USING MECHANISM-FOCUSED RESEARCH TO ACCELERATE INNOVATION

The Challenge: Accelerating the Rate of Climate Innovation

Achieving global climate goals will require an acceleration of the rate at which we, as a society, invent, develop, commercialize, and adopt climate solution technologies. A new report from the Trancik Lab at the Massachusetts Institute of Technology (MIT) provides an approach for identifying promising mechanisms of technological change that can serve as leverage points for accelerating innovation. Applying this methodology — and the lessons learned from existing research — can help policymakers make the best use of funds provided by recent climate legislation, including the Infrastructure Investment and Jobs Act (IIJA), Inflation Reduction Action (IRA), and CHIPS and Science Act.

How Can the Trancik Lab's Research Help?

The Trancik Lab at MIT has developed a novel research approach that can be used to guide policy and funding decisions toward achieving the greatest impact. The methodology, laid out in full in the report, focuses on modeling the mechanisms—or causes—of technological change for specific technologies. These mechanisms range from low-level (e.g., increased efficiency, reduced input prices) to high-level (e.g., research and development (R&D), economies of scale, learning by doing), as well as the types of policies that drive these high-level processes. Benefits of this approach include:

- Enabling researchers to look backwards to identify the mechanisms that drove past technology improvements—such as the exponential reductions in cost in recent decades for solar panels and lithium-ion batteries—thereby providing insights into how to better leverage these mechanisms to accelerate future technological progress;
- Offering federal agencies and innovators a methodology for looking forward to identify the mechanisms that are most likely to drive rapid improvements in both existing and new technologies, which can help with prioritization of funding and agenda-setting in the R&D context;
- Providing powerful insights into how the design, sequencing, and implementation of policies can influence the development of a technology, allowing policymakers to make informed decisions about not only which policies to use to support technological development, but also where in a technology's lifecycle these should be focused to speed up development;
- Differing from previous approaches to understanding innovation by enabling researchers to precisely quantify how specific mechanisms contribute to technological progress, even when many changes happen simultaneously.

Key Takeaways: Lessons Learned From Applying Trancik's Methodology

Key takeaways are included below from the application of this methodology to the three case studies presented in the report: solar photovoltaics, lithium-ion batteries, and nuclear fission.

- **R&D and market-expansion policies are both critical for technology innovation**

  The report's examination of solar PV modules demonstrated that both R&D funding and market-expansion policies contributed significantly to observed cost declines. This is not unique to solar and is likely to apply to many other emerging technologies. Any technology that is manufactured and has the potential for efficiency improvements will likely need multiple policies to accelerate innovation at different stages in its lifecycle. Going forward, policymakers involved in setting climate policy and R&D budgets should coordinate to ensure that the potential benefits of both types of policies are captured.

- **R&D investment can be beneficial well past initial commercialization of a technology**

  Research in the Trancik Lab also suggests that sustained, and not just early-stage, R&D support can be an important driver of cost reduction for clean energy technologies. Conventional wisdom in technology policymaking is that "science and technology–push" processes can precede "demand-pull" processes. Their results are consistent with this model and provide additional insight by suggesting that technology-push policies may remain important for certain technologies even long after demand-pull processes begin to contribute to cost reduction.

- **Technologies with low levels of design complexity may be particularly well positioned to advance rapidly**

  This studies' results are consistent with other research that suggests that technologies that allow some components to be improved without requiring improvements elsewhere in a design can improve more quickly than those with many dependencies between components. Lithium-ion batteries provide a prime example.

- **Policymakers and regulators should collect and share data on technology variables affecting costs and other aspects of technology performance, and how these variables change over time**

  The studies of technological change described in this report and the insights this research provides require extensive collection of data that is often difficult to obtain. Policymakers could specifically allocate funding for collecting data on technologies and how they change, including details on technologies' components and other features, their manufacturing processes, performance and cost, and how these change over time. Making these data publicly available would enable third-party researchers to continue investigating the possible mechanisms of technological change.

Learn more about the new research method devised by the Trancik lab by reading the full report here.

Contact: Chandler Green, Communications Manager, chgreen@edf.org