Energy efficiency is the business of ABB

Staff report

In the global battle against rising greenhouse gas emissions, the priority of energy efficiency in generation, distribution and consumption is growing. This is the core of ABB's business in the power, industrial and transportation sectors. The task of optimizing the energy used to produce a unit of goods or services is the overriding aim of much of what the company does. This article discusses a few examples.

Power sector

Energy management solutions optimize the performance of power generation or co-generation by considering fuel costs, combustion efficiency and emission limits. The result is a reduction in green house gas emissions per MW generated. Reduction of CO_2 is the hallmark of a suite of combustion management solutions, which integrate advanced diagnostics and control applications with sophisticated sensing techniques.

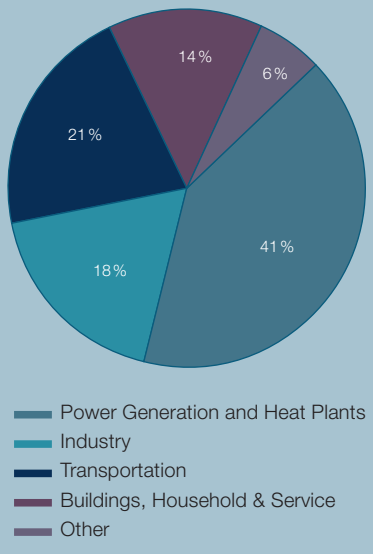
The leading edge performance monitoring application, *Optimax*, and the neural-net based *Combustion Optimizer*, have helped hundreds of power plant operators around the globe improve the operating efficiency of their plants. These efficiency improvements allow power to be generated using less fossil fuel while still meeting their generation goals.

Before a process can be controlled and optimized, its key variables need to be measured. ABB supplies analyzers for measuring flue gases; for monitoring the flow of coal to the furnace; and for analyzing combustion and the composition of flyash.

Reducing the amount of unburned coal leads to lower fuel requirements to gen-

Box 1 Interesting Facts

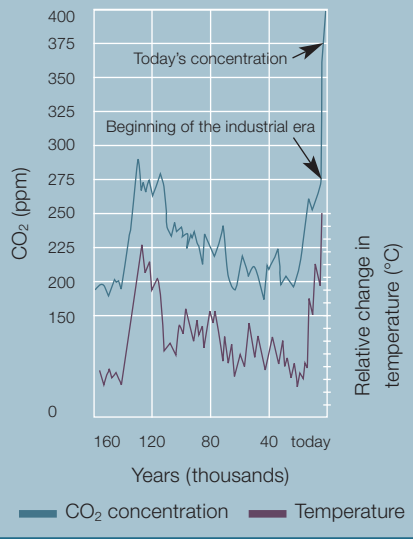
Global contribution of atmospheric CO_2 per sector for year 2002



(Soure: IEA)

- CO_2 makes up 70 % of Greenhouse gases (GHG). The other components are CH_4, N_2O, SF_6, PFC, HFC.
- Emission of CO_2 gas is measured in Gtonnes of CO_2 or sometimes expressed as Gtonnes of carbon: 1 Gtonnes CO_2 = 44/12 Gtonnes of carbon.
- In 2002 the world emitted 23.6 Gtonnes of CO_2.
- The CO_2 level has increased in the atmosphere from prehistoric levels of 200 ppm to a pre-industrial level of 280 ppm to today's level of 375 ppm. By 2050, if no action is taken, the ppm level will reach 560, double the pre-industrial level. Stabilization at around 450 ppm would limit global temperature rise to 2 °C, and force the industrial world to reduce emission of CO_2 by 75% from today's level by 2050.
- An average European car driving 16,000 km (10,000 miles) per year with a relatively good fuel economy of 7.8 litres/100 km (36 miles per gallon) emits almost 3 tonnes of CO_2 per year. This is roughly 3 times its own weight.
- A coal-fired plant loses 2/3 of its energy input while converting 1/3 to electricity.
- A typical British household produces 23.6 tonnes of CO_2 annually.
- The average per capita emission of CO_2 in the USA is twice the level in the UK and more than 20 times that in India.

Change in temperature and CO_2 concentration during the last 160,000 years



erate the same power output. Additionally, low-carbon flyash has considerable commercial value in the production of high-quality cement and gypsum board. Every ton of flyash used in cement production as filler reduces harmful CO_2 emissions by a like amount.

Industrial sector

Industrial processes produce just short of 20% of global CO_2 emissions. Roughly 50% of this comes from the iron, steel and building materials industries. Cement is the main contributor among building materials, emitting approximately one ton of CO_2 per ton of cement produced and accounting for 5 to 6% of global CO_2 emissions.

Under the umbrella of the World Business Council for Sustainable Development (WBCSD), the cement industry (ten major companies) has agreed on a methodology to monitor, calculate and report CO_2 emissions. This is known as the *Cement CO_2 Protocol*. This is an essential first step in identifying emission-cutting strategies. ABB has incorporated this calculation and reporting ability into its real-time information management package for the cement industry.

40% of CO_2 emissions originate in the energy producing part of the process and can be reduced by measures similar to those discussed for the power industry above. The remaining 60% are emitted in the calcinations process, where *Kiln Fuel Optimization* and *Cement Scheduling* are two solution packages helping the industry to control emissions. Similar solutions exist for many other industries.

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Kiln Fuel Optimization

Kiln Fuel Optimization from ABB computes the lowest-cost fuel mix that satisfies current process and market constraints. It uses real-time information from sources such as: laboratory analyses, market prices, forecasts of alternative fuel availability, environmental constraints (including the cost of CO_2 as determined by the Cement Protocol) and process conditions. The engine in this solution combines rules-based control with modern methods such as neural networks and fuzzy control. It is enhanced with an alternative fuels optimization module. Developed to meet the industry's need for a tool that will allow optimal management of alter-

native as well as traditional kiln fuels, this module can significantly enhance the performance of kilns.

Cement grinding plant scheduling

In the final stage of cement manufacturing, clinker is ground with additives to obtain cement. Different types are defined by their chemical composition and grades by their particle size. Cement mill scheduling, ie, deciding when to produce a certain grade and where, is currently mostly performed manually using heuristic rules and relying on operator experience. However, the numerous mills, grades and silos, plus the various operating constraints make the problem complex. ABB's Cement Scheduling Solution helps find the optimal approach.

Based on customer orders and energy price forecasts, an outer-loop is executed at least once a week and its output is used as a reference schedule for mill operation. Here, the functional represents costs associated with electricity consumption and the amount of low-grade cement produced (cement produced during the switch from one grade to another). Electricity cost reduction is achieved by committing the production to time periods when the tariffs are lower, and by managing the mills in such a way that contracted thresholds of maximum electrical power are not exceeded. Reductions in low-grade cement are obtained by penalizing the number of production switches. The cost functional also includes components related to soft constraints.

However, unplanned events such as component failures or unexpected orders are frequent, and an inner scheduling loop is used to react to these disturbances.

The direct customer benefits of the described solutions are estimated to be savings of up to 5% in thermal and electrical energy, a reduction in low-grade cement, more stable operation, consistent clinker quality, strict emissions control, and lower maintenance costs.

Transportation sector

The Compact Azipod propulsion system is an environmentally friendly form of propulsion. The most significant improvement, when considering the environmental performance, occurs in fuel consumption. The concept also enhances the maneuverability and thus the safety of the ship. Maneuverability can be maintained even at zero-speed, and with side thrusters the vessel can be controlled even in emergency situations. Since the consequences of accidents are often severe for the marine environment, this safety argument cannot be overstated. Continued R&D efforts are focusing mainly on further enhancing the environmental performance by considering the whole delivery to the customer. The aim is to develop an even more eco-efficient package and by doing so to promote the goals of ABB's sustainable development policy.