Development of the EU Energy System – Low-Carbon Scenarios

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European TIMES Model (ETM-UCL)

- Energy systems model built on the TIMES model generator
- Dynamic partial equilibrium model approach with inter-temporal objective function minimising total discounted system costs
- Technology-rich bottom-up model
- Covers energy flows from the useful energy demand over end-use sectors and conversion sector to the primary supply
- ETM-UCL is calibrated to 2010 data
- Base-year energy-service demand is exogenous and it is projected for the future using drivers such as GDP, population, output by sector, etc.
- Each region is modelled in its supply, power generation and demand sectors.
- The European regions are linked through the trade in crude oil, hard coal, pipeline gas, LNG, petroleum products, biomass and electricity
European TIMES Model (ETM-UCL)
European TIMES Model (ETM-UCL)

- 11 regions (EU28, plus NOI & SWZ)
- ‘Rest of World’ region – functions as a ‘basket of resources’

<table>
<thead>
<tr>
<th>Region</th>
<th>Country</th>
</tr>
</thead>
<tbody>
<tr>
<td>BNL</td>
<td>Belgium, Netherlands and Luxembourg</td>
</tr>
<tr>
<td>SWZ</td>
<td>Switzerland</td>
</tr>
<tr>
<td>DEU</td>
<td>Germany</td>
</tr>
<tr>
<td>FRA</td>
<td>France</td>
</tr>
<tr>
<td>IAM</td>
<td>Italy, Austria and Malta</td>
</tr>
<tr>
<td>IBE</td>
<td>Spain and Portugal</td>
</tr>
<tr>
<td>NOI</td>
<td>Norway and Iceland</td>
</tr>
<tr>
<td>SDF</td>
<td>Sweden, Denmark and Finland</td>
</tr>
<tr>
<td>UKI</td>
<td>UK and Ireland</td>
</tr>
<tr>
<td>EEN</td>
<td>Estonia, Lithuania, Latvia, Czech Republic, Slovakia and Poland</td>
</tr>
<tr>
<td>EES</td>
<td>Slovenia, Hungary, Romania, Bulgaria, Greece, Cyprus and Croatia</td>
</tr>
</tbody>
</table>
Scenarios

• **Common Assumptions**
  
  – 2020 GHG emissions & renewables targets reached (‘202020’ targets – except energy efficiency)
  
  – Closure of existing nuclear follows end of current licences and phase-out plans. No new nuclear in Germany, Italy, Austria and Malta. No specific restrictions elsewhere.
  
  – GDP, population & households projections match IEA 2012 Energy Technology Perspectives data for EU

<table>
<thead>
<tr>
<th>Driver</th>
<th>2015</th>
<th>2020</th>
<th>2030</th>
<th>2040</th>
<th>2050</th>
</tr>
</thead>
<tbody>
<tr>
<td>Population</td>
<td>506m</td>
<td>511m</td>
<td>516m</td>
<td>515m</td>
<td>512m</td>
</tr>
<tr>
<td>Households</td>
<td>217m</td>
<td>-</td>
<td>238m</td>
<td>-</td>
<td>252m</td>
</tr>
<tr>
<td>GDP Growth</td>
<td>2% (2009-20)</td>
<td>1.8% (2020-30)</td>
<td>1.7% (2030-50)</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
Scenarios

• **Reference**
  – No targets after 2020
  – IEA ETP 6DS prices for oil, gas and coal imports

• **‘Fragmented Policy’**
  – Binding Target of 60% GHG reduction below 1990, by 2050
  – ‘Firm’ national policies achieved (e.g. UK Climate Change Act)
  – IEA ETP 4DS prices for oil, gas and coal imports

• **‘Policy Success’**
  – Binding Target of 80% GHG reduction below 1990, by 2050
  – ‘Firm’ national policies achieved (e.g. UK Climate Change Act)
  – IEA ETP 2DS prices for oil, gas and coal imports
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Electricity Generation Trends

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Road Transport Trends

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Fuel consumption by all road transport (EJ)

- Hydrogen
- Electricity
- Ethenol/methanol
- LPG
- Natural gas
- Bio-diesel
- Diesel
- Gasoline

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Regional GHG Trends

GHG emissions by region (GtCO2)

- UKI: 34%
- SDF: 18%
- IBE: 10%
- IAM: 30%
- FRA: 25%
- EES: 28%
- EEN: 24%
- DEU: 18%
- BNL: 32%

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Electricity Inv. Costs & Marginal CO$_2$ Price

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Next Steps...

• Analyse results in detail (by sector, by key technology, etc.), and refine where required
• Run alternative ‘policy success’ scenarios
• Draw policy conclusions