Capgemini | intel

The Smart Substation

Substation & Edge-of-the-Grid Automation

Enabling the Smart Substation

Increased use of distributed energy resources (DERs), electric vehicles (EVs), and intelligent automation applications require a significant change in the way today's power grid is designed, built, and operated. To maintain a stable, efficient and sustainable energy ecosystem, utilities must transform the grid from a rigid, one way journey to a two-way exchange of power leveraging the ability to exchange data and using communication in a secured way.

The need for an open, smarter grid starts with substation modernization. Acting as a conversion hub, the substation needs to facilitate a frictionless exchange of power for a wide variety of assets, including EV charging stations, storage systems, and large and small generation sources. Energy organizations must optimize the production and consumption of energy in this complex ecosystem, while also protecting, preserving and extending the useful life of the existing infrastructure.

Implementing software-defined control systems for utilities enables digitalization of Automation, Protection and Control systems and more intelligent predictive maintenance and edge analytics. These types of control systems help reduce risk of hardware failures and result in improved safety, security, reliability and manageability.

Intel & Capgemini: Enhancing utility reliability, sustainability and resiliency through substation modernization

Substation & Edge-of-the-Grid Automation is a new, real-time, adaptive solution from Capgemini and Intel that leverages data, analytics, and intelligent automation to help utilities monitor and manage load and flow across all grid assets, simplify the energy ecosystem, prioritize production and consumption of clean energy sources, and flatten the rate structure. This solution helps utilities improve the overall reliability, resiliency, and sustainability of the grid while also unlocking valuable operational efficiencies and cost reductions.

Capgemini and Intel's Substation & Edge-of-the-Grid Automation service offer is the only non-proprietary, end-to-end, industry-driven solution that addresses the full energy value chain, from 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.

The Substation & Edge-of-the-Grid Automation solution is fully integrated with the Intel platform and can also be fully operated through Capgemini's digital engineering and manufacturing 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.

Intel & Capgemini's Substation & Edge-of-the-Grid Automation is purpose-built to address the limitations of a one-way grid, helping utilities:

- **Monitor and manage load and flow across all assets**
- **Prioritize production and consumption of clean energy sources**
- **Simplify the energy ecosystem**
- **Flatten the rate structure**
- **Extend asset life duration**
- **Reduce IT infrastructure footprint within the substation**

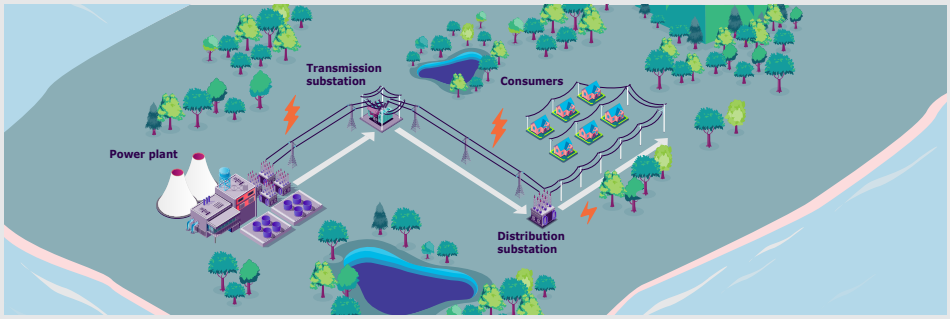
The grid modernization journey

Grid modernization transforms the grid into a balanced, efficient, multi-directional electricity flow between sources and consumers.

Flattening the Grid: Today's one-way implementation

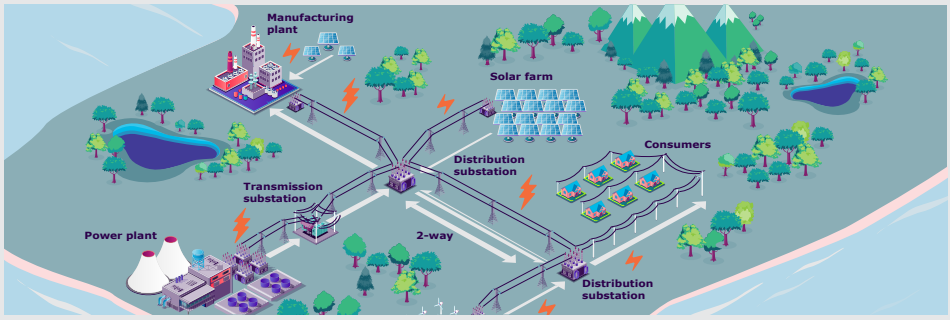
Traditional energy generation is built on a framework of large-scale generation centers. Energy is created at central sources of production, leveled down and moved to substations, then on to homes and businesses, as shown in Figure 1.

Figure 1: Traditional one-way energy flow



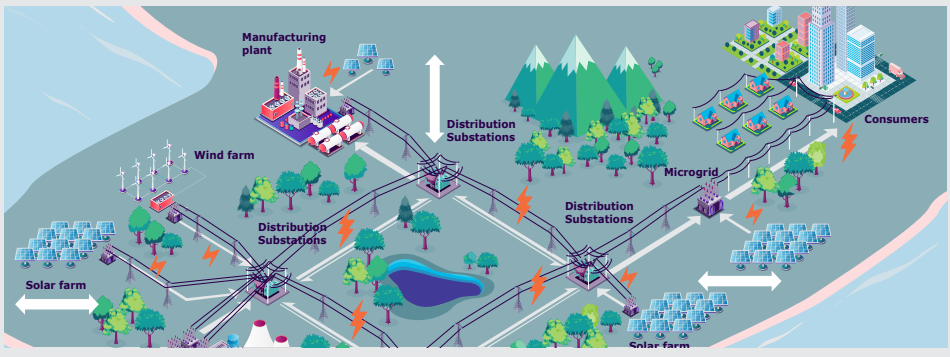
As shown in Figure 2, to serve a more complex ecosystem of energy production, traditional systems must be revectored for a multidirectional flow to seamlessly manage supply and demand across the grid, including large and small loads, and various generation sources spanning nuclear, steam, solar, wind, EV, batteries and storage systems. Enabling this integrated, responsive and adaptive system is often referred to as "flattening the grid."

Figure 2: Flattening the grid through "Smart Substation" two-way implementation



Finally, as shown in Figure 3, flattening the grid at scale requires fully virtualized and two-way multi-directional operations. This model enables utilities and service providers to monitor and manage load and flow across all assets, simplify the energy ecosystem, prioritize production and consumption of clean energy sources and flatten the rate structure.

Figure 3: Flattening the grid at scale – fully virtualized and two-way multi-directional operations



Grid modernization through substation automation delivers significant business value benefits as shown in Table 1. Together Capgemini and Intel deliver an end to end grid modernization solution that combines Capgemini services and Intel technology as shown in Table 2.

Table 1: Driving business value through a two-way grid

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 predictive maintenance in an agnostic manner (manage / integrate any supplier solution)	**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. While the solution provides data and insights to validate billing measurements, the meter or equivalent is still the primary source for billing calculations.	**Business transformation:** Enable new revenue streams, including EV charging stations and as-a-service capabilities by easily deploying both utility or third party solutions	**Cost savings:** Reduce operational costs, as realized through improved efficiency and resiliency and as-a-service business models. Combine multiple proprietary asset management platforms into one flexible standardized unit to reduce footprint and management costs.
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 accuracy of monitoring

Table 2: Capgemini + Intel: An end-to-end solution

Capgemini Services	Intel Technology	Solution differentiators
Capgemini combines domain expertise and business consulting capabilities to help navigate the how of grid modernization. • Transformation strategy & solution design • System integration • Substation resource virtualization • Technology implementation • Capgemini Cybersecurity Services • Intelligent automation • IT/OT infrastructure management • Regulatory compliance	Intel provides best-in-class technology and AI/machine learning capabilities via their intelligent ecosystem, helping connect assets and improve efficiencies: • Transformation strategy & solution design • System integration • Substation resource virtualization • Technology implementation • Intelligent automation • IT/OT infrastructure management • Regulatory compliance	• The only non-proprietary, end-to-end, industry-driven solution powered by an end to end secured platform, which creates an interoperable solution that can orchestrate and run any (third party) functionality • Plug and play capabilities with Intel's platform, driving down utility costs • Solution addresses the full value chain, from consulting to business services, to implementation and integration, and delivery and operations • Ability to fully operate and maintain the system, manage upgrades and perform maintenance, delivered as a service

Capgemini and Intel's Substation & Edge-of-the-Grid Automation solution helps organizations jumpstart their transformation journey by enhancing the digital capabilities of existing substations through data, analytics, and intelligent automation as shown in Table 3.

Table 3: Solution Overview and Benefits

Features	Overview and Benefits
Digital and Virtual Substation & Smart Grid at Scale	• Enable real-time grid health monitoring and management • Integrate unlimited renewable sources within the network
Renewables Operations & Maintenance	• Enable real-time management of generation asset performance • Improve grid integration • Reduce maintenance costs
Visual Data Analytics	• Activate 360-degree monitoring capabilities for energy assets and operations • Improve detection and response for incidents
Distributed Energy	• Support decentralized energy distribution at a district scale
Data Security	• Provide data security at rest (in any location) and "in transit" for all associated communications
Grid Monitoring / Outage Detection	• Anticipate and manage outages • Launch maintenance operations based on real-time usage • Provide digital communications to consumers informing them how to reboot or check the status of their connected devices
Aggregation / Flexibility	• Support real-time grid balancing • Enhance demand response potential, including billing schemes
Virtual Power Plant	• Aggregate heterogeneous distributed energy resources (DERs) in a cloud-based, virtual power plant • Enable power generation, as well as trading or selling power within new ecosystems, based on territory

Utility Function Virtualization

Through utility function virtualization, common substation functions from the list in Table 4 are virtualized and aggregated into common function systems that save substation frame and floor space as shown in Figure 4. The impact on associated control room footprint is shown in Figure 5

Table 4: Virtualize and aggregate these substation functions to reduce footprint and cost

Primary substation functions	Secondary substation functions
• Distributed ADMS at the edge • Edge Analytics & Asset Monitoring • Security Firewall • Anomaly Detection • Business Intelligence and Autonomous Control • RTU and HMI • Frequency and Voltage Regulation • Transformer Tap Position Monitoring • Load Curtailment and Balancing • Capacitor Bank Controller • Fault Detection & Event Recorder • Transformer Monitoring using infra-red cameras • Phasor Measurement Unit (PMU) • Protocol Translation & Data Aggregation at the edge • And more	• Data Concentrators for Smart Meters • Advanced Low Voltage Monitoring & Control • Demand and Generation Prediction Analytics • Remote Terminal Unit (RTU) • Intelligent Smart Meter Topology Analysis • Distributed Energy Resource Management (DERM) • Demand Response Management (DR) • Energy Storage Management • Substation Load Balancing & Load Profiling • Advanced Medium Voltage Monitoring & Control • Transformer Regulation Monitoring & Control • Streaming Video for Visual Monitoring • And more

Software Defined Modernization & Digitalization

Figure 4: Smart Substation utility function virtualization enables workload consolidation and footprint reduction

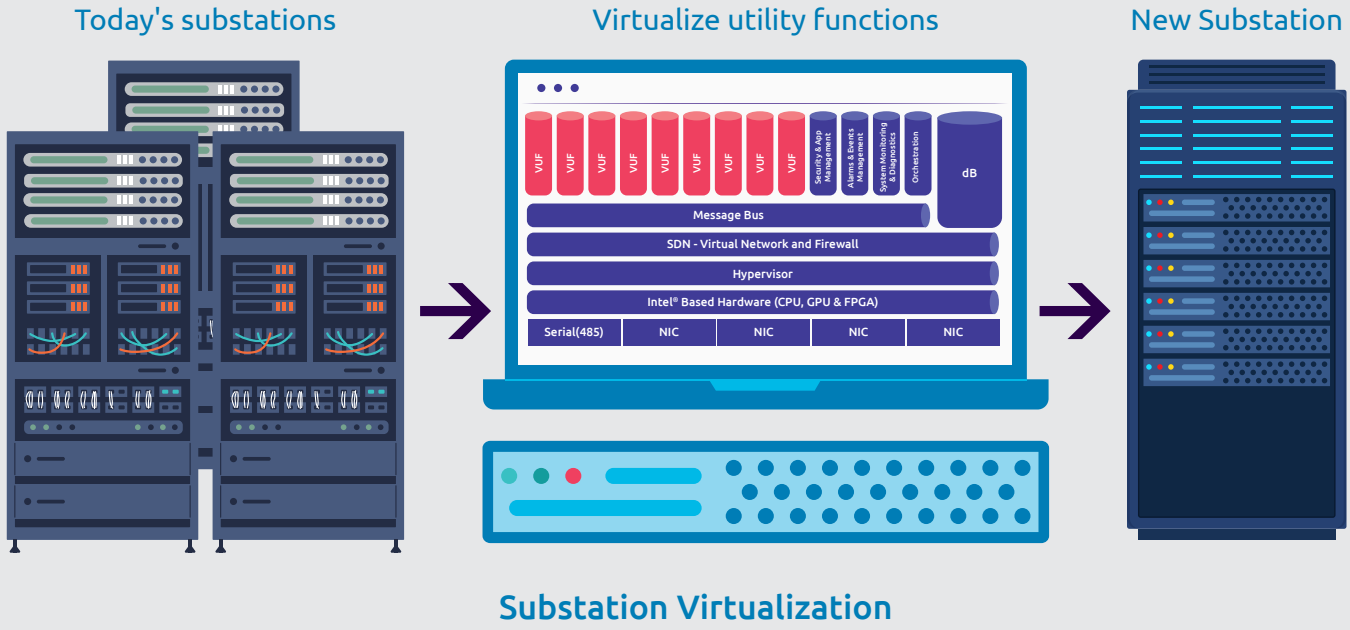
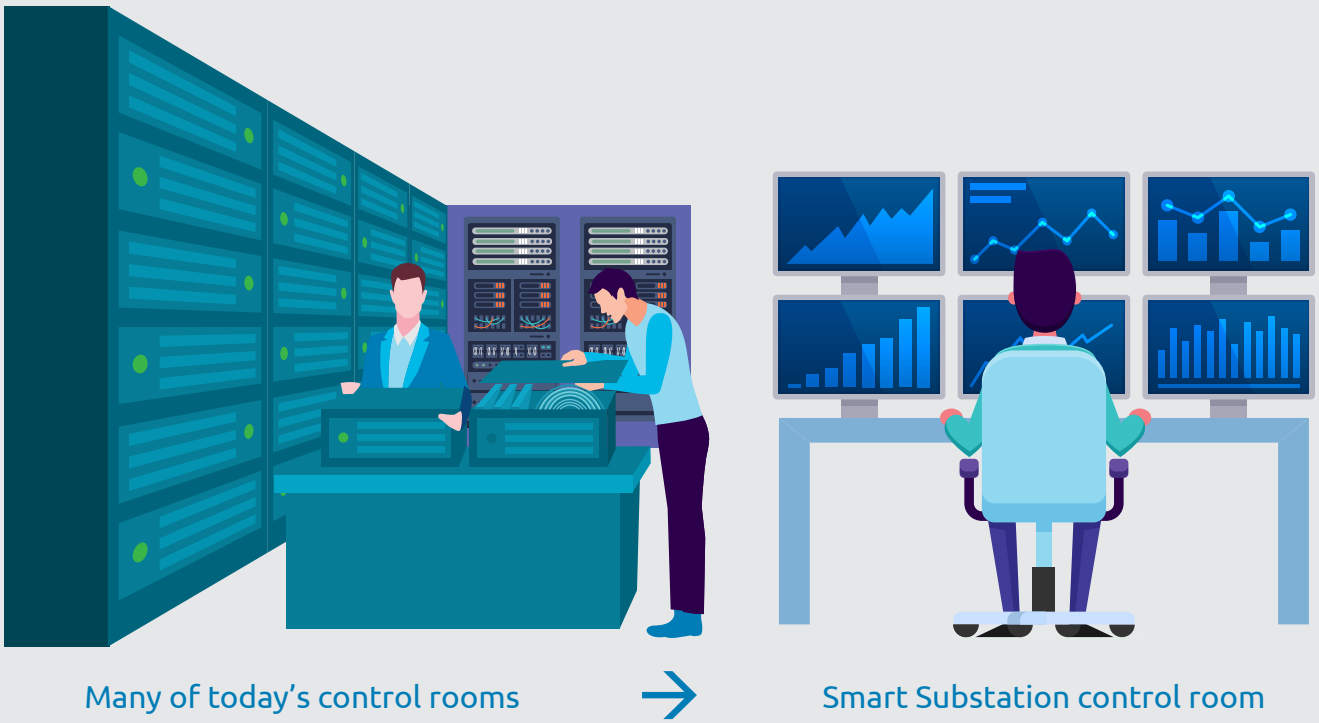


Figure 5: Smart Substation control room transformation



Why Capgemini + Intel

Smarter. More connected. More intelligent.

The Substation & Edge-of-the-Grid Automation solution is the latest example of Capgemini and Intel's long-time partnership. Our organizations have a deep and rich history of working together to create and deliver innovative, cross-industry, end-to-end solutions to help organizations transform their core business, enable new operating models, and launch services of the future.

As an Intel Technology Provider, Registered Partner, and an Intel IoT Solution Alliance Affiliate Member, Capgemini is proud to collaborate with Intel on innovations that drive new capabilities and business models to help our clients reach new levels of success.

Sectors we address together:

- Energy & Utilities
- Retail
- Manufacturing
- Transportation and logistics
- Smart cities and buildings
- Automotive
- Healthcare

New technologies we leverage together:

- Edge Computing
- Computer Vision
- Workspace Modernization
- Cybersecurity
- DevOps
- Digital Assurance & Testing
- Technology Services for Digital Automation
- Asset Management
- AI
- Analytics
- Cloud Services

Learn more about our partnership with Intel:

https://www.capgemini.com/partner/intel/

Learn more about our smart services IOT solutions:

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Transform your organization through substation modernization

To maintain a stable, efficient and sustainable energy ecosystem, utilities must transform the grid from a rigid, one-way journey to a two-way exchange of power, data and communication.

Capgemini and Intel help organizations accelerate their grid modernization journey, working with utilities and service providers to craft effective, efficient, and attainable transformation roadmaps.

Our Substation & Edge-of-the-Grid Automation solution is the only non-proprietary, end-to-end, industry-driven solution that addresses the full energy value chain-helping organizations improve their overall reliability, resiliency, and sustainability in an increasingly complex world.

About Capgemini

Capgemini is a global leader in consulting, digital transformation, technology, and engineering services. The Group is at the forefront of innovation to address the entire breadth of clients' opportunities in the evolving world of cloud, digital and platforms. Building on its strong 50-year heritage and deep industry-specific expertise, Capgemini enables organizations to realize their business ambitions through an array of services from strategy to operations. A responsible and multicultural company of 265,000 people in nearly 50 countries, Capgemini's purpose is to unleash human energy through technology for an inclusive and sustainable future. With Altran, the Group reported 2019 combined global revenues of €17 billion

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For more details contact:

Philippe Vié
Global EUC Sector Head, Capgemini
Philippe.vie@Capgemini.com

Thierry Batut
Smart Services Business Development Lead, Capgemini
Thierry.batut@Capgemini.com

Michael Bates
General Manager, Intel Corporation
Michael.e.bates@intel.com

Joe Jankosky
Director, Utilities and IoT, Intel Corporation
Joe.f.jankosky@intel.com

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