U.S. DEPARTMENT OF ENERGY | Office of Science

The DOE National Laboratories

Brookhaven National Laboratory
Community Advisory Council

Frank Crescenzo, Manager
Brookhaven Site Office
September 11, 2014

Today's DOE Laboratories

Why do we have national laboratories?

Couldn't we simply outsource R&D to universities and industry?

Why do we have National Laboratories?

- **Execute long-term government scientific and technological missions, often with complex security, safety, project management, or other operational challenges;**
- **Develop unique, often multidisciplinary, scientific capabilities beyond the scope of academic and industrial institutions, to benefit the Nation's researchers and national strategic priorities; and**
- **Develop and sustain critical scientific and technical capabilities to which the government requires assured access.**

Why do we have National Laboratories?

- **To perform missions of national interest**
- **To perform "government only" missions**
- **To design, build and operate specialized scientific facilities that industry and academia will not/cannot**
  - Usually very expensive to build *and* operate
  - Mostly available to user communities (academia, industry, national labs, others)
  - Designed and operated to meet user community needs

DOE and Its Predecessors and the Formation of the National Laboratories

- **1942-1946 Manhattan Project, War Department Army Corps of Engineers**
  - Wartime weapons development
  - Foundations of first DOE multi-purpose national labs

- **1946-1974 Atomic Energy Commission created by the 1946 Atomic Energy Act (P.L. 79-585)**
  - Research in basic nuclear processes, nuclear reactor technologies, use of nuclear materials for variety of purposes
  - Establishment of several DOE national labs

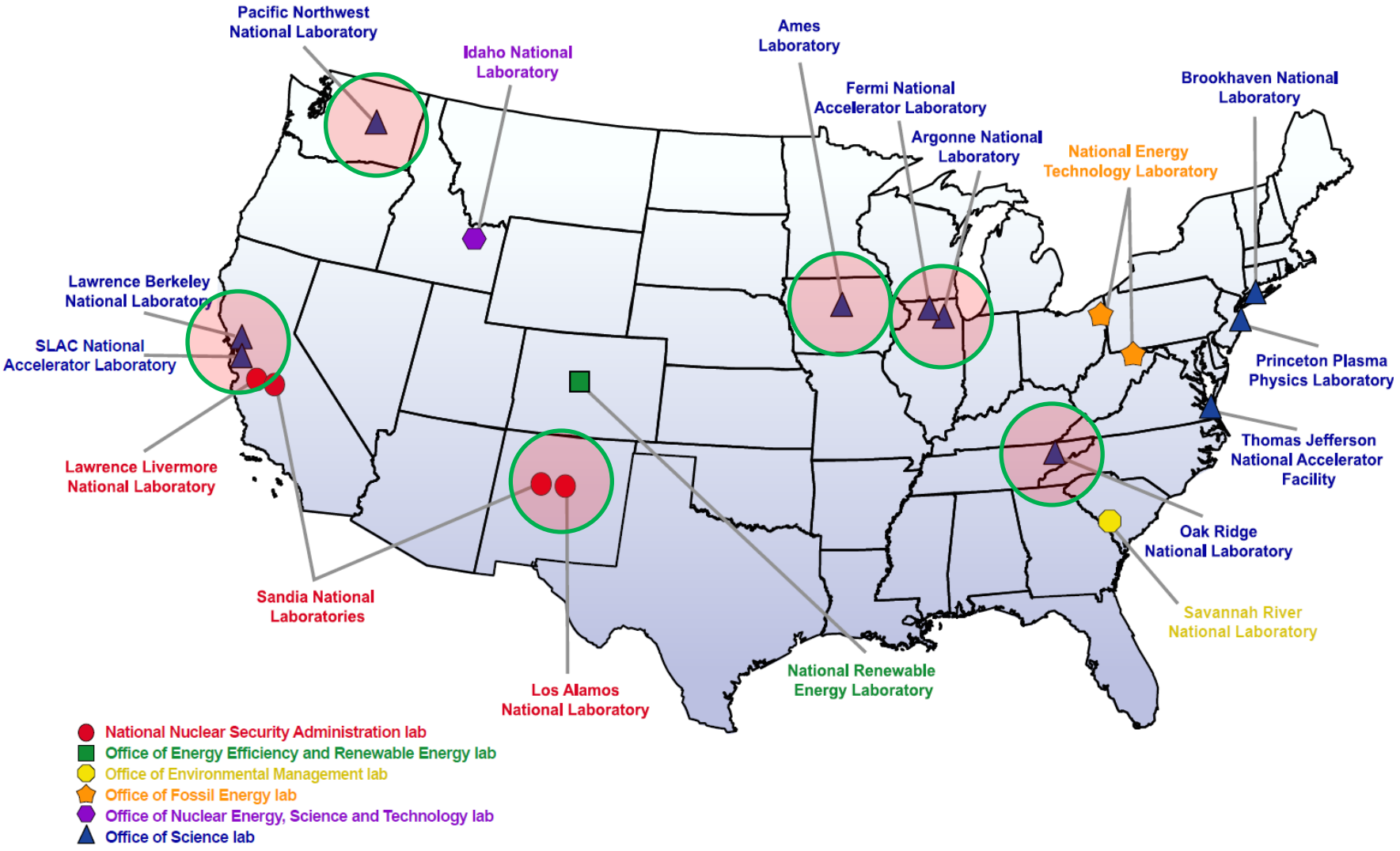
- **1974-1977 Energy Research and Development Administration, a new energy R&D agency motivated by Arab oil embargo and created by (P.L. 93-438)**
  - Research expands to include solar, fossil, geothermal, synthetic fuels, transmission, conservation, etc.

- **1977-present Department of Energy (P.L. 95-91)**
  - Separation of management oversight of weapons and non-weapons labs and separation of basic and applied research
  - Several DOE labs undergo transition to “open” labs with thousands of external visitors/users annually

Big Science and the Office of Science

- Big science was born at the labs after WWII.
- Over time, big science begat the large suite of Office of Science user facilities.
- These facilities transformed the nature of the labs, and they define the Office of Science today.

Today's DOE Laboratories



DOE Laboratory Complex

- **Management model:**

  Federally Funded Research and Development Center (FFRDC)

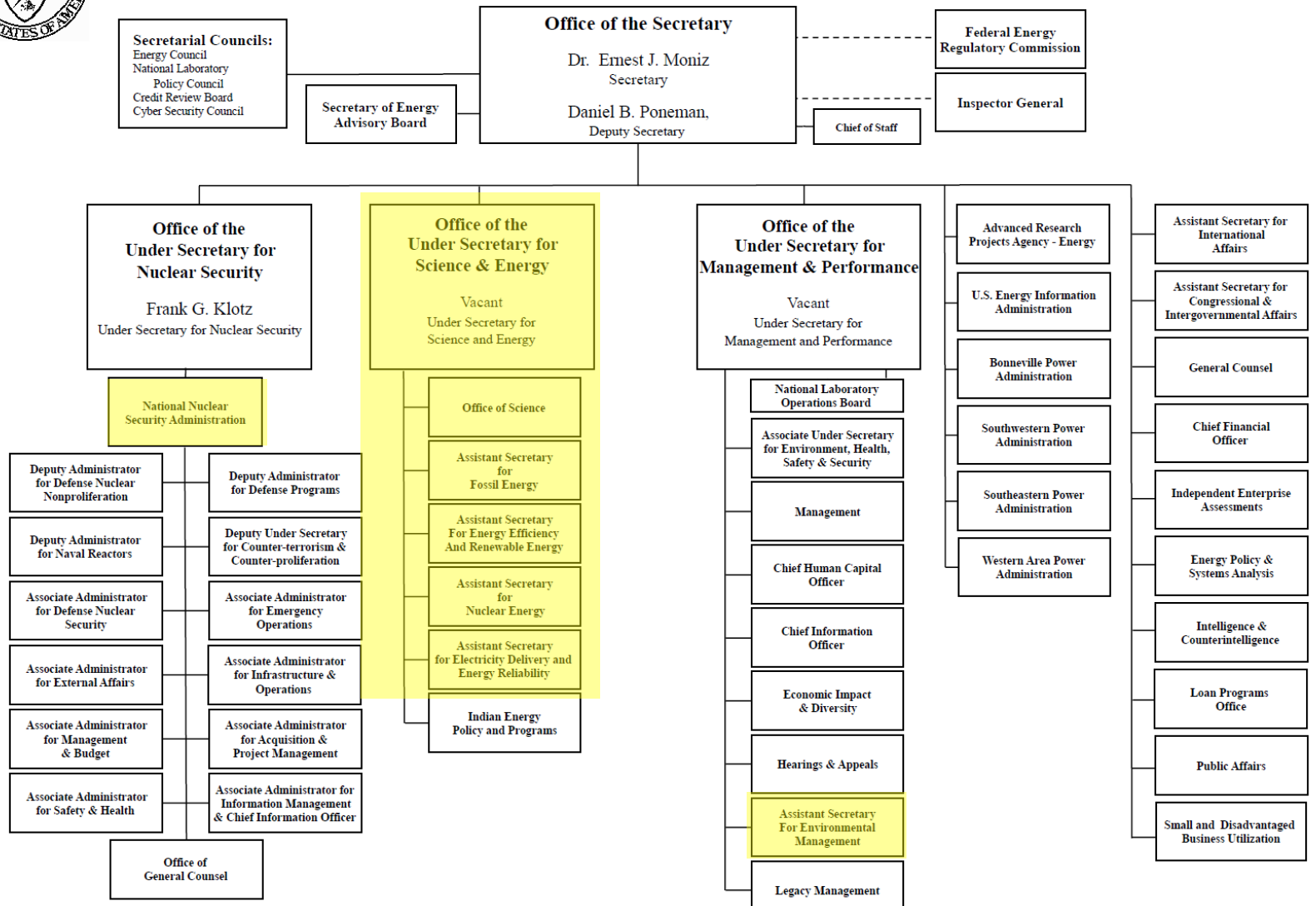
  - Government-Owned Contractor-Operated (GOCO)
  - Federal program direction/oversight from HQ and Federal "site offices"
  - (except Fossil Energy's National Energy Technology Laboratory, which is Government-Owned Government-Operated (GOGO))

- **Most Labs receive funds from multiple sources**

- **Each Lab is stewarded by one headquarters program office**

  - 10 Office of Science (Ames, Argonne, Berkeley, Brookhaven, Fermilab, Jefferson Lab, Oak Ridge, Princeton, PNNL, SLAC)
  - 3 NNSA (Los Alamos, Livermore, Sandia)
  - 1 Energy Efficiency & Renewable Energy (NREL)
  - 1 Environmental Management (Savannah River)
  - 1 Nuclear Energy (Idaho)
  - 1 Fossil Energy (NETL)

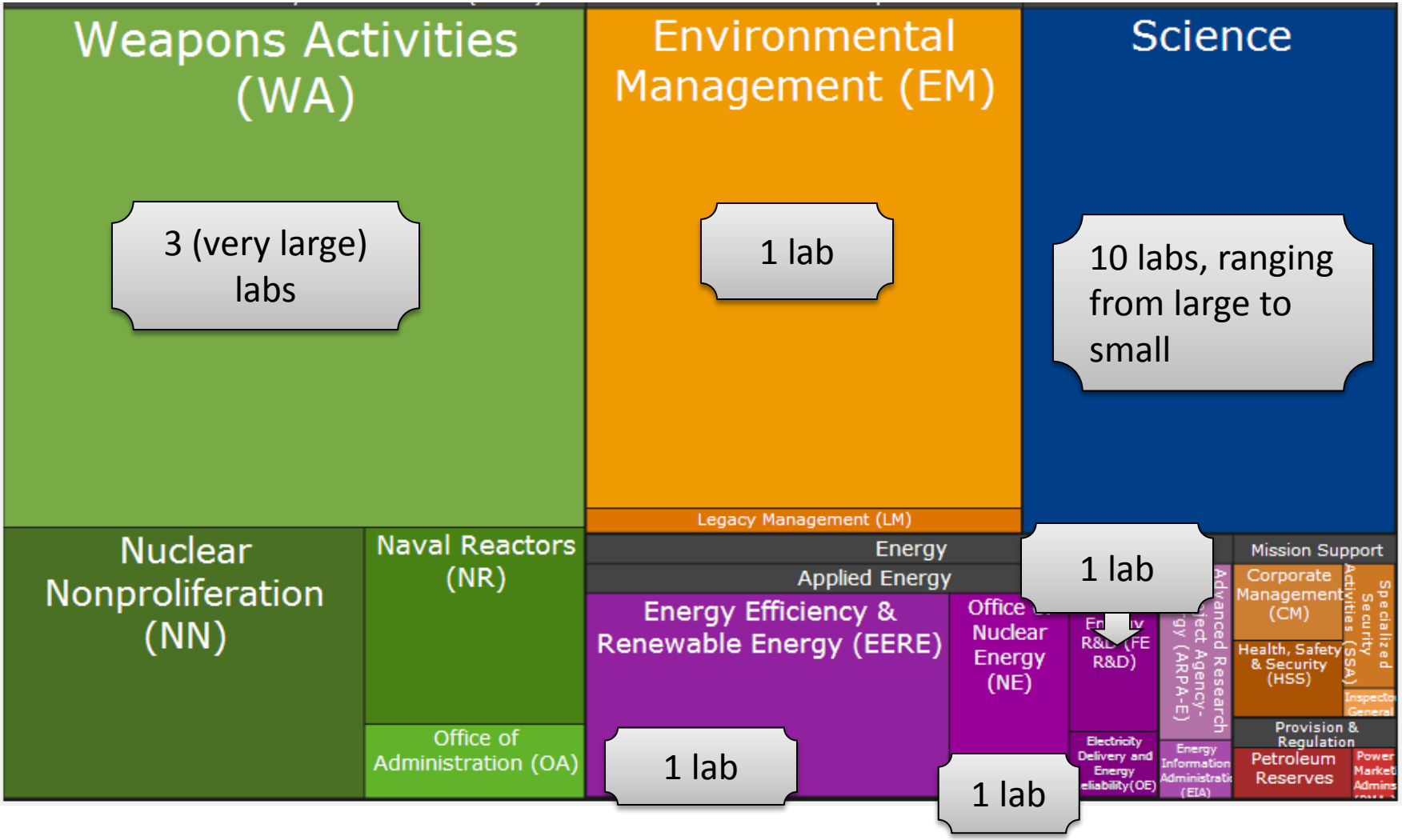
DEPARTMENT OF ENERGY



= Stewards of laboratories

05 May 2014

The DOE Portfolio



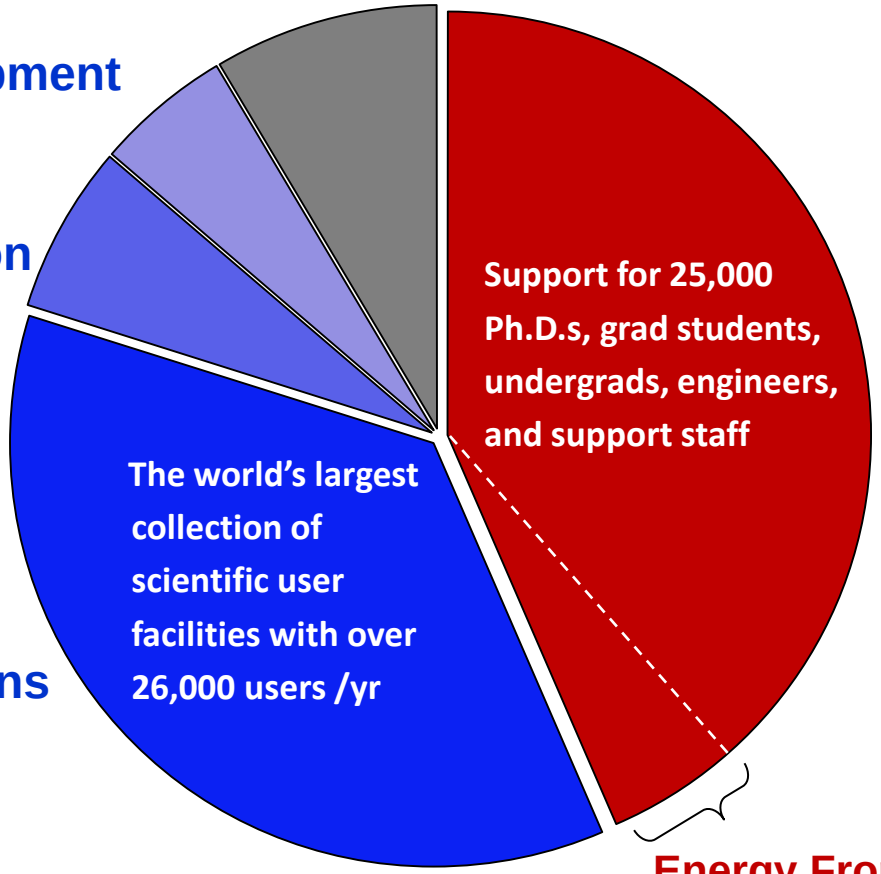
Credit: DOE Office of the Chief Financial Officer

The Office of Science (SC) Research Portfolio

Basic Energy Sciences	• Understanding, predicting, and ultimately controlling matter and energy flow at the electronic, atomic, and molecular levels
Advanced Scientific Computing Research	• Delivering world leading computational and networking capabilities to extend the frontiers of science and technology
Biological and Environmental Research	• Understanding complex biological, climatic, and environmental systems
Fusion Energy Sciences	• Building the scientific foundations for a fusion energy source
High Energy Physics	• Understanding how the universe works at its most fundamental level
Nuclear Physics	• Discovering, exploring, and understanding all forms of nuclear matter

Research and Facilities in the Office of Science

Funding = $5B



Research
(About 1/3 of the research is sited at universities)

Energy Frontier Research Centers, Energy Innovation Hubs, Bioenergy Research Centers

Office of Science User Facilities

31 world-leading facilities serving over 29,000 researchers annually

- **supercomputers,**
- **high intensity x-ray, neutron, and electron sources,**
- **nanoscience facilities,**
- **genomic sequencing facilities,**
- **particle accelerators,**
- **fusion/plasma physics facilities, and**
- **atmospheric monitoring capabilities.**

- Open access; allocation determined through peer review of proposals
- Free for non-proprietary work published in the open literature
- Full cost recovery for proprietary work

Work for Others

- **National Labs are authorized to conduct work for "others" or non-DOE customers provided:**
  - Work is consistent with lab mission and capabilities
  - Lab does not compete with industry or commercially available services
  - Restrictions on pricing and future liabilities
- **Important source of capabilities for the nation**
- **Important and often significant source of revenue for the labs**

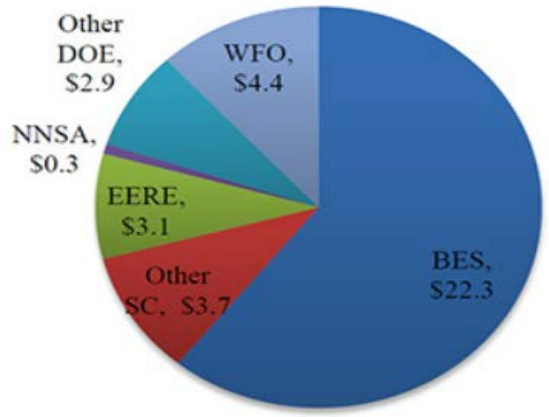
Characteristics of a National Lab

- Size and location
- Core capabilities
- Funding sources
- Facilities

Office of Science Laboratories

THE Ames Laboratory
Creating Materials & Energy Solutions
U.S. DEPARTMENT OF ENERGY

FY 2012 Funding by Source (Costs in $M):



Quick Facts

- Location: Ames, Iowa
- 8 acres and 12 buildings
- 310 Full Time Employees
- 149 Students

FY14 Budget (enacted): $33M

Core Capabilities

- Condensed Matter Physics and Materials Science
- Chemical and Molecular Science
- Applied Materials Science and Engineering

DHS = Department of Homeland Security
EERE = DOE Office of Energy Efficiency and Renewable Energy
EM = DOE Office of Environmental Management
NE = DOE Office of Nuclear Energy
NNSA = National Nuclear Security Administration
WFO = Work for Others

Office of Science (SC) Programs:

ASCR = Advanced Scientific Research Computing
BES = Basic Energy Sciences
BER = Biological and Environmental Research
FES = Fusion Energy Sciences
HEP = High Energy Physics
NP = Nuclear Physics

Office of Science Laboratories

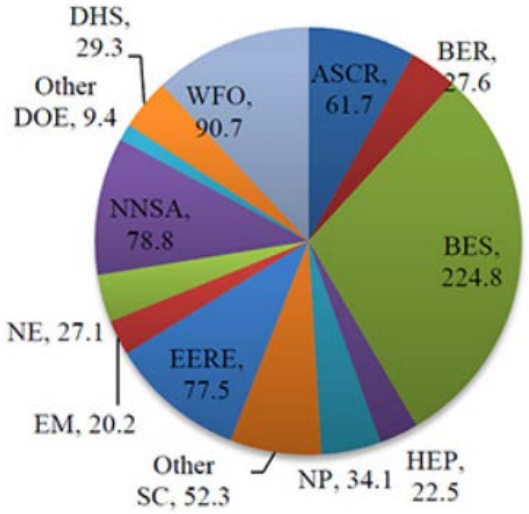
Quick Facts

- Location: Argonne, Illinois
- 1,500 acres and 99 buildings
- 3,402 Full Time Employees
- 812 Students
- 5,525 Facility Users
- 979 Visiting Scientists

FY14 Budget
(enacted): $559M

Argonne NATIONAL LABORATORY

FY 2012 Funding by Source (Costs in $M):



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Office of Science Laboratories

Argonne NATIONAL LABORATORY

Core Capabilities

- Particle Physics
- Nuclear Physics
- Accelerator Science and Technology
- Condensed Matter Physics and Materials Science
- Chemical and Molecular Science
- Applied Mathematics
- Advanced Computer Science, Visualization, and Data
- Applied Nuclear Science and Technology
- Applied Materials Science and Engineering
- Chemical Engineering
- Systems Engineering and Integration
- Large Scale User Facilities / Advanced Instrumentation

Office of Science User Facilities

- Advanced Photon Source (APS)
- Argonne Leadership Computing Facility (ALCF)
- Center for Nanoscale Materials (CNM)
- Electron Microscopy Center (EMC)
- Argonne Tandem Linac Accelerator System (ATLAS)
- ARM Climate Research Facility

Office of Science (SC) Programs:

ASCR = Advanced Scientific Research Computing
BES = Basic Energy Sciences
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HEP = High Energy Physics
NP = Nuclear Physics

Office of Science Laboratories

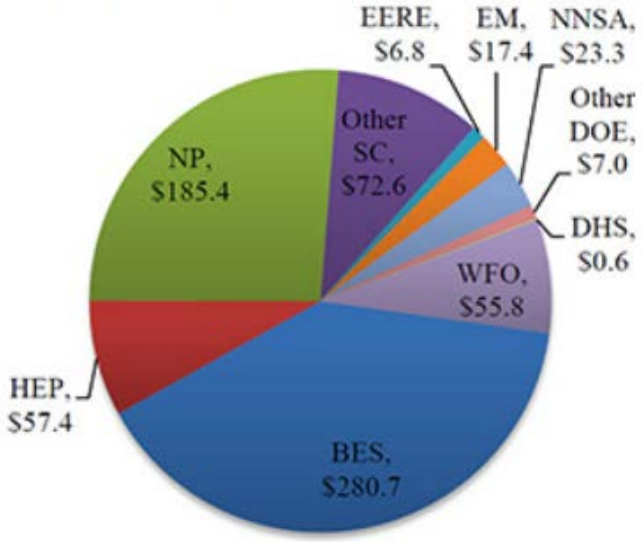
BROOKHAVEN NATIONAL LABORATORY

Quick Facts

- Location: Upton, New York
- 5,320 acres and 302 buildings
- 2,989 Full Time Employees
- 399 Students
- 4,427 Facility Users
- 1,348 Visiting Scientists

FY14 Budget (enacted): $504M

FY 2012 Funding by Source (Costs in $M):



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Office of Science Laboratories

BROOKHAVEN NATIONAL LABORATORY

Core Capabilities

- Particle Physics
- Nuclear Physics
- Accelerator Science and Technology
- Condensed Matter Physics and Materials Science
- Chemical and Molecular Science
- Climate Change Science
- Biological Systems Science
- Applied Nuclear Science and Technology
- Applied Materials Science and Engineering
- Chemical Engineering
- Systems Engineering and Integration
- Large Scale User Facilities / Advanced Instrumentation

Office of Science User Facilities

- National Synchrotron Light Source (NSLS)
- Relativistic Heavy Ion Collider (RHIC)
- Center for Functional Nanomaterials (CFN)
- ARM Climate Research Facility

Office of Science (SC) Programs:

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HEP = High Energy Physics
NP = Nuclear Physics

Office of Science Laboratories

Fermilab

Quick Facts

- Location: Batavia, Illinois
- 6,800 acres and 362 buildings
- 1,757 Full Time Employees
- 4,300 Facility Users
- 32 Visiting Scientists

FY14 Budget (enacted): $423M

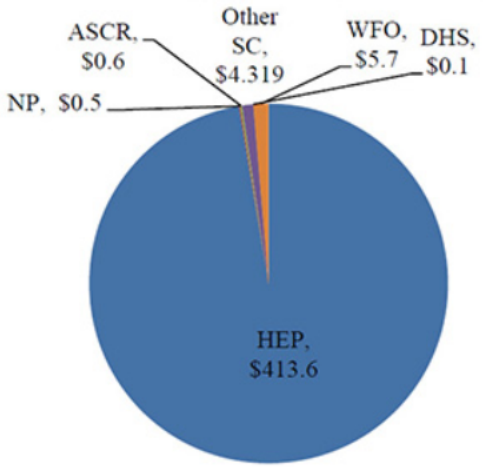
Core Capabilities

- Particle Physics
- Accelerator Science and Technology
- Large Scale User Facilities / Advanced Instrumentation

Office of Science User Facilities

- Fermilab Accelerator Complex

FY 2012 Funding by Source (Costs in $M):



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Office of Science (SC) Programs:

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FES = Fusion Energy Sciences
HEP = High Energy Physics
NP = Nuclear Physics

Office of Science Laboratories

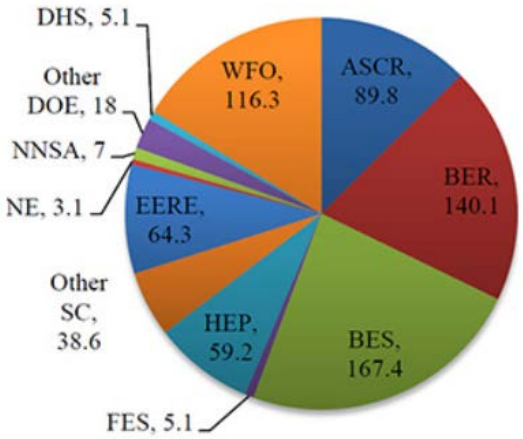
BERKELEY LAB

Quick Facts

- Location: Berkeley, California
- 202 acres (leased) and 97 buildings
- 3,395 Full Time Employees
- 493 Students
- 9,330 Facility Users
- 1,524 Visiting Scientists

FY14 Budget (enacted): $566M

FY 2012 Funding by Source (Costs in $M):



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Office of Science Laboratories

BERKELEY LAB

Core Capabilities

- Particle Physics
- Nuclear Physics
- Accelerator Science and Technology
- Condensed Matter Physics and Materials Science
- Chemical and Molecular Science
- Biological Systems Science
- Environmental Subsurface Science
- Climate Change Science
- Applied Mathematics
- Advanced Computer Science, Visualization, and Data
- Computational Science
- Applied Nuclear Science and Technology
- Applied Materials Science and Engineering
- Chemical Engineering
- Systems Engineering and Integration
- Large Scale User Facilities / Advanced Instrumentation

Office of Science User Facilities

- Advanced Light Source (ALS)
- Molecular Foundry
- Joint Genome Institute (JGI)
- National Energy Research Computing Center (NERSC)
- Energy Sciences Network (ESnet)
- National Center for Electron Microscopy (NCEM)
- ARM Climate Research Facility

Office of Science (SC) Programs:

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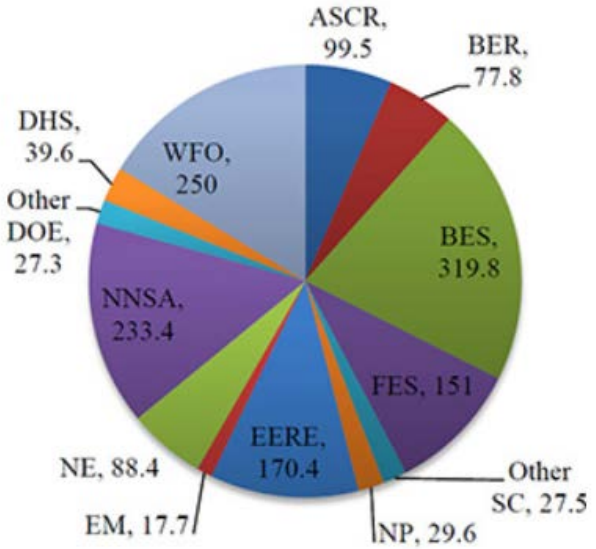
Office of Science Laboratories

OAK RIDGE National Laboratory

FY 2012 Funding by Source (Costs in $M):



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Quick Facts

- Location: Oak Ridge, Tennessee
- 4,421 acres and 196 buildings
- 4,368 Full Time Employees
- 520 Students
- 3,115 Facility Users
- 2,280 Visiting Scientists

FY14 Budget (enacted): $1.05B

Office of Science Laboratories

OAK RIDGE National Laboratory

Core Capabilities

- Nuclear Physics
- Accelerator Science and Technology
- Plasma and Fusion Energy Sciences
- Condensed Matter Physics and Materials Science
- Chemical and Molecular Science
- Climate Change Science
- Biological Systems Science
- Environmental Subsurface Science
- Advanced Computer Science, Visualization, and Data
- Computational Science
- Applied Nuclear Science and Technology
- Applied Materials Science and Engineering
- Chemical Engineering
- Systems Engineering and Integration
- Large Scale User Facilities / Advanced Instrumentation

Office of Science User Facilities

- Spallation Neutron Source (SNS)
- High Flux Isotope Reactor (HFIR)
- Oak Ridge Leadership Computing Facility (OLCF)
- Center for Nanophase Materials Sciences (CNMS)
- Shared Research Equipment User Facility (ShaRE)
- ARM Climate Research Facility

Office of Science (SC) Programs:

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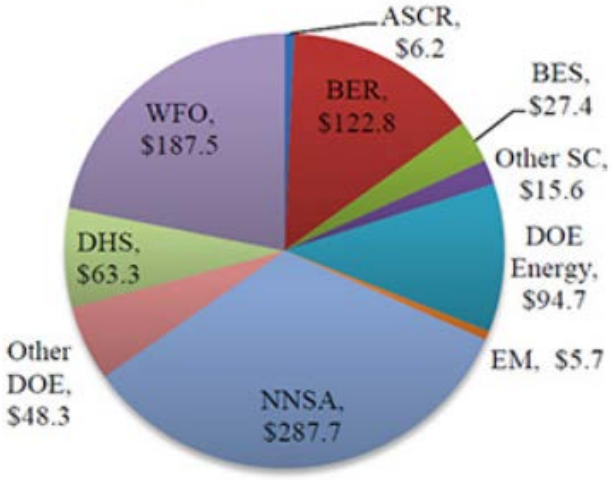
Office of Science Laboratories

Pacific Northwest
NATIONAL LABORATORY

FY 2012 Funding by Source (Costs in $M):



Quick Facts

- Location: Richland, Washington
- 670 acres and 95 buildings
- 3,922 Full Time Employees
- 366 Students
- 2,400 Facility Users
- 49 Visiting Scientists

FY14 Budget (enacted): $566M

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Office of Science Laboratories

Pacific Northwest
NATIONAL LABORATORY

Core Capabilities

- Chemical and Molecular Science
- Climate Change Science
- Biological Systems Science
- Environmental Subsurface Science
- Advanced Computer Science, Visualization, and Da
- Applied Nuclear Science and Technology
- Applied Materials Science and Engineering
- Chemical Engineering
- Systems Engineering and Integration
- Large Scale User Facilities / Advanced Instrumentation

Office of Science User Facilities

- Environmental Molecular Sciences Laboratory (EMSL)
- ARM Climate Research Facility

Office of Science (SC) Programs:

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BER = Biological and Environmental Research
FES = Fusion Energy Sciences
HEP = High Energy Physics
NP = Nuclear Physics

Office of Science Laboratories

PPPL
PRINCETON PLASMA PHYSICS LABORATORY

Quick Facts

- Location: Princeton, New Jersey
- 88.5 acres and 34 buildings
- 414 Full Time Employees
- 40 Students
- 300 Visiting Scientists

FY14 Budget (enacted): $77M

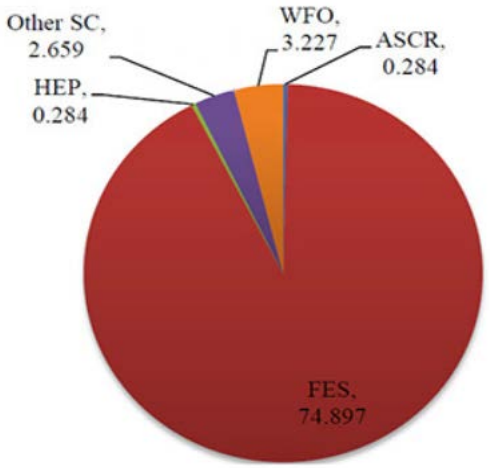
Core Capabilities

- Plasma and Fusion Energy Sciences
- Large Scale User Facilities / Advanced Instrumentation

Office of Science User Facilities

- National Spherical Torus Experiment (NSTX)

FY 2012 Funding by Source (Costs in $M):



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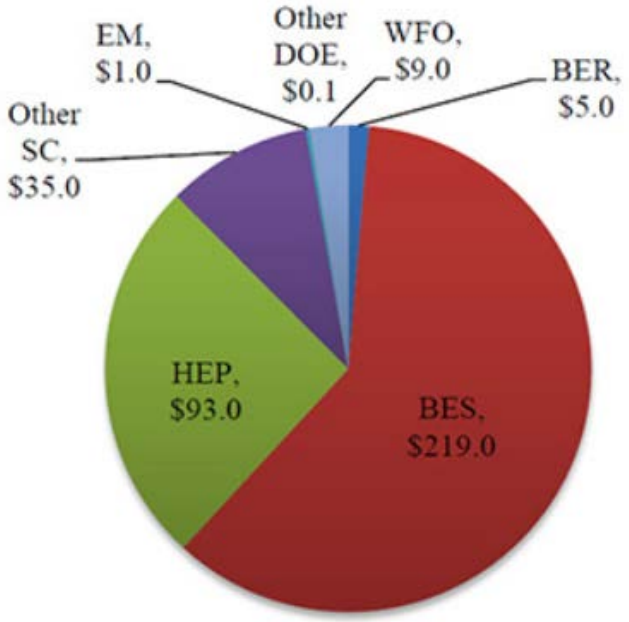
Office of Science Laboratories

SLAC NATIONAL ACCELERATOR LABORATORY

FY 2012 Funding by Source (Costs in $M):



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Quick Facts

- Location: Menlo Park, California
- 426 acres and 151 buildings
- 1,684 Full Time Employees
- 124 Students
- 3,411 Facility Users
- 31 Visiting Scientists

FY14 Budget (enacted): $398M

Office of Science Laboratories

SLAC NATIONAL ACCELERATOR LABORATORY

Core Capabilities

- Particle Physics
- Accelerator Science and Technology
- Condensed Matter Physics and Materials Science
- Chemical and Molecular Science
- Large Scale User Facilities / Advanced Instrumentation

Office of Science User Facilities

- Stanford Synchrotron Radiation Lightsource (SSRL)
- Linac Coherent Light Source (LCLS)
- Facility for Advanced Accelerator Experimental Tests (FACET)

Office of Science (SC) Programs:

ASCR = Advanced Scientific Research Computing
BES = Basic Energy Sciences
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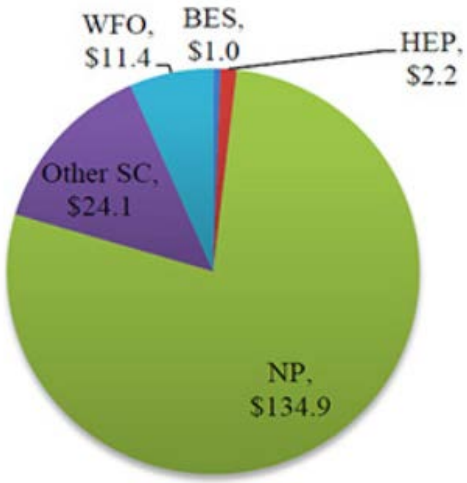
FES = Fusion Energy Sciences
HEP = High Energy Physics
NP = Nuclear Physics

Office of Science Laboratories

Jefferson Lab
Thomas Jefferson National Accelerator Facility

FY 2012 Funding by Source (Costs in $M)



Quick Facts

- Location: Newport News, Virginia
- 169 acres and 83 buildings and trailers
- 759 Full Time Employees
- 43 Students
- 1,385 Facility Users

FY14 Budget (enacted): $163M

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WFO = Work for Others

Office of Science Laboratories

Jefferson Lab
Thomas Jefferson National Accelerator Facility

Core Capabilities

- Nuclear Physics
- Accelerator Science and Technology
- Applied Nuclear Science and Technology
- Large Scale User Facilities / Advanced Instrumentation

Office of Science User Facilities

- Continuous Electron Beam Accelerator Facility (CEBAF)

Office of Science (SC) Programs:

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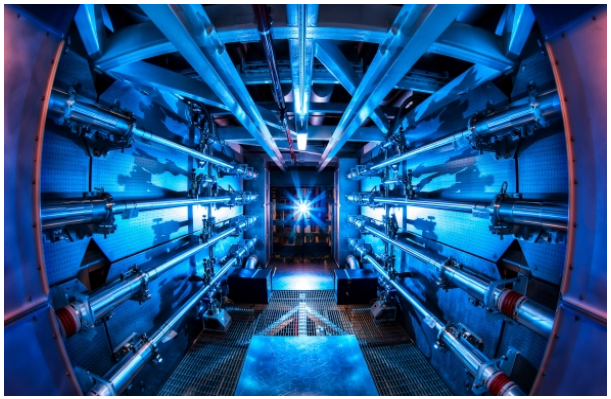
National Nuclear Security Administration Labs (FY14 Budget)

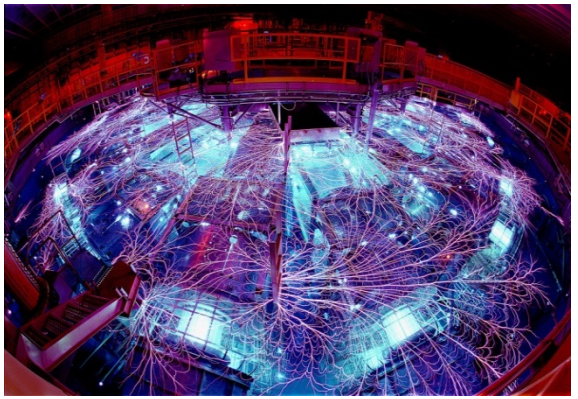


Lawrence Livermore ($1.1B)

Responsible for the safety and reliability of the nuclear explosives package in nuclear weapons; supports surveillance, assessment, and refurbishment of the nuclear weapons stockpile.

Los Alamos ($1.9B)

Responsible for the safety and reliability of the nuclear explosives package in nuclear weapons; possesses unique capabilities in neutron scattering, enhanced surveillance, radiography, and plutonium science and engineering.



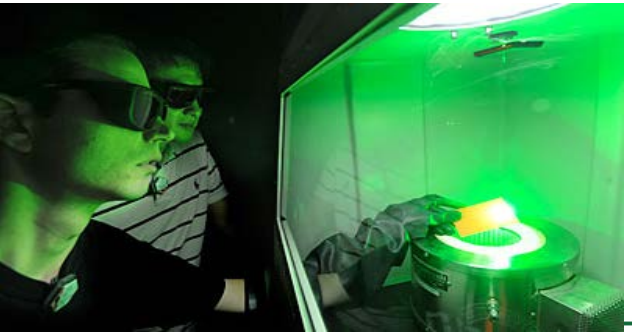
Sandia Laboratories ($1.7B)

Responsible for the development, testing, and production of specialized nonnuclear components and quality assurance and systems engineering for all US nuclear weapons.

Other National Laboratories

SAVANNAH RIVER ($15.9M)
Office of Environmental Management
Creates, tests and deploys solutions the technological challenges in three key areas: national and homeland security, energy security, and environmental management

NATIONAL RENEWABLE ENERGY LABORATORY ($270M)
Office of Energy Efficiency and Renewable Energy
Renewable energy/energy efficiency research and development; advances related science and engineering, and transfers knowledge and innovations to address nation's energy/environmental goals.

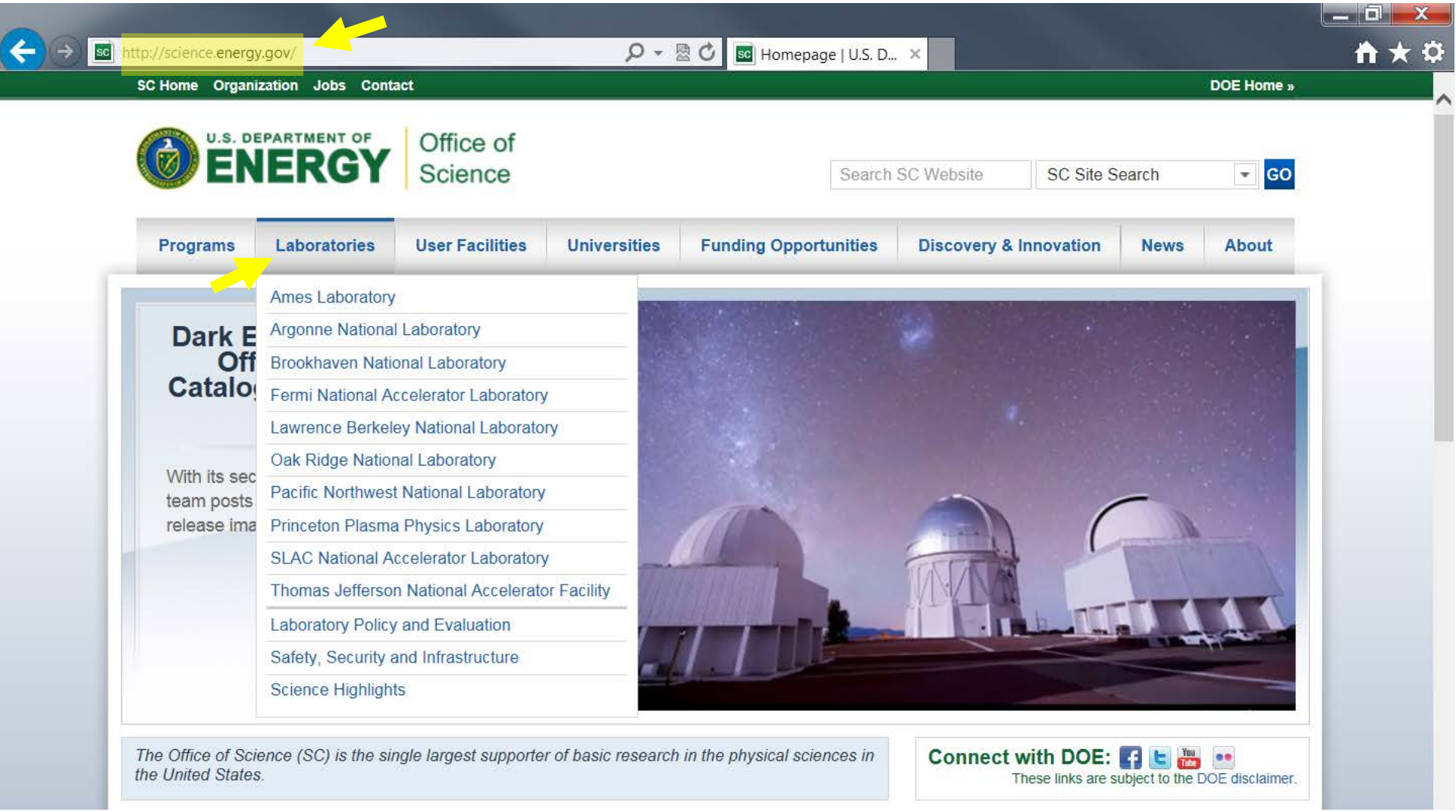


IDAHO NATIONAL LABORATORY ($1.07B)
Office of Nuclear Energy, Science and Technology
Science-based applied engineering supporting nuclear and energy research, science, and national defense.

Other National Laboratories

NATIONAL ENERGY TECHNOLOGY LABORATORY ($731M)
Offices of Fossil Energy, Energy Efficiency & Renewable Energy, and Electricity Delivery & Energy Reliability
Implements energy and environmental research and development programs, including those related to domestic coal, natural gas, and oil to power homes, industries, businesses, and transportation.

Office of Science Laboratory Links



National Nuclear Security Administration Lab/Facility Links