Maximizing the value and performance of energy storage – EssPro™ Grid

With over a decade of expertise in energy storage systems, ABB is a pioneer and leader in the field of distributed energy storage systems. ABB’s EssPro Grid provides safe, reliable and fully integrated energy storage systems for power and energy applications.

As the demand for safe and reliable electricity increases, our infrastructure continues to evolve and innovate in order to accommodate such growth. Harnessing the power to control energy can enable our current infrastructure to readily expand.

Strategically placed energy storage systems can increase operational performance and grid reliability, better integrate alternative energy sources, balance supply and demand, and ensure that energy is readily available when primary power sources are interrupted. The benefits of energy storage can span power generation, through transmission and distribution, and all the way to users.
### Energy storage applications

<table>
<thead>
<tr>
<th>Application</th>
<th>EssPro Grid benefits</th>
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<tbody>
<tr>
<td>Frequency regulation</td>
<td>EssPro Grid absorbs and injects power in order to keep grid frequency within pre-set limits.</td>
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<tr>
<td>Spinning reserve</td>
<td>To provide effective spinning reserve the EssPro Grid is maintained at a level of charge to respond to a generation or transmission outage.</td>
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<tr>
<td>Capacity firming</td>
<td>EssPro smooths the output and controls the ramp rate to eliminate rapid voltage and power swings created by the intermittent power output from renewables, such as solar and wind.</td>
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<tr>
<td>Peak shaving</td>
<td>EssPro Grid can be installed close to loads and shift expensive peak load to low tariff times.</td>
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<tr>
<td>Power quality</td>
<td>EssPro Grid eliminates short voltage sags e.g., caused by power system faults or the start-up of a large motor.</td>
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<tr>
<td>Uninterruptable power supply</td>
<td>In case of a mains failure or blackout, EssPro Grid can bridge the gap in supply.</td>
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<td>Load leveling</td>
<td>EssPro Grid stores power during low-load periods and delivers it during periods of high demand in order to reduce the load on less economical peak-generating facilities.</td>
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<tr>
<td>Voltage support</td>
<td>To help maintain the grid voltage, EssPro Grid injects or absorbs both active and reactive power.</td>
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**EssPro™ Grid turnkey solutions**

Complete grid integrated energy storage solutions tailored to fit your operational and commercial needs.

ABB’s EssPro™ Grid is a battery energy storage system that provides users with electricity whenever and wherever it is needed. This integrated solution enables fast response to instant variations in energy demand and supply. The turnkey solutions are available for power requirements ranging from hundreds of kilowatts to tens of megawatts and are ready for connection to medium- or high-voltage grids. The optimized systems help to maintain grid stability and ensure reliable and high-quality energy supplies through a range of applications.

<table>
<thead>
<tr>
<th>Component</th>
<th>Description</th>
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</thead>
<tbody>
<tr>
<td>Power converter</td>
<td>ABB offers a range of leading-edge power converters to suit a wide range of applications and system sizes. For higher power requirements, several units are connected in parallel. These also provide dynamic control of active and reactive power flow in both directions.</td>
</tr>
<tr>
<td>Control system</td>
<td>ABB’s integrated EssPro Grid control system enables manual and automatic operation of all system components in various control modes. An array of communication protocols supports access to the system for remote control and monitoring. Advanced control algorithms consider load and weather forecasts for higher operational efficiency.</td>
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<tr>
<td>Protection equipment</td>
<td>ABB offers state-of-the-art protection systems for AC and DC equipment.</td>
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<tr>
<td>Switchgear</td>
<td>ABB’s low-, medium- and high-voltage switchgear ensures safe and reliable grid connection and operation of the system.</td>
</tr>
<tr>
<td>Transformers</td>
<td>ABB offers a full range of transformers for ANSI, IEC and other local standards. The offering includes both liquid-filled and dry-type transformers.</td>
</tr>
<tr>
<td>Batteries</td>
<td>ABB chooses the optimal battery technology for every application. Among others, these include lithium-ion (li-ion), sodium-sulfur (NaS), nickel-cadmium (NiCd), lead-acid or flow batteries.</td>
</tr>
</tbody>
</table>
Modular designs ensuring mechanical, electrical and environmental safety meeting stringent requirements.

Example of a 1 MW, 15 min EssPro Grid layout

**EssPro Grid system features**

- Dynamic active and reactive power control
- Active filtering of harmonics
- Islanding mode and black start capability
- Manual and automatic operation in various control modes
- Advanced control algorithms for optimized operation
- Ensured compliance with utilities’ standards through in-depth knowledge of grid codes

**Grid studies**

ABB has long experience in performing grid studies, supporting customers in:
- Identifying weak points in the network
- Performing system stability studies
- Defining the optimal location for EssPro Grid (point of common connection)
- Defining the size and technology of the EssPro Grid installation
- Determining requirements for active power, reactive power and harmonic performance.

The sizing and choice of storage medium of a battery energy storage system are critical issues and require in-depth knowledge of the functional requirements on the storage system and the demands of such systems on the grid. ABB helps users to choose the optimal battery technology for each application, based on comprehensive knowledge of the particular advantages and disadvantages of each energy storage technology as well as the behavior of the grid. The size of the system is calculated in accordance with the customer-specific load profile and application requirements. The result is an optimal scope of delivery – EssPro Grid with maximum technical and economic performance considering the expected charging/discharging schedule, system lifetime and lifecycle costs.
EssPro™ Grid service and support

Other lifecycle services
ABB does not only assume system responsibility, but also provides additional services along the system lifecycle including project management, engineering, installation, commissioning, training, maintenance and recycling. In addition, ABB offers customized operation, maintenance and service contracts over the entire lifecycle of the installation. In cooperation with a battery recycling company, we ensure maximum reuse of battery components for the production of new batteries.

Advanced algorithms
In addition to the basic control functions, advanced algorithms can be applied in order to further optimize the operation of a battery energy storage system. These control algorithms consider – e.g., weather forecasts and projected load profiles to help optimize the state of charge as well as charging/discharging schedules and enhance operational efficiency.

Safety and quality
The modular concept and proven components facilitate easy and safe operation as well as maintenance of the EssPro Grid installation.
ABB is following the concept of “safety through design”, which is aimed at eliminating risks in the engineering and project-planning phase to ensure high safety standards during project implementation as well as the operational phase. This is achieved through best practices in project planning, health and safety, quality assurance, scheduling as well as optimal customer service.

Example of a 20 MW, 60 min EssPro Grid layout
### EssPro™ Grid ratings

#### Technical data

<table>
<thead>
<tr>
<th><strong>Parameter</strong></th>
<th><strong>Value</strong></th>
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</thead>
<tbody>
<tr>
<td>Power</td>
<td>min. 100 kW up to n x 30 MW</td>
</tr>
<tr>
<td>Energy</td>
<td>min. 200 kWh up to n x 7.2 MWh</td>
</tr>
<tr>
<td>AC voltage</td>
<td>All voltages</td>
</tr>
<tr>
<td>Frequency</td>
<td>50 or 60 Hz</td>
</tr>
<tr>
<td>Efficiency</td>
<td>&gt; 95% (converter)</td>
</tr>
</tbody>
</table>

#### Battery

- **Technology**: Individual selection depending on application and customer requirements (e.g. Lithium-ion, NaS, NiCd, Lead acid, battery)
- **DC voltage range**: < 1,200 VDC
- **Harmonic mitigation**: Up to 50th (optional)

#### Control

- **Options**: Standard and advanced algorithms
- **Converter control modes**: Dynamic power mode and voltage control mode (closed-loop control)
- **Communication protocols**: Modbus TCP/IP, IEC 61850, IEC 60870-5-101, IEC 60870-5-104, DNP

#### Safety

- **Protection**: Chemical, mechanical, electrical, fire and environmental protection

#### Installation

- Containerized or building solution, as per customer requirements

#### Applications

- Peak shaving, capacity firming, load following, spinning reserve, frequency regulation, power quality, UPS, load leveling, voltage support, island mode, black start

#### Standards, product related

All components of the system comply with the relevant standards - e.g.

- Battery and battery management system (BMS)
  - IEC 62620-CD: Secondary cells and batteries containing alkaline or other non-acid electrolytes
  - UL 1642: Standard for safety for lithium-ion batteries
  - CISPR 22: Electromagnetic waves emission/conduction test
  - 73/23/EEC: Low voltage directive

- Converter
  - IEEE 519: Recommended practices and requirements for harmonic control in electrical power systems
  - CISPR11 – 2011: Industrial, scientific and medical equipment
  - IEC 60664-1: Insulation coordination for equipment within low-voltage systems
  - IEC 62103: Electronic equipment for use in power installations

- HVAC
  - EN 292: Safety of machinery

- Container/building
  - IEC 61140: Protection against electric shock
  - IEC 60364: Electrical installations for buildings
  - EN 15004: Fixed firefighting systems

#### Standards, system related

EssPro Grid complies with all relevant local standards for installation and safety - e.g.

- EN 50110-1: Operation of electrical installations