

The benefits of energy efficiency
Doing more while lowering costs
and emissions

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ABB has been in the energy business for 120 years. Our technologies are used along the entire energy value chain: from the extraction of resources and their transformation into electricity, liquefied natural gas or refined petroleum products, to their efficient use in industry, transportation and buildings. We help our customers squeeze the most value from each unit of energy they use.



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How ABB can help From waste to reward



Tight budgets, environmental pressures and rising energy demand are clamouring for our attention. Fortunately, we can tackle all of these challenges by making the energy we already use work harder for us. By increasing our energy productivity, or efficiency, we can do more with less.

Energy efficiency improvements are attainable with the best available technology and practice. Energy efficient systems can pay for themselves in energy savings, sometimes within months, and further reduce operation and maintenance costs in the long term.

The International Energy Agency (IEA) says we should place the highest priority on becoming energy efficient, as this offers the highest potential for reducing carbon emissions, at the lowest cost.

“Increasing energy efficiency, much of which can be achieved through low-cost options, offers the greatest potential for reducing CO₂ emissions over the period to 2050. It should be the highest priority in the short term.” IEA, Energy Technology Perspectives 2010

Overcoming barriers

In practice, however, it can be challenging to capture these benefits. Governments, businesses and individuals all play a role, but there's no easy way to coordinate their actions. Barriers to investing in energy efficiency include lack of knowledge, lack of resources and limited capital.

Right now, the energy we use doesn't work nearly hard enough for us. The process of finding, harvesting and transforming energy resources into products like electricity and gasoline and then using them is so inefficient that we lose most of the poten-



tial energy value of our energy resources. Faced with finite fossil fuel supplies and rising demand, this situation is not sustainable.

Making energy more productive

There is heavy pressure to reduce energy consumption and carbon emissions across every facet of human activity. The electricity supply system is evolving particularly fast: the need to produce more power from renewable sources at one end of the chain and to use energy more productively at the other is accelerating the development of smarter power networks.

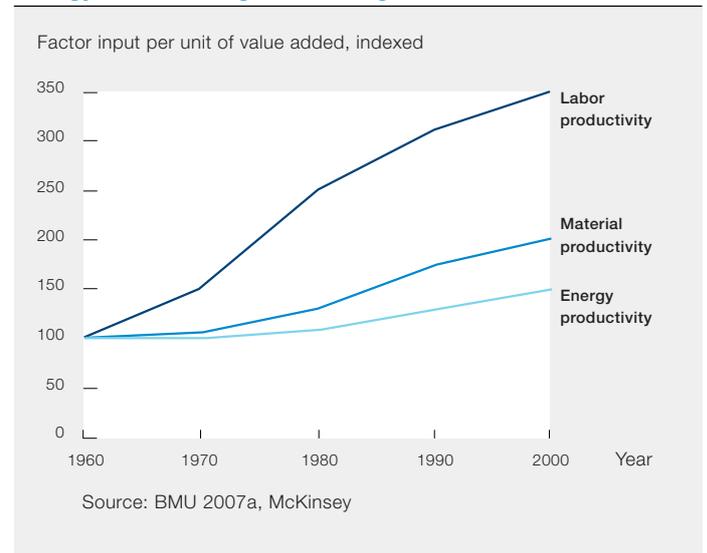
ABB can contribute to energy efficiency improvements in two key ways. First, by providing specialists capable of appraising and monitoring how energy is used and of identifying specific areas for improvement. Second, by providing the equipment, systems and solutions to reduce energy consumption and losses, improve productivity and manage equipment and processes more effectively.

Moreover, ABB is the market leader for key energy-saving technologies in emerging economies, where the energy-efficiency need and potential is greatest. In China and India, ABB is among the main providers of power transmission and distribution technology and a leading supplier to fast-growing industrial sectors.

Individual products can significantly increase energy efficiency, but the most impressive savings come from optimizing entire systems and processes. For this reason, the International Organization for Standardization (ISO) has identified energy management as a priority area for the development of interna-

tional standards, and is now drafting the ISO 50001 standard to help companies globally reduce energy intensity in their facilities and benchmark their achievements.

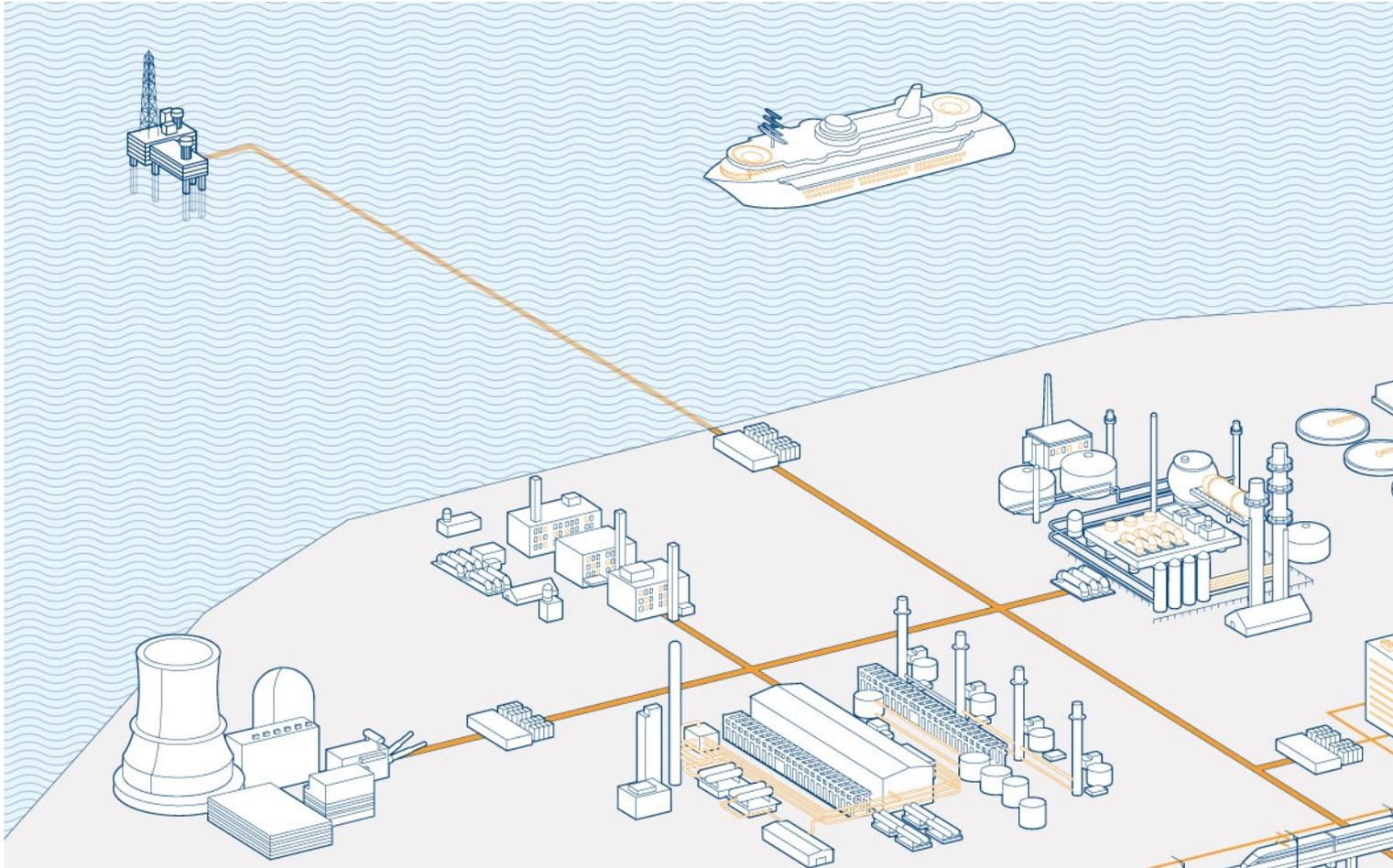
Energy isn't working hard enough



ABB's energy management software is an example of a solution that helps customers monitor and manage energy use to reduce overall energy costs and improve efficiency. The solution won the 2010 Control Engineering "Engineers' Choice" Award.

Our goal is to help our customers identify and adopt best practice in the way they manage their energy, so that they can do more with less.

ABB has the technologies and expertise to help customers extract greater value from the energy they use



Industry and utilities

Power utilities:

Power plants consume 5 percent of the electricity they generate. This can be cut by 10 to 30 percent by optimizing operations and auxiliary systems using sophisticated control systems and energy-efficient equipment. In transmission and distribution, ABB technologies enable more power to travel over existing networks and reduce power losses.

Other industry:

ABB's offering for industry improves energy savings by helping plants run more productively and efficiently, using modern control solutions, automation products and electrical equipment. Key technologies include controls, enterprise software, instrumentation, low-voltage products, drives, motors, robots and turbochargers. ABB's energy consultants are experts at identifying energy waste.

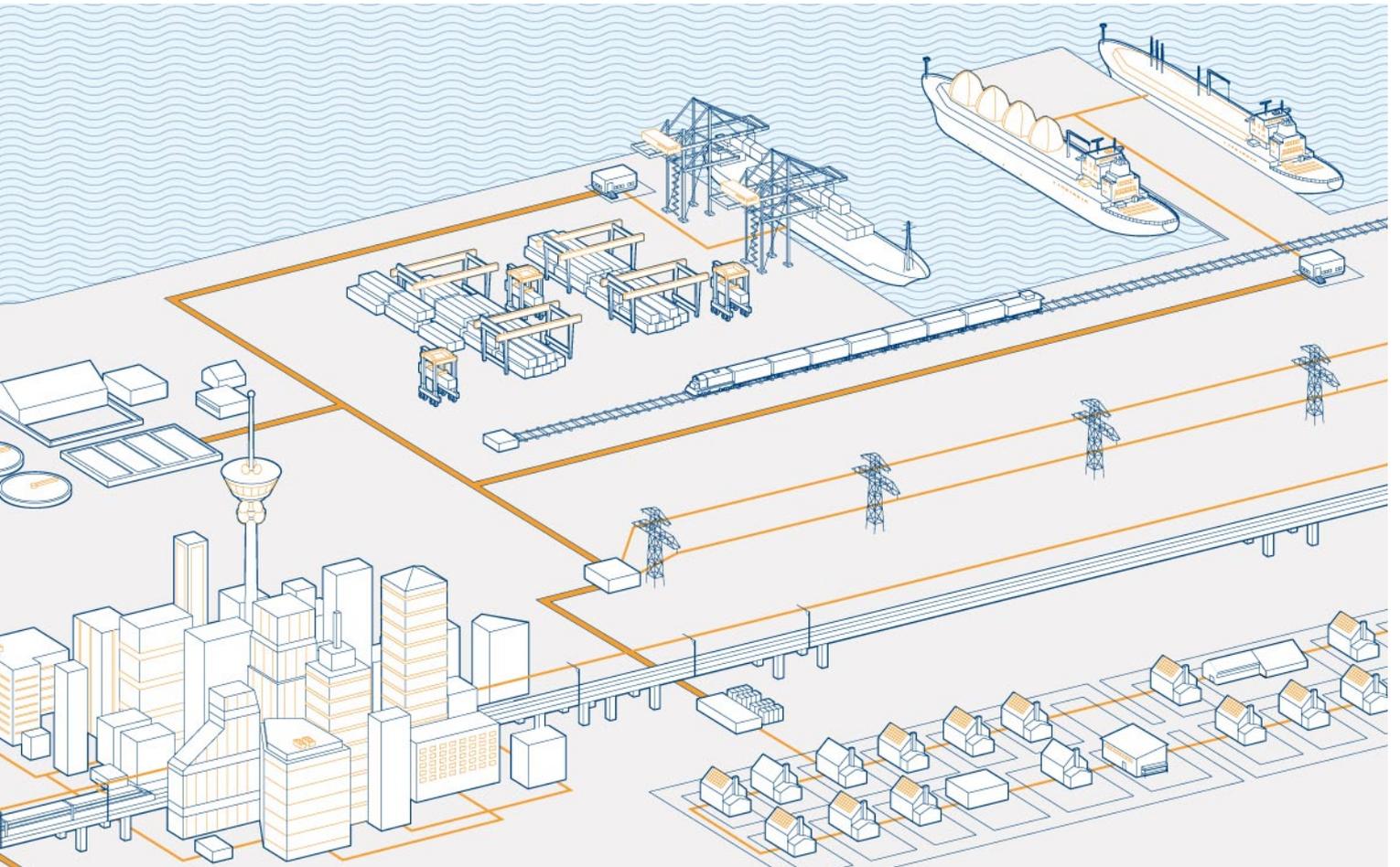
Transport

Shipping:

ABB's Azipod propulsion system typically reduces energy consumption of open-water vessels by 5 to 15 percent, while ABB diesel engine turbochargers increase power output four-fold. ABB also supplies solutions that enable vessels in port to connect to onshore electricity supplies, rather than generate their own electricity from onboard diesel generators.

Rail:

ABB technology for rail infrastructure includes solutions for transferring power efficiently from grids to railways. On board trains, the combination and design of traction components are the main determinants of a train's efficiency, and ABB supplies both individual components and complete traction packages. ABB turbochargers boost the performance of diesel engines.



Buildings

Buildings account for about 40 percent of energy consumed, mainly for heating, cooling and powering electric appliances. ABB offers low-voltage devices, and automated control and building automation systems that can achieve savings by adjusting the temperature, lighting and the energy consumption of electric appliances.

Energy efficiency in industry and utilities

Securing a competitive advantage



Power generation is by far the largest energy consuming industry. The efficiency of power generation varies widely with the fuel and technology used. In traditional coal-fired plants, only about 35 percent of fuel consumed is converted into electricity.

Conversion losses can be high, but there's more: On average, power plants consume 5 percent of the electricity they generate. Significant efficiency gains can be made by optimizing operations and auxiliary systems using sophisticated control systems and energy-efficient equipment. ABB is the market and technology leader in most such auxiliary systems, which can reduce the energy consumption of an existing facility by 10 to 30 percent.

In addition, 9 percent of all the electricity generated worldwide is lost in transmission and distribution. The best available technology can substantially increase the amount of electricity that reaches the end user. A family of technologies known as FACTS (flexible AC transmission systems) enables more power to travel over existing networks, while high-voltage direct current (HVDC) electrical transmission and high-efficiency power and distribution transformers reduce power losses.

Extensive research and development and many pilot projects are underway to achieve further efficiency gains in the distribution network with the help of smart technologies.

About 33 percent of global final energy consumption is attributed to all the other industries combined. Two-thirds of this is consumed by just six process industries: iron and

steel, oil and gas, chemical and petrochemicals, non-metallic minerals, pulp and paper, and non-ferrous metals.

ABB's range of products for industry improve energy savings by helping plants run more productively and efficiently by using modern control solutions, automation products and electrical equipment. ABB's key technologies for industry include controls, enterprise software, instrumentation, low-voltage products, drives, motors, robots and turbochargers.

Taming the workhorses of industry

Upgrading and improving the control of the hundreds of millions of electric motors employed by virtually all sectors of industry would achieve large savings as these products account for about two-thirds of industry's electricity usage. The installed base of ABB's energy-efficient motor control devices saved an estimated 220 million megawatt-hours (MWh) of electricity in 2009 alone. This is equivalent to the electricity consumption of 54 million European households.

In addition to a broad portfolio of energy-efficient technologies, ABB has teams of energy consultants around the world who are trained to find energy waste in industrial facilities.



Grosskraftwerk Mannheim AG (GKM), Germany

GKM installed two ABB medium-voltage drives and a Resibloc dry-type transformer to control two boiler feed pumps at its 1,675 megawatt (MW) coal-fired power plant at Mannheim, Germany. Pump energy consumption was cut by 25 percent, increasing revenues by \$800,000 a year. In addition, the solution reduced annual CO₂ emissions by 10,200 metric tons.

– 25% energy consumption
+ \$800,000 revenues

Power Grid Company, Bangladesh

ABB installed FACTS technologies in eight substations owned by the Power Grid Company of Bangladesh, reducing electrical losses by 34 MW. The cost of achieving those savings was less than 15 percent of the investment needed to build a conventional fossil-fuel power plant with a similar power capacity, producing a payback time of just 18 months.

Cementos Cruz Azul, Mexico

A Mexican cement plant is saving 5,300 MWh of electricity and \$260,000 annually since replacing the existing damper fan control of two fixed-speed fans with ABB drives. In addition, CO₂ emissions have been reduced by 2,650 metric tons per year and the investment has had a payback time of about six months.

ArcelorMittal, France

An industrial energy efficiency appraisal conducted by ABB at ArcelorMittal's steel mill in France identified 53 energy-saving opportunities yielding annual savings of about \$13.9 million. Gas savings were estimated to be as much as \$8.3 million and electricity savings as much as \$6 million per year. "We are very pleased with the results, as ABB has defined very clearly where energy can be saved and how to achieve it. The work is really appreciated: it is better than just an audit" - Jeroen van Lishout, energy manager, ArcelorMittal, Europe.

Energy efficiency in transportation

Making energy go further



In transportation, the most significant reductions in energy usage and carbon emissions can be made by shifting traffic from roads and air to rail and ships. But there are significant measures that rail and ship operators can take to reduce their own energy consumption, and this is where ABB can help.

Innovations for shipping

One of the biggest contributors to energy efficiency for ship operators is ABB's Azipod ship propulsion system. When launched in 1990, Azipod opened up a new dimension in marine technology as the world's first rotating propulsion device fitted to the outside of a ship's hull.

The energy-saving reputation of this system is such that it is now installed on half of all cruise liners built over the past two decades. The system typically reduces energy consumption of open-water vessels by 5 to 15 percent, but savings as high as 25 percent have been recorded.

ABB also supplies solutions that enable vessels in port to connect to onshore electricity supplies, rather than generate their own electricity from onboard diesel generators. The world's first commercial system of this kind was installed by ABB at the Swedish port of Gothenburg in 2000 and won the Clean Marine Award from the EU in 2004 and the Clean Seas Award from Lloyd's List in 2008.

In addition, tankers, container ships and mining vehicles fitted with high-performance ABB diesel engine turbochargers can increase power output four-fold.

ABB and Finland's Wärtsilä, a provider of power solutions for the marine and energy markets, have together developed a means of applying new ABB two-stage turbocharging technology to large diesel engines, a key technology for the next generation of Wärtsilä emissions-friendly engines. This advanced solution has been specifically developed to help reduce fuel consumption and CO₂ emissions in both marine and power plant applications.

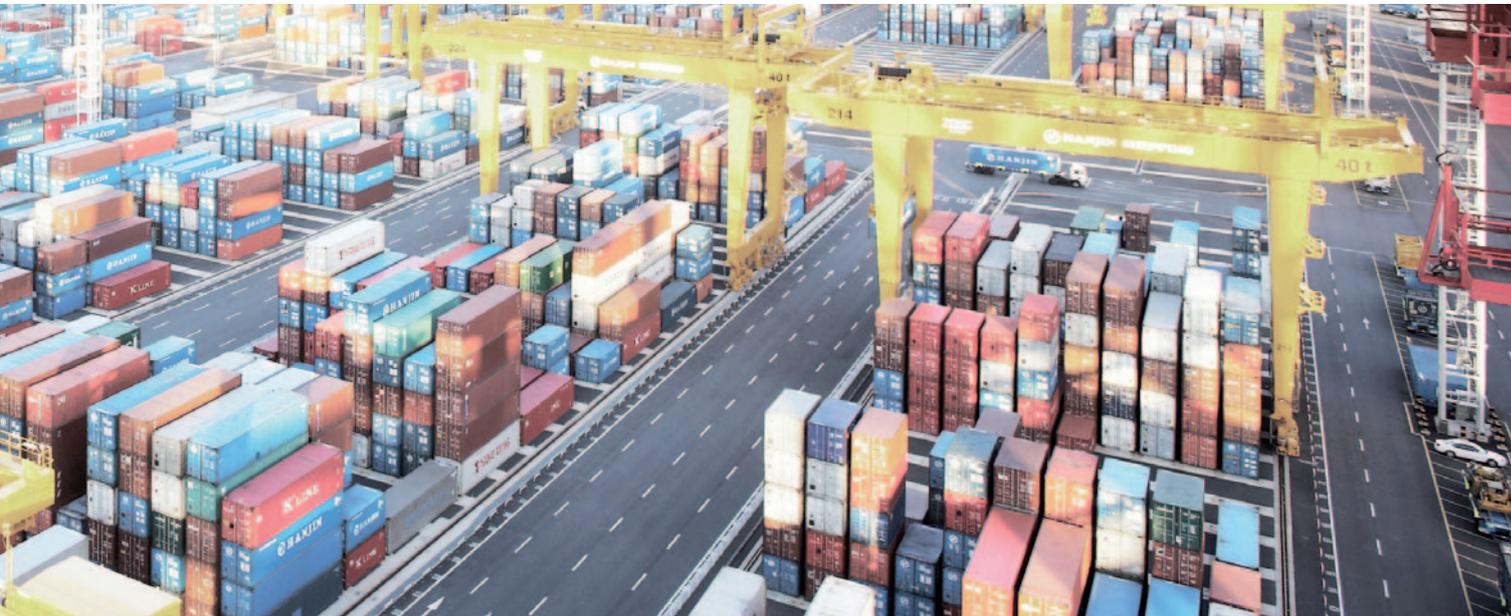
Keeping rail energy usage on track

Rail is being rediscovered as a sustainable and energy-efficient form of transport capable of reducing congestion in cities. This is reflected in a seven-fold increase in ABB's orders from the rail sector from 2004 to 2009.

ABB provides technology for both rail infrastructure and rolling stock. This includes solutions for transferring power efficiently from grids to railways, including transformers, frequency converters, switchgear and FACTS devices.

On board trains, the combination and design of traction components (generators, circuit breakers, transformers, traction converters and motors) are the main determinants of a train's efficiency. ABB supplies both individual components (ABB is No. 1 in train traction transformers globally) and complete traction packages to rolling stock manufacturers.

ABB also offers technologies such as regenerative braking systems that capture and store energy that would otherwise be lost. ABB's high-efficiency turbochargers boost the performance of diesel engines.



Sinorail Bohai Train Ferry Co., China

ABB provided Azipod power and propulsion solutions for three new ferries linking the Chinese cities of Dalian and Yantai across the Gulf of Bohai, a distance of 185 kilometers. The ferries use at least 20 percent less fuel than similar vessels with traditional mechanical propulsion arrangements, and are also more maneuverable, quieter and have more space on board. “We have three ferries equipped with Compact Azipod. Each ferry can save roughly four tons of fuel oil, which equates to an annual saving of approximately 15 million yuan” (\$2.2 million) - Meng Guang Li, technical director, Sinorail Bohai Train Ferry Co.

– 20% fuel consumption
+ \$2.2 million annual savings

Deutsche Bahn, Germany

ABB has developed a new traction converter to refurbish the first fleet of high-speed InterCityExpress trains operated by Deutsche Bahn, Germany’s national rail operator. This is the first project worldwide involving the exchange of high-speed train converters while leaving all other components of the traction chain and all interfaces unchanged. The converter, developed within just 13 months, has cut energy consumption by at least 12 percent and minimizes stress on the motors, considerably reducing operating and maintenance costs.

Energy efficiency in buildings

Getting the balance right



Buildings account for about 40 percent of the energy consumed in most countries – mainly for heating, ventilation, air conditioning and powering electrical appliances. Increasing the energy efficiency of buildings can make a sizeable contribution to reducing energy demand and carbon emissions.

The consumption of electrical energy in buildings can be reduced with modern electrical installation systems based on the KNX standard, a global open standard for house and building installations.

The ABB intelligent building control system based on this standard is increasing efficiency in thousands of new and existing buildings in more than 60 countries. ABB systems typically enable customers to achieve a combined reduction in energy consumption of around 50 percent, with a payback period of between 1 and 5 years.

In addition to automated control and building automation systems, ABB is a leading producer of low-voltage, energy efficient devices for building applications.

A study by the Association of the German Electrical Industry (ZVEI) found that energy consumption and costs for lighting in buildings of all kinds can be reduced by up to 80 percent using intelligent building systems.

Another major energy consumer in buildings is heating. Annual energy consumption for heating and ventilation can be cut by as much as 45 percent using very simple methods such as individual room temperature control combined with moderately reducing the room temperature, or heating control based on the outdoor temperature.

ABB intelligent building solutions manage temperature, lighting and electrical appliances to exact requirements, without compromising comfort or quality of life. They reduce energy use in buildings in three key ways:

- By ensuring energy is only used when it is really needed, for example by using motion detectors
- By ensuring that only the right amount of energy is used for each requirement, for example through constant light control
- By minimizing undesirable external factors that affect energy balance, for example by employing shutter control on windows

Today, such intelligent building systems operate independently of the power grid. In a smarter network, they will interact with the grid to give consumers greater control over the amount of electricity they use as well as when they use it.

High-efficiency ABB motors and the alternating current (AC) drives used to control them offer further efficiencies as motors consume about 40 percent of a building's electricity, mostly in fans and pumps for heating, ventilation and air-conditioning (HVAC) systems. AC drives can reduce energy consumption in these applications by as much as 80 percent.



State Library of Victoria, Australia

ABB drives help control the indoor climate of the State Library of Victoria, a two-hectare, 150-year old building, producing energy savings of between 30 and 60 percent across a range of applications. As a result, total annual energy use was cut by 1,800 MWh, saving about \$160,000. The investment paid for itself in energy savings within 13 months.

– 60% energy consumption
+ \$160,000 savings

Museo d'Arte Moderna, Rovereto, Italy

ABB i-bus KNX technology installed in one of Italy's most important contemporary art museums produced annual energy savings of about 28 percent with advanced lighting control systems. The installation has reduced electricity consumption at the Museo d'Arte Moderna in Rovereto by more than 450,000 kilowatt-hours (kWh) per year and cut costs by \$112,000 in the first year.

What ABB is doing

Energy efficiency begins at home



At ABB, we aim to steadily increase the efficiency of our operations, including through the use of our own products. We have set ourselves the target of reducing the energy we use as a company by 2.5 percent per employee per year.

The measures needed to meet this target are determined locally at our 350 production and administrative sites worldwide. They are measured and monitored by a global network of 400 employees responsible for sustainability and environmental issues.

The program is already showing results:

- A new transformer factory in Germany uses 40 percent less energy than its predecessor, saving about \$140,000 per year, thanks to a range of energy-efficient technologies including ABB switches that activate the lights when they detect motion and transformers from ABB's ultra-efficient EcoDry line, and by using a different fuel.
- An energy audit at an ABB plastic injection factory in Italy led to the installation of modern drive technology that reduced annual electricity consumption by 442 MWh, and is saving \$80,000 a year.
- ABB in Sweden has identified and implemented around 50 energy-saving projects in technical and behavioral categories that have already saved 4,150 tons of CO₂ emissions and reduced energy bills by \$800,000 annually.

Using our global influence

ABB also works with international groups to identify ways of enabling economic growth and development in a sustainable, environmentally-friendly way.



ABB is engaged with the Combat Climate Change (3C) initiative in partnership with the Stockholm Environment Institute and other energy-related companies. As part of this, ABB is engaged in climate discussions with political leaders around the world, and pressing for the introduction of a global price for greenhouse gas emissions.

ABB is supporting research into low-carbon technologies for the power sector in the World Business Council for Sustainable Development, a coalition of 180 international companies. ABB also works with the Pew Center on Global Climate Change, a US-based forum for business, policy makers, scientists and other experts, where we are participating in an energy efficiency initiative.

Building sustainability into our products

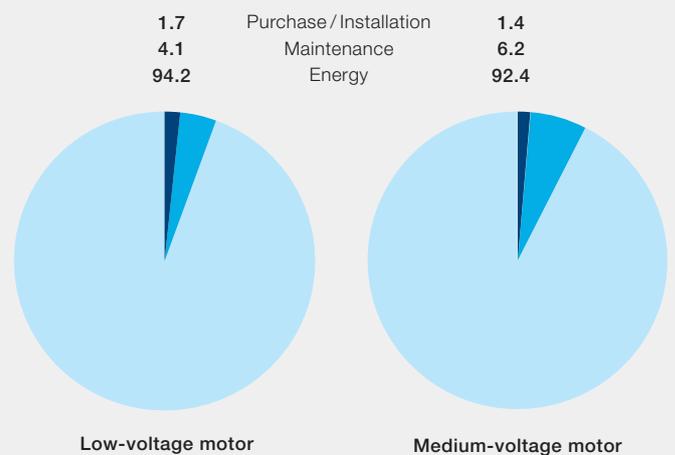
When it comes to product development, ABB uses a seven-step process that starts by defining the project scope and ends by investigating whether a product delivered the expected benefits to customers and to ABB. Development objectives generally include functionality and ease of use, maintenance and replacement that are comparable to or exceed those of existing products.

Sustainability criteria have been built into this model at several of the development stages, ensuring that design and assembly takes into account the materials used to manufacture a product, the cost of the energy required to operate it, and its disposal at the end of the product life.

These sustainability aspects are now mandatory across the entire ABB Group, and all new products now being introduced have been developed using this methodology. The goal is to improve the return on investment for customers by reducing the total cost of ownership, which is the complete cost from purchase to disposal, including environmental impact.

It pays to consider the total cost of ownership

Breakdown of cost of ownership (%)



Calculations based on typical applications.
Contact ABB for more detail.

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