Letters

The Electricity Industry

Mark Crawford (News and Comment, 19 July, p. 248) echoes the power industry's warnings of impending electrical shortages, but omits the best ways to ensure abundance.

Few utilities take electrical efficiency seriously. All their forecasts of demand assume several-year-old technologies for wringing more work from each kilowatt-hour, and many are 10 years behind. Yet most of the best such technologies have been on the market for less than a year. Collectively, they now cost a third as much as they did 5 years ago, yet can save twice as much electricity; fully used, they can quadruple U.S. electrical productivity (*1, 2*). Measures that save 80+ percent in commercial lighting on retrofit (90+ percent in new buildings), 80+ percent in fully equipped all-electric houses, and about 50 percent in industrial drivepower all pay back in a few years (*1, 3*). Our own research center uses no heat and 5 to 10 percent the usual amount of electricity (*4*), repaying the capital cost of those savings in 10 months.

Utilities have meanwhile developed new ways to implement and finance electrical savings, including loans, rebates, and generous payments for whatever customers save. By recognizing that demand is not fate but choice, smart utility managers can and now do save electricity faster than they could build a coal or nuclear plant and more cheaply than they could operate one, even if building it were free (*1, 5*). Thus abandoning a giant plant even after spending several billion dollars on it, and buying efficiency instead, can save billions of dollars—enough to repay the investors while lowering the rates (*1, 6*).

Utilities that promote end-use efficiency can make more money at less risk. They save operating, construction, and replacement costs, and reduce the uncertainty of demand and hence the risk of overbuilding. They can even earn a spread on financing. Conversely, utilities that ignore the efficiency revolution risk obsolescence. Now that electricity costs an order of magnitude more than efficiency, customers want less electricity and more efficiency. If utilities instead raise prices to try to pay for expensive new plants, sales may drop so dramatically that long-run revenues fall.

Utilities can make future demand more uncertain—as they did by raising prices to finance huge new plants that, ironically, were meant to "insure" against uncertain demand. Or utilities can reduce uncertainty by encouraging and enabling customers to buy efficiency. Further, to minimize the cost of hedging against residual uncertainty, successful utility managers acquire only options that are small, fast, and cheap. Rather than playing "You Bet Your Company" that their forecast of demand 8 to 15 years ahead is right by committing billions to a plant which takes that long to build, they seek to reduce risk and uncertainty to an affordable level.

Under this central imperative of modern utility management, the forecast-and-build methodology that Crawford describes is obsolete—replaced by a wide array of flexible options that can be relied on to meet demand essentially ad hoc (*7*). That is the main reason why only a few central power plants, none with a capacity of more than 600 megawatts, were ordered between 1982 and 1984. It is why central-station orders between 1981 and 1984, less cancellations, totaled −65 GW, while new orders (*8*) were placed for 25 GW of cogeneration and 20+ GW of small hydro, wind power, and other renewables (*9*). The booming market in small, fast power plants with affordable risks is nearly compensating for the collapse of the market in huge, slow plants with intolerable risks; and efficiency, where tapped, is more than making up the difference.

For example, a least-cost investment strategy has reduced electricity sold per real dollar of California's Gross State Product by about 17 percent between 1975 and 1983. This ratio is officially projected to fall by another 30 percent between 1985 and 2004 (*10*) just from existing market forces and policies (such as tighter building codes and appliance standards). That will eliminate the need for 12 GW of peak capacity by 1994 (16 GW by 2004), with another 7 GW of 1994 savings under consideration and more available. Moreover, by the end of March 1985, with 37 GW of peak demand and 10 GW of in-state utility-owned hydro and geothermal capacity, California had been firmly offered 20.3 GW of independent small power production (*11*). Entrepreneurs were offering an additional 9 GW per year until, this April, the resulting power glut forced suspension of new contracting. Yet two dozen other states and provinces, undeterred, all hope to sell California their surplus power simultaneously.

National trends are less mature, but moving the same way. Cogeneration rose from 5 percent to 7 percent of electric output just in 1984, and small power commitments now cover, for example, more than 22 percent of Maine's and 14 percent of New Hampshire's peak loads. Between 1982 and 1984, U.S. electric demand grew only 0.87 times as fast as gross national product, with this elasticity continuing its 30-year decline. (Most prophets of power shortages project an elasticity of 1.0 or more, but California projects 0.53 through 1996.) In the past 4 years, U.S. electric sales per real dollar of industrial output have fallen 7 percent, with demand per residential and commercial customer remaining nearly constant. Yet this gradual decoupling of electric from economic growth, proceeding most quickly when economic growth is fastest, has occurred despite many barriers to efficient investment. Among these was $30 billion of federal subsidy in fiscal year 1984—per unit of energy, eleven times the subsidy to direct fuels and at least 48 times that to energy efficiency (*12*).

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References and Notes

1. A. B. Lovins, *Least-Cost Electrical Services as an Alternative to the Braidwood Project* (Illinois Commerce Commission Exhibit BPI-12, Docket 82-0855, 3 July 1985; available from the author).
2. The average direct cost of these measures is under $0.02 per kilowatt-hour saved in 1984 dollars.
3. For motors, see also A. B. Lovins, *Scoping Calculation of Electrical Savings in a Pulp-and-Paper Mill*, June 1985; available from the author. The household norm referred to is for San Diego in 1984.
4. It uses 1.3 average watts per square meter, two-thirds of which is for office equipment.
5. See also A. B. Lovins, "Saving Gigabucks with Negawatts," *Public Util. Fortn.* **115** (No. 6), 19 (21 March 1985); *ibid.* **115** (No. 8), 12.
6. Similarly, saved operating costs from end-use efficiency can pay for abating acid rain while lowering electric rates.
7. A. Ford, in *The Future Market for Electric Generating Capacity: Technical Documentation* (LA-10285-MS, Los Alamos National Laboratory, Los Alamos, N.M., March 1985), chapter 2, pp. 77–181, shows that reduced risks make it worth paying up to four times as much per kilowatt for an option that takes 5 years to build as for one that takes 15 years. Options with a 1- or 2-year lead time are even more valuable.
8. Including firm letters of intent.

9. Roughly a quarter of the cogeneration was also renewable, burning mainly forestry wastes. By 1984, renewable sources provided 10 percent of total U.S. primary energy—the fastest growing part, outpaced only by savings. Between 1979 and 1983, the United States got more than 100 times as much new energy from savings as from all net expansions of energy supply.
10. *The 1985 California Electricity Report* (P106-85-001, California Energy Commission, Sacramento, May 1985), pp. 12–15. Additional cost-effective savings are stated to be available if desired.
11. Mostly renewable, with an average project size of 12 megawatts. This capacity is generally more likely to operate on-peak than central thermal plants are: even wind, 5.8 GW of the offered 20.3 GW, is quite reliable on hot summer afternoons.
12. Counting electricity at its heat value of 3.6 megajoules per kilowatt hour. See H. R. Heede, "A preliminary analysis of federal energy subsidies in FY1984," testimony before the U.S. House of Representatives, Commerce Committee, Subcommittee on Energy Conservation and Power, 20 June 1985, available from the author. Heede's data show that fiscal year 1984 federal energy subsidies exceeded $46 billion, and that $1 of subsidy to efficiency and renewables yielded 80 times as much energy as $1 of subsidy to nuclear power.

Smart utility managers can save electricity faster than building new power plants. In most instances it is the smart path. But as Lovins says himself: "Few utilities take electrical efficiency seriously." In the next few years it may become clear whether the utility industry will become truly aggressive in their conservation efforts or remain wedded to the "build" mentality.—MARK CRAWFORD

Crawford accurately describes a growing concern that generating capacity may be insufficient to meet demand in some parts of the country during the next decade. As he notes, major factors in this problem are the sizable uncertainty in future demand coupled with high social costs from either excessive or inadequate capacity. He also points out that new coal-based technologies are becoming available which have very attractive characteristics for adjusting to uncertain demand and environmental requirements: low air emissions, short construction lead times, and small unit size (and small capital investment commitments). Despite this, few new power plants have been ordered recently due to utility concerns that construction costs will not be recovered if demand grows more slowly than projected. The lack of new orders presages two other problems for the industry: an aging stock of power plants and dispersion of experienced engineering talent by power plant vendors.

The article does not mention the other major uncertainty facing the industry for the next decade—the environmental requirements for existing and new coal-fired generating plants. That reductions in sulfur and NO_x emissions are desirable is not in dispute; the problem is cost and its distribution.

A partial solution to both environmental and potential capacity problems may be possible through a linkage of the two issues. For regions with dirty coal plants where capacity additions are desirable, it appears attractive to construct clean coal plants based on combined-cycle coal gasification or fluidized bed combustion. The new, clean plants would displace generation by plants with less sophisticated and effective pollution controls. The combined-cycle coal gasification system in particular has been demonstrated at a commercial scale to have low air emissions, high reliability, short construction periods, and generation costs which, although currently high, appear to be potentially competitive with standard coal plants with scrubbers. Such plants are now being offered to utilities by vendors.

The primary advantage from building these plants is that construction expenditures would provide both capacity additions and air emission reductions. Old coal plants would become part of the utility's capacity reserve, to be used if demand turned out to be high. Under slow demand growth, the older, most polluting plants would not operate. Unlike expenditures for scrubber retrofits to existing plants (some of which are already quite old), this program would not only reduce emissions but would increase peak generating capacity needed to deal with high demand. In contrast, scrubber retrofits do not increase capacity.

At present, scrubbers represent a cheaper path to pollution control than does construction of new, cleaner plants. Just how much additional cost is justified for new plants that provide both reductions in emissions as well as increased system capacity needs to be judged in each specific context. But a number of less tangible benefits are associated with new generation additions. Practical experience with new generating technologies, necessary for future utility commitments, would be gained. The aging of the power plant stock would be slowed, and power plant vendors and constructors would be kept going. Environmentalists may find the approach attractive as an addition to conservation and load management programs. State utility commissions could reassure utilities that cost recoveries for such projects would be allowed even if demand is low, recognizing that pollution reduction is the primary objective. This approach moves in the direction of reduced emissions, and also advances the availability of attractive new generating technologies.

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