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BOOK REVIEW

The Economics of Energy Efficiency: Barriers to Cost-Effective Investment

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The authors of this book define a barrier to energy efficiency as "a mechanism that inhibits a decision or behaviour that appears to be both energy efficient and economically efficient" (p. 27). Such mechanisms prevent (sufficient) investment in cost-effective energy efficient technologies, and therefore contribute to the energy efficiency gap, which the authors imprecisely define as "the existence of unexploited investment opportunities that appear worthwhile at current prices" (p.30). Of course such investment opportunities could just as easily arise in a variety of contexts, not just those associated with improvements in energy efficiency. The narrower focus of this book is on whether there are widespread and cost effective opportunities available to improve energy efficiency, and if so, what might be done to encourage exploitation of these opportunities, particularly in terms of public policy or organizational change.

The material in this book essentially summarizes – and puts in a particularly reader-friendly form – a selection of the information obtained and analysis conducted as part of a project on barriers to energy efficiency in public and private organizations that was undertaken in the U.K., Ireland, and Germany during 1998-2000. The project itself involved surveys and detailed interviews with various people in these organizations who were selected because they were in charge of, associated with, or had some knowledge and/or related interest in, energy use and possibly (although not necessarily) energy efficiency within those organizations. To put the results of such a project in an accessible form, the analysis is broken into case studies of particular sectors in the various countries, where the information and analysis in the case study for each sector is typically based on surveys that elicited responses from many entities (firms or organizations) in that sector, and then detailed follow-up interviews with between four and seven of these entities within each sector. The four sectors that are considered in this book, each forming a separate chapter, are the higher education sectors in Germany and in the U.K, the brewing sector in the U.K., and the mechanical engineering sector in Ireland. In addition, reflecting the author's contention that ongoing reforms to U.K construction industry have the potential to address many of the barriers they identify elsewhere (at least in the U.K.), and motivated mainly by comments obtained in the interviews conducted for the case studies in the U.K. higher education sector, the book includes an additional chapter that focuses on the U.K construction industry, although without the benefit of the same type of survey and interview information obtained for the other sectors.

To provide a framework for the case studies, Chapter 2 is a stand-alone methodological piece that develops a taxonomy of six barriers to energy efficiency and identifies the causal mechanisms that underlie these barriers. In developing this categorization, the authors emphasize – and to my mind overemphasize, both here and throughout the remainder of the book – the need to use ideas from transactions cost economics and behavioural economics (mainly the concept of bounded rationality, which can loosely be described as individuals not seeking out or using all available relevant information when making a decision) as well as ideas from what the authors refer to as orthodox or neo-classical economics. I don't believe this distinction between the different areas of economic theory from which the ideas are drawn to be important to, or even adopted by, a majority of economists, and it is unlikely that non-economists would care. The authors, however, use this distinction to emphasize that some of the barriers that they identify may not be viewed as barriers in the orthodox sense since they are not market failures and provide no grounds for policy intervention, while others may prove too costly to overcome (p. 83). This seems like an overly strong simplification, or

overly tight definition of barriers that is at odds with the authors' earlier definition. Their definition of barriers, as repeated in the opening sentence of this review, contains no reference to the need for policy intervention, so this inclusion here seems misleading. In terms of barriers being too costly to overcome, it is difficult to understand why this might prevent something being described as a barrier, although it does raise questions about what costs are included for a potentially energy efficient investment to be described as "economically efficient" in the first place, as specified in the definition of barriers.

Regardless of their origins, the six barriers to energy efficiency are identified as risk, imperfect information, hidden costs, access to capital, split incentives, and bounded rationality. Each of these barriers is discussed in some detail, including its nature and determinants, and is interpreted using more formal economic concepts. In some cases the discussion of a particular barrier identifies and describes several components, such as with the imperfect information barrier, which includes imperfect information in energy service markets as well as asymmetric information and adverse selection in these markets. The discussion of this barrier also suggests how these information problems might be overcome, and concludes with a very useful summary. These summaries, which occur in numerous places throughout the book, are generally quite helpful at synthesizing a number of different ideas. Chapter 2 concludes with a table that identifies mechanisms through which energy efficient opportunities may come to be neglected for each of the six barriers. The case studies in the following chapters are interpreted in terms of this framework.

The particular sectors that are selected for the case studies differ in the predominant ways in which they use energy, as well as in terms of the proportion of their costs accounted for by energy expenditures. For the public sector organizations that dominate the higher education sector, energy use is less than 2% of total costs, and is primarily required for applications in building services, such as heating, lighting and air conditioning. In process industries, of which brewing firms are taken to be representative, energy use is mainly required for process applications that are specific to the sector, and comprises less than 5% of total costs. In mechanical engineering firms, which are viewed as being representative of light industry, energy costs comprise less than 2.5% of total costs, and energy is required mainly for generic technologies such as mechanical drives, furnaces, and space heating. As the authors note, although the shares of costs attributable to energy are relatively small in all three sectors, "these types of organization account for around 20-25 per cent of final energy demand in OECD countries" (p. 11). Thus, to the extent that documented "studies regularly suggest that cost-effective opportunities to improve energy efficiency in these sectors are widely

available" they may be considered as prime targets by those concerned with greenhouse gas emission reductions through improved energy use.

The format of each of the four chapters containing the case studies is very similar, beginning with a description and overview of the sector that also includes details concerning the pattern of energy use and energy costs, as well as other information, the nature of which differs across sectors, on such areas as the financial and organizational context, the decision-making procedure for investments, the determinants of energy performance, and recent initiatives on energy and environmental management. In the case of the U.K. higher education and brewing sectors, this is followed by analysis of a postal survey on energy management practices, technology adoption, and perceived barriers to energy efficiency. It is unfortunate that similar surveys were not conducted for the other two sectors, since the survey response rates (30% for U.K. higher education and 53% for U.K. brewing) suggest that the information from the surveys may be more representative of the sector than the (more detailed) information from the five or so individual organizations in each sector on which the remainder of the analysis is based.

The focus of the analysis of the mail surveys and case study organizations is on judging and explaining the reasons underlying the overall performance of the organization in terms of energy efficiency. In terms of the mail out surveys, performance measures are derived from self-assessment of variables such as technology adoption. The authors note (p. 135) that this is "subjective and indirect, but nevertheless useful". This seems like a somewhat self-serving evaluation, especially in view of the biases that may have been introduced by self-selecting respondents, and while information about how organizations view themselves may be of interest (and I certainly found it so), it is difficult to envisage how this could be used as the basis for policy prescriptions.

The analysis of the mail-in surveys is similar for both sectors for which these were available, and is organized in several categories that include energy and environmental management, energy information systems, investment in energy efficiency, technology adoption, and barriers to energy efficiency. Of these, perhaps the most interesting are the last two sections. Technology adoption reports the percentage of respondents that have adopted each of the relatively short payback period energy efficient technologies or techniques that was included on an extensive list tailored specifically to each sector. The barriers to energy efficiency section provides a summary of respondents' perceptions of the importance of each item contained on a similarly long tailored list of barriers to energy efficiency that were phrased in terms designed to be meaningful to the survey participants. While this list generally contains items that would be difficult to dispute (Lack of time/other priorities, Technical risk, Lack of staff awareness, Business/market

uncertainty, etc.), some of the items seem strange. For example, in the case of the U.K. brewing sector, the most important barrier was "Technology inappropriate at this site". It is difficult to reconcile this description with the definition of a barrier as "a mechanism that inhibits a decision or behaviour that appears to be both energy efficient and economically efficient".

The information obtained in the interviews that were undertaken as part of the case studies for three of the four sectors (the Irish mechanical engineering sector analysis is structured differently) is usefully categorized under a series of headings that generally include Organization, Energy and Environmental Policy, Energy Information Systems, Accountability and Incentives, Capital Budget and Investment, New Building and Refurbishment, Purchasing and Policy Integration, Awareness and Culture, Energy Services and Outsourcing, and Status of Energy Management. Following this discussion, the main barriers to energy efficiency in each sector are identified and explained, utilizing the framework that was introduced in Chapter 2. Each case study chapter then concludes with a section on policy implications, focusing on how the barriers may be overcome and energy efficiency improved, and an overall summary and conclusions section. As might be expected, both the barriers and recommendations differ from sector to sector. At the risk of oversimplification, to the extent that there are recurring barriers (although they are not always the most important), they would appear to be access to capital and hidden costs, predominantly involving constraints on staff time, which, it is argued, would best be remedied through changes at the organizational level. As the authors note, such changes are unlikely to occur while energy costs and environmental performance remain a relatively marginal concern.

Chapter 7 summarizes features of the U.K. construction industry, and highlights important barriers to energy efficiency that appear to have been identified predominantly from the case studies of U.K. higher education sector. The key problems that are noted here include transactions costs associated with energy efficiency information, asymmetric information between contractors and clients or between subcontractors, lack of incentive to minimize life-cycle as opposed to initial purchase and installation costs, and severe time constraints which lead to the use of rules of thumb rather than the specific detailed analysis that would be appropriate in particular circumstances. The main recommendation here is for full integration of climate policy objectives into building industry reforms that are designed to change the organization of the industry.

The overall results of the project are summarized in a final chapter, while two appendices contain examples of the questionnaire and interview protocols that were used. The authors conclude that cost-effective energy efficiency opportunities are widely available but that the typical definition ignores

hidden costs and other barriers that may be of considerable importance. Hidden costs and capital constraints are suggested as the main reasons for not investing in energy efficiency in the case study organizations, although evidence of the other four barriers identified in the taxonomy is found to differing extents in the various sectors that were examined. The authors argue that these barriers "can be overcome if there exist alternative institutional arrangements that can lower the net transaction cost of improving energy efficiency" (p. 306). Desirable criteria for organizational or public policy initiatives designed to improve energy efficiency cost-effectively are identified, although it is noted that in view of the barriers being "multi-faceted, diverse and often specific to individual technologies and sectors" (p. 309), it is likely that a co-coordinated policy mix will be required. Some directions for future research are also suggested.

Overall, this is a very interesting and generally well-written book (apart from an obvious disconnect between pages 240 and 241) that contains considerable information on why certain energy efficiency initiatives are not undertaken in a wide variety of circumstances. Yet at the end there remain a number of issues that are not resolved entirely satisfactorily. First, in what sense can an energy efficient investment be regarded as cost effective if there are hidden costs, no access to the required capital, split incentives, bounded rationality, etc? To my mind, these are all factors that act to make an investment not cost effective to those who are making the actual decision, so that it is not surprising that it would not be undertaken. Of course this observation does not detract in any way from the authors' analysis of what these factors are and how they may be alleviated, but it suggests that perhaps these so called barriers might be better interpreted as factors that contribute to what appears to be a perfectly understandable (albeit boundedly rational) decision not to proceed with an investment in a more energy efficient technology. Similarly, rather than implicitly or explicitly (Chapter 4) suggesting that money has been left "on the floor" – creating an energy efficiency gap – due to the non-adoption of certain energy efficiency investment opportunities, and clearly implying a misallocation of resources, it may be better to interpret this "gap" simply as an opportunity cost, a measure of the extent of some foregone opportunity due to actions that are not being taken, with no judgment involved about the appropriateness of such actions.

Second, and perhaps more importantly, the authors do not address the question of why we would or should expect firms or organizations to focus on energy efficiency. Many energy efficient techniques or technologies with relatively short payback periods may be available, as this book suggests, but presumably so are many other investment opportunities not involving energy efficiency, and in some cases these may have even shorter payback periods – an example might be reorganization or restructuring of human resources

within an organization. Presumably the reason that we care about firms not being energy efficient but we don't worry about them being human resource efficient is that we are viewing them from a wider perspective, due to concerns with climate change, for example. But if energy costs are relatively small, so that increasing energy efficiency will not have much effect on the organization's bottom line, and if society regards increased energy efficiency as important, why not address this issue directly by increasing the costs of energy to these organizations in such a way or with such incentives that they feel compelled to make the organizational and other changes that are required to use energy more efficiently?

There is a long tradition of concern with barriers to energy efficiency, and as the authors point out in the preface, "Ultimately what is required are detailed empirical studies of the nature, origin and operation of the supposed barriers to energy efficiency in a wide range of energy service markets, together with evaluation studies of the costs and benefits of different types of policy intervention" (p. 4). The book delivers on these requirements, and in doing so admirably satisfies its objective of contributing to the ongoing "barriers" debate. It provides an interesting, detailed, well-researched contribution that may indeed help in accomplishing the authors' stated intention "to build a bridge between the energy economics community and engineering-based practitioners in the energy efficiency field" (p.vi).

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