

DATA CENTER SOLUTIONS

The data center industry is evolving at an unprecedented pace, facing rapidly increasing demand, constantly shifting regulatory requirements, and surging need for energy efficiency and sustainability. As the industry adapts, there is a growing necessity for reliable and innovative solutions that help data center operators boost the potential of their infrastructure, reduce operational costs, and meet regulatory requirements for uptime, data security, and energy efficiency.

At GE Vernova offers full range of innovative products and service offerings for hyperscale, colocation, and enterprise data centers. Our solutions and services enhance operational uptime, improve performance, and lower total cost of ownership, allowing operators to meet both business and regulatory targets while supporting their long-term growth..

Challenges

- **Unplanned Outages:** Variation in workloads, particularly in AI-driven Data Centers, along with sudden loss of on-site power generation, can lead to significant downtime and disruption of critical operations.
- **Asset Performance:** Data center operators often manage significantly more secondary systems, such as cooling, power distribution, Back-up Diesel Generators and network infrastructure, than primary compute and storage assets. Lacking visibility on assets to identify and address performance issues promptly can lead to higher operational costs.
- **Cybersecurity Compliance:** Ensuring compliance with evolving cybersecurity standards requires substantial investment in advanced solutions, as well as continuous monitoring and updates to protect against emerging threats and safeguard critical infrastructure.
- **Datacenter Upgrades:** Flexible solutions to manage upgrades are crucial in the data center sector because they help address the challenges of continuous operation, scalability, cost efficiency, energy management, and security.

Key Benefits

- **Minimize unplanned outages:** GE Vernova's Asset Management Solutions and Protection & Control devices equipped with SSO functionality assist data center operators in ensuring stability and performance within high-performance computing environments. By proactively monitoring and mitigating sub-synchronous oscillations, these solutions enhance overall data center availability, especially in support of high-performance AI infrastructure.
- **Reduce downtime costs:** Our solutions such as Fast Load Shedding can operate in less than 15ms, preserving critical loads for greater reliability. Operators can also adjust the dispatch of on-site distributed energy resources for market participation and grid compliance.
- **Lower emissions for a greener environment:** Achieve easy monitoring and management of the site's energy consumption using GE Vernova's Energy Efficiency Software, while reducing GHG emissions and reaching sustainability goals.
- **Upgrade Infrastructure for Efficiency:** Using the latest electronic devices, operators can meet cybersecurity requirements, lower power consumption and increase reliability.
- **Greater deployment speed with standardized and modular solution** allowing to become more agile, cost-effective, scalable while improving future readiness.



Solutions and Services

- Energy Asset Performance Management (EnergyAPM)
- Motor Health Management (MHM)
- Device Management (DvM)
- Microgrid and Industrial Power Management
- Distributed Energy Resource (DER) Integration
- Fast and Secondary Load Shedding
- Electrical Control System (ECS)
- Energy Efficiency Software Solution
- Protection and Control – Metering, Protective Digital Relays, Digital Substations
- Industrial Communication – Wireless, Hardened Optical Networks
- Cybersecurity Solutions
- Engineering

Benefits

- Increased Availability and Reliability
- Sustainability
- Energy Saving
- Decarbonization
- Improved Asset Performance
- Improved Power Quality

Value Drivers

- End-to-End Solutions
- Vendor Agnostic
- Scalable and Flexible (from 10 to over 1 million assets)
- Highly Configurable
- Fast Deployment



GE Vernova: Data Center Industry Solutions

We offer a suite of innovative, end-to-end solutions to help Data Center owners for fast-to-deploy, integrated, vendor-agnostic, advanced, modular and more sustainable solutions.

Our solutions for the data center industry are flexible, scalable, vendor-agnostic, and configurable to meet specific operational needs. From a first equipment pilot to a full end-to-end solution, we can help transform data centers into modern, high-performance environments. Powered by AI and Big Data, our solutions offer reliable monitoring, diagnostics, and data visualization, seamlessly integrating with existing IT systems and scaling from 10 to over 1 million assets.

Our broad experience lets us better understand your needs as we develop a path to achieve desired outcome. We bring a complete range of technologies and industry knowledge together to enable cleaner, safer, more competitive, and more efficient operations for your facility.

Asset Management	With solutions such as GridBeats™ EnergyAPM, Motor Health Management and GridBeats™ Device Management, Data center operators can get increased visibility, control and monitoring of secondary and primary assets, and achieve reduced unplanned downtime and O&M costs for the facility.
Advanced Automation Applications (AAA)	AAA boost revenue by optimizing control and dispatch of on-site assets and loads, ensuring grid code compliance and access to ancillary services. They decrease unplanned downtime and protect critical loads with advanced solutions like Fast Shedding and Secondary Load Shedding. AAA support intensive AI and HPC workloads using PMU technology for real-time, high-resolution monitoring of electrical power systems, enabling efficient load balancing, power quality improvement, and system stability.
Sustainability	Our Energy Efficiency Solution (EES) revolutionizes the management and efficiency of energy consumption while effectively curbing GHG emissions, propelling organizations towards a more sustainable future.
Protection, Control and Monitoring	Reduce CAPEX and deployment time, and improve reliability with GE Vernova's Digital Relays, Feeder and Motor protection, Digital Substation, Electrical Control System and Metering products. With over 100 digital substation projects in 27 countries, GE Vernova's expertise helps industries future-proof their electrical grids and optimize asset utilization.
Industrial Communications	GE Vernova delivers comprehensive solutions for secure, resilient communication networks, specifically designed to meet the critical demands of modern infrastructure. With advanced wireless routers, cellular gateways, optical edge technologies, TDM and packet transport systems, and high-density Ethernet switches, customers gain seamless connectivity that maximizes uptime, enhances operational efficiency, and safeguards data with robust security measures.
Cybersecurity, Engineering & Consulting Services	Protect your critical industrial assets and systems from increasing threat of cyberattacks by using GE Vernova's Cybersecurity Solutions. GE Vernova also offers cutting edge technical consulting services to assist with power protection, substation automation, and monitoring and diagnostics challenges.

Data Center Facilities

- Metering (PQM, PQ, revenue grade)
- GPS and time synchronization
- Communication devices (ethernet switches, protocol converters)
- Cyber security (services - infrastructure audits, password solutions – substation layers of security, controllers & gateways)
- Software solutions (power monitoring systems, energy management system)
- Asset management, monitoring and diagnostics

Microgrid, Ren. Integration, Standby Generation & Controls

PowerNode

- Microgrid
- Fast Load Shedding
- Power Management
- ECS
- Energy Optimization

Energy Efficiency

DESP SaaS

- GHG Emissions
- Energy Monitoring
- Energy Audits

Device & Asset Health

Asset Health

- Transformer, Feeder, Motor Health Management
- Energy APM Device Health
- Device Management

Typical Data Center

Intelligent Electronic Devices

- Protection relays for LV/MV switchgear

ELECTRIC DISTRIBUTION & LOADS PROTECTION & MONITORING
GE Vernova's Data Center Solutions

Networking & Comms

Switches, Time Synch

- S20, RT430 Radio
- Orbit MCR/ECR

Generator

Generator

- 8 Series

MV Equipment

Feeder and Tie

- 8 Series
- Multilin Agile Transformer
- 8 Series

LV Equipment

Feeder & Tie

- Multilin Agile

LV Motor / MCC

Motor

- MM300E
- P50

Meters

Power Quality

- EPM5900
- PQMII Load Monitoring
- EPM6000

Substation Solutions

- PowerNode Controls
- Protection & Control
- Energy Efficiency
- Metering
- Asset Health Monitoring
- Services
- Device Management
- Advanced Automation Applications (AAA)
- Microgrid control and PMS
- Services (Engineering & Consulting, LCM, training, MSAS)
- Asset Conditions Monitoring

DATA CENTER

Asset Management Solutions

Innovative, AI-powered Asset Management Solutions to increase asset visibility, performance, reliability, and business profitability.

GE Vernova's GridBeats™ Energy Asset Performance Management (Energy APM) solution gives complete visibility into asset health with predictive and prescriptive failure detection, enabling smarter, more efficient maintenance strategies. Built with a unique and safe microservices architecture, EnergyAPM can be customized to different application needs, from daily operation to strategic planning, ranging from 10 to 1M+ assets.

Functionalities, processing power, and storage can be tailored to evolving needs at any time. The solution can be installed on premises or delivered as a cloud managed service through various contractual set-ups including multi-year agreements and outcome-based contracts.

In existing Data Centers, diesel generators are a critical backup power source should a power cut occur on the grid supply. Diesel generators can remain dormant for long periods with periodic testing based on the organizational maintenance schedules. Therefore, there is a high risk that the diesel generator will not start

when required causing an outage. EnergyAPM can capture asset design, inspection and measured information on diesel generators and provide a health and maintenance index by ensuring this critical asset is ready and reliable when needed.

The impact of unplanned downtime due to breakage of electrical motors is estimated to be more than US\$30 billion each year*. Using the **Motor Health Management** solution, data center owners and operators can leverage the latest in condition-based asset monitoring, such as Electrical Signature Analysis (ESA) and Machine Learning algorithms, to provide early detection of abnormalities and avoid process disruption from critical failures.

GE Vernova's GridBeats™ Device Management (DVM) solution simplifies lifecycle management for intelligent electronic devices (IEDs), ensuring security and resilience, and avoids human errors while streamlining operations.

* Source: GE Power. (2016). Electrical Rotating Machine APM Overview.

BUILDING YOUR ENERGYAPM

CHOOSE FROM A SUITE OF INDEPENDENT MICROSERVICES AND MICROAPPLICATIONS



Health

Improve asset life and value

- Single asset health
- Fleet health
- Zonal health
- Grouped asset type health
- Network health

Reliability

Based on assets' failure modes

- Detects impending failures
- Provides warnings and urgency
- Reliability analysis
- Asset criticality management

Strategy

Focus on target outcomes

- Lifecycle cost analysis
- O&M planning
- Simulate, improve and compare project costs and risks
- Return-on-investment analysis

Work

Prevent failures and enhance field work

- Recommendations
- Work requests
- EnergyFIT backoffice
- EnergyFIT mobile application for data collection

Lab

Advanced diagnostics and prognostics engines

- Asset diagnostics
- Dynamic loading
- Digital twin
- Predict failure and end-of-life

100+ asset models (FMEA, Health, Recommendations, Maintenance Plan)

CORE FUNCTIONALITY

DATA PROCESSING

- Data integration and storage
- Online monitoring integration
- Data classification, preparation, persistency
- Big data processing

CYBERSECURITY

- Logging
- Access control (ABAC, RBAC)
- Secure data at rest and in transit

ALERTS

- Critical events
- Alarms and events
- Offline alarm

INVENTORY

- Installed base
- Spares quantity (EnergyFIT)
- Spares cost

Advanced Automation Applications (AAA)

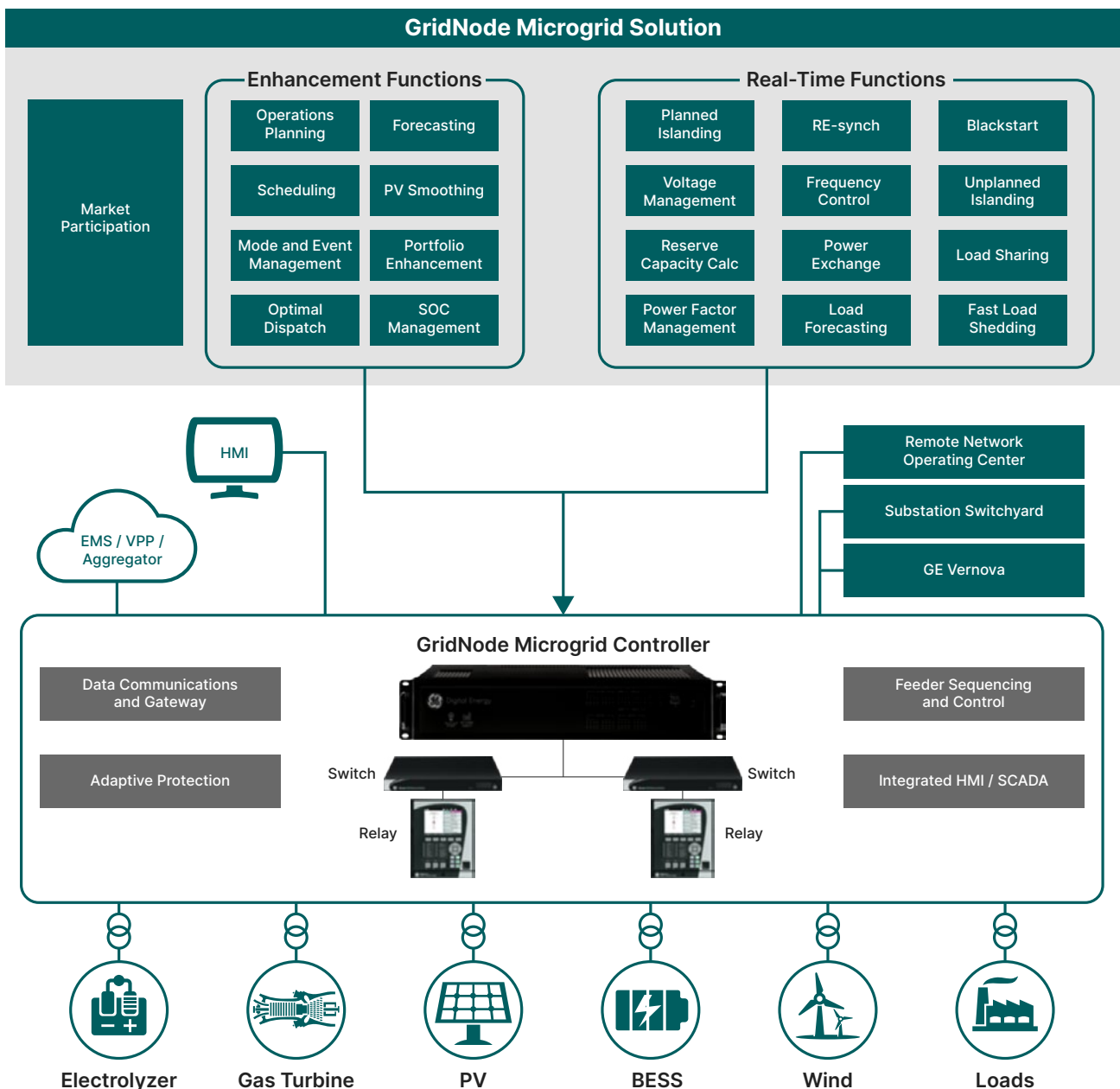
Real-time control, advanced optimization and electrical control solutions can help operators increase Return on Investment (ROI) through reduced unplanned downtime and market participation.

GE Vernova's **Microgrid** and Industrial Power Management solution offers real-time control and energy optimization to boost Return on Investment (ROI), seamlessly integrate renewables, and support sustainability goals. Data Center operators can run their facilities in grid-connected or islanded mode. The solution enables improving asset operation performance, reduces downtime and participation in ancillary services such as demand response and peak shaving to comply with grid regulations, and increases revenue.

The **DER Management** solution manages active/reactive power, power factor, and voltage at the point of interconnection, improving renewable energy integration. Additionally, GE Vernova's industry leading **Fast load shedding** solution lowers unplanned downtime

and high electricity costs, operating in as less as 15ms and ensuring system stability during critical situations. The solution provides real-time capabilities to unify load management and advanced electrical control and monitoring.

PMU (Phasor Measurement Unit) solutions in the data center industry help enhance real-time monitoring, control, and optimization of power systems. They provide precise, time-synchronized measurements of electrical parameters enabling early detection of power fluctuations, improving energy efficiency, and preventing downtime. By offering better insights into power quality and grid stability, PMU solutions help data centers maintain continuous, reliable operations while improving energy use and reducing costs.



Energy Efficiency Solution

Monitor energy consumption, reduce costs, and track associated Greenhouse Gas (GHG) emissions for the facility.

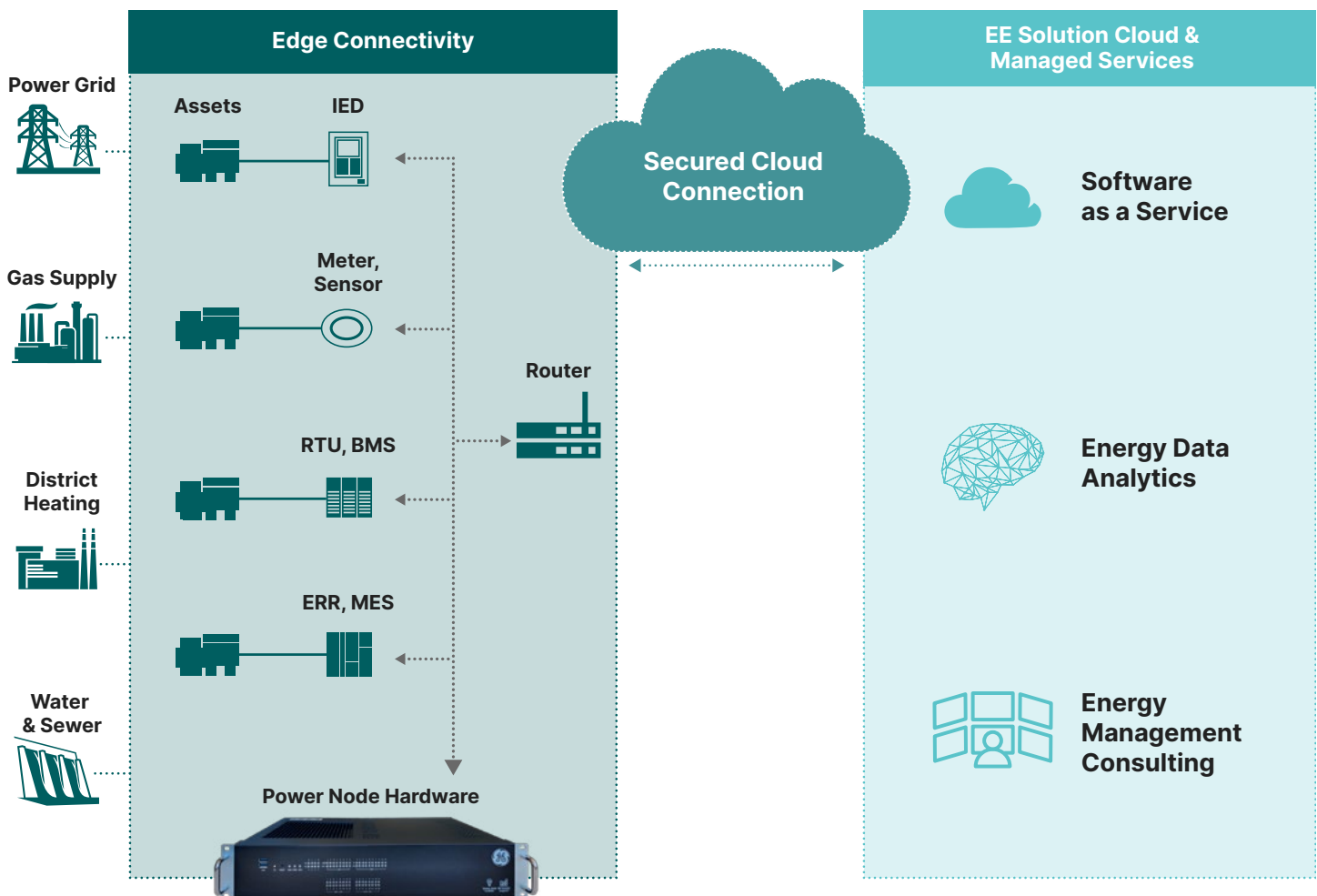
Energy costs are significant expenses for utilities and industries at large, particularly those that are energy-intensive or operate heavy machinery. Between 5% and 25%* of the expenses in these organizations are allocated to energy payments, with up to 15%** of this energy consumption being wasted during operations.

GE Vernova's **Energy Efficiency Solution (EES)** solution revolutionizes the management and efficiency of energy

consumption while effectively curbing GHG emissions, propelling organizations towards a more sustainable future. The robust and scalable EES system architecture integrates data from various sources, including sensors, meters, and IoT devices, to provide real-time energy monitoring and optimization. It leverages advanced algorithms and cloud-based infrastructure to enable seamless data analysis, decision-making, and energy management.

Key Features

- **Customizable Dashboard:** The EES solution uses a cloud-based application to store and display data for analytics and monitoring. The EES dashboard personalizes the user experience by tailoring data views based on individual preferences. Users can select and share a range of widget types for effortless collaboration.
- **Energy Performance Indicators:** Easily create and configure energy performance indicators using any type of data, giving the power to track the most important business metrics.
- **Energy Data Management:** The EES solution relies on efficient energy data management, allowing for the collection, analysis, and utilization of energy data. It enables detailed insights into energy consumption patterns through meter interval data calculation. Advanced analytics are utilized to identify anomalies, promptly notifying users of overconsumption or deviations.
- **Managed Services:** Services include site audits, energy performance follow-up and benchmarking to evaluate energy performance against industry standards.



*Source: CaixaBank Research

**Source: IEA (International Energy Agency)

Protection, Control and Monitoring

Enhance reliability of your critical assets and reduce cost of unplanned downtime through advanced diagnostics, monitoring and predictive maintenance.

Protection Relays and Power Quality

GE Vernova's digital relays protect vital equipment, reducing downtime with advanced diagnostics and predictive maintenance features. Our **feeder protection systems** provide flexible and programmable protection for switchgear across voltage levels, with high-speed tripping, Sub-Synchronous Oscillations detection and arc flash sensor technology reducing damage and downtime in critical situations. The **motor protection systems** use advanced thermal modeling to provide enhanced protection and ensure highest process uptime.

GE Vernova's **Metering** devices ensure reliable and efficient energy use, improving power quality through cost-saving solutions like harmonics monitoring and voltage balance.

Electrical Control System

GE Vernova's Electrical Control System (ECS) is a comprehensive solution that includes software and distributed logic for the automation and monitoring of electrical networks. ECS collects, controls, and monitors electrical data from a wide range of devices, such as protection relays, circuit breakers, transformers, and control systems within the data center, from high-voltage transmission systems to low-voltage distribution panels. The multiprotocol ECS platform offers the flexibility and scalability required to integrate multivendor devices, enabling seamless adaptation from small installations to large substations. With ECS, the operational control and protection systems remain independent yet fully integrated, utilizing unified interfaces such as Operator Workstation HMIs, alarm management systems, and data historians to ensure efficient, real-time monitoring and control across the entire system.

Digital Substation

GE Vernova's **Digital Substation** solutions convert analog data into digital for seamless real-time transmission and sharing across devices and substations. This enables reduced CAPEX, faster deployment, improved reliability, and enhanced system awareness. By using IEC 61850 communication protocols, our solution allows greater interoperability and lowers the total cost of ownership. With over 100 digital substation projects in 27 countries, GE Vernova's expertise helps industries future-proof their electrical grids and optimize asset utilization.

GE Vernova's digital substation solutions:

- Reduce CAPEX by eliminating duplicated hardware (CT, VT are no longer required)
- Improve workforce safety (miles of copper wires are replaced with fiberoptic cables)
- Reduce substation footprint by up to 50% through a smaller control room
- Reduce engineering work through simplified system drawings
- Bring easier, faster and remote commissioning/testing
- Improve system reliability through increased situational awareness and asset utilization



Industrial Communications

GE Vernova provides advanced communications solutions for the Data Center industry, designed to enhance reliable and flexible communications across critical infrastructure and operational environments.

In the fast-evolving world of data centers, environments demand communication solutions that are engineered to perform reliably in highly controlled yet critical conditions.

GE Vernova provides advanced equipment designed to support data center substations and the broader connectivity grid, enabling real-time monitoring, control, and communication. From wireless routers and networking solutions to TDM and packet transport systems, these technologies ensure seamless power distribution and grid connectivity, minimizing downtime and enhancing overall data center performance.

- **Real-time Monitoring & Control:** Enable continuous monitoring of power grids and network performance, allowing for faster response to issues and proactive management of critical assets.
- **Optimized Uptime:** Reliable equipment and communication solutions that maximize uptime by maintaining smooth, seamless operations and efficient power distribution across the facility.
- **Enhanced Reliability:** Ensure consistent and uninterrupted communication between data center systems and substations, reducing the risk of downtime and power disruptions.



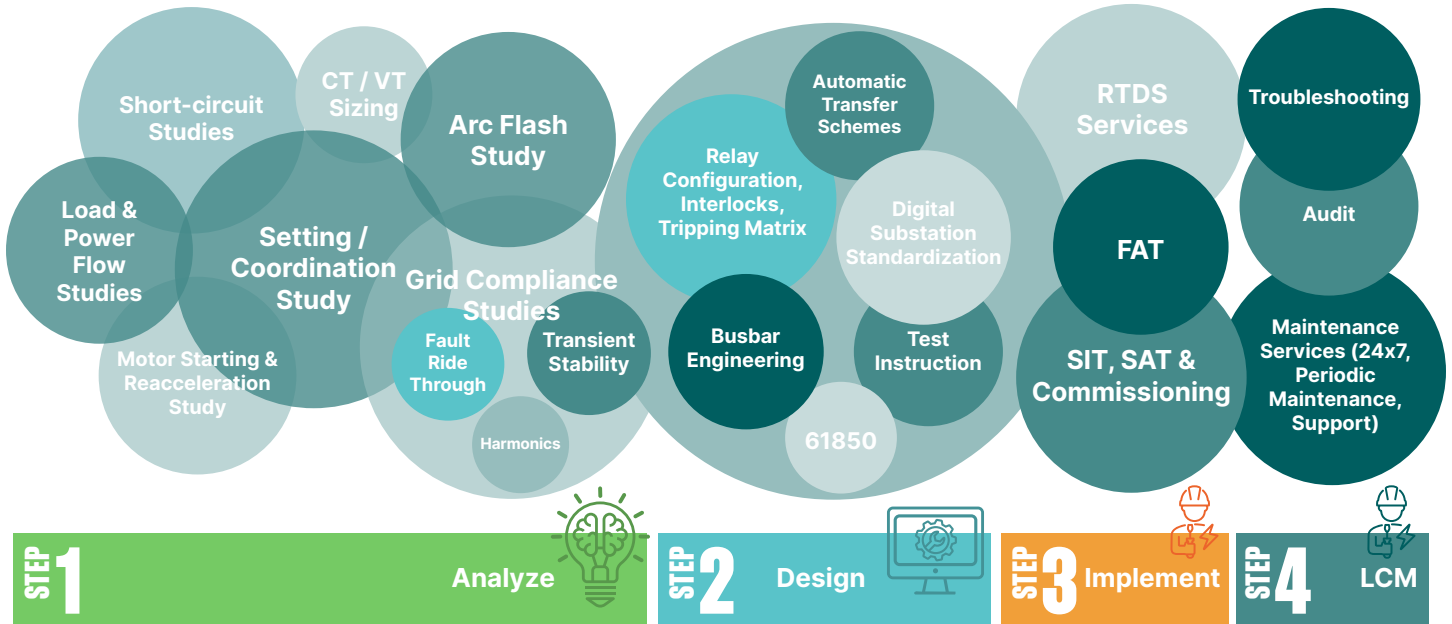
Engineering and Consulting Services

GE Vernova designs and executes a comprehensive service strategy that is tailored to data center specific needs for best-in-class performance and long-term success.

GE Vernova Grid Automation's technical consulting services team provides a wide range of capabilities to assist with power protection, substation automation, and monitoring and diagnostics challenges. From new installations to upgrading an existing system, our consulting team has been trusted to analyze, design, and implement modern power systems.

What sets us apart is our commitment to a complete life cycle approach right from real time simulations, network studies, and

testing and commissioning Support. GE Vernova knows that successful projects require seamless coordination and collaboration across various phases. By offering end-to-end solutions, the need for multiple suppliers or consultants are eliminated, thus Data Centers are provided with a streamlined and efficient experience. Our team possesses the expertise and experience to navigate the complexities of every project stage, from engineering design to commissioning, ensuring a successful outcome.



Cybersecurity

To protect critical data center systems from the increasing threat of cyberattacks, GE Vernova offers innovative Cybersecurity solutions to increase operational integrity, comply with regulations and control costs of security.

Key Features:

- Centralized users, roles, and password management
- Centralized logging of security events through SYSLOG
- Intrusion detection system
- Network segregation with VLANs and Firewalls
- Centralized anti malware management
- Security updates

Key Benefits:

- Increased security with multi layered approach
- Interoperability with use of standard protocols
- Faster incident response with enhanced monitoring capabilities
- Assists in compliance for regulatory and international standards, such as NERC Business

For more information visit www.gevernova.com/grid-solutions



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