Bipartisan Policy Center

Pathways to Decarbonization: Accelerating Clean Energy Technology Innovation

1. Why Focus on Clean Energy Technology Innovation?

The United States and the world face enormous energy challenges. Among those challenges, meeting the energy needs of a growing economy and population while simultaneously achieving deep reductions in greenhouse gas emissions, stands out as one of the most consequential. Success in this effort will be driven by our ability to develop and deploy advanced energy technologies that provide equivalent or better energy services than those available today, with no GHG emissions, and at reasonable cost. Recent progress in improving the efficiency of energy use, reducing the cost, and expanding the deployment of renewable energy technologies has been encouraging, but it isn't enough. Economically and politically, transformation on the scale needed to address climate change will not be possible without more, and better, deployable clean energy options.

Fortunately, technology innovation has long been one of our nation's great strengths. With smart policies and an effective partnership between government and industry, America's track record of leadership in clean energy can continue over the crucial decades to come. To create the conditions for success, however, a reassessment—and a reinvigoration—of the federal government's role in energy innovation is overdue.

2. What Is the Role of Government in Clean Energy Technology Innovation?

The United States has long been a world leader in energy innovation. This success includes the commercialization of nuclear power in the 1960s; the development, in more recent decades, of breakthrough solar and wind technologies; and the deployment of new methods for extracting oil and gas that have transformed the energy supply landscape domestically and abroad. The federal government played an important role in much of this history: directly sponsoring the fundamental science and research that enabled these developments, and through supportive policies that helped new technologies gain a foothold in the market.

Technology innovation in general is often described as a process with four steps: research, development, demonstration, and deployment, or RDD&D. In theory and in practice, the public sector typically plays a larger role in the earlier stages (R&D), where the private sector has fewer incentives to invest due to the uncertainty of a potential payoff. As new technologies progress to the demonstration and deployment stages, and certainly at the point of large-scale commercialization, the private sector role becomes more dominant. In reality, this division of stages and roles is rarely so simple or formulaic: few technologies travel a straight

line from basic research to commercial deployment, and government and business more often operate as partners, with varying degrees of involvement and risk, throughout the innovation process.

The rationale for greater public investment in energy technology is strong, because of the large environmental and public health impacts involved. Further, the energy industry itself—when compared to other major technology-driven sectors such as pharmaceuticals and computers/electronics—has historically lagged in investments on innovation (as measured by dollars devoted to R&D relative to industry revenues). Reasons for this include the high capital intensity of much energy technology and the challenges of scaling innovation in this sector. Additionally, financial incentives for innovation are often lacking due to the low-margin commodity markets in which energy companies operate. Given the weaker role of the private sector, it is concerning that federal expenditures on energy innovation in the United States have been falling—particularly when one considers the massive public investments in energy technology innovation being made by our major trading partners, such as China.

3. What Are the Primary Ways that Government Supports Technology Innovation?

Government support for technology innovation take a variety of forms. The most important are summarized here:

Direct investment in RDD&D: In the United States, much of this spending supports basic and applied R&D activities at universities and in the network of national laboratories run by the Department of Energy. At times, the federal government has also invested directly in clean energy start-ups and research labs associated with large industrial players. More recently, a relatively new federal entity, modeled on the Defense Advanced Research Projects Agency, was launched in 2009 to focus on cultivating "high-risk, high-reward" energy technologies through a more entrepreneurial model. Called the Advanced Research Projects Agency–Energy (ARPA-E), this agency operates independently of DOE and was designed to be nimble and flexible in working with the private sector to move promising innovations out of the lab and toward commercialization.

Financial incentives: Tax incentives are a popular mechanism for promoting new technologies, though they must be carefully designed to work efficiently and avoid supporting mature industries. The federal tax code provides a general incentive for companies to conduct R&D in an effort to reward companies for continuing to innovate and develop new products and services. Later in the innovation lifecycle, tax incentives exist to support the deployment of specific energy technologies. Production tax credits and investment tax credits, also known as the PTC and the ITC, have played critical roles in reducing the costs and improving the performance of wind and solar technologies, respectively. The PTC is directly designed to support energy produced (dollar per kilowatt-hour generated), while the ITC helps to offset capital expenditures to build new generation capacity (dollar per kilowatt of capacity built). Recent discussions around changing the PTC and ITC to more effectively target new (as opposed to mature) technologies have focused on mechanisms for phasing out the tax credits as technologies gain market penetration and on making the tax credits technology neutral by basing eligibility on zero- or low-carbon characteristics.

Government procurement: As a major user of energy and consumer of products and services, the federal government can help create market demand for energy innovation by serving as a large, reliable first customer for advanced technologies. By emphasizing clean energy characteristics and other difficult-to-monetize attributes in its procurement practices, these mechanisms can provide the market scale necessary to help develop supply chains and drive lower-cost products that can then transition to more competitive private markets. Several policies of this type are already in place. For example, the 2005 Energy Policy Act included renewable electricity purchase requirements for government agencies; the General Services Administration issues specifications for government vehicles; and the Federal Energy Management Program provides

efficiency guidelines for federal buildings, thereby incentivizing investments in energy-saving measures, such as improved insulation, advanced windows, and more efficient thermal management systems.

Other policies: Historically, one of the most important ways government has influenced innovation has been indirectly, by adopting policies, such as standards or regulations, that create economic incentives for bringing new technologies to market. Examples of this dynamic are too numerous to list, but they include the development of catalyst technology to meet automobile tailpipe standards and scrubbers to reduce sulfur dioxide emissions from power plants. The government can also use voluntary programs and information to stimulate consumer demand for cleaner technologies; an example is the Energy Star labeling program.

4. How Can the U.S. Improve its Performance in Clean Energy Technology Innovation?

There are many opportunities to accelerate and expand the nation's innovation enterprise. Policy makers interested in redefining and strengthening the federal role in clean energy technology innovation face several key questions:

The appropriate level of direct investment: What should the balance of investment be across the innovation lifecycle? Should we emphasize demonstration and deployment or basic energy science? The American Energy Innovation Council (AEIC) recommends tripling DOE's clean energy innovation budget (from basic research to applied demonstration programs) to $16 billion a year over 2010 levels, including funding ARPA–E at $1 billion per year. The AEIC also recommends a greater federal focus on pilot and demonstration projects, along with reforms to help DOE partner more effectively with the private sector.

Leveraging tax incentives: Should incentives be technology-neutral or technology-specific? Should credits phase out over a set timeframe or should phase-out be tied to market penetration? Should they be monetizable or transferable?

Leveraging government procurement: Should the focus be on agency-by-agency performance targets, or should agencies rely on GSA and FEMP specifications, or both? Similarly, should agencies focus on a few major products and services or undertake more comprehensive efforts? Finally, what are the opportunities for improving broad procurement mechanisms, such as performance contracting? The federal government can serve as a first market for innovative clean energy technologies.

5. Is the 116th Congress Considering Clean Energy Technology Innovation?

Numerous clean energy technology innovation bills have been introduced in the current Congress. The Senate Energy and Natural Resources Committee; the House Space, Science, and Technology Committee; and the House Energy and Commerce Committee have been particularly active. Bills have been introduced on several topics including, but not limited to the bills outlined below. The Senate introduced bipartisan energy package, the American Energy Innovation Act, includes many of these bills.

- Carbon capture, utilization, and storage
  - S. 2300 and H.R. 4230, the Clean Industrial Technology Act
  - S. 1201, the Enhancing Fossil Fuel Energy Carbon Technology Act
  - H.R. 3607, the Fossil Energy R&D Act
  - S. 1685 and H.R. 3828, the Launching Energy Advancement and Development through Innovations for Natural Gas Act
  - S. 383 and H.R. 1166, the Utilizing Significant Emissions with Innovative Technologies Act
- Energy efficiency
  - H.R. 34, the Energy and Water Research Integration Act
  - S. 1706 and H.R. 3079, the Energy Savings Through Public-Private Partnerships Act

- S. 2137 and H.R. 3962, the Energy Savings and Industrial Competitiveness Act
- S. 1857 and H.R. 5650, the Federal Energy and Water Management Performance Act

- Energy storage
  - S. 1602 and H.R. 2986, the Better Energy Storage Technologies Act
- Finance and tax incentives
  - S. 1841 and H.R. 3249, the Financing Our Energy Future Act
  - H.R. 5523, the Energy Sector Innovation Credit Act
- Innovation ecosystem
  - S. 2714 and H.R. 4091, the ARPA-E Reauthorization
  - S. 2005 and H.R. 3575, the Increasing and Mobilizing Partnerships to Achieve Commercialization of Technologies for Energy Act
  - S. 2688, the Technology Transitions Act
- Nuclear
  - S. 903 and H.R. 3306, the Nuclear Energy Leadership Act
  - S. 2368, the Nuclear Energy Renewal Act
  - H.R. 6097, the Nuclear Energy Research and Development Act
- Renewable energy
  - S. 2657, the Advanced Geothermal Innovation Leadership Act of 2019
  - H.R. 5374, the Advanced Geothermal Research and Development Act
  - S. 2660 and H.R. 3609, the Wind Energy R&D Act
  - S. 2668 and H.R. 3597, the Solar Energy Technology R&D Act