Expanding the Human Dimensions Research Agenda

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The ACEEE Summer Study's Human Dimensions panel has included research that addresses management and market decisions. This paper argues that current trends, including declining real energy prices, increasing world population and world economic growth, and the threat of global warming, require that we broaden our research agenda. Specifically, research should include not only efficiency in meeting demand for energy-using services and products, but also the mapping of human desires and needs onto demands. In contrast to technical efficiency and economic efficiency, we refer to this new area as cultural energy efficiency.

Introduction

From the perspective of our Panel on Human Dimensions, energy efficiency can be divided into two analytic areas: hardware and humans. The ACEEE Summer Study on Energy Efficiency in Buildings places more emphasis on hardware — building components, building systems, and their related energy-using devices. Yet, since its inception in 1980, it has always actively solicited contributions in the human dimensions areas — attempts to understand the energy effects from the creatures who occupy, maintain, purchase, use design, build, and enjoy buildings, devices, and services. Issues concerning human dimensions are raised in all the Summer Study panels — more frequently and pervasively than, for example, most ASHRAE- or ASTI-sponsored conferences — but this panel takes human dimensions as its primary focus. (In some years it has also been called the "behavioral" or "social" panel.)

What range of human dimensions topics has been considered? Even within the Human Dimensions panel the range of topics pertaining to energy consumption and energy efficiency has in the past been rather limited. We outline in Table 1 a more complete range of relevant topics, because the range has expanded within papers accepted this year and because we feel that it must expand more if we are to meet today's challenges.

ACEEE papers have stayed close to the top of the list of topics laid out in Table 1, and almost all have been above the line in Table 1. ACEEE papers have primarily expounded on how occupants physically interact with building systems. They have explained why people do (or do not) decide to retrofit or buy an efficient appliance, how thermostat setbacks are determined, whether residents take back some efficiency savings in greater comfort, and how people react to DSM marketing. A few have reported attempts to change occupant knowledge of building systems.

Little work has been brought forth on such topics as whether people can be comfortable in moderate climates without air conditioning (Kempton and Lutzenhiser 1992) or how to encourage movement to more compact housing. Little attention has been paid to fundamental questions of generating demand, for example, by examining how individuals in U.S. subgroups such as the Amish and the Home Power Movement can lead satisfying, high-quality lives on a fraction of the U.S. average (Tatum 1991; Rudin 1991). That is, we have seen little on the factors underlying demand for building services, for residential building types, or for goods and services (which require energy to produce and deliver).

In short, we have paid more attention to the smaller issues than to the larger ones, the dynamics of the effects more than the fundamental causes, the little picture more than the big picture. On the positive side, ACEEE human dimensions papers have usually been closely tied to actual consumption measurements, direct measurements that keep the papers practical and that keep the theorizing from getting removed from reality.

One can imagine reasons for this skewing of topics toward the top of Table 1. Advocating changing demand for services is controversial; some would question whether it is even proper to do so. And it is probably more difficult. If we cannot understand why people will not buy a

Table 1. A Range of Human Dimensions Issues Bearing on Energy Use and Energy Efficiency in Buildings, Approximately Ranked from More Conventional Summer Study Topics to Those Not Yet Broached

Hardware purchase decisions
Equipment-operating decisions (e.g., thermostat setting, appliance runtime)
Owner-initiated retrofits
Occupant response to retrofits (e.g.,take-back effect)
Differences in energy use by social class
Demographic trends affecting energy use

Changes to occupant knowledge (e.g., energy education)
Attempts to change attitudes or values (e.g., social marketing)
Environmental motivations for lower energy use
How to change demand for building services (tolerable comfort changes)
Demand for building configurations
Sources of life satisfaction

cost-effective efficient refrigerator, how can we understand why a bachelor wants to live on a half acre in the suburbs, or why air conditioning is used so much more heavily in the United States than in climatologically and economically similar areas of Europe?

The Need to Expand the Research Paradigm

But the reasons to expand our reach are more compelling than the reasons to stay narrow. Today, as Schipper et al. 1989 (and Schipper 1993) point out, human dimensions matter because the present era of relatively flat energy prices witnesses only very slow changes in energy efficiency. In this environment, the role of behavior as an significant driver of changes in energy use becomes more important than during times when energy prices are rising rapidly and households are scouring hardware stores and utility stuffers for ways of saving energy. That the price of oil keeps falling, in spite of local wars and other problems, has lulled us into lowering our concern over "energy security."

Indeed, energy efficiency per se may not have any real value. Because of concern over the environment however, total non-renewable energy use, not simply efficiency, has become of greatest concern, since environmental problems are generally proportional to the total use of energy. This means that we need to understand not only the factors influencing energy efficiency but also those influencing total energy use. Hence people's behavior — their patterns of heating, cooling, and driving — as well as their long-term choices on where and how to live, where to work, and where to play, are as important to total energy use as the efficiency of refrigerator compressors. Energy efficiency is an inanimate concept, but energy use is an animate one, full of all the foibles of human life that are not reflected in considerations of the cost effectiveness of one more pane of glass in Northern Sweden. In short, human dimensions matter as much as engineering.

In a global and future-oriented perspective, the human factor is even more compelling. Beyond the boundaries of the U.S. and the European community, the growth numbers are frightening: expect a doubling of world population and perhaps sextupling of economic activity during the next century. Such growth would be worrisome for traditional reasons, such as regional pollution and strategic petroleum dependency. In addition, the world is now confronted with potential environmental problems, notably global warming, which could require more reduction of energy use than efficiency alone can give us. That is, global warming could potentially require not just halving current fossil fuel use — a reasonable goal for a nation trying to eliminate oil imports — but reducing them by 60% to 90% globally, while accommodating a doubling of world population and a six-fold increase in economic activity. To anyone concerned about the effects of major climate change, those numbers sound scary. And they do not sound like something even the most optimistic projections of efficiency improvement can handle alone. We suggest that a response to these problems will also require

some changes in the levels or types of goods and services used in developed countries.

In other words, we may need not only to heat residences more efficiently, but also to heat smaller residences with more common walls. We may need not only to increase miles per gallon but also decrease vehicle miles traveled. Together, these two end uses accounted for 23% of total primary energy use consumed in the U.S. in 1991 (Schipper, Howarth and Geller 1990). Since 1973, fuel use/km of automobile travel fell over 33%, while energy use per unit of house area for heating fell by over 45%. Perhaps the next "savings" will come by foregoing increases in distance traveled or area heated, or even gradual decreases in these two important parameters.

That does not necessarily mean "giving up" anything, as we will argue in a moment. However, it does mean considering policy options and social or cultural changes, which have traditionally been avoided, even shunned, by the community of energy efficiency analysts and policymakers. For one thing, imagine if the income tax deduction for mortgage interest was phased out: house prices would fall, but the size of new homes would likely fall, too, leading to small reductions in future space-heating demands. Americans need only look to their Canadian neighbors, who certainly have no scarcity of land, energy, or building materials, but who have never had this tax subsidy, to see a society built on somewhat smaller homes arranged in somewhat more compact cities.

How can we suggest the idea that reduction in energy services does not mean consumers having to give up anything? Certainly when consumers react to higher energy prices by reducing energy use, they are "giving up" some of the heating comfort they did not value as greatly as the monetary reductions in their heating bills. Environmental costs will likely be the main reason why prices rise, in part to pay for cleaner energy, and in part to pay for residual pollution through "green taxes, " as economists have argued for a long time. Indeed, over the short term, consumers who control and pay for their energy are notoriously quick to respond to price increases by cutting back. But in the longer run, consumers may face enormous difficulties in calculating just how much marginal investment in energy-saving technologies is justified, given current energy prices and price expectations. Understandably they may retreat into doing little or nothing to invest in efficiency at the margin. We would argue that there is as much inefficiency in our choice of demands to meet our desires as there is in the way those demands are provided. That is, the economy's apparent lack of efficiency in providing services (converting fuels into heated interior space or cooled refrigerator volume) may be rivaled or even excelled by our culture's lack of efficiency in demanding services to meet our underlying needs and desires (demanding miles travelled to satisfy need for companionship, choosing a large residence to meet a desire for a better school district, or demanding more energy-intensive durable goods to meet a desire for respect and status from our peers).

How could a better understanding of the cultural bases of inefficiency be used? We frankly are not sure of the best vehicle. Would advances in understanding demand lead to policy changes? Would the most likely audience for such research findings be a government, a utility, an environmental activist group, or a religious order? Would the research we suggest here be used to try to influence the direction of society's demands, or be used only to understand changes that may occur anyway, for example, brought about by increasing public environmental values? Recommendations in these areas, we feel, would be premature — although we intend the foregoing lists to suggest that the application might or might not be through traditional policy vehicles. Our goal in this paper will instead be to suggest some possible research in these directions.

Research Questions

Technical Economic Issues

Why is the gap growing between available savings and actual savings? Are consumers indifferent, or have we misunderstood the economics of energy use and energy efficiency? While some economists dispute these gaps, a case can be made for many large gaps in the efficiency of new equipment bought by households and small consumers.

What is the real marginal impact of efficiency programs, be they standards, promotions, subsidies, or something else? It may be politically correct to advocate energy efficiency programs, and indeed fund them (as long as Congress or local regulators agree), but the huge size of the world's energy bill behooves us to use our resources to influence this bill sparingly. When can we show that an energy efficiency program both saves energy at the margin and clearly enhances welfare after all hidden and indirect costs are counted?

How great is the feedback between increased efficiency and increased demand for energy services? Most research finds this to be a small effect (less than 15%), but its existence still blocks many debates about energy efficiency programs. Will energy intensities begin to increase with lower prices or at least prolonged steady prices? One of us writing elsewhere in this conference (Schipper and Sheinbaum 1994) finds a clear plateau of energy efficiency improvements that set in after the crash of oil prices in 1985. But is this plateau a logical consequence of the

growing energy gap, a pure and "correct" reaction to stagnant or falling energy prices, or some combination?

Policy Issues

Why the fear in the U.S. of using energy prices as a tool? Are there no other ways of solving the poor and equity problems? Elsewhere, green taxes are discussed as a way of shifting taxation from goods (capital, income, and labor) to bads (pollution). But strong forces are aligned against this shift in the U. S., not the least of which is a generation that has passed through an era where proposing five-cent-per-gallon gasoline taxes is seen as an act of political suicide.

Lifestyle

If there is political resistance to energy taxes in the U. S., are there any other handles on energy use, say, reducing energy use in the name of environment? Why the fear of challenging people to live differently? What does it mean to live differently?

Conversely, it is possible to have an environmentally sound and sustainable future with present lifestyles? Or worse, with lifestyles that are an extension of present trends: larger homes to heat, more places to go that are heated and cooled, longer vacations by air, more dispersed settlements, and more automobile driving? What are the fundamental sources of a satisfying life? How is that related to energy and materials use? What can we learn from low-energy-use subgroups?

What motivates the choice of high-energy-use home attributes (large conditioned space, high land use, central air conditioning even in moderate climates) by first-time home buyers?

Why do empty-nest parents (households with all children departed) rarely move into smaller residences or multifamily residences?

What infrastructure and social marketing would be needed to really shift 10-20% of trips onto human-powered vehicles?

Cross-Cultural Comparisons

Why does demand differ among European countries (e.g., hot water in Italy vs. U.S. or Scandinavia)?

Are Japanese heating practices (low temperatures, heating mostly where people are, not the entire room) unique and a function of culture (and high energy prices), or could they spread? Are they permanent in Japan?

The Swedes have the most efficient space-heating practices in northern countries. Yet they also have the warmest indoors. Are they spoiled? Did they over-invest in comfort?

Travel

We develop in more detail one example of possible research in the area of travel. A large number of studies, committees, and collaborative actions now are focusing on personal transportation, that is, the most important source of energy growth in wealthy nations (Schipper, Meyers, et al. 1992; Schipper et al. 1993). Restraining travel (and freight) growth for environmental reasons, reducing congestion, accidents, and noise are all laudable social objections. But growth in travel seems to overwhelm all efforts to reduce the unit "pollution" of travel. Are we fighting a losing battle? Why do people travel so much, particularly on short trips? Do we use cars to save time, or because we simply feel we have to move around a great deal? What more basic needs and desires are served by travel? This is an important question because in spite of popular perceptions, trips to and from work only account for 25% of travel and about the same share of total kilometers traveled. In the U.S. travel for non-work purposes, particularly shopping and free time, represent the major growth.

For example, using a car to shop greatly increases the range of stores a family can visit in a given amount of time for a relatively low cost. This ease of mobility increases competition, because more stores are effectively competing with each other, compared to a walking shopping routine, where only the stores on Main Street are important. Finally, there is an important topic scarcely examined in our work. How does energy use interact between sectors because of human activity patterns? In the residential energy consumption surveys (RECS), for example, Schipper et al. (1989) discerned a pattern whereby older retirees had low energy use for transportation (fewer cars, less travel) but surprisingly higher home energy use because they were home more than other people. Comparing retired singles with young singles, for example, showed the young singles with much higher gasoline use but somewhat lower heating energy use. Beyond this simple comparison, however, may lie important relationships between energy use at home and energy use way from home? And when people are away from home, they stimulate energy use in those indoor environments dimensioned for their visits, like stores, concert halls, indoor stadia, hotels, and restaurants. Can we imagine a future where people go out significantly more than today, or significantly less, as posited by Schipper et al.? What would drive us to such changes beyond factors like aging or perhaps even changes in family structure?

Technical, Economic, Institutional, and Cultural Energy Inefficiencies

We might define "cultural energy inefficiency" as a sub-optimal translation of human needs and desires into demand for goods and services. The next step, of defining "sub-optimal" could quickly become complex and controversial; we mean by sub-optimal that other combinations of goods and services could provide as much or more human satisfaction at lower energy use and less environmental cost.

To clarify, we give examples of technical inefficiency and economic inefficiency, which are already familiar to the energy efficiency community, and institutional and infrastructure inefficiency, which has occasionally been discussed. These are compared with examples of cultural inefficiency. These are illustrated in Table 2.

Can we map research findings in the area of cultural energy inefficiency into policy? It may be difficult. But some reflection on the technical inefficiencies and economic inefficiencies, and even more so institutional and infrastructure inefficiencies, will remind us that we have not created the ideal policies to resolve these problems either. Also, as we suggested earlier, research findings might be translated into action by different mechanisms and institutions than those we have come to associate with technical and economic inefficiencies.

Conclusion

We have tried here to begin to stimulate a broader research agenda for the Human Dimensions of Energy Efficiency. To date, the agenda has included human barriers and opportunities for technical efficiency and economic efficiency. We suggest expanding the research to also examine cultural energy efficiency: the mapping of

Table 2. Examples of Different Types of Inefficiencies

Technical inefficiencies
Low insulation levels
Air infiltration
Incandescent lighting
Electric-resistance heating
Economic inefficiencies
Energy prices do not reflect external costs of energy production
Market barriers to efficiency
• misleading price signals
• imperfect information
• split incentives (e.g., owner/renter)
Institutional and infrastructure inefficiencies
Easier to buy new than repair
Hard to market information, local services
Profit of firms linked to quantities of throughput
DSM unheard of outside of utilities
No transportation infrastructure for human-powered vehicles
Few stores within walking distance
New housing cheaper and easier to develop on unused land
Cultural inefficiencies
More desirable to buy new than repair
"Business" clothing does not allow for temperature extremes
Belief that constant temperature is most comfortable (24 hours, 12 months)
Unacceptability of sweat for thermal regulation
Status derives from quantity and newness of material possessions
"American dream" of a detached house in suburbs
Second family member takes a job, rather than reducing expenditures
Lack of knowledge of energy impacts on environmental problems

human needs, aspirations, and desires into demand for energy-using goods and services.

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