Energy for Europe: building a new paradigm

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Energy in Europe: searching for equilibrium

Primary energy demand EU27

- 2008: 1,749 Mtep
- 2035: 1,831 Mtep (+5%)

55% of fossil fuel supplies are imported

European generation mix

<table>
<thead>
<tr>
<th>Energy Source</th>
<th>Italy</th>
<th>Germany</th>
<th>Spain</th>
<th>France</th>
<th>EU27</th>
<th>Turkey</th>
</tr>
</thead>
<tbody>
<tr>
<td>Oil</td>
<td>13%</td>
<td>46%</td>
<td>14%</td>
<td>5%</td>
<td>14%</td>
<td>27%</td>
</tr>
<tr>
<td>Gas</td>
<td>51%</td>
<td>13%</td>
<td>36%</td>
<td>75%</td>
<td>3%</td>
<td>10%</td>
</tr>
<tr>
<td>Coal</td>
<td>17%</td>
<td>23%</td>
<td>14%</td>
<td>2%</td>
<td>28%</td>
<td>20%</td>
</tr>
<tr>
<td>Nuke</td>
<td>10%</td>
<td>1%</td>
<td>18%</td>
<td>6%</td>
<td>19%</td>
<td>6%</td>
</tr>
<tr>
<td>RES</td>
<td>26%</td>
<td>26%</td>
<td>26%</td>
<td>14%</td>
<td>1%</td>
<td>5%</td>
</tr>
</tbody>
</table>

Import by country 2008

- Russia: 33%
- Norway: 17%
- North Africa: 13%
- Persian Gulf: 7%
- South Africa: 3%
- Kazakhstan: 3%
- Others: 22%
- Iran: 2%

Energy price

- Power Germania Cal+1
- TTF Cal+1

Source: IEA 2010
The challenges of the European energy sector

Security of supply  Sustainability  Competitiveness

Diversification of energy sources and routes
Development of low carbon technologies

- Renewable energy sources
- Nuclear power
- CCS
- Energy efficiency
Diversification of energy sources and routes
New gas routes and infrastructures to Europe

New infrastructures are indispensable to increase security, competition and flexibility

Source: IEA 2010 Medium Term Outlook, Jun 2010
Diversification of energy sources and routes
New interconnection capacity in Europe

Priority development directions

- Offshore grid connection between northern seas and Northern and Central Europe
- Interconnections in southwestern and central Europe to integrate wind, hydro, solar energy and use the renewable energy generated in North African coast
- Connections with central eastern and southern eastern Europe, to promote the integration of energy markets and isolated energy islands
- Completion of the interconnection with the Baltic energy market (BEMIP), to facilitate the integration of the European market

80 GW of additional transmission capacity needed to optimize flows
Development of low carbon technologies
Renewable energy: a growing industry

EU27 installed capacity base (GW)

- 2008: 378 GW
- 2009: 407 GW
- 2010: 432 GW
- 2020 min: 616 GW
- 2020 max: 1030 GW

Installed capacity by technology
2010, GW

- Hydro: 67%
- Wind: 20%
- Biomass: 6%
- Solar and other: 7%

Installed capacity by technology
2020, GW

- Hydro: 51%
- Wind: 34%
- Biomass: 8%
- Solar and other: 6%

Enormous renewable potential and favourable growth conditions need to be balanced by a thoughtful incentive system.

## Strategic advantages of nuclear generation

### Competitiveness, security of supply and climate change combatement

<table>
<thead>
<tr>
<th>Strategic aspects</th>
<th>Nuclear benefits</th>
</tr>
</thead>
</table>
| **Competitiveness** | • Nuclear **cost of generation is 20% lower** than the cost of CCGT and in line with the USC coal  
• Nuclear generation reduces the dependence on the imports of fossil fuels  
• Nuclear generation is relatively unaffected by the fuel price fluctuations |
| **Security of supply** | • The supplies of uranium are distributed on the planet  
• The supplies of uranium, unlike fossil fuels, generally come from the countries with lower geopolitical risks (Canada, Australia, South Africa) |
| **Climate change** | • Nuclear power plants **don’t emit CO2**  
• **Producing 100 TWh/year with the nuclear power plants** instead of combined cycle gas power plants, the **CO2 emissions can be reduced by about 35 million tons** |

Nuclear generation is a key technology for building a modern and efficient energy system, while reducing the carbon footprint.
Cost of generation for different technologies
Comparing CCGT, USC coal and nuclear

Index of average generation cost
[CCGT=100]

<table>
<thead>
<tr>
<th>Technology</th>
<th>Fixed costs</th>
<th>Variable costs</th>
</tr>
</thead>
<tbody>
<tr>
<td>CCGT¹)</td>
<td>~20%</td>
<td>100</td>
</tr>
<tr>
<td>Coal USC²)</td>
<td>~22%</td>
<td>80</td>
</tr>
<tr>
<td>Nuclear³)</td>
<td>~85%</td>
<td>80</td>
</tr>
</tbody>
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Effects on the cost of generation of a change in fuel cost

<table>
<thead>
<tr>
<th>CCGT¹)</th>
<th>Nuclear</th>
</tr>
</thead>
<tbody>
<tr>
<td>Δ gas price</td>
<td>+100%</td>
</tr>
<tr>
<td>Δ generation cost</td>
<td>+70%</td>
</tr>
<tr>
<td>Δ uranium price</td>
<td>+100%</td>
</tr>
<tr>
<td>Δ generation cost</td>
<td>+8%</td>
</tr>
</tbody>
</table>

Cost of generation from coal and nuclear power is less by 20% compared to CCGT - The cost of generation from nuclear power is not affected by fluctuations in the price of uranium

1) CCGT: Combined Cycle Gas Turbine
2) Ultra Super Critic Coal
3) EPR Tecnology - Assuming the cost of oil 86$/baril and cost of CO2 quotes 25 EUR/t

Source: Enel analysis
Energy efficiency with Smart Grids and E.Mobility

Intelligence and telecoms to manage variability

Energy Storage
Electric Mobility
Energy Management 8-15% emissions decrease
Buildings 30-50% emissions decrease
Distributed Energy Generation
Smart and Informed Customer 5-15% emissions decrease

Electric Mobility

Overall efficiency 18%
Overall efficiency ≈ 36%

Reduction of GHGs and pollutants

- CO2: -46%
- NOx: -48%
- Particulate: -75%

Saves around 50% of primary energy, while reducing by half COx and NOx pollutants