# Blackouts: How often do we want them?

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We live in a subdivision where the power lines are strung on poles in our back alleys and we have had more than our usual share of power outages this summer. This has been blamed on the rapid expansion of the neighborhood squirrel population because of the loud pop of the short-circuit that preceded every incident. On August 14, my wife wondered how big this squirrel must have been to have popped everything from Detroit to New York City.

The blame game is just starting. We'll hear about the operators who didn't open circuit breakers in time; the engineers who didn't design the separation schemes just right; the manufacturers whose equipment didn't work exactly; the (de)regulators who didn't provide the right incentives. With a few months of hind-sight analysis there will be lots of blame to go around. The difficult part will be to find the solutions that'll prevent such cascading blackouts.

Let's get one thing straight. Power outages, like my house this summer, will happen; there are "squirrels" everywhere. But the probability of large cascading blackouts can be reduced – its called reliability engineering – and most of this for the power grid was worked out after the 1965 blackout. Given that nothing as extensive as that blackout has happened till 2003, some may even think that once in 40 years is an acceptable level of reliability. Whenever such an incident occurs, however, we need to ask the question whether the reliability is going down. Unfortunately, most engineers believe that corners have been cut in grid reliability in recent years and the probability of blackouts is going up rather than down.

One obvious and immediate action item is to beef up the reserve capacity in transmission. This has been falling due to increases in both generation capacity and electricity demand but no new transmission lines. The engineering of determining new transmission needs is well known and all the barriers are disagreements on how to get it done economically and politically. This blackout may break the logjam.

Incidentally, the reserves of generation capacity, although barely OK for now, can easily fall short as it is mostly being impacted by market forces and not reliability concern. Many economists predict boom-bust cycles in generation capacity. The fact is that somebody needs to be in charge, with both the responsibility and authority for adequate grid reliability. For thirty years after the 1965 blackout the regulated utilities developed reliability standards and voluntarily designed and operated the grid according to these. Since the breakup of these companies during the 90s, organizational responsibility for grid reliability has fallen through the cracks to the despair of the generation of post-1965 engineers.

It is, in the long run, not enough to just ensure transmission and generation capacity. This will ensure reliability but is expensive not only in cash but also in environmental impact.

New technologies must be brought to bear and this means research and development. The electric power industry, one of the largest, is one of the smallest spenders on R&D. This distinction is not just limited to the utilities and manufacturers, who usually do the applied research, but also the federal government who relegated basic research in this area to a very low priority.

The result of this neglect is the lack of any dramatic breakthroughs in generation and transmission technologies in several decades. Even where technology breakthroughs have appeared – new power electronics that can better control grid equipment, new communications that can provide split-second coordination of such controls, microprocessor technologies that can better track everything happening on the grid, to name just a few – their application and adoption have been sporadic at best.

As a society, we need to figure out how this R&D will get done. The complete deregulation of electric generation and the ensuing competition may spur the R&D spending on generation technologies. A glimmer of this is already visible with the heightened interest in wind generation, fuel cells and micro-turbines. Distribution and transmission, however, will continue to be the problem of the commons, and R&D will have to be funded either by government or with the proper incentives to private industry. The health of the grid and its technological improvement will have to be dealt as a public good.

Finally, one should mention the oncoming crisis in the workforce needed to design, build and operate this large infrastructure that keeps our lives humming. There has been a major downsizing of the utility industry in North America, not to mention the off-shore outsourcing of most of the equipment needed for this industry. Of the remaining workforce, from skilled linesmen and technicians to power engineers, a majority are closing in on retirement age. The training and education pipeline needed to produce the replacements has slowly dwindled in keeping with the downsizing of the industry. If we decide to start reinvesting in this critical electricity infrastructure, we will also have to start cranking up the needed training and education.

The reliability of the power grid is not a mystery; it can be maintained at the highest level that we expect. It costs money, of course, but more than that, it requires attention and the will. It can be made easier still if we invest in new technologies and the skilled people needed to develop and work them. We can’t stop lightning strikes, storms, random equipment failures, human errors – and squirrels – but we can certainly decide how often we want to have cascading blackouts.

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