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Lights out: The dark future of electric power

12 May 2014 by **Hugh Byrd** and **Steve Matthewman**

Electrical blackouts that cause disruption to millions are a looming threat to society

ON 14 August 2003, the north-eastern US and Ontario, Canada, were crippled by an enormous electrical blackout that affected 50 million people. Commuters struggled to get to work, ATMs failed, 36 car manufacturing plants were closed and hundreds of flights were cancelled, resulting in tens of millions of dollars in economic losses. The cause was later found to be a software bug in a control room in Ohio.

A few weeks later, the whole of Italy was cut off from Europe's electricity grid for 18 hours after falling trees took out two power lines in neighbouring Switzerland.

We tend to think of such events as occasional, inconvenient blips. But in fact they are becoming increasingly common, and will only get more frequent and severe. This is because our electricity systems are more fragile than is commonly supposed, and are getting frailer. Unless we act, blackouts will become a regular, extremely disruptive part of everyday life.

Electricity fuels our existence. It powers our food, waste, water, transport and communication systems. Modern life is impossible without it.

Yet interruptions are inevitable. Electricity systems are complex,

high-tech assemblages in which small failures can interact in unanticipated and often incomprehensible ways.

The North American grid, for example, is arguably the world's largest machine, but is highly fragmented. It crosses borders and regulatory zones and has no single owner or manager. Over 3100 utility companies are on it. Other continent-scale grids have similar weaknesses.

The vulnerability of such systems is demonstrated by the Italian blackout of 2003. The event began when a falling tree broke a power line in Switzerland; when a second tree took out another Swiss power line, connectors towards Italy tripped and several Italian power plants failed as a result. Virtually the whole country was left without power. It says something when a nation can be brought to a halt by two trees falling outside its borders.

Such failures cause widespread and instant chaos. Italy's deprived more than 60 million people of electricity; an unscheduled blackout in India in 2012 affected as many as 600 million.

We predict that blackouts will occur with greater frequency and greater severity due to trends in both electricity supply and demand. Supply will become increasingly precarious because of the depletion of fossil fuels, neglected infrastructure and the shift toward less reliable renewable energy. Demand, meanwhile, will grow because of rising populations and affluence.

Resource depletion is already having an effect on countries that rely on fossil fuels such as coal for electricity generation. Countries with significant renewable resources are not immune either. Weather is not predictable and is likely to become less so, courtesy of climate change: in the past decade shortages of rain for hydro dams has led to blackouts in Kenya, India, Tanzania and Venezuela.

Deregulation and privatisation have created further weaknesses in supply as there is no incentive to maintain or improve the grid. Almost three-quarters of US transmission lines and power transformers are more than 25 years old and the average age of power plants there is 30 years.

The looming threat of blackouts cannot be solely blamed on vulnerabilities in generation, however. Overconsumption is also a factor. Between 1940 and 2001, average US household electricity use rose 1300 per cent, driven largely by growing demand for air conditioning. And such demand is forecast to grow by 22 per cent in the next two decades.

Demand for aircon is also growing elsewhere. In China, ownership tripled in the decade since 1997 and aircon units already account for 20 per cent of the country's electricity consumption. A similar pattern is seen in India. Global warming will only add to demand.

Another future driver of demand is likely to be electric vehicles. The World Bank forecasts that these could total 10 per cent of all new vehicle sales by 2020, requiring a 15 to 40 per cent increase in electricity demand.

Overall, between 2008 and 2035, demand for electricity is expected to grow by 80 per cent across the world. No one knows how this will be generated.

These converging trends are already impacting the system's integrity. In the US, blackouts increased across all three five-year periods between 1995 and 2009. A report written for the Executive Office of the President concedes that the incidence of major blackouts is increasing.

It is worth reiterating what is at stake here. We analysed almost 50 significant power-outages across 26 countries. They had numerous causes, from technical failure to sabotage. Nonetheless, the same set of problems emerged.

Blackouts affect computers, microprocessors, pumps, fridges, traffic and street lights, security systems, trains and cellphone towers, with consequences across society. The economic losses can be enormous: power outages are already estimated to cost up to $180 billion a year in the US.

As the world becomes more reliant on digital technology, where interruptions of as little as one-sixtieth of a second can crash servers and computers, the negative effects will only multiply.

These problem have not gone unnoticed. The American Society of Civil Engineers has warned that without an investment of $100 billion, the US power generation system will collapse by 2020. In the UK, the National Grid, Ofgem, the Department of Energy and Climate Change and the Royal Academy of Engineering have all warned that the system's integrity could be seriously reduced by the winter of 2015. Societies need to heed these warnings, or face a very dark future.

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