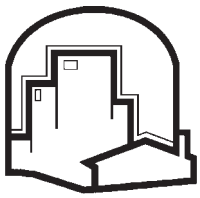
2000 ACEEE SUMMER STUDY ON ENERGY EFFICIENCY IN BUILDINGS



Efficiency & Sustainability

PROCEEDINGS

# 8 Consumer Behavior and Non-Energy Effects

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# Foreword

Responding to the theme of this Millennium Summer Study—"Efficiency and Sustainability"—professionals from around the world discussed the technological basis for and practical methods of implementing efficient and (hopefully) sustainable energy use in buildings. Issues, trends, challenges, and accomplishments were discussed. Each volume in this proceedings focuses on specific issues that encompass global visions for the future and discussion of future trends.

The 2000 Summer Study continued to emphasize new trends in buildings, equipment, markets, and social issues. Topics ranged broadly from the ENERGY STAR® program for new construction to building envelope and system engineering issues. The papers presented reviewed the latest information on utility restructuring and impacts on utility-sponsored programs, as well as global market issues, information technologies, and non-energy benefits. Sustainable development strategies; community-scale initiatives; factors influencing energy consumption and purchase of energy-efficient technologies; and how to design, implement, and evaluate energy programs were just a few of the cutting edge discussions that warm the mind and stir our quest for enlightment.

The subjects of the ten volumes in this proceedings are:

1. Residential Buildings: Technologies, Design, and Performance Analysis
2. Residential Buildings: Program Design, Implementation, and Evaluation
3. Commercial Buildings: Technologies, Design, and Performance Analysis
4. Commercial Buildings: Program Design, Implementation, and Evaluation
5. Deregulation of the Utility Industry and Role of Energy Service Companies (ESCOs)
6. Market Transformation
7. Information and Electronic Technologies
8. Consumer Behavior and Non-Energy Effects
9. Energy and Environmental Policy
10. Building Industry Trends

We, the co-chairs, would like to thank the 23 panel leaders who sorted more than 658 abstracts, selecting and nurturing 309 papers through the rigid review and publishing process, and selecting more than 60 talks for the poster sessions. We would also like to thank the many peer reviewers who worked with the panel leaders. Finally, a well-deserved thank you to the staff of ACEEE, in particular Glee Murray and Rebecca Lunetta (who received key assistance from Renee Nida and Julia Harvell) for their support and guidance throughout this process and for making the week a very successful "energy camp."

*James McMahon, Lawrence Berkeley National Laboratory*
*Pat Love, Oak Ridge National Laboratory*

# Acknowledgments

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# PANEL 8: INTRODUCTION

# Consumer Behavior and Non-Energy Effects

The papers in this volume cover a wide range of topics related to energy use and efficiency. They share an interest in what has been termed the "human dimensions" of energy—although many move beyond the traditional focus on individuals and behavior associated with that term to consider the larger *systems* in which persons and technologies are located.

The authors are an eclectic group that includes academic social scientists, utility program managers, evaluators, consultants, and national laboratory scientists. The approaches they take cross disciplinary lines—from marketing to sociology, economics to engineering. Some papers are interested in applying and expanding theory, while others offer insights from the "nuts and bolts" inner workings of energy programs. Most are from the United States but there is a good representation of work from Europe and Asia as well. All offer new information that helps us better understand how persons, organizations, technologies, programs, and policies interact to shape energy flows and affect efforts to improve the efficiency of energy use.

## Thinking About Energy: From "Behavior" to "Systems"

Four papers approach the problem at a very basic level—in terms of how the energy community *thinks* about energy and efficiency. Each offers a critique and some suggestions for improved models, theories, policy approaches, and program designs. Two of these papers concern peoples' understandings and misunderstandings. Diamond and Moezzi present and debunk a number of *myths* about energy use in buildings—myths held by consumers, utilities, and designers alike. Rudin's work builds on this by pointedly raising the twin questions of whether an emphasis on *efficiency* blinds us to opportunities to simply *not use energy*, and whether the interest in efficiency tends, at least in some important cases, to actually encourage *increased* energy use. The two other papers in this set offer complementary views of how we might begin to *rethink* energy and efficiency—particularly in terms of social and technical *systems*. The paper by Wilhite et al. brings together four leading academic social scientists in a joint effort to correct stubborn limitations in conventional thinking about energy. Rather than focusing on devices and techno-rational models of human behavior, they propose a much broader view of the interactions between consumers and producers (and the shaping dynamics of the larger social systems in which consumers and producers are embedded) as a central focus of energy analysis. Lutzenhiser and Gossard amplify this position, arguing for the importance of the concept of *lifestyle* in the analysis of energy demand. Reviewing research in marketing and sociology, and presenting empirical data on lifestyles, they explore the ways in which *social stratification* and related patterns of *social distinction* drive the expansion of energy consumption.

## Individual Entities: Consumers, Households, Firms, and Utilities as Energy Users

Two papers focus on consumer behavior and energy use in households. Nevius and Pigg examine the thermostat setting practices and resulting consumption of energy in households with and without programmable thermostats. They find that the effectiveness of the latter depends upon conservation attitudes and values, and that many consumers with older manual thermostats actually use energy in about the same amounts as those with programmable ones. Weber et al. report the results of a study of the consumption behavior of a group of "eco-pioneers" who live in an environmentally oriented German community. While all members practice various eco-friendly behaviors, some important consumption patterns (particularly in regard to mobility) were found to be rather conventional and hardly environmentally friendly in their consequences.

Eight papers in the volume address various "non-energy benefits" (NEBs) of energy efficiency enhancements—benefits to individual consumers, to firms, and to utilities. We have known for some time—and several papers in this collection reinforce the finding—that non-energy considerations routinely scuttle the best intentions of efficiency programs. NEBs are the other side of that coin. In recent years, efficiency advocates have argued that technical improvements in the efficiency of buildings and systems are accompanied by a variety of (often unexpected) benefits. Until recently, however, these benefits (e.g., to health, safety, comfort, productivity, profit, the environment, etc.) have been difficult to measure. This volume reports several important studies that empirically test for the existence of NEBs and attempt to quantify their contributions.

For example, Heschong, Wright, and Okura present the results of research conducted in a large sample of Washington, Colorado, and California schools where student performance was recorded across classrooms with and without *natural light*. In all cases, significantly higher rates of academic progress were observed for the students in the day-lit spaces. Okura, Heschong, and Wright also report strong positive correlations between the use of daylighting and higher retail sales in a study of closely matched commercial businesses. Ring and Brager report high levels of occupant satisfaction in a study of three new "mixed-mode" office buildings that use both operable windows and full heating, ventilation, and air conditioning systems. Pomerantz, Akbari, and Harvey show that by making asphalt street pavements more reflective—and, therefore, cooler—not only is energy saved, but the pavement is less costly to install and lasts longer. Middleton, Murray, and Brohard use case studies of California utility programs to estimate the environmental benefits of reduced water use and emissions that accompany energy reductions. Skumatz, Dickerson, and Coates present an innovative method for quantifying and estimating the magnitude of a variety of non-energy benefits, including enhancements to comfort, health and safety, noise reduction, increased system durability, and environmental improvement. Riggert et al. report the results of a meta-study of NEBs associated with low-income residential weatherization. They argue that the indirect benefits to health, safety, the environment, and the sponsoring utility are often larger than the direct benefits of reduced energy costs. And Snell et al. present an analysis from the point of view of a large public housing authority and an urban public health department, where planners must balance the benefits of lower energy usage against possible adverse health effects and costs. Because many low-income households have chronic housing-related health problems as well as poor energy efficiency, the authors argue that efficiency programs can be key contributors to health improvement.

## Organizations: The Dynamics of Action within and among Governments and Firms

Moving to an organizational level of analysis, six papers explore energy use and efficiency action in business and government settings. The majority of these are concerned with the status of efficiency in the development and operation of large commercial buildings. Beamish et al., for example, present a model of narrowing choice or increasing constraint, in which "upstream" decisions made by real estate developers, bankers, and leasing agents in turn shape and limit the efficiency choices of "downstream" "communities of practice" (e.g., architects, engineers, utilities, occupants) in the design and utilization of buildings. Janda and Brodsky look at the corporate philosophies and efficiency interests involved in the first ninety buildings enrolled in the U.S. Environmental Protection Agency's ENERGY STAR Buildings™ program. They identify several features of the managerial context that are likely to be important for the potential transformation of commercial buildings markets. In closely related work, Shockman and Piette explore the worlds of commercial property management, considering the thorny problems of efficiency innovation faced by even the most creative and successful technical managers who must operate in systems dominated by non-technical interests. Parker, Chao, and Gillespie interviewed corporate decision-makers in order to better understand how they made energy-related decisions. They describe different energy efficiency investment strategies and the processes used by U.S. firms to evaluate alternative investments. Weber also considers corporate energy use and decision-making, but in a large sample of Swiss firms. He finds that energy efficiencies often result from non-energy decisions and argues for an improved model of organizational decision-making to help explain these results. Finally, Kunkle, Lutzenhiser, and Dethman argue that influencing the purchasing decisions of public agencies "isn't as easy as it looks." They draw upon surprising findings from their study of government purchasing in the Pacific Northwest to argue that a comprehensive form of efficiency intervention is needed in this sector—one that focuses on making *organizational* rather than *technological* changes.

## Programs: Learning from Efforts to Change Patterns of Consumption

Eleven papers consider what can be learned from efficiency programs designed to influence individuals' energy use behavior. It is a truism in energy research that consumers and firms really know very little about energy. So offering better *information* about energy and efficiency has been an important program goal for many years. Three papers are specifically concerned with the provision of energy information via *bills* and *labeling*. Payne finds considerable variation in how business owners actually use billing information. A key difference has to do with the sizes of the businesses—a difference that turns out to have important consequences for energy efficiency investment. Dethman, Unninayar, and Tribble describe innovative (what we might call "bottom-up") efforts in India to develop appliance labels that reflect real consumer preferences, rather than government and industry interests. Egan, Payne, and Thorne report the results of work in progress to improve the (largely "top-down") U.S. EnergyGuide appliance label, including testing alternative label formats.

Two papers consider *energy education* programs in some detail. Peters et al. report success in providing energy education to visitors at a children's museum. They also offer a "program logic model" for the evaluation of similar undertakings in other contexts. Green and Skumatz use a meta-study to consider the behavioral impacts across energy education and advertising programs. They conclude that significant savings can be produced by education, outreach, and advertising interventions, and they suggest some appropriate evaluation techniques for these types of programs.

Two papers consider the utility of "conjoint analysis" in efficiency program design. Grover and Babiuch use a study of consumer preferences for various washing machine features to show how this technique can simultaneously consider energy savings along with other attributes of technologies from the buyer/user's point of view—helping program planners assess the prospects of potential interventions. Torok and Cavalli draw upon data from a conjoint analysis of compact fluorescent residential lighting preferences to argue that this technique can make significant contributions to the design of market transformation interventions.

What consumers know or *want* may not align very well with utility understandings of consumer demand. Farhar and Coburn summarize the results of a series of consumer surveys that show significant demands for renewable energy products that utilities have been reluctant to supply. On the other hand, it's also often difficult to determine just what people are thinking and doing—even armed with sophisticated research methodologies. Along these lines, Leach, Latta, and Laurence report the frustrating results of attempts by the U.S. Energy Information Administration to collect accurate and useful information from consumers about their energy use behavior.

At a more macro level, several papers consider large-scale efficiency interventions and their impacts on consumption. Sulyma et al. describe Thailand's success in establishing a set of comprehensive national efficiency programs that have produced important changes in consumer and producer behavior, and have resulted in significant energy savings and non-energy benefits in that society. Jayalath considers the efforts by Sri Lanka to craft energy efficiency policies that will be effective in the emerging context of utility deregulation. And Fernstrom et al. assess the potentials for a new "time-dependent basis" for state energy codes in California's restructuring electric utility environment—an innovation that would credit designs and systems that mitigate the growth of peak loads.

## Systems

Finally, three papers explore energy and technology in the contexts of the larger *systems* in which persons, buildings, and machines are embedded. They round out the collection by illustrating the potential of the broader view advocated by Wilhite et al. In this set, Chappells and Shove explore the ways in which "systems of provision" shape the energy-related actions (and possibilities for change) of persons and organizations. Banks takes an "actor-network" approach (from European social studies of technology) to consider the diffusion—and non-diffusion—of energy efficiency in the "sad case" of the condensing boiler in the U.K. And Burke uses a "sociotechnical systems" approach (from the largely American history of technology) to explore how energy-efficient mortgages have developed in different parts of the United States.

## A Final Note

Taken together, this collection of thirty-five papers offers a fairly good snapshot of the current state of affairs in "human dimensions" energy research. It reveals a wide diversity of interests and orientations—and a field that has yet to gain coherence. It shows that high-quality cutting-edge work is being done on a number of fronts—as is some critical reflection on the nature of the enterprise. And the collection offers the energy community a number of quite useful—and sometimes bold—suggestions for improving the design of interventions, policies, and research and design agendas.

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