

Powering the **most advanced** energy storage systems



Greensmith **grid-edge** intelligence

Building blocks for a smarter, safer, more reliable grid

Wärtsilä Energy Solutions is a leading global energy system integrator offering a broad range of environmentally sound solutions. Our offering includes ultra-flexible internal combustion engine based power plants, utility-scale solar PV power plants, energy storage & integration solutions, as well as LNG terminals and distribution systems. The flexible and efficient Wärtsilä solutions provide customers with superior value and enable a transition to a more sustainable and modern energy system. As of 2017, Wärtsilä has 65 GW of installed power plant capacity in 177 countries around the world.

Founded in 2008, Greensmith is a recognized leader in energy storage technology and systems integration, responsible for deploying over 150 MW to some of the largest power companies globally. Greensmith has developed a world-leading energy management software system called GEMS (Greensmith Energy Management System), currently offered in its fifth generation. This

platform enables utilities, engineering procurement and construction companies and independent power producers to manage and monitor individual systems or entire fleet of systems, identifying and diagnosing equipment issues in real time, and extending system performance and longevity—therefore increasing return on investment.

Together, Wärtsilä and Greensmith will deliver the industry’s most-advanced energy storage solutions including an optimized hybrid power plant product offering, incorporating internal combustion engines, solar PV and energy storage. In addition, this partnership allows customers to fully leverage a global services organization to ensure complete lifecycle management.



Established leader in energy storage



Successfully powering over
50 sites



Working with 40 customers,
including utilities and independent
power producers (IPPs)

1/3

Over one-third of all energy
storage capacity installed in the
U.S. is running on the GEMS
platform



Technology neutral with
unparalleled integration expertise
managing 16 different batteries
and 10 inverters

Proven performance and safety

The GEMS software platform, now in its fifth generation, follows the highest performance and safety standards. As a result, deployed systems have achieved 99.9 percent uptime. With storage available on demand, you maximize the system's lifetime return on investment.

Our systems have also recorded a flawless safety record, thanks

to a rigorous, two-step testing procedure that begins at our Herndon, Virginia, facility and ends in the field. Greensmith provides full lifecycle support from design and integration to deployment and management so all systems achieve optimal results.

Unparalleled experience

Backed by world-class technical expertise and software innovation, Greensmith has demonstrated

solutions for some of the most critical challenges facing utilities: easing demands on aging infrastructure, adapting to a higher penetration of renewables, and improving grid reliability. With the industry's most tested and proven systems, Greensmith strengthens all links in the energy storage value chain.

Greensmith Energy has
successfully deployed over
150 Megawatts of energy
storage globally

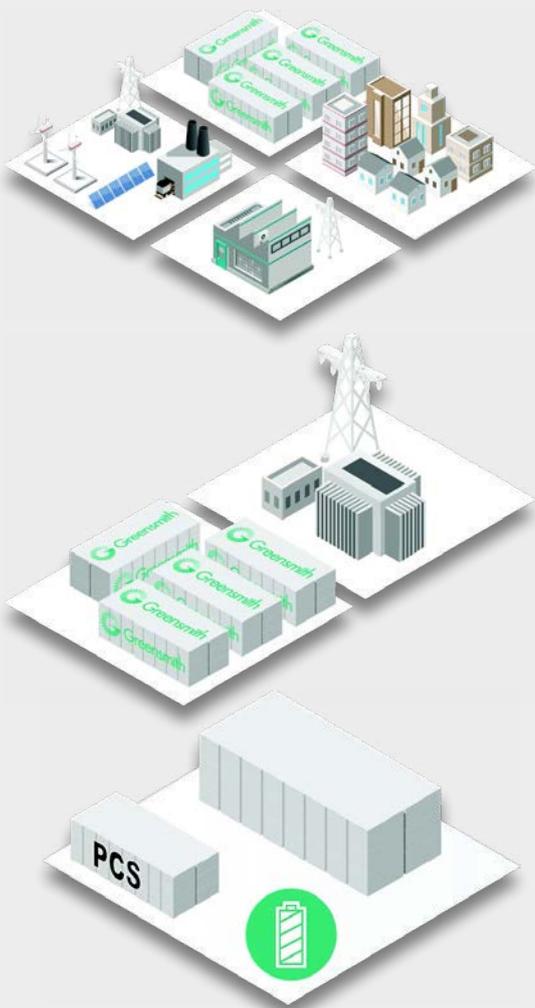
Purpose-built, end-to-end energy storage management

As a truly technology-neutral energy storage partner, Greensmith provides unbiased industry expertise. With this comes flexibility to choose the appropriate hardware for each application. The Greensmith team has over 100 collective years of experience designing, deploying, and maintaining energy storage systems.

GEMS enables utilities, EPCs, and IPPs to remotely monitor individual systems or entire fleets, identifying and

diagnosing equipment issues in real time, and extending system lifetime – increasing return on investment.

With robust, best-in-class capabilities, the GEMS software platform helps customers leverage various applications to create revenue streams and mitigate grid issues.



GEMS Applications

- Frequency regulation
- Capacity dispatch
- Renewables firming
- Intermittency smoothing



- Ramp rate control
- Load management
- Demand management
- Microgrid

Optimization Platform

- Operation scheduling
- Peer-to-peer group control
- Real-time equipment control
- Fleet management
- Local HMI
- Advanced analytics
- Extensible software toolkit

Physical Storage Layer

- BMS drivers
- Power conversion systems
- Inverters
- Diesel generators and CHP

DMS

BIG DATA

SCADA



20 MW/80 MWh
Resource adequacy

Grid-scale

Engineered for grid-scale

Greensmith established roots in grid-scale energy storage, the most challenging market segment, in 2011. We developed a flexible yet robust software platform, GEMS, to address the industry's greatest obstacles. Backed by GEMS, now the most widely deployed energy storage management software, our expertise and technology set the standard for quality, reliability, and innovation.

Holistic technology platform

Designing, integrating, and deploying grid-scale storage requires deep industry knowledge, as energy storage is a system of systems with great potential for failure if any one piece is out of sync. Greensmith has over 100

collective years of expertise in battery and power control systems (PCS), container designs and strategies, and system design and safety. Our solution is built to manage the toughest challenges on the grid.

GEMS: utility-ready

The GEMS platform is powering over one-third of all the energy storage capacity in the U.S., including the most advanced installations. Key benefits include:

- Seamless utility **back-office system integration**, including SCADA, DMS, DERMS
- **Asset management & optimization** to monitor storage assets and extend battery life
- Flexible **fleet management**

- **Balance of plant integration** with HVAC, fire safety, security components, plus real-time equipment monitoring
- Secure access to the GEMS portal with **role-based authentication**
- Streamlined **operations & maintenance** with integrated notification and reporting

Advanced, proven, reliable

Greensmith is working with some of the largest and most progressive utilities and utility partners to deliver grid-scale solutions for stability, increased renewable penetration, and aging infrastructure. By doing so, we enable our customers to create new revenue streams and offer new services to their customers.

Microgrids

Managing complexity – maintaining stability and reliability

As complex distributed energy systems that feature local generation and storage to power groups of inter-connected loads, microgrids present a unique set of challenges for grid owners and operators. These electrically islanded systems can operate with or without a connection to the grid. The ability to operate independently assures reliability and resiliency for customers with critical power needs who cannot afford untimely service interruptions. With dynamic energy storage control software, microgrids can take on a

high penetration of renewables while optimizing various generation sources to provide the most cost-effective power source and providing stable and reliable power to the grid.

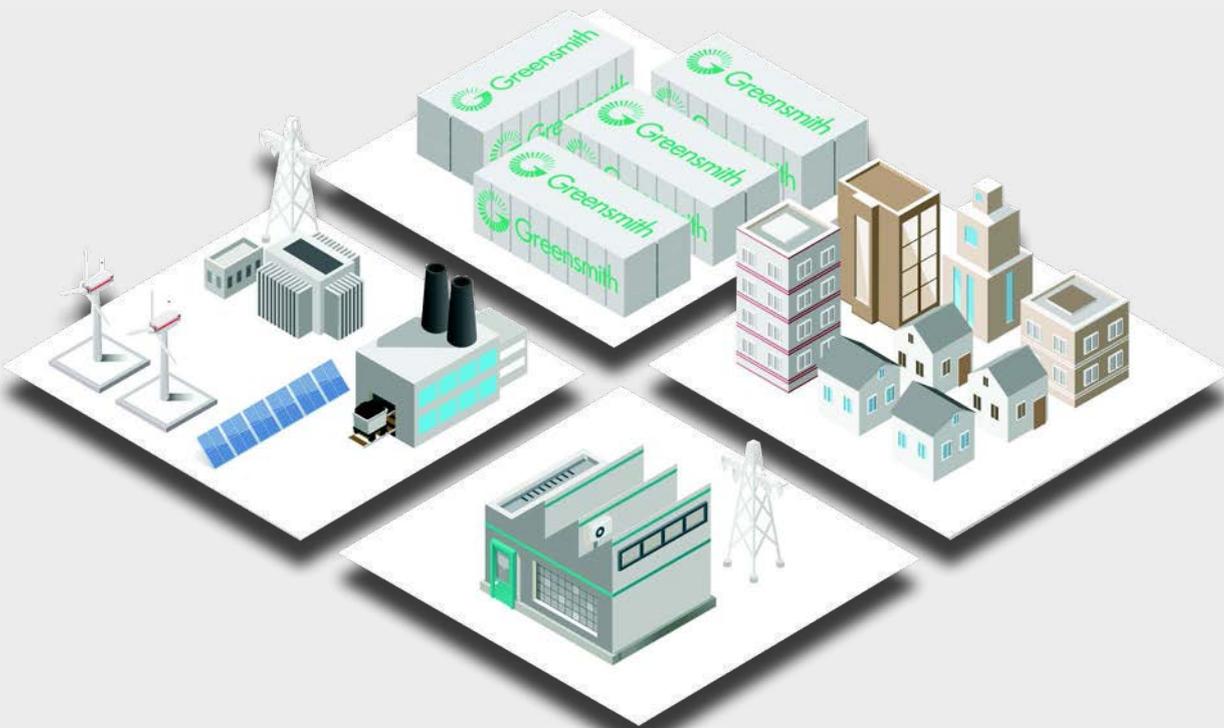
GEMS: enabling a system of systems

Operating as a system of systems, energy storage is dynamically managing complex commands in real-time. Like any other system of systems, without the proper control mechanisms, if any one piece is out of sync, the entire system itself is at risk. The GEMS software platform provides the essential architecture for safe and reliable microgrids, while ensuring

maximum return on investment by enabling optimal storage system design, integration, and operation.

System-wide expertise + best-in-class technology

Greensmith has been successfully designing and deploying microgrid solutions since 2010—with a 100 percent safety record. Microgrids are complex systems, yet they are essential to the evolution of the electrical grid. Our deep system expertise combined with industry-leading technology enables our customers to safely and successfully deploy advanced, resilient, and reliable microgrids around the world.



The Greensmith GEMS software platform integrates multiple power generation sources (i.e. renewables, coal, nuclear, etc.) and seamlessly leveraged the most cost-effective source in real-time, while maintaining the stability of the grid.

Behind-the-meter

Beyond demand charge reduction

A successful behind-the-meter energy storage system must be held to the same high standard as any other deployment on the transmission and distribution system. It should have a comprehensive library of control algorithms for demand charge reduction, PV integration, EV charge management, frequency regulation, microgrids, and many other applications. Greensmith's intelligent software delivers advanced command and control capabilities, whether capacity is 200 kW or 200 MW. Peaks in demand, no matter how brief, translate to increased costs—in addition to creating challenges for the grid operator.

Addressing complex demands

Distributed energy resources by themselves may introduce challenges to grid stability, especially where distribution feeder circuits have a high penetration of intermittent PV capacity. Responding quickly to changes in supply and demand to solve these challenges is an essential function of energy storage. Greensmith software supports a wide variety of battery and power electronics vendors to achieve optimal system performance with minimal impact to the grid.

GEMS: flexible and intelligent

More than 30 major customers worldwide are now using GEMS

on both sides of the meter. When deployed behind the meter, key benefits include:

- **Demand charge management** with optimal reduction of peak load
- PV and EV integration for **maximum energy self-consumption**
- **Critical load support** for buildings and grid-connected renewable microgrids
- Enhanced **revenue opportunities** from demand response programs
- Wholesale **reserve capacity and ancillary service market participation** via DER aggregation

Setting the standard for behind-the-meter

Greensmith helped lead the U.S. energy storage market to record growth in 2015, especially behind-the-meter, where the segment grew fivefold compared to the year before. Regardless of size or location, we offer a robust solution to satisfy the requirements of our customers, regulators, and the grid.



1 MW/500 kWh

Grid congestion ramp rate control solar PV integrated



Wärtsilä is a global leader in advanced technologies and complete lifecycle solutions for the marine and energy markets. By emphasising sustainable innovation and total efficiency, Wärtsilä maximises the environmental and economic performance of the vessels, power plants and LNG infrastructure of its customers.

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