Siemens Power Generation in China & Its Contribution to Energy Efficiency

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Chinese energy goals

• Ensure energy supplies for China
• Secure resources for energy production
• Environmentally-friendly energy solutions
• Increase energy efficiency 20% by 2010
• Stress energy-saving innovations
• Stricter pollution controls
Large potential for improving energy efficiency

- Energy consumption per unit produced is higher than the world level due to outdated technology\(^1\)
  - Thermal power +22%
  - For steel making +21%
  - For cement making +45%
  - For buildings higher by 2-3x

- To produce $1 of its GDP, China needs 3.5x the amount of energy as the world average\(^2\)

- China uses 15% of the energy consumed in the world to produce 5.5% of the GDP\(^3\)

Source:
2). Asian Development Bank (ADB) analysis
Primary energy consumption (Mtoe) world and China

2002

- Compressed scale
  - 1241, (12%) Share of World
    - China
    - Other World
  - 9104 Mtoe

- Total *) From it
  - 713 (30%)
    - China
    - Other World
  - 1676 Mtoe

- Coal
  - 247 (7%)
    - China
    - Other World
  - 3429 Mtoe

- Oil
  - 32 (1%)
    - China
    - Other World
  - 2158 Mtoe

Mtoe

- 2030
  - 2540 (15%)
    - China
    - Other World
  - 13947 Mtoe

- 2030
  - 1354 (38%)
    - China
    - Other World
  - 2247 Mtoe

- 2030
  - 636 (11%)
    - China
    - Other World
  - 5130 Mtoe

- 2030
  - 158 (4%)
    - China
    - Other World
  - 3972 Mtoe

Source: IEA, WEC  *) includes fossil, nuclear and renewable energy sources

Reserves (China), Mtoe

<table>
<thead>
<tr>
<th></th>
<th>2030</th>
<th>2022</th>
<th>2030</th>
</tr>
</thead>
<tbody>
<tr>
<td>Coal</td>
<td>1354</td>
<td>2247</td>
<td>5130</td>
</tr>
<tr>
<td>Oil</td>
<td>636</td>
<td>3429</td>
<td>5130</td>
</tr>
<tr>
<td>Gas</td>
<td>158</td>
<td>2158</td>
<td>3972</td>
</tr>
<tr>
<td>Reserves (China), Mtoe</td>
<td>60000</td>
<td>3300</td>
<td>1700</td>
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</tbody>
</table>
Coal dominates the fuel mix

China Energy Consumption Breakup

1990: 1 BTCE

2006: 2.46 BTCE

Nuclear and Renewables
- Strong government program

Increasing Dependence on Oil & Gas
- > 40% of oil imported
- Overseas oil supply source to be diversified
- Limited potential to discover big domestic oil and gas reserves

Source: China Statistical Annual Report 2006

* BTCE: Billion tons coal equivalent
CO2 emissions trends

CO₂ Emissions Trends in the Reference Scenario, 1990-2030
Siemens PG’s profile

- Number 2 ranking in the global power plant and industrial applications market

- Broad portfolio from fossil-fueled power generation over key components for industrial cogeneration plants as well as drive and compressor solutions to renewable energy systems

- Competent partner for products, systems and plant services as well as plant construction, including turnkey projects

- Long-term operation and service agreements

With sales totaling around EUR 10.1 billion* and a global work force of more than 36,400*, the Power Generation Group (PG) of Siemens is one of the leading companies in the international energy business.

* fiscal year 2006
## Siemens PG: Complete product and service portfolio; leading market position in nearly all businesses

<table>
<thead>
<tr>
<th>Business activities</th>
<th>Fossil Power Generation</th>
<th>Oil &amp; Gas and Industrial Applications</th>
<th>Instrumentation &amp; Control</th>
<th>Wind Power</th>
</tr>
</thead>
<tbody>
<tr>
<td>Portfolio</td>
<td>Gas turbines and gas turbine power plants</td>
<td>Industrial gas turbines</td>
<td>Instrumentation and control systems for all types of power plants</td>
<td>Wind turbines (on- &amp; offshore)</td>
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<tr>
<td></td>
<td>Steam turbines and steam power plants</td>
<td>Industrial steam turbines</td>
<td>IT solutions</td>
<td>Wind farms (on- &amp; offshore)</td>
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<tr>
<td></td>
<td>Fuel gasification technology</td>
<td>Electrical generators</td>
<td>Service solutions</td>
<td>Service solutions</td>
</tr>
<tr>
<td></td>
<td>Combined-cycle power plants</td>
<td>Key components for industrial power plants, incl. cogeneration of heat and power</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Electrical generators</td>
<td>Solutions for oil &amp; gas</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Service solutions</td>
<td>Compressors &amp; drives</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>e.g. Balance of Plant, plant diagnostics, operating plant, boiler, environmental and modernization service</td>
<td>Service solutions</td>
<td></td>
<td></td>
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</tbody>
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Power Generation Group / China
Siemens PG in China

- Siemens installed **first generator** for illuminating the Shanghai harbor in **1879**
- Constructed China’s first tram line and related **power plant in Beijing in 1899**
- Today:
  - In close cooperation with its JV partner Shanghai Electric Group (SEG), designs and delivers components for fossil power plants (incl. Combined Cycle Power Plants) and for the Conventional Island of nuclear power plants.
  - Designs and supplies gasification equipment for the coal to chemical industry.
  - Supplies parts, provides service, offers modernization and upgrades for power plants including environmental improvement.
  - Supplies instrumentation and control equipment for power plants
  - Supplies turbines and compressors for the oil & gas industry and industrial applications

**We are the leading partner for the Chinese power industry**
Siemens PG country setup

- Number of locations (incl. Minority-JVs): 15
- Number of employees (incl. Minority-Vs): ~6,800
- Power plants with imported equipment: 22 GW
- Power plants in operation or under construction with Siemens Technology: ~93 GW
Siemens PG’s references - fossil power plants in China

- **Steam Power Plant**
- **Combined Cycle Power Plant**

- Waigaoqiao 2nd phase: 2x900 MW
- Waigaoqiao 3rd phase: 2x1000MW under construction
- Huaneng Shanghai: 3x400 MW CCPP (Shidongkou)
- Yuhuan: 4x1000 MW under construction
Schematic of a combined-cycle (GUD) power plant with unfired heat-recovery boiler

Gas turbine system
1. Air intake duct
2. Compressor
3. Gas turbine
4. Heat-recovery
5. Steam generator
6. Exhaust stack
7. Bypass stack
8. Generator, Transformer

Steam turbine system
9. Steam turbine
10. Condenser
11. Pump
12. Feedwater tank
13. Generator
14. Transformer

Heat-recovery boiler

Electric power

Air

Natural gas, Fuel oil, etc.

Cooling tower

Condensate

Circulating water

Cooling air

Fresh water

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Typical 3-D CAD model of a combined cycle power plant
Otahuhu, New Zealand
combined cycle power plant
Huaneng Shanghai CCPP
3x400 MW combined cycle power plant (Shidongkou)

High efficiency level and low emissions

Customer:
Huaneng Shanghai Gas Turbine Power Generation Ltd.

Scope of Supply:
SGT5-4000F-gas turbines
(co-manufactured by SEG)

Operation: 2006
1st unit in the record time of 13 month

Efficiency: 58%
Schematic of a coal-fired steam power plant

1. Steam generator
2. DeNOx plant
3. Air preheater
4. Fan
5. Electrostatic precipitator
6. Desulfurization plant
7. Stack
8. Steam turbine
9. Condenser
10. Pump
11. Feedwater heater
12. Feedwater tank
13. Generator
14. Transformer

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Power Generation Group / China
Waigaoqiao phase II & III steam power plants

“Excellence in Clean Coal Technology”

Customer:
Waigaoqiao (No. 2 & No. 3) Power Generation Co., Ltd.

Fuel: Bituminite

Scope of Supply:
Phase II: High performance turbines and generators
Phase III: Key components to support SEG

<table>
<thead>
<tr>
<th>Plant Name</th>
<th>Capacity</th>
<th>Efficiency</th>
<th>Operation</th>
</tr>
</thead>
<tbody>
<tr>
<td>WGQ Phase II*</td>
<td>2x900 MW</td>
<td>42%</td>
<td>2004</td>
</tr>
<tr>
<td>WGQ Phase III (USC)</td>
<td>2x1000 MW</td>
<td>~ 45%</td>
<td>Expected 2008</td>
</tr>
</tbody>
</table>

* Asian Power Award 2006 for “Excellence in Clean Coal Technology” for reduced emission and fuel costs at stable operating reliability
Siemens advanced steam power plants
lower coal consumption & lower CO2 emission

- Coal saved per year: approximately 1 mio tons by which saves 32 million Euros of fuel cost.
- CO2 emission reduction per year: approximately 2.1 mio tons

Source: Local 300MW Power Plant emission data is from NDRC Long-Term Energy Conservation Plan
Customer:
Huaneng Power International Inc.

Scope of Supply:
• Siemens technology for USC steam turbines
• Engineering
• Technical services
• Key components
• Turbines and generators manufactured by SEG

Operation:
Unit 1 & 2: December 2006
Unit 3 & 4: expected autumn 2007

Efficiency: 45%
Shenhua Ningxia Coal Group
- coal-based dimethylethe (DME) phase I

Advanced Gasification for China’s largest coal supplier

Customer:
Shenhua Ningxia Coal Group

Scope of Supply:
2 x 500 MW<sub>th</sub> entrained-flow gasifiers
Key equipment for gasification

Operation:
2009
China’s aging fleet –
performance enhancement programs
steam turbine modernization - objectives

Improvement of steam turbine performance
- Newest steam path technology
- Reduction of exhaust losses
- New sealing technology
- Elimination of age caused deficiencies

Improvement of cycle performance
- Increased steam mass flow
- Increased steam temperature

Improvement of operational flexibility and reliability
- Adaptation to new cycling requirements
- Replacement of aged components
- Elimination of design weakness
Performance enhancement programs
steam turbine modernization - main focus

- Reduced Exhaust Losses
- Efficiency: + X MW (green)
- Newest Steam Path Technology
- Swallowing Capacity: + X MW
- Adapted Swallowing Capacity
Performance enhancement programs  
steam turbine modernization - emission reduction

Electric Power Emissions Calculator

A 1% efficiency improvement of a 500MW coal fired power plant would save the following mix of pollutants and quantities each year (assumes 0.9 capacity factor and western coal)*:

- Sulphur Dioxide (SO2) : 60 t
- Oxides of Nitrogen (NOx) : 100 t
- Particulate Matter (PM10) : 3.6 t
- Carbon Dioxide (CO2) : 35,700 t
- Volatile Organic Compounds (VOCs) : 2.1 t

* Source – www.infinitepower.org/calc_pollution.htm

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Guohua Ninghai power plant 4x600MW

PROFI – best practice in China

Customer:
Beijing Guohua Electric Power Corporation

Scope of Supply:
Siemens Cockpit information system
Siemens DCS Teleperm XP system
Siemens Optipro system
Siemens PROFI optimization system
Siemens BFS++ system

Operation:
2006
China’s bright future

Thank You for Your Attention!