

The Commercial Energy Consumer: About Whom Are We Speaking?

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ABSTRACT

Who are commercial sector customers, and how do they make decisions about energy consumption and energy efficiency investment? The energy policy field has not done a thorough job of describing energy consumption in the commercial sector. First, the discussion of the commercial sector itself is dominated by discussion of large businesses/buildings. Second, discussion of this portion of the commercial sector's consumption behavior is driven primarily by theory, with very little field data collected on the way commercial sector decision-makers describe their own options, choices, and reasons for taking action. These limitations artificially constrain energy policy options.

This paper reviews the extant literature on commercial sector energy consumption behavior and identifies gaps in our knowledge. In particular, it argues that the primary energy policy model of commercial sector energy consumption is a top-down model that uses macro-level investment data to make conclusions about commercial behavior. Missing from the discussion is a model of consumption behavior that builds up to a theoretical framework informed by the micro-level data provided by commercial decision-makers themselves. Such a bottom-up model could enhance the effectiveness of commercial sector energy policy. In particular, translation of some behavioral models from the residential sector to the commercial sector may offer new opportunities for policies to change commercial energy consumption behavior. Utility bill consumption feedback is considered as one example of a policy option that may be applicable to both the residential and small commercial sector.

Introduction

What does the existing literature have to say about energy consumption decision making in the commercial sector? There are two areas of discussion from which to draw: literature about commercial sector investment in energy-efficient technologies, and literature that deals generally with energy consumption behavior. There is residential sector literature on energy consumption behavior, and there is commercial sector literature on investment practices. The two have essentially no overlap.

In the commercial sector, the main approach has been one of descriptions of the economics of business investment practices. As we will see, these descriptions have often proceeded with little primary data on the expressed decision-making practices of the business in question. Instead, the analysis has been conducted by inferring decision-making models from macro-level data about technology adoption. Almost nothing is known about how individual decision makers in the commercial sector environment describe their own energy consumption practices.

By comparison, there is a rich literature describing the energy consumption behavior of individuals in the residential sector. In fact, the general consensus of the analytical community suggests that it is very difficult to describe residential energy consumers using the standard analytical techniques of economics.

At the same time, though, there is not a lot of data on the impact of multiple actors in a decision-making context on energy consumption. Residential sector energy studies have generally treated the homeowner as a single decision maker. The commercial sector often has multiple actors playing a role in the energy consumption of the business. As a result, the applicability of the lessons learned in the residential sector to analysis of the commercial sector is unclear.

Each of these literature topics is discussed in turn below.

Commercial Sector Investment in Energy Efficiency

One strong theme running through publications on commercial sector energy policy is the idea of an “efficiency gap.” Hirst and Brown seem to have popularized this term when they titled their 1990 journal article *Closing the efficiency gap: barriers to the efficient use of energy*. In that article, they define the gap this way:

For a variety of reasons, households, businesses, manufacturers, and government agencies all fail to take full advantage of cost-effective, energy-conserving opportunities. The result is a significant gap between the current and optimum levels of energy efficiency. (Hirst and Brown 1990, 267.)

More precisely, the efficiency gap is the difference between technical predictions of cost-effective energy efficiency technology options and the observed implementation of those technologies. Hirst and Brown (1990) write that for energy efficiency improvements in the US, “[O]nly half of the total potential is likely to be achieved unless government policies are changed.” (Hirst and Brown 1990, 269) They argue that opportunity to achieve this energy efficiency improvement potential is blocked by a number of structural and market barriers. Structural barriers include elements such as artificial pricing of energy, limited access to capital, and supply infrastructure limitations. As these structural barriers are beyond the control of the energy consumer, they are not considered in this discussion. Market barriers, on the other hand, are issues with which the commercial consumer has direct connection. What, then, is identified as the form these barriers take?

Hirst and Brown list four market barriers that inhibit the ability of the individual to make a cost-effective decision about energy consumption:

- attitudes toward energy efficiency,
- perceived risk of energy investment,
- information gaps, and
- misplaced incentives.

Hirst and Brown recommend a number of policy responses to overcome these barriers. They conclude, however, that more research is necessary, “...to understand barriers, to assess their importance sector by sector, and to examine the effectiveness of policy options that might overcome them.” (p. 278) Specifically of interest to this discussion, they recommend that future work include “field tests to improve understanding of how end-users make energy-related decisions.” (Hirst and Brown 1990, 279)

Commercial Sector Energy Consumption Analysis

The discussion of this efficiency gap created a locus of attention around which a number of later publications gathered. These publications are dominated by economic discussions of the nature of this identified gap and generally fall into two camps: neo-classical economics on the one hand, and institutional or behavioral economics on the other. Several publications have summarized this literature, including Kulakowski (1998) and Golove and Eto (1996). These are briefly summarized again here.

Neo-Classical Economics

The first school of thought, the neo-classical economics school, argues that businesses do not forego profitable investments. If businesses are not investing in technologies to reduce energy consumption, the technology options available must not actually be cost-effective. The cause of the “efficiency gap” is therefore an error in the predictions made of cost-effective technologies available for investment. In this view, the predictions do not take into account hidden costs to the businesses of investment in the efficient technologies. If those costs are taken into account, the potential for cost-effective efficiency improvement is reduced and the difference between predicted and actual investment behavior is eliminated. For example, Sutherland (1991) argues that investment in energy-efficient technologies involves a degree of risk. Since there are not good methods for businesses to mitigate that risk, they choose to forgo investment. Hassett and Metcalf (1993) and Metcalf (1994) argue that the purchase of an energy efficient technology requires a commitment to the technology for the life of the product. Since there is no secondary market for energy technologies (e.g., a “used chiller” market), investing in energy efficiency locks the investor into a long-term investment with uncertain returns. This illiquidity of the investment option, in turn, makes the necessary return on investment higher and the cost-effectiveness ratio lower; ergo, lower investment in energy technologies.

Behavioral/Institutional Economics

The second school of thought, the “behavioral economics” or “institutional economics” school, relaxes some of the assumptions of the neo-classical school about market conditions and decision maker rationality. In this view, a number of market barriers exist to investment in energy efficient technologies. Howarth and Sanstad (1995), for example, argue that “asymmetric information, bounded rationality, and transaction costs are major contributors to the so-called ‘efficiency gap.’” These are all forms of market action based on imperfect information - a major feature of the behavioral economics school. Neo-classical economics generally assumes that decision makers are aware of the cost of energy consumption and the availability of technologies to affect that consumption. Behavioral economics, in contrast, argues that firms must accept the fact of incomplete information and develop ways to deal with it. An example of a mechanism to deal with incomplete information is “satisficing,” in which a decision maker chooses not the best option of the universe of options available but rather the first option that satisfies the requirements necessary to meet the particular issue at hand. See, e.g., Simon (1987). In this way, decisions are not optimal in a rational utility maximization sense, but they are satisfactory for continued operation of the business.

Golove and Eto (1996) summarize three other market failures:

- externalities, particularly environmental externalities associated with energy production;
- imperfect competition, such as the consolidation of technology production in the hands of a few firms; and
- public goods, in which later market players benefit from the decisions made by earlier decision-makers, reducing the benefit to the early decision-maker.

Public goods barriers exist for both buyers and sellers of products. Manufacturers may choose to forego production of efficient technologies if they believe that investments in basic research may not be fully recoverable because the information generated cannot be fully protected. Buyers may choose to forego purchasing an untested product, as the risk associated with early adoption of a technology is not borne by later adopters, yet the value of early adoption may not compensate the risk taken.

Much of the discussion about market failures then devolves into discussion of the proper role of government policies in intervening in energy markets. (Golove and Eto go to some length to identify and avoid this confluence of analysis and policy implication.)

One flaw with either the neo-classical or the behavioral/institutional school of analysis is that each is very “top-down” driven. Each looks at macro-level behavior of the commercial sector and makes conclusions about the cause of that behavior. Neither addresses issues of how individual actors are behaving in the marketplace. Analysis of commercial-sector energy consumption behavior would be more effective if the analysis used data from individual consumers and built from this base of data up to a theoretical framework that was informed by the data – a “bottom-up” development of theory rather than a “top-down” imposition. The lack of “bottom-up” data gives both the neo-classical and the behavioral/institutional economic frameworks an incomplete view of the energy consumption decision-making process.

Another problematic issue with both of these lines of argument is that they tend to treat firms as black boxes generating a unique decision about energy consumption and energy technology investment. A more recent set of literature using a different set of analytical methods seeks to open this black box a bit.

Organization Theory

Organization theory looks more closely inside the business to examine the decision-making process as the outcome of a set of interactions among organizational members. In a review of the development of organizational analysis, Scott (1998) writes, “Most analysts have conceived of organizations as *social structures created by individuals to support the collaborative pursuit of specific goals.*” (Scott 1998, 10; emphasis original.) In this type of analysis, generally known as organizational analysis or organization theory, businesses are made up of various individuals who provide specialized skills necessary for the proper, efficient function of the business. The actions of the business are governed by the collective action of these individuals.

Some researchers have used organization theory to analyze commercial sector energy consumption. Ross (1986), for example, argues that the internal process of budgeting for energy efficiency investment leads to high requirements for return on investment and overly simplistic economic decision criteria to determine choices among investment options. Cebon (1990, 1992a, 1992b, 1993) and Kulakowski (1998) have investigated the sociology of internal firm actors to identify additional barriers to energy efficiency investment in firms. In their analyses, issues of

inter-group communication, information flow, task assignment, etc. determine corporate actions. The efficiency gap is therefore described as a result of barriers within the organization to a corporate decision of energy efficiency. Examples include:

- the lack of prestige afforded energy managers within a firm and therefore the discounting of their recommendations when compared with other business options;
- lack of information flow between employees responsible for paying utility bills and employees responsible for operating energy-consuming equipment, therefore eliminating the price signal necessary for appropriate market response; and
- problems with allocation of financial resources between operating budgets (which pay the utility bills) and capital budgets (which would be used to invest in new energy-efficient technologies).

More recently, DeCanio (1998) and DeCanio and Watkins (1998) have found that firm characteristics play a role in determining the level of efficiency investment undertaken. DeCanio (1998) concludes, "...organizational and institutional factors are important determinants of firms' investment behavior and outcomes. While economic forces also play a role, economics alone cannot explain either the level of or the variation in returns...." (p. 453)

Most recently, Lutzenhiser et al. (2002) used an approach informed by organization theory to analyze commercial and institutional response to the California energy crisis of 2001. In examining the actions firms took to react to the energy crisis, they identified the need for a new model to describe how and when organizations act. This view recognized that the context in which firms operate is a key determinant of firm behavior: "...this model is an alternative to the market barriers view. [Original emphasis] It recognizes the internal dynamics of organizations and the conditions they face. It suggests that programs should focus on organizational concerns, conditions, and capacity rather than market barriers." (p. ix-x.)

What is interesting to me in the comparison of these three models of commercial sector analysis (neo-classical economics, behavioral economics, and organizational analysis) is that they seem to move from a view of "business as black box" (the neo-classical model) to looking inside the box to see what is happening. As said above, this has been a weakness with the bulk of commercial energy studies, which fall largely in the neo-classical or behavioral economics realm – they do very little to ask why people within these businesses are behaving the way they do. This is not a shortcoming that is completely overlooked in their debate. Sanstad, for example, has expressed the need for more research in this area, writing:

Few if any [papers in the literature] report on *actually going out and looking* [original emphasis] at what people do and don't do, and why. Suffice it to say that both engineers and economists have been guilty of a good deal of not-particularly-well-grounded speculation on this point. (Sanstad 2000)

Rather than go out and gather data from commercial customers themselves about how they make energy consumption choices, analysts of the commercial sector have instead argued over the proper factors to include in the a priori models of commercial sector consumption. What is it that drives the behavior of decision-makers within firms? What do they say they use to make their choices? This kind of behavioral research is almost completely missing in the commercial sector. It has, though, been done in the residential sector. What can we learn about behavior in

the small business sector from the behavioral research that has taken place in the residential sector?

Changing Consumption Behavior

One thing that is striking about the difference between residential sector and commercial sector literature is the presence in the residential sector literature of explicit intent to change consumption behavior. While the commercial sector literature reviewed above primarily discusses inferred descriptions of business energy consumption, much of the residential sector literature describes specific interventions to change residential energy consumption and the relative effectiveness of these interventions.

Katzev and Johnson (1987) provide a significant review of this literature. In it, they argue that efforts to promote energy conservation have used three main strategies:

- 1) antecedent intervention, in which information is provided to the target consumer to convince the consumer of the value of taking a conservation action;
- 2) consequence information, in which information is provided to the target consumer about the effect of actions the consumer has taken; and
- 3) social influence techniques, which use interaction between the consumer and a larger group to provide “peer pressure” of one form or another to encourage or support the consumer’s conservation action.

After examining each of these strategies, Katzev and Johnson (1987) conclude:

In short, currently the overall consensus of most investigators is that incentive and feedback contingencies have been the most effective techniques in promoting energy conservation. On the other hand, prompts and information techniques have been criticized as relatively ineffective, while social influence techniques have only recently been the subject of experimental analysis. In contrast to these conclusions, we believe that a detailed look at the evidence indicates that consequence techniques are not nearly as effective as claimed and that antecedent strategies may have potential value. Further, we believe that social influence techniques, especially commitment procedures, hold considerable promise for promoting both short-and-long-term reductions in energy use. (P. 172)

This is not a resounding encouragement for any one form of behavioral intervention. However, what if one were to combine these forms? It is interesting to note that the utility bill received by both residential and commercial customers can provide several of these forms of information at once. It can provide antecedent information to develop conservation values and intent to conserve. It can provide consequential information about the effect of conservation actions the consumer has taken on typical consumption. It can also provide comparative information about the consumer’s energy consumption relative to a peer group. Given this significant opportunity, what is known about the use of utility bills in changing consumption behavior?

Residential Sector Consumption Feedback

In some respects, the small business owner may be hypothesized to behave in a similar manner to the residential customer. One area of overlap is the receipt and payment of the utility bill. The relationship between energy consumption behavior and the receipt of the bill is strong in the small commercial sector, unlike in the large commercial sector. Specifically, the small business owner who uses the energy also pays the bill, or at least has knowledge of the bill. It might be hypothesized that the business owner would be as motivated to reduce energy cost as a residential consumer would be. In fact, the business owner might be even more economically motivated, as business people are more likely to have a “bottom line” focus. Given these hypotheses, what can we infer from the research that has been done in the residential sector?

While the household has been the primary area of analysis in human behavior research, residential behavioral studies provide information that is likely applicable to the commercial sector. Studies of how homeowners understand their utility bills—e.g., Kempton and Montgomery (1982), Kempton and Layne (1994)—found that residential customers’ analytical capabilities were constrained by the form and content of the utility bill. For example, Kempton and Layne (1994) argue that “price and consumption data [is] difficult to acquire and expensive to analyze. ... [B]ills in kilowatt hours meet the seller’s need for revenue flow but ... poorly serve buyer decisions about consumption and efficiency investments.” Kempton and Montgomery (1982) found that families used dollars as the measure of energy consumption because “Dollar measurements, though inexact, offer advantages in household management. Dollars apply broadly to housing, food, and other expenses; thus, they allow comparisons across expenditure categories.” Similar issues could be hypothesized to arise in the commercial sector. Certainly businesses receive much the same information as residential customers do on their bills, and, since small businesses are often owner-managed, they are hypothetically just as interested as individuals in comparing their expenditures across consumption categories.

There has been one main study of commercial energy consumption behavior – a research project involving forty business managers and owners in a New Jersey strip mall. Four papers resulted from this study: (Haberl and Komor 1989), (Haberl and Komor 1990), (Komor and Kempton 1991), and (Komor and Katzev 1988). Komor and Katzev (1988) found that, similar to the Kempton and Layne (1994) research, business owners had difficulty identifying components of their energy cost. The businesses were not able to identify significant components of their bill, such as a demand charge. Komor and Katzev (1988) identified five main themes influencing energy consumption behavior: “(1) poor information, (2) no perceived control, (3) the belief that conservation entails reduced comfort, (4) a diffusion of responsibility, and (5) the fact that energy costs are small as a percent of gross income.” (Komor and Katzev 1988, 235.)

These themes identified by Komor and Katzev indicate significant similarities between small commercial customers and residential consumers. Compare, for example, the diffusion of responsibility for the energy bill within a small commercial building with the family management necessary to reduce residential consumption. In both cases, there are a number of energy-using actors in the environment, and effecting change among all the actors can be challenging. Even the fifth issue identified by Komor and Katzev (1988) finds resonance in the Kempton and Montgomery (1982) research: while the families are not concerned with percentages of gross income, Kempton and Montgomery (1982) do mention, “...the small potential savings mean that even diligent lighting managers are unlikely to notice any change in monthly bills, and may conclude that energy conservation efforts are futile.”

Utility Bills and Billing Feedback

Given some of these similarities between residential and small business energy consumers, what policy interventions might be useful in the small business arena?

A number of residential studies have shown that the provision of consumption information can result in reduced energy use. Harrigan et al. 1995 discuss two forms of feedback: feedback based on reading standard utility meters, and feedback based on customer-readable meters. I focus here on feedback using standard utility meters, as such meters are more common within today's small business environment. Harrigan et al. find five types of feedback based on standard metering technology:

- 1) more frequent billing,
- 2) consumer reading of the meter,
- 3) disaggregated reporting of end-use consumption
- 4) enhancements to monthly utility bills, and
- 5) periodic reports and analysis.

In a sense, more-frequent billing and self-reading of the meter are two sides of the same coin – an attempt to reduce the time lag between taking actions that result in energy consumption and receiving information about the impact of those actions. More-frequent billing provides the benefit of translating the utility tariff into the specific dollar cost associated with the energy consumption, but there is a practical limit to the number of bills a utility could send out. Self-reading can reduce the time lag between action and feedback, but (a) it typically doesn't provide cost information, and (b) it can become burdensome to the consumer. As reported in Harrigan et al., Winett et. al (1979) found that only half of the study participants performed the daily meter reads they had agreed to perform as part of the study.

The other three types of feedback reviewed by Harrigan et al. are mechanisms to improve the type of information provided to the consumer by the utility. Disaggregated reporting of end-use consumption can help the consumer identify which end uses are the major energy consumers. This can be valuable, as consumers often have inaccurate concepts about the energy consumption impact of specific end uses. Kempton and Montgomery (1982), for example, found that residential customers overemphasized lighting as a major end use.

The drawback to this disaggregated reporting of end-use consumption as a form of feedback, though, is that it is typically an expensive mechanism for providing consumption information. The information necessary to estimate end-use consumption is collected through multi-page customer surveys. Those surveys are time-consuming for the customer and expensive for the utility to analyze. Harrigan et al. conclude, "...while it probably is valuable for a one-time identification of which end-uses are the larger ones – an important function – it would not be desirable to mail repeatedly for ongoing feedback to evaluated customer-initiated changes." (p. 25.) Newer forms of data collection and analysis (for example, web-based surveys) are bringing this cost down, but it remains significant.

The final two forms of consumption feedback – enhancements to utility bills and periodic reports and analysis – can work well together. As Harrigan et al. write, "A periodic report assumes bills already are sent monthly and provides a separate mailing with longer-term, or more extensive, analysis of energy consumption." (p. 24.) Periodic reports can go into greater detail or provide information in a format (e.g., large graphics) that cannot be fit onto the constrained space of a monthly utility bill.

What types of information can be useful on a monthly basis? Two significant feedback mechanisms are historic feedback, in which the consumer receives information about their prior energy use; and comparative feedback, in which the consumer receives information about their energy use compared to others.

Siero et al. 1996 conducted a study of energy consumption feedback within two geographically separate units of a metallurgy company. Both units received information about how to reduce energy use, and both received information about their unit's energy consumption relative to a defined baseline every week for twenty weeks. This was historic feedback—each unit received information about its energy consumption history. In addition to the historic feedback, one of the two units also received information about the other unit's consumption—comparative feedback. Energy consumption decreased within both units, but the unit that received comparative consumption feedback showed a greater energy consumption decrease. In addition, energy consumption within both units remained reduced six months after the information campaign had concluded. The unit that received comparative feedback still maintained a lower energy consumption level than the unit that received only historic feedback. In other words, consumption feedback was shown to have a significant and lasting effect, and comparative consumption feedback was more effective than historic feedback.

Consumption feedback is an area that has received significant attention in the residential sector but very little attention in the commercial sector. Based on the literature above, consumption feedback presents one example of a potential energy policy alternative for the commercial sector—particularly the small commercial sector—that has gone largely unexamined.

Conclusion

While there have been some efforts to collect data about energy consumption behavior in the commercial sector, much of the energy policy literature, at least at the nationwide level, has used a top-down analytical approach to posit reasons for macro-level results. The debate has to a great degree overlooked the elephant in the room – the expressed rationale of the decision maker him/herself. As a result of this top-down focus, policies to alter commercial sector energy consumption behavior have been artificially constrained.

When one looks to the residential literature on consumption behavior, a wide variety of models of consumption are available. The human dimensions of energy consumption are described in a variety of terms, including psychological, social, and cultural. These data collection and analysis techniques are noticeably missing from the vast majority of commercial sector research.

One application of residential sector research to the commercial sector may be the use of consumption feedback as a mechanism to reduce energy use. Within the billing feedback literature, a number of descriptions of the consumer's decision-making process can be hypothesized to be analogous to the commercial sector – particularly the small commercial sector. This hypothesis should be tested, as consumption feedback may offer a largely untapped opportunity for energy savings in the small commercial sector.

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