



U.S. DEPARTMENT OF
ENERGY

Office of
Science

Office of Basic Energy Sciences Update

*ERC 2009 Annual Meeting
December 3, 2009*

Michael Casassa

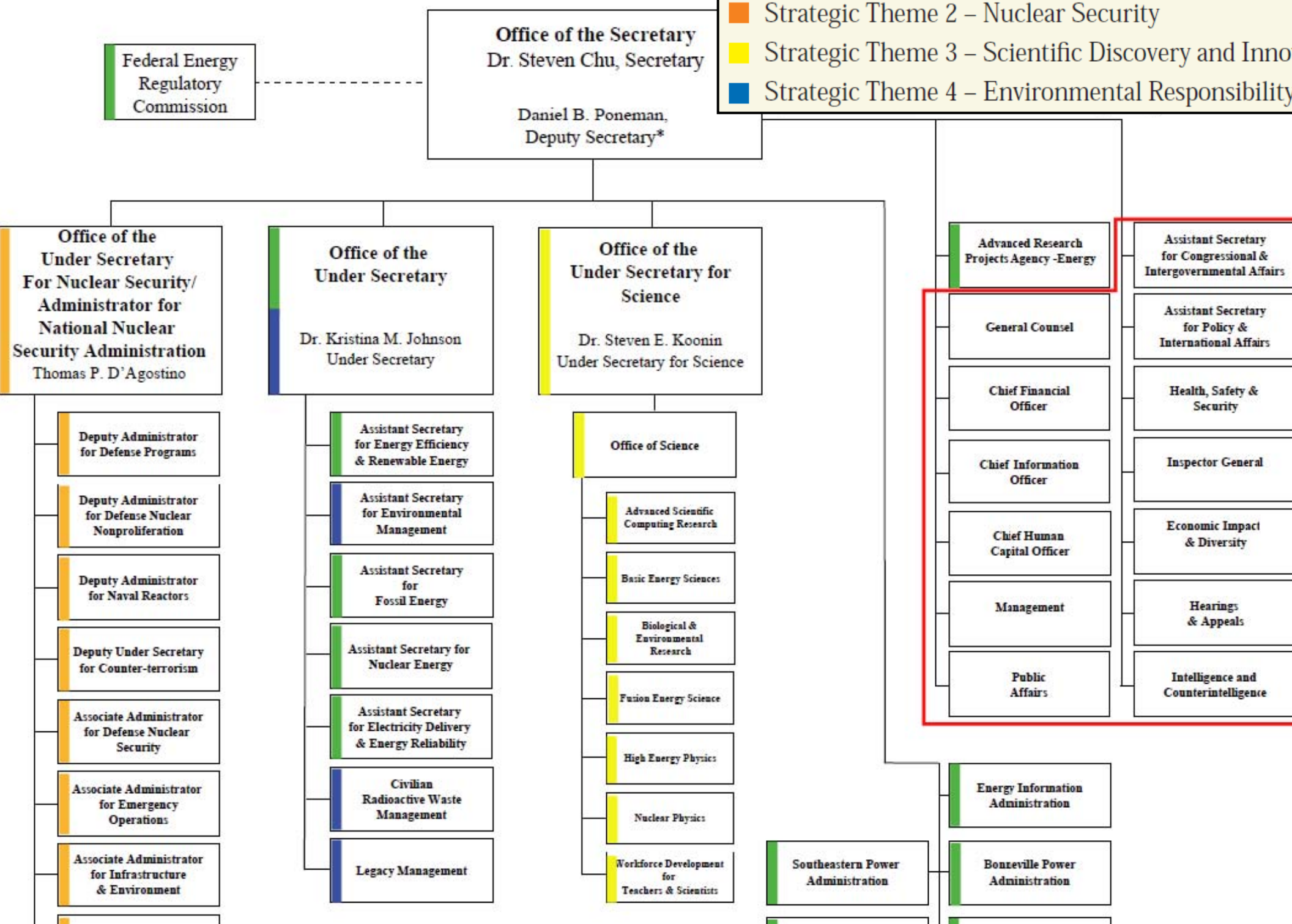
*Chemical Sciences, Geosciences, and Biosciences Division
Office of Basic Energy Sciences*

<http://www.sc.doe.gov/bes/bes.html>

An exciting time at DOE BES....

- Energy, climate change, and science are important priorities for Administration and Congress.
- The Secretary of Energy has ambitious plans for DOE. Senior political appointees in DOE have extensive backgrounds in science and technology.
- The FY 2009 appropriation for DOE was excellent for BES – in one year we jumped back onto the “doubling curve.” Energy Frontier Research Centers introduced.
- The Recovery Act brought another \$36B into DOE; \$1.6B to the Office of Science; \$555M to BES. Early Career and Graduate Fellowships introduced.
- FY 2010 Energy Innovation Research Hub.

- Strategic Theme 1 – Energy Security
- Strategic Theme 2 – Nuclear Security
- Strategic Theme 3 – Scientific Discovery and Innovation
- Strategic Theme 4 – Environmental Responsibility





- ***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

- ***Science for National Need – Bringing forefront scientific knowledge and state-of-the-art tools to solving grand energy challenges***
 - Hydrogen Economy
 - Solar Energy Utilization
 - Superconductivity
 - Solid-state Lighting
 - Advanced Nuclear Energy Systems
 - Clean and Efficient Combustion of Fuels
 - Electrical Energy Storage
 - Geosciences
 - Catalysis for Energy
 - Materials under Extreme Environments

- ***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

How Nature Works ↔ Materials and Chemistry by Design ↔ 21st Century Technologies



Grand Challenges
How nature works

Discovery and Use-Inspired Basic Research
Materials properties and functionalities by design

Applied Research

Technology Maturation & Deployment

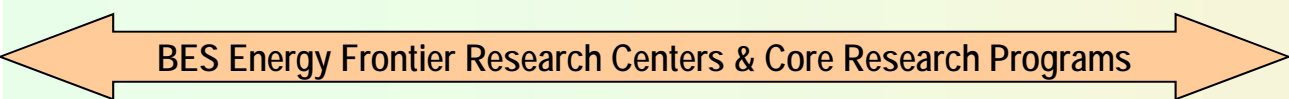
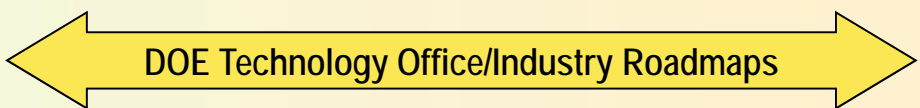
- Controlling materials processes at the level of quantum behavior of electrons
- Atom- and energy-efficient syntheses of new forms of matter with tailored properties
- Emergent properties from complex correlations of atomic and electronic constituents
- Man-made nanoscale objects with capabilities rivaling those of living things
- Controlling matter very far away from equilibrium

- Basic research for fundamental new understanding on materials or systems that may revolutionize or transform today's energy technologies
- Development of new tools, techniques, and facilities, including those for the scattering sciences and for advanced modeling and computation

- Basic research, often with the goal of addressing showstoppers on real-world applications in the energy technologies

- Research with the goal of meeting *technical milestones*, with emphasis on the development, performance, cost reduction, and durability of materials and components or on efficient processes
- Proof of technology concepts

- Scale-up research
- At-scale demonstration
- Cost reduction
- Prototyping
- Manufacturing R&D
- Deployment support



Basic Energy Sciences

Goal: new knowledge / understanding

Mandate: open-ended

Focus: phenomena

Metric: knowledge generation

DOE Technology Offices: EERE, NE, FE, EM, RW...

Goal: practical targets

Mandate: restricted to target

Focus: performance

Metric: milestone achievement

Science for Discovery & National Needs - 3 Research Modes

increasing progression of scientific scope and level of effort

▪ Core Research

Single investigator and small group projects to pursue specific research interests.

- Enable seminal advances in the core disciplines of the basic energy sciences—materials sciences and engineering, chemistry, and aspects of geosciences and biosciences. Accelerator and detector R&D is also supported.
- Build research programs that provide world-class, peer-reviewed research results cognizant of both DOE mission needs and new scientific opportunities. Scientific discoveries at the frontiers of these disciplines establish the knowledge foundation to spur future innovations and inventions.

▪ Energy Frontier Research Centers

\$2-5 million-per-year research centers, established in 2009, concerted efforts focused on fundamental research related to energy

- Multi-investigator and multi-disciplinary centers to harness the most basic and advanced discovery research in a concerted effort to accelerate the scientific breakthroughs needed to create advanced energy technologies. Bring together critical masses of researchers to conduct fundamental energy research in a new era of grand challenge science and use-inspired energy research.
- EFRCs are overseen by program staff, who are managed centrally within BES to ensure a unified management strategy and structure.

▪ Energy Innovation Hubs

\$20 million+ -per-year research centers will focus on integrating basic & applied research with technology development to enable transformational energy applications

- Hubs comprise a larger set of investigators spanning science, engineering, and other disciplines focused on a single critical national need identified by the Department; each Hub is expected to become a world leading R&D center in its topical area to develop a complete energy system.
- With robust links to industry, the highly integrated Hubs can bridge the gap between basic scientific breakthroughs and industrial commercialization.

Research

- \$100M for Energy Frontier Research Centers
- Core research increases (~3%) for grand challenge science, accelerator & detector research
- EPSCoR funded at \$22M

Scientific user facilities operations

Increase in operation funding (~ 3%):

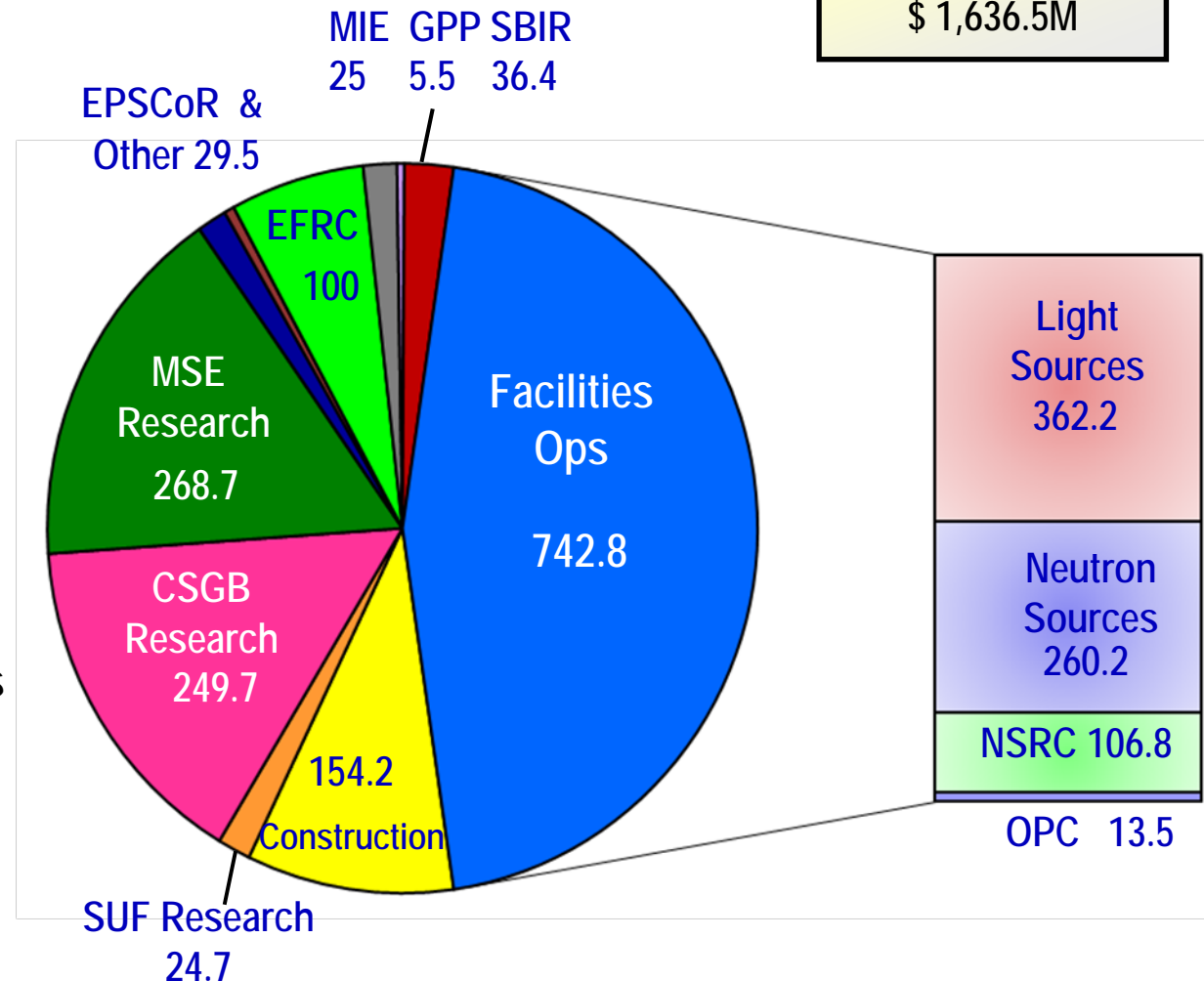
- Synchrotron light sources
- Neutron scattering facilities
- Nanoscale Science Research Centers

Construction and instrumentation

Full funding per request for:

- National Synchrotron Light Source-II
- Linac Coherent Light Source
- Spallation Neutron Source instruments
- SNS Power Upgrade

Appropriation
\$ 1,636.5M



SISGR will significantly enhance the core research programs in BES and pursue the fundamental understanding necessary to meet the global need for abundant, clean, and economical energy.

Most awards are for three years, with funding in the range of \$150-300k per year for single-investigator awards and \$500-1500k per year for small-group awards

Areas of interest include:

Grand challenge science: ultrafast science; chemical imaging, complex & emergent behavior

Use inspired discovery science: basic research for electrical energy storage; advanced nuclear energy systems; solar energy utilization; hydrogen production, storage, and use; geological CO₂ sequestration; other basic research areas identified in BESAC and BES workshop reports with an emphasis on nanoscale phenomena

Tools for grand challenge science: midscale instrumentation; accelerator and detector research

95 new awards started in September, 2009.

FY 2009 Omnibus = \$55M/year

Tackling Our Energy Challenges in a New Era of Science

- To engage the talents of the nation's researchers for the broad energy sciences
- To accelerate the scientific breakthroughs needed to create advanced energy technologies for the 21st century
- To pursue the fundamental understanding necessary to meet the global need for abundant, clean, and economical energy

46 centers awarded (\$777M over 5 years), representing 102 participating institutions in 36 states and D.C.

Pursue *collaborative* basic research that addresses both energy challenges and science grand challenges in areas such as:

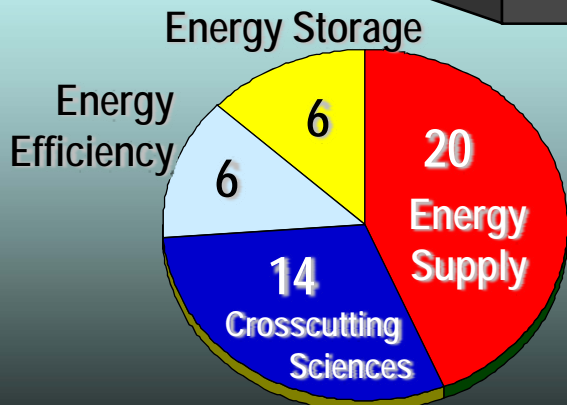
- Solar Energy Utilization
- Combustion
- Bio-Fuels
- Catalysis
- Energy Storage
- Solid State Lighting
- Geosciences for Energy Applications
- Superconductivity
- Advanced Nuclear Energy Systems
- Materials Under Extreme Environments
- Hydrogen



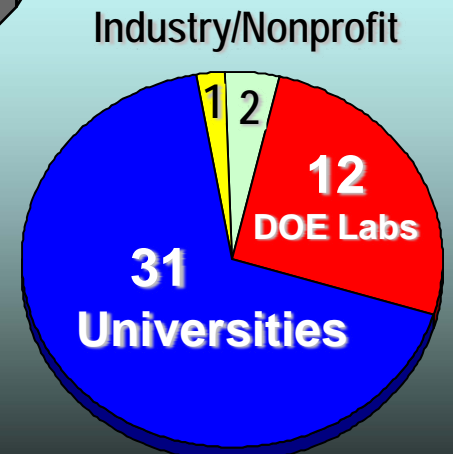
Energy Frontier Research Centers

46 centers awarded, representing 103 participating institutions in 36 states plus D.C

Energy Frontier Research Center Locations (★ Leads; ● Participants)



By Topical Category



By Lead Institution



- **Hubs selected for funding at \$22M each in FY 2010 are:**

Fuels from Sunlight (EERE, SC lead)

Energy Efficient Building Systems Design (EERE)

Modeling and Simulation for Nuclear Fuel Cycles and Systems (NE)

- **Characteristics of Hubs:**

Each Hub will comprise a world-class, multi-disciplinary, and highly collaborative research and development team.

Strong scientific leadership must be located at the primary location of the Hub.

Each must have a clear organization and management plan that “infuses” a culture of empowered central research management throughout the Hub.

- **The Department hopes to add additional Hubs in FY 2011.**



- The Department of Energy is now reviewing 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.
- University grants will be at least \$150,000 per year for five years to cover summer salary and expenses; Lab awards will be at least \$500,000 per year for five years to cover full annual salary and expenses.
- Proposals now under peer review, with award decisions expected in January
- <http://www.science.doe.gov/SC-2/earlycareer>



- The Office of Science established the DOE Office of Science Graduate Fellowship program to support outstanding students pursuing graduate training in basic research in areas of physics, biology, chemistry, mathematics, engineering, computational sciences, and environmental sciences relevant to the Office of Science.
- The fellowship award provides partial tuition support (\$10.5K/year), an annual stipend for living expenses (\$35K), and a research stipend (\$5K) for full-time graduate study and thesis/dissertation research at a U.S. academic institution for three years.
- The fellowship is open to students who are currently an undergraduate senior or in their first or second year of graduate school.
- The program is now reviewing applications for the 2010-2011 academic year.
- Recovery Act funds (\$12.5M) will fully support approximately 80 fellowships; FY 2010 appropriated funds will support approximately 80 additional fellowships in the program's first year.
- <http://www.scied.science.doe.gov/SCGF.html>