Forty years ago, a college textbook proclaimed: “Commercial feasibility of extensive use of the gas turbine for electric power generation has yet to be proved.”

Forty years later, it’s been proved, all right. In a big way.

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Gas turbines had what might be considered their best year yet in 1999. According to Diesel & Gas Turbine Worldwide, utilities throughout the world ordered 875 gas-turbine units between June 1, 1998, and May 31, 1999, representing 64,254 MW. This nearly doubled output from the previous year, when utilities ordered 754 units, representing 33,197 MW. Most of this growth was in the largest turbines, 60 MW or more.

So it seems that gas turbines have arrived in full force. But what’s behind this power surge that doesn’t appear to be slowing as we arrive in the 21st century?

“It’s actually a combination of things,” says Bob Balsbaugh, Burns & McDonnell’s gas turbine business unit manager. “A strong economy, the need for fuel efficiency, deregulation, environmental concerns, the spike in spot energy prices – they all have contributed to a mad dash for gas turbines.”

Feeling the Heat
The current gas turbine boom in North America might not have been so remarkable if not for a severe heat wave that hit Texas and other Midwestern states in the summer of 1998. During the heat wave – when Texas experienced 19 straight days of 100+ temperatures – prices for power on the spot market shot to $7,000+ per megawatt hour. Gas turbine orders in North America nearly tripled from 128 units in 1997-98 to 362 in 1998-99.

“Up to that point, power producers were unsure about the best way to compete in a deregulated market and were unwilling to invest without knowing what the rules would be,” Balsbaugh said. “The combination of that spike in prices and a surging economy put power producers in the position of scrambling to find more economical energy sources.”

Coming Out
So it is clearly time for gas turbines to enjoy their time in the sun. Although they have been around for some time – the first gas turbines were tested around the turn of the century – gas turbines began to move ahead when aircraft engine technology such as temperature-resistant materials and new blade-cooling techniques began to be applied to ground-based units. Power Engineering magazine in 1995 said it was a development that “is responsible for the incredible performance gains the technology’s experienced over the last 10 years.”

“The price spike helped give gas turbines a higher profile,” Balsbaugh said. “And more and more people began to discover their pluses: clean burning, efficient, easy to install, cheap to run.”

Cleaner Burning
The time hasn’t yet arrived when power plants emit pure air into the atmosphere, but with the help of gas turbines, that time may soon be here.

The U.S. Department of Energy is working on a new generation of gas turbine for testing this year with an emissions goal of less than 9 parts per million of nitrogen oxides (NOx). And new technologies are being developed as of this writing that promise to reduce NOx and CO in gas turbines to virtually non-existent levels.

This is part of the reason gas-fired generation in the United States is expected to increase 38 percent between 1999 and 2003. Chris Leshock, senior consultant at Resource Data International, an energy information and consulting firm, told Engineering News Record that coal-fired generation for the same period will increase only 7.8 percent.

While emissions-control equipment is making coal-fired generation cleaner, that equipment brings with it an added expense, and other trade-offs.

“You could probably design a coal-fired plant that burns almost as clean as gas,” says Balsbaugh. “But that emissions equipment is going to drive your capital costs up, and you’ll have to deal with operations and maintenance costs as well. Not to mention disposal costs for the inevitable by-products generated from the coal.”

Faster, Faster
Of course, the nine-year expansion of the U.S. economy certainly has not hurt the gas-turbine market. As more housing sprouts across the country, the demand for power keeps growing.
Engineering developments in the last 50 years, however, have pushed that to 40 percent for simple-cycle turbines and 55 to 58 percent for combined-cycle turbines. Coal-fired turbines have efficiencies around 40 percent.

Efficiency is one of the reasons natural gas combustion turbines are increasingly being used for electricity production. Westinghouse engineers L. Southall and G. McQuiggan said as much in their paper, "The Next Generation of High Efficiency Industrial Combustion Turbines," presented at Power-Gen '94 in Orlando, Fla.

The years between 1989 and 1994 have seen a large increase in the application of the industrial combustion turbine for electricity production…One principal factor is the very high combined cycle efficiencies that can be achieved with the present generation of combustion turbines.”

Efficiency, Efficiency
The turbines of 50 years ago did not set records for fuel-to-electricity efficiencies, which refer to the percentage of fuel that is converted to electricity. Turbines developed in the late 1930s and 1940s could expect to have efficiencies of only 18 to 20 percent.

Burns & McDonnell provided design and resident representative services for three combustion turbines (160 MW each) and heat recovery steam generators to repower Cleco Corp.'s Coughlin Power Station.

“Gas turbines are sort of like Model Ts,” Balsbaugh says. “They come significantly standardized so they are easy and fast to set up.”

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The high demand has not been without its downside for the generation industry. Major gas turbine suppliers are experiencing such a glut of orders that lead times for the machines are stretching into several years. Lead times that used to be around 14 months are now about three years and longer for the major gas turbine manufacturers. Those suppliers are telling customers they won’t be able to deliver turbines of F-Class size and above (the largest of the machines) until at least 2003, Balsbaugh says.

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"We've got a lot of clients who want their plants operational in time to meet the peak summer hours," says Larry Thies, a Burns & McDonnell principal in charge of marketing turnkey projects.

"With design-build, before you've even gotten the design documents done, you're already breaking ground," says Dave Buttrum, a Burns & McDonnell construction project manager. "Not only does this save time, it saves money."

Buttrum is the manager for a project to design and build two combustion turbines for SEI-Wisconsin, L.L.C. in Neenah, Wis. The $100 million project broke ground in April 1999 and is expected to be complete by April of this year, perhaps sooner. Burns & McDonnell is also doing combustion turbine design-build work in Illinois, Minnesota and Wyoming.

"If this plant had been built using a design-bid-build method, it would have taken several more months, and several hundred thousand more dollars, to complete," Buttrum says.