The Department of Energy and the Office of Science

November 18, 2009

Advanced Energy 2009

New York State's Conference for Advanced Energy

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Office of Science, U.S. Department of Energy

The Department of Energy

DOE Mission

- Advance the national, economic, and energy security of the United States;
- Promote scientific and technological innovation in support of that mission; and
- Ensure the environmental cleanup of the national nuclear weapons complex."

DOE Headquarters, Forrestal Building, Washington DC

DOE Quick Facts

- $26.4B FY 2010 budget request
- $36.7B in Recovery Act funds
- 14,000 Federal employees
- 93,000 contractor employees
- 17 National Laboratories
- 4 Power Marketing Administrations
- 86 Nobel Laureates

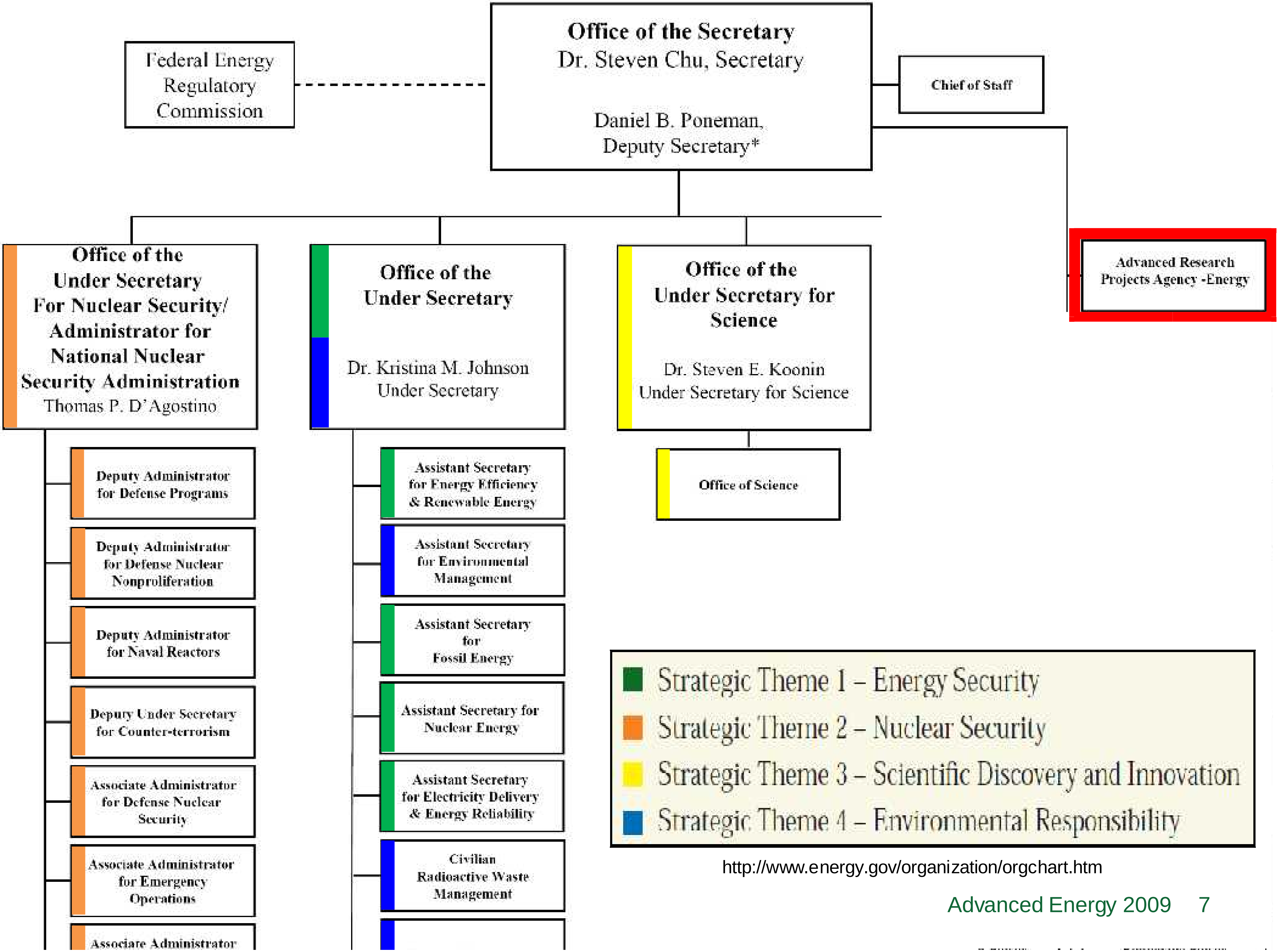
DOE Evolution - I

- **1942-1946 Manhattan Project led by War Department Army Corps of Engineers**
  - Classified R&D
  - Sprawling logistical and technical demands
  - Foundations of first multi-purpose national labs

- **1946 Atomic Energy Act (P.L. 79-585)**
- **1946-1974 Atomic Energy Commission (AEC)**
  - Charter emphasized research into
    - Basic nuclear processes
    - Nuclear energy
    - Utilization of nuclear materials for variety of purposes
  - Continual expansion of R&D activities and facilities

DOE Evolution - II

- **1971 AEC charter expands to non-nuclear energy**
- **1974 Arab oil embargo motivates creation of new energy R&D agency (P.L. 93-438)**
- **1974-1977 Energy Research and Development Administration**
  - Nuclear, solar, fossil, geothermal, synthetic fuels, transmission, conservation, etc.
- **1977 Consolidation of Federal energy activity into a new Department of Energy (P.L. 95-91)**
  - Formal separation of management oversight of weapons and non-weapons labs
  - Formal separation of basic and applied research programs



http://www.energy.gov/organization/orgchart.htm

DOE Leadership

Steven Chu
Secretary of Energy

DOE Leadership

More DOE Leadership

Dan Poneman

Kristina Johnson

Steven Koonin

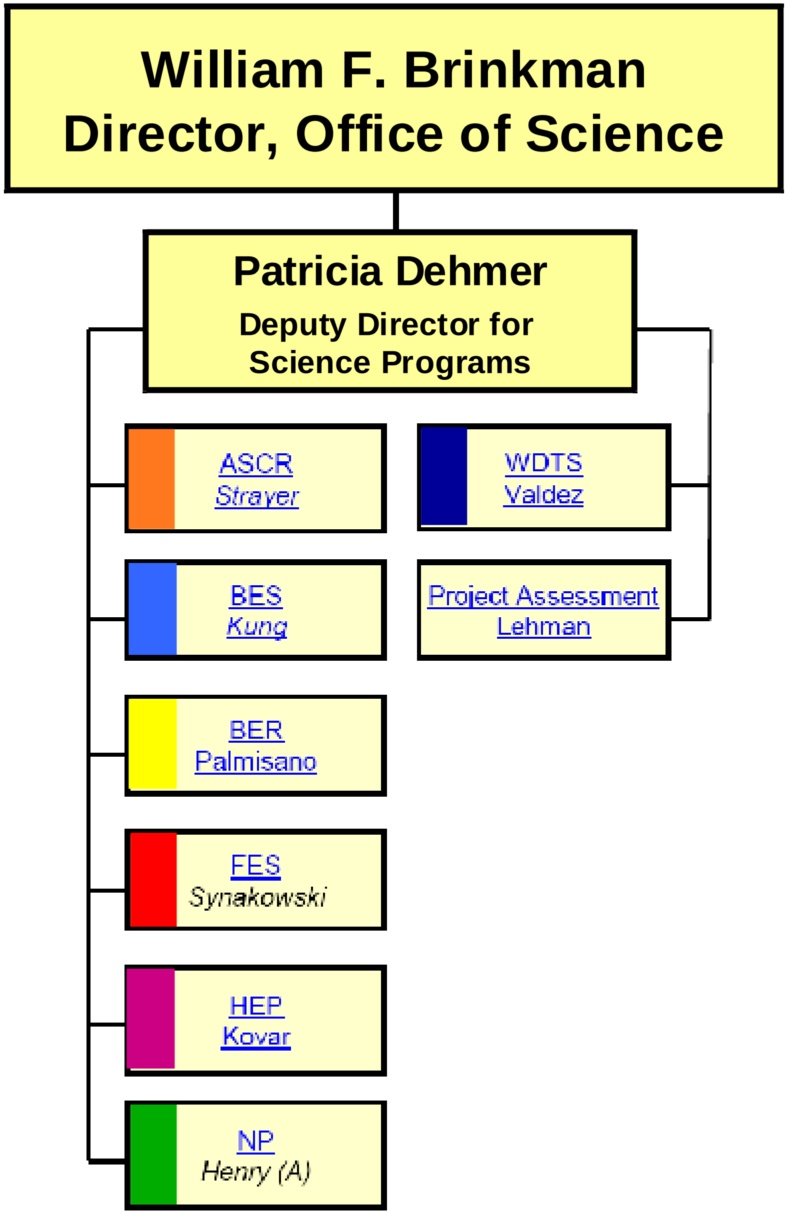
Tom D'Agostino

DOE’s Office of Science

Office of Science Quick Facts

- $4.9B FY 2010 budget request
- $1.6B in Recovery Act funds
- 10 National Laboratories
- 1,000 Federal employees
- Support for:
  - 25,000 Ph.D.s, graduate students, undergraduates, engineers, and technicians
  - 300 academic institutions and all 17 DOE laboratories
  - 25,000 users at the scientific user facilities

Office of Science – the Science Programs

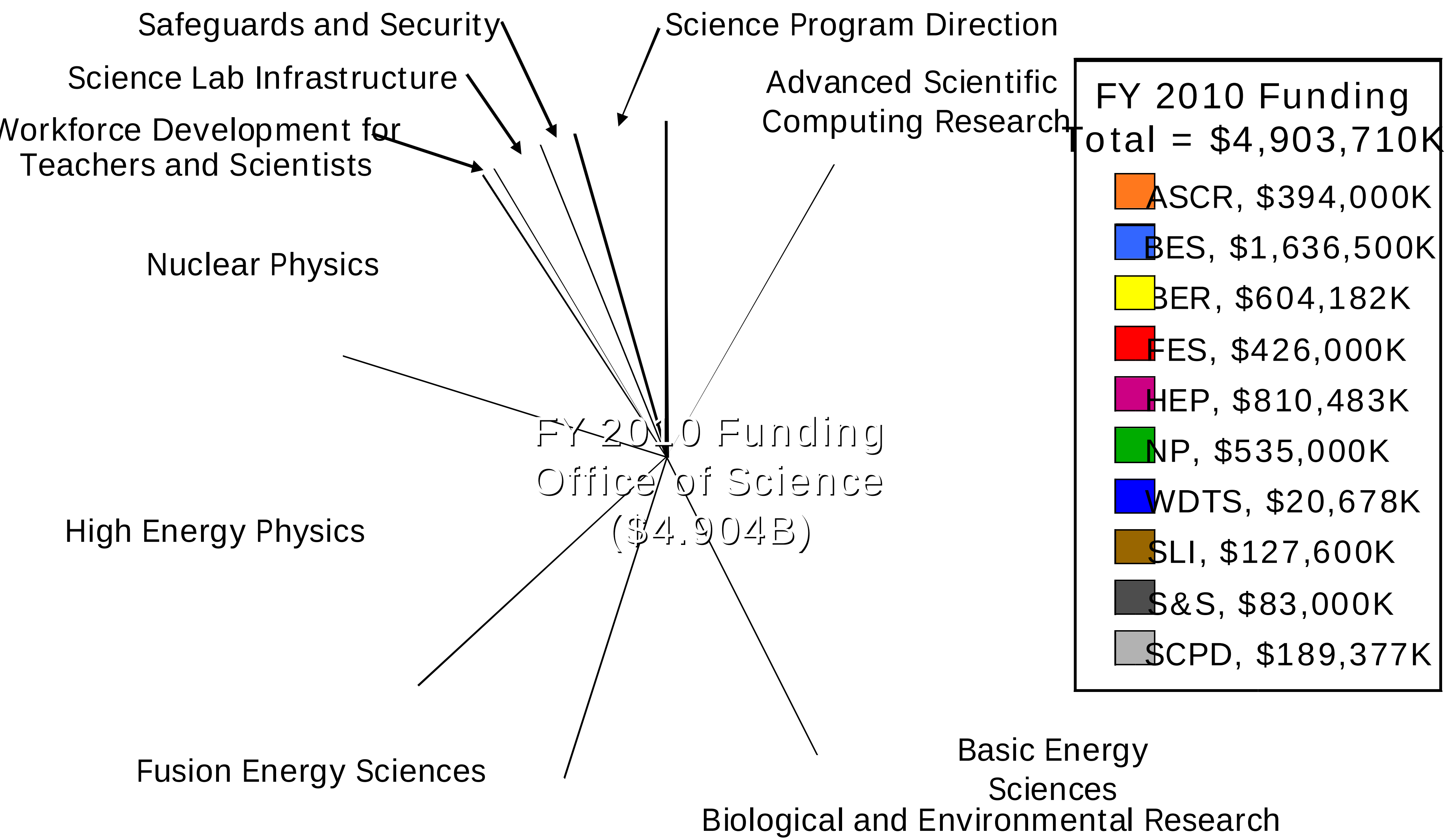


FY 2010 Funding
Total = $4,903,710K

- ASCR, $394,000K
- BES, $1,636,500K
- BER, $604,182K
- FES, $426,000K
- HEP, $810,483K
- NP, $535,000K
- WDTS, $20,678K
- SLI, $127,600K
- S&S, $83,000K
- SCPD, $189,377K

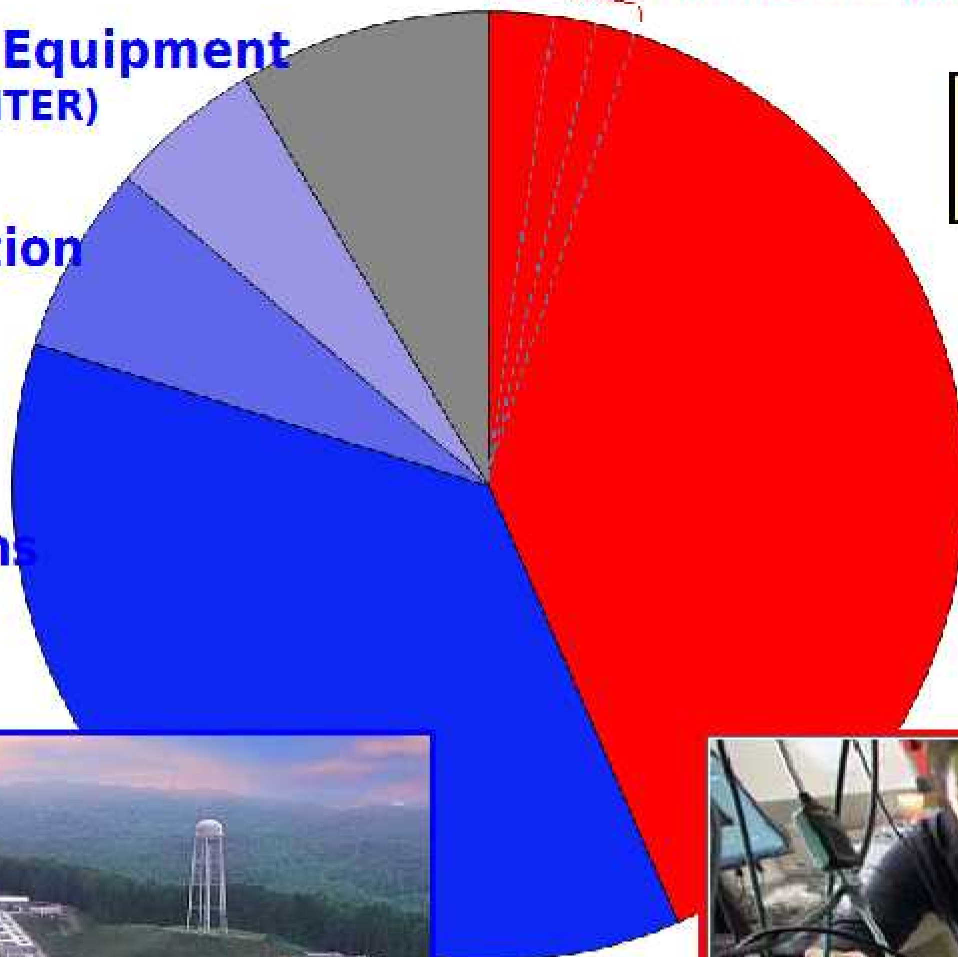
Office of Science Programs

$4.904 B in FY 2010



Support for Research and for Facilities

50% of program funding supports facility operations

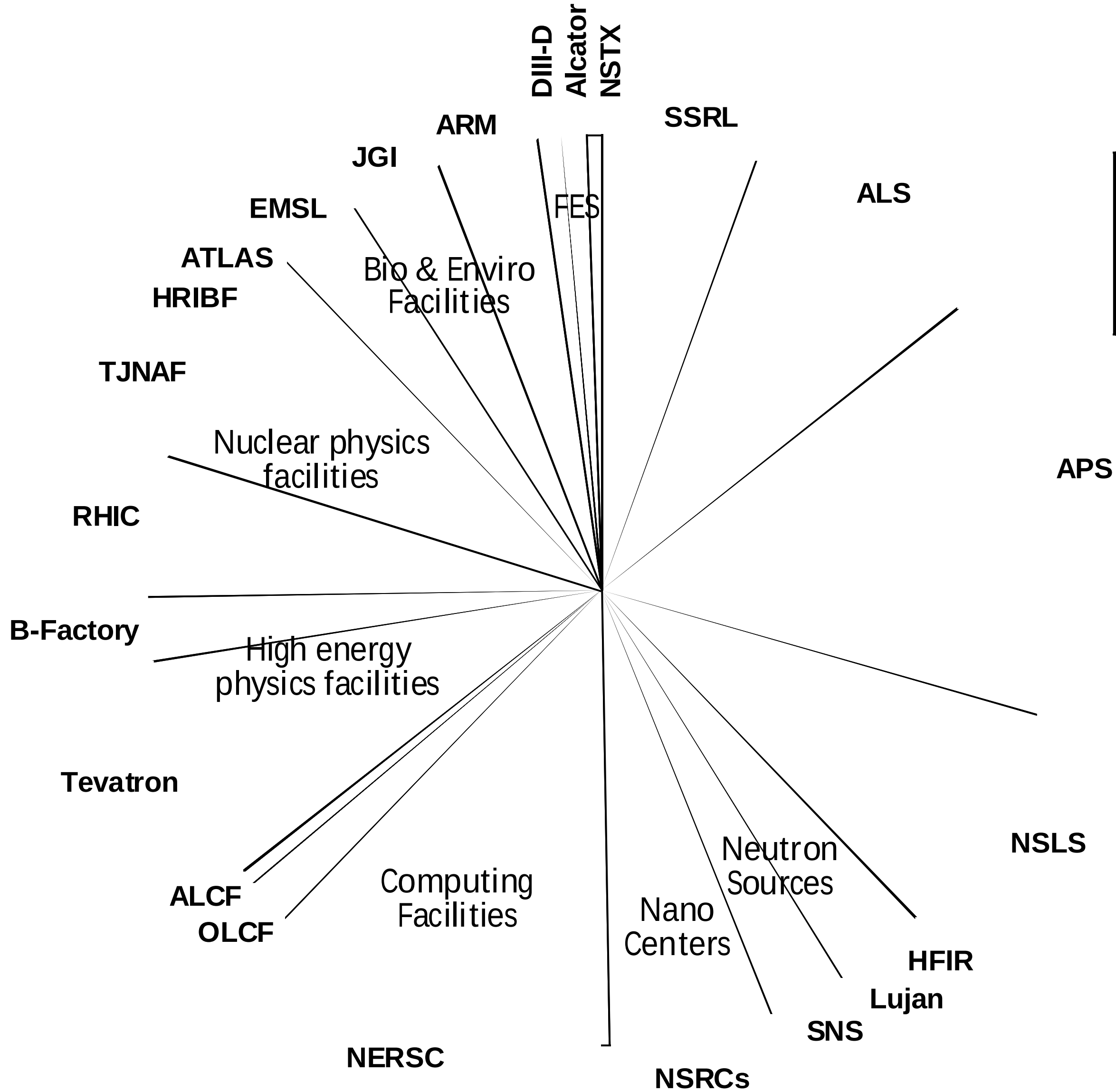


Breakdown of Users by Facility

The light sources host 40% of all SC users

~25,000 users at the facilities in FY 2010:
~1/2 from universities;
~1/3 from labs;
the remainder from industry, other agencies, and international entities.

Distribution by facility of ~25,000 users in FY 2010



FY 2010 funding for the light sources is $258M, ~17% of the total funding for the operating facilities.

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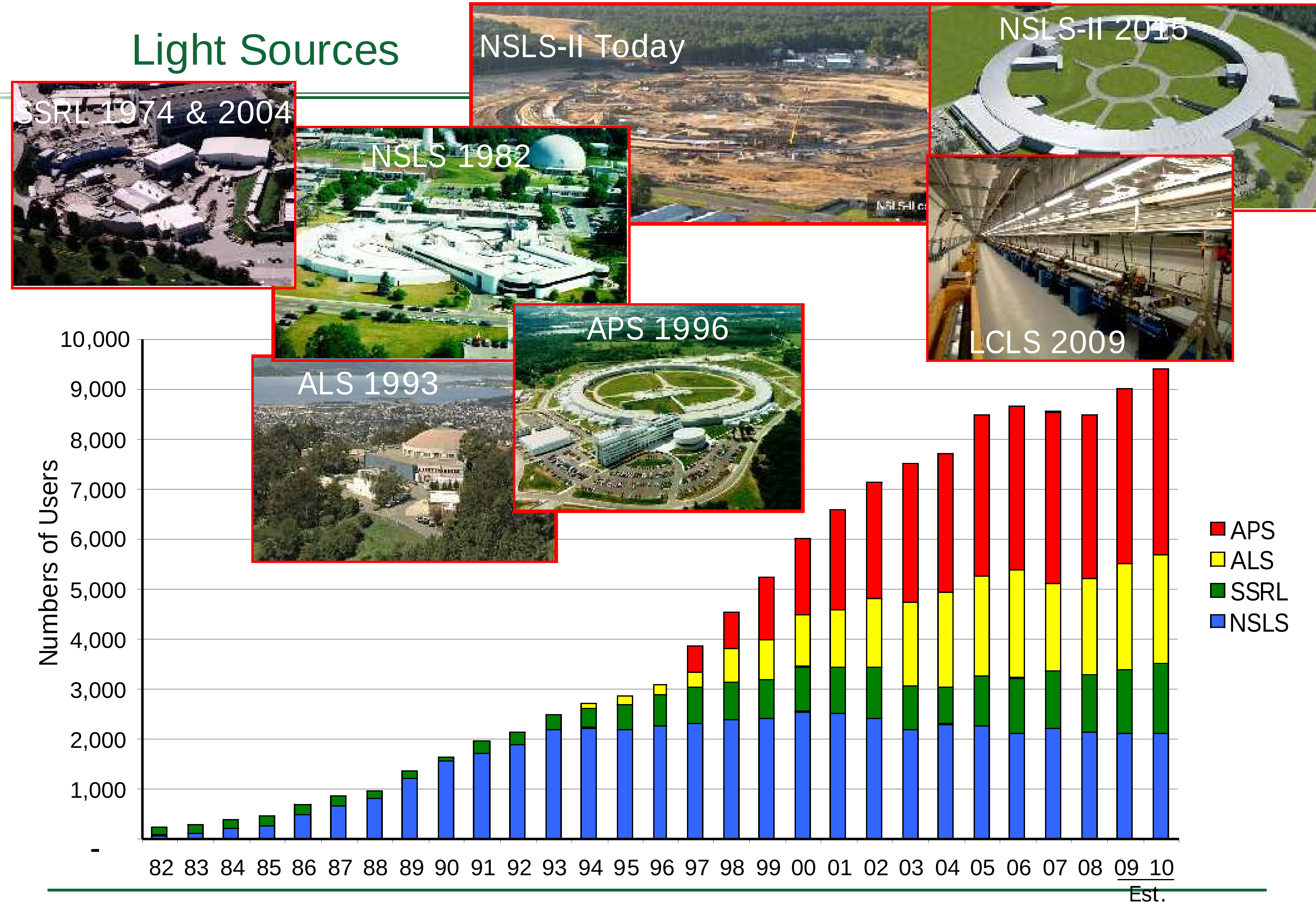
Light Sources



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3 Nobel Prizes in Chemistry in 6 Years Using X-ray Crystallography

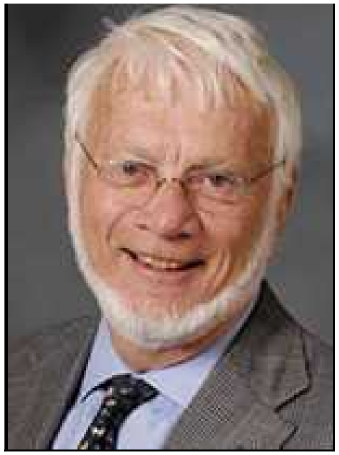
2003: Roderick MacKinnon (Chemistry) for “structural and mechanistic studies of ion channels.” *Used NSLS beamlines X25 and X29.*

2006: Roger Kornberg (Chemistry) "for his studies of the molecular basis of eukaryotic transcription.” *Used SSRL macromolecular crystallography beamlines.*

2009: Venkatraman Ramakrishnan, Thomas A. Steitz, and Ada E. Yonath (Chemistry) "for studies of the structure and function of the ribosome.” *Used all 4 DOE light sources.*

Venkatraman Ramakrishnan

Ada Yonath

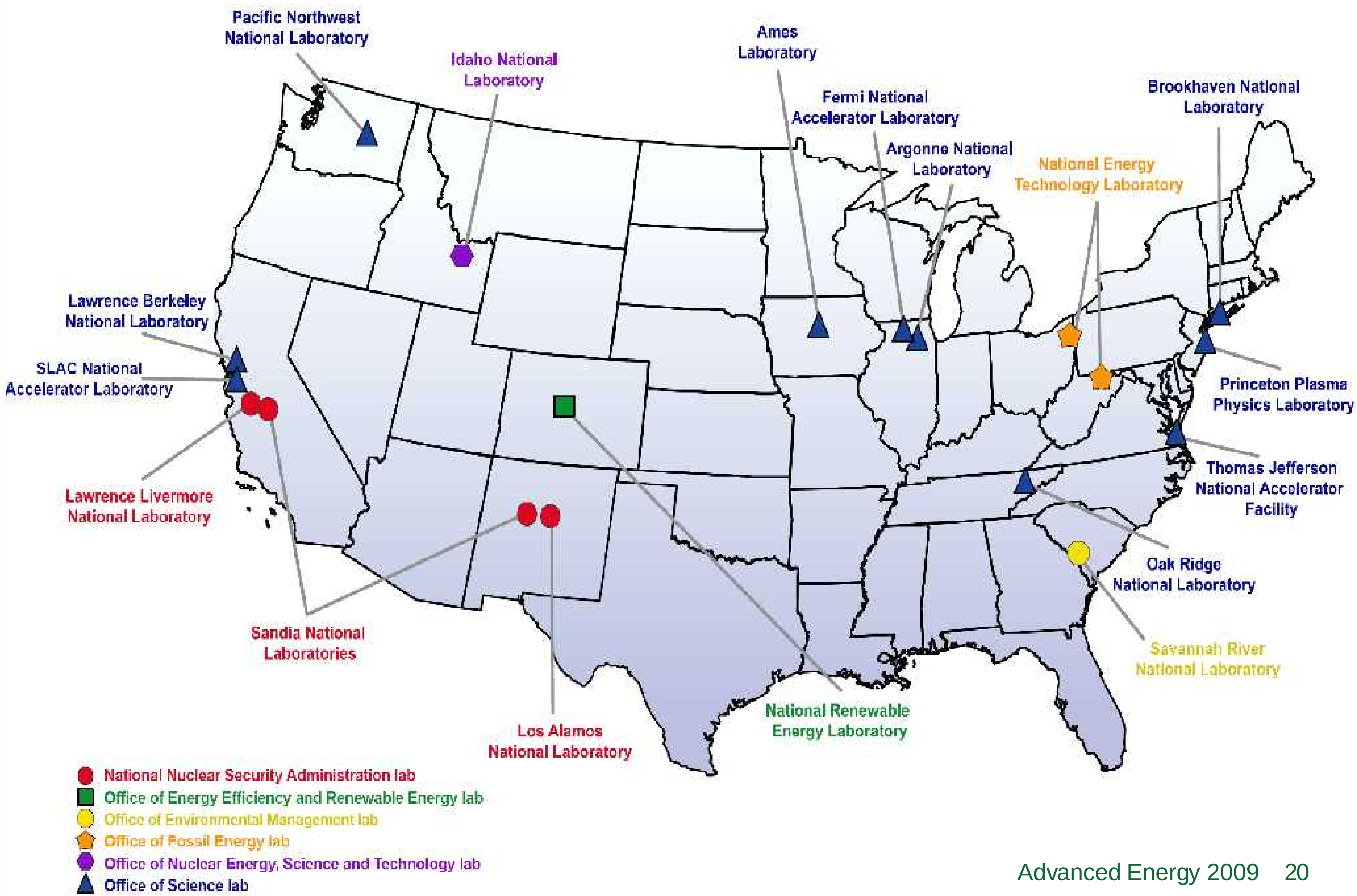


Thomas Steitz

The 10 DOE/SC Laboratories

▲SC Labs

The DOE Laboratories

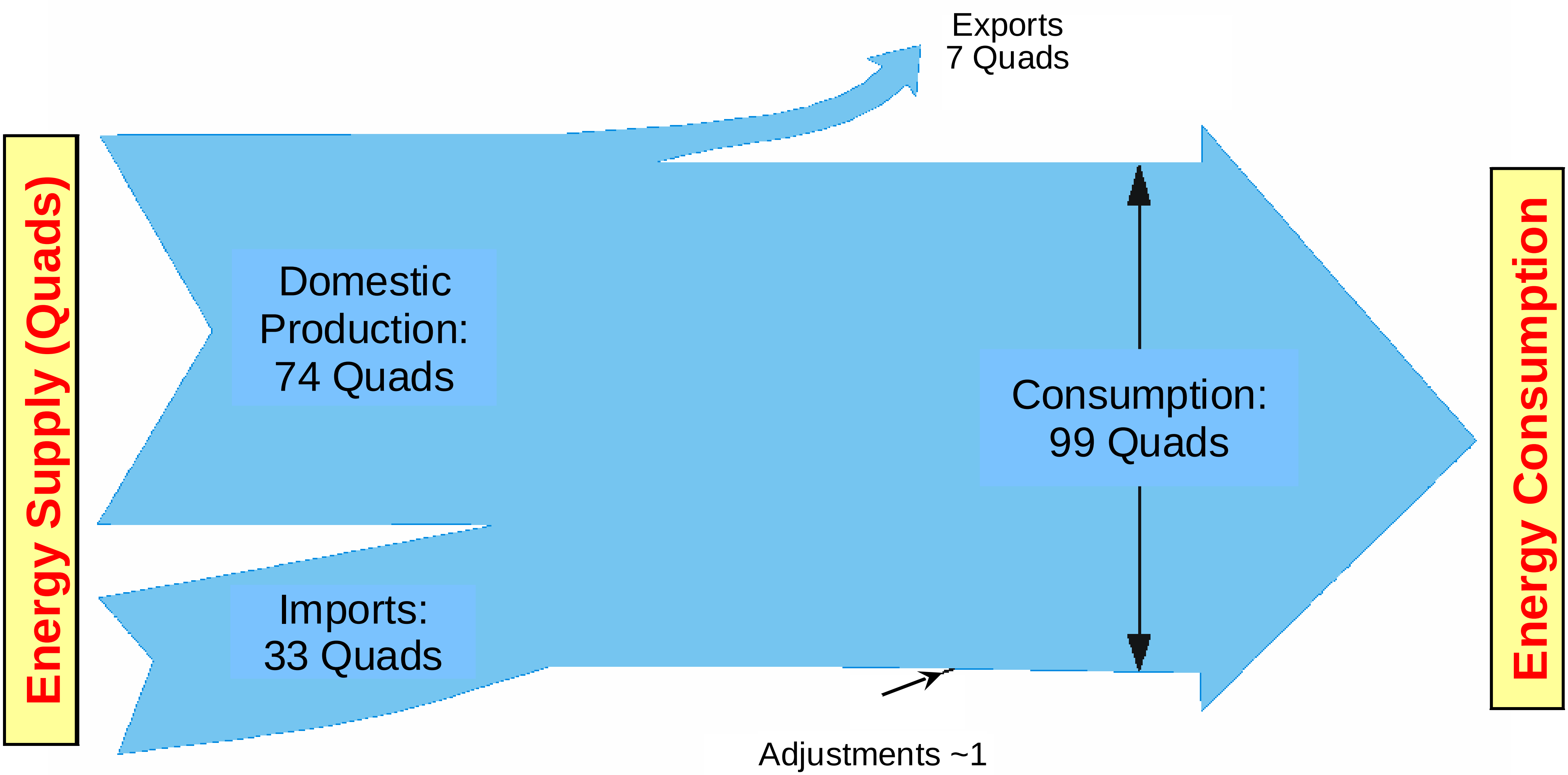


NSLS-II at BNL

The Energy Challenge

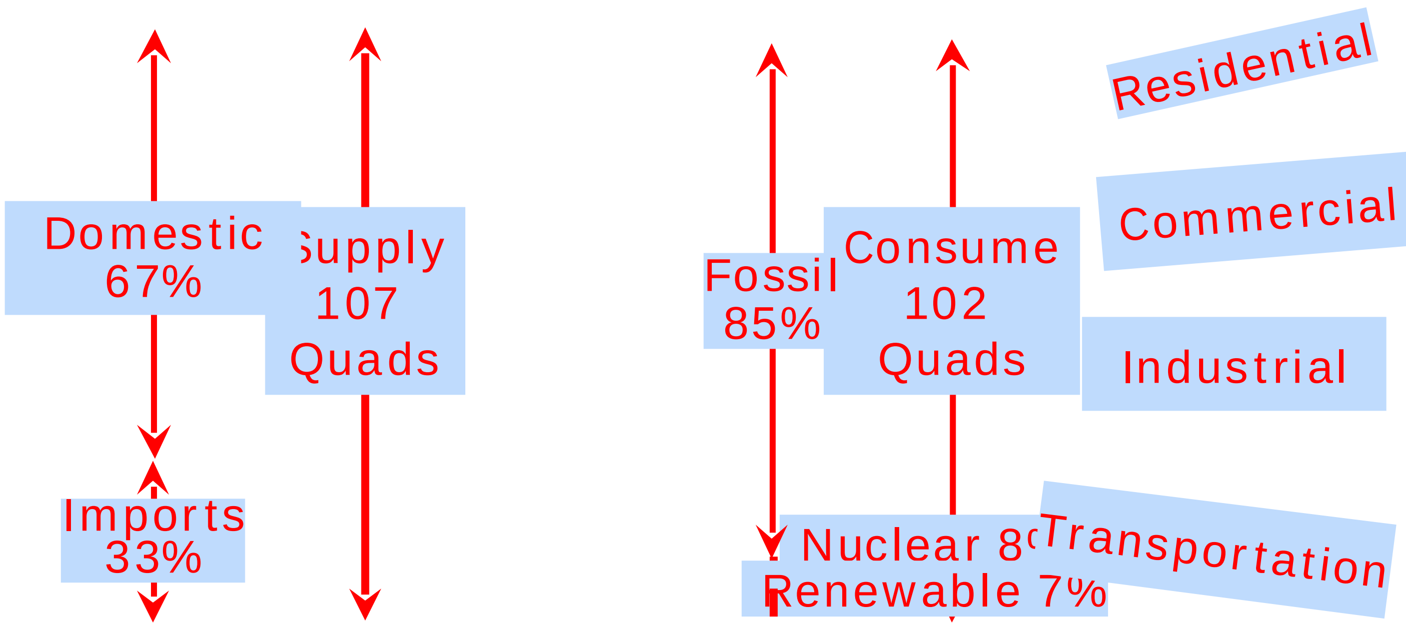
U.S. Energy Flow, 2008

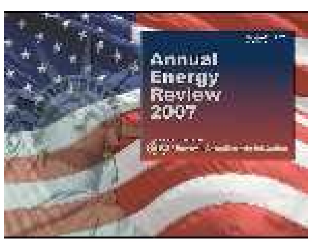
About 1/3 of U.S. primary energy is imported

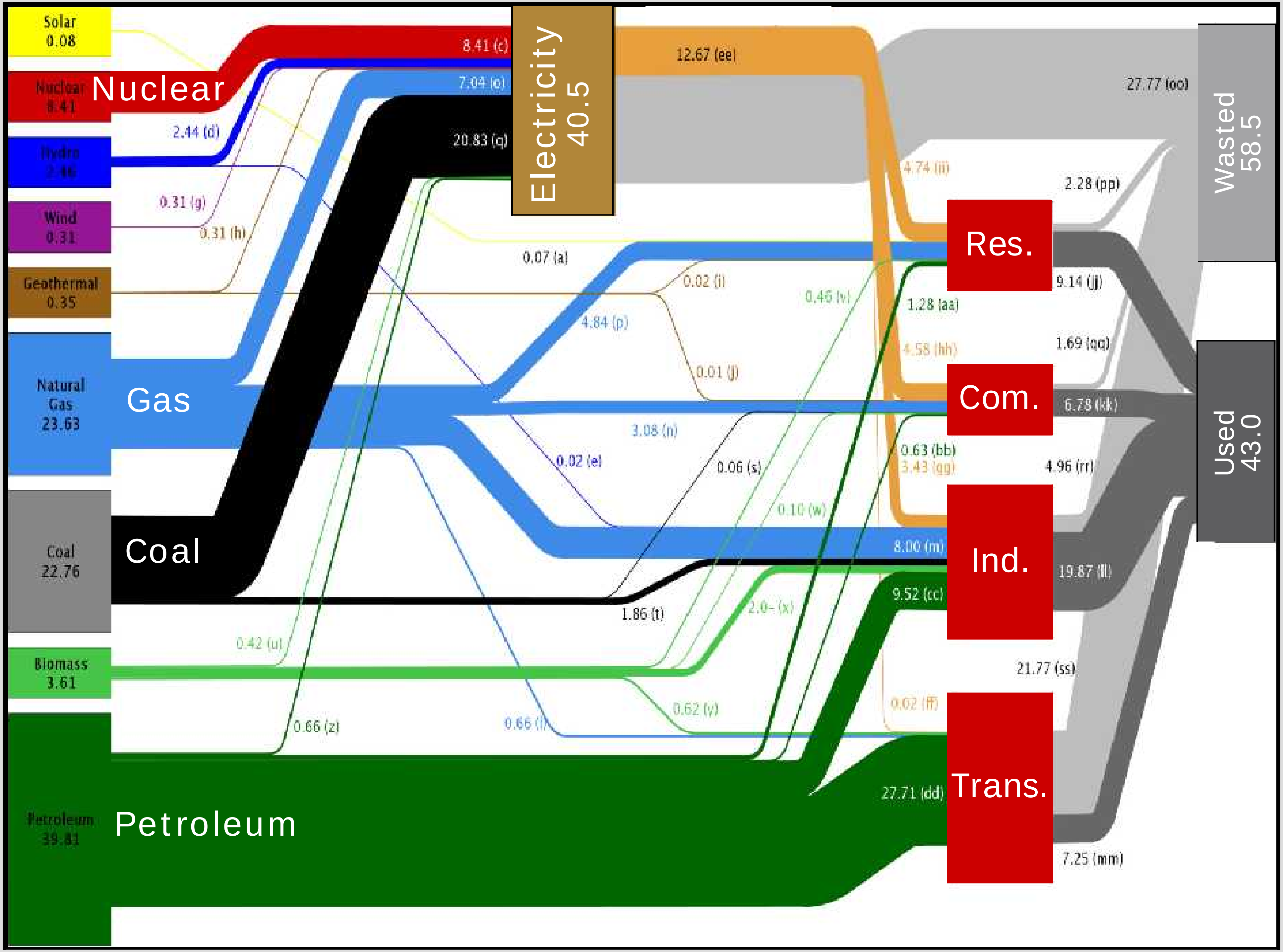


U.S. Energy Flow, 2007 (Quads)

85% of primary energy is from fossil fuels

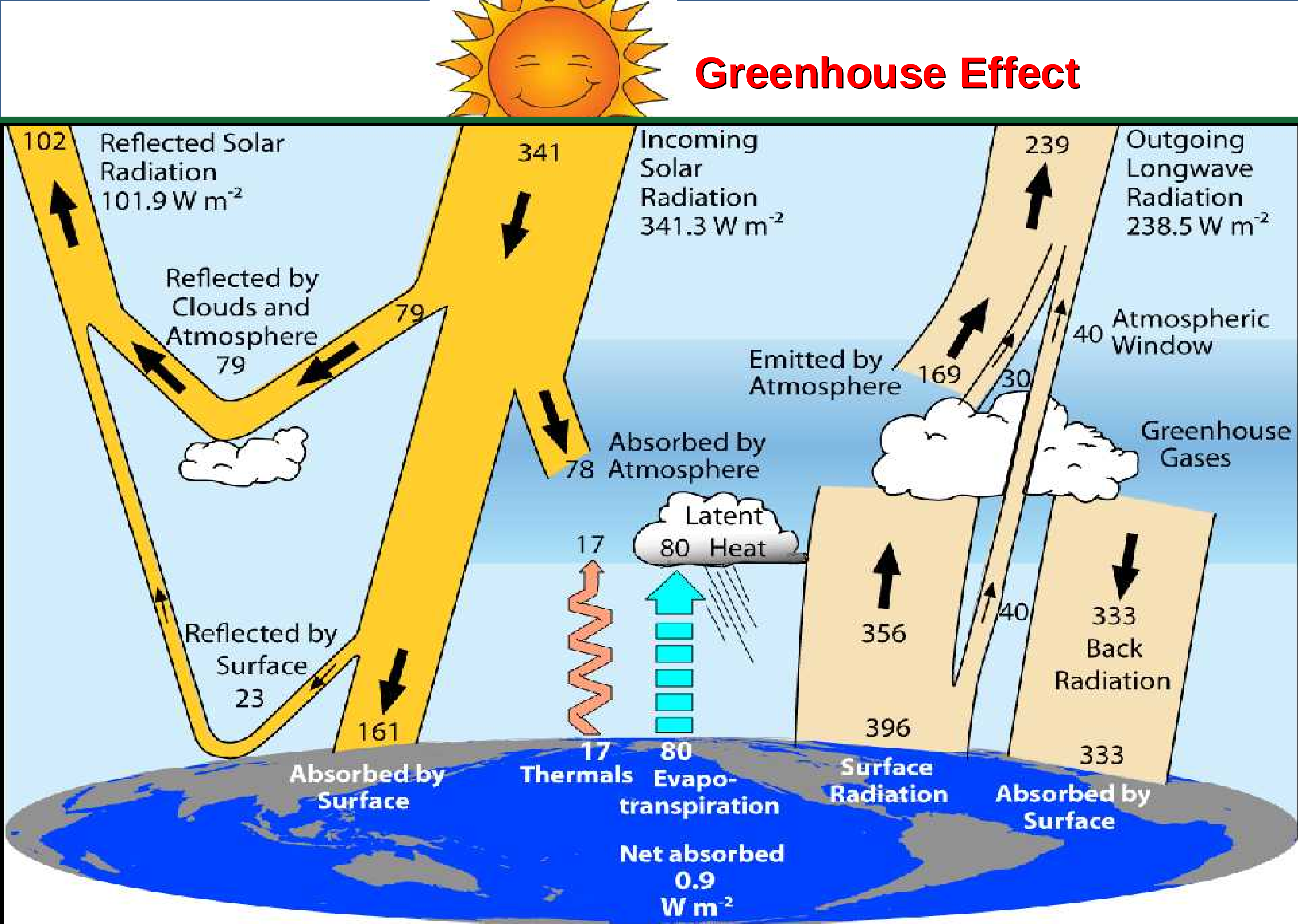






e: LLNL 2008; data are based on DOE/EIA-0384(2006). Credit should be given to LLNL and DOE.

Greenhouse Effect



Naturally occurring greenhouse gases include water vapor, carbon dioxide, methane, nitrous oxide, and ozone. Greenhouse gases that are not naturally occurring include hydro-fluorocarbons (HFCs), perfluorocarbons (PFCs), and sulfur hexafluoride (SF_6), which are generated in a variety of industrial processes.

Atmospheric CO_2 at Mauna Loa Observatory

ata

Concentration now ~388 ppm

Concentration prior to 1800 was ~280 ppm

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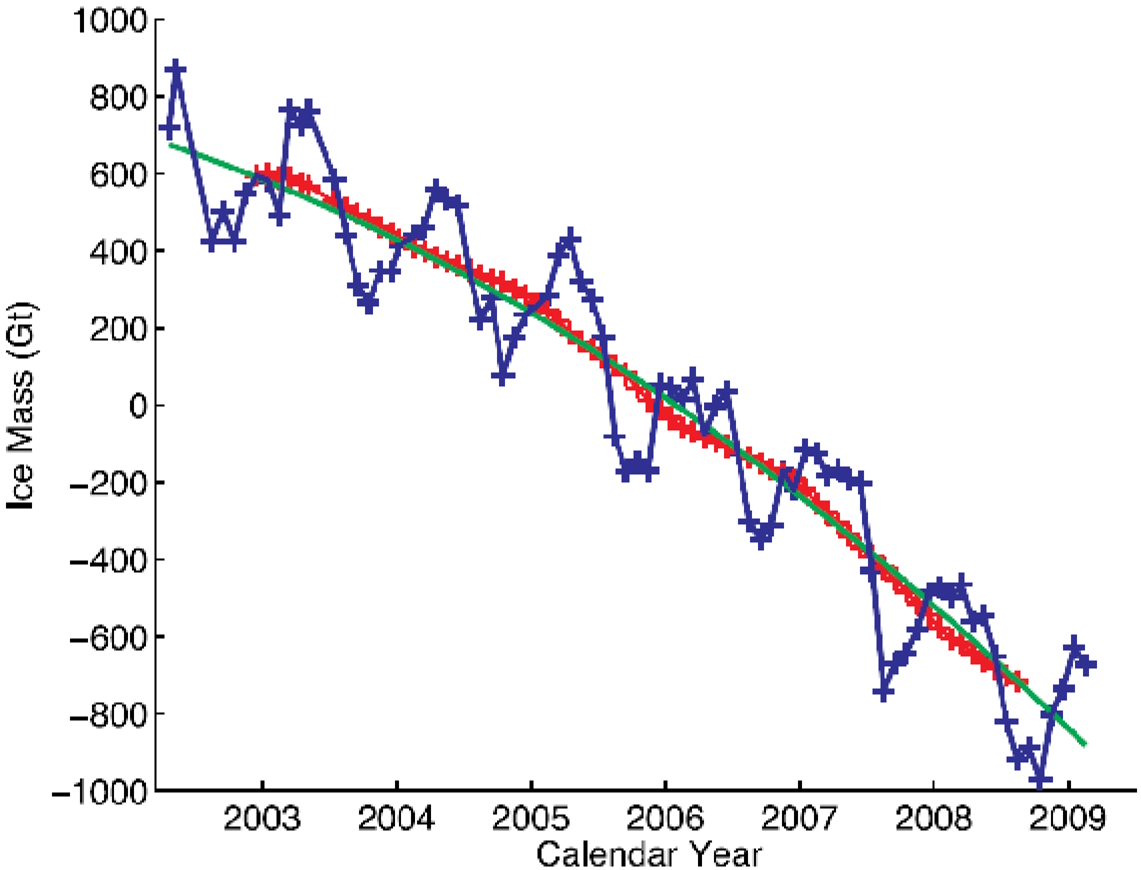
Greenland Ice Mass Loss – 2002 to 2009



Time series of ice mass changes for the Greenland ice sheet estimated from GRACE monthly mass solutions for the period from April 2002 to February 2009. Unfiltered data are blue crosses. Data filtered for the seasonal dependence using a 13-month window are shown as red crosses. The best-fitting quadratic trend is shown (green line). The GRACE data have been corrected for leakage and GIA.

L19503, doi:10.1029/2009GL040222, 2009

Increasing rates of ice mass loss from the Greenland and Antarctic ice sheets revealed by GRACE (Gravity Recovery and Climate Experiment) satellite

- In Greenland, the mass loss increased from 137 Gt/yr in 2002–2003 to 286 Gt/yr in 2007–2009
- In Antarctica, the mass loss increased from 104 Gt/yr in 2002–2006 to 246 Gt/yr in 2006–2009

Electric Energy Storage

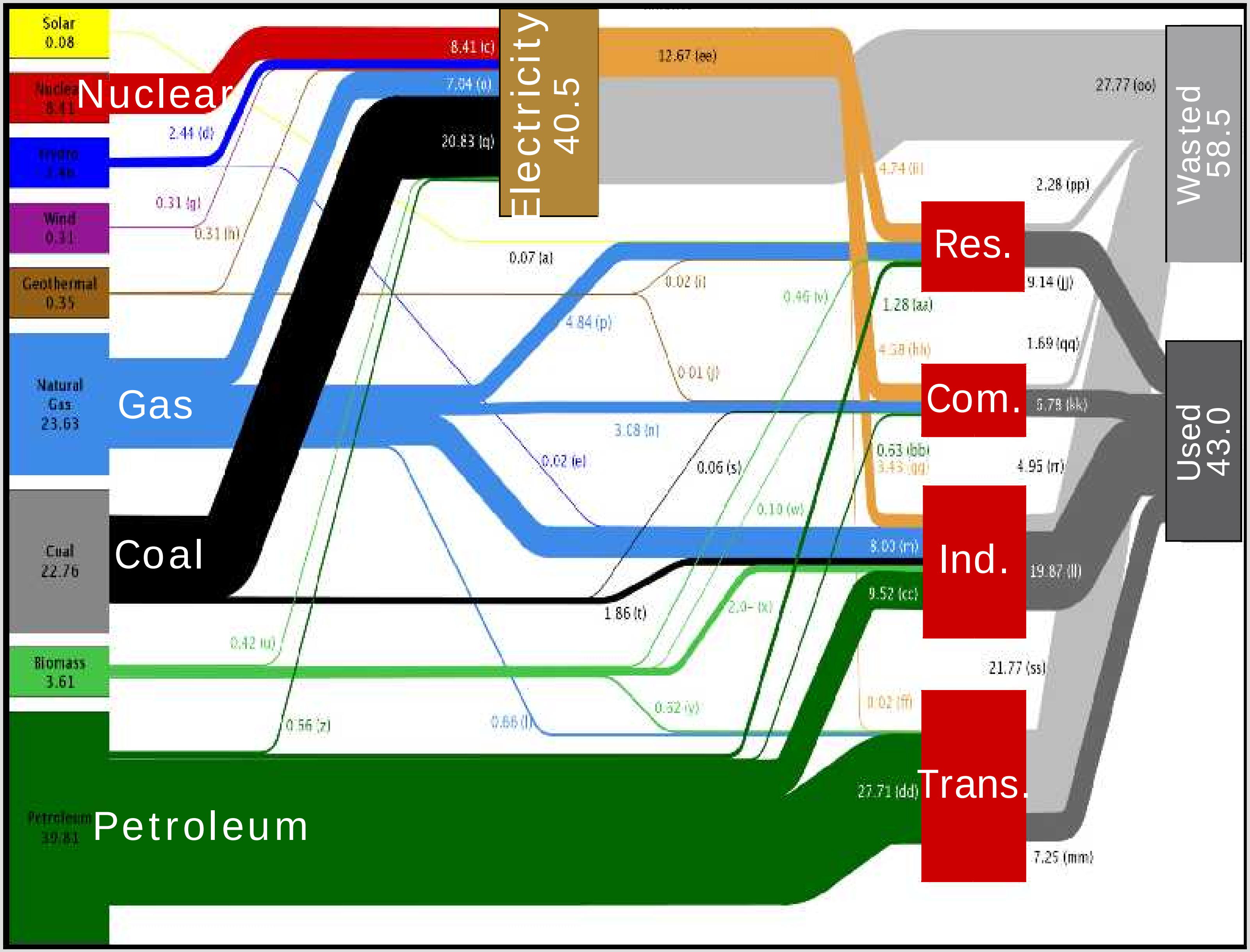
Transmission & Distribution

Zero-net-emissions Electricity Generation

Fuel Switching

CCS

Fuel Switching



End-use Efficiency

Climate/Environment Science

e: LLNL 2008; data are based on DOE/EIA-0384(2006). Credit should be given to LLNL and DOE.

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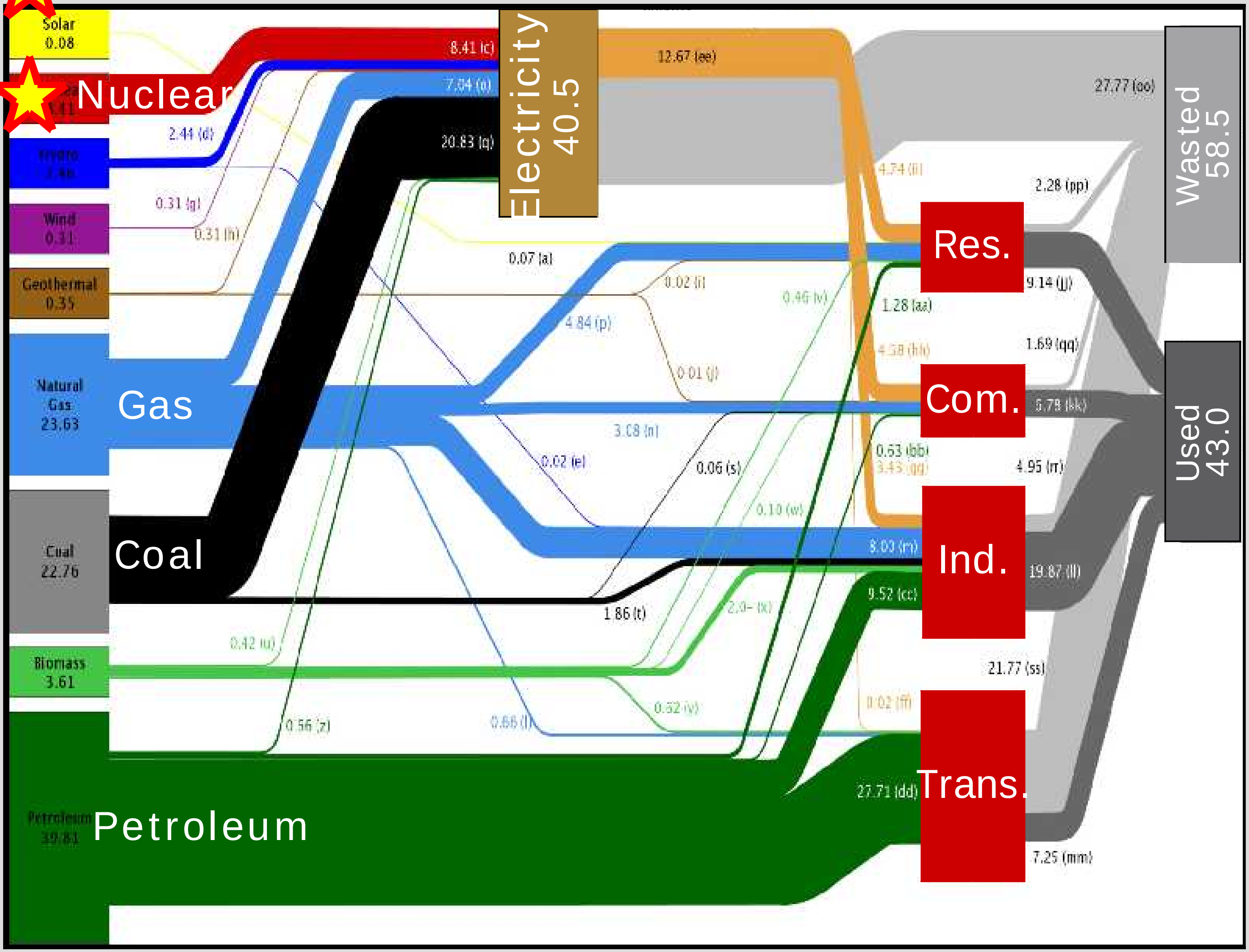

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END

Gravity Recovery and Climate Experiment (GRACE)

GRACE uses a microwave ranging system to measure changes in the speed and distance between two identical spacecraft flying about 220 kilometers apart, 500 kilometers above Earth. Separation changes as small as 10 microns—about one-tenth the width of a human hair—can be detected.

GRACE satellites can sense minute variations in Earth's gravitational pull. When the first satellite passes over a region of slightly stronger gravity, it is pulled ahead of the trailing satellite, causing the distance between the satellites to increase.

By measuring the changing distance between the two satellites and combining that data with positioning measurements from GPS instruments, a gravity map can be constructed.