

## Promoting Innovation for Low-Carbon Technologies

A Hamilton Project proposal by David Popp of the Maxwell School of Citizenship and Public Affairs at Syracuse University aims to increase innovation in low-carbon energy technologies, making it possible to achieve ambitious climate goals at a lower cost. Popp draws on a growing body of evidence to explain what policy can and cannot do to promote low-carbon technologies, then provides specific guidelines for policymakers.

### Issue Overview

- **Promoting low-carbon energy innovation is crucial** for replacing fossil fuel energy sources and thereby meeting ambitious climate goals.
- **Public investments in clean energy innovation** are best used on high-risk, high-reward projects as well as public good infrastructure projects—both of which are likely to be undervalued by the private sector. By contrast, government R&D spending should not be allocated to projects that would otherwise be likely to receive private sector investment.
- **A portfolio of policy tools should be used** to (1) increase the potential market for innovation (the demand side) and (2) address market failures that hinder innovation (the supply side).

### The Challenge

Despite progress made over the past decade, further innovation is necessary to achieve deep decarbonization of the U.S. economy. Meeting climate policy goals currently under consideration will not be possible without further technological improvement. Many technical barriers remain, and the technological challenges of further reducing GHG emissions will be much greater than those overcome so far.

It will take several steps—from basic and applied research to demonstration and commercialization—to bring about technological change at the scale required to meet our goals for GHG reduction. Unfortunately, market failures affect all stages of clean energy technology development, meaning that market forces alone will not lead to sufficient investment. One market failure is that high-carbon energy sources do not pay for the social costs stemming from their emissions. Carbon pricing directly addresses this type of market failure, and can partly level the playing field for clean energy, but it does not address market failures affecting innovation itself. This second class of market failures includes knowledge spillovers that make it difficult for firms to capture the full social value of their inventions as well as the increasing returns to scale that make the energy sector especially capital intensive. Properly targeted government policies can address these market failures, leading to greater innovation in clean energy.

There is no silver-bullet policy to promote the many types of innovation necessary to meet the climate challenge. Various policy instruments have different effects that depend on the type of technology, the stage of development, and the sector of the economy. Since separate policy instruments are needed to address different market failures, supporting clean energy innovation requires a portfolio of policy tools.

## The Path Forward

As a response to these challenges, Popp provides guidelines for U.S. policymakers attempting to promote clean energy innovation. His guidelines for making better use of public R&D investments are as follows:

- 1. Restore progress toward Mission Innovation goals.** The United States is currently far below its Mission Innovation goal of doubling R&D spending on clean energy by 2020 and must recommit to achieving this target. Social returns to increased investment continue to be high and would remain so even with substantial increases in funding.
- 2. Phase in spending increases over a four-year period.** Long-term sustained research support is more effective than short bursts of inconsistent funding. Researchers are limited in their ability to absorb large sudden increases in funding.
- 3. Emphasize high-risk, high-reward opportunities that are unlikely to receive private sector support.** Government R&D should focus on breakthrough technologies that are not yet close to market. Although potential short-term payoffs may be low, these technologies have potential for large long-term payoffs if successful.
- 4. Emphasize applied research on public good infrastructure that is unlikely to receive private sector support.** Within the energy sector, the next wave of energy innovation is likely to require public infrastructure such as smart-grid technologies, the integration of intermittent renewable energy technologies into the grid, the adoption of connected vehicle infrastructure, and the charging infrastructure for electric vehicles. Governments and regulated utilities will be the main consumers of many of these technologies.
- 5. Be patient evaluating project outcomes, but be willing to adjust decisions over time.** Studies suggest that it can take a decade or more for the effects of government energy R&D to be fully realized. Because R&D is uncertain and some projects will fail, it is important to evaluate the full portfolio of research.
- 6. Enhance opportunities for technology transfer through DOE laboratories.** DOE laboratories should be encouraged to adopt a more entrepreneurial culture by rewarding researchers for working with start-ups as well as by adjusting performance and evaluation standards for researchers.
- 7. States should increase their investments in clean energy innovation in the absence of enhanced federal innovation support.** The federal government is in a better position to fund energy R&D spending, both because it is better able to diversify risk and because federal research spending avoids potential duplication of research programs across multiple states. Nonetheless, further investment from states could help close the gap between current federal energy R&D levels and the Mission Innovation goals.

## About the Author

David Popp is the Caroline Rapking Faculty Scholar in Public Administration and Policy at the Maxwell School of Syracuse University.