Office of Science by the Numbers
Science to Meet the Nation’s Challenges Today and into the 21st Century

- Supporting 25,000 Ph.D. scientists, graduate students, undergraduates, engineers, and support staff at more than 300 institutions
- Providing the world’s largest collection of scientific user facilities to over 29,000 users each year
- Supporting research that led to over 100 Nobel Prizes during the past 6 decades—more than 20 in the past 10 years
- Providing 45% of Federal support of basic research in the physical and energy related sciences and key components of the Nation’s basic research in biology and computing
### Office of Science FY 2014 Budget Request to Congress

(B/A in thousands)

<table>
<thead>
<tr>
<th></th>
<th>FY 2012</th>
<th>FY 2013 Annualized CR (per budget)</th>
<th>FY 2014 President's Request</th>
<th>FY 2014 President's Request vs. FY12 Enacted Approp.</th>
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</thead>
<tbody>
<tr>
<td></td>
<td>Enacted Approp.</td>
<td>Current Approp.</td>
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<tr>
<td>Science</td>
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<tr>
<td>Advanced Scientific Computing Research</td>
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<td>Basic Energy Sciences</td>
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<td>Biological and Environmental Research</td>
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<td>Fusion Energy Sciences</td>
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<td>High Energy Physics</td>
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<td>Nuclear Physics</td>
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<td>Workforce Development for Teachers and Scientists</td>
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<td>Science Laboratories Infrastructure</td>
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<td>112,485</td>
<td>97,818</td>
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<td>Safeguards and Security</td>
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<td>Program Direction</td>
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<td>185,000</td>
<td>186,132</td>
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<td>Small Business Innovation Research/Technology Transfer (SC)</td>
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<td><strong>114,125</strong></td>
<td><strong>114,125</strong></td>
<td><strong>114,125</strong></td>
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<tr>
<td>Subtotal, Science</td>
<td>4,873,634</td>
<td>4,873,634</td>
<td>4,903,461</td>
<td>5,152,752</td>
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<tr>
<td>Small Business Innovation Research/Technology Transfer (DOE)</td>
<td>61,346</td>
<td>61,346</td>
<td>61,346</td>
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<tr>
<td>Total, Science Appropriation</td>
<td>4,873,634</td>
<td>4,934,980</td>
<td>4,903,461</td>
<td>5,152,752</td>
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</tbody>
</table>

With sequester: 4,621,075
% Funding for (ASCR+BES+BER) vs. (FES+HEP+NP)
Multiagency priorities:

- Advanced manufacturing
- Clean energy
- Global climate change
- R&D for informed policy-making and management
- Information technology R&D ("Big Data")
- Nanotechnology
- Biological innovation
- STEM education
- Innovation and commercialization

And, in addition, no/few new starts in order to manage outyear commitments.
The Office of Science HPCs Continue to Lead the World

Titan System Specifications
Cray XK7 (ORNL):
- Peak performance of 27.1 Petaflops
  - 24.5 GPU + 2.6 CPU
- 18,688 Hybrid Compute Nodes with:
  - 16-Core AMD Opteron CPU
  - NVIDIA Tesla “K20x” GPU
  - 32 + 6 GB memory
- 200 Cabinets; 710 TB total system memory; 8.9 MW peak power
- Currently in Acceptance - passed performance & functionality tests; Cray repairing boards before stability test
- Early Science testing both CPUs and GPUs

Mira System Specifications
IBM Blue Gene/Q (ANL):
- Peak performance of 10 Petaflops
- 49,152 Compute Nodes each with:
  - 16-Core Power PC A2 CPU with 64 Hardware Threads and 16 Quad FPUs
  - 16 GB memory
- 56 Cabinets; 786 TB total system memory; 4.8 MW peak power
- Accepted December 18, 2012.
- Transitioned to operations April 9, 2013
- Early Science used over 900M core hours

#1 in Nov 2012
#4 in Nov 2012
The BES Nanoscale Science Research Centers
Completed 2006-2008

Center for Functional Nanomaterials
(Brookhaven National Lab)

Molecular Foundry
(Lawrence Berkeley National Lab)

Center for Nanoscale Materials
(Argonne National Lab)

Center for Nanophase Materials Sciences
(Oak Ridge National Lab)

Center for Integrated Nanotechnologies
(Sandia & Los Alamos National Labs)
Energy Frontier Research Centers

Participants:
- **46** EFRCs in **35** States + Washington D.C.
- ~**850** senior investigators and ~**2,000** students, postdoctoral fellows, and technical staff at ~**115** institutions
- >**250** scientific advisory board members from **13** countries and >**40** companies

Progress to date (~3.5 years funding):
- >3,400 peer-reviewed papers including >**110** publications in *Science* and *Nature*
- **18** PECASE and **11** DOE Early Career Awards
- >**200** patent/patent applications, plus an additional >**60** invention disclosures and at least **30** licenses
- At least **60** companies have benefited from EFRC research
- EFRC students and staff now work in: >**195** university faculty and staff positions; >**290** industrial positions; >**115** national labs, government, and non-profit positions

FY 2014 recompetition:
- Open competition for new and renewal EFRCs
- Annual funding continues at $100M/year; in addition, there is one-time funding of $68.7M to forward fund a number of EFRCs
- Selection based on peer review; for renewal proposals, review will consider of progress during the first 5 years

[http://science.energy.gov/bes/efrc/](http://science.energy.gov/bes/efrc/)
Companies that Benefit from EFRC Research

- QuantumScape
- Anellotech
- Chromaion
- Unite to Light
- Global Photonic Energy Corporation
- CAELUX Solar Energy
- MESA, LLC
- WCFC Watt Fuel Cell
- N8HMs Technologies
- GMZ Energy
- RSOFT
- Asylum Research
- Alta Devices
- NEXT
- Ubiquitous Energy
- Wildcat Discovery Technologies
- American Aerogel
- SuperPower
- Dioxide Materials
- LifeCell Technology
- PRIMET
- Polyera
- amsc
- Universal Display Corporation
- Pall Corporation
- CORNING
- GE
- DuPont
- Phillips Lumileds
- Fulcrum Bioenergy
- MSRI
- GENTHERM
- EMD
- Delphi
- Semprius
- Xactiv
- Samsung
- Cheil Industries
- P&G
- Novaled
- Sharp Laboratories of America
- MilliFluidica
- Amc10
- Topsoe Fuel Cell
4 Nobel Prizes in 10 Years Using SC Light Sources

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.

2012: Robert J. Lefkowitz and Brian K. Kobilka (Chemistry) "for studies of G-protein-coupled receptors."
Used APS beamline 23-ID.
The DOE Bioenergy Research Centers
Fundamental science underpinning new biofuel technologies

Multidisciplinary fundamental science to improve production of biofuels from renewable biomass.

- BioEnergy Science Center (Oak Ridge National Lab)
- Joint BioEnergy Institute (Lawrence Berkeley National Lab)

In 5 years of operations:
- 1,110 peer-reviewed publications
- Over 400 invention disclosures and/or patent applications

In FY 2014, the BRCs will target:
- Detailed characterization of selected candidate biofuel crops (switchgrass and poplar lines) with reduced recalcitrance properties.
- Improved lignin removal techniques producing a new product stream from pretreated biomass during biofuel production.
- Increased tolerance of biofuel-producing microorganisms to pretreatment processes.
- Optimized biosynthetic pathways in microbial hosts for conversion of cellulosic sugars to a variety of drop-in hydrocarbon fuel components.
- Incorporation of microbe-plant interactions and biogeochemical relationships into analyses of bioenergy crop sustainability on marginal lands.
The Bioenergy Research Centers Contributing to Industry

- All three BRCs have industry partners, collaborators, intellectual property and technology licensees.

- BRC-developed high throughput pretreatment and enzyme capabilities were licensed to Aspen Machining for manufacture and sales to outside parties (Codexis was the first customer).

- BRC-developed specialty software to facilitate automated design and cloning of DNA pieces was licensed to Genomatica, for use in production of 'greener' intermediate and basic chemicals made from renewable feedstocks.
Multiagency priorities:

- Advanced manufacturing
- Clean energy
- Global climate change
- R&D for informed policy-making and management
- Information technology R&D ("Big Data")
- Nanotechnology
- Biological innovation
- STEM education
- Innovation and commercialization

Physics and astronomy is increasingly globalized:
What gets globalized and what doesn’t? What should we own, and what should we share? How do these decisions affect the U.S. position in physics and astronomy?
A particle that looks a lot like the Standard Model Higgs Boson has been discovered at CERN.

Daya Bay reactor neutrino experiment definitively shows that the unmeasured neutrino mixing is large (of order 10%).

BOSS has measured the characteristic length scale of the universe.