

# Is There an Energy Efficiency Gap?

## THE ENERGY EFFICIENCY GAP: WHAT IS THE BEST POLICY?

RESEARCH BY: HUNT ALLCOTT (NYU) AND MICHAEL GREENSTONE (MIT)

### CONTEXT

Energy efficiency is often billed as a “win-win” proposition because it can both save money and reduce pollution associated with energy use. Many argue that there is insufficient investment in energy efficiency due to two market failures: externalities (e.g., pollution) associated with fossil-fuel energy use and investment inefficiencies. Investment inefficiencies arise when consumers and firms under-invest in energy efficiency due, for example, to imperfect information.

It is crucial to distinguish between these two types of market failures so that the most appropriate energy efficiency policy can be adopted. This study asks whether there are investment inefficiencies that policy could correct. In other words, “is there an energy efficiency gap?”

### OUR DEFINITIONS

Energy efficiency gap, n.: the wedge between the cost-minimizing level of energy efficiency investment that a firm or household should make and the investment level actually realized.

Energy efficiency policies, n.: the set of subsidies and standards that directly encourage investment in energy efficient capital stock but do not directly affect energy prices. Although gasoline taxes, cap-and-trade programs, or other policies that affect energy prices will of course also increase investment in energy efficient capital stock, these policies that act through energy prices are conceptually distinct in the policy analysis.

### MAIN LESSONS

1. **There is a need for additional evidence on the energy efficiency gap**, including through RCTs. Much of the existing empirical work does not meet rigorous requirements for establishing a causal link between the energy efficiency program and savings.
2. Generalizing across a variety of settings, **the available evidence suggests that the magnitude of the energy efficiency gap in the field is small relative to the assessments of the potential energy efficiency gap from engineering analyses**. Such analyses often overstate energy cost savings and often fail to include time and other “hidden” costs incurred by consumers.
3. **Policy design and evaluation should target market failures**. For example, households that use more energy than other comparable households are more likely to have low-cost energy conservation opportunities of which they are unaware, and many U.S. utilities now target energy conservation information to these relatively heavy users.

### ORIGINAL CITATION

ALLCOTT, Hunt and Michael GREENSTONE, 2012. “Is There an Energy Efficiency Gap?” *Journal of Economic Perspectives*, 26(1), Winter 2012

### THIS STUDY

This study distinguishes between these two market failures and clarifies the separate policy implications:

- If **externalities** associated with fossil-fuel energy use were the only market failure, it is widely agreed that the optimal policy would be to tax the pollution directly or through an equivalent cap-and-trade program such that the cost of the pollution is incorporated into the price of the energy.
- If **investment inefficiencies** exist, then the optimal policy is to address the inefficiency directly, for example, by providing information to imperfectly informed consumers. If investment inefficiencies cannot be addressed directly, energy efficiency subsidies and standards may be merited.



## BACKGROUND

### Defining the debate

This study focuses on household energy use and personal transportation because these are areas where inefficiencies of imperfect information might be more severe:

**Table 1: Use of Energy in the US**

U.S. Energy Use by Sector		Residential	
Commercial	19%	Refrigerators	5%
Industrial	30%	ACs	8%
Transport	29%	Water Heating	20%
Residential	22%	Space Heating	41%
<b>Total</b>	<b>100%</b>	Other and Lighting	26%

Source: U.S. Energy Information Administration.

### The American experience

The US is now less energy intensive, although it is hard to say whether it is at or near the efficient level:

1. **Energy productivity** per unit of GDP is 2.4 times higher than in 1949. The country is economizing on energy faster than on other factors.
2. **High energy prices** seem to be correlated with the fastest improvements in energy productivity.
3. **US energy intensity:** more than OECD, less than set of low- and middle-income countries.

### The model

Allcott and Greenstone develop a model that analyzes what affects an individual's choice when deciding between two goods, one of which is energy efficient. In the model, the consumer decides to purchase the energy efficient good if the energy savings, net of unobserved costs, outweigh the purchase price. The model takes into consideration the possibility of externalities and investment inefficiencies, providing a framework to guide the choice of policies.

## EXISTING STUDIES: EVIDENCE OF THE EE GAP

The study analyzes the evidence on whether consumers and firms leave profitable energy efficient investments on the table:

### The categories of evidence they analyze are:

1. Engineering estimates of returns to potential investments
2. Empirical estimates of returns to observed investments
3. Cost effectiveness of energy conservation programs run by electric utilities
4. Estimated demand patterns for energy-using durables.

### Available analyses suffer from these problems:

1. There are important factors that are difficult to observe or measure, such as the time and effort required to weatherize a home.
2. The energy use reductions are often not well-measured and sometimes overstated.
3. There are substantial differences across consumers in their use and unobserved costs such that identifying the average returns for adopters may not be informative for other communities.

**Evidence for an energy efficiency gap seems to be situation-specific, mixed, often inconclusive, and its magnitude seems to be small relative to the assessments from engineering analyses.**

## EVIDENCE OF INVESTMENT INEFFICIENCIES

Looking at particular investment inefficiencies, what is the existing empirical evidence on their magnitudes?

### (1) Imperfect Information

There are two forms of imperfect information:

1. Agents may be unaware of potential investments. For example, homeowners may not know how poorly insulated their home is and may not be aware of the opportunity to weatherize.
2. Buyers know<sup>1</sup> that products have different levels of energy efficiency, but these differences are costly to observe.

### (2) Inattention

Choice problems have many different facets, some less salient at the time the choice is made even if they are potentially important later. For example when buying a printer, consumers tend to focus on the purchase price and fail to consider the cost of replacement ink cartridges.

Evidence in other non-energy settings is suggestive of inattention.

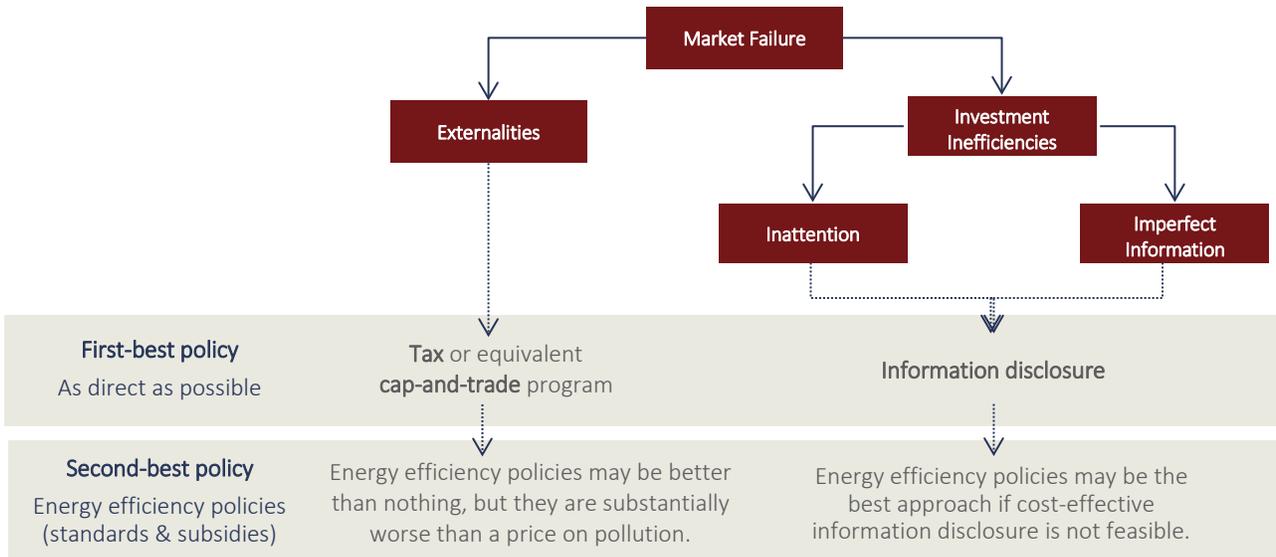
**Existing research suggests that the magnitude of investment inefficiencies varies in different contexts.**

<sup>1</sup> Resembles Akerlof's (1970) "lemons" model



## WHAT ARE THE POLICY RECOMMENDATIONS? ADDRESS THE FAILURE AS DIRECTLY AS POSSIBLE

Even in the absence of ironclad evidence, policy-makers must make decisions. The following chart outlines the proper responses, which vary with the market failure:



## THE SECOND-BEST: POLITICAL REALITIES OFTEN MAKE THE OPTIMAL POLICY INFEASIBLE, BUT THERE IS A COST...

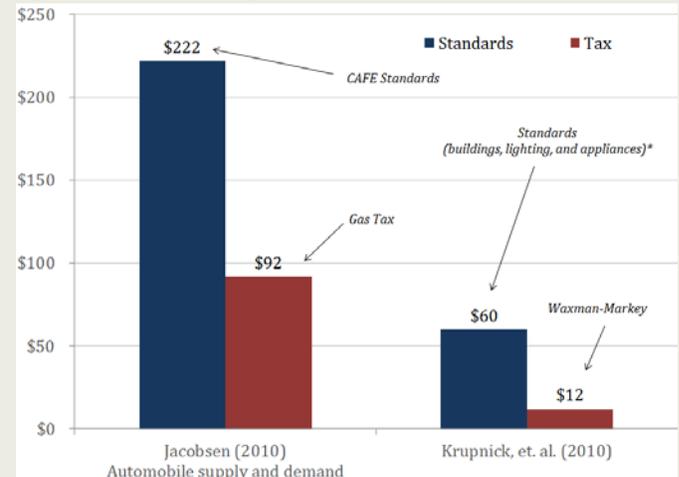
### 1. In the presence of externalities

Energy efficiency policies could have larger costs per unit of pollution abated compared to a price on pollution for several reasons:

1. Subsidies and standards change relative prices for all consumers equally, while a tax provides the largest incentive to consumers with the greatest consumption to purchase the energy efficient good.
2. Only a tax imposes the right price on a consumer's decision on how much to consume.
3. A tax is easier to calculate and can be more accurately set to reflect the level of marginal damages.

In settings where these factors are small, energy efficiency policies are almost as good as a price on pollution.

Figure 1: Welfare cost per metric ton of carbon dioxide abated



### 2. In the presence of investment inefficiencies

When information disclosure is ineffective or infeasible, then energy efficiency subsidies and standards may be the best option. However, it is important to target the policies at the market failures that motivate them. For example:

1. If subsidizing weatherization due to "landlord-tenant" information asymmetries, consider limiting subsidies to rental properties.
2. If lighting efficiency programs are justified due to lack of awareness of or attention to electricity costs, consider marketing the programs to consumers that are the least aware of energy efficiency - not previous participants in other utility programs.

## CONCLUSIONS

Since the energy crises of the 1970s, many have made the “win-win” argument for energy efficiency policy: subsidies and standards can both address investment inefficiencies in the purchase of energy-using durable goods and reduce externalities from energy use. However, a reliance on observational studies of variable credibility and the possibility of unobserved costs and benefits of energy efficiency make it difficult to assess the magnitude of the Energy Efficiency Gap definitively.

Nevertheless, the available evidence from empirical analyses of weatherization, demand-side management programs, automobile and appliance markets, the “landlord–tenant” agency problem, and information elicitation suggests that while investment inefficiencies do appear in various settings, the actual magnitude of the energy efficiency gap is small relative to the assessments from engineering analyses. Furthermore, it appears likely that there is substantial variation in investment inefficiencies across the population. Thus, targeted policies have the potential to generate larger welfare gains than general subsidies or mandates. Given this, policy analyses need to do more than assess how much a policy affects energy efficiency: they must also identify what types of consumers are induced to be more energy efficient.

We believe that there is a tremendous opportunity and need for policy-relevant, rigorous empirical research that uses experimental and quasi-experimental techniques to estimate the impacts of programs on different consumer types and to address the challenges posed by unobserved costs and benefits. The economic insights from such research are potentially generalizable, and the policy implications are significant.

## ABOUT US: E2E PROJECT’S MISSION AND STRATEGY

*Supported by a generous grant from The Alfred P. Sloan Foundation, the E2e Project is a joint initiative of the Energy Institute at the University of California at Berkeley’s Haas School of Business, the Energy Policy Institute at Chicago at the University of Chicago, and the Center for Energy and Environmental Policy Research at the Massachusetts Institute of Technology. E2e unites top researchers in economics, engineering and other fields and uses transparent and state-of-the-art analytical techniques. Our mission is to solve one of the most perplexing energy puzzles of our time—the efficiency gap. Infusing the creation of knowledge with a commitment to non-partisan outreach, E2e aims to create a cheaper and greener future. (<http://e2e.haas.berkeley.edu/>)*

