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Market failures and barriers as a basis for clean energy policies ☆

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Abstract

This paper provides compelling evidence that large-scale market failures and barriers prevent consumers in the United States from obtaining energy services at least cost. Assessments of numerous energy policies and programs suggest that public interventions can overcome many of these market obstacles. By articulating these barriers and reviewing the literature on ways of addressing them, this paper provides a strong justification for the policy portfolios that define the "Scenarios for a Clean Energy Future," a study conducted by five National Laboratories. These scenarios are described in other papers published in this special issue of *Energy Policy*. © 2001 Elsevier Science Ltd. All rights reserved.

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1. Background

Examination of energy trends following the 1973–74 oil embargo has highlighted the great strides in energy efficiency that have made the US economy much less energy intensive today than it was in 1970. Nevertheless, numerous engineering-economic studies have identified many potential investments in energy efficiency that appear to be cost-effective, but which remain unexploited (Interlaboratory Working Group, 2000; Office of Technology Assessment, 1991; National Academy of Sciences, 1992; Tellus Institute, 1997). This would not be surprising if a relatively small number of such investments were identified, or if only a small portion of future energy growth were to be prevented by making these investments. However, a large number of analyses indicate the continued existence of a sizeable untapped reservoir of highly cost-effective investments that could have a significant impact on US energy use and greenhouse gas emissions.

If energy-efficient technology is cost-effective, why doesn't more of it just happen? If individuals or businesses can make money from energy efficiency, why don't they all just do so? Assuming the empirical data show that a significant proportion of truly cost-effective and efficient technologies are not adopted, why does their cost-effectiveness fail to propel them to commercial success? Conversely, if consumers and businesses are not taking actions to bring about energy efficiency, then perhaps these reports of widespread untapped energy efficiency opportunities are exaggerated. Is it possible that these opportunities carry liabilities (e.g., different labor skill requirements) and costs (e.g., greater maintenance or program administration costs) that are simply hidden or are difficult to quantify? Are other characteristics (other than cost) more important?

Energy markets are not unique in their imperfections. Other products and services face obstacles that hinder their adoption, even when their consumer economics appear to be favorable. Conditions hindering cost-effective investments in energy efficiency and clean energy resources have received considerable attention because of their widespread environmental, national security, and macroeconomic repercussions. The motivation behind the re-examination presented in this paper

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was to provide a foundation for the *Scenarios for a Clean Energy Future* (CEF) Study (Brown et al., 2001; Interlaboratory Working Group, 2000). The CEF study is a comprehensive assessment of policy opportunities to accelerate the market penetration of efficient and clean energy technologies. Understanding the barriers to this penetration was essential to defining potentially effective policies.

This paper provides evidence that sizeable cost-effective opportunities for energy efficiency improvements exist in the economy. First we look at individual technology case studies that present compelling evidence of an efficiency gap. Next we describe a range of market failures and institutional barriers that explain the existence of this gap. Then we characterize sector differences in market failures and barriers. This lays the groundwork for discussing the government's role and the rationale for clean energy policies and programs.

2. The efficiency gap

The term "efficiency gap" refers to the difference between the actual level of investment in energy efficiency and the higher level that would be cost-beneficial from the consumer's (i.e., the individual's or firm's) point of view. The existence of this gap has been documented in many case studies.

2.1. Case studies of individual technologies

Many different case studies could be cited showing that consumers and businesses often choose not to purchase highly cost-effective energy technology. The technologies in these examples were clearly superior to the technologies being replaced and no significant "hidden costs" to the consumer could be identified.

Efficient magnetic ballasts for fluorescent lighting were commercially available as early as 1976. They were a well-tested technology, with performance characteristics equal to or better than standard ballasts by the early 1980s. By 1987, five states—including California and New York—had prohibited the sale of standard ballasts. But the remaining three-quarters of the population chose standard ballasts over efficient ballasts by a ratio of 10-to-1, even though the efficient magnetic ballast paid back its investment in less than two years for virtually all commercial buildings (Koomey et al., 1996). The time required to establish retail distribution service networks and to gain consumer confidence are typical causes of slow innovation diffusions such as this. (Since 1990, federal standards have prohibited the sale of the standard ballast.)

In a more general study of efficient lighting investments using data from EPA's Green Lights Program, DeCanio (1998) has shown that there is a large potential for profitable energy-saving investments in *lighting* that is not being realized because of impediments that are internal to private and public-sector organizations. While economic forces play a role, economics alone cannot explain the level of investments made in energy-efficient lighting projects. Impediments to these investments include capital rationing and lack of organizational rewards for energy managers who reduce utility bills.

Meier and Whittier (1983) studied a case in which consumers were given a choice in stores throughout the United States of two *refrigerators* that were identical in all respects except two: energy efficiency and price. The energy-efficient model (which saved 410 kilowatt hours per year, more than 25% of energy usage) cost $60 more than the standard model. The energy-efficient model was highly cost-effective in almost all locations of the country. In most regions, it provided an annual return on investment of about 50%. In spite of these favorable economics, which were easily observed by the purchaser, more than half of all purchasers chose the inefficient model. The higher purchase price of the efficient model was presumably the principal barrier to its purchase.

To enable the use of remote controls for *televisions* in the early 1990s, it became necessary for televisions to consume some amount of power continuously. Typical televisions with remote controls at that time used 5–7 W of standby power for that purpose. The Energy Star television program was able to reduce these power losses by requiring that televisions qualifying for the Energy Star label must reduce standby power to three watts or less, a savings of roughly 50%. The resulting price increase had a payback period of 1–2 years for consumers. Because this saving was no more than a few dollars a year per television, there was no public outcry for manufacturers to deliver the improvement. At the same time, the aggregate savings to the nation of widespread market penetration was significant. Through the labeling program, the lack of consumer interest could be overcome. About ten major manufacturers now offer such televisions, and several of them have reduced standby losses to 0.5 W (Interlaboratory Working Group, 2000, Chapter 4).

Industrial motor systems represent the largest single end use of electricity in the American economy—23% of US electricity consumption—and they present a very substantial energy-efficiency potential. The results of a recent market assessment involving on-site surveys of 265 industrial facilities document that technologies offering a simple payback of 3 years or less can typically save businesses 11–18% of the energy used to drive motors (Xenergy, Inc., 1998). DOE's Motor Challenge program conducts audits, demonstrations and technical assistance to encourage the use of proven, cost-effective technologies to improve industrial motor systems.

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