WHAT PRICE STABILITY?

THE VALUE OF PRICE STABILITY FOR DIFFERENT POWER GENERATION TECHNOLOGIES

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Different Notions of Economic Risk Affecting Investment Choices

1. Long-term electricity price stability in order to compensate the inability of technologies with high fixed cost (sunk costs) to leave markets with unanticipated price falls (absence of real option, independent of risk preferences);

2. Investment flexibility in the face of uncertain but growing electricity demand due to lower absolute size of units (SMRs, NEA (2012));

3. Exposure of different technologies to long-term changes in different input factors such as interest rates, carbon costs, fuel costs... (IEA/NEA 2010);

4. Ability to ride out short-term variations in input prices (mainly gas) as the price-setting marginal fuel (Newbery, Roques et al.);

5. Value of price stability for risk-averse investors administered through long-term price contracts, feed-in tariffs, regulated prices, contracts-for-difference etc. for different technologies.
Methodology

1. NPV calculations following methodology in *Carbon Pricing and the Competitiveness of Nuclear Energy* (NEA, 2011); daily European prices for gas and electricity 2005-2010 (with “suspension option” to adjust load factors);


3. Logic of real-valued option following Dixit and Pindyck (1994) as the value of flexibility (also the “value of waiting”) in the face of unanticipated uncertainty, which is possessed by technologies with low fixed costs (FC);
   a) Share of FC in LCOE nuclear up to 73% or 85% at 5% or 10% interest rate;
   b) Share of FC in LCOE gas (CCGT) 8% to 13% at 5% or 10% interest rate;

4. Risk aversion modelled as constant relative risk aversion (CRRA) that takes into account wealth effects;

5. Further research on more realistic representation of private investor choices through inclusion of tax effects and debt-equity splits.
The NPV of a Nuclear Power Plant in Function of a Fall in Electricity Prices and the Onset of the Price Fall Years after Commissioning (r = 5%)
The NPV of a Gas-Fired Power Plant in Function of a Fall in Electricity Prices and the Onset of the Price Fall Years after Commissioning (r = 5%)
The Value of Price Stability

The Value of the Option to Exit the Market for Gas
(Assuming an unanticipated 30% decline in electricity prices)
The Value of Price Stability

Option Value of a Gas-Fired Power Plant over a Nuclear Power Plant at Unanticipated Price Declines of Different Sizes (r = 5%)
The Value of Price Stability
Offsetting Interest Rate Differential

Compensating Interest Rate Differential Required to Offset the Exit Option of Gas when Faced with Electricity Price Falls of 30% and 50%
The Value of a Contract-for-Difference (CfD) for Nuclear and Gas for Different Degrees of Risk Aversion (CRRA)
The Value of a Contract-for-Difference (CfD) for Nuclear and Gas as a Percentage of Overnight Costs
The Value of a Contract-for-Difference Mark-Up over Market Prices

The Net Present Value of a Nuclear Plant at Different Strike Prices

NPV Market Prices (Avg. 55 €/MWh)
NPV Mark Up 10 €/MWh
NPV Mark Up 30 €/MWh
NPV Mark Up 50 €/MWh
Value of CFD Market Prices (Avg. 55 €/MWh)
Value of CFD Market Up 50 €/MWh
Institutional Choices are Technology Choices

Levelised Costs of Electricity (LCOE) under Different Financing and Regulatory Arrangements
(USD/MWh, Commissioning 2018)

Source: California Energy Commission (2010), Comparative Costs of California Central Station Electricity Generation
• Long-term electricity price volatility is a major source for risk and uncertainty facing investors in nuclear new build and needs to be appropriately managed;
• Technologies with high fixed to variable cost ratios are particularly vulnerable even at similar LCOEs (fixed price by definition);
• Neglect may lead to economically suboptimal choices in the long-run as investors rationally eschew technologies with high fixed cost in markets with price risk;
• Technologies with low fixed costs, however, are almost by definition carbon-intensive fossil fuel technologies
• Long-term electricity price risk is fundamentally different from short-term price risk which affects high variable cost technologies first.
• Institutional choices (regulated vs. deregulated markets) are neither technology-neutral nor environmentally neutral and need to be discussed in broader fashion.
• Independent of the competitiveness of different technologies, due to selective subsidisation, current electricity market prices would not allow any new dispatchable capacity to be built, which requires discussion about “mark-ups”.
### Assumptions on Cost and Technology

<table>
<thead>
<tr>
<th>Technical Assumptions</th>
<th>Nuclear</th>
<th>Gas</th>
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<tbody>
<tr>
<td>Capacity</td>
<td>1000 MW</td>
<td>1000 MW</td>
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<tr>
<td>Construction years</td>
<td>7</td>
<td>2</td>
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<tr>
<td>Lifetime</td>
<td>60</td>
<td>30</td>
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<tr>
<td>Electrical conversion efficiency</td>
<td>n.a.</td>
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<td>Gross energy content of fuel unit</td>
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<td>1 MWh</td>
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<td>CO2 emissions per MWh</td>
<td>0</td>
<td>0.37 tCO2/MWh</td>
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</table>

<table>
<thead>
<tr>
<th>Cost Assumptions</th>
<th>Nuclear</th>
<th>Gas</th>
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<tbody>
<tr>
<td>Overnight costs</td>
<td>4 186 €/kW</td>
<td>851 €/kW</td>
</tr>
<tr>
<td>O&amp;M</td>
<td>10.92 €/MWh</td>
<td>3.54 €/MWh</td>
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<td>Fuela</td>
<td>6.31 €/MWh</td>
<td>Daily</td>
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<tr>
<td>Decommissioning</td>
<td>628 €/kW</td>
<td>43 €/kW</td>
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*Fuel costs for nuclear energy include cost for the back-end of the fuel cycle.*
