Update on EU Energy Markets

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2) German power prices and spreads

2) Outlook for EU gas market
1. DB base-case scenario for EU carbon markets
Base-Case EUA Forward Curve, on 20% Target

**EU Cap (MtCO2)**

- **2008**: 2,075
- **2010**: 1,714
- **2012**: 1,065
- **2020**: Banking

**CO2 price (€/t)**

- **2008**: 30 €/t
- **2010**: 20 €/t
- **2012**: Risk of backwardation
- **2020**: Borrowing not allowed

**Short Run abatement supply curve**

- **Low risk of backwardation**
- **Risk of backwardation**
- **Average residual abatement over 2010-20**: 34Mt p.a.

**In power-plants**

1,065m EUAs and/or CERs/ERUs quota banked from Phase 2 into Phase 3

Source: Deutsche Bank

Deutsche Bank
EU Energy Research
February 2011
Base-Case EUA Forward Curve, on a 30% Target

- **EU Cap (MtCO2)**
  - 2008: 2,075
  - 2010: 1,431
  - 2020: 1,015

- **CO2 price (€/t)**
  - 2008: 40
  - 2010: 37
  - 2020: 37

- **Average residual abatement over 2010-20: 112Mt p.a.**

- **Rise in temperatures < 2°C**
  - Phase 2: 2008-2010
  - Phase 3: 2010-2020

- **Borrowing not allowed**
  - 2008
  - 2020

- **Long Run abatement supply curve – ordinarily in Contango**
  - Low risk of backwardation
  - Risk of backwardation

- **Up to 50GW of new CCGT required**

- **CO2 price (€/t)**
  - 25

- **In power-plants**

- **1,015m EUAs and/or CERs/ERUs quota banked from Phase 2 into Phase 3**

Source: Deutsche Bank
20% of Final Energy from Renewables by 2020

The EU is now committed to ensuring that

(i) 20% of its final-energy consumption comes from renewable sources by 2020
   ➔ The EU estimates that the annual emissions savings would be 400Mt

(ii) to incentivising the construction of 12 large-scale CCS plants by 2015.
   ➔ We estimate that this could lead to emissions reductions of approximately 35Mt per year by that time assuming 5.4GW of total CCS capacity.

BOTH will have to increase their share of overall global power output

The problem at the moment remains one of cost
A 20% Reduction in Energy Consumption by 2020

- Primary energy consumption in the EU-25 to be reduced by 20% by 2020 to 1,500 Mtoe against the 1,890 Mtoe that would otherwise be consumed on BAU projections.

- If this target were achieved this would reduce GHG emissions by 780 Mt per year by 2020 against the BAU scenario.

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**EU Energy Efficiency Target by 2020 (Mtoe)**

- **Current primary energy consumption (2005):** 1,750 Mtoe
- **BAU projection (2020):** 1,890 Mtoe
- **New Policy beyond Directive (2020):** 1,700 Mtoe (-0.5% change per year)
- **Resulting in 20% extra savings**

**Source:** European Commission

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**EU-25 Primary Energy consumption, 2005 (1,750 Mtoe)**

- **Non-Energy Uses:** 33%
- **Transport:** 19%
- **Industry:** 17%
- **Household:** 16%
- **Transformation losses:** 9%
- **Tertiary:** 6%

**Source:** EEA, Deutsche Bank
2. German Power Prices and Spreads
German power prices over 2005-10

Key points
- Baseload prices have followed the commodity price cycle and the contraction in demand
- Peakload prices have followed the same pattern
Evolution of commodity prices, 2005-10

Key points

- Commodity prices have been exceptionally volatile in the last five years, but oil and coal prices have been remarkably robust in the last 12 months, reflecting very strong demand out of Asia in general and China in particular.
- EU gas and CO2 prices have been more subdued in the last 12 months, reflecting the continuing fragile state of the EU economy.
Clean dark spreads over 2008-10

Clean dark spread, 2008-10 (€/MWh)

Clean spark spread, 2008-10 (€/MWh)

Key points

- Clean dark spreads reached a high of €20/MWh in late 2008 as coal prices fell faster than German power demand, but have contracted sharply over the last 12 months as coal prices have recovered in the face of strong Asian demand but German and EU demand have remained weak.
- Clean spark spreads have been more volatile still, and have actually been negative in the last few weeks.
- Both clean dark and clean spark spreads are currently trading at or near three-year lows.
Clean spreads over 2008-10

Clean lignite spreads peaked at €45/MWh in July 2008. Despite coming well off their highs and now trading at three-year lows, as power prices have fallen, clean lignite spreads remain very healthy at €25/MWh. This reflects the very low fuel-input costs of lignite generators, and the fact that CO2 costs have been reduced by the impact of the recession.

Source: Deutsche Bank
**Key points**

- All the key commodities that drive power prices are in a contango forward pattern
- Oil-indexed gas prices are on average materially above EU market prices for gas, again reflecting strong Asian/Chinese demand for oil but weak EU demand for gas
- This is a problem for German gas-fired generators, most of which source most of their gas at oil-indexed prices under long-term contracts
German baseload and peakload forward power curves, 2008-10 (€/MWh)

Key points
- German baseload prices for over 2011-14 average €52/MWh, well below the new-entrant level for new fossil-fuel plant
- We estimate new-entrant costs for new CCGTs at €65-70/MWh, and for coal at €70-75/MWh
- However, there are already 13GW of fossil-fuel fire capacity under construction, dating from plans made in 3-5 years ago when the capacity situation looked very different
- Moreover, there will likely be large amount of new renewable capacity built over 2011-14, because the decision to invest in renewables is independent of wholesale prices
Stylized analysis of impact of EUA auctioning, 1 of 3

Key assumptions for our stylized analysis of the impact of full EUA auctioning

<table>
<thead>
<tr>
<th></th>
<th>Lignite</th>
<th>Coal</th>
<th>Gas (OCGT)</th>
</tr>
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<tbody>
<tr>
<td>Actual 2009 output (TWh)</td>
<td>143</td>
<td>108</td>
<td>60</td>
</tr>
<tr>
<td>Assumed generic thermal-efficiency rate</td>
<td>33%</td>
<td>36%</td>
<td>37%</td>
</tr>
<tr>
<td>Imputed emissions (Mt)</td>
<td>165</td>
<td>99</td>
<td>32</td>
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<tr>
<td>Assumed forward power price (€/MWh)*</td>
<td>52</td>
<td>52</td>
<td>63</td>
</tr>
<tr>
<td>Assumed fixed costs (€/kW)</td>
<td>45</td>
<td>40</td>
<td>40</td>
</tr>
<tr>
<td>Assumed fuel costs in 2012 (€/MWh)</td>
<td>7</td>
<td>32</td>
<td>60</td>
</tr>
<tr>
<td>CO2 forward price for 2012 (€/tonne)</td>
<td>15</td>
<td>15</td>
<td>15</td>
</tr>
<tr>
<td>Proportion of EUAs operators must buy in 2012</td>
<td>40</td>
<td>40</td>
<td>40</td>
</tr>
</tbody>
</table>

Source: RWE, Deutsche Bank;*We here calculate the profitability of the different plant types on the assumption that lignite and coal plants receive the baseload price and gas generators the peakload price.

Key points

- We look at the impact of full EUA auctioning on fossil-fuel plant using the stylized assumptions set out above.
- Germany’s fossil-fuel generators will on average receive 60% of their EUAs for free over 2008-12, meaning they have to pay only 40% of their carbon costs over this period while receiving 100% of the market value of CO2 in their selling price for electricity.
- From 2013, however, they will have to pay for 100% of their EUAs, which means covering fixed costs will become a much bigger issue.
Key points

- Looking at clean spreads for 2012 on our stylized assumptions, lignite generators are doing very well but coal generators much less so and gas generators are at or even below cash costs.
- However, in 2012 fossil-fuel generators will still be receiving 60% of their EUAs for free, so the stylized real-cash profit in 2012 is higher than the clean spreads would indicate, especially for lignite generators.
Looking at all-in clean spreads for 2012 on our stylized assumptions, lignite generators are still doing very well even after factoring in fixed costs, but both coal and gas generators are not covering their fixed costs, with gas generators in particular deep in the red.

With fossil-fuel generators still receiving 60% of their EUAs for free until 2012, the stylized all-in real-cash profit in 2012 shows that the value of free CO2 allowances to lignite generators is greater than their fixed costs, for coal generators it is about even, but for gas generators it is below the level of their fixed costs.
Nuke capacity and output that would have been lost by 2014

Key points
- 7GW of nuclear capacity would have come offline under the previous legislation
- Revised legislation passed in the Bundestag means that nuclear plants will now receive an average lifetime extension of 12 years
- However, there is still legal, political, and financial risk surrounding the proposed extensions
Key points
- We expect 17.6GW of fossil-fuel closures over 2011-14, with 8.3GW of gas, 4GW for coal, 3.6GW for lignite, and 1.7GW for oil.
- We expect 12.1GW of new fossil-fuel capacity over 2011-14, of which 6.5GW of coal, 2.8GW of CCHGT, and 2.8GW of lignite.
- Overall, this gives a net reduction of -5.5GW over the period.
DB projected net change in total capacity over 2011-14

Key points
- We see a net reduction in fossil-fuel capacity of -5.5GW over 2011-14
- We see a net increase in renewable capacity over 2011-14 of 27GW, of which 21GW is PV solar capacity
- In total, therefore, we see a net increase in capacity of 22GW over 2011-14
3. The outlook for EU gas markets
The Global Gas Market is actually De-Globalizing!

Source: Deutsche Bank
EU clearly over-supplied in 2010

Source: Wood Mackenzie, Deutsche Bank
Material disconnect between EU spot and contract pricing

Source: BP Statistical Review 2010, Wood Mackenzie
EU-15 gas demand in 2010

**Key points**

- UK, Germany, and Italy account for 60% of EU-15 demand
- Residential & commercial is the biggest source of demand but is very sensitive to temperature
- Power-sector demand driven by EU CO2 policy
- Industrial demand characterized by improving energy efficiency

**EU-15 demand by country in 2010**

- Germany: 21%
- UK: 20%
- Italy: 19%
- Netherlands: 11%
- France: 10%
- Spain: 8%
- Belgium: 4%
- Austria: 2%
- Ireland: 1%
- Other: 4%

**EU-15 demand composition by type in 2010**

- Residential & commercial: 49%
- Industry: 25%
- Power generation: 25%
- Others: 1%

Source: Eurogas, BMWI, National Grid, Snam Rete, Gas Transport Services, GRTGaz, Enagas, Fluxys, Deutsche Bank
EU-15 gas supply by source

Key points

- EU domestic production dominated by Netherlands and the UK
- LNG have been a new and growing source of imports but pipeline imports remain the dominant model
- Pipeline imports are typically based on long-term oil-indexed contracts

Source: Deutsche Bank
**EU-15 gas supply in 2010 by contract type**

- **EU-15 gas supply by contract type, 2010**
  - Oil indexed: 70%
  - Spot indexed: 3%
  - Spot market: 27%

- **EU-15 (ex-UK) supply by contract type, 2010**
  - Oil indexed: 80%
  - Spot indexed: 4%
  - Spot market: 16%

**Key points**
- Oil-indexed contracts remain the dominant supply model, but importance of spot market has been growing.
- Pressure on oil indexation has grown in last two years owing to the large and prolonged discount of hub prices to contract prices.
- Key question is how long it takes to remove the market overhang caused by the 2009 demand shock.

**Source:** Wood Mackenzie, Deutsche Bank
Typical structure of a long-term oil-indexed contract

Source: Wood Mackenzie
Breakdown of EU-15 gas demand, 1997-2010

Source: Wood Mackenzie
Residential-demand sensitivity to temperature

Source: Wood Mackenzie
## EU-15 base-case gas demand forecast, 2011-15 (bcm)

<table>
<thead>
<tr>
<th></th>
<th>2010</th>
<th>2011</th>
<th>2012</th>
<th>2013</th>
<th>2014</th>
<th>2015</th>
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<td>Residential and commercial demand</td>
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<td>169</td>
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<td>Power generation</td>
<td>126</td>
<td>131</td>
<td>137</td>
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<td>Industrial demand</td>
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<td>125</td>
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<td>Cushion-gas injection</td>
<td>1.0</td>
<td>4.6</td>
<td>6.2</td>
<td>6.2</td>
<td>4.9</td>
<td>5.0</td>
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<td>Others</td>
<td>16</td>
<td>17</td>
<td>18</td>
<td>18</td>
<td>18</td>
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<tr>
<td><strong>Total</strong></td>
<td>461</td>
<td>449</td>
<td>457</td>
<td>460</td>
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EU gas production is in structural decline

Source: Wood Mackenzie

Deutsche Bank
EU Energy Research
Mark C. Lewis
February 2011
EU production’s structural decline means growing imports

Source: Wood Mackenzie
EU contracted imports out to 2030

Source: Wood Mackenzie

Deutsche Bank
EU Energy Research
Mark C. Lewis
February 2011
EU vulnerability to LNG cargo diversions

Source: Wood Mackenzie
# EU-15 base-case forecasts for imports, 2011-15

<table>
<thead>
<tr>
<th>Year</th>
<th>Russia</th>
<th>Norway*</th>
<th>Algeria</th>
<th>Qatar</th>
<th>Nigeria</th>
<th>Lib Egy</th>
<th>Trini</th>
<th>Other</th>
<th>Total</th>
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<tbody>
<tr>
<td>2010</td>
<td>92.6</td>
<td>95.3</td>
<td>45.2</td>
<td>27.6</td>
<td>12.2</td>
<td>8.5</td>
<td>4.2</td>
<td>6.8</td>
<td>301.4</td>
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<td>2011</td>
<td>97.6</td>
<td>95.3</td>
<td>47.8</td>
<td>27.8</td>
<td>12.2</td>
<td>8.3</td>
<td>5.1</td>
<td>6.2</td>
<td>307.1</td>
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<td>2012</td>
<td>97.6</td>
<td>94.1</td>
<td>47.8</td>
<td>26.8</td>
<td>12.2</td>
<td>8.3</td>
<td>7.8</td>
<td>6.2</td>
<td>307.7</td>
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<td>2013</td>
<td>110.9</td>
<td>93.9</td>
<td>49.8</td>
<td>25.1</td>
<td>12.2</td>
<td>8.3</td>
<td>7.4</td>
<td>6.2</td>
<td>320.8</td>
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<td>2014</td>
<td>110.9</td>
<td>93.7</td>
<td>51.8</td>
<td>23.9</td>
<td>12.2</td>
<td>8.3</td>
<td>6.6</td>
<td>6.2</td>
<td>320.5</td>
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<tr>
<td>2015</td>
<td>110.9</td>
<td>91.3</td>
<td>53.9</td>
<td>28.9</td>
<td>12.2</td>
<td>8.3</td>
<td>3.8</td>
<td>6.2</td>
<td>322.4</td>
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Source: Wood Mackenzie, Deutsche Bank; *Of which 14bcm represents direct spot-market sales
## EU-15 base-case supply forecasts, 2010-15

<table>
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<tr>
<th></th>
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<th>2011</th>
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<th>2013</th>
<th>2014</th>
<th>2015</th>
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<td>EU-15 indigenous production</td>
<td>157.1</td>
<td>143.2</td>
<td>138.3</td>
<td>137.8</td>
<td>132.9</td>
<td>134.3</td>
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<tr>
<td>Total imports</td>
<td>301.4</td>
<td>307.1</td>
<td>307.7</td>
<td>320.8</td>
<td>320.5</td>
<td>322.4</td>
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<td>o/w contracted imports</td>
<td>287.4</td>
<td>293.1</td>
<td>293.7</td>
<td>306.6</td>
<td>306.5</td>
<td>308.4</td>
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<tr>
<td>o/w spot-market sales</td>
<td>14.0</td>
<td>14.0</td>
<td>14.0</td>
<td>14.0</td>
<td>14.0</td>
<td>14.0</td>
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<tr>
<td>TOTAL SUPPLY</td>
<td>458.5</td>
<td>450.3</td>
<td>446.0</td>
<td>458.5</td>
<td>453.4</td>
<td>456.7</td>
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<tr>
<td>Imports as % of total supply</td>
<td>65.7</td>
<td>68.2</td>
<td>69.0</td>
<td>70.0</td>
<td>70.7</td>
<td>70.6</td>
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Source: Wood Mackenzie
DB base-case supply/demand balance, 2011-15

Source: Wood Mackenzie
### DB base-case scenario for gas prices, 2011-15

<table>
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<tr>
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<th>2014</th>
<th>2015</th>
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<td>Japanese LNG Contract (DB estimate)</td>
<td>30.4</td>
<td>31.7</td>
<td>32.5</td>
<td>33.6</td>
<td>34.7</td>
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<td>Oil-indexed formula (DB forecast)</td>
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<td>28.9</td>
<td>29.5</td>
<td>30.0</td>
<td>30.4</td>
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<td>NBP gas price (DB forecast)</td>
<td>22.5</td>
<td>23.8</td>
<td>25.0</td>
<td>28.0</td>
<td>30.2</td>
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<tr>
<td>Fuel Switching Price (Forward curve)</td>
<td>22.3</td>
<td>22.7</td>
<td>23.3</td>
<td>23.7</td>
<td>24.3</td>
</tr>
<tr>
<td>Henry Hub (DB Forecast)</td>
<td>10.5</td>
<td>12.9</td>
<td>13.7</td>
<td>14.4</td>
<td>15.1</td>
</tr>
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</table>

*Source: Deutsche Bank*
Db base-case scenario for EU market prices

Source: Wood Mackenzie
DB base-case NBP forecast versus current forward curve

Source: Wood Mackenzie
DB high-demand case for gas, 2011-15

Source: Wood Mackenzie
DB high-case demand scenario for gas prices

Source: Wood Mackenzie
DB low-demand case for gas, 2011-15

Source: Wood Mackenzie

Annual surplus (deficit)
Deferred gas balance

Surplus
Deficit
Warm weather year

DB low-case demand scenario for gas prices

Source: Wood Mackenzie

Deutsche Bank
EU Energy Research
Mark C. Lewis
February 2011
Supply gap returns beyond 2015

Source: Wood Mackenzie
Appendix 1
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