Today’s energy challenges

Public opinion:
- Growing concern over global and local energy challenges
  - Access to affordable energy
  - Global and local environmental impact and sustainability

Process industries:
- Energy is an important and growing part of Operational Expenses
  - For many businesses, a 20% cut in energy cost yields benefit comparable to 10% increase in sales
- Energy use and “carbon footprint” increasingly discussed as part of corporate citizenship and license to operate
A challenge for both mature and emerging nations

Amount of energy used in 2004 to produce $1 GDP

Losses along the energy value chain

- Primary energy
- Electrical energy
- Transmission & Distribution
- Industrial Plant
- Motors & Drives
- Buildings

80% "waste"
Potential for energy efficiency at every stage

- Useful energy
- Net energy
- Transport
- Conversion efficiency
- Line losses
- Production process
- Motor efficiency

Primary energy
Electrical energy
Transmission & Distribution
Industrial Plant
Motors & Drives
Buildings
ABB contributions to energy efficiency

- Process automation systems
- Transport systems
- Plant automation systems
- Grid operation systems
- Process automation systems
- Drive & motor systems
- Building Installations

ABB technology can cut waste by 20-30%

- Primary energy
- Electrical energy
- Transmission & Distribution
- Industrial Plant
- Motors & Drives
- Buildings

Net energy → transport → conversion efficiency → line losses → production process → motor efficiency → 20-30%
Transport: Azipod and turbochargers

- Azipod® is a podded propulsion unit which rotates through 360 degrees, incorporating an electric motor and a frequency converter. A recently launched cruise liner fitted with an Azipod® propulsion system achieved an 8% reduction in fuel consumption, equivalent to 40 tons a week.

- Turbochargers boost diesel engine output by up to 300% and save fuel.
Grid operations: nine imperatives

- More power through (existing) systems
- Generate more and/or differently
- Serve new customers
- Manage market driven power flow
- Store some energy
- Hide and make “green”
- Connect grids
- Provide better quality and higher efficiency
- ...and extend and replace as usual
Reduced line losses, better integration

- Higher voltages, incl HVDC for bulk transmission
- Higher currents
- Power electronics integrate renewables & storage
- New advanced monitoring and control solutions
Example: NorNed Link, Norway – Netherlands

Customer’s need
- Optimize existing generation
- Enable power trading

ABB’s response
- Turnkey 700-MW system with innovative ± 450 kV converter system

Customer’s benefits
- Low transmission losses
- Reduce CO2 emissions by nearly 1.7 million tons per year
- Support wind power development in the Netherlands

The world’s longest sea cable 580 km
Example: Thornton Bank wind farm, Belgium

Customer’s need
- To connect wind-generated power to the grid reliably and efficiently

ABB’s response
- Electrical system analysis, underwater power cables and electrical equipment

Customer’s benefits
- Supply enough power to satisfy the annual energy needs of 600,000 people.
- Reduce CO2 emissions by nearly 450,000 tons per year
- Help Belgium meet its European Union renewable energy target
Renewables and storage integration

Power electronics
- Improved grid integration of renewable power generation
- Energy storage

Example
- GVEA, Alaska, backup for transmission system loss, win time to start up local generation
- Battery energy storage system (with Saft NiCd batteries) to deliver 27 MW for 15 minutes; 46 MW max.
- Avoids running backup generation units in costly idle mode

⇒ http://www.gvea.com/about/bess/
Example: control methods for pumps

- Throttling
- Bypassing
- On/off control
- Variable speed
A drive can reduce energy consumption by 50% for motors running pumps or fans.

The alternative is often to let the motor run at full speed and simply “throttle” the output.

It’s like controlling a car’s speed by stepping on the brake while the other foot remains on the accelerator.

Less than 10% of motors worldwide are equipped with a variable speed drive.
The efficiency level of ABB motors sold in China is 1.5 to 2 percent higher than average.

ABB motors sold in China to date save 2.1 billion kWh of power annually.

This is equivalent to the annual power consumption of 1.5 million households.

Energy saving potential for Chinese industry by improving the efficiency of all electric motors = 33 billion kWh / year.
The installed base of ABB low-voltage drives alone saved about 120 million megawatt-hours of electricity in 2006, equivalent to the annual consumption of about 32 million EU households (the average consumption is about 3800 kWh per household in the 27 countries of the EU).

- CO2 savings are about 100 million tons, more than the yearly emissions of Finland.
Motors and drives: where to use them?

- Fans
- Conveyors
- Winders
- Roller tables
- Spinning
- Pumps
- Cranes
- Paper machines
- Offshore
- Ski lifts
- Debarking drums
- Centrifuges
- Propulsion
- Drilling
- Windmills

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Example: Water pumps in the metals industry

China Steel, Taiwan

- Replaced mechanical valves to regulate water pressure in a hot rolling mill
- Added ABB AC drives to existing fixed-speed booster pump motors
- Energy savings of 2,930,000 kWh/year
- Reduced CO2 emissions by 1,465,000 kg/yr
- Other benefits:
  - Reduced water costs (savings of ca. 65,000 tons of water/year)
  - Reduced maintenance cost
  - Improved product quality
Example: Fan control in the cement industry

Cruz Azul cement plant, Mexico

- Replaced control of two 1000 horsepower fixed-speed fans with AC drive control from ABB
- Energy savings of 5,500,000 kWh/year
- Reduced CO2 emissions by 2,750,000 kg/yr
- Other benefits:
  - $900,000 revenue increase from better productivity
  - Maintenance reduced by 97%
- Payback period: 6 months
Optimization and control
Example: TiO2 refinery

- **Operational challenge**
  - Decide when to charge and discharge aerators
  - Determine cycloning, leaching and drying flow rates
  - Mix of batch and continuous process, large time delays

- **Objectives**
  - Increase production
  - Minimize energy bill
  - Less off-spec product
  - Lower reagent consumption
Natural gas burner: reduced to zero, use exhaust gases from kiln
TiO2 customer benefits: Output ↑, Energy ↓

- **Reduction process**
  - Significantly lower energy consumption
  - More stable quality
- **Aerators**
  - Minimized idle time
  - $120,000 savings due to less electricity consumption
- **Leaching**
  - Less process stops
  - $80,000 savings in sulphuric acid consumption
  - More production (+500 tons/year)
- **Drying process**
  - Best usage of kiln waste energy
  - $240,000 savings from reduced natural gas consumption
Technology mission and drivers

- ABB spent $1.1 billion on research and order-related development in 2006.
- Safeguard and extend ABB’s leading technology position in power and automation.
  - Secure above average returns on technology investments.
  - Develop and protect strategic intellectual property.

<table>
<thead>
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<th>Increase value:</th>
<th>Decrease cost:</th>
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<tr>
<td>↑ Performance</td>
<td>↓ Energy intensity</td>
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<tr>
<td>↑ Intelligence, communication</td>
<td>↓ Volume, weight</td>
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<tr>
<td>↑ Functional integration</td>
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<td>↑ Reliability, robustness</td>
<td>↓ Environmental impact</td>
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<tr>
<td>↑ Usability</td>
<td>↓ Maintenance need</td>
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ABB Technology Areas “Soft”

- Sensing & analyzing
- Control & protection
- Software & communication
- Manufacturing & engineering processes

Information flow
ABB Technology Areas “Hard”

- Insulation, limiting
- Switching, breaking
- Power electronics
- Mechatronics
Conclusion

- Energy Efficiency is “The *other* alternative fuel”
- Great time for tackling energy efficiency
  - High energy prices $\rightarrow$ economically attractive
  - Strong public concern $\rightarrow$ corporate citizenship
  - Technology for lowering energy losses is there
- ABB
  - Is a world leader in energy efficiency technologies
  - Supports utilities and industries along whole value chain