ABB's vision of the future electricity

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March 20, 2002

Agenda

- ABB in brief
- Trends in future electricity
- Future grid
- How do we in ABB cope with that
- Concluding remarks

ABB in brief

Power Technology Products
Financial Services
Automation Technology Products
Utilities
Process Industries
Oil, Gas & Petrochemicals
Manufacturing and Consumer Industries

24 BUSD revenues
Present in more than 100 countries

A global technology leader

Market position

Drives
Robotics
Analytics
Electrical Machines
Line protection
Force Measurement
Power Electronics
Switches & fusegear

1

Instruments
Motors
Metering
Control products

2

Source - AMR Research, Goldman Sachs, CSFB and others

A global knowledge leader

Market position

- Power plant automation
- Power transmission
- Upstream Oil & gas
- Flexible automation
- High voltage D/C

1

- Substation automation
- Metals automation
- Pulp & paper automation
- Pharmaceutical biotech automation

2

Source - AMR Research, Goldman Sachs, CSFB and others

Power technology – global leadership

- Global presence with 28,600 employees in over 170 factories in 42 countries
- The world's leader in power technology products with the largest product portfolio and the highest market share

High voltage technology
Medium voltage technology
Power transformers
Distribution transformers
Trends in Power Transmission and Distribution
- Increased competition due to deregulation
- Customers interested in solutions, not only products
- Strong focus on environmental issues
- More intelligent networks

Continuous growth of energy consumption

World CO₂ Emission

Sustainable development: Driving forces
- Environment a growing concern
- Reduction of greenhouse gases
- Growth in alternative energy solutions
- More distributed power - fuel cells, wind power, combined heat and power, microturbines

Renewable Energies*

Vision of a bright future
*Proposed by Sanyo

PHOTON
January-February 2000
Vision of solar farms in China along the historic silk road to cover 1/3 of China’s energy demand in 2030
Towards a hydrogen based society

example Iceland

- 2040 Hydrogen society completed
- 2000 Start of a hydroelectric hydrogen economy
- 1940 Geothermal space heating
- 1800 Importing liquid fossil fuels
- 1700 Importing coal and coke
- 874 Settlement of Iceland

Wind Energy: Global availability

Available wind energy

\[ = 4 \times \]

Global installed capacity of conventional electrical energy

Windpower -

the fastest growing renewable energy

Windpower Generation Gotland /Sweden

- Already today about 18% of the energy supply is based on wind power
- The goal is to increase this share to 30%

Vision: Remote renewable energy sources

connected to loads by DC grid

Visibility: a growing environmental concern

- No longer accepted

Invisible grids
- water
- oil & gas
- electricity
- information
The future grid

- A network of distributed generation sites
- Renewable energies a major part
- Mostly invisible
- Cost effective DC transmission and distribution
- Controlled by “virtual utilities”
- Operated and controlled via Internet / Intranet

How does ABB cope with that?

- Components
- Systems
- Technology

A comprehensive portfolio for wind power

- A whole range of generators (already produce 25% of world’s wind power generators)
- Converter technology
- System design
- Windformer

Partnership for fuel cell systems

ABB and DuPont have formed an alliance

- Feedstock
- Air
- AC
- Heat
- DC
- Water

TURBEC

A partnership for microturbines

- ABB / Volvo JV
- Up to more than 60 units (~100 KW) delivered
- Building up business in combined heat and power

Going Underground: Renaissance for Cables

- Conventional HVAC
- ABB HVAC with reactive compensation
- ABB HVDC
- ABB HVDC with cables
HVDC Light: new transmission technology

- Modular build-up
- Compact
- Stabilizing networks

Conventional HVDC
130 MW
10,000 m²

HVDC Light
130 MW
2,000 m²

HVDC units shrink in size

Power: 50 MW

<table>
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<th>Plant size:</th>
<th>10,000 m²</th>
<th>1,000 m²</th>
<th>350 m²</th>
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<tr>
<td>Power/area:</td>
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<td>50</td>
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<tr>
<td>Frequency:</td>
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<td>1 kHz</td>
<td>5-10 kHz</td>
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Technology platforms

for HVDC and SVC Light (annual growth 30%)

- HVDC Cables
- Dry Capacitors
- Power Electronics

Cables for environmental friendly solutions

- Invisible power
  
- Oil free transformers
  
- HV machines
  
- Highly efficient Windpower

High energy density capacitors

- Very compact capacitors - 75% volume reduction

- Compact substations, SVC and HVDC plants possible, customers save space

New power electronic technologies

Relative loss (%)

2000 → Time
AC substations shrink in size

Plug And Switch System

Conventional AIS

PASS

245 kV PASS system of ABB

The INTERNET as platform for network control

Internet/Intranet (TCP/IP)

Web HMI and server

Subtransmission

Distribution Substation

Distribution Feeder

Consumers

Virtual Utility

Business center

Central center

Web based substation control

Remote web-based monitoring and control

Standard browsers as human machine interface, all functions accessible

Operating the future grid

Power Flow

Revenue Flow

Concluding remarks

The future grid will be very different

New technologies will change

sustainability and efficiency

visibility and economy

operation and control

ABB through its R&D is shaping this future