SIPS, Energy Efficient Buildings, and US Challenges in Energy and Climate Change

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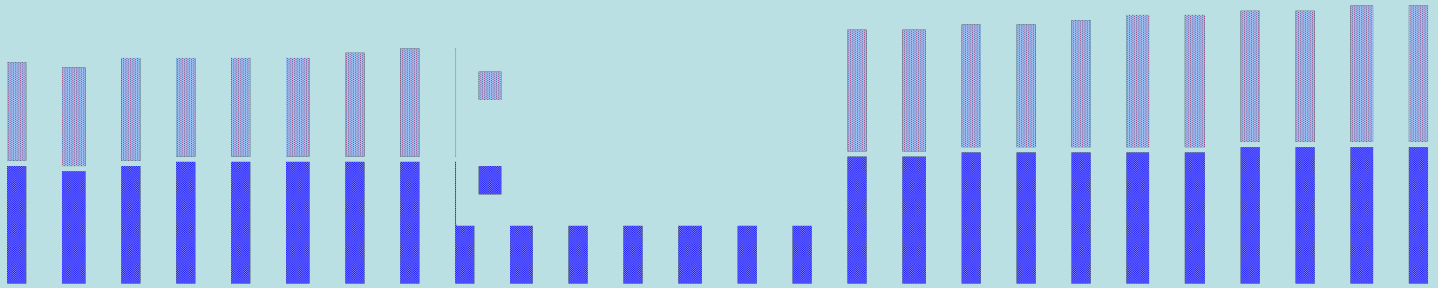
Federation of American Scientists

SIPA Annual Conference
2008

The Argument

- The US and the world face enormous challenges in supplying a growing population and growing economy with energy and doing so in a way that avoids the hazards of climate change.
- Residential buildings are 20% of the energy and climate problem
- New building technologies, and SIPs in particular, present some of the most powerful and cost-effective solutions



EIA/DoE Revised Annual Energy Outlook 2008 (3/2008)

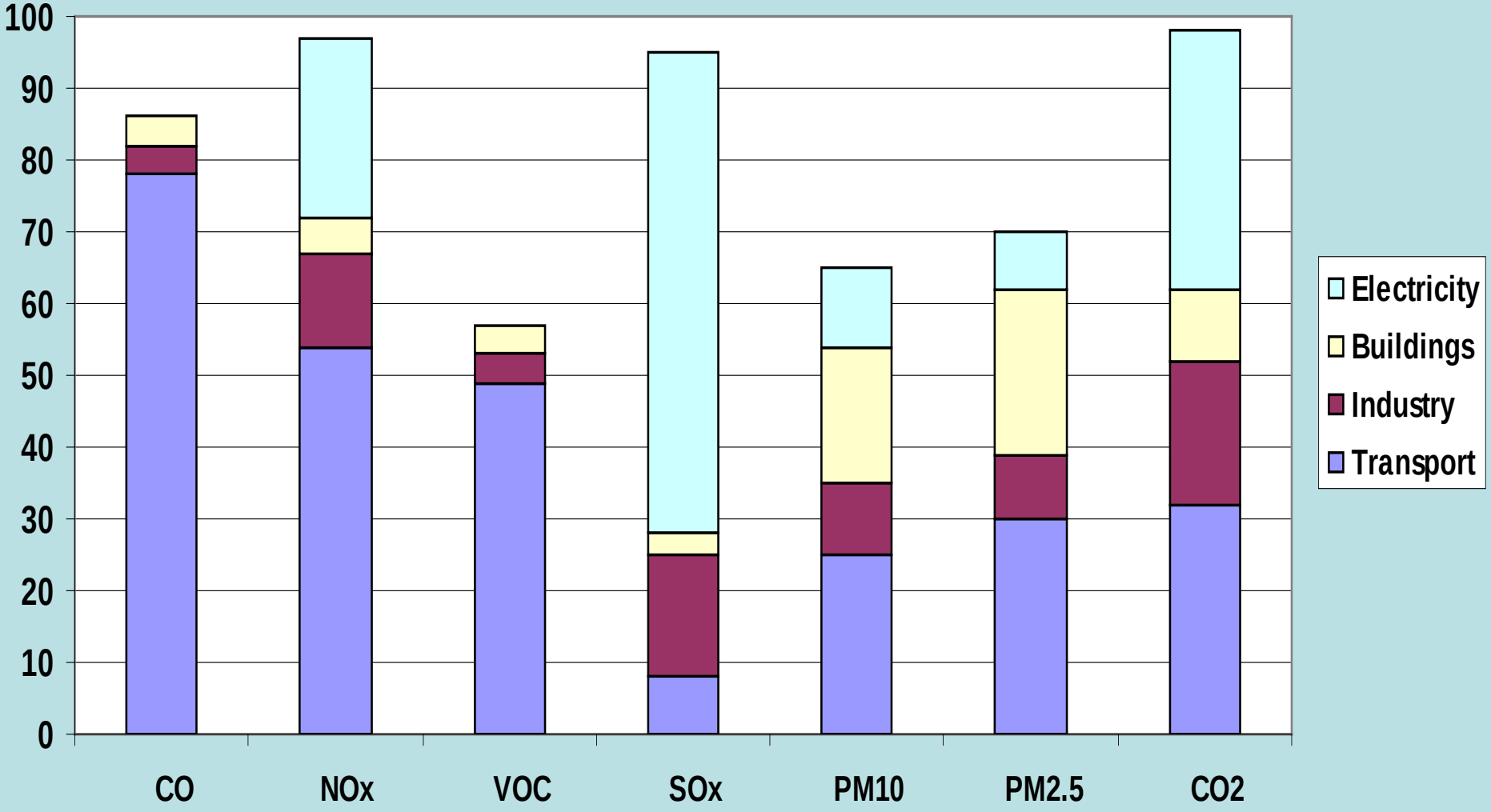
The Oil Problem

Nations that **HAVE** oil (% of Global Reserves)	
Saudi Arabia	26%
Iraq	11%
Kuwait	10%
Iran	9%
UAE	8%
Venezuela	6%
Russia	5%
Mexico	3%
Libya	3%
China	3%
Nigeria	2%
U.S.	**2%**

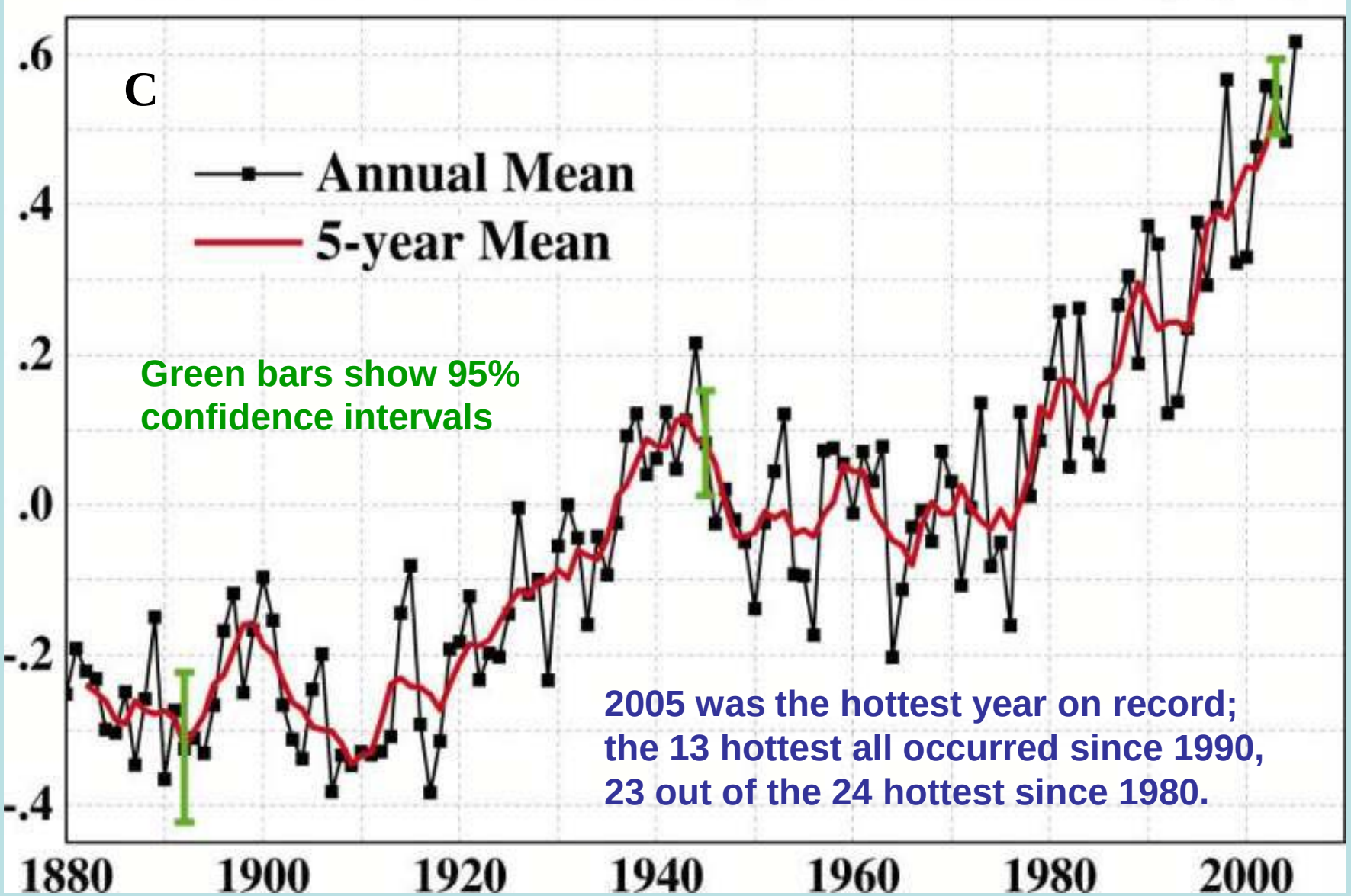
Nations that **NEED** oil (% of Global Consumption)	
U.S.	**26%**
Japan	7%
China	6%
Germany	4%
Russia	3%
S. Korea	3%
France	3%
Italy	3%
Mexico	3%
Brazil	3%
Canada	3%
India	3%

Source: EIA International Energy Annual

U.S. Energy-Linked Emissions as Percentage of Total Emissions

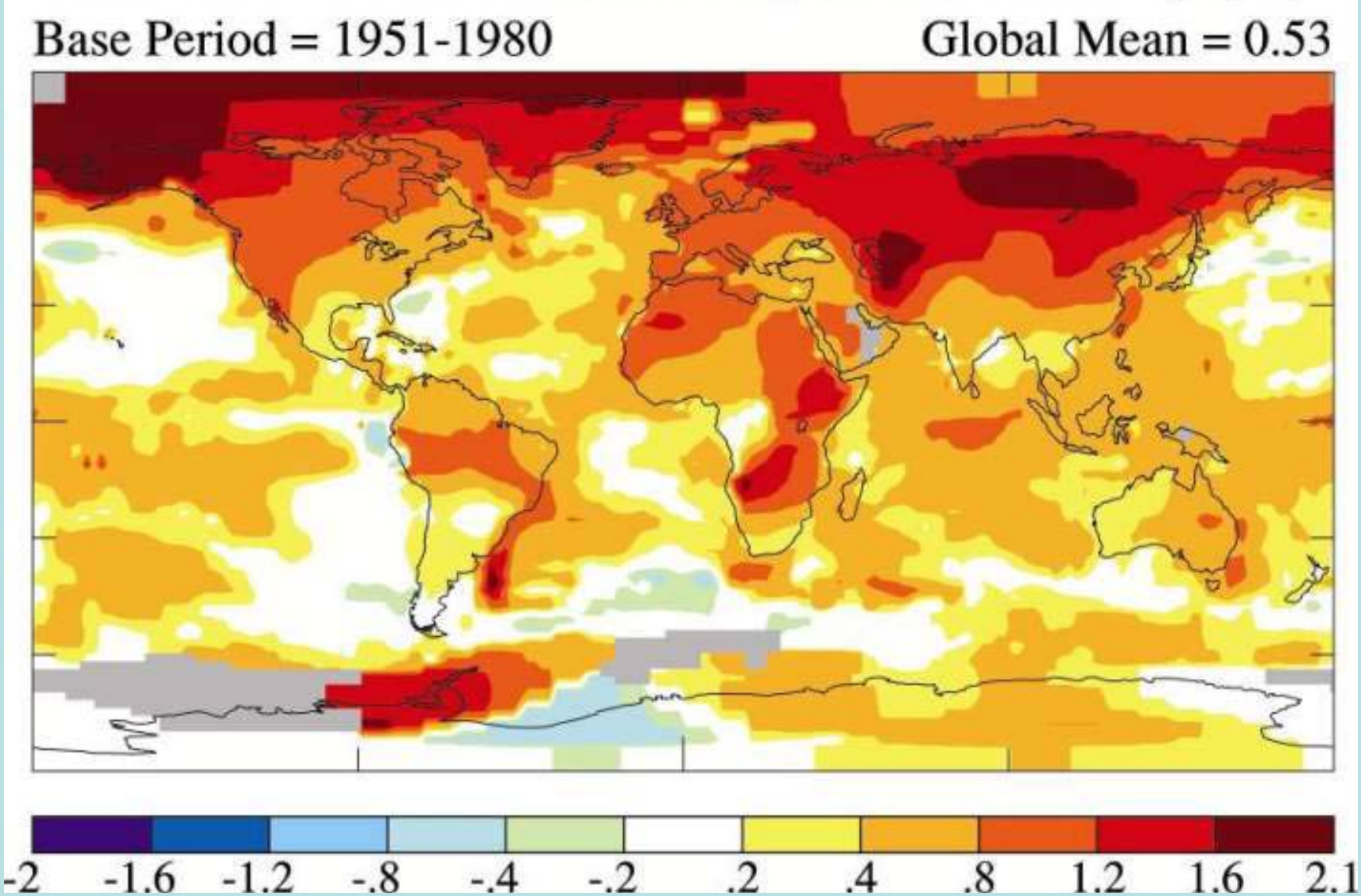


Global surface temperature since 1880



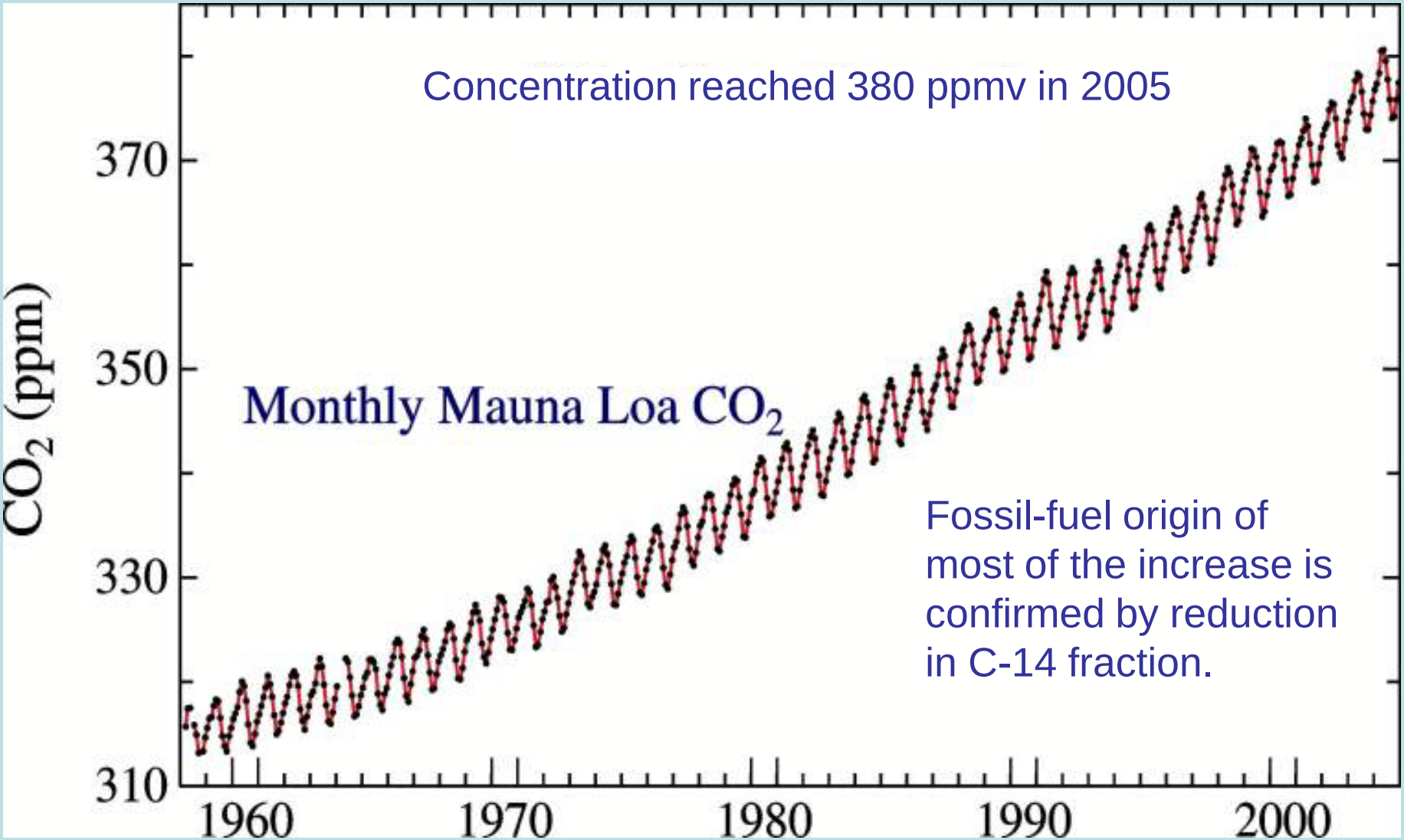
J. Hansen et al., *PNAS 103*: 14288-293 (26 Sept 2006)

Average T in 2001-2005 versus 1951-80 base, C



J. Hansen et al., *PNAS 103*: 14288-293 (2006)

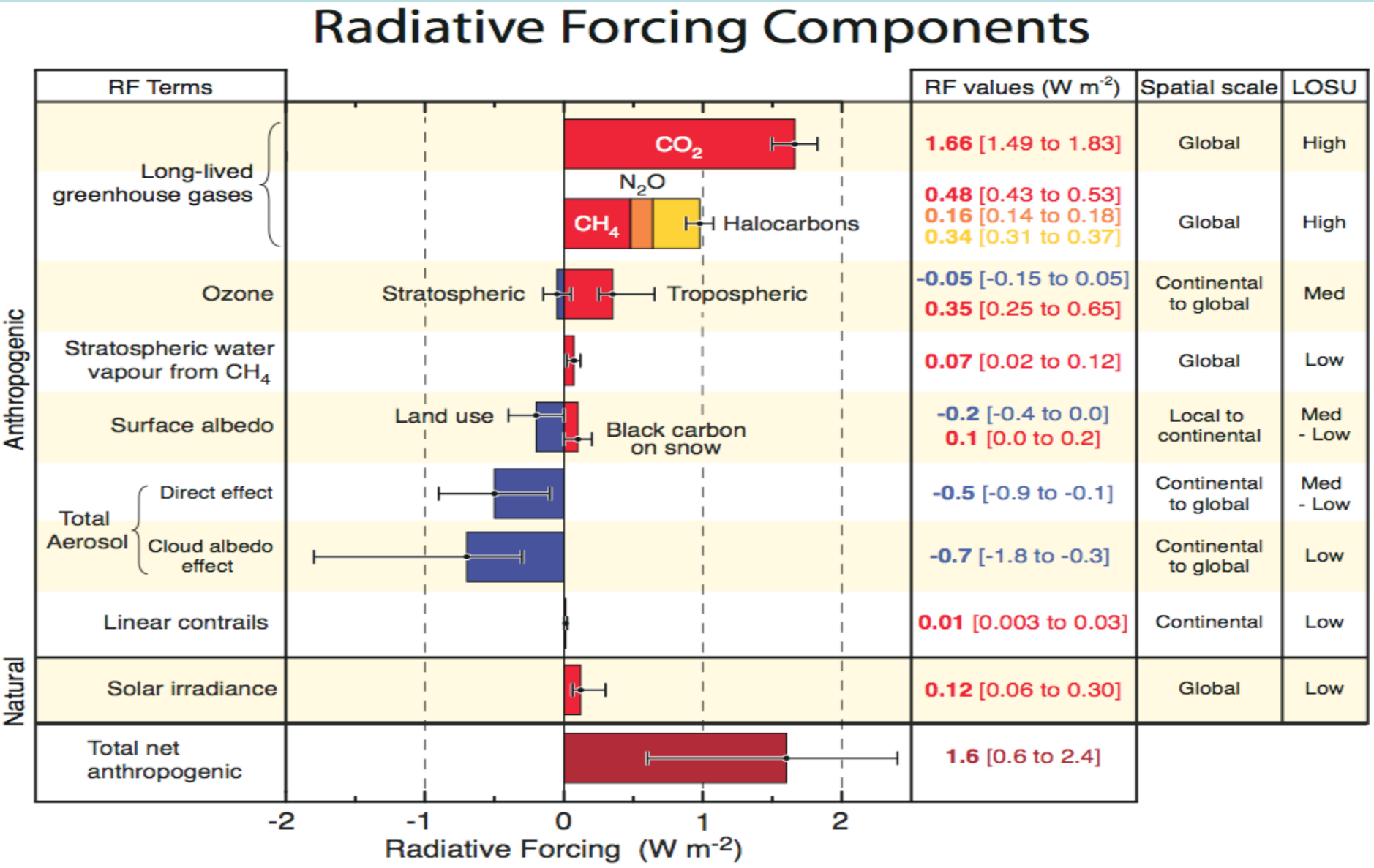
Direct measurements of CO_2 show continued rise

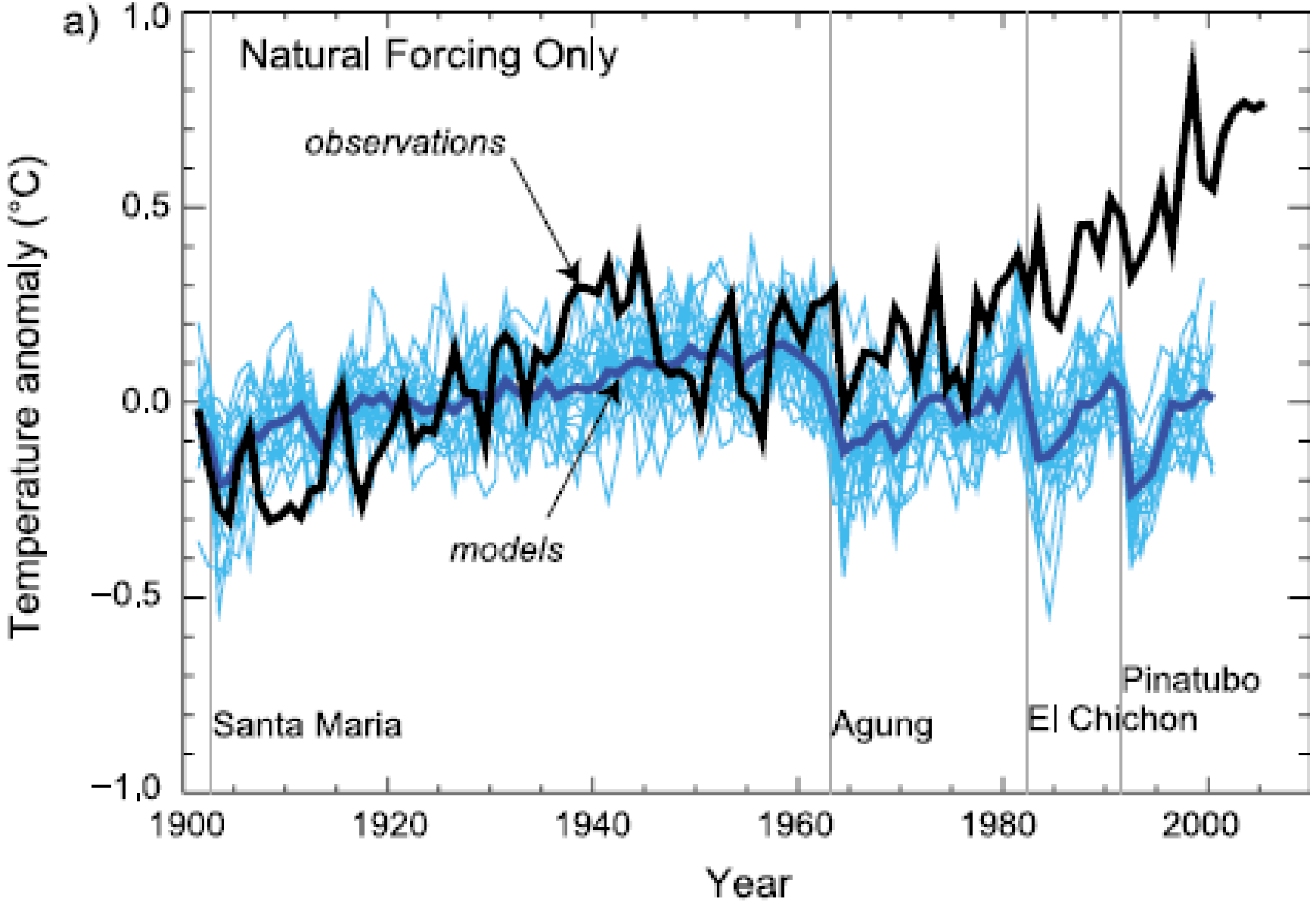


Atmospheric CO_2 measured at Mauna Loa, Hawaii.

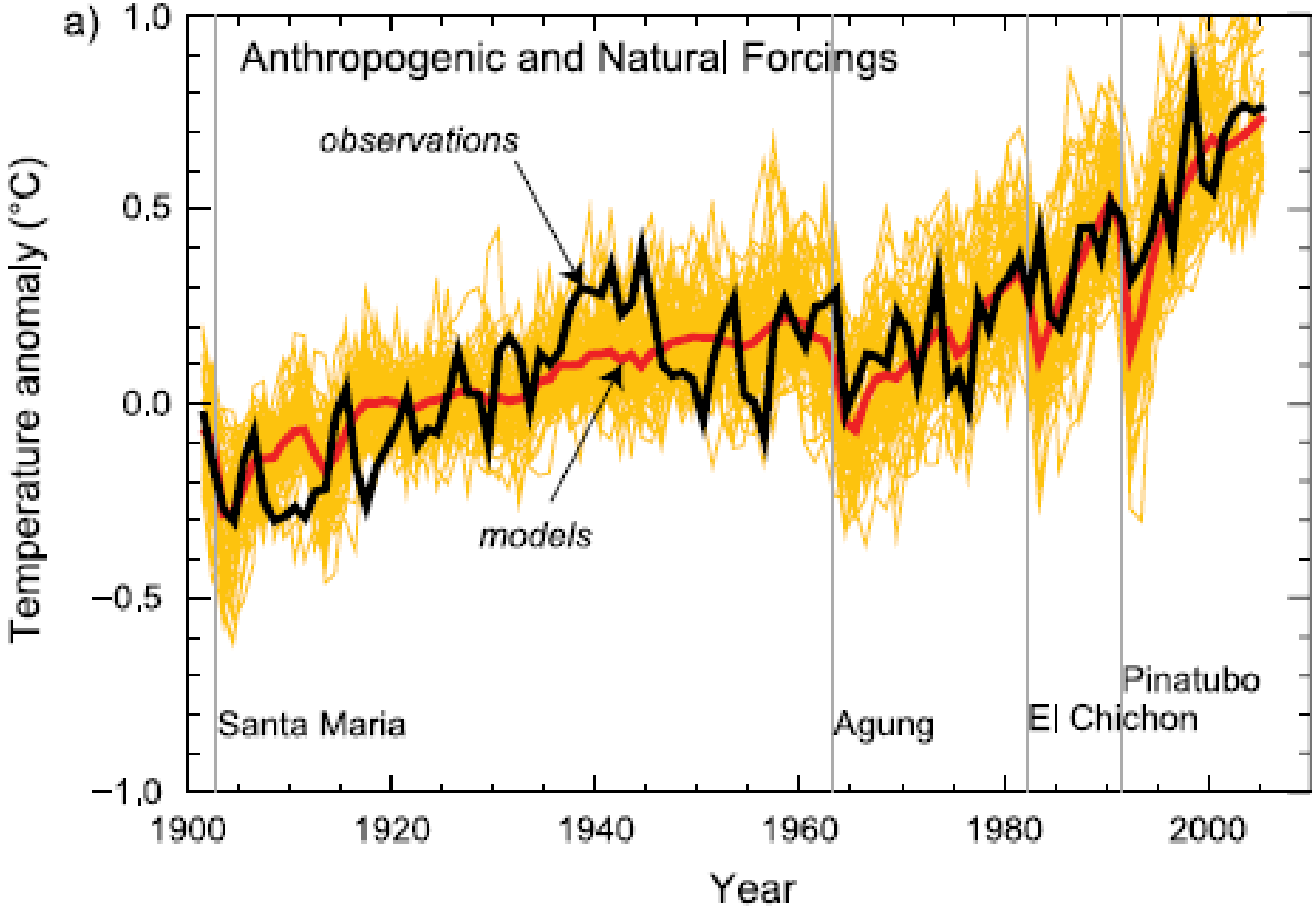
Source: NOAA Climate Monitoring and Diagnostic Laboratory

What Affects the Climate?





IPCC WG1 2007


a)
Anthropogenic and Natural Forcings
observations
models
Temperature anomaly (°C)
1.0
0.5
0.0
−0.5
−1.0
1900
1920
1940
1960
1980
2000
Year
Santa Maria
Agung
El Chichon
Pinatubo

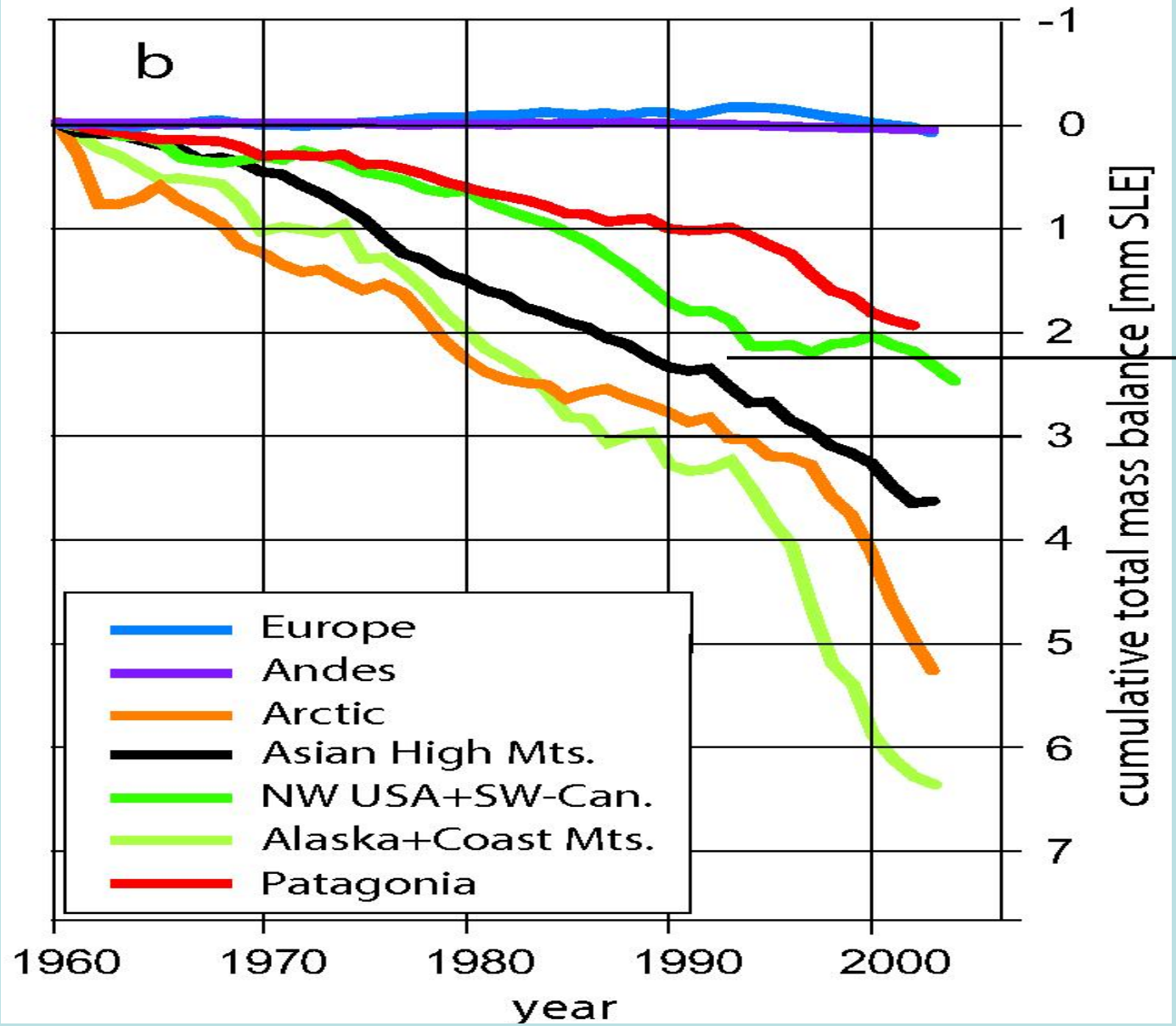
Arctic Summer Sea Ice

1979

2003

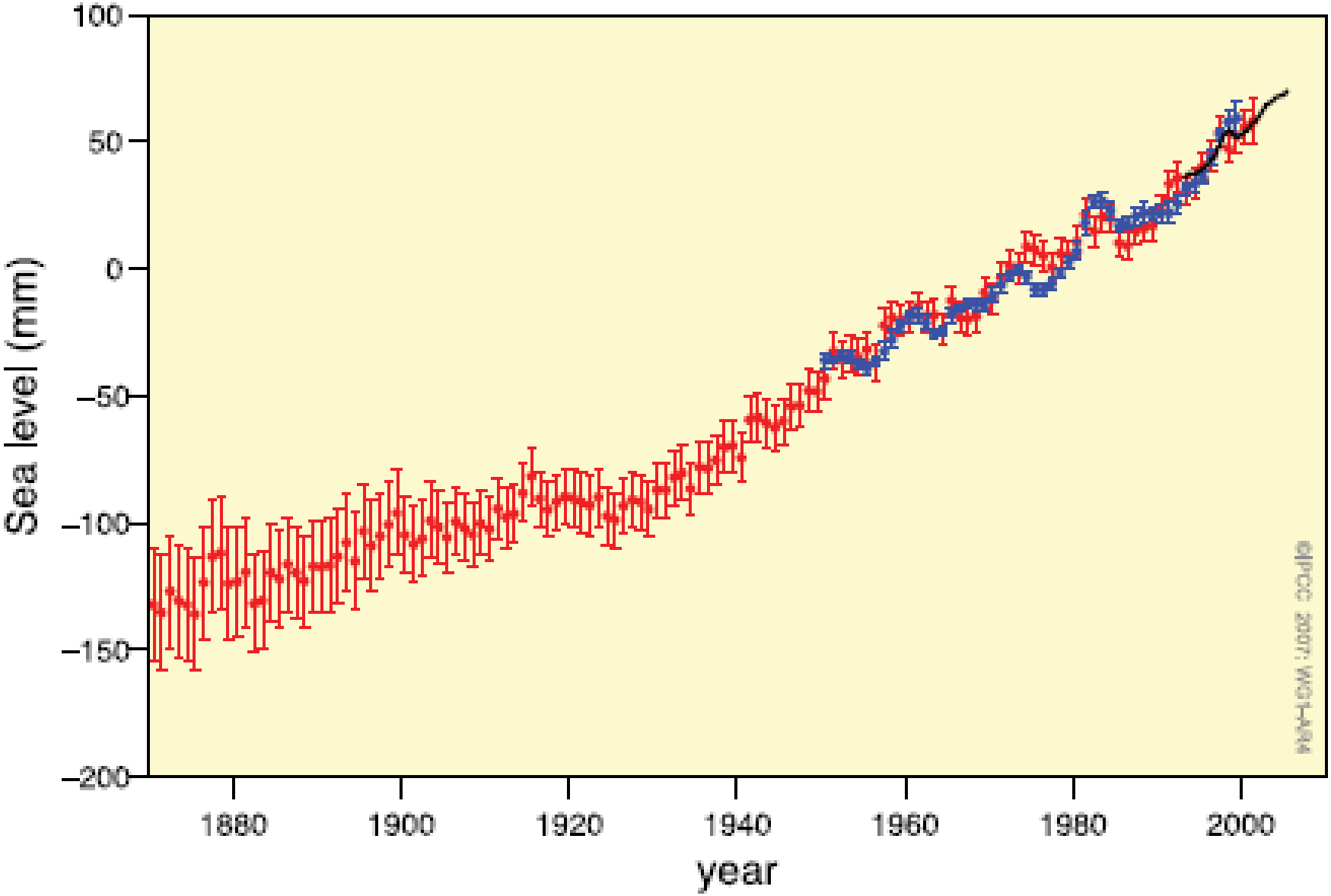
NASA photograph

Glaciers are receding



Source: IPPC 2007

Global Mean Sea Level

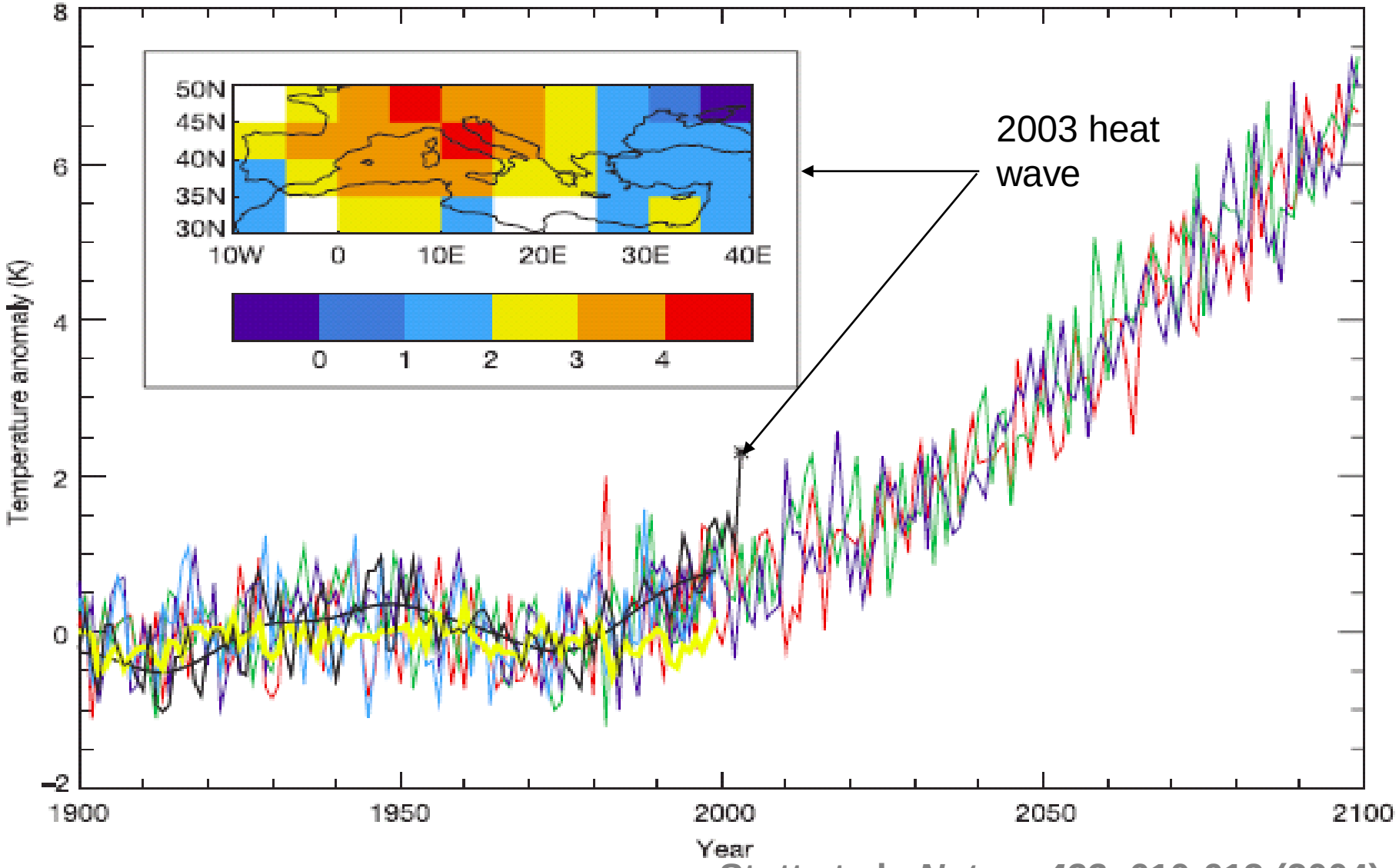


IPCC WGI 2007

Impacts

- Terrestrial ecosystems change (possibly rapidly)
- 2ºC could commit 1/6 to 1/3 of animal species on land to extinction
- Costal and marine ecosystems (1-2ºC could destroy coral reefs
- Increased areas of drought
- Health (spread of tropical disease)
- Benefits: Arctic shipping, increased agricultural productivity in some regions

Extreme heat waves in Europe already 2X more frequent because of global warming, with much more to come



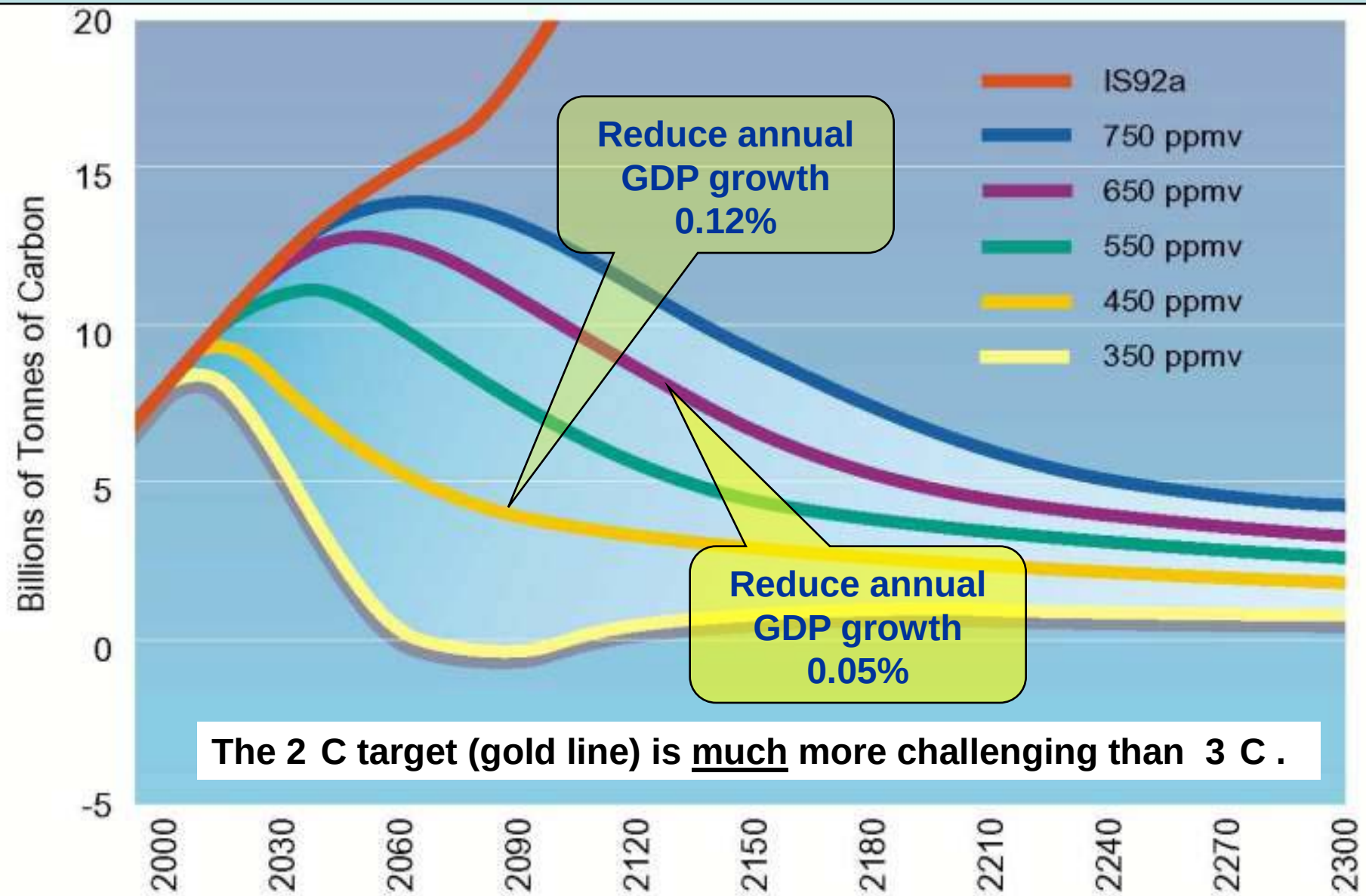
Stott et al., *Nature 432*: 610-613 (2004)

We only have three options

1. Mitigation: reduce human contributions to climate change .
2. Adaptation reduce harmful impacts of climate change
3. Suffering: endure impacts not prevented by mitigation or adaptation.

We'll need to use all three

Stabilizing Atmospheric CO2 Concentrations



Climate Change Reduction Goals for 2050

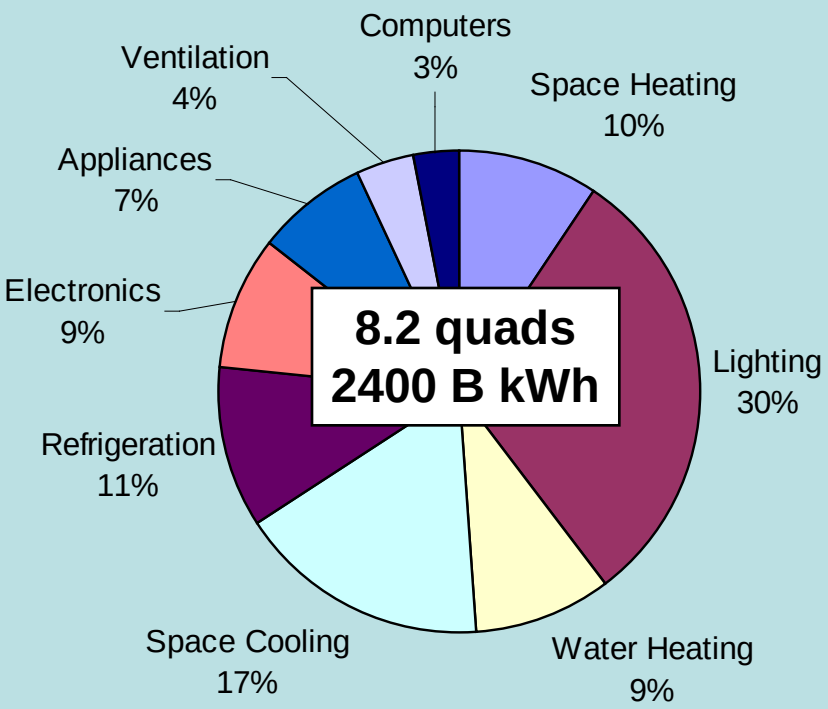
John McCain :	70%
Hillary Clinton:	80%
Barack Obama:	80%

Climate and Buildings

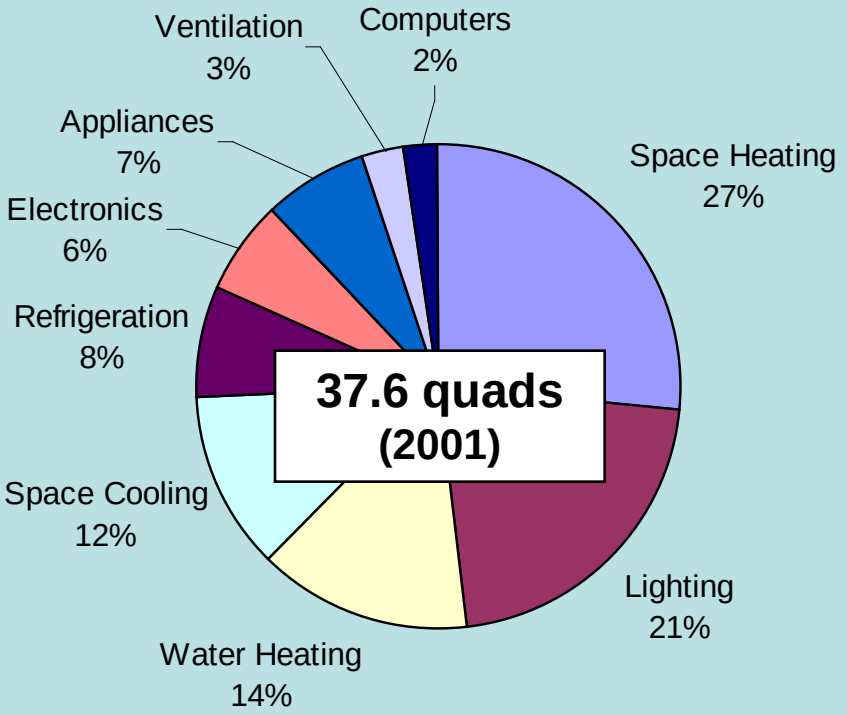
- Buildings are responsible for 1/3 of all energy related greenhouse gas emissions (~68% of electricity)
- Climate change will influence building energy use – more cooling, less heating
- Stabilizing climate will require ~3x reduction in energy use per square meter.

Buildings Energy Use

Site Electricity Consumption

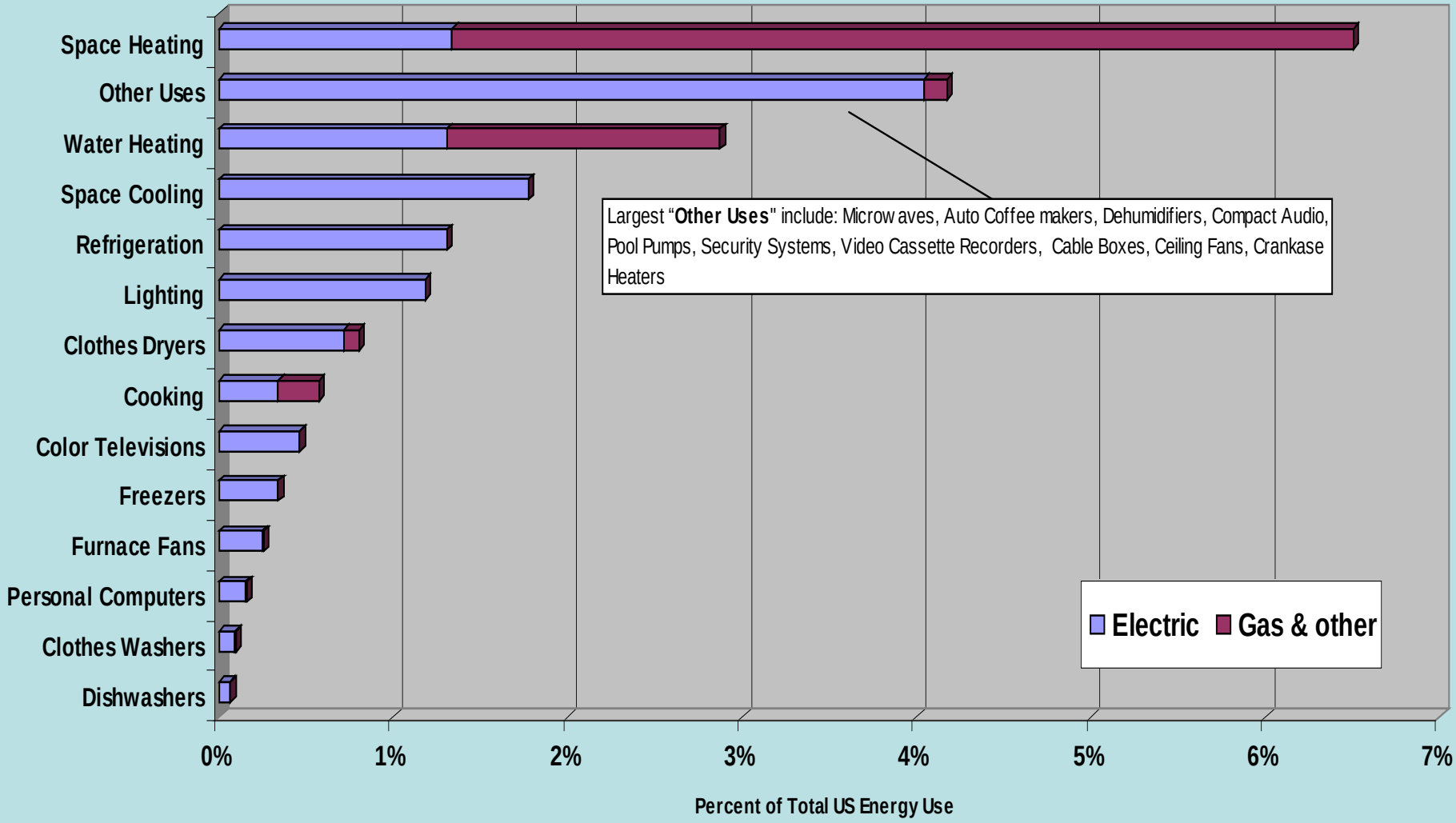


Total Primary Energy (all fuels)



Source: Building Technology Program Core Databook, August 2003. http://buildingsdatabook.eren.doe.gov/frame.asp?p=tableview.asp&TableID=509&t=xls

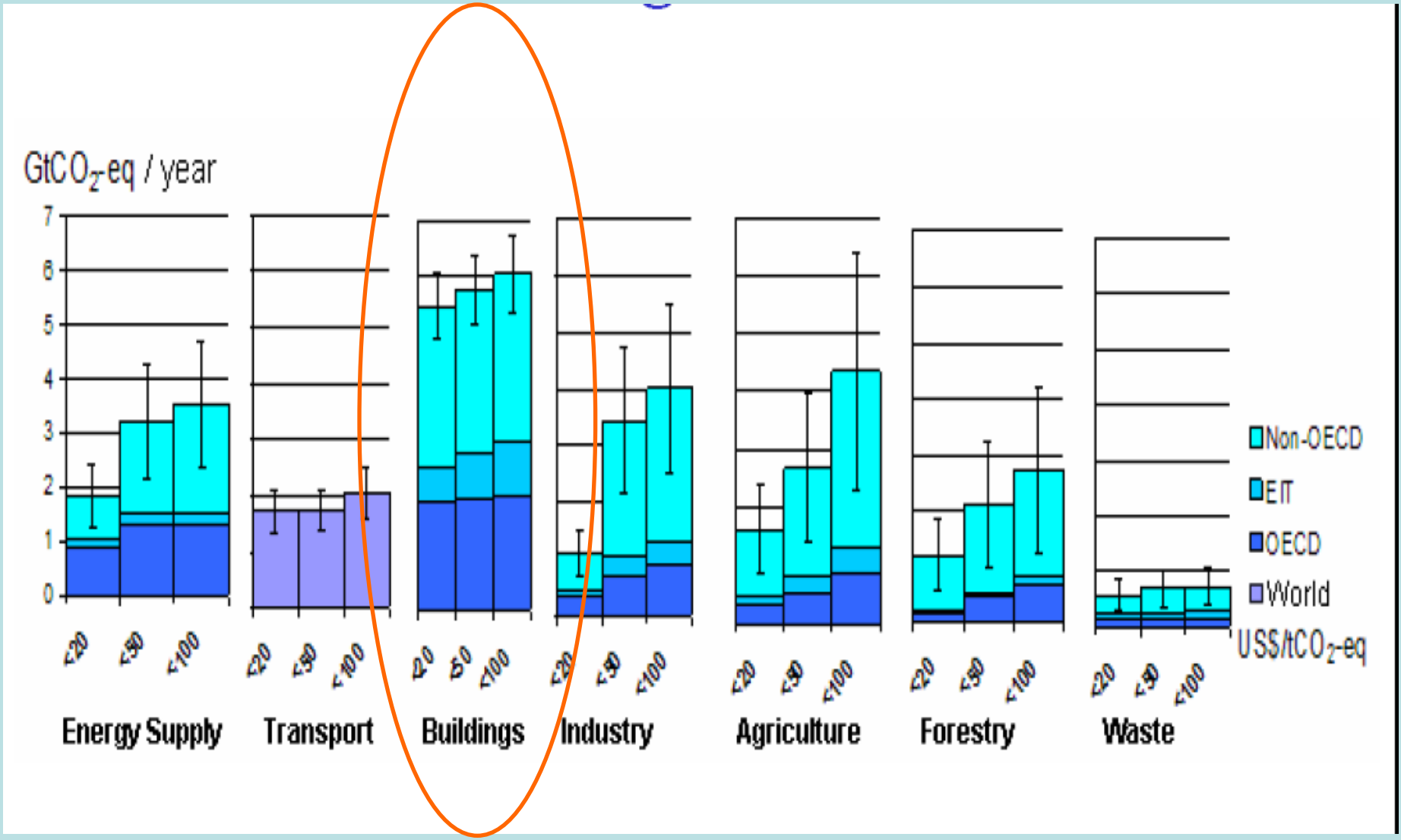
Residential Energy Use



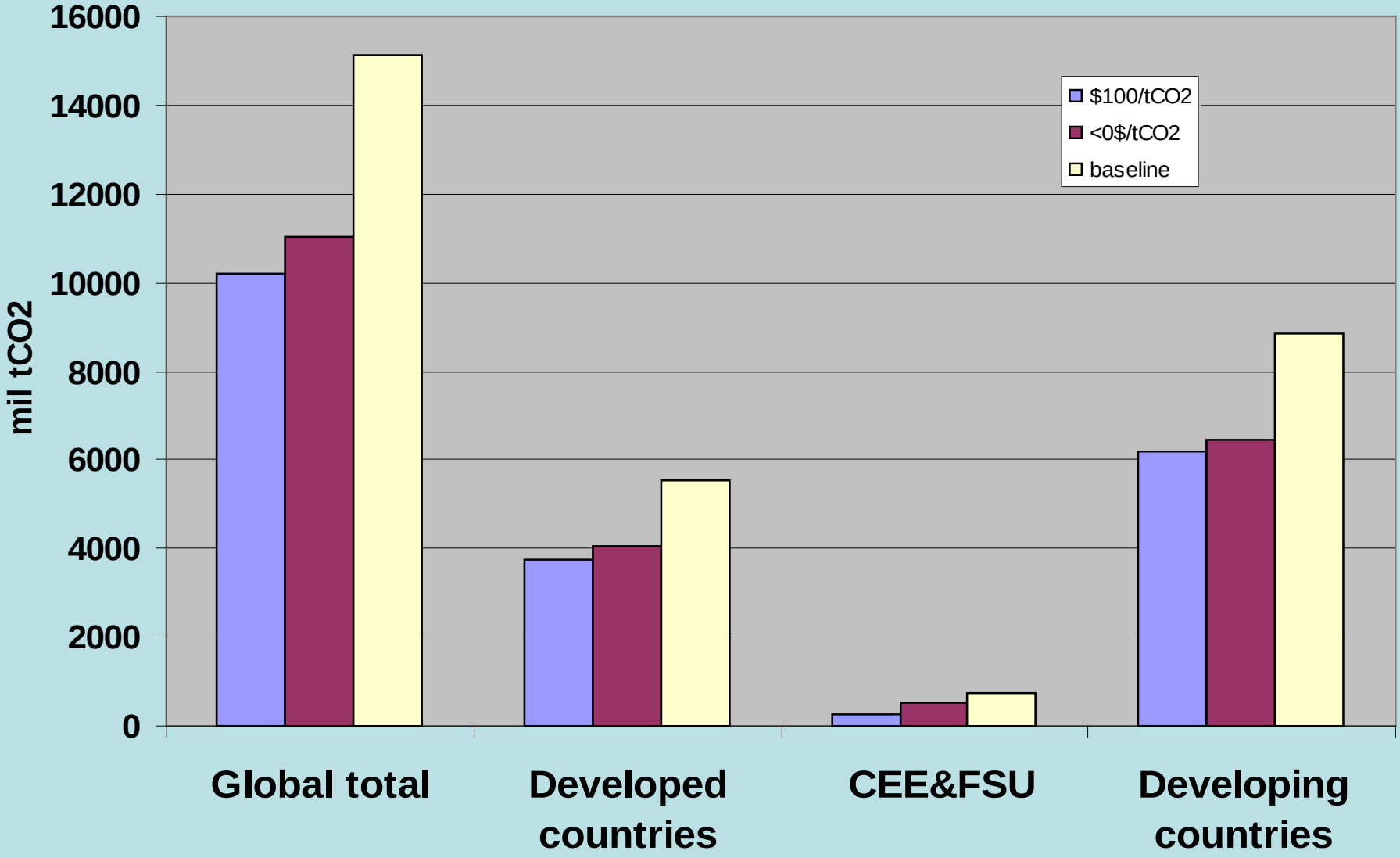
IPCC Conclusions (5/2007)

- Buildings have the largest savings potential of any sector
- 29% of buildings-related global CO2 emissions can be cut cost-effectively by 2020
- Developing countries have the largest cost-effective potential -- up to 52% of building-level emissions
- transition economies and industrialised countries have cost-effective potentials up to 37% and 25% .
- Energy-efficient lighting is the most attractive measure worldwide both reduction potential and cost-effectiveness.

Potential Emission Reductions of CO_2 Emissions

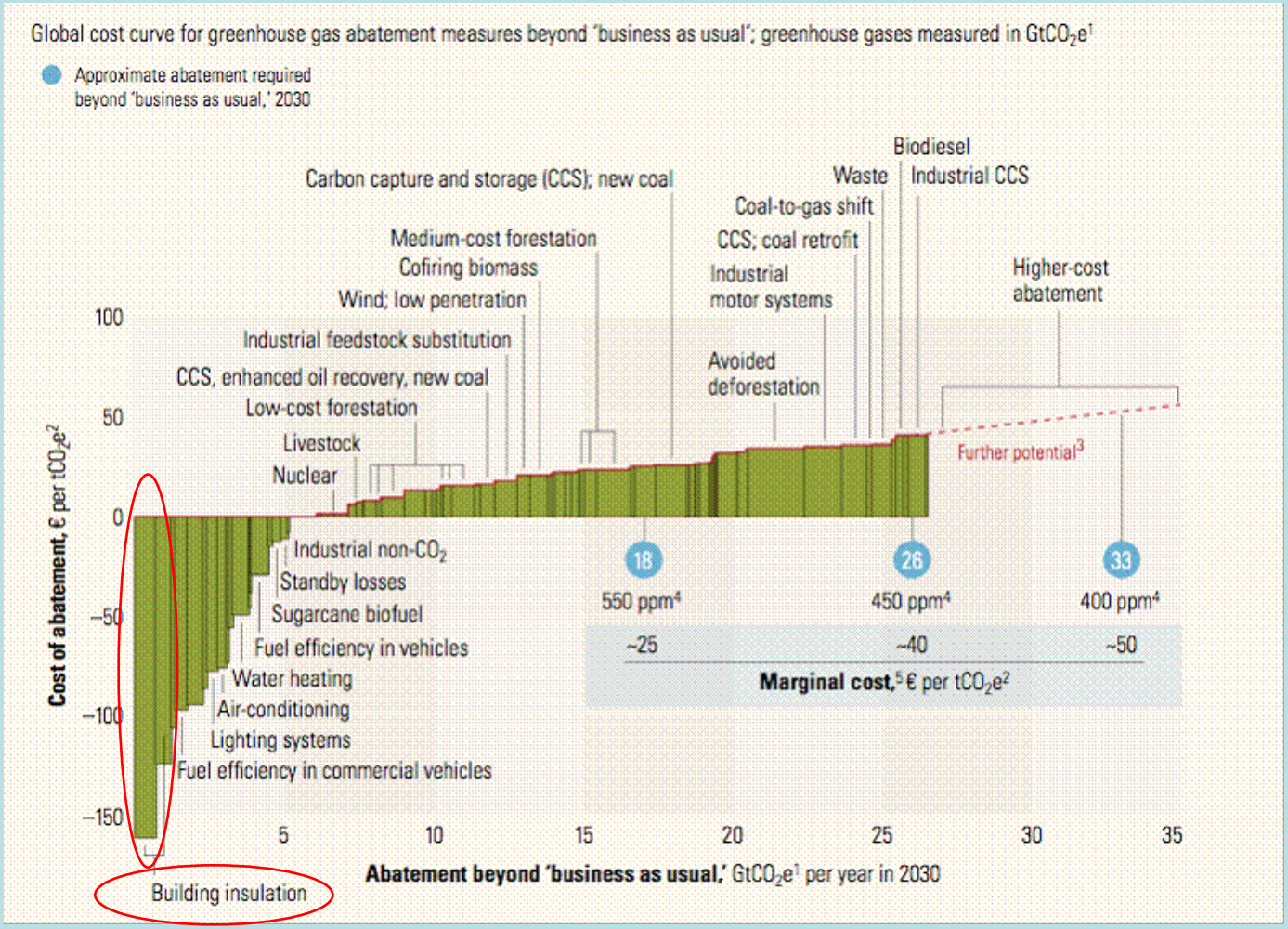


CO2 reductions from building efficiency



Diana Ürge-Vorsatz et al. for IPCC 2007

Building Savings Underscored by McKinsey



Mckinsey Report 2007 http://www.mckinseyquarterly.com

Other benefits of building efficiency technology

- Energy imports reduced
- Economic benefits (costs can be lowered)
- Health benefits (indoor air quality– particularly important in developing countries)
- Increased occupant productivity (11% increases measured)
- Increased comfort and occupant control

Design Principles for Advanced Building Technologies

- energy goals and other design objectives should be part of integrated engineering design:
  - Attractive/flexible designs
  - High energy efficiency
  - Low construction costs/ low maintenance costs
  - Safe for fire, earthquake, strong wind, insects, mould
  - High quality indoor air
  - Accessible
- Ensure reliable performance, quality control
- Proper building commissioning (can save 30% energy)

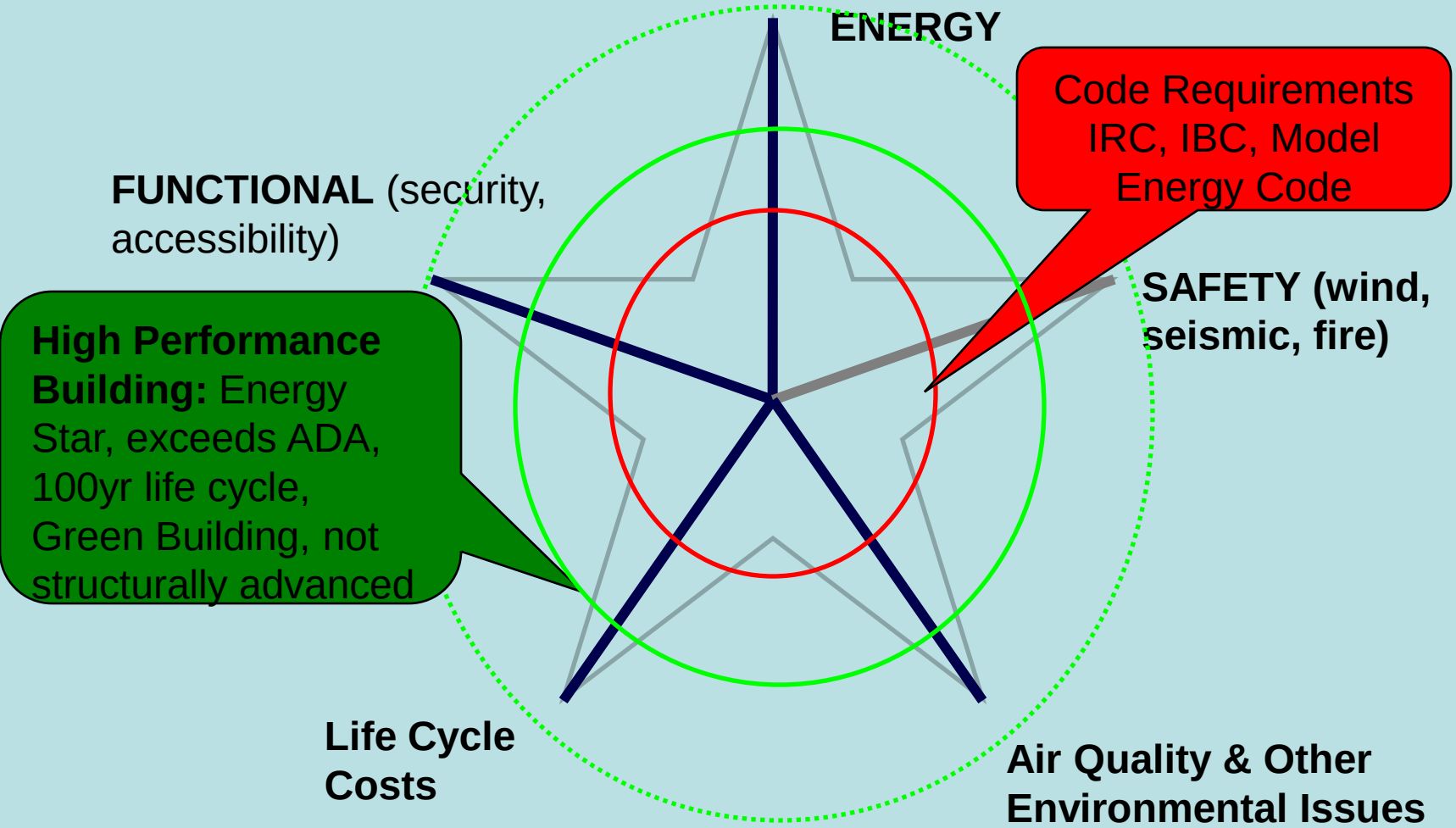
FAS Programs

Research and Policy that makes sense for:

- **Meeting national energy, environmental, safety goals**
- **Consumers**
- **The Industry**

Initial focus on SIPS because they can play a key role

High Performance Buildings



Building Technologies

- Minimize loads
  - Insulation
  - Colors cut solar gain
  - Vegetation
  - Orientation & Daylighting
  - Hot water management
- Efficient HVAC
  - Equipment efficiency
  - Controls
  - Design (separate H+V+AC)
- Efficient Appliances
  - Lighting
  - Low voltage transformers
  - Refrigerators, etc.
- Renewable
  - hot water
  - electricity

SIP Testing With Industry & U.C. Berkeley

- Working closely with SIP Industry & Trade Organization to bring nationally recognized researchers & professionals into the discussion of present & future technologies.
- Bringing nationally recognized material manufacturers to expand the SIP industry & vendor offerings.
- Improving industry efficiency of product certification & options to get products into the market faster.
- Continued testing with the University of California Berkeley

Pseudo-dynamic testing

Location of
Selected Panel

actuator

Panel

Compute
forces on
selected
panel

Real data
on seismic
forces

Habitat SIP Demonstration 2007

- Constructed a cementitious SIP home in Mobile, Alabama with Habitat for Humanity. Family will soon move (in if not already).
- House was started in DEC 2006 & delayed due to vendor & volunteer issues.
- Testing will soon be scheduled to monitor & benchmark out houses & Habitat's traditional models.
- Planning 4 house demonstration village with Habitat for Humanity International in 2008.

Turkey SIP Demonstration 2007

- Completed Lale Villa with ILHAS (Turkey's largest developer), a demonstration house in a suburban Istanbul development on the Sea of Marmara.
- Support the transfer of advanced structural insulated panels systems to Turkey in cooperation with the IHLAS.
- Participated and made presentations at conferences in Turkey on advanced housing technologies. (Henry Kelly gave a keynote address on Global Climate Change)

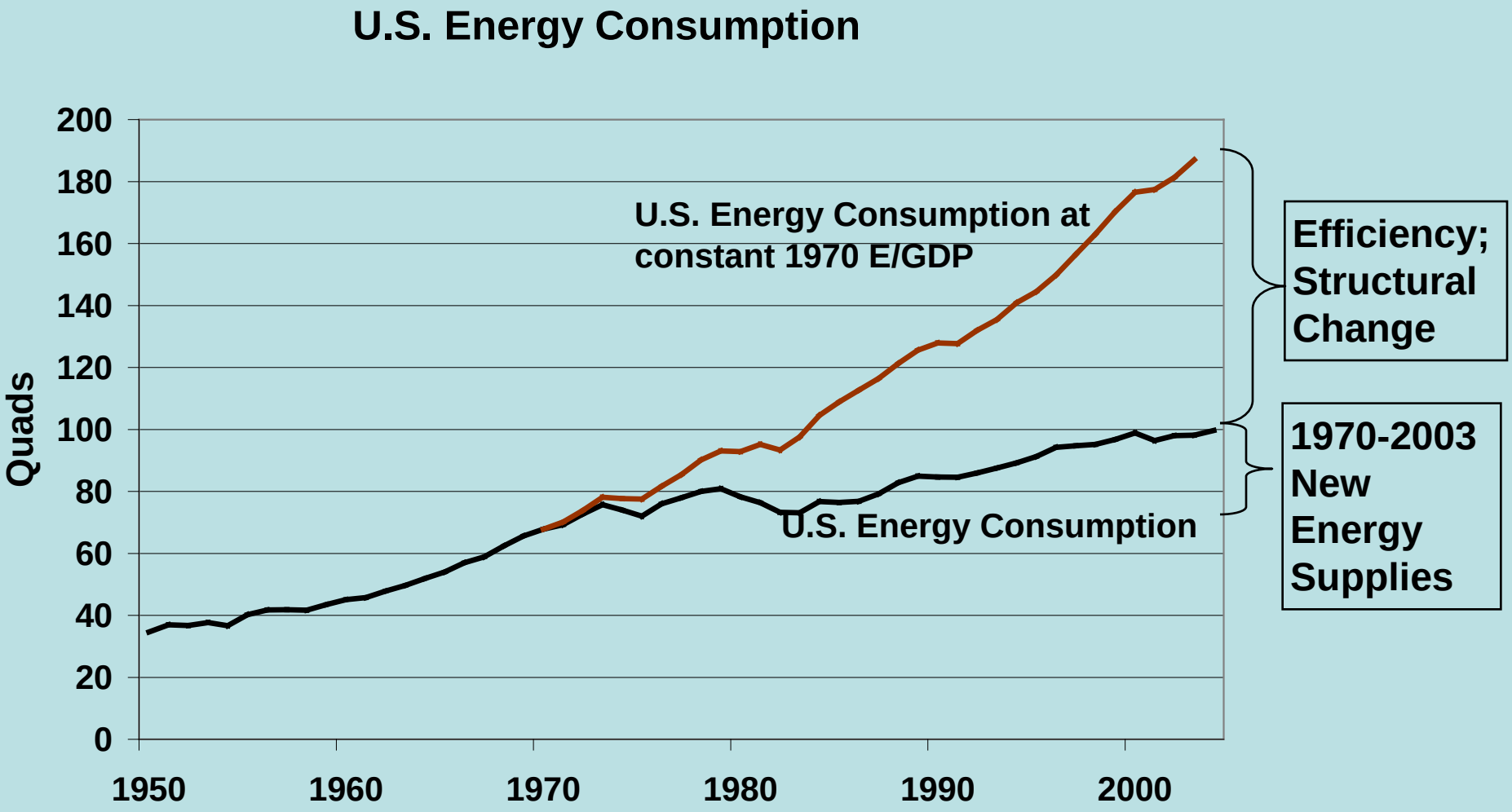
2007 Baku Workshop on Safe, Energy Efficient Construction

- DOE-Azerbaijan co-sponsored workshop on advanced building technologies. FAS emphasized the advantages of new construction techniques emphasizing SIP advantages in energy performance, cost, safety, use of widely available materials.
- The technologies are critical for Azerbaijan, because of its rapid growth in a seismic active area (current growth is based primarily on masonry construction).
- The advanced panel systems are also offer a promising solution for providing housing and community buildings to a large internally displaced population -- The international technology transfer activities also provide important social, economic, and political benefits.

SIPs for Commercial Structures (Pankow Foundation)

- Broaden the UCB partnership & include all forms of SIPs – but highlights Cementitious panels.
- Draft Final Report with Industry Experts as editors to gain best leverage of adoption/success.
- Present Research at the ASCE conference in September to 100s of professionals.
- Coordinate with Structurally Insulated Panel Association’s push into the commercial sector.

The Impact of Energy Efficiency



What's To Be Done to Reach the Ambitious National Goals

- Well funded, sustained, well balanced program in research, development, demonstration, and evaluation of high performance building technologies
- Carbon cap and trade measures that give adequate benefits to buildings
- Other regulations and incentives, crafted with the industry, that drive continuous improvement

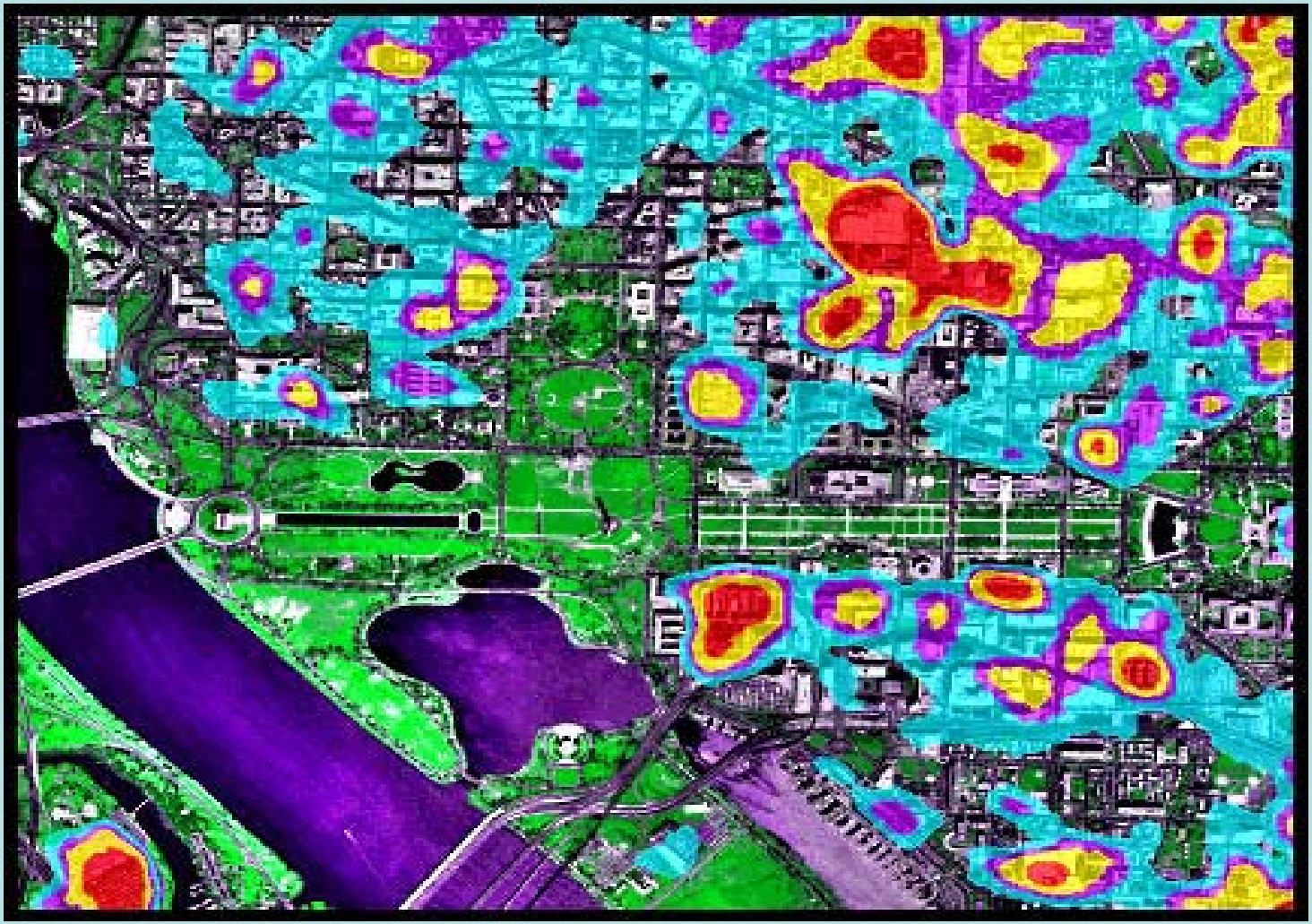
The Bottom Line

Construction Technology, and SIPs in particular, are a key part of the solution to national energy and environmental challenges

For more information see:

www.fas.org look for Buildings Technology

IR Photo of Washington DC



Source: Landsat & Spot Imges