



Remarkable energy starts at the edge

How edge computing and 5G can help decarbonize power networks

Table of Contents

Sustainability in an energy-hungry world	Page 3
From centralized to distributed generation	Page 4
From one-way to two-way supply	Page 5
The need for remarkable grids	Page 6
Decarbonizing with data	Page 7
From power networks to 5G networks	Page 8
Two cultures become one: delivering IT capabilities with OT reliability	Page 9
Past experience will not unlock future performance	Page 10
A unique facilitator for energy and telecom collaboration	Page 11
Our commitment to the open 5G future	Page 12
Driving innovation and choice across the open 5G ecosystem	Page 13
10 years' expertise across energy exploration, generation, and supply	Page 14
Customer Stories	Page 15
The Road to Net Zero - Find Out More	Page 17

Sustainability in an energy-hungry world

The history of the second half of the 21st century will be written before the first half is complete. To mitigate the worst effects of climate change, the world needs to achieve net zero by 2050.

At Dell Technologies, we're committed to sourcing 100% renewable energy across all of our facilities by 2040. Further, we believe we can help advance a remarkable revolution in energy sustainability. The energy sector currently generates 75% of global greenhouse gases*, and demand for energy continues to increase. Over the next 8 years, 1 billion more people will become significant energy users, mostly in developing countries seeking the most affordable sources of energy.

Fossil fuels have recently assumed great geopolitical significance, with global crises driving countries to focus on energy security. In the short term, this may increase reliance on national hydrocarbon reserves. The only sustainable long-term strategy is to dramatically raise the share of renewable energy sources in the overall mix.

Clearly, the future is electric. In order to keep up with the shift to dynamic, distributed power generation, energy grids need to embrace IT advances like automation and artificial intelligence, together with edge computing and high capacity, ultra-low latency data communications.

At Dell Technologies, we are committed to facilitating innovation and collaboration between the telecom and energy sectors to achieve this. This guide looks at how 5G networks and data-driven power grids can combine IT agility and Operational Technology (OT) to deliver sustainable power to an energy-hungry world.

From centralized to distributed generation

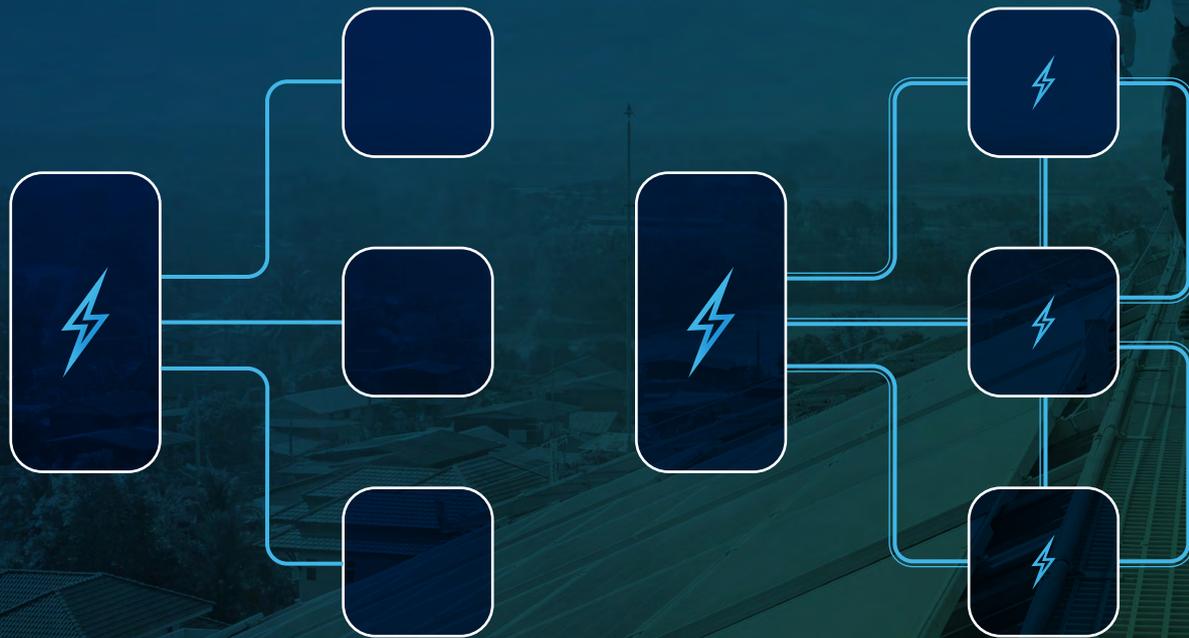
The need to decarbonize and improve energy security is driving massive investment and diversification. And the shift to renewables – wind, wave, and solar technologies – is changing everything.

Since the days of Edison, power grids have been built around central generation, with demand predicted in advance and power generation scheduled to meet the need. Today, the U.S. is powered by roughly 60% coal, oil, and gas, 19% nuclear and only 17% variable renewables.²

As renewables increase in the overall mix, energy generation will become more geographically distributed. The intermittent nature of renewable energy must be considered, with output peaks that may not coincide with demand, and limits on energy storage capacity.

Managing energy systems with a greater proportion of intermittent generating capacity requires a transformation to manage realtime demand and supply, as well as distributed energy storage systems. This transformation will require sophisticated data-driven autonomous systems at the edge of our networks to minimize the carbon intensity of consumed energy.

From one-way to two-way supply

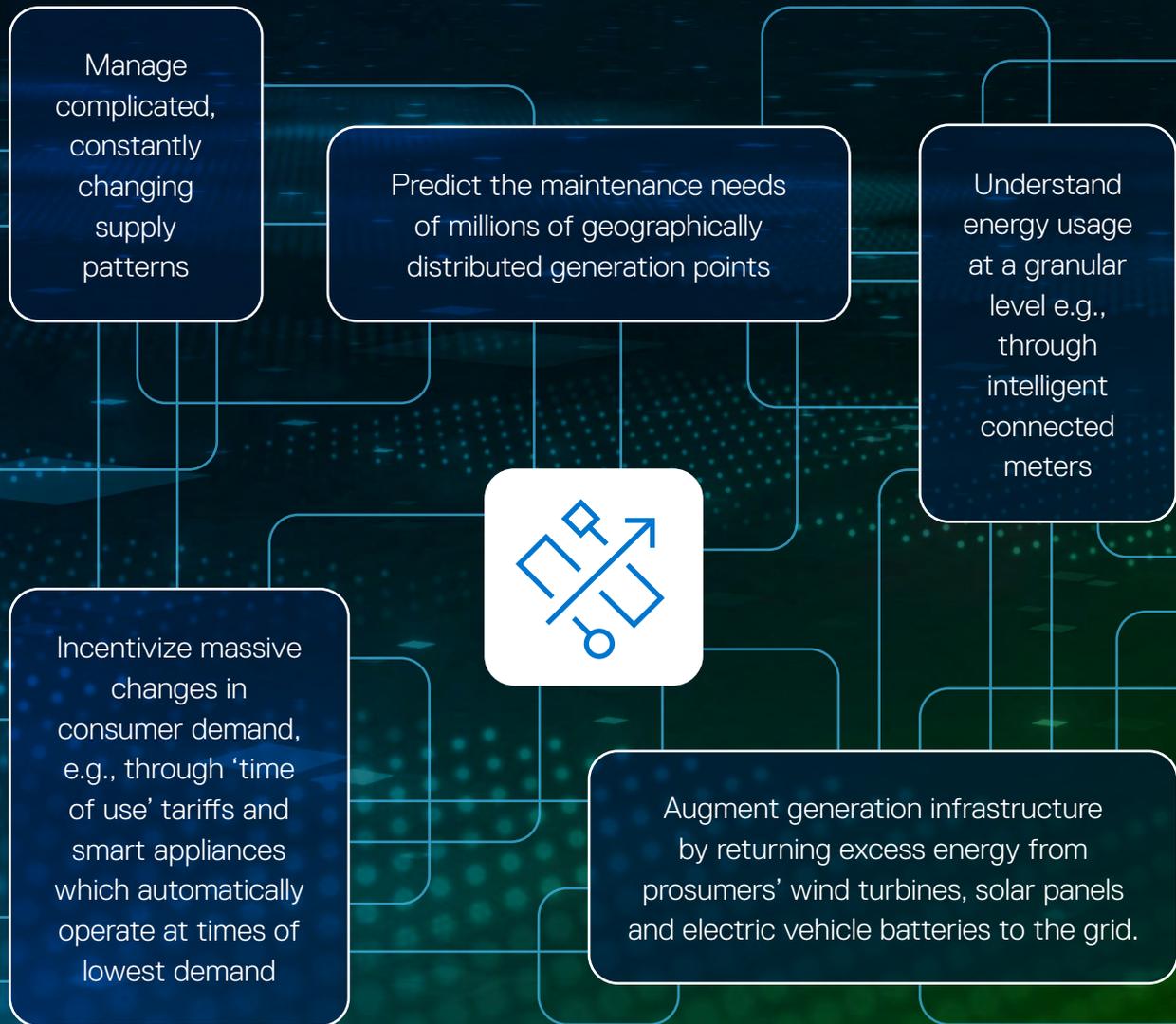


Another fundamental change is the growing number of end users investing in micro-generation and energy storage. Each producer/consumer may only feed a few kW of surplus energy back to the grid each year, but this capacity grows in significance as it is multiplied across millions of households and businesses. The increasing uptake of electric vehicles is also fueling interest in V2G (vehicle to grid) technologies. Here, high voltage vehicle batteries release power back to the grid at peak times, aiding in demand response and reducing pressure on the grid.

The same load balancing principle could also be applied to domestic appliances and industrial processes, controlled by an edge of smart 'meters' at every consumer site. Smart dishwashers can automatically be scheduled to operate at the optimal time overnight when electricity prices are lowest and there is available renewable energy.

The need for remarkable grids

This fundamental transformation in energy infrastructure makes it possible to accommodate more complex patterns of supply and demand. Instead of just meeting peak demand, grids will:



To achieve this, grids will need the capacity to make intelligent autonomous decisions based on real time data and very large numbers of variables.

Decarbonizing with data



Reaching net zero by 2050 is an incredible challenge. Among many other things, it requires a fundamental transformation of global energy infrastructure to harness two-way power flows.



However, even more complex is load distribution to optimize energy usage by millions of end users.



Achieving the two objectives of guaranteeing supply and managing demand requires the ability to gather and analyze data from billions of dispersed devices, and then turn insight into action within milliseconds.



This requires a dramatic increase in computational capacity at the edge, delivered by a new generation of technology that prioritizes cyber security and resilience.



It also demands the capacity to transmit significant volumes of data with minimal latency to inform high volumes of real-time data-driven decisions.



From power networks to 5G networks

High capacity, low latency data communications on a vast scale are critical to enable this transformation. For Communication Service Providers (CSPs), this is an exceptional new opportunity to put their 5G spectrum to work.

Furthermore, in the US, the Infrastructure Investment and Jobs Act earmarked billions of dollars for energy utilities to implement broadband and wireless technology as part of their networks. In other words, energy utilities will soon need high capacity, low latency networks and be in a position to invest in them. 5G can deliver exactly that.

Dell Technologies already has experience in a similar use case for the mining sector. Rogers Telcom recently built Canada's first 5G wireless private network (WPN) with Dell Technologies providing key infrastructure. Using Dell infrastructure and technologies from other industry partners, the Rogers Business 5G WPN provides mining workers with better connectivity, communication, and safety today while enabling a truly scalable network that will power thousands of modern solutions.

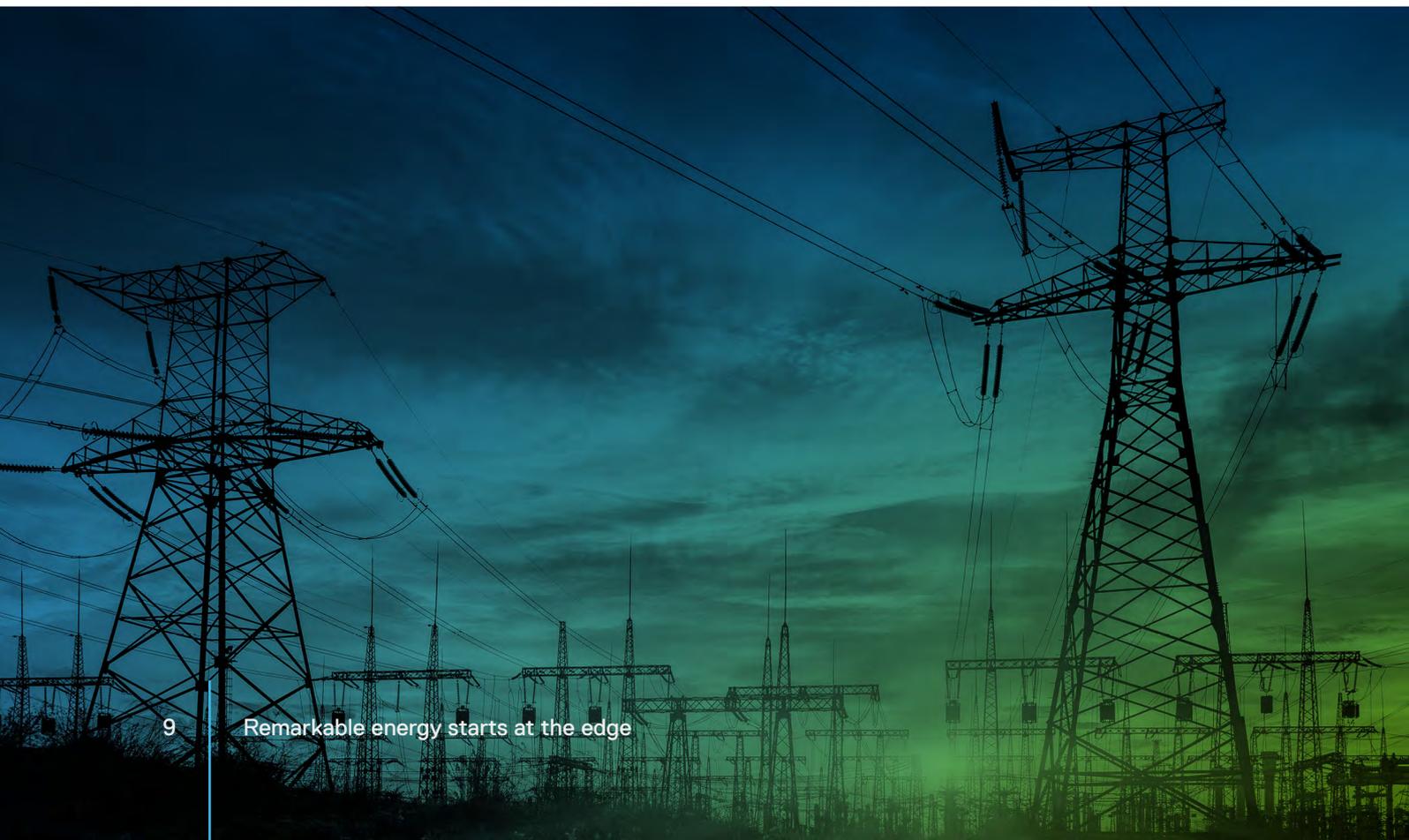
Two cultures become one: delivering IT capabilities with OT reliability

The other side of the equation is the need to carry out complex data processing and analytics at massively distributed edge locations while ensuring the security of critical national infrastructure.

The energy sector needs to make remarkable advances in its OT capabilities. The world of IT already has the artificial intelligence and automation tools needed to achieve this.

However, IT replacement cycles are typically three years, while OT systems have often been deployed with service lives of ten years or more. IT providers will also need to step up to the challenge of delivering the OT-like levels of security, safety, and resilience essential in critical industries like energy.

Energy infrastructure of the near future will be far more complex than today. To control it, the energy sector requires OT modernization to leverage vast quantities of real time data. At the same time, IT providers must gear up to deliver far higher levels of security, safety, and resilience.



Past experience will not unlock future performance

“ Electricity security frameworks are the result of more than a century of experience, with a relatively stable set of technological choices and well-understood risks. But past experience, is not always enough to prepare for the future”¹

The International Energy Agency (IEA)

Summarizing the challenge facing energy providers (2020)

Achieving the remarkable capabilities needed to unlock global energy sustainability advances requires systemic change in not one but two critical infrastructure sectors:



For CSPs, there is the complexity of creating and deploying new 5G use cases based on IT principles to the OT standards of the National Equipment Building System (NEBS)



For energy utilities, there is the challenge of creating and deploying massively more complex edge infrastructure (again, based on IT principles) to the safety and security standards needed for critical national infrastructure.

In turn, there is also the need to build compatibility between these two very different industry verticals.

A woman with dark hair, wearing a light-colored blazer over a white shirt, is seated at a desk in a dimly lit office at night. She is looking down at a laptop, with her hands on the keyboard. The desk is cluttered with papers and a desk lamp is visible to her left. The background shows a window with a view of a city at night, with some lights visible. The overall lighting is a mix of blue and green tones.

A unique facilitator for energy and telecom collaboration

With a major commitment to 5G's open, software defined future and over a decade's specialist experience in the energy sector, Dell Technologies is in a unique position to facilitate this transformation. We are experts in both edge computing and virtualization. We have deep experience in deploying, managing, and securing software defined devices across vast areas and have expertise to meet the technical and logistical challenges of network transformation.

This means we can help CSPs and utilities find the optimum balance between IT and OT in each design space. If you're modernizing a data center, we can do it at IT speeds. If you're updating critical OT-like substations or base stations, we will integrate, test, and validate solutions so that you understand their performance and reliability long before you deploy them in your network. And when you're bringing IT technologies into OT operations, Dell is well positioned to help you find the best of both worlds and achieve your modernization goals.



Our commitment to the open 5G future

Dell Technologies is committed to building compatibility to enable CSPs to meet the needs of many different industry verticals from a common platform.

We are investing heavily in expanding the boundaries of 5G technology. OTEL, our Open Telecom Ecosystem Laboratory, is a major part of this investment. The idea is to foster innovation by bringing together hardware and software manufacturers with CSPs, partners and customers from the most rapidly transforming sectors. At OTEL, we aim to catalyze cross-industry collaboration, drive forward adoption of open RAN technologies and create tested, validated, ready-to-deploy 5G solutions.

In the energy sector, we are already helping leading original equipment manufacturers to embed 5G in their customer offerings. We are also working to create a common 5G platform on which CSPs can build the real-time high-capacity data links that energy utilities will need to maximize the potential of sustainable energy and smart networks.

Driving innovation and choice across the open 5G ecosystem



State of the art virtual & physical labs and flagship facility in Round Rock, TX



Drive industry standards compliance, simplify integration and interoperability



Facilitate experimentation and learning with access to cutting edge resources



Move certified and validated solutions from the lab to the marketplace



Reduce risk and develop certified, secure solutions that capture 5G's potential for CSPs



Build and test customer-centric new solutions in production-like, vendor-neutral environments



Build and test solutions in production environments and state of the art facilities



Develop and demonstrate custom solutions to CSPs and partners in a controlled and secure environment

10 years' expertise across energy exploration, generation, and supply

Dell Technologies has a wealth of experience across the entire energy ecosystem - from exploration, production and transportation to power generation, transmission, distribution, and consumption.

As a leader in AI and HPC for the energy sector, we offer validated products, solutions and expertise that deploy advanced technologies in extreme and inaccessible environments. We have extensive experience in developing OEM hardware solutions for some of the world's leading OT power equipment manufacturers. Dell Technologies is a global leader in virtualization, containerization and edge computing - technologies that are critical to building next generation power grids.

This gives us an extremely broad range of skills to help you create the sustainable energy landscape of the future. Alongside our partner ecosystem and industry providers, we deliver a broad portfolio of solutions including infrastructure, applications, and services.





Intelligent Metering

Building the infrastructure to decarbonize energy demand

In order to build demand-side grid management solutions and minimize the carbon intensity of consumed energy, massive increases in data and connectivity will be required throughout our metering infrastructure.

A new generation of 5G enabled intelligent meters are increasing sampling rates from four times an hour to 32KHz. 5G connectivity will be essential to grid enable a range of devices including EVs, Battery Storage, Smart Devices, and Solar PV.



Wind Turbine Farms

Improving generating capacity, reducing operation and maintenance costs

Wind turbines are typically deployed in farms and optimizing the performance of the turbines requires careful co-ordination. A new generation of control systems is being developed to take advantage of the low latency, high bandwidth capabilities of 5G to improve generating capacity and reduce operations and maintenance costs using AI- enabled predictive maintenance algorithms.



Connected Workforce

Improving safety and efficiency for utility fieldworkers

With increasing extreme weather events, the role of the utility fieldworker is ever more challenging. Task optimization technologies like augmented reality are key to driving improvements in health and safety whilst reducing maintenance costs. Numerous utility companies are already seeing the benefits of 5G enabled ruggedized devices to enhance their operational effectiveness.



Digital Substations

Enabling data-driven, cyber-resilient autonomy

The digitalization of substations is a critical part of most utility companies' grid modernization strategies. The deployment of a new generation of digital substation technologies built on virtualized and containerized infrastructure is transforming the traditional SCADA systems with access to massive increases in data which can be processed and actioned by autonomous systems.

5G will play an increasingly critical role connecting the equipment both inside and outside the substation and ensuring that the rigorous cyber-resilience requirements of the industry will be met and exceeded.

Join us on the road to net zero

Achieving global net zero targets is critically important to us all. At Dell Technologies, we believe there will never be greater opportunities to do well by doing good.

The challenges of transforming global energy supply and demand at speed are enormous, but together we will meet them. Find out more about how we are working with CSPs and the energy sector to create the sustainable energy infrastructure of the future.

Join us as we sustainably energize the future

[Find Out More](#)

* [Renewable energy – powering a safer future](#) | United Nations

[1] IEA (2020), [Power Systems in Transition](#), IEA, Paris

[2] [What is U.S. electricity generation by energy source?](#) [View Report on eia](#)