Twenty Years of Energy Demand Management: We Know More About Individual Behavior But How Much Do We Really Know About Demand?

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ABSTRACT

DSM replaced energy conservation in the mid-1980's as the umbrella term for measures intended to change the ways in which energy is consumed. For the majority of the energy community of researchers, policy makers and practitioners, DSM has meant getting efficient technologies out there and into use. Frustrations with DSM programs which had not lived up to expectations in the years after the oil shocks led to the acknowledgment that homes, offices and businesses, were inhabited by people, and if anything were to be accomplished these "end-users" had to be aware that more efficient technologies existed, had to be interested in purchasing them and had to use them as they were intended. Hence, the invention of the domain of research and policy termed "energy behavior" and the invitation of social scientists to join the energy debate in order to explain why people were not behaving as they were supposed to. At the ACEEE meetings, a "behavior" panel was created in the early 1980's. Though "behavior" was dropped at the end of the 1980's, reference to behavior has been brought back a decade later. In this paper, the authors will discuss how the focus on individual behavior, both at the conference and in the energy world in general, has limited the role of social science in contributing to an understanding of demand. Little attention has been given to the contribution of other actors, institutions and non-energy related policies which contribute to the structuring of choice, including commercial organizations, advertising, media, and the plethora of government policies which influence consumption. The principal concern has been to increase technical efficiency, leaving unattended the evolution of notions of comfort and convenience and their considerable implications for the demand for energy services. We recommend a new approach which recasts the demand for energy, and the things which use energy, as a social demand, dependent not just on prices and degree of consumer awareness, but also on social norms and a network of social institutions. We also challenge energy research and policy to seriously address escalating demand for energy services.

Introduction

Managing energy demand has been an objective of energy policy since the 1970s. These efforts have been supplemented by regulations, standards and more recently by efforts to affect energy efficiency markets. Called "energy conservation" in the early years (demand management supplemented by regulations and standards) demand-side management (DSM) became the overarching label in the 1980's. In recent years, the semantic evolution has gone

on to terms like "market transformation" and "energy efficiency on the demand side." Over this 20 year period, there have been significant gains in energy efficiency; however, the total energy demand in the United States and most European countries has increased over that same period (and in most cases has increased per capita as well). This paper will argue that the nature and causes of energy demand have been oversimplified, reduced or ignored in the community of research and policy. Contributions by the social sciences to energy demand management have been mainly directed at the "behavior" of the "end user." As a result, we do not know much more about the nature of energy demand today than we did in 1980. The necessity for absolute reductions of fossil fuel use in industrial countries, given climate change and CO2 reduction agreements, challenge energy research and policy to rethink their scope and their approaches. We recommend a new approach which recasts the demand for energy, and the things which use energy, as a social demand, dependent not just on prices and degree of consumer awareness, but also on social norms and a network of social institutions. We challenge energy research and policy to seriously address escalating demand for energy services.

In section 2, we look back at the ways in which energy social science was founded and the roles it was initially given in energy conservation research and policy. We trace some of the early difficulties with the dominant techno-economic approaches to reducing consumption and the discovery that the social sciences could be useful in addressing questions about (often unpredictable) human "behavior" that might improve energy demand models. In section 3 we discuss the implications of this "behavior" orientation and its consequent diversion of attention away from other important characteristics of societal demand. In section 4 we outline a new social science agenda which fills some of the gaps in the theories of energy demand which inform policy. As a specific suggestion for the ACEEE Summer Study, we suggest panel titles which escape the narrow focus on behavior and encourage serious research in pursuit of the broader agenda which we outline in this paper.

Energy and the Social Sciences

Following the 1970s energy crises, social scientists in the U.S. and elsewhere began to take an interest in energy as a social problem — paying particular attention to the impacts of energy shortages for various social groups (e.g., Dillman et al., 1983; Morrison, 1978; Newman and Day, 1975). These studies drew on a long-standing interest in the environmental and technological foundations of human society by sociologists, anthropologists and human ecologists (e.g., Cottrell, 1955; White, 1975; see Rosa et al., 1988 for a review). But while classic work in this area was largely theoretical, the new empirical studies were motivated by immediate policy problems and mainly concerned persons' attitudes toward the conservation of energy in short supply, patterns of energy use, willingness to change energy-using practices, and hardships experienced as a result of rising energy costs. Researchers came from the ranks of social psychology, anthropology, sociology, political science, and related disciplines. Their work ranged across multiple levels of analysis, including the individual, small group, community, firm, and society (see Lutzenhiser, 1993 for a review). Their results were published in a variety of social science and energy policy journals, and by the early 1980s, there had been a sufficient growth in knowledge to warrant the formation of a U.S. National Research Council panel on energy and human society. The panel produced a widely-read overview volume entitled Energy

Use: The Human Dimension (Stern and Aronson, 1984) and called for an expansion of social research on energy. In the intervening years, there has been a steady decline in social science interest in energy per se (Lutzenhiser, 1992).

Technical Approaches to Understanding Energy Use

During that same period of the early 1980s, analysts working in universities, utilities, national laboratories, and government energy programs were taking a different approach to energy use. Trained in engineering and physics, and with some awareness of economics, they focused on machines, devices (e.g., furnaces, motors, lights, water heaters, air conditioning compressors, etc.) and buildings as "users" of energy. Elaborate mathematical models designed to mimic the "performance" of buildings and equipment — both individual devices and structures, as well as large populations or "stocks" of buildings and appliances – – were constructed and used to estimate the effects of energy conservation initiatives, to assess the impacts of device-by-device efficiency improvements, to predict future changes in aggregate energy demand, and to explore the effects of policy on alternative societal level energy usage patterns (see Lutzenhiser, 1993 for a review of this approach and critique of its underlying paradigm).

Trained in technical disciplines, technical modelers quite naturally see the energy problem as one involving flows of energy (electrons, natural gas, petroleum) through physical systems that convert it into heat, light, motive power, etc. The energy use rates of these systems, in principle, can be closely estimated and improvements in efficiency — an obvious conservation strategy — can be assessed. In initial thinking about these systems, humans were believed to be of little importance, in the sense that they were simply recipients of energy services and thereby not an important part of the energy-using system subject to analysis. However, efforts to match models with measurements of real world energy flows turned out to be problematic. Humans re-appeared as active energy "users" — manipulating devices, managing buildings and interacting with energy flows at every turn. This realization led some physical modelers to invite social scientists to join in an effort to improve the predictions of device-centered modeling systems.

Bringing the Social Sciences to Bear on Energy Policy Research

The carving out of a "behavioral" niche in energy research for the social sciences in the early 1980s came in response, then, to the sometimes dramatic problems encountered in applying technical and economic perspectives to energy policy. One early study, for example, showed that physically-identical townhouses varied by 2-to-1 in energy use, presumably due to occupants (Socolow, 1978). A related analysis by Sonderegger showed that about half the variation among similar houses was due to the occupants, concluding "We have proved experimentally that (so far) unpredictable behavior patterns of the occupants introduce a large source of uncertainty in the computation of residential space heating energy requirements ... there is little practical usefulness in pushing too far the detail of any deterministic model [e.g. physical/engineering model] for the prediction of heating load requirements... (1978: 323)." For apartments in moderate climates, where appliance use was a larger proportion of the total, variation in total energy use among identical apartments was found to be as great as 10-to-1 (Diamond, 1984). Amendment of technical models with

social variables was found to significantly improve their ability to estimate measured consumption in the real world (Cramer et al., 1985).

These findings opened a space for the social sciences in the energy policy and program arenas. Social psychology was the first discipline to occupy that niche, bringing with it perspectives on individual motivation and information (Stern and Aronson, 1984; Ester 1985; and de Young 1991). Another early concern was with the "diffusion" of technologies. Here social psychologists and sociologists attempted to understand why persons were not adopting new, more efficient, devices at predicted rates. This "failure to adopt" flew in the face of assumed consumer (and business) rationality, since the economic rewards of more efficient technology clearly outweighed their costs. Some anthropologists and sociologists pointed to the problems of applying diffusion theory when dealing with household rather than individual decision making (Kempton and Montgomery, 1982; Wilk and Wilhite, 1985). This turn of attention to households proved fruitful, subsequently opening analysis to the consideration of socio-cultural differences among groups in levels of energy consumption as well as in understandings, willingness to conserve, and ability to make technological changes (Cebon, 1992; Erickson 1997; Hackett and Lutzenhiser, 1991; Lutzenhiser and Hackett, 1993).

Efforts to bring about a "social amendment" of the dominant paradigm of policy research have not been very successful. There has been little interest in the U.S. in improving upon the device-centered and physical systems models, and while European attempts have been more ambitious (e.g., IAE, 1995; ECU, 1996) they have also had limited impact upon conventional theory and practice.

A Limited Social Science Contribution

Although leading energy analysts understand that human action is the central and controlling element of energy systems (e.g., Lovins, 1992; Schipper, 1991), the insight is not widely acknowledged in energy policy discourse. As noted, social science interest in energy has declined since mid-1980s, and several important developments have contributed to researcher disenchantment with the energy policy agenda. These include the rise of DSM, more pressing concerns about global environmental change (GEC), and recent energy system interest in "market transformation" (MT).

DSM translated energy "conservation" into "efficiency," and "efficiency" into "least cost source of energy supply," forcing a narrow policy focus on the marginal costs of small improvements in devices. The second development, GEC, captured the attention of social scientists who had been concerned about energy in the 1980s — and who had even been involved in efforts to improve the device-centered approach — but had grown weary of the limited role represented by the terminology of "human factors". By contrast, in the evolution GEC thinking in the 1990s, energy came to be seen as one of several crucial variables involved in the "society-environment interactions" responsible for environmental change on a global scale (Stern et al., 1992). From the vantage point of GEC, DSM seemed (and still seems) a narrow and self-absorbed enterprise. The third development, MT, could result in a renewed interest in the contributions of the social sciences, since it views the task of efficiency as one which involves less costly intervention in markets to induce the diffusion and adoption of more efficient devices, buildings, etc., but again, the human role is reduced to one of "behavior" in physical systems — in this case behavior that might be shaped

through various "marketing" efforts. In MT there is also a continued focus on the "individual" (and continued confusion about the role of larger forms of organization), as well as an unfortunate language of "market barriers," "market interventions," "exit strategies," and so forth, which puts markets at the center and social context at the margins.

The inability of social scientists to bring insights to bear on energy and environmental problems can be partly traced to the political and organizational contexts of energy research agenda-setting. For a variety of reasons (see Lutzenhiser and Shove, 1999), those agendas are stubbornly reliant — despite two decades' evidence of programs which fail to live up to expectations — on a view in which human "behavior" remains conceptually distinct from the workings of devices, buildings, infrastructures and the other socio-technical arrangements involved in energy use. In the balance of this paper, we consider the continuing limitations of this conception, argue for a more social view of energy use, and offer an expanded research agenda that addresses the interests of the GEC and DSM/MT communities in reducing the amount of energy used to sustain social life.

The Problems of Reducing the Role of Social Science to that of Understanding the End-user's "Efficiency" Behavior

One of the fora responsible for opening energy research to social science was the ACEEE and its Summer Studies on Energy Efficiency in Buildings. A watershed was passed in 1980, when the organizers recruited social psychologists from the university local to the conference location (UCSC) to organize and add a "behavior" panel to an otherwise heavily technical conference. The every-other-year ACEEE Summer Study provided the basis for a continuing, if minority, interest in energy-related social science research.

By the late 1980s the panel title "Behavior" was changed to "Behavior and Lifestyle", partly in response to the work by Morrison and Schipper on lifestyles (Morrison, 1979; Schipper et al., 1989). This concept of "lifestyle" lives on in many energy circles, though divergent operative definitions abound. While Schipper and his co-authors called for the addition of demographic elements to the definition of lifestyle, most follow the conventions of market research, defining lifestyle clusters by aggregating individual beliefs, values or attitudes (Shove et al. 1998). Lifestyle was dropped from panel title in 1990 partly in response to concerns that the terminology failed to capture the full range of actors, practices and interactions relevant to the understanding of energy consumption.

The 1990 title, "Human Dimensions," maintained over 4 Summer Studies (8 years), was thought to be broad enough to subsume behavior, lifestyle, marketing and studies of diverse "end users", including institutions. However, in 1998 there was a reversion to the title of Behavior, thrown together in an odd mixture with information technologies and non-energy benefits.

This story of the labeling of the social science role indicates tentative steps towards a more comprehensive social approach to understanding energy consumption. However, the reinstatement of the behavioral terminology suggests that the underlying approach has not changed much over the last 20 years. In the remainder of this section we explore the problems and consequences of this narrow focus.

The Individual as the Locus of Control and Change

In an article in Per Otnes' (1988) anthology The Sociology of Consumption, he takes us through a typical day in his life, getting out of bed, brushing his teeth, showering, shaving, making coffee and toast, driving to work, and so on. He then goes on to discuss how each of these activities is bounded by a limited matrix of choice from the point of view of the end consumer (deemed "structures of constraint" by Kabeer (1994)). The point is that individual choice in industrial societies is limited by the way cities, energy and water supply systems, housing designs, product designs, etc. are configured. Individuals can influence what happens at the end of the pipe, but significant changes in energy use are bounded by the "upstream" systems they are plugged into. The way these systems come into place, the interactions among the actors involved in their construction and maintenance, and thoughts on how they might be changed are certainly relevant for the science of energy reduction. Yet the concept "behavior" neither signals their importance nor captures their workings.

In short, if one accepts that significant changes in the ways we use energy will be predicated on a significant social transformation, then focusing on behavior of individual end-users as the only key to change is both overly simplistic and counterproductive. As anthropologist Sidney Mintz (1979) put it over 20 years ago, there is a need "to specify with more confidence the way individuality plays itself out against terms set by socio-cultural forces." This is not to say that understanding individual action and choice is irrelevant. The point is that this has been taken as the only role for social science.

Overcoming the Barriers

Above, we discussed the socio-psychological models that dominated early energy social science. Other models which have had a strong influence assume that people respond rationally to economic and technical opportunities (call it techno-economic rationality). One of the main roles of social science has been to figure out why people do not act in accordance with this model. For example, perhaps a particular energy-efficient device, if purchased, would yield energy savings, and thus an provide an "income stream" better than alternative investments such as bonds or stocks. Given this definition of the problem from economics or technology, the social scientist is offered the task of figuring out why energy users are not adopting the technology (even working within this paradigm, energy users can be seen as rational, but optimizing other things than what physical or economic models predict e.g. see Kempton (1986) on folk theories of thermostats). Thus social science has been diverted into the exercise of barrier analysis. This is at best a limiting role which distracts resources and attention from the effort of understanding changes at the societal level, for instance, in the conventions and norms of comfort, aesthetics or convenience.

Energy Consuming Behavior or the Consumption of Energy Services?

Aside from those who deal with the production or transmission of energy, no one really "behaves" in relation to energy (with the exception of someone who inadvertently sticks their finger in the electricity outlet). Devices convert energy into services; people are interested in services, not energy. So what is needed is a social science of energy service consumption, something much broader than a science of energy behavior.

The recent literature abounds with calls for researchers and policy makers to move the focus from energy to energy services (see Wilhite et al., 1996a; Wilhite and Lutzenhiser, 1998; also Laitner et al. in this volume). The services most often discussed are space heat and cooling, light, and cleanliness (or hygiene). Understanding how and why demand for these services is growing is essential to making any headway on developing instruments for encouraging reductions in energy use. We would argue however that the broadening of the frame from energy to service has thus far been modest. There are developments driving energy demand which have not yet been classified as energy services at all, examples being escalating dwelling size, comfort and convenience.

Dwellings everywhere in the industrial world are getting larger. The number of specialized rooms is growing (offices, second baths, individual bedrooms for children, entertainment rooms, etc.), as are the number of appliances, and the physical space needed to accommodate them, particularly for entertainment, information and kitchen services. Bigger volume means larger space heat and cooling needs, two of the strongest drivers of energy demand. An example is the growth in energy used to heat Norwegian homes. In spite of more stringent building codes and a doubling of the thermal efficiency of the Norwegian home from 1960 to 1990, energy use for space heating rose over the period, due to a doubling of the per capita size of dwellings (Hille, 1997). Central space heating is not common in Norway, but indications are that in other OECD countries, the transition to central space heating has contributed significantly to increased energy use. The share of central space heating in both Denmark and France doubled in the period from 1960-1980, tripled in Germany and Italy, and increased eight-fold in the Netherlands. The use of energy for space heat has more than doubled in all of those countries over the same period (Chateau and Lapillone, 1980). Another example is space cooling in Japan, where air conditioners are technically very efficient, but where space cooling demand is still increasing dramatically, due to increases in dwelling size, changing tastes and modern building designs which do not support natural cooling (Wilhite et al. 1996b). All of these dimensions — size, taste and design — are crucial to understanding energy consumption.

Comfort and convenience can be thought of as meta-energy services. In the literature on energy behavior and lifestyles, their importance has been acknowledged in analyzing how and why, and for what purposes people use energy. The issue which has yet to be fully addressed relates to the dynamics of change: How do notions of comfort and convenience evolve, and how does this relate to the provision and consumption of energy?

Changes have been dramatic in almost every aspect of energy consumption: indoor space cooling and heating; clothes and dish washing; bathing; media entertainment; and more. Cooper's (1998) story of how America was air-conditioned documents the transformation of comfort standards. In the early days of air-conditioning in the 1920s, temperatures around 25 C were considered comfortable. The first ASH and VE guidelines published in 1925 were for 25,5 C and 50% relative humidity. Building operators in the United States now view 21 — 22 C to be an appropriate indoor summer temperature, and some service establishments such as malls and theaters set temperatures as low as 19 C. There is evidence that these changes from natural to artificial cooling, and towards cooler indoor temperatures, are not user-driven. There is considerable variation in assessments of the desirability of air conditioning, even in tropical climates (Kempton and Lutzenhiser 1992). The increasing use of hot water as a provider of pleasure (hot tubs, Jacuzzis, Roman-sized bath tubs), and space heat and light to provide atmosphere, are other examples of

rapidly evolving ways in which energy provides comfort.

Regarding the notion of convenience, Warde et al. (1999) argue that convenience has become an obsession in modern industrial societies. In fact the authors define the "hypermodern" society to mean the convenience-obsessed society. They show how convenience in the 20th century meant "saving" time, i. e. compressing the amount of time taken to do an activity like clothes washing. More recently the concept has expanded to include the "scheduling" of time, the process of ordering and managing activities so as to be able to cram ever more events into a given day or week. Both of these aspects of convenience have implications for energy use, the former justifying the introduction of ever more efficient mechanical substitutions for manual work, the latter leading to more activities, more devices to manage the pressures of time, more traveling and greater demand for faster means of getting from one place to another.

Erickson (1997) looked at the "scheduling" aspect of convenience in her cross-cultural ethnographic study of household energy use in Sweden and Minnesota. In both places the respondents indicated that being "busy" was an important indicator of a successful life. At the same time "busyness" was said to be one of the greatest contributors to stress and dissatisfaction (this apparent paradox of striving for something and at the same time being distressed by it is also addressed by Juliet Schor in The Overspent American (1999)). In a newly published anthropological study of "Silicon Valley" in California, reported in Knowltan (1999), the researchers found that people used an inordinate amount of time in "making their busy lives manageable." People equip their homes with the latest gadgets so they can work at night and get ahead (or as one interviewee put it "to stop me from falling behind"). They use voice mail, modems and digital organizers to exchange schedules among family members and to divide up domestic chores. As one of the researchers, Charles Darrah, observed, "It's not so much a life lived, but a life managed." Silicon Valley is not representative of an average community, but the idea of the "managed life" may be spreading. It signals a change in the notion of convenience that could lead to significant increases in energy consumption.

Studies documenting changing societal demands for comfort and convenience touch on the classic debate in the social sciences regarding "needs" and "wants." Energy analysts have drawn distinctions between "basic" and "other" energy needs. Viewed in the context of evolving energy services, these distinctions are moving targets which are analytically problematic. Once established and reified, the categories divert attention and debate from underlying inequalities in access to energy. This is true for privileged as well as underprivileged groups. Is an automobile a "need" or luxury for someone without access to a well developed and well functioning public transport system? Is central air conditioning a luxury or necessity in a building designed in such a way that it could not employ natural ventilation? These are hopeless questions. They disguise the political issues surrounding distribution and equality and impede the discussion of important theoretical issues surrounding the growing social demand for energy and how wants are constructed and manufactured. We agree with Slater (1998) that the issue is not about appropriate "levels" of energy use, but about how such levels are conceptualized (deduced, analyzed and debated). We must go beyond merely descriptive accounts of changing expectations of convenience and comfort, important though these are. What the energy world requires, and what social scientists are in a position to provide, is an analysis of how conventions evolve, ohow energy intensive ways of life become normal, and how energy demand is embedded in society.

Demanding a New Agenda?

In this section we outline a framework for social science research which addresses the challenge of understanding escalating demand for energy intensive services, practices and ways of life and which goes beyond a narrowly behavioral perspective.

At first sight, the challenge of understanding behavior might not seem to be so different from that of understanding demand. In the world of energy policy, the behavior which is of interest, and which has been the focus of attention, is that which is associated with energy consumption and hence with demand for energy resources. In terms of social theory, these two concepts are, however, a world apart. As we have shown, theories of behavior have an ancestry grounded in psychology and the study of individual belief and action. By contrast, the concept of demand points to the development of markets, the social and technical construction of needs, and the steady evolution of expectations about what constitutes a 'normal' way of life.

Economics appears to offer a bridge between these two strands: notions of rational action, market imperfections and the barriers to technical change and innovation all promise to link macro trends at the level of markets to the micro level patterning of individual behavior. Though it is an important element in this narrative, theorizing about demand remains relatively undeveloped: in energy planning, at least, the working assumption is that there is a demand for energy originating from individual consumers' preferences and that the level of demand is sometimes influenced by price (Boardman 1991). Such an approach generally involves distinguishing between needs and wants; that is, between "necessary" and "optional" energy demand, then speculating on the implications of this distinction for consumer responses to different price signals. But that is about as far as it goes.

Re-positioning Debate

In shaping up a new agenda we begin by re-framing the discussion of needs and wants. Rather than spending further effort trying to distinguish between the two we take a different tack, asking how conventions of social life come to be established and what this means for energy demand. In so doing we make three critical steps.

First we take the escalation of energy demand and the evolution of consumer expectations as a problem to be explained and understood in social, cultural and collective, rather than individualistic, terms. Second, we view costs and prices as a secondary dimension. Recognizing that economics is a relative not an absolute enterprise and acknowledging that values are anchored in social judgement, our goal is to understand how energy consuming practices come to be valued as they are. In this we agree with Hefner's (1983) critique of neo-classical economic approaches to consumer choice: "most neo-classical studies do not investigate the history or social genesis of subjective preference...An adequate account of economic action...requires examination of the interaction between individual preferences, the means available for their satisfaction, and a social world which shapes both." By asking how demand is made, constructed and sustained, we are drawn, like it or not, into an analysis of the inter-dependent practices of producers, providers, utilities, and governments.

Our third and perhaps most important change of emphasis is to acknowledge that energy is not a meaningful term when it comes to understanding consumption and demand.

People do not consume energy. They consume the services it makes possible. This is a simple but important point. Graphs of increasing energy consumption are, in fact, graphs of the societal appropriation or increasingly intensive use of technologies such as lighting systems, refrigerator-freezers, air conditioning, and so on. If we are to understand the dynamics of energy use, we are consequently obliged to take note of the development and diffusion of energy using devices and technologies. Understanding the dynamics of energy demand (or demand for the services energy makes possible) is thus an exercise in understanding socio-technical change and the co-evolution of infrastructures, devices, routines and habits.

This approach has immediate implications for the framing of problems and for the sorts of questions which are, and are not, important to address. The table below highlights some of the assumptions and starting points which underpin the traditional, behavioral, agenda and the more challenging analysis of demand which we advocate.

Table 1. Established and New Agendas for a Social Science of Energy Demand

Established Agenda: Energy Behavior	**New Agenda: The Construction of Demand**
Choices are driven by economics	Economics is relative (changes through history) and contextual (embedded in other systems of decision and desire)
Analysis of energy consumption separated from the analysis of other forms of consumption	Social scientific theories of consumption are relevant for understanding energy
Demand comes from consumers; hence the focus on consumer choice	Producers and consumers are implicated in the co-evolution of demand, and the choices of both are highly structured
Consumer choice is sovereign	All of the forces contributing to escalating demand for energy services may be studied for policy opportunities
Focus on classic end uses: lighting, heating, cooking, etc.	Focus on changing conventions of comfort, cleanliness and convenience.
Demand side management is viewed as a bounded technique for influencing behavior	Demand is a societal, not an individual phenomenon; it could be managed at multiple levels
Needs and wants are distinguished, and the latter are assumed to be subject to individual preference	Rejects the relevance of needs-wants distinctions on the grounds that for all practical purposes (e.g., all but basic nutrition) both are socially constructed

Having established the principles and starting points for a new agenda, we are now in a position to identify some of the research questions which emerge, and consider the range of theoretical and methodological resources which might be used in response.

Re-formulating Questions

Having turned the debate around it is clear that the primary challenge is to understand the dynamics of demand. How are new 'needs' constructed, and how do expectations of comfort and convenience evolve?

One means of addressing this question to document change and variation either historically or cross culturally. This does not on its own advance theoretical understanding of the processes involved and in any event, we might expect different dynamics to be at play in different contexts and circumstances. Nonetheless there is important work to be done by taking the practice of everyday life as the starting point and seeking to capture the variety of ways in which 'normality' is made and reproduced. Comparative research undertaken as part of a European Science Foundation funded initiative on "Consumption, Everyday Life and Sustainability" revealed the value of such an approach, examining 'normal' energy consuming practices in Turkey and Denmark, and tracking the recent evolution of both (Ger et al. 1997).

Of course there is enormous variation in what constitutes normal standards of comfort, cleanliness and convenience (and so energy demand) within any one society. More needs to be known about how expectations change between one generation and the next, how they differ between social classes and what this means for the socially mobile.

We have already learned that the management of demand for energy (in terms of its extent and timing) involves many actors: builders, utilities, estate agents, government regulators, retailers, and engineers are all implicated in the construction and maintenance of normal energy consuming practices. Some of the more successful energy efficiency-oriented programs have taken a more integrated approach to connections and interrelationships among these various actors. Examples are Energy Star in the USA and the market transformation programs of the Swedish National Energy Administration (STEM).[1] Understanding the nature of the various interests, and the relationships between them with respect to different fields of consumption, such as the indoor environment, laundry or food provisioning etc. represents a further challenge. Better knowledge of differences in the organization and management of energy demand at home and at work also promises to illuminate the different ways in which similar services might be provided.

Our approach cuts across traditional ways of thinking about supply-demand and production-consumption dichotomies. Individual actors chose from a limited number of choice alternatives. Production of alternatives cannot be de-coupled from individual choice. This recognition prompts questions about the distinctive dynamics of the manufacturing of energy demand at different levels, and about how the possibilities and opportunities open to households relate to the structuring of national systems and infrastructures. It is also important to focus attention on moments and thresholds of change. Major investment now has implications for the structuring of future supply and demand just as the practices of the

[1] Energy Star is a national program which assigns an energy star label to equipment which meets a given energy efficiency standard. A focus of the program is to encourage partnerships among relevant actors. According to John Laitner (personal communication) of the USEPA, the program now has more than 1200 manufacturers producing a total of 7000 individual product models in 30 consumer product categories. STEM has heavily promoted technology procurement, which it defines as "a kind of public competition in which different types of actors are brought together to define a technology goal which is reached through a competition including market incentives" (Lund, 1997).

past influence perceptions of energy use today. We do not mean to argue that research and policy which focuses on individual belief, action and choice is in itself irrelevant, nor do we suggest that more systemic research strategies should take the place of "human dimensions" style enquiry. But neither do we think these strands can be woven together to form some new integrated approach to energy research. An integrated understanding of societal energy consumption is one which views individuals and institutions in complex relations; in fact, the nature of these interrelationships provide the most fertile ground for new research perspectives on how energy services are evolving.

The paragraphs above outline themes and questions that deserve further attention. They illustrate the sorts of problems that would figure on a research agenda that really was about the management of energy demand. It is already obvious that the familiar repertoire of economic and social psychological expertise is not sufficient to cope with challenges of this kind, and that we need to make use of a much broader armory of theoretical concepts and methodological approaches. The following section identifies some of the resources available.

Re-tooling Research

What ideas can we borrow, appropriate and adapt in order to address the dynamics of energy demand? This necessarily speculative section identifies a handful of concepts which promise to be of real value, and identifies some of their limitations as well.

We have noted above that energy consumption is always mediated by technology. Following this theme, there is much to be gained from the sociology of science and technology. While more recent studies address regime-level transformation (de Laat, 1996; Schaeffer 1998), most work concentrates on innovation and change at the level of individual devices such as the bicycle (Bijker, 1995), the fluorescent light (Bijker, 1992) or the refrigerator (Cowan, 1985). The career of things has been the focus of attention rather than the services which they make possible, or the patterns of inter-dependence which link devices together to form co-dependent suites of technology (and of attendant practices). The units of analysis so far fail to include the kitchen or the home as a total energy system. Links are sometimes made between individual technologies and the infrastructures of which they are a part (e.g. Forty, 1986) but more could be done by way of understanding these relationships and their implications for regime level transformation.

Changing tack, the sociology of consumption has much to offer energy researchers by way of ideas about meaning, identity, acquisition and so on. For obvious reasons, there is relatively little work on what we might term 'inconspicuous' consumption (Shove and Warde, 1998) — for instance the consumption of water or electricity. On the other hand, economists Fine and Leopold's (1993) 'systems of provision' approach offers a very relevant framework with which to understand the structuring and organization of utility sectors. Hodgson (1998) and Brekke and Howarth (1999) draw on institutional economic approaches in efforts to recast consumption in a way which involves interrelationships between actors from both sides of the traditional supply and demand divide.

Environmental sociologists have paid more attention to the use of energy than most, but again their interests are partial. The idea that environmentally conscious consumers might drive a move towards 'ecological modernization' and so transform the relationship between households and energy suppliers is contested and controversial. Nonetheless, the

work of Spaargaren (1997) and others at least reminds us of the extent to which consumers are implicated in the design and operation of utility services.

Anthropological research reveals cross-cultural variation, demonstrates the malleability of normal conventions, and highlights the symbolic significance of energy consuming practices and habits. Miller (1998) and Appadurai (1996) address how the local and global contexts surrounding consumption contribute to changing consumption norms and practices. Appadurai also looks at global media and advertising, another subject barely touched on in energy consumption research to date. Social historians have made valuable contributions to documenting diversity and tracking change. In both cases, there is real potential for the development of more theoretical accounts of stability, order, routinization and innovation. Recent trends in social psychology call for an opening of the discipline to the social contexts described above (Wetherell,1998).

This brief and selective catalogue suggests that there are existing tools and resources which can be used to tackle the broader agenda of energy demand. It also suggests the need to develop, extend and adapt many of these ideas and approaches. There are gaps within and between sub-disciplines which threaten to hamper research in this field. This uneven intellectual backdrop reflects the fact that few sociologists, social historians, anthropologists or scholars of science and technology have devoted serious attention to the dynamics of energy demand. This is hardly surprising since the field has been described in terms of 'behavior' and marginalized as a result.

If questions of demand are to be tackled head on, and if there is to be any chance of realizing the potential for exploiting theoretical and conceptual resources from the social sciences, it will be necessary to draw a new population of social researchers into the field. The present framing of research agendas in terms of 'end user' behavior is not inviting.

Re-thinking Policy

Several policy implications follow from our argument. First, if device-centered approaches are limited in their ability to represent the real world conditions of consumption, then the policy initiatives guided by those approaches (e.g., with a focus on engineering design, provision of technical information, incentive subsidies for equipment purchase, etc.) will misunderstand social action and fail to deliver predicted energy savings. Wirl (2000) argues that this has been the case with DSM. Second, even with a "behavioral" amendment (e.g., technical assistance/public information initiatives aimed at "decision-makers"), device-oriented models direct policy attention primarily to the behaviors of engineers and accountants, in the case of firms, or furnace-repairs and energy bills, in the case of households — in both cases, low status areas that are likely to receive little attention in decision-making, particularly when energy costs are small. Third, if social perspectives on demand offer a more accurate conception of energy use, then policy analysis is able to explore a larger number of causal accounts and entertain a wider range of interventions. This is particularly important for the development of policies that might successfully stimulate energy savings and significant CO2 reductions. It is also important in uncovering inequalities in the present system and anticipating equity problems in proposed policies.

Given that energy use is shaped in complex systems that often submerge energy and other environmental concerns, it follows that existing policies not directed toward energy and the environment are nonetheless likely to shape patterns of energy consumption. Here we

have in mind state policies in the form of subsidies for fuels, zoning and land use planning, transportation regulations, building codes, engineering standards, etc. But we are also thinking of policies not traditionally related to energy, such as social welfare policies that affect the length of the work week, housing policy affecting the set up of housing for space heating and cooling, and policies in the arena of communications, media and advertising. The effects of these sorts of existing policies, and the possibilities for new policies, ought to be thoroughly considered in analysis and development of new energy saving initiatives.

Conclusions

Our intention in the paper has been to explore new ways of approaching a science of energy demand. We have used the history of the ACEEE panel title to show how the role of social science has evolved over the years. There have been a few steps forward, some shuffling in new directions — but still ending up two decades later not far from the starting point. Since all of the four co-authors of this paper have been contributors for most or all of these past two decades, we concede that in some ways this mark-stepping can be ascribed to our own inability to shift the debate. We are also aware that a change of title will not of itself set the stage for a revolution. But what if the panel was to be renamed "the dynamics of consumption", or "understanding demand" or "understanding consumption". A move of this kind might actively encourage social scientific research which takes due account of the actors, institutions and networks which contribute to change; which re-envisions the object of inquiry as the services which energy provides; and which is equipped to understand change. This new approach would not obviate the individual, nor research intended to track changes in how individual consumers think and act. It would, however, recast demand as the result of interactions in the social, cultural and technical contexts in which individual lives are played out.

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