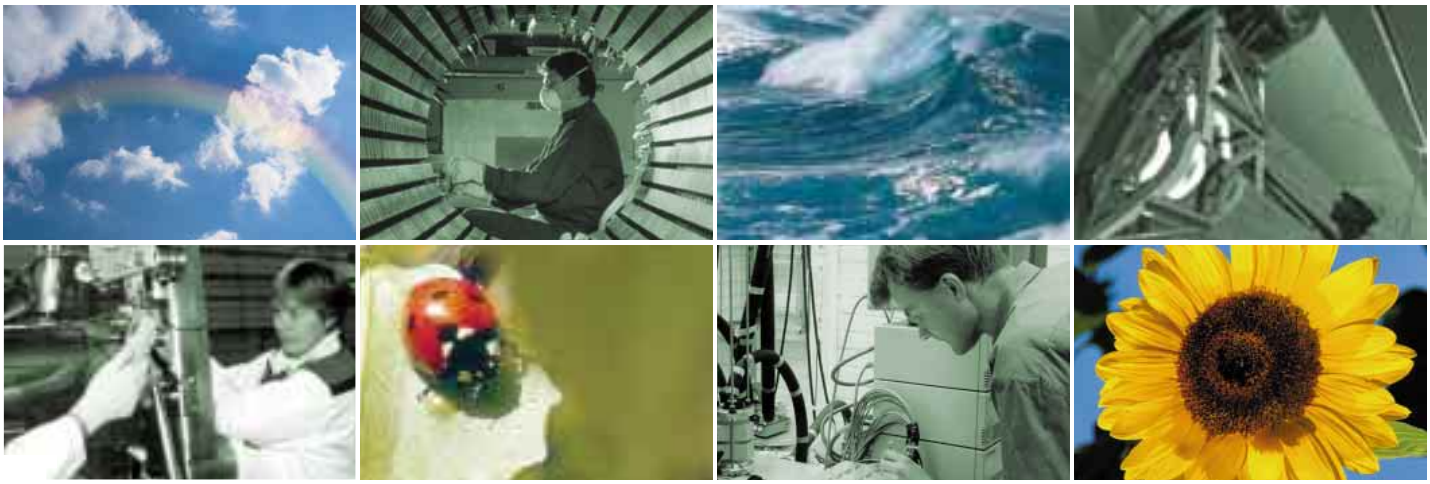
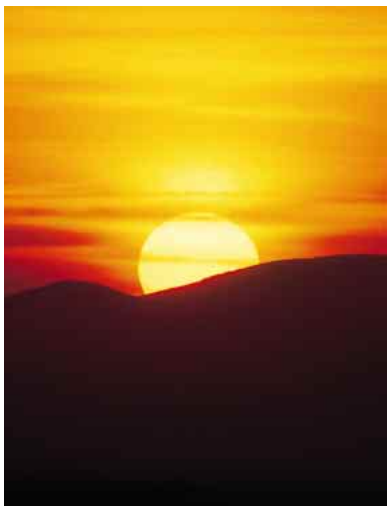
Environmental Management Report 1998



The number of sites that have implemented ISO 14001 has more than tripled – from 150 to 449. Environmental Declarations for the business areas were introduced. A new-generation life cycle assessment tool with an expanded database was launched.

INGENUITY AT WORK



The ABB Group

ABB is a global engineering group with 200,000 employees and orders received of US$ 31 billion in 1998.

The Group is organized into seven business segments. The segments are: Oil, Gas and Petrochemicals; Power Generation; Power Transmission; Power Distribution; Products and Contracting; Automation; and Financial Services.

1998 environmental highlights

- The number of sites that have implemented the ISO 14001 environmental management system increased from 150 to 449.
- The number of environmental performance indicators increased from 20 to 28.
- The concept of Environmental Declarations was introduced, and several business areas began developing declarations.
- A new-generation life cycle assessment tool with an expanded database was introduced.
- An enlarged environmental website and a widely distributed environmental brochure—200,000 copies in 23 languages—helped improve environmental communication.

ABB Environmental Management Report 1998 is available on the Internet; www.abb.com

Contents

President's message

Environmental care is good citizenship and good business

I am encouraged by the evidence that concern for the environment and commitment to sustainable development are gaining ground almost everywhere.

Impressive new environmental programs are appearing in business and industry. Public support is increasing. And, most gratifying of all, politicians in both industrialized and developing countries are recognizing that sustainable development demands partnership—demands consultation with all the interested parties, including industry—when environmental actions are decided.

The environmental field is complex, and its characteristics are the product of many interacting factors. Sustainable development—social policy to use environmental resources today in ways that do not compromise the environment of future generations—is even more complex and much easier to talk about than to undertake. That is why ambitions to protect the environment and fulfill commitments to sustainable development need a clear focus and understandable and accepted definitions. And it needs clear international standards and harmonized rules.

In 1997, the Third Conference of the Parties to the United Nations Framework Convention on Climate Change (COP3), held in Kyoto, Japan, agreed on targets for reductions in greenhouse gases. In 1998, at Buenos Aires, Argentina, COP4 kept the process on track by adopting a work program to be completed by the year 2000 at the latest.

This program demands continued negotiations between the Kyoto signatories and the countries in the Group of 77 and China to define a framework for so called Kyoto Protocol Mechanisms. Covering emissions trading, joint implementation and clean development mechanisms, these will demand cooperation between governments and industry to achieve emission reduction targets in a cost-effective manner. The program offers ABB opportunities for participation in bilateral solutions to make these mechanisms work in practice. You will find details beginning on page 43 in the section describing ABB's Financial Services segment.

The Kyoto goals are to be reached between 2008 and 2012, so we have only ten years to go. How much of this precious time will elapse before all the agreements are concluded and finally ratified?

By signing the Convention, most of the world has affirmed the need to reduce emissions. Many industries and governments have included reduction targets and programs in their strategies and plans. But there is also strong opposition by some companies and governments who claim that action to reduce emissions might be bad for their economies and damage conditions for their standards of living. In the absence of 100 percent scientific proof of a causal connection between emissions and climate change, they are reluctant to take precautions.

I find it difficult to understand this position. For while there is some uncertainty—there always is in science—we know enough to be sure that manmade greenhouse gas emissions are significant and growing. We know that a natural greenhouse effect makes the planet some 30 °C warmer than it would otherwise be. Carbon dioxide is one of the greenhouse gases and since the global society is emitting carbon dioxide in greater quantities it is strange to deny the likelihood that further increases in atmospheric carbon dioxide will make it warmer still.

Public opinion wants industry to address these con-

Göran Lindahl, President and CEO

cerns. And reducing emissions is no new requirement for industry. Just look back a few decades and compare the environmental performance then and now for any product or system, be it on the supply side or the demand side of the energy chain. There are many examples where emissions have been reduced and efficiencies increased by factors of four or even as much as ten. Improvement will continue regardless of the Convention on Climate Change because the market constantly demands greater efficiency and cleaner products.

I believe it is possible to address these concerns through the right mix of precautionary actions, minimizing costs and at the same time promoting economic and environmental benefits. For developing countries, the effort to reduce the growth of emissions offers an opportunity to leapfrog from old technologies directly to new ones. Actions that secure the voluntary engagement of industry are more likely to engender the most effective response and stimulate innovation and the application of suitable technologies without creating market distortions.

The introduction of new mechanisms, such as emissions trading, joint implementation and clean development, will add a new impetus to reducing greenhouse gas emissions. If we fully utilize the three key elements of best technology, commitment and the new mechanisms as part of a global approach, then I think we can come within reach of meeting the greenhouse gas reduction targets.

If we make the Kyoto greenhouse gas reduction targets our prime goal, I am sure that the efforts we undertake will also solve many other environmental problems. The concentrations of carbon dioxide and other greenhouse gases in the atmosphere can serve as worthy indicators of progress in sustainable development because curbing these gases will address many of society's unsustainable issues—environmental, economic and social. Reduction of carbon and carbon dioxide emissions gives sustainable development a face, making it understandable by making it measurable, controllable and communicable—all important factors in gaining public acceptance and cooperation.

As I see it, a successful outcome requires that we focus all our efforts on the same goal. Achieving the Kyoto targets means reducing carbon emissions in so called Annex I countries by presumably as much as one billion metric tons (1 Gt), or carbon dioxide emissions by four billion metric tons (4 Gt). In reality, however, emissions in North America and Europe are steadily increasing, by as much as 0.1 Gt of carbon or 0.4 Gt of carbon dioxide per year. So by the year 2001 these regions will emit 1 Gt more carbon dioxide into the atmosphere than they do today.

There are many recent initiatives to reduce greenhouse gases at regional, country, sector and company levels. Some of these were presented in Buenos Aires. Together, they demonstrate a large potential for greenhouse gas reduction. It would be valuable to know the total reduction these initiatives will achieve, and I think we should find this out.

That is why, in my keynote address to the World Energy Congress (WEC) in Houston in September 1998, I proposed that we start with a global pilot project to reduce carbon dioxide emissions by 1 Gt. The work should begin by establishing the present carbon dioxide baseline and carry out an inventory of all significant reduction projects worldwide. The pilot project should span the complete energy chain—from resource extraction to energy consumption. It should involve business and industry, governments and multilateral institutions, universities and other organizations.

The project should be planned during 1999, started up during 2000, then run for three to four years, with continuous evaluation starting from 2002. It should include demand-side programs, afforestation, carbon dioxide capture and sequestration, carbon dioxide chemistry and eco-efficient technologies, as well as all the new mechanisms proposed in the Kyoto Protocol. A pilot project is an efficient way of translating talk into action, and of quickly discovering in practice the effectiveness of various remedies. The results will provide valuable experience and ideas on how to continue to achieve the remaining 3 to 3.5 Gt reductions of CO_2 that the world requires to reach the full Kyoto target.

This obviously won't happen by itself—it will take leadership and cooperation by industry, institutions and governments. But I can already see many industries and government agencies that could take a lead. And the plans and preparations made in the meantime by the WEC to pursue this initiative are most encouraging. I feel sure that with the participation of my like-minded peers, colleagues and politicians, the project will take off. If we can join hands, we will not fail.

I have emphasized greenhouse gas abatement because it is the biggest single environmental challenge facing governments and industry today. But ABB's commitment to sustainable development goes wider. It is based on the ICC Business Charter for Sustainable Development and comprises four key elements:

- to develop and design ecoefficient products and systems
- to share state-of-the-art technologies with emerging markets
- to contribute to common efforts
- to continuously improve our own environmental performance

The following chapters cover the first, third and fourth elements (the main chapter in our 1997 report addressed the second, reviewing our long-term presence in emerging markets and examples of technology sharing). The main chapter discusses our products, their environmental aspects and examples of the goals we have established to improve their environmental performance. We have covered all business segments, focusing on areas that contribute to greenhouse gas reduction, including examples that span the whole energy chain, from resource extraction to the use and control of energy and other global resources. We have also included Financial Services, which is of special interest in relation to the new trading mechanisms in the Kyoto Protocol.

At the end of 1998, ABB acquired Elsag-Bailey Process Automation—a US$ two billion company with a leading position in instrumentation and automation. With this acquisition, ABB will become one of the world's largest companies providing end-use efficient devices. This will complement the Group's traditional broad range of high-performance supply-side equipment and further increase our contribution to sustainable development.

The second chapter illustrates a contribution to common efforts through the work of the World Commission on Dams. Described in last year's report, the Commission is now implementing its two-year work program, running from June 1998 to June 2000, which includes case studies, thematic reviews and input from interested parties. The outcome will enable the Commission to meet its mandate for a global review of the development efficiency of dams, for developing option assessments and decision-making frameworks for water and energy resource projects and for proposing internationally acceptable criteria and guidelines for developing such projects.

I consider the Commission's work to be a truly representative process, and the issue of large dams to be important to sustainable development, all of which makes me happy to be one of the twelve commissioners as a representative of the private sector.

The third chapter covers ABB's internal environmental program. We have now all but reached the first-generation goal we had set for ourselves—to have the international environmental management standard ISO 14001 implemented at all our manufacturing and service sites by the end of 1998. I'm pleased to report that we now have ISO 14001 implemented at some 449 sites, representing 84 percent of our manufacturing and service sites worldwide. Remember that we are up against a moving target—the acquisition of Elsag-Bailey gave us an additional 40 sites to include in our environmental management program. We will also include some 150 non-manufacturing and service sites in our goal for 1999. But still we have established a formidable benchmark for our industry, an accomplishment in which we can all take much pride.

We are now in an excellent position to focus more attention on our products and systems. For most of these, environmental performance is critical as an integrated part of the technology strategy of our business areas. However, our products' environmental performance is not always visible to external audiences. This is why we will increase our visibility by developing what we call Environmental Declarations for each core product line. These Declarations will show how our products relate to the environment, presenting their significant environmental aspects and our goals to improve their environmental performances. The ABB Group's corporate objective is to have Environmental Declarations for all our core product lines ready by the year 2000.

For the second year running, we have commissioned Det Norske Veritas (DNV), an internationally accredited classification society, to assess how we comply with our declared environmental policy, which is directly based on the 16 principles of the ICC Business Charter for Sustainable Development. The fourth and final chapter compares these findings with DNV's assessment last year. Here, too, we have made progress, appreciably raising ratings for lagging areas.

All in all, 1998 has been another year of much activity and sound progress. Backed by ISO 14001, our factories are fit for the future. The Environmental Declarations for our core products will form the basis for ABB's next generation of environmental goals and improvement programs. Through our participation in the World Commission on Dams, and through our high-profile response to greenhouse gas reduction programs, ABB is actively engaged in international initiatives to improve the environment. In special meetings throughout 1998, ABB's expanded Environmental Advisory Board has given valuable support in identifying the challenges and opportunities we will face during the next few years.

Improving the environment through the measures I have outlined cannot fail to sharpen our competitive edge—goals I believe well worth pursuing, for the betterment of our lives and our business.

Göran Lindahl, President and CEO

Products: their environmental performance now and in the future

Introduction: toward Environmental Declarations

ABB's environmental reports provide information to shareholders, customers, employees and other interested parties about the progress made in environmental management. The focus is on our environmental management program and our efforts to implement the ISO 14001 standard throughout the organization.

The reports also offer a broad perspective on ABB technologies in the context of sustainable development, describe the rationale for employing them and communicate the environmental performance of specific products. These are the themes of the reports published so far:

1994: Energy, environment and the impact of the use of ABB products.

1995: Environmental leadership and products to promote ecoefficiency.

1996: The Bakun hydroelectric project and the environmental impacts of different methods of generating electricity.

1997: Technology transfer and the use of modern technology to help curb harmful climate change.

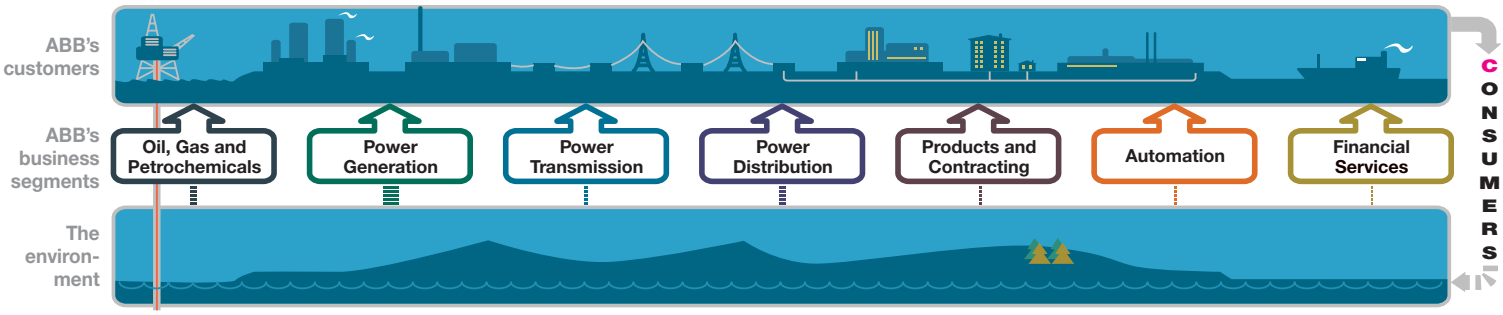
1998: This year's report focuses on the efforts to develop Environmental Declarations for ABB products.

Because most of our technologies and products are used in the energy and industrial sectors, we believe communication on environmental issues to be vitally important. Access to energy and electricity is crucial for our standard of living and quality of life. But their use can harm the environment.

Therefore, it would be helpful if producers and consumers could accurately determine the positive and negative aspects of products in simple, balanced terms, using a standard aggregated index for sustainable development. Because of the complexity involved, this is not possible today and probably never will be. So we must report the negative and positive aspects separately even in the future. But this should not prevent us from attempting to improve environmental reporting.

Goal 2000

In 1997, CEO Göran Lindahl introduced ABB's second corporate environmental objective—Goal 2000—to have quantified, visible and communicated environmental goals and programs ready for all core products, and at the same time, integrated into the strategies of all business areas, by the year 2000.



ABB's seven business segments cover the entire energy chain—from the extraction of energy resources to final electricity consumption—with a wide range of technologies, products, plants and services. Environmental Declarations will be developed for the key product lines of each sector as tools for monitoring progress in reducing environmental impact and communicating environmental performance to all interested parties.

To facilitate this, we are introducing the concept of Environmental Declarations, though the work of developing them has just begun. We hope that this will be as well received as our early introduction of performance indicators for our manufacturing and service processes according to the ISO 14030 draft standard last year.

An Environmental Declaration is a description of the environmental aspects of an ABB product line, including relevant environmental goals and programs. It can also be defined as a description of an ABB business area's agenda for integrating its products with ABB's global ISO 14001 implementation program. Together with the environmental performance indicators mentioned above, Environmental Declarations will help improve communications with all interested parties.

Declarations will include both current and future environmental performance, the latter as goals and programs. The idea is to reduce the product's environmental impact over its full life cycle. Other aims can be, for example, to eliminate certain materials or comply with new environmental legislation.

Environmental goals will be set on different levels—for use of materials, design of components and products, for systems engineering, construction, operation and decommissioning of complete plants. In line with the ISO 14001 philosophy, and to avoid suboptimization, the focus will be on the significant aspects. This means there may be relevant environmental goals even for activities such as marketing, sales and service. Using life cycle assessment and other tools, business areas must use all opportunities to reduce environmental impact and assign priorities to the most significant ones.

The work of developing Environmental Declarations has just begun as an integral part of the business areas' strategic planning. Our goal is to publish the first generation declarations during 1999. A few business areas have already developed Environmental Declarations. You will find an extract of one example from the Cables business area, which is part of the Power Transmission segment, on page 25. On page 32 there is another example from the Products and Contracting segment.

The following pages demonstrate the complexities and challenges we will face in setting environmental goals and developing Environmental Declarations.

We need your input

We believe setting environmental goals is of vital importance to all of us. While our presentation of Environmental Declarations is far from complete, we have chosen to offer it at this early stage to get views from readers as quickly as possible. So please let us know how you feel about it. Mail or fax your comments to the address below:

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Business Areas:
Oil, Gas and Petrochemicals

Products and Services:
Refineries and petrochemical plants
Subsea production systems
Floating production systems
Pressure-containing equipment
Maintenance and modification of offshore and onshore facilities

Oil, Gas and Petrochemicals

Extraction and processing of nonrenewable fossil resources is a challenging business. World demand for oil keeps growing at a rate of two percent a year, for natural gas by three percent. But there is increasing opposition to the dependence on fossil fuels. Moreover, extraction, transportation and processing of oil and gas involve risks of spills and contamination.

For these reasons, the petroleum industry is under constant, close scrutiny by the general public, politicians and legislators. Strict safety and environmental protection measures have been adopted. Companies operating in this sector are among the most sophisticated and demanding in the world. ABB is proud to serve them as a supplier and business partner.

It is true that the world's fossil reserves are finite. But they will not run out in the foreseeable future if we use them wisely and sparingly and replace them with renewable energy sources wherever possible. Advanced, innovative technology is required to make their use sustainable. ABB provides such technology for all parts of the oil and gas industries, onshore and offshore, as a supplier of equipment and systems, turnkey projects, services and technology licensing.

ABB's scope of supply

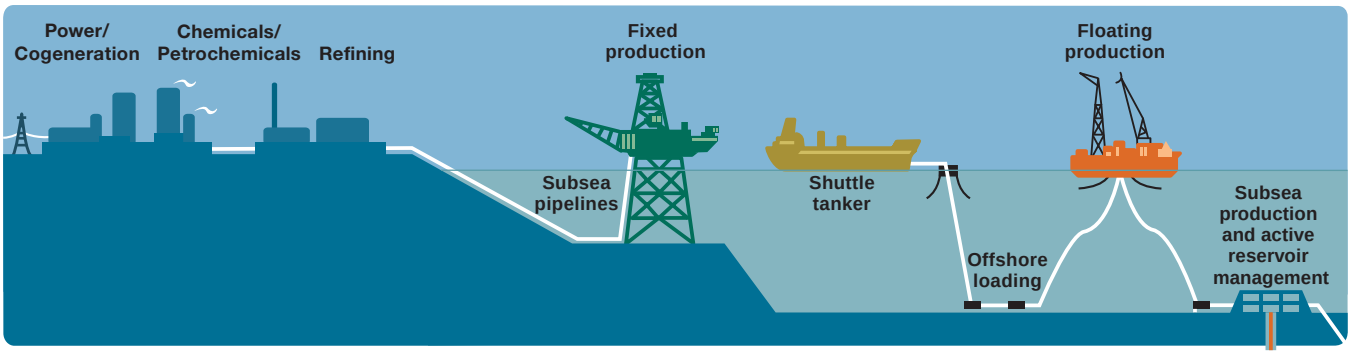
Our offerings to the petroleum industry include:

- Refineries
- Petrochemical plants
- Gas processing plants
- Floating production systems
- Subsea production systems
- Offshore platforms
- Production equipment
- Subsea production control systems
- Offshore drilling equipment
- Surface wellhead and flow control systems
- Maintenance and repairs
- Project management
- Engineering and procurement
- Financing

Most deliveries to customers also include products from other ABB business areas—for example, for power generation, power distribution, drives and process automation, heating, ventilation and air conditioning.

The market

ABB's activities in this sector are split evenly between the upstream market and the downstream market.



The upstream market needs equipment, systems and services for oil and gas exploration and production. This includes offshore and onshore platforms, floating production and subsea production units. The downstream market needs processes to convert hydrocarbon raw materials into fuels, lubricants and chemical products. This includes refineries, chemical plants, gas processing and power cogeneration.

Customers are becoming increasingly involved in the entire supply chain, from exploration of oil and gas to the supply of electricity to consumers. These large energy companies often operate on a global basis. They face a broad range of challenges caused by constant changes in energy prices and taxes; by more stringent health, safety and environmental standards; by the diversity of national cultures and local legislation; and, not least, by rapid development of new technologies.

For these reasons, customers increasingly demand system deliveries or turnkey contracts for their projects. Such total responsibilities, including full liability for the entire project development, call for financial strength, cutting-edge technical expertise and advanced skills in enhancing safety and minimizing environmental impact.

The service content of our deliveries is constantly increasing. We are no longer primarily an equipment supplier. We are a service company, working in partnership with customers.

Environmental management

Protecting the environment is a basic driving force for ABB, equally important to productivity and quality in serving our customers. This applies both to the direction of our research and development and to the way we manage our operations. Environmental management is a necessity for success and an integral part of all activities. Engineering offices and manufacturing sites use ISO 14001 certification as a tool for continuous improvement of environmental performance.

Life cycle assessment

In developing new products, as well as in improving existing ones, life cycle assessment is used to enhance the environmental performance. Developing new technology and improved processes that minimize environmental impact, jointly with customers or of our own accord, has the highest priority.

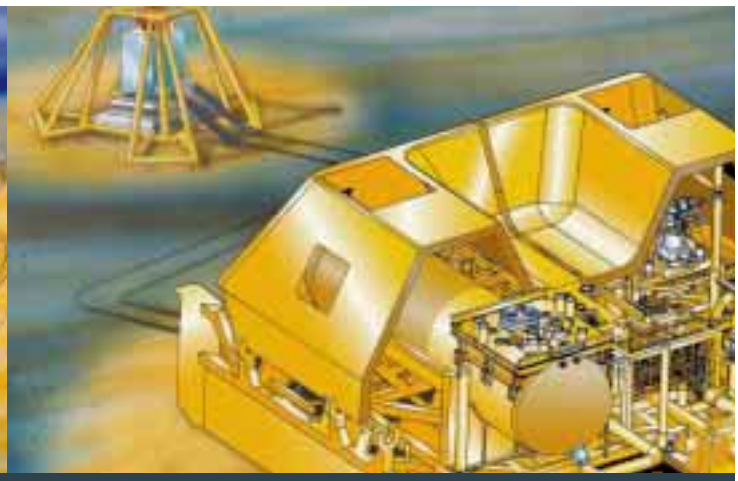
This is not just a matter of complying with existing or anticipated environmental regulations. In the oil, gas and petrochemicals industries, environmental performance is a powerful driver of value. Customers are well aware that preventing pollution and reducing waste are cheaper than cleaning them up. Minimizing throughputs of energy and materials increases margins, reduces working capital expenses, lessens operating risk and can increase labor productivity. There is a clear connection between environmental and financial performance.

Environmental aspects

The most significant environmental aspects in manufacturing, building, operating and decommissioning our products, systems and plants include:

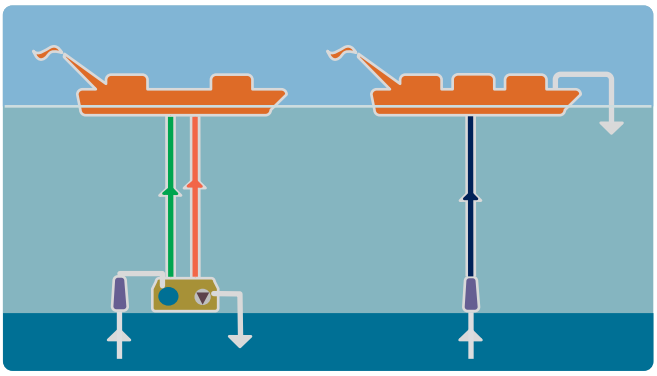
- Use of materials
- Use of energy
- Emissions to air
- Discharge to water
- Generation of waste
- Use and release of chemicals
- Aesthetic considerations

ABB's subsea systems.



World's first subsea processing and separation plant—Troll Pilot for Norsk Hydro.

Large-scale operations and heavy-duty equipment characterize the petroleum industry. Huge amounts of materials are required both for building plants and for feeding processes. Transporting and processing large flows of oil, gas and chemicals consume vast quantities of energy and generate waste. There are risks of leakage and contamination of water and soil. And offshore platforms and refineries seldom enhance nature's beauty. We face the challenge of minimizing or avoiding all these aspects over the full life cycle of products, systems and plants.



Subsea production.

Environmental goals

ISO 14001 implementation at all sites and plants is the prime goal that ABB will achieve before the end of 1999.

The environmental goals for products and systems are less clear-cut. This is because each delivery is designed to meet a specific set of requirements under a specific set of conditions. The way each process impacts the environment is unique, as are its various environmental aspects. Local environmental requirements and customer demands for environmental performance vary widely. As a result, each new system or process calls for new environmental goals.

Modular subsea systems

Oil and gas are currently in plentiful supply at relatively low prices, but this situation will not last. Fossil fuels will eventually run out, and there is an urgent need for innovative extraction technologies that use reserves more effectively. Exploitation of offshore reserves is taking place at ever-greater distances from existing infrastructure and in deeper water.

ABB supplies complete subsea production systems capable of operating at depths of up to 2,000 meters at present, with a goal of 3,000 meters. Based entirely on the seabed, they represent a new method of extracting oil and gas. This opens up new areas for exploitation, making the extraction of previously unreachable reserves economically and environmentally viable. As offshore exploration and production move into deep and ultradeep waters, oil and gas reserves may last substantially longer than previously anticipated.

Underwater installations are more cost effective than fixed or floating ones. They offer dramatic reductions in cost and time to open up new fields. They use less material and less energy and reduce the risk of leakage and contamination. In addition, they have the aesthetic advantage of not being visible above the surface. This new technology may be the beginning of a trend away from using offshore platforms.

ABB's modular subsea systems include equipment for pull-in and connecting, processing, electrical controls and instrumentation. Environmental aspects are fully integrated, resulting in less need for materials and energy, reduced pollution and easy decommissioning. Life cycle assessment is being applied to find subsea solutions that improve cost effectiveness and reduce environmental impact.

ABB's marine service.

Cost and delivery times for subsea wells

FIELD	YEAR	COST	DELIVERY PERIOD
Togi Subsea	1990	300	50 months
Tordis I Subsea	1991	100	30 months
Vigdis Subsea	1994	40	22 months
Tordis II Subsea	1995	34	12 months
Snorre B Subsea	1998	33	<10 months

Rapid technological progress has led to dramatic reductions of costs, expressed in the table in million Norwegian Kroner, as well as delivery times, in number of months from discovery to start of production in opening up new fields.

Subsea wellhead systems

Wellhead systems connect wellpipes on the seabed to the production system. They must withstand high pressure, mechanical damage and corrosion. Accordingly, they must be robust and heavily dimensioned. However, as is often the case with heavy equipment, it is possible to reduce size and weight without jeopardizing safety and long service life.

A new type of subsea wellhead system introduced by ABB weighs 15 percent less than earlier types and contains 40 percent fewer parts. Yet it increases reliability and is easier to use.

This system was established by life cycle assessments comparing the old and new designs. The environmental aspects relate mainly to manufacturing. Because of its reduced weight, simpler design and shorter manufacturing time, the new system requires substantially less material and energy, reducing the amount of waste. The assessments revealed that there is potential for further improvement of environmental performance.

Life cycle assessment will be applied to other key components, such as the Christmas tree, which is the assembly of special pipings and valves that controls the rate of flow and the pressure and volume of the well. There is ample opportunity for further improvement by integrating challenging environmental goals into research and development programs.

Subsea separation and injection

In some fields, the water content of the wellstream can be as high as 90 percent. The presence of water can cause corrosion of metals and hydration of the oil. The additional volume also increases the amount of materials and energy required for transportation, and therefore the cost.

ABB has developed technology to separate oil and water on the seabed and reinject the water into the well. Reinjection maintains the pressure, extends the well's life span and increases the amount of oil and gas that can be extracted, often by as much as ten percent.

Separation plants previously located on platforms can be placed on the seabeds, reducing platform size and cost. Smaller-diameter pipelines can be used, as the concentration of oil and gas is higher. The amount of interconnecting piping and cables is reduced. There is reduced leakage, and the life span of equipment is increased.

Offshore combined-cycle power plants

Single-cycle gas turbines used to supply power on offshore platforms are a significant source of carbon dioxide and nitrogen oxide emissions. In the spring of 1999, ABB will deliver the steam-cycle portion for the world's first offshore combined-cycle power plant to the Oseberg gas field in the North Sea. This plant alone will reduce the amount of carbon dioxide produced by 80,000 metric tons

ABB process engineering at an oil refinery in Aruba, off the Venezuelan coast.

per year. This is equivalent to the carbon dioxide emitted by 25,000 cars traveling 16,000 km per year.

ABB's combined-cycle technology marries a steam cycle, consisting of a steam generator and steam turbine, with a gas turbine. This improves thermal efficiency to 50–60 percent so that less fuel is required to generate power. At the same time, emissions of carbon dioxide and nitrogen oxides are reduced by 30 percent.

Until now, combined-cycle power plants have been too large to use offshore. ABB has developed a compact, lightweight steam generator suitable for offshore use. This technology can also be used to convert older, single-cycle plants to high-efficiency combined-cycle plants.

HVDC Light power distribution

This new ABB technology, described on pages 23 and 24, can supply electric power via underwater cables with low losses and at reasonable cost. This offers several interesting opportunities for the offshore industry. For example, a large gas turbine generator can be located offshore and power distributed to several platforms. This would free space on the platforms and reduce dependency on one generator. If a platform generator stops, power can be provided from generators on other platforms or from the onshore AC grid. Excess power can even be routed to the AC grid.

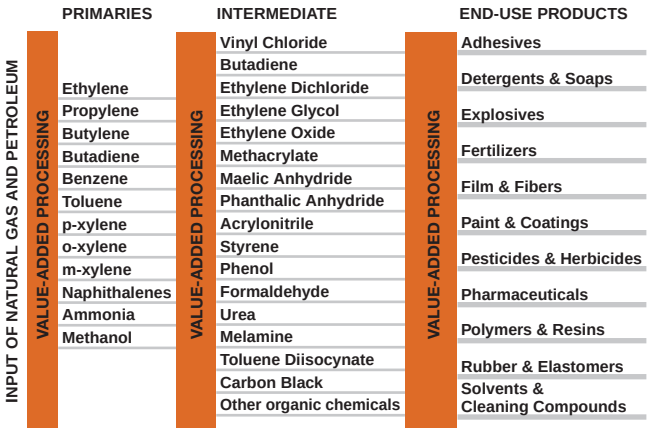
By interconnecting power supplies between platforms, a more optimized operation of the generating sets can be achieved, which facilitates higher efficiencies. For example, the power plant duty on new platforms can be extended to include the export of power to nearby older platforms, whose less efficient generating sets can be shut down, thereby raising the overall efficiency of a field's power supplies. By providing such common generating reserves to supply several platforms, fuel-gas consumption and CO_2 emissions can be reduced.

Gas turbines driving compressors on offshore platforms are a significant source of emissions. Using HVDC Light, compressors can be driven by electric motors instead.

Processing plants

The petrochemicals industry applies many different processing technologies—such as distillation, catalysis, thermal cracking, heat transfer and mass transfer—to convert raw material in the form of crude oil and natural gas into fuels, lubricants, chemicals and specialty products. Driven by the demand from developing countries, companies are building new plants, expanding existing ones and upgrading them to supply cleaner products.

Throughout the world, the industry faces an increasing number of national and supranational laws and regulations that have an impact on operations. Bringing plants into



Examples of products for which ABB supplies technologies and complete plants.

ABB's Energy and Global Change Department.

compliance and keeping them there pose challenges for plant owners. In 1999 alone, processing companies are expected to spend more than US$ 7 billion to prevent, contain, treat, recycle and dispose of gaseous, liquid and solid wastes.

A key challenge for ABB as a supplier to this industry is to develop efficient processes and build plants that convert as much as possible of the raw materials into useful products and minimize the amount of waste. Environmental aspects also include use of energy, emissions from burners, leakage and odors from processes and the appearance and visibility of processing plants.

ABB provides a fully integrated package of process technologies, plant engineering and a wide range of services. We are the leading designer of 45 of the most important process technologies in refining chemicals and petrochemicals. We take turnkey project responsibility and offer project financing in addition to all key technologies and systems. Environmental concern is a key consideration in our research and development as well as in operations.

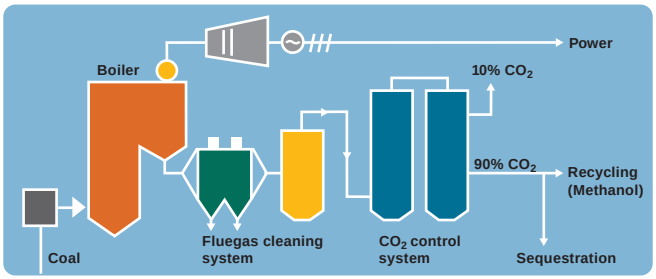
Carbon dioxide recovery

The 1997 global meeting on climate change in Kyoto (COP3) put the spotlight on greenhouse gas emissions and their consequences, particularly on the vast amount of carbon dioxide being released by the combustion of fossil fuels. Global targets were set for reducing emissions. Several countries are applying environmental fees and taxes on carbon dioxide emissions, and more will follow.

However, carbon dioxide is not just a pollutant. It is also a raw material increasingly in demand by a variety of industries. In liquid form, it is used for freezing foods and for carbonating beverages. Substantial quantities are used in oil recovery. The chemical processing and metal-working industries also use it. This means there is a market for carbon dioxide.

ABB offers proven technology for recovery of carbon dioxide from flue gases—for use as a raw material or for sequestration and disposal on land, in aquifers or in the oceans. Several plants producing carbon dioxide for food and chemical processing have been in commercial operation since 1996. So far, because of the costs involved, recovery plants have been built only where there is a strong local demand for carbon dioxide.

The recovery technology is flexible enough to operate with boilers or cogeneration systems that burn fuels ranging from natural gas to high-sulfur coal and coke. It can also recover carbon dioxide from gas turbine flue gases. The product purity will typically be better than 90 percent. The process can be easily adapted to large-scale recovery for either industrial applications or greenhouse effect abatement.



ABB's technology for carbon dioxide recovery from flue gases.

Business Areas:
Gas and Combi-Cycle Power Plants
Steam Power Plants
Nuclear Systems
Power Plant Systems
Environmental Systems
Power Segment Manufacturing
Power Plant Service

Products and Services:
Turnkey fossil-fueled power plants and components (boilers, turbines, generators)
Gas turbine and combined-cycle power plants
Combined heat and power, district heating
Advanced light-water reactors and fuel
Hydro and diesel power plants
Clean coal systems
Control systems, retrofit and maintenance
Air pollution and control systems
Complete service, maintenance and retrofit

Power Generation

Economic development can be expected to increase the demand for power. To achieve sustainable development we must improve the efficiency of existing power-generation systems while developing new technologies for generating power. Fossil fuels currently provide approximately 70 percent of the world's power supply, but they are a finite resource. Nuclear and hydropower provide most of the remainder. Renewable sources, such as wind and solar energy, account for about two percent.

Challenges

- Developing new technologies for generating power from sustainable sources.
- Utilizing existing sources as efficiently as possible.
- Reducing pollutant emissions by providing efficient, affordable technologies.

Market and environmental requirements

OECD countries are implementing strict programs to reduce emissions from power plants, covering sulfur oxides (SO_X), nitrogen oxides (NO_X) and particulates. Developing countries are in different stages of following the same course, but there is a clear global trend to reduce power plant emissions, including CO_2, and to counter the greenhouse effect. Nuclear power does not produce CO_2, but its continued use faces strong opposition due to public concerns about operating safety and disposal of nuclear waste. Hydropower does not involve the release of CO_2, but the number of suitable hydropower sites is limited in the long term. Renewable energy sources have increasing potential as technology evolves.

Environmental management

Power Generation was one of the first ABB business segments to integrate environmental management into all activities at all levels. This has led to the reduction of emissions and waste and also to environmentally favorable developments such as low-NO_X burners, sequential combustion and high-efficiency boilers.

Environmental aspects

Much progress has been made in recent years in raising the efficiencies of thermal power plants. From an average of 35–45 percent for the existing pool of power plants, efficiencies have been raised to 55–60 percent when using today's designs of gas turbines operating in the combined-cycle mode. Moreover, in the combined heat and power mode (CHP), fuel utilization of up to 90 percent can be achieved. The operation of the plants causes the main environmental impact by far. Other significant aspects include use of materials in manufacture, production of waste, emissions and decommissioning. Aesthetic aspects are also of concern.

Environmental goals

- Increasing total efficiency of power-generating plants, i.e. total performance of all individual components, products and subsystems and their interaction.
- Increasing total efficiency of the system, i.e. efficient usage of resources with respect to the energy produced.
- Achieving further advances in fluid dynamics and combustion technology.
- Using environmental performance indicators to assess fossil fuel power plant efficiency, such as for control of SO_X, NO_X, VOC and CO_2 emissions.
- Developing preventive environmental solutions, such as NO_X control through the use of advanced burner technology.

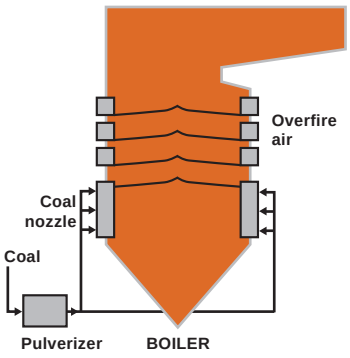


ABB Low NO_X pulverized coal combustion TFS 2000™.

NO_X emission from coal-fired boilers.

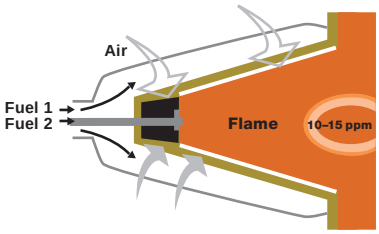


ABB Low NO_X burner.

- Convincing consumers and lenders to invest in air pollution control equipment, financed by an increase in electricity charges.
- Reducing cost and weight of emission control equipment, such as electrostatic filters, fabric filters and scrubbers.
- Reducing the impact of hydropower plants on people and nature.
- Retrofitting old hydropower facilities to increase efficiency.
- Improving safety systems in nuclear power plants.
- Improving the burn-up ratio for nuclear fuel to reduce the amount of waste.

Usage of environmental products and services

ABB's product range includes gas turbines, combined-cycle power plants, steam power plants, cogeneration and district heating equipment. ABB also provides and manages a wide range of environmental systems for pollution control, such as electrostatic precipitators and equipment for the removal of nitrogen oxides (NO_X) and sulfur oxides (SO_X). ABB also manufactures nuclear fuel and provides turnkey project management for nuclear and hydropower plants.

Reducing NO_X emissions

Nitrogen oxides (NO_X), generated during the combustion of fossil fuels, contribute to ozone formation and acid rain. Nitrogen oxides are formed by the oxidation of nitrogen from the air and fuel used in the combustion process. They can be controlled either by reducing their formation during the combustion process or removing them from the exhaust gases after combustion. Efficient combustion requires the proper balance of oxygen and fuel at the correct temperatures. This process includes staged combustion and water injection. NO_X can be removed from the exhaust gases by a selective catalytic reduction process. ABB has developed a number of technologies to reduce the production of NO_X during combustion. These include the EV burner and the TFS 2000™ system.

The EV burner is a dual-fuel premix burner for liquid and gaseous fuels in a combustion turbine. The cone-

shaped burner injects air and fuel in a manner that creates a stable and cool flame, with a temperature 250 °C lower than a normal burner. The burner permits very thorough combustion that reduces levels of CO and unburned hydrocarbons while minimizing NO_X formation. NO_X levels can be reduced to as low as 15 ppm when using gas fuel.

An individual regulatory mechanism allows complete control over combustion conditions during start-up and part-load operation, ensuring optimal combustion during all stages of operation.

The TFS 2000 system reduces NO_X emissions from fixed geometry furnace boilers by as much as 50–70 percent from uncontrolled combustion. It can be retrofitted to tangential, coal-fired furnaces without any major system changes and has minimal impact on performance and efficiency.

The system accurately controls the ratio of air and coal entering the furnace. By appropriately controlling the oxygen levels, production of NO_X can be minimized while achieving essentially complete combustion of the fuel. If not closely controlled, an oxygen-deficient environment will cause incomplete combustion, producing CO and high levels of unburned carbon in the ash. If air levels are too high, this will cause the production of higher levels of NO_X. The TFS 2000 provides effective control of the factors affecting NO_X production.

The system also uses a classifier that removes large coal particles before they enter the furnace. This allows rapid ignition of the coal particles as they enter the chamber. Fuel-bound nitrogen is also released very rapidly, so it is quickly reduced to molecular nitrogen.

Electrostatic precipitators

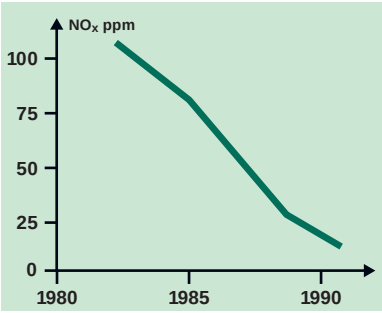
Electrostatic precipitators remove very fine particles from exhaust gases, for example, in the combustion of pulverized coal. Exhaust gases pass through a battery of electrodes that ionize the particles. The ionized particles migrate to the grounded collecting plates where they are stored temporarily. Particles are collected by rapping the collecting electrodes, causing the particles to fall into hoppers.

Using pulsed direct current to supply the electrodes reduces electricity consumption by 20–25 percent and increases the collection efficiency by 25–50 percent. Electrode design can be tailored to provide optimum performance for different conditions. For instance, the multipeak electrode employs barbs facing the collecting surface to generate optimal current and voltage over the whole electrode; this improves reliability and discharge efficiency.

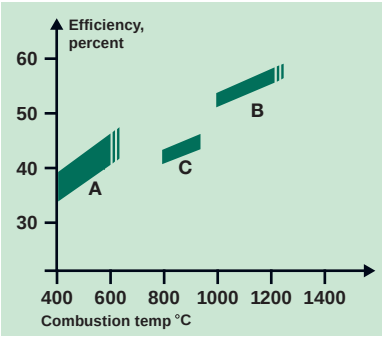
Increasing gas turbine efficiency

Gas turbines are used to produce electricity and heat. A highly competitive marketplace demands efficient, flexible, reliable gas turbines that comply with stringent emission levels. Gas turbine efficiency is dependent on the interaction of the compressor, combustor, turbine, and the exhaust system.

Combined-cycle operation is used to greatly improve gas turbine performance. Hot exhaust gases are passed through a waste-heat recovery unit to produce steam. High efficiency leads to less fuel consumption and lower emissions. ABB's industrial gas turbines are particularly suited for combined-cycle use as they produce high-temperature exhaust gases. They can be used both for district heating and steam production in process industries. In its



NO_x emissions for ABB combined-cycle power plants.



A: Steam power plants with pollution control
B: Combined-cycle gas turbine plants
C: PFBC

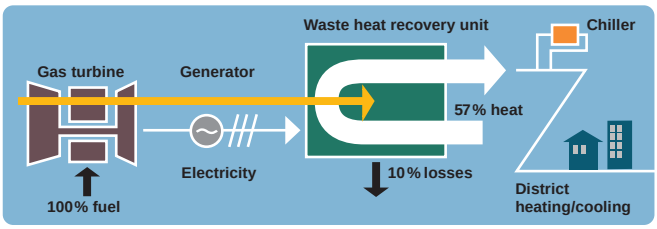
Power plant efficiency.

class, ABB's recently launched 50-MW GTX100 gas turbine has the highest efficiency in combined-cycle mode of 54 percent. Equipped with the latest generation of EV burner—the advanced AEV burner—it also has the lowest NO_x emissions in its class of 15 ppm. Combined-cycle operation can also be used in conjunction with an incineration plant, increasing the amount of energy recovered.

ABB's gas turbines use a ring formation of burners. This produces a uniform gas flow with no temperature variations. The turbine can be placed closer to the burner without overheating the blades. This reduces the amount of cooling required so more air is available for flame dilution, thereby substantially reducing NO_x levels. The GT24/26 gas turbines are the largest in ABB's range and use sequential combustion to further improve the efficiency and to reduce NO_x production. The GT24/26 in combined-cycle mode can achieve efficiency levels very close to 60 percent.

Cogeneration

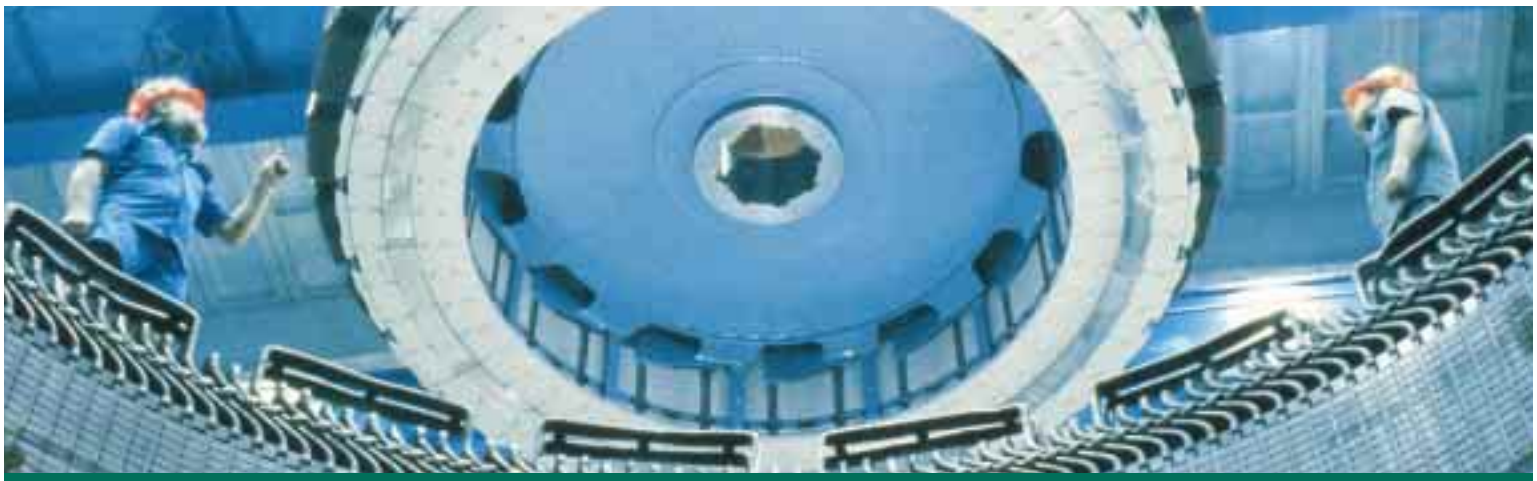
Cogeneration or combined heat and power (CHP) is the use of one fuel to produce two types of energy; mechanical energy to generate electricity and thermal energy for heating or cooling purposes. System efficiency is increased by recovering waste heat from the exhaust gases. A conventional power plant has an efficiency of 35–45 percent, but plants with cogeneration can reach fuel utilization levels of 75–90 percent. A district heating plant located close to an urban area can provide hot water and electricity. Biofuels and waste are often used to fuel these plants. The Swedish town of Eskilstuna has just commissioned a US$ 57 million biofuel cogeneration plant. It will produce 38 MW of heat and 86 MW of electric power, enabling the town to be totally self-sufficient in heat and electricity.



The principle of cogeneration.

Waste incineration

Disposal of municipal waste in landfill sites requires large amounts of land and produces toxic liquid run off and methane, one of the most potent greenhouse gases. A sustainable alternative must be found. Combustion of domestic waste reduces its mass by up to 75 percent,



Erection of an ABB-generator
in the Mrica hydropower plant, Indonesia.

and the energy liberated can be used to produce electricity and heat. The energy content of one ton of municipal waste is equivalent to 300 m^3 of natural gas, so it represents a significant source of fuel. The thermal value of waste has increased thanks to improved sorting, separation and recycling.

ABB has developed furnaces to enable high-temperature combustion. A temperature of 1,200 °C is necessary to minimize the formation of pollutants such as dioxins. The Advanced Combustion Control (ACC) system continuously monitors and compares the properties of the waste. This information is used to control combustion, enabling efficient waste incineration and stable steam production.

ABB's water-cooled incineration grate allows controlled transportation, mixing and incineration of waste within a furnace. Water cooling reduces temperature variations, ensuring even and complete combustion. Two separate systems control cooling and incineration, allowing accurate regulation of the combustion environment. Burn-out levels are high and the amounts of fly ash and NO_X are reduced. The heat collected from the cooling of the grate can be used to produce steam.

Biofuels

Biofuels can be used to generate energy without contributing to the greenhouse effect. They are particularly suitable for energy generation when a biofuel is produced as an industrial by-product, for example, in the sugar, forestry and pulp and paper industries.

ABB's fluid-bed boilers enable highly efficient combustion of biofuels. Biofuels are typically low in ash, sulfur and nitrogen and, when properly burned, will produce low emissions of SO_2 and NO_X. Biofuel has the potential to provide an increased proportion of the world's energy. However, high transportation costs limit the viability of fuel supply even in high-yield areas. Small boilers using cogeneration provide the most efficient use of resources. Improvement in biofuel crop yields can increase their use. For example, eucalyptus yields have been increased from five to 40 tons per hectare per year in Brazilian and Ethiopian plantations.

Microturbines

The growing interest in microturbines reflects to some extent the trend in the computer industry. In the past, we used large mainframe computers; now we use personal computers with access to a network. Even if we disregard this conjecture, the joint venture recently formed between ABB and Volvo to develop micro gas turbines is likely to benefit from current trends within the power industry toward deregulation and decentralization of electricity supplies. We expect such turbines to reach fuel utilization levels of almost 85 percent when operated as a combined heat and power package.

This solution will be of particular interest to power consumers such as hospitals, shopping malls, commercial and business centers, factories, real estate owners, etc, who will be able to produce their own electricity, heating and cooling at economical rates, as and when they require. In addition to providing such high efficiencies, micro gas turbines produce very low emissions and therefore offer significant environmental benefits over conventional small and standby power generation sources, such as diesel generating sets. The ABB/Volvo joint venture company, Turbogen AB, is developing its first microturbine system for an output of 100 kW. Other sizes are being planned.

ABB Microturbine.

Flue gas desulfurization

The combustion of fossil fuels produces sulfur oxide (SO_X), which contributes to acid rain. ABB has developed the Novel Integrated Desulfurization (NID) system for dry flue gas desulfurization. The system combines proven technology with simplified operation to achieve more than 90 percent SO_X removal. It consists of a fabric filter to remove fine particles, a reactor chamber and an end product handling system. The system's simplicity makes it cheaper than traditional systems as size, maintenance and power consumption are reduced.

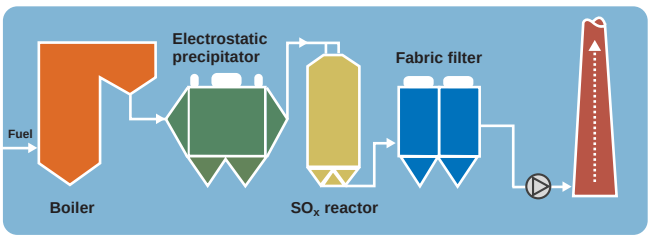
The process uses powdered lime to remove SO_X, and efficiency is increased by raising humidity. Traditional flue gas desulfurization processes spray lime slurry into the reacting chamber. The NID process uses powdered lime sprayed with water. The humid reaction environment reduces the reaction time so the reaction vessel can be an order of magnitude smaller than that of a conventional spray dryer. The use of solid lime also allows very efficient recycling, enabling recirculation rates 30 to 50 times higher than with other systems, reducing the amount of lime required. The simplicity of the reaction minimizes the amount of equipment required.

The end product is a dry powder consisting of a range of calcium compounds. This hardens when mixed with water, and practical applications for the use of this end product are being pursued.

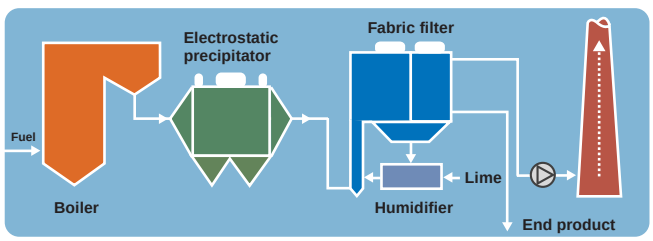
Nuclear fuel burn-up

ABB manufactures nuclear fuel rods for boiling water reactors (BWR) and pressurized water reactors (PWR). Improvements in fuel-rod design have enabled a 50 percent increase in fuel burn-up. This has been achieved by keeping the fuel in the reactor for longer periods and improving thermal discharge properties. Improved fuel burn-up performance utilizes uranium reserves more efficiently as more energy is produced and the quantity of nuclear waste is reduced. Longer intervals between fuel-rod changes also increase reactor operational time.

The integrity of the fuel rod is the key element determining the length of in-reactor exposure. This has been achieved by producing a very high-quality fuel rod with a high degree of protection. Non-destructive testing ensures very high fuel quality by removing any substandard rods. The OPTIN™ cladding system provides excellent corrosion resistance, ensuring that the fuel rod retains its integrity even after long reactor residence times. Improvement in thermal discharge efficiency is also important in increasing burn-up rates. ABB's TURBO™ fuel rod employs a mixed vane grid to increase the heat transfer efficiency.



Conventional system.



NID system.

Business Areas:	Products and Services:
High-Voltage Products and Substations	Air- and gas-insulated switchgear products, solutions and high-current systems
Power Transformers	Power transformers, reactors, components and insulating material
Cables	Products and solutions for power cables
Power Lines	Products and solutions for overhead lines
Power Systems	High-voltage direct current systems, reactive power compensation and capacitors
Transmission and Distribution Service and Support	Retrofit, maintenance, operations consultancy and project development

Power Transmission

Electricity is seldom generated close to the population centers where it is consumed. This is true of nuclear and fossil fuel plants primarily but also of renewable energy, such as, hydro, wind and solar power. Therefore, there will always be a need to transport electricity over long distances.

There are two stages in getting electricity from power plants to consumers; transmission systems carry electricity over long distances at high voltages (generally well over 145 kV), which minimizes power losses, distribution systems radiate out over shorter distances to the end users, stepping down the voltages to domestic requirements.

ABB is the world's largest supplier in this field. We have the widest global presence and the most complete product range available. The Power Transmission segment covers high-voltage products and systems, power transformers, cables, power lines, and power systems, as well as a dedicated service operation.

The market for power transmission systems

The business of power transmission is a fast-changing one. Deregulation and privatization of the electricity supply business are growing trends around the world. One consequence of this is an increased need for sophisticated monitoring and control of power networks to ensure that the most efficient generation and distribution schemes are always in play.

Market forces tend to encourage eco-efficiency. Controlling losses in electricity supply networks reduces greenhouse gas emissions; and they also make power providers more cost-competitive.

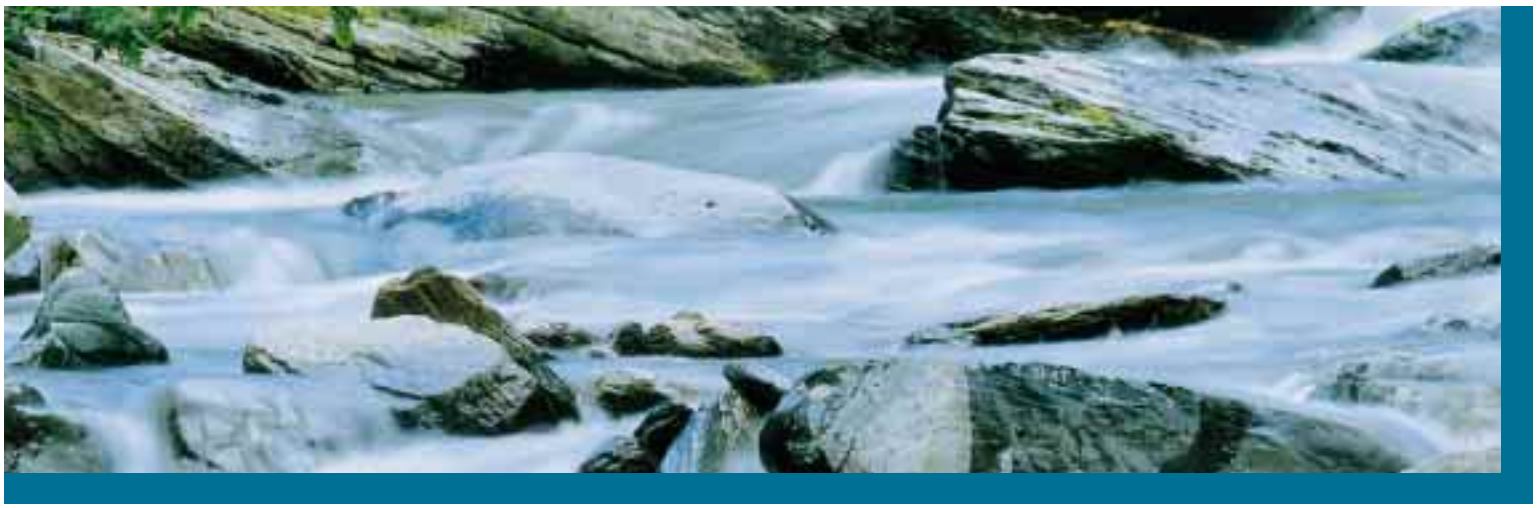
Deregulation is breaking down the vertical integration of the electricity supply industry in which a single monopoly corporation would own all power supply resources for a defined captive market. Nowadays, electricity supply companies are increasingly free to "shop around" for electricity from different sources. By allowing electricity to flow freely from producer to consumer, transmission networks can be used to create a free market in electricity.

By transmitting electricity at high voltage, losses can be minimized and the power lines can carry more power per line, which means that the number of power lines—and hence the environmental impact—can be reduced. ABB's research indicates that it is now economical to transmit electricity over distances as great as 5,000 km. This could permit a great deal of international trade in electricity, crossing time zones to even out peaks in demand and to use generating capacity more efficiently. This can have positive environmental benefits, in particular by removing the need to use inefficient or environmentally unfriendly power plants to meet demand peaks.

Environmental management

Environmental management systems (EMS) are integrated in all of ABB's power transmission businesses, at all levels. The same manufacturing processes and standards are used at all of ABB's manufacturing plants around the world, and all have now been certified, or are working toward certification, to ISO 14001.

Commercial factors alone encourage customers to buy—and suppliers like ABB to develop—environmentally friendly systems. The overriding priority is to minimize losses in the power network. In the most technically advanced electricity networks, five to ten percent of power is lost in transmission and distribution; in older networks the figure can be as high as 30 percent. The drive to cut losses extends throughout the range of ABB's products for transmission.



Environmental aspects

Aside from the priority of minimizing electrical losses, there are other environmental aspects that relate to the transmission area. Examples include the use of materials (copper conductors, lead to seal submarine cables, various polymers in insulation) and oils and SF_6 gas used as insulation. Aesthetic considerations are important environmental aspects of overhead power lines and electrical substations; electromagnetic fields from power lines and substations, though their effects are not yet known, are also a cause for concern.

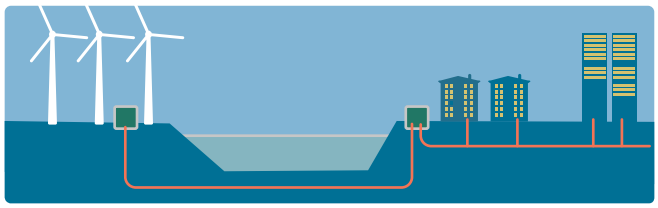
Environmental goals

Environmental goals that ABB has identified for various product lines within the transmission area include:

- Developing sealed-for-life gas-insulated switchgear systems. These virtually eliminate the possibility of accidental leakage of SF_6 gas.
- Development of oil-free transformers.
- Reduced losses in transformers through new technology (high-temperature superconductors).
- Replacement of lead in submarine cables.
- Increased use and marketing of PVC-free products.
- Increased use of dry (oil-free) technologies.
- Reduced size of components, and reduced materials usage, through greater use of “smart” electronics.
- Reduced electromagnetic fields and smaller dimensions for overhead power lines.

Bringing renewable energy sources on line

Two different techniques are used in long-distance power transmission: high-voltage alternating current (HVAC) and high-voltage direct current (HVDC). HVDC transmission is more applicable for long distances, with up to 50 percent lower losses and more controllable power flow than for HVAC. ABB is the world’s leading supplier of HVDC power systems, including the converter stations that convert between AC and DC at each end of an HVDC line.



HVDC Light, windpower.

Recent advances in converter and cable technology, have enabled the introduction of a new ABB product range called HVDC Light. HVDC Light extends the benefits of HVDC to low-power applications, in the range of 5–100 MW, and spanning distances down to a few tens of kilometers.

This technology has many applications. It can connect small power stations, such as wind, hydro, solar and biomass plants, to national grids. It can supply electricity from a national grid to remote areas and islands which would otherwise require small local power plants, typically utilizing diesel-powered generators.

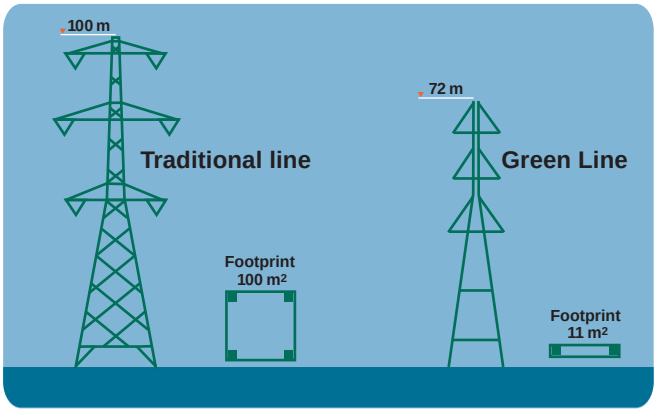
HVDC Light offers many other environmental benefits in addition to lower losses. Materials use is reduced compared with previous HVDC designs, and very little space is required. Furthermore, new extruded HVDC cables developed by ABB can be buried in trenches at a cost comparable to that of an overhead line. These cables contain no free oil, reducing the risks of oil spills and fires, and they can also be used for submarine connections.

The first HVDC Light project, already in operation, connects a 50-MW wind farm on the southern tip of the Swedish island of Gotland to the island’s main city, Visby.

Laying of high-voltage submarine cables.

Another project in Denmark, connecting a 7-MW wind farm to the national grid, is currently being built.

HVDC Light has attracted considerable interest in the industry, and ABB is constantly pursuing new applications for the technology. ABB's Power Systems business area has set the goal for HDVC Light systems to account for 50 percent of business by 2015, and for half of the installations to serve renewable energy sources—wind, solar, biomass, small hydro and ocean power.



Cutting the impact of overhead power lines

Overhead power lines are the most common means of transmitting electricity over long distances. The environmental impacts in manufacture, erection and end-of-life disposal of pylons and power lines are relatively easy to minimize by new designs that reduce the amount of materials and land required.

But in recent years, public attention has been focused on the environmental impact of overhead power lines during their useful life. In many countries there is growing public pressure to reduce the eyesore of power lines crossing the countryside, and it is becoming more difficult for utilities to negotiate the planning permission for a new line. Reduction of the electromagnetic fields (EMF) produced by power lines is also an issue, partly because of radio interference, and also because of fears of various health risks to those living near power lines, although these risks have not been scientifically proved.

Therefore, efforts have been made to develop compact overhead lines, with minimal visual impact and EMF characteristics. But these solutions have still been much more expensive than conventional overhead lines.

However, ABB has recently introduced a new compact overhead line design, called "Green Lines," with a radical new concept that brings the cost down to the same level as conventional lines. The green system is currently designed to carry power at up to 400 kV, one of the transmission voltages in common use today. It is easy to erect, with minimal need to clear land for pylon sites. The pylons themselves, with legs of two formed-steel shells, are very light and rigid, and their footprints are 70–90 percent smaller than those of conventional pylons. The overall space reduction cuts the visual impact of the pylons by 50–70 percent.

The green system has more closely spaced conductors than conventional systems. This reduces the EMF profile of the line, and increases the amount of power that can be carried. Existing power lines can be replaced with the green system to increase overall network capacity without having to use new rights of way.

ABB is heavily promoting the green solution for rehabilitation of existing power lines as well as for new lines. The target is for Green Lines to progressively and substantially increase their share of ABB's power line business in the next 15 years.

ABB Green Lines.

ABB PASS plug and switch system.

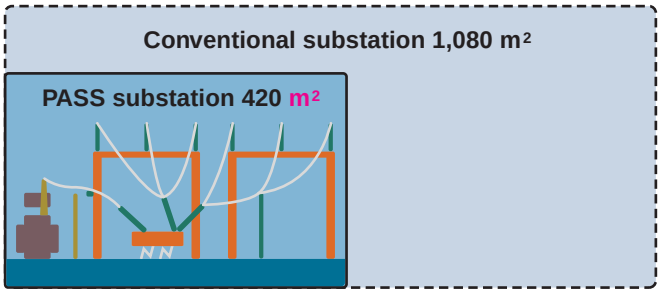
Saving space and materials in substations

The basic layout of high-voltage substations has changed little in recent decades. While key elements like circuit breakers, surge arresters and instrument transformers have undergone major technology changes, their physical dimensions have remained about the same, with no major changes in substation layout.

A new ABB substation solution called PASS (Plug and Switch System), could change this, allowing existing substations to be refurbished with substantial savings in space and materials. PASS integrates the circuit breaker, disconnect switches, earthing switch, current and voltage sensors and bushings within one common gas compartment. The switchgear is limited to the minimum of equipment required to guarantee the functioning of the substation in all typical configurations.

PASS benefits considerably from digital control, which simplifies operation. Enhanced monitoring and diagnostic systems further reduce operating costs and increase substation availability.

Other benefits include space savings and reductions in material requirements for manufacture, site preparation and network connections. For example, in a typical double-busbar layout, conventional switchgear uses 1,080 m^2. PASS needs only 420 m^2—a savings of 60 percent.



ABB's business area for cables drafts its Environmental Declaration

ABB's Cables business area was one of four business areas chosen to pioneer the drafting of Environmental Declarations as part of ABB's corporate Goal 2000 project.

The business area has 2,500 employees and its sales in 1997 were US$ 850 million. There are ten manufacturing companies in six countries. Eight of these companies are already certified to ISO 14001.

Activities focus on developing, producing and selling a wide range of power transmission cables and cable systems. The products and systems are mainly used as components in customers' power systems, and are based on national and international standards and on customer specifications.

There are three main lines of business:

- Submarine cable systems
- XLPE (cross-linked polyethylene) cable systems
- Oil, gas and petrochemical cable systems

These are supported by a further three businesses—medium-voltage cable accessories, low-voltage energy cables and communication cables.

Initial investigations of the environmental impacts of these activities led to a number of improvement programs.

For example, studies demonstrated that end-of-life disposal of cables has a significant environmental impact. The business area is now cooperating with specialist companies to determine the best way to recycle old cables. This also includes the recycling of scrap from the manufacturing process as an alternative to incineration.

The business area's products mainly use copper, aluminum, steel, rubber, XLPE and PVC. Lead is also used as a stabilizer, a pigment and a moisture barrier. Lead is

currently being phased out as alternative materials are being introduced. One exception, however, is the use of lead as a water barrier in submarine cables, for which there is at present no suitable alternative.

Some additives are used in manufacturing, such as phthalates as softeners in PVC, and antimony trioxide as a flame retardant. A ban on phthalates as softeners will probably lead to a total replacement of PVC in cables, and the business area has already introduced non-PVC cables, though at a higher initial cost.

The business area's technology unit acts as the central coordinator for implementing the environmental management program (EMP), in cooperation with country and local (factory) environmental controllers.

The EMP is based on a series of directives covering the entire business area's environmental performance.

Some of the more important measures are as follows:

- Implement ABB's new EcoLab LCA tool to carry out environmental impact studies for all products.
- Increase the marketing of lead- and PVC-free products.
- Cooperate with recycling companies regarding scrap plastic disposal.
- Develop technical solutions for submarine HVDC cables, to avoid chlorine effects at sea electrodes.
- Actively enforce the principle of substitution of less desirable materials used in processes and products.
- Establish environmental goals and improvement programs for each product.
- Provide environmental declarations for each product for customer information.

Submarine cable systems

ENVIRONMENTAL ASPECTS	ENVIRONMENTAL PERFORMANCE	ENVIRONMENTAL GOALS	ENVIRONMENTAL PROGRAMS
Material: Lead	Tons/MW/m—current and historical.	100 percent recycling. Replace as soon as possible.	Advise customers on recycling (EPD). Optimize design to use less. R&D for replacement material.
Material: Copper	Recycled copper content (percent) —current and historical.	100 percent recycling.	Advise customers on recycling (EPD). Supply management.
Material: Oil	Only for impregnation (no free oil).	Replace with dry extruded insulation.	R&D.
Energy losses	Depend on customers' specs and cable length.	Minimize total losses in system.	R&D/LCA. Influencing customers' increased use of HVDC.
Electrolytic effects (Chlorine)	Amounts are a function of energy handled (MWh, amps).	Offer bipolar links. Determine/quantify the problem.	R&D. Develop environmental condition indicators.
Oil leakage	Amount lost (percent).	Replace with dry extruded insulation.	R&D.
Environmental impact of recycling process	Maximize direct recycling by suppliers. Recycle scrap to as high a quality as possible.	Minimize incineration/landfill. Maximize material recovery; Return as much as possible to suppliers.	Advise customers on recycling (EPD). Supply management and production control.

As the main feature of its Environmental Declaration, the Cables business area has produced a summary of the significant environmental aspects and performance of its main products, together with proposed future goals and improvement programs to meet these goals. Shown here is an example for submarine cables.

Business Areas:	Products and Services:
Medium-Voltage Equipment	Products for distribution of electrical energy including medium-voltage switchboards, apparatus and prefabricated factory assemblies
Distribution Transformers	Distribution transformers
Distribution Systems	Solutions and systems for distributing energy to rural, urban and industrial customers as well as for airport installations

Power Distribution

Power distribution networks carry electricity to the point of power usage—domestic or industrial consumers. The distribution network links the high-voltage transmission grids with users at lower voltages.

Because power distribution equipment is located close to people, there are strict requirements concerning safety, aesthetics, noise and electromagnetic fields, as well as the basic requirements for low energy losses and high operational reliability.

ABB provides a complete range of equipment for power distribution, from distribution transformers and switchgear to complete distribution systems.

The market for power distribution systems

Deregulation of the electricity supply industry is having an impact on the market for power distribution. Free trade and competition between electricity providers place extra requirements on flexibility, automation and metering in distribution networks.

In industrialized countries, power distribution networks are being modernized to cope with these new demands, and also to reduce the manpower requirement for operation and maintenance of networks. Meanwhile, in markets such as Asia and Latin America, rapid urbanization and the consequent growth in demand for electricity are driving major investments in power distribution. In many cases, improved distribution networks reduce the reliance on local generation using diesel power plants; these plants have a very high environmental impact.

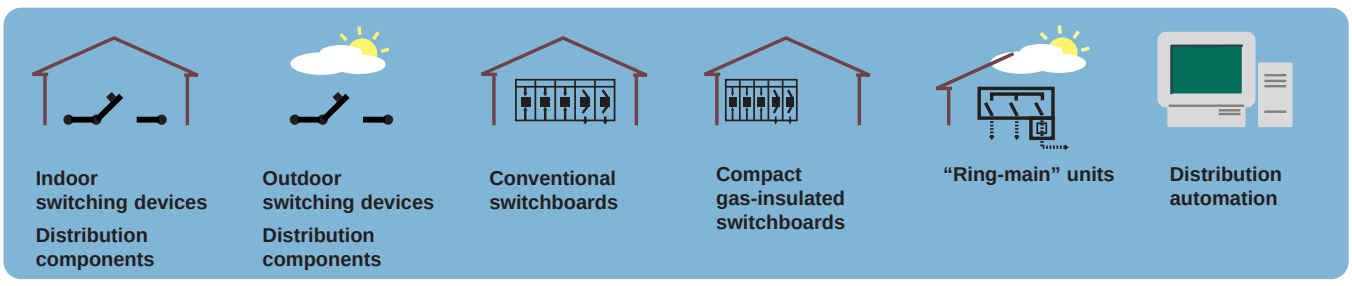
Environmental performance has a significant factor in the power distribution market. Minimizing power losses in distribution has a direct impact on the electricity supply company's bottom line. But other aspects of environmental performance, such as the use of toxic materials and end-of-life disposal costs, are also important in customers' purchasing decisions.

Environmental management

Customer sensitivity to environmental issues makes environmental management within ABB's power distribution businesses a vital condition for remaining in business. All manufacturing sites have environmental management systems in place, and most have now been certified to ISO 14001.

In addition, ABB is taking a leading role to improve environmental performance. For instance, ABB chairs the CIGRE task force on sulfur hexafluoride (SF_6), which is actively seeking ways to minimize emissions of this persistent greenhouse gas, although emissions are very low.

Today, the focus is shifting to the products themselves, using tools like life cycle assessment to set benchmarks for ABB's global product lines.



Environmental aspects

One environmental aspect that applies to all of ABB's power distribution equipment and systems is energy losses. The use of SF_6 for insulation and arc quenching in gas-insulated switchgear and the use of oil in distribution transformers have potential environmental impacts, particulary if mishandled. Electromagnetic fields are increasingly tightly regulated in some countries, although their impact on health and on the environment is still unknown.

Environmental goals

Among the environmental goals for ABB's Power Distribution segment are:

- To reduce leakage losses of SF_6 in switchgear from 1 percent to 0.1 percent per year.
- To improve handling and recycling procedures for SF_6 and reduce lifetime losses from 15–25 percent to less than five percent.
- To increase the marketing of sealed-for-life SF_6 switchgear having zero leakage in normal operation.
- To offer systems with very low or eliminated electromagnetic fields.
- To offer distribution products and systems with low losses, together with life cycle assessments to help customers understand the economics of these alternatives.
- To increase the range of oil-free transformers, and improve their relative cost efficiency.
- To reduce the weight and energy losses of distribution transformers by 50 percent within 10–20 years by using high-temperature superconductors.
- To implement life cycle assessments and materials databases for all products.

ABB introduces biodegradable transformer oil

In recent years there has been growing concern regarding the use of mineral oil in transformers. Oil containing PCBs has now been eliminated from all of ABB's current transformer range, but transformer oils are still often considered hazardous materials and of particular concern when used in distribution transformers in heavily populated areas or near waterways. Any oil spill requires special attention, and major spills result in significant cleanup costs.

ABB has succeeded in developing a new dielectric fluid that can replace the mineral oil conventionally used in distribution and small power transformers. Called BIOTEMP™, it is based on a property-enhanced vegetable oil, combined with stabilizers to enhance its oxidative stability. This is the first time a vegetable oil has met the performance requirements for use in transformers.

Tests have shown that BIOTEMP is functionally equivalent or superior to current transformer fluids, as well as being 97 percent biodegradable. In addition to being "environmentally friendlier," BIOTEMP has fire and flash points well above 300 °C, making it much safer than mineral oil. ABB is continuing with the development of BIOTEMP, which could also have applications in other electrical equipment.

The "Green Transformer"—an oil-free solution for power distribution

In 1998, ABB made a major breakthrough in distribution transformer technology with the introduction of the "Green Transformer"—a transformer made entirely from solid materials without any conventional insulation liquid.

The Green Transformer combines a solid insulation system with a composite shielding envelope and a simple

ABB URBAN compact substation, Halmstad, Sweden.

ABB Green Transformer.

yet highly effective cooling system. It is waterproof and airtight, with no corrodable parts, and can be safely installed underground and in corrosive conditions such as immersion in salt water, wastewater and sewage. A powered prototype unit was completely immersed in a concentrated chloride solution for one month.

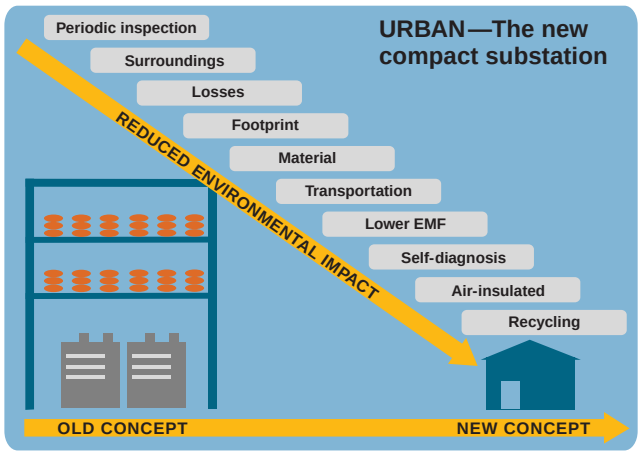
The solid-state design, containing no oil or gas, eliminates the danger of fire or explosion and generates no pollutants. These factors make it particularly suitable for underground installations (common in urban areas) and harsh environments (humid, dusty, corrosive or flammable) such as offshore platforms, ships and petrochemical plants, as well as the pulp and paper, mining and metals industries. It is silent in operation and can easily be dismantled and recycled at the end of its useful life.

The Green Transformer is available for power ratings up to 1,000 kVA three-phase, 20 kV. It is being marketed as a replacement for oil-insulated transformers of similar ratings, specifically targeting the applications and environments that benefit the most. At the same time, development work continues with the aim of scaling up the design to reach higher power ratings.

URBAN™—A discreet and compact substation for populated areas

Substations are necessary throughout a power distribution network to reduce the voltage of the main power lines and cables to the lower voltages required by the various consumers.

Rather than subject consumers to the presence of nearby large outdoor substations with their steel structures, transmission lines, transformer noise and visual impact, ABB has developed a compact indoor substation for voltages up to 170 kV, named URBAN™, which requires



only a fifth of the space of a conventional substation. The first substations of this new concept replaced existing unsightly outdoor installations, and have brought many benefits to the utility and to the neighborhood.

The 80 percent space reduction and much smaller footprint enable the building to be styled to merge with the local surroundings. The adjacent land is freed up for other uses compatible with the neighborhood. The compact design has been achieved by a simplified layout utilizing electrical plant modules which also incorporate the interconnections. The building protects the equipment from the effects of weather, reduces transformer noise and prevents interference from wildlife and trespassers. Reliability, recyclability of its components, and safety of operating personnel and the public, have all been increased. On the other hand, electromagnetic fields, materials, maintenance and the associated environmental impact of maintenance visits, have all been reduced.

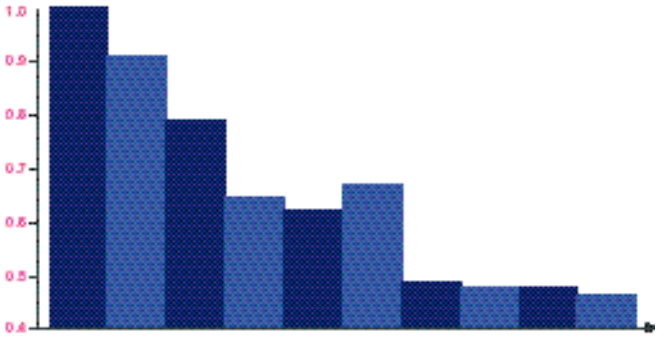
This concept allows the substation to be located in residential and urban areas, thereby reducing power losses through shorter connections to the consumers and pro-

ABB's distribution automation system.

viding considerable lifetime reductions in overall costs and environmental impact.

Feeder automation

Feeders are the connections that carry electricity from the local power plant or substation to the consumer. In rural areas they comprise overhead lines; in towns they are usually underground. Various items of equipment—secondary substations, step-down transformers and switching devices—are located throughout the network.



How one power utility in Finland has reduced relative mean power outage times by over 50 percent by implementing ABB's automation systems in its distribution and feeder networks.

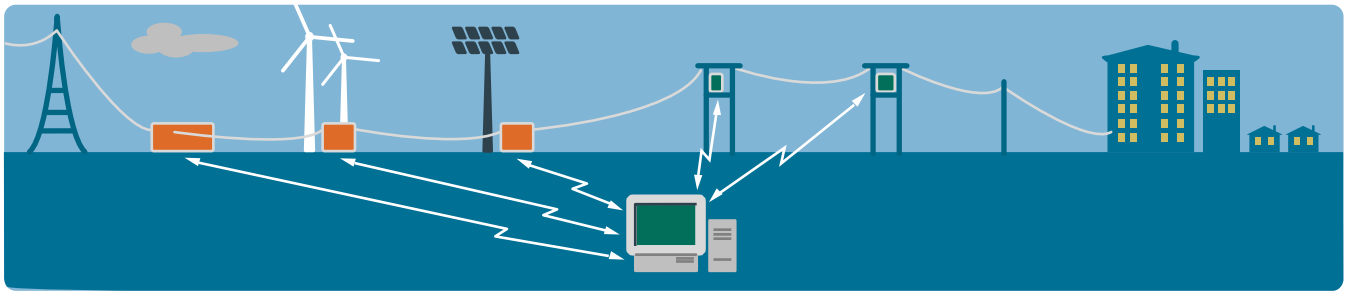
The last five years have seen an increasing focus on the application of automation in the secondary substations, and in the switching devices. Switching operations to deal with service interruptions, re-routing of supplies or maintenance outages can now be performed remotely without the need to send out engineers to perform switching operations manually. This was expensive and time-consuming, and all the more critical if consumers were affected by power failures.

ABB has developed a complete solution for feeder automation including automated switches, remote control units, and the monitoring and measurement of network behavior. All the devices in the network can communicate with, and be controlled from, a network control center.

ABB's feeder automation system helps power companies cut outage times, improve power quality, reduce the amount of undelivered energy and keep maintenance costs under control.

Sustainable development relies on the availability of electric power. Sudden losses of power can be a severe hardship to affected communities. Even in the best-run networks, adverse weather, for instance, can be a major cause of unplanned power outages. The expansion of automation throughout distribution networks is therefore a clear goal for power companies.

Feeder automation



Business Areas:
Low-Voltage Products and Systems
Contracting
Service
Air-Handling Equipment
Other (not assigned to specific Business Area)

Products and Services:
Design and installation of electrical, ventilation and refrigeration systems
Complete infrastructure systems for industrial and commercial buildings
Operation and maintenance of building systems
Low-voltage switchgear, and control equipment
Circuit breakers, and programmable controllers
Electrical installation material
Service, maintenance and repair of industrial equipment

Products and Contracting

This ABB business segment manufactures key components for electrical installations, industrial applications, machine building, and heating, ventilation and air-conditioning systems. Based on these components and ancillary products from other manufacturers, the segment designs and builds complete installations for industrial and commercial buildings, and operates and maintains building systems. The segment also offers service, maintenance and repair of industrial equipment and processes. This applies not only to ABB-manufactured equipment but to other manufacturers' products as well.

The market for products and contracting

This business segment serves a wide variety of customers, from large multinationals to small local businesses. In most industrial and commercial buildings there are many applications for the segment's products and services. There is an increasing demand for modern, cost-effective and energy-efficient installations and systems, both for new construction and for upgrading existing installations. There is a growing environmental awareness among customers, especially utilities and process industries, but also real-estate companies and governmental and municipal authorities.

Increasingly, customers want to buy complete solutions rather than single products. The service content of these solutions is often very high, including not only design and installation but also preventive maintenance, repairs and even operation of facilities. Full-service maintenance of customers' production plants, including equipment from other manufacturers and total responsibility for maintaining an agreed-upon uptime, is in increasing demand. Customers want to ensure uninterrupted production with high availability of their processes through more professional plant maintenance.

Contracting and service require highly skilled people possessing not only technical skills but also the ability to listen to customers and understand their particular needs. They must be able to see and seize on all opportunities to continually improve processes and practices from both an economic and an environmental point of view.

Environmental management

The basic considerations of environmental management are always the same, regardless of the type of industry, activity, process, equipment or service. They include using less materials, generating less waste and reducing emissions to air and water. This applies equally to the manufacturing and service-performing activities of this business segment. Good housekeeping, as manifested by implementing ISO 14001, pays off both in economic and environmental terms.

The ISO 14001 environmental management system is being implemented throughout the business segment, at all manufacturing sites, service shops and contracting companies. Life cycle assessment is used to improve the environmental performance of low-voltage and air-handling products and systems.

Environmental aspects

For low-voltage products and systems, the environmental aspects are mainly related to the use of materials and the generation of waste in manufacturing. In operation, these products use only small amounts of energy, in some cases no energy at all. Most of them are easy to decommission and recycle.

Careful choice of materials is of key importance in reducing environmental impact. Steel, copper and plastics

make up the bulk of materials used in low-voltage apparatus. Copper is used in wiring and steel for structural applications, such as trunking and cabinets. Both are highly recyclable. Aluminum can replace copper for some applications but is not as efficient a conductor.

Plastics are primarily produced from oil, a finite resource that must be used sparingly. Our goal is to use environmentally benign materials that require fewer natural resources, and to eliminate hazardous materials entirely. PVC poses an environmental dilemma. It combines high performance with low cost. But the stabilizers used contain heavy metals, including lead, while the softeners contain phthalates. Combustion can produce dioxins. Wherever possible, ABB is phasing out PVC.

For air-handling products, the significant environmental aspects stem from operation. Maintaining a suitable indoor climate requires a great deal of energy, both for conditioning the air and for distributing it, overcoming the resistance of dampers, filters, ducts and grills. In fact, 20 percent of all energy produced in the world is used for this purpose.

While improved environmental management has reduced industrial energy consumption in recent years, energy consumption in buildings has increased. This is mainly due to the demand for better internal environments and to increasing usage of electrical equipment. Traditional emphasis on start-up costs of buildings, rather than on operating costs, has resulted in buildings with high energy demands.

Energy consumption can often be drastically reduced without sacrificing comfort, for example, by installing modern equipment, cutting back on or redistributing energy in the building and by installing systems to recover cold or heat. Modern control technology can also produce spectacular results. It is often possible to reduce energy consumption by 25 percent, sometimes by up to 40 percent.

Contracting and service activities usually do not harm the environment. On the contrary, repairing, reconditioning, upgrading and maintaining products and processes improve their performance and extend their lifetimes. This adds economic value for the customer and reduces negative effects on the environment. Take-back, sorting and recycling of decommissioned products and waste

Information included in an Environmental Declaration

	SIGNIFICANT ENV. ASPECTS	CURRENT ENV. PERFORMANCE	ENVIRONMENTAL GOAL	ENVIRONMENTAL PROGRAM
DESIGN/ MANUFACTURING	use of cadmium	50 kg/year	eliminate	
	use of plastics	304.4 tons/year	unchanged	
	solder waste	10 kg/year	eliminate	R&D project
	metal scrap	220 tons/year	reduce to 70 tons/year	incl. in 1998/99
	use of electricity energy	5,735,000 kWh	reduce by 15%	
	use of chemicals	180 different	reduce number by 25%	
OPERATION	use of energy	N/A	minimize	
DECOMMISSIONING	different plastic parts	N/A	labelling	R&D project incl. in 1998/99

This example applies to a range of large, low-voltage contactors with a manufacturing volume of 500,000 units per year.

Fitting fan ducts at ABB Fläkt Öst AB, Sweden.

are growing in importance, both as integral parts of ABB's full-service activities and as standalone services.

Environmental goals

- Implementing the ISO 14001 environmental management standard at all manufacturing sites, service workshops and contracting companies.
- Applying life cycle assessment to products and systems to identify areas for environmental improvement.
- Improving the aerodynamic efficiency of fans, ducts and other components to reduce losses.
- Introducing modern, energy-saving controls for heating, ventilation and air-conditioning installations.
- Upgrading the plants and processes that the segment builds, services and operates for customers to modern, environmentally sound standards.

Life cycle assessment

Life cycle assessment can be applied in choosing products and equipment that reduce energy consumption. Total energy input and output, and the flow of materials for individual products, can now be calculated. ABB's EcoLab LCA tool handles more than 500 items of inventory data, enabling us to assess the environmental impact of most activities and products. For example, using different configurations of air-handling systems, a building's energy consumption can be accurately projected. The cost and environmental impact of waste disposal can also be included in assessments.

ABB's Netto 98 tool combines life cycle information and operational requirements for various technologies and systems. This enables customers to make informed decisions about equipment and systems to improve energy efficiency.

Life cycle assessment of an office building in Västerås, Sweden, showed that approximately 98 percent of the total environmental impact was due to the use of the building, with only two percent resulting from its construction. This study covered the building's consumption of electricity derived from fossil fuels and a combination of nuclear and hydropower. Environmental impact for the coal-based electricity was approximately twice that of the hydro/nuclear power combination. Installing energy-efficient appliances and systems, or retrofitting existing buildings with new systems, constitutes a tremendous potential for energy conservation.

Energy-efficient air quality

ABB's ThermoNet system manages air quality and energy use in residential and commercial buildings. In both heating and cooling applications it combines high indoor air quality with low energy consumption and reduced life cycle costs. Low-grade energy sources, such as process waste heat and condensing heat from refrigeration machines can be fully utilized. A sophisticated control system adjusts indoor climate to individual requirements and increases energy efficiency.

Total energy consumption can be as much as 50 percent less than that of a conventional system with equivalent capacity. This also reduces the environmental impact.

Precision control

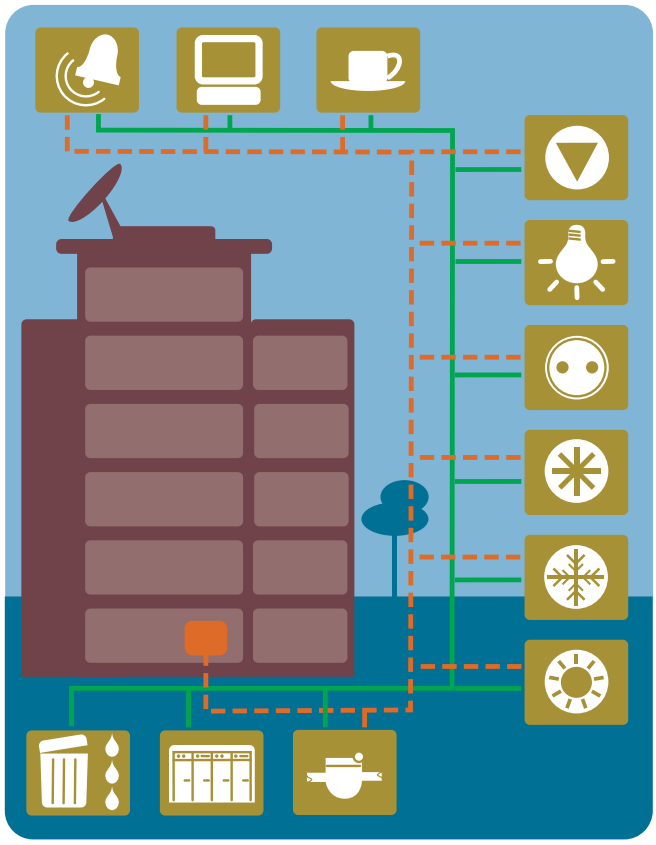
Residential and commercial buildings can be fitted with sensors feeding information about internal and external conditions to a control system that provides continuously variable control of services.

The Heinz Georg Holl building near Mannheim in Germany has been fitted with such an ABB control system.

Indoor climate system for Stuttgart International Airport.

Low-voltage distribution systems for the Lingotto Fair Center, Torino, Italy.

Electrical and ventilation systems for Piteå aquatic center, Sweden.



Intelligent building system

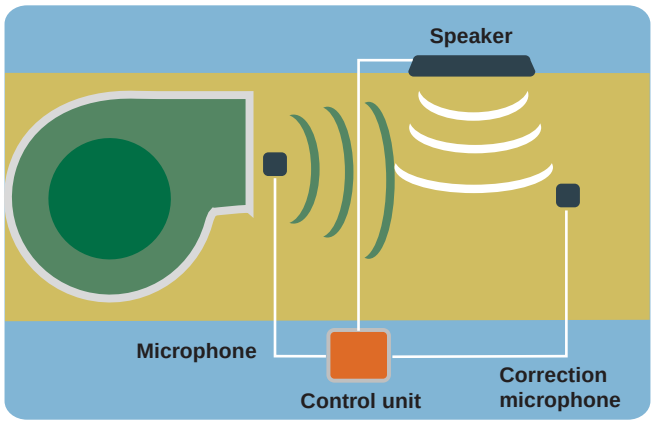
Blinds and lighting are programmed to operate at designated times. Movement sensors detect anyone who enters a room, activating lighting and deactivating it when the person exits. Linked to an alarm center, the building is continuously monitored for burglary and fire. And it can be programmed to maintain a stable indoor climate over designated periods. After hours or during slack periods, energy-consuming services can be reduced to a minimum, cutting power consumption. Programming for extended periods of inactivity, for instance, during holidays and weekends, allows almost total shutdown, further reducing power consumption. Other services can be adapted to periods of short-term occupancy.

Building-block ventilation systems

ABB's EU2000 ventilation system conforms to all current and proposed regulations. Software programs ensure highly accurate assessment of system requirements for each installation, resulting in improved operational performance. Noise in the system can be reduced by passive sound-damping materials or by advanced active reduction systems. Modular design allows systems to be tailored to exact requirements for each installation, further reducing energy demands.

The components used substantially reduce air leakage. Friction inside the ducts is reduced by smooth internal wall surfaces free from recesses or projections where debris can accumulate. Ducts stay cleaner over longer periods, and they are easier to clean, improving long-term performance.

Heat exchangers that recover and reuse waste heat from ventilation systems can improve system efficiency by up to 65 percent.



Active noise-reduction technology.

Business Areas:	Products and Services:
Automation Power Products	Automation power products such as drives, motors and power electronics
Instrumentation and Control Products	Instrumentation and control products such as field devices for sensing, controlling and actuating; analyzers; metering equipment; control and information systems
Flexible Automation	Flexible automation and robotics products and systems
Marine and Turbochargers	Diesel engine superchargers
Metals and Minerals	Application expertise, project management, and integrated system deliveries to markets such as electrical and water utilities, the petrochemical and chemical industry, metals and mining, pulp and paper, marine and automotive.
Petroleum, Chemicals and Consumer Industries	
Pulp and Paper	
Utilities	

Automation

ABB's Automation business segment provides a wide variety of products, systems and services used in almost all industries, as well as solutions for particular applications and industries.

Within the segment are electric motors and drives and their associated electronic and control systems; instrumentation and control products, including sensors, valves and meters (for water, gas, electricity, energy, etc.); protection products; and supervision, control and data acquisition (SCADA) systems for monitoring and control of large, complex networks (for electricity, water, gas, oil, etc).

ABB's flexible automation systems, including industrial robots and other plant automation systems, are used throughout the manufacturing industry. Automation systems for power industries are another expanding field of activity.

The business segment also includes marine propulsion systems; products and systems for mining and processing minerals and metals; manufacturing systems for the petrochemical, pharmaceutical and food industries; and electrical systems and machinery used in paper mills.

The market for automation products and systems

Regardless of the industry and process involved, the requirements for products and services to be reliable and cost efficient are the same. Many of the industries that ABB supplies are themselves subject to environmental regulations; they also have customers who are sensitive to environmental issues.

The common thread running through all of ABB's very diverse range of automation products and systems is increased efficiency—which invariably produces both economic and environmental benefits.

Electric motors, for instance, use nearly two-thirds of the electricity used in industry. The greater their efficiency, the less electricity has to be generated and the lower the levels of pollution from power generation. New regulations in North America and Europe specify minimum efficiency levels for electric motors, levels that ABB's motors consistently exceed, and which ongoing research and development are continually raising further.

Automation and control systems are used to improve product quality and consistency and to replace humans in hazardous environments. In use, they cut waste and reduce the possibility of accidental emissions as a result of human error.

Another example is diesel turbochargers, which are used in marine propulsion systems and diesel generators. ABB is the world's leading supplier of diesel turbochargers, which can increase the power output of a diesel engine by a factor of four, while reducing fuel consumption, and hence pollution, by ten percent or more.

Environmental aspects and goals

For the segment's products and systems, environmental aspects vary tremendously. Instrumentation and control systems are largely composed of electronics and software. Their environmental aspects are almost negligible: The main issue is decommissioning and take-back of electronic systems at the end of their useful lives.

Other industrial products, such as electric motors, have very significant environmental aspects. Here, environmental management has always been integrated in research and development, in the past informally and more lately formally, because high efficiency and low weight give these products a competitive edge in the marketplace. To reduce the use of raw materials (e.g. copper), and to invest in product design for recyclability are two of the goals.

Drives and motors: a huge opportunity to save resources

Life cycle assessment shows that by far the greatest environmental impact of electric motors and drive systems comes from the energy they consume during their operational lifetimes. The environmental impacts of manufacture, delivery and end-of-life disposal/recycling are negligible in comparison. Nonetheless, ABB has stringent policies on design, materials use, logistics and recyclability for all products in this area, which also extend to component suppliers.

In October 1997, the Energy Policy Act in the U.S. introduced mandatory minimum efficiency levels for all standard motors (equivalent to regulations already in force in Canada). These levels were much higher than those commonly found in motors supplied in Europe. But Europe, too, is moving to enforce the use of high-efficiency motors. The European Commission will introduce a classification system for low-voltage motors in 1999. The minimum efficiency levels for the highest class will be higher than those specified in North America. Following the introduction of the classification, the European Commission will progressively enforce the use of high-efficiency motors by banning motors in the lower efficiency classes.

As the leading supplier of high-efficiency motors in Europe, ABB strongly supports the activities of the European Commission. ABB already produces high-performance motors that exceed the North American requirements. The main challenges that face ABB now are first, to extend the high-performance motor range to cover all sizes and power outputs; and second, to develop new motor concepts that meet the highest efficiency criteria at the lowest possible cost. An example is the 75-kW motor that recently won a contest designed to promote the use of high-efficiency induction motors. The contest, sponsored by the International Energy Agency (IEA), was open to all motor manufacturers. Developed by ABB in Finland, the winning motor achieved 95.8 percent efficiency.

Further gains in efficiency can be achieved through the use of variable-speed drives, in applications ranging from low-power pump and fan drives to heavy-duty operation in cranes, paper machines and steel rolling mills. Speed control in electric motors can help to optimize manufacturing processes, increase production capacity, reduce operating costs and save energy.

The savings can be huge. Installing AC drives in the ventilation systems at London's Heathrow Airport, for instance, cut electricity consumption by over 50 percent. And replacing old DC drives with modern AC technology reduced electrical losses from more than 20 percent to less than ten percent in a copper rolling mill at Pori, Finland.

In total, the AC drives delivered by ABB over the last decade are estimated to save around 30,000 GWh annually. If that energy were generated in coal-fired power stations, it would produce over 25 million tons of CO_2.

Instrumentation and control

From controlling an entire power generation plant to metering water consumption for individual households and monitoring emissions throughout industry, ABB's instrumentation and control products are important in improving environmental performance in a wide range of applications.

An example of ABB's business in this area is the supply of control systems for power plants: steam, gas turbine and combined-cycle, industrial and district heating plants,

waste-to-energy plants and nuclear power plants. Instrumentation and control for auxiliary systems, such as flue-gas cleaning and wastewater treatment, are also often included.

The environmental impact of these products and systems is not so much related to their own manufacture and use, but to optimizing the environmental performance of the plants they control. In recent years, ABB has supplied instrumentation and control systems for over 50 flue-gas cleaning plants in coal and waste-to-energy power stations. New markets for these technologies are currently opening up in eastern Europe and Asia.

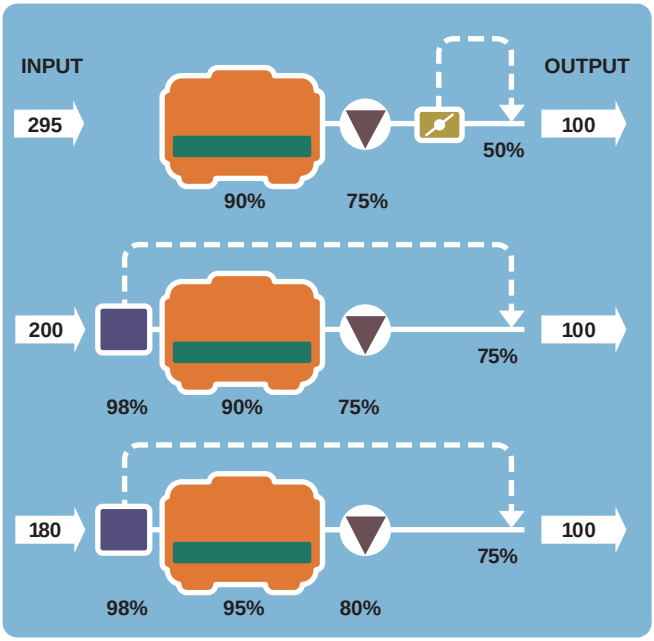
However, new technology in the products themselves can have environmental benefits. In recent years, ABB has been installing control systems incorporating intelligent peripheral components and local field bus technology. This greatly reduces the amount of cabling required. Two recent installations at power plants in Germany resulted in savings of more than three tons of copper and two tons of PVC insulation.

ABB Optimax

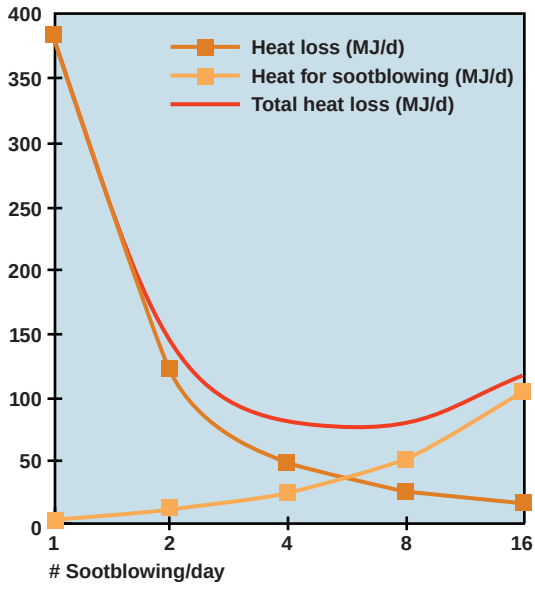
This software package calculates online the efficiency of power plants.

Calculations include all critical parameters for the steam generator, the heat exchanger, the condenser, the steam turbine and the balance of the plant.

It enables the plant operator to make the right decision and consequently to run the plant in a cost effective and environmentally friendly way.



Energy savings by using high-efficiency motors and variable speed drives.



Optimax boiler cleanliness calculation supports plant operators in optimizing the sootblowing scheme to achieve significant heat-rate savings.

Control room with ABB Master operator stations at the Korsnäs paper mill, Sweden.

For a 500 MW coal-fired power plant, Optimax can save as much as 600 metric tons of coal per year—which reduces CO_2 emissions by 1,600 metric tons.

Flexible automation

ABB supplied the world's first electric robot in 1974. With an installed base of more than 60,000 robots worldwide, ABB is now the world's largest supplier of robots and flexible automation systems. The automotive and automotive parts industries are major market segments, and general industry and consumer goods are also important.

Manufacturers are under constant pressure to reduce costs and to raise productivity and quality. Additional pressures are tightening environmental regulations and stricter demands and controls relating to quality of life within the workplace.

With world markets changing at an ever faster pace, lean, efficient and flexible just-in-time production has never been more important. Flexible automation systems can handle an increasing number of product variants and frequent production changeovers.

Flexible automation also eliminates hazardous, dirty and strenuous human tasks, making industrial work safer and more appealing. In this way, and by improving quality and reducing waste, flexible automation systems have a positive environmental impact.

In the manufacture of its industrial robots and other flexible automation systems, ABB is already following policies to minimize emissions and to make its products totally recyclable. Life cycle assessment is used in the development of new products and function packages, and component suppliers are also included in this assessment.

Where robots are used in environmentally hazardous situations, environmental performance is a very important criterion. Probably the most significant application is in automotive paint finishing, where many countries already have strict controls on noise and emissions of VOCs and particles. Here, there is continuous pressure to improve environmental performance.

But probably the greatest potential for improvement lies in improving the environmental performance of the manufactured goods themselves. For instance, a draft directive from the European Commission stipulates that by 2002 it must be possible to recover at least 85 percent by weight of the material used in vehicles for reuse, recycling or energy recovery. By 2015, the figure will increase to 95 percent. Today, less than 75 percent of the weight of a vehicle can be recovered at the end of its life.

This draft directive has considerable implications for automotive manufacturing. New assembly and connecting technologies—like gluing, laser welding, clipping and punch riveting—will have to be developed for new materials and compounds. And new surface treatment technologies will also be needed.

There are also opportunities to develop dismantling centers using a high degree of automation. Today, dismantling of vehicles takes place in relatively small workshops, with little or no automation and little regard to environmental issues.

Optimizing marine systems

ABB is a major supplier of electrotechnical systems and solutions to the marine industry. These include shipboard electric power generation and distribution systems, propulsion, steering and positioning systems, automation systems and optimization and energy management systems. Most types of vessels use our products—for example,

Passenger ship Elation equipped with two Azipod units.

passenger, cargo, tanker, and offshore production and supply ships.

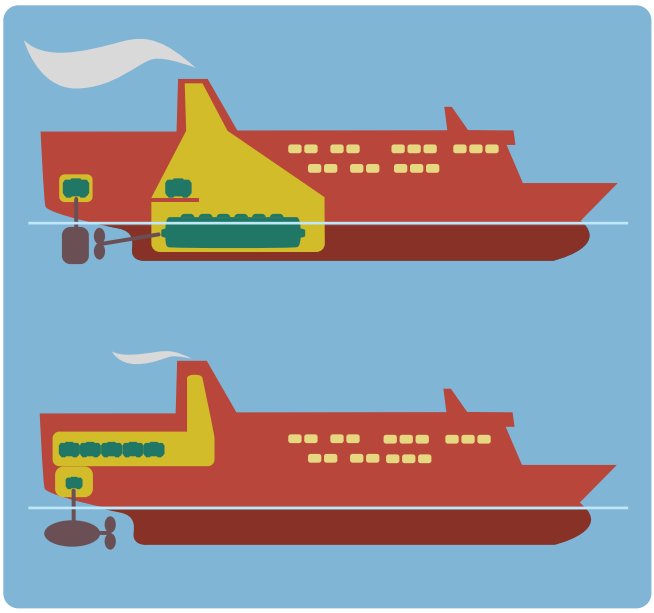
Ships are self-contained entities that require many different systems—to supply energy, lighting, ventilation, food, water and telecommunications and to handle waste. Since ships have no political borders and operate independently of land-based systems, there is a great opportunity to optimize the total shipboard operation with regard to economy, safety and environmental performance. The focus is on the interaction and integration of the various systems.

As a leading supplier of electrical and automation systems, ABB offers physically integrated solutions. For the vessel operator, these solutions improve performance and reliability while minimizing energy consumption and emissions of pollutants. The vessel builder saves time and money on simplified engineering, installation and commissioning.

ABB Industri AS in Norway is responsible for project management of the international Marintronics R&D project. Participants include manufacturers of ship equipment, ship designers, ship operators and oil companies. Universities and research institutes also participate. The main objectives of the project are to minimize emissions of NO_X and CO_2, reduce operational and capital costs, and maximize operational stability and safety.

Functional integration of power generation and distribution, automation, propulsion and positioning systems for marine, oil and gas vessels is the core of the project. This will also include energy management systems, simulation systems and advisory systems.

Two specific ABB product lines have significant environmental benefits for the shipping industry: ABB's recently developed Azipod® propulsion system, and ABB's



The Azipod propulsion system saves valuable shipboard space and reduces fuel consumption.

range of diesel turbochargers.

Azipod represents a radical rethink of marine propulsion systems. Instead of diesel engines and gearboxes directly connected to a long drive shaft and propeller, the Azipod unit integrates propeller and rudder in a single unit outside the ship's hull, driven by a variable-speed AC motor, which can be rotated through 360 degrees.

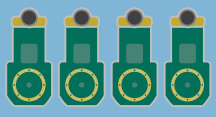
Azipod makes ships far more maneuverable since the propeller can be steered, rather than having to work against a rudder. The improved propulsion efficiency more than offsets the losses involved in using electric propulsion compared with mechanical drives—and since there is no longer a requirement for a long drive shaft between engines and propellers, ship designs are less constrained.

ABB also participates in a European project, that is

ABB's Advant Station 500.

an innovative approach to inland ship design. It aims to minimize the impact on the environment, reduce energy consumption and improve safety and commercial efficiency in inland shipping. The concept is based on diesel electric power with ABB's Azipod.

A diesel engine equipped with a turbocharger can produce about four times as much power, and consume 10–15 percent less fuel, than a normally aspirated engine. For a given power output, a turbocharged engine is much lighter and more environmentally benign to manufacture. A 2,000-kW normally aspirated engine, for instance, requires 110 tons of steel and cast iron, and making it consumes 110 tons of coal and emits 403 tons of CO_2. A turbocharged engine with the same power output requires just 36 tons of metal and 36 tons of coal, with emissions of 132 tons of CO_2 in the manufacturing process.

Diesel engine	Turbocharged	Non turbocharged
		
MANUFACTURING		
Power	2,000 kW	2,000 kW
Weight	36 tons	110 tons
CO_2 emission	132 tons	403 tons
OPERATION (15 years, 50 percent power demand)		
CO_2 emission (tons)	86,700	100,400
NO_x emission (tons)	1,735	1,905
Particulate (tons)	131	197
Fuel consumption	25,000	28,900

In 1998, ABB introduced a new generation of diesel turbochargers, the TPS series, for engines up to 3,200 kW, and the TPL for engines up to 25,000 kW. These new turbochargers have improved compressor ratios and efficiency compared to previous generations as well as a weight reduction (and consequently, lower environmental impact in manufacturing) of 25–30 percent.

Further development continues, with the aim of improving specific power output by 14 percent, and efficiency by two percent, by the year 2000. Another target is to reduce NO_x emissions by 30 percent.

Mining, mineral processing and metals

Mining, mineral processing and metal production are large consumers of electrical energy. ABB's electrical engineering expertise makes it a natural partner in these industries, and ABB is a major supplier of electrification systems.

One of the world's most productive iron ore mines can be found at Kiruna, in the north of Sweden. Here, 500 men work underground to produce 22 million tons of ore a year. The mine, which opened in 1910, has already been sunk to a depth of over one km, and is sunk on average a further 19 meters each year.

To bring ore to the surface from such depths, ABB developed a radical new electric truck solution, in conjunction with a local company, Kiruna Truck AB. The electric truck system provides much greater flexibility than with traditional hoist systems, and also has environmental benefits: emissions are eliminated and noise greatly reduced compared with diesel trucks. Low operating costs also make it economically feasible to exploit smaller ore deposits on the outskirts of the main lode, which could not be economically connected to a conventional hoist system.

The ABB Smart platform sensors measure and control a moving paper web 1,200 times per second. Fletcher paper, Alpena, Michigan, USA.

The Kiruna electric truck system is just one example of ABB's broad competence in the mining industry. Ranging from complete electrification systems for open-cast mines through motors and drive systems for pulverizing equipment to control systems for ore concentration facilities, ABB is helping mining companies find processing and restoration procedures that alleviate the environmental consequences of mineral extraction. Variable-speed drives reduce energy consumption; filtration systems lower dust emissions; and power generation and distribution systems raise the efficiency of resource utilization.

Steel mills benefit from reduced energy consumption using ABB's instrumentation and control technology for exact timing and sequencing. ABB's advanced process control systems for electric arc furnaces reduce raw material consumption.

ABB offers effective environmental control technologies for the steel industry, including materials treatment systems for recycling processes. There is also a broad spectrum of services for air emissions control, water treatment, and complete environmental compliance assessments to maximize the environmental performance of steel mills. Monitoring dioxins, furans and other contaminants with ABB's intelligent systems can greatly reduce emissions.

In the aluminum industry, increasingly strict environmental standards are leading producers to deploy a full range of emissions control and recovery systems.

More than 50 aluminum smelters have selected ABB as their environmental partner. Each year, ABB systems treat over 137 million m^3 and recover 320,000 tons of valuable material. ABB has supplied more than 100 dry fume treatment and fluoride recovery plants using specially developed fabric filters in high-efficiency reactors. More than 300 ABB wet scrubber systems are in use for both fluoride and SO_2 removal.

More than a third of the world's aluminum is now produced in plants equipped with environmental systems from ABB, providing cost-effective emission control for fluorides, dust, tars and SO_2.

Advanced controls for gasification power plant

As a turnkey project, ABB is responsible for the engineering and construction of a complete 260-MW, low-emission, integrated gasification combined-cycle power plant at an oil refinery in Falconara, Italy. ABB supplies the gas and steam turbines for combined-cycle operation, together with the associated heat-recovery steam boiler, the electricity generators and the power plant control system.

The plant will convert up to 440,000 tons per year of heavy oil-refinery residues into clean synthetic gas to fuel the gas turbines. The plant will supply steam to the refinery and power to the national Italian electricity grid. ABB's advanced combined-cycle technology with low-NO_x burners will achieve high fuel efficiency with low emissions, well below the EU's stringent future limits.

A very advanced control system integrates the combined-cycle power plant with the synthetic gas manufacturing process to optimize plant efficiency and minimize emissions.

Pulp and paper

Paper mills are major consumers of energy and important customers for ABB's electrification systems. ABB has completed electrification projects for more than 100 pulp and paper mills around the world.

ABB's expertise in AC drive technology and its Direct Torque Control (DTC) drive systems make it the market

Newsprint paper machine, Sachsen Papier, Germany.

leader in sectional drives for paper mills—systems that control the passage of paper through the mill. On average, two new systems from ABB are started up every week. The DTC technology enables precise control of torque, draw and speed in small and large drive sections. Product quality is improved, and higher drive efficiency and lower maintenance needs cut costs for mill operators.

Pulp bleaching

At the start of a pulp line, a digester processes the raw material—wood chips—chemically at a high temperature. After processing, the dissolved fibers retain a dark color. Further processing with chlorine oxides or hydrogen peroxide is required to bleach them.

After bleaching, fibers are washed in several steps. This generates large quantities of water, polluted by bleaching chemicals and oxygen-consuming organic matter from the raw material. These substances can form very long-lived chlorinated compounds that may harm the environment. For both environmental and economic reasons, it is important to minimize the amount of chemicals used in the process.

ABB Autobleach is a high-level control system that measures and monitors the color of the fibers throughout the process. At each process step, it feeds the exact amount of chemicals required to obtain the correct degree of bleaching. It also controls the temperature. The combination of optimal chemical conditions and optimal temperatures produces high-quality fibers.

The improved quality generates extra income for the mill, and the reduced consumption of chemicals and energy cuts costs. A typical mill can save between US$ 0.5–1 million per year. The greatest benefit, however, is the sharply reduced environmental impact. So far, 35 mills in different parts of the world have installed this system.

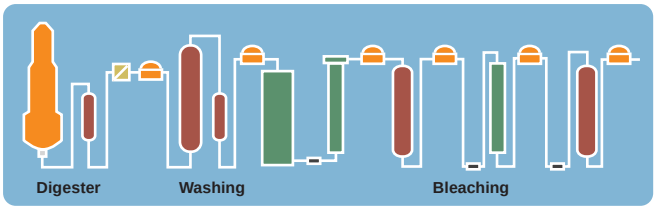


ABB Autobleach control system monitors the color of the fibers throughout the bleaching process.

Business Areas:	Products and Services:
Treasury Centers	Management of Group liquid assets and borrowings, positions on foreign exchange and money markets within predefined risk limits
Leasing and Finance	Financial consulting services
Insurance	Asset backed financing, large financial packages, financing for investments and financial advisory services
Structured Finance	Traditional reinsurance, financial insurance/reinsurance and insurance brokerage
Energy Ventures	Project and export finance advisory services and countertrade
Holding activities and eliminations	Project underwriting and debt financing
	Project development and equity financing of IPP projects

Financial Services

Financing—a key to a better environment

Efforts to promote environmental improvements understandably place a focus on the need to develop new technologies. On the other hand, the lack of financial resources often restricts the improvements that could be achieved to a far greater extent than the lack of new technology itself. Simply by applying today's Best Available Technologies (BAT) on a global scale, the world would witness an environmental improvement that would eclipse any conceivable technological breakthrough. So, clearly, technology offers a big, unexploited potential to improve environmental performance, particularly in developing countries through upgrading applications with utilities, industrial processes and buildings of all types.

Yet we are faced with a paradox. The richer developed countries that have already cleaned up much of their gross industrial pollution use substantial financial resources to achieve only marginal improvements. Meanwhile, the poorer developing countries do not have the means to afford BAT. Furthermore, when it comes to the application of new breakthrough technologies, these tend to be affordable only by those already at the BAT level.

There is therefore a real danger that the gap between the richer and poorer countries will widen as a result of technological advancement unless more capital is mobilized and channeled to the areas of real need. With more favorable cost-benefit terms for investment in developing countries, much more progress would be possible in breaking away from the business-as-usual path toward significant environmental improvements.

It follows that for ABB to be a leading and global supplier of ecoefficient products, skills and resources in financing are just as important as advanced technology. The capabilities of ABB's Financial Services segment therefore make an important contribution to the Group's environmental policy and performance. The Financial Services segment has developed tools and expertise to assist customers in arranging financing for environmental improvement projects across the whole span of the Group's activities. In addition, it plays an important role in serving as the interface with the international institutions involved, such as the World Bank (GEF/Carbon Fund), IFC, EBRD, EU-Phare, NIB, NEFCO, ASDB and the commercial banking network.

The future—new environmental challenges

One of the main future environmental challenges for ABB's Financial Services segment will be to focus on the terms of the so-called "Kyoto Protocol Mechanisms" contained within the Kyoto Agreement on Climate Change that aim to reduce overall emissions of greenhouse gases. The new mechanisms include Emissions Trading, Joint Implementation and Clean Development Mechanisms. They are expected to come into effect as soon as an appropriate framework is in place. For the Clean Development Mechanisms this is currently planned by the end of the year 2000, whereas the other mechanisms are expected to generate credits between 2008–2012. One therefore expects most early action to take place through the application of Clean Development Mechanisms. In fact, the challenge posed by these mechanisms is a business opportunity for ABB. The goal is to integrate them wherever possible and wherever relevant into ABB's financial engineering strategies for projects.

Credits arising from these mechanisms could take the form of grants from project proponents who lead efforts to reduce CO_2 emissions. A particular merit of Joint

The Kyoto Protocol Mechanisms

Emissions Trading **is initially restricted to trading between Annex I countries, namely the OECD countries, Central and Eastern Europe including the Commonwealth of Independent States (CIS).**

Joint Implementation **is a specific form of emissions credit trading related to individual projects within the Annex I parties.**

Clean Development Mechanism **is joint implementation with credits between Annex I parties and non-Annex I parties (particularly the developing countries).**

Implementation and Clean Development Mechanisms is that investments can be directed to countries where CO_2 reductions can be achieved more cost effectively than in, for example, Western Europe and North America. This will help finance badly needed projects which would otherwise not materialize due to lack of capital. The retrofitting of power plants in Central and Eastern European countries is a good example. Retrofits will always result in increased thermal efficiencies. Therefore, in addition to the benefit of reduced CO_2 emissions, fuel consumption and the costs of electricity production will go down. This is only one example of how environmental benefits often go hand in hand with economic improvements.

ABB's Financial Services segment will further build up its skills to be able to select target countries and locations, to identify and develop qualifying projects, and to match the best technical solutions to the local demands while making an optimal contribution to the reduction of the country's emissions. ABB is in a good position to grasp these new opportunities and develop the interface between these mechanisms and private sector initiatives. As a way of accelerating this process, ABB would consider participating with equity in selected projects to promote Clean Development Mechanisms and to start up viable but capital-short projects in developing countries. The most straightforward approach is to develop bilateral projects, thereby providing a good starting reference for the more complicated multilateral schemes that will surely follow.

An example of a bilateral Joint Implementation scheme is a project to convert 30 heating plants in a number of towns and cities in Poland from coal-fired to advanced, low emission, gas-fired combustion—a project that is promoted and partly financed by Norway. According to the Joint Implementation concept, Norway and Poland can agree on how to split between them the corresponding emissions credits. Credits that accrue to Norway can either be banked towards meeting its own Kyoto targets or traded on an international emissions market, as it develops. Poland, on the other hand, achieves a way of financing its projects. Furthermore, as a member of the Annex I countres, Poland will also benefit through reduced emissions, thereby contributing to the targets it agreed to at the Kyoto summit.

ABB's Financial Services segment is a critical player in ABB's strategy to take a lead in this new business. It will develop the financial support and the new thinking and project evaluation skills necessary for success. The project economics will include the market price of greenhouse gas emission reductions, rather than just traditional market energy prices and normal pay-off periods.

Norway trades power for climate

Norway is again in the headlines, this time pioneering a novel and entrepreneurial form of climate-related business

under the 'Clean Development Mechanism' (CDM) outlined in the Kyoto Protocol. A project has been identified, a Letter of Intent signed, but much now depends on the outcome of the United Nations committees who are charged with agreeing the definitions, details and regulations on how CDM would work in practice and what type of projects would qualify.

In the meantime, a Norwegian consortium, named Consorcio Noruego, and comprising ABB Kraft, Kvaerner Energy and EEG-Henriksen, is collaborating with the state-owned power utility in Costa Rica in planning the construction of a small hydropower plant on the Virilla River near the country's capital. Electricity from the plant will replace that currently produced by diesel-fueled plants and therefore contribute to a reduction in CO_2 emissions. It is estimated that over a 20-year period the CO_2 reduction will be well over four million tons. The two countries want to see this project qualify as an example of CDM, where Costa Rica would earn emission credits on the savings achieved. The CO_2 credit certificates would then be bought by Norwegian companies who would be free to sell them to other Norwegian companies in need of reducing their own CO_2 emission quotas or to other buyers on an international emissions trading market. The suggested price for these credit certificates already approaches about ten percent of the total hydro plant investment.

As electrical partner in the project consortium, ABB is taking a leading role in this entrepreneurial venture, which could serve as a model to the rest of the world as one of the first applications of the new Clean Development Mechanism covered by the Kyoto Protocol.

The same consortium has already pioneered a 'dry-run' of such a CDM project. Some kilometers upstream of the new plant, Consorcio Noruego has already completed construction of another hydro plant with a capacity of 30 MW. The contract with the consortium was part of a climate improvement project between Norway and Costa Rica, where Norway's Foreign Office and the Consorcio Noruego supported a new forest plantation, or 'carbon sink', in the catchment area of the Virilla River with a grant of Norwegian Kroner 15 million. In return, Norway received CO_2 reduction certificates from Costa Rica equivalent to the amount of CO_2 that the forest would absorb or 'bind' from the atmosphere. Being a pilot project, the certificates have only a symbolic value. The real value comes from the experience in demonstrating how the Kyoto mechanisms can be applied, and in seeing how such a 'win-win' solution can benefit both partners—to the betterment of the local environment and of business.

We have given some space in this chapter to these Norwegian initiatives as they clearly demonstrate that a significant momentum is building up relating to the reduction of greenhouse gases, implying that a strong and justified sense of urgency prevails. This is not the time to sit and wait for international frameworks to come into being, but rather to initiate actions in the spirit of Kyoto. ABB, for its part, will certainly contribute in every possible respect to support further proactive initiatives along the lines we have described.

"An unusual and unique opportunity": the World Commission on Dams starts work

In ABB's Environmental Management Report for 1997, we devoted a chapter to the World Commission on Dams (WCD), which at the time was preparing for its launch early in 1998.

In this year's report we are presenting an outline of the WCD's current activities and aims. We have also included comments from the WCD's chairperson and four of its commissioners, which help to give insights into the broad spectrum of interest groups that the WCD has uniquely drawn together.

The WCD was established as a result of a workshop jointly organized by the World Bank and IUCN, the World Conservation Union, in April 1997. It is the most serious attempt yet to examine the social, environmental and economic consequences of large dams, and to arrive at a new consensus on the role of large dams in sustainable development.

In the words of its chairperson, Professor Kader Asmal, the WCD "provides an unusual and unique opportunity to address one of the most intensely debated issues in sustainable development today. The fact that both dam proponents and critics reached consensus on creating the commission, and have continued to work together, is a significant step forward and one that bodes well for the future."

The WCD has a budget of US$ 10 million (which has been partly secured) and will work for two years, producing an interim report in June 1999, and the final report by June 2000. Its headquarters are in Cape Town, South Africa, where a secretariat, including nine expert staff, has been established to support and drive the WCD's activities.

ABB fully supports the WCD. ABB's president and CEO, Göran Lindahl, is one of the WCD's twelve commissioners and represents the interests of the private sector.

The WCD had its first three meetings during 1998: in Washington, D.C., in May, in Cape Town, South Africa, in September, and in Colombo, Sri Lanka, in December. This last meeting was extended to accommodate several days of public consultations, where the WCD heard the views of various interest groups and people affected by large dams, particularly in Asia.

"Progress so far has been remarkable," comments Kader Asmal. "We have been set a tight time schedule, and we are determined to complete our work within that schedule. We have managed this because we have developed open lines of communication with and between commissioners. Our meetings have been businesslike and conducted with the aim of working together to get a good job done. Hopefully the process we follow will be a beacon for future commissions such as ours."

The WCD's next meeting will take place in Prague, the Czech Republic, in March 1999, where a meeting of the WCD Forum will also be held. The WCD Forum is a representative grouping, bringing together a wide variety of actors in the debate on dams and including the original participants in the World Bank/IUCN workshop.

What to do? Drafting the work program

Bringing together a very wide range of constituencies and sometimes entrenched viewpoints is never a recipe for smooth progress. For many of the participants, the experience of working together will be as important as the eventual result.

As commissioner Medha Patkar puts it, "I see the WCD not just as a dialogue, but a joint inquiry by several of the interest groups in the dams debate. In my experience, each of them develops a clearer understanding of their

own views, but also comes to understand others. Such a process can always help to resolve conflicts in an indirect, long-term manner. But it also facilitates a joint exploration, coming closer to the reality, and the just and reasonable solution."

At its first meeting in Washington, D.C., the WCD agreed to focus its work on three key objectives:

- To conduct a global review of the developmental effectiveness of large dams.
- To formulate a framework for assessing options and making decisions that promotes the sustainable management of water and energy resources.
- To propose a set of internationally acceptable criteria and guidelines for the planning, appraisal, design, construction, operation, monitoring and decommissioning of large dams.

The WCD's second meeting, in Cape Town, was devoted to drafting the detailed work program. Three main areas of activity were agreed: case studies, thematic reviews, and inputs from interested groups.

Case studies

"Building a competent and credible 'knowledge base' on the performance of a range of large dams is the most important task facing the WCD," says commissioner Don Blackmore. "Based on this experience, we can review and refine the guidelines and criteria for future investment. Without it, the work of the Commission will be hollow."

Depending on definitions, there are about 45,000 large dams in the world. Obviously this is a number far beyond the scope of the WCD to investigate. Instead, it will make detailed studies of at least ten river basins, concentrating on a focal dam within each basin to assess its performance and development effectiveness. Key issues in each of these case studies include how actual costs and benefits compared with those originally projected; what (if any) were the unintended costs and benefits; who gained and who lost as the overall result of the dam project; how well the project conformed with the criteria and guidelines of the day; how decisions were reached concerning the project; and whether the project would be built today.

As well as the detailed case studies, the WCD intends to compile a comparative database covering a larger sample of 150 or more dams. The results will be less detailed, but potentially more useful in terms of drawing general conclusions. The database will seek to provide quantitative data on the performance of dams, as well as more qualitative information on development effectiveness.

The final aspect of the case study work is to conduct up to three country-level reviews, looking at the national water and power strategies within which governments will have determined the role of large dams. These country-level studies will be undertaken as an enhancement to selected studies of river basins.

"River basins tend to be national heartlands; how they are developed will influence the environment and citizens for generations to come," says commissioner Thayer Scudder. "In the past, the adverse environmental, socio-economic and political impacts of far too many dam projects have been underestimated. On the other hand, because of failure to consider a wider range of development options, too many of the better dam projects have failed to realize what potential they had.

"I hope that our final report and influence will lead to consideration of a wider range of alternatives than dams for the development of river basins," he continues. "And

when dams are built, we will show the advantages of integrating them into an overall basin and interbasin strategy intended to achieve a wider range of benefits with lower costs."

Thematic reviews

Drawing on experience and lessons learned, the thematic reviews will provide baseline information, analysis and recommendations on six major areas of concern associated with large dams:

Future context: Describing the future strategic context in which lessons learned so far will be set; providing summary analyses of the major global trends expected to affect future water resources activities; and providing the setting for the work on criteria and guidelines for future actions.

Social issues: This review will deal with the central question, "Who benefits, and who pays?" Issues to be examined include social equity, rights to natural resources, the impacts of dam projects on affected people, displacement, resettlement, compensation/mitigation, and development schemes.

Environmental issues: This review will contribute to expanding the scope of environmental assessment and management of large dams. Issues to be examined include biodiversity conservation; the impact of modified hydrological regimes on ecosystems (especially estuarine and marine ecosystems) and on the ecological functions of rivers; and dams in the context of global warming and climate change.

Economic issues: Here, the WCD will focus on two aspects. First, it will look at how well past and present financial analyses determine the overall economic development rationale for dams, and how future options assessments can take account of intangible natural and cultural values. It will also examine the need for improved risk analysis and standardized discount rates between sectors. Second, it will examine the trends and options in private and public financing of large dams, and how these trends affect future decision-making frameworks, especially for hydropower.

Options assessment: This review will look at the range of options to achieve the objectives of large dam projects in the areas of hydropower, irrigation, flood management and water supply. In addition, it will investigate the alternatives of decommissioning and refurbishment when a large dam reaches the end of its useful life. This review should contribute to the design of true multipurpose projects in the context of river-basin management.

Institutional processes: This theme will look at the decision-making structures and processes required in order to assess development options and apply economic, social and environmental criteria effectively. It will examine issues such as how to identify the "most attractive" development options; how to manage river basins and allocate water rights; participatory planning processes for equitable decision making and conflict resolution; and governance structures that influence compliance and implementation capacity.

Powerformer—ABB's new high-voltage generator.

Inputs from interested groups

The WCD views it as essential that all interested groups and individuals—especially people affected by large dam projects—should have opportunities, both formal and informal, to give their input to the work program. The greater the involvement of interested groups, the greater the weight of the WCD's eventual findings within the international community. As commissioner Joji Carino states, "The success of the WCD will depend on the extent to which we can engage the range of stakeholders and enable diverse perspectives and voices to be heard in its report."

Carino herself comes from the central Cordillera region of the Philippines—the watershed of the main river systems in northern Luzon. "Dams have been a major development debacle in this region," she explains. "Ibaloi families who were displaced in the 1950s and '60s as a result of the Ambuklao and Binga dams on the Agno river are still today seeking justice for their involuntary displacement and lack of resettlement and development provisions. Until recently, many Ibaloi communities have been left without electric power, despite the fact that these dams are major electricity providers for the national grid.

"The negative experience of these communities spurred the Kalinga and Bontoc peoples to successfully oppose the building of four major dams along the Chico River in the 1970s and '80s, during the period of martial law under President Marcos," she continues. "The campaign against these dams was a significant strand in the development of environmental and human rights movements of that period, marking the emergence of a strong indigenous peoples' movement in the Philippines."

The WCD plans to hold consultations around the world, enabling different groups to participate in the process through submissions and debate. In addition, a valuable contribution is expected from the members of the WCD Forum, which will meet three times during the WCD's lifespan.

Further input from interested groups will come as a result of the WCD's work program, in particular the case study work. Independently submitted material will be welcomed and incorporated into the work program wherever possible, and the WCD's website will be used to make draft materials available and to gather ideas and comments on ongoing work.

Several of the WCD commissioners—including Joji Carino and Medha Patkar, who have contributed their thoughts to this article—are active campaigners on behalf of affected peoples. "We must reach out to different constituencies, especially those who rarely have a voice but have serious stakes in water-power policy," says Medha Patkar. "We need hydropower in a way that can not only attain wide social and economic benefits, but will also help the affected people. No one can be for hydropower without fulfilling basic needs such as food and drinking water. I don't think anyone can argue against this. So despite differences in approach between groups, an in-depth discussion on how to achieve this is always possible."

Communications

The final report of the WCD will not be binding, and will have no legal force. But it will, the commissioners hope, have moral authority. "The report will be more useful if the various interest groups are in continuous dialogue with commitment to the cause," says Medha Patkar. "It's up to us to make this a high-quality, usable document. And beyond that, the WCD must facilitate dissemination and discussion of the report."

Itaipu hydropower plant, Brazil/Paraguay.

The WCD's secretariat includes professional communications staff. Its brief is to maximize the WCD's visibility, and so encourage external submissions and expand dialogue around the world; and to build confidence in the WCD's work among all interested parties, so as to make the results of its work as credible, legitimate and widely accepted as possible.

To facilitate communications, a large, global mailing list has been assembled covering all target audiences. A global network of media contacts is being established. Press releases, briefing notes, articles, regular newsletters and promotional publications—as well as an extensive website—are being used to highlight the WCD's work, and to provide information on key issues and facts related to dams.

Professor Asmal and the other commissioners interviewed for this article were uniformly enthusiastic about the WCD's progress so far, though mindful of the magnitude of the work still to be done. In the words of Don Blackmore: "We have accomplished much to date. All commissioners are making a significant contribution and there is clearly unity in the approach being taken. I would rate progress as fantastic given the start-up time and the size of the task."

WCD commissioners

Important input to this article came from the World Commission on Dams' chairperson and four of its commissioners, who were kind enough to share with us their personal insights and hopes for the ultimate effects and influence of the WCD's work. Their own words have been used to illustrate and amplify key aspects of this article, and we would like to sincerely thank them for their time and effort in responding to our questions and giving substance to this important issue.

Professor Kader Asmal is chairperson of the WCD and Minister of Water Affairs and Forestry in South Africa. He has a distinguished record in water resources management as well as human rights. As a prominent member of President Nelson Mandela's cabinet, Professor Asmal led a fundamental review and reform of South Africa's water management policy. In 1983 he received the Prix UNESCO award for the advancement of human rights, and in 1996 he was awarded the Gold Medal for conservation from the World Wide Fund for Nature—South Africa. He is also a patron of the Global Water Partnership.

"Though I am a minister responsible for water, I do not represent any organization or particular interest or lobby, including the broad category of government," he says. "I expect to learn a great deal from the work and studies we undertake. While our concentration will be on the end product, the process of getting there through multistakeholder participation is a unique form of canvassing opinions at an international level."

Donald J. Blackmore is chief executive of the Murray-Darling Basin Commission in Canberra, Australia. He has brought the principles of environmentally sustainable water management to a major river basin, which was initially focused on hydroelectric power generation. He is currently also serving as a member of the International Advisory Panel for the Aral Sea.

"The WCD provides an opportunity to produce a well researched, reasoned and comprehensive report that should make a significant contribution. It is on this basis that I accepted an appointment on the Commission," he says. "Success will be determined by whether the dam building and investment community pick up on our findings. We will have to look two or three years beyond the

Thayer Scudder (right), WCD commissioner, on a Mekong tributary.

The World Commission on Dams

completion of our work to determine whether we have succeeded."

Joji Carino is executive secretary of the International Alliance of Indigenous Tribal Peoples of the Tropical Forest. Her work began as an activist and analyst of indigenous peoples in her native Philippines and has effectively extended into the field of global forums. She is now serving as a member of the Executive Committee of Survival International for Tribal Peoples.

"My personal and professional life connects with promoting understanding and respect for the rights of indigenous peoples in all parts of the world, and in all areas of human endeavor—not least in renewing human relationships with nature," she says. "The WCD must be alert to the pitfalls of becoming a technocratic research operation, rather than an informed political process. Aiming for consensus-building rather than consensus is realistic, and if the process proves to be productive, then a useful report will be the result."

Mehda Patkar is a social scientist and founder of the Narmada Bachao Andolan (Struggle to Save the Narmada River) in India, an affected people's organization campaigning against the construction of dams on the Narmada River. She is also a founding member, and currently national coordinator, of the National Alliance of People's Movements. She is internationally recognized as a campaigner for human and political rights.

"My invitation to serve on the WCD came with the endorsement of a large number of nongovernmental organizations, people's organizations and movements, including the Save Narmada movement," she says. "It was a result of a long process involving struggle and dialogue, and my serving on the WCD thus involves a role and responsibility to represent their views in the joint inquiry. I see the main role of the WCD as to bring out the truth about dams and the water policy revolving around them while comparing them with various alternatives."

Thayer Scudder is Professor of Anthropology at the California Institute of Technology. His work on the social issues associated with river basin development has been definitive in its field. His work in Africa is best known, but he has undertaken studies of sustainable resource use in all parts of the world, with a focus on resettlement and social issues related to infrastructure development.

"I suppose I take what I would define as a middle-of-the-road approach to hydropower," he says, "though one which advocates of hydropower might see as left of center. My inclusion on the Commission is based primarily on my 42 years of research on the impact of large dams on project-affected people, and on their responses to these impacts. I do not represent any specific group as such. Rather, I have a number of colleagues belonging to a wide range of constituencies with whom I discuss various issues."

Environmental management program

Introduction and general status

In ABB's Environmental Management Report 1997, we introduced performance indicators proposed in the draft international standard ISO 14031 to report our environmental performance.

We have used Management Performance Indicators (MPIs) to monitor progress in meeting ABB's corporate environmental objectives and Operational Performance Indicators (OPIs) to report on specific environmental performance.

The experience we have gained encourages us to expand the use of these indicators and also to gradually use them for our products and other activities.

This chapter describes our progress based on the use of two MPIs and 26 OPIs.

The MPIs are the same as last year:

- implementation of ISO 14001 in manufacturing sites and service workshops
- the related costs

Environmental performance evaluation

The ISO 14031 draft standard includes three types of indicators:

Management performance indicators (MPIs), which provide information about management efforts to influence an organization's environmental performance.

Operational performance indicators (OPIs), which provide information about the organization's environmental performance.

Environmental condition indicators (ECIs), which provide information about the condition of the environment. This can help an organization understand the actual or potential impact of its activities.

The 26 OPIs cover specific environmental aspects for our manufacturing processes and service activities both on the input and output sides.

These OPIs are selected by the criteria specified in ISO 14001: environmental significance and views of interested parties, such as environmental protection agencies.

Activities during 1998 focused on meeting the Group's corporate objectives:

- implementation of ISO 14001
- integration of environmental management into the strategic plans of the business areas

Thanks to the dedicated efforts from ABB's CECs, LECOs and the strong support from country and site management, the implementation of ISO 14001 made substantial progress during 1998 and improved ABB's environmental performance.

We did not quite reach Goal 98, that is, to implement ISO 14001 at all our manufacturing sites and service workshops. But ISO is now implemented in 449 sites, which fulfills 84 percent of Goal 98, and I think we can be proud of our accomplishment. Besides, the sites that did not make it in 1998 will succeed in 1999.

Preparations started during 1998 to find a practical way of formally integrating environmental management into the strategies of the business areas, thereby taking the next step to include ABB's products in the Group's environmental management program.

The task is both easy and difficult; easy because environmental aspects have already been integrated for a long time, difficult because most aspects are related to the use and operation of our products by our customers.

The main chapter of this report deals with our ideas and efforts in this direction.

The environmental aspects of our suppliers are part of the environmental management program. A register containing information about the environmental certification and qualification status of corporate-wide suppliers has been added to ABB's Supply Management database. At the end of 1998, about 150 suppliers were included.

Suppliers' environmental performance is a significant environmental aspect in the ISO 14001 planning process. Direct assessment of suppliers' environmental standards is therefore part of ISO 14001 implementation.

To increase the awareness of ABB's corporate environmental strategies, the President's message in the 1997 Environmental Management Report was translated into 23 languages and 200,000 copies were distributed throughout ABB.

The environmental program is published on the Web, and progress is reported regularly. The website also includes the latest environmental news from the ABB Group and information about environmental speeches by ABB's CEO and Executive Committee members.

Measuring and reporting environmental performance is a challenge that attracts many organizations and experts, some of whom also have the ambition to integrate the other two elements of sustainable development—economic performance and social performance.

ABB, too, has the ambition to move in this direction. This is reflected in the assessment by DNV of ABB's compliance with the ICC Business Charter for Sustainable Development, first published in our 1997 report and updated in this year's report.

I believe that consistent development and bottom-up use of performance indicators, combined with top-down assessment based on the principles of the ICC Business Charter, will gradually lead us forward on the challenging road toward the vision of sustainable development.

Jan Strömblad
Senior Vice President, Environmental Affairs

The first seven years

1992
- ABB signs the ICC Charter and forms its Environmental Advisory Board.
- The decision is made to start a formal environmental management program, and establish a corporate staff for environmental affairs (CS-EA).
- First life cycle assessment (LCA) work is begun to quantify the total environmental impact of products and systems throughout their lifetime and beyond.

1993
- ABB's international environmental affairs organization with Country Environmental Controllers (CECs) and Local Environmental Control Officers (LECOs) is established.
- ABB companies in 38 countries are selected to participate in the environmental program.
- Initial environmental reviews are begun at most ABB manufacturing sites to establish an environmental baseline.
- The first corporate procedure for reporting on environmental performance at manufacturing and service facilities is introduced (approximately 400 sites are included).

1994
- Initial reviews at most manufacturing sites are completed.
- The decision is made to implement environmental management systems (EMSs), as specified in the draft ISO 14001 standard, at all manufacturing and service facilities.
- ABB publishes its first environmental report.
- The ABB environmental program is expanded to include 43 countries (650 sites are included).
- Major site remediation projects are completed (Sweden and Germany) and started up (Finland and Switzerland).

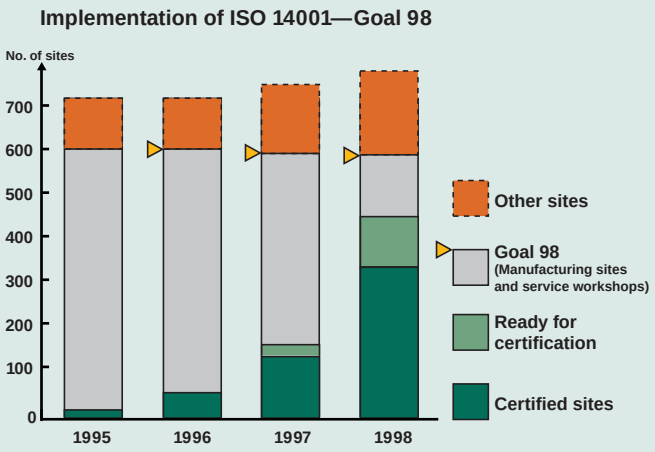
1995
- Fifteen ABB sites complete implementation of EMSs, and the first sites certified to BS 7750 and/or EMAS are registered.
- The first international Environmental Affairs workshop is organized.
- The first set of corporate environmental objectives is published.
- The first "train-the-trainers" seminar for internal EMS trainers is conducted, and ABB starts to conduct internal EMS seminars.
- The ABB CS-EA internal environmental communication database is established.
- The first design tool for LCA studies of products is launched.

1996
- A target date of 1998 is set for EMS implementation at all manufacturing and service facilities (Goal 98).
- ISO 14001 is published, and full-scale implementation begins. By the end of 1996, 50 ABB sites have been certified to ISO 14001 or its predecessor, BS 7570.
- Three more substances are monitored and included in corporate consolidated figures.
- The first ABB-specific guidelines for ISO 14001 implementation are published.
- EMS training seminars are conducted in 12 countries.
- The first ABB construction site (South Humber Bank power station in England) is certified to ISO 14001.
- The first ABB site in China, ABB Switchgear in Xiamen, is certified to ISO 14001.

1997
- Implementation of ISO 14001 proceeds. By year-end, 123 sites in 20 countries are certified, including one in India, two more in China and one in Indonesia.
- A second-generation life cycle assessment strategy is developed. ISO 14001 implementation seminars are held in seven more countries.
- The first external certification of an ABB environmental lead auditor is achieved.
- Eight more operational performance indicators are included in corporate consolidated figures.
- A second generation of environmental objectives is introduced by ABB's CEO (Goal 2000).

1998
- ISO 14001 is implemented in 449 sites in 32 countries. This achievement fulfils 84% of Goal 98.
- Sixty ABB employees graduate as internal environmental auditors, strengthening ABB's internal implementation procedure.
- Eight more operational performance indicators are included in the program.
- The concept of Environmental Declarations is introduced into the business areas to facilitate the integration of environmental management into the products and activities of the business areas.
- The second generation of LCA software tool and database is introduced and implementation begins in several business areas.
- The President's message in the 1997 report along with a synopsis of the complete report, is translated into 23 languages and 200,000 copies distributed throughout ABB.
- The 1997 report is published on ABB's website together with regularly updated environmental news.
- A new database is established for registering environmental improvement projects within ABB worldwide.

Management performance indicators



The corporate directive to implement ISO 14001 throughout ABB was issued in April 1996. This cut the original time schedule by two years. Then, about 600 manufacturing sites in 44 countries were included. Now, restructuring, closures and divestments have reduced the number to 583.

At the end of 1998, 449 sites had implemented ISO 14001. 330 of these had been certified by external bodies, and the remaining 119 were ready for certification.

Forty-nine of the 134 facilities that did not meet Goal 98 will undergo major reorganization in 1999. They have been excluded from the 1998 figure and moved to 1999. The actual basis for Goal 98 is therefore 534 facilities. 449 of these, or 84 percent, met the goal while 85 sites, or 16 percent, were delayed.

Some 40 of the delayed sites are in emerging markets and in Central and Eastern Europe. Many of these countries are now in severe recession. Implementation still continues, and several sites will be ready during the first quarter of 1999. However, some sites in the hardest hit countries may not be ready even at the end of the year.

Environmental costs

Estimated costs (US$ millions)	1995	1996	1997	1998
ABB Environmental Affairs network, 600 people	30	33	35	36
Implementation of ISO 14001	6	15	29	43
Development of life cycle assessment	1	1	1	1.5
Total	37	49	65	80.5

As in previous years, ABB accounts separately only for costs relating to its Environmental Affairs organization, to ISO 14001 implementation, and to the development of life cycle assessment tools and databases.

This is because it is often difficult or impossible to separate environmental costs from other costs. For example, investments to boost productivity can seldom be distinguished from investments to improve environmental performance. Nor is it possible to determine if R&D investments are driven by the need to improve business performance, environmental performance, or both.

ISO 14001 implementation

Country	No. of sites	CEC	Phone
AR	2	Justo Gonzales-Litardo	54-114229 5590
AT	1	Erwin Wippel	43-1601 09 2361
AU/NZ	16	Peter Kinsey	61- 2 9356 0999
BE	3	Joseph Billet	32-2 718 6599
BR	4	Sérgio dos Santos	55-11 7088 9392
CA	6	Randy Plener	1-905 803 7019
CH	43	Jakob Weber	41-56 205 7133
CN	8	Jean-Jie Gao	86-10 6595 6688
CO	0	Albert Tibavizco	57-1 415 6566
CZ	2	Frantisek Dobes	420-2 2283 2245
DE	36	Chris Huf	49-6221 59 7200
		Helmut Sogl (deputy)	49-6221 597212
		Udo Weis (deputy)	49-6221 597214
DK	15	Henning Flugt	45-66 14 7080
EE	0	Bo Henriksson	372-6 711 801
EG	2	Hassan Shaarawi	20-2 29 88 155
ES	9	Roberto Sellés	34-93 681 0402
FI	25	Sakari Hakkarainen	358-1022 41597
FR	6	Jean-Luc Raphet	33-14197 4418
		Valérie Rimonteil (deputy)	33-13028 6008
GB	33	Marc Slater	44-1 332 20 4205
HU	1	István Horváth	36-1 339 9399
ID	1	vacant	—
IE	4	Tom O'Reilly	353-429 38 5181
IN	4	Satinder K. Maira	91-33 470 1811
IT	17	Guido di Renzo	39-02 26 23 2059
JP	3	Takao Yamaguchi	81-78 303 5090
KR	0	Heung-Soo Lee	82-417 529 2111
LV	0	Kjell Andresen	371-724 9087
MX	0	Rodolfo Montelongo	52-5 328 1400
MY	0	Max Wong	60-3 451 0669
NL	7	Joost Kuijpers	31-10 407 8556
NO	31	Sven Lie	47-66 84 3430
		Ivar Bjorseth (from 1/1-99)	47-22 87 4119
PE	0	Cesar Fernandez	51-1 561 0404
PH	0	Augusto Quitco	63-2 823 2366
PL	12	Piotr Ciechanowski	48-12 411 1199
PT	2	Carpinteiro Albino	351-1 416 8419
RO	1	Andrei Guran	40-1322 0600
RU	0	Viatcheslav Grichtchenko	7-812 326 9200
SA	1	Lars Olsson	966-1 476 2644
SE	82	Marja Widell	46-21 32 3081
		Gunnel Wisén (deputy)	08-658 8065
SG	2	Boon Eng Ong	65-776 5711
TH	1	Sinhaseni Charnwit	66-2 324 0505
TR	0	Refik Can Erkök	90-216 387 3750
US	69	Dave Onuscheck	1-919 856 23 68
VE	0	Mario Martinez	58-2 203 1819
ZA	0	Clive Govender	27-11 883 8300
Total	449 sites		

Operational performance indicators—inputs

Energy used

GWh used	Electricity	District heating	Oil**	Coal*	Gas	Total	MWh per empl***	Comments
ABB Total	1,680	445	323	212	1,386	4,045	27	For the second time, we report the amounts of energy used by our sites. The amounts are specified for primary energy fuel, electricity and district heating. The reporting form has been changed, compared with 1997. A comparison is therefore not meaningful.
Europe	1,243	441	300	199	720	2,902	26	
Americas	330	1	5	2	650	987	49	
Asia Pacific, Africa and Middle East	107	3	18	11	17	156	8	

* 38 kilotons **32 kilotons ***employed on the sites

Materials and chemicals (metric tons)

Substance	ABB major application	1996	1997	1998	Comments
PVC	• Insulation of cables • Housings for breakers	12,900	16,280	11,769	Introduced a new halogen-free cable design
Phthalates	• Softener for PVC	n. acc.	4,600	4,893	More accurate reporting in 1998
PBB and PBDE	• Flame retardants in PVC and other plastics	92	75	82	Change in product mix
SF_6	• Insulation gas in breakers	440	450	353	Increased production of SF_6-free breakers
Insecticides	• Control of insects	27	12	0	
Fungicides	• Control of water fungi	n. acc.	0.4	0.5	Used in closed loop systems
CFC class I	• Service of customer plants/products	27	12	0	Use eliminated according to plan
CFC class II	• Service of customers plants/products	222	74	65	Handling only—to well-defined procedures
Lead	• Protection shield in cables (mostly sea-water cable) • Counter weight in robots • Stabilizer in PVC compound	n. acc.	n. acc.	4,139	New lead-free PVC cables introduced. Lead-stabilized PVC will gradually be phased out.
Cadmium	• Used in rechargeable batteries	n. acc.	n. acc.	0.8	New generation of cadmium-free batteries will be used when available.
Nonylphenoletoxylate	• Used as degreasing agent	n. acc.	n. acc.	2	
Chloroparaffine	• Used as additives in PVC and in cutting-oil	n. acc.	n. acc.	3	To be significantly reduced in 1999

In use

Equipment	1996	1997	1998
No. of transformers with PCB oil	109	103	78
No. of capacitors with PCB oil	45,560	19,314	5,416

The quantity of oil in transformers and capacitors still in use was 124 tons in 1998. The program to completely replace these transformers and capacitors will continue.

Mercury (kg)			10

A few sites use mercury in seam-welding machines and pressure gauges. At these sites, the use is carefully managed as a significant aspect of the ISO 14001 program. In addition, local environmental agencies monitor the use.

Operational performance indicators—outputs

CO_2 emissions

	CO_2 kton	CO_2 ton per empl**	Comments
ABB total	1,689	11	The emission of CO_2 is calculated from the use of electricity and prime energy. We have used official conversion factors where available to calculate the CO_2 related to use of electricity and district heating. For the coal, gas and oil consumed we have used average qualities to calculate the CO_2 emission.
Europe	856	8	
Americas	355	18	
Asia Pacific	234	13	
Africa & Middle East			

**employed on the sites

Waste and emissions other than CO_2 (metric tons)

Substance	1993	1994	1995	1996	1997	1998	Comments
Hazardous waste, solid	17,500	15,800	9,980	10,100	9,850	8,820	The amounts of hazardous waste reported follow the national definitions. They vary somewhat between countries. Some countries have no infrastructure for handling hazardous waste. ABB must store waste on some sites while waiting for possibilities for disposal or destruction.
Hazardous waste, liquid	6,100	14,850	7,200	5,100	7,334	7,044	
VOC emission	2,280	1,990	1,821	1,863	1,817	1,623	Increased use of water-borne paint systems has reduced emission.
VOCcl	560	295	187	152	179	197	Three sites account for 50 percent of the amount (one in southern Europe and two in Asia). Replacement of the VOCcl process in the European plant using 50 tons is delayed from 1998 to 1999. Efforts are being intensified to reduce the use of VOCcl in all countries.

Recycled and in storage for future disposal (metric tons)

Recycling	1993	1994	1995	1996	1997	1998
Solid waste	31,000	33,000	97,000	120,000	123,300	195,198
Liquid waste	1,800	2,600	2,650	6,800	4,200	4,437
Energy (Oil)	n. acc.	n. acc.	n. acc.	n. acc.	n. acc.	51,432

The increase is a result of the implementation of ISO 14001. In particular the recycling of cable cut-offs and other metal scrap has increased.

Temporary storage of PCB	110	110	220	78	58	32

The storage of PCB in ABB facilities is subject to strict control both by environmental agencies and the site-specific environmental management programs.

Outlook for 1999

Activities will proceed in the same main direction as in 1998, covering sites, products and suppliers. We will continue to improve open reporting and communication.

Sites The implementation of ISO 14001 will continue. The scope will include those sites that did not make it in 1998 and approximately 150 additional sites, such as R&D and engineering centers, installation offices and catering units. Most of these existed in 1996 but were not included in the scope for Goal 98, which focused on manufacturing and service units.

Some additional countries and new acquisitions will join the program during 1999. This includes facilities belonging to the recently acquired Elsag-Bailey company.

In addition, we will increase the compatible use of the ISO 14001 and ISO 9001 management systems.

New ISO 9001—increased compatibility

ABB is actively involved in the effort within ISO to increase the compatibility between the ISO 9001 quality management standard and the ISO 14001 environmental management standard.

The aim is to help organizations to implement elements of these two standards in a shared manner and to avoid unnecessary duplication by using common definitions and texts wherever possible in both sets of standards.

This will reduce the cost for implementation, certification and maintenance of the two systems.

The first step will be taken by ISO Technical Committee 176 in the next revision of the standard for quality management, which is due to replace the existing ISO 9001 by the year 2000. It is then expected that ISO 14001 will be reviewed to take account of the text and definitions contained within the revised ISO 9001 (year 2000 version).

Products The focus will be on developing Environmental Declarations for ABB's business areas. This involves two challenges. One is to assess realistically the conditions under which the products will operate. The other is to evaluate the existing options for improving environmental performance and to set the right priorities.

To meet these challenges, we must combine our business areas' vast funds of experience of the way customers operate their products with life cycle assessments of these products' environmental impact. The second generation of ABB's life cycle assessment tool with its expanded database, combined with training for research, development and design engineers, will support these efforts.

Main elements of ABB's new life cycle assessment strategy

In September 1998, ABB released EcoLab, a second-generation life cycle assessment tool that will improve our ability to study our products' environmental impact. EcoLab features:

- Powerful software with an easy-to-use graphical interface
- A relational database containing almost 600 inventory items
- A flexible report generator
- Runs on a standalone PC or over a network with several simultaneous users

An interactive training course in life cycle assessment by means of the EcoLab tool has been developed. It uses actual cases involving ABB products.

To expand the database, ABB supports the Center for Environmental Assessment of Product and Material Systems (CPM) at Chalmers University of Technology in Gothenburg, Sweden. An important activity at CPM, besides methods development, is establishing a public database for life cycle assessment studies containing verified and credible data.

Suppliers Efforts to include more suppliers in our program will continue, both on business area and business unit levels. Our target is to include about 3,000 suppliers in the Supply Management database.

Openness and reporting Our efforts to reach out internally and externally and inform about ABB's environmental performance will continue. We feel that the hard work to reduce the environmental impact of our manufacturing processes, our products and those of our suppliers deserves to be better known, both among our employees and by our external audiences.

Our ambition is gradually to identify and use management performance indicators and operational performance indicators for the business areas, the products, for Supply Management and also for reporting and communication where feasible.

Three years of ISO 14001 experience: improved performance, lower costs and reduced risks

- The implementation of ISO 14001 generates between five and ten improvement programs for each site. This totals around 3,400 programs in the 449 sites that currently have ISO 14001 in place.
- These programs cover, directly and indirectly, the significant environmental aspects identified at the sites, for example, resource depletion, emissions, legal requirements and the views of interested parties.
- Many programs result in cost reductions and quick payback periods.
- About one-third of the programs are related to education and training, risk management, and other activities that indirectly improve environmental performance.
- ISO 14001 also reduces the sites' risk exposure, for example from leakage, fire or explosion.
- By involving the employees, ISO 14001 reinforces values such as motivation and pride and also helps enhance the company's image.
- Over time, as interested parties gain a better understanding of the specific, structured way ISO 14001 helps improve environmental performance, openness will increase and reporting will become easier.
- ISO 14001 implementation produces a better understanding of improvement programs and how they reduce internationally recognized environmental threats.

Environmental threats

1 **Greenhouse gases**
2 **Depletion of the ozone layer**
3 **Acidification of water and soil**
4 **Photochemical oxidants and ground-level ozone**
5 **Urban air pollution and noise**
6 **Eutrophication of water and nitrogen saturation of soil**
7 **Effects of metals**
8 **Effect of persistent organic pollutants**
9 **Introduction and spread of alien organisms**
10 **Inappropriate use of land and water resources**
11 **Exploitation of land and water for housing, industry and infrastructure**
12 **Pressure on areas of special conservation interest**
13 **Non-cyclic material flows and environmental hazardous residues**

Environmental Affairs organization

Environmental Advisory Board (EAB). A panel of independent experts, chaired by ABB's CEO, who act as a sounding board for ABB, bring their expertise to ABB's environmental management program, and offer objective opinions. The experts are David Buzzelli, José Goldemberg, Martin Holdgate, Ken McCready, Ingar Palmlund, Ulrich Steger and Björn Stigson. The secretary of the EAB also heads ABB's CS-EA, ensuring that the EAB's recommendations pervade the environmental management organization.

Corporate Staff Environmental Affairs (CS-EA). Reporting directly to the president and CEO of ABB, CS-EA is responsible for developing, communicating, implementing, monitoring and improving the environmental management program. It also develops and conducts training programs to increase environmental awareness and proficiency.

Country Environmental Controllers (CECs). Forty-three CECs, reporting to their country managers and to CS-EA, are responsible for establishing and communicating ABB's environmental policies, programs and procedures to all facilities within their countries. They also commission independent environmental audits and prepare environmental performance reports.

Other responsibilities include promoting new, ecoefficient technologies and developing country-specific education and training programs. CECs also work with LECOs to coordinate with local authorities.

Local Environmental Control Officers (LECOs). There are approximately 550 LECOs at ABB manufacturing, service and construction sites. LECOs report to local site managers and the relevant CEC.

LECOs facilitate the implementation and maintenance of environmental procedures, including local environmental manuals. They initiate plans for continuous improvement, ensure that plans are implemented, and follow up recommendations from environmental audits.

Statement by Det Norske Veritas 1998

Assessment against the ICC principles is a top-down procedure looking at corporate priorities and initiatives.

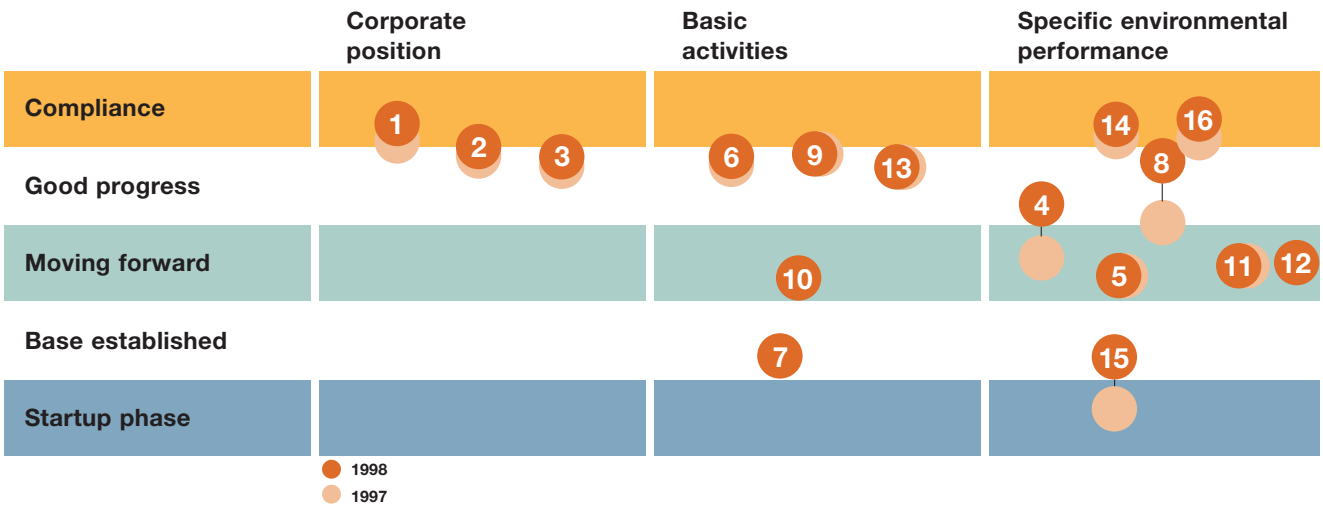
Our assessment of ABB includes both quantitative assessment and verification of how well environmental management policies and programs are implemented throughout the Group and a qualitative assessment of the Group's activities and efforts.

The assessment is based both on random checking and interviews with key persons worldwide, at corporate and site level, and on documents made available to us by ABB. In addition, our knowledge of best practice regarding environmental management serves as a reference point.

We have assessed ABB's environmental performance in 1998 against the Group's policies and objectives on the corporate level and at many business areas, as well as through our own site visits.

We have grouped the 16 principles into three categories: principles regarding corporate position, basic activities, and specific environmental performance. Scores for each are compared with last year's performance.

ICC principles	Findings and conclusions
(1) **Corporate priority**	Management commitment is shown through strong support of the environmental management program and its implementation. CEO is holding steady last year's focus on environmental issues. ABB's environmental policy is well disseminated throughout the business areas (BAs) and business units (BUs). A process towards establishing long-term goals for sustainable development has started. ***Conclusion:*** **Compliance; improvement over 1997**
(2) **Integrated management**	Environmental issues are being incorporated into the management structure and business plans of the BAs and BUs. Many of the programs and targets at BA level directly or indirectly include environmental targets, such as efficiency, lower emissions and material use. Four Environmental Declarations were drafted at BA level in 1998. At the end of 1998, 449 manufacturing and service sites have ISO 14001 already implemented. ***Conclusion:*** **Good progress; improvement over 1997**
(3) **Process of improvement**	There are many signs of progress within ABB. Corporate environmental performance indicators were increased from 20 to 28 in 1998, and a large number of improvement projects have been identified during the year. It will, however, take some time before the implementation of ISO 14001 fully shows improvements in performance at all sites. Consolidated data for the Group shows improvement for several indicators, such as CFC, PCB, VOC and SF_6. ***Conclusion:*** **Good progress; improvement over 1997**
(4) **Employee education**	Basic awareness training is in accordance with the implementation of ISO 14001, and covers almost 80 percent of all employees at the sites where ISO 14001 is in place. In addition, more specialized training, for example, life cycle assessment and internal environmental auditing, were also given in 1998. ***Conclusion:*** **Good progress; improvement over 1997**
(5) **Prior assessment**	Environmental assessment is often a part of ABB's procedures for acquisitions and divestments of companies and real estate. We were given examples of comprehensive environmental due diligence performed in 1998. Both external experts and ABB's corporate environmental staff are being used for such investigations. ***Conclusion:*** **Moving forward; same level as in 1997**
(6) **Products and services**	ABB has started a process to incorporate LCA techniques as a standard tool in all product development processes. We were given examples of product development projects where LCA was used and of the efforts to spread the technique throughout the Group. In addition, four Environmental Declarations related to products were drafted during 1998. ***Conclusion:*** **Good progress; improvement over 1997**
(7) **Customer advice**	There is a variation in the level and depth of the advice to customers depending on the particular products and services. We have seen examples of progress toward long term partnership and dialogues with key customers. ***Conclusion:*** **Base established (not assessed in 1997)**
(8) **Facilities and operations**	ABB has organized a strong network for implementation of ISO 14001. At the end of 1998, implementation of ISO 14001 was achieved in 449 sites, of which 330 were certified and 119 ready for certification. This is significant progress compared to 1997. ***Conclusion:*** **Good progress; significant improvement over 1997**
(9) **Research**	In 1998, about 55 percent of ABB's long term research program was allocated to projects that directly address environmental issues or where environmental issues are one of the main drivers. All of ABB's R&D laboratories plan to be ISO 14001 certified during 1999. ***Conclusion:*** **Compliance; same level as in 1997**
(10) **Precautionary approach**	Right through the broad scope of ABB's activities there are extensive efforts to improve environmental performance. A structured program to phase out the greenhouse gas SF_6 is one example. ***Conclusion:*** **Moving forward (not assessed in 1997)**



ICC principles	Findings and conclusions
(11) **Contractors and suppliers**	ABB has shown some progress in imposing environmental requirements on contractors and suppliers. For example, some BAs have established supplier dialogues and partnerships with key suppliers. However, it has been difficult to see clear evidence of further progress compared to 1997. ***Conclusion*: Moving forward; same level as in 1997**
(12) **Emergency preparedness**	Emergency preparedness is mainly dealt with at the local level as part of the Health and Safety and Risk Management programs. It is also partly included in ISO 14001. ***Conclusion:* Moving forward (not assessed in 1997)**
(13) **Transfer of technology**	ABB is actively transferring technology within the company. It includes employee training, benchmarking activities and sometimes includes outside suppliers. However, we have not been able to see clear evidence of further progress compared to 1997. ***Conclusion:* Good progress; same level as in 1997**
(14) **Contributing to the common effort**	ABB shows continuous effort at a high level, including active participation in COP meetings, WBCSD, WCD, ISO and other international organizations. In 1998 ABB hosted the IEA conference on Greenhouse Gas Control Technologies and strongly supported the Alliance of Global Sustainability. ***Conclusion:* Compliance; improvement over 1997**
(15) **Openness to concerns**	We have seen examples of new efforts towards openness on both the central and local levels. Internet pages on environmental news have been established. Corporate Environmental Affairs works closely with ABB's worldwide communication managers. ABB has established a platform for environmental messages. An environmental report summary was distributed in 200,000 copies and 23 languages to ABB employees and to external readers. ***Conclusion:* Base established; improvement over 1997**
(16) **Compliance and reporting**	The requirements regarding the compliance part are to a large extent covered by ISO 14001. Considering the 28 environmental performance indicators reported at Group level, the ABB website and regular reporting to the ABB Environmental Advisory Board, we find improved compliance. ***Conclusion:* Compliance; improvement over 1997**

Oslo, 1 February 1999

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The ABB policy for environmental protection

Environmental protection is among ABB's top corporate priorities. We address environmental issues in all of our operations and public policies.

ABB is a signatory to the ICC Business Charter for Sustainable Development and is working toward fulfilling its requirements. Our environmental policy is based directly on the principles of the ICC Charter, reproduced below.

ICC principles

1. Corporate priority
To recognize environmental management as among the highest corporate priorities and as a key determinant to sustainable development; to establish policies, programs and practices for conducting operations in an environmentally sound manner.

2. Integrated management
To integrate these policies, programs and practices fully into each business as an essential element of management in all its functions.

3. Process of improvement
To continue to improve corporate policies, programs and environmental performance, taking into account technical developments, scientific understanding, consumer needs and community expectations, with legal regulations as a starting point; and to apply the same environmental criteria internationally.

4. Employee education
To educate train and motivate employees to conduct their activities in an environmentally responsible manner.

5. Prior assessment
To assess environmental impacts before starting a new activity or project and before decommissioning a facility or leaving a site.

6. Products and services
To develop and provide products or services that have no undue environmental impact and are safe in their intended use, that are efficient in their consumption of energy and natural resources, and that can be recycled, reused or disposed of safely.

7. Customer advice
To advise and, where relevant, to educate customers, distributors and the public in the safe use, transportation, storage and disposal of products provided; and to apply similar considerations to the provision of services.

8. Facilities and operations
To develop, design and operate facilities and conduct activities taking into consideration the efficient use of renewable resources, the minimization of adverse environmental impact and waste generation and the safe and responsible disposal of residual wastes.

9. Research
To conduct or support research on the environmental impacts of raw materials, products, processes, emissions and wastes associated with the enterprise and on the means of minimizing such adverse impacts.

10. Precautionary approach
To modify the manufacture, marketing or use of products or services or the conduct of activities, consistent with scientific and technical understanding, to prevent serious or irreversible environmental degradation.

11. Contractors and suppliers
To promote the adoption of these principles by contractors acting on behalf of the enterprise, encouraging and, where appropriate, requiring improvements in their practices to make them consistent with those of the enterprise; and to encourage the wider adoption of these principles by suppliers.

12. Emergency preparedness
To develop and maintain, where significant hazards exist, emergency preparedness plans in conjunction with the emergency services, relevant authorities and the local community, recognizing potential transboundary impacts.

13. Transfer of technology
To contribute to the transfer of environmentally sound technology and management methods throughout the industrial and public sectors.

14. Contributing to the common effort
To contribute to the development of public policy and to business, governmental and intergovernmental programs and educational initiatives that will enhance environmental awareness and protection.

15. Openness to concerns
To foster openness and dialogue with employees and the public, anticipating and responding to their concerns about the potential hazards and impacts of operations, products, wastes or services, including those of transboundary or global significance.

16. Compliance and reporting
To measure environmental performance; to conduct regular environmental audits and assessments of compliance with company requirements, legal requirements and these principles; and periodically to provide appropriate information to the Board of Directors, shareholders, employees, the authorities and the public.

Glossary

Acidification. Chemical alteration of the environment, resulting in hydrogen ions being produced more rapidly than they are dispersed or neutralized. Occurs mainly through fallout of sulfur and nitrogen compounds from combustion processes. Acidification can be harmful to terrestrial and aquatic life.

Agenda 21. A world action plan for sustainable development, adopted in 1992 by 178 national governments at the United Nations Conference on Environment and Development, in Rio de Janeiro, Brazil.

Air pollution. Accumulation in the atmosphere of substances that, in sufficient concentration, endanger human health or produce other measurable effects on living matter and other materials. Major types of pollutants are carbon dioxide, carbon monoxide, hydrocarbons, nitrogen oxides, particulates, sulfur dioxide and photochemical oxidants, including ozone.

Alliance for Global Sustainability, AGS. A partnership involving the Massachusetts Institute of Technology (MIT), the Swiss Federal Institutes of Technology (ETH) and the University of Tokyo (UT). The alliance was formed in 1994 to work on integrated aspects of environment and sustainability problems through research, education and global outreach.

Aromatics, or aromatic hydrocarbons. Highly stable organic compounds, including benzene, toluene and xylene. Certain aromatic hydrocarbons, found in gasoline and exhaust emissions, have carcinogenic properties.

Biofuel. Fuel derived from biomass, i.e., a substance produced by living organisms, but not fossil fuels, for example, wood from energy forests and timber waste.

BS 7750. The first national standard for environmental management, published by the British Standards Institution in 1992.

Byproduct. A secondary product resulting from the production of a primary product.

Cadmium, Cd. A cumulatively toxic element used in the manufacture of batteries, for electroplating, and in circuit board contacts.

Carbon, C. A nonmetallic element found widely in nature. 94 percent of all known compounds (more than four million) contain carbon. Its most abundant compound is carbon dioxide, which constitutes approximately 0.04 percent of the atmosphere and is found in a dissolved state in all natural waters. Carbon compounds make up approximately 18 percent of all living matter (the remainder being mostly water). During this century, carbon-based fuels have provided most of the world's energy needs.

Carbon cycle. Circulation of carbon in various forms through nature.

Carbon dioxide, CO_2. A colorless and, at room temperature, gaseous substance found in the atmosphere as part of nature's life cycle. Human activities, especially the burning of fossil fuels, can increase levels of carbon dioxide in the atmosphere, which is believed to affect the climate. The primary greenhouse gas is carbon dioxide.

Carbon monoxide, CO. A colorless, odorless gas, found in trace amounts in the atmosphere. Produced by incomplete combustion of carbonaceous materials, CO is highly toxic because of its high affinity for hemoglobin in red blood cells.

Carbon sink. Something that absorbs carbon dioxide from the atmosphere. Vegetation is the most important carbon sink. Using photosynthesis, land plants and marine plants convert great quantities of carbon dioxide, water and sunlight energy into oxygen and carbohydrates.

CFCs. (Chloroflurocarbons) See freons.

CIGRE. Conference Internationale pour les Grands Réseaux Electriques.

Climate. Temperature, humidity, precipitation, winds, radiation, and other meteorological conditions characteristic of a locality or region over an extended period of time.

Chlorinated paraffins. Highly complex, stable compounds containing chloride that are resistant to degradation and oxidation. Used as softeners in plastics and rubber, as flame retardants and as components of cutting fluids in metalworking. Harmful primarily to aquatic life.

Chlorinated volatile organic compounds, VOCcls. Compounds containing chlorine that are highly volatile and easily disperse into the immediate environment and the atmosphere. They are often directly, or indirectly, hazardous to the environment and to health. Large quantities of VOCcls were previously used as industrial solvents, for degreasing and in dry cleaning. Other substances are now gradually replacing them. VOCcls include trichloroethane, trichloroethylene and perchloroethylene.

Cogeneration. Usage of heat from a combustion process (that would otherwise be released into the environment) as an additional source of electricity generation, or as a heating or cooling source.

COP. Conference of the Parties to the UN Framework Convention on Climate Changes. The most recent sessions were in Tokyo in 1997 (COP3) and in Buenos Aires in 1998 (COP4).

Corporate Staff Environmental Affairs, CS-EA. ABB's central environmental staff, reporting directly to the CEO, with overall responsibility for developing and implementing the environmental management program throughout the ABB Group.

Country Environmental Controller, CEC. An ABB manager who reports to country management and coordinates all environmental management activities in that country.

Design for environment, DFE. An engineering approach for optimizing environmentally related characteristics of a product, process or facility.

Dioxin. A group of chlorinated organic chemicals formed in very small quantities in most combustion processes and as accidental byproducts of the manufacture of certain herbicides, bactericides, wood preservatives and other products. Of the 210 dioxins, about a dozen are considered highly toxic, causing skin disorders, cancer and genetic disorders.

Ecoefficiency. The continuous process of translating the vision of sustainable development into reality. An environmental management program is an instrument for achieving ecoefficiency. The term ecoefficiency was introduced by BCSD. See WBCSD.

Ecology. The scientific study of the interrelationship of organisms and their environments.

Ecosystem. A functional unit of nature comprising both organisms and their inorganic environment, intimately linked by a variety of biological, chemical and physical processes.

EMAS, Eco-Management and Audit Scheme. An EU regulation promoting continuous improvement of the environmental performance of industrial activities. Once an organization has set up an EMAS-approved environmental management system, an independent, accredited person or organization audits the environmental work. The organization can then seek registration by a competent body designated by the governments of the member states.

Emission. Release or discharge of any substances, effluents or pollutants into the environment.

Emissions trading. A tool for reducing emissions of greenhouse gases. Sources of a particular pollutant (most often carbon dioxide) are given permits to release a specified number of tons of the pollutant. A government or trading agency issues only a limited amount of permits consistent with the desired level of emissions. The owners of the permits may keep them and release the pollutants, or reduce their emissions and sell the permits. The fact that permits have a value and can be sold or traded gives owners an incentive to reduce emissions. In 1997, the Kyoto Protocol authorized emissions trading as a means of controlling greenhouse gases.

Environment. The terrestrial human habitat, including air, water, land, natural resources, flora, fauna, humans and the interrelation of these and other constituents.

Environmental Advisory Board, EAB. At ABB, a panel of outside experts who advise the Group on environmental matters.

Environmental aspects. Elements of an organization's activities, goods or services that can interact with the environment.

Environmental Declaration. A description of environmental aspects, environmental goals and programs to fulfill these goals for the core products, product lines and systems of an ABB business area.

Environmental fee. Economic means of control to limit environmental damage. Several countries levy environmental fees, for example, on nitrogen oxides and carbon dioxide emissions from combustion processes and on the use of certain other substances.

Environmental impact. Any change to the environment, whether adverse or beneficial, wholly or partially resulting from an organization's activities, products or services, or from human activities in general.

Environmental management system, EMS. That part of an overall management system that includes organizational structure, planning activities, responsibilities, practices, procedures, processes and resources for developing, implementing, achieving, reviewing and maintaining an environmental policy.

Environmental performance. The measurable results actually attained by an organization through environmental management.

Environmental performance indicators, EPI. Standardized metrics that provide information for measuring and motivating progress toward environmental goals, serving the needs of business managers and interested parties outside the corporation. According to the ISO 14031 standards draft, the three main classes of EPI are Management performance indicators (MPI), Operational performance indicators (OPI), and Environmental condition indicators (ECI).

Environmental strategy. A business strategy with environmental improvement as an explicit objective or expected outcome.

Eutrophication. Enrichment of bodies of water by nitrates and phosphates from organic material or the surface runoff. This increases the growth of aquatic plants and can produce algal blooms that deoxygenate water and smother aquatic life.

Fossil fuels. Fuels found in earth strata, deriving from organisms of an earlier geological age. Fossil fuels include oil, natural gas, coal and peat.

Freons. (CFCs) A group of halogenated hydrocarbons where fluorine atoms, chlorine atoms or both have replaced one or several of the molecule's hydrogen atoms. The name is derived from the Freon trademark registered by DuPont in the 1930s. Freons, or CFCs (chloroflurocarbons) were previously used widely as cooling agents and as expanding agents in insulation foam. Since they contribute to both the depletion of the ozone layer and the greenhouse effect of global warming, their use is now banned in many countries.

Global warming. The increase in the Earth's mean temperature that is, or is believed to be, occurring as a result of human activities impacting the Earth's atmosphere.

Greenhouse effect. The effect that certain variable constituents of the Earth's lower atmosphere have on surface temperatures. Greenhouse gases keep ground temperatures at a global average of approximately 15° C. In their absence, the global average would be below the freezing point of water. Environmental scientists are concerned that changes in the atmosphere's CO_2 content, caused by human activities, could have a dangerous warming effect on the Earth's atmosphere.

Greenhouse gases. Gases that contribute to the greenhouse effect and global warming. The most significant are carbon dioxide (CO_2), water vapor (H_2O), methane (CH_4), nitrous oxide (N_2O), chlorofluorocarbons (CFCs), hydrofluorocarbons (HFCs), perfluorocarbons (PFCs) and sulfur hexafluoride (SF_6).

Halogenated hydrocarbons. Hydrocarbons where halogen atoms have replaced one or several hydrogen atoms, i.e., fluorine, chlorine, bromine and iodine. Solvents, cooling agents, insect repellents, fire retardants and transformer oil often contain halogenated hydrocarbons. They are chemically and biologically stable, and their large-scale use has led to environmental damage and health risks. Bans in many countries have drastically reduced usage of halogenated hydrocarbons.

Hazard. A material condition that may cause damage, injury or other harm, frequently established through standardized assays performed on biological systems or organisms. Hazard and exposure constitute risks.

Hazardous waste, HW. Waste requiring special disposal techniques. Different countries have different definitions and regulations, and national standards are frequently changed.

HCFCs. (Hydrochlorofluorocarbons). Also known as soft freons. Alternative to CFCs, with only approximately one-tenth of the ozone-destroying properties and greenhouse effect potential of CFCs.

HFCs. (Hydrofluorocarbons). A major substitute for chlorofluorocarbons and halons. HFCs contain no chlorine or bromine, only fluorine, which is benign toward the ozone layer. Therefore, their ozone depletion potentials are essentially zero. The major HFCs are CF_3CFH_2 (134a), CF_3CF_2H (125), CHF_3 (23), CF_3CH_3 (143a) and CF_2HCH_3 (152a). In paricular, HCFC-134a has begun to be widely used in air conditioning and refrigeration applications.

Hydrocarbons. Chemical compounds consisting of carbon and hydrogen. There are many different hydrocarbons, mainly extracted from petroleum. Hydrocarbons are increasingly replacing freons (CFCs and HCFCs) as cooling agents and insulation gases. They do not contribute to ozone depletion and contribute only negligibly to the greenhouse effect. Most hydrocarbons are highly flammable, and many are hazardous to health.

ICC (International Chamber of Commerce). A nongovernmental organization, founded in 1919, that serves world business by promoting trade and investment and the free market system. The ICC helps the international business community to develop solutions for environmental problems, while striving to ensure that intergovernmental organizations concerned with the environment take business views into account.

Interested party. An individual or organization directly affected by the fortunes of an enterprise. Corporate management has a responsibility to interested parties, including customers, employees, shareholders, suppliers, communities and others.

International Energy Agency, IEA. An agency established in 1974 within the framework of the Organization for Economic Cooperation and Development (OECD). One of the IEA's basic aims is to promote cooperation among participating countries, in order to increase energy security through conservation, development of alternative energy sources, and energy research and development.

ISO, International Organization for Standardization. Founded in Geneva in 1946, ISO is concerned with standardization in all technological or nontechnological fields, except for electric and electronic engineering, which is the responsibility of IEC, the International Electrotechnical Commission. Membership comprises more than 80 countries.

ISO 9000. A series of international standards for quality assurance, adopted in 1987.

ISO 14000. A series of international standards for environmental management systems, life cycle assessment, environmental auditing of processes, environmental labeling, environmental performance evaluation and terms and definitions.

IUCN. The World Conservation Union, established in 1948. A union of governments, government agencies and nongovernmental organizations working with scientists and other experts to protect the environment. IUCN advises and helps governments, organizations and local communities in devising and implementing conservation strategies.

Kyoto Protocol. A legally binding agreement under which industrialized countries will reduce their collective greenhouse gas emissions by 5.2 percent. The agreement was reached in Kyoto on December 11, 1997, at a meeting arranged by UNEP and attended by delegates from 160 nations.

Lead, Pb. A metallic element used in many industrial processes. Accumulates in biological systems and is linked to behavioral change, paralysis and blindness. Use of tetraethyl lead as an anti-knocking petroleum additive has resulted in its widespread release along roads.

Life cycle assessment, LCA. A management tool for appraising and quantifying the total environmental impact of products or activities over their entire lifetime by analyzing the entire life cycle of particular materials, processes, products, technologies, services or activities. Life cycle assessment comprises three complementary components—inventory analysis, impact analysis and improvement analysis.

Local Environmental Control Officer, LECO. An ABB executive who reports to a local site management to ensure that the appropriate environmental procedures are carried out at that site.

Methane, CH_4. A hydrocarbon that is the main component (approximately 85 percent) of natural gas and is widely distributed in nature as a byproduct of the decay of organic matter. In addition to its use as a fuel, methane is used to manufacture many organic chemicals. The gas is nonpoisonous, but atmospheric methane is a greenhouse gas.

Mercury. A heavy metal used in mercurial catalysts and the paper industry and released by the combustion of fossil fuels. Organic mercury compounds, such as methyl mercury, act as cumulative poisons that affect the nervous system.

Nitrogen. A gaseous element that forms the major part (78 percent) of the atmosphere. Nitrogen is an important building block for all forms of life. It is transferred in a continuous cycle between the atmosphere and the biosphere.

Nitrogen oxides, NO_X. Nitrogen forms a number of oxides such as nitrogen dioxide (NO_2), nitric oxide (NO) and nitrous oxide (N_2O). Human activities, primarily industrial processes and fossil fuel combustion, release large amounts of nitrogen oxides into the atmosphere. They contribute to acidification, eutrophication and to the formation of smog and ground-level ozone.

Nitrous oxide, N_2O. Also known as laughing gas. A greenhouse gas.

Nonrenewable energy resources. Irreplaceable energy resources, representing an energy capital that must be conserved and utilized wisely. These include coal, oil and natural gas, and fuels for nuclear energy, such as uranium for fission, as well as lighter elements for fusion.

Nonylphenoletoxylates. Complex hydrocarbons used in industrial cleaning and degreasing, paint manufacture and as components of cutting fluids in metalworking. May be harmful to aquatic life.

Nuclear energy. Energy obtained from nuclear fission and fusion.

Nuclear fission. The splitting of a heavy nucleus, such as uranium, into two parts, releasing neutrons and energy. Nuclear fission is the process used in nuclear reactors, as well as in nuclear weapons.

Nuclear fusion. A nuclear reaction where atomic nuclei with low atomic numbers fuse to form a heavier nucleus, accompanied by the release of large amounts of energy. Nuclear fusion is used in nuclear weapons but not yet for power generation.

Ozone, O_3. A form of oxygen with three oxygen atoms. The upper atmosphere's ozone layer protects life against harmful ultraviolet radiation, while ground-level ozone is a pollutant that is harmful to life forms and can cause breathing disorders.

Ozone depletion. Degradation of stratospheric ozone due to the photochemical reaction of ozone, primarily with CFCs. A global phenomenon with regional variations, characterized by holes in the ozone layer over the Antarctic, the Arctic and other regions.

Particulates. A collective term for very small solid and/or liquid particles found in the atmosphere. Particle sizes range from 0.005–500 micrometers. Particulates can be generated by natural processes but more commonly result from human activities, as from operational diesel engines, power plants, and from other industrial processes. Particulates have been linked to a number of significant health problems, including respiratory afflictions and heart disease.

Peat. Fibrous debris produced by the partial disintegration of vegetation in wet places. Classified as a fossil fuel as it is not part of the carbon cycle.

Photochemical oxidants, smog. Mixture of pollutants produced by the photochemical effect of sunlight on a range of chemicals, including nitrogen oxides, hydrocarbons and ground-level ozone. Primarily an urban phenomenon caused by inhibition of pollutant dispersal due to topological or meteorological conditions.

Phthalates. Salts or esters of the aromatic hydrocarbon phthalic acid. Used as softeners in plastics. Up to half the weight of PVC can sometimes consist of phthalates. It is suspected that phthalates diffusing into the environment might harm living creatures' capacity for reproduction.

Polybrominated biphenyls, PBBs. A group of biologically persistent organic compounds containing bromine, used as fire retardants in plastics, as in the housings of electrical apparatus. The negative effects of PBBs are similar to those of PVC.

Polybrominated diphenyl ethers, PBDEs. A group of biologically persistent organic compounds containing bromine, used as flame retardants in plastics. The negative effects of PBDEs are similar to those of PVC.

Polychlorinated biphenyls, PCBs. A group of biologically persistent organic compounds containing chlorine, previously used in electrical transformers and capacitors for their insulating and fire resistance properties. PCB compounds are toxic to marine life. Now being phased out and disposed of.

Polyvinylchloride, PVC. A plastic with a wide range of applications, used in pipes, profiles, bottles, cable insulation, etc. Its environmental impact, which has been the subject of intensive debate, involves especially the discharge of heavy metals from stabilizers and from phthalates used as softeners, as well as dioxin formation during combustion.

Primary energy. Energy that has not undergone transformation. Sources of primary energy that can be transformed into electricity and heat include crude oil, coal, natural gas and water used to generate hydroelectric power.

Recycling. Reintroduction of used materials or liquid residual products into manufacturing processes. A natural part of resource conservation. Today, most products are designed and manufactured with recycling in mind.

Renewable energy sources. Energy sources that replenish themselves naturally within a short period of time, making them continuously available. Sources of renewable energy include hydroelectric power, geothermal energy, ocean thermal energy, solar energy, wind power, peat and fuel wood.

Residual product. Something left over from manufacturing or consumption, such as waste heat, scrap metal, rubber and plastic parts or leftover paper. Depending on the utility value, residual products are classified as return products, recyclable products, or waste.

Resource. A known and accessible supply that constitutes a means by which to achieve a specific goal. In a wider sense, everything that an organization can use to create value for customers is a resource, including employees, knowledge and know-how, capital, materials and energy. In a narrower sense, resources are those that are used in manufacturing, mainly materials and energy.

Solvent. A medium, usually a liquid, in which other substances can be dissolved without being chemically altered. Solvents are used in industrial processes as part of paints, lacquers and plastics. Many solvents can affect human health and/or damage the environment.

SO_x. A collective name for sulfur oxides: sulfur dioxide (SO_2) and sulfuric trioxide (SO_3).

Stakeholder. See interested party.

Sulfur. A nonmetallic element, one of the most common in the Earth's crust and vital to all living organisms. Sulfur compounds take part in a continuous cycle that encompasses living organisms, bedrock, land, water and air. Human activities have seriously altered the sulfur cycle, mainly due to extensive combustion of coal and oil.

Sulfur dioxide. A colorless, poisonous gas. Affects breathing, damages plants and contributes significantly to terrestrial and aquatic acidification. Large amounts are produced as an unwanted byproduct from the combustion of sulfurous fossil fuels. Sulfur dioxide can also be oxidized to sulfur trioxide, which forms sulfuric acid when exposed to air (humidity), contributing to acidification of land and water.

Sulfur hexafluoride, SF_6. A gaseous insulator, used in electric circuit breakers. SF_6 is a greenhouse gas.

Sustainable development, or sustainability. Meeting the needs of the present without compromising the ability of future generations to meet their own needs; combining economic growth and greater prosperity with environmental quality for people around the world.

UNCED, United Nations Conference on Environment and Development. This conference, in 1992, marked the beginning of systematic efforts by nations and companies to save and improve the environment.

UNEP, United Nations Environment Program. An organization within the UN, formed as a consequence of the 1972 Stockholm Conference on the Human Environment. UNEP's mission is to provide leadership and encourage partnerships in caring for the environment by inspiring, informing and enabling nations and people to improve their quality of life without compromising that of future generations.

Volatile organic compounds, VOCs. Compounds that easily evaporate and spread in close surroundings and in the atmosphere. Often directly or indirectly hazardous to the environment and to health. The largest releases of volatile organic compounds stem from combustion of fossil fuels. Other sources are solvents and paints. VOCs include toluene, xylene, styrene, naphthalene and ethanol.

Waste. Different types of residues considered as lacking any utility value. The opposite of waste is a resource, i.e., something considered useful. What is considered waste or resource may depend on its location and on who is doing the defining.

WBCSD, World Business Council for Sustainable Development. An organization established on January 1, 1995, through the merger of BCSD (Business Council for Sustainable Development) and WICE (World Industry Council on the Environment).

WEC, World Energy Council. A nongovernmental energy-policy forum, founded in 1923, with headquarters in London. Its objective is to promote the sustainable supply and use of energy for the greatest benefit of all.

World Bank. An agency of the United Nations, with headquarters in Washington, D.C. The World Bank (officially, the International Bank for Reconstruction and Development, or IBRD) was established in 1944. It offers loans and technical assistance to promote balanced growth of international trade and economic development, especially in developing regions. Funds from loans support long-range projects in such fields as energy, agriculture and transportation, with the aim of improving living standards. Providing technical assistance to member nations is a major World Bank activity.

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