

Microgrid energy system — government applications

Electrical Engineering Services & Systems



Power is everything... ensuring mission operability

The government's as well as the Department of Defense's most critical global assets rely on commercially operated electrical grids for their primary source of electricity. In most cases, neither the grid nor on-base backup power provides sufficient reliability to ensure continuity of critical national priority functions and oversight of strategic missions in the face of a long-term outage.

The solution? Microgrids. A microgrid is a stand-alone, power generating, distribution and storage system that can isolate itself from the primary utility grid, provide load control and optimize energy usage—it is a reliable and efficient solution to unexpected power loss.



According to Eaton's Blackout Tracker Annual Report, electric outages cost our economy \$150 billion annually and impact approximately 14.2 million people.

Eaton's microgrid/energy storage experience

The nation's IT and communication infrastructure rests on a fragile foundation—the utility grid. The grid is susceptible to natural disasters (Super Storm Sandy and Hurricane Katrina), solar flares (Canada 1989), circuit overload/failure (2003 Northeast blackout), sabotage (PGE Santa Clara, CA substation shooting) and electromagnetic pulse detonation (EMP) that could result in massive, long-term outages affecting the most critical of areas.

Over the last decade, Eaton has successfully applied its power systems expertise to the design and implementation of microgrids and complex energy storage systems for military facilities, government campuses, forward operating bases, mission-critical facilities, hospitals and more. We understand microgrids' and energy storage's inherent electrical behavior and challenges. Our power system experts have developed and harnessed unique optimization strategies that maximize system performance, functionality and reliability.

Eaton's solution

Our experience supplying control systems for microgrid and energy storage applications molded the design basis for the Eaton Microgrid Energy System (MES) with the Power Xpert Energy Optimizer™ controller: a microgrid/energy storage control system that, by design, simplifies control system configuration, testing, project cycle time and future adaptability to changing microgrid assets. At Eaton, we believe that advanced control systems should be configured rather than custom programmed—the Power Xpert Energy Optimizer controller accomplishes these goals for both microgrid and stand-alone energy storage applications.

Eaton's solution creates energy islands for the long-term operation of critical infrastructure, which is a must in providing the level of power supply security necessary to ensure continued mission-critical operations as well as life-sustaining support.

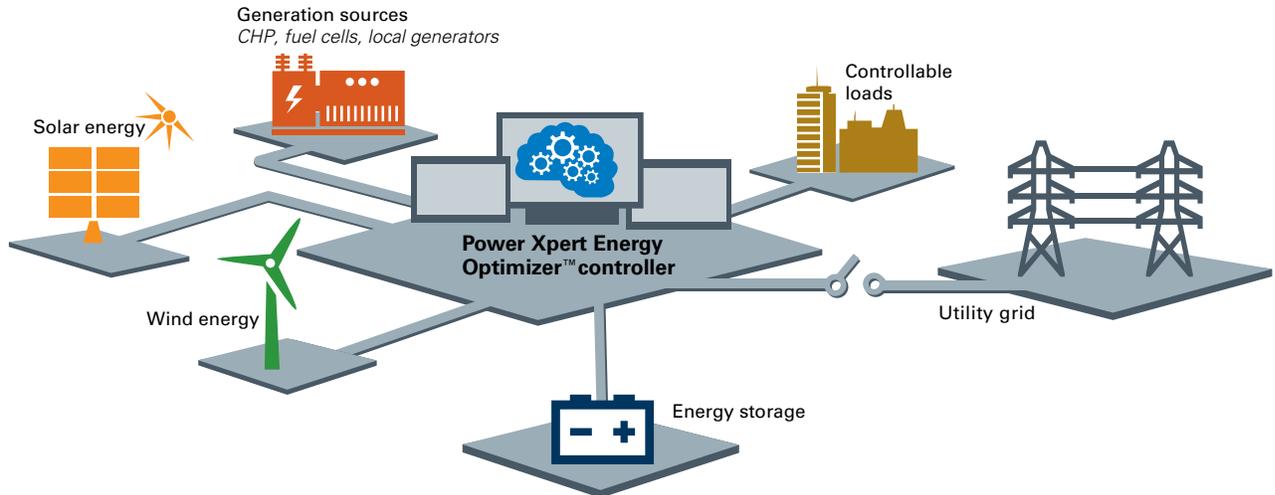
EATON

Powering Business Worldwide



View Eaton's microgrid capabilities video.

Eaton microgrid energy system



Generation, distribution and control



Eaton's modular approach greatly simplifies the overall control system configuration, integration, testing, training, on-going support and future adaptability of the Eaton MES to changing assets as microgrid systems evolve with new generation resources, economics and changing load configurations and priorities.

Proven, reliable systems

The hardware basis of the Eaton MES is the utility-proven SMP family of controller, server and I/O modules coupled with our Yukon™ Visual T&D HMI products. These products are designed and implemented for substation automation applications with installations throughout the world, and are environmentally hardened with a long operational history in harsh outdoor utility applications. By careful design, they include the latest utility cybersecurity features and safeguards embedded into each system device as well as system wide.

For ease of configuration and maintenance, the Eaton MES is based on open standards throughout, including IEC 61850 communications. Designed for substation applications, IEC 61850 has the advantage of providing fast communications for successful control strategy execution requiring low latency times such as equipment protection applications or voltage and frequency regulation control.

Power Xpert Energy Optimizer controller

The Power Xpert Energy Optimizer controller is the MES' system control module. It maintains overall system stability, shaves peak demand, shifts loads, manages black starts, achieves lowest total cost, maximizes renewable energy contribution and provides utility demand response functionality.

Modular approach/scalable system

The Power Xpert Energy Optimizer controller implements a modular approach. Each type of generation source and load modules are configured for each application using unique templates. Each module includes the unit/load control module, alarms, reports and needed HMI screens for integration and implementation of that generation source or load.

The Power Xpert Energy Optimizer controller's modular approach allows the Eaton MES to be efficiently scaled to any application size, or adapted to changing generation/load assets, simply by choosing and configuring the appropriate templates. Preconfigured and customer templates are available so our customers can achieve their specific functionality requirements.

Predictive control

Predictive control strategies utilize weather or price forecasts to proactively engage assets and load controls to achieve maximum system performance.

Pre-tested to ensure functionality

Prior to delivery, each microgrid system is subjected to a closed loop simulation test to ensure system functionality and control integrity before it arrives at the customer site.



Available functionality

- Individual generation source and load control
- Ramp rate control for integrated energy storage and PV applications
- Smart energy storage integration and management
- Full system communications including high-speed peer-to-peer messaging
- Local system HMI with system displays for control and system status, alarming, trending and history
- Unintentional and intentional seamless islanding
- Automatic energy management control
- System power quality management
- Synchronized grid reconnection
- Grid-fault detection, isolation and safety interlocks
- Black start, including sequencing and power quality stabilization
- Frequency and voltage control, including ancillary services
- Fast internal demand response control
- Enterprise integration (SCADA, OMS, etc.)

Control options

- Low cost operation
- Priority load control
- Renewable maximization
- Energy arbitrage
- Peak shaving
- Load shifting
- Conservative voltage regulation
- Predictive control profiles given weather and price forecasts
- Utility demand response functionality
- Embedded battery management system

Total system design and support

Eaton's power system expertise and engineering service capabilities cover the vital aspects of a microgrid or energy storage system application including:

- Microgrid feasibility study
- Total system design
- Control system
- Project implementation
- Full system commissioning and startup
- Ongoing maintenance

Eaton offers turnkey solutions for microgrid systems, including generation equipment. The benefit of turnkey supply is having a single point of contact for the entire microgrid project given our advanced project management capabilities. Our electrical engineering services and systems capabilities span the total life-cycle from engineered design, testing and commissioning, through life extension and modernization needs.

Eaton's broad utility product capabilities, power systems design expertise, supply of renewable energy installations, energy storage systems, microgrid systems, utility automation components and solutions, and advanced optimization algorithms make us uniquely qualified with a unique set of skills.

Eaton's engineering service team

Eaton's engineering service team delivers solutions to enhance your electrical distribution system's power performance, reduce operating costs, and maximize reliability, safety and integrity. Independent of the age, manufacturer or complexity of your electrical distribution system, our design, build and support services integrate and optimize power systems to ensure that it is aligned with your goals.

Eaton's service team is one of the largest and most experienced teams of power system engineers in the industry, with industry-standard software and advanced modeling and analysis capabilities at their fingertips. Their comprehensive portfolio of design services includes safety studies and energy management, power quality and reliability audits.

Eaton understands your requirements and sets strategies for your power system. With Eaton's help, you'll witness a range of business benefits, from reduced costs to a more effective use of capital. Our engineering and consulting services help you manage your power system as a strategic resource that can help ensure mission operability.



Success stories

U.S. MILITARY BASE

This installation at a U.S. military base demonstrates a full-scale microgrid with features including seamless transfer between islanded and grid connected operation, energy storage, renewables integration, load shedding and power export. The microgrid is composed of natural gas generators, inverter and energy storage, static switching, wind turbine and local loads.

This microgrid demonstrates the potential of microgrids designed for seamless transitions between grid-connected and islanded operation, and experience with a high concentration of dynamic and nonlinear loads. It is anticipated that many real-world microgrid installations will be retrofit applications with a high penetration of dynamic loads. This is particularly the case in DoD installations, which will almost entirely be retrofit. This microgrid improves energy security by providing operation during grid outages, seamless transition between grid-connected and islanded operation, and integration of renewables.

FORWARD OPERATING BASES

The Eaton Intelligent Mobile Power Distribution System transforms generators into a fuel-reducing demand-managed microgrid by applying proven technology that enhances fuel savings, reliability and troop safety on military forward operating bases.

This system demonstrated reductions in fuel consumption in excess of 30 percent. The microgrid is an intelligent system, designed to provide power to meet current demands (instead of engaging all generators at all times).

By increasing efficiency of on-site power, the system helps limit the risks that troops face as they use, transport and store fuel.

Eaton experience

Eaton has been engaged with microgrid and energy storage technology development, design, demonstration projects and construction with various federal agencies and utilities since 2008. These projects were awarded as grants as well as competitive bids. In addition to the projects mentioned above, the following is a summary of Eaton awards for microgrid technology programs.

- U.S. Army: Intelligent power distribution for mobile systems includes load and source control, dynamic reconfiguration and self-commissioning. Eaton has delivered 200 systems since 2012 and now has a commercial offering—the Intelligent Mobile Power Distribution System
- U.S. Army: Microgrid to microgrid communication and controls enable microgrids to be commissioned in subsets as funding allows
- U.S. Air Force: Large-scale power distribution (700 kW) with load shed, power management, renewable and storage connectivity, and management
- U.S. Air Force: Designed and developed a smart shelter power management and communication system to intelligently reduce energy consumption, maintain occupant comfort and provide reliable and timely in-shelter and base-level communication and energy management data

- Dept. of Defense: Demonstrated that power storage could be used instead of energy storage for microgrid islanding ride-through as well as grid stability for renewables/distributed energy resources (DERs). Showed 80 percent reduction in necessary storage costs
- Dept. of Defense: For closely sited installations, demonstrated the capability to use DER from one installation to power loads on another installation. This will optimize the DER controls when multiple installations can be islanded together
- Dept. of Energy: Demonstrated upgraded controls to optimize the use of PV integrated with energy storage for increased stability and reliability with larger PV utilization
- Dept. of Energy: Provided a distributed control solution that significantly reduces computational and communication complexity, enabling large-scale coordinated control of a vast number of heterogeneous DERs

For more information,
visit Eaton.com/microgrid,
Eaton.com/service or Eaton.com/govt

Eaton
1000 Eaton Boulevard
Cleveland, OH 44122
United States
Eaton.com

© 2016 Eaton
All Rights Reserved
Printed in USA
Publication No. PA027034EN / Z19007
December 2016



Eaton is a registered trademark.
All other trademarks are property of their respective owners.

Follow us on social media to get the latest product and support information.

