Powering Tomorrow: Innovation in the BESS Market

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US Energy Storage Summit 2024

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- Industry veteran with 20+ years leading global product teams.
- Deep electrical engineering, technology innovation, and energy storage product development experience—spanning C-Suite roles at NECES, Gridco Systems and Amperion.
- Previous active member of the IEEE 1547-2018 standardisation effort to define the grid interconnecting technical requirements for distributed energy resources (DER).
- Darrell started his career as a founding member of Concord Data Systems and was a founding member of a spin out called Concord Communications.
- Founded Sagamore Systems as its President.
- Darrell is a native of New England and earned his BSEE, Summa cum Laude, from Northeastern University in Boston, MA.

Innovation in the BESS Landscape: Wärtsilä ES&O

Wärtsilä Energy Storage & Optimization (ES&O) is delivering significant growth, ongoing customer success and strong financial results.

To-date Wärtsilä ES&O has:

>5 GW/ 12.5 GWh

of energy storage capacity awarded, contracted, or deployed across **125+ projects** globally.

Wärtsilä ES&O was founded through the acquisition of Greensmith Energy in 2017—a grid-scale energy storage technology company specializing in a **battery-agnostic energy storage and integration software called GEMS**.

Wärtsilä ES&O is a **top-7 storage integrator globally**, according to reporting by BNEF (2023) and top-3 by **S&P Global**.

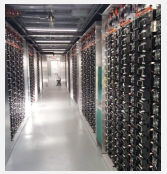
In 2023, Wärtsilä was named one of **TIME's 100 Most Innovative Companies** as well as one of **Reuters 100 Innovators Leading the Energy Transition** due to its accomplishments and market impact.

Throughout this period, ES&O has an unparalleled safety and on-time delivery record in the industry for its **award-winning energy storage system, Quantum**.

We will continue to provide **safe, on-time deliveries** for our customers **globally**. This includes continued work with Tier-1 suppliers and further global diversification of manufacturing to meet **regional decarbonization** ambitions and evolving policy requirements.

Innovation in the BESS Landscape: Battery Technology Evolution

The BESS landscape continues to be dynamic with technology evolution—
product design has changed over time according to available technology and project sizes



"Building" sized projects

Wärtsilä GridSolv Max 4.08 - 6.1MWh MWh

Wärtsilä ES&O Quantum 1.5 MWh

Wärtsilä ES&O Quantum-HE 1.69 MWh

2018

Heightened focus on **product safety design**

2019

Projects are small (<50MWh), modules installed at site, air-cooling predominant, **containerized for easy transport/shipment**

2020

2021

Wärtsilä ES&O is one of a few players with **modular, liquid-cooled product**

Significant cost advantage over air-cooled, large systems that required battery install at site

2022

2023

Higher density cells/modules available in the market

2024

Innovation in the BESS Landscape: Bridging the Gaps

Many challenges face the BESS industry—continued leadership is differentiated by ability to innovate in these areas

Evolving battery technology

- Rapid integration of new cell technology
- **Support long sales cycles** with quick technology evolution cycles
- Consider alternatives while maintaining high performance and availability

Cost-effective large scale deployment

- Reduce required land space
- **High-efficiency deployment:** decrease number of units to transport, install and service
- Fully-integrated and tested platform delivery
- **Reduced auxiliary power consumption**

Fire Safety

- Compliant with international standards
- Mentality shift to **explosion prevention** from fire prevention
- **Safe first responder access**
- Electrical safety to mitigate fire risk

Sustainability

- Reduce noise sound pressure at site level
- **Decrease GWP** and other environmental concerns
- Traceability of manufacturing process

Software

- Optimised and adaptive software control
- Efficient serviceability with seamless software patches and updates
- **Single, unified communication interface**

EVOLVING BATTERY TECHNOLOGY | COST-EFFECTIVE LARGE SCALE DEPLOYMENT | FIRE SAFETY | SUSTAINABILITY | SOFTWARE

Innovation in the BESS Landscape: Wärstilä ES&O's Quantum2

Quantum2 is a new High Energy Quantum platform using the latest LFP energy cell, a next-generation of Quantum enclosure with advanced controls.

Highlights:

- Higher energy density 4073 kWh
- Higher end-of-life usable energy
- Standard 20' shipping size
- Reduced site footprint
- Units delivered to site fully-tested and loaded with batteries
- End-to-end battery fire safety approach with compliance to NFPA 855 2023
- Electrical safety with DC Main Fuses and isolation switch
- Low GWP refrigerant and noise optimized design
- Hybrid cooling to reduce auxiliary power consumption
- Single, unified communication interface via GEMS platform for all Quantum components

Quantum2 with 306 Ah battery

Global UL/IEC Markets

Nominal energy (kwh): 4073

Configuration: 10P x 8S x 52S

Voltage range (VDC): 1164–1498

Nominal voltage (VDC): 1331

Nominal C-rate: 0.1–0.5

Auxiliary load (voltage): 480 V 60 Hz and 380–415 V 50/60 Hz 3-phase

Auxiliary peak load (kW): 30

Weight (lbs/kg): 83775/38000

Operating temperature (°C): -30 – +50

Dimensions (w, d, h) (m): 6.1, 2.4, 2.8

Coolant type: Water and Glycol mix

EVOLVING BATTERY TECHNOLOGY | COST-EFFECTIVE LARGE SCALE DEPLOYMENT | FIRE SAFETY | SUSTAINABILITY | SOFTWARE

Innovation in the BESS Landscape: Technology & Cost

Cost reduction opportunities exist within full TCO, across equipment and soft costs

ESS Site Cost

Battery Racks

- **Shorten development cycle** to integrate cells when available to market
- New **higher density cells** also have **better performance**
- **Evolution** of Li-Ion cells (higher density and size), and non-Li-ion options
- As battery costs decrease, **other categories become more important**

Transportation

- **Fewer** total number of units
- **Standard** shipping methods
- **Locality** of supply chain

Lifecycle

- Reduced **aux power**
- Reduced component complexity to **improve service time**

Commissioning

- **Standard** connections
- Increased **accessibility**

EPC/BOP

Standardize electrical interface between units (BESS, inverter, aux power, etc.)

- Opportunity as industry matures
- Reduce unique site training required, and therefore reduce time at site

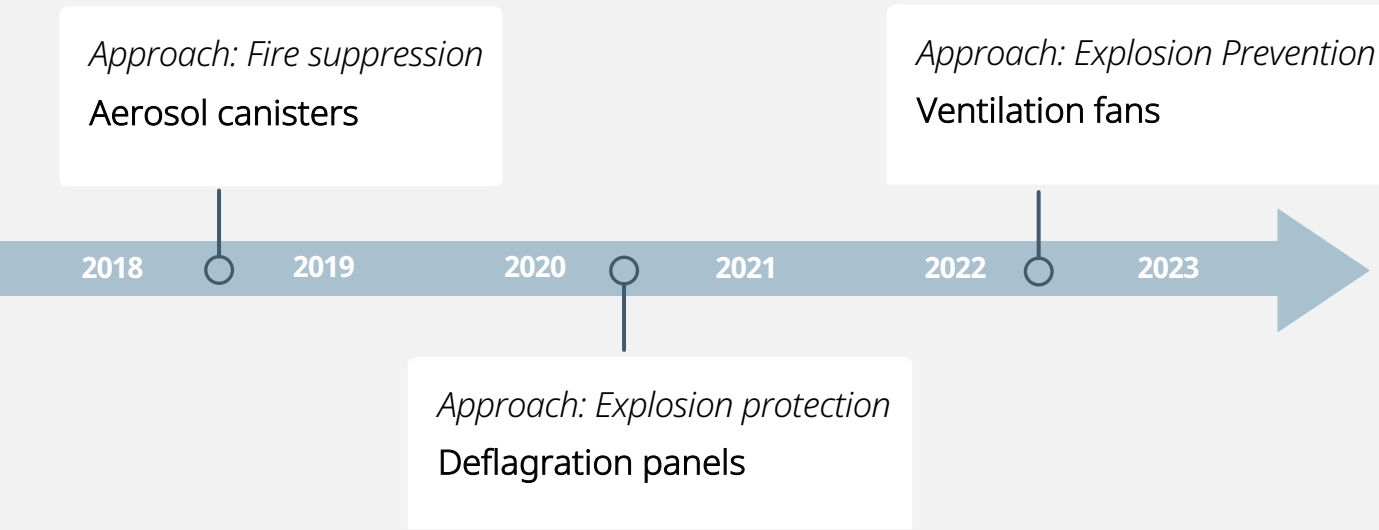
Equipment

BESS enclosure, inverters & electrical connections

- **Rapid adaptation** to new battery technology requires flexible and well-established design practices
- Cost may also be driven by **decreasing total # units** – may **increase unit cost** to decrease soft costs

Innovation in the BESS Landscape: Fire Safety

Comprehensive design and approach to safety—de-risking the total cost of ownership throughout the project lifecycle



Ongoing evolution of fire safety best practices:

- Proactive approach – ensure integration of features that align with the next generation of standards and best practices
- Must continue working with AHJs to understand local concerns
- Regionally differentiated issues (remote vs. urban sites)

Innovation in the BESS Landscape: Environmental, Social, Governance (ESG)

Carbon Footprint

Traceability of full manufacturing process, from cell production through integration and delivery at site

Noise

Reduction of total site noise, with focus on inverter and chiller

Recycling

High demand for lithium-ion recycling capacity

Innovation in the BESS Landscape: Software & Controls

Seamlessly and safely integrate your operations

Platform Flexibility

- Ability to communicate and remain compatible with various BMS and control platforms

Control & Monitoring Ecosystem

- Advanced logic and functionalities for real-time analysis and operation across asset portfolios
- Consistent focus on cybersecurity

Unified & Seamless Communication

- Apply AI and emerging technologies for dynamic insights, system control and performance output
- EMS intelligence for reliability and data management

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