Rebuild America's Energy Infrastructure

by Marsha Freeman

If you think sending a few Enron executives to jail will fix our decrepit energy infrastructure, think again.

For the past 25 years, the electricity generation, transmission, and distribution system of the United States, which had been the envy of the world, has been the victim of targetted financial disinvestment and political attack. This has left the electric grid system outmoded, frail, subject to equipment failures, inefficient, and unable to meet demand. On top of that, deregulation—also starting about 25 years ago, and becoming a financial cancer on the industry over the past five years—has looted not only the physical plant and equipment of the system, but also the industries and citizens that depend upon it.

As in transportation, technological innovation in the electricity industry ended, for all intents and purposes, in the mid-1970s. Inefficient 19th-Century steam turbines still produce most of our electrical power. Coal, a 19th-century fuel, still produces half of the United States' electricity. Power lines still run above ground, subject to the whims of weather and natural disaster.

California—which became the poster-state for how deregulation destroys infrastructure—provides the quintessential example of what has happened to our electric grid system over the past 25 years.

In the 1970s, Pacific Gas & Electric, the largest California utility, and now in bankruptcy reorganization thanks to deregulation, planned to go completely nuclear by the year 2000. Southern California Edison signed a contract in 1979 to build a 60 megawatt (MW) direct conversion magnetohydrodynamic (MHD) system, to double the amount of power it could generate from its fossil fuel plants, increasing productivity and lowering costs. Neither plan came to fruition.

In the 1970s, advances in superconductivity offered improved electricity transmission, which would have increased available power by eliminating losses between its generation and delivery.

But in the mid-1970s, the Carter Administration promulgated environmental hoaxes, amplified in California, in order to stop construction of any fossil fuel power plant. Anti-nuclear "environmentalists" demonstrated at nuclear plants, to shut them down. Plant construction was endlessly challenged in court, forcing dozens of utilities to cancel more than 100 plants already on order.

Carter and his entourage promoted the hoax of non-proliferation—that any nation that wants nuclear power really plans to build bombs—as another part of its Malthusian zero-growth program to kill the nuclear energy industry, both for export to developing nations and at home.

Quackademics at universities and think-tanks assured the American people that the "energy crisis," could be alleviated, if Americans cut back energy use, and built windmills and burned waste. California implemented this self-destruct policy with zeal. Then, in October 1979, Federal Reserve Chairman Paul Volcker raised interest rates, which soon topped 20%, ending the possibility that the capital-intensive electric industry could afford to build new facilities.

No-Growth in Electricity Demand

The only reason there have not been widespread blackouts, is because of the stagnation in demand from the industrial sector, whose electricity consumption over the past 30 years has fallen from nearly half of total national consumption, to about one-third. This is a result of the U.S. becoming the "importer of last resort": rather than producing goods (which consumes energy), importing electricity in the form of steel, capital goods, food, and consumer goods. And over the last two years, electricity growth has taken a new, downward ratchet, with the collapse of the manufacturing and commercial sector of this "New Economy," and the looting through deregulation.

In fact, the economy should have become increasingly *more* electricity-intensive. By now, commuter and high-speed electric rail should have replaced a good deal of auto travel. Primary metals processing should have progressed to high-temperature plasma and directed-energy processes. U.S. railroads should have been electrified, and magnetic levitation (maglev) could be replacing short-haul passenger airline flights.

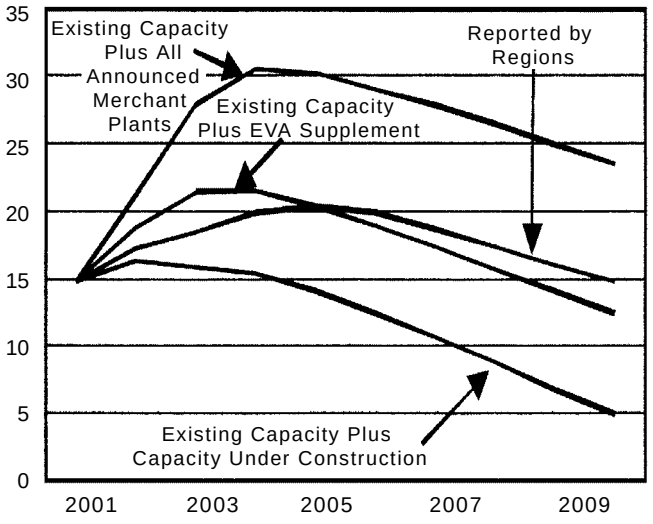
In its assessment, released in May, of the reliability of the bulk electric supply system for this Summer, the North American Electric Reliability Council (NERC) projected a 2.7% increase in peak demand compared to the actual 2001 Summer peak, but only a 0.4% increase compared to the peak demand that had been projected for Summer 2001. (The "actual" peak demand reflects the incidental conditions that can drive up demand briefly, such as heat waves. The projected demand is the baseline projection of what will be needed under normal weather circumstances.) NERC explains: "The relatively flat growth in the projection for this Summer, compared to 2001, is reflective of the slowdown in the North American economy. To put this growth rate in perspective, the historical average annual demand growth for the last ten years has been about 2.5%," as compared to 0.4%, leaving weather fluctuations aside.

Learning a lesson from last year's electricity shortages—both real, and manipulated by Enron and fellow energy pirates—municipal and private utilities nationally planned to add 48,000 MW of new generating capacity between March

FIGURE 1

Projected U.S. Summer Capacity Margins

(%)



Source: North American Electric Reliability Council, "Reliability Assessment: 2001-2010," October 16, 2001.

and September this year, or a 5% increase in total generating capacity. But of the more than 250 power plants slated to begin operation during the Summer months, only about 40 are baseload plants of 500 MW and up, designed to operate 24 hours a day. The rest are designed for peak load operation. Almost all of the new power plants are of the gas turbine or combined cycle variety, wasting this useful chemical feedstock to produce heat to turn turbines.

In order to gear up the production of the steel, concrete, specialty metals, plastics, and other materials that will allow the reconstruction of bridges and tunnels, ports, municipal water systems, hospitals and health-care facilities, railroads and advanced transport sytems, and power plant construction itself, there will have to be a massive crash program of power-plant construction.

During the 1960s, when the United States was expanding industrial capacity, led by the innovation required to put men on the Moon, electricity consumption had a ten-year doubling time, or a growth rate of about 7% per year. That slowed to a crawl in the 1970s, especially after the 1975 oil/energy "crisis," and dropped further by the early 1980s to near zero, after the Volcker measures.

By the early 1990s, with deregulation becoming a serious threat, utilities refused to build anything, because they had no way of knowing who would end up owning, and paying for, the capacity. California, New York, and Pennsylvania started passing deregulation laws in 1996, with other states close behind, crippling state authorities' ability to regulate electricity. Deregulation unleashed not only speculation and looting, but created chaos, in this high-precision, highly coordinated industry, as utilities were now supposed to "compete."

The system today is so old and fragile, that a single natural perturbation, such as a heat wave, causes equipment failures and interrupts service. In some states, the price of electricity has risen up to an order of magnitude higher than it was five years ago, imposing a speculative tax on the citizens, industry, and agriculture, and lowering the productivity of the economy and living standards.

Without an adequate, reliable, affordable, universally available supply of electric power, there can be no massive expansion of other infrastructure, or the overall economy.

An Immediate Mobilization

When President Franklin D. Roosevelt instituted measures to regulate the financial and physical operation of the electricity industry in the 1930s, he declared that electricity was no longer a luxury, but a necessity. As such, it comes under the General Welfare clause of the Federal Constitution, and its availability must be guaranteed to the entire citizenry.

Living up to this mandate today requires a number of immediate steps:

1. Industry must gear up to build sufficient online generating capacity to ensure the reliability of the system. Utilities and municipal agencies must be required, under the supervision of state regulatory bodies, to maintain approximately a 15% reserve margin of capacity, which protects the system from breakdown should plants need to be taken offline. The volume of gigawatts of new electric-generating capacity needed for that 15% margin will increase geometrically, once a reconstruction program is under way, to keep in step with the increasing growth rate in demand.

Even the lackluster Bush Administration projects that by the year 2020, some 393,000 MW of new generating capacity will be needed (about a 50% growth in capacity over 20 years, a far cry from the actual ten-year doubling time of the 1960s). This would add up to 400-800 power plants, or nearly one every other week. The Bush Administration has offered no plan to accomplish this.

2. Transmission system capacity must be upgraded and expanded. Deregulation has promoted the practice of wheeling power from hundreds, if not thousands of miles away from the point of consumption, both in search of a "cheaper" supply and because deregulation has helped create regional shortages. This has strained the transmission grid to near-breakdown, and increased inefficiency in the system.

Transmission Breakdown

The transmission bottleneck is worsening in many parts of the country. California had blackouts a year and a half ago, because available power could not be transported through Path 15, from the southern to the northern part of the state. New York City has to generate all of its own additional new

power, because the transmission lines from outside the city are filled to capacity. Nationally, thousands of miles of new transmission capacity must be built, and existing infrastructure must be upgraded. Transmission investments are required in the tens of billions of dollars.

3. In order to carry out the generation and transmission investment programs, many of which will take up to a decade to complete, long-term, low-interest credit must be made available to municipal and investor-owned utilities. This is not an industry that should rely on Wall Street for financing, or be measured by its stock valuation.

It is true that energy crooks stole billions of dollars from workers, investors, and consumers; that they looted the physical infrastructure, by closing capacity in the context of mergers; and they made little or no repairs or improvements. However, the problem of disinvestment in the energy grid did not start in the 1990s. In California, for example, more than *half* of the state's power plants (30,000 MW), are over 30 years old. For years, nearly as many power plant megawatts of capacity have been retired, as have come online.

4. We must reverse and repeal deregulation, which requires that we reverse state deregulation legislation, which is already under way in some states, as well as Federal laws that have undermined the utilities' ability to safely, economically operate the electrical system.

Congress must repeal the 1978 Public Utility Regulatory Policy Act and the 1992 Energy Policy Act, both of which "promoted" (subsidized) "non-utility" generation, lowering the energy density of the entire economy. These laws opened the transmission system to use by "non-utility" generators, thereby threatening the integrity of the grid; and further, by allowing exceptions to the 1935 Public Utility Holding Company Act, they opened the door to huge mergers and monopoly control over a rigged "market," which the abuses of Enron and the other financial/energy pirates epitomized.

The Federal Energy Regulatory Commission (FERC), which is overseeing the national implementation of deregulation, should be disbanded, and the Federal Power Commission reinstated, with the single purpose of overseeing the needed infrastructure expansion program.

Moving Into the 21st Century

If investment in government-sponsored research and development in energy technologies had not been sabotaged, virtually ending it by the mid-1970s, we would have had:

- Nuclear power plants, including high-temperature reactors (HTR), as the core of nuplex-style agro-industrial complexes and the rebuilding of cities; breeder reactors, which produce fuel while producing power; reprocessing facilities to recover the 90%-plus of usable material from spent nuclear fuel; fusion-fission hybrids as the intermediate step between fission and fusion; next-generation laser and other uranium-enrichment techniques to produce nuclear fuel; and an array of demonstration fusion power plants, using various configurations and techniques.
- Magnetohydrodynamics (MHD) direct energy conversion, to supersede the century-old steam turbine cycle, and to potentially double the efficiency of conversion from heat (fossil or nuclear) to electricity. For example, MHD would cut in half the amount of coal needed to produce a megawatt of electricity, also cutting by half the tonnage of coal hauled by rail.

MHD systems would be designed in energy cascades, in which the highest temperature needed to ionize the working fluid would produce power directly. The lower-temperature heat could be used for high-temperature turbine cycles, and the lowest-temperature heat could be used for a technology like thermionics. Upwards of 80% of the energy produced would be turned into electricity, compared to the 34-45% for steam turbines today.

- Superconducting transmission systems, originally studied by Brookhaven National Laboratory in the 1970s, would be more economical today, using higher-temperature superconductors. Presently, about 10% of the electricity generated is lost in transmission, depending upon the distance, and many transmission failures occur in hot weather. Using underground, superconducting cables, in which no heat is generated because there is no resistance, losses could be largely eliminated. However, all that is left of the earlier R&D program, is a small test project of Detroit Edison.

The commercial introduction of these technologies will require a "full-set" mobilization of resources. In the United States today, there is *no* factory that can produce pressure vessels for even conventional nuclear power plants, much less equipment for high-temperature and other advanced nuclear technologies. For the near term, we will have to import such equipment, while at the same time we build the manufacturing plants that can mass-produce standardized next-generation nuclear reactors.

Today's civilian magnetic and inertial fusion energy R&D programs are less than half the effort of 20 years ago, thanks to "budgetary considerations." The only limit to research into this technology, which can produce virtually unlimited, high-quality energy and electricity, should come from a lack of ideas, not funding.

No other aspect of rebuilding American infrastructure will be possible, without a revitalization of the energy and electricity industries that are its foundation.