As a global solutions provider for a sustainable energy future, ALSTOM is strongly committed to the development of applications that improve energy efficiency and preserve our planet’s resources.

Thanks to ALSTOM Grid’s energy management experts and IT specialists – together with our global technology partners – we satisfy our customers’ demands throughout the whole energy value chain, offering today concrete solutions for truly smarter grids.

The management of Renewable Energy Resources is a top priority in ALSTOM Grid’s “Smarter Grid” program.

Our R&D group works in tandem with our customers and industry partners to deliver solutions for the fast evolving business needs in this field. As the world’s leading supplier of network management solutions, ALSTOM Grid has developed a set of innovative solutions based on state-of-the-art technology combined with actual field experience, and covers today the whole business domain in a consistent and effective manner.

### Business challenges

The urgent need to reduce the global carbon footprint has created a strong and long term demand for energy efficiency, with Renewable Energy Resources as a key element to meet these objectives.

Power generation companies, Transmission and Distribution actors, Wholesale traders, Utilities and Market operators, you are exposed to supply constraints and ever-larger amounts of Renewable Energy Resources (RERs) in your business environment.

Whether you are using wind, solar, curtailable loads, or others renewable sources, you need effective tools to cover the whole process, from forecasting the power output of energy resources of various origins, to effective scheduling, secure planning, reliable operations, with accurate monitoring & reporting of your key performance indexes.

### Customer Profiles

- Generation companies
- Transmission & Distribution system operators
- Market operators
Because you know the intermittent nature of Renewable Energy Resources (RERs), you are cautious about the accuracy of RER power production predictions, and you strive to maximize RER asset production to ensure higher utilization factors of renewable resources and compliance with regulatory framework and with contractual performance obligations.

Today, ALSTOM Grid has a number of proven platforms available to support the new renewable energy resources paradigm and the corresponding application requirements in both grid operation and business domains.

**Our approach**

ALSTOM Grid has a dedicated Renewable Operation Portal solution which adapts to all the functional requirements you may have when integrating RER into your daily and real-time operations.

The ALSTOM Grid Renewable Operation Portal has been designed to allow a phased approach:

- **Passive stage**: monitoring information related to Renewable Energy Resources operation
- **Active stage**: responding automatically to current power balance changes
- **Proactive stage**: anticipating potential problems and providing recommendations

For existing e-terra customers, ALSTOM Grid can also propose a step-up approach where new modules are smoothly added to current operational systems, such as SCADA, EMS, DMS and Market systems.

**Key Highlights and Features**

- **Data Acquisition**, for collection of Renewable Energy Resources related data
- **RE Forecast Plan**, also known as e-terra renewableplan, an interface with 3rd party Renewable Energy Resources production forecast engines. It’s also a server to multiple applications and user interfaces
- **RE Estimation**, also known as e-terra disgen, a power estimation engine with flexible aggregation capabilities
- **RE Generation Control & Dispatch**, a production and energy storage portfolio optimization module including regulation and curtailment functions
- **RE Network Security**, an advanced network analysis suite taking into account specific Renewable Energy Resources contributions and impacts
- **Simulator** for realistic training session and scenario evaluations in the context of Renewable Energy Resources
- **Advanced User Interface (UI)** to provide user-oriented screens
- **Historian** to provide support for historical information data processing, KPI calculation and reporting tools
- **Modeling**, a data and display configuration environment using standard resource models
ALSTOM Grid solutions for RE asset owners and RE operators

Renewable Energy Asset Owner and Operators need:

- A single, central SCADA system with standard data modeling
- A scalable solution and open architecture to cope with ever-expanding RE portfolio and geographical solution footprint
- State-of-the-art RE resources monitoring and control with advanced user interface and decision support tools
- Key Performance Indicators to monitor operational efficiency and report against expected operational and financial performance of assets
- Enriched information to support condition monitoring and preventive maintenance activities

**Key Highlights and Features**

- **RE Forecast Plan**, to maximize asset utilization taking into account future asset availability and weather conditions
- **RE Estimation**, to provide real-time production information in case of lack of telemetry
- **RE Generation Control & Dispatch**, to control production assets and comply to TSO regulation requirements
- **Advanced User Interface**, to provide user-oriented screens for situation assessment and efficient decision support
- **Historian**, to support all levels of the organization with dashboards and reports including assets Key Performance Indicators calculations (availability, compliance to operational expectations, etc. ...)
- **Data and Display Modeling**, to support quick and flexible additions or modifications of renewable energy resources objectsets

In a context of high penetration of Distributed Energy Resources, Generation Management Systems from ALSTOM Grid can combine the assets operation side, the performance monitoring, with advanced scheduling and fleet optimization programs.
ALSTOM Grid solutions for transmission system operators

Key Highlights and Features

- **RE Forecast Plan**, to provide the operator with developing renewable production conditions knowledge and understanding
- **RE Estimation**, to provide flexible up-scaling with aggregation at multiple levels: per generation owners, per areas, per generation type and per substation HV. This module can also interface and use several estimation models from external providers
- **RE Generation Control & Dispatch**, to automatically counteract renewable production power balance disturbances and optimize reserve calculations
- **RE Network Security**, to determine impacts of renewable production on network reliability
- **Simulator**, fed by RE production forecast inputs and taking into account forecast accuracies to support dispatcher training and assess multiple renewable production penetration scenarios
- **Advanced User Interface**, to help the operator efficiently assessing current and future renewable productions
- **Historian**, to support reporting and data historization
- **Data and Display Modeling**, to support quick and flexible additions or modifications of renewable energy resources objects

Due to rapid development of renewable energy resources generation, Transmission System Operators and Reliability Coordinators need:

- RE resources real-time monitoring and control with advanced user interface. This includes RE production observability for power injections from distribution feeders into sub-transmission grids
- Integration into the real-time environment of the RE resources production forecasts to deal with uncertainties and inaccuracies of forecasts
- Network security from an advanced suite of network applications with full integration of weather conditions. Example: dynamic contingency list depending on current Renewable Energy conditions
- Reserve management and generation control, from the ability to optimize reserve calculation and minimize generation control required to compensate intermittent

ALSTOM Grid helps Transmission companies in the modeling of large quantity of Distributed Energy Resources, for the integration of Renewable energy in the operations planning, network look-ahead analysis and real time monitoring, to preserve a secure and reliable operation of the transmission grid.
ALSTOM Grid solutions for distribution system operators

With the high penetration of Distributed Generation, Distribution System Operators need to deal with significant changes in their day-to-day operations. In particular, the presence of generating units in distribution feeders has a dramatic impact on some of the key operation processes. Thus Distribution System Operators request:

● Proper estimation of power flows for network planning, taking into account various generation scenarios
● Accurate energy flows directions and Short Circuit analysis for protections setup and tuning
● Careful management of operation switching plans for the personnel security
● Better management of the uncertainty and intermittent nature of Distributed Generation (DG) resources like wind or solar power
● Outage restoration and feeder reconfiguration strategies in case of presence of DG
● Studies and simulations of the network states in various load/generation conditions, with a seamless interface to DG forecast engines and powerful simulators

ALSTOM Grid’s e-terra distribution suite fully integrates RE resources today. Our Distribution Network Applications support real-time monitoring, analysis of the contribution of the corresponding injections into the grid, together with powerful and secure network operation.

Key Highlights and Features

- **RE Forecast Plan**, for renewable energy production forecast interface
- **RE Estimation**, for real-time DG production estimation
- **RE Network Security**, robust power flow and short circuit algorithm, allowing powerful load calculation in dynamically changing load, generation and topology conditions. Any type of loop conditions and power sources can be accommodated
- **UI**, Each individual DG unit can be represented in its own geography and network topology
- **Modeling**, Advanced load and generator models to represent the various DG units fully and accurately. Both data and display representation can be imported from GIS via a CIM-compliant interface

In addition, e-terra distribution supports operation processes and associated security measures like switching jobs, reconfiguration plans, outage restoration, and network optimization in the presence of DG in distribution network.
Denmark has more than 6,300 individual wind generators that produce more than 20% of the country’s total generation. Most of the production is located in distribution networks and is not telemetered. In 2008, ALSTOM Grid implemented a new SCADA/EMS system with dedicated wind power and combined heat & power distributed generation management system for the Danish National Control Center.

**Key benefits**

The system provides crucial information for accurately estimating all individual generators (ranging from tens of kW up to several MWs) and performs flexible up-scaling with production aggregation at multiple levels (per market participant, per substation HV injection, per areas, per generation type).

**Concrete results**

- Accurate real-time calculation and monitoring of DG production made available to the operator thanks to telemetry and estimation techniques
- Capability to perform ‘look ahead’ network security analysis thanks to integration of wind production forecasts
- Realistic simulation environment driven by wind production forecasts provided within the Dispatcher Training

With the addition of a new wind farm, combined with existing geothermal production, the big island of Hawaii was experiencing renewables penetration in excess of 60% of low load generation levels. Being an island, the system was significantly impacted by short-term fluctuations in the wind farm outputs. Moreover, the ridge-top location of the wind farm experiences more turbulence-based fluctuations than some other wind farm locations.

**Key benefits:** Automatic Generation Control function was enhanced to reduce the impact of these short-term fluctuations on control of the units used to regulate the system. Also, after considerable study, AREVA determined that the most significant action to mitigate wind power fluctuations was effective AGC tuning.

**Concrete Results:**

- A seamless enhancement on the top of an operational SCADA/EMS system
- An adapted generation control automatically smoothing and counteracting the fluctuation of wind energy production

France has more than 4000 MW of wind production on its system with a 2020 target of 20 GW of wind production as well as 5 GW of solar production. In order to meet these goals, ALSTOM Grid delivered in 2009 a state-of-the-art Renewable Energy Resources monitoring system which allowed for seamless integration of both wind and solar energy production on the French electrical system.

**Key benefits:** One of the major benefits for the customer is the real-time observability of these RE productions, allowing to securely determining reserve amounts. Although only part of the production is telemetered, ALSTOM Grid delivered a flexible RE production estimation which proved to be very adaptable in determining the contribution of distributed generation into the transmission grid. The flexible and scalable architecture of the e-terra solution has been a key decision factor knowing the tremendous increase of RE production in the coming years.

**Concrete Results:**

- 100% observability on renewable energy production injected on transmission network to better assess network grid state and impact on grid reliability
- Improved actual wind production knowledge as well as developing conditions (forecast) for reliable reserve requirements determination in a timely and secure way
- Single source system to host wind farm and wind production related reference model parameters
- Situation awareness via advanced user interface based on GIS
Most of ALSTOM Grid’s SCADA/EMS customers are facing new challenges to integrate Renewable Energy Resources. Thanks to the open and modular architecture of our e-terra platform, a new wind energy curtailment module has been seamlessly integrated with the generation management function in Ireland.

**Key benefits:** In the event of system restriction needs, a wind production dispatch module provides the user with the capability of specifying the amount of MW to be curtailed. Via dedicated displays, a user can select the wind farms to be part of the wind dispatch effort. Once activated, the new required output of each contributing wind farm is calculated using pre-defined rules, and automatically transmitted to wind farms via SCADA setpoints upon confirmation.

**Concrete Results:**
- A user oriented wind production dispatch dashboard to support the efficient operator decision making during curtailment situations
- Complete market transparency of dispatch instructions thanks to a detailed audit log, which records all wind production dispatch instructions

Renewable Energy Resource producers must choose systems which can support reliable and efficient operations with a high return on investment. ALSTOM Grid delivered a scalable solution, including a decentralized data acquisition architecture to allow smooth integration of new wind farms into the system, to a large global wind power operator.

**Key benefits:** Our tested and field-proven e-terra scada solution was selected for its ability to deal with several hundred thousand data points needed to support not only the real-time operation of the resources, but also the collection of non-operational data supporting asset management requirements. User-oriented screens allow asset monitoring at different levels of granularity. A full-fl edged historian solution also serves as a foundation to support the calculation and monitoring of Key Performance Indicators and to support adaptive operation and maintenance procedures and decision-making processes.

**Concrete Results:**
- Reduced down time thanks to enhanced alarming system and capability to provide synthetic information to the maintenance team
- Capability to assess real time performance of wind farm manufacturers and in turn to optimize selection for incoming wind parks

In 2006, ALSTOM Grid was contracted by a major U.S. electricity company to study the operational impacts of wind generation on its network. The project focused on the potential technical and economic impacts of operating up to 1,500 MW of wind generation on the Northern States Power system.

**Key benefits:** The study analyzed the impacts of significant amounts of large-scale wind generation on the real-time operations and short-term planning of the utility’s electric power system. These functions, also known as ancillary services, are critical to reliable and economic operation of interconnected power systems, and represent tangible costs to the utility.

**Concrete Results:**
- Determination of accurate models following an investigation of the wind patterns in the Northern States control area
- Thorough analysis of past wind generation data to assess wind generation forecast accuracy
- Simulation using ALSTOM Grid’s e-terra simulator of the real-time effects on the power system of higher penetration wind power production