Center for American Progress

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The United States must confront the reality of its energy circumstances. Consumers and industry are facing the prospect of a continued rise in the real price of oil and natural gas as conventional reserves are depleted. The increased reliance of the United States and its partners on imported oil—a large proportion of which comes from the hostile and politically fragile Persian Gulf—is constraining the nation's pursuit of important foreign policy objectives. At the same time, greenhouse gas emissions, especially carbon dioxide emissions from coal-fired electricity-generation plants, are contributing to dangerous global climate change. In the absence of an aggressive U.S. carbon-emission control policy, there in no possibility of an international agreement on greenhouse gas emissions that includes both developed countries and rapidly emerging ones such as China and India.

There is only one solution to the challenge: The United States must begin the long process of transforming its economy from one that is dependent on petroleum and high-emission coal-fired electricity to one that uses energy much more efficiently, develops alternative fuels, and switches to electricity generation that is low-carbon or carbon-free.

The benefits of such a transformation are indisputable: It would avoid unnecessary cost and disruption to the U.S. economy, protect the environment, and enhance national security. The United States has sought to adopt an effective and coherent energy policy since the first oil crisis of 1973, but it has failed to do so. The challenge for U.S. political leaders is to craft, fund, and diligently sustain a range of policy measures that will make this critical transition as certain, rapid, and cost-effective as possible.

In order to meet this challenge, the United States must undergo an innovation revolution. The rate at which the United States is able to develop and deploy new energy technologies will, to a great extent, determine the ultimate speed and cost of the economic transformation. Large-scale carbon capture and sequestration, advanced batteries, plug-in hybrid vehicle technologies, next-generation biofuels for the transportation sector, and a number of other innovations will be vital to achieving a low-carbon economy, and the United States must not only develop but deploy these technologies. The benefits of such innovation will accrue to other countries as well, for U.S. technical assistance programs and trade will carry these advances abroad.

Over the years, the U.S. government has spent more than $300 billion in direct expenditures on energy research, development, and demonstration (RD&D) that have been combined with a variety of indirect financial incentives such as tax credits, loan guarantees, guaranteed purchase, and even equity investments. In addition, the government has adopted a patchwork quilt of regulations designed to speed the adoption of various energy technologies.

Unfortunately, the resulting pace of innovation generated by this public investment has not been sufficient given the urgency and scale of today's energy challenge. The various measures that it has employed (including direct federal support for RD&D, indirect financial incentives, and mandatory regulations) have been developed and implemented individually with too little regard for technological and economic reality and too much regard for regional and industry special interests. There has not been an integrated approach to energy technology innovation that encompasses priority areas of focus, the responsibilities of various funding agencies, and the mix of financial assistance measures that are available.

If the United States simply continues to pursue energy innovation as it has in the past, then the path to a low-carbon economy will be much longer and costlier than necessary. We propose a new approach for energy RD&D in the United States that will set in motion an innovation revolution by

- Creating an interagency Energy Innovation Council to develop a multiyear National Energy RD&D strategy for the United States.
- Increasing the energy RD&D program budget to more than twice its current level.
- Launching a sustained and integrated energy R&D program in key areas.
- Establishing an Energy Technology Corporation to manage demonstration projects.
- Creating an energy technology career path within the civil service.

Songs of Experience

Some important lessons can be gleaned from previous federal efforts to promote energy innovation through direct federal support, indirect financial incentives, and regulatory mandates.

Direct federal support. The Department of Energy (DOE) is the agency that provides the most financial support for energy RD&D. Yet many of the demonstration projects undertaken by DOE since the 1970s have not been successful. Prominent examples include the Clinch River Breeder Reactor in the early 1970s; DOE-managed large-scale synthetic fuel projects such as Solvent Refined Coal; surface and in-situ shale projects; the Barstow, California, Central Solar Power Tower; and the Beulah, North Dakota, Great Plains coal gasification project.

There are many reasons why these demonstration projects failed, but three shortcomings stand out. First, the projects were based on overly optimistic engineering estimates of technological readiness and cost. Some of these difficulties could have been averted if more time had been spent gathering data from small-scale engineering development projects and more attention had been paid to modeling and simulation of process performance and economics.

Second, some of the demonstration projects met predicted levels of technical performance, but the cost was so far above the then-prevailing market prices that the projects were market failures. This was a particular problem for synthetic fuel projects. It can be avoided only if there is a clear differentiation between those projects that are intended to demonstrate technical performance, cost, and environmental effects and those that are undertaken to increase production with federal assistance or in response to federal mandates.

Third, DOE business practices differed dramatically from commercial practices, and thus its project results were not credible demonstrations for private industry or investors. Tight DOE budgets caused projects to be funded inefficiently, which led to stretched schedules and increased capital costs. Budget pressure also invited cost-sharing requirements that were motivated by fiscal necessity rather than fair compensation for proprietary information. In addition, federal acquisition regulations, auditing, work rules, and project management contributed to cost overruns.

The underlying difficulty is that DOE, and other government agencies, are not equipped with the personnel or operational freedom that would permit the agency to pursue a first-of-a-kind project in a manner that convincingly demonstrates the economic prospects of a new technology. A different approach is needed.

The record of DOE in earlier-stage energy technology development is much stronger. DOE's work has directly contributed to advancements in technologies ranging from simulation tools for coal-bed methane production to basic materials development for photovoltaics. Nevertheless, there are several areas, such as batteries, where progress has not met expectations despite significant DOE support.

Indirect financial incentives. Indirect financial incentives are measures such as loan guarantees, guaranteed purchase, tax credits, and equity investment that "pull" innovation by providing financial benefit for deploying a new technology. The indirect incentives have the advantage that they do not introduce government procedures into the development and innovation process, thereby allowing it to take place in a more fully commercial manner.

Indirect incentives are appropriate for the demonstration phase, when technology feasibility is established and commercial viability needs to be demonstrated in early deployment. Guaranteed purchase is often proposed as a way of buying down the unit cost of new technology (as, for instance, was the case with photovoltaic arrays). Loan guarantees and tax credits, meanwhile, are popular measures for early demonstration of large-scale clean coal technologies, such as integrated coal gasification combined cycle with carbon capture and sequestration, and of nuclear power plants. The 2005 Energy Policy Act contains significant indirect incentives of this type, but the technology demonstrations should be considerably broadened.

It is important to note that different measures have different incentives. Production tax credits (such as those for wind power) and guaranteed purchases spend government money on projects that successfully produce some product, whereas loan guarantees are designed to provide protection for the investor even if the project fails.

Of course, all indirect incentives are not equally sensible. For instance, the existing volumetric ethanol excise tax credit of $0.51 per gallon of ethanol is not the most economically efficient way to reduce U.S. dependence on imported oil. A better approach is to provide tax credits for cellulosic ethanol production, because this technology uses a less energy-intensive biomass feedstock to produce the desired liquid product than traditional ethanol production does.

Regulatory mandates. Regulatory mandates can significantly encourage innovation by accident or design, and there is a complex pattern of purpose and mechanism. For example, the Environmental Protection Agency (EPA) mandates "best available control technology" and sets emission standards in order to force the adoption of new technology. This approach has proved successful in, among other things, reducing diesel emissions and reducing criteria-pollutants emissions from power plants. Furthermore, in the early 1970s when domestic oil production was under price controls, DOE and its predecessor agency gave "entitlement" benefits for domestic production that used enhanced oil recovery techniques. This is an important example of how a regulatory incentive can result in the wide dissemination of an important energy technology.

The adoption of Corporate Average Fuel Economy standards is also widely viewed as a critical regulatory measure, given the political resistance to increased taxes on gasoline. In addition, many believe that government programs designed to encourage greater efficiency in appliances and buildings are effective, although the effects of higher energy prices and the new technology these higher prices encourage should not be overlooked.

Today, there is a particularly strong interest in using mandatory regulation to drive innovation, in part because of the strong political opposition to increased taxes for carbon emissions and gasoline use. For instance, Congress is now considering the use of a renewable portfolio standard for electricity generation and a renewable fuel standard for automobile fuels. Moreover, there have been situations in which such regulation has generated successful solutions to environmental problems, such as the EPA's market-based cap-and-trade program for SO2 to address the threat of acid rain.

Regulatory mandates, however, lack the transparency and some other advantages of taxes. They must be carefully designed and coordinated at all levels to produce economically efficient results, and there are numerous instances in which poorly designed regulatory action has bred inefficiency. For example, states (and even localities) have found it necessary to adopt CO_2 emission restrictions because the federal government has failed to do so, resulting in a flawed patchwork of regional emission controls rather than a more effective and comprehensive national standard. Ultimately, regulation is a tool that can accelerate innovation by serving as either a substitute for or complement to direct federal RD&D support, and policymakers must do far more to ensure that they strike the proper balance between them.

Federal Flaws

The United States will not be able to achieve an innovation revolution until it addresses fundamental flaws in its approach to RD&D—flaws that cannot be repaired simply by increasing federal funding.

First, the current federal approach to innovation is based on a linear sequential process: research, exploratory development, engineering, system development, manufacturing, deployment, and logistic support. This model was developed (and has been used successfully) by the Department of Defense (DOD), but it is not well suited to today's energy innovation challenge. The DOD's primary RD&D objective is to create new technologies for its own use that meet set performance, schedule, and cost objectives. Although some of this research has applications in the private sector and is widely adopted, the DOD process is not designed specifically for broad commercial application.

Energy innovation, however, requires a market-driven rather than technology-driven approach to RD&D, because new energy technologies are only useful insofar as they are adopted and deployed by private industry. This requires that the government work closely with the private sector and environmental regulators to develop and demonstrate technologies that can be profitable given existing and anticipated market conditions and environmental standards. This also has the important benefit of creating some real assets, such as production facilities and intellectual property, that could enable the government to recoup a portion of its outlay.

Second, the RD&D efforts of the involved federal agencies are not properly designed to meet the interdisciplinary and cross-cutting challenge of energy innovation. Energy innovation requires coordinated and integrated progress on multiple fronts at multiple stages of development in areas ranging from genetic research on plants to the industrial design of refineries. The government's fragmented approach reflects the prevailing RD&D model in which technology is developed to suit the needs of a single client (such as the agency overseeing it), and thus the related work and needs of other agencies are not adequately considered. Furthermore, there is no single governmental body responsible for harmonizing the disparate energy innovation efforts of DOE, the Department of Agriculture (USDA), Department of Commerce (DOC), National Science Foundation (NSF), the EPA, and others. The government must instead seek to reflect the trend in universities toward greater interaction and coordination among different fields of research. Until this happens, limited resources will continue to be allocated inefficiently, thereby slowing the energy innovation process.

Third, the government relies largely on traditional mechanisms, such as cost reimbursement for contracted work, for support of RD&D. From the Clinch Breeder Reactor to today's FutureGen coal power plant project, the federal government does not make adequate use of indirect innovation incentives such as guaranteed purchase, loan guarantees, and tax credits. This is a result of a lack of authority to use indirect financing and a lack of personnel qualified to design and manage these more complex financial assistance mechanisms. By relying on direct cost reimbursement, the federal government increases the risk that it will end up underwriting the development and demonstration of technologies that are not commercially viable, as was the case with the U.S. Synthetic Fuels program.

Fourth, the participation of the private sector in energy innovation is critical, yet the roles of the public and private sectors in joint RD&D projects have not been effectively defined. The most striking contrast is the incredible explosion of venture capital activity financing startup energy companies as a result of the sharp increase in oil and gas prices and increased commercial interest.

The generation and distribution of energy are primarily private-sector activities in the United States and most other countries. Private energy concerns invest billions of dollars in all aspects of energy, from capital infrastructure to power plants to transmission grids to refineries to pipelines. These private companies also invest large amounts of money in energy RD&D—more, indeed, than DOE itself does. In addition, the energy industry is increasing its efforts in innovation, whereas DOE has reduced its expenditures, in real terms, to less than one-half of the 1978 level. Clearly, if federal and private-sector efforts are complementary, then progress will be faster and development costs less.

Over the years, DOE has made many attempts to integrate industry and public RD&D efforts. A variety of mechanisms have been explored, including consortia, such as the Advanced Battery Consortia and the Program for a New Generation of Vehicles, and cooperation with industry associations, such as the Electric Power Research Institute and the Gas Research Institute.

The record of these efforts is mixed. Progress has been hampered by bureaucratic rules governing intellectual property, cost sharing, and access to government facilities, as well as by the different objectives of the government and industry in R&D. However, there have been some notable successes, especially when industry and the government jointly pursue efforts to develop basic technology for general use by employing DOE laboratory facilities such as the Sandia combustion facility and synchrotron light and high-flux neutron sources at several DOE labs. Congress can build on these successes and significantly improve government-industry RD&D collaboration by expanding the ability of DOE, NSF, and other federal agencies to make cooperative agreements with industry.

It is particularly important to foster effective government/industry collaboration on demonstration projects because the purpose of such projects is to establish commercial feasibility. Too often, the commercial potential of demonstration projects is obscured by the involvement of federal agencies and their restrictive federal procurement requirements, government-loan repayment procedures, and concerns about intellectual property rights. As a result, the market is not convinced of an effective demonstration of technology and private industry does not get the information it needs from the demonstration to make investment decisions.

Fifth, although members of Congress have indeed proved willing to provide substantial funding for energy RD&D programs over the past three decades, they also have sought to influence the RD&D selection and development process in order to benefit their home districts. These pressures, in addition to the uncertainties surrounding the annual budget cycle, interfere with the energy RD&D process.

Sixth, successful innovation requires both the creation of new technology and the demonstration of technical performance, economic feasibility, and compliance with environmental regulations. The federal government has had considerable success in researching and developing new technologies; however, its record in the critical demonstration phrase, in which the technology needs to prove its commercial value in order to be adopted by the private sector, is far weaker. The root cause of these deficiencies is that energy projects are selected and R&D is undertaken without sufficient consideration or understanding of the goals of the demonstration phase (the widespread adoption of technology by the private sector). Moreover, DOE and other federal agencies lack the requisite financial and policy tools to carry out demonstrations in a manner that is credible to private investors.

Keys to Success

A successful energy RD&D program should contain the following elements:

- There must be ample and sustained support for early-stage research and exploratory development. It is important that these early stages of the RD&D process are not neglected because of the budget demands of later-stage technology demonstrations, for it is here that many entirely new ideas with long-term relevance are generated. The research agenda must also be managed to ensure that it encompasses the full range of energy challenges that the United States faces, from supply to production to distribution to end use.

- RD&D spans the spectrum from early-stage research that explores new technical opportunity to later-stage demonstration projects that often require considerable resources. For the government, therefore, there should be an intimate relationship between setting policy and establishing programs designed to stimulate innovation.

- The decisionmaking process must be integrated so that the factors of cost, technical performance, and environmental impact are factored in at each stage of development.

- From the outset, every program should have a multiyear plan that clearly establishes a role for the federal government, industry, universities, and laboratories. This will help to ensure sustained (and disciplined) support and project management.

- All later-stage demonstration projects should be carried out on as close to commercial terms as possible in order provide the private sector with the information it needs to make large investments in new energy technologies. This can best be achieved by using indirect financing methods and significantly easing federal procurement regulation.

- There is opportunity for substantial international participation in selected energy RD&D projects. An important goal of many energy programs is to develop technologies that are attractive not only to U.S. companies but to foreign countries and investors as well. There is a wide range of mechanisms for international cooperation across the energy RD&D spectrum, and the United States should pursue new opportunities to coordinate the energy research efforts of countries around the world. Expensive long-term projects such as magnetic fusion energy attract significant international participation, as is the case with the $13 billion International Tokamak Experimental Reactor project.

In the future, the greatest opportunity may well lie in transferring technology developed in the United States or other industrialized countries to rapidly emerging counties such as China and India. Such transfers could help to induce rapidly emerging countries to participate in a global regime to limit greenhouse gas emissions. The Joint Implementation and Cooperative Development Mechanisms created in the Kyoto Protocol are examples of such an approach. These mechanisms are currently restricted to carbon-mitigating technologies, but the transfer of a broader range of technologies, addressing renewable energy, biofuels, and energy efficiency, could also be envisioned. It is unlikely, however, that technology transfer alone will be sufficient to bridge the gap between how developed and developing countries control carbon emissions.

The proposal to establish within DOE an Advanced Research Projects Agency for Energy (ARPA-E) that is modeled on the Defense Advanced Research Projects Agency (DARPA) is intended to replicate many elements of the innovation model that has been successful for the DOD, but it is unlikely to have a similar transformative effect on the energy sector. The DARPA model is technology-driven, not demand-driven; the focus is on performance, not cost. In the DARPA model, industry is an R&D contractor paid on a cost-plus basis with no indirect financial incentive mechanisms to encourage industry to demonstrate the commercial feasibility of new technology.

In order to accelerate energy innovation in the United States, the following five steps should be taken:

Create a new interagency group, the Energy Innovation Council (EIC), responsible for developing a multiyear National Energy RD&D Strategy for the United States. The mandate of the EIC would be to construct a plan that integrates the RD&D programs of the involved federal agencies over a multiyear period. The RD&D program would include both direct expenditures to support technology development and indirect financial incentives or regulations that are intended to promote demonstration of the new technology.

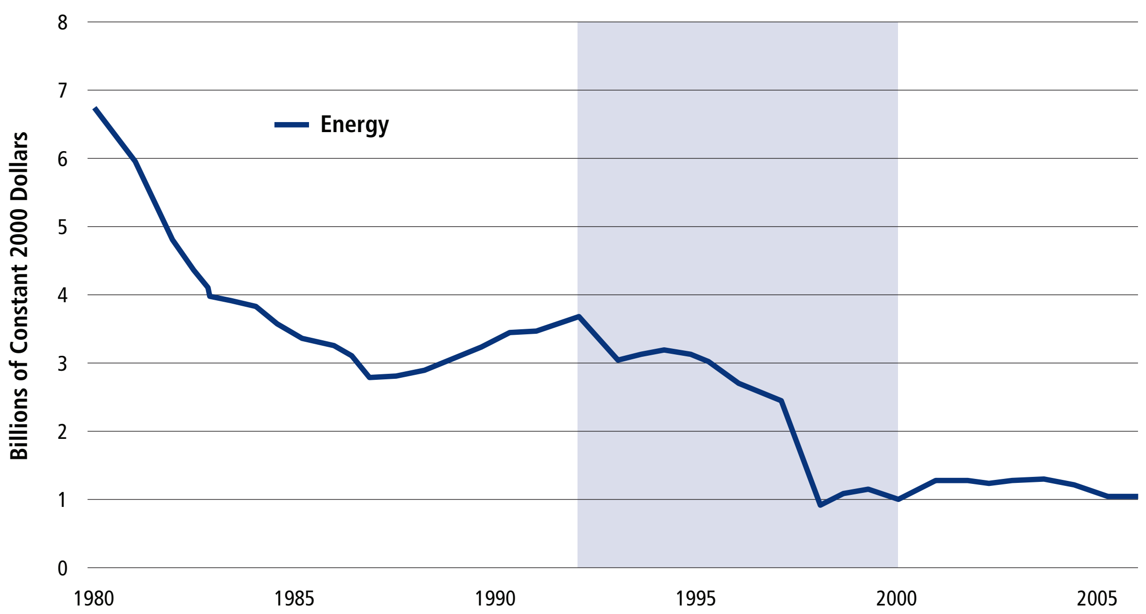
The EIC would be housed in the Executive Office of the President and composed of representatives from each of the federal agencies involved in energy and energy-related environmental RD&D, including DOE, the EPA, USDA, the DOC, and NSF. The president would appoint a chairperson who would manage the affairs of the council and oversee the development of the national strategy. Examples of suitable EIC chairs are the director of the Office of Management and Budget (OMB), the national economic advisor, or the director of the Office of Science and Technology Policy (OSTP).

The National Energy RD&D Strategy should include program priorities, schedules, and resource requirements. Though federal agencies could and should undertake some energy-related work outside of this RD&D interagency program (such as in fundamental research), such endeavors should be limited in number and scope in order not to detract from the larger integrated RD&D effort.

In developing the strategy, the EIC would make use of sophisticated modeling and simulation tools, as well as relevant engineering and cost data. This will enable it to assess alternative technology pathways and make the necessary tradeoffs. An advisory group made up of individuals from a range of industries, universities, and public interest organizations should be appointed by the president to support the council. When completed, the National Energy RD&D Strategy would be submitted to Congress for its review and endorsement. This strategy could then serve as the basis of a five-year authorization and appropriation for energy RD&D programs.

Increase the national energy RD&D budget to at least twice today's level. Even a

FEDERAL NONDEFENSE R&D, 1980–2006



Source: Science and Energy Indicators (2006).
Note that the sharp drop between FY1997 and FY1998 is due to a shift in accounting methodology that moved some energy R&D dollars to the General Science account.

well-designed RD&D program will not be able to achieve the necessary rate of innovation at the current level of funding. According to NSF, federal nondefense energy R&D has declined sharply in real terms from almost $7 billion (in 2000 dollars) in 1980 to about $1 billion in 2006.

Although about $1.5 billion of this decline is explained by a change in accounting methodology in the late 1990s, the overall decrease in federal energy R&D funding remains striking. There have been increases in some areas of energy RD&D in the past year, but much greater resources are still required. The additional funding could come from a portion of the new revenue generated by a petroleum use tax, carbon-emission charge, or revenues from the sale of allowances in a cap-and-trade system.

The question is how much to allocate and to which agencies. To answer this question one must know, among other things, the expenditures of the various agencies on energy RD&D. As uncompromising management specialists say, "If you cannot measure it, you cannot manage it." But although we have much information on DOE's RD&D spending, numerous important participating agencies—the DOC, USDA, NSF, the EPA, and the DOD—do not disaggregate their RD&D expenditures by application, making it impossible to get a complete and detailed budgetary picture.

In part this is due to a genuine problem with classification. For example, NSF expenditures on materials science or chemistry that are principally motivated by the objective of advancing the basic understanding of a disciplinary subject also may have important implications for energy (such as catalysis and materials for batteries), yet are not classified as such. However, it is also true that agencies are reluctant to report expendi-

DEPARTMENT OF ENERGY RD&D (SELECTED PROGRAMS)	EST. FY06 ($M) APPROPRIATION
Energy Efficiency (excl. vehicle and hydrogen technology RD&D)	267
Vehicle Technologies (hybrids, electric cars, etc.)	178.4
Hydrogen Technology (incl. fuel cells)	153.5
Renewables (solar, biomass, geothermal, wind, etc.)	259.4
Nuclear Fission and Fusion	562
Nuclear Nonproliferation and Verification	318.78
Carbon Sequestration	66.33
FutureGen	17.3
Oil and Gas (includes adv. E&P, GTL, LNG, oil sand, calthartes)	64.4
Electricity Delivery and Energy Reliability (incl. energy storage, high temp. superconductivity, electricity distribution transformation)	136.29
Basic Energy Sciences (BES)	933.9
Climate Change Research (included in Biological and Environmental Research (BER))	137
TOTAL DOE RD&D (incl. BES and BER)	**3309**

Sources: Gallagher, K.S., Sagar, A, Segal, D, de Sa, P, and John P. Holdren, "DOE Budget Authority for Energy Research, Development, and Demonstration Database," Energy Technology Innovation Project, John F. Kennedy School of Government, Harvard University, 2007; DOE FY2007 Statistical Table by Appropriation; American Association for the Advancement of Science.

tures by application for fear that the OMB, the OSTP, or Congress may insist on a reallocation of the agency's effort from its functional interest to broader national purposes.

For a few areas that it views as especially important or promising, the White House will mount a multiagency planning effort. One such initiative is the Climate Change and Science Program/Global Change Research Program. With funding from the National Aeronautics and Space Administration, the DOE, NSF, the EPA, the DOC, USDA, the Department of Interior, and others, this program receives a great deal of public and congressional attention, as it should. Its multiagency cross-cutting budget is also valuable for program analysis. In this case, its history of funding reveals erratic financial contributions from the numerous agencies involved, which indicates how difficult it is to maintain sustained funding for federal R&D efforts.

Although noteworthy, this climate program is much smaller in scope than a truly comprehensive energy plan, which would require managing all of the budgetary resources devoted to energy RD&D by all government agencies. Based on the available information, and in particular on the DOE budget, we believe that the comprehensive energy RD&D budget should be at least twice what it is today.

Launch a sustained and integrated energy R&D program. A robust technology base program has multiple purposes:

- Discover and explore new ideas for energy supply and efficiency use. This research and exploratory development activity is less costly to pursue than commercial-stage demonstration projects.

- Acquire scientific and engineering data that provide a practical design base for deployment and scale-up when combined with modeling and simulation. This implies much greater reliance on process development unit scale development, augmented with serious theory and analysis.

- Construct and support the needed experimental facilities for the R&D program located at DOE laboratories, universities, and industry consortia.

- Establish mechanisms for interaction between technology experts and demonstration project design and operation. In many cases, early and consistent involvement of research specialists can solve technical issues that arise during project development. The innovation process is not one-directional.

- Educate scientists and engineers for careers in the energy sector. Professional organizations such as the National Petroleum Council and the American Nuclear Society have noted the looming shortage of individuals with the technical skills needed for U.S. energy industries.

Energy efficiency, for instance, is one area that deserves greater research effort, as it is likely to yield important long-term and short-term payoffs. This new initiative on energy R&D should also embrace efforts at DOE and other agencies such as NSF, the EPA, and the DOC. Research is needed in nanoparticles to improve high-temperature ceramic materials and basic separation technology to use in hydrogen storage. Development efforts could be productive in fenestration, lighting, metering instruments, and advanced vehicles.

Create an Energy Technology Corporation (ETC) to manage demonstration projects. One of the recurring weaknesses in federal RD&D is the demonstration phase. Too often, this expensive stage in the energy innovation process is carried out in a manner that provides little useful information to the private sector.

What is needed is an ETC. This new semipublic organization, governed by an independent board of individuals nominated by the president and confirmed by the Senate, would have a single function: to finance and execute select large-scale demonstration projects in a manner that is commercially credible. To this end, the ETC should be composed of people who have expertise in areas where DOE officials traditionally have little experience: market forecasting, the use of indirect financing mechanisms, and industry requirements. Because it would not be a federal agency, the ETC would be free from the federal procurement regulations and mandated production targets that currently make it difficult to demonstrate a new technology's commercial viability under real market conditions. In addition, the ETC would be funded in a single appropriation, which would reduce the influence of Congress and special interest groups on its decisionmaking. All of this makes the ETC uniquely suited to manage demonstration projects in a way that will accelerate the adoption of new technologies by private industry and, ultimately, the transformation of the U.S. economy.

There are many examples of demonstration projects that would dramatically improve the pace of energy innovation:

- Cellulosic biomass–to–biofuels plants

- Carbon sequestration

- Integrated coal-fired electricity generation and CO_2 capture

- Smart electricity networks

- Production of natural gas hydrates

- Nuclear power projects based on the once-through fuel cycle

- Superconducting transmission lines

The ETC we propose here differs fundamentally from proposals sometimes advanced for a new Manhattan or Apollo project for energy. The Manhattan and Apollo projects had solely technological purposes: the former to produce a nuclear weapon, the latter to put a human on the moon. The government was the only user of the output, there was no private market, and cost was not an object. In contrast, the ETC would be structured as a quasipublic corporation that operates in a manner of a private corporation embarked on expensive first-of-a-kind technology deployment.

The ETC also differs from the industry-managed technology consortia that DOE has sponsored for a number of decades in an attempt to increase private-sector participation [such as the Partnership for a New Generation of Vehicles, the Advanced Battery Consortium, the Electric Power Research Institute, and the Gas Research Institute (now part of the Gas Technology Institute)]. In spite of some successes, however, the rate of innovation here has not exceeded that of other RD&D models.

The ETC does resemble the U.S. Synthetic Fuels Corporation (SFC) that was established in 1980 for the purpose of reducing U.S. dependence on imported oil by producing synthetic gas and liquid fuel from coal, oil sands, and shale. Its mandate was to subsidize the construction of plants that would reach a target production level of 500,000 barrels per day by 1987. This production target was justified on the assumption that oil prices would double in the near future. In fact, prices fell by more than half, thereby rendering the enormously expensive SFC undertaking commercially unfeasible and making apparent the risks of funding demonstration projects that are designed to reach a fixed production level regardless of prevailing market conditions.

The essential difference between the ETC and SFC is that the ETC is exclusively concerned with demonstrating the operational and economic readiness of new technologies, whereas the SFC was concerned with achieving production targets without regard to the difference between production cost and market price. The ETC does, however, adopt the philosophy of SFC structure (properly conceived at the time) that DOE and other energy-related government agencies do not have the flexibility, tools, and competence to execute successful large-scale projects that must operate in the private sector.

Create an energy technology career path within the civil service. The new approach to RD&D that we are proposing requires a new type of civil servant to implement it. Federal agencies must develop or recruit a set of specialists who have the technical, financial, and management skills to participate in the integrated effort needed for successful energy innovation. This will require establishing a new career path with a distinct set of rules covering compensation, conflicts of interest, and promotion. Initially, the cadre should be limited to approximately 200 individuals.

An important motivation for the creation of this elite career service is that energy innovation is intrinsically interdisciplinary, requiring the integration of a number of disciplines for a successful RD&D program. For example, biomass requires the involvement of individuals with expertise in plant biology, agronomy, chemical engineering, economics, and environment. International experience in the Department of State or U.S. Agency for International Development would also be valuable. A career service that provides the opportunity, or even the requirement, that an individual have experience in a number of different agencies will strengthen the capability of the country to manage energy innovation successfully.

The country desperately needs dedicated public servants who have the capability to manage the sophisticated and expensive energy innovation challenge ahead. Establishing an elite service has the additional benefit of attracting a new generation of specialists who have the requisite skills but currently do not see government service as a sufficiently rewarding or prestigious career path.

About the Authors

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John Deutch is an Institute Professor at the Massachusetts Institute of Technology and a trustee of the Center for American Progress. He has been a member of the MIT faculty since 1970, and has served as Chairman of the Department of Chemistry, Dean of Science, and Provost. Deutch has served in significant government and academic posts throughout his career. In May 1995, he was sworn in as Director of Central Intelligence following a unanimous vote in the Senate, and he served as DCI until December 1996. From March 1994 to May 1995, he served as the Deputy Secretary of Defense. From March 1993 to March 1994, Deutch served as Under Secretary of Defense for Acquisitions and Technology. From 1977 to 1980, he served in a number of positions for the U.S. Department of Energy: as Director of Energy Research, Acting Assistant Secretary for Energy Technology, and Undersecretary of the Department. Mr. Deutch earned a B.A. in history and economics from Amherst College, and both a B.S. in chemical engineering and Ph.D. in physical chemistry from M.I.T.

John Podesta

John Podesta is the President and Chief Executive Officer of the Center for American Progress. Podesta served as Chief of Staff to President William J. Clinton from October 1998 until January 2001, where he was responsible for directing, managing, and overseeing all policy development, daily operations, congressional relations, and staff activities of the White House. He coordinated the work of cabinet agencies with a particular emphasis on the development of federal budget and tax policy, and served in the President's Cabinet and as a Principal on the National Security Council. Podesta is currently a Visiting Professor of Law on the faculty of the Georgetown University Law Center, a position he also held from January 1995 to 1997. He has taught courses on technology policy, congressional investigations, legislation, copyright and public interest law. Podesta is a 1976 graduate of Georgetown University Law Center, and a 1971 graduate of Knox College.

Peter Ogden

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