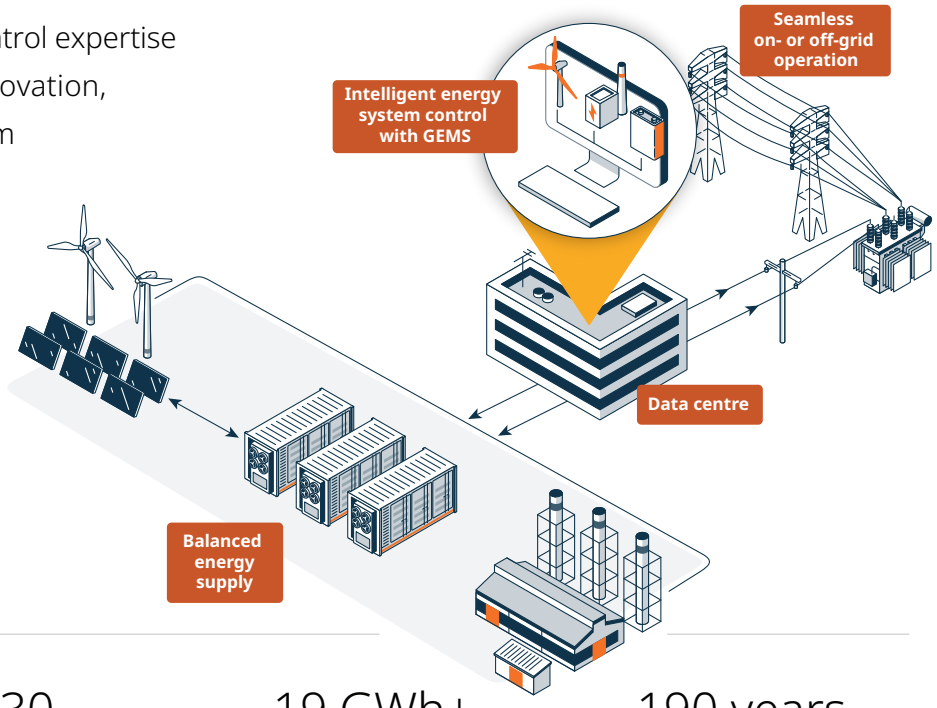
GEMS: Intelligent energy control and optimisation for data centres

Serving as the beating heart of Wärtsilä's fully-integrated data centre solution, Wärtsilä's **GEMS Digital Energy Platform** meets the complex control and optimisation demands of large-scale data centres—whether hyperscale, AI-driven, or hybrid cloud facilities.

GEMS tackles the unique challenges of **volatile load profiles, stringent uptime requirements, and seamless operation both on and off the grid.** It automates the dispatch of diverse energy assets—including batteries, engines, and renewables—to maximise reliability, optimise fuel consumption, and protect asset health, delivering both economic and environmental benefits.

Backed by a decade of microgrid control expertise and Wärtsilä's 190-year legacy of innovation, GEMS continuously monitors system conditions—from battery state-of-charge and engine status to grid signals and data centre load—and makes real-time decisions to ensure the right resource is deployed at the right time.



There's power in numbers.

130
global energy storage projects

19 GWh+
of successful control and operation

190 years
of reliable partnership and innovation legacy

GEMS Digital Energy Platform

A platform designed to meet the complex demands of data centres

Maintains stability for AI power swings

AI workloads create highly volatile demand. GEMS responds within milliseconds to sudden load changes by dispatching or absorbing power through batteries or deploying engines, preventing voltage or frequency dips. It also preserves battery headroom for future transients and minimises unnecessary cycling to extend battery life.

How it works

- Primary control: With the droop set points dictated by the GEMS PPC, engine governors and BESS provide primary response. The BESS fast power electronic control allows batteries to regulate frequency and voltage during sudden load changes, ensuring voltage ride through compliance.
- Reserve margin management: Maintains state-of-charge headroom to ensure capacity for the next transient.

Partner with our Lifecycle Services team for:

- Power system simulations to assess stability under worst-case scenarios.
- Site commissioning and network cybersecurity assessment.

Optimises cost and sustainability

GEMS lowers the levelised cost of energy (LCOE) by forecasting renewable output to time battery charge/discharge. It prioritises low-cost and renewable energy, reduces fuel burn, and runs engines at efficient points—delivering lower costs, reduced emissions, and an optimised mix of assets.

How it works

- Intelligent dispatch: Coordinates batteries, renewables, and engines for lowest-cost operation, while observing the contractual obligations of each connected asset.
- Forecast-based scheduling: Schedules charging/discharing to leverage low-cost or renewable energy.
- Engine optimisation: Runs engines at efficient load points.

Partner with our Lifecycle Services team for:

- Power system analysis to optimise system sizing.
- Grid code compliance studies and solution tailoring for site-specific needs assessment.

Provides predictive intelligence and proactive dispatch

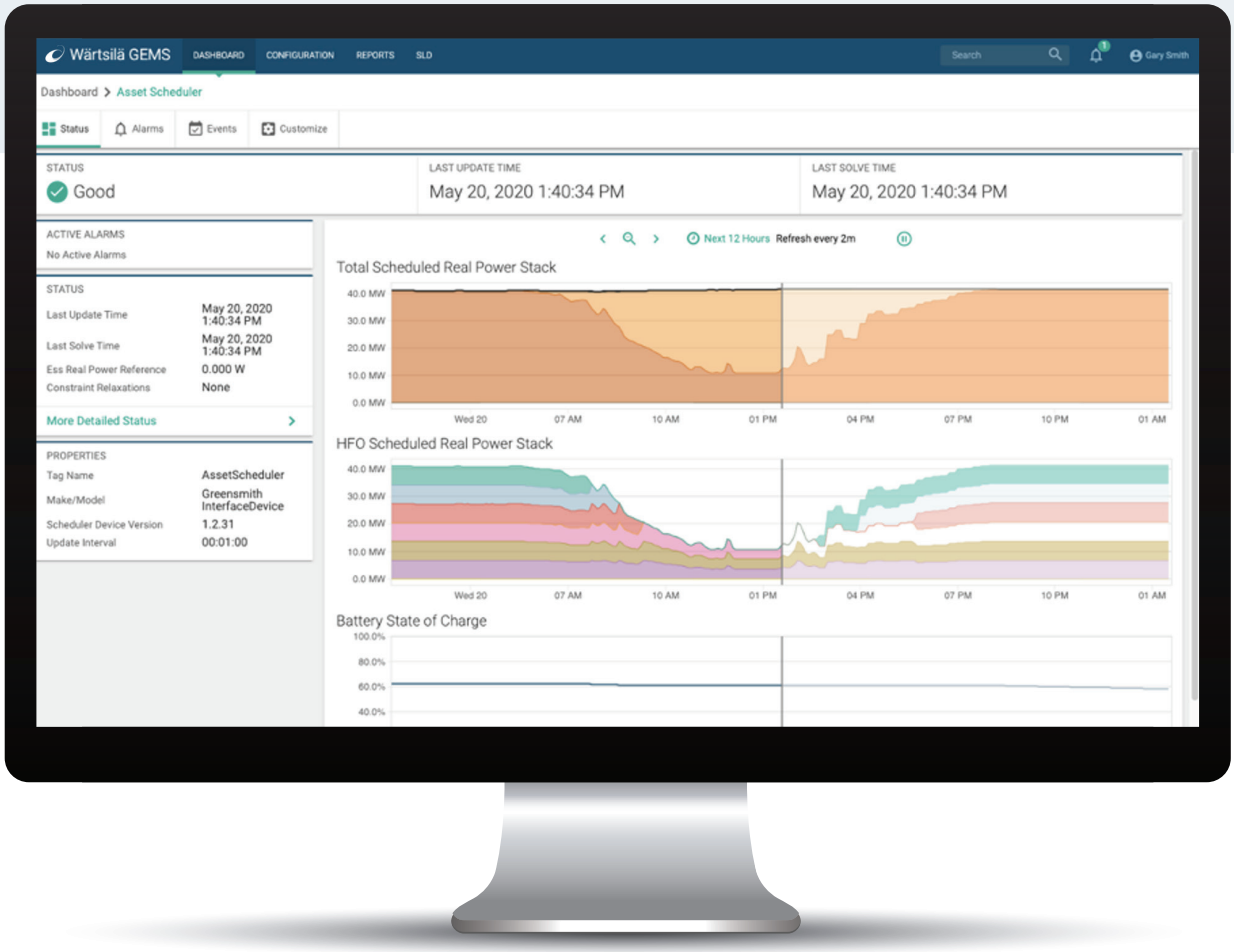
Using advanced forecasting and machine learning, GEMS anticipates load and renewable output to plan dispatch, pre-charging batteries or starting engines ahead of surges. It adapts over time, improving accuracy and ensuring cost-effective, reliable operation for evolving AI workloads.

How it works

- Tertiary control: Dispatches assets in strategic combination to maximise short and long-term grid stability and financial benefits.
- Advanced forecasting: Uses weather data, machine learning, and statistical models to predict load and renewable energy forecasts.
- Adaptive intelligence: Continuously improves accuracy as site patterns evolve.

Partner with our Lifecycle Services team for:

- Virtual simulation and cloud-based training for operators and analysts.
- SCADA and UI customisation to meet customer requirements.



Layered control for seamless on- and off-grid operation

GEMS combines primary, secondary, and tertiary control layers for utility-grade performance. Fast battery response stabilises frequency and voltage, while engines and batteries share load for power quality. For greater financial returns and community impact, GEMS enables demand response and ancillary services, turning data centres into grid assets.

How it works

- Primary response: Battery and engine governors maintain frequency and voltage.
- Secondary control: Balances real and reactive power across running BESS and engines for power quality.
- Grid-connected and off-grid operations: Seamless transition between modes, blackstart capability, and rapid emergency handling to maintain stability during failures, supply interruptions, or sudden load changes.

Partner with our Lifecycle Services team for:

- Grid code compliance and advanced power system studies and analysis.
- Site commissioning.

A transparent and flexible architecture

GEMS is built with transparency, visibility, and flexibility top of mind, giving operators full control and confidence in their power system.

How it works

- Unified control: Manage diverse assets under one platform with GEMS' intuitive UI, API, and SCADA integration.
- Actionable insights: Gain real-time visibility and analytics for smarter, site-specific decision-making.

Partner with our Lifecycle Services team for:

- Site network cybersecurity assessment.
- Solution function tailoring to meet site specific needs.

A fully integrated solution for safe, efficient, and streamlined operations

GEMS components

- GEMS Grid Controller and GEMS Rack allow for complete onsite control, visiblity, and asset management
- GEMS Fleet Director is your cloud connection, giving access to advanced optimisation solutions

BESS technology

- With modular DC and AC block configurations, high power density, and a fully integrated system, the Quantum product suite is designed to support peak shaving, fast commissioning, and backup power for critical data centre operations.

Lifecycle Services

- From 24/7 remote monitoring to proactive maintenance and end-of-life planning, Wärtsilä's Lifecycle Services ensure your system performs optimally—day one to year ten and beyond.

Engine power plants

- GEMS easily integrates all your assets onsite, including our engine power plants. Our engines have fast deployment times, can run on natural gas and/or liquid biofuels and are able to act as the primary or backup source of on-site power for data centres.