DOE Office of Science

Update and FY 2018 Budget Request to Congress

Presented to the
Fusion Energy Sciences Advisory Committee

by
Steve Binkley
Deputy Director for Programs

February 1, 2018
Outline

- Message from DOE leadership
- Appointee status
- FY 2018 budget
The FY18 budget request attempts to refocus and refine our mission on several critical fronts that directly affect the safety and security of the American public.

The $28 billion FY 2018 budget advances the DOE mission in key areas through significant investments to:

- Modernize the country’s nuclear weapons arsenal
- Achieve exascale computing
- Advance the Nation’s nuclear waste management program
- Protect our national electric grid from cyberattacks
- Shift the Department’s focus to early-stage research and development at our national laboratories to more efficiently and cost effectively advance American dominance in scientific and energy research
Our job is to deliver the best science we can with the resources we are given by the President and Congress.

There will be some challenges for FY 2018, and we are awaiting final passage of the House-Senate conference.

Once the final appropriation is passed, we will be working out the FY 2018 execution details.

In the meantime, we need to remain clear about our priorities:

- Deliver the best science we can with the resources we have when Congress votes and the President finally signs an FY 2018 budget.
- Continue tradition of excellence in SC-funded university-based research, lab-based research, and operations of scientific facilities.
Appointee Status

Deputy Secretary of Energy Nominee Dan Brouillette
- Nomination announced April 3, 2017
- Senate Hearing May 25, 2017
- Senate Confirmation on August 3, 2017
- Sworn in as Deputy Secretary, August 7, 2017

Under Secretary for Science Nominee Paul Dabbar
- Nomination announced July 12, 2017
- Senate Hearing July 20, 2016
- Senate Confirmation on November 2, 2017
- Sworn in as Under Secretary for Science, November 7, 2017
Paul Dabbar is Managing Director in the Global Mergers & Acquisitions Group, and Head of Energy Mergers & Acquisitions at J.P.Morgan, the investment banking division of JPMorgan Chase & Co. He has also led a number of M&A transactions for JPMorgan Chase. He has been financial advisor on over $300 billion in M&A transactions, including corporate mergers, subsidiary sales and purchases, government privatizations, joint ventures, corporate restructurings, private equity transactions, and unsolicited corporate transactions for companies in the energy sector, including nuclear, as well as in the industrials and financial institutions sectors.

Mr. Dabbar is a member of the Board of the U.S. Department of Energy Environmental Management Advisory Board, and is chairman of his U.S. Naval Academy class fundraising board.

Prior to J.P.Morgan, Mr. Dabbar was a nuclear submarine officer, serving on board the U.S.S. Pintado (SSN-672) out of Mare Island, CA, and Pearl Harbor, HI, where he completed deployments to places including the North Pole and South America. He also worked at the Johns Hopkins Applied Physics Laboratory conducting U.S. Department of Defense research.

Mr. Dabbar has a B.S. with merit in marine engineering from the U.S. Naval Academy (Class of ‘89) and a M.B.A. from Columbia University. He also completed the U.S. Naval nuclear program’s Engineer’s School.
FY 2018 PRESIDENT’S BUDGET REQUEST
Priorities for FY 2018

- **Focus on cutting edge, early stage research and development; achieve 40% funding for research**
  
  - The Office of Science (SC) is the largest Federal supporter of basic research in the physical sciences in the United States. SC supports research at the frontiers of science—discovering nature’s mysteries, from the study of subatomic particles, atoms, and molecules that are the building blocks of the materials of our everyday world, to the DNA, proteins, and cells that are the building blocks of entire biological systems.
  
  - SC also supports science for energy—advancing a clean energy agenda through fundamental research on energy production, conversion, storage, transmission, and use, and through advancing our understanding of the earth.

- **Continue operations of the national laboratories**
  
  - SC oversees the operation of ten DOE national laboratories. SC conducts a formal laboratory strategic planning process annually with its labs to understand future directions, immediate and long-range challenges, and resource needs. SC also conducts an annual evaluation of the scientific, technological, managerial, and operational performance of the management and operating contractors of its laboratories. In addition, SC funds mission-ready infrastructure and investments that foster safe and environmentally responsible operations at the labs.

- **Increase funding for Exascale Computing**

- **Maintain all on-going projects and start two new construction projects**
  
  - 2 New Construction Projects:
    - Advanced Photon Source Upgrade (APS-U) at Argonne National Laboratory (ANL) in Basic Energy Sciences and
    - Energy Sciences Capability at Pacific Northwest National Laboratory (PNNL) in Science Laboratories Infrastructure.
# FY 2018 SC Budget Request

<table>
<thead>
<tr>
<th></th>
<th>FY 2017 Enacted Approp.</th>
<th>FY 2018 President's Request</th>
<th>FY 2018 House Mark</th>
<th>FY 2018 Senate Mark</th>
</tr>
</thead>
<tbody>
<tr>
<td>ASCR</td>
<td>647,000</td>
<td>722,010</td>
<td>694,200</td>
<td>763,000</td>
</tr>
<tr>
<td>BES</td>
<td>1,871,500</td>
<td>1,554,500</td>
<td>1,871,500</td>
<td>1,980,300</td>
</tr>
<tr>
<td>BER</td>
<td>612,000</td>
<td>348,950</td>
<td>582,000</td>
<td>633,000</td>
</tr>
<tr>
<td>FES</td>
<td>380,000</td>
<td>309,940</td>
<td>395,000</td>
<td>232,000</td>
</tr>
<tr>
<td>HEP</td>
<td>825,000</td>
<td>672,700</td>
<td>825,000</td>
<td>860,000</td>
</tr>
<tr>
<td>NP</td>
<td>622,000</td>
<td>502,700</td>
<td>619,200</td>
<td>639,200</td>
</tr>
<tr>
<td>WDTS</td>
<td>19,500</td>
<td>14,000</td>
<td>19,500</td>
<td>19,500</td>
</tr>
<tr>
<td>SLI</td>
<td>130,000</td>
<td>76,200</td>
<td>105,600</td>
<td>143,000</td>
</tr>
<tr>
<td>S&amp;S</td>
<td>103,000</td>
<td>103,000</td>
<td>103,000</td>
<td>103,000</td>
</tr>
<tr>
<td>PD</td>
<td>182,000</td>
<td>168,516</td>
<td>177,000</td>
<td>177,000</td>
</tr>
<tr>
<td><strong>Subtotal, Science</strong></td>
<td><strong>5,392,000</strong></td>
<td><strong>4,472,516</strong></td>
<td><strong>5,392,000</strong></td>
<td><strong>5,550,000</strong></td>
</tr>
<tr>
<td><strong>Rescission of PY Bal.</strong></td>
<td><strong>-1,028 a</strong></td>
<td>......</td>
<td>......</td>
<td>......</td>
</tr>
<tr>
<td><strong>Total, Science</strong></td>
<td><strong>5,390,972</strong></td>
<td><strong>4,472,516</strong></td>
<td><strong>5,392,000</strong></td>
<td><strong>5,550,000</strong></td>
</tr>
</tbody>
</table>

---

The Department of Energy (DOE) is committed to reducing regulatory burdens on American families and businesses. Earlier this year, DOE formed a Regulatory Reform Task Force to evaluate and reform existing regulations that could eliminate jobs or inhibit job creation that are outdated, unnecessary, ineffective, or imposes costs that exceed benefits. The Task Force’s activities are carried out pursuant to the President’s direction in Executive Order (EO) 13771, “Reducing Regulation and Controlling Regulatory Costs”, EO 13777, “Enforcing the Regulatory Reform Agenda”, and EO 13783, “Promoting Energy Independence and Economic Growth.”

... Given the significant amount of expertise possessed by DOE’s FACA committees and their members, and the President’s direction to reduce regulatory burdens, I hereby direct each FACA committee, in carrying out the charges for which they were created, to consider regulatory reform and to provide appropriate advice and recommendations on DOE regulations, guidance or policies ...

➢ A charge will be issued in advance of the next FESAC meeting
In Conclusion …

• **In the immediate future:**
  – Keep producing great science!
  – Continue tradition of excellence in SC-supported research and operations of our scientific facilities

• **In the coming weeks and months:**
  – Congress is deliberating its appropriations decisions
  – We must be ready to execute when the new fiscal year starts on October 1, 2017
Questions?
Backup Slides
**Exascale Computing Initiative (ECI) and Exascale Computing Project (ECP).** The ECP is initiated as a joint ASCR/NNSA partnership using DOE’s formal project management processes. A new budget line was created for the SC-ECP in FY 2017.

**Facilities** operate optimally and with >90% availability; deployment of 200 petaflop upgrade at OLCF and site preparations for exascale machines and NERSC-9 and upgrade of ESnet.

**SciDAC partnerships** were recompeted in FY 2017 with new institutes and partnerships that span basic science priorities.

**Applied Mathematics research** addresses challenges of increasing complexity and **Computer Science research** and **Research and Evaluation Partnerships** explores technologies “beyond Moore’s law” including testbeds.

**The Computational Sciences Graduate Fellowship** is funded at $10 million.
The BES FY 2018 Request of $1,554.5 million is a decrease of $294.5 million or 16% from the FY 2016 Enacted level.

The overall research funding in FY 2018 is reduced by 18% from FY 2016, requiring a significant shift in priorities with targeted reductions of activities that extend to later-stage fundamental research. Both the core research and the EFRC program will emphasize emerging high priorities in quantum materials and chemistry, catalysis science, synthesis, and instrumentation science.

No funding is requested for the two BES-supported Energy Innovation Hubs, Batteries and Energy Storage and Fuels from Sunlight, or for the DOE Experimental Program to Stimulate Competitive Research.

All BES user facilities will operate at significantly below optimal levels. Selected light source beamlines and neutron flight paths will be shut down. The Stanford Synchrotron Radiation Lightsource will operate up to the first quarter and then transition to a warm standby status. No funding is requested for two Nanoscale Science Research Centers: the Center for Functional Nanomaterials or the Center for Integrated Nanotechnologies.

No funding is requested for Long Term Surveillance and Maintenance or for the disposition of unused equipment for the Lujan Neutron Scattering Center.

To maintain international competitiveness of our facilities, BES will continue to support the Linac Coherent Light Source-II (LCLS-II) and Advanced Photon Source Upgrade (APS-U) projects. APS-U will transition from a major item of equipment to a line item construction project.
Genomic sciences supports recompeted Bioenergy Research Centers at reduced levels, microbiome research, and efforts in biosystems design for bioenergy and renewable bioproducts.

Mesoscale-to-molecules research supports the development of enabling technology to visualize key metabolic processes in plant and microbial cells at the subcellular and mesoscale, including new efforts in cryo-EM.

Atmospheric System Research supports research to advance the understanding of cloud-aerosol-precipitation interactions to improve dynamic earth system models.

Environmental and Earth System Modeling supports development of physical, chemical, and biological model components, as well as fully coupled Earth system models to simulate climate variability at regional and global scales.

Environmental System Science supports research to provide a robust, predictive understanding of terrestrial surface and subsurface ecosystems. Supports the Next Generation Ecosystem Experiment in the Arctic, targeting a terrestrial ecosystem not well represented in earth system models.

User facilities operate at reduced levels: ARM continues measurements at two fixed sites: North Slope, Alaska and Southern Great Plains, Oklahoma; one mobile facility deploys to the Southern Ocean. JGI provides genome sequence data, synthesis, and analysis. EMSL focuses on molecular scale analysis for biological and environmental samples.
Fusion Energy Sciences
Matter at very high temperatures and densities and the scientific foundations for fusion

- DIII-D will operate for 18 weeks and focus on high priority research
- NSTX-U is down for repair. Scientists will analyze previous data, support recovery, and perform collaborative research on other tokamaks
- Support increases for Scientific Discovery through Advanced Computing activities
- Support is maintained for U.S. research involvement on international machines EAST (China), KSTAR (Korea), and W7-X (Germany)
- Materials and Fusion Nuclear Science research will focus on high priority research
- HEDLP research will focus on the MEC instrument at LCLS
- General Plasma Science activities will continue, including the partnership with NSF
- The Request supports the U.S. Contributions to ITER Project

Performing astrophysics experiments in the lab (MEC / SLAC)
New γ-ray camera in DIII-D to detect ultra high energy electrons
Atomistic modeling of H-He synergies in tungsten
Advanced simulations lead to optimized stellarator coils
High Energy Physics
Understanding how the universe works at its most fundamental level

- The HEP mission is to understand how our universe works at its most fundamental level:
  - Discover the most elementary constituents of matter and energy
  - Probe the interactions between them
  - Explore the basic nature of space and time

- In May 2014 the Particle Physics Project Prioritization Panel (P5) released a report presenting an actionable long-term strategy for U.S. particle physics that enables discovery and maintains the U.S. position as a global leader in particle physics.
  - The P5 report identified five intertwined science drivers, compelling lines of inquiry that show great promise for discovery:
    - Use the **Higgs boson** as a new tool for discovery
    - Pursue the physics associated with **neutrino mass**
    - Identify the new physics of **dark matter**
    - Understand **cosmic acceleration**: dark energy and inflation
    - **Explore the unknown**: new particles, interactions, and physical principles

- Science drivers identify the scientific motivation while the **Energy, Intensity, and Cosmic Research Frontiers** provide a useful categorization of experimental techniques
Nuclear Physics
Discovering, exploring, and understanding all forms of nuclear matter

- Decreased funding for research focuses resources on the most critical areas of nuclear science research.

- Operations at RHIC will be supported for ten weeks in FY 2018. Beam time in FY 2018 will be combined with planned operation in FY 2019 to explore the properties of the quark gluon plasma first discovered there and to enable studies of spin physics.

- The 12 GeV CEBAF Upgrade, completed in FY 2017, will begin its scientific program with a ten week run, promising new discoveries and an improved understanding of quark confinement.

- Operations at ATLAS are supported, continuing to provide high-quality beams of all the stable elements up to uranium as well as selected beams of short-lived nuclei.

- Construction will continue on the Facility for Rare Isotope Beams following a rebaseline of the project reflecting reduced construction funding in FY 2018. Funding for the Gamma-Ray Energy Tracking Array (GRETA) MIE is continued to exploit the scientific potential of FRIB.

- Fabrication continues on the Stable Isotope Production Facility (SIPF) to produce enriched stable isotopes, a capability not available in the U.S. for almost 20 years.
FY 2018 Construction Projects

<table>
<thead>
<tr>
<th>Ongoing Projects:</th>
<th>FY 2016 Current w/ SBIR/STTR</th>
<th>FY 2017 Enacted</th>
<th>FY 2018 President's Request</th>
</tr>
</thead>
<tbody>
<tr>
<td>BES - 13-SC-10 Linac Coherent Light Source II (LCLS-II), SLAC</td>
<td>200.3</td>
<td>190.0</td>
<td>182.1</td>
</tr>
<tr>
<td>FES - 14-SC-60 U.S. Contributions to International Thermonuclear Experimental Research (ITER)</td>
<td>115.0</td>
<td>50.0</td>
<td>63.0</td>
</tr>
<tr>
<td>HEP - 11-SC-40 Long Baseline Neutrino Facility/Deep Underground Neutrino Experiment (LBNF/DUNE)</td>
<td>26.0</td>
<td>50.0</td>
<td>54.9</td>
</tr>
<tr>
<td>HEP - 11-SC-41 Muon to Electron Conversion Experiment (Mu2e)</td>
<td>40.1</td>
<td>43.5</td>
<td>44.4</td>
</tr>
<tr>
<td>NP - 14-SC-50 Facility for Rare Isotope Beams (FRIB), Michigan State University</td>
<td>100.0</td>
<td>100.0</td>
<td>80.0</td>
</tr>
<tr>
<td>SLI - 15-SC-76 Materials Design Laboratory at ANL</td>
<td>23.9</td>
<td>19.6</td>
<td>24.5</td>
</tr>
<tr>
<td>SLI - 15-SC-78 Integrative Genomics Building at LBNL</td>
<td>20.0</td>
<td>19.6</td>
<td>24.8</td>
</tr>
<tr>
<td>SLI - 17-SC-71 Integrated Engineering Research Center at FNAL</td>
<td>...</td>
<td>2.5</td>
<td>1.5</td>
</tr>
<tr>
<td>SLI - 17-SC-73 Core Facility Revitalization at BNL</td>
<td>...</td>
<td>1.8</td>
<td>1.5</td>
</tr>
<tr>
<td><strong>Total, Ongoing Projects</strong></td>
<td><strong>525.3</strong></td>
<td><strong>477.0</strong></td>
<td><strong>476.7</strong></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>New Starts in FY 2018:</th>
<th>FY 2016 Current w/ SBIR/STTR</th>
<th>FY 2017 Enacted</th>
<th>FY 2018 President's Request</th>
</tr>
</thead>
<tbody>
<tr>
<td>BES - 18-SC-10 Advanced Proton Source (APS) Upgrade, ANL*</td>
<td>...</td>
<td>...</td>
<td>20.0</td>
</tr>
<tr>
<td>SLI - 18-SC-71 Energy Sciences Capability, PNNL</td>
<td>...</td>
<td>...</td>
<td>1.0</td>
</tr>
<tr>
<td><strong>Total, New Starts in FY 2018</strong></td>
<td><strong>...</strong></td>
<td><strong>...</strong></td>
<td><strong>21.0</strong></td>
</tr>
<tr>
<td><strong>Total, Construction</strong></td>
<td><strong>525.3</strong></td>
<td><strong>477.0</strong></td>
<td><strong>497.7</strong></td>
</tr>
</tbody>
</table>

*converts from MIE to Line-Item Construction
FY 2018 MIE Projects

<table>
<thead>
<tr>
<th>Ongoing Projects:</th>
<th>FY 2016 Current w/ SBIR/STTR</th>
<th>FY 2017 Enacted</th>
<th>FY 2018 President's Request</th>
</tr>
</thead>
<tbody>
<tr>
<td>BES - Advanced Photon Source Upgrade (APS-U), ANL*</td>
<td>20.0</td>
<td>42.5</td>
<td>...</td>
</tr>
<tr>
<td>HEP - Large Synoptic Survey Telescope camera (LSSTcam)</td>
<td>40.8</td>
<td>45.0</td>
<td>9.8</td>
</tr>
<tr>
<td>HEP - Dark Energy Spectroscopic Instrument (DESI)</td>
<td>9.8</td>
<td>12.0</td>
<td>1.9</td>
</tr>
<tr>
<td>HEP - Facility for Advanced Accelerator Experimental Tests (FACET-II)</td>
<td>...</td>
<td>0.5</td>
<td>2.0</td>
</tr>
<tr>
<td>HEP - Large Underground Xenon (LUX) - ZonEd Proportional scintillation in Liquid Noble gases (ZEPLIN) experiment (LZ)</td>
<td>10.5</td>
<td>12.5</td>
<td>14.1</td>
</tr>
<tr>
<td>HEP - Super Cryogenic Dark Matter Search at Sudbury Neutrino Observatory Laboratory (SuperCDMS-SNOLab)</td>
<td>2.4</td>
<td>3.4</td>
<td>2.0</td>
</tr>
<tr>
<td>NP - Gamma-Ray Energy Tracking Array (GRETA)</td>
<td>...</td>
<td>0.7</td>
<td>0.2</td>
</tr>
<tr>
<td>NP - Stable Isotope Production Facility (SIPF)</td>
<td>...</td>
<td>2.5</td>
<td>1.5</td>
</tr>
<tr>
<td><strong>Total, Ongoing Projects</strong></td>
<td><strong>83.5</strong></td>
<td><strong>119.1</strong></td>
<td><strong>31.5</strong></td>
</tr>
</tbody>
</table>

| New Starts in FY 2018:                                                          |                              |                |                            |
| HEP - High Luminosity Large Hadron Collider Accelerator Upgrade Project (HL-LHC AUP) | ...                          | ...            | 27.0                       |
| **Total, MIEs**                                                                 | **83.5**                     | **119.1**      | **58.5**                   |

*converts from MIE to Line-Item Construction