EFFICIENT USE OF ELECTRICITY THROUGH DEMAND-SIDE MANAGEMENT

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Keywords: demand-side management, energy efficiency, conservation

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Summary

This article introduces the concept of demand-side management and efficiency in the utilization of energy, especially electricity.

1. Introduction

Electricity is fundamental to the quality of modern life. It is a uniquely valuable, versatile, and controllable form of energy, which can perform many tasks efficiently. In little over 100 years, electricity has transformed the ways most peoples of the world live. Lighting, refrigeration, electric motors, medical technologies, computers, and mass communications are but a few of the improvements it provides to an expanding share of the world's growing population.

2. The Use of Energy and Electricity

Electricity is a uniquely valuable form of energy, offering unmatched precision and control in application as well as efficiency. It offers unrivaled environmental benefits when compared with other energy options. And finally, electricity provides individuals with a clean comfortable supply of energy. Because of these unique attributes, new electric appliances and devices require less total resources than comparable natural gas or oil-fired systems.

Electricity's utility is so diverse. Certain energy forms can meet one need more efficiently than electricity, but these forms are extremely limited in their range of application. Only one energy form—electricity—can meet all of a customer's energy needs (comfort, convenience, appearance) as well as facilitate the achievement of other needs (medical diagnostics, money from automatic teller machines, personal computers). Electricity is extraordinarily unique in its ability to deliver packages of concentrated, precisely controlled energy and information efficiently to any point.

In addition, electricity can help alleviate many of the concerns facing this country and the world (e.g., environmental problems, limited resources and the spiraling costs for obtaining them). In fact, it is uniquely suited for this critical task because it is available from various sources at a reasonable cost, its versatility allows it to be readily converted into easily and efficiently usable forms, and its efficiency at the end use comes from its versatility.

Electricity's efficiency at the end use is critical for future energy, resource, and environmental "conservation" and to rebut the incorrect perception held by some that electricity is an "inappropriate" power source due to its "low efficiency."

3. Technological Revolution

A kilowatt-hour of electricity can light a 100-watt lamp for 10 hours or lift a ton 1000 feet into the air or smelt enough aluminum for a six-pack of soda cans or heat enough water for a few minutes' shower. To save money and ease environmental pressures, can more mechanical work or light, more aluminum, or a longer shower be wrung from that same kilowatt-hour?

The answer is clearly yes. Yet estimates as to how much more range from 30 to 75%. Also at issue is how fast efficiency can be improved and at what cost.

Between the oil embargo of 1973 and 1990, energy intensity—the amount of energy required to produce a dollar of gross national product—fell by 29% in the U.S. Plugged steam leaks, caulk guns, duct tape, insulation and cars whose efficiency increased by seven miles per gallon helped to extract more work from each unit of fuel. Applications of electricity, too, made important contributions to productivity and to a more information-based economy. Electricity accounts for a growing fraction of energy demand, and its relation to gross productivity continues to increase in recent years. Technologies and implementation techniques now exist for using electricity more efficiently while actually improving services. Harnessing this potential could get society off the present treadmill of ever higher financial and environmental risks and could make affordable the electric services that are vital to global development. In the U.S., California reduced its electric intensity by 18% from 1977 to 1986. Nevertheless, in such major industries as cars, steel and paper, Japan's electric use per ton is falling while the U.S.'s is rising, chiefly because American companies are still adopting new fuel saving "electrotechnologies" already common in Japan. But companies there are improving their efficiency at a faster rate. The resultant widening efficiency gap contributes to Japanese competitiveness.

Other industrialized nations are also setting higher standards for efficiency. Sweden has outlined ways to double its electricity. Denmark has vowed to cut its carbon dioxide output to half the 1988 level by 2030 and West Germany to 75% of the 1987 level by 2005; both nations emphasize efficiency.

These encouraging developments reflect rapid progress on four separate but related fronts: advanced technologies for using electricity more productively; new ways to finance and deliver those technologies to customers expanded and reformulated roles for electric utilities; and innovative regulation that rewards efficiency.

The technological revolution is most dramatic. The 1980s created a flood of more powerful yet cost-effective electricity-saving devices. If anything, progress seems to be accelerating as developments in materials, electronics, computer design, and manufacturing converge. The Rocky Mountain Institute estimates that, between 1985 and 1990, the potential to save electricity doubled, whereas the average cost of saving a kilowatt hour fell by about two-thirds. The institute also found that most of the best efficient technologies were less than a year old.

Of course, while some innovations are saving electricity, others will use electricity in new ways in those areas where electricity has an advantage over other forms of energy. For example, electricity can be environmentally beneficial and cost effective in ultraviolet curing of finishes, microwave heating and drying, induction heating, and several other industrial uses. Such electrotechnologies save money and fuel and reduce pollution overall.

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Biographical Sketch

Clark Gellings' 30-year career in energy spans from hands-on wiring in factories and homes to the design of lighting and energy systems to his invention of "demand-side management" (DSM). Mr. Gellings coined the term DSM and developed the accompanying DSM framework, guidebooks, and models now in use throughout the world. He provides leadership in EPRI, an organization that is second in the world only to the Department of Energy (in dollars) in the development of energy efficiency technologies. Mr. Gellings has demonstrated a unique ability to understand what energy customers want and need and then implement systems to develop and deliver a set of R&D programs to meet the challenge. Among Mr. Gellings' most significant accomplishments is his success in leading a team with an outstanding track record in forging tailored collaborations—alliances among utilities, industry associations, government agencies, and academia—to leverage research and development dollars for the maximum benefit. Mr. Gellings has published 10 books, more than 400 articles, and has presented papers at numerous conferences. Some of his many honors include seven awards in lighting design and the Bernard Price Memorial Lecture Award of the South African Institute of Electrical Engineers. He has been elected a fellow in the Institute of Electrical and Electronics Engineers and the Illuminating Engineering Society of North America. He won the 1992 DSM Achiever of the Year Award of the Association of Energy Engineers for having invented DSM. He has served as an advisor to the U.S.

Congress Office of Technical Assessment panel on energy efficiency, and currently serves as a member of the Board of Directors for the California Institute for Energy Efficiency and EPRI PEAC. He is Chairman of the Board of PRIMEN, Inc., and Global Energy Partners, LLC.

Mr. Gellings has received distinguished awards from a number of organizations, including The Illuminating Engineering Society, the Association of Energy Services Professionals, and the South African Institute of Electrical Engineers.

Mr. Gellings is a registered Professional Engineer, a Fellow in the Institute of Electrical and Electronics Engineers (IEEE), a Fellow in the Illuminating Engineering Society (IES), a Vice President of the U.S. National Committee of CIGRE' (International Council on Large Electric Systems), and is active in a number of other organizations. He has degrees in Electrical Engineering, Mechanical Engineering, and Management Science.