Grid Solutions

MICROGRID SOLUTIONS

Improve Grid Resiliency, Reliability and Efficiency

GE VERNOVA

Today's Environment

As power demands continue to rise, and energy availability and reliability become a primary concern, utilities, commercial and industrial companies need solutions to ensure they have a reliable, resilient, and economical supply of electricity.

Decarbonization, Digitization, Decentralization, and Electrification trends are leading to the current changing energy landscape. This includes wide proliferation of Distributed Energy Resources (DERs), which is being driven by the following factors:

Changes in Policy and Regulation

Globally countries have set targets for the increase of renewable energy and reduction of greenhouse gas emissions. For example, the UK is aiming to reduce 20% of greenhouse gas emissions by 2020. In the US, many states have recently set renewable energy targets for 2020 and beyond.

Security of Supply

As traditional fossil fueled generation plants are reaching end of life, countries need to find new sources to meet their growing demand. Implementing and managing multiple energy sources, including renewable generation, helps to maintain energy security. Furthermore, local management of DERs reduces supply chain risks associated with traditional energy sources.

New Revenue Streams

Attractive feed-in tariffs for renewable generation have seen new investors outside the traditional energy industry investing in renewables bringing new entrants to the market. New commercial models are emerging including peer to peer energy transactions.

Increasing Availability and Affordability

As DERs are becoming more cost effective and readily available, there is a rise of the prosumer, where customers are both the producers and consumers of electricity.

Helping Enhance Productivity Through Energy Surety

When industrial and manufacturing companies lose power, it can cost millions of dollars in down-time, waste and equipment damage. Implementing distributed energy resources enable industrial customers to continue operating even if the main grid is down.

Utilities and power producers must adapt and ensure they can find an optimal balance between supply and demand, and facilitate market changes to ensure reliable and economic operation. Integrated Microgrid Systems provide the set of solutions that are needed to manage Distributed Energy Resources efficiently and can also help the grid address the growing demand while enabling higher levels of devolved control.

In US 95GW generating capacity has or set to retire

More than 1.2B people around the globe live with power

By 2040, RENEWABLES will represent 30% of global net electricity

TRENDS DISRUPTING THE TRADITIONAL POWER SECTOR

What is a Microgrid?

A microgrid is a contiguous section of the grid consisting of inter-connected Distributed Energy Resources (DERs) and loads under common control. DERs can be distributed renewables, generators, storage devices, electric vehicles and demand response. Microgrid controls can optimize the power mix of the DERs and loads to provide reliable and economic operation to the end users.

Microgrid controls can also provide a resiliency service by operating the microgrid as an independent electrical island disconnected from the rest of the grid if required. There are different types of microgrids including:

Permanently Islanded Microgrids

These are off-grid systems where only locally generated power is consumed to meet the needs of the local demand.

Grid Connected Microgrids

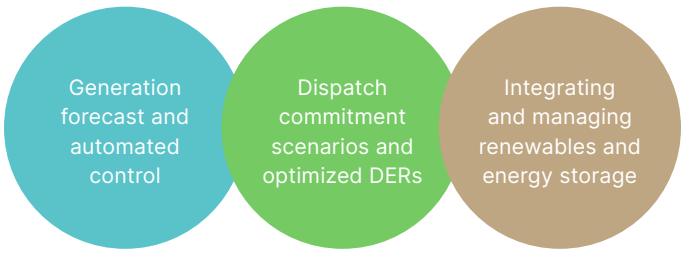
These can produce and distribute power within its local distribution network as well as import power from a utility source.

Virtual Power Plants and Microgrids

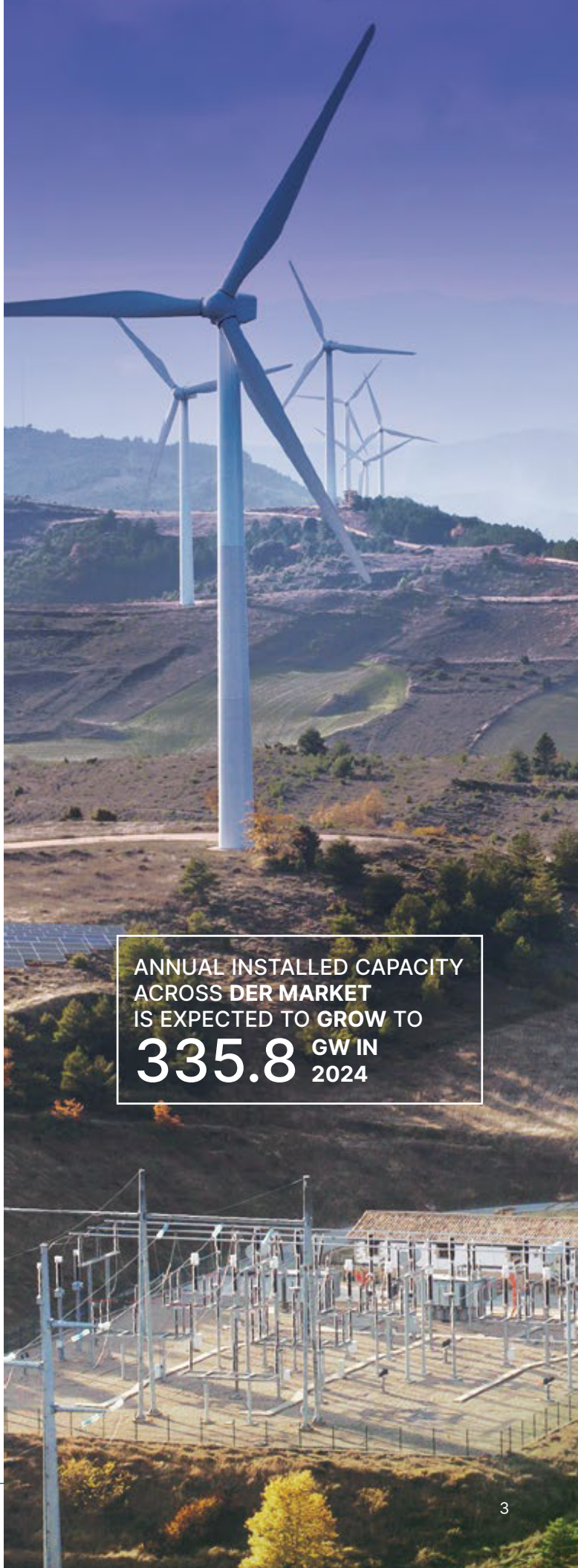
A Virtual Power Plant (VPP) differs from a microgrid in that a VPP is typically associated with energy resources but not within a specifically defined grid boundary or grid sections. A VPP could be associated with, and operate within, a microgrid if the VPP resources are connected within the microgrid. Alternatively, a VPP can be a collection of microgrids.

Benefits of Microgrids

Microgrids can improve the electrical network through an optimized balance between supply and demand, where customers are able to dynamically utilize the most economic mix of supply and integrate variable supply resources. This is done through:



In addition, microgrids can help facilitate the energy trading mechanism and enable market transaction integration with utilities providing proactive management of existing energy contracts.



GE Vernova Solution

GE Vernova's GridNode Microgrid solution is a field proven, modular and comprehensive offering that integrates primary equipment, intelligent controls and communications, with advanced visualization and supervisory control software to monitor, track, and forecast load and generation resources within the microgrid network. Although each solution is tailored to a customers specific system it is based our configurable GridNode solution.

Consulting Services Include:

- Technical and economic feasibility studies
- Business case development
- Detailed engineering designs
- Grid interconnection studies
- Protection and controls

The System Components Include:

- GridNode Microgrid Control System
- GridNode Microgrid Energy Management System
- Generation solutions – gas, storage, hydro & wind
- Protective Relays and Communications
- Services (engineering, project management, installation & commission, maintenance and asset performance management services)

Functionality Includes:

- Real Time Controls and Operations
- Transition Management
- Optimization and Dispatch Control
- Operational Planning and Scheduling
- Ancillary Services Participation
- ADMS/DMS Integration
- Analytics and Reporting

The Solution can be Delivered as:

- Engineering Solutions & Services
- Technology & Equipment
- Full Engineering, Procurement and Construction

GE Vernova Advantage

GE Vernova is globally recognized for designing, delivering and servicing customized microgrid solutions for diverse applications. GE Vernova is able to offer a comprehensive solution including feasibility studies and network analysis, project management and design, primary and secondary equipment, controls and advanced visualization tools. Working with GE Vernova, customers can realize the following business outcomes:

Improve Grid Reliability

With GE Vernova's uniquely designed solution for grid resilience, energy and system reliability

Reduce Op-Ex

Advanced operation controls for energy bill reduction, demand response efficiencies and power mix optimization

Improve Financial Performance

Monetize the value of assets through new revenue streams

Increase Operation Efficiency

Single platform for managing grid assets, generation assets, customers (loads), markets and other counter parties

INTEGRATED, TAILORED SOLUTIONS
FROM CONSULTING SERVICES TO SYSTEM OPTIMIZATION

GE Vernova Approach

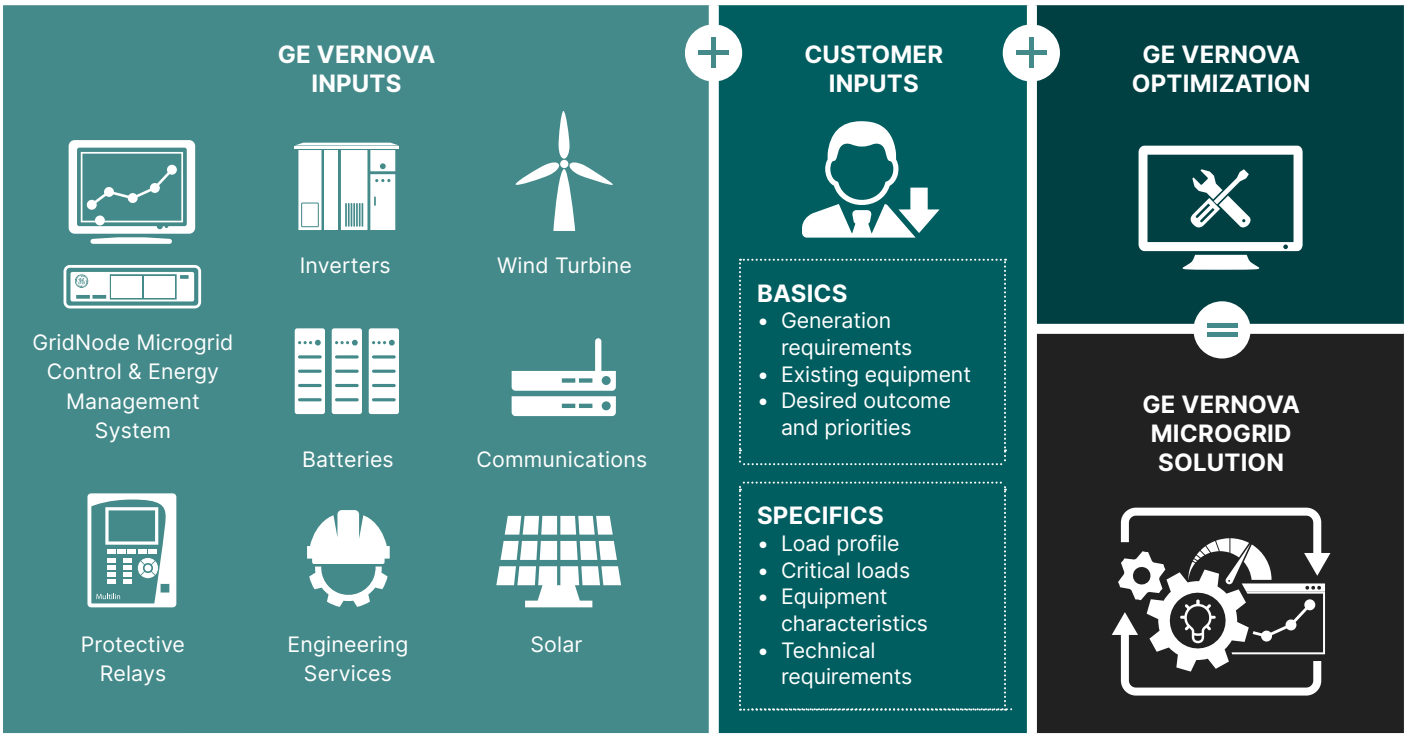
GE Vernova works with customers and partners to define the project scope and vision. This process begins with the development of the "Microgrid Energy Master Plan," when GE Vernova consultants perform the cost-benefit analysis of different scenarios to define the multi-year roadmap of capital projects supported by operation and maintenance projects. Our approach results in a formalized business case tailored to the desired customer outcome for the project.

GE Vernova's System Approach

1	2	3	4
Business Case Cost-benefit Simulation Analysis	**System Engineering** Feasibility and Planning Studies	**Engineering Solutions & Services** Design, Configuration, Integration, Installation, Commissioning and Testing	**Service Agreement** Training, Operation, Long Term Services

System Design Process & Optimization

Once the project scope, business objectives and services are understood, GE Vernova's technical experts will scope the energy sources, equipment and services required. Then, utilizing an advanced optimization tool, GE Vernova delivers an a tailored solution to meet the customer's requirements and business objectives.

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kW Plan 22
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kVAR Plan 13
Oct 11, 2016 9:05 AM
kW Plan 21
Oct 11, 2016 2:02 AM
OPERATING PLAN
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Enphase
Green Charge

Application Examples

APPLICATION
MILITARY

PROJECT
NAVY SHIPYARD

LOCATION
PHILADELPHIA

Challenge

Meet the existing and future electricity capacity needs and integrate on-site generation and storage capabilities to reduce and flatten the overall load curve of the campus. Ensure greater energy efficiency and power system availability.

Solution

A suite of power system modernization solutions and a grid connected microgrid system for resilient, reliable power including:

- Microgrid Energy Management System
- e-terra software platform (Microgrid-SCADA & Microgrid-DMS)
- Digital Substation - Agile protection and control relays
- DS Agile – DAPserver grid automation controller
- Reason Ethernet switches
- Nanogrid controllers

APPLICATION
INDUSTRIAL

PROJECT
ALUMINIUM PRODUCTION FACILITY

LOCATION
UNITED ARAB EMIRATES

Challenge

Ensure maximum uptime for continued and safe plant operations in the event of utility power loss.

Solution

Microgrid system with fast loadshed capabilities to enable:

- Optimal integration and management of renewable generation including solar and back-up for maximum process uptime
- Seamless transition of power from utility source to on-site generation
- Fast loadshed of non-critical loads if load exceeds available generation

APPLICATION
CAMPUS

PROJECT
UNI. OF ONTARIO INSTITUTE OF TECH.

LOCATION
CANADA

Challenge

Reduce electricity costs on campus while maximizing renewable sources, and provide a seamless transition between grid connection and on-site generation for critical loads during grid failures.

Solution

Campus-based microgrid system with monitoring and control capabilities deliverying:

- Active system to optimally control Battery Energy Storage System (BESS) and other energy storage sources based on different forecasting engines, providing a seamless transition in case of grid failure
- Simulation tool to evaluate the performance of the control system when faced with different load and electricity prices
- Monitoring system to provide status, event, and alarm management with remote data access

APPLICATION
SMART CITY MICROGRID

PROJECT
NICE GRID

LOCATION
NICE, FRANCE

Challenge

Enable the prosumer to efficiently take advantage of significant photovoltaic distributed generation and energy storage, by enabling islanding for secure supply and provide demand response solutions for flexible consumption.

Solution

Grid modernization solutions delivering a community based microgrid including:

- e-terra Platform Distributed Energy Resource Management Solution (DERMS)
- Microgrid Energy Management System
- DS Agile microgrid controller
- DAPserver substation SCADA SA-DA platform
- Agile protection and control relays
- Reason Ethernet switches

APPLICATION
UTILITY

PROJECT
ISSY GRID

LOCATION
ISSY-LES-MOULINEAUX, FRANCE

Challenge

Reduce consumption peaks and ensure grid balance while reducing the carbon footprint of the district.

Solution

District level microgrid system to optimize energy efficiency for a variety of loads including: commercial, residential, street lighting, EV charging and public buildings. GE Vernova's microgrid solution provides monitoring and control of:

- Renewable generation integration
- Energy storage
- Smart street lighting
- EV charging

APPLICATION
COMMUNITY RESILIENCY

PROJECT
POTSDAM NY MICROGRID

LOCATION
POTSDAM, NY USA

Challenge

This town in northern New York, near the Canadian border, had experienced significant winter ice storms that wiped out power to much of the town and its critical and emergency response infrastructure for an extended period of time, putting the community and its residents at risk.

Solution

GE Vernova's Energy Consulting business partnered with National Grid, Clarkson University and Nova Energy specialists to engineer the technical and economic designs for a resilient microgrid for the community. This project is part of the state's larger "Reforming the Energy Vision" initiative, also known as NY REV. GE Vernova's scope of the solution includes:

- Business case development
- Economic dispatch modelling
- Interconnection and stability studies
- Distribution infrastructure, communications and controls design and engineering

Key Components

Microgrid Services

GE Vernova provides a full range of services from microgrid design and simulation to optimizing microgrids for resiliency, reliability, up-time and performance. GE Vernova's service agreements are customized based on the customers' requirements. Microgrid owners can lower their operating costs and mitigate operational and financial risks. GE Vernova's services include:

Microgrid Advisory Services

- Concept plan
- Load analysis and DER specification
- Cost-benefit analysis and energy master plan

Microgrid Engineering Services

- Feasibility Studies
- System Studies (transient and steady state)
- Configuration
- Integration
- Installation & Commissioning
- System Testing

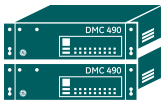
Microgrid Operation & Maintenance Services

- Multi-year service agreement
- Performance and availability based contract
- Preventive and condition based maintenance
- Asset Performance Management (APM)
- Grid modernization and upgrade

GridNode Microgrid Optimization

GE Vernova's GridNode Microgrid Energy Management System (MEMS) is a single, unified platform for microgrid planning and operation optimization. Operators are able to monitor, optimize and control the system to reduce the overall energy cost and improve system reliability and resiliency. The MEMS is a multi-layer control system with the functionality to:

- Create a Day-Ahead (24hr), 15min or 1hr granularity, Optimal Dispatch Plan for Grid (import/export), DERs, and Loads.
- Optimize based on *Economics, Maximize Renewables, Minimize Emissions, Maximize Time of Life, Peak Reduction, or Minimize the Use of a Battery*.
- Incorporate real-time asset status , network changes, and operating values
- Perform Event Driven optimization
- Integrate dynamic data include Grid Prices, Load Forecast and Generation Forecast.
- Manage the State of Charge of the BESS with hard and soft limits
- Track key KPIs for the optimization cases and system
- Compare multiple multiple optimization cases prior to scheduling.
- Track plan verse actuals for the optimization schedule



GridNode Microgrid Control

consist of a powerful multi-functional automation controller that operates the GridNode Microgrid Control Appliction Function Blocks (AFBs) that is specifically designed, tested and validated for the control of microgrids.

The GridNode Microgrid Controller supports applications for real-time operations control, transition management, optimal dispatch, and operational planning. Each application and system can be designed and configured based of the system requirements.

Energy Storage Solution

GE Vernova's Reservoir solution is a flexible and modular energy storage solution for AC or DC coupled systems. This innovative and standardized architecture is designed for energy, power and renewable applications.

The Reservoir solution is an integrated turnkey offering that combines GE Vernova's advanced technologies and expertise in controls, power electronics, battery and operational management systems, and electrical balance of plant – all backed by GE Vernova's performance guarantees.

FROM OPERATIONAL SOFTWARE AND INTELLIGENT CONTROLS TO ENERGY STORAGE AND SERVICES, **GE VERNOVA DELIVERS COMPREHENSIVE MICROGRID SOLUTIONS**

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

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