Implicit Fuel Hedge

Understanding the value of RWE’s hedging approach

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RWE follows a risk mitigating and value enhancing hedging strategy

- Risk mitigating hedging strategy focuses on reducing commodity price risks of outright generation position (Lignite & Nuclear)
- Earnings from RWE’s lignite and nuclear power plants are positively correlated to outright power prices and can be defined as “long power” and “short carbon”
- A perfect hedge of the outright (“long”) power position against commodity price risks would be to sell power (fully hedged)
- However, liquidity in national power markets can be limited and therefore constrain hedging volumes. Further, it is sometimes forecast that the spreads are undervalued

RWE generally covers outright position first by implicit fuel hedging

- Power prices in any time period are determined by the marginal or price setting power plants during that period, which are often hard-coal or gas-fired power plant in Germany
- Therefore, power prices correlate well with the price setting fuel complex (coal, gas and CO₂)
- Selling the fuel complex is therefore an adequate proxy hedge to sell outright power, mitigating the majority, but not all, of the risk and allowing to retain any upside in spreads
- The fuel complex matches the estimated ratio at time gas, coal (and other) power stations are the price setting power plant

- Specific proportion of CO₂ intensity of fuel complex is smaller than specific CO₂ intensity for RWE’s outright generation
- RWE buys CO₂ certificates to fill this gap – CO₂ financially hedged (earnings-neutral)
Hedge path of outright production volume – RWE differentiates between two hedge types

**Hedging types of outright production volume**

- **Open position** is RWE’s completely unhedged position
- It is fully exposed to CO₂ adjusted power price development
- CO₂ financially hedged\(^1\)

- **Implicit Fuel Hedged (IFH)** – sold fuel complex (basket of coal, gas and CO₂)
- Risk profile of implicit fuel hedged position matches the risk of price setting power plants – via the implicit fuel hedge an outright position is transformed into a **mix of Clean Dark and Clean Spark Spreads**
- Substitutes power sales transactions that would exceed available market liquidity for power
- CO₂ financially hedged\(^1\)

- **Fully hedged** position represents sold power volumes (locked in at a specific power price)
- CO₂ fully hedged\(^2\)
- Perfect hedge achieved

\(^1\) CO₂ requirements are covered to close the gap between higher CO₂ intensity of outright generation and CO₂ intensity of the price setting power plant
\(^2\) Total CO₂ requirements covered
Valuation of average hedge price derives from both hedged positions and is driven by spreads & hedge volume

\[ \bar{\text{Hedge price}}_t = p\% \times (\bar{FC} + \text{PSS}_t) + f\% \times \bar{PWR} \]

\[ \bar{\text{Hedge price}}_t \]

Average hedge price at t (€/MWh)

FC

weighted average hedge price for all implicit fuel hedges (€/MWh)

PWR

weighted average hedge price for all power hedges (€/MWh)

PSS_t

Price Setting Spread at t (€/MWh)

- Average hedge price is the weighted sum of the hedged fuel complex (implicit fuel hedged) and the hedged power price (fully hedged)
- Current Price Setting Spread is added to hedged fuel complex to reflect required conversion from implicit fuel hedged at a later point in time. This conversion is priced into the average hedge price at current market levels

Valuation of Ø-Hedge price – Impact of changes in parameters

What if prices change²...

- …power price increases, but fuel complex increases less
- …power price increases, but fuel complex increases more
- …power price and fuel complex change in an equal proportion

Impact...

- Increase of price setting spread hence hedge price increases
- Decrease of price setting spread hence the hedge price decreases
- No change of price setting spread hence neutral for hedge price

What if hedge proportions change...

- …change open position into implicit fuel hedge or fully hedge
- …change implicit fuel hedge into fully hedge

Impact...

- Hedge price increases, if current power price > Ø hedge price
- Hedge price decreases, if current power price < Ø hedge price
- Neutral for hedge price

¹ Note that p% + f% = 100% | ² Only relevant for implicit fuel hedged volume
Collection of average hedge price calculations illustrating the impact of changes in parameters on its development

Implicit Fuel Hedge: Overview of scenarios illustrating development of the average hedge price - ILLUSTRATIVE

Remainder

\[ \text{Hedge price}_t = p\% \times (FC + PSS_t) + f\% \times PWR \]

<table>
<thead>
<tr>
<th>Market situation</th>
<th>A</th>
<th>B</th>
<th>C</th>
<th>D</th>
</tr>
</thead>
<tbody>
<tr>
<td>Power Price – PWR, (€/MWh)</td>
<td>29</td>
<td>35</td>
<td>35</td>
<td>40</td>
</tr>
<tr>
<td>Fuel Complex – FC, (€/MWh)</td>
<td>25</td>
<td>31</td>
<td>28</td>
<td>37</td>
</tr>
<tr>
<td>Price Setting Spread – PSS, (€/MWh)</td>
<td>4</td>
<td>4</td>
<td>7</td>
<td>3</td>
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<table>
<thead>
<tr>
<th>Hedge situation</th>
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</thead>
<tbody>
<tr>
<td>Proportion Proxy Hedged (p%)</td>
<td>75%</td>
<td>75%</td>
<td>75%</td>
<td>75%</td>
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<tr>
<td>Proportion Fully Hedged (f%)</td>
<td>25%</td>
<td>25%</td>
<td>25%</td>
<td>25%</td>
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</table>

| Weighted Hedge Price Proxy Hedged (€/MWh) | 21,8 | 21,8 | 24,0 | 21,0 |
| Power Price (€/MWh) | 25,0 | 25,0 | 25,0 | 25,0 |
| Fuel Complex (€/MWh) | 29,0 | 29,0 | 32,0 | 28,0 |

| Weighted Hedge Price Fully Hedged (€/MWh) | 7,3 | 7,3 | 7,3 | 7,3 |
| Power Price (€/MWh) | 29,0 | 29,0 | 29,0 | 29,0 |

\[ \text{Hedge price}_t (€/MWh) \]

29,0  29,0  31,3  28,3

Note: Changes in the \( \text{Hedge price} \) stemming from different hedge proportions would require a more comprehensive formula
Profitability of lignite plants are determined by hedged power prices and hedged carbon prices

Deep dive on commercial implications of RWE’s ‘Lignite’ outright position

- RWE’s specific CO₂ intensity of its outright generation portfolio is higher than specific CO₂ intensity of average price setting power plant
- Financial CO₂ hedge brings RWE’s CO₂ intensity in line with average price setting power plant to be earnings-neutral to changes to the CO₂ price
- For the profitability of the outright position both, the hedged power price as well as the hedged CO₂ price, are relevant

<table>
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<tr>
<th>Hedged Scenario</th>
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<th>B</th>
<th>C</th>
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<tbody>
<tr>
<td>Hedged Power price (€/MWh)</td>
<td>29</td>
<td>41</td>
<td>45</td>
</tr>
<tr>
<td>Hedged CO₂ price (€/MWh)</td>
<td>6</td>
<td>18</td>
<td>18</td>
</tr>
<tr>
<td>Realised margin for lignite generation (€/MWh)</td>
<td>23</td>
<td>23</td>
<td>27</td>
</tr>
</tbody>
</table>

Comments on earnings compared to scenario A:

- Power price increase purely driven by CO₂ price increase. No margin impact (earnings-neutral)
- Power price increase driven by CO₂ price & fuel price increase. Margin increase (earnings-positive)
Hedging figures Q1/2018 – lower Ø hedge price for 2020 due to strong decline of spreads since beginning of 2018

Expected positions and hedge status as of 31 March 2018

- **Outright (Lignite & Nuclear)**
  - **Average hedge price 2018 – 2021** corresponds with average hedged CO₂ price in the range of ~€5 – 6/t²
  - 2018E: ~28
    - Open position: 85 – 90 TWh
    - Fully hedged position: >90%
  - 2019E: ~28
    - Open position: 80 – 85 TWh
    - Fully hedged position: >90%
  - 2020E: ~29
    - Open position: 80 – 85 TWh
    - Fully hedged position: >80%
  - 2021E: ~29
    - Open position: 80 – 85 TWh
    - Fully hedged position: >30%

- **Spread (European Power)**
  - **50 – 70 TWh¹**
    - 2018E: >90%
    - 2019E: >50%
    - 2020E: <10%
    - 2021E: <10%

- **CO₂**
  - Position financially hedged until end of 2022

¹ Total in-the-money spread | ² Equivalent to emission costs of ~€6 – 7/MWh for lignite generation
Significant decline of fuel spreads since end of 2017

Development of German fuel spreads\(^1\) – reported Q1/2018

![Graph showing development of German fuel spreads](image)

1 Fuel spread defined as: Power price - (pass-through-factor carbon \(\times\) EUA price + pass-through-factor coal \(\times\) coal price + pass-through-factor gas \(\times\) gas price)

2 Note: Shown figures based on average fuel spreads per month (€/MWh) | Source: Bloomberg; data until 31 March 2018
CAO activities extract additional value on top of hedging

CAO value contribution

**Deviation from Reference Hedge Path**
- Within defined limits
- Based on fundamental market views

**Fuel procurement & logistics**
- Physical procurement of fuel and substitutes
- Commercialisation of by-products

**Reserve & ancillary services**
- Reserve, voltage support/reactive power
- Frequency response, black start

**Option management**
- Re-optimisation of power station option
- Shape management
- Trading around hedge positions

**Short-term optimisation**
- Short-term trading
- Balancing markets
- Dispatch/intra-day trading

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1 On top of realised forward hedges as per Reference Hedge Path. Reported within results of Lignite & Nuclear and European Power
Key messages of outright generation hedging

✔ In general, a perfect hedge for outright generation positions against commodity price risks is selling power at attractive market conditions.

✔ The implicit fuel hedge (selling the fuel complex) is the best proxy hedge to substitute outright hedge.

✔ Implicit fuel hedging allows to overcome liquidity constraints in the power market and accelerated risk reduction compared to purely outright hedging of power.

✔ Implicit fuel hedging retains upsides and downsides from an under/overvaluation of the power price relative to the fuel complex (price setting spread).

✔ CO₂ is financially hedged until 2022: power price changes driven by CO₂ (via the price setting plant) have no impact on RWE’s earnings.
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- IR videos
  http://www.rwe.com/ir/videos
- Consensus of analysts’ estimates
  http://www.rwe.com/ir/consensus-estimates

Financial Calendar
- 14 August 2018
  Interim statement on the first half of 2018
- 14 November 2018
  Interim statement on the first three quarters of 2018
- 14 March 2019
  Annual report 2018
- 3 May 2019
  Annual General Meeting
- 15 May 2019
  Interim statement on the first quarter of 2019

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