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# Method or Madness: Insights from Germany's Record-Breaking Offshore Wind Auction and Its Implications for Future Auctions

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## Key Points

The use of auctions to determine required support levels has been a hot topic in renewables for a number of years now. The offshore wind auction results that Germany's energy regulator (BNetzA) announced on 13 April 2017 certainly turned up the heat in this industry even further.

Of the four winning projects, **three did not request any output subsidy on top of wholesale electricity prices** (referred to as "zero market premium" or "zero MP" bids in this paper).<sup>2</sup> Majority state-owned Danish energy company DONG secured three projects in the North Sea with an overall capacity of about 600 MW, of which 480 MW will be delivered as zero MP bids, while majority state-owned German utility EnBW pledged to deliver a full 900 MW of capacity (also in the North Sea) as a zero MP project.

On its face, the fact that two bidders have pledged to deliver offshore wind farms at a market premium ("Marktprämie")<sup>3</sup> of zero suggests that expected cost reductions are well beyond what commentators thought possible.<sup>4</sup> If the projects are indeed delivered as planned, the results represent a paradigm shift in the offshore wind industry and underline the power of auctions as a tool for efficiently deploying renewable energy.

However, some features of the auction design in Germany (namely long lead times until realization and relatively low penalties for non-realization) do raise red flags that these bids may simply be used as so-called "real options" that will allow the successful bidders to "wait and see" how technology and the electricity market (particularly electricity prices) develop until the final investment decision has to be made in the early 2020s. Under the German scheme, this option of backtracking from the project potentially comes at a relatively low cost,<sup>5</sup> meaning the jury is still out on whether the current results will eventually vindicate auction proponents, or instead, the opponents who have pointed to the higher risk of projects not being delivered under auctioning systems.

In any case, EnBW’s and DONG’s record-breaking bids have succeeded in “rewriting” the rules for auction participants — bidders in future rounds will need to assess and account for any possible option value included in their bids to stand a chance of being successful. Option values will differ across auction rounds, across policy regimes, and between projects, but adequately accounting for whatever option value is available may make the difference between a successful and an unsuccessful bid.

Alongside the implications for project sponsors, policymakers will need to take a close look at auction design if they want to limit the risk of being left with record-breaking bids that are not delivered years later (or face the risk of “blackmail” associated with such scenarios). By designing the rules efficiently, policymakers will be able to harness the power of auctions as a tool for revealing the true cost of projects and driving cost reductions, while limiting the risk of project non-delivery.

## The Results

The German offshore wind auction that closed on 3 April 2017 allocated 1,490 MW (out of an available maximum of 1,550 MW) of offshore generation capacity, to be developed between 2021 and 2025 among owners of existing pre-developed projects.<sup>6</sup> The following projects were successful:

Project	Owner	Volume (MW)	Strike Price (€/MWh)	Delivery Year
<b>He Dreiht</b>	EnBW	900	0	2025
<b>OWP West</b>	DONG	240	0	2024
<b>Borkum Riffg W 2</b>	DONG	240	0	2024
<b>Gode Wind 3</b>	DONG	110	60	2023

Source: Company press releases and finalization years of the relevant network connections, as per BNetzA announcement of the auction.

Over a 20-year period starting from the delivery year, the auction winners will receive a market premium that is a top-up payment equal to the difference between their individual strike price and the average market price realized by all German offshore wind farms each month (henceforth referred to as the technology average price). The strike price is not indexed to inflation. If the strike price exceeds the technology average price, an operator whose wholesale market sales are exactly in line with the average offshore wind farm obtains the strike price exactly (because its revenues are equal to wholesale market revenues plus the calculated market premium), while an operator whose wholesale market revenues exceed or fall short of the technology average price earns more or less, respectively, than the strike price. Germany employs a one-way strike price system: If the technology average price exceeds the strike price, the operator gets to keep its wholesale market revenues and does not have to pay back the difference.

In practice, the zero MP wind farms earn exactly their wholesale market revenues.<sup>7</sup> For the Gode Wind project, which bid a €60/MWh strike price, the wind farm will keep its wholesale market revenues in months when the technology average price exceeds €60, and it will receive a top-up payment (equal to the difference between the strike price and the technology average price) in months when wholesale prices are lower. After the 20-year subsidy period elapses, all operators can sell their output on the wholesale market for an additional five to 10 years before the license to use the site is transferred back to the state.<sup>8</sup>

Various market analysts (including authors of this paper) have undertaken power price modeling that indicates that German wholesale prices may rise to in excess of €60/MWh for most of the operating life of the four winning projects, as nuclear power plants and various other conventional German power plants are phased out by 2022. Under these circumstances, the strike price for Gode Wind can be understood as insurance against adverse market developments. No such insurance value exists for the zero MP bids, although the successful bids may provide other forms of insurance.<sup>9</sup>

## Understanding the Winning Bids—Technological and Market Developments

With the winning projects not due to be delivered until the mid-2020s, the strike prices likely do reflect significant expected technological progress and market developments. In particular, the successful bidders publicly provided the following insight into the motivations behind their bids<sup>10</sup>:

- **Scale effects and location:** Both successful auction participants stress that project scales and synergies with nearby offshore wind farms will reduce average costs. DONG plans to combine the “OWP West” and “Borkum Riffgrund West 2” projects into one large-scale project with the option of adding more volume in the 2018 auction. EnBW’s He Dreiht project was the single biggest project competing (900 MW), and EnBW also expects to realize substantial scale effects through its proximity to other EnBW wind farms. Moreover, DONG’s projects also benefit from some of the highest wind speeds seen across its portfolio.
- **Technology improvements:** Both EnBW and DONG expect that future technological advancements will substantially decrease costs. Notably, DONG expects that 13-15 MW capacity turbines will be on the market by 2024, substantially reducing the cost per MW.<sup>11</sup>
- **Lifetime:** German authorities have allowed the possibility of a lifetime extension up to 30 years, which lets the project owners spread project costs over a longer time period.
- **Power prices:** Both companies expect that future power prices will make their investments profitable. EnBW states that the expected return for the He Dreiht offshore wind farm is considerably above hurdle rates (of 7.5%, according to EnBW’s annual report<sup>12</sup>), even under moderate assumptions regarding future electricity prices.

There may also be an intention among the winning bidders to conclude direct long-term power purchase agreements (PPAs) with third party off-takers, which would allow the operators to shield themselves from some market risk.<sup>13</sup>

## Understanding the Winning Bids—Competitive Pressures

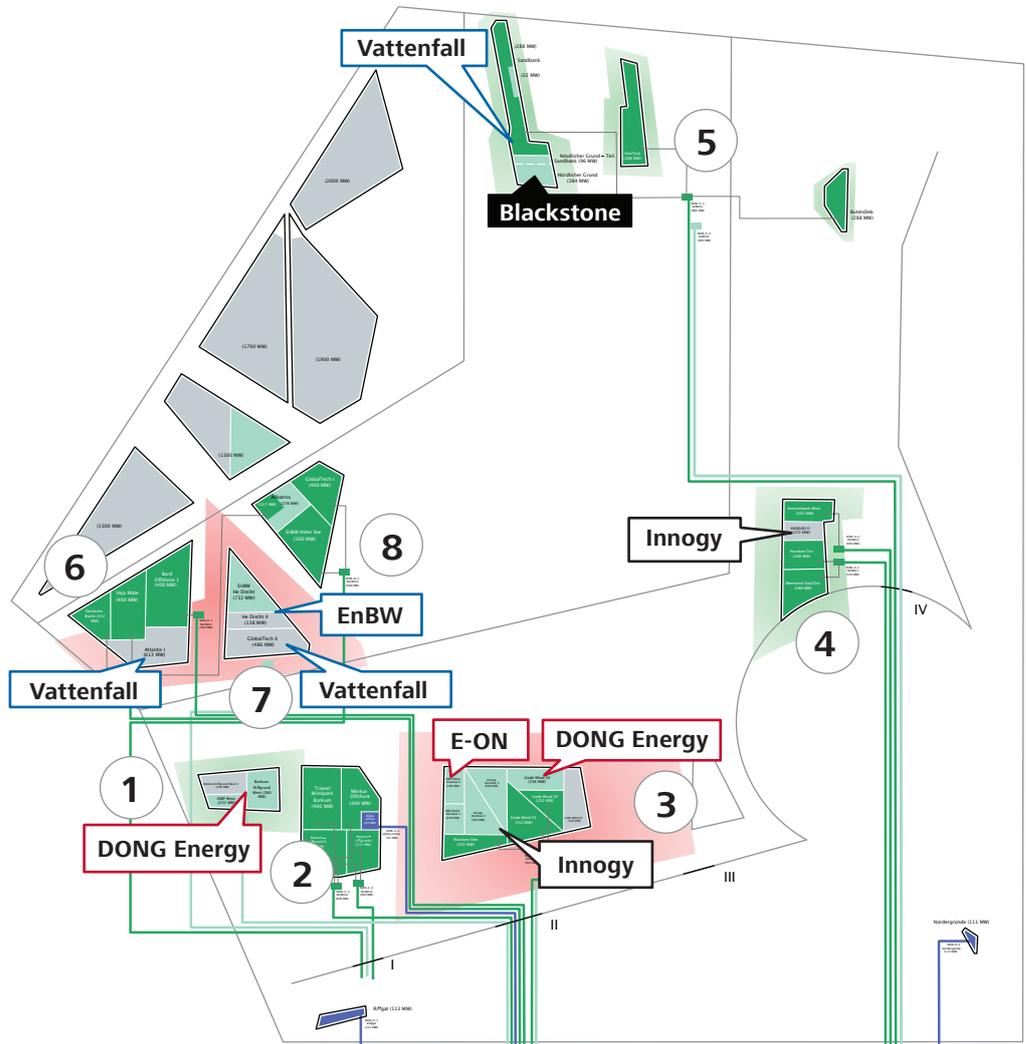
In addition to the technological and market features expected to determine the viability of an offshore wind farm in the mid-2020s and the 20 years that follow, competitive pressures in the current auction are also likely to have affected bidding behavior.

Owners of approximately 7,000 MW, in total, were cleared to take part in the auction. With only a maximum of 1,550 MW available in the first auction, competition was always going to be fierce. This pressure was intensified by the fact that unsuccessful bidders would have only one more chance to secure support in the planned 2018 auction before their projects become ineligible for a network connection, leaving approximately 4,000 MW out of those initially cleared with the prospect of having to be abandoned by the original developer.<sup>14</sup>

Although the competitive pressures were known in advance, outturn bids were even lower than the forecasted price range of €60/MWh to €90/MWh that various observers expected prior to the auction.<sup>15</sup> The zero MP bids defied expectations even further, signing up to a floor price well below recent results in the Netherlands and Denmark, which—while not fully comparable—had seen strike prices at or around €50/MWh.<sup>16</sup>

The German auction was designed as a “pay-as-bid” auction, a straightforward auction procedure that will have been understood well by all participants. A degree of complexity was introduced by the fact that the overall volume cap of 1,550 MW was supplemented by individual volume caps for each location cluster.<sup>17</sup> These cluster sub-caps are determined by the maximum network capacity available for connecting each cluster.<sup>18</sup> For example, Cluster 1, 4, and 5 have sufficient network capacity to connect all potential bidders in that cluster, while the network capacity available to Cluster 3 and Cluster 6/7 (which are connected through the same cable; NOR 7-1) were both oversubscribed by a factor of nearly 2x.<sup>19</sup>

The figure below shows the respective clusters and bidders in the North Sea. Bidders in the Baltic Sea will also face significant within-cluster competition when participating in the 2018 auction.



EnBW’s zero MP bid, He Dreiht, is located in Cluster 7, where scarce network capacity also represented a binding sub-cap. On the other hand, DONG had eligible projects in Cluster 1 and Cluster 3. Despite Cluster 1 having sufficient network capacity for all projects, DONG chose to bid more aggressively in Cluster 1 (where it placed zero MP bids for both OWP West and Borkum Riffgrund West 2) rather than in Cluster 3, where the €60/MWh Gode Wind project is located. This bidding behavior may be explained by relative project size and by Cluster 3 requiring wind farms to be constructed and connected a year earlier than Cluster 1 (2023 vs. 2024). Other cost drivers, such as distance from shore and water depth,<sup>20</sup> do not appear to justify a significantly higher premium for Cluster 3 relative to Cluster 1.

## Understanding the Winning Bids—Real Option Value

In addition to technological and competitive reasons for the very low bids observed in Germany, the auction design creates what is known as a “real option value”<sup>21</sup> for a successful bidder. Option value is likely to be a key driver behind the very low support levels included in the April 2017 bids for the reasons outlined below.

The German Offshore Wind Energy Act requires bidders to post a bid bond equivalent to €100/kW prior to auction (i.e., €90 million in the case of EnBW’s He Dreiht, the largest project amongst all bidders). Once that bid bond is posted and if the relatively inexpensive step of starting the planning approval (“Planfeststellung”) process is taken within 12 months after the conclusion of the auction, the next milestone is not due until 24 months before the expected completion of the project (which in the case of EnBW’s He Dreiht may be as late as end of 2023).<sup>22</sup> The penalty associated with not delivering at this point is the cancellation of the award and a penalty which may be as low as 30% of the bid bond, i.e., €27 million, in the case of EnBW’s He Dreiht wind farm.<sup>23</sup>

The penalty structure limits the losses associated with not developing the project as initially envisaged by the successful bidder if market conditions do not develop as expected (for example, large turbines might not become available in time, or wholesale power prices might not rise as anticipated). The bidder can potentially abandon the project at a relatively low cost, as late as the end of 2023 in EnBW’s case.<sup>24</sup> The appendix provides a stylized example of a bidder’s rationale for bidding aggressively today when there is a “real option” to abandon a contract won today, while an unsuccessful project becomes ineligible for the future.<sup>25</sup>

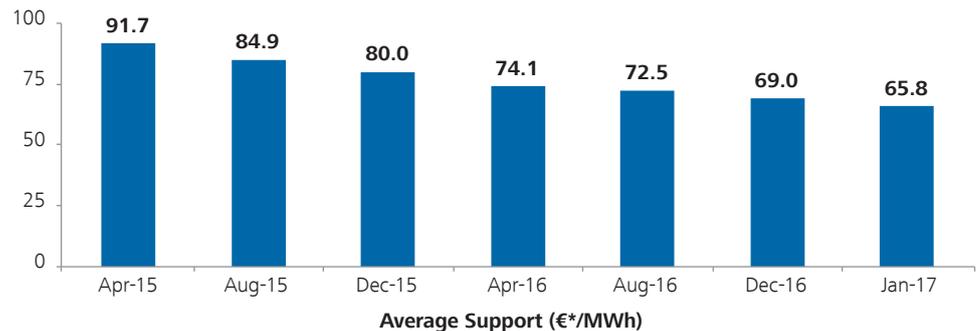
Generally, the value of the real option increases with:

- The time period for which the owner of the option (permit) is allowed to wait and see how trends develop;
- The volatility of factors affecting the value of the project (e.g., technology and wholesale market prices) and the extent to which waiting reduces uncertainty about these elements;
- Low discount rates, as the present value of future cash flows is not discounted significantly compared to the cost of “buying the option” (posting the bid bond) today; and
- Low costs at which the project can be abandoned (i.e., the lower the penalty for non-delivery at different stages of the process, the higher the option value).

A number of factors do appear to make the option particularly attractive in EnBW’s case: a distant commissioning date increases the potential gains from waiting, and the large scale of the project offers potentially significant cost advantages if there are major technology improvements.<sup>26</sup> Hence, others may find their option value to be smaller. But their individual valuations notwithstanding, EnBW and DONG have “changed the rules of the game”: to ensure success, bidders will have to move from thinking only about the value of a commissioned project to thinking about the option value of the project given possible future scenarios.

## What Do These Results Mean for Bidders in Germany's Next Auction?

The unsuccessful bidders of the first round, including offshore stalwarts such as Vattenfall, will have a second shot at obtaining a share of the remaining 1,610 MW in April 2018 before all currently pre-developed sites become ineligible for future support.<sup>27</sup> If Germany's solar photovoltaic (PV) auctions provide any indication of future results, the 2018 auction offers little hope to the remaining bidders that prices will recover. As shown below, solar PV subsidies have dropped lower with each round.



Note: \*Estimated Ultimate Recovery  
Source: NERA analysis of BNetzA documents.

Does this mean that the age of the subsidized German offshore wind farm is over once and for all? Perhaps not, as there are at least a few rays of hope that potential bidders in the 2018 auction will want to consider, among which are:

- The specifics of the legal framework, including a specific allocation to the Baltic Sea (“Ostsee Quote”);
- The stipulation that links the *lowest* bid in the second auction round to the maximum price for the central model, both of which encourage less aggressive bidding;
- Bidders learning from the first round that zero MP bids were lower than necessary, thereby “wasting” value; and
- A decrease in the real option value that can be captured by bidders due to the shorter time lag between the allocation of capacity and the necessary start of construction in most cases.

We discuss each of these in turn.

### 1. The Specifics of the Legal Framework—“Ostsee Quote”

As part of the 2018 auction, the Offshore Wind Energy Act (WindSeeG) allocates a minimum of 500 MW for projects in the Baltic Sea to be delivered in 2021 (the so-called Ostsee Quote). Given the lower level of competition in applications for this subset of projects and given the fact that these projects will have to be delivered in 2021 when technological progress is unlikely to be as advanced as in 2025, these projects are less likely to be delivered without subsidy. Moreover, most bidders will not be able to benefit from the same scale effects as in the North Sea. Hence, projects in the Baltic Sea may still legitimately expect to capture positive subsidies in the 2018 auction.

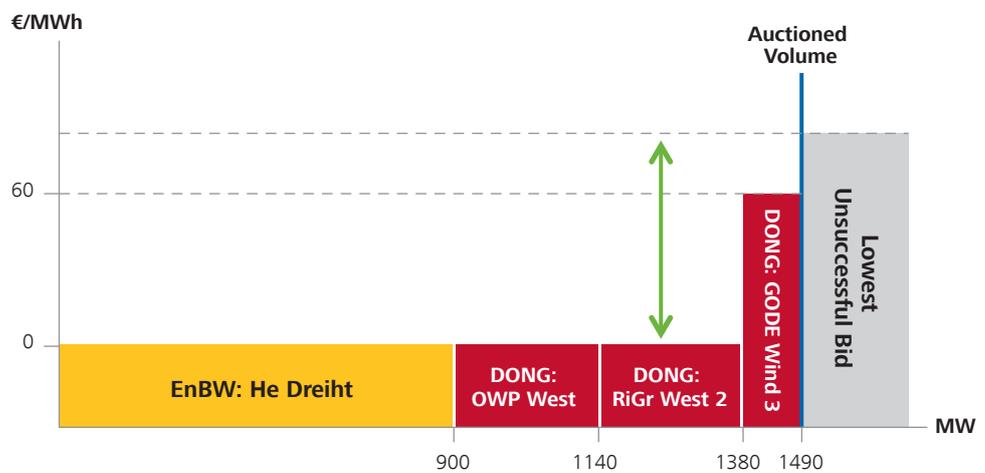
Given that the allocation of at least 500 MW (up to the maximum available network capacity of 765 MW) will be subtracted from the capacity available to projects in the North Sea, bidders in the North Sea will also need to understand the likely ranking and bidding strategies of projects in the Baltic Sea to gauge the volume available to the North Sea.

### 2. The Specifics of the Legal Framework—“Maximum Price for the Central Model”

In addition, the WindSeeG requires the BNetzA to use the *lowest* bid received in the 2018 auction for setting the maximum price for all auctions under the central model. If taken at face value, any “zero subsidy” bid received in the 2018 auction would imply that all auctions under the central model will not be able to allocate any subsidy.<sup>29</sup> Hence, bidders with an interest in taking part in auctions under the central model will need to consider the implications of their bids, not only on the profitability of the projects taking part in the 2018 auction but also on the viability of their participation in future auctions. Knowing that this is the case, other bidders may also believe they are themselves able to bid less aggressively. That said, bidders may also need to account for the possibility of other bidders expecting the government to step in and change the rules if the results from the 2018 auction are seen as producing unsustainably low maximum prices for subsequent auction rounds.

### 3. Lessons Learned from the 2017 Auction

Bidders will also want to take account of lessons learned from the 2017 auction. As illustrated below, the companies offering zero MP bids would have also been successful at significantly higher strike prices, e.g., €59/MWh.



Source: NERA illustration.

In hindsight, a bid closer to the highest successful bid would have allowed DONG and EnBW to capture significant insurance against downside price risk while still being successful. A higher strike price would likely have also increased the probability of project realization. Obviously, the exact valuations of competing bidders cannot be known *ex ante*, and any bidder will need to analyze the tradeoff between the likelihood of success and the expected value from a successful bid. The fact that projects from different clusters, delivery years, and with very different geographical attributes were successful suggests that there is no simple ordering and that different simulations of uncertain parameters need to be undertaken.

Given the focus on scale effects by both successful bidders, the results from the 2017 auction also likely imply a renewed need to look into strategic acquisitions, either to reduce competition (where it does not fall afoul of competition law) and/or to generate scale effects.

#### **4. Real Option Valuation**

As set out above, bidders will need to look into incorporating the full value of any optionality that can be included in their bid, as the ability to do so may well be the differentiator between a won and a lost bid. There are a range of models (of varying complexity) that can be used to determine the option value, but the primary drivers that need to be assessed, both for one's own project and competing ones, are:

- The relevant "underlying" (the value of the project) and the number of periods (years) for which the project can be delayed;
- The volatility of the underlying and its dimensions (e.g., technology risk and market price risk);
- The appropriate discount rate; and
- The "price" or present value for which the project bidder can abandon the project.

Appendix 1 provides a stylized example of how these steps can be used for quantitative valuation of the option.

Conceptually, this will involve understanding the potential for uncertainty to resolve between the submission of the bid and the various project milestones, in addition to determining a realistic central case valuation. Among other things, this will require bidders to understand the impact that different market developments will have on power prices and thus, the distribution of power price levels around the base case.

The bidder will also need to understand in detail: i) the likely resale value of the project to another bidder (which depends on the degree to which risks affect all bidders in the same way) and ii) the (financial and reputational) cost of abandoning the project altogether at the various points in time should technology and market price developments not move in the expected direction.

Given that penalties for non-delivery increase over time, the same consideration applies for bidders that have already been awarded a project. They will need to re-evaluate their options whenever a penalty milestone approaches in order to validate whether continuing to develop the project remains the preferred option.

## What Does The Result Mean for German Offshore Wind Policy?

If the winning projects from Germany's recent auction are successfully delivered, the results will mark a breakthrough for offshore wind as a cost-competitive generation technology. Not surprisingly, the results have almost immediately raised calls for lifting the cap on offshore generation capacity (which currently stands at 15 GW until 2030).<sup>30</sup>

However, allowing for faster expansion by increasing auctioned capacities may actually hurt the chances of unsubsidized projects being realized, as the expansion of additional zero marginal cost generation will likely lower the wholesale prices earned by offshore wind farms. Hence, increasing the expansion targets may not lead to increased realization rates because some successful bidders could trigger their wait and see options and eventually abandon their projects.

Policyholders themselves would appear to be better off making use of the wait and see option with regard to the successful delivery of the projects at a market premium of zero before significantly expanding the offshore wind target under the current framework. In light of the option value considerations set out above, there is already a non-trivial risk that projects will not actually be completed. Given the long lead times for other project development and the comparatively rigid framework that the WindSeeG imposes on possible adjustment measures, Germany's ability to reach its medium-term offshore wind goals would need to be closely monitored.

Policyholders will, therefore, need to put in place provisions to avoid possible "blackmailing" behavior by bidders in which they threaten not to deliver in order to push for concessions.<sup>31</sup> In addition, policymakers also need to assess whether penalties for non-completion of successful projects and lead times between capacity allocation and construction remain appropriate, in the context of option value and risks around project delivery. Obviously, any measure taken to redesign the auctions should avoid *ex-post* interference in order not to damage confidence in future auctions.

## What Do the Results Mean for Auctions Abroad

There are also lessons to be learned for auctions outside Germany—most immediately for the upcoming auction in the UK, in which a number of gigawatt-scale offshore wind farms may be competing.<sup>32</sup>

In light of the German result, it seems reasonable to expect that DONG (and others) will also bid aggressively in the UK. This will be driven in part by expectations of cost reductions. Also pointing in this direction is that the UK auction design imposes only modest penalties for non-delivery on winning projects, which may make the real option value of projects an important consideration.<sup>33</sup>

That said, auction watchers should not expect “zero bids” in the UK auctions, for a number of reasons. First, the UK auction is for projects to be delivered from 2021 to early 2023, so there is less time for cost reductions to materialize. Second, as NERA has discussed elsewhere,<sup>34</sup> projects in the UK must factor in the cost of grid connection, whereas in Germany much of this cost is in fact borne by consumers through network charges. Third, competition in the upcoming UK auction looks set to be more limited in this auction round, in the sense that there may be only a few offshore wind projects bidding.<sup>35</sup> And finally, there is the important difference that the UK subsidy is for a “two-way” contract—that is, it provides not only a floor to bidders’ revenue per MWh as in Germany, but also a ceiling—which is absent from the German format. Not even the most aggressive bidders will be capping their revenues at £0/MWh! Bids around the expected future wholesale price (projected by the UK government to be around £52/MWh in 2024, in 2012 prices) would be the lowest one might expect bidders to go.

The final point to take from the German results is that the details of auction design make a big difference to optimal bidding strategy; most notably in relation to penalties for non-delivery but also in relation to delivery years and regional caps. In the UK, there are some similar capacity constraints—with a maximum capacity imposed on some technologies. There are also, in effect, multiple *budget* constraints that can bind in each year, and project sponsors are able to offer to commission their projects in multiple years. When there are a small number of large projects, this allows sponsors to influence when budget constraints are breached and hence, when the auction clears and at what price. All of which suggests an equally interesting result emerging from the UK over the summer...

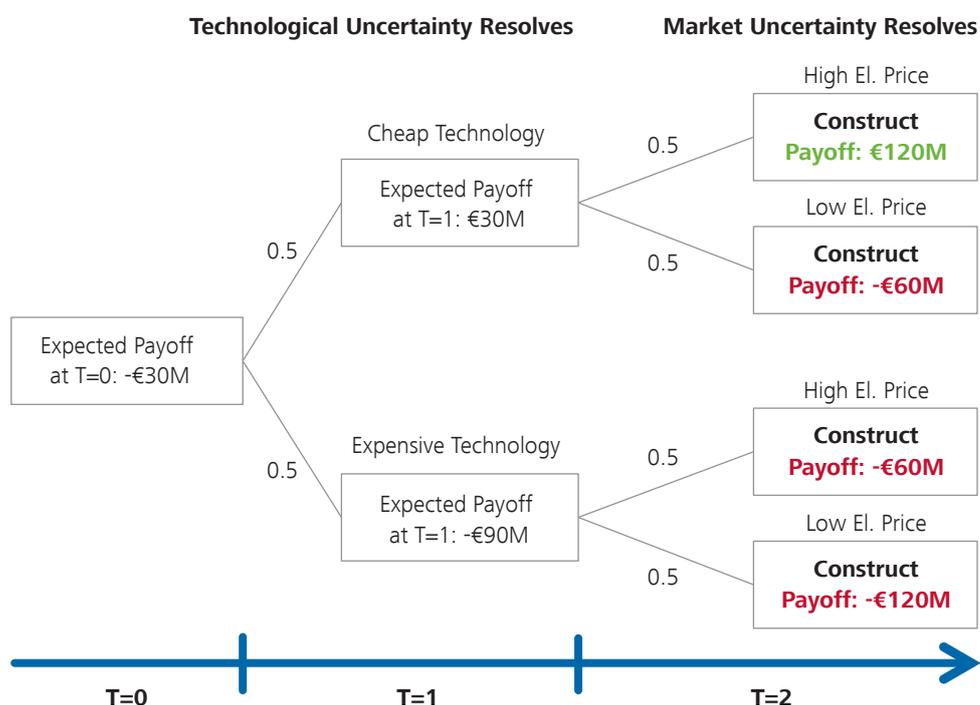
## Appendix 1: Example of Real Options Applied a to Stylized Offshore Wind Auction Decision-Making Process

The following stylized example illustrates the value of the real option to be included in the decision-making process of whether to offer a zero MP bid.<sup>36</sup> The bidder has to make the bid submission at  $t=0$  and makes a final investment decision at  $t=1$ . In this example, there are two types of uncertainty:

- **Technology uncertainty** (which will have been resolved by the time the bidder has to make the final investment decision); and
- **Market price uncertainty** (which will not have been resolved by the time the bidder has to make the final investment decision).<sup>37</sup>

We illustrate the issue using only two states of the world: With probability 0.5, the technology available to the owner of the pre-developed offshore wind farm will be cheap at the time of construction and with probability 0.5, it will be expensive. The electricity price over the life of the wind farm will be high with probability 0.5 and low with a probability 0.5. The payoffs in the different states are chosen for illustrative purposes.

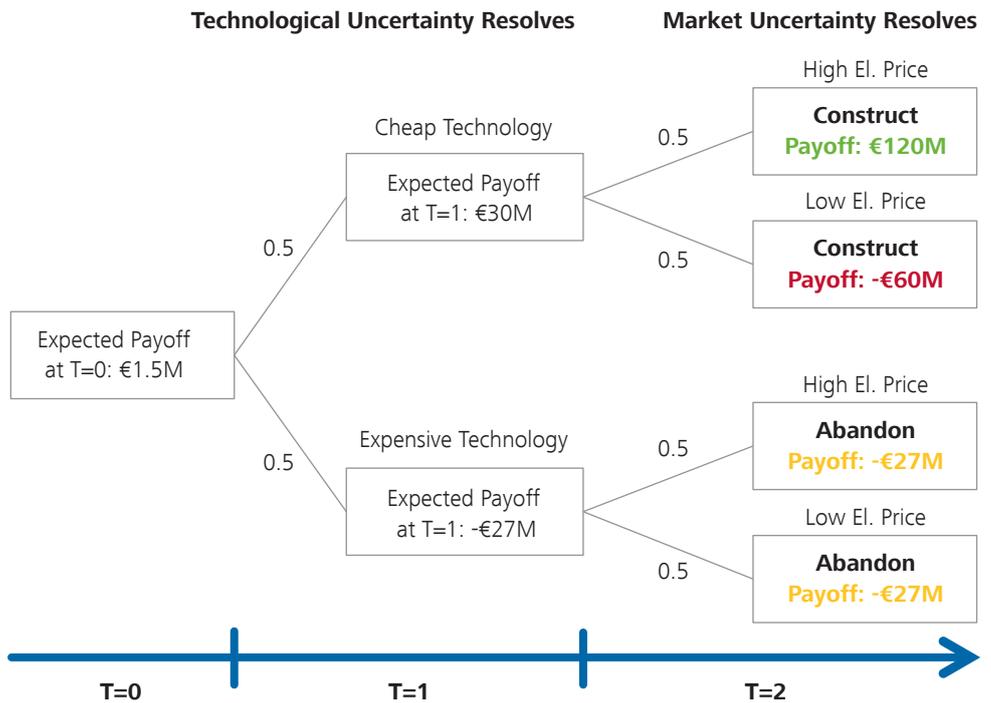
First, consider the case where the owner of the pre-developed project does not have the option of abandoning the project before making the final investment decision (i.e., during period  $t=1$ ), as illustrated in the below chart.



Source: NERA illustration.

If the owner of the pre-developed project enters an auction at  $t=0$  and does not have the option to abandon the project at  $t=1$ , four different scenarios arise. Given the probabilities for each of the scenarios, the expected payoff for the project at a zero MP given what is known at  $t=0$  is  $-\text{€}30$  million. The owner of the pre-developed project would decide against entering a zero MP bid (as the NPV is negative) and instead would need to reduce its chances of success by including a significant premium in its bid.

In an alternative scenario corresponding more closely to the situation that bidders faced in the current auction round, a different outcome arises. A successful bidder at  $t=0$  will have the option of abandoning the project at  $t=1$  at a cost of  $\text{€}27$  million, as illustrated in the below chart.



Source: NERA illustration.

With the option of abandoning the project at  $t=1$ , the owner of the project can await and react to the development of the technology. Depending on whether cheap technology is available, the owner will either construct the offshore wind farm or abandon the project. If only expensive technology is available, the owner will abandon the project in period  $t=1$  at a payoff of  $-\text{€}27$  million (the penalty). This cost is an improvement compared to the expected average payoff of  $-\text{€}90$  million in the "expensive technology" scenario without the real option.

The option to limit losses in the case of expensive technology from €90 million to €27 million changes the expected payoff in period  $t=0$  from -€30 million to +€1.5 million. At  $t=0$ , the expected payoff from submitting a zero MP bid is positive. Consequently, the value of the option to wait and see how technology and markets develop can explain what looks like very aggressive bids given today's expectations about technology and electricity price developments.

In practice, an individual bidder will need to check whether a zero MP bid is indeed the preferred option by weighing it against the expected payoff from other bid prices (and their associated probabilities of success) and by taking account of the respective option values that the different bids entail, given what is known about technology and power price uncertainty.

## Appendix 2 – List of Eligible Projects

Project Name	Capacity	Ultimate Owner	Cluster	Availability of Network Connection	Distance	Depth
<b>North Sea</b>						
<b>Gode Wind 3</b>	<b>110</b>	<b>DONG</b>	<b>3</b>	<b>2023</b>	<b>39</b>	<b>30-34</b>
Gode Wind 4	336	DONG	3	2023	42	30-34
Nordsee 2	384	Northland Power/ Innogy	3	2023	47	29-34
Nordsee 3	400	Northland Power/ Innogy	3	2023	47	28-33
KASKASI II	272	Innogy	4	Available*	48	18-24
OWP Delta Nordsee 1	210	E.ON	3	2023	50	26-34
OWP Delta Nordsee 2	160	E.ON	3	2023	51	29-33
Borkum Riffgrund West 1	270	DONG	1	2024	53	29-31
<b>OWP West</b>	<b>240</b>	<b>DONG</b>	<b>1</b>	<b>2024</b>	<b>58</b>	<b>29-33</b>
<b>Borkum Riffgrund West 2</b>	<b>240</b>	<b>DONG</b>	<b>1</b>	<b>2024</b>	<b>67</b>	<b>29-31</b>
<i>Atlantis I</i>	<i>613</i>	<i>Vattenfall</i>	<i>6</i>	<i>2025</i>	<i>83</i>	<i>37-40</i>
Nördlicher Grund	384	Blackstone Group	5	2025	84	27-38
<b>He Dreiht</b>	<b>900</b>	<b>EnBW</b>	<b>7</b>	<b>2025</b>	<b>85</b>	<b>39</b>
<i>Global Tech II</i>	<i>486</i>	<i>Vattenfall</i>	<i>7</i>	<i>2025</i>	<i>85</i>	<i>37-39</i>
Nördlicher Grund (Sandbank)	240	Vattenfall	5	2025	95	26-34
<b>Baltic Sea</b>						
Arcadis Ost 1	348	Wintershall/KNK	4	2021	17	41-46
Baltic Eagle	500	Sea Wind Holding	2	2021	28	40-44
Ostseeschatz	252	Windreich AG	2	2021	30	45-47
Adlergrund GAP	155	BEC Energy Consult	1	2021	36	34-37
Adlergrund 500	72	BEC Energy Consult	1	2021	40	34-37
Wikinger Nord	40	Iberdrola	1	2021	40	40
Wikinger Süd	85	Iberdrola	1	2021	41	27-37
Windanker	250	Iberdrola	1	2021	42	41-45

Source: NERA analysis of 4coffshore, BSH, and network development plan data. Availability refers to the availability of the network connection. Kaskasi II can be connected to an existing network connection.

**Projects in bold** represent projects that were successful in the 2017 auction.

*Projects in grey italics* represent projects for which no (meaningful) further network capacity is available, given the results of the 2017 auction.

## Notes

- <sup>1</sup> The authors would like to thank Clemens Koenig, Sebastian Hanson, Petra Loerke, and Florian Mockel for research and support in developing this paper.
- <sup>2</sup> It is not strictly accurate to say that the projects are free of subsidy, as a significant portion of the grid connection costs are paid by end users as part of network charges.
- <sup>3</sup> In Germany, wind farms receive financial support through a “market premium” approach. The market premium can be thought of as a top-up on the market price. If the market price is lower than the operator’s strike price (“anzulegender Wert”), the operator will receive a market premium defined as an additional top-up equal to the difference between the strike price and the (monthly average technology-specific) market price. I.e., the operator bears the risk of realizing sales at less than the technology average price. If the market price is higher than the strike price, the operator will receive the market price that it is able to realize. There is no obligation to pay back the premium over the strike price.
- <sup>4</sup> Note that the weighted average strike price of €4.4/MWh across all four projects is not very informative in this context (because no operator will actually receive €0/MWh but rather the market price in the majority of hours, except for those periods where the market price drops to below zero).
- <sup>5</sup> We understand that the eventual interpretation of the penalties clause in the Offshore Wind Act (WindSeeG) is disputed in the legal community. However, even under what we understand to be the higher of the plausible penalty scenarios, a successful bid still carries significant option value. NERA Economic Consulting is not licensed to provide legal advice and hence any questions regarding the legal interpretation of the WindSeeG should be clarified with your legal advisers.
- <sup>6</sup> Under the Offshore Wind Energy Act (WindSeeG), projects that were already approved prior to 1 August 2016 or those for which a hearing at the responsible authority had taken place prior to 1 August 2016 are classified as pre-developed and were eligible to participate in the current auction round.
- <sup>7</sup> These are likely to be below the wholesale market average price as offshore wind generation profiles have generally realized wholesale market prices below the general average wholesale price. See <https://www.netztransparenz.de/Erneuerbare-Energien-Gesetz/Marktpraemie/Marktwerte>.
- <sup>8</sup> Art. 48 of the Offshore Wind Energy Act limits the initial license at 25 years with a possible five-year extension if there is no immediate and alternative demand for use of the site.
- <sup>9</sup> E.g., EnBW may treat the offshore wind farm as a hedge for its Southern German coal plants, with the former gaining under a faster exit from coal (which would hurt the latter) and vice versa under a splitting of the German electricity market.
- <sup>10</sup> Information taken from EnBW and DONG press releases: [https://www.enbw.com/unternehmen/presse/pressemitteilungen/presse-detailseite\\_157185.html](https://www.enbw.com/unternehmen/presse/pressemitteilungen/presse-detailseite_157185.html) and <http://www.dongenergy.com/en/media/newsroom/company-announcements-details?omxid=1557851>.
- <sup>11</sup> The turbines deployed in DONG’s offshore wind farms Borkum Riffgrund 1 (operational) and Borkum Riffgrund 2 (under construction) are of 4 MW and 8 MW capacity, respectively.
- <sup>12</sup> See <https://www.enbw.com/media/downloadcenter-konzern/geschaeftsberichte/enbw-integrierter-geschaeftsbericht-2016.pdf>, p. 62.
- <sup>13</sup> In March 2017, DONG concluded its first direct offshore wind PPA with a UK clean energy retailer (Good Energy), which both parties have stated they are looking to expand and extend. See <http://www.dongenergy.co.uk/news/press-releases/articles/good-energy-sources-wind-power-from-dong-energy%E2%80%99s-westermost-rough>.
- <sup>14</sup> After 2018, the renewable support scheme for offshore wind farms switches to the so-called “central model,” which is comparable to those in Denmark or Netherlands and under which the state will pre-develop sites for which bidders compete. The only compensation for original developers that transfer their projects to the state to develop as part of the central model is a “right to replace” (“Eintrittsrecht”) the successful bidder at the given strike price. Given current uncertainty about the timing of future development and pricing, this right to replace is generally not considered to be of high (if any) value.
- <sup>15</sup> See for example, KfW Research, “Teurer Wind auf rauer See: Lassen Ausschreibungen die Preise purzeln?“, 3 April 2017 and Frankfurter Allgemeine Zeitung, „Strom aus Meereswindparks wird deutlich billiger,“ 6 April 2017.
- <sup>16</sup> E.g., the Dutch and Danish auctions provide the support for a shorter period but require the bidder to pay for a smaller share of the within-park cabling costs. In addition to treatment of grid costs, the Danish and Dutch projects also differ from the German ones with respect to water depth, distance from shore, planning and licensing costs, type of contract (one-way vs. two-way contracts for difference (CfD)) and grid access.
- <sup>17</sup> A cluster refers to a pre-determined area to be connected by (usually) one network connection. There are eight different clusters in the North Sea. In the Baltic Sea, eligible bidders are located in three different clusters, but in practice, these amount to one and the same cluster as they are all linked by one network connection.
- <sup>18</sup> For clusters where network capacity was scarce, bidders needed not only to be competitive overall but also to submit lower bids than their direct competitors within the cluster, to the extent where it may be possible for a project to be unsuccessful despite being the second cheapest overall if all capacity in the cluster is taken up by the cheapest project overall.
- <sup>19</sup> E.g., this meant that the six projects in Cluster 3 had to compete for the 900 MW of network capacity available to that cluster, so projects that did not fit into the 900 MW sub-cap would be ineligible to win support even if they were among the cheapest 1,550 MW overall.
- <sup>20</sup> For the cost impact of distance to shore and water depth, see the detailed industry study Fichtner & Prognos (2013), *Kostensenkungspotenziale der Offshore-Windenergie in Deutschland*.
- <sup>21</sup> See Dixit and Pindyck (1994): *Investment under Uncertainty* for general introduction to real options in investment analysis and Haug et al (2015): *Deriving ALFs from Lump-Sum Valuations – A Response to Ofcom’s Third Consultation, Appendix* (available at: [https://www.ofcom.org.uk/\\_\\_data/assets/pdf\\_file/0015/82104/telefonica\\_-\\_annex\\_4.pdf](https://www.ofcom.org.uk/__data/assets/pdf_file/0015/82104/telefonica_-_annex_4.pdf)) for an application of the real option value concept to a returnable license.
- <sup>22</sup> See Art. 59 of the WindSeeG. The network development plan only states that the connection for cluster 6/7 will be delivered in 2025. The exact month setting the deadline for completion of the wind farm and network connection will be determined at a later stage.
- <sup>23</sup> See Art. 60 of the WindSeeG. We understand that the interpretation of Art. 60 is not straightforward from a legal perspective. An alternative interpretation of Art. 60 would see EnBW forfeit the entire bid bond of €90 million in case of non-delivery. The most likely interpretation would need to be clarified with your project’s legal advisers. The equivalent penalty for either of DONG’s zero MP bid wind farms is €7.2 million and €24 million, respectively under the different interpretations of the penalty clause.
- <sup>24</sup> Also see [http://bizzenenergytoday.com/die\\_offshore\\_sensation\\_und\\_ihre\\_fallstricke](http://bizzenenergytoday.com/die_offshore_sensation_und_ihre_fallstricke), which similarly raises the issue that the winning bids essentially constitute call options.

## Notes

- <sup>25</sup> One might argue that the “right to match” offers a way back and thus, a real option for the owner of an existing project because the owner of a right to match can always “step in” at a minimum of zero subsidy (or the auction-clearing price) once the project is offered in the central model. Unlike bidding at zero subsidy in the original auction, following this approach would not expose the owner to a risk of penalties. However, two aspects of the German system limit the viability of such a strategy: i) The tendering authority may reshape and combine plots, which means no right to match may materialize and/or ii) the plot may not come up for auction before the late 2020s, thereby significantly delaying the ability to develop the project.
- <sup>26</sup> While the size of the penalty is proportional to project size, there may still be benefits from a project’s large size if there are non-linearities in the development of project costs.
- <sup>27</sup> The only compensation they receive is if the German regulator auctions their pre-developed sites again after 2025, they will have the right to build their pre-developed offshore wind farms at the lowest bid received. It is unclear whether this right to match will be worth a lot as it depends on the behavior of other bidders and on the Federal Maritime and Hydrographic Agency considering particular sites again. There is significant doubt in the legal community as to whether this instrument provides “just compensation” as required by the constitution.
- <sup>28</sup> The joint German/Danish auction from December 2016 is omitted in this illustration as the price was set by Danish plants only.
- <sup>29</sup> The WindSeeG contains some stipulations that the BNetzA can adjust the maximum price by a certain maximum percentage if it finds demand in the auction to be insufficient at the given price. However, at face value a percentage adjustment of a strike price of zero will not do anything to solve the issue.
- <sup>30</sup> See e.g., <http://www.windkraft-journal.de/2017/04/16/wirtschaftsminister-fordert-staerkeren-ausbau-der-offshore-windenergie/101214> and <http://www.offshore-stiftung.de/bundesnetzagentur-ver%C3%B6ffentlicht-ausschreibungsergebnisse>.
- <sup>31</sup> The opportunity for “blackmail” will only be credible if the reputational damage for government from not reaching its renewables targets due to large offshore wind farms not being delivered exceeds the financial and reputational damage to the bidder abandoning the project after taking account of possible additional damage the government can cause to the bidder in the future.
- <sup>32</sup> This second auction round under the contracts for difference (CfD) scheme opened in April 2017, with results due in the summer of 2017. The first round ran from late 2014 to early 2015 and saw winning bids for offshore wind projects far above the levels currently seen in the market (exceeding €100/MWh).
- <sup>33</sup> While the penalties for non-delivery in the second round have somewhat increased relative to the first round, they are still limited to exclusions of the project from future auctions, i.e., unlike in Germany, there is no direct financial penalty.
- <sup>34</sup> See [http://www.nera.com/publications/archive/2016/PUB\\_offshore\\_wind\\_A4\\_0916.html](http://www.nera.com/publications/archive/2016/PUB_offshore_wind_A4_0916.html).
- <sup>35</sup> Competition in the UK auction is also more complex, in that it plays out along more dimensions than in the German case. For example, “choice of commissioning year,” i.e., when a bidder promises to have completed the project, is a relevant strategic variable in the UK auction, whereas bidders in the German auction cannot influence the scheduled commissioning year for their project.
- <sup>36</sup> For simplicity, we assume a discount rate of  $r=0$ .
- <sup>37</sup> In practice, some market price uncertainty will have been resolved at the time of the final investment decision (although significant uncertainty will remain). Hence, the true option value is likely to be understated by the example shown here.

## About NERA

NERA Economic Consulting ([www.nera.com](http://www.nera.com)) is a global firm of experts dedicated to applying economic, finance, and quantitative principles to complex business and legal challenges. For over half a century, NERA's economists have been creating strategies, studies, reports, expert testimony, and policy recommendations for government authorities and the world's leading law firms and corporations. We bring academic rigor, objectivity, and real world industry experience to bear on issues arising from competition, regulation, public policy, strategy, finance, and litigation.

NERA's clients value our ability to apply and communicate state-of-the-art approaches clearly and convincingly, our commitment to deliver unbiased findings, and our reputation for quality and independence. Our clients rely on the integrity and skills of our unparalleled team of economists and other experts backed by the resources and reliability of one of the world's largest economic consultancies. With its main office in New York City, NERA serves clients from more than 25 offices across North America, Europe, and Asia Pacific.

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