Making power plants energy efficient
Comprehensive solutions for power generation
ABB energy efficiency solutions have a proven and well-documented ability to improve the energy efficiency of power plants. They can improve power output to the grid by up to 10% without increasing fuel consumption.

- Raise the plant’s electrical output by correcting process inefficiencies
- Generate more energy from less fuel by lowering the plant’s fuel consumption
- Increase plant revenues by selling more energy and reducing fuel wastage
- Improve operational flexibility by maximizing process efficiency
- Extend the operating life of the plant by optimizing asset performance
- Reduce greenhouse gas emissions by minimizing the plant’s carbon footprint
Energy efficiency solutions from ABB
The efficient way to generate more power

The quickest and least expensive way to meet the growing demand for more electric power is through energy efficiency.

By improving the plant’s energy efficiency, you not only generate more power and higher revenues, you reduce fuel consumption and greenhouse gas emissions.

It’s a win-win situation – many times over.

Energy efficiency is our specialty...

Energy efficiency is ABB’s specialty. So too is raising productivity, and ensuring that power plants operate reliably and the transmission grids they are connected to are stable.

These four drivers – energy efficiency, productivity, reliability and stability – are intimately connected.

When ABB improves the energy efficiency of a power plant, we improve plant output and equipment reliability as well, while ensuring the stability of the surrounding power network.

ABB does this across a broad range of industries, predominantly in energy-intensive sectors like power generation.

...power generation is our business

ABB is a leading provider of integrated power and automation solutions for conventional and renewable-based power generation plants.

We have one of the largest installed bases in the industry, market and technology leadership in power and automation technologies, and unrivaled application know-how and process expertise based on more than 125 years of power generation experience.

Our extensive offering includes turnkey electrical, instrumentation and control solutions, and a comprehensive service portfolio that is geared to optimize plant performance, reliability and efficiency, while minimizing environmental impact.

Meeting your strategic and operational targets

ABB energy efficiency solutions have a proven track record in achieving double-digit improvements in power plant energy efficiency.

These solutions are built on our extensive application experience and are designed to meet the strategic requirements of plant management and the operational demands of plant engineers. We know that if our solution is to succeed, it has to have the backing of both management and operations staff – they have to be convinced that it will make a difference and meet their respective targets and objectives.

ABB prides itself in providing solutions that deliver on both counts.

4 ways to improve energy efficiency

ABB’s portfolio of energy efficiency solutions for power plants meets the strategic and operational requirements of all types of thermal power generation – coal-fired, combined heat and power, waste-to-energy, and combined cycle.

Our portfolio covers the four essential areas of energy efficiency enhancement:

- Energy efficiency assessments
- Application-based solution packages
- Plant and process optimization systems
- EBoP upgrade and rehabilitation projects with an energy efficiency focus
Energy efficiency assessments

Identifying opportunities for energy savings

Everything grows older with time. After 10 or more years of operation, a plant will no longer be operating at best practice levels. Efficiency deteriorates, new technologies appear and benchmarks are raised. Not to mention the growing constraints of environmental requirements and the rising cost of fuel. The most efficient way to meet these challenges is to improve the energy efficiency of the plant. The first step in that process is to perform an energy efficiency assessment.

Phase 1: Identifying the opportunities

The purpose of an ABB energy efficiency assessment is to identify opportunities for improving the energy efficiency of the power plant and to estimate the size and value of those improvements.

We do this by dispatching a small, experienced and highly qualified team of ABB experts to the plant. Each member of that team is a vastly experienced electrical or automation engineer and has a deep understanding of power plants and power generation processes. The team uses its expertise to determine where the most significant plant inefficiencies are likely to be found. By combining plant operational data and working closely with the plant operations and maintenance staff, we are able to quickly identify 30–50 opportunities for improvements in energy efficiency. These are analyzed, evaluated and narrowed down to the 10–12 that best meet the customer’s priorities and requirements for return on investment.

Typical areas of investigation

Typically, an ABB energy efficiency assessment investigates the following areas:

- Power generation processes
- HV, MV and LV electrical systems
- Compressed air and industrial refrigeration and chilling systems
- Gas equipment; heating, ventilation and air conditioning systems
- Electricity generation equipment; pump, fan and motor systems
- Plant operational data

We measure and record the energy consumption of the equipment and systems, correlate it with plant output, and compare it to an appropriate benchmark. We then set targets to reduce or control energy consumption, frequently compare the amount of energy consumed with the targets set, report any variances and implement measures to correct the variances. We also assess plant practices and staff behavior in energy efficiency matters, from energy strategy and policy to capital investment, operational planning and performance, staff training and development, and staff motivation.

Case study

Total opportunities savings worth $11 million/year identified

The site is a power and desalination complex in the Gulf Arab states. It produces 1,000 MW of power and approximately 68 million imperial gallons of water a day. ABB conducted an energy efficiency assessment in 2011 and identified 32 energy-saving opportunities in various site systems.

The potential savings of these 32 opportunities were estimated to be worth up to 400,000 MWh/year and US$ 11 million/year. Eight of these opportunities were quick-win opportunities, providing an immediate return on investment, with no third-party requirement and little or no further development or investment required. One opportunity was a major quick-win, with potential fuel savings worth $1 million a year.

Phase 2: Prioritizing the opportunities

The 10–12 opportunities are developed into a detailed implementation plan to deliver the energy savings estimated. The plan takes the form of a suite of improvement projects, each with well-understood benefits and benchmark verification methods, including implementation costs and implementation scheme, technology options and potential vendors. The opportunities cover three types of improvement projects:

- Quick-win optimization projects that are quick and inexpensive to implement
- Intermediate projects that are relatively inexpensive to implement and have relatively fast payback times
- Large rehabilitation projects that offer large returns but require larger investment

Phase 3: Implementing the opportunities

The projects are implemented, completed and the benefits validated by ABB. Simple projects might be implemented within a few weeks, more complex projects may take up to two years.

ABB has supplied and implemented solution packages at thermal power plants worldwide, and has achieved some remarkable results. Our target is always to improve the plant’s energy efficiency significantly. Our portfolio consists of three solution packages for steam generation, power generation, and auxiliaries and balance of plant.

Steam generation

Optimize the boiler air-to-fuel ratios and blow down rates

Stoker furnaces are often run with excessive oxygen levels. This generates heat losses, requires high volumes of air to be blown into the furnace and high volumes of flue gases to be treated in the flue gas cleaning system. By reducing the oxygen level and maintaining a low level of carbon monoxide, ABB has achieved the following performance improvements at a thermal power plant:

- 10% reduction in plant auxiliary power consumption
- 1% increase in combustion efficiency, which is equal to a 1% increase in gross electrical output.

Optimize the boiler load profiles to meet demand forecasts

ABB has developed a sophisticated solution for waste-to-energy plants that optimizes grate combustion and forecasts district heating consumption. This enables the plants to convert excess thermal energy into electricity for sale on the spot market. The results achieved at one plant include a 20% reduction in CO emissions, a 2.5% reduction in steam flow rate variations, and monthly revenues of up to $180,000 from the sale of excess electricity on the spot market.

Application-based solution packages

Boosting plant efficiency

ABB application-based solution packages are designed to cover all eventualities. Our objective is to provide a complete solution to a problem – not just a tool or service that solves a small part of a larger problem.

Installation of efficient burners

Inefficient boilers consume excessive quantities of coal and water. During an energy efficiency assessment for a thermal power plant in China, ABB discovered that the boiler blow-down rate was above normal, causing heat and water losses that cost more than $500,000 a year. This was one of many quick-win opportunities with low investment costs that ABB identified at the site.

Power generation

- Thermodynamic performance
- Optimization of extraction/back-pressure steam control
- Turbine control of individual units
- Turbine control of multiple units for optimum heat rates
- Performance deterioration – monitoring of turbine performance
- Predictive maintenance programs for turbine and condenser

Auxiliaries and balance of plant

- Transformers
- Switchgear
- Field devices (instrumentation and analytics)
- Compressed air system
- Leakage reduction program
- Optimized compressor operation
- Reduced header pressure
- Cooling water system optimization
- VSDs for cooling water pumps and fans
- Data acquisition system
- Alarm systems

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Plant and process optimization systems
Getting the most from your assets

ABB offers a comprehensive portfolio of plant and process optimization products that improve the efficiency and lower the energy consumption of plant equipment and entire power plant units. These widely proven products are part of ABB’s hugely successful OPTIMAX® and WACS optimization suites for power plants and waste-to-energy plants respectively.

Intelligent multi-pump control
ABB’s Intelligent Pump Control (IPC) incorporates all the functions necessary to make pumps operate energy efficiently. Designed for multi-pump applications where the flow rate is variable, IPC delivers significant energy savings by – among other things – adjusting the number of pumps in operation to match the changing flow rate. Its built-in redundancy ensures the highest levels of availability, even if one of the pumps fails.

Pump efficiency monitoring
ABB’s PumpEfficiency continuously and accurately monitors pump efficiency and flow by measuring the water temperature, water pressure and motor power of each pump. The solution is based on the ABB High Accuracy Delta-T Transmitter (HADTT), which was developed and patented especially for this application. This easy-to-install product provides a rich source of data that can be used for maintenance planning and for optimizing load allocation to pump groups.

MPC combustion control for WtE plants
For waste-to-energy plants, ABB has developed a model predictive combustion control module that achieves maximum fuel conversion efficiency and lowest flue gas losses, even with a highly variable waste quality. It can be easily configured to follow preselected targets, such as maximum waste, water pressure and motor power of each pump. The solution is based on the ABB High Accuracy Delta-T Transmitter (HADTT), which was developed and patented especially for this application. This easy-to-install product provides a rich source of data that can be used for maintenance planning and for optimizing load allocation to pump groups.

Boiler start-up optimization
Boiler start-up optimization

BoilerMax is ABB’s predictive model-based multivariable controller for online optimization of boiler start-up. It reduces start-up and shutdown times, while taking into account specific process conditions such as thermal stress of critical components and the margins for maximum permissible loads. The resultant savings in fuel and auxiliary power are between 10–20% for each plant start-up.

Turbine and boiler coordination
Large energy savings can be achieved during plant start-up and shutdown through the coordination of turbine and boiler control. ABB’s MODAN and MODAKOND unit control systems enable controlled start-ups/shutdowns and load changes under economically optimized conditions. One of their main functions is to reduce the unnecessary throttling of turbine control valves. A reduction of just 3 bar can save around 1500 MWh in energy a year and result in smoother operation and less stress on the main plant components.

Boiler temperature control
ABB’s State Space Controller provides advanced temperature control and improves temperature control performance. It lowers the deviations for live steam and/or reheat temperature, and allows follow preselected targets, such as maximum waste, water pressure and motor power of each pump. The solution is based on the ABB High Accuracy Delta-T Transmitter (HADTT), which was developed and patented especially for this application. This easy-to-install product provides a rich source of data that can be used for maintenance planning and for optimizing load allocation to pump groups.

Loop optimization
Loop optimization can be frustrating. Within a few months all the results can be lost in process variability. Plant engineers have to look at hundreds of signals and try to detect possible problems. ABB’s Loop Optimizer solves this difficulty by both performing the optimization and maintaining the process at the optimal operating conditions. It monitors DCS signals and detects problems at their first occurrence, while also fulfilling preventive maintenance requirements.

Lifetime monitoring of steam generators
ABB’s BoilerLife provides lifetime monitoring of boilers and heat recovery steam generators. It measures the onset of fatigue and creep in major thick-walled components against German TRD and European EN standards for steam boilers. Benefits include improved boiler maintenance scheduling, feedback on the effects of operational methods, and the avoidance of excessive stress on the boiler and costly unscheduled repairs.

Power plant performance monitoring
ABB’s PlantPerformance continuously compares actual plant performance with expected plant performance. Users can configure models based on their own calculation principles or integrate simulation models to calculate the best achievable plant performance. PlantPerformance monitors the effects of sootblowing (improved boiler and fuel efficiency) and provides an early warning of equipment degradation and performance deviations, and is a valuable decision-support tool for predictive maintenance and energy trading.

Load scheduling optimization
ABB’s PowerFit determines the optimal distribution and scheduling of power and/or heat generation for multi-unit power plants (also known as unit commitment). Users can define technical and commercial constraints, as well as lifetime and emission constraints. PowerFit optimizes generated and purchased energy to satisfy load demands posed by energy consumers, and acts as a decision-support tool for cost-optimal trading in deregulated markets.

Sootblowing optimization
ABB’s Sootblowing Advisor calculates the surface cleanliness values of the heat exchanger sections in boilers and determines the optimal sootblowing strategy. Sootblowing is a necessary boiler cleaning procedure which aims to maintain or improve the unit’s heat rate. Sootblowing Advisor takes into account the cost of sootblowing (steam consumption, etc) and the increased revenues from the effects of sootblowing (improved boiler and fuel efficiency).

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EBoP upgrade projects
Reducing plant power consumption

The plant electrical system consumes between 7% and 15% of the electricity that the plant produces. The less efficient the electrical system, the more power it consumes – power that could have been sold to increase the plant’s revenues and profitability.

Reducing the plant’s parasitic load
Even though ABB electrical equipment is designed for a long and trouble-free operating life, we can still achieve significant improvements in plant energy efficiency by upgrading or rehabilitating selected areas of the plant electrical system.

In our experience, the speediest and largest improvements are achieved by installing high efficiency motors, equipping pump and blower applications with variable speed control, improving the performance of the generators, and increasing the efficiency of the transformers.

High-efficiency motors
One of the most effective ways to reduce energy consumption is to install high efficiency motors and variable speed drives. In many instances the return on investment is achieved within a few months.

A typical power plant has up to 20 medium voltage motors and around 20 low voltage motors, which drive the plant’s most energy-hungry applications – pumps, fans and blowers. By replacing older less efficient motors with ABB high-efficiency motors, the energy consumption of each motor can be reduced by as much as 10%.

High-efficiency motors are the default offering of ABB. Each ABB motor is specifically designed to meet international energy efficiency classes and the various minimum energy performance standards (MEPS) of the world. In addition to energy savings, better efficiency means lower running temperatures and higher reliability.

Variable speed drives for pumps, blowers and fans
Pumps and fans are the world’s two largest motor applications. Together, they account for half of all the motors in use and a significant proportion of the energy consumed by motors worldwide.

Many motors continue to run at full load, even under partial load conditions. By replacing the existing motor with a high efficiency motor, equipping it with a variable speed drive and a pump or fan efficiency monitoring system, considerable energy savings can be achieved. These savings can be as much as 50% for applications currently controlled by a throttling valve or hydraulic coupling.

Improving generator performance
The generator is the heart of the power generation process. Although generators are engineered to perform at a high rate of efficiency, ABB can make performance improvements by redesigning the electrical and cooling characteristics and some of the mechanical characteristics. Instead of investing huge amounts of capital in a new generator, it is often considerably more economical to perform a generator rehabilitation and combine it with a performance improvement program. This will extend the generator’s lifetime by 10–20 years and produce a performance that is close to that of new state-of-the-art equipment.

Depending on the age of the generator, ABB has achieved energy savings of up to 8% through these and similar measures.

Boosting transformer efficiency
Large power transformers are extremely efficient machines. Even though their efficiency levels can be close to 100%, there is still margin for improvement.

The throughput of large generator step-up transformers can be up to 1,000 MVA, so even small gains in efficiency of less than half a percent translate into hundreds of megawatt-hours of saved power annually. Multiply this over a 25-year extended life cycle of the transformer and the savings are worth hundreds of thousands of dollars.

ABB takes the risk, you take the savings
By signing a long-term service contract with ABB (usually for a period of 5 years), ABB undertakes to deliver energy savings on a performance guarantee basis. We make the investments and take the financial and technical risk – you share the savings with us. At the end of the contract, you take possession of the investment made and harvest the full 100% of the savings for years to come.

Can ABB deliver?
ABB is one of a small number of solution providers who have the expertise and resources to deliver a total energy efficiency project from beginning to end – identifying the opportunities, drawing up detailed specifications, supplying the equipment, executing the project and validating the results.

ESCO energy service contracting
Risk-free performance guarantees

For those customers who prefer a risk-free implementation of the energy efficiency opportunities identified, ABB offers an attractive and budget friendly option.

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