U.S. DEPARTMENT OF ENERGY | Office of Science

News from the Office of Science

Basic Energy Sciences Advisory Committee

July 9, 2009

Dr. William F. Brinkman
Director, Office of Science
U.S. Department of Energy

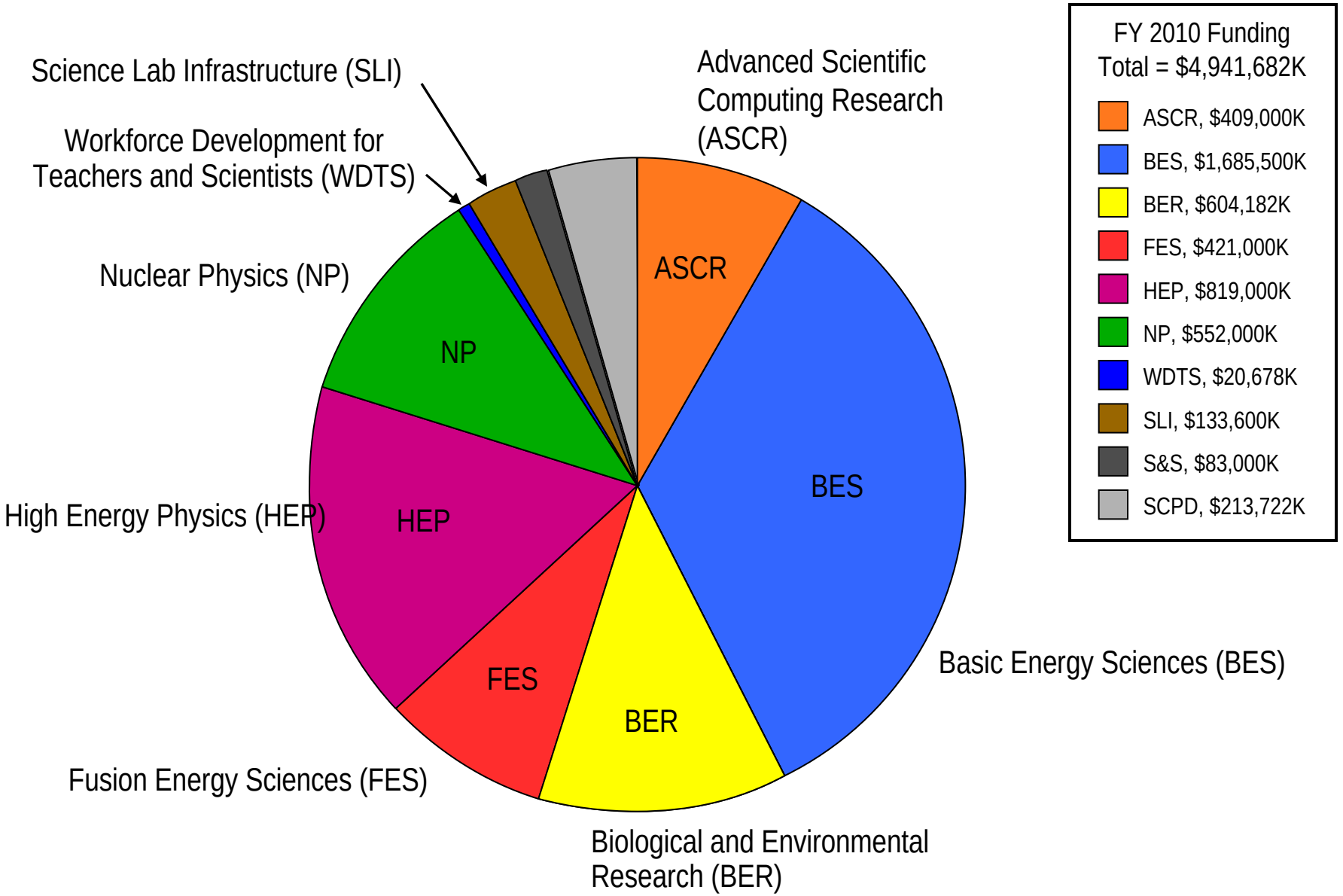
DOE's Office of Science

The Office of Science is one of the nation's largest supporters of peer-reviewed basic research, providing 40% of Federal support in the physical sciences and supporting ~25,000 Ph.D.s, graduate students, undergraduates, engineers, and support staff at more than 300 universities and at all 17 DOE laboratories.

Three themes describe the work supported by the Office of Science:

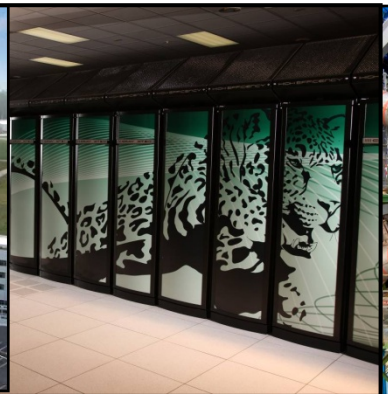
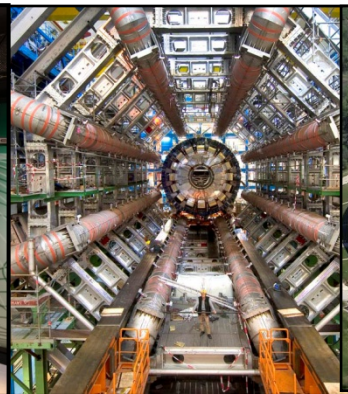
- **Science for discovery**
  - Unraveling Nature's deepest mysteries—from the study of subatomic particles; to atoms and molecules that make up the materials of our everyday world; to DNA, proteins, cells, and entire natural ecosystems
- **Science for national need**
  - Advancing a clean energy agenda through basic research on energy production, storage, transmission, and use
  - Advancing our understanding of the Earth's climate through basic research in atmospheric and environmental sciences and in climate modeling
  - Supporting DOE's missions in national security
- **National scientific user facilities, the 21st century tools of science**
  - Providing the Nation's researchers with the most advanced tools of modern science including accelerators, colliders, supercomputers, light sources and neutron sources, and facilities for studying the nanoworld, the environment, and the atmosphere

Office of Science Programs



User Facilities

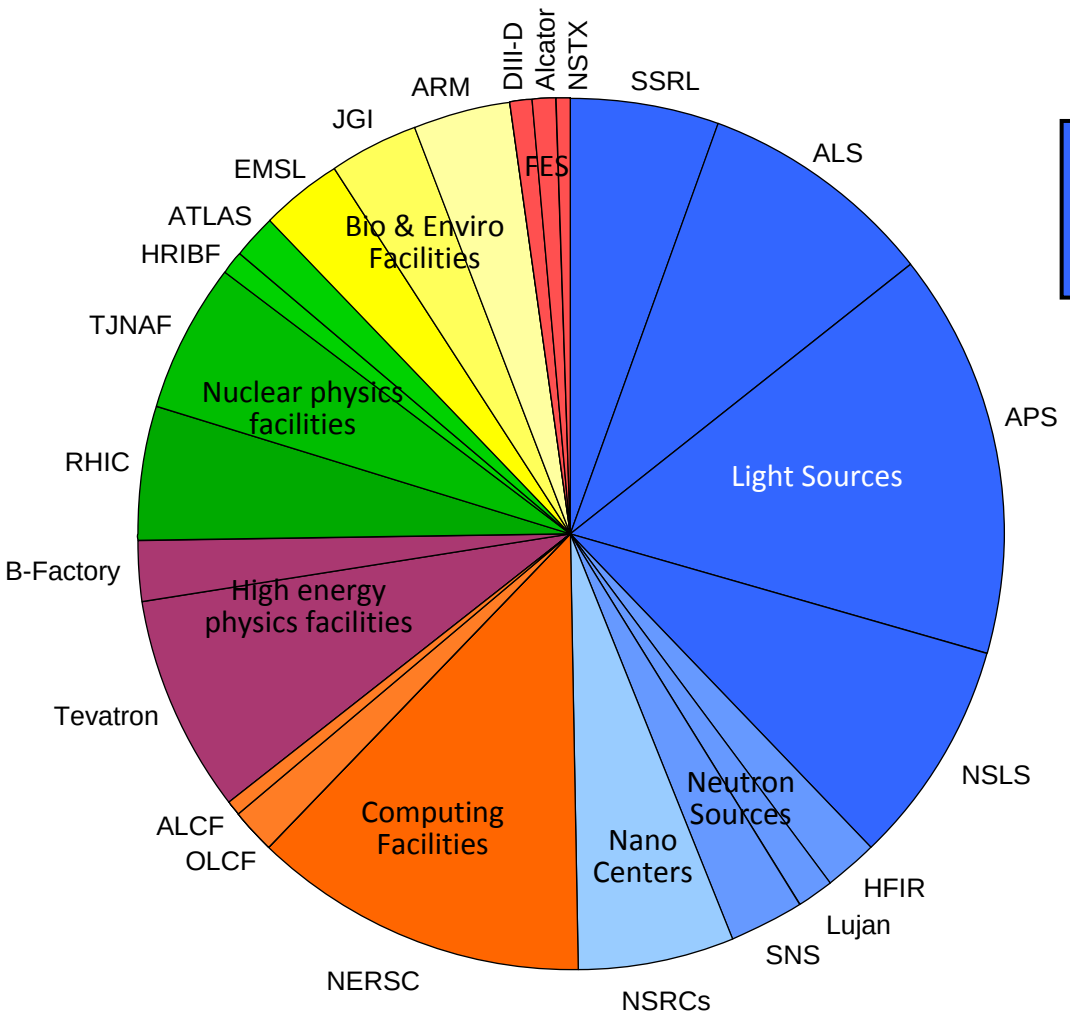
- Advanced **computational resources** – terascale to petascale computing and networks for open science
- Four **synchrotron light sources**, and two next-generation light sources in construction
- Three **neutron sources** for scattering
- **Particle accelerators/colliders/detectors** for high energy and nuclear physics
- **Fusion/plasma facilities**, including **ITER** which seeks to demonstrate a burning plasma
- Five **Nanoscale Science Research Centers** – capabilities for fabrication and characterization of materials at the nanoscale
- **Joint Genome Institute** for rapid whole genome sequencing
- **Environmental Molecular Science Laboratory** – experimental and computational resources for environmental molecular sciences
- **Atmospheric and Environmental Facilities** – capabilities for cloud and aerosol measurement and for carbon cycling measurements

Distribution of Users by Facility

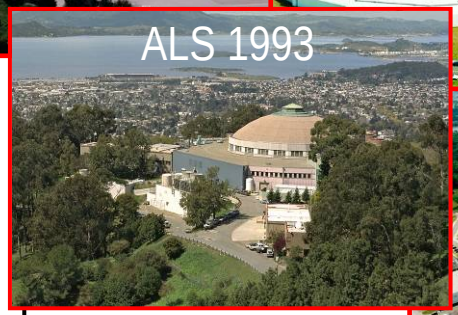
~25,000 users at the facilities in FY 2010: ~1/2 from universities; ~1/3 from national labs; and the remainder from industry, other agencies, and international entities.

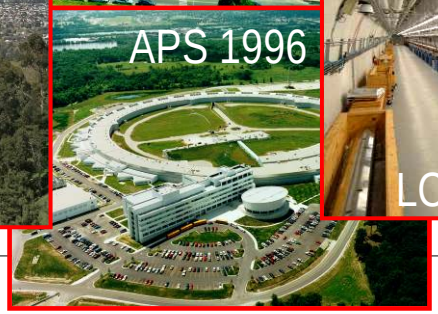
Breakdown by facility of ~25,000 users in FY 2010



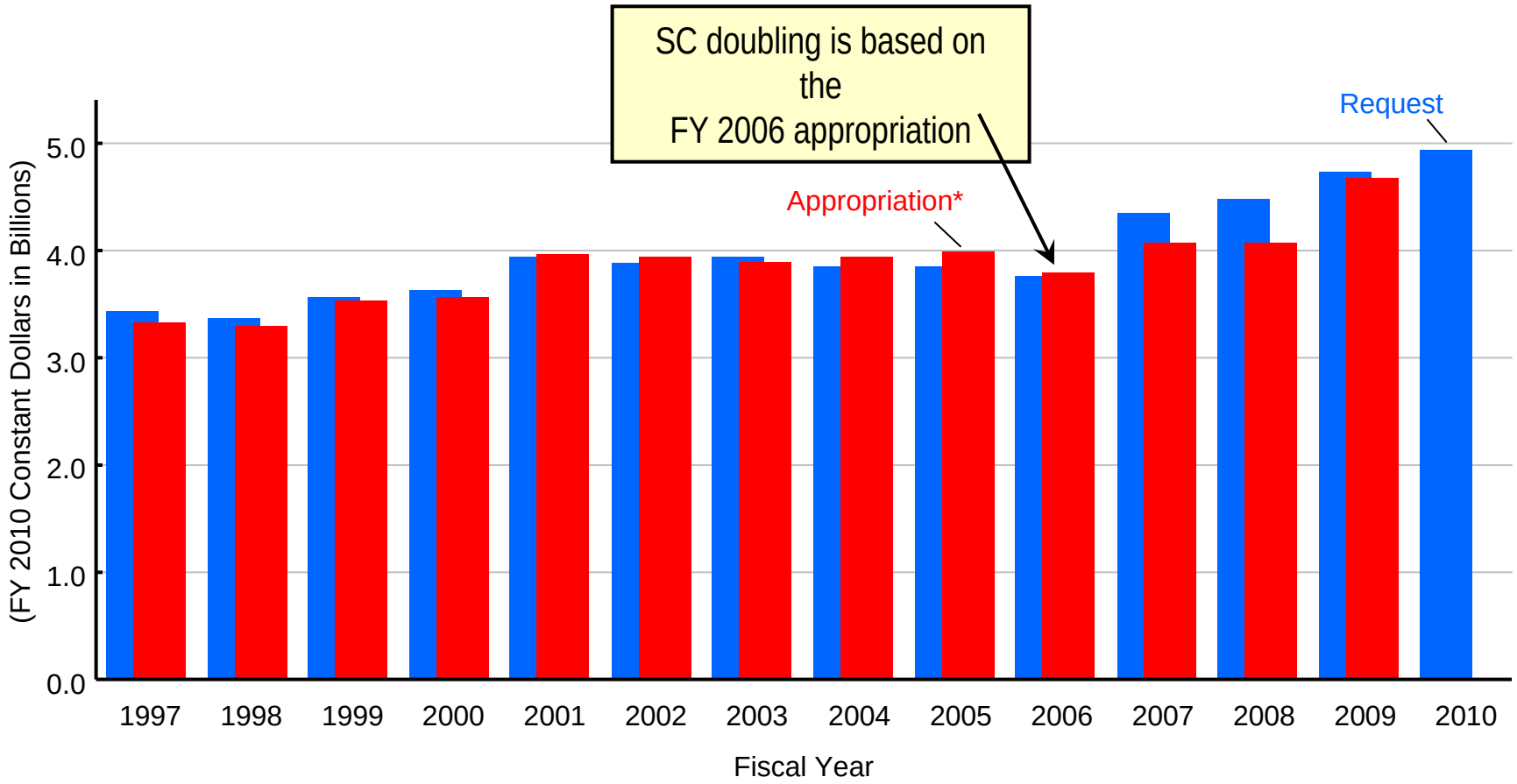
FY 2010 funding for the light sources is $258M, ~17% of the total funding for the operating facilities.

35 Years of Light Sources





SC Request vs. Appropriation (FY 2010 Constant $s)



* Appropriation amounts exclude Congressionally directed projects.

Training the Next Generation of Scientists and Engineers

The Department of Energy has >50 year history of training scientists, mathematicians, and engineers through research grants, the DOE national laboratories, and targeted education programs.

- In FY 2008, more than 300,000 K-12 students; 21,000 educators; 3,000 graduate students; and 4,200 undergraduate students participated in opportunities at the DOE labs, funded by DOE and other federal and non-federal sources.
- SC will support over 4,400 graduate students and 2,700 post docs in FY 2009.
- In FY 2009, the Office of Workforce Development for Teachers and Scientists will support ~550 undergraduates in research internships at the DOE laboratories (and 1,175 in FY 2010 request) and ~280 K-16 educators.
- The DOE National Science Bowl attracts ~22,000 high school and middle school students every year.
- With ARRA funds and the FY 2010 request, SC initiated the DOE SC Graduate Fellowship Program, supporting over 160 graduate students in fields important to SC missions.
- SC proposes to increase the Graduate Fellowship Program to support approximately 400 graduate students in the out-years.

Early Career Research Program

The Department of Energy is now accepting proposals for the DOE Office of Science Early Career Research Program to support the research of outstanding scientists early in their careers.

Purpose: To support the development of individual research programs of outstanding scientists early in their careers and to stimulate research careers in the disciplines supported by the Office of Science.

Status of FY 2010 Appropriations

(dollars in thousands)

	FY 2009		FY 2010		
	Enacted Approp.	Recovery Act Approp.	Request to Congress	House Mark	Senate Mark
Office of Science					
Basic Energy Sciences	1,571,972	555,406	1,685,500	**1,675,000**	
Advanced Scientific Computing Research	368,820	161,795	409,000	**409,000**	
Biological & Environmental Research	601,540	165,653	604,182	**597,182**	
High Energy Physics	795,726	232,390	819,000	**819,000**	
Nuclear Physics	512,080	154,800	552,000	**536,455**	
Fusion Energy Sciences	402,550	91,023	421,000	**441,000**	
Science Laboratories Infrastructure	145,380	198,114	133,600	**133,600**	
Science Program Direction	186,695	5,600	213,722	**190,932**	
Workforce Development for Teachers & Scientists	13,583	12,500	20,678	**20,678**	
Safeguards & Security	80,603	——	83,000	**83,000**	
Small Business Innovation Research/Tech. Transfer	——	18,719	——		
Subtotal, Science	4,678,949	1,596,000	4,941,682	**4,944,000**	**4,899,000**
Advanced Research Projects Agency-Energy	15,000	——	——	——	
Unallocated	——	4,000	——	——	
Congressionally-directed projects	93,687	——	——	37,740	
Subtotal, Science	4,787,636	1,600,000	4,941,682	4,944,000	
Use of prior year balances	-15,000	——	——	——	
Less Advanced Research Projects Agency-Energy	-15,000	——	——	——	
Total, Office of Science	4,757,636	1,600,000	4,941,682	4,944,000	

DOE Energy Innovation Hubs

Proposed topics for Hubs:

- **Solar Electricity (EERE)**
- **Fuels from Sunlight (SC)**
- **Batteries and Energy Storage (SC)**
- **Carbon Capture and Storage (FE)**
- **Electrical Grid Systems (OE)**
- **Energy Efficient Building Systems Design (EERE)**
- **Extreme Materials for Nuclear Fuel Cycles and Systems (NE)**
- **Modeling and Simulation for Nuclear Fuel Cycles and Systems (NE)**

Each Hub will comprise a world-class, multi-disciplinary and highly collaborative research and development team working largely under one roof. This team will focus on solving critical technology challenges that prevent large scale commercialization and deployment of the energy systems needed to address our Nation's greenhouse gas emission, energy security and workforce creation goals

Status of SC Recovery Act Projects

The goals of the Recovery Act are articulated in the Act's "Statement of Purpose." Two that were key to our decisions are:

- "(1) To **preserve and create jobs** and promote economic recovery"; and
- "(3) To provide investments needed to increase economic efficiency by **spurring technological advances in science** and health."

SC ARRA projects were selected having specific characteristics:

- Shovel-ready
- Enhance research infrastructure and support high-priority R&D
- Low risk (e.g., construction projects were baselined with in-place or imminent CD-3; research projects had proposals in hand or solicitations were to be fast)
- No out-year mortgages, with two exceptions (EFRCs and Graduate Fellowship/Early Career Awards)

Status of SC Recovery Act Projects

51 projects totaling $1.6B

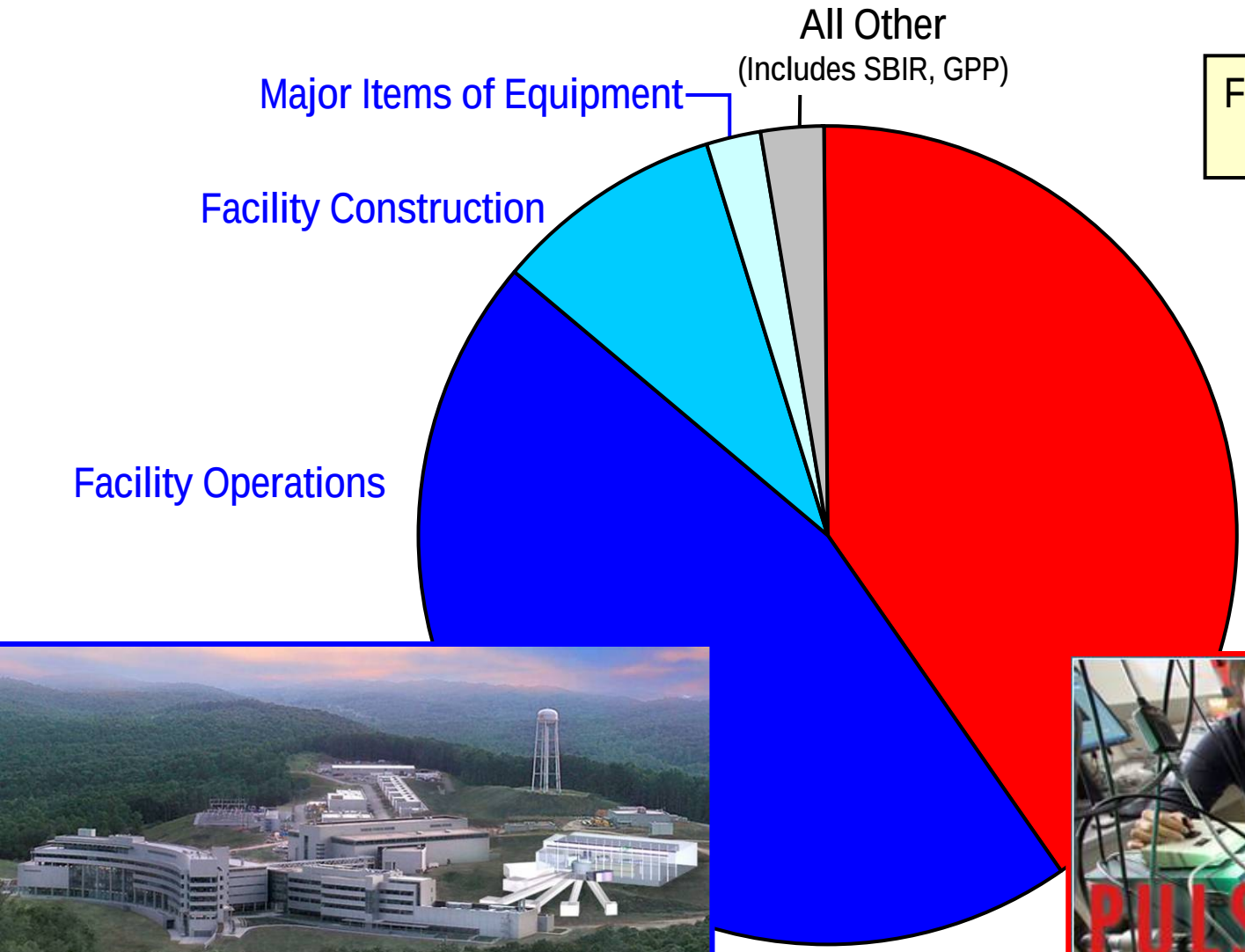
- **Acceleration of Ongoing Line-Item Construction Projects - $338.2M**
  - NSLS-II ($150.0M)
  - TJNAF 12 GeV upgrade ($65.0M)
  - Science Laboratory Infrastructure (SLI) Construction ($108.5M)
- **Acceleration of Major Items of Equipment - $171.1M**
  - NOvA MIE ($55.0M)
- **Upgrades to SC User Facilities - $391.0M**
  - Advanced Networking ($66.8M)
  - Atmospheric Radiation Measurement (ARM) Climate Research Facility ($60.0M)
  - Environmental Molecular Sciences Laboratory ($60.0M)
  - Light Source Instrumentation/Enhancements ($24.0M)
  - Nanoscale Science Research Center Instrumentation ($25.0M)
- **Laboratory General Plant Projects - $129.6M**
- **Scientific Research - $562.1M**
  - Energy Frontier Research Centers ($277.0M; forward-funded 5 years)
  - Energy Sciences Fellowships and Early Career Awards – ($97.5M; forward-funded 3-5 years)
- **Management and Oversight - $8.0M**

Status of BES Recovery Act Projects

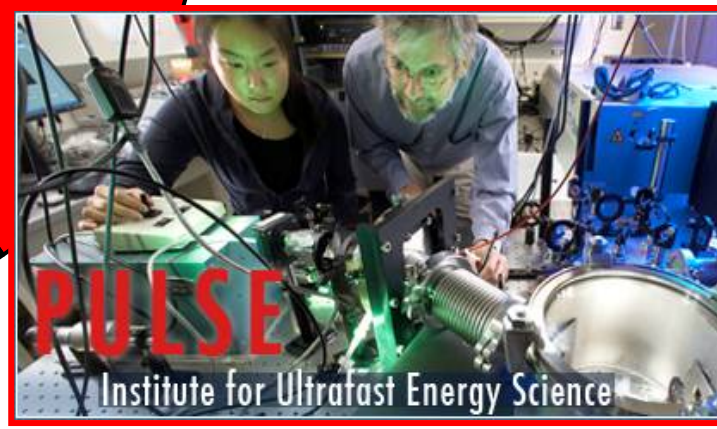
	Amount
NSLS-II	150,000
ALS User Support Building	14,682
LCLS Ultrafast Science Instruments	33,600
Energy Frontier Research Centers	277,020
Nanoscale Science Research Centers	25,000
Light Source Improvements	24,000
Total, BES	524,302

(dollars in thousands)

BES Support by Major Function



FY 2009 Appropriation
Total = $1,571,972K



New BESAC Charge

To conduct a follow-on study to those of the past seven years that links basic research with more applied problems in energy technologies.

Three main parts of the study:

1. Summarize the science themes that emerged from recent BESAC reports with an emphasis on the needs of more applied energy technologies. Identify grand challenges science drivers that could impact the energy arena in the near term.
2. Identify how the suite of BES-supported and -managed scientific user facilities can impact basic and applied research for energy.
3. Identify other major impediments to successful achievement and implementation of transformative energy technologies, including potential deficits in human capital and workforce development, and possible solutions to these problems.

Outputs: Two reports

1. A short report along the lines of the New Era for a Secure and Sustainable Energy Future and;
2. A more detailed technical report to provide detailed justification. This new study should be regarded as the “technology companion study” to the grand challenges report.

BES Strategic Directions- 2010 & Beyond

Science for Discovery – Directing and controlling matter and energy

- Control the quantum behavior of electrons in materials
- Synthesize, atom by atom, new forms of matter with tailored properties
- Control emergent properties that arise from the complex correlations of atomic and electronic constituents
- Synthesize man-made nanoscale objects with capabilities rivaling those of living things
- Control matter very far away from equilibrium

National Scientific User Facilities – the 21st century tools of science

- Maintaining and renewing 3rd generation light sources, including complete construction of NSLS-II
- Expanding neutron scattering capabilities and user base
- Ensuring operation excellence and scientific impact of nanoscale research tools
- Planning and executing a strategy to maintain U.S. leadership in photon science- 4th generation source
  - Control of complex materials and chemical processes
  - Real time evolution of chemical reactions, motion of electrons and spin
  - Imaging and spectroscopy of individual nano objects
  - Statistical laws of complex systems
  - Simultaneous ultrashort and ultrafast measurements

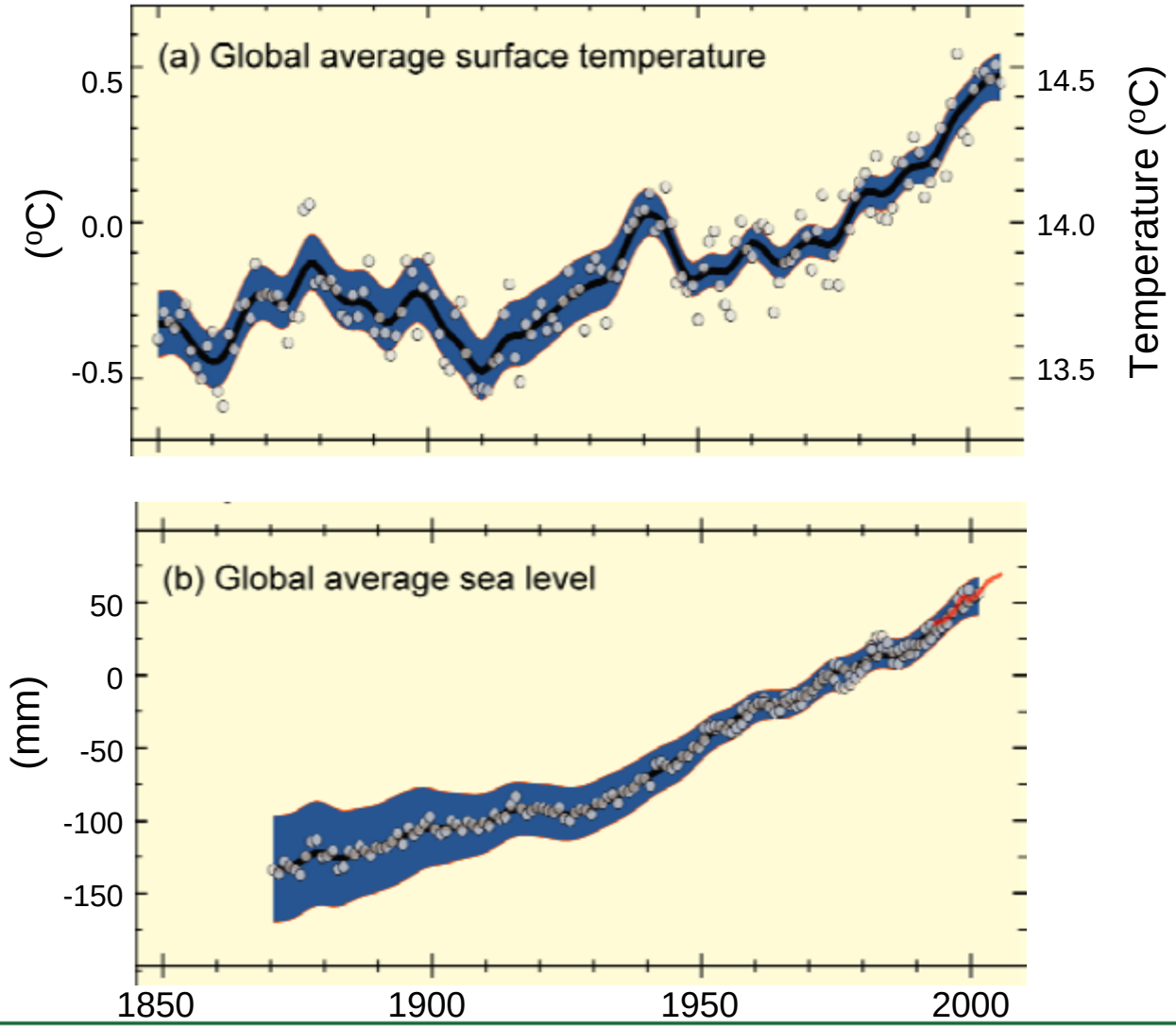
BES Strategic Directions- 2010 & Beyond

Science for National Need – Bringing forefront scientific knowledge and state-of-the-art tools to solving grand energy challenges

- Advanced Nuclear Energy Systems
- Catalysis for Energy
- Clean and Efficient Combustion of Fuels
- Electrical Energy Storage
- Geosciences
- Hydrogen Economy
- Materials under Extreme Environments
- Solid-State Lighting
- Solar Energy Utilization
- Superconductivity

Can BES deliver on these?

Recent Climate Trends



Annual Greenhouse Gas Contributions