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Maximizing the Effectiveness of Support for Energy Technology Innovations

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Between 2011 and 2035, the world will spend up to \$4.8 trillion on public policy measures to subsidize investment in renewable energy technologies like wind and solar, Joern Huenteler, pre-doctoral research fellow in the Science, Technology, and Public Policy Program of the Belfer Center for Science and International Affairs, said in a talk on his research on energy technology development on Monday. Most of this spending will be in the form of feed-in tariffs, tax credits and renewable portfolio standards.

“We want this money to stimulate innovation,” Huenteler emphasized in his talk, “so we have to think about these measures as innovation policies”. He suggested that this means going beyond ‘one-size-fits-all’ approaches and tailoring our policy instruments to the drivers of innovation in the different energy technologies. “The way we currently think about deployment policy design is strongly influenced by models that have been developed for consumer goods and that *do not apply* to all energy technologies,” Huenteler said, “and that make us believe that more demand will more or less automatically lead to more innovation. Deployment policies could stimulate innovation more effectively if they account for differences between technologies.”

In general, Huenteler explained, our thinking about deployment policies is based on a model of the technology development cycle in which, after an initial phase of rapid technological innovation, further improvements come primarily through lowering production costs, especially through learning-by-doing effects and scale in manufacturing. Given this pattern of development, after the first innovation phase, the only real objective for technology development is stimulating demand, allowing for more production and more learning.

However, this model, developed with evidence from mass-produced consumer goods, may not be a good representation of the development process for energy technologies, such as wind or geothermal energy, that more closely resemble large infrastructure projects than mass-produced consumer goods, Huenteler noted. In these cases, simply subsidizing demand may not be the most effective way of stimulating innovation

In order to gain insight into the kinds of differences that may be found in the development of different energy technologies, Huenteler analyzed the history of patenting in the wind and solar industries. Focusing on the most influential (most often-cited) patents in each area, Huenteler sorted these by the focus of the invention and by date, revealing contrasting development paths in each industry.

In wind, major technology innovations cluster around improvements to different parts of the system—rotors, power trains, and grid connections—but Huenteler found no evidence for a surge in process innovations, as it has been observed for consumer goods.

Solar PV, in contrast, Huenteler showed, more closely resembles the mass-produced good development model—early product innovations have been followed by an extended period of innovation in the solar cell production process.



Such differences, Huenteler argued, may point to the need to tailor deployment policies to specific energy technologies. For a mass-produced technology like solar large markets, ideally coordinated internationally, are needed to enable the necessary economies of scale and the learning-by-doing in production – a patch-work of small niche markets will not overcome the ‘chicken-and-egg’ problem of low production volumes and high production costs. For larger and more complex technologies, such as geothermal plants or wind turbines, on the other hand, simply subsidizing investment in more of the same might not lead to the desired improvements in technology. Instead, policy support should explicitly be targeted at improving our understanding of the technology, for example by tying subsidies to requirements to publish cost and performance data, or by financing experimentation in different geographical and climatic environments. .

Huenteler spoke as part of the Kennedy School’s Energy Policy Seminar Series, which is jointly sponsored by the Energy Technology Innovation Policy research group of the Belfer Center on Science and International Affairs and by the Consortium for Energy Policy Research of the Mossavar-Rahmani Center on Business and Government.