Assessing the Energy-Efficiency Gap

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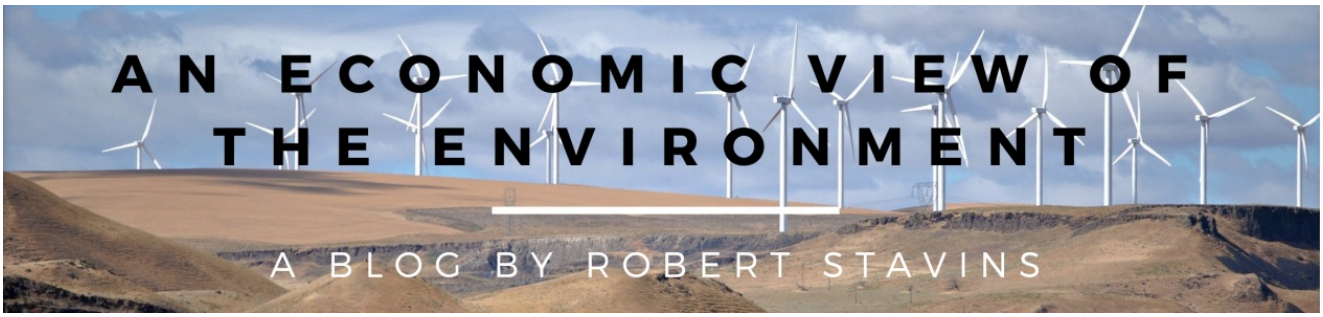

Global energy consumption is on a path to grow 30-50 percent over the next 25 years, bringing with it, in many countries, increased local air pollution, greenhouse gas (GHG) emissions, and oil consumption, as well as higher energy prices. Energy-efficient technologies offer considerable promise for reducing the costs and environmental damages associated with energy use, but these technologies appear not to be used by consumers and businesses to the degree that would apparently be justified, even on the basis of their own (private) financial net benefits.

For some thirty years, there have been discussions and debates about this phenomenon among researchers and others in academia, government, non-profits, and private industry, typically couched in terms of potential explanations of the so-called "energy efficiency gap" or "energy paradox."

Thinking About the Energy-Efficiency Gap

I wrote about this some two years ago at this blog (Thinking About the Energy-Efficiency Gap). I noted then that Professor Richard Newell of Duke University and I had just launched an initiative – sponsored by the Alfred P. Sloan Foundation — to synthesize past work on potential explanations of the energy paradox and identify key gaps in knowledge. We subsequently conducted a comprehensive review and assessment of social-science research on the adoption of energy-efficient technologies.

We worked with leading social scientists — including scholars from economics, psychology, and other disciplines, at a workshop held at Harvard — to examine the various possible explanations of the energy paradox and thereby to help identify the frontiers of knowledge on the diffusion of energy-efficient technologies. As materials became available, we posted them at the project's Harvard website and the project's Duke website.

Releasing a New Monograph

I'm pleased to inform readers of this blog that we have now released a major monograph, Assessing the Energy Efficiency Gap, co-authored with Todd Gerarden, a Harvard Ph.D. student in Public Policy and a Pre-Doctoral Fellow of the Harvard Environmental Economics Program (HEEP). The monograph draws in part from the research workshop held at Harvard (in October 2013), in which most of the U.S.-based scholars (primarily, but not exclusively, economists) then conducting research on the energy-efficiency gap participated. HEEP co-sponsored a second such research workshop with the Centre for European Economic Research (ZEW) in Mannheim, Germany in March 2014, where European economists explored the same topic. Closely-related research was presented by panelists at the annual conference of the Allied Social Science Association in January 2015.

In the new monograph, Gerarden, Newell, and I examine both the "energy paradox," the apparent reality that some energy-efficiency technologies that would pay off for adopters are nevertheless not adopted, and the broader phenomenon we characterize as the "energy-efficiency gap," the apparent reality that some energy-efficiency technologies that would be socially efficient are not adopted. The contrast is between private and social optimality, which ultimately has important implications for the role of various policies, as well as their expected net benefits.

Four Key Questions

We begin by decomposing cost-minimizing energy-efficiency decisions into their fundamental elements, which allows us to identify four major questions, the answers to which are germane to sorting out the causes (and reality or lack thereof) of the paradox and gap.

First, we ask whether the energy efficiency and associated pricing of products on the market are economically efficient. To answer this question, we examine the variety of energy-efficient products on the market, their energy-efficiency levels, and their pricing. Although the theory is clear, empirical evidence is—in general—quite limited. More data that could facilitate potential future empirical research are becoming available, although firm-level data are much less plentiful than data on consumers. We do not see this area as meriting high priority for future research, however, with the exception of research that evaluates the effectiveness and efficiency of existing energy-efficiency information policies and examines options for improving these policies.

Second, we ask whether energy operating costs are inefficiently priced and/or understood. Even if consumers make privately optimal decisions, energy-saving technology may diffuse more slowly than the socially optimal rate, because of negative externalities. So, even if the energy paradox is not present, the energy-efficiency gap may be. As in the first realm, the theoretical arguments are strong. Empirical evidence is considerable, and in many cases

data are likely to be available for additional research. Existing policies appear not to be sufficient from an economic perspective, suggesting that further research is warranted. Indeed, we ascribe high priority to the pursuit of research in this realm.

Third, we ask whether product choices are cost-minimizing in present-value terms, or whether various market failures and/or behavioral phenomena inhibit such cost-minimization. We find that the empirical evidence ranges from strong (split incentives/agency issues and inattention/salience phenomena) to moderate (heuristic decision-making/bounded rationality, systematic risk, and option value) to weak (learning-by-using, loss aversion, myopia, and capital market failures). Importantly, here, as elsewhere in our review, the bulk of previous work has focused on the residential sector and much less attention has been given to the commercial and industrial sectors. Some areas merit priority for future research, such as empirical analysis of split incentives/agency issues in areas where efficiency standards are not present, and much more work can be done in the behavioral realm.

Fourth, we ask whether other unobserved costs may inhibit energy-efficient decisions. We find that the empirical evidence is generally sound, and that data needed for more research are available. We assign a relatively high priority to future research, particularly to aid understanding of consumer demand for product attributes that are correlated with energy efficiency, thereby informing policy and product development decisions.

Three Categories of Potential Explanations of the Gap

Finally, we ask what these findings have to say about the three categories of explanations (reviewed in detail in my 2013 essay at this blog) for the apparent underinvestment in energy-efficient technologies relative to the predictions of some engineering and economic models: (1) market failures, (2) behavioral effects, and (3) modeling flaws. In brief, potential market-failure explanations include information problems, energy market failures, capital market failures, and innovation market failures. Potential behavioral explanations include inattentiveness and salience, myopia and short sightedness, bounded rationality and heuristic decision-making, prospect theory and reference-point phenomena, and systematically biased beliefs. Finally, potential modeling flaws include unobserved or understated costs of adoption; ignored product attributes; heterogeneity in benefits and costs of adoption across potential adopters; use of incorrect discount rates; and uncertainty, irreversibility, and option value.

It turns out that all three categories of explanations are theoretically sound and that limited empirical evidence exists for every category as well, although the empirical research is by no means consistently strong across all of the specific explanations. The validity of each of these explanations—and the degree to which each contributes to the energy-efficiency gap —are relevant for crafting sensible policies, so Gerarden, Newell, and I hope that our new monograph can help inform both future research and policy. Given the many energy-

efficiency policies and programs that are already in place, high priority should be given to research that evaluates the effectiveness, cost-effectiveness, and overall economic efficiency of existing energy-efficiency policies, as well as options for their improvement.

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