By Robert N. Stavins

Closing the Energy-Efficiency Gap

Adoption of energy-efficient technologies could reap both private and social rewards, in the form of economic, environmental, and other social benefits. Social benefits include improvements in air quality, reduced greenhouse gas emissions, and increased energy security. Governments have adopted policies to increase efficiency, but various barriers have prevented the realization of a substantial portion.

For some thirty years, there have been debates among researchers and others in academia, government, nonprofits, and private industry regarding the so-called "energy efficiency gap" (or "energy paradox") — the apparent reality that many energy-efficiency technologies are not adopted even when it makes sense for consumers and businesses to do so, based on their private costs and benefits. That is, decisionmakers appear to "under-invest" in energy-efficient technologies, relative to the predictions of some engineering and economic models.

What causes this gap? The answer to that question could presumably help inform the development of better public policy. Potential explanations for the energy efficiency gap tend to fall into three broad categories: market failures; behavioral effects; and modeling flaws.

Let's start with the potential market-failure explanations. First, various innovation market failures have been posited, including research and development and learning-by-doing spillovers; inefficient product quality and differentiation due to market power; and inefficient introduction of new products due to consumer taste spillovers (for example, consumers becoming comfortable with a new technology).

Second, another set of potential market-failure explanations for the gap may be characterized as information problems. These include: lack of information on the part of consumers; asymmetric information (the "lemons problem"); and split incentives and principal-agent issues (such as the frequently discussed renter/owner dichotomy). Third, there are capital market failures and liquidity constraints, which may be a particularly significant issue in developing-country contexts. Fourth, there are energy market failures, including various externalities (environmental, energy security, congestion, and accident risk), as well as average-cost pricing of electricity.

Next, the rise of behavioral economics has brought to the fore another set of explanations of the gap. A variety of taxonomies could be employed to separate these explanations, but one such taxonomy would categorize the explanations as inattentiveness and salience issues (although inattention can be rational and efficient under some circumstances); short-sightedness; prospect theory (and reference point issues); bounded rationality and heuristic decisionmaking; and systematically biased beliefs (regarding, for example, future energy prices and the development of new technologies).

Decisionmakers appear to "under-invest" in energy-efficient technologies

Finally, there are model and measurement explanations. This category of explanations of the energy efficiency gap consists essentially of a set of reasons why observed levels of diffusion of energy-efficiency technologies may actually be privately optimal. First, there is the possibility of unobserved or understated adoption costs, including unaccounted for product characteristics. Second, there may be overstated benefits of adoption, due to inferior project execution relative to assumptions or poor policy. Third, an incorrect discount rate may be employed in an analysis, when the correct rate should vary with opportunity cost of and access to capital, income, buying versus retrofitting equipment, systematic risk, and option value.

Another aspect of model and measurement explanations is connected with the reality of heterogeneity across end users in the benefits and costs of employing energy-efficiency technologies, so that what is privately optimal on average will not be privately optimal for all. This can refer either to static (cross-sectional) heterogeneity or to dynamic (intertemporal) heterogeneity, that is, technology improvements over time, which raises two possibilities: the reality of some potential adopters being short of the frontier, and the presence of option value to waiting. Finally, there is the possibility of uncertainty (real, not informational, as above), irreversibility, and option value. This could be due to uncertainty regarding future energy prices, or can be linked with option value that arises for delaying investments that have only minimal if any salvage value.

Determining the validity of each of these possible explanations and the degree to which each contributes to the energy efficiency gap are crucial steps in crafting the most appropriate public policy responses. Professor Richard Newell of Duke University and I have recently launched an initiative, sponsored by the Alfred P. Sloan Foundation, to do just that — synthesize past work on these potential explanations of the energy paradox and identify key gaps in knowledge.

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