THE WALL STREET JOURNAL

EASTERN EDITION WEDNESDAY, SEPTEMBER 17, 1986 PRINCETON, NEW JERSEY

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Gas Turbines Could Meet Electricity Demand

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Analysts from the Energy Department and private utilities often warn that unless more and more large coal and nuclear power plants are built, the U.S. will face economically crippling power shortages in the future. This is not necessarily the case. Advances in gas-turbine technology, arising in large part from Defense Department support for research and development on military-aircraft engines, make possible a more hopeful electric future.

Large, new nuclear and coal plants have proved to be very costly, accounting for much of the 60% increase in the U.S. average, inflation-corrected price of electricity since 1970. Growing concerns about nuclear safety and acid rain are likely to lead to further regulatory constraints on nuclear and coal power, which will make it difficult to reduce these costs. In addition, future growth in electricity demand is highly uncertain. Thus by investing in large plants that take at least eight years to build, utilities risk being caught up in a vicious circle. If demand grows more slowly than expected, the resulting excess capacity leads to higher customer rates, which reduce demand further, necessitating still higher rates, etc.

Consider instead new gas-turbine technologies having largely unfamiliar names (e.g., advanced combined cycles, evaporative-regenerative gas turbines, turbocharged steam-injected gas turbines, and intercooled steam-injected gas turbines), which have recently become available or could be commercialized quickly. These advanced gas turbines, like turbines now used by utilities for meeting peak electrical demands, have low capital costs. But unlike peaking turbines they are highly energy efficient, requiring 30% to 40% less fuel.

These natural gas-fired turbines can produce electricity at less total cost than coal or nuclear plants, even with gas prices much higher than at present. Having small sizes and short lead times, these gas turbines are ideal for planning in the face of uncertainty: Utilities can wait to see how demand is evolving before deciding to build. If natural gas should eventually get too costly, these plants could be shifted to synthetic gas derived from coal and still be competitive with conventional coal or nuclear plants. Using coal this way would produce much less air pollution than burning it in conventional coal power plants. For the more efficient options, the switch to coal gas could probably be delayed until well after the year 2000.

Despite such attractions, utilities are not rushing to buy advanced gas turbines nor are manufacturers rushing to build them. The bias against gas turbines began in the mid-1970s, when natural gas was being used up at a much faster rate than new supplies were being found, leading Congress to pass the Powerplant and Industrial Fuels Use Act of 1978, which put constraints on the use of natural gas by utilities. Since the deregulation of the price of new natural gas, however, the supply outlook has improved. Additions to gas reserves have been comparable to production, and there is now a gas surplus. Present law, however, perversely allows utilities to use gas inefficiently (in existing plants) but prohibits them from using it efficiently (in new plants).

While the Fuels Use Act constraints are not absolute, few utilities are interested in getting exemptions—in part because they have not yet adapted to thinking of the gas turbine as a major power-generating option and in part because most utilities don't need new generating capacity. However, it is also worthwhile to replace existing gas-fired steam-electric plants with efficient gas turbines. This could lead to lower electrical rates and to gas savings nationwide equivalent to about 500,000 barrels of oil a day. But utilities are not adequately motivated to retire economically inefficient capacity, so no significant replacement market is developing for these new turbines.

Manufacturers are not pushing to develop and market these new turbines, because the utility market is uncertain and the Defense Department already provides a secure and profitable military-aircraft market for gas turbines. The high efficiency that could be achieved in utility applications is, to a large degree, the result of Defense Department R&D on jet engines, which averaged $425 million a year over the past decade.

Because they are not looking for new civilian markets, U.S. manufacturers are not prepared to commit the modest incremental R&D investments needed to tailor advanced gas turbines to utility needs. However, these technologies are so inherently attractive, and their development costs so low, that they will be developed somewhere. A Japanese consortium is already being organized to finance the development of utility-scale steam-injected gas turbines.

Barring immediate and politically unlikely support for new nuclear and coal plants, new gas-turbine technologies spell the end of the era of the electric behemoths. The speed of the transition to these new technologies and U.S. manufacturers' roles in marketing them are, to some extent, dependent on public policies. Ending restrictions on utility use of natural gas, providing incentives for utilities to replace economically inefficient equipment, and perhaps redirecting a modest amount of military R&D money to utility gas turbines would all help shape a formidable U.S. capability in these new gas-turbine markets. The U.S. can be a technological leader in these markets, building on its undisputed lead in jet-engine technology, or follow others, to its economic detriment.

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