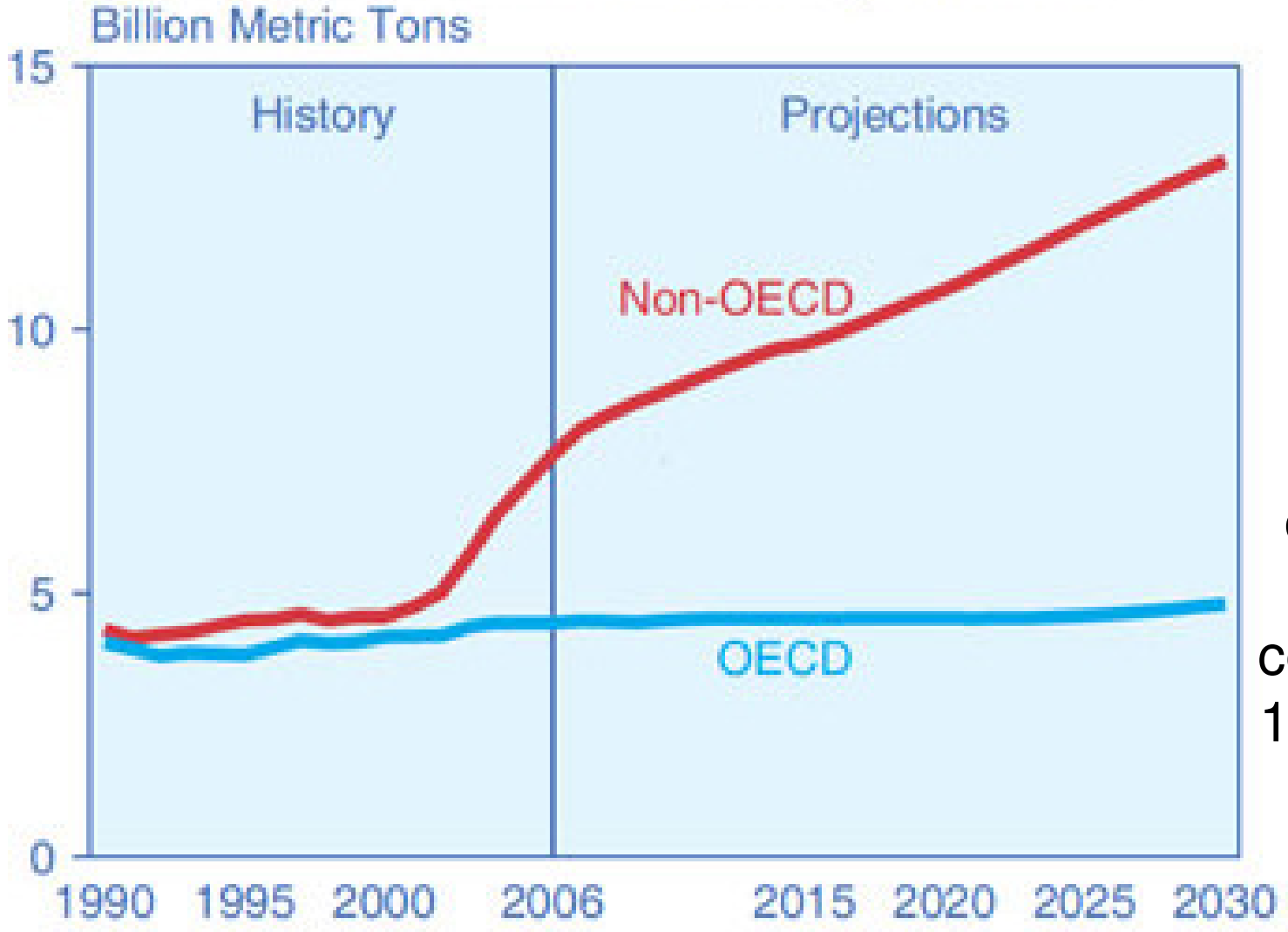
carbon sequestration leadership forum

G-8 leaders have called for at least 20 CCS projects by 2010

In July, we announced a U.S. – China Clean Energy Research Center

*The CSLF is vital for promoting CCS globally*

# We need to share solutions with developing countries




Projected world carbon dioxide emissions from coal combustion, 1990 - 2030

Sources: History: EIA International Energy Annual 2006; Projections: EIA, World Energy Projections Plus (2009)

# **Temperature Record** (1850 – 2006)

From the Intergovernmental Panel on Climate Change (IPCC) 2007 assessment