



ENERGY

Curbing Carbon

New energy technologies need the support of sound economic policy to prevent further damage to our climate, says Robert N. Stavins.

Throughout the U.S. economy, millions of decentralized decisions are made every day that contribute to the problem of climate change. A national carbon-pricing system—in the form of either carbon taxes or cap-and-trade—is the only policy that can significantly tilt them all in a climate-friendly direction. Given the ubiquity and diversity of energy use in a modern economy, conventional regulatory approaches simply cannot do the job.

Furthermore, carbon pricing is the least costly approach. In the short term, the cost of reducing emissions will vary wildly across sources as different as coal-fired power plants and cars and trucks. Only carbon pricing provides strong incentives that can push all sources to control at the same marginal cost, achieving the lowest possible expense overall. In the long term, it will create incentives to develop carbon-friendly technologies (*see*

“Energy Hedtk,” p. 46) that reduce costs over time.

But carbon pricing cannot fix all the market failures that are causing our climate’s problems. It must work alongside policies that foster climate-friendly technology research and development if we are to bring carbon dioxide emissions under control.

The most important failure that carbon pricing cannot address is the fact that firms pay the costs of their R&D but do not reap all the benefits. Even if intellectual-property rights were perfectly enforced, tremendous spillover benefits would accrue to other firms. Inventions and innovations by one firm provide valuable information that leads to new inventions and innovations by other firms.

Thus the information created by R&D is what economists describe as a “public good,” benefiting actors entirely external to its place of origin. A rational response from the private sector is to carry out less than the “efficient” amount of research into new climate-friendly technologies, even under carbon pricing. Hence, other public policies are needed to address this failure of the R&D “market.”

Public support will be necessary to develop new technologies to combat climate change. And to address the climate-change market failure itself, carbon pricing will be necessary. This is an application of a fundamental principle in economics: two market failures require the use of two policy instruments. Empirical economic analysis has repeatedly verified that combining carbon pricing with R&D support is more cost-effective than adopting either approach alone.

Both carbon pricing and direct technology-innovation policies are necessary. Neither is sufficient. These are complements, not substitutes.

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INNOVATION

Users Rule

Novel technologies that create new markets often emerge from pioneering user inventions, argues Eric Von Hippel.

Sometimes pioneering innovation comes from a company offering a new product or service—a number of examples are featured in this issue (*see “The TR50,” p. 35*). But these producers, and those still to come, will do their jobs better if they understand a lesson my colleagues and I have learned in our research: users of a particular technology, whether they’re individuals or companies, are usually the initial developers of important and novel innovations that enable them to do new things and create new markets.

Twitter is one example. Its community of users invented retweets and hashtags, both now core parts of the service. Important processing techniques now embodied in equipment sold by Applied Materials were initially developed by major equipment users such as Western Electric, IBM, and Intel. Users excel at this role because they understand their emerging needs better than producers do.

The pattern holds true in developed as well as emerging economies. For example, the idea of banking by cell phone first emerged in Bangladesh, Kenya, and other countries poorly served by banks. The service is enabled by wireless carriers, but the innovation originated when users without bank accounts began to buy credits for cell-phone minutes and exchange them between phones to settle financial transactions. From that developed a major business.

Working with Harvard Business School’s Christoph Hienerth and Copenhagen Business School’s Carliss Baldwin, I’ve studied the ways that user-developed innovations become commercial products or services. The process begins