Industry 4.0
plus Net Zero

Why the combination of the current revolutions in the manufacturing sector are making **power resilience** a key priority

powerstar

Industry 4.0

Industry 4.0 describes the latest phase in the Industrial Revolution. It is focused on interconnectivity, machine learning and real-time data.

The previous 'Third Industrial Revolution' brought electronics and computer technology into industry; individual items of production equipment automated and electronically programmed and controlled.

The Four Industrial Revolutions

INDUSTRY 1.0

Mechanisation and the introduction of steam and water power

INDUSTRY 2.0

Mass production assembly lines using electrical power

INDUSTRY 3.0

Automated production, computers, IT systems and robotics

INDUSTRY 4.0

The smart factory, autonymous systems, IoT machine learning

For manufacturers, Industry 4.0 presents an opportunity to increase productivity, as well as more connected processes and supply chains.

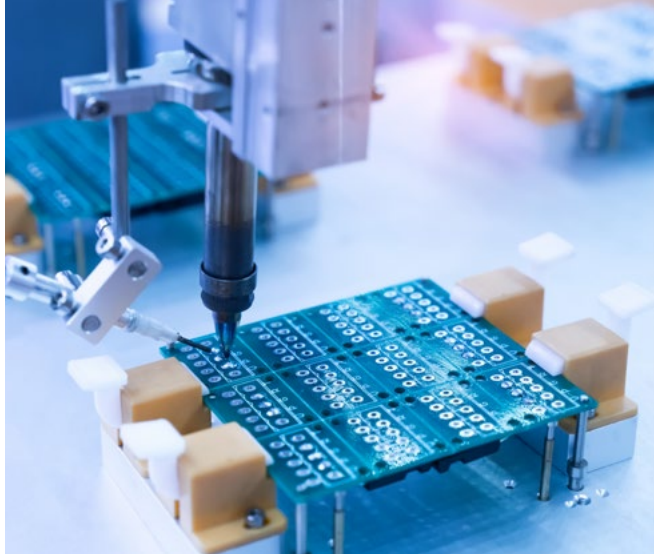
THIS MEANS:

- Harnessing data from all production processes
- Using feedback loops to automatically improve processes
- Automatic analysis of large data sets to predict bottlenecks, downtime, maintenance requirements and supply chain demands
- Remote 24/7 monitoring and optimisation of an entire production facility
- Interconnectivity of production equipment to optimise flows, increase utilisation and flexibility
- Connectivity of production data to other business processes, allowing flexibility in customer orders

A study by Autosys Industrial Solutions for Forbes found that Industry 4.0 offered huge improvements for manufacturers across a wide range of their operations elements, including:

- 35% to 40% reductions in equipment downtime
- 15% to 20% improvement in production
- 35% to 40% improvements in quality
- 35% to 40% improvements in asset utilisation
- And an enormous 65% to 70% improvement in overall productivity

Source



Power Resilience is Key

The rapid march of digitisation comes with risks as well as opportunities. Energy disruption is already a major threat to the productivity and profitability of many manufacturers. The increasingly interconnected nature of Industry 4.0 makes your site even more dependent on a stable and uninterrupted power supply.

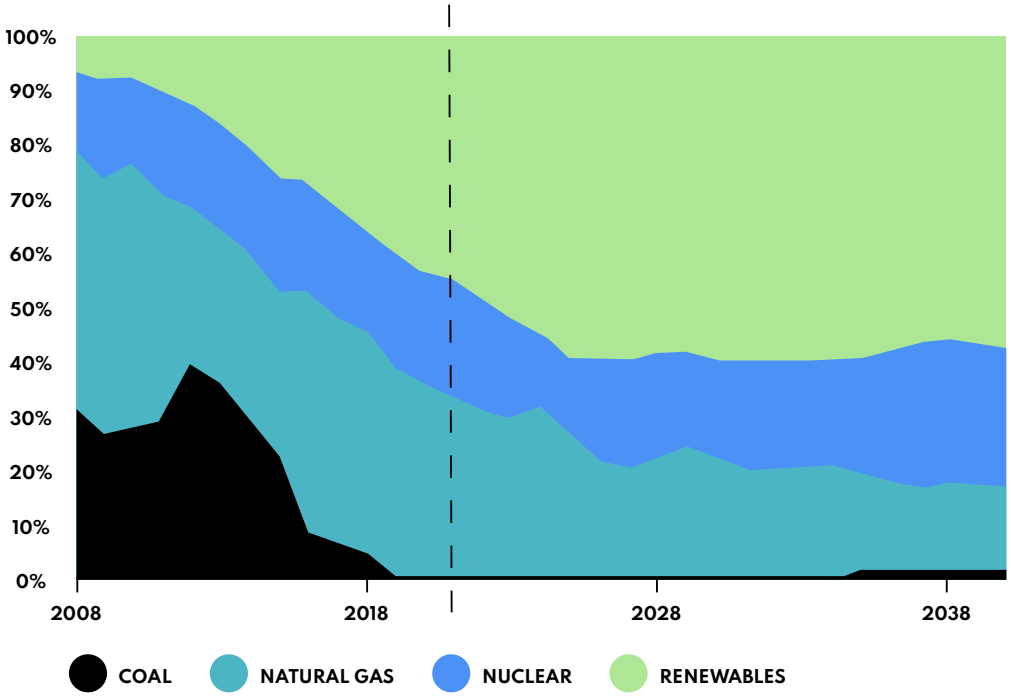
Critical electrical equipment has traditionally been protected with an Uninterruptable Power Supply (UPS) – usually a small battery that can supply power to the critical equipment in the event of a disruption.

However, increased connectivity means a UPS that protects only critical equipment and circuits will soon be wholly inadequate. Automation, centralised control, data acquisition, robotics and autonomous production all require the whole site to be protected by a comprehensive, site-wide power resilience strategy. For example, it is no use keeping a production line running if all of the feeding equipment, robotics, traceability software and dispatch systems do not continue to run as well.

The Changing National Grid

Industry 4.0 comes at a time when the way we generate, use and transmit energy is changing more rapidly than at any time in our history. The UK's ambitious emission targets have left both the manufacturing sector, and the country as a whole, facing a perfect storm of potential power disruption.

UK Energy Mix Forecast



Source: BEIS Projections of greenhouse gas emissions and energy demand from 2019 to 2040

The Department for Business, Energy & Industrial Strategy currently project 58% of UK energy will be from renewable sources by 2027.

Renewable sources of electricity, such as solar and wind, are inherently inflexible. Whereas we can simply burn more fossil fuels when we need more electricity, we can't turn the wind up or down or change the hours of sunlight. Furthermore, the natural variations in wind and sun throughout the day lead to constant fluctuations in the electricity supplied. This presents National Grid with a complex balancing act to maintain the stable and reliable supply that we expect. As more renewable generation capacity is added to the grid, the risk of blackouts or other disruption increases.

Alongside the growth of renewable generation, a shift away from large, centralised power stations to lots of local generation introduces further instability.

Much of the UK transmission and distribution network, by National Grid's own admission, is aging and unfit for this new purpose. Designed simply to relay power to end-users, the infrastructure is struggling to manage large amounts of both incoming and outgoing power. In areas with large amounts of local generation, high demand, or both, disruption caused by overloaded local distribution networks can be frequent.

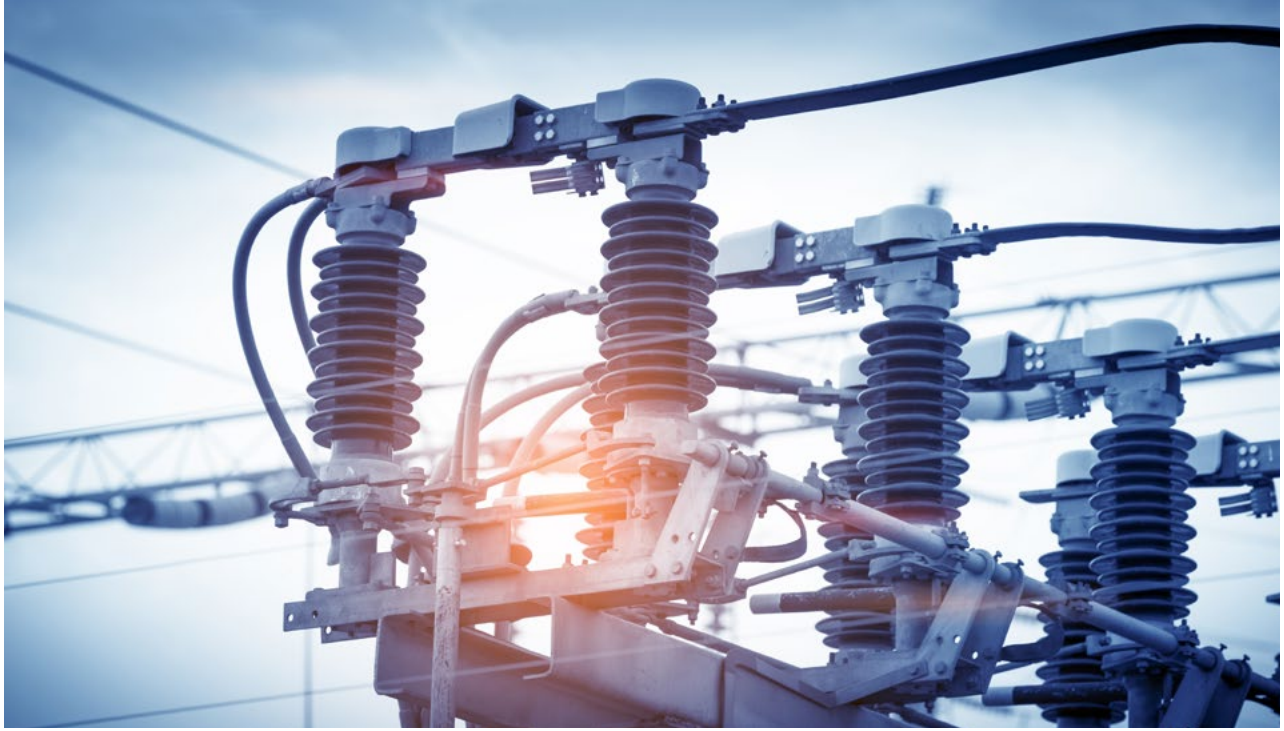
HOSEPIPE BANS FOR ELECTRICITY

We are already familiar with seasonal resources - reservoirs store water in exactly this way. The future energy mix will require large scale storage of electricity to balance both daily and seasonal variations in generation. But it will take years of risk before this system is stabilised and, even then, extreme weather conditions could impact the availability of electricity. In the meantime, it is the responsibility of every manufacturing business to safeguard their own power resilience.

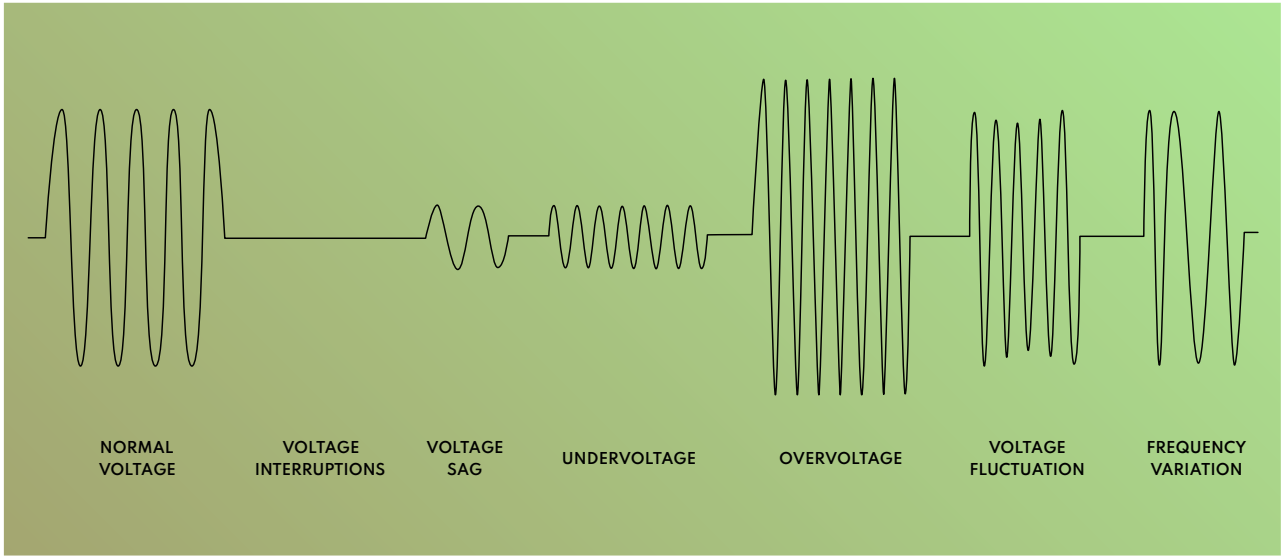
National Grid have already warned that total demand may exceed available capacity by as much as 5% during the coming winter. This is the tightest margin since 2016, where some manufacturers and other energy-intensive end users were asked to shut down or reduce operations as a last resort method of balancing supply and demand.

Source

T: +44 (0)1142 576200 I E: info@powerstar.com I www.powerstar.com



Different types of Power Disruption



HOW YOUR SITE IS IMPACTED

This additional strain on the electricity distribution network means an increase in the risk of power disruption to your manufacturing site. This goes far beyond the threat of black-out.

On-site generation, while an important step towards lower energy costs and addressing carbon emissions, can be a common point of failure when not properly integrated. Fluctuations in voltage and frequency need to be balanced to avoid damage to key equipment through overvoltage.

Sudden equipment failures can have a knock-on effect to your site resilience, causing wider disruption than just the specific item of equipment. Particularly as manufacturing sites become more digitised, sudden changes in voltage can damage sensitive equipsment or cause vital data to be lost.

Blackouts have historically been rare in the UK, giving us relatively little historical data on their impact in terms of cost. However, a study by Imperial College London found the economic impact of a blackout to be £35,488/MWh for SMEs.

Source

Power Resilience as a Priority

Manufacturing is one of the most energy-intensive sectors of the economy. Many processes are also highly sensitive to power outages, risking severe disruption as well as significant costs and wasted materials. Even small dips or surges in power can shut down PLCs, damage sensitive equipment or render precisely tooled product unusable. Any power disruption can impact productivity and profitability, as well as negatively impact other important aspects of your operations, such as safety.

With the UK's changing energy mix and the growth of distributed generation increasing the risk of power disruption, power resilience needs to be a board-level priority. Putting strategies in place to deliver Industry 4.0 and achieve net zero emissions, without also addressing the business' power resilience could create significant operational risk.

Machine downtime accounts for the loss of 3% of all working days by British manufacturers, equating to £31,000 per company per year. Across 133,000 UK manufacturers, according to the Office for National Statistics (ONS), this equates to £180 billion lost by the sector annually.

Source

Critical electrical infrastructure forms the backbone of today's manufacturing industry. These systems are supplying energy in almost all cases to mission critical operations. However, years of reactive maintenance, planned or emergency repairs and differing or inconsistent service practices have made it near impossible to accurately gauge how electrical assets are actually shaping up.

Source: Siemens

AEROSPACE MANUFACTURER

Case Study

CHALLENGE

A global leader in the manufacture of landing gear, suspension and tram coupling bearings was suffering significant scrappage caused by power disruptions.

The high quality and precision of the manufacturing process meant that an energy disruption caused operations to halt and destroyed an average of 8 material blocks per year, worth over £150,000 each.

SOLUTION

To protect the entire manufacturing site and all processes from energy failures, Powerstar installed a bespoke 1MW battery energy storage solution with fast switching and control software capable of providing comprehensive Uninterruptible Power Supply (UPS).

The impact of, and subsequent recovery from, COVID-19 has highlighted the need to build resilience into all areas of the manufacturing sector. As part of its enquiry into sustainable manufacturing, The Manufacturing Commission, chaired by Lord Bilimora of Chelsea, is seeking to answer the question of how to do this. It summarised 'very early on' that resilience is essential not only to weathering the impact of the pandemic, but also to the wider sustainability agenda in manufacturing.

A common attribute of businesses that were successful in mitigating the impact of the pandemic was that they prioritised non-labour efficiency, increasing the value derived from every tonne of material, litre of water or kilowatt of energy that went into its production process.

Source

T: +44 (0)1142 576200 I E: info@powerstar.com I www.powerstar.com

Manufacturers need to achieve Net Zero

Manufacturers face a growing need to demonstrate a clear commitment to sustainability goals.

A range of factors means that the manufacturing sector is ahead of many others, with carbon reductions already offering quantifiable benefits in terms of discounts on energy bills and improved relations with retailers and end users.

There is a mounting legislative, social and business expectation for manufacturers to declare concrete net zero targets. Doing so without a clear picture of how to achieve it risks doing more harm than good. Many manufacturers, particularly those with products that are sold to the general public, have found themselves under fire for so-called 'greenwashing'.

Science-Based Targets are intended to clearly demonstrate to companies how much, and how quickly, they need to reduce their emissions to contribute to preventing the worst impacts of climate change. Targets are considered 'science-based' if they are in line with what the latest climate science considers necessary to meet the goals of the Paris Agreement. Collectively, this would limit global warming to below 2°C, and potentially achieve the ideal limit of 1.5°C.

The Science-Based Targets Initiative (SBTi) provides guidance and support for companies and organisations. As of 2020, 590 companies with a combined market capitalisation of $10.8 trillion had seen their science-based targets ratified by the SBTi.

https://sciencebasedtargets.org/

Without ratifying your goals against science-based targets, you leave your business open to accusations of greenwashing. Buying a green energy tariff simply doesn't cut it any more in the eyes of investors, partners and the public.

And rightly so, because the amount of renewable generation in the UK far outstrips the amount of energy purchased via green tariffs. By switching to a green tariff you will make no actual change to emissions levels, you are just adding a market pressure to an area that is now being driven by government commitments.

Net zero can only be responsibly achieved through a site-wide, consistent approach, managing and sourcing all energy to be as green and efficient as possible.

T: +44 (0)1142 576200 I E: info@powerstar.com I www.powerstar.com

CLIMATE CHANGE AGREEMENTS

Climate Change Agreements (CCA) are voluntary agreements between energy-intensive sectors of UK industry and the Environment Agency. Under a CCA, manufacturers and other heavy industries agree to actively reduce energy use and carbon emissions, in return for a substantial discount on their Climate Change Levy (CCL). Ordinarily, the CCL is a levy placed on electricity and fuel bills, calculated against your total kilowatt hours of usage. A CCA allows a 90% discount on the levy for electricity, and a 65% discount on gas. For energy-intensive manufacturers, this is a substantial discount. Beginning in April 2013, the CCA scheme will run until at least March 2025.

Failing to demonstrate clear progress towards improving sustainability risks most manufacturers losing their access to the CCA held by their sector association. Failing to report energy use and carbon emissions against two-year targets means that a manufacturer could lose their discount on the CCL. Commitments vary by sector, for example the Plastics Federation is targeting a collective energy efficiency improvement of 3.8% during Target Period 5 (2021-2022). Failing to meet this collective target means having to pay for the difference between actual and target performance at a price of £18/tonne of CO_2 emissions, in order to continue with the scheme.

https://www.bpf.co.uk/bpf-energy/cca/home.aspx

ELECTRIC VEHICLE CHARGING

To meet your carbon reduction commitments, it is likely that any vehicle fleet you maintain will need to switch to electric. A growing number of employees will also be making the change away from internal combustion engines.

This requires charging infrastructure. While it may seem like a cheap and simple task to install EV charging points, it can be far more complex and expensive. Most manufacturers that procure their energy effectively and responsibly will not have sufficient additional capacity authorised at their site to simply add EV charging. This is particularly the case for high-speed charging, with the largest models drawing more than 250kW, which is more than the entire demand of a medium-sized manufacturing facility.

Requesting additional supply capacity from your Network Operator is an option, but one fraught with difficulties. At best the additional grid connection needed to handle the power will cost tens of thousands of pounds, and can climb over a million depending on location and requirements. The worst-case scenario is that the existing strain on your local distribution network means they will simply turn down your request.

Instead, you have to get more creative with your energy management behind the meter. By using a Battery Energy Storage System (BESS) you can provide the additional capacity needed to charge an EV fleet from stored energy, before recharging more slowly at low demand times. Battery storage also allows on-site generation to be matched up with EV charging far more effectively. It allows the 100% green energy you generate yourself to be used to charge your vehicles at any time, rather than just when it is generating.

T: +44 (0)1142 576200 I E: info@powerstar.com I www.powerstar.com

Next Steps for Improving Resilience

Some manufacturers may already have power resilience measures in place. Servers and critical pieces of equipment are often supported with a lead acid Uninterruptable Power Supply (UPS). And many sites will have some sort of fossil fuel back-up power supply – a diesel generator or perhaps a Combined Heat and Power (CHP) unit.

However, with the need to reduce carbon emissions across the board, these technologies have a variety of drawbacks.

- A traditional UPS typically provides emergency power to a single piece of equipment. This keeps it running or gives time to shut it down safely. However, it leaves the rest of your site vulnerable, risking digital systems being knocked offline or valuable data being lost.
- A traditional UPS benefits you only in the event of a power disruption. At other times, it actively contributes to your overheads, losing an average of 10% to 15% of its power capacity as it charges and discharges to monitor incoming grid supply. Unless 100% of your electricity is coming from renewables this adds to site emissions.
- The standby nature of a UPS means that there is a substantial risk that if your UPS is going to fail, it will do so when you most need it - i.e. when it is supposed to switch on to protect you from a power cut.
- Diesel backup generators contribute directly to a site's greenhouse gas emissions. Although they are run infrequently, when they are, they can swamp normal emissions profiles.
- CHP units cannot typically operate uninterrupted in the event of a mains power failure. Since they require the grid supply to operate, the switching time is not normally fast enough and they will shut down. Restarting them can take a long time.

T: +44 (0)1142 576200 I E: info@powerstar.com I www.powerstar.com

SMART POWER RESILIENCE

It is now possible to combine a site-wide, containerised Uninterruptable Power Supply with a Battery Energy Storage System (BESS). The instantaneous switching of this system requires sophisticated power management technology to prevent disruptions and ensure that the battery system has sufficient capacity at all times to support the site.

Rather than simply standing by to protect your site in the case of a power disruption, a microgrid configuration with UPS and BESS works constantly to improve your energy efficiency and management.

Outside of power resilience, battery storage offers a host of additional benefits:

- **Reducing energy costs.**
  BESS can achieve this in a number of ways, including charging during off-peak times so that lower cost power can be used during peak periods. Supplementing grid supply during periods of peak site demand also protects you from exceeding your authorised capacity.
- **Maximising on-site renewables.**
  With energy prices in the UK increasing, many manufacturers are turning to Behind-the-Meter generation to reduce costs. Solar PV or wind turbines offer plentiful, low-cost power. By implementing storage, you can store electricity generated during optimal periods, such as during bright, windy weather. This power can then be called upon during periods when generation is lower.
- For extended disruption a battery alone will not be enough to provide full resilience. However, BESS offers the potential to be deployed as part of a wider smart micro-grid. This means that while your site generally operates connected to the grid, it is able to run independently in island mode indefinitely if properly implemented. For example, a CHP unit can be isolated from the grid supply to run continuously through a mains supply disruption.

DIGITAL TWINS

With an estimated 21 billion connected sensors and endpoints by the end of 2020, digital twins will exist for billions of things in the near future.

Source

Digital Twins represent a rapidly growing new field for manufacturing, as well as offering applications to almost any sector. Complex infrastructure projects, such as the implementation of new digital equipment or the rollout of site-wide power resilience, can be modelled in real-time before being commissioned. This ensures that the chosen solution will operate as intended across a wide range of different internal and external factors. For manufacturers, this will become vital to ensuring complex overhauls of equipment or further digitisation can be implemented without risking unforeseen downtime.

Digital twins are becoming a business imperative, covering the entire lifecycle of an asset or process and forming the foundation for connected products and services. Companies that fail to respond will be left behind.

– Thomas Kaiser, Senior Vice President, Internet of Things

T: +44 (0)1142 576200 I E: info@powerstar.com I www.powerstar.com

Power **resilience** for a net zero world

powerstar

Work with Powerstar

Powerstar are the UK's leading provider of intelligent battery solutions, with an established track record supporting businesses in the manufacturing sector. From design and testing, through commissioning, installation and aftercare, Powerstar supports you to ensure your chosen energy solution delivers exactly what you need from it.

RESILIENCE +

To find out how Powerstar can help you achieve your energy management goals, however unique or complex they may be, contact our specialists on:

T: +44 (0)1142 576 200 | E: info@powerstar.com
www.powerstar.com
4 Cowley Way, Ecclesfield, Sheffield, S35 1QP