



RISK & INNOVATION

Power Infrastructure: Keeping The Lights On

OVERVIEW

Imagine that all of a sudden, as you're doing your daily work, your computer shuts down. The lights around you turn off. Elevators in your building stop in their tracks. You glance out the window, and street lights have ceased to function. As you reach for your phone, you see that the network is out. This might sound like a science fiction movie, but for many, it has already become a reality. Over the last two decades, major power outages have left communities around the world without essential services, causing disruption to the normal operation of society.

The world is increasingly reliant on secure, sustainable and affordable energy. The US Energy Information Administration (EIA) projects a 48 percent increase in global energy consumption between now and 2040, putting even greater pressure on aging power grids around the world.

In the U.S, for instance, the 2003 Northeast blackout affected over 50 million people and was estimated to have cost between \$4.5 billion and \$10.3 billion in economic losses. The University of Cambridge Centre for Risk Studies and Lloyd's of London recently estimated the costs of a 'total business blackout scenario,' at \$61 billion to \$223 billion in economic losses, depending on the number of generators affected, and how long it would take to restore 90 percent of the power.

Beyond short-term outages, there are other strains that could impact longer-term economic growth. The failure to ensure a diverse mix of energy sources is likely to affect the performance of power grids if the dominant source suddenly suffers shortages. Similarly, the increasing susceptibility of networks to cyber attacks – as occurred in Ukraine last year – also presents a serious risk to the maintenance of safe, secure and reliable energy supplies.

Taking steps to improve and maintain power grids and address the causes of blackouts represents a key concern for businesses and society more widely – one that requires constant vigilance, planning and increased investment.



IN DEPTH

Population growth and rapid urbanization continue to place pressure on today's infrastructure. Power presents a particularly complex challenge, due to the variety of energy sources, the declining role of conventional power in favor of renewable energy sources, aging networks, challenges in investment, and a shortage of the engineering skills needed to address the complexities.

Beyond just infrastructure, there are additional challenges to be considered. "In the power industry, the risk profiles are different for each generation source – coal, gas, or renewables," says Mark Fishbaugh, U.S. Power Practice Leader, Aon Global Power. However, there are common challenges facing the industry as a whole. "From cyber-terrorism to power supply failures, generation capacity leaders in the industry are aiming to find solutions that address not only mitigating the risk of today, but preparing for tomorrow," he says.

Blackouts: An Increasing Trend?

Blackouts have become a concern throughout the developed world. "It is likely that power blackouts will become more frequent in Europe," warns Denis Waerseggers, Chairman Aon Global Power. Waerseggers notes that there is currently a lack of incentives for organizations and governments to invest in national grid infrastructures. "Then there's the fact that energy from decentralized, 'volatile' renewable sources is not well suited to work on electricity grids that were mainly designed after the Second World War," he explains.

In the last 15 years, Europe has experienced 20 major blackouts affecting a variety of countries. In 2003, for example, a serious blackout, originating from a power cut on a trans-border high voltage line, affected almost the whole of Italy and parts of Switzerland. Lasting over 12 hours, it was the largest blackout in a series of outages that year, affecting a total of 56 million people.

As seen by the outage impacting both Italy and Switzerland, an even greater challenge in addressing the challenge is due to the interconnection of most of the European grids. "A blackout in one region is ever more likely to cause a 'domino effect' leading to supra-regional blackouts," says Waerseggers.

This web-like structure has led to complexities in other parts of the world too. In Pakistan in 2015, the electricity supply was cut to almost 80 percent of the country following a reported "rebel attack" on a transmission line that connected a privately-run power plant with the national grid, which affected many major cities, including the capital Islamabad. More recently, Turkey saw a nationwide power outage caused by line maintenance and a hydro production oversupply. With metro and trams in Istanbul and Ankara coming to a halt, traffic light failures, cell phone networks down, and some factories having to temporarily cease production, the country experienced severe disruption. A 2012 outage in India saw 670 million people – 10 percent of the world's population – lose power, as blackouts extended for 2000 miles across the entire breadth of the country.

The Broader Causes Of Power Supply Disruptions

"The world's energy infrastructure is facing a multiplicity of risks when it comes to maintaining a reliable supply, undermining economies and leading to serious consequences for societies more broadly," says Waerseggers. Whether property damage, business interruption, bodily injury, or even death, the general impacts of large scale blackouts can be severe, says Brian DeBruin, Nuclear Practice Leader, Aon Global Power. "Large scale outages affect critical infrastructure and the economic impacts of these events can be significant," warns DeBruin.

But if blackouts are the symptom, what are the causes? The issue of aging infrastructure continues to put pressure on the power industry, but Waerseggers also points to a number of other issues, particularly around the rapidly changing nature of energy production. "While renewable energy sources are rapidly developing in many countries, a major risk appears to be the 'volatility' of supply. And volatility is what any network doesn't like," he says. "The unsteady production of energy, especially from renewable sources such as wind or solar makes it harder to balance the supply through the networks, which are often old and not built to sustain these highly flexible operating models."

And if compatibility is one thing, then diversity is another. This is potentially a bigger issue than the fallibility of infrastructure per se – over-reliance on one source of energy could pose a greater risk. "There is a developing weakness in the diversity of generation resources, says DeBruin, with the majority of new generation in the U.S skewed toward natural gas fired power plants. "If that fuel became scarce it could impact the reliability of the power grid more broadly."

Cyber attacks are also becoming an increasing threat, with "the utilities, energy and infrastructure industries – petroleum, gas, electric power, nuclear, renewable, telecoms, water and sewage – under constant attack," says Kevin Kalinich, Global Practice Leader, Cyber Insurance, Aon Risk Solutions. Our dependence on round-the-clock electricity, the basis of almost all economic and social activity, combined with the increasing digitization of the systems that run power networks, means systems themselves can become vulnerable and victims of cyber attacks. Last year, the disruption of utilities in western Ukraine, which affected nearly 250,000 people, was due to just such an attack, which experts believe to be the first known successful cyber intrusion to knock a power grid offline.

Meeting The Challenges

With so many variables and such potentially catastrophic consequences, where does one begin to address the issue?

The answer could simply be in controlling the levels of energy we actually use: "conservation and slowing the demand is a first step in addressing the issue," Fishbaugh advises. "As a society, we need to be more mindful of what we're consuming. The power industry is moving towards a more measured approach and combined with technology, working to increase overall system efficiency," he says.

Another approach is moving to a 'smart grid' to increase reliability and reduce the likelihood of power outages. Special meters can continually monitor supply and demand, while similar devices measure the flow of electricity in real time, allowing operators to anticipate and avoid disruptions. These smart appliances can 'talk' to the grid and shift electricity use to off-peak periods, which eases the burden on the network and reduces prices.

In order to make this happen, investment is key. This combination of energy conservation, technological improvements, and system upgrades, requires practical decision-making and sustained financial commitment.

Overhauling national grids is no small task. EU studies estimate the investment over the next five years needs to reach almost €200 billion. Waerseggers explains that "in a uniform grid this investment would be almost a no-brainer. But the European electricity grid consists of myriad of regulators, grid owners and operators, which renders consensus for priorities on investment difficult."

Finally, he adds: "long-term infrastructure investments funded by regional, national and supranational authorities to create new power transit highways and upgrade the obsolete grid equipment is the only way to prevent an even more worrying situation."



TALKING POINTS



"The electricity industry is transforming, with a number of structural and disruptive changes challenging the traditional utility model. A mix of technological, economic, regulatory, environmental and societal factors is resulting in a lower carbon, digitized electricity system with new players emerging. This new landscape will be more complex and interrelated than ever before." – Steve Bolze, President and Chief Executive Officer, GE Power & Water



"Cyber is definitely the most dangerous emerging risk. The digital infrastructure was not designed to protect against bad guys." – Andrew Coburn, Director of the advisory board at the Cambridge Centre for Risk Studies



"If people love the grid, they will have to find a way to cover the cost of it." – Jon Wellinghoff, former chairman of the US Federal Energy Regulatory Commission



FURTHER READING

- How America Could Go Dark – Wall Street Journal, July 16, 2016
- Energy Infrastructure Investments Vital To Economic Growth – The Hill, June 02, 2016
- South India Hit Hard By Weak Power Grid – Business Standard, May 05, 2016
- Power Networks On High Alert Amid Cyber Threats – Sydney Morning Herald, May 08, 2016
- Latest Map Of Key EU Cross-Border Energy Infrastructure Projects Published – European Commission, July 28, 2016
- Cyber Risk For Energy/Power Industry – Aon Report

