Who can best carry the risk of the future Energiewende?

PPAs as a tool to allocate risk to the most suitable parties

January 2019
PPA negotiations try to strike a deal between the technology cost and the fair market value perspective.

Developers take the perspective of *technology cost* during PPA negotiations...

...while off-takers should focus on the perspective of *fair market value* of power.

PPAs can create value for both parties with the right trade-off between guaranteed cash flow (reducing the financing cost for asset) and the value-at-risk and energy market value for the off-taker.

*Source: Aurora Energy Research*
A fixed price enables debt finance leverage and can reduces project WACC by 4.3%

Debt Perspective

- Lender interested in secured repayment of debt & interest
- Debt sizing based on conservative estimation of repayment ability:
  - Based on P90 wind year
  - Guaranteed cash flow (fixed or floor price)
  - Additional buffer applied through Debt Service Coverage Ratio DSCR (secured cash flow needed to repay e.g. 1.1 – 1.4 x debt & interest in each period)

Example 1: fixed price PPA enables debt financing

Example 2: without PPA asset is financed all equity

Offshore wind farm, COD 2023
PPA: 12-year, volume as-produced
Debt: tenor 15 years at 3%, DSCR 1.2

1) All interest rates are nominal. 2) The rates represents a generic assumption and can vary depending on project parties and details.

Source: Aurora Energy Research
Fair market value of an offshore wind fixed price 12-year PPA is around 45 EUR/MWh for volume as-produced

Contract clause: **Duration**: 12 years starting 2023 // **Price**: fixed price // **Volume**: as-produced & no economic curtailment

Fair price calculation for offshore wind with fixed price PPA, EUR/MWh

<table>
<thead>
<tr>
<th>Expected energy value of onshore profile over next 12 years is 7.4 EUR/MWh below baseload</th>
<th>Price effect of high/low wind year increases expected value</th>
<th>Forecast uncertainty Day-ahead to final delivery decrease value</th>
<th>Outlook for GoO price</th>
<th>The cost of holding capital to cover a P90 loss is 5.9 EUR/MWh</th>
<th>Value at risk (EUR/ MWh)</th>
<th>Off-taker holds downside risk if market price falls below contract value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Wholesale price</td>
<td>Asset profile</td>
<td>Interannual variability</td>
<td>Short-term balancing cost</td>
<td>Value of energy</td>
<td>GoO</td>
<td>Cost of capital at risk</td>
</tr>
</tbody>
</table>

Source: Aurora Energy Research
For long-term contracts which could enable green-field developments VaR rises to 11 EUR/MWh

Value of delivered energy in a offshore wind PPA\(^1\), EUR/MWh

Market scenario:
- P50
- P90
- P10
- Expected value

Value at risk, EUR/MWh
- 11

Cost of capital at risk\(^2\), EUR/MWh
- 5.9

1) Capture prices shown for a representative asset, with GoO value added, and cost for short-term imbalance and interannual variability subtracted. 2) Based on corporate WACC of 9%

Source: Aurora Energy Research
To a certain level a rising price floor improves project economics

Impact of price floors on equity IRRs

<table>
<thead>
<tr>
<th>Price floor in EUR/MWh</th>
<th>Equity IRR in %</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td></td>
</tr>
<tr>
<td>5</td>
<td></td>
</tr>
<tr>
<td>10</td>
<td></td>
</tr>
<tr>
<td>15</td>
<td></td>
</tr>
<tr>
<td>20</td>
<td></td>
</tr>
<tr>
<td>25</td>
<td></td>
</tr>
<tr>
<td>30</td>
<td></td>
</tr>
<tr>
<td>35</td>
<td></td>
</tr>
<tr>
<td>40</td>
<td></td>
</tr>
<tr>
<td>45</td>
<td></td>
</tr>
<tr>
<td>50</td>
<td></td>
</tr>
</tbody>
</table>

CAPEX assumptions: Strong reduction (-33%)  Returns for fixed price

Typical IRR range for equity investors in infrastructure

- **Fixed price** most profitable as off-taker is accepting all risk and discount is lowered by foregone upside
- **Raising floor** returns little value
- **Benefit of higher price floor** outweighs bigger value discount

**Equity IRR**

Debt/Equity ratio

1) EDHEC Infrastructure Institute (2017). 2) Nominal IRR for fully leveraged equity

Source: Aurora Energy Research
Increasing floor beyond 35 EUR/MWh has marginal return for equity but adds significant VaR for off-taker

CAPEX assumptions:
- Moderate reduction (-12%)
- Medium reduction (-20%)
- Strong reduction (-33%)
- Fixed price contract

**Impact of price floors on equity IRRs**

**Impact of price floors on Value-at-Risk**

Who can best carry the long-term value at risk?

Source: Aurora Energy Research
C&I ability to take power price risk is estimated to be limited to ~60 TWh/a or 1 bn EUR value at risk

Rough estimate of C&I PPA market potential, TWh/a

<table>
<thead>
<tr>
<th>Industry</th>
<th>Share of big consumers</th>
<th>Share with ability to absorb risk</th>
</tr>
</thead>
<tbody>
<tr>
<td>All Metalls</td>
<td>365</td>
<td>147</td>
</tr>
<tr>
<td>Chemical</td>
<td>315</td>
<td>112</td>
</tr>
<tr>
<td>Mining</td>
<td>235</td>
<td>70</td>
</tr>
<tr>
<td>Food and Tobacco</td>
<td>183</td>
<td>62</td>
</tr>
<tr>
<td>Paper &amp; Print</td>
<td>112</td>
<td>62</td>
</tr>
<tr>
<td>Telecom.</td>
<td>62</td>
<td>62</td>
</tr>
<tr>
<td>Trade &amp; Com.</td>
<td>57</td>
<td>57</td>
</tr>
<tr>
<td>Hotels &amp; Restaurants</td>
<td>57</td>
<td>57</td>
</tr>
<tr>
<td>Automotive</td>
<td>57</td>
<td>57</td>
</tr>
<tr>
<td>Machinery</td>
<td>57</td>
<td>57</td>
</tr>
<tr>
<td>Rail</td>
<td>57</td>
<td>57</td>
</tr>
<tr>
<td>Other Services</td>
<td>57</td>
<td>57</td>
</tr>
</tbody>
</table>

Short duration PPA potential: Ability to absorb power price risk depends on share of power on total cost & level of competition

Long duration PPA potential: PPAs are only bankable if off-taker are of sufficient size

Source: Aurora Energy Research
Until 2030 Energiewende requires investments with 24 – 33 bn EUR in value at risk, ca. twice C&I absorbability

Cumulative value at risk over investment payback time vs. ability to absorb risk, bn EUR

Source: Aurora Energy Research
Outlook for the future

Industry
- Large off-taker who are able to absorb power price risk are likely a scarce resource and thus have a strong negotiation power.

Utilities
- To transition to a “subsidy-free” Energiewende the market needs large risk accumulators who are able to manage long-term power price risks. This would favour the classical utility model.

Regulation
- If the aim is to transition away from subsidies regulator should focus on reducing downside risks e.g.: Carbon price floor, fixed long-term build out targets etc.

Source: Aurora Energy Research
Disclaimer

General Disclaimer
This document is provided “as is” for your information only and no representation or warranty, express or implied, is given by Aurora Energy Research Limited (“Aurora”), its directors, employees, agents or affiliates (together its “Associates”) as to its accuracy, reliability or completeness. Aurora and its Associates assume no responsibility, and accept no liability for, any loss arising out of your use of this document. This document is not to be relied upon for any purpose or used in substitution for your own independent investigations and sound judgment. The information contained in this document reflects our beliefs, assumptions, intentions and expectations as of the date of this document and is subject to change. Aurora assumes no obligation, and does not intend, to update this information.

Forward looking statements
This document contains forward-looking statements and information, which reflect Aurora’s current view with respect to future events and financial performance. When used in this document, the words "believes", "expects", "plans", "may", "will", "would", "could", "should", "anticipates", "estimates", "project", "intend" or "outlook" or other variations of these words or other similar expressions are intended to identify forward-looking statements and information. Actual results may differ materially from the expectations expressed or implied in the forward-looking statements as a result of known and unknown risks and uncertainties. Known risks and uncertainties include but are not limited to: risks associated with political events in Europe and elsewhere, contractual risks, creditworthiness of customers, performance of suppliers and management of plant and personnel; risk associated with financial factors such as volatility in exchange rates, increases in interest rates, restrictions on access to capital, and swings in global financial markets; risks associated with domestic and foreign government regulation, including export controls and economic sanctions; and other risks, including litigation. The foregoing list of important factors is not exhaustive.

Copyright
This document and its content (including, but not limited to, the text, images, graphics and illustrations) is the copyright material of Aurora[, unless otherwise stated]. No part of this document may be copied, reproduced, distributed or in any way used for commercial purposes without the prior written consent of Aurora.