

Smart Substation

The bridge to the future

Why smart substations are needed to modernize the grid, address the world's climate change agenda, and unlock new revenue streams



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Renewables have ushered in a new energy system paradigm, which establishes the substation as the foundation of a smarter, more intelligent grid and the catalyst for climate change.”



Philippe Vié

Group Vice President, Energy and Utilities
Capgemini

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Autonomous control and low latency compute is absolutely essential to a modern energy system. As the grid is increasingly made up of intermittent loads, then the grid must be able to adapt to intermittency changes, automatically, and in real-time.”



Michael Bates

Global General Manager, Energy
Intel



Distributed energy and distributed intelligence go hand in hand.

As the grid accommodates a rapidly growing mix of distributed renewable resources, the grid must deliver enhanced compute, communication, monitoring, and optimization capabilities.

At the heart of this change is the smart substation—a responsive, near-autonomous, digital conversion hub that facilitates the frictionless exchange of power for a wide variety of assets, including EV charging stations, storage systems, and distributed and intermittent generation sources.

In this paper, we explore the concept of a smart substation and how organizations can harness this new asset to modernize the grid, tackle the climate change crisis, and enable valuable new revenue streams.

The smart substation as the smart grid foundation... at the edge

As utilities accommodate a rapidly growing array of distributed renewable resources at the edge of the distribution grid, they must also aggregate and optimize those resources through a range of flexible solutions, such as storage and demand response management. This optimization will enable the distributed sources to act like the types of energy they are meant to replace—namely, fossil fuel generation or other centralized generation sources that have an always-on baseload generation.

Managing this new energy system paradigm requires utilities to grow the smart grid at scale—a concept that is now possible after years of experimentation, technology improvements, and the growth of industry digital maturity.

This distributed generation model must be matched by a distributed intelligence model—by which we mean enabling computation to be deployed at the edge of the grid in order to connect and optimize intermittent loads through intelligent substation applications that communicate in real-time across grid supervisory control and data acquisition (SCADA) systems and protocols.

This transformation requires a significant change in the way today's power grid is designed, equipped, and operated; it also requires the distribution power grid to become intelligent at all levels.

“Our current grid was built to support a one-way flow,” explains **Michael Bates, Global General Manager, Energy, Intel**. “However, our current electric system requires a two-way flow between points of generation on the edge and points of demand. Implementing a smart substation can take away the friction associated with monitoring and optimizing these distributed resources and enabling the use of the highest and best use electron, be it a battery, a gas plant, or other source.”

We imagine the future of our energy system using the smart substation as the foundation of the smart grid, facilitating the two-way exchange of power, data and communication, as well as the seamless management of supply and demand balanced across the grid.

“Renewables have ushered in a new energy system paradigm,” notes **Philippe Vié, group Vice President for Energy and Utilities, Capgemini**. “Distributed energy resources necessitate an intelligent grid, which requires intelligence at any node in the grid, and also at the edge.”



What's driving the need for the smart substation



EV adoption



Energy storage



Intermittent and distributed renewables



Consumer-led demand



Consumption and generation flexibility needed for local balance



Pressure to reduce carbon footprint



Journey to the edge: Realizing the smart substation

Substation modernization requires a complete shift in the business mindset, not just for utilities, but among the supporting partner ecosystem.

Incumbent equipment and solution providers have been operating, selling, and deploying closed proprietary solutions. These are mostly point solutions, such as metering, monitoring with local IOT appliances, or security enhancements.

This traditional model creates complexity because it requires integrating a variety of solutions; it also creates silos of disparate and sometimes inaccessible data. The inability to integrate devices and applications from different vendors prevents communication and collaboration between these different components. As a result, the utility cannot operate the system holistically.

The basic premise of the smart substation is that it will:

- **Consolidate disparate grid components** into a single compute platform that delivers intelligence at every level of the grid.
- **Produce a centralized data stream** which can be used to identify new insights that the grid was not able to track before.
- **Support and enable new workloads**, like batteries and solar panels, as well as new load curves.

In this way, the substation becomes a server that monitors multiple points of input and output—in addition to its primary purposes of acting as a power transformer and distribution point. The smart substation also enables the use of intelligent automation, such as AI and ML, and pushes these technologies to the edge of the grid, enabling local, nearly autonomous, smart functionality.

“Building the substation of the future will be a big mountain for utilities to climb,” admits Bates. “At the same time, autonomous control and low latency compute are absolutely essential to a modern energy system. As the grid is increasingly made up of intermittent loads, then the grid must be able to adapt to intermittency changes, automatically, and in real-time.”

Enabling the ecosystem to realize the smart substation

While utilities may recognize the need to create a single, unified compute platform at the substation level, the current vendor ecosystem is generally unable or unwilling.

“Many vendors are willing to work with utilities to enable the smart substation through intelligent automation or next-gen technology—but they are still creating closed, point solutions,” explains Vié. “For energy companies, there is a sense of urgency about the need to move to an open solution and a frustration that they cannot get their partner ecosystem to shift in tandem.”

Defining and implementing the appropriate compute and communication architecture can only be done if all members of the ecosystem share a common vision. This means that leading IT / OT solution providers and integrators must propose and oversee such changes; the solution must also be recognized by leading transmission and distribution system operators.

Thus, we see that creating the smart substation isn't just about building a digital platform and embracing new technologies, but convening the partner ecosystem, including industrial IT / OT players, industry solution providers, network operators, technology partners, application developers, and other utilities.

"All parties must agree to use a common architecture," notes Vié. *"This is the key to ensuring ubiquitous interoperability, scalability, and cybersecurity."*

The smart substation as a climate change catalyst

Nearly every industry group and authority, including the International Energy Agency (IEA), views grid modernization as the main enabler of addressing the world's climate change needs.

Grid modernization starts with substation modernization. The substation is the critical enabler of all aspects of the smart grid, including increasing the use of renewables, EV charging, and short-term storage for intermittent renewables. Without substation upgrades, the vision for the smart grid cannot be realized.

"What people don't appreciate is the impact that the smart grid can have on climate change if we remove the bottlenecks that exist at the substation level. We can think about the grid as a climate change catalyst—in fact, the largest catalyst we have to enable widescale change," notes Bates.

Enabling new revenue streams through the smart substation

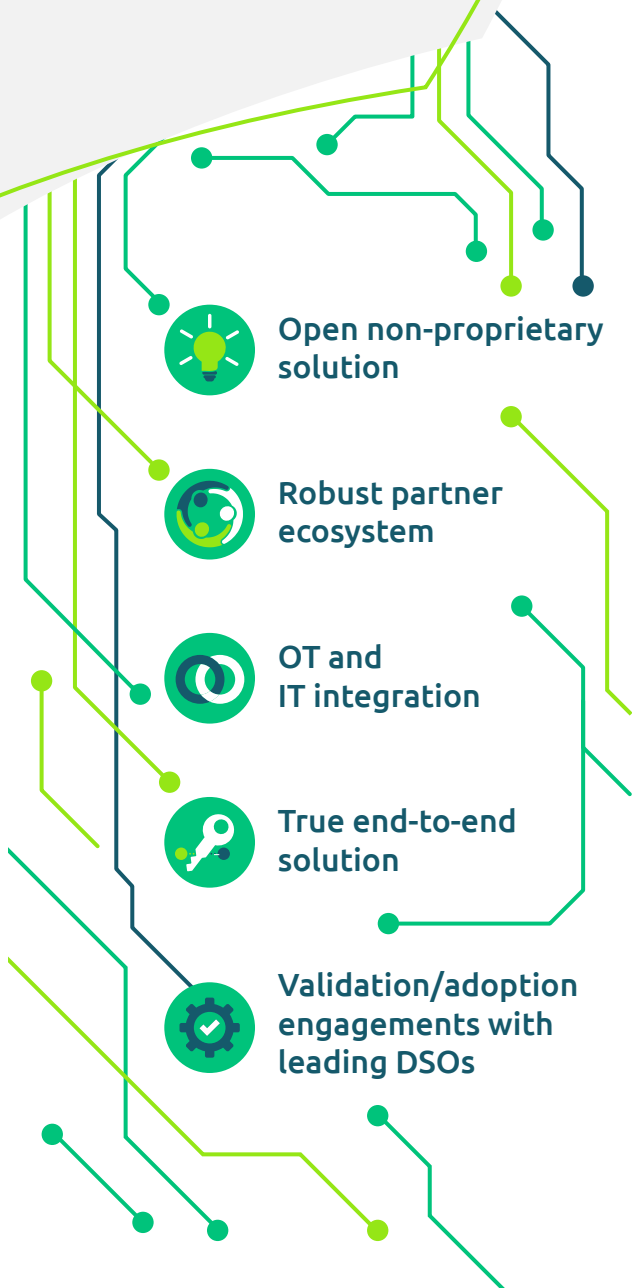
Investment in the smart grid isn't just a matter of modernizing the grid—it will also modernize the business itself, unlocking new revenue streams and enabling new business models for the energy industry.

As a point of comparison, we can consider the digital transformation of the telecom industry. Decades ago, Telcos made significant investments in broadband—an investment on which the modern-day empires of Amazon, Google, Facebook, and others are built. The companies that built the infrastructure didn't necessarily reap the rewards. What we see today with the 5G revolution is that Telcos are being much more strategic in how they monetize that service and use it as the foundation for new revenue streams.

As utilities modernize the grid and its different components—the substation chief among them—it will be important to consider how this data can be used to unlock new revenue streams. For example, the smart grid will enable new electric uses, including EV charging, auto-consumption, flexibility compensation and smart heat pumps. Deploying the smart grid also positions the electric grid as the network convergence enabler across electricity, gas, hydrogen and heating/cooling networks. Finally, the smart grid will facilitate new energy system development, including power to gas, gas to power, Vehicle to Grid and other flexible resources.



Our Substation & Edge-of-the-Grid Automation solution



Part two: Enabling the smart substation with Intel and Capgemini

Substation & Edge-of-the-Grid Automation is a new, real-time, adaptive solution from Intel and Capgemini that provides the distributed intelligence overlay to help utilities monitor and manage load and flow across all grid assets, prioritize production and consumption of clean energy sources, and flatten the rate structure.

Substation & Edge-of-the-Grid Automation from Intel & Capgemini

Intel and Capgemini's **Substation & Edge-of-the-Grid Automation** service offer is the only non-proprietary, true end-to-end, industry-driven solution that addresses the full energy value chain, from technology supply, consulting and business services, to implementation and integration through delivery and operations.

The solution combines Capgemini's extensive domain expertise and business consulting services with Intel's best-in-class technology and AI/machine learning capabilities to help utility clients enable the multidirectional flow needed to seamlessly manage supply and demand across the grid, including large and small loads and a variety of generation sources through a distributed intelligence model.

The **Substation & Edge-of-the-Grid Automation** solution is fully integrated with the Intel platform and can be operated through digital engineering services. System upgrades and maintenance are also supported as a service, improving flexibility and scalability while enabling valuable operational efficiencies and cost savings throughout the business.

Capgemini and Intel also leverage their combined relationships across the energy and technology sectors, as well as with network operators, industrial IT players, application developers, and other potential partners, helping utilities establish a compelling business case for an open, non-proprietary solution.

At a glance:

Benefits of Intel and Capgemini's Substation & Edge-of-the-Grid Automation



Traceability:

Track energy and power transactions using all nodes and administer the flow as-a-service; support fair rate regulation across the grid



Resiliency:

Reduce the prevalence of outages and associated impact through improved planning and management, increased power quality, and preventive maintenance



Efficiency:

Enable enterprise-wide efficiencies through intelligent automation, such as AI/ML, RPA, computer vision, and other high-tech applications



Tariff remediation:

Introduce greater flexibility within the tariff structure



Business transformation:

Enable new revenue streams, including EV charging stations and as-a-service capabilities



Cost savings

Reduce operational costs, as realized through improved efficiency and resiliency and as-a-service business models



Investments and planning:

Improve medium- and long-term grid planning, balancing demand and generation forecasts



Asset lifecycle improvement:

Monitor and pinpoint abnormal conditions, including edge-of-the-grid load, to better assess asset performance and identify the need for future investments



Reduced loss

Eliminate technical and non-technical loss through improved speed and monitoring accuracy

Conclusion

Grid modernization starts with substation modernization. And with Intel and Capgemini's Substation & Edge of the Grid Automation offer, it's possible for utilities to begin their journey toward a more advanced grid, healthier planet, and more resilient business today.

To learn more about [Substation & Edge-of-the-Grid Automation](#) [and schedule a demo], contact our authors and download our brochure today.



About Capgemini

Capgemini is a global leader in partnering with companies to transform and manage their business by harnessing the power of technology. The Group is guided everyday by its purpose of unleashing human energy through technology for an inclusive and sustainable future. It is a responsible and diverse organization of 270,000 team members in nearly 50 countries. With its strong 50 year heritage and deep industry expertise, Capgemini is trusted by its clients to address the entire breadth of their business needs, from strategy and design to operations, fuelled by the fast evolving and innovative world of cloud, data, AI, connectivity, software, digital engineering and platforms. The Group reported in 2020 global revenues of €16 billion.

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For more details contact:

Philippe Vié

Group Vice-President, Energy & Utilities
Capgemini
philippe.vie@capgemini.com

Michael Bates

Global General Manager, Energy
Intel
michael.e.bates@intel.com