

US should act to support innovation in increasingly clean electric power technologies: report

September 8 2016

A new [report](#) from the National Academies of Sciences, Engineering, and Medicine urges Congress, federal and state agencies, and regulatory institutions to significantly increase their support for innovation for what the report's study committee calls "increasingly clean" electric power technologies - nuclear power, carbon capture and storage, and renewables such as solar and wind. Some of these technologies have seen recent cost and price declines and are cost-competitive in certain locations. But significantly greater market penetration of these technologies will be required to help address the worst impacts of climate change, as well as harms to human health such as asthma and premature death caused by pollution.

Currently, most increasingly clean power technologies cost too much and do not perform well enough to achieve high global levels of adoption, the report says. Reducing the cost and improving the performance of increasingly clean power technologies in ways that support wide adoption will, in many cases, require improvements to current technology that are more than incremental. Changes in the way the electricity grid is engineered and operated will be needed as well. The report recommends a range of specific steps the U.S. federal and state governments and regulatory agencies should take to support [innovation](#) that improves the performance and cost-competitiveness of increasingly clean electricity generation and grid technologies.

"We called our report The Power of Change because changing where we get our electricity from will require changing how we think, so that we see this not just as one of the greatest challenges of our time but also as one of our country's greatest opportunities," said Charles O. Holliday, Jr., chair of the committee that wrote the report, and chair of Royal Dutch Shell, PLC. "We are only in the second inning of energy innovation, but we could take the lead globally by working together as a nation, and tapping the ingenuity we have always been known best for, to achieve breakthrough innovation."

Innovation is hampered by market failures and nonmarket barriers at all stages of the innovation process, and the report identifies measures that can help overcome them:

- Proof-of-concept and pilot projects should have clear missions and goals. The U.S. Department of Energy should help advance innovation by using sector-specific road-mapping and challenge funding.
- The intermediate stages of innovation are among the most critical and often overlooked. Once a concept has been proven, it faces a range of scale-up, manufacturing, regulatory, and market challenges to commercialization. The Small Business Investment Company program can help overcome these barriers; for example, allocating 20 percent of SBIC funding to create new venture capital funds focused on early-stage increasingly clean power technologies.
- Simulation and testing of new technologies are key capabilities. DOE should take the lead in assessing public and private simulation and testing capabilities, identifying gaps, and supporting or incentivizing creation of capabilities to fill those gaps.

The report identifies additional steps that federal and state governments

should take to speed innovation in and adoption of increasingly [clean energy technologies](#).

Pricing pollution. Congress should consider an appropriate price on pollution from electricity production, including greenhouse gases and pollutants such as nitrogen oxides and particulate matter, to reflect fossil fuels' "hidden costs" to human health and the environment, the report says. Requiring electricity producers to take those harms into account would help make increasingly clean energy sources cost competitive.

Innovating to improve current generating technologies. In 2015, two-thirds of U.S. electricity was produced from fossil fuels, evenly divided between coal and [natural gas](#). Despite significant federal and state efforts in recent years to spur deployment, wind produced less than 5 percent, solar produced less than 1 percent, and other renewables combined (mostly hydroelectric) produced about 8 percent of all U.S. electricity in 2015. The largest low- or no-carbon production of electricity came from nuclear power plants, many of which may be shuttered in the coming decades as their operating licenses expire. (See Figure 2-2 from report.)

The large leaps in performance and cost declines necessary for increasingly clean power technologies to compete in the market will require substantial improvements in currently available technologies and/or significant technological breakthroughs. The scale of innovation needed, and companies' fear that they may not realize an adequate return on their investments, make it unlikely that companies alone will pursue the needed amount of innovation. Moreover, large-scale deployment alone is unlikely to produce cost breakthroughs or technological improvements.

The report identifies steps policymakers can take to encourage innovation in and greater deployment of current increasingly clean power technologies and resources. For example, to speed development

and use of carbon capture and storage technologies, Congress should direct the U.S. Environmental Protection Agency to develop a set of long-term performance standards for the transport and storage of captured CO₂. In the nuclear sector, the U.S. Nuclear Regulatory Commission should prepare for a rulemaking that would change the licensing of advanced nuclear reactors to establish a risk-informed regulatory pathway for considering advanced non-light water reactor technologies, as well as a staged licensing process. As the costs of renewables like wind and solar approach becoming competitive with cheaper natural gas generation, states should expand competitive solicitation processes for the most cost-effective renewable projects and consider the long-term power purchase agreements (PPAs) necessary to enable low-cost capital for project financing.

Improving electric power infrastructure, including the transmission and delivery system. Equally important to improving the current generation technologies are changes to the electricity transmission and distribution system so that it is capable of integrating variable and distributed generating technologies at greater levels. Utility regulators will need to provide incentives to utilities to become fully engaged in innovation and demonstration of new technologies. State regulators and policymakers should implement policies designed to support innovation. For example, they could evaluate approaches in which utility or energy customer funds are set aside to support state and regional innovation programs.

Increasing energy efficiency. The committee also examined opportunities for reducing electricity use by increasing efficiency. It recommends that DOE, on an ongoing basis, set new standards for home appliances and commercial equipment at the maximum levels that are technologically feasible and economically justified. The agency should also increase its investments in innovative [energy efficiency technologies](#), and in behavioral strategies to improve consumers' use of current

energy efficient technologies.

Focusing subsidies on initial development of energy technologies.

History suggests that such supports as direct subsidies and tax exemptions tend to continue well after technologies have matured and are market-competitive. While subsidies can serve important public policy functions in helping to establish industries, they should be structured to be performance- or outcome-oriented without regard to specific technologies, and to include sunset provisions so they expire either after a specified length of time or a certain performance level has been achieved—as is the case with the recently renewed production tax credits for power from wind and solar. In contrast, the many subsidies for oil and natural gas have no sunset provisions despite the maturity of those industries.

Provided by National Academies of Sciences, Engineering, and
Medicine

Citation: US should act to support innovation in increasingly clean electric power technologies: report (2016, September 8) retrieved 9 April 2024 from <https://phys.org/news/2016-09-increasingly-electric-power-technologies.html>

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