CO_2 emissions will grow by 130% by 2050

Energy efficiency makes a difference

World energy consumption has been rising steadily. The International Energy Agency (IEA) finds in its June 2008 report that if governments around the world continue with policies in place to date CO_2 emissions will grow by 130 percent and oil demand will rise by 70 percent by 2050. This expansion in oil equals five times today's production of Saudi Arabia.

The IPCC (Intergovernmental Panel on Climate Change) finds in its reports that increasing levels of carbon dioxide lead to atmospheric warming. Warming of the climate system is unequivocal, as is now evident from observations of increases in global average air and ocean temperatures, widespread melting of snow and ice, and rising global average sea level.

Eleven of the years 1995 - 2006 rank among the 12 warmest years in the record of global surface temperature (since 1850). Numerous long-term changes in climate have been observed. These include changes in Arctic temperatures and ice, widespread changes in precipitation amounts, ocean salinity, wind patterns and aspects of extreme weather including droughts, heavy precipitation, heat waves and the intensity of tropical cyclones.

Industry consumes more than 40 percent of total world electricity

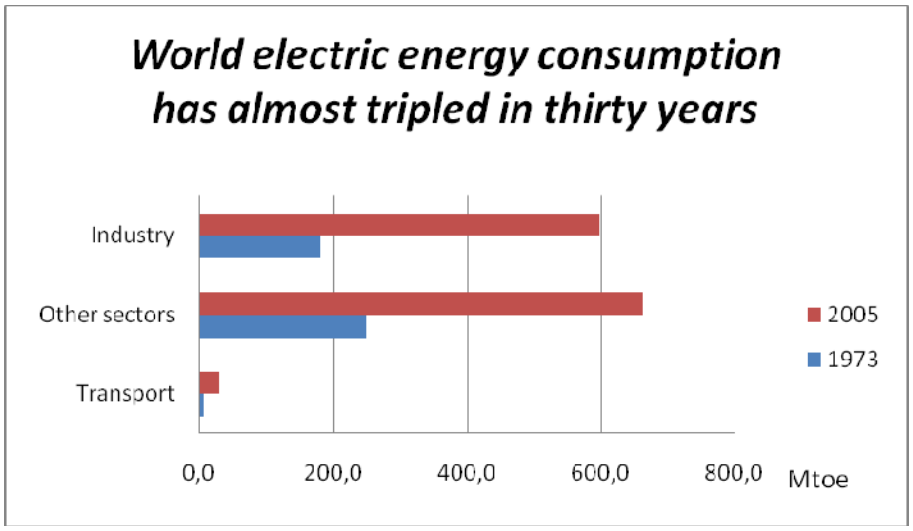
What can we do right now to reduce CO_2 emissions, cheaply, quickly and efficiently? One answer is to use energy more efficiently. Over the years, ABB has been developing and delivering energy efficient technologies and the savings in energy and emissions that they bring are the low-hanging fruit which can be employed to help protect the environment.

China, for example, has vast energy requirements that alternative fuels are not ready to meet. The country is opening coal-fired power plants at the rate of one a week, so the issue that needs to be tackled today is how we can help and encourage China to raise the efficiency of those coal-fired power plants to minimize emissions of carbon dioxide.

Similarly in industry, the biggest reductions in emissions in the short term will come from measures to run processes more efficiently. About 40 percent of electricity is consumed by industry, and two-thirds of that is used by electric motors. Variable speed drives (VSDs), which regulate the speed of a motor, can reduce their energy consumption by 50 percent in many applications. Yet less than 10 percent of motors are equipped with such a device.

It is cost effective to invest in energy efficiency

Energy saving is without doubt the quickest, most effective and most cost-effective manner for reducing greenhouse gas emissions, as well as improving air quality, in particular in densely populated areas.



World electric energy consumption has almost tripled in thirty years and electricity consumption by industry grew by 260 per cent in the same period.

Other sectors comprises agriculture, commercial and public service, residential and non-specified

Source: International Energy Agency, Key World Energy Statistics 2007

More cost-effective to invest in energy efficiency than new power production

The IPCC finds in its report on "Mitigation of Climate Change" that it is often more cost-effective to invest in end-use energy efficiency improvement than in increasing energy supply to satisfy demand for energy services. Efficiency improvement has a positive effect on energy security, local and regional air pollution abatement, and employment.

The report also concludes that the economic potential in the industrial sector is predominantly located in energy intensive industries. Full use of available mitigation options is not being made in either industrialized or developing nations.

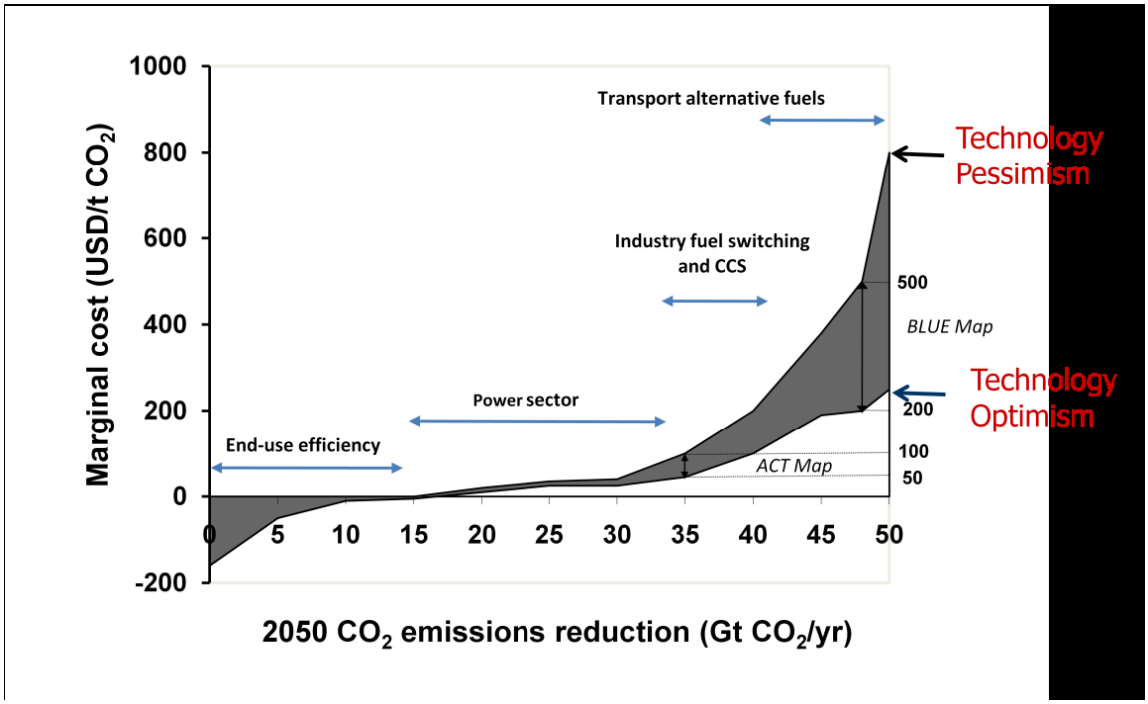
Many industrial facilities in developing countries are new and include the latest technology with the lowest specific emissions. However, many older, inefficient facilities remain in both industrialized and developing countries. Upgrading these facilities can deliver significant emission reductions.

The slow rate of capital stock turnover, lack of financial and technical resources, and limitations in the ability of firms, particularly small and medium-sized enterprises, to access and absorb technological information are key barriers to full use of available mitigation options.

End-use efficiency does not inflict marginal costs

These barriers can be lowered by making available the required information as well as by advancing for instance the usage of payback schemes in financing the energy efficiency investments.

The IEA has made a scenario that concludes that end-use efficiency and a virtually CO_2-free power sector can yield emissions stabilisation in 2050 at today's level. End-use efficiency accounts for 36 percent of all savings in the scenario, renewables for 21 percent and CO_2 capture and storage 19 percent. The remaining 24 percent is accounted for by nuclear, fossil fuel switching and efficiency in power generation.



Contrary to other means in reducing CO_2 emissions end use efficiency does not inflict marginal costs.

Source: IEA - Energy Technology Perspectives (ETP) 2008

Energy efficient motor driven systems would save billions of kWh

The Motor Challenge Programme claims that motor driven systems account for approximately 65 percent of the electricity consumed by EU industry. The Motor Challenge Programme is a voluntary programme promoted by the European Commission to help companies improve the energy efficiency of their electric motor driven systems.

Efficiency standards for motors are required

Switching to energy efficient motor driven systems can save Europe up to 202 billion kilowatt-hours (kWh) in electricity consumption, equivalent to a reduction of €10 billion per year in operating costs for industry.

Table: Savings potential for motor systems in the EU is over 200 billion kWh annually.

	Savings potential (billion kWh/year)					
	EU-15	EU-25	France	Germany	Italy	UK
High efficiency motors	24	27	4	6	4	3
Variable speed drives	45	50	8	10	7	6
Application part of the motor systems (pumps, fans, compressors)	112	125	19	26	17	15
Total electricity savings potential	181	202	31	42	28	24

Source: Energy Efficient Motor Driven Systems, The Motor Challenge Programme

Because of identified market barriers, increasing carbon price is a necessary but not sufficient instrument to achieve economically optimal level of investment into energy saving measures. Additional, more targeted measures are necessary. Binding efficiency standards for electric motors of a certain size and the use of variable speed drives in such environments would be a strong and effective measure.

Efficient speed control with variable speed drives

By far the most effective method of controlling a motor's speed is through the use of variable speed drives. However, much control is still performed with throttling valves in pump systems or vanes in fan applications, while the demands for rotating machinery are solved by gears or belt drives. Speed control with belt drives, gearboxes and hydraulic couplings all add to the inefficiency of the system to varying degrees, and require the motor to run at full speed all of the time. In addition, mechanical drives can be noisy as well as difficult to service, situated as they are between the motor and the driven machinery.

These arrangements often seem cost-effective at first sight, but they are energy wasters. Imagine trying to regulate the speed of your car by keeping one foot on the accelerator and the other on the brake. Running a motor at full speed while throttling the output has the same effect; a part of the produced output immediately goes to waste. Of that estimated 65 percent trial energy used by electric motors, some 20 percent is lost by wasteful throttling mechanisms.

Less CO_2 emissions by over 70 million tonnes every year

Half speed – 1/4 of the energy

In pump and fan applications, using variable-speed drives can cut the energy bill by as much as 60 percent. A pump or fan running at half speed consumes only one-fourth of the energy compared to one running at full speed.

As a small reduction in speed can make a big difference in the energy consumption, and as many fan and pump systems run at less than full capacity a lot of the time, a variable speed drive can produce huge savings. This is particularly so when compared to a motor that is continuously running at full speed.

The efficiency of motors and drives has improved considerably over the years. Motors have improved in efficiency by an average of three percent over the last decade, while For over 30 years, ABB has delivered millions of AC drives worldwide, which collectively have cut electricity consumption by about 140 TWh per year. This is equivalent to the average annual consumption of electricity of more than 36 million households in the 27 member countries of the European Union. This corresponds to an average reduction of CO_2 emissions by over 70 million tonnes every year.

Energy audits quantify potential savings

Only a few industrial systems are optimally dimensioned from the point of view of energy efficiency. It is an extremely challenging task to design an optimized plant with hundreds of actuators, valves, pumps, fans, etc. for a complex process involving multiple parameters from varying demand to ageing equipment. The investment cost for both the (re)design and selection of control equipment technology still remains a major decision criterion, even if it only represents less than five per cent of the plant's life cycle costs.

In order for a company to reduce its energy costs, it needs to evaluate how it uses energy. An energy audit is a systematic examination of key pump and fan applications that includes the monitoring of energy consumed both before and after the change to variable speed drives.

The audit defines where and how much energy can be saved by installing variable speed drives. These figures are then translated into a potential monthly saving, i.e. this is the reduction in energy costs possible if the equipment is installed.

It is not unusual for users to dismiss the promise of a 50 percent energy saving through a 20 percent speed reduction as the exaggerated claim of a vendor looking to make a sale. The savings can be verified, however, and the best way to start is with an energy audit.

While the processes are looked through, also different means of process control should be taken into account. By making leaner or smarter process flows, considerable amounts of energy can saved.

Power savings are relatively easy to calculate, but once the new equipment is in place it is often realised that the temperature and noise levels in the factories decrease dramatically.

When the machines need less cooling, their service intervals usually become longer which, in turn, reduces costs even more. This extends the lifecycle of isolation and lubrication materials as well.

Also in some cases, the consumption of raw materials is decreased. This happened for instance when a fan was previously always run at full blast which led to light weight particles being blown away.

In another instance when compressors were fitted with AC drives, a problem with overheating was overcome. When the compressor reached a certain heat level, it was automatically turned off in order to protect the machine. Now the compressors can be run without cessation.

Audit check list

Hold initial meeting
Define scope of audit
Perform walk-through on the premises
Check plate values
Check load variations
Check type and model of the motor and the device it is running
Check whether flow is restricted by throttling
If necessary, bring in data locker and wheelie bin – movable AC drive
Calculate savings

Energy price works as carrot and stick

The EU Prime ministers agreed on March 8 2007 upon Energy and Climate Policies for the 27 EU countries including a 30 percent reduction of greenhouse gas (GHG) emissions 1990 - 2020 on the condition that other countries also commit to reductions, and with a view to reduce GHG emissions 60-80 percent by 2050. If an international agreement is not possible, they agreed that the EU countries must reduce GHG emissions at least by 20 percent for the period 1990 - 2020.

As one of the main targets, the Heads of State and Government have endorsed a binding target of a 20 percent share of the renewable energies in overall EU energy consumption. EU has also an indicative energy efficiency target of 20 percent increase until 2020.

These targets require action from all countries and all industries. The greenhouse gases can very effectively be reduced by applying new technology to industrial processes. By using new high efficiency motors and variable speed drives to control them, the industries not only contribute to a cleaner environment, but also can save considerable amounts of energy and money.

Many initiatives have payback times of less than a year

Money is after all the most effective carrot industries have in their investment decision processes. Many energy saving initiatives have payback times of less than a year and most projects get paid back in a couple of years.

In some countries the state subsidises investments in energy efficiency. Constantly rising energy prices have, on the other hand, been the stick that have made many industries to make the move towards new ways of controlling how their motors are run.

In the UK, for instance, the government has offered a tax break for buying variable speed drives and EFF1 motors, but this has resulted only to a small amount of investments. The tax break was, however, quite small and difficult to claim and was not therefore really viewed as an incentive. The rising cost of electricity is doing more to drive behaviour in the UK.

In Italy energy has always been more expensive and so there would be more incentive for industries to invest in energy efficient technology. In Italy you can get a tax deduction of 20 percent of a motor-investment. Despite this the law has not really had the impact that was anticipated. This may be due to the fact that many companies have been unaware of the benefit and that many companies have believed that applying for the benefit would mean a lot of bureaucracy (although it is, in fact, really simple). Also some companies have found it not worth while applying because payback times are often shorter than one year.

Even if the Italian law has not been very effective as such, it bears an important institutional message: The energy efficiency potential is real and not only a sales gimmick from greedy suppliers.

Italy has also a so called white certificate mechanism which is more complicated but has drawn more attention but brought only little results.

Sweden shows progress

In Sweden energy has been relatively inexpensive in comparison to many Central European countries. Sweden, however, has very energy intensive industries, like pulp and paper industries and mining. Saving energy has therefore become an issue also in Sweden.

The Swedish programme for improving energy efficiency in energy-intensive industries (Programmet för Energieffektivisering, PFE), provides a clear financial incentive for participating industries to systematically improve their energy efficiency and integrate energy saving measures into the company's core management systems. The PFE, launched in January 2005 is a voluntary energy efficiency program that allows industries to avoid paying the energy tax of 0.5 öre/kWh (approximately 0.5 euro/MWh), provided that they take specific steps to improve the efficiency of their electricity use within their own companies. The ca 120 companies participating in the program use approximately 30 terawatt-hours (TWh, including both purchased and own produced electricity) corresponding to over one fifth of Sweden's total electricity use, and over half of the electricity used by industry

During the first two years of the program, the companies have carried out extensive audits and analyses of their energy use, and introduced certified energy management systems. The companies have identified close to 1 000 measures, with an average payback period of 2.5 years that will to improve their efficiency of electricity use by a total of over 1 TWh of electricity per year. The measures identified so far, with an estimated total investment cost of over SEK 1 000 million (107 million euro), will be implemented by 2009 at the latest. The climate effects of electrical efficiency improvements are considerable – according to preliminary estimates ca 0,5 million CO_2 tons/year, with the exact amount depending on the primary source of energy in electricity production that is been avoided.

In addition to the avoided taxes of approximately SEK 150 million/year (17 million euro), with an average electricity price of about 50 öre/kWh (6 cent/kWh), the companies should make annual cost savings of about SEK 500 million (55 million euro). There energy efficiency measures will also contribute to reductions in NOx and SO_2 emissions from cold condensing power stations. In addition, many companies will carry out improvement measures in respect of energy carriers other than electricity, such as in connection with improving the efficiency of use of fuels or heating, which will also reduce the overall environmental impact.

Case studies

Kemira GrowHow fertilizer plant finances equipment through energy savings

A project to upgrade five process fans at a Kemira GrowHow fertilizer plant has delivered a reduction in annual electricity consumption of more than 4,000 MWh. The project involved installation of new motors and industrial drives to replace the existing motors and mechanical flow control systems. As an additional benefit, the equipment is paying for itself through the energy savings realized.

The Kemira GrowHow plant in Uusikaupunki on Finland’s south-western coast has two fertilizer production lines and two nitric acid production units. The project to upgrade process fans in one of the plant’s fertilizer lines was undertaken in 2005. Following a comprehensive energy analysis at the plant, Kemira GrowHow decided to commission Inesco Oy, an Energy Service Company (ESCO), to study the potential for energy saving with special reference to the air and gas flows in the fertilizer plant.

Like many other processes in the chemical industry, fertilizer production lines include a number of fans to move gases, fumes and air. Inesco examined nine fans altogether, rated 132 - 630 kW, and selected five for more detailed study. The five fans in question were operated by electric motors connected direct-on-line and running at full speed, with inlet vanes to provide mechanical control of the rate of flow. Some of the vane installations were approaching the end of their service life and would soon need replacing at a cost of tens of thousands of euros per fan.

Energy consumption can be slashed by up to 80 percent

During the three-year term of the agreement Kemira GrowHow will pay a service fee to Inesco which is calculated as 80 percent of the energy cost reduction achieved. At the end of the three-year agreement Kemira GrowHow will take full ownership of the installed equipment.

McDonald's restaurants save 50 percent on fan power with ABB standard drive for HVAC in the UK

Fifty McDonald's restaurants across the United Kingdom are now saving 50 percent on power bills for kitchen extractor fans with the help of variable speed drives. The restaurant chain was updating old equipment and realised that their carbon footprint could be reduced by making large fans run more slowly.

Variable speed control was implemented on fan units with large 5.5 kW motors. These now draw about 2kW for most of the time, but have the capacity to boost extract volumes significantly at busy times.

McDonald's was hoping to see 40 percent energy savings and less wear and tear on the fan, including soft start-up. An energy efficiency company was asked to look at the application and come up with the correct drive. The solution was a 5.5 kW ABB standard drive for HVAC (Heating, Ventilation, Air Conditioning).

Using the drive's real-time clock, the fans were made to run at full speed over the busy periods and at 80 percent speed at other times. This resulted in a 50 percent saving in energy. On some installations, a boost button allows the fan to be speeded up to its full extraction speed if needed. Another major benefit was the reduced fan noise that this drive method allowed, particularly important to McDonald's at night.

Swedish sawmill slashes energy consumption by 80 percent

Swedish Södra Timber replaces its conventional hydraulic motors with energy-efficient ABB drives and process performance motors at its Kinda sawmill. Sawmills the world over traditionally use hydraulic motors to power the band saws, conveyors, driers and other heavy equipment in what is one of the toughest and most demanding of industrial environments.

Södra Timber has calculated that the ABB motor and drive solution uses only 20 percent of the power used by a 30 kilowatt hydraulic motor.

ABB drives controlling high-efficiency ABB motors slash energy consumption at Södra Timber's Kinda mill by 80 percent. That's a considerable reduction in energy consumption and greenhouse gas emissions for a mill that produces 240,000 cubic meters of wood products a year. And, there's the additional benefit of not using hydraulic oil and running the risk of impacting the environment with oil spillages.