

**A Vision for the Future of Power:
Who Should Worry About the Long Term?**

by

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The U.S. power system today is, in large measure, the system that was cobbled together from various smaller regional grids over the years, adding an occasional plant here or there as need and demand rose. In many areas of the country, the system is vulnerable to weather; this winter's storms in the Midwest have left tens of thousands without power for days; hurricane damage, ice storms and even extended spells of hot weather have produced brownouts and blackouts (including infamous "cascading failures"). Quality of maintenance varies by area, and as household demand rises, systems are more frequently pushed to or near their limits. A host of strategic issues loom – but there is not much evidence of strategic consideration.

Who should worry about the long term future of the power industry? In general, such long-term issues are the responsibility of the "senior statesmen" and executives in the industry, whose companies are at risk. Consideration is also the task of government -- which, after all, has responsibility for the security of the country and for fostering economic growth and development. However, there is much less attention to these issue than there should be, by anyone: the situation is, if anything, less comforting and reassuring than it was in 2000 and 2001, when Jelinek and Illich were discussing it at NSF. Then, we speculated about system robustness, and the potential application of

network analytics to the power grid; about hybrid systems and fail-safes, and about coming technologies that might overturn the power industry's long slumber.

Strategy in the power industry, from a business professor's perspective, is about the continued survival and prosperity of the firm. On the immediate horizon are issues like how to make a given company's grid more secure and reliable. But necessarily, the longer view also includes broad considerations of the strength, reliability and overall robustness of the entire grid. From my perspective as a strategy scholar, this longer view is a crucial issue: without such reliability and robustness, the search for alternative means of satisfying the need for power is accelerated. That is, in other words, technological alternatives to the current regime become increasingly attractive, and their price differential seems less important. Meanwhile, of course, development has lowered the price of numerous alternatives. So, for instance, solar power of various sorts becomes much more attractive; wind power does; and local-site small turbines for home or neighborhood use become more attractive. This opens a huge vulnerability, the potential for displacement of current arrangements, to which the power companies seem mostly indifferent.

This indifference is scarcely surprising: several abundant literatures (in strategy, sociology of organizations, and the history of technology, for instance) testify to the difficulty of envisioning that which does not yet exist, especially the convergence of formerly separate technologies. The entire careers of senior power firm executives rests on their mastery of the *current* regime of coal, gas and oil plus a bit of nuclear power generation in large, centrally-located plants that transmit power for many miles. Few such executives have experience outside their industry, or in other technologies. No presently

available alternative to centrally-generated, widely distributed electric power appears economically competitive. Yet there are troubling signs of potential change, for those who would bother to look.

My own situation is not atypical: I'm a professional, a homeowner, and have suffered extended power outages due to hurricanes and ice-storms in the past 10 years: 21 days one time, 18 days another, 3 days another still. And this doesn't mention the much more frequent hour or two, here or there. As a professional, I'm "addicted" to my information sources, computer, entertainment and the like (we won't say anything about my microwave, refrigerator, and air conditioning (essential in summertime Virginia!). I am not especially mollified by providers' explanations for outages as "an act of God," for which they bear no responsibility. I note that it's human choice to put the wires above ground and through the trees (for instance), or to skimp on maintenance and tree-trimming. The bottom line, for me, is that I am sick and tired of outages (especially extended ones), and actively investigating alternatives.

Solar power seems very attractive -- especially since there are now companies offering lease arrangements in which they provide all of the equipment, install and maintain it, manage the permitting, and so on. Oh, yes: I have also read that one of those companies in this area has yet to build its photovoltaics plant – my point is, my power company has a restive customer. Why would a business professor who already has a house be investigating alternative power arrangements?

From a non-specialist's perspective, the general technology of the US power grid remains essentially the same overall approach – massive centralized generation facilities, and long-distance transport of power via "leaky" wires that are often not well maintained

and are all too vulnerable to predictable natural occurrences like winter storms, hurricanes, trees falling and so on. Both the inefficiency of the long-distance transfer of power (and the attendant traffic issues around load balance, bottlenecks and choke points, and power loss – abundantly illustrated in the California power crisis of not long ago), as well as the development of much more powerful small turbines provoke thoughtful consideration of a completely different configuration for power sources for domestic use.

The cost-benefit tradeoffs usually discussed are silent on the cost to the consumer (or, for that matter, to businesses, for the most part) of outages, brownouts, surges and dirty power supply. The greater the adoption of electronic controls for common appliances – dishwashers, say, or refrigerators, to say nothing of computers – the greater the cost and risk to homeowners of dirty power (and it's all over the place) as well as outages. The only reason that the current configuration is “attractive” to the power companies is that they *can* skimp on maintenance, avoid the cost of burying lines or upgrading long transfer lines to eliminate leakage and so on: the costs to consumers are “externalities,” not part of the equation. If the full cost of the current system were more visible, it wouldn't be nearly so attractive – and, conversely, alternatives would look a whole lot more sensible. Why should we assume consumers (voters, after all) will consent to continuing to subsidize electric companies?

We have seen legislation requiring the providers to buy back surplus power generated by homeowners; it's not so great a step for legislation holding power companies responsible for outages. From a consumer's standpoint, it's high time for providers to be penalized for outages, brownouts and damage caused by their failure to in fact provide the energy-on-demand they advertise. If my local power supplier had been

required to reimburse me for lost food, weeks of accommodations with heat (or AC in the warmer weather), restaurant food (because I couldn't cook) and other living expenses, the bill would have been much higher than the cost for a household generator. Since I had to foot that bill, that tradeoff begins to look very sensible to me. This translates to a major PR headache for companies, with potential for regulation, legislation, or new forms of competition -- what about the company that guarantees no outages (e.g., by local neighborhood generators, or buried lines)? What about the burgeoning photovoltaics industry?

All of this suggests that the physical resources, and in particular the technology of generation and transmission, are the focus. If one considers alternative technologies and their related new issues facing industry, then both the hardware (equipment) and the people (skills, human resources) become an issue. The expertise to run a coal- or oil- or gas-fired plant, or a nuclear generator, is somewhat different from that required for photovoltaics. Certainly the academic disciplines and craft skills underlying these are somewhat different. Then, too, if technology development makes photovoltaics more attractive (for instance), than the growing companies and "good jobs" will reside elsewhere than in the legacy firms seeking to sell power through the existing grid.

If the power grid must be redesigned to standards of much greater robustness, than a very different approach to how much power, how the power is moved around, where it's sourced and so on comes into play. New disciplinary knowledge – like network analytics and communication and control systems – becomes critical. Will the experts who possess it want to work for power companies, rather than, say, internet companies?

These are major strategic issues for power companies and the industry at large -- they affect survival and the adequacy of business models as currently known. They are especially difficult for industry incumbents to think about, because they sweep away many of the assumptions about continuity on which incumbent executives' professional lives, careers and successes have been built. This constitutes a huge competitive advantage for any company with a different business model centered on the new technology -- just like the minimills in steel, or the Japanese carmakers' Just-in-Time and Lean Manufacturing methods, a new configuration in power seems so far out that it's easily dismissed by those in the center of the industry. Historically, new technologies often first appear *less* capable, more expensive and thus less desirable – but as they improve, they first overtake and then surpass the older systems' ability to improve. The displaced feel they were blind-sided by a completely unanticipated threat.

So far, my discussion has addressed strategic issues facing the power industry. But there is, as well, a national security component. Power systems constitute a major infrastructure, and as the destruction wrought by Katrina makes clear, a major city without power is virtually uninhabitable: you cannot run contemporary households for long – or businesses, hospitals, or schools at all – without power. A centrally-located major power plant would be a tempting target, since we don't appear to have much surplus capacity. A softer target would be grid choke points – which were widely publicized in discussions of the California crisis, for instance.

These shortcomings of the system are “strategic “-- both as a threat for companies and as a military/terrorist threat in terms of national security. They exist in part because we all have assumed for a long time that occasional outages are “OK,” that companies

aren't responsible for them, and that the power grid can't be done any more robustly. Every one of those assumptions should be challenged: envisioning a different future is the first step toward creating it. Challenging these assumptions successfully will very likely rest upon bringing multiple disciplines together with current power systems knowledge.

Let the games begin!