

# Offshore Wind Development in Germany

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## Abstract

Offshore wind development in Germany has been a critical focus of the country's energy transition strategy. The government has ambitious targets for offshore wind power, looking to install 30, 45, 70 GW by 2030, 2035, and 2045 respectively. This expansion in capacity targets has required a significant auction design overhaul, with the state tendering 1.8 GW of pre-examined and 7 GW of unexamined sites in parallel for the first time in 2023. The German government has scaled back its economic support for developers in recent years, pointing to recent zero-subsidy bids as an indication that competition in the industry is heating up. Bid value remains the most important tender criterion, making financial backing an enterprise's most significant competitive advantage. Germany's first dynamic bidding process generated EUR 12.6 billion in proceeds, paid for by the O&G majors TotalEnergies and BP. For the pre-examined sites, German corporations RWE and Luxcara secured 3 and 1 sites, respectively, with legacy developer Vattenfall exercising its step-in right for one site in September. Germany intends to utilize a large share of the proceeds to reduce consumer costs. However, fear exists that additional costs for offshore wind developers will eventually be passed on to an already struggling supply chain or to the consumers suffering under increased power prices and cost of living due to the 2022 energy crisis. In response, the industry has proposed reforms for upcoming auctions, including a limited number of sites per developer, price caps, or more weight given to qualitative criteria.

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# 1. Introduction

## 1.1 Global Energy Outlook

In the wake of the Covid-19 pandemic, global energy consumption is again reaching new heights. Primary energy consumption increased from 168 450 TWh in 2020 to 177 050 TWh in 2021 (+5.1%) and exceeded 178 900 TWh in 2022 (+1.7%). It remains evident that most of the energy is still produced using fossil fuels such as coal, oil, and natural gas (*Statistical Review of World Energy*, 2023). Fossil energy releases CO<sub>2</sub> and various other greenhouse gases and pollutants. With an ever-growing energy demand, annual CO<sub>2</sub> emissions have reached record levels, at 34.3 Gt in 2022. Extensive scientific studies detail the pivotal role of CO<sub>2</sub> as a driving force in anthropogenic warming through the enhanced greenhouse effect (Khandekar et al., 2005).

## 1.2 The EU's Energy Landscape

### 1.2.1 EU Energy Mix

Since the industrialization of Europe, the continent's energy mix has been dominated by fossil fuels. Despite the rapid expansion of renewables, biofuels, and waste, 70% of the EU's energy supply still stemmed from oil, natural gas, and coal combustion in 2020 (*Emissions and Energy Use in Large Combustion Plants in Europe*, 2023). While nuclear power accounted for a sizable 9 000 000 TJ of energy in 2020, it has become highly controversial in the aftermath of the 2011 Fukushima Daiichi accident, with member states such as Germany and Belgium announcing their complete phase-out by 2023 and 2025, respectively (Welle, 2023). Notably, the economic crises of 2008 & 2020 are reflected through a sharp decline in energy supply in those years.

### 1.2.2 Country Spotlight: Germany

Germany is one of the founding nations of the EU and widely regarded as the key member state shaping the bloc's future. With a population of 83.2 million (2023) and a nominal GDP of 4.3 trillion euros (est 2023), Germany is both the most populous country and the largest economy in the European Union, featuring the single largest energy demand (Felixhagleitner, 2022). In 2021, the primary energy demand totaled 3448 TWh, with the vast majority (77%) originating from fossil fuel sources such as coal, gas, and mineral oil. 72% of this energy was imported, with local sources concentrated in brown coal and renewable electricity (*Supply – Key World Energy Statistics 2021 – Analysis - IEA*, 2021). Renewable energy sources accounted for just 16% of primary demand. Germany's energy strategy, known as the 'Energiewende' was initially designed to map out the country's transition towards a low-carbon, nuclear-free energy future. Renewable targets were expanded significantly as electricity coming from both wind and solar were identified as effective substitutes. Some of the crucial laws subject to amendments were the Renewable Energy Act (EEG), as well as the Onshore and Offshore Wind Act (WindSeeG).

### 1.3 TotalEnergies & OFW in Germany

With their recent rebranding, TotalEnergies has pivoted from a traditional oil and gas major towards becoming a multi-energy company. To become carbon neutral by 2050, TTE is looking to expand its renewable portfolio from 1.5 GW at present to 100 GW by 2030, becoming a top 5 player in renewables in the process. Offshore wind is of significant strategic importance as part of renewable portfolio development, particularly when it comes to delivering

a more baseload-like production profile to end-users. Germany is one of the key target markets. TTE is already one of the leading energy players in a market that lacks any major national champions. They employ more than 4500 people, own 12.1% of the market in refining and rank 3<sup>rd</sup> by number of service stations (*TotalEnergies SE (TTE) Stock Price | Stock Quote Euronext Paris - MarketScreener*, 2001). There exists a real opportunity to leverage key advantages such as strong international expertise and significant customer/partner base. TTE Germany will diversify its hydrocarbon centered portfolio to develop a multi energy offer.

## 2. Offshore Wind: a Literature Review

Despite the associated costs and technological hurdles an ocean environment presents, offshore wind as a renewable technology offers some distinct advantages. Offshore winds are unobstructed by topography or man-made structures, allowing for higher wind speeds and greater consistency. This makes offshore wind farms considerably more efficient, less intermittent, and capable of delivering more power than onshore installations (*Onshore Vs Offshore Wind Energy: What's the Difference?*, 2022). Furthermore, the noise/visual pollution factor is much less of a limiting factor out at sea. Many European nations have recognized OFW's role in their renewable energy strategies. For energy companies coming from oil & gas, offshore wind farms are attractive developments due to their size (up to several GW's) and the overlap in expertise when compared to traditional offshore energy projects.

### 2.1 OFW in Germany

As part of their strategy to ensure energy security and reduce greenhouse gas emissions, Germany is preparing to expand its use of renewable energy sources greatly. Offshore wind will play a key role in the nation's ambition to grow its renewable penetration in gross electricity consumption from 41% to 80% by the end of the decade. In terms of installed renewable capacity, OFW is projected to grow from 6% of the total mix in 2020 to 9% in 2030 (*Executive Summary – Renewables 2021 – Analysis - IEA*, 2021). One of the key advantages of wind offshore is its relative consistency. The ability to reduce volatility in a grid where the share of variable renewables is ever-growing cannot be overstated. International grid connections coupling offshore assets to different member states will also reduce costs, ease congestion, and increase flexibility.

For this reason, Germany has set out some of the most ambitious OFW targets of all EU members. Their latest build-out targets, described in the amended WindSeeG, account for 30 GW by the decade's end, increasing to 40 GW by 2035 and 70 GW by 2045. This rapid expansion will contribute significantly to Germany's renewable electricity production and green hydrogen demand. Green hydrogen is set to play a crucial role in the future of Germany's steel industry, with ThyssenKrupp, ArcelorMittal, etc. identified as major off-takers (Thyssenkrupp, 2022). OFW is envisioned to become Germany's fastest-growing source of electricity, taking it from a mere 27 TWh in 2020 to a projected 197 TWh of the total power mix in 2045.

### 2.1.1 Germany's Offshore Potential

Due to its geography, Germany's OFW deployment faced challenges previously unseen in OFW frontrunners such as Denmark or the UK. Most of Germany's territorial waters (12 miles closest to shore) are dedicated to the Wadden Sea National Park, complicating cabling routes as well as near-shore installation. Furthermore, its Exclusive Economic Zone (EEZ) envelopes a mere 33,000 km<sup>2</sup>, compared to the 6.8 million km<sup>2</sup> in the UK, and faces further competition from intense shipping, fishing, and military activity. Through a dedicated site development plan, the nation's total OFW potential is now estimated at approximately 70 GW (Naimoli, 2022).

### 2.1.2 The 2023 OFW Auctions

This report's analysis will be centered around the OFW auctions of 2023. Under a new auctioning system, 2023 has seen a record 8.8 GW of OFW capacity tendered, 7.8 GW in the North Sea and 1 GW in the Baltic Sea. In 2023, the site development plan has, for the first time, defined sites that will not undergo assessment by the BSH prior to auctioning. These non-examined sites will be auctioned off in parallel with sites that have been pre-examined, to accelerate OFW deployment in Germany. To achieve 50 GW of installed capacity by 2035, the FEP has outlined 36.8 GW of tenders, as illustrated in Figure 1 below. The upcoming tenders are given by type and volume, indicating that by 2027, the split between pre-examined and non-examined sites will be 50-50.

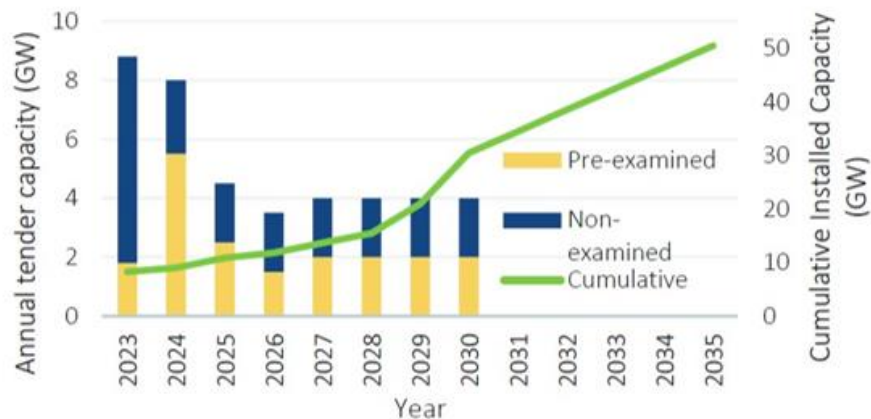


Figure 1: OFW capacity to be tendered by type and volume as per FEP schedule. By 2027, the split between pre- and non-examined sites will be 50-50 (Adapted from Bundesnetzagentur).

OFW Site	Capacity (MW)	Date of Commissioning (COD)	Auction type
<b>N-11.1</b>	2000	2030 Q3	Non-examined
<b>N-12.1</b>	2000	2030 Q3	Non-examined
<b>N-12.2</b>	2000	2030 Q4	Non-examined
<b>O-2.2 (Baltic Sea)</b>	1000	2030 Q3	Non-examined
<b>N-3.5*</b>	420	2028	Pre-examined
<b>N-3.6*</b>	480	2028	Pre-examined
<b>N-6.6*</b>	630	2028	Pre-examined
<b>N-6.7</b>	270	2028	Pre-examined

Table 1: German OFW tenders 2023 (Adapted from Bundesnetzagentur). \*Existing step-in rights.

Of all the OFW sites listed in Table 1 above, only O-2.2 is located in the Baltic Sea. Non-examined sites feature significantly larger capacities (up to 2 GW) and a COD at least 2 years later than the pre-examined sites due to a lack of metocean data and the need for extensive site surveying prior to construction. Sites N-3.5, N-3.6 and N-6.6 are subject to 'step-in' or 'subrogation' rights, awarded to original developers already developing projects on sites re-auctioned through the centralized tendering system in 2017. These legacy developers have the right to acquire the sites won by another developer on the same terms. RWE holds subrogation rights for N-3.5 and N-3.6, whilst Vattenfall holds the subrogation rights for N-6.6.

### 3. Methods

#### 3.1 2023 Tender Analysis Framework

As mentioned earlier, the 2023 auctions will be divided across non-investigated and pre-investigated sites. Key tender information will be included under the following headers:

- **Tender authority** – the party responsible for regulating the auctions.
- **Auction date** – the bid submission date.
- **Subject of tender** – bid objective and rights tied to the winning bid.
- **Auction design** – tender criteria and scoring system.
- **Bid bond & lease fee** – mechanism describing how the bid bond & lease fee will be paid out.
- **Approval procedure** – description of post-bid milestones.

#### 3.2 Competitor Analysis Framework

A consolidated SWOT analysis of TTE Germany will provide insight on TTE's position in the country as well as on the front of OFW. This includes an internal and external outlook. Internal strengths and weaknesses are related to company presence, reputation, expertise and organization, whilst external opportunities and threats are related to regulation, market demand, market ambition and national infrastructure. To select TTE's main competitors for the 2023 German OFW bids, it is useful to identify key competitor characteristics. These will represent a competing institution's ability to outmaneuver TTE in the upcoming tenders, financially or otherwise.

### 4. Analysis & Discussion

#### 4.1 Detailed Auction Design

The non-examined auction is described as 'price-based', as its sole award criteria is the bid value. Bidders are to submit a 'lowest bid value' for a market premium, in €/kWh, under which they will complete the OFW project. This value is capped at 6 €/kWh, with the lowest bid value securing the award. Bids for these sites (see Table 2 below) are due the 1<sup>st</sup> of June 2023. In the event of several 0-cent bids, BNetzA (OFW regulatory authority) would invite involved bidders to a second phase of uncapped 'negative bidding'. Instead of receiving state subsidies to develop a project, developers would pay the government to secure the rights to an OFW site, with bids expressed in €/MW. This second phase is dynamic: developers are invited to a first-round bid with an initial price of 30,000 €/MW of capacity. If all parties involved agree to match the bid, a new round commences, and the price is raised by a further 30,000 €/MW.

	Non-examined	Pre-examined
<b>Tender authority</b>	The federal network agency known as BNetzA is Germany's regulatory authority for all electricity & gas projects.	
<b>Auction date</b>	1 <sup>st</sup> of June, 2023	1 <sup>st</sup> of August, 2023
<b>Subject of the tender</b>	Site exclusivity, permitting process & grid connection.	
<b>Auction design</b>	<p>Bid price is sole auction component (100%). Bidders are required to have Lol with offtakers for at least 20% of production capacity for 5 years.</p> <p>2-stage design:</p> <ol style="list-style-type: none"> <li>1) Single feed-in tariff bid capped at 6.2ct/kWh.</li> <li>2) In the event of multiple 0-cent bids, dynamic bidding commences for all 4 sites in parallel.</li> </ol>	<p><b>Financial component (60 points):</b></p> <ul style="list-style-type: none"> <li>- Highest bid value in €/MW of capacity</li> </ul> <p><b>Qualitative criteria (40 points):</b></p> <ul style="list-style-type: none"> <li>- Decarbonization of offshore wind energy expansion (10 points)</li> <li>- Extent of supply of energy marketed via PPA's (10 points)</li> <li>- Noise pollution and sealing of the seabed (10 points)</li> <li>- Contribution to securing skilled labor (10 points)</li> </ul> <p>In case of a tie, the highest bid price wins. In case of identical bid price: additional auction round(s)</p>
<b>Bid bond &amp; lease fee payments</b>	<p>The bid bond will be 100 €/kw of capacity.</p> <p>10% of the lease fee is to be paid within 12 months of the bid award.</p> <ul style="list-style-type: none"> <li>- 5% is dedicated to marine nature conservation.</li> <li>- 5% is dedicated to local fisheries.</li> </ul> <p>The remaining 90% is to be paid in yearly installments over a period of 20 years, starting from COD.</p>	<p>The bid bond will be 200 €/kw of capacity.</p> <p>10% of the lease fee is to be paid within 12 months of the bid award.</p> <ul style="list-style-type: none"> <li>- 5% is dedicated to marine nature conservation.</li> <li>- 5% is dedicated to local fisheries.</li> </ul> <p>The remaining 90% is to be paid in yearly installments over a period of 20 years, starting from COD.</p>
<b>Approval procedure</b>	Complete permitting application is to be submitted within 24 months after bid award.	Complete permitting application is to be submitted within 12 months after bid award.

Table 2: Key tender rules for non-examined sites (Adapted from Federal Network Agency - Offshore Wind Farms, 2022).

Once a bidder drops out, the first subsequent round will see a price raise of 15 000 €/MW, after which the increment is restored to its original value. Bidding ends if there is only one remaining bidder (this for all sites in parallel). If all bidders drop at the same exit price, sites are awarded as per the lottery system of pre-2023 auctions.

Unlike for the non-examined sites, the auction design of the examined sites includes multiple award criteria, each weighted by their importance worth a cumulative total of 100 points. Bidders will aim to score as many points as possible in a closed envelope bid without a dynamic phase 2. These criteria can be subdivided into quantitative criteria (60 points) and qualitative criteria (40 points) as shown in Table 2 above.

The quantitative component of the auction is an uncapped flat bid value stated in €/MW. The highest bid value will score a maximum 60 points, with all other bids receiving a fraction dependent on their bid value relative to the highest bid.

Besides the weighting of the criteria, it is essential to identify the specific points where a competitive advantage can develop. *'Decarbonization of OFW expansion'*, *'extent of supply of energy produced marketed via PPA'*, and *'noise pollution and sealing of the seabed'* are criteria for which multiple bidders will likely achieve the full 10 points. This is because they are very achievable by developers with more robust financials (renewable electricity and alternative pile driving methods are merely more expensive) or require a simple letter of intent. Contrarily, the criterion involving the workforce's share of apprentices/trainees heavily favors local developers as Germany is one of the nations with the largest involvement of 'trainees' in the world (Sloane, 2014). Important to the 2023 auctions is the fact that 3 out of 4 sites remain under step-in rights held by legacy developers. This guarantees RWE and Vattenfall the right to develop these sites, even without a winning bid. These rights are expected to reduce the appetite of other developers from bidding on the examined sites of the 2023 auctions.

#### 4.2 Competitor Analysis

Offshore wind appetite based on announced targets and an appetite for the German market in general (power, hydrogen) will give a very strong picture of competitive will in the 2023 summer tenders. Offtake advantage was also scored, as the most aggressive bidders will look to leverage regional assets and

customers. Out of the O&G majors, BP and Equinor have demonstrated the largest appetite for OFW development in the region, with BP opening a new office in the critical seaport of Hamburg. BP, like TotalEnergies, operates a major refinery in Germany that could lead to significant synergies with a German offshore wind farm. Out of the list of utilities, EnBW & RWE are expected to have a major offtake advantage as they are operating on home turf, whilst Vattenfall also still has considerable thermal generation in Germany. An interesting distinction can be observed between the hurdle rates of the O&G majors and the utilities, in that the weighted average cost of capital for BP, Shell, Equinor and Eni is significantly larger. This is due to the larger expected internal rate of return of shareholders for these companies as opposed to national utilities like EnBW (Germany) or Vattenfall (Sweden). A cumulative score is used to identify which corporations will likely be TTE's most prominent competitors in the 2023 auctions. BP leads the tally, followed closely by RWE, Vattenfall and EnBW.

Figure 2 below is a chart combining the key characteristics of the competitor analysis framework. BP, Equinor and RWE are categorized as the 'most dangerous' competitors, featuring a combination of financial strength, German presence & appetite, and bid aggressivity. Strategic bidders such as Iberdrola, Vattenfall, and Ørsted also display significant appetite. However, they will likely not have the financial capacity to outlast BP or TotalEnergies in the event of prolonged uncapped negative bidding. EDF, Eni & Shell have considerable resources but have thus far shown limited interest in the German offshore wind auctions.



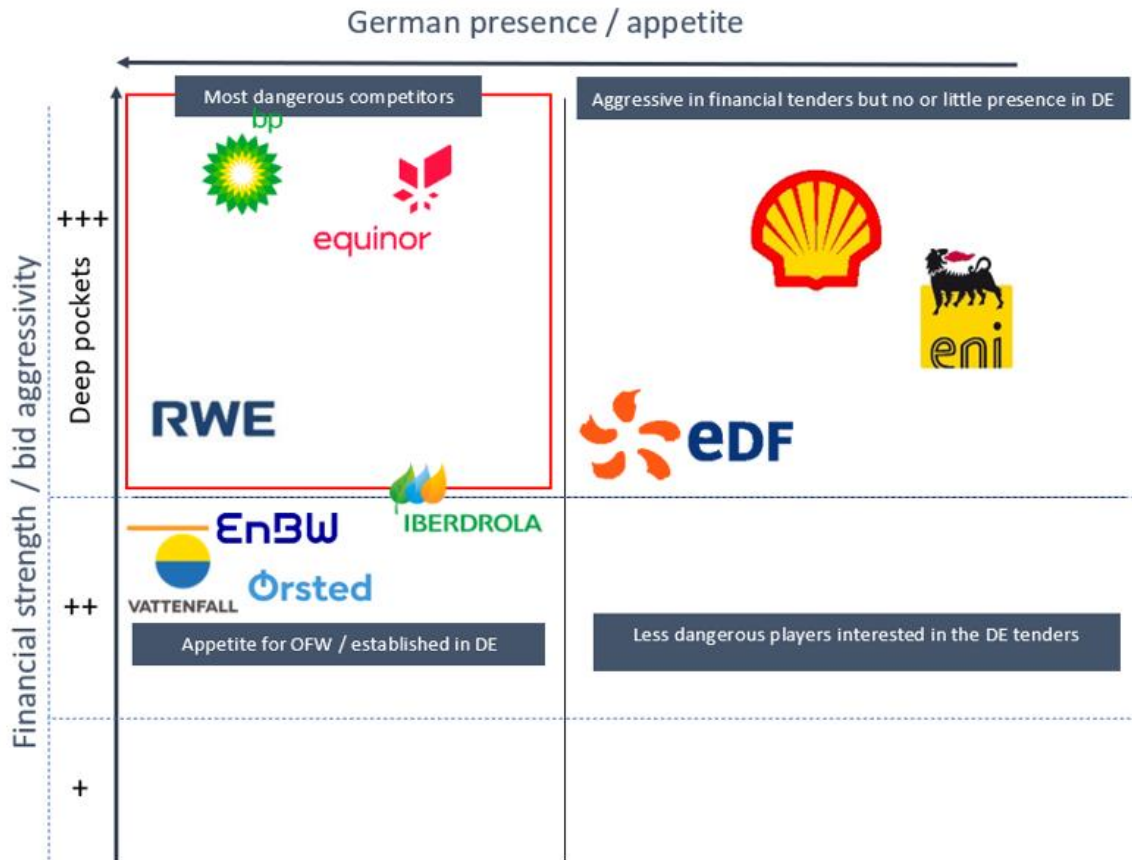


Figure 2: Competitor chart of the main players in the 2023 German OFW tenders. Most dangerous competitors are highlighted in the red square in the top left corner of the chart.

This concludes the discussion of the competitive landscape before the publishing of the auction results. The section hereafter is a follow-up to the recent publications surrounding the winners of the 2023 auctions for both non-examined (June 2023) and examined sites (August 2023).

### 4.3 2023 Auction Results & Discussion

#### 4.4.1 Non-examined Sites

The price-based non-examined sites tendered in June of 2023 were dominated by oil and gas majors, seeing record-high bids through the newly introduced uncapped dynamic bidding. Competition was expected to be tough and as anticipated; several 0 subsidy bids were submitted for all 4 sites in the North and Baltic Seas.

BP's first OFW auction win in continental Europe amounts to 4 GW, with TTE awarded 3 GW. The highest price per megawatt was observed for site O-2 (€2.07mn/MW), where coastal proximity and favorable wake effects likely played a role in the site's attractiveness.

The record-breaking lease fees (average of €1.83mn/MW) produced by these enterprises highlight the high level of competition in the German OFW market and the massive financial appetite developers display in an auction of this design.

The root causes of the observed price escalation are found both in the target market and the auction design. The fact that Germany is an established renewables market with clear political backing and



immense potential for purchasing power agreements in its industry help reduce project risk. Germany also has its transmission infrastructure built and operated by its TSOs, without developer involvement. The resulting reduction in scope of German OFW projects is again a risk-reducing factor for developers. Regarding auction design, the tendering process can be described as 'straight-forward' because it was based solely on price, making it especially attractive to developers with deep pockets. Another key auction design criterion was the lease fee payment structure. Unlike most other auctions (US, UK), the German auctions were designed such that the lease fee payment is spread over operational lifetime rather than being due at the start of the project. With only 10% of the costs due within the first year after the bid award, most of the cost burden is born during revenue-earning years, again reducing developer risk. Considering these factors, it is no surprise that TTE and BP, each with considerable German assets available for leverage, have come out on top in the most recent non-examined auctions.

#### 4.4.2 Pre-examined sites

The German pre-examined site tenders delivered what can be described as mainly 'predictable results', but also welcomed a new entrant. Sites N-3.5 and N-3.6 were awarded to German multinational energy company RWE without a negative bid component. Sites N-6.6 and N-6.7 were awarded for a total bid value of €784mn, to RWE and Luxcara (independent asset manager) respectively, although an exact price distribution was not published. In September 2023, Swedish utility Vattenfall exercised its step-in rights for N-6.6, matching RWE's winning bid value and assuming the site developer role (Buljan, 2023).

RWE had already secured nearby sites N-3.7 and N-3.8 in the 2021 auctions. Given the company's ambition to commission their 1.6GW 'Nordseecluster' project by 2029, the acquisition of sites N-3.5 and N-3.6 was widely anticipated. Similarly, Vattenfall was expected to seize development of site N-6.6 in light of its ongoing 'Atlantis 1' project. The disparity in bid-values between the examined and non-examined auctions reflects varying levels of attractiveness and results from several key factors: site size (capacity), presence of step-in rights, and the proximity between neighboring wind farms. Multi-gigawatt projects are often more attractive as they are more cost-effective (cost per unit electricity) to developers. The cost of building and maintaining a wind farm decreases as the size increases as developers take advantage of economies of scale. Step-in rights deter competitors as they represent unwanted risk to competitors that do not hold these rights. Finally, the pre-examined sites presented in this report are closer to one another and other existing/future projects. This creates higher risks for detrimental wake effects, reducing a project's overall capacity factor and revenue-generating ability.

#### 4.4.3 Outlook

Offshore wind projects are seeing unprecedented competition, with record-breaking lease fees and rising costs making developers more and more selective. A prime example observed in the German 2023 auctions was leading OFW developer Ørsted, who did not participate in the uncapped bidding rounds of the unexamined sites citing unsustainable price levels.

Auctions with an uncapped financial component are likely to favor players with deeper pockets, suggesting a rise in the involvement of O&G majors relative to traditional renewable energy companies and an overall reduction in developer diversity as smaller enterprises can no longer compete. In the wake of the German auctions, renewable energy companies will likely lobby for reforms to ensure a viable pathway towards new OFW projects remains for them. These reforms could include the removal of uncapped bidding, limiting the number of sites awarded per developer, and a heavier weighting on qualitative criteria such as local content. Uncapped bidding has been criticized for causing unsustainable price levels that risk increasing the LCoE of projects critical to realizing renewable energy ambitions. Although the German government has indicated site acquisition fees will contribute to reducing consumer power prices, there is a considerable risk of the financial burden of these fees being passed down to consumers. In combination with the recent inflation and commodity price hikes, exorbitant lease fees are likely to cause an uptick in project abandonment as developers lose confidence in the viability of OFW projects.

## 5. Conclusion

Germany aims to generate 80% of its power from renewable sources by 2030, up from around 40% today, and to phase out coal and reduce its reliance on natural gas. Offshore wind has been identified a key renewable technology, for which the nation has set an ambitious target of installing 30 GW of offshore wind power by 2030, which is expected to increase to 40 GW by 2035 and 70 GW by 2045.

TotalEnergies is committed to being a world-class player in the energy transition and has set an ambitious target of having 35 GW of gross renewable power generation capacity by 2025. Offshore wind is a growing part of TotalEnergies' portfolio in renewable energy, and the company is leveraging its expertise in offshore oil to develop this resource, with Germany one its key target markets. In 2023, Germany's Federal Network Agency has auctioned a record of 8.8 GW of offshore wind power with auctions held in June and August for non-examined and centrally pre-developed sites and respectively. The auction for non-examined sites was purely price-based, whereas the pre-examined site auction included qualitative criteria. As a result of the auction design (uncapped & dynamic negative bidding), financially dominant players were identified as most significant competitors, with a focus on O&G majors. TotalEnergies, along with BP, won a total of 7 GW in the unexamined site auctions worth €12.6 billion, while RWE and Luxcara won the considerably smaller pre-examined sites for a total of €784mn. Site size, proximity between neighboring wind farms and the presence of step-in rights likely cause the large disparity in total cost. Despite the government hailing the auctions as a success, fears exist that the record-breaking lease fees will result in additional costs for consumers and the OFW supply chain, with renewable developers and industry bodies calling for reforms.

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