Foreword

Welcome to the 1998 ACEEE Summer Study on Energy Efficiency in Buildings, the tenth in a series of biennial workshops devoted to technology, policy, and implementation issues related to energy use in buildings. This week-long conference brings together a diverse group of professionals from around the world representing the views and expertise of utilities, industry, national laboratories, government agencies, public interest groups, and universities.

The theme of this Summer Study is ***Energy Efficiency in a Competitive Environment***, reflecting one of the major trends in the field of energy efficiency—the growing need to strategically position energy-efficient and renewable energy technologies in ways that harness market forces. Restructuring of the electric utility industry and increased retail competition in both electric and gas markets has made it imperative to prove to consumers that energy efficiency improvements in buildings can constitute profitable investments. The need to compete in both domestic and international markets is forcing corporations and nations to focus on energy efficiency as a means of improving productivity and reducing costs. Across the globe, efforts to capture the benefits of energy efficiency are increasingly market-driven and market-based.

Other drivers for energy efficiency are also emerging. Of particular note are the environmental benefits of energy efficiency. Numerous studies have documented that energy efficiency is a highly cost-effective and politically palatable near-term solution for addressing global warming. In many countries, including the U.S., buildings are heated, cooled, lit, and powered primarily by fossil-generated electricity, making the buildings sector an important target for reducing greenhouse gas emissions through improved energy efficiency.

But there are also new and continuing challenges. The first decade of the next century promises to extend the current era of low energy prices. At the same time there is no perceived threat of near-term electricity shortages or oil supply disruption. With much of the public still unaware of how energy efficiency contributes to the environment, it is not surprising to find relatively little interest by citizens, corporations, and the government in saving energy for its own sake.

The downward slide of utility demand-side management investments that was so apparent at the 1996 Summer Study is continuing; however, in a few key states such as California and New York the decline is being offset by market transformation programs funded through public benefits charges. In response to such opportunities presented by electric utility industry restructuring, portions of the industry and its efficiency services subsidiaries are staffing up and forming strategic alliances to offer not only performance contracting, but also commodity sales, maintenance, power quality, load profiling, billing, metering, and other services to its customers.

Set against the backdrop of these trends, noteworthy technology developments and implementation progress have been made since the 1996 ACEEE Summer Study. A growing body of research expertise has been translated into innovative and advanced technologies that are now cutting energy costs in both residential and commercial markets. Examples include gas-driven heat pumps, duct diagnostics and sealing, and low-emissivity windows. The past several years have also heralded the rapidly growing use of information technologies in building construction, energy metering, energy management and control systems, and telecommunications. Another technical development is the expanded scope of energy efficiency activities to include building start-up and operations and maintenance, in addition to installing energy conservation measures. The result has been an improved ability to deliver long-term savings.

These market successes reflect the great progress being made in integrating industry and government research agendas, the growing role of energy service companies, the mainstreaming of performance contracting, and the maturation of market transformation efforts. They have also benefited from better alignment between energy efficiency and diverse goals such as indoor air quality and health; occupant comfort, amenities, and productivity; and peak demand reduction. In addition, recent successes

have capitalized on the growing understanding of how individuals and organizations make decisions that affect energy use (such as choice of building and lighting designs and the purchase of heating and cooling equipment) and the expanding field of knowledge of how energy is used in society.

All of these issues, trends, challenges, and accomplishments are discussed in the ten panels that comprise the 1998 Summer Study. Each panel deals with a particular cluster of issues and presents its papers in a separate volume of the proceedings. The ten volumes are as follows:

Volume 1 — Residential Buildings: Technologies, Design, and Performance Analysis

Volume 2 — Residential Buildings: Program Design, Implementation, and Evaluation

Volume 3 — Commercial Buildings: Technologies, Design, and Performance Analysis

Volume 4 — Commercial Buildings: Program Design, Implementation, and Evaluation

Volume 5 — International Collaborations and Global Market Issues

Volume 6 — Deregulation of the Utility Industry and Role of Energy Services Companies (ESCOs)

Volume 7 — Market Transformation

Volume 8 — Information Technologies, Consumer Behavior, and Non-Energy Benefits

Volume 9 — Sustainable Development, Climate Change, Energy Planning, and Policy

Volume 10 — Building Industry Trends

The 1998 Summer Study repeats the panel devoted to building industry trends, which was introduced in 1996. Several new topics have been introduced this year, including sustainable development, information technologies, non-energy benefits, and global market issues.

In closing, we would like to thank the 22 panel leaders who worked their way through more than 600 abstracts, shepherded nearly 300 papers through the peer-review process, and selected 30 displays. The ACEEE staff also deserve special recognition, in particular Glee Murray and Rebecca Lunetta, for their coordination of a complex of logistical details that must come together to make the conference a success.

Enjoy the conference.

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PANEL 3 INTRODUCTION

Commercial Buildings: Technologies, Design, and Performance Analysis

Papers in this panel focus on the energy performance of new and existing commercial buildings. Beginning with a session on designing energy-efficient new buildings, the panel proceeds through a wide range of topics including monitoring, modeling, technologies, and applications. Specialty sessions this year focus on schools, daylighting, cooling, and HVAC distribution.

New Buildings: Right from the Start features papers evaluating the unique opportunities for maximizing cost-effective energy efficiency in new buildings. The first describes a "whole building design approach" implemented at the National Renewable Energy Laboratory (NREL) in Golden, Colorado. The paper emphasizes communications between all members of the building team, including energy consultants, and follows key steps in the whole building approach including predesign, design, construction, and commissioning. The second paper presents guidelines supported by case studies for design-build, plan/specification/bid, and speculative approaches to new commercial building construction. The final paper violates the session theme by evaluating energy efficiency opportunities in an existing commissary, but maybe folks building new commissaries will use the results!

Tracking Performance. During the 1980s, the ACEEE Summer Studies were the only major conferences that really made measurement and tracking of the energy performance of buildings a central activity. Indeed, only a handful of people outside of ACEEE seemed interested in this topic. About five years ago, the level of energy service company activity began to skyrocket, which led to a flurry of interest in tracking energy performance for savings measurement and related uses. Today, we continue to see advances in hardware for building monitoring and in ways of using the data collected to determine savings or diagnose operating problems. This session begins with a presentation on the development of an Internet-based data acquisition system that incorporates a number of additional advanced features. We then see some new ways to look at and analyze the formidable amounts of data that modern data acquisition systems so routinely collect. We conclude with the presentation of additional evidence of the need for measurement to accurately determine the savings from even "simple" retrofits such as lighting upgrades.

Making It Work. During the 1980s most of the emphasis in the energy efficiency community was focused on learning the best ways to design buildings, or get them right from the start. This is still a critical topic but there has been an increased realization that even the best designs can give efficiency a bad name if they aren't implemented so they actually work—to provide a comfortable environment, save energy, and reduce the impact of the building on the environment. There are many elements to making a building work. Some require the rare ability to get a very diverse community of building users to apply "common sense" to building operation while other facets of making it work require an extremely sophisticated level of understanding of a building and its systems. This session opens with a presentation of 15 "best practices" for energy-efficient operation; it is interesting to note that two-thirds of these deal with the "people" side of energy management, and only a third with the technology side, emphasizing again that the best technology won't work if it isn't people friendly. One of the least people-friendly technologies has been the calibration of simulation models. We next see a new way of plotting performance data to speed calibration of simulation models used for building diagnostics, which hopefully will make this process a bit more friendly and useful. DOE-2 and BLAST precede ACEEE—and the session concludes with a look at a sophisticated simulation tool that should lead to their retirement party.

Applications: Learning Our Schools. Public schools spend more than $5 billion annually on energy in the United States alone. Around the world, schools will have increasing space needs as class sizes are reduced and world populations increase. This session presents three papers that use large data sets in statistical studies of public school energy use. The first paper uses a large U.S. database to identify benchmarks for public schools, potentially providing a tool for rapidly identifying facilities with energy problems. The second paper studies a 26-school database in Sweden and, like the first paper, uses linear regression analysis to correlate energy performance with key building features. The last paper presents a statistical review of energy use in Florida schools, correlating energy use with both building features and occupancy characteristics.

Technologies: Pushing the Envelope. The three papers in this session highlight energy opportunities with commercial building envelope systems including light-colored roofs, wall and ceiling insulation, and phase-change wallboard. The first paper reports monitored energy savings for three California commercial buildings based on cooling use data "before and after" application of a light-colored roof coating . The second paper evaluates the combined energy and global warming impacts of alternate commercial building insulation materials. The third paper evaluates the potential for using phase-change wallboard for downsizing cooling systems in three California climates.

Technologies: Daylighting Plus originally included one daylighting paper and two papers summarizing improved electric lighting systems, but the latter two were somehow "switched off," and two more general papers with significant daylighting components were substituted. The first paper in this "all-California" session compares four popular daylighting software programs using a challenging sample San Francisco building. The second paper further pursues the school theme of Session 4 by presenting a California energy-efficient modular classroom project featuring strip skylights in one advanced energy package. The third paper presents performance results for "California's most energy-efficient office building," which relies substantially on daylighting.

Technologies: Cooler Choices. Commercial building cooling offers significant opportunities for both energy efficiency and demand reduction. This session includes two papers on commercial building evaporative cooling and, for those cooling applications that just can't do without those ubiquitous compressors, a third paper on software for evaluating efficient chiller upgrades. The first evaporative cooling paper focuses on commissioning and controls for a plate-type indirect system, and the second presents an international review of natural down-draft evaporative coolers.

Technologies—Go with the Flow. Air and water flow are key elements in the efficient operation of any building—and they are typically more important in commercial buildings than in residential, since there is less mixing of hot and cold streams in houses. Ground-coupled heat pumps offer very attractive efficiency but their application has been limited by the cost of getting heat to flow into or out of the ground. Several innovative approaches to cutting this cost are highlighted in the opening paper of this session. The last decade has seen an increasing appreciation for the role played by air flow and heat transfer leaks in air-side distribution systems. Most of this work has dealt with residential systems but we find in our next paper that small commercial buildings have a huge problem with leaky ducts. The session ends with a look at some of the lowest efficiencies you've probably ever seen—the second law efficiencies of air-side distribution systems.

Special Topics

Any topic that has a significant impact on the energy efficiency of commercial buildings is "special." Commercial refrigeration accounts for 6 to 7 percent of commercial sector energy use and easily qualifies as "special" but has received very little attention at the Summer Studies —or other conferences. In the first look at the technical potential for savings in this niche, we find that savings of over 25 percent are readily achievable. Everyone uses copiers—but they use only about 1 percent of commercial sector energy use. However, they have undergone significant changes in energy use and operating patterns as a result of the U.S. Environmental Protection Agency's ENERGY STAR® copier program—as we find in the concluding paper in Panel 3.

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