Electricity Crunch Foreseen . . . Maybe

Economists say some power plant construction could be avoided if investments in efficiency are properly compensated

ACROSS THE COUNTRY this summer, demand for electricity hit new peaks, strained some utility generating capabilities, and led to voltage reductions in parts of the Midwest and East Coast. Although the record temperatures recorded may be an aberration, utility industry organizations say these problems foreshadow trouble ahead if new power plants are not ordered soon.

The North American Electric Reliability Council, for example, estimates that the equivalent of 73 1000-megawatt (MW) power plants could be needed by 1997 to maintain reliable service. An analysis by the Department of Energy's Energy Information Administration (EIA) also suggests that dozens of aging coal-, nuclear-, and petroleum-fueled plants—the equivalent of 34 1000-MW units—must be replaced.

But political and economic factors make such a construction schedule highly unlikely. High capital costs, regulatory snarls, and public opposition make building nuclear plants virtually impossible. And coal-powered generating stations, which can cost upward of $2 billion, also are increasingly controversial because the gases they emit contribute to global warming and acid rain.

Since the energy crises of the 1970s, however, an increasing number of economists, some industry groups, and federal and state policy-makers have been urging an alternative path: an aggressive program of energy efficiency and conservation, financed partly by the utilities themselves, that would offset at least some of the need for new construction.

This approach is being tried by a handful of utilities around the nation with considerable success. But experience is limited because utilities generally have not been allowed attractive and sustained profits on investments that result in customers using less energy. Furthermore, the rate structures that most state regulatory commissions use to govern the earnings of investor-owned utility companies encourage growth in electricity consumption, not conservation.

Demand for electricity has been growing since 1983 when the economy rebounded from the recession. Relatively level electricity prices contributed to this growth in the 1980s and prices are expected to remain stable through the early 1990s. Utilities have been able to accommodate this growth because the industry as a whole has been burdened with excess production capacity. This surplus, however, is now eroding.

There is, in fact, mounting concern about the outlook for electric power, but no national crisis is foreseen in the near term. Power companies along the East Coast, however, could encounter service reliability problems in the early 1990s, if growth in electricity consumption is stronger than anticipated and if new power plants and transmission lines are delayed.

EIA's estimate of major new generation capacity that will be required by the end of the century is based on electricity demand growing at an average annual rate of 2.4% into the 1990s. The agency expects that electricity will jump from 36% of U.S. primary energy consumption in 1987 to 42% in 2000. Even so, many state regulators around the nation are treating power demand projections with caution, because the utility industry has overestimated its capacity needs in the past.

"There is no way utilities are seriously going to consider conservation unless they can make money."

Intensified conservation measures could dampen growth curves, reduce capital requirements for new power plants, and contribute to improved efficiency in the industrial and commercial sectors of the economy. In resource-rich America, energy consumption has traditionally been higher than that of our trading partners, mostly because of lower fuel costs.

The United States is using energy much more efficiently than before the oil shocks of the 1970s—total energy consumption has not grown while the economy has expanded by 40% over the past 15 years. Still, other countries have improved their energy efficiency at an even faster rate. In 1986 Japan used 36% less electricity to produce $1 of gross domestic product than the United States, and the International Energy Agency projects that the difference will grow to 45% by 2000.

Even since the oil shocks of the 1970s, many opportunities to save energy in the United States have been ignored. Electricity-saving programs often have been fragmented, or limited to rebates for purchases of efficient appliances, insulation programs, and building energy audits. "There has not been much activity in trying to get programs to save the maximum kilowatt-hours," observes David Goldstein, of the San Francisco office of the Natural Resources Defense Council. The organization sued the government in the mid-1980s to force it to set efficiency standards for major home appliances.

Why are utilities not doing more? The key roadblock is the rate structure used by states. State regulatory commissions allow power companies to recoup operating costs and to earn a profit of about 12% on their investments in generating plants. Utilities also can boost their earnings if they can manage to produce power at less that the cost established by a utility commission. This often can be done by selling more electricity, which adds revenues and may lower the cost of producing electricity.

Efficiency programs, however, can work against this reward system because they can reduce electric demand. Utilities generally are not compensated for the loss of load. Moreover, for utilities with lots of excess capacity and heavy debt, keeping load demand high is essential to maintaining revenue. Comments Robert H. Williams of Princeton University's Center for Energy and Environmental Studies, "When you overbuild you kill the incentive to see what you can conserve."

Only when state regulators make it as attractive for utilities to invest in efficiency programs as in new generating units will utilities move aggressively to promote energy savings, say Charles Cicchetti and William Hogan of Harvard University's Energy and Environmental Policy Center. A 1000-MW block of fixed electricity savings should be treated the same way as power from a new generator, and utilities should decide whether to invest in energy savings or new capacity on the basis of which costs less, they contend.

It appears that some regulators are heeding arguments such as those made by Amory Lovins, who says that before new power plants are built, utilities have an obligation to "first wring the fat out of the system."

Lovins, director of research for the Rocky Mountain Institute in Old Snowmass, Colorado, performs efficiency analyses for a number of electric utilities. He contends that as much as three-quarters of the nation's generating capacity could be idled with the adoption of cost-effective power-saving technologies. This would amount to about 500 1000-MW power stations.

Lovins' estimates may be on the high side, regulators concede, but they still are convinced that conservation will reap big large blocks of new capacity. Peter Bradford, chairman of the New York State Public Service Commission, is urging commission members to provide power companies with substantial economic rewards. Other utility commissions in Maine, Massachusetts, Connecticut, and the District of Columbia are forcing utilities to go after energy savings in homes, offices, and industry.

Boston Edison, for example, has been ordered by the Massachusetts state utility commission to implement an aggressive energy efficiency program or face having its allowed rate of return on investment cut back from 12%. The order requires the utility to develop its energy-saving program jointly with the Conservation Law Foundation—a Boston-based group that challenged the adequacy of Boston Edison's conservation program and those of six other Massachusetts utilities.

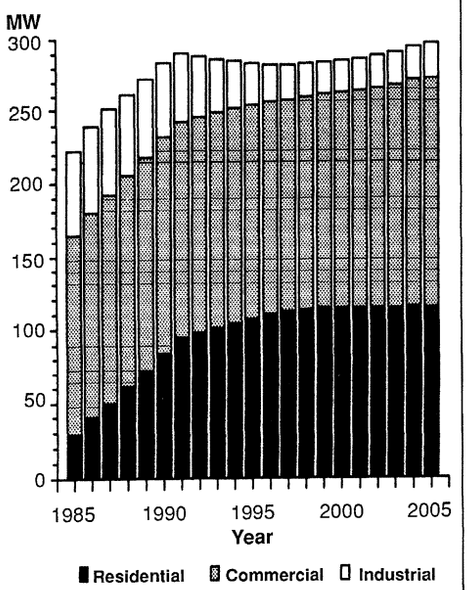
By 1998, the utility hopes to have mined 184 MW of electricity savings from commercial customers and another 8 MW from the residential service sectors by means of increased efficiency rather than reduced service. These savings would be obtained by paying for engineering studies for modifying building lighting, heating, and cooling systems; and paying for one-half the cost of equipment retrofits.

Douglas I. Foy, executive director of the foundation, says there is a potential to economically squeeze 1000 MW in capacity out of Boston Edison's commercial, residential, and industrial service areas. Across much of the nation, the most definable, near-term electricity savings are in commercial office buildings where lighting alone can account for 45% of the electric load. Nationally, about 25% of the electric power consumed goes for lighting.

Norman Blake, head of marketing for Sylvania lighting equipment division of GTE, estimates that Boston Edison can pick up 170 MW of capacity just by modifying lighting in commercial buildings. Power consumption on ballasts that drive pairs of standard fluorescent lights could be cut one-third to 65 watts if magnetic units were replaced with solid-state devices. Use of more efficient light tubes would shave another 6 watts per bulb. Reduced monthly electric bills, says Blake, more than offset the cost of installation for building owners. This occurs in part because Boston Edison will provide a subsidy of $1 for every high-efficiency, 4-foot fluorescent tube that is installed and $3 for an electronic ballast.

Lighting is just the leading edge of predictable day-in and day-out savings that utilities can extract out of the country's commercial buildings. Air-conditioning power requirements, which can account for almost half of a building's electric use, can be reduced because more efficient lighting generates less heat. Installation of speed controls on electric motors used in cooling and heating systems, and sun-shielding films on glass, will produce further savings.

In a study performed for General Public Utilities (GPU), the Alliance To Save Energy found that enough electricity could be saved in the winter to displace construction of a 750-MW power plant. These savings could be attained at a price below GPU's cost of producing peak power. The first 25% of this potential could be attained for $25 per kilowatt, substantially less than purchased power at $36 per kilowatt.



Hidden power. *With an aggressive rebate program to foster use of energy-efficient equipment, General Public Utilities could obtain large power savings from commercial buildings, says the Alliance To Save Energy.*

Outwardly, most power companies are supportive of efficiency and conservation. Their efforts to achieve savings, however, often do not go much beyond energy audits of homes and buildings, urging the use of heat pumps, and running TV and radio jingles. Says New York's Bradford, "Most utilities ... have adopted measures that convey an enthusiasm for conservation without actually cutting sales."

The bias of the current reward system is such that when a capacity-short utility acts to reduce demand, it is likely to pursue a strategy of cutting peak demand rather than stressing efficiency programs. Potomac Electric Power Company (Pepco), based in Washington, D.C., for example, plans to obtain 200 MW in efficiency savings from its service area by 1993 and another 540 MW through the use of time-of-day rates for electricity, radio-controlled power devices to cut off air conditioners, and other energy intensive machinery.

Power companies tend to prefer this approach because it allows them to maintain high plant utilization rates and maximize revenues while coping with spikes in demand. Says Marc Ledbetter of the American Council for an Energy Efficient Economy, "There is no way utilities are seriously going to consider conservation options unless they can make money out of this."

Larry B. Barrett, manager of Pepco's energy management division, agrees that efficiency improvements can yield large amounts of power. But he argues that his utility cannot count on purchases of efficient refrigerators or use of special light bulbs to free up enough capacity to keep pace with rapid suburban growth. The ongoing computerization of the workplace, additional commercial buildings, and overall economic growth in the Washington area, he says, require that the company erect as least one 750-MW power plant in the 1990s and that it build smaller oil-fired turbines to meet peak summer loads.

Obtaining sizable chunks of power through efficiency, says Barrett, is not always as economic as it may seem. The presence of asbestos, Boston Edison officials say, may pose problems in making lighting changes, for example. Also, some building heating systems that capture waste heat from lights may be adversely affected by cooler running, high-efficiency lighting.

Although problems do arise, Foy contends that they often can be overcome and that substantial efficiency gains can be realized in many commercial buildings. Within 2 years, he says, Boston Edison's program should have amassed sufficient data to clearly assess the economics of building retrofit programs. New York's Bradford, however, already is convinced. He says it is time for utility executives and state regulators to work together to remove barriers that discourage investment in efficiency programs.

Even without prodding by Congress and state regulatory bodies, utility interest in efficiency programs is growing, says Scott A. Fenn, a program director at the Investor

Responsibility Research Center, which analyzes public policy issues for institutional investors. While the profit incentives are currently lacking to intensify industry efforts nationwide, Fenn says some companies are pushing efficiency harder because it is less risky than construction. "We see utility adoption of this strategy as a sign of good management," says Fenn. Managements that are not very interested in this, he adds, "are probably shooting themselves in the foot." ■ MARK CRAWFORD

ADDITIONAL READING

Energy Policies and Programmes of IEA Countries (International Energy Agency, 75775 Paris Cedex 16, France, 1988).

Annual Energy Outlook [Office of Energy Markets and End Use, Energy Information Administration, Department of Energy (DOE/EIA-0383[87]), Washington, DC 20585].

Designing and Evaluating DSM Rebate Programs: Analytical Tools and Case-Study Application (Alliance To Save Energy, 1925 K Street, NW, Washington, DC 20006, April 1988).

NSF's Bloch Attacks Iowa State's Pork

When National Science Foundation (NSF) Director Erich Bloch spoke on the campus of Iowa State University (ISU) on 17 October, he stressed the need for Congress and the scientific community to rely on merit review rather than political gamesmanship in deciding what research to fund. Bloch cited a recent action by Congress to require the National Institute of Standards and Technology (NIST) to fund a new, $7.5-million research center, as an improper way to allocate scarce research money.

Bloch did not mention the recipient of the funds. ISU officials, however, knew his remarks were directed at the university and they have protested. ISU President Gordon P. Eaton has sent Bloch a six-page, single-spaced letter, stating that he was being unfair in portraying the appropriation for a "Center for Integrated Design, Nondestructive Evaluation, and Manufacturing" as a pork-barrel research program.

Eaton asserted that the appropriation is "the result of 12 months of discussion with NIST regarding how they, as an agency with a developing mission in the manufacturing sciences, might link up with the existing ISU Center for Nondestructive Evaluation." He said the university was not attempting to bypass a technical review process. NIST, he added, is not bound to give the funds to ISU.

ISU, however, previously failed to get NSF to fund the materials research endeavor as part of the agency's science and engineering centers program. Moreover, NIST officials told *Science* that their fiscal year 1989 budget request never included any funding for the project.

With the help of Representative Neal Smith (D–IA), a member of the House Appropriations Committee, the funding bill for the Department of Commerce was amended to provide $7.5 million for a cooperative materials research program. Although ISU is not designated by name, an appropriations committee aide told *Science* that the amendment was tailored for the university. ■ MARK CRAWFORD

Erickson Charge Dropped

James Erickson, the former director of malaria research at the Agency for International Development (AID) has won a partial victory in a long-running battle over his personnel record. Eighteen months after charging him with engaging in sexual harassment (*Science* 29 July, p. 521), AID on 3 November withdrew the allegation.

Erickson will be punished instead for the lesser offense of using bad judgment in that he had an affair with a contract employee who worked for his office.

In reducing a proposed penalty from 14 to 7 days without pay, AID official Robert Halligan wrote: "Having considered the record as a whole, I find that the evidence before me does not rise to this level of proof [required by U.S. regulations]. . . . Consequently, the charges of quid pro quo and hostile environment sexual harassment are withdrawn." ■ ELIOT MARSHALL

Soviets Invite U.S. Scientists to Planets

Following up on the U.S.–Soviet Space Cooperation Agreement, which was signed in the spring of 1987 and then extended at the Moscow Summit of June 1988, Soviet planetary scientists have officially invited their American counterparts to participate in all of their country's upcoming planetary missions. The invitation was announced on 10 November at the conclusion of a meeting in Washington between high-level Soviet scientists and officials of the National Aeronautics and Space Administration (NASA).

As a first step, four additional U.S. scientists were named to participate in the Soviets' upcoming Phobos mission to Mars, joining the six Americans who had already received informal invitations before the agreement was signed. Launched in July, Phobos is scheduled to arrive at the Red Planet in January 1989. In return, ten Soviets were named to participate in the U.S. Mars Observer mission, scheduled for launch in 1992. Three-member Soviet teams have also been invited to participate in next year's Magellan radar mapper mission to Venus, and in the Voyager encounter with Neptune in August 1989.

Looking further ahead, NASA and the Soviets also discussed a deeper U.S. involvement in the Soviet Mars 1994 mission, which is now in its planning stages. One NASA proposal, which aroused considerable interest, was to fly an infrared mapping instrument that had to be dropped from the U.S. Mars Observer. The instrument's $40-million development cost could be shared three ways, since the French national space agency, which has a long-standing collaboration with the Soviet planetary program, is also interested. And once developed, it could be duplicated and reused on future missions. ■ M. MITCHELL WALDROP

Britain to Boost Research Spending

The British government has announced that it plans to make a 16% increase next year in the funds made available to support research through the five research councils financed by the Department of Education and Science. It will be the first significant increase in the budget for basic science since the beginning of the decade.

No decision has yet been made on how the extra money, which will raise the joint budgets of the research councils from $1.24 billion in the current financial year to $1.44 billion in the year beginning 1 April 1989, will be divided among the councils. This will depend on advice provided by the Advisory Board for the Research Councils, which will report back to the government at the beginning of December.

However, the new money has been broadly welcomed in the scientific community, and is being seen as concrete evidence backing up recent declarations by various government ministers, including Prime Minister Margaret Thatcher, that support for basic research is now an important government priority (*Science*, 4 November, p. 664).

The five research councils, covering science and engineering, medicine, agriculture and food, the natural environment, and economics and the social sciences, are the chief sponsors of basic research in Britain. They currently account for about 18% of the total amount spent by the government on research and development.

■ DAVID DICKSON