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Towering Design Flaws

Blackouts come from dim planning decisions—a brittle, centralized grid and inefficient pricing policies, says U.S. energy guru AMORY LOVINS

By AMORY LOVINS

The usual suspects — politicians, regulators, deregulators, utilities, and environmentalists — were promptly rounded up when the Aug. 14 blackout lost 61 billion watts of capacity in nine seconds. Yet the real culprit was none of the above — just as in 1965, 1977, and other regional blackouts that I described in a 1981 report for the Pentagon, *Brittle Power: Energy Strategy for National Security* (see: www.rmi.org/sitepages/pid533.php).

The real cause is the overcentralized power grid. Its giant machines spin in exact synchrony across half a continent, co-ordinated by frail aerial arteries and continuous, precise technical controls. Usually, it works well. But every few years by mishap, or anytime by malice, it can fail catastrophically.

A fixed-wing aircraft can glide to a safe landing without engines, but without instantaneous active control and a tail rotor, a helicopter drops like a stone. The grid is more like a helicopter. Seeing this demonstrated may inspire terrorists to make it happen more often.

After previous major blackouts, more giant power plants were linked by more, longer, and heftier transmission lines. Some of these changes relieved local power shortages, but most were unhelpful. Ontario's latest power woes were prolonged because nuclear plants dislike sudden shutdowns and don't restart gracefully: They're the opposite of a plant providing power at peak times — guaranteed unavailable when most needed.

New power lines, plus wholesale competition, have also spawned huge new long-distance power sales. That much power traveling that far can slosh around uncontrollably if a local mishap roils the flow and circuit breakers don't instantly open. But the unimaginably complex grid's "fault tree" of potential failure modes is growing new branches faster than we lop off old ones. The well-meaning operators are always surprised — but if they keep building the same architecture, it will keep failing for the same basic reason.

Modernizing with fast, solid-state switches and advanced controls may help block blackouts, and often boosts existing lines' capacity. Market structures whose rules require and reward high reliability are thus essential (and missing in much of the U.S.). But as one utility executive notes, the emerging policy consensus — that we need to build more and bigger power lines because usage has outpaced capacity — is as wrong as prescribing bloodletting for a patient with a high fever. It reflects a fundamental misunderstanding of what is amiss.

In fact, more wires may make cascading failures more likely and widespread. And they're almost always slower and costlier than three functionally equivalent alternatives: using electricity efficiently, letting customers choose to tailor their usage to price, and decentralized generation.

The cheapest, fastest way to save energy dollars and pollution is to use energy efficiently. (My household electric bill is \$7 [Cdn.] a month for a 372-square-metre living space, before counting my larger solar production, which I sell back to the local electricity power co-operative at the same price — now allowed in 38 states.)

Ottawa just earmarked \$1-billion for conservation (and to meet Kyoto obligations). Each saved kilowatt-hour (kwh)

saves three kwh of coal at the power station. In the 1970s, Canada had world-class energy-efficiency programs; now they're unimpressive, any incentives to use energy more efficiently removed by rules that reward distributors for selling more electricity and penalize them for cutting customers' bills. Ontario has corrected this perverse incentive for gas but not electricity distributors, and doesn't let efficiency bid directly against generated electricity. This "inefficiency tax" on every home and business hurts competitiveness.

A second key option, "demand response," signals participating customers (electronically or by price) to avoid unneeded use when power is scarce. This needn't inconvenience anyone: If your electric water heater or air conditioner were off for 15 minutes, you'd never know.

Ontario lets this resource compete conveniently against supply only for big customers (and in pilot-project communities). Yet new "smart meters" now make load management profitable for homes as well as businesses — and, like efficient use of electricity, the strategy frees up transmission capacity without building more. A few hundred megawatts of load management, as well as properly opening breakers, might have averted the blackout.

Demand response also stabilizes electricity prices and markets. If California in 2000 could have dispatched load management equaling just 1 per cent of power demand, then when nutty rules led suppliers to withhold supply and boost prices, entrepreneurs could simply have shorted the power market, dispatched their load management, and taken \$1-billion (U.S.) of the suppliers' money — enough to deter such antisocial behavior.

In the U.S., where inefficient gas-fired turbines make nearly all peak power, demand response saving just 5 per cent of U.S. peak electric load would save about 9.5 per cent of all U.S. natural gas. That could quickly return natural gas prices from around \$6 to \$7 (U.S.) per gigajoule to just a few dollars for years to come, on both sides of the border — and quickly. Between 1983 and 1985, the 10 million people served by Southern California Edison Company used efficiency and load management to cut the decade-ahead forecast of peak demand by 7 per cent of actual load per year, at only 1 per cent of the cost of new supply. Today's technologies and delivery methods are far better.

A third option: Decentralized (also called "distributed") generation is unaffected by transmission failures. Last week in Ontario, Markham, Hamilton, and Sudbury District Energy, among others, isolated their engine-generators from the collapsing grid; they kept running. So did some New York-area industries with microturbines and homes with solar cells. These islands of light in a sea of darkness were powered by local generators that had been installed mainly to save money, but delivered reliability, too. A megawatt generated where it's needed is far more reliable than a megawatt generated far away — yet Ontario prices them the same, with no credit for reliability.

Throughout electricity's first century, power plants were costlier but less reliable than the grid, so ever-bigger power plants backed each other up through the grid. But new power plants are now cheaper and more reliable than the grid, so delivering reliable and affordable power now means generating it at or near the customers (see: www.smallisprofitable.org).

Central thermal power stations stopped getting more efficient in the 1960s. They stopped getting cheaper in the 1980s, and stopped getting bought in the 1990s: Now utility orders are back to Victorian levels. Yet public policy continues to favor central plants and big transmission lines. Transmission is still centrally planned, and needn't compete fairly with its cheaper alternatives.

Our problem isn't too few power lines; it's obsolete rules, rewarding perpetuation of an inherently vulnerable grid.

Letting all options compete fairly — whether they save or produce energy, no matter how big they are, what kind they are, or who owns them — would gradually and profitably build a power system as resilient as the Internet. Then major failures, instead of being inevitable by design, would become impossible by design.

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