ABB Seminario de Transformadores – Santiago CL
Tendencias Actuales en el Sistema de Energía Eléctrica y su Repercusión en los Diferente Componentes de la Rede
Chile sets sights on 100% renewables by 2040

11 January 2018 by David Weston

According to Acera, the country’s installed renewable capacity has grown from 952MW in 2012 to 4.9GW by the end of 2017 — with a further 1GW of mainly wind and solar power to be expected in 2018.
Chile – Fuentes Principales de Generación de Energía Eléctrica
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Power Systems and Substations – Strategy and Directions

Power Transformer: 50%...70% Substation Cost

New Design Concepts & Materials
Substation Management Issues
Life-Cycle Management & Maintenance
New Communications & Smart Grids

Strategy and Directions
Power System and Substations
CIGRÉ SC B3 2015Apr
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Electric Power Grids Changes

- **Generation Mix**
  - renewable share ~40% of capacity by 2035
  - greater volatility and less predictability
  - more feed in modes

- **Transmission Distribution**
  - increasing complexity
  - control and information Flow is key value
  - longer distances
  - higher voltages

- **Nano Grids Micro Grids**
  - on and off grid
  - control and automation at local level
  - energy storage is a key
Transformers in SAM – Growing Demand
Transformers in USA – Growing Demand

Projected Demand Growth for Large Power Transformers in the United States through 2030
(Power transformers with a capacity rating greater than or equal to 100 MVA)

Note: As noted in earlier discussions, utilities were not investing in the 1990s due to uncertainty surrounding regulation.
Source: SPX Electrical Products Group, May 2010. SPX analysis based on EIA data and research.
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Electric Power Grids - Trends
Daily power fluctuations from renewables

- Inherent volatility of renewables can compromise grid stability
- Grid stability requirements are traditionally fulfilled by diesel generation (base load)
- Optimized microgrid solution maximizes ROI* and fuel savings
Uninterrupted Power Supply

Integrated Solar-Battery Systems

- can provide firm dispatchable energy
- batteries can smooth the rapid output shifts that can lead to fluctuations in customer service voltage
- batteries can also reduce a feeder`s load during high demand periods
Energy Storage and Grid Stabilization

- Containerized plug-and-play solution in various ratings
- Fully productized and scalable to address all market segment applications.
  - Seamless transition from grid connected to islanded mode
  - Stabilizes against voltage and frequency variations
  - “Virtual Generator” can form the grid, integrating up to 100% of renewable energy
- Microgrid Plus Controller
- Maximizes fossil fuel savings and optimizes use of renewable energy
- Guarantees optimum loading and spinning reserve in fossil fuel generators
- Distributed logic enhances reliability and scalability for future system expansions
Integration of Renewables in a Mining Site -- Australia

**ABB solution**

- PV/diesel Microgrid with PowerStore grid-stabilizing technology and Microgrid Plus System
- The resulting Microgrid system consists of:
  - PowerStore Battery (2x2 MW/ 1.8 MWh)
  - Microgrid Plus Control System
  - Solar PV (10.6 MWp)
  - Diesel (22 MW)

**Customer benefits**

- Expected diesel fuel saving: 5 million liters per year, a 20% reduction
- Expected CO₂ reduction: 12,000 tons

**About the project**

- The new hybrid solar facility is the largest integrated off-grid solar and battery storage plant in Australia

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Project name
DeGrussa Copper-Gold Mine

Country
Western Australia, Australia

Customer
Juwi Renewable Energy

Completion date
2016
### Integration of Renewables in a Mining Site – Alaska US

**Project name**
Kodiak Island

**Location**
Alaska

**Customer**
Kodiak Electric Association (KEA)

**Completion date**
2015

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#### ABB solution

Two PowerStore flywheels act in parallel to shave off peak load and to reduce the stress placed on an existing battery energy storage system. The resulting Microgrid system consists of:

- PowerStore Flywheel (2 MW/33 MWs)
- Wind (6 x 1.5 MW)
- Hydro (3 x 11 MW)
- Diesel (1 x 17.6 MW, 1 x 9 MW, 1 x 3.6 MW, 1 x 0.76 MW)

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#### Customer benefits

- Stabilizing frequency regulation
- Provide frequency support for a new crane
- Help to manage the intermittencies from a 9 MW wind farm
- Reduced reliance on diesel generators

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#### About the project

Two PowerStore Flywheels act in parallel in order to deliver optimal grid stabilization on Kodiak Island
Renewables – Stable, Safe and Reliable Power Supply

"Extensive experience with every form of energy generation helps ABB design and implement protection schemes tailored for the most innovative generating technologies."

Alternative sources of electrical power connected to the grid require enhanced levels of protection and control to ensure smooth integration with existing power supplies. Hydroelectric, solar, wind, and wave, biomass, tidal and geothermal are all contributing to global electricity supplies, but this generation presents individual challenges to the protection and management of electrical systems.
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Renewables – Automation of the Renewable Grid
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Renewables – Integrated Solar PV Automation System

From PV Panels to Remote Monitoring
Renewables – Integrating Solar PV Plants with a Grid

| Grid Impact Studies | – Customer support to assess compliance to applicable grid code  
|                     | – Verification of proposed plant controller performances to meet grid requirements |
|                     | – Coordination of all inverters to achieve required control command  
|                     | – Outages analysis and automatic maintenance schedule for inverters  
|                     | – Power production curtailment according to TSO (transmission system operator) set points management  
|                     | – Ramp rate management as per the specification in grid codes  
|                     | – Frequency control, power factor and voltage control at point of coupling with the utility |

| Power Plant Control System | – The automation system supports various architecture as per PV plant size and topology  
|                           | – Controller manages plant power production in real-time as per grid code requirements  
|                           | – Direct communication with TSO (transmission system operator) |

Providing Grid Code Compliance at Point of Connection
### Renewables – Solar PV Automation System

**Who can benefit?**

- Independent power producers (IPP)
- Renewable energy companies
- Power utilities
- Engineering, Construction & Procurement (EPC)
- Renewable project developers
- PV plant owners

**Bi-directional Solar PV SCADA**

- Monitor, analyze and control the PV fleets real-time with bi-directional SCADA system
- Dedicated HMI displays for plant control operations
- Ergonomic monitoring HMIs
- User-friendly graphic displays

**Intelligent Analytics & Efficient Engineering**

- Accurate data capture and injection to ensure intelligent analytical predictions
- IEC 61724 performance calculations
- Productivity, energy and efficiency calculations
- Both standard and custom reporting on critical PV parameters
- Ability to schedule automated reports over defined durations
- Reduction in configuration time with bulk engineering & template-based engineering
- Drag and drop functionalities with auto-populated base information models
- Standard and unified information models across PV applications

**Solution Highlights and Benefits**
Customer challenge

Amongst the largest installation using thin-film photovoltaic panels

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зонокССАДA ПроМетеорологические датчики собирают и обрабатывают информацию о погоде сгенерированной' Live updates to the national grid

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Customer benefit

Improve the reliability of the operation and its efficiency
Disturbances to be quickly identified
Renewables – Integrated Wind Automation System

From Wind Turbines to Remote Monitoring

Monitor, Control & Operate wind farms in real-time
Wind Farm Optimization – Wake Based

- Improve wind farm power production using aerodynamic interaction between turbines
- Define setpoints for wind turbine operation by accounting aerodynamic interactions (wake effect) between the wind turbines
- 4% to 7% of potential improvement on farm level power capture through a coordinated approach
- Set points either dispatched to existing wind farm controller, or utilizing our wind farm control solution

Wake based Optimization
Who can benefit?

- Independent power producers (IPP)
- Renewable energy companies
- Power utilities
- Engineering, Construction & Procurement (EPC)
- Renewable project developers
- Wind farm owners

Highlights

- Bulk engineering through efficient system engineering tool which reduces system engineering time in case of utility scale wind farms
- Reduction in engineering time through drag & drop functionality with auto-populated base information models
- IEC 61400-26-1 and IEC 61400-12-1 performance calculations
- Ergonomic HMI to visualize data from plant, grid connection and weather stations.
- Unified HMI for all renewables applications and possibility to extend to the electrical substation
- Bi-directional SCADA with high reusability of commands, faceplates, monitoring symbols, and underlying information models
- Pre-defined reports, as well as custom reports to suit to customer needs

Solution Highlights and Benefits
## Renewables – Grid Automation Care

### Our Care offering

<table>
<thead>
<tr>
<th>Rapid response</th>
<th>Lifecycle management</th>
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<tbody>
<tr>
<td>- We guarantee fast and flexible response to maximize your equipment uptime.</td>
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<td>- Repairs</td>
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<td>- Spare parts and consumables</td>
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<td>- Replacement</td>
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<td>- Training</td>
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<tr>
<td>- We employ powerful tools and knowledge to optimize and extend your equipment life.</td>
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<td>- Extensions, upgrades and retrofits</td>
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<td>- Installation and commissioning</td>
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<td>- Maintenance</td>
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<td>- Replacements</td>
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<tr>
<th>Performance improvement</th>
<th>Operational excellence</th>
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<tbody>
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<td>- We optimize connectivity, reliability and efficiency of your assets to increase speed and yield.</td>
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<td>- Engineering and consulting</td>
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<td>- Maintenance</td>
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<tr>
<td>- We together manage your assets, operations, and risk to deliver strategic business results.</td>
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<tr>
<td>- End-of-life services</td>
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### Protection of Investments – from Today into the Future
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Renewables – Grid Automation Care Packages
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Renewables – Transformers