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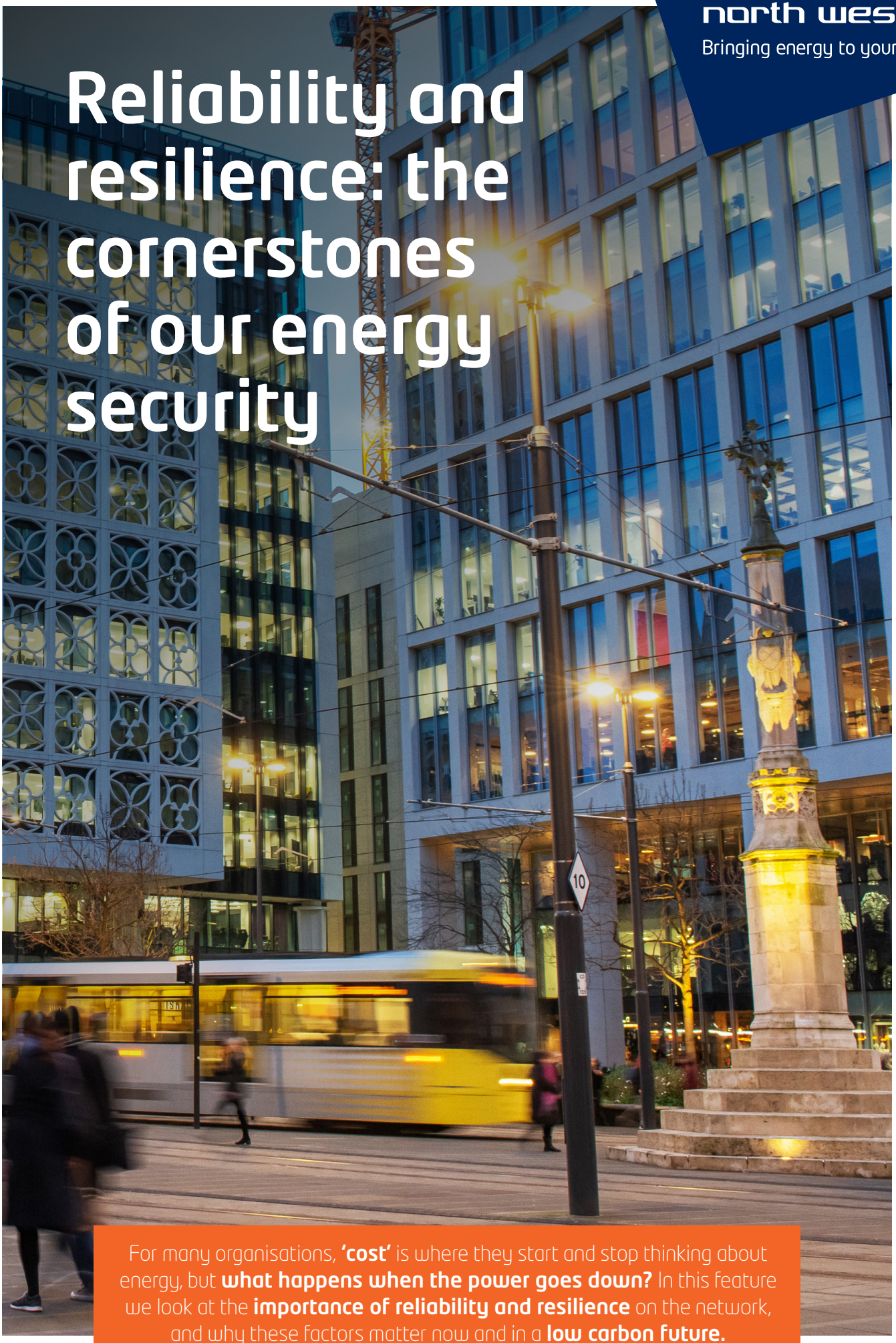
Bringing energy to your door

Reliability and resilience: the cornerstones of our energy security



For many organisations, **'cost'** is where they start and stop thinking about energy, but **what happens when the power goes down?** In this feature we look at the **importance of reliability and resilience** on the network, and why these factors matter now and in a **low carbon future.**

Meet the contributors

Councillor Andrew Western
Regional Lead for Greater Manchester Green City

Emma Gardner
Head of Environment Sustainability, University of Manchester

Katherine Jackson
Technical Director, Energy, WSP

Paul Morris
Director of Capital Development and Estate Operations, Lancaster University

Peter Catlow
Director, Businesswise Solutions

Todd Holden
Director for Low Carbon, Business Growth Hub

Until five years ago, Lancaster University had kept the lights on nearly without issue. While occasional power cuts hit campus, the main line from the town's substation, with 13 local units, a wind turbine and a combined heat and power facility on site, kept things running for 3,000 staff and 13,500 students, working in the small but growing 'town' at Bailrigg next to the M6.

Lancaster's strong research base and growing international standing, meant students from all over the world lived on campus, tapping into expertise across business and management, health, data, and cyber security, alongside a growing list of world-beating fields. The university had a global reputation to uphold.

But in December 2015, Lancaster's resilience and capability to function was hit hard.

A wet start to the winter brought the impending risk of flooding and disruption to many parts of the UK, particularly to areas in the north of the country. Just three days into the month, extratropical cyclone Storm Desmond moved in for five days across Cumbria, Lancashire, and the Scottish Borders. Heavy rainfall combined with a high water-table to bring widespread disruption to the area. When the River Lune burst its banks, the resulting flood hit the town's main substation, cutting power to 60,000 properties, including the university.

"Storm Desmond showed that the university's reliability on the electricity network had increased significantly," says Paul Morris, director of capital development and estate operations. "By wiping out the main substation in Lancaster for three days, we had multiple challenges: the loss of communication and IT systems meant you couldn't switch on your computer and your IP phone didn't work. We also found that the resilience of mobile phone masts dropped off very quickly.

"Where we could get mobile signal," he adds, "we didn't have charging points. We had people sitting in cars, with their engines running to charge their phones."

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Ultimately, the biggest impact of Storm Desmond for the university was on its people. With 7,000 residential spaces, plus staff and other students arriving to study each day, the university found very quickly it could not function. It also had the added challenges of getting people off site when the transport system was badly affected and limited emergency space to cope just before Christmas.

Hygiene factors, or something more?

According to research from network operator Electricity North West, reliable and resilient power ranks highly, alongside cost, as an energy priority for businesses. While reliability refers to the consistent performance of supply, and resilience indicates its ability to bounce back when the power goes out, the two terms often appear together in conversations about energy.

Companies were also surveyed about helping the region to become carbon neutral, supporting vulnerable customers, and keeping people safe, as part of a ten-strong list of factors that can be influenced and invested in.

While 98 per cent voted for ‘keeping Electricity North West’s part of the bill as low as possible’, a significant 82 per cent voted for the lowest-ranked factor – ‘raising awareness’.

With just 16 percentage points separating everything in the research, it appears that businesses value all aspects of power delivery. But that doesn’t mean they think about it very much.

“I would argue that quite a lot of things on that list are hygiene factors,” says Todd Holden, director for low carbon at the Business Growth Hub. “Their presence is not valued, but if you didn’t have them, you would value them.”

His view is backed up by everyone we spoke to for this feature: businesses assume power will be reliable and its resilience is rarely tested.

“Since the three-day week in 1974, there has pretty much been wall-to-wall power” adds Peter Catlow, director at Businesswise Solutions, which provides energy management services. “I don’t think it is on people’s radar; unless you tell them to think about it.”

But Lancaster’s experience shows what can happen when power is taken away and back-up plans are designed to support hours, rather than days, of disruption. In these rare cases, the ability to bounce back is badly affected and these hygiene factors become very apparent.

As a result of Storm Desmond, Lancaster University now has more than 3MW of installed emergency capacity on campus. Its standby generators, which can be complemented by further units at short notice, can support a series of emergency planning centres, including the sports hall, and facilitate communication with the outside world. Mobile power packs have also been purchased and the estates team have been working with mobile phone operators to increase the resilience of local masts.

“There is no doubt that in any failure of critical systems, communication is one of the things that comes under pressure,” says Morris. “People want information and you’ve got to be able to provide it. We now have a large screen in Alexandra Square, in the heart of the campus, which is provided with power back up. The last time we had a series of emergencies, we had messages running across the screen that anybody could read.”

He adds that the team has been working with Electricity North West to enhance resilience on the line from the town’s main substation to the campus. For the nine substations on the university’s private network that remain without generator capacity, there are now injection points for mobile generators. “We believe we can have the whole campus up and running, subject to generator availability, in a maximum of 12 hours,” says Morris.

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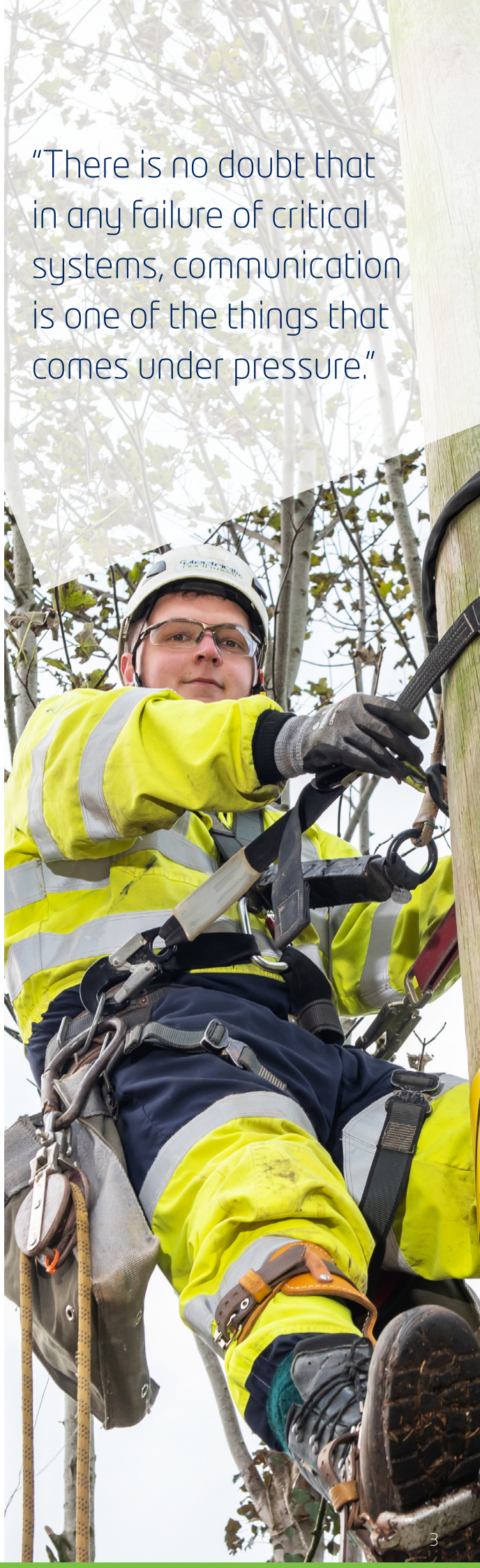

The renewables switchover challenge

While standby generation will meet the needs of an emergency, the consistent supply of power is pivotal to an industry on the cusp of big change. Future reliability and resilience of the network will depend on a smooth transition to renewable supply. The current coronavirus pandemic has also highlighted, alongside Lancaster's crisis, the amount we depend on our cyber infrastructure to maintain business continuity. As we switch to a low carbon world that dependency will only increase further.

"As we move away from gas as a heating system, and we move towards everything being connected; if your broadband goes down, your life stops," says Holden from the Business Growth Hub. Resilience is important from a physical point of view, but also from a cyber point of view."

According to Katherine Jackson, technical director at consultancy WSP, a lot of work goes into making sure energy systems are resilient. But there are some risks to consider as we move away from more conventional sources of power. Renewables can be intermittent, but with so many schemes being added to the system each month, we can have too much of a good thing.

Jackson describes examples during the coronavirus pandemic when there has been too much generation on the network. National Grid has brought in special measures at short notice, she says, asking smaller generators to switch off, contracting with EDF to shutdown nuclear power station Sizewell, and talking to battery storage aggregators.

"It's all about frequency on the system," she says. "Normally, the generation matches demand and it's the role of the operator to match that. If you have too much generation and not enough demand, the frequency goes up. If it goes too high or too low, it damages the electrical equipment. You would need to start tripping the system before the frequency gets to that point."

Catlow from Businesswise Solutions adds: "What a lot of people haven't realised yet, is that the actual sources of energy generation are changing very rapidly. In early June 2020, for example, something like 37 per cent of electricity consumed in the UK was generated by renewable sources.

"That shift has all kinds of implications, not least for the legacy assets out there. To fire up a power station costs a lot of money as it does to keep one sat there doing nothing. There is going to be some radical rethinking about how you sustain supply whilst pivoting to non-fossil fuel sources."

At the University of Manchester, head of environmental sustainability Emma Gardner is thinking a lot about these issues. At the time of writing, during the middle of the coronavirus pandemic, the campus had seen a drop in its base and peak loads of power, but the questions of delivering reliable and resilient supply long into the future, are still front of mind.

"We need to look at generating our own electricity to drive that added resilience as well," she says. "We do have some local generation, which only provides a small contribution, and we have had a number of studies done to explore additional opportunities. Local generation should be part of the solution; however, for the amount of energy we use, I do not think we could generate it all locally; we have to look at a blended approach."

Holden from the Business Growth Hub agrees that mixed forms of generation will be important in this transition. "It might not always be windy, it might not always be sunny, but it's usually windy or sunny," he says. "Tidal and wave power are also developing opportunities."

Towards local generation and management

Longer term, if power is generated closer to where it's needed, there will be fewer losses on the network and users will receive greater clarity on the prices they pay. Commentators argue that moving to local generation will improve reliability and resilience and introduce the opportunity to trade energy as well. This is especially important as businesses start to consider their resilience to climate change shocks and more frequent extreme weather events.

"Our greatest carbon reduction opportunities lie in the decarbonisation of heat and transport and one of the ways we can achieve that is through electrification," says Greater Manchester Green City-region lead, Councillor Andrew Western. "But this would dramatically increase electricity use, which leads to questions about how the electricity grid can cope, potentially through greater local energy generation, storage and local smart energy management.

"Greater Manchester produces 50 per cent less local renewable energy per household than other English cities, but there is no real reason for that. If you generate energy locally, or have a local supply chain for energy, then that should give you greater resilience and visibility about the price you pay."

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Work is underway to look at the feasibility of a local energy market for Greater Manchester. A project led by Electricity North West in 2019, alongside the Greater Manchester Combined Authority, Hitachi, Bruntwood and Upside Energy, was funded by UK Research and Innovation. In February 2020, the government announced further support for the scheme in a £21m funding round to back ten local projects in the demonstration phase, which also included Warrington's Rewire-NW initiative.

The aim is to explore how to increase the flexibility of the distribution network to allow faster deployment of renewable schemes and manage demand by working with energy aggregators, virtual power plants and building management systems.

"Greater demand on the network could be partly managed by localised control and management, rather than having to replace the existing network," says Jackson from WSP. "By getting electric vehicles charging when there is spare generation and providing some local smart management, then it will help."

Holden from the Business Growth Hub adds: "We are all used to paying for electricity based on what we use, but we don't live in that world anymore. The marginal cost for renewables is zero. What you are trying to do is recover the cost of the infrastructure.

"In future, what you use will be less important than when you use it. If you use electricity when no-one else does, they will be giving it away. We are already seeing businesses looking at how they use and manage energy, so they can reduce their maximum demand."

This is a big shift, from a national system managed regionally, to local generation and local markets, with multiple renewables projects feeding into the grid. The model will depend on network operators like Electricity North West working on schemes like the one in Greater Manchester – to aggregate, manage and store energy in a way that creates value for customers.

"We have to be able to convince businesses, and a wide group of stakeholders, that this is the right thing to do," says Councillor Western. "It might cost a little more now, but it creates resilience in the system and more affordable and reliable energy supplies in the future."

Who will pay for the transition?

Transitioning to local energy supply and trading is funded through multiple sources. From research grants, to government backing, alongside network operators' balance sheets and customer bills, money is also spent by organisations themselves wanting to reduce their overheads and carbon footprint.

But as more and more companies invest in low carbon renewable energy, trading back to the grid and storing up supply, the less they will pay in traditional electricity bills. In practice, this means fewer people are paying up front for the cost of the infrastructure.

Holden believes this is unfair: "At the moment, you have got this situation where switched-on businesses are doing everything they can to take their peak load off the grid, using battery storage for example, and they contribute a lot less to the electricity network costs," he says. "That is regressive because those who can't afford it, or don't have the knowledge, are picking up more and more of the costs.

"Our current model is that the customer pays. Why should the customer pay now, when the asset will be there 30 to 40 years into the future? If we as a country are going to decarbonise, why isn't that something that is funded from general taxation, which would be progressive? Instead of charging it on customer bills, which is regressive."

There is also the issue of businesses being willing to invest upfront. Two companies we spoke to for the first paper in this series, had invested in solar arrays and battery storage to provide renewable energy on site, because they felt it was the right thing to do. Lancaster University has invested in its own wind turbine and combined heat and power facility, independently of the resilience measures taken since Storm Desmond.

But these are largely exceptions, according to Catlow from Businesswise Solutions, who works with more than 350 clients. While a small minority of operations are embracing the move to local generation, there is a long tail of companies out there only starting to look at energy efficiency, let alone spending money on kit that could save them more.

"I can think of one customer of ours that spends £2.5m a year on electricity and he has got one meter," says Catlow. "If you ask him where his energy is going, he has no clue. Our energy management-as-a-service offering has really taken off because we are measuring consumption of specific machines or assets and understanding where money is being spent and wasted."

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Catlow says that if people have to invest and get involved in capital expenditure, then it's very difficult to get sign off for consumption or reduction activity.

Looking to the future, learning from the past

Back in Lancaster, Morris is in a reflective mood. The university has made great strides to address the problems it faced five years ago and has used the lessons learned to deal with power outages since. But local generation, as a source of long-term reliability and resilience, is still work in progress.

“We have a significant wind turbine on campus, which we own; and we also have a combined heat and power engine unit that provides a lot of the campus’ electricity and heat during normal running periods,” he says. “But both of those automatically switch off when there are power outages. They take their reference points for generation from the grid.”

While the university produces more renewable energy than any other higher education institution in the UK, switching these assets into ‘island mode’, would require significant battery storage and reconfiguration of the network.

“In future, we will be an exporter and an importer of electricity,” he says. “It is a challenge that we have these two fantastic sources of electricity, but because we don’t operate in island mode, they shut off the second the power goes off. For us to be able to generate power efficiently, as battery storage technology is improving all the time, it is inevitable that we will do that too.”

But while emergencies like Storm Desmond are unusual, in a world of warming climates and changing weather patterns, they are becoming more frequent. The presence of the coronavirus pandemic has also meant that more people have relied on their home broadband and cyber infrastructure to keep companies going.

Electricity North West continues to invest in its own network to improve reliability and resilience against extreme weather events, physical and cyberattacks, but all these challenges are perhaps a prelude to the longer-term impacts of climate change and disruption to business as usual.

While companies are currently treating reliability and resilience as hygiene factors, they are likely to become more pressing for the growing number of people in leadership positions.

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“We had reasonably good plans for dealing with an emergency but considered losses as something that happened between five minutes and a few hours,” says Morris. “We learned we needed plans that could be operated independently from other things outside of our control. We couldn’t rely on people being able to leave campus or everything else working; the likelihood is there will be other emergencies happening at the same time.

“I would draw parallels between the pandemic and Storm Desmond,” he adds. The university has learned a lot from Storm Desmond because we now have a clear, practised understanding of how the organisation needs to communicate. We were able to put that in place earlier this year and understood what it meant.”

As organisations seek to understand the security of their energy supply, their willingness to invest for the future, and the challenges and opportunities that local generation can bring, they would do well to understand Lancaster’s journey and the partnerships it has forged along the way. As we all become more reliant on electricity in a low carbon future, keeping power flowing every day regardless of the challenges ahead, is going to be key for businesses across the North West – for their operations and their reputations.