Energy Management Solution for the Process Industry

Energy Management and Optimization

Reduce energy costs and improve profits

Energy efficiency and energy cost have top priority all over the world, in particular for heavy energy consumers. ABB´s Energy Management and Optimization Solution (EMO) offers tools for energy cost cutting and energy efficiency improvement.

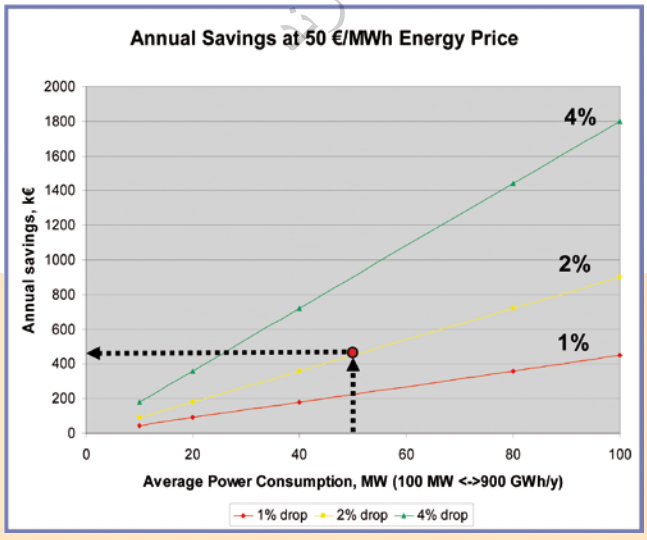
ABB has extensive experience in developing and supplying energy management systems for the process industry, especially in paper and steel production. The same techniques and solutions are available for all customers in the pulp and paper, metal and mineral, chemical and petrochemical or other industries that consume large quantities of energy at varying rates.

The energy management system, which aims at reduced energy use and costs, represents a key element in any company's energy management program. Energy management is based on real time information obtained from process monitoring and control systems, and on production plans received from production planning systems.

The total solution includes planning and scheduling tools to optimize energy use and supply, energy balance management tools to support the real-time monitoring and control of the energy balance, and reporting tools to evaluate and report energy consumption, costs, efficiency and other energy-related information.

The solution is scalable from a single plant or mill-wide energy reporting application up to the multi-mill system of a big enterprise serving hundreds of users at mill sites and at corporate level in different regions, or even in different countries, with a host of applications covering all aspects of energy planning, operation and reporting.

Opportunities for cost reduction are greatest when both electricity consumption and prices vary over time, which is common in process industries, and open electricity market environments. Typically, the overall cost reduction can be 2 to 5 per cent of the total energy cost.



- Payback from reduced energy consumption and price
- Savings (€) = Energy bill (€) * drop (%) in energy (price + consumption)
- Total savings 2-5% of the energy bill depending on the initial level





EMO provides significant cost savings and increased profits as a result of reduced energy consumption and energy prices. The savings result from various sources, for instance:

- Lower electricity purchase prices due to accurate consumption forecasting
- Avoiding price peaks and penalty charges
- Employing optimal resources in the supply of electric power
- Enhanced awareness of energy consumption and energy costs
- Early detection of poor performance based on real time monitoring of performance against set targets

Comprehensive software toolset

ABB's EMO Solution provides a sophisticated and comprehensive toolset for managing and optimizing energy operations in an open energy market environment.

Planning tools for energy scheduling

EMO planning tools are used to predict energy consumption and calculate the corresponding energy supply schedule. In the balancing process of the European open electricity market, schedules are calculated and agreed for the day ahead. In strategic planning and budgeting, these schedules may extend over years, while during real-time monitoring they may cover only the next few minutes or hours.

Load forecasting

Consumption forecasts for major consumers are calculated based on the planned production schedule. Production line load forecasts are derived from the planned production grades and rates, which are received from the production planning system through an interface. In a steel mill, the arc furnace is the largest consumer and its consumption forecast is based on planned melt schedules and typical load profiles during the melt cycle. Some consumers' consumption levels are forecast through weekly load profiles. An outage can be specified for any consumer with lower consumption in shutdown status, while total mill consumption is calculated as the sum of the individual unit consumption schedules.

The load forecast contains valuable information for the power supplier, especially if consumption is considerable and varies over time, since knowing the load schedule enables the planning and optimization of the supply schedule. Large users can plan and optimize their power supply themselves using EMO tools, while smaller users may submit their predicted load schedules to the power supplier. Accurate load forecasts help lower the price of purchased electricity.

Contract and Balance Management

The Contract and Balance Management module balances time-varying energy consumption with supply resources. The total energy network is modeled as a number of balancing areas, which contain resources (own generation and purchase) and consumption (own consumption and sales). In each balancing area the total consumption is balanced with supply resources. The balancing areas may cover different items, such as electric power, water, steam, gas, greenhouse gases (CO2), etc.

Balancing areas can be interconnected by transfer contracts that model the conversion of media between the areas (e.g. fuel to steam, or steam to electric power). As required, balancing resources are selected so as to minimize the total energy cost or maximize the total profit.

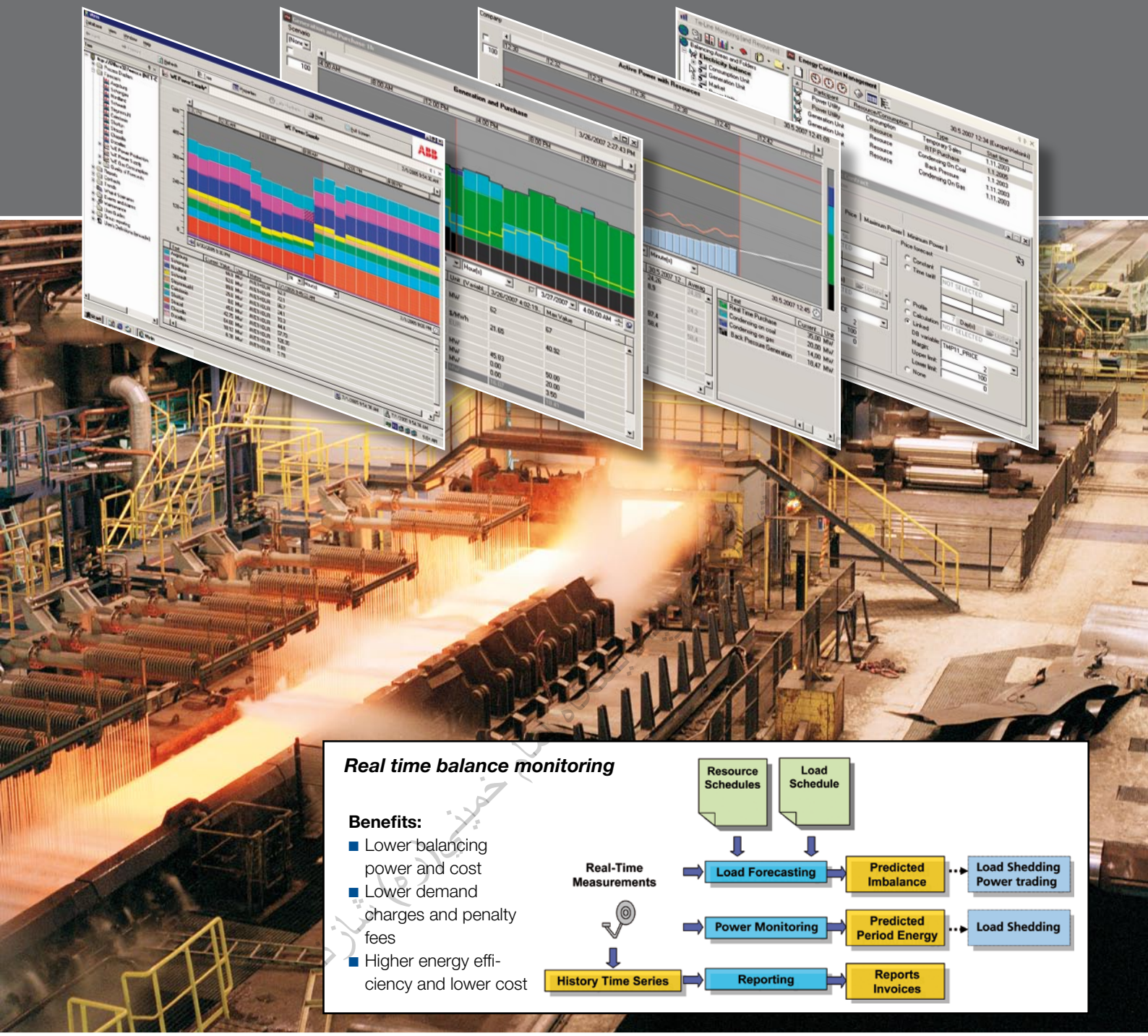
The system administrator can specify and set the parameters for the balancing areas, energy trading partners and contracts, while the users record individual sales and purchase transactions alongside prices, amounts, validity times and other relevant information.

Real-time balance monitoring

EMO tools can be used during the real-time operating phase to monitor the execution of power schedules in order to detect deviations or unexpected events and to minimize their costs.

The Load Forecasting module automatically recalculates the consumption forecast upon any changes in process measurements, the production plan or user inputs. If an imbalance between predicted power consumption and planned supply is detected, e.g. due to an unexpected process disturbance, the deviation may be balanced through additional trading in power.

The Power (Tie-Line) Monitoring module predicts total power consumption within the current billing period by integrating and extrapolating the power flow in the tie-line. If the predicted energy exceeds pre-set or calculated alarm limits, alarms can be generated enabling the operator to take action to limit the deviation.



Real time balance monitoring

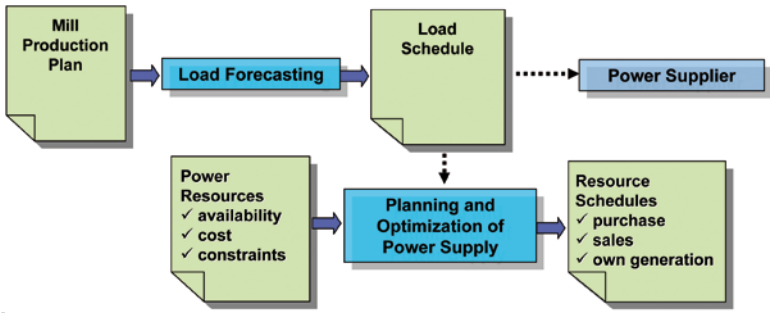
Benefits:

- Lower balancing power and cost
- Lower demand charges and penalty fees
- Higher energy efficiency and lower cost

The planning tools include

- Load Forecasting module to predict energy consumption,
- Contract and Balance Management module to balance energy consumption and supply,
- Resource Optimization module to calculate optimal supply resources and
- What-If Simulation module to evaluate and compare alternative operating scenarios.

Planning and scheduling



Power price advantage from:

- Providing load schedules to power supplier
- Employing optimal power resources

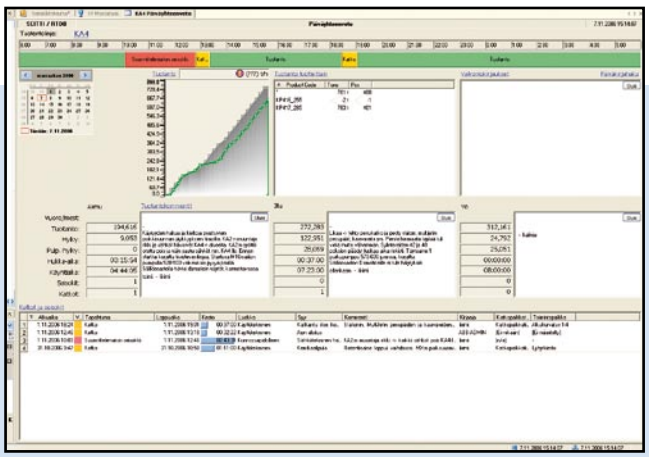
Performance reporting based on Process Data Management

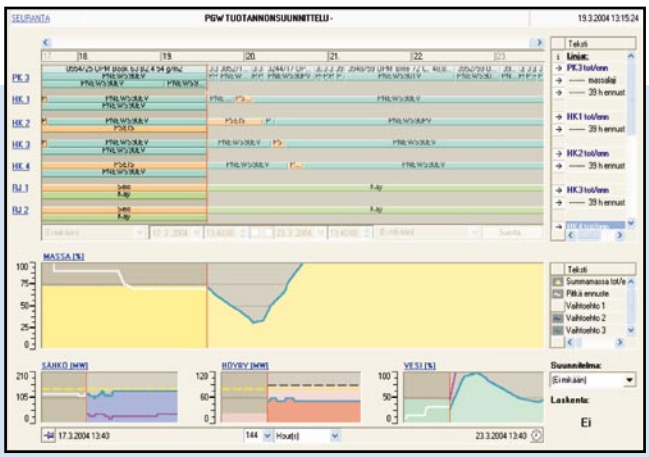
The EMO Solution is implemented upon ABB's Process Data Management (PDM) software platform that includes

- **Real Time Database (RTDB)** – a relational database designed and optimized for high performance process data management and for the recording of time series – both histories and forecasts - of measured and calculated data. Real-time process data is collected from various data acquisition systems through interfaces and stored in the database as time histories. RTDB is compatible with MS-Office and other industry standard office software and reporting, analyzing, and application development tools.
- **User Interface** – a modern presentation tool based on Microsoft .NET technology, programmed using C# and applying the latest usability engineering knowledge in the visualization of process information. Downloaded into the user's workstation from a web link, the User Interface makes the EMO tools and the information stored in the server's RTDB database available to all authorized users through the enterprise data network. Client – server communication between the database server and the user client is protected by data encryption and each client has user-group-specific access rights to system functions and data.

Performance calculations, data displays and reports can be easily configured using PDM engineering tools. The PDM calculation tool enables the use of real-time or various types of data based on the history time levels in the calculation equations. The navigation menu and data displays can be configured from the user interface using powerful display elements, including chart and list controls. A unified time-based report template is available for presenting user configurable data based on the history time levels in table form.

PDM also provides alarm management, operating diary, and other process information management functions complementing the EMO tools.





The energy management system analyzes the use of energy and utilities and supports energy efficiency improvement by quickly and accurately indicating actual performance and comparing it with set targets. Some examples of the performance reports are:

- Consumption and cost of utilities per hour/day/month/year, by individual and aggregated users
- Consumption and cost of utilities per end product unit
- Analysis of load profile and peak demand
- Benchmarking (comparing current performance against the past)
- Best practices performance
- Budget performance

Managing energy resources and reducing costs

ABB's energy management systems are based on the latest software technology and over 20 years of experience gained in supplying hundreds of challenging industrial process information management systems worldwide.

UPM-Kymmene's Corporate-wide Energy Management System

UPM-Kymmene Corporation is one of the world's leading manufacturers of printing paper. Energy plays an important role in production and, as part of its corporate strategy, the company seeks a high level of self-sufficiency in energy production. In addition to using and generating electricity, UPM purchases it from and sells it to external partners on the local markets. Knowledge of expected energy demand and optimizing energy resources create significant savings.

To achieve this goal, over the years the company has invested considerably in energy efficiency and availability, and the predictability of energy use and supply. The key tool in this area is the corporate wide energy management system consisting of 18 mill level systems - 10 in Central Europe and 8 in Finland - and two control centers, all interconnected into a network. The system has been implemented and extended in several phases over more than 20 years.

The mill level systems collect real-time data from the process, calculate and report electricity, steam, water and natural gas balances and predict energy consumption and the firm's own generation based on paper mill production plans. Energy balance data and consumption forecasts are consolidated in control centers.

These control centers trade electricity and natural gas with external parties, and distribute the same commodities within the corporation at internal rates. Trading is based on the balance between predicted consumption schedules, the firm's own generation, and existing sales and purchase contracts. EMO tools are applied when selecting the optimal balancing resources during the planning phase and predicting and monitoring the balance in real time.

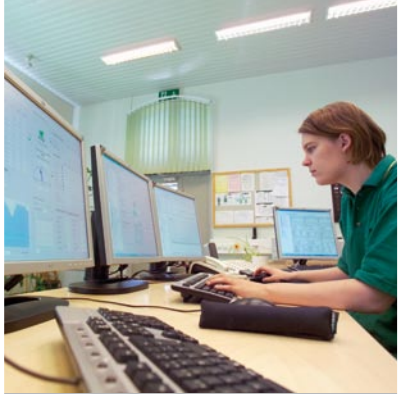
The system also performs extensive reporting functions both at mill and corporate level, including greenhouse and flue gas emission reporting in accordance with the law and regulations.

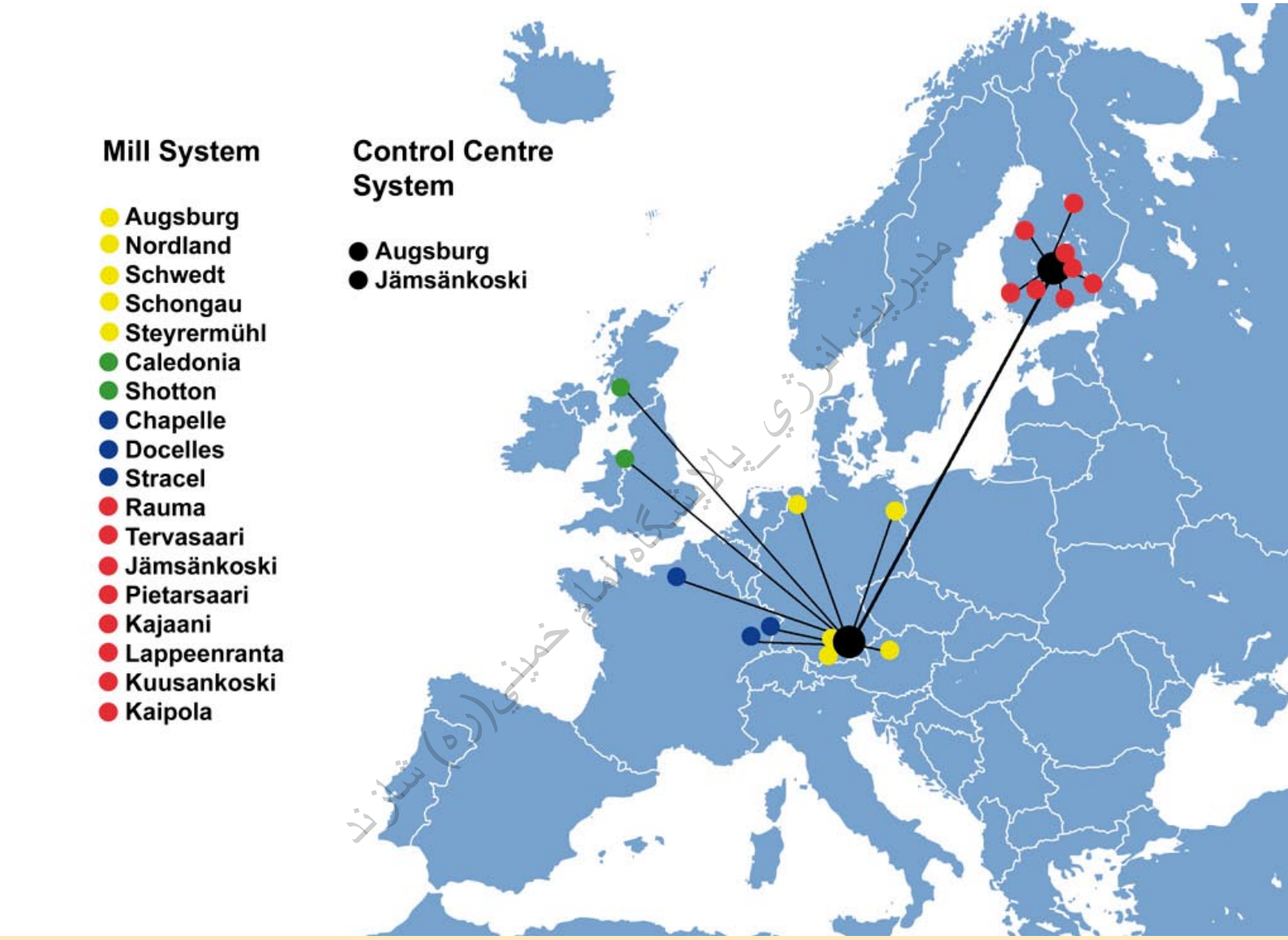
Energy Management at Mayr-Melnhof's Board Mills

The Mayr-Melnhof Cartonboard Group is the leading producer of recycled cartonboard within Europe and world-wide.

In 2001, ABB delivered mill-wide energy management systems to 7 Mayr-Melnhof board mills in Austria, Germany, the Netherlands, Switzerland and Slovenia, when the energy market environment was beginning to liberalize in Central Europe.

"We use the system to manage energy, water, chemicals, compressed air, production and quality data and statistics. The ABB RTDB system represents our connection between local processes and offices, and provides a handy instrument for optimizing the process and detecting failures more easily. We are happy with the system and have ordered an upgrade this year in order to obtain further benefits", explains Mr. Johan Maier, responsible for energy and water management at Mayr-Melnhof in 2007.



The extent of the UPM energy management system is characterized by the following figures:

- 20 TWh electric yearly total procurement
- 100 energy resources including fossil, nuclear, and hydro
- 18 mill level systems and 2 corporate level control centers
- up to 600 simultaneous users
- 40 000 tags in databases
- 50 interfaces for process data collection

Energy Management at Swiss Steel

Swiss Steel AG (formerly von Moos Stahl), located in Emmenbrücke near Luzern is one of the leading suppliers of high quality, refined and free cutting steels to European automobile, machine and component industries.

The energy management solution delivered by ABB to Swiss Steel reduces the price of electricity by sending predicted load schedules to the electricity supplier and monitoring actual consumption. These load schedules present consumption for the current and following day at 15-min intervals.

The energy management system receives the production plans of the steel mill and hot rolling mill from the production planning systems, and calculates the corresponding energy consumption forecasts. With respect to this, the biggest consumer is the electric arc furnace, whose load changes sharply between zero and maximum power during a melt cycle of around 50 min. The rolling mill's consumption depends on the type of end product and the mill train in operation.

Due to the electric arc furnace the load schedules exhibit a strong time variation. If the consumption schedule is not correctly predicted, the electricity supplier incurs additional costs, which are transferred to the user in the form of forecast error penalty charges. To avoid these penalties, any changes in production plans or disturbances in operation are continuously updated in the energy management system, and the revised load schedules are sent to the electricity supplier.

Operators monitor consumption using the tie-line monitoring display that activates an alarm if a deviation leading to a penalty charge is expected.

The energy management system allocates the costs of the used energy to the users (mill departments). These penalties, if any, are shared between the users that contributed to the forecast error in order to provide an incentive for better forecasting.

Energy Management & Optimization at Public Works Government Services Canada (PWGSC)

PWGSC is responsible for government assets including office buildings, central heating and cooling plants as well as high voltage, water and sewage distribution systems that vary in size, complexity and age. Its activities include delivering, verifying, forecasting and reporting on utilities (e.g. electricity, natural gas, water and different grades of fuel) for all of these facilities. These tasks are complicated by the need to deal with different energy suppliers and different energy commodities for many internal departments and other government departments.

PWGSC found that the multiple budgeting, reporting, billing and forecasting systems in place could not effectively manage all of its required energy and asset management activities. As a result, it compiled comprehensive specifications for a new energy management system. The answer proved to be ABB's EMO tool, which PWGSC identified as the one "commercial off-the-shelf software package" that could provide it with a unified approach to energy conservation and optimization across all of its facilities. As an example, PWGSC users will not have to overcome language constraints (very important in Canada) since the user interface switches from English to French in accordance with the language setting of the user's login station.

Furthermore, by providing "what-if" scenarios and contract management, EMO helps optimize energy costs. The system collects real-time data from different energy markets, such as the Independent Electrical System Operator, Environment Canada and other energy markets within North America. EMO tools support the analysis of the cost impact of different combinations of electricity and natural gas purchased from different sources, and provide the information needed to negotiate and purchase different energy commodities directly from the main suppliers and markets.

The energy management system at PWGSC helps determine optimum energy conservation schemes for different buildings, so that they can be operated at maximum energy efficiency while reducing greenhouse gases. The reports include:

- Energy usage and cost per m^2 for all utilities per day/month/year
- Energy usage and cost by building
- Average daily profile - showing average pattern of demand over a specified period by individual meter/ multiple meters/ building
- Aggregate analysis - totalizing data points and determining peak, minimum and maximum consumption to determine demand-limiting options for all utilities.
- Normalization of building consumption against its characteristics
- Temperature and weather correlation
- Benchmarking

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