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Department of Energy

Mark T. Elsesser and Michael S. Lubell
American Physical Society

HIGHLIGHTS

– The absence of a budget agreement until late December last year and the consequent shelving of FY 2014 appropriations legislation until Jan. 17 this year led to a one-month delay in the release of the White House FY 2015 spending request. In his first full year as Secretary of Energy, Dr. Ernest Moniz also found himself virtually flying solo. Four key science positions were vacant: Under Secretary for Science and Energy, Director of ARPA-E, Director of the Office of Science (SC), and Under Secretary for Nuclear Security and Administrator for the National Nuclear Security Administration (NNSA). The Department of Energy's "Budget Highlights" summarizes its priorities with these words: "The United States…faces challenges in addressing the threat of climate change and capturing the jobs of tomorrow's clean energy economy...The Department of Energy (DOE) requests $27.9 billion to…address these challenges…by investing in innovative and transformative scientific and technological solutions…"

– The Department has been a perennial target of Capitol Hill critics who have charged it with exhibiting poor efficiency, lack of transparency, wasteful programming, and in recent years absence of strategic planning. To right the DOE ship, Secretary Moniz has moved aggressively to reorganize the Department into "three Under Secretaries – Science and Energy, Nuclear Security, and Management and Performance – that recognizes the complex relationships among program officers."

– The FY 2015 budget would continue to concentrate funding increases on programs the Obama Administration has emphasized in previous years. The Department's proposed spending would be closely aligned with the President's 2013 Climate Action Plan (CAP) that has set a target date of 2020 for reducing U.S. greenhouse gas emissions to 17 percent below 2005 levels. Energy R&D would increase by 12.2 percent, led by

Energy Efficiency and Renewable Energy (EERE), which would receive a 20.6 percent boost, and the Advanced Research Projects Agency–Energy (ARPA-E), which would get a 17.4 percent plus up. Electricity Delivery and Energy Reliability would see its R&D programs expand as well, with a 7.9 percent increase focused on energy storage and micro-grids. By contrast, Fossil Energy R&D would decline 26.2 percent.

– The FY 2015 budget would continue to provide funding at FY 2014 levels for 46 Energy Frontier Research Centers, following re-competition of the existing program during the current fiscal year. The selected centers – which would receive three-year initial awards – would continue to address "both grand challenge science and energy use-inspired research" but with increased emphasis on mesoscale investigations, predictive materials, and chemical sciences. The Department would also continue to support four energy hubs (Fuels from Sunlight, Batteries & Energy Storage, Critical Materials, and Nuclear Energy Modeling & Simulation), as well as the Consortium for Building Energy Innovation (formerly the Energy Efficient Buildings Hub).

– Pursuant to the joint Defense Department and NNSA planning process in 2013, the Department would ramp up R&D spending on Atomic Energy Defense Activities by 14.4 percent overall, although Nonproliferation programs would decline again, this time by 9.5 percent.

– If any set of DOE programs can be assigned a losing status, Science (SC) would have that distinction. The Department would increase spending on those accounts by a scant 0.9 percent, failing to even keep pace with inflation. But within the SC accounts, Advanced Scientific Computing Research (ASCR) would see a major increase of 13.2 percent, while Fusion Energy Sciences (FES) and High-Energy Physics (HEP) would absorb cuts of 17.6 percent and 6.6 percent respectively.

HISTORICAL PERSPECTIVE AND POLITICAL CONTEXT

DOE traces its origin to 1946, when Congress established the Atomic Energy Commission (AEC) to oversee the nation's embryonic nuclear weapons and civilian nuclear reactor programs. In 1974, Congress consolidated energy R&D programs housed throughout the federal government and combined them with the non-regulatory activities of the AEC to create the Energy Research and Development Administration (ERDA). In 1977,when ERDA achieved Cabinet status, it was renamed the Department of Energy. Today, DOE provides more than 45 percent

of the nation's support for basic research in the physical sciences, ranking first among government agencies in that regard. It ranks second in mathematics and computer science, and its research programs play a key role in training the next generation of scientists and engineers. For example, SC funds programs at 300 leading academic institutions and supports 25,000 Ph.D.s, graduate students, undergraduates, engineers and technicians. SC also maintains 30 R&D facilities at 17 laboratories that service almost 30,000 researchers in universities, industry and other federal agencies, covering virtually every congressional district and spanning virtually every discipline. SC has an enviable record of accomplishment: over a 60-year period it has supported research leading to more than 100 Nobel Prizes, about a fifth of them in the last decade.

Historically, DOE has devoted half or more of its R&D budget to developing, building, and operating its research laboratories. They include multipurpose, specialized-civilian and national weapons facilities that afford researchers across disciplines the opportunity to tackle large, complex problems ranging from climate modeling and combustion dynamics to nuclear safeguards and non-proliferation. Among the facilities for which DOE has responsibility are synchrotron and free-electron laser light sources, neutron sources, specialized accelerators, super computers, and nanoscale research centers.

The Department's budgets have generally tracked the nation's concerns with energy and national security, growing in times of crisis and suffering from benign neglect otherwise. Once the Cold War ended, with uncertainties in foreign supplies of petroleum seemingly less threatening, DOE R&D budgets began to decline, especially in constant dollars. And over the course of the next two decades, the Department lost 25-30 percent of its capacity to support research. But in FY 2009 and 2010, with Congress and the White House increasingly focused on innovation, competitiveness and energy security, DOE's R&D spending grew much faster than inflation. Since then, however, caught in a partisan cross fire over deficits, national debt, climate change, "fracking," and, more generally, disagreements over where the legitimate role of government begins and ends, the Department's research budget has stagnated and for many of its accounts actually declined in inflation adjusted dollars.

The political environment is little changed from last year, and the Administration's request is likely to run into similar headwinds in the GOP-controlled House of Representatives. The Department's alignment of research funding with the president's CAP might elicit a sympathetic

response from Democrats, but it is certain to run afoul of traditional conservative budget hawks and Tea Party skeptics. They will unquestionably view the proposed increases for EERE and ARPA-E not only as fiscally irresponsible, but also as an intrusion of the federal government into arenas that belong to the private sector. It is difficult to see how the request for those accounts will escape the House scalpel.

The Office of Science might fare much better, and it is possible Congress could see fit to plug some of the holes in the Department's request, especially for Fusion Energy Sciences and High-Energy Physics. William F. Brinkman, SC's former director, had a rocky relationship with congressional appropriators, and although Marc Kastner, his designated successor, had not yet been confirmed prior to the start of the appropriations season, Acting Director Patricia Dehmer has received high marks for the clarity of her testimony and vision for SC's programs.

IN DEPTH REVIEW

Top Line Summary

For FY 2015, the proposed $27.9 billion DOE budget would represent an increase of $715 million or 2.6 percent relative to FY 2014. It would boost total spending for the Energy programs [+$369 million (+9.9 percent)], NNSA [+$451 million (+4.0 percent)] and ARPA-E [+$45 million (+16.1 percent)]. It would provide a small, sub-inflation increase for SC [+$45 million (+0.9 percent)]. The combined R&D portfolio would climb $977 million or 8.6 percent to $12.4 billion (See Table II-11). Technology R&D would be the prime beneficiary: Atomic Energy Defense Activities [+$639 million (+14.4 percent)], ARPA-E [+$44 million (+17.4 percent)] and Energy (not including ARPA-E) [+$236 million (+11.6 percent)]. Science would gain, but not enough to cover the increased inflationary costs of research [+$59 million (+1.3 percent)].

Energy Programs

After four years of strong support under a Democratic Congress and White House, appropriations for DOE's Energy R&D portfolio grew from $1.5 billion to $2.27 billion starting in FY 2006. But Republican House victories in 2010 curbed the Administration's push for continued budgetary growth. By proposing to increase Energy R&D (including ARPA-E) appropriations by 12.2 percent to $2.57 billion the presidential request for FY 2015 sets the stage for another partisan skirmish.

EERE would continue to be a priority, with proposed increases of at least 6 percent – and in many cases much larger (see Table II-11) – for all of its programs except Hydrogen and Fuel Cell Technologies, whose funding which would essentially remain flat at $93 million. And once again the largest budget increase would belong to Advanced Manufacturing, which would see its funding rise by $125 million to $305 million (+69.1 percent) and would include support for the deployment of at least one new Clean Energy Manufacturing Innovation Institute.

The presidential request would provide $180 million for overall Electricity and Reliability R&D, a 22.2 percent increase. But Infrastructure Security & Energy Restoration and Smart Grid R&D would see the largest gains, with FY 2015 budgets increasing to $22.6 million (+182.6 percent) and $24.4 million (+67.2 percent), respectively. The proposed budget would also include $36 million for Clean Energy Transmission and Reliability and $19 million for Energy Storage.

Budget reductions would continue in FY 2015 for Nuclear Energy R&D, which would receive $863 million [-$25 million (-2.8 percent)] overall. While its new Supercritical Transformational Electric Power Generation (STEP) program would be buoyed by a $27.5 million commitment, other programs would face steep cuts. For example, the Reactor Concepts RD&D budget would be reduced by $12 million (-10.9 percent) to $101 million and the Integrated University Program, which previously fully funded single- and multi-year fellowships in nuclear energy-related fields of study, would see its funding eliminated.

The FY 2015 budget would fund overall Fossil Energy R&D at $476 million, a sharp decrease of $86 million or 15.4 percent from the enacted FY 2014 level. With the exception of $25 million in funding for the Natural Gas Carbon Capture and Storage program, a new FY 2015 program focused on directly demonstrating technology to store more than 75 percent of carbon from treated emissions from a natural gas power system, all other Coal programs would receive budget reductions with a total budget request of $302 million: Carbon Capture would receive $77 million [-$15 million (-16.3 percent)] and Carbon Storage, $80 million [-$28.7 million (-26.4 percent)]. Natural Gas Technologies would receive an increase of $14 million (+69.9 percent) to $35 million, and Unconventional Fossil Energy Technologies would be zeroed out.

Office of Science

The Office of Science (SC) continues to be the dominant federal sponsor of physical sciences research, a role it has played for decades. It also continues to provide extensive support for research in computer science, mathematics, biological and environmental science, materials science, nanotechnology, and engineering. After almost two decades of declining level of effort, DOE Science in 2007 became one of three federal programs identified in the America COMPETES Act for budget doubling by FY 2016. But except for major increases in FY 2009 and 2010, SC has fallen far short of the authorized doubling trajectory. The $4.71 billion R&D budget for FY 2015 would not even allow SC spending to keep pace with inflation, forcing many activities to make very difficult choices. Most programs would see modest changes (see Table II-11), but Advanced Scientific Computing Research (ASCR) would get a 13.2 percent boost, while Fusion Energy Sciences (FES) and High-Energy Physics (HEP) would suffer cuts of 17.6 and 6.6 percent respectively.

The proposed budget for ASCR, which focuses on large scale modeling and simulation capabilities, would support three petaflop computing facilities: the Argonne Leadership Computing Facility (ALCF), the Oak Ridge Leadership Computing Facility (OLCF), and the National Energy Research Scientific Computing Center (NERSC) at Lawrence Berkeley National Laboratory (LBNL). The budget would also allow NERSC to begin to deploy its 20-30 petaflop upgraded facility and initiate 75-200 petaflop upgrades at ALCF and OLCF. The budget would also support continuing research on technologies needed for exascale computing.

The request for BES, which has responsibility for operating four synchrotron light sources, one high-flux neutron source, one free electron laser facility, and five nanoscale science research centers, would increase support for facilities operations by 3.6 percent (see Table II-11). It would also boost Material Sciences and Engineering R&D by 6.6 percent, while keeping Chemical Sciences spending level. The request would allocate $56 million for transferring synchrotron operations at Brookhaven National Laboratory (BNL) from the National Synchrotron Light Source (NSLS) to NSLS-II that is nearing completion. It would further devote $85.7 million to R&D, design, prototyping, long-lead procurement, and construction of technical systems for the Linac Coherent Light Source-II at SLAC National Accelerator Laboratory. Finally, BES would provide $20 million to R&D, design, and limited prototyping for the Advanced Light Source Upgrade at Argonne National Laboratory (ANL).

The proposed BER budget would ramp up Climate and Environmental Sciences by 10.1 percent (see Table II-11), with the continuing goal of improving climate model resolution, validation, and verification. The request would renew the Department's attempt to reduce spending on Biological Systems Science, which failed congressional muster last year. The 2014 request would trim the program 3.8 percent.

The request for FES reflects two realities: overall spending constraints imposed by last December's bipartisan budget agreement and difficulties and delays faced by the international fusion project known as ITER. The $88.7 million (-17.6 percent) budget reduction proposed for FY 2015 would be divided between domestic research programs and ITER. Although the Administration last year had committed to a flat annual funding profile of $225 million, its ITER request for FY 2015 is only $150 million. The Department asserts its request is sufficient to provide for critical path items that would maintain required U.S. in-kind contributions in light of the project's delay. While the FY 2015 request would cut ITER support by $49.5 million (-24.8 percent), the project's allocation would still represent more than a third of the FES budget.

U.S. commitments to ITER and budgetary constraints limit the resources for FES domestic research programs, which would face a $39.2 million reduction (-12 percent). The cuts would be spread across a number of research programs with the High Energy Density Laboratory Plasmas (HEDLP) suffering the most [-$10.6 million (-61 percent)]. Support would continue for the MEC beam-line science team and HEDLP research group at SLAC. However, the HEDLP program's contraction would result in no new academic grants for basic HEDLP research as part of the SC/NNSA joint program; no new research projects in basic HEDLP science at DOE national laboratories; and the cessation of operations of the NDCX-II facility at LBNL. The budget reduction is unfortunate since plans to expand outside user access to the National Ignition Facility (NIF) are nearing completion.

The sharp reduction [-$53 million (-6.6 percent)] in proposed FY 2015 HEP spending reflects the inability of that high-profile research field to produce a prioritized strategic plan in a timely fashion. Ignoring warnings from DOE management and other policymakers, the Particle Physics Project Prioritization Panel (P5) did not complete its work before the Department prepared its budget request. In fact, P5, a subpanel of the High-Energy Physics Advisory Panel (HEPAP) that reports to both DOE and the National Science Foundation, might not release its report until

after the House Energy and Water Appropriations Subcommittee has completed its FY 2015 bill. Should the proposed cut remain in the final bill, the high-energy physics community will face a major hurdle when it seeks to restore funding in FY 2016. By that time, the luster of the Higgs boson discovery, in which American physicists played a dominant role, will probably have worn off. Still, in light of the P5 delays, the HEP request ought to be viewed as a placeholder.

Although the budget request would provide a 4.3 percent increase for NP, the entire $24 million increase would be allocated to construction, largely for developing the Facility for Rare Isotope Beams at Michigan State University. Funding for core research programs would remain flat, as would support for facilities operations at BNL's Relativistic Heavy Ion Collider (RHIC) and Jefferson Laboratory's Continuous Electron Beam Accelerator Facility (CEBAF), where the 12 GeV upgrade will have been successfully completed. The NP request would continue to leave nuclear physics research squeezed for resources.

Atomic Energy Defense Activities

The DOE and its predecessors have long had responsibility for managing the nuclear weapons stockpile, supplying naval reactors, addressing the environmental legacy of nuclear weapons work, and attending to technical issues associated with non-proliferation goals. For FY 2015, increases for Atomic Defense R&D [+$639 million (+14.4 percent)] would continue the trend of recent years. The total budget of $5.08 billion would provide major R&D increases for NNSA Weapons Activities and Naval Reactors (see Table II-11). Also following recent trends, Defense Nuclear Nonproliferation R&D would continue to drop, but the NNSA Science Campaign would grow dramatically.

In FY 2015, the Inertial Confinement Program would continue to strongly emphasize high-energy-density (HED) weapons R&D while continuing a balanced effort in ignition and alternate ignition concepts. The budget would provide level funding for NNSA's three major HED facilities – NIF at Lawrence Livermore Laboratory, the Z Facility at Sandia National Laboratories, and the Omega Laser Facility at the University of Rochester's Laboratory for Laser Energetics – as well as support for experiments by external users.