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Offshore Wind in Germany

Status Quo and Prospects



Structure

1. **Status quo:** regulatory framework, spatial planning, auctions, permitting, grid infrastructure, domestic supply chain
2. **Lessons learned:** framework for successful OFW development
3. **Prospects:** capacity targets and expected deployment, OFW to green hydrogen, technical developments
4. **Current challenges:** regulatory framework, tenders and auctions, permitting procedures, infrastructure, the OFW industry



Status Quo

Unless stated otherwise, the following slides refer to activities in the Exclusive Economic Zone (EEZ). Regulations for coastal waters, which play a minor role overall, may differ.

Introduction: Offshore Wind in the German Energy System

- Germany's long term energy and climate strategy – labelled „Energiewende“ („energy transition“) – aims at reducing greenhouse gas emissions (and energy imports) by significantly increasing energy efficiency and boosting the use of renewable energies.
- The renewable energy target for 2030 is currently set at 80% of gross electricity consumption (status as of 2021: 41%).
- Offshore wind energy (OFW) plays an important role in reaching those goals - its share in total installed renewables capacity was 6% in 2020 and is expected to rise to almost 9% in 2030.
- OFW is seen as an important factor for reducing volatility in a grid with a high share of variable renewables. It is also expected to help bring down costs and increase flexibility through international grid connections.

Review: The beginning



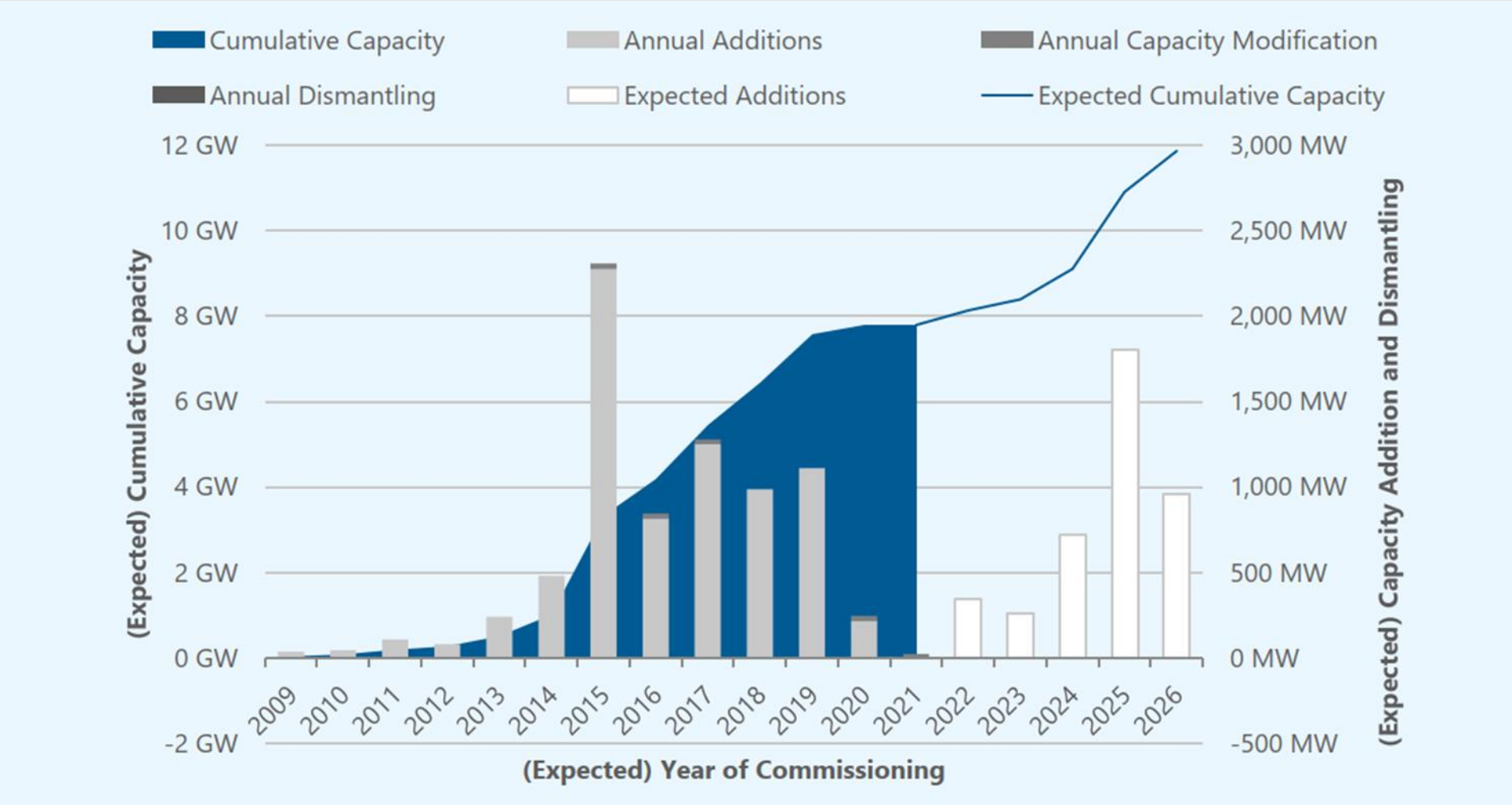
Picture: TenneT

- Germany's first Offshore Wind Farm „Alpha Ventus“ became operational in 2010.
- The wind farm consists of 12 turbines of two different types with a total capacity of 60 MW and served as a test run for planning and permitting procedures as well as technical challenges.
- The project served as an initial spark and helped to kick off offshore wind development in Germany.

Review: The beginning

- The initial development of the sector was further facilitated by a fixed feed-in tariff (2008 – 2014) of up to 15.4 €/kWh (in some cases up to 19.4 €/kWh), decreasing for projects being commissioned later in the time period the scheme was in place.
- This support scheme (borne by electricity customers) proved very effective for the initial phase of OFW deployment and was later changed to a market premium approach (see below, slides 16 - 18).
- Initially, developers had to identify and investigate potentially suitable sites themselves and then apply for permission, which produced mixed results (suboptimal site allocation, partially overlapping projects, relatively high risk of stranded investments and insufficient coordination with regard to grid connection).
- This experience prompted the adoption of a first Spatial Offshore Grid Plan (2013/2014) and eventually led to the introduction of a centralized model for planning and commissioning.

Development of installed capacity



Source: Deutsche WindGuard 2022

Facts and Figures

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- The technical potential for OFW in Germany is estimated at 50 – 70 GW of installed capacity.
- Official targets have been increased in 2022 to 30 GW by 2030, 40 GW by 2035 and 70 GW by 2045 (previously 20 GW by 2030 and 40 GW by 2040).
- As of Dec 31, 2021, the total installed capacity was 7.8 GW in 1,501 turbines (up from next to zero in 2010).
- With 24 TWh produced in 2021, OFW made up more than 20% of total wind energy produced and contributed 4.9% to net electricity production.
- With an average water depth of 30m in the German EEC, monopiles are the standard foundation type used.

Facts and Figures

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- The average capacity of all OFW turbines installed in German waters until 2021 was 5.2 MW. Projects starting in 2022 will use turbines with capacities of up to 15 MW.
- LCOE for OFW projects commissioned in 2019 ranges from 7 to 12 €Cent/kWh. It is expected to drop to 5 – 7 €Cent/kWh by 2025.
- 860 companies employed 21,400 people in the sector in 2020, roughly 50% of which in regions with no direct access to the sea.



Regulatory Framework

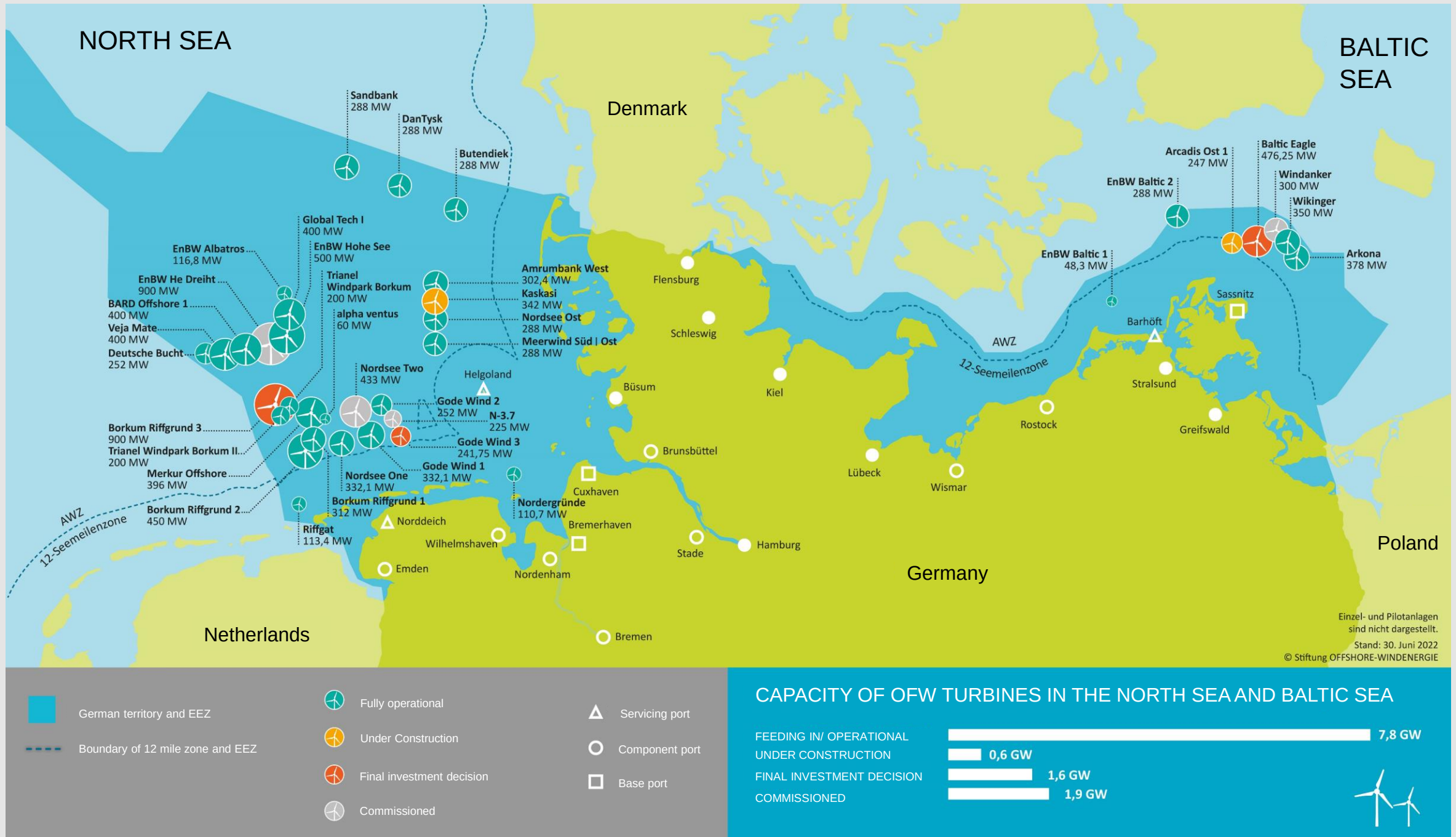
The single most important legal source is the Wind Energy at Sea Act (German acronym: WindSeeG). It was last updated in July 2022. The Wind Energy at Sea Act...

- ... sets concrete targets for offshore wind capacities
 - ... defines responsibilities of the federal agencies, states and other stakeholders
 - ... outlines the process of assigning and developing maritime areas for offshore wind
 - ... regulates the process of tendering
- The Renewable Energies Act (EEG) is relevant in particular with regard to cases where the tendering procedures foresee the payment of a market premium (see below).
 - The Energy Industry Act (EnWG) regulates grid development and integration.
 - Further federal laws and regulations on environmental protection apply.

The geography of OFW in German waters

For geographical reasons, OFW deployment in Germany started under more challenging conditions than other OFW frontrunner countries, such as the UK and Denmark:

- The Wadden Sea National Park (North Sea) hinders OFW close to shore and complicates routing for cables.
- As a result, there is hardly any OFW development in territorial waters (first 12 miles), which are regulated by the federal states. Instead, nearly all OFW development takes place in the Exclusive Economic Zone (EEZ), under jurisdiction of the federal government.
- Germany's EEZ comprises just 33,000 km² (compared to 6.8 million km² in the UK and 11.4 million km² in the US). In the scarce water surface, there is fierce competition between different uses (shipping, fishing, military, other infrastructure, research, nature protection, etc.)
- All of this leads to a high ratio of installed capacity and of OFW targets per available surface.



Spatial Planning

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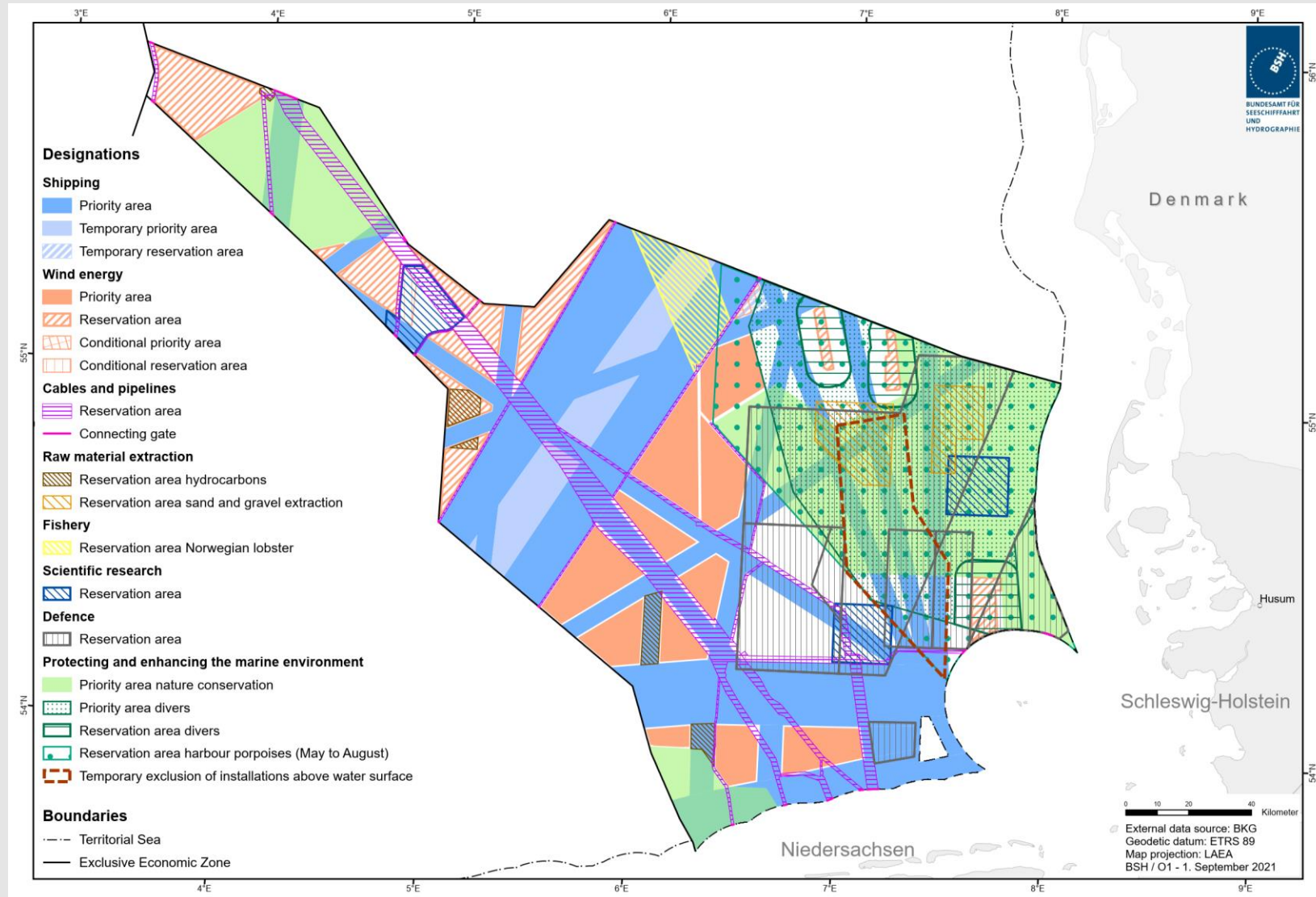
- The main responsibility for maritime spatial planning rests with the Federal Maritime and Hydrographic Agency (BSH, supervised by BMWK for questions regarding OFW).
- The general framework for the exclusive economic zone is set by the Maritime Spatial Plan (ROP), coordinated by BSH and defining prioritized areas for different types of use.
- Based on the installation targets and the ROP, the BSH identifies OFW sites in the North and Baltic sea, including their size, capacity potential and a timeframe for their development as well as grid connections required.
- The result is a Site Development Plan (FEP) that needs to be, in particular, coordinated with the Federal Network Agency (Bundesnetzagentur) and the Transmission System Operators (comp. slide 26) and is updated on a regular basis. It contains, in particular, information on sites, expected dates for tendering and commissioning as well as plans for grid connections.

Spatial Planning

2/2

- Until 2023 (starting from 2017), the sites defined were subject to a preliminary assessment by BSH (usually commissioned via public tenders), the purpose of which was to prepare the tendering of the site and provide additional information to potential bidders (including subsoil and wind characteristics).
- Thus, bidders were applying for “pre-developed” sites.
- Starting from 2023, the Site Development Plan will also define sites that are not subject to this pre-assessment and will be auctioned in parallel in order to speed up deployment (see also slides 20; 22).
- By 2027, the ratio of pre-developed and non-pre-developed sites should reach 50/50; in the transition period until 2027, pre-developed sites will remain prevalent.

Maritime Spatial Plan – Map North Sea



Source: Federal Hydrographic Agency (BSH) 2021

Auctions before 2023

(1/3)

The procedure described below started in 2021 (so called „centralized model“ because of the centralized preliminary assessment of sites) and applies to projects becoming operational from 2026 onwards. As the mechanism supersedes many years of supporting RES via fixed feed-in tariffs, there was a „transitional period“ during which it was also applied to projects already under development before 2016 (two rounds of auctions in 2017 and 2018, respectively).

- On the basis of the sites identified (and having undergone the pre-development) and the timeframe for their development identified in the documents above, the Federal Network Agency holds yearly auctions (Sept 1) to award the exploitation of the respective sites.
- The purpose of the auction is to allocate sites to developer(s)/operator(s) which promise to operate the wind farms on that site at the lowest cost for the tendering authority.
- Contrary to some other countries, sites are provided to the successful bidder(s) without a “lease sale”. Instead, the bidders bid for the exclusive right to develop sites that have been pre-developed by a public authority. The successful bidder does not bear the cost for the transmission line to the mainland grid.

Auctions before 2023

(2/3)

- Until the end of 2022, all auctions aim at determining a „market premium“. Bidders have to indicate a minimum guaranteed price for the electricity produced (in €ct per kWh), which they require to realize the project. The price cap per auction decreases over time. In case the actual monthly average wholesale electricity price falls below the minimum indicated by the successful bidder, the difference is reimbursed by the government. The costs of the scheme are passed through to the electricity customers.
- The lowest bid wins the tender, meaning the sole right to conduct a planning approval procedure for the site, the right to receive subsidies as indicated and the entitlement to have the turbines connected to the grid. If there is more than one bid with 0 €ct/kWh (i.e. not requiring any subsidies at all), winners are chosen by the lot.

Auctions before 2023

(3/3)

- Example: A successful bid of 6 €/ct/kWh means that the operator will always receive at least that amount for electricity fed into the grid – or more, if the wholesale electricity price rises above that threshold. A successful bid of 0 €/ct/kWh, on the other hand, means that the operator will receive exactly the market price, thus renouncing to the guaranteed minimum income. Alternatively, the operator is allowed to sign Power Purchase Agreements with customers willing to pay for green electricity.
- As timely completion of transmission lines is an essential prerequisite for construction and commissioning, the failure of Transmission System Operators to officially acknowledge construction timeframes can significantly inhibit the process.
- In practice, the mechanism outlined above has triggered a quick development towards 0€/ct bids, prompting the need for introducing additional criteria for project selection. Also, updated deployment targets imply the awarding process needs to be sped up. In response to these challenges, the auctioning mechanism will be adapted described below.

Example: Results of the auctions conducted Sept, 2021 and 2022

Site	Location	Capacity	Successful bidder	Successful bid*
N-3.7	North Sea	225 MW	RWE Renewables Offshore Development Two GmbH	0,- €ct/kWh
N-3.8	North Sea	433 MW	Nordsee Two GmbH**	0,- €ct/kWh
O-1.3	Baltic Sea	300 MW	Windanker GmbH**	0,- €ct/kWh
N-7.2	North Sea	980 MW	RWE Renewables Offshore HoldCo Four GmbH***	0,- €ct/kWh

*as there were several 0€ct bids for two of the sites, bidders were chosen by the lot

**those two companies exercised pre-emptive rights stemming from their development of the respective sites prior to the introduction of the centralized planning and auctioning system. Initial winners were EDF Offshore and RWE Renewables Offshore Development Two GmbH

***pre-emptive rights may yet be exercised by initial developer



Auctions 2023+: Overview

From 2023 onwards, the auctioning system will be adapted as follows:

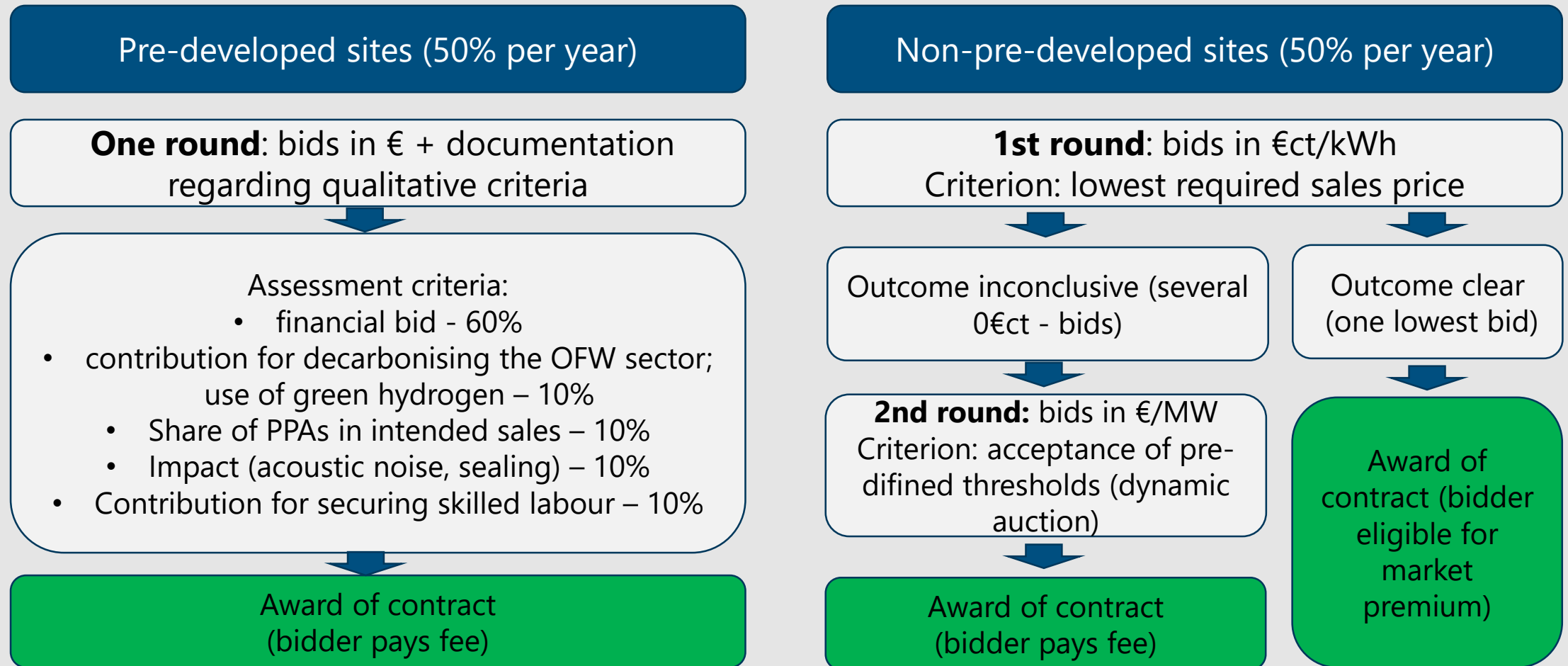
- *Non-pre-developed sites* will make up a significant part of future auctions. In this case, the auctioning mechanism by and large corresponds to the one in place until 2022, with one notable exception: If there are several 0€ct-bids, a second round of bidding will be prompted, in which the contracting authority defines a price (in €/MW) to be paid by the successful bidder for the respective site. If more than one bidder agrees to this threshold, the process is repeated.
- *Pre-developed sites* will be auctioned in one round of bidding based on a combination of the highest bid (in €) and four qualitative criteria (see boxed text next slide). The financial bid is by far the single most important criterion for decision.
- The fees paid by successful bidders in both schemes are earmarked for lowering the cost of electricity (90%, through the Transmission System Operator); marine conservation (5% each for marine conservation and fishery, through the federal budget)

Auctions 2023+: Qualitative criteria

The introduction of suitable qualitative criteria for auctioning pre-developed sites was subject to intensive debate. As a result, the following criteria have been established:

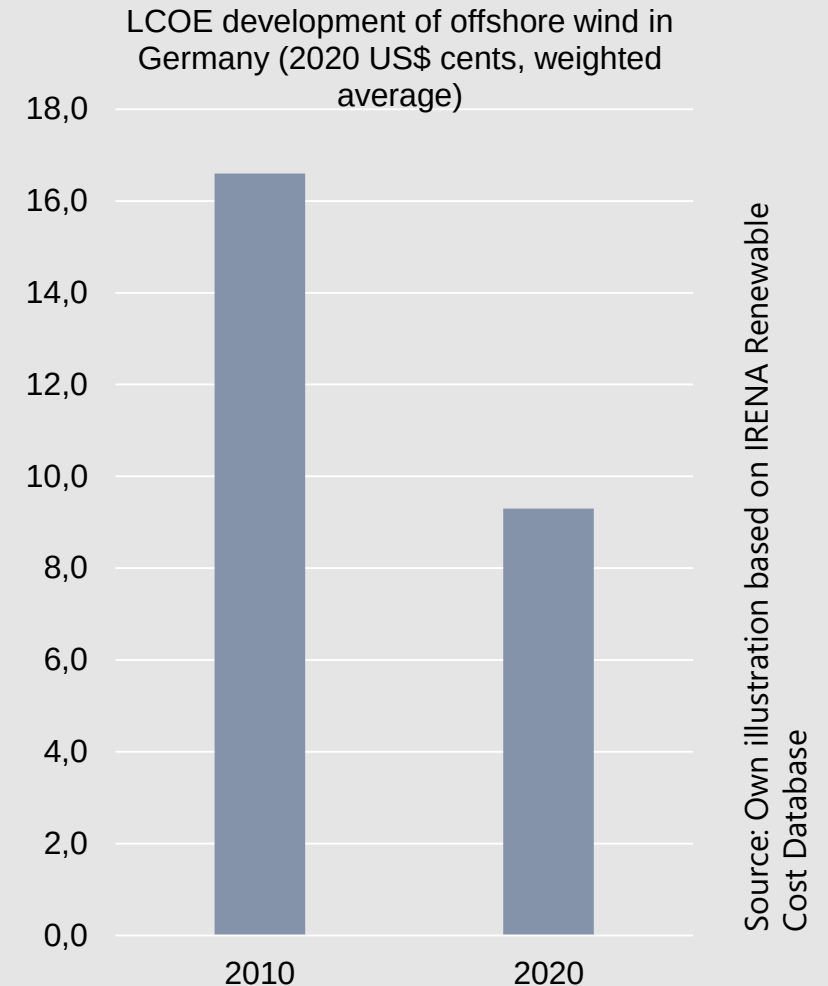
- The bidder's contribution for decarbonising the offshore wind sector (use of non-subsidised renewable energy and green hydrogen in the production process; includes subcontractors)
- Share of energy produced on the site that will be marketed via PPAs (substantiated by MoUs)
- Share of turbines that will not be installed using either pulse piling or gravity based foundations
- Share of apprentices/trainees in the overall workforce of the bidder and their subcontractors

Auctions 2023+: At a glance



LCOE development

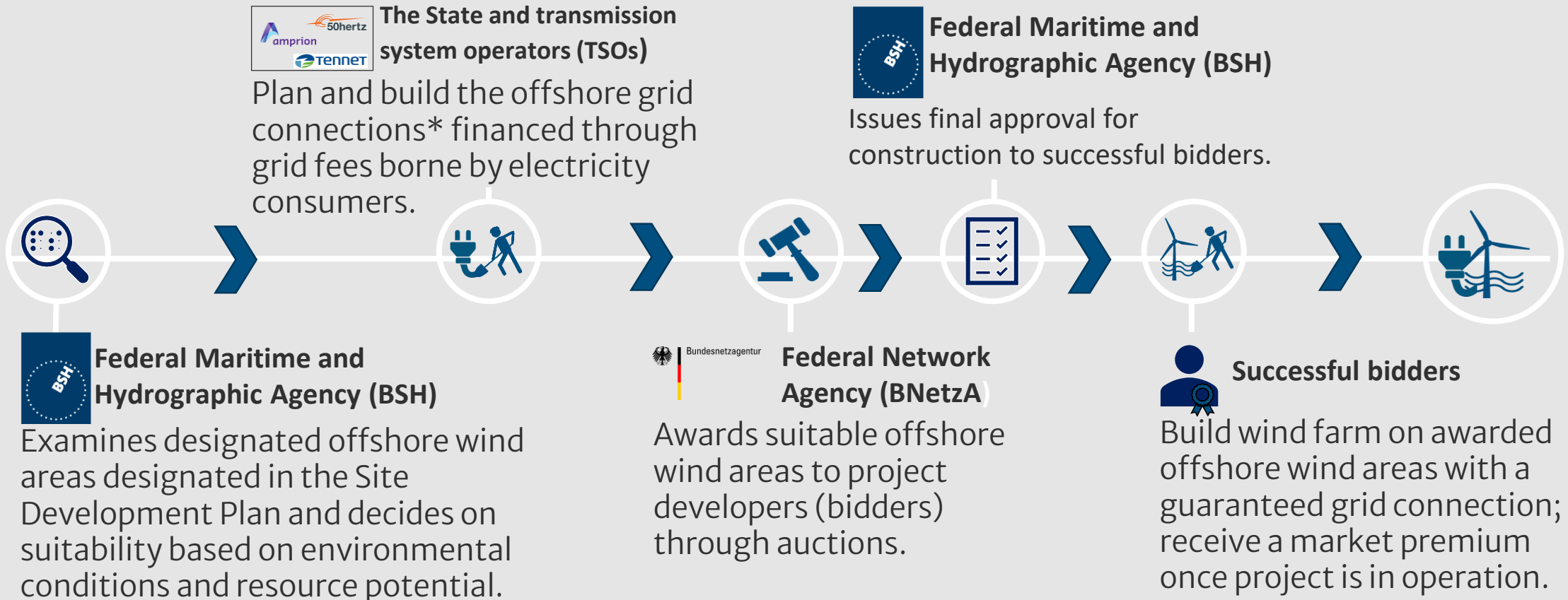
- In line with international trends, LCOE for offshore wind in Germany has decreased by more than 40% between 2010 and 2020.
- LCOE of 9,3 US cents/kWh in 2020 (slightly higher than the European average, but lower than in the UK or Japan) make OFW competitive with traditional forms of power generation.
- This general development corresponds with the decrease in governmental support required for the projects, which has also roughly halved in the same time period.
- The repeated 0€ct-bids in the auctions (see slides 18 and 19) indicate that market actors trust in the competitiveness of the technology and future market development.



Permitting procedures

- The construction and operation of offshore windfarms in Germany requires a detailed planning assessment procedure by the Federal Maritime and Hydrographic Agency (BSH).
- Applications for permits can only be submitted by applicants who have won the auction for the site in question. They are required to file an application to BSH no later than 12 months after the auctions for *pre-developed sites* or 24 months for *non-pre-developed sites*. According to the updated Wind at Sea Act, BSH is supposed to grant permission within 12 to 18 months from 2023.
- In addition to technical documentation, the applicant has to prove that no damage will be done to the marine environment; naval and air transport will not be impaired and the safety of national defense is not at risk. Also, it must show that the project is compatible with existing or planned infrastructure such as cables, grid connections, pipelines or transformer stations.
- For sites having undergone a *pre-development* (see slide 14), some of the documentation (e.g. on maritime environment) may not have to be duplicated.

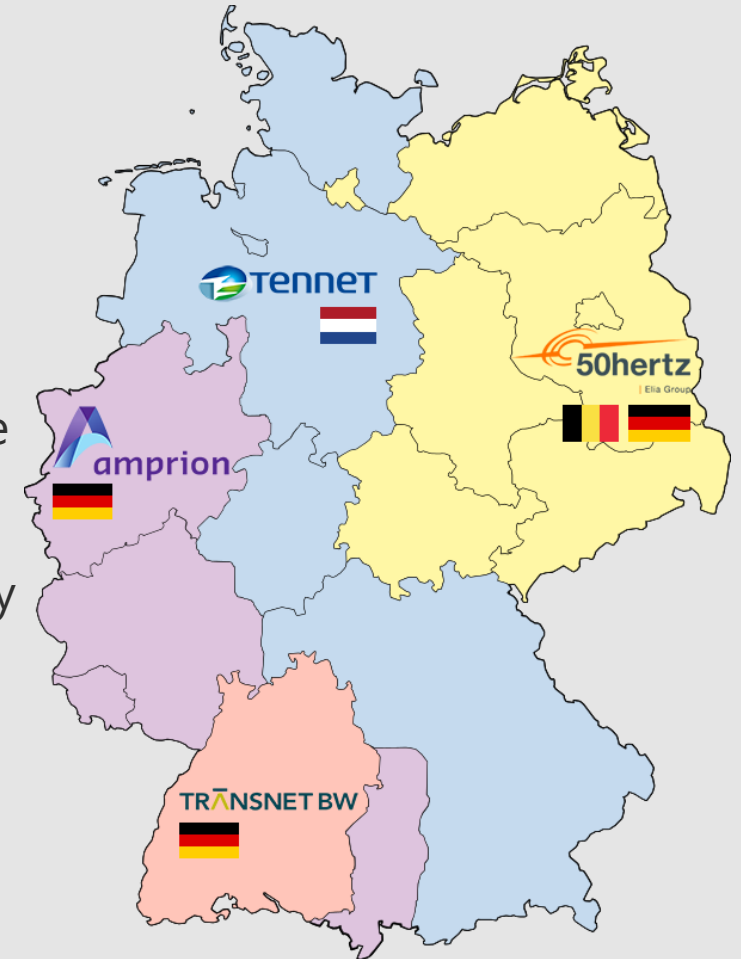
Overview: From Spatial Planning to Commissioning



Source: Guidehouse 2020 based on BSH 2019
Icons from Flaticon; own adaptation

Grid Infrastructure

- General responsibility for the transmission grid in Germany rests with 4 Transmission System Operators (TSOs).
- The TSOs are also key for developing and continuously updating the national grid development plan (NEP). The multi-stage process involves several other public stakeholders, from the description of first scenarios to the finalized plan. With regard to Offshore wind, it needs to be in line with BSH's site development plan (s. slide 13).
- The grid development plan is confirmed by the Federal Network Agency and forwarded to the Federal Government to be passed as a Federal Law.
- Once the Federal Law enters into force, TSOs start working on the planning and implementation of grid extensions.



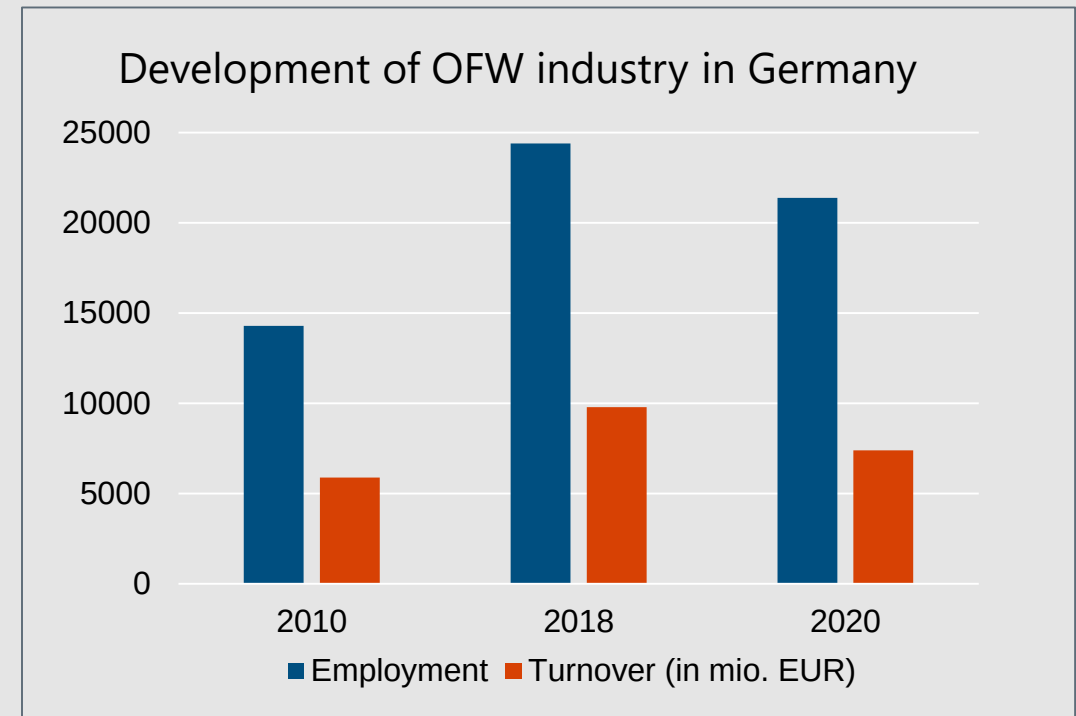
Source: [Francis McLloyd](#), - Eigenes Werk (CC BY-SA 3.0)

Overview: Development and funding

Process	Who's in charge?	Who funds it?
Site development for <i>pre-developed sites</i> (incl. environmental assessments, etc.) before auction	BSH	Taxpayers (via BSH)
Site development for <i>non-pre-developed sites</i> (incl. environmental assessments, etc.)	Private OFW companies	Private OFW companies (government support for operation depending on auction result)
Project development after auction, construction, decommissioning	Private OFW companies	Private OFW companies
Operation & Maintenance of Wind Farms	Private OFW companies	Private OFW companies (government support for operation depending on auction result, via tax payers)
Interconnection planning (e.g., routing, commissioning year, technical parameters)	BSH	Taxpayers (via BSH)
Interconnection construction and operation	TSO	TSO receives a fixed return on investment from BNetzA, financed via a grid fee paid by electricity consumers

OFW industry development

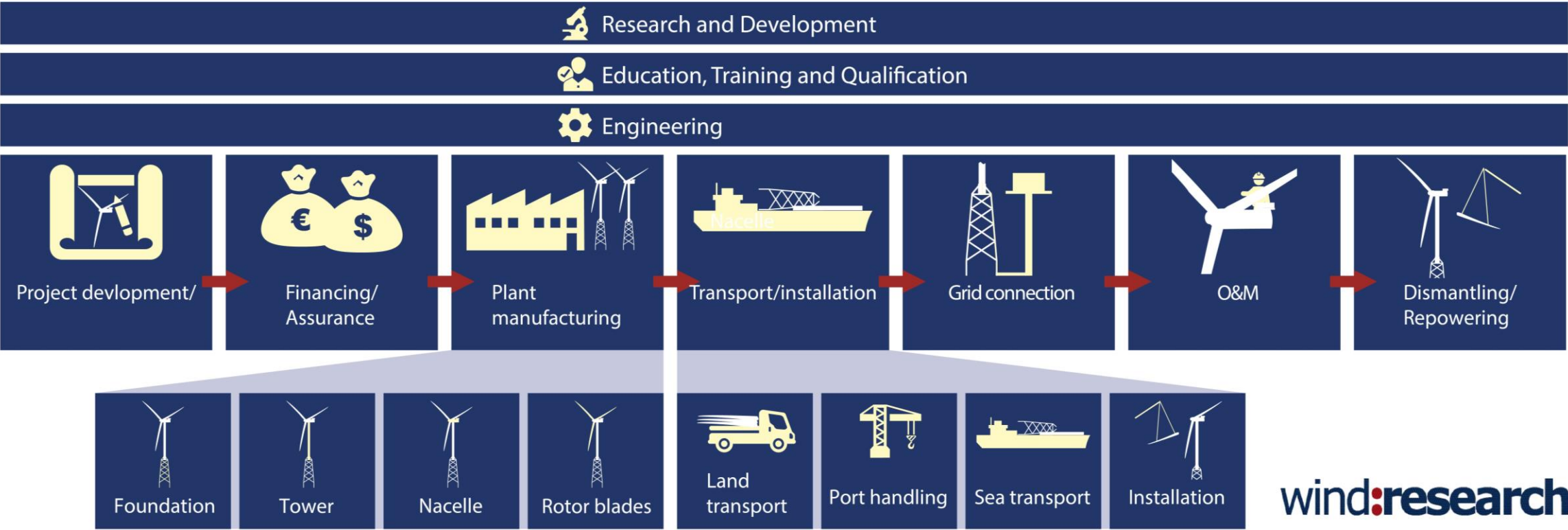
- Germany's OFW industry is currently "still" at crossroads, after great progress in the past but also stagnation in the recent years due to changes to the EEG in 2014, 2017 and 2021 limiting OFW expansion.
- In 2020, 862 companies (incl. subsidiaries) were active in the German OFW sector (23% of them exclusively in offshore wind).
- Since 2018, OFW employment in those companies decreased by 3,000 to 21,400 full-time equivalents in 2020; in the same time turnover was reduced from 9.8 to 7.4 billion EUR (incl. exports).



Source: Own illustration based on wind:research 2022; wind:research 2019; PwC & WAB 2011

Domestic supply and value chain

(1/3)



Source: wind:research (2022)

Domestic supply and value chain (2/3)

- Strengths and opportunities:
 - The German Offshore Wind Industry covers most of the supply chain and ranges from start-ups to big industrial enterprises
 - The OFW value chain is distributed throughout Germany (not just in the coastal states)
 - There is significant technical and procedural experience in the sector
- Weaknesses and challenges:
 - Some parts of the supply chain are not sufficiently covered. There is, in particular a lack of companies in tower and platform construction as well as in the installation logistics/maritime industry
 - Existing supply chain bottlenecks include sensor technology and semiconductors as well as installation logistics
 - Enhanced development goals require large numbers of qualified personnel to be recruited and/or trained

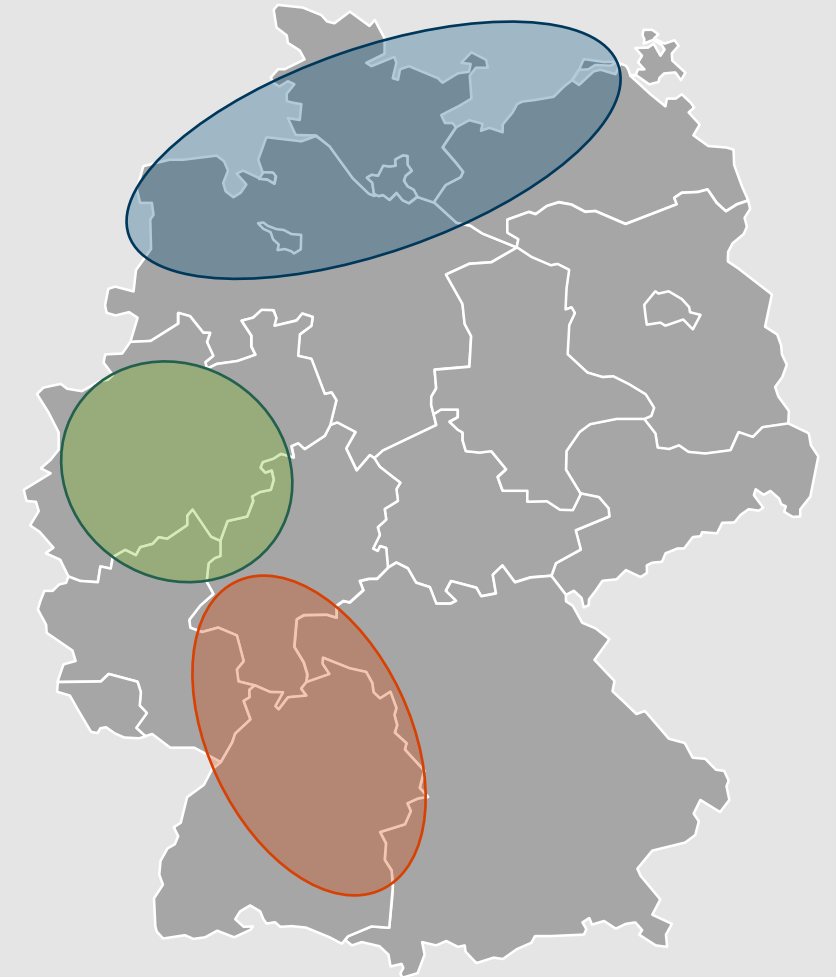
Domestic supply and value chain (3/3)

Regional distribution of OFW industry by numbers of employees in different parts of the supply chain:

Project development & planning
Manufacturing
Transport and installation
Operation and maintenance
Decommissioning and repowering

Research & development
Financing & insurance
Sub-supplier

Engineering
Research & development
Sub-supplier



Source: Own illustration based on wind:research (2022)

Lessons Learned

Lessons Learned

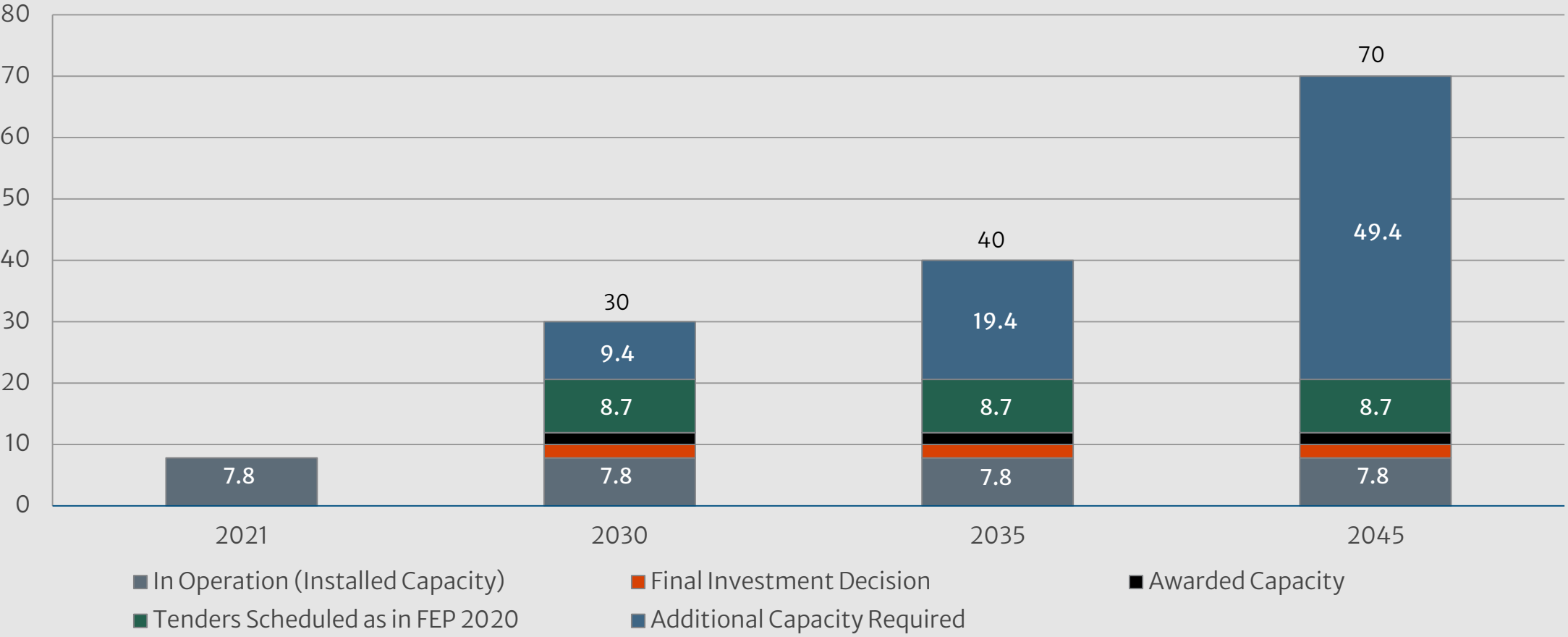
- Importance of continuity and **stable regulatory framework**: predictability and reliability are key for ensuring continuous engagement of investors and other stakeholders.
- Need for **reduction of bureaucracy**: planning and permitting procedures need to be as streamlined and transparent as possible.
- **Public acceptance** of grid reinforcement and grid extension is important: as theoretically ideal solutions for grid extensions often run into opposition from various interest groups „on the ground“, the public should be included at early stages of the process.
- Prevention of a “**race to the bottom**” to stabilize supply chain.
- Suitable tender design and intensive dialogue with industry vital to achieve targets efficiently.

Prospects

Capacity targets and expected deployment

- In 2022, offshore wind targets were increased strongly to at least 30 GW by 2030, 40 GW by 2035, and 70 GW by 2045 as part of the new federal government's coalition agreement and latest amendment to the Wind-at-Sea Law.
- Yearly tender volumes are 8-9 GW in 2023/2024, 3-5 GW 2025/2026, and 4 GW from 2027 onwards.
- Most of the additionally planned deployment until 2030 will have to happen in the last years of this decade due to long lead times for planning and construction → currently planned tenders need to be enlarged and happen earlier in order to avoid an expansion and supply bottlenecks at the end of the decade.
- Government aims to achieve those expansion targets also by building wind farms in closer proximity to each other for increased power density but with the consequence of shadowing effects.
- Current focus on ensuring security of energy supply and reducing energy imports will likely incentivize a faster and stronger OFW deployment.

Deployment status and targets



Source: Own illustration based on Deutsche WindGuard 2022

Offshore wind to green hydrogen

- Germany's current National Hydrogen Strategy set the goal to use onshore and offshore energy production to produce up to 14 TWh of green hydrogen by 2030 and 28 TWh by 2035/2040.
- A recent study by Deutsche WindGuard found that OFW-based green hydrogen production (in addition to the general offshore electricity generation) has the technical potential to make a very large contribution to achieving the goals of the National Hydrogen Strategy or even fully meet them on its own.
- OFW-based hydrogen production at the wind farms or in close geographic proximity onshore is and will be tested in Germany through multiple projects, e.g.:
 - *AquaVentus*: goal is to provide a capacity of 10 GW for the production of green hydrogen from OFW and transport it onshore by 2035.
 - *OYSTER* (funded by EU): build an electrolyzer that can be integrated into an OFW turbine
 - *PosHydon*: develop the world's first offshore platform with an electrolyzer
 - Tractebel: electrolyzer and desalination plant on an offshore platform for OFW-based hydrogen production
 - Orsted & BP (funded by the BMWK): develop an electrolyzer onshore in Emsland using electricity from Orsted OFW farms
 - *H2Giga project* (by BMBF): funding for a pilot plant of an electrolyzer integrated into an OFW turbine

Technical developments

- Studies show that continued improvements in OFW technologies can be achieved and thus a large increase in individual generation output is possible, which would contribute significantly to achieving the increased expansion goals.
- Through technology improvements and innovation, OFW turbines are expected to become much bigger in size over the next years (to about 15-20 MW by around 2030) as well as more efficient and resilient, resulting in LCOE reductions and increased deployment (but compare opposite development for costs of material, see slide 48).
- The European OFW sector should target the following next advancements:
 - combining OFW and green hydrogen production
 - developing floating OFW technology (which is set reach full commercialization by 2030)
 - continue to cutting costs further via technological innovation and industrialization (e.g., the use of digital maintenance)
 - increase technical standardization of parts

Current Challenges

Regulatory framework

- Simplification and acceleration of permitting and approval processes for OFW projects and grid connections is needed to speed up OFW deployment.
- Set the right regulatory framework on EU level for the development of a European offshore grid and European hybrid-OFW-hydrogen projects.
- Limit legal action possibilities against OFW projects to fewer instances to avoid years of disputes, while sufficient considerations of interests should remain.
- Enable green hydrogen production based on OFW by operationalization of the National Hydrogen Strategy to set clear annual expansion targets in the OFW sector, designation of the additionally required areas for hydrogen production, and comprehensive investigation of possible transport concepts.
- Develop an ordinance for pre-developed sites as foreseen in the current law.
- Intensify dialogue with the industry to avoid regulations that do not contribute to achieving targets.

Spatial planning

- Based on the current Maritime Spatial Plan 2021 and Draft Site Development Plan 2021, sufficient OFW areas are available to achieve the targets for 2030 and 2035. However, additional areas have to be found and developed in order to realize the new 70 GW target by 2045.
- Finding a good balance between increased area-specific power density for achieving the expansion targets (more efficient use of OFW areas) and acceptable electricity production costs (negatively affected by shading).
- Co-use of maritime areas for multiple purposes at the same time as a compromise in contrast to just one use form should be implemented where necessary to allow OFW development (under special conditions) in areas where it would otherwise not be possible.
- Transparently include military training areas in the considerations for the development of further OFW areas and start a dialogue between the stakeholders for compromises, from which both sides can profit.

Tenders and auctions

1/2

- Increase the volumes of the next tender rounds to align with the increased deployment targets and to maintain and expand innovation potential, employment, and the value chain in Germany.
- Earlier tendering of areas required in order to distribute OFW expansion more evenly and avoid deployment and supply chain bottlenecks towards the end of the decade.
- It remains to be seen if the new tendering procedure – including, in particular, the qualitative criteria established – adequately serves the intended purpose of speeding up the deployment process and facilitating a meaningful distinction between bidders. Further refinement or readjustment may be necessary.
- The recently updated Wind Energy at Sea Act explicitly allows for extensive future adjustments in the tendering procedures via an additional ordinance, including criteria for selection of the bidders, marketing mechanisms and support schemes.

Tenders and auctions

2/2

- Support domestic value creation and employment in the German OFW industry (to also maintain its local acceptance), e.g., by introducing qualitative criteria for “local content” (as is common practice in other countries).
 - German shipyards, for example, have hardly benefited from the OFW deployment so far, since they often do not stand a chance in tenders against cheap competition especially from Asia with regards to manufacturing of e.g., OFW foundations and substations.
- Maintain the diversity of market participants and ensuring competition in future tender rounds.

Permitting procedures

- Relevant authorities have a growing need for additional qualified personnel and financial resources to accelerate permitting approval processes and cope with the new deployment targets.
- Need for legally reliable, uniform and fast implementation of the regulatory requirements in the OFW sector.
- Better coordination between the different authorities in charge of spatial planning and site development, environmental protection, grid expansion and regulations for the construction and operation of OFW farms is necessary.

Grid infrastructure

1/2

- Better coordination and integration of the different planning processes for OFW farms and grid infrastructure, e.g., by
 - adapting the Grid Development Plan Electricity (NEP Strom) to the new OFW deployment goals.
 - synchronizing the existing Grid Development Plans for electricity and gas (NEP Strom and NEP Gas) (similar to the happened synchronization of the Draft Site Development Plan (FEP) and the Grid Development Plan Electricity).
 - Development of a proper integrated system development plan as the basis for other specific planning to achieve the overall decarbonization goals.

Grid infrastructure

2/2

- Prevent grid connection bottlenecks for OFW by e.g.,
 - planning the grid connection systems not based on a conservative but on an optimistic utilization situation with a buffer, since further technology improvements are expected, development of connection line retrofits/ additional lines is time consuming, costly, and complicated, and a restrictive sizing of the grid connection would counteract technological developments for improved utilization of the area
 - Starting the construction of high capacity grid connections systems (e.g., with 2 GW) earlier than currently planned
- Enhance the public acceptance of grid development projects in general to ensure that electricity generated offshore can contribute in an optimal way to the decarbonization efforts.

Harbor infrastructure

- Rapidly expand heavy-duty port infrastructure necessary for OFW construction processes to ensure that deployment goals can be achieved and that Germany's overall OFW sector (incl. suppliers), characterized by many small and medium-sized enterprises, can benefit from the transformation and maintain associated employment and value creation.
- Address problematic transport conditions for the wind turbines and -components on roads and in ports to enhance planning and construction of projects.

Challenges for the private sector

- Address the current shortage and increasing needs for skilled workers in the German OFW sector, e.g., by improving the different training/qualification programs and relevant university courses along the entire value chain and increasing the attractiveness of jobs (especially long-term job security).
- Address existing and potential future supply chain bottlenecks and increasing material costs resulting from the fast deployment planned from the second half of the decade onwards.
- Create sustainable, less emissions-intensive OFW supply chains, e.g., by encouraging the procurement of platforms and other parts from regional suppliers instead of emissions-intensive long distance shipping of such.
- Other topics: Potential extension of OFW farm service life, continued use forms, and decommissioning and subsequent use of offshore installations.

Authors and Disclaimer

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This overview was prepared by adelphi and the German Offshore Wind Energy Foundation on behalf of BMWK as part of the US-Germany Climate and Energy Partnership.

The views expressed are solely those of the authors listed below and do not necessarily reflect the opinions of the members of the Climate and Energy Partnership. This explicitly includes BMWK as the financing body.

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