Combined Heat and Power in China: Lessons on Technology Adoption

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Outline

- CHP Industry Trends
  - The Heat Market in China
- Key Barriers
  - Natural Gas Supply
- Policies: Power, Heat and CHP
- Lessons Learned on Technology Adoption
CHP Industry Trends

- China had 56 GW of CHP in 2004, 12.7% of total power capacity
- 1,900 CHP installations over 6 MW in China in 2005
- CHP is growing faster than total power supply
- Less information on CHP in district heat, but appears low compared to other countries with district heating

Most CHP is:
- Coal based (~95%)
- 6-25 MW in size
- Financed domestically
- Supplies industry (though some questions on share)
Drivers for CHP

- Need for more and more reliable power and heat
- Environmental concerns
- Energy efficiency goals
## Growth of CHP in China

<table>
<thead>
<tr>
<th>Year</th>
<th>MW Capacity</th>
<th>% growth</th>
</tr>
</thead>
<tbody>
<tr>
<td>1995</td>
<td>17</td>
<td>n.a.</td>
</tr>
<tr>
<td>1999</td>
<td>26</td>
<td>12</td>
</tr>
<tr>
<td>2000</td>
<td>29</td>
<td>12</td>
</tr>
<tr>
<td>2001</td>
<td>32</td>
<td>11</td>
</tr>
<tr>
<td>2002</td>
<td>40</td>
<td>25</td>
</tr>
<tr>
<td>2003</td>
<td>48</td>
<td>20</td>
</tr>
<tr>
<td>2004</td>
<td>56</td>
<td>17</td>
</tr>
<tr>
<td>2006</td>
<td>69.8</td>
<td>12</td>
</tr>
</tbody>
</table>
### Power Sector Growth Rates in China

<table>
<thead>
<tr>
<th>Power Type</th>
<th>Growth, 2003-2004</th>
</tr>
</thead>
<tbody>
<tr>
<td>Total</td>
<td>12.0%</td>
</tr>
<tr>
<td>Fossil</td>
<td>11.3%</td>
</tr>
<tr>
<td>Of which CHP</td>
<td>16.0%</td>
</tr>
<tr>
<td>Hydro</td>
<td>14.9%</td>
</tr>
<tr>
<td>Other</td>
<td>12.9%</td>
</tr>
</tbody>
</table>
Trends in Chinese Power and CHP Capacity

# Approximate CHP in China by Sector, 2000

<table>
<thead>
<tr>
<th>Sector</th>
<th>MW Installed</th>
</tr>
</thead>
<tbody>
<tr>
<td>Petroleum</td>
<td>6,400</td>
</tr>
<tr>
<td>Chemicals</td>
<td>1,885</td>
</tr>
<tr>
<td>Pulp and Paper</td>
<td>1,500</td>
</tr>
<tr>
<td>Metals</td>
<td>520</td>
</tr>
<tr>
<td>Space heating (District heating)</td>
<td>1,000</td>
</tr>
</tbody>
</table>
CHP Business Models in China

- CHP owned by large, state-owned power plants (over 300 MW)
  - Sell power to grid, heat to district heating networks
- CHP owned by provincial or municipal companies (6-12 MW)
  - In South, sell mainly to industry
- CHP in industrial parks (privately owned)
  - Government closing many of these
Heat Demand in China, 2004

District heating saw 72% growth in demand from 1994 to 2004
Barriers to CHP

- Institutional barriers
- Grid issues
- Uncertainty during reform
- Power prices not cost reflective
- Lack of domestic high-end equipment
- Financing
Natural Gas Supply

- Small today: 2.8% of Total Primary Energy Supply; 1.7% of power supply
- Main sources: East-West Pipeline; new LNG terminals; domestic offshore production
- Growth expected from new E-W pipeline; LNG and Sichuan Province fields
- New E-W pipeline largest and most problematic. Target dates will likely be missed.
Power Sector Reform

- China has recently unbundled its power sector.
- Limited competition now, but plans to expand.
- Prices for grid power are set by the government based on averages. CHP price set too low and is being raised.
- Have many IPPs already, though it is not clear if they produce CHP.
- Tremendous demand growth creates challenges for reform: reform has focused more on supply than on efficiency to date.
District Heating Reform

- 304 of 662 cities have district heating
- Reforms began in 2003
- Most DH networks are jointly owned by private sector and municipalities; foreign investment up
- Heat prices have risen and now seem to cover all costs
- Metering and controls rare but growing
- Networks are consolidating boilers
- Some cities switching to gas, but most still use coal
CHP Policy Evolution

- 1989 SPC regulations
- 1998 “Some Regulations for Cogen Development”
- 2000 “Regulations for Cogen Development”
  - Clarifies definition of CHP and sets standards for efficiency and power to heat ratio
- 2002 Clean Production Law (covers waste heat)
- Jan. 2007 Temporary Regulation
  - Defines priorities and rules for CHP development
- 11th 5 Year Plan (Apr. 2007)
- Aug. 2007 Dispatch Regulation
Lessons Learned on Technology Adoption

What does CHP teach us about adoption trends for other innovative technologies, like carbon capture and storage?

Barriers play a key role in technology adoption rates
- Grid access and regulatory environment are critical
- So too are habits
- Can turn profitable investments into loss-makers

Carefully designed policy can help overcome barriers
- Important to address root causes, i.e., need for sectoral reform
- Create level playing field for different technologies