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Department of Energy Budget Cuts: Time to End the Hidden Green Stimulus

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Abstract
Government spending has been spiraling upward—and spending by nearly all government agencies can, and should, be cut. President Obama has just submitted his 2013 budget request to Congress, providing fertile ground for spending cuts. The Department of Energy (DOE), with its many research, development, and grant programs offers many opportunities for savings. While there is an important role for DOE in energy security and environmental management, many DOE projects fall outside its mission, supporting everything from commercialization of technologies to noncritical research—which can be conducted, usually much more efficiently, by the private sector. This paper provides a common-sense guide to saving $5.5 billion in the FY 2013 budget proposal while maintaining funding for the DOE's real mission of promoting national and economic energy security.

This paper, in its entirety, can be found at **http://report.heritage.org/bg2668**

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Government spending has increased considerably over the past decade, and, unless a dramatic shift occurs, spending will continue to grow at unsustainable rates. Alleviating the huge debt burden that the government is placing on future generations, that is, reining in federal spending, must be a priority for Congress. Congress must make prudent cuts in the fiscal year (FY) 2013 budget and examine the role of each government agency. One good place to start is to cut the wasteful, inefficient, and unnecessary spending at the U.S. Department of Energy (DOE).

Congress's ultimate objective should be to eliminate any Department of Energy function that does not support a critical national interest unmet by the private sector. This objective will require a broad reorganization, and could very well result in the elimination of the entire department. Elimination, however, should not be the immediate policy goal. A graduated approach that begins with reining in spending would likely enjoy bipartisan support and provide a foundation for further reform.

The Department of Energy's budget grew from $15 billion in FY 2000 to $25.7 billion in FY 2011—a

Talking Points

- Reining in federal spending is a national priority, and Congress must make prudent cuts in the FY 2013 budget, examining the role of each government agency. One good place to start is with the wasteful and unnecessary spending at the Department of Energy (DOE).
- Congress should eliminate any DOE function that does not support a critical national interest, returning the DOE to its traditional mission of promoting national and economic energy security.
- The budget cuts proposed in this paper would achieve a savings of $5.3 billion compared to the FY 2012 enacted budget.
- The DOE has ballooned by subsidizing and forcing energy technologies into the marketplace. The private sector has demonstrated countless times that it is far better equipped than government to allocate resources and develop commercially viable technologies.
- President Obama uses the DOE budget to pick winners and losers, which promotes crony capitalism as companies lobby for favorable treatment.

staggering 71 percent increase in only one decade. Many government programs included in various Presidents' annual DOE budgets evolved from basic research and development to attempts at commercialization better left to the private sector. Other programs are politically correct pet projects of various Members of Congress that have little business being supported by taxpayers. The private sector is much better at allocating resources and developing energy technologies than government-directed initiatives. Such wasteful use of taxpayer money provides Congress an opportunity to significantly scale back or eliminate a number of government energy programs and return the Department of Energy to its traditional mission of promoting national and economic energy security and focus on areas that meet a critical national objective.[1]

The budget cuts proposed in this paper apply to President Barack Obama's FY 2013 budget proposal of allocating $27.2 billion to the Department of Energy. The proposed cuts would save $5.5 billion compared to President Obama's FY 2013 budget request and save $5.3 billion compared to the FY 2012 enacted budget.[2]

Defining the DOE Mission

The Department of Energy bases its mission on five core strategic themes: (1) energy security, (2) nuclear security, (3) scientific discovery and innovation, (4) environmental responsibility, and (5) management excellence. This paper focuses on cuts that should be made to applied research, commercialization, technology deployment, and basic research programs, with consequent reductions in overall DOE personnel. More specifically, programmatic cuts focus on spending on energy and related issues rather than cuts to Environmental Management or National Nuclear Security Administration (NNSA) programs.

- **Energy Security.** President Obama's FY 2013 budget discusses the importance of reducing America's dependence on foreign oil and investing in clean energy and nonpetroleum fuels that will reduce America's reliance on oil from terror-supporting countries. Typically, the ideas for improving energy security are either protectionist or attempt to deploy uncompetitive technologies. Improving energy security should not be an excuse for the DOE to invest in commercialization projects (biofuels, for instance) for which the private sector is much better equipped to determine whether they can compete in the market. The federal government's role in improving energy security is to open access to America's own energy supply, but that role falls under the purview of the Department of the Interior, not the Department of Energy.

- **Nuclear Security.** A large part of the Department of Energy's nuclear security mission is nuclear deterrence and keeping nuclear materials secure. Many of these national security needs fall under the purview of the NNSA. While reforms to NNSA may well be appropriate, traditional national security questions are beyond the scope of this paper.

- **Scientific Discovery and Innovation.** Some argue that the DOE has a role to play in basic research—investing in ideas that can provide benefits but are too financially risky for the private sector to undertake. But an endeavor being too financially risky for a company to undertake does *not* mean it becomes something for which the government should pay. It could be argued that government can have a role in basic research that ultimately may have commercial value—but that should not be the purpose of the research. Government research programs should advance specific critical national interests that is not being met by the private sector. Defense programs often fall into this category. The DOE's basic energy research for developing new commercial energy technologies application is not in this category.

  This does not mean that no research should be conducted by the Department of Energy, but it is strongly questionable whether the government is best suited to oversee that research. Energy production is a viable commercial enterprise, so the U.S. does not *need* a government agency dedicated to advancing this activity. Nevertheless, the Department of Energy has expanded its role beyond basic research to technology development, demonstration, and commercial application, which interferes with the

1. U.S. Department of Energy, "About DOE," at *http://www.energy.gov/about/index.htm* (February 27, 2012).
2. See the appendix for a detailed breakdown of spending cuts to proposed FY 2013 and enacted FY 2012 budgets.

marketplace. At these stages of development, profits and losses are a better indicator of whether a project or an idea should move forward than continued use of taxpayer money to force products into the marketplace, or to offset investment that the private sector would have made without the government subsidy. Congress should make immediate cuts to the programs that fall under scientific discovery, innovation, and applied-research categories. Congress should then phase out federal funding for basic research.

- **Environmental Management.** As a result of government-funded defense and civilian nuclear activities, the Department of Energy created the Office for Environmental Management (EM) to clean up the environmental legacy of the Cold War era. EM hires contract workers for much of this work. Environmental management activities are valuable, but this program needs structural reform to remove inefficiencies from contract work. Reforms are likely necessary, but also beyond the scope of this paper

- **Management Excellence.** DOE stresses that to effectively carry out its mission, it must have sound management. While the soundness of that management is questionable, the focus of this paper will remain on programmatic cuts. (Any budget reductions for personnel will be a result of programmatic cuts.)

The Proper Role of the Department of Energy

Policymakers frequently create a sense of urgency for the particular government programs that they support, and such is the case with many energy projects. But the United States enjoys robust domestic energy resources (nuclear energy, oil, coal, and hydroelectric power). The energy market can be diverse and competitive without government interference. DOE programs should not compete with or crowd out private-sector research. Even though some government research can spur new breakthroughs, they should not be the main objective of DOE programs. President Obama's budget proposal, however, moves in the opposite direction, spending more money on activities best left to the private sector.

The government programs that have become commercial successes—the Internet, computer chips, the global positioning system (GPS)—were not intended to meet a commercial demand. They were each the result of defense-related programs that were created to meet national security requirements. Entrepreneurs saw an opportunity in these defense technologies and created the commercially viable products available today.

The reality is that when it comes to energy policy, the free market works. Indeed, the business environment for energy is robust despite seemingly endless forays by policymakers and bureaucrats into the energy industry. But those attempts to control energy markets do have an effect: They result in higher prices, fewer available energy sources, reduced competition, and stifled innovation. As federal interventions increase, so do the—almost always negative—effects. As a result, the U.S. is now dangerously close to a point where meddling by Washington could have a long-term negative impact on the standard of living of every American.

By attempting to force government-developed technologies into the market, the government diminishes the role of the entrepreneur and crowds out private-sector investment. This practice of the government picking winners and losers denies energy technologies the opportunity to compete in the marketplace, which is the only proven way to develop market-viable products. When the government attempts to drive technological commercialization, it circumvents this critical process. Thus, almost without exception, it fails in some way.

The DOE may not be explicitly involved in commercialization, but the agency has intervened through applied research, technology development, and demonstration activities, such as carbon capture and sequestration and biomass infrastructure. With respect to the DOE budget, necessary reforms generally fall into two major categories: (1) programs that the DOE should eliminate or privatize, and (2) programs for which the DOE should scale funding back significantly because they evolved well beyond the scope of basic research.

Eliminate Hidden Green Stimulus Efforts

Throughout the entire FY 2013 budget, but primarily in the DOE budget, President Obama proposes $8.4 billion for energy conservation efforts. Such efforts include programs to make buildings, homes, manufacturing processes, and appliances more energy efficient.

For instance, the budget proposal states that the Office of Energy Efficiency and Renewable Energy (EERE) "will help address our Nation's energy security, environmental, and economic goals by: Providing American businesses and

households with low-cost energy services by creating low-cost renewable supplies and energy efficient products and systems."[3] Programs for different energy sources lay out specific price target goals in kilowatt hours. It is simply not the role of government to make energy technologies cost competitive. The demand for electricity and transportation fuels is immensely large; whichever source and technology can meet that demand in an affordable, reliable manner will capture a share of the market without the government's help.

EERE also includes an 80 percent increase in energy-efficiency spending. The President's budget says that

> the Budget provides DOE with $290 million to expand R&D on innovative manufacturing processes and advanced industrial materials that will enable U.S. companies to cut the costs of manufacturing by using less energy, while improving product quality and accelerating product development.[4]

When the government doled out billions of dollars in the stimulus bill to make homes more energy efficient, several problematic themes became apparent across the United States: shoddy workmanship requiring follow-up work, uncompetitive bidding, poor record keeping, and overcharging for energy-efficient light bulbs and carbon monoxide detectors. These programs do not properly align incentives to spend public money most efficiently, thereby resulting in waste, fraud, and abuse.[5] The federal government's involvement in deciding which companies receive contracts to install energy-efficient devices also means that these businesses will send more lobbyists to Washington not only to receive the contracts but also to expand the programs. The federal government's involvement in economic decision making creates a crony capitalist system in which those companies in best favor with the government receive the handouts.

Energy-efficiency spending programs and legislation have largely enjoyed bipartisan support because resourcefulness and saving money are inherently desired. Those reasons are precisely why the U.S. does not need spending initiatives to make businesses and homeowners more energy efficient. Businesses do not need public investment to improve efficiency and cut costs; they make those investments regularly with their own money. Technological advancements do often improve efficiency, but those investments should not be subsidized by the taxpayer, much less selected by Washington bureaucrats. Businesses and consumers will make these decisions, weighing preferences and considering trade-offs. Congress should eliminate all spending on energy conservation.

Although this paper specifically addresses the DOE, Congress should also eliminate green energy programs outside the DOE budget. For example, the Department of Agriculture's budget includes $6.1 billion for loans to rural electric companies that switch to clean-energy generation, and the National Science Foundation budget includes $355 million for clean-energy research, especially solar energy and energy efficiency. Facing high debts and recognizing that attempts to subsidize green energy have been unsuccessful, other countries, such as Germany, are cutting funding for their "green" energy programs.[6] President Obama, on the other hand, is doubling down. Congress should identify the green-energy programs throughout the budget and remove this spending entirely.

Eliminate Commercial Deployment and Technology Development (Savings: $3.04 billion)

The DOE budget funds applied-research programs on fossil fuels, renewable energy sources, and nuclear energy. But such technologies are developed at least as well, usually

3. Office of Management and Budget, "The President's Budget for Fiscal Year 2013," February 13, 2012, at *http://www.whitehouse.gov/omb/budget* (March 14, 2012).
4. Department of Energy, "FY 2013 Congressional Budget Request," February 2012, Vol. 3, at *http://www.cfo.doe.gov/budget/13budget/content/volume3.pdf* (March 13, 2012).
5. See, for instance, U.S. Department of Energy, Office of Inspector General, Office of Audit Services, "Audit Report: The State of Illinois Weatherization Assistance Program," October 2010, at *http://energy.gov/sites/prod/files/igprod/documents/OAS-RA-11-01.pdf* (March 14, 2012), and DOE Office of Inspector General, Office of Audits and Inspections, "Cuyahoga County of Ohio Department of Development—Weatherization Assistance Program Funds Provided by the American Recovery and Reinvestment Act of 2009," *Examination Report*, September 2011, at *http://energy.gov/sites/prod/files/OAS-RA-11-19.pdf* (March 14, 2012).
6. Kate Connolly, "Germany to Cut Solar Power Subsidies," *The Guardian*, March 2, 2012, at *http://www.guardian.co.uk/world/2012/mar/02/germany-cuts-solar-power-subsidies* (March 13, 2012).

much better, by the private sector. The DOE also funds technologies that, if they cannot survive without the government crutch, should not be in the marketplace to begin with. Furthermore, many of these DOE endeavors have the dubious goal of reducing carbon dioxide emissions. The DOE budget reiterates President Obama's goal of reducing CO_2 emissions by more than 80 percent by 2050 and states that DOE will help meet that goal by investing in "the research, development, and deployment of technologies that will position the United States to lead international efforts to confront climate change now and in the future." Even if reducing CO_2 emissions were a worthy goal, the private sector would achieve it better than a government agency.

The DOE's approach to reducing CO_2 emissions includes research on energy efficiency, renewable energy sources, carbon capture and sequestration, clean coal technologies, natural gas development, nuclear energy, new vehicle technologies, and loan guarantees for carbon-free sources of energy. All these energy sources and technologies are available today, but they are not commercially viable, whether due to burdensome regulations or simply because they are still prohibitively expensive. The government is not equipped to determine commercial viability and can *retard* the process by misallocating resources to inefficient uses. The following DOE applied-research programs should be reformed or eliminated:

- **Office of Energy Efficiency and Renewable Energy (Savings: $2.3 billion).** The Office of Energy Efficiency and Renewable Energy (EERE) funds research and development of what the government deems clean-energy technologies—hydrogen technology, wind energy, solar energy, biofuels and bio-refineries, geothermal power, vehicle technology, and building and weatherization technologies, most of which have been in existence for decades. Promoting these technologies is not an investment in basic research, but mere commercialization. Congress should deny the complete $2.3 billion requested, and eliminate the EERE.

- **Office of Electricity Delivery and Energy Reliability (Savings: $113 million).** The Office of Electricity Delivery and Energy Reliability (OE) pursues activities to modernize the nation's grid; it is evident that much of the funding advances the Administration's goals of promoting electric vehicles and renewable energy. In fact, the proposal recognizes, "Without development and deployment of 'next generation' electric transmission, distribution and customer technologies, the grid could become a barrier to the adoption of cleaner energy supplies and more energy-efficient demand-side measures."[7] Upgrading the nation's electricity grid has merit, but it should not be a government-centric approach, nor should it be used as a subsidy to advance renewable energy sources, especially by focusing on building new transmission lines to remote areas. Furthermore, smart-grid technology should be developed and driven by the private sector. The FY 2013 budget allocates $30 million of the proposed $143 million for cybersecurity, and, while the need exists for a cooperative, public–private role for grid protection, this could very well fall under the Department of Homeland Security's purview.

- **The Office of Fossil Energy (Savings: $428 million).** Most of the funding for fossil-energy research and development focuses on technologies that will reduce carbon dioxide emissions. This program includes a clean coal power initiative, research on fuels and power systems to reduce fossil power plant emissions, innovations for existing plants, integrated gasification combined cycle (IGCC), advanced turbines, carbon sequestration, and natural gas technologies. DOE's strategic plan emphasizes bringing five commercial-scale carbon capture and sequestration plans online by 2016.[8] The President's proposal also calls for $12 million to reduce the risks of an already safe method of natural gas extraction, hydraulic fracturing. The Administration proposes a phase-out of fossil fuel subsidies, and significantly cuts

7. U.S. Department of Energy, *FY 2013 Congressional Budget Request: Department of Energy: Volume 3*, February 2012, at *http://www.cfo.doe.gov/budget/13budget/content/volume3.pdf* (March 14, 2012).
8. *Ibid.*

funding for the Office of Fossil Energy. But the Administration is cutting this spending not primarily because this proposal is good economic policy, but to promote Administration-preferred energy sources. Eliminating these programs while keeping the funding necessary to maintain the Strategic Petroleum Reserve and Naval Petroleum and Elk Hills School Lands Fund would save $428 million.

- **The Office of Nuclear Energy (Savings: $178 million).**[9] Funding to promote nuclear energy development should be reduced from the $770 million requested by the President to $592 million. Specifically, research, development, and demonstration of reactor concepts should be reduced by $52 million to $21 million to include only enough funds to maintain the Next Generation Nuclear Plant project. The Office of Nuclear Energy also includes $67 million for small modular reactor (SMR) licensing and support programs. While SMRs have great potential, commercialization must be shouldered by the private sector. A portion of these funds should be redirected to the Nuclear Regulatory Commission for SMR-licensing preparation. This does not preclude DOE from engaging in SMR-related work. The President's Nuclear Energy Enabling Technologies (NEET) program is charged with investigating the crosscutting of technologies with applicability to multiple reactor designs, including SMRs. Cuts to the NEET budget should include $24 million from the unnecessary modeling and simulation hub, and $15 million from the National Scientific User Facility, which supports work that should be funded by the Science budget, if at all. That still leaves $26 million to fund NEET projects. Fuel-cycle research and development should also be cut by $55 million, leaving $120 million, which should almost entirely be dedicated to restart the Yucca Mountain project for storing spent nuclear fuel. Finally, $31 million should be cut from the Program Direction budget to account for Office of Nuclear Energy downsizing.

The Office of Science (Savings: $1.42 billion)

The Department of Energy's Office of Science (SC) is very different from the applied research programs where many of the technologies already exist and are ready to be tested in the marketplace. The Office of Science is meant to bring about groundbreaking discoveries and inventions as well as to conduct basic research on energy sources and employ computational modeling for a wide variety of research.[10]

The FY 2013 presidential request for the SC is $5 billion, an increase of $118.4 million over the FY 2012 enacted figure. Even though the goal of the Office of Science is to deliver major scientific discoveries, it, too, has evolved into a program that offsets research investment that should be undertaken by the private sector. Given the problems with overspending by Washington, Congress should take this opportunity to return the Office of Science to its original intent. The Office of Science budget more than doubled from FY 1997 to FY 1998 and has grown rapidly ever since. The SC received an additional $1.6 billion from the American Recovery and Reinvestment Act in 2009.[11]

Reductions in federal research funding for energy need not result in fewer worthwhile projects. It simply means that research institutions will have to find greater efficiencies, drop less promising research, or find alternative sources of funding. Moreover, removing government funding from research will remove meddlesome political and special interest motivations with it. Instead of lobbying Congress for more funds, research laboratories and universities would search more thoroughly for private donors and alumni. Unique and distinguished science programs at universities will attract bright students and professors, and will also encourage alumni and other philanthropists to donate to these programs. United Technologies Research Center, Aspen Technology, General Motors, Caterpillar, and the American Chemical Society Petroleum Research Fund are all funding biofuels research at the University of

9. The slightly higher recommended total amount for 2013 (compared to 2012) reflects the $95 million additional line item for Idaho Sitewide Safeguards and Security within the Nuclear Energy budget, which had previously resided in other accounts.
10. U.S. Department of Energy, *Department of Energy FY 2013 Congressional Budget Request: Science, Advanced Research Projects Agency–Energy*, February 2012, at *http://www.cfo.doe.gov/budget/13budget/content/volume4.pdf* (February 27, 2012).
11. *Ibid.*

Massachusetts Amherst.[12] Similar cases can be made for other renewable energy technologies, fossil-fuel research, nuclear energy, and advanced-technology vehicles.[13]

Even for technologies that are not yet commercially feasible, the private sector is making financial investments. One clear instance in which the DOE dedicates a section of its science budget is fusion power, but there are many businesses undertaking fusion research. General Fusion, a small start-up company in Vancouver, is a prime example. While General Fusion has received money from the Canadian government (Business Development Bank of Canada), it has also enjoyed support from Amazon CEO Jeff Bezos's venture-capitalist firm Bezos Expeditions, as well as from Chrysalix Energy Venture Capital, GrowthWorks, Braemar Energy Ventures, Entrepreneurs Fund, and SET Venture Partners.[14] General Fusion CEO Doug Richardson says, "There's a feeling that the research has to be done by a government, that it costs billions of dollars, and that 3,000 smart people can't be wrong. People have a mindset that this can't be done by a small company."[15] General Fusion is one of several companies proving that sentiment wrong. Helion Energy is another fusion start-up seeking capital funds to build a full-scale model of its fusion reactor.[16] Tri-Alpha Energy is a third fusion start-up that recently raised $50 million from venture capitalist firms.[17] All of this is occurring despite fusion being years or even decades away from commercialization.

Fusion technology is not the only groundbreaking idea receiving private support. Kenneth Rines, a physics and astronomy professor at Western Washington University, for instance, received a grant from the privately funded and operated Research Corporation for Science Advancement to "prob[e] dark energy and galaxy cluster evolution with optical spectroscopy."[18]

While the DOE may be in a better position to prioritize certain parts of a smaller budget, there are numerous justifications for significantly scaling back the programs and subprograms within the Basic Energy Sciences program and the Biological and Environmental Research program. They are either duplicative or extend beyond basic research. Funding for the Advanced Scientific Computing Research, Fusion Energy Sciences, High Energy Physics, and Nuclear Physics programs should all return to FY 2008 levels. The Workforce Development for Teachers and Scientists program should be cut entirely. Overall, $1.42 billion can be cut from these SC programs:

- In FY 2009, the Department of Energy established **46 Energy Frontier Research Centers (EFRCs)** to accelerate R&D and provide a foundation for future energy technologies. EFRCs attempt to bridge the gap between basic and applied research with activities like "accelerate the transition of EFRC scientific discoveries into innovative, prototype clean energy technologies and enhance coordination between fundamental EFRC research and applied research and engineering development supported by EERE."[19] Congress should eliminate these research centers, saving $120 million.
- **Energy Information Hubs** that create multidisciplinary teams to overcome obstacles in energy technologies; and fuels from a **Sunlight Hub** that strives to use the process of photosynthesis

12. The Institute for Massachusetts Biofuels Research (TIMBR), University of Massachusetts Amherst, "Partners," 2007, at *http://www.ecs.umass.edu/timbr/sponsors.html* (March 20, 2011).
13. Jack Spencer and Nicolas D. Loris, "Washington Subsidies Not Necessary to Rebuild U.S. Nuclear Industry," Heritage Foundation *Backgrounder* No. 2207, November 10, 2008, at *http://www.heritage.org/research/reports/2008/11/washington-subsidies-not-necessary-to-rebuild-us-nuclear-industry*.
14. News release, "General Fusion Closes $19.5M Serious B Funding Round," General Fusion, May 5, 2011, at *http://www.generalfusion.com/downloads/gf_pr_series_b.pdf* (March 14, 2012).
15. Warren Frey, "Big Bang from a Small Company," *H+ Magazine*, March 2, 2010, at *http://www.hplusmagazine.com/articles/energy/big-bang-small-company* (February 27, 2012).
16. Justin Moresco, "Helion Energy Seeks $20M for Fusion Engine," Gigaom, April 24, 2009, at *http://gigaom.com/cleantech/helion-energy-seeks-20m-for-fusion-engine/* (February 27, 2012).
17. "Tri Alpha Energy Gets $50M," SocalTech.com, July 26, 2010, at *http://www.socaltech.com/tri_alpha_energy_gets___m/s-0030022.html* (February 27, 2012).
18. Research Corporation for Science Advancement, "Cottrell College Science Awards: Single Investigator Awards 2010 Spring," at *http://www.rescorp.org/cottrell-college-science-awards/single-investigator-awards/recent-awardees/2010-spring* (February 27, 2012).
19. U.S. Department of Energy, *Department of Energy FY 2012 Congressional Budget Request: Science*.

to make a transportation fuel—eliminating these hubs would save $48.5 million.

- The Office of Science also includes **Small Business Innovation Research (SBIR) and Small Business Technology Transfer (STTR)** programs with the original intent to "increase private sector commercialization of innovations derived from Federal R/R&D, thereby increasing competition, productivity, and economic growth."[20] A recent overview of the SBIR/STTR stresses that the goal of the programs today is to place more emphasis on commercialization and "[a]ccepting greater risk in support of agency missions."[21] Using taxpayer dollars to offset higher risk is no way to promote economic development. It ensures that the public pays for the failures, as they have with failed government energy investments, while the private sector reaps the benefits of any successes. Congress should remove all SBIR/STTR funding in the DOE budget, saving $121 million.

- **Basic Energy Sciences (Savings: $287.6 million).** Basic Energy Sciences (BES) is a legitimate program that investigates "fundamental research to understand, predict, and ultimately control matter and energy at the electronic, atomic, and molecular levels in order to provide the foundations for new energy technologies and to support other aspects of DOE missions in energy, environment, and national security."[22] However, many of the BES subprograms stray from fundamental research into commercialization. The government should eliminate such aspects of these programs, since private companies are capable of fulfilling these roles, whether through their own laboratories or by funding university research. The excerpted quotations from each subprogram below are not the complete descriptions, but they are clear illustrations of the kinds of activities the DOE should *not* be funding—because they seek to advance specific technologies and goals such as photovoltaics, batteries, nuclear energy, carbon capture and sequestration, transportation fuels, and increasing energy efficiency that are much better suited to the private sector. On areas that focus on fundamental research and not commercial activities, the funding has simply become too excessive. While there is reason to phase out all Basic Energy Science funding, these proposed immediate cuts would eliminate some subprograms entirely, and return others close to FY 2008 levels:

  - *The Experimental Condensed Matter Physics* research area includes research on "the elementary energy conversion steps in photovoltaics, and the energetics of hydrogen storage."[23] The FY 2013 request for $51.3 million should be cut by $23 million.

  - *The Theoretical Condensed Matter Physics* research area emphasizes modeling and computer simulation to develop next-generation energy technologies such as "inverse design of compound semiconductors for unprecedented solar photovoltaic conversion efficiency, solid-state approaches to improving capacity and kinetics of hydrogen storage, and ion transport mechanisms for fuel cell applications."[24] The FY 2013 request for $41.6 million should be cut by $14 million.

  - *The Mechanical Behavior and Radiation Effects* research area includes reliability and storage of "fossil, fusion, and nuclear energy conversion; radioactive waste storage; environmental cleanup; and defense."[25] The FY

20. U.S. Department of Energy, "DOE SBIR/STTR Programs Introduction Overview Presentation of the U. S. Department of Energy's SBIR/STTR Programs," 2012, at *http://science.energy.gov/~/media/sbir/pdf/files/120205Web_Overview.pdf* (February 27, 2012).
21. *Ibid.*
22. U.S. Department of Energy, "FY 2013 Congressional Budget Request: Budget Highlights," p. 25, at *http://www.cfo.doe.gov/budget/13budget/Content/Highlights.pdf* (February 27, 2012).
23. U.S. Department of Energy, *FY 2013 Congressional Budget Request: Science*, p. 79.
24. While the budget cuts are with respect to President Obama's FY 2013 request, the FY 2012 budget request provides a better comprehensive look at each subprogram. U.S. Department of Energy, *Department of Energy FY 2012 Congressional Budget Request: Science*, February 2011, p. 105, at *http://www.cfo.doe.gov/budget/12budget/Content/Volume4.pdf* (March 19, 2011).
25. *Ibid.*, p. 106.

2013 request for $23.1 million should be cut by $11 million.

- *The Physical Behavior of Materials* research area includes energy improvement and storage research for "corrosion, photovoltaics, fast-ion conducting electrolytes for batteries and fuel cells, novel magnetic materials for low magnetic loss power generation, magnetocaloric materials for high-efficiency refrigeration, and new materials for high-temperature gasification."[26] The FY 2013 request for $32.7 million should be cut by $7 million.

- *The Neutron and X-ray Scattering and the Electron and Scanning Probe Microscopies* programs should return to FY 2008 levels. The FY 2013 request for $44.8 million and $29 million, respectively, should be cut by $14 million and $13 million.[27]

- *The Experimental Program to Stimulate Competitive Research (EPSCoR)* makes grants to research programs in areas that have not traditionally received funding for the basic energy sciences and the applied-research program, and should be eliminated. Eliminating the program would save $8.5 million.

- *The Synthesis and Processing Science* research area focuses on developing "new techniques to synthesize materials with desired structure, properties, or behavior; to understand the physical phenomena that underpin materials synthesis."[28] The application of this research is geared toward types of lighting such as semiconductor light-emitting diodes (LEDs), organic light-emitting diodes (OLED), or polymer light-emitting diodes (PLED) (rather than electric filament, such as the traditional incandescent bulb), solar energy conversion, hydrogen storage, and electricity storage. The FY 2013 request for $25.3 million should be cut by $11 million.

- *The Materials Chemistry and Biomolecular Materials* program produces research on chemical and bio-inspired synthesis. The budget profile of each subprogram mentions that the Materials Chemistry and Biomolecular Materials subprogram "underpins many energy-related technological areas, such as batteries and fuel cells, catalysis, energy conversion and storage, friction and lubrication, high efficiency electronic devices, hydrogen generation and storage, light-emitting materials, light-weight high-strength materials, and membranes for advanced separations."[29] This subprogram also includes "expanded research to understand carbon capture phenomena ... including investigation of novel chemical and biomimetic approaches for efficient carbon capture and release."[30] The FY 2013 request for $59.2 million should be cut by $25 million.

- *The Atomic, Molecular and Optical Science* research area emphasizes that "study of formation and evolution of energized states in atoms, molecules, and nanostructures provides a fundamental basis for understanding elementary processes in solar energy conversion and radiation-induced chemistry."[31] The FY 2013 request for $22 million should be cut by $10 million.

- *The Chemical Physics Research* program spends a significant amount of money on improved engine designs. The justification in the budget proposal is that

  > truly predictive combustion models enable the design of new combustion devices (such as internal combustion engines, burners, and turbines) with maximum energy efficiency and minimal

26. *Ibid.*, p. 107.
27. *Ibid.*, pp. 107–109.
28. *Ibid.*, p. 111.
29. *Ibid.*, p. 112.
30. *Ibid.*
31. *Ibid.*, p. 121.

environmental consequences. In transportation, the changing composition of fuels, from those derived from light, sweet crude oil to biofuels and fuels from alternative fossil feedstocks, puts increasing emphasis on the need for science-based design of modern engines.[32]

The FY 2013 request for $49.5 million should be cut by $20 million.

- *The Solar Photochemistry* research area focuses on "molecular-level research on solar energy capture and conversion." Solar photochemistry "energy conversion is an important option for generating electricity and chemical fuels and therefore plays a vital role in DOE's development of solar energy as a viable component of the nation's energy supply."[33] It is not the agency's role to develop solar energy as part of the nation's energy supply if it is not economically viable; therefore, Congress should eliminate this program. Eliminating the program would save the $40.3 million requested in the FY 2013 budget.

- *The Photosynthetic Systems* research area "supports fundamental research on the biological conversion of solar energy to chemically stored forms of energy."[34] *The Physical Biosciences* research area also focuses on next-generation energy storage systems as well as biomass conversion to chemical fuels. Both of these research activities can be left entirely to the private sector. Eliminating the two programs would save the $19.4 million and $18.1 million requested in the FY 2013 budget, respectively.

- *The Catalysis Science* research area focuses on catalyst design and chemical transformation control. The budget justification document stresses

  > catalytic transformations impact an enormous range of DOE mission areas. Particular emphasis is placed on catalysis relevant to the conversion and use of fossil and renewable energy resources and the creation of advanced chemicals. Catalysts are vital in the conversion of crude petroleum and biomass into clean burning fuels and materials. They control the electrocatalytic conversion of fuels into energy in fuel cells and batteries and play important roles in the photocatalytic conversion of energy into chemicals and materials.[35]

The FY 2013 request for $53.7 million should be cut by $20 million.

- *The Separations and the Heavy Element Chemistry* programs should both return to FY 2008 levels. The FY 2013 requests for $16.2 million and $23.4 million, respectively, should be cut by $2 million and $7 million.

- *The Geosciences* research area, which focuses on geochemistry and geophysics, is another program that focuses on studying carbon dioxide sequestration and waste storage. The program should be cut entirely, saving $24.3 million.

- **Biological and Environmental Research (Savings: $456.6 million).** The Biological and Environmental Research (BER) program funds research for a variety of energy-related subjects including biology, radiochemistry, climate science, and subsurface biogeochemistry. At a basic research and development level, the funding for some of the research endeavors is valid, but climate change should not be one of them, because it is not part of the DOE's mission. Furthermore, BER also supports such activities as how plants and microbes "can be manipulated to harness their processes and products that contribute to new strategies for producing new biofuels, cleaning up legacy waste, and sequestering carbon dioxide."[36] The entrepreneur who can make a biofuel product that is cost-competitive

32. *Ibid.*, p. 122.
33. *Ibid.*, p. 124.
34. *Ibid.*
35. *Ibid.*, p. 126.
36. *Ibid.*, p. 10.

with oil does not need government funding. The need to capture and sequester CO_2 is questionable because the policy goal of reducing carbon dioxide itself is questionable. Even so, carbon capture and sequestration is a technological hurdle that the private sector should overcome without the government's help. Many BER programs should be cut drastically or entirely because they are private-sector activities or do not align with the DOE's mission. Another problem with BER programs is that they have become heavily earmarked and have thus become a slush fund for pet projects of Members of Congress. The following program descriptions support drastic cuts to FY 2008 levels: BER has two larger subprograms, Biological Systems Science and Climate and Environmental Sciences, and smaller programs within those subprograms. Most of the funding in the Biological Systems Sciences goes to the Genomics Science program.

- *The Foundational Genomics Research* subprogram (part of the Genomic Science program) focuses on fundamental plant and microbe research. "In FY 2012, new research will be initiated to provide the scientific foundation for a bio-economy in which carbon-neutral and renewable processes can be safely designed and optimized."[37] The FY 2013 request for $67.3 million should be cut by $35 million.

- *The Genomics Analysis and Validation* subprograms (part of the Genomic Science program) support "activity [that] develops the tools and resources needed to fully exploit the information contained in complete DNA sequences from microbes and plants for bioenergy, carbon sequestration, and bioremediation applications."[38] The FY 2013 request for $10 million should be cut by $2 million.

- *The Metabolic Synthesis and Conversion* subprogram (part of the Genomic Science program) focuses on

  > genome-based knowledge of metabolic functions and regulatory networks in microbial systems, plants, and plant-microbe associations [that] can enable strategies to increase biomass formation for conversion into advanced biofuels or to increase the sequestration of carbon in terrestrial ecosystems.[39]

  Other funds in the Metabolic Synthesis and Conversion subprogram will continue to support "research on carbon storage in plant biomass for conversion into advanced biofuels or for carbon sequestration."[40] The FY 2013 request for $19.5 million should be cut by $3 million.

- *The Computational Biosciences* subprogram (part of the Genomic Science program) focuses on using models and algorithmic tools to advance Genomic Science activities. The FY 2013 request for $16.4 million should be cut by $12 million.

- In 2007, the DOE established *Bioenergy Research Centers* (also part of the Genomic Science program) "to accelerate the transformational breakthroughs in basic science needed for the development of cost-effective technologies to make production of cellulosic (plant-fiber based) biofuels commercially viable on a national scale."[41] It is the private sector's role to determine whether biofuels can be commercially viable on a national scale, and the company that commercializes biofuels capable of competing with oil will reap the benefits. These research centers should be eliminated, saving $75 million.

- The President's 2013 budget request reduces the *Radiological Sciences* (Radiochemistry and Imaging Instrumentation and Radiobiology research)

37. *Ibid.*, p. 181.
38. *Ibid.*, p. 181.
39. *Ibid.*, p. 182.
40. *Ibid.*
41. *Ibid.*, p. 183.

budget from $34.9 million in the FY 2012 encacted budget to $28.2 million. The new budget also zeroes out funding for the Ethical, Legal, and Societal Issues and Medical Applications Research and Radiobiology. These are appropriate cuts.

- Funding for the *Biological Systems Facilities and Infrastructure* program should return to FY 2008 levels. The FY 2013 request for $84 million should be cut by $14 million.

- *The Climate and Environmental Science* subprogram supports three research activities—Atmospheric System Research, Environmental System Science, and Climate and Earth System Modeling. Research on, and modeling of, how and why earth's climate is changing can be valuable for future discussions, but it should be done objectively and not with the predisposition that greenhouse gas emissions are the main contributor to global warming and that reducing them is a top priority. Either way, leading such a discussion is not the role of the DOE. It is not related to the DOE's mission. Environmental management, which *is* part of DOE's mission, includes activities such as toxic-site cleanup, not climate change. Given the other extensive research on climate change in the government, privately and internationally, funding for climate-change research should be cut entirely from the DOE budget. This would save the entire $315.6 million requested in the FY 2013 budget.

- **Advanced Scientific Computing Research (Savings: $114 million).** This program under the Office of Sciences conducts computer modeling, simulations, and testing to advance DOE's mission through applied mathematics, computer science, and integrated network environments. These models can lay the foundation for scientific breakthroughs and are arguably some of the most important aspects of basic DOE research, but this program has also been the beneficiary of a consistently expanding budget, and in order to live within today's fiscal constraints, the FY 2013 request for $455.6 million should be returned to the FY 2008 level of $341.7 million, a savings of $114 million.

- **Fusion Energy Sciences (Savings: $104 million).** Fusion technology has much potential to offer inexhaustible quantities of energy without the byproduct of spent nuclear fuel that results from nuclear fission—the way that conventional nuclear power plants produce electricity. While research on fusion should continue, the question is whether the federal government should be involved and to what extent. Currently, there are 63 public and private universities, 11 national laboratories (eight belong to DOE), nine private companies**,** and 29 international institutions that have fusion or plasma physics programs.[42] The basic science for fusion energy already exists, which is why several start-up companies are raising capital for their own fusion reactors. Although the universities and private companies have received federal funding, now is the time to reduce the DOE's involvement in studying plasmas. The DOE should remain involved, perhaps by continuing to participate in the international ITER[43] program, an international effort to advance fusion, but more of the research should be driven by the private sector. One area to cut would be the Enabling R&D program, which develops and improves "the hardware, materials, and technology that are incorporated into existing fusion research facilities, thereby enabling these facilities to achieve higher levels of performance." The FY 2013 request for $398 million should be returned to the FY 2008 level of $294 million, saving $104 million.

- **High Energy Physics (Savings: $55 million).** The High Energy Physics (HEP) program has the mission of uncovering "how our universe works at its most fundamental level."[44] In effect, HEP exists to explore how space, matter, time, and energy interact with one another. Financial support from the HEP goes to 10

42. U.S. Department of Energy, "U.S. Fusion Program Participants," at *http://www.science.doe.gov/ofes/fusioninstitutions.shtml* (February 27, 2012).
43. U.S. Department of Energy, "ITER and the Promise of Fusion Energy," at *http://www.science.doe.gov/ofes/ITER.html* (February 27, 2012).
44. U.S. Department of Energy, "High Energy Physics: Funding Profile by Subprogram," at *http://www.science.doe.gov/hep/files/pdfs/FY2009HEPBudget.pdf* (March 23, 2011).

national laboratories and more than 100 public and private universities to study proton accelerator-based physics, electron accelerator-based physics, non-accelerator physics, theoretical physics, and advanced technology research and development.[45] Understanding these issues is an area of research that the private sector would likely not undertake, so it is an appropriate endeavor for America's research labs and universities—but it is certainly not a critical function of government, especially considering America's fiscal situation. The HEP is an area in which universities would strive to be the best and attract young talent and private funding. The FY 2012 request for $756.5 million should be returned to the FY 2008 amount, saving $55 million.

- **Nuclear Physics (Savings: $104 million).** The Office of Nuclear Physics supports theoretical and experimental research in the field. The DOE and the National Science Foundation conduct nearly all basic nuclear physics research. Research groups at 90 public and private universities, and nine federally funded laboratories (including Brookhaven, Oak Ridge, and Los Alamos), are exploring heavy ions, medium-energy physics, low-energy research, theory, accelerators, and isotopes. Much like HEP, funding for Nuclear Physics has become excessive. The FY 2012 request for $527 million should be returned to the FY 2008 amount of $423 million, saving $104 million.

- **The Workforce Development for Teachers and Scientists Program (Savings: $14.5 million).** The Workforce Development for Teachers and Scientists (WDTS) program trains teachers and scientists "to help ensure this Nation has the scientific workforce it will need in the twenty-first century." Funding goes to about 300 colleges and universities nationwide.

  Workforce development should fall squarely on the private sector. Federal funding simply crowds out private-sector investment. Universities and the private sector already conduct programs and training for future employees of the science sector. The Georgia Institute of Technology, for instance, recognizes the need to equip students with skills in science, technology, engineering, and mathematics (STEM). Through a program called Enterprise Innovation Institute (EI^2), Georgia Tech is collaborating with economic developers, the academic community, and employers in southwestern Georgia to launch programs that will help meet future workforce needs in biotechnology and agribusiness. EI^2 is a partnership between universities and members of the technology and agriculture industries. The initiative is connected to the statewide program called Georgia Work Ready, started in 2006 by Governor Sonny Perdue's Office of Workforce Development. Industries, not taxpayers, should bear the costs of educating their workforces. Eliminating the WDTS would save $14.5 million.

Cutting the Advanced Research Projects Agency–Energy (Savings: $350 million)

The Advanced Research Projects Agency–Energy (ARPA-E) is another energy program designed to fund high-risk, high-reward projects on which the private sector would not embark on its own. ARPA-E also has the goal of reducing energy imports, increasing energy efficiency, and reducing energy-related emissions, including greenhouse gases.[46] ARPA-E is responsible for funding specific high-risk, high-payoff, game-changing research and development projects to meet the nation's long-term energy challenges. ARPA-E received initial funding in FY 2009 to fund transformational energy research that private industry by itself cannot and will not support. There is an inherent risk associated with these programs, but the payoff will be not only monetary but also socially rewarding.[47]

Such a definition provides a very clear path under which ARPA-E should operate and allocate awards, and could provide real value to the

45. U.S. Department of Energy, "Office of High Energy Physics: Research Areas," at *http://www.science.doe.gov/hep/research/index.shtml* (March 23, 2011).
46. U.S. Department of Energy, "FY 2011 Congressional Budget Request: Budget Highlights," February 2010, at *http://www.cfo.doe.gov/budget/11budget/Content/FY2011Highlights.pdf* (February 27, 2012).
47. *Ibid.*

future of American energy. Of more than 3,600 applications, the government awarded ARPA-E funds to 37 companies.[48]

The problem is that ARPA-E does not always seem to follow this clear guideline: The federal government has awarded several ARPA-E grants to companies and projects that are neither high-risk nor something that private industry cannot support. These problems with ARPA-E were recently identified by the Government Accountability Office (GAO), the Department of Energy's Inspector General (DOE IG), and the House Science, Space, and Technology committee staff. Of the 44 small and medium-size companies that received an ARPA-E award, the GAO found that 18 had previously received private-sector investment for a similar technology. The GAO found that 12 of those 18 companies planned to use ARPA-E funding to either advance or accelerate prior-funded work.[49]

FloDesign Wind Turbine, for instance, received an $8.3 million grant for a project to develop an advanced, shrouded wind turbine.[50] ARPA-E's project announcement "Why ARPA-E Funding and Not Private Capital" addressed the issue by explaining that

> ARPA-E permits an accelerated introduction of advanced materials and aerodynamics that would not be possible with private capital alone. In addition, ARPA-E's commitment, support and technical diligence greatly assisted FloDesign Wind to raise $34.5M in private capital to compliment [*sic*] the award. This partnership between public and private sectors significantly reduces risk and enhances the chance for successful commercial deployment of this critical renewable technology.[51]

But the reality is that FloDesign received private capital before receiving its ARPA-E grant. Venture capital firm Kleiner Perkins Caufield & Byers invested $6 million in FloDesign through its purchase of FloDesign's Series A stock.[52] Venture capitalists could have undoubtedly funded FloDesign's new wind technology without the ARPA-E grant. Several other recipients of ARPA-E grants also received money from the government program after receiving funds from venture capitalists.[53]

There are those ideas and technologies that truly cannot obtain private investment. There is usually a reason. The market is the best place to determine the merit of an investment. If a project cannot find private support, it is a good indicator of its prospects for success (think Solyndra). And, certainly, a lack of private investors alone does not justify using taxpayer money to support a project. Indeed, technologies that lose private financing as they move closer to commercialization are likely the *worst* bets for taxpayer money, since professional investors have already determined them to be losers.

That is why the approach to technology development that seems to be driving ARPA-E is so troubling. Carrying technology from the research and development stage through to commercialization should be a private endeavor. To the extent that the government supports energy research, it should be much earlier in the process.

Congress should ultimately restructure the entire DOE. A more legitimate role of government is to conduct the basic research that the private sector would not undertake and create a system to allow the private sector, using private funds, to tap into that research and commercialize it if it sees an opportunity to do so.

Before that point can be reached, however, Congress must hold

48. Press release, "Sun Catalytix Signs $4M ARPA-E Contract, Grows Team," SunCatalytix, January 25, 2010, at *http://www.suncatalytix.com/Sun_Catalytix_Signs_4M_ARPA-E_Contract.pdf* (February 27, 2012).
49. Government Accountability Office, "Department of Energy: Advanced Research Projects Agency–Energy Could Benefit from Information on Applicants' Prior Funding," January 2012, at *http://www.gao.gov/assets/590/587667.pdf* (March 14, 2012), and U.S. Department of Energy, Office of Inspector General, Office of Audits and Inspections, "The Advanced Research Projects Agency–Energy," *Audit Report*, August 2011, at *http://science.house.gov/sites/republicans.science.house.gov/files/documents/hearings/2011%2008%20DOE%20IG%20ARPA-E%20Audit.pdf* (March 14, 2012).
50. U.S. Department of Energy, "ARPA-E's 37 Projects Selected from Funding Opportunity Announcement #1," at *http://arpa-e.energy.gov/LinkClick.aspx?fileticket=aBlsCuR97m4%3D&tabid=221* (March 14, 2012).
51. *Ibid.*
52. Efrain Viscarolasaga, "FloDesign Finds $6M in First Funding," Mass High Tech, August 1, 2008, at *http://www.masshightech.com/stories/2008/07/28/weekly12-FloDesign-finds-6M-in-first-funding.html* (February 27, 2012).
53. ARPA-E recipients who received the federal funding *after* receiving funds from venture capitalists: Sun Catalytix, Agrivida Planar Energy Devices, Codexis, General Compression, and 24M Technologies.

ARPA-E accountable to its mission and intended purpose. More scrutiny is necessary to ensure that ARPA-E is not funding projects already receiving private funding or using technicalities to justify those grants. Confining ARPA-E to its mission is critical to the program's success and could serve as a model for how DOE's research programs could be restructured.

Although the mission of ARPA-E may be a laudable one, the $350 million budget request for FY 2013 should be cut entirely until the appropriate reforms are made—especially since the American Recovery and Reinvestment Act of 2009 included $400 million for ARPA-E.

Eliminating the Power Marketing Administrations (Savings: $85 million)

The DOE's Power Marketing Administrations (PMAs) consist of four power entities that sell electricity that stems primarily from hydroelectric power. Formed in the early 1900s, PMAs were set up to provide cheap electricity to rural areas, mostly small communities and farms. PMAs originated as federal water projects currently operated by the Army Corps of Engineers and the Bureau of Reclamation.[54] PMAs use the revenue generated from electricity sales to reimburse taxpayers for construction and operation costs, but PMAs can sell the electricity at below-market rates because of favorable financing terms—they receive federal tax exemptions and receive loans at below-market interest rates.[55] The PMAs' construction, rehabilitation, operation, and maintenance costs are financed through the main DOE budget, offset collections, alternative financing, and a reimbursable agreement with the Bureau of Reclamation.

PMAs are an outmoded form of providing rural areas with electricity, yet they still enjoy tremendous special privileges that interfere with market competition. The DOE should restructure PMAs to sell electricity at market rates by eliminating the subsidy for federal electricity rates. By doing so, Congress could remove the $85 million requested in the FY 2012 budget. Congress should then end PMA subsidies.[56]

DOE Budget Reform: Urgent and Necessary

It is not the role of the federal government to force certain technologies into the marketplace or to subsidize their commercialization. The $5.5 billion in cuts from the President's FY 2013 budget request for the Department of Energy would achieve significant and necessary savings without affecting legitimate energy research by the government. These cuts would remove the government—and the taxpayers—from the role of subsidizing research that should be the purview of the private sector, thereby allowing more private-sector innovation. Following through with these cuts would also be a signal to the American public that Washington is finally serious about putting an end to out-of-control spending.

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54. Congressional Budget Office, *Budget Options: Volume 2*, August 2009, at *http://www.cbo.gov/ftpdocs/102xx/doc10294/08-06-BudgetOptions.pdf* (February 27, 2012).
55. *Ibid.*
56. Milton R. Copulos, "Cutting the Deficit by Selling Federal Power Marketing Administrations," Heritage Foundation *Backgrounder* No. 485, February 13, 1986, at *http://www.heritage.org/research/reports/1986/02/cutting-the-deficit-by-selling-federal-power-marketing-administrations*.

APPENDIX

Heritage Foundation Recommendations for Energy Department Program Spending

FIGURES IN THOUSANDS OF DOLLARS

Program	FY 2013 Request	FY 2012 Enacted	Heritage Foundation Recommendation
Energy Efficiency and Renewable Energy	$2,267,333	$1,809,638	$0
Fossil Energy	650,792	564,435	222,704
Non-Defense Nuclear Energy (NE)	770,445	858741	592,000
Small Business Innovation Research/Small Business Technology Transfer	121,536	113,413	0
Energy Frontier Research Centers	120,000	100,000	0
Energy Innovation Hubs	48,474	53,673	0
Experimental Condensed Matter Physics	51,281	466,781	28,281
Theoretical Condensed Matter Physics	41,623	31,623	27,623
Mechanical Behavior and Radiation Effects	23,082	17,582	12,082
Physical Behavior of Materials	32,737	27,737	25,737
Neutron and X-Ray Scattering	44,766	37,766	30,766
Electron and Scanning Probe Microscopies	28,955	26,955	15,955
Office of Experimental Program to Stimulate Competitive Research	8,520	8,520	0
Synthesis and Processing Science	25,348	22,348	14,348
Materials Chemistry and Biomolecular Materials	59,237	57,270	34,237
Atomic, Molecular, and Optical Science	22,070	23,130	12,070
Chemical Physics Research	49,492	46,492	29,492
Solar Photochemistry	40,251	38,251	0
Photosynthetic Systems	19,424	17,424	0
Physical Biosciences	18,147	16,147	0
Catalysis Science	53,650	49,650	23,650
Separations and Analysis	16,193	14,193	14,193
Heavy Element Chemistry	16,751	14,751	9,751
Geosciences Research	24,281	22,281	0
Biological and Environmental Research	625,347	609,557	0
Foundational Genomics Research	67,292	63,111	32,292
Genomics Analysis and Validation	10,000	10,000	8,000
Metabolic Synthesis and Conversion	19,462	19,462	16,462
Computational Biosciences	16,395	16,395	4,395
Bioenergy Research Centers	75,000	75,000	0
Radiological Sciences	28,160	34,938	28,160
Ethical, Legal, and Societal Issues	0	0	0
Medical Applications	0	0	0
Biological Systems Facilities and Infrastructure	84,082	83,395	74,082
Joint Genome Institute	70,756	68,500	60,756
Climate and Environmental Sciences	315,574	298,072	0
Advanced Scientific Computing Research	455,593	440,868	341,593
Fusion Energy Science	398,324	400,996	294,324
High Energy Physics	756,521	790,860	701,521
Nuclear Physics	526,938	547,387	422,938
Workforce Development for Teachers and Scientists	14,500	18,500	0
Advanced Research Projects Agency—Energy	350,000	275,000	0
Power Marketing Administrations	85,242	85,080	0
Electricity Delivery and Energy Reliability	143,015	139,103	30,000
Total	$8,596,589	$8,415,025	$3,107,412
Difference between FY 2013 Request total and Heritage total	$5,489,177		
Difference between FY 2012 Enacted total and Heritage total		$5,307,613	

Source: U.S. Department of Energy, "Department of Energy FY 2013 Congressional Budget Request: Budget Highlights," February 2012, at *http://www.cfo.doe.gov/budget/13budget/Content/Highlights.pdf* (March 20, 2012).