Business and Policy Challenges
In European Electricity Industry

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The Norwegian Business School

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Electricity Industry Under Pressure From Crises and Transitions

Western/European Economic Crisis
BUSINESS CHALLENGES
Mixes of Market and Politics

Primarily Market driven

Fig. 7 ETS-induced changes in the EU-20 merit order at 20 €/t CO2 and 2006 fuel prices
Both Conventional and Renewable Investors are in Trouble

Conventional

Greens
### Top 10 Global PV Cell Manufacturers 2006, 2010

**Rank Order by Capacity**

<table>
<thead>
<tr>
<th>Company</th>
<th>Country</th>
<th>Capacity (MW)</th>
<th>2006</th>
<th>2010</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Sharp</td>
<td>Japan</td>
<td>500</td>
<td></td>
<td></td>
</tr>
<tr>
<td>2. Q-Cells</td>
<td>Germany</td>
<td>420</td>
<td></td>
<td></td>
</tr>
<tr>
<td>3. Suntech</td>
<td>China</td>
<td>270</td>
<td></td>
<td></td>
</tr>
<tr>
<td>4. Motech</td>
<td>Taiwan</td>
<td>240</td>
<td></td>
<td></td>
</tr>
<tr>
<td>5. Solarworld</td>
<td>Germany</td>
<td>200</td>
<td></td>
<td></td>
</tr>
<tr>
<td>6. China Sunergy</td>
<td>China</td>
<td>180</td>
<td></td>
<td></td>
</tr>
<tr>
<td>7. Kyocera</td>
<td>Japan</td>
<td>180</td>
<td></td>
<td></td>
</tr>
<tr>
<td>8. Isofoton</td>
<td>Spain</td>
<td>130</td>
<td></td>
<td></td>
</tr>
<tr>
<td>9. Schott</td>
<td>Germany</td>
<td>121</td>
<td></td>
<td></td>
</tr>
<tr>
<td>10. Sanyo Electric</td>
<td>Japan</td>
<td>115</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**2006**

**+46% per year**

<table>
<thead>
<tr>
<th>Company</th>
<th>Country</th>
<th>Capacity (MW)</th>
<th>2010</th>
<th>2010</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. JA Solar</td>
<td>China</td>
<td>1,900</td>
<td></td>
<td></td>
</tr>
<tr>
<td>2. Suntech</td>
<td>China</td>
<td>1,620</td>
<td></td>
<td></td>
</tr>
<tr>
<td>3. First Solar (TF)</td>
<td>US</td>
<td>1,502</td>
<td></td>
<td></td>
</tr>
<tr>
<td>4. Yingli</td>
<td>China</td>
<td>1,100</td>
<td></td>
<td></td>
</tr>
<tr>
<td>5. Trina Solar</td>
<td>China</td>
<td>1,000</td>
<td></td>
<td></td>
</tr>
<tr>
<td>6. Q-Cells</td>
<td>Germany</td>
<td>1,000</td>
<td></td>
<td></td>
</tr>
<tr>
<td>7. Canadian Solar</td>
<td>China</td>
<td>800</td>
<td></td>
<td></td>
</tr>
<tr>
<td>8. Motech</td>
<td>Taiwan</td>
<td>600</td>
<td></td>
<td></td>
</tr>
<tr>
<td>9. Gintech</td>
<td>Taiwan</td>
<td>600</td>
<td></td>
<td></td>
</tr>
<tr>
<td>10. JinkoSolar</td>
<td>China</td>
<td>600</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**Note:** Capacity counted as either crystalline silicon cell or thin film module. TF is thin film.

Source: Bloomberg New Energy Finance, company announcements.

*From Kåberger 2012*
Wind Turbine Manufactures

Vestas, Denamark (12.7 marked Share 2011)
- Sinovel, China (9)
- GoldWind, China (8.7)
- Gamesa, Spain (8)
- Enercon, Germany (7.8)
- GE Energy, US (7.7)
- Suzlon, India (7.6)
- GuoDian, China (7.4)
- Siemens, Germany (6.3)
- MingYang, China (3.6)
Smart Grids, crossover between el and IT
Prosumer Systems

Top-down supply system (central control)

- Nuclear and coal lignite generation
- Hydro & storage
- Industry
- Household, commerce, services

→ Multi-level exchange system (subsidiarity, shared responsibility)

- Offshore wind generation
- Wind PV
- PV & CHP biogas
- Industry
- Household, commerce, services
- International exchange
Sustaining (ST) versus disruptive technologies (DT)

Figure 1.1 The Impact of Sustaining and Disruptive Technological Change

- Performance demanded at the high end of the market
- Disruptive technological innovation
- Progress due to sustaining technologies
- Performance demanded at the low end of the market
Develop robust strategies

• Be good at political as well as commercial strategising

• Be prepared for «normal» global production logic

• Take part in the new end-user dynamic – with appropriate organisational design!
  – Parallel to media - paper and digital – need to be in both
POLICY CHALLENGES
A Plea for Greening by Carbon Pricing

The problematic effects of green and white certificates

From Bye 2013
Can Carbon Pricing Realistically Drive Greening?
Economics and Politics

El-price
Price necessary to drive technology

Price acceptable to majority

Electoral Acceptance

Graph: Electric Technologies in EU 1980-1995

- Photovoltaics
- Wind Power - Best Performance
- Electricity from Biomass
- Supercritical Coal
The learning effect

<table>
<thead>
<tr>
<th>Value</th>
<th>Series 2</th>
<th>Series 3</th>
</tr>
</thead>
<tbody>
<tr>
<td>0.001</td>
<td>0.500095</td>
<td>10</td>
</tr>
<tr>
<td>0.002</td>
<td>0.500155</td>
<td>8.25</td>
</tr>
<tr>
<td>0.004</td>
<td>0.500409</td>
<td>6.80625</td>
</tr>
<tr>
<td>0.008</td>
<td>0.500661</td>
<td>5.615156</td>
</tr>
<tr>
<td>0.016</td>
<td>0.501063</td>
<td>3.821816</td>
</tr>
<tr>
<td>0.032</td>
<td>0.501698</td>
<td>3.152998</td>
</tr>
<tr>
<td>0.064</td>
<td>0.50269</td>
<td>2.601223</td>
</tr>
<tr>
<td>0.128</td>
<td>0.504214</td>
<td>2.146009</td>
</tr>
<tr>
<td>0.256</td>
<td>0.506505</td>
<td>1.770458</td>
</tr>
<tr>
<td>0.512</td>
<td>0.509837</td>
<td>1.460628</td>
</tr>
<tr>
<td>1.024</td>
<td>0.514439</td>
<td>1.205018</td>
</tr>
<tr>
<td>2.048</td>
<td>0.52024</td>
<td>0.99414</td>
</tr>
<tr>
<td>4.096</td>
<td>0.526228</td>
<td>0.820165</td>
</tr>
<tr>
<td>8.192</td>
<td>0.53894</td>
<td>0.676636</td>
</tr>
<tr>
<td>16,384</td>
<td>0.559079</td>
<td>0.558225</td>
</tr>
<tr>
<td>32,768</td>
<td>0.574137</td>
<td>0.460536</td>
</tr>
</tbody>
</table>
Dumping Effects of Renewables

Input renewables
With very low operating costs

Dumping effect of renewables volume

Fig. 7 ETS-induced changes in the EU-20 merit order at 20 €/t and 2006 fuel prices
Static Efficiency: IEA Example

- Least cost solutions
- Rapid discounting of future
  = basically business as usual

**Scenario made by IEA 1997**

- Energy projections based on least cost solutions going forward

Environment factored in as extra costs: "Burden sharing"
Dynamic Efficiency IEA Example

- Energy projections based on learning curves going forward
- Scenario made by IEA 1997

Learning curves for energy technologies

Technology Path with Fuel Cells, PV and Wind

- Total system cost: 9106 billion US$

Electric Technologies in EU 1980-1995

Cost of Electricity (ECU(1980)/kWh) vs. Cumulative Electricity Production (TWh)
Policy as a Transition Tool

- Competition Policy,
- Access policy
- Monopoly regulation policy etc.

Niche market policy
Technology subsidy policy
R&D policy

volume

Carbon taxes/emissions trading?
Certificates?
Auctions?
Feed in
time
EURO CHALLENGES
Factors determining prices

Factors determining el-prices, from NOU 2012: 9

- Determines LTMC
- Determines STMC
- Determines Price Diff Between Nordics and Cont.

Factors:
- Capital costs
- Fuel costs
- CO2 price
- RES inv./Power balance
- Transmission Connections
- Continent
- Nordic

Subdivisions:
- Nordic
- Continental
When can we add up the merit order curve?

Grid Connections Nordics-Continental Europe
Causal loop diagram illustration of the various feedback processes in the Nord Pool market, including real-time, spot and futures market (Source: Klaus-Ole Vogstad)
A Tall Order for Petro-Norway

Klimagassutslipp tønn CO₂en/minbygger

2010

IPCC – Sustainable Level

2050

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Norge

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