BUNDESAMT FÜR
SEESCHIFFFAHRT
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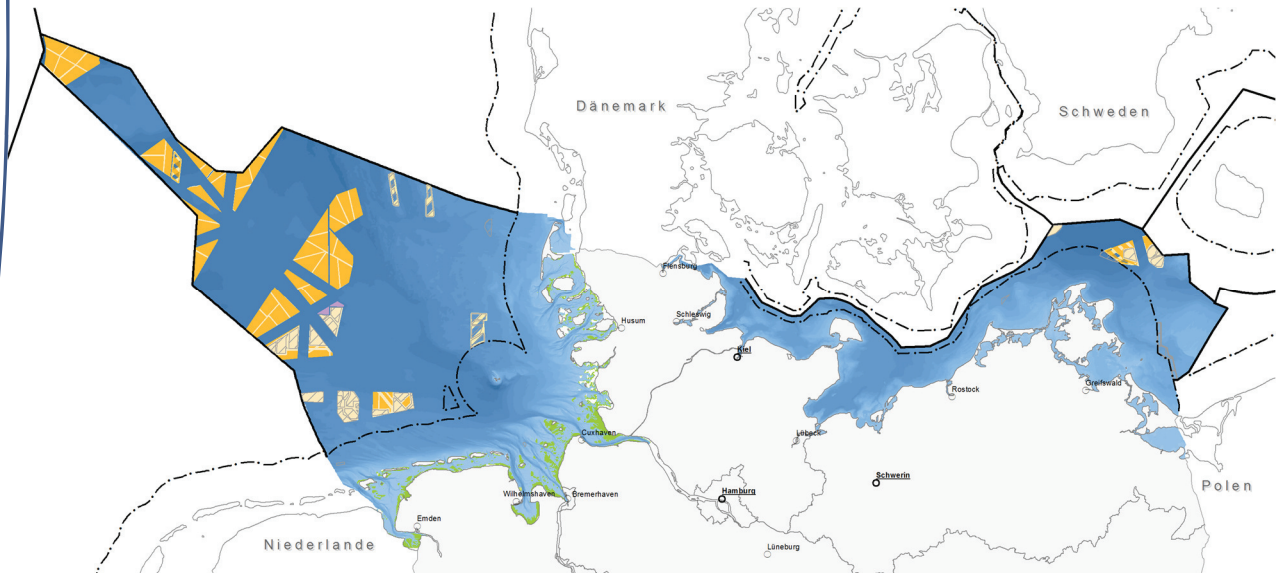
Preliminary Draft
Site Development Plan



Hamburg, 17 December 2021

Content

1 Introduction

The Offshore Wind Energy Act (WindSeeG)[1] sets the target to increase the installed offshore wind capacity to 20 GW by 2030 and to a total of 40 GW by 2040.

With the Site Development Plan (Flächenentwicklungsplan – FEP) 2020, published on 18 December 2020, in a first step areas for achieving the expansion target of 20 GW by 2030 were determined. This preliminary draft initiates the process of updating the FEP.

Now that the Maritime Spatial Plan (Raumordnungsplan - ROP) 2021 for the German exclusive economic zone (EEZ) of the North Sea and Baltic Sea[2] has come into force on 1 September 2021 following extensive participation of the authorities and the public, a spatial basis for the further expansion of offshore wind energy in the EEZ has become available. On this basis, further areas for the expansion of offshore wind energy can be defined within the framework of an updated FEP.

The coalition agreement concluded on 7 December 2021 between the SPD, BÜNDNIS 90/DIE GRÜNEN and the FDP provides for an increase in the targets for the expansion of offshore wind energy to 30 GW by 2030, 40 GW by 2035 and 70 GW by 2045. To achieve these targets, the additional commissioning of offshore wind farms by 2030 is required. This preliminary draft does not yet contain any information on calendar years for tendering and commissioning of the sites and grid connection systems, because an acceleration of the currently planned commissioning years is to be expected. The preliminary draft of the FEP initially maps the areas and sites that were defined as priority and reservation areas for offshore wind energy in the Maritime Spatial Plan 2021. A total of 43 GW of offshore wind capacity can probably be commissioned in the sites shown in table 1. In addition, a further 14.5 GW are expected to be in operation in Zones 1 and 2 in 2030 in accordance with the specifications of the FEP 2020. These sites suffice to achieve the targets set in the coalition agreement of 30 GW by 2030 and 40 GW by 2035. In order to achieve the expansion target of 70 GW by 2045 set out in the coalition agreement, a considerable amount of additional areas must be developed for the expansion of offshore wind energy.

This preliminary draft is to be the basis for determining further tender quantities. For this purpose, the areas in zones 3 to 5 of the EEZ are divided into sites. Furthermore, it has been possible to achieve an increase in capacity by adjusting the site layout. These measures contribute to supporting the achievement of the increased targets for the expansion of offshore wind energy.

Following consultation on this preliminary draft, it is expected that a developed draft FEP will be put out for consultation in mid-2022.

[1] Act of 13 October 2016, Federal Law Gazette I p. 2258, 2310, last amended by Article 1 Act Amending the Offshore Wind Energy Act and Other Provisions of 03.12.2020, Federal Law Gazette 2682.

[2] Ordinance on Spatial Planning in the German Exclusive Economic Zone in the North Sea and the Baltic Sea of 19 August 2021, BGBl. I p. 3886

2 Framework conditions for designations

2.1 Areas in the Maritime Spatial Plan

The Maritime Spatial Plan for the German EEZ, which came into force on 1 September 2021, is an overall spatial plan that brings together the interests of various uses. It safeguards and develops the functions and uses of the sea, taking into account the ecosystem approach. The Maritime Spatial Plan regulates area categories (priority and reserved areas), as well as other objectives and principles, for various uses at a strategic planning level. The Maritime Spatial Plan has defined new priority and reservation areas for offshore wind energy.

The starting point for defining priority areas for offshore wind energy were initially the areas O-1 and O-3 (Baltic Sea), N-1 to N-3 and N-6 to N-13 (North Sea) as defined in the FEP 2020. In the Maritime Spatial Plan these areas were defined as priority areas EO1 to EO3 (Baltic Sea) and EN1 to EN3 and EN6 to EN13 (North Sea).

In addition, reservation areas for offshore wind energy have been defined. These aim at securing areas for the further expansion of offshore wind energy.

Individual areas are designated as conditional priority or conditional reservation areas. These are designated as areas for offshore wind energy use unless, by a certain date, the competent federal ministry provides compelling reasons that the respective area is required for other uses.

The area designation in the Maritime Spatial Plan for the EEZ in the North Sea (Figure 1) and in the Baltic Sea (Figure 2) form the basis for the amendment and updating of the sectoral planning in the FEP.

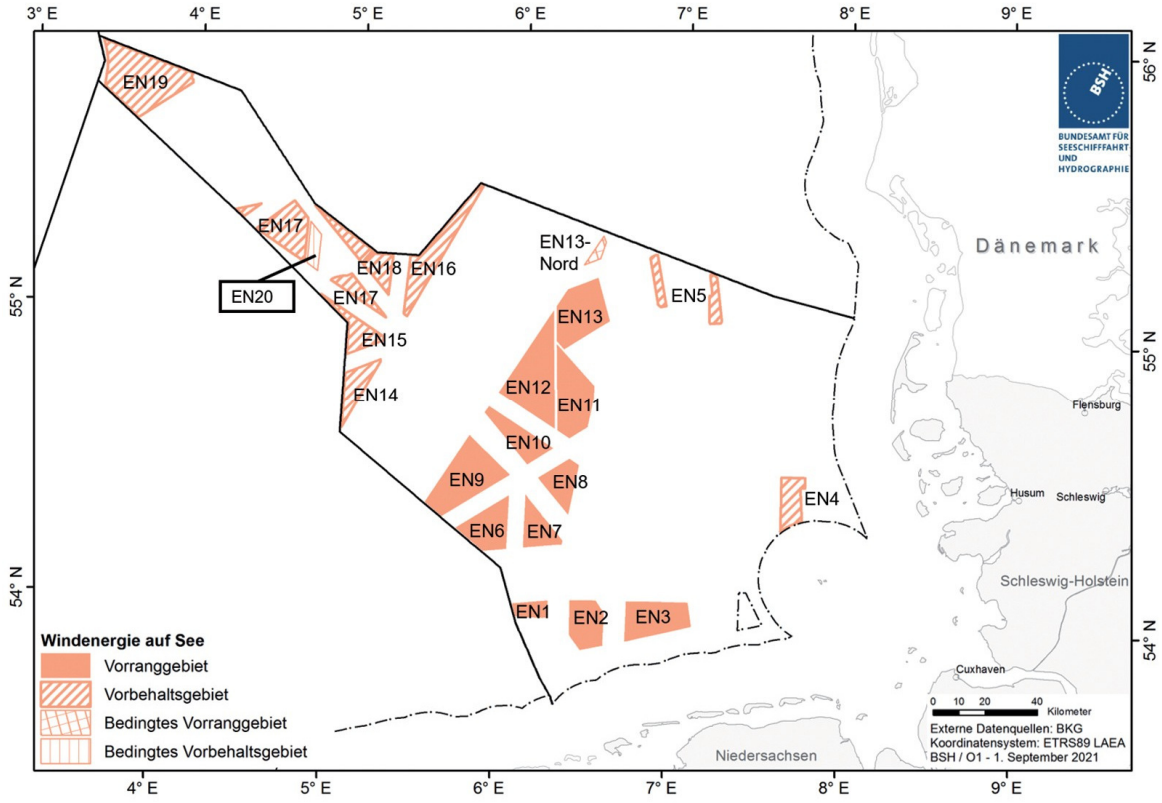


Figure 1: Designations of the 2021 Maritime Spatial Plan for offshore wind energy in the North Sea

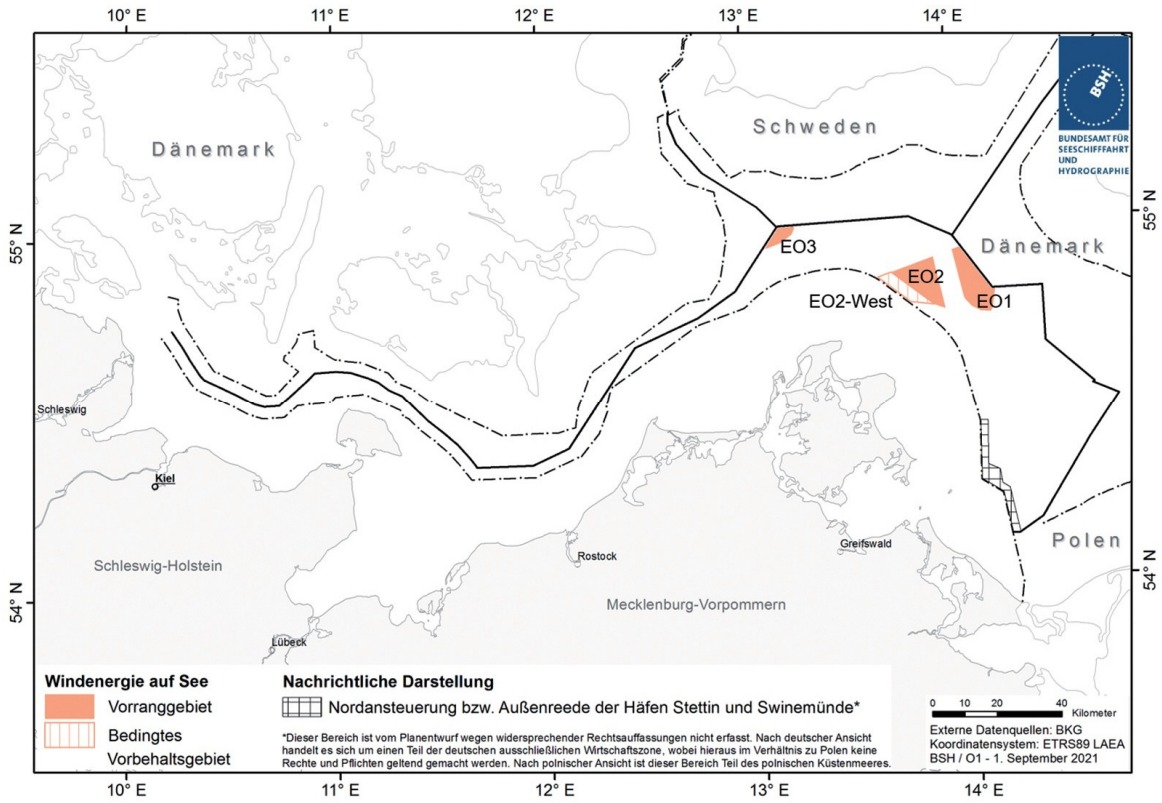


Figure 2: Designations of the 2021 Maritime Spatial Plan for offshore wind energy in the Baltic Sea

2.2 Assumptions on decommissioning of facilities

The first offshore wind farms in the German EEZ were commissioned from 2009 onwards. By 2040, a significant number of wind turbines are expected to have reached the end of their service life and to have been dismantled. In order to reliably achieve the statutory expansion targets, reasonable assumptions must be made about the extent of the expected decommissioning.

The permits or planning approval decisions for the offshore wind farms currently in operation were generally granted for a limited period of 25 years, with an extension of a further five years possible on application in accordance with § 48 para. 7 sentence 2 WindSeeG if the FEP does not provide for any direct subsequent use of the site.

Offshore wind farms that are commissioned by 2021 generally receive feed-in tariffs under the Renewable Energies Act (Erneuerbare-Energien-Gesetz – EEG) for a period of 20 years. After that, direct marketing of the electricity generated is possible.

According to the current state of knowledge, it can be assumed that no electricity production can take place on the areas between decommissioning and subsequent use for a certain period of time, so that the decommissioned capacity must be compensated for by the designation of additional areas in order to achieve the statutory targets. The amount of space required for this depends largely on how orderly and coordinated decommissioning and subsequent use of the site can be. This preliminary draft uses consultation questions to prepare for the establishment of provisions on the subject of decommissioning.

2.3 Identification of the expected generation capacity

The aim of identifying the expected generation capacity is to ensure the expansion of offshore wind energy and offshore connection systems in parallel and consequently to achieve the expansion targets for offshore wind energy. On the basis of this determination, the required capacity of the offshore grid connection cable can be determined. This ensures the orderly and efficient use of offshore grid connection lines and an appropriate designation for the cables required to connect this area to the grid.

Furthermore, the anticipated tender volume for the respective area is predetermined by specifying the expected generation capacity. However, the actual share of the respective area in the tender volume is determined later in the process on the basis of the offshore site investigation in the suitability assessment for the respective site, as set out in the ordinance for the implementation of the Offshore Wind Energy Act (Windenergie-auf-See-Verordnung – WindSeeV) in accordance with § 12 para. 5 WindSeeG. Therefore, the generation capacity to be installed as determined in the offshore site investigation may deviate from the specifications of the Site Development Plan.

The methodology for determining the expected generation capacity for a site was consulted as part of the Site Development Plan 2020.

To determine the expected annual electricity production in various expansion scenarios, taking into account large scale wake effects, the BSH has commissioned a scientific report. The first interim report, which is being published together with this preliminary draft, already contains the results of initial modelling cases. It shows that the efficiency of electricity generation depends on a large number of factors. The installed capacity per area of the wind farm, the size of the continuous area and the inflow situation have turned out to be the most important factors. However, since the characteristics of the areas to be considered vary greatly, it does not appear to be expedient to determine the expected generation capacity solely on the basis of the methodology introduced in the Site Development Plan 2020. In order to determine the expected generation capacity of the respective site, an assessment is therefore made on a case-by-case basis, taking into account the increase in installed capacity and the achievement of the set expansion targets, the possibilities for grid connection with standard grid connection concepts, and the expected annual energy generation, taking into account losses due to wake effects.

The adjusted power density as a target value for determining the expected generation capacity was increased as much as advisable within the framework of an overall assessment in view of the increased expansion targets for offshore wind energy, compared to the planning in the Site Development Plan 2020. For this reason, the division of areas N-9 and N-10 into sites and their expected generation capacity have been adjusted compared to the Site Development Plan 2020.

With this increase in power density, the generation capacity on the sites can be increased overall, but the utilisation of the wind farms will be significantly reduced due to the expected losses from wake effects (see background information on the following page).

In order to outline the expansion path for the period after 2030, the expected generation capacity in areas N-11 to N-13 was presented for information purposes in the annex of the Site Development Plan 2020. With reference to the need for further investigations into the extensive wake losses of the wind farms and the ongoing procedure for updating the maritime spatial plan in the EEZ, the possible capacity was given with a range of 8 to 10 GW. As a result of the specifications in the Maritime Spatial Plan 2021, the size of areas N-11 to N-13 has increased compared

to the specifications in the Site Development Plan 2020. Against this background, the designation of 12 GW in areas N-11 to N-13 appears possible in an overall assessment.

Background information: Development of full load hours

When determining the expected generation capacity to be installed on a site, the **increase in installed capacity and its contribution to achieving the target**, the **cost efficiency** of electricity generation and the **efficient use and utilisation of grid connections** must be weighed against each other.

The **annual energy yield** corresponds to the amount of electricity that can be produced in the course of a year. If the installed generation capacity on a site is increased, the annual energy yield and thus the amount of electricity that can be produced on a site increases.

Every wind turbine extracts kinetic energy from the air flow for electricity production and also causes turbulence in the air layers in the wake of the turbine. These so-called wake effects imply that less kinetic energy is available to a lee-side turbine - thus reducing the utilisation of this turbine. The **full load hours** are used as a measure for the utilisation of a wind turbine or wind farm. They represent the number of hours in a year during which the wind farm generates energy at full load.

In order to improve the level of knowledge on the link between power density and full load hours, the long-term yield potential in various expansion scenarios is being modelled as part of a scientific report. It is shown that with increasing expansion of offshore wind energy and an increase in power density to the extent proposed in this preliminary draft, average full load hours of approx. 3,100 [3]h/a can be expected in zones 1 to 3. Despite a reduction of the cost efficiency of electricity generation and the utilisation of the grid connection systems, the annual energy yield can still be increased overall through the increased installed generation capacity. With regard to achieving the expansion targets for offshore wind energy, the reduction in the overall utilisation of the wind farms and grid connections must be weighed against achieving the expansion targets and increasing total electricity generation.

[3] Compared to the first interim report of the accompanying scientific report (Baumgärtner et al. , 2021. *Further development of the framework conditions for planning offshore wind turbines and grid connection systems, First interim report.* Fraunhofer IWES on behalf of the BSH), the modelled annual energy yield was additionally reduced by 9.5 percent to reflect losses due to technical unavailability, electrical and other losses (Falkenberg et al., 2020. *Future framework conditions for the design of offshore wind farms and their grid connection systems, Final Report.* Prognos AG on behalf of the BSH).

2.4 Availability of suitable grid connection points

Ever since its 2019-2030 edition, the Network Development Plan (Netzentwicklungsplan – NEP) has also contained all effective measures for the needs-based optimisation, reinforcement and expansion of the offshore grid connections in the EEZ and in the territorial sea, including the grid connection points onshore which will be required by the end of the period under consideration in accordance with section 12a (1) sentence 2 of the EnWG. The specifications of the Network Development Plan and Site Development Plan must be aligned.

Due to the uncertainty regarding the acceleration potential of grid connections with regard to the expansion targets outlined in the coalition agreement, this preliminary draft refrains from naming calendar years for the commissioning of grid connection systems.

2.5 Availability of cable routes in the territorial sea

Pursuant to § 5 para. 1 no. 8 WindSeeG, the Site Development Plan specifies locations where the offshore grid connections cross the boundary between the EEZ and the territorial sea (so-called gates).

The routes planned in the Site Development Plan must be able to be reasonably routed through the territorial sea to the grid connection point. For coordination with the coastal states, the gates serve as locations where the offshore grid connections cross the border between the EEZ and the territorial sea. In this way, the cable systems are to be concentrated as far as possible at these points and bundled for further routing towards the grid connection point. The routing in the territorial sea is not determined in the Site Development Plan; this is the responsibility of other bodies in the procedures provided for this purpose.

According to table 1, compared to the Site Development Plan 2020 there are one additional grid connection system in the Baltic Sea with a capacity of 1 GW and 18 additional grid connection systems in the North Sea with a capacity of 2 GW each.

The connection system in the Baltic Sea serves to connect the additional sites in area O-2 and is expected to be routed via gate O-I to the territorial sea of Mecklenburg-Western Pomerania.

The additional grid connection systems in the North Sea are to be routed to gates N-II and N-III in the direction of Lower Saxony and to gate N-V in the direction of Schleswig-Holstein.

According to the current state of knowledge, it is possible to route two further systems via gate N-II. The total capacity of gate N-III has not been conclusively determined, but according to findings from the "Seetrassen 2030" project, a potential total of 13 systems could be conceivable.

The state of Schleswig-Holstein does not specify a maximum number of connection systems for gate N-V to Schleswig-Holstein.

3 Intended designations

This preliminary draft of the Site Development Plan only presents the intended designations of spatial capacity of areas and sites, the expected generation capacity and the required capacity of the associated offshore grid connection systems. Due to the expected acceleration of developments, the calendar year in which areas will be put out to tender and the commissioning date for sites and grid connection systems will not be specified at this stage. Similarly, no statements are made on the spatial course of the connection lines, the associated gates to the territorial sea or possible grid connection points. Even though the intended timeframes are not yet presented in this preliminary draft, the order in which the sites and grid connection systems are presented in Table 1 can be used as an indicator of the probable order of implementation.

Compared to the designations of the Site Development Plan 2020, the spatial designation and expected generation capacity in areas N-9 and N-10 were adjusted to allow for an overall increase in the installed capacity. In table 1 the corresponding sites in areas N-9 and N-10 are therefore also shown. In total, 43 GW of wind energy can probably be installed on the sites shown. A further 14.5 GW are expected to be in operation in Zones 1 and 2 in 2030 in accordance with the determinations of the Site Development Plan 2020. Due to the significant decommissioning of existing wind farms from 2035 onwards, a certain share of the sites will not be available to contribute to the expansion target because of the time lag between decommissioning and subsequent use of the sites (cf. chapter 2.2).

The basis for the intended designations of this preliminary draft are the priority and reservation areas for offshore wind energy as shown in the Maritime Spatial Plan 2021.

Note: The size of a site is only of limited suitability as an indicator for the volume of the expected generation capacity. In addition to size, site geometry and the underlying turbine technology are essential aspects in determining the potential generation capacity on a site. For this reason, the Site Development Plan 2020 introduced the corrected power density as a comparative value (cf. chapter 4.7 of the FEP 2020). Here, the generation capacity that is expected to be installed is related to the corrected size of the site, which buffers the designated site with an additional spacing of half the minimum distance between two turbines. This makes it possible to compare sites of different sizes and geometries. To allow for a comparison of the sites, Table 1 also shows the corrected power density. For calculating the corrected power density, a buffer distance of 600 m was selected for the sites in zone 3, and a buffer distance of 700 m for the sites in zones 4 and 5 due to the expected development in turbine technology.

Table 1: Intended designations for areas, sites, expected generation capacity and grid connection systems

Area	Site				Grid connection system	
Name area	Name site	Size [km²]	Expected generation capacity [MW]	Corrected power density [MW/km²]	Name grid connection system	Capacity grid connection system [MW]
N-9	N-9.1	76	1.000	10,5	NOR-9-1	2.000
N-9	N-9.2	76	1.000	10,9		
N-9	N-9.3	76	1.000	10,5	NOR-9-2	2.000
N-9	N-9.4	77	1.000	10,6		
N-9	N-9.5	106	1.500	11,2	NOR-9-3	2.000
N-10	N-10.3	31	500	10,7		
N-10	N-10.1	75	1.000	10,6	NOR-10-1	2.000
N-10	N-10.2	73	1.000	10,3		
O-2*	O-2.2	93	1.000	7,3	OST-2-4	1.000
N-12	N-12.1	95	1.000	8,5	NOR-12-1	2.000
N-12	N-12.2	97	1.000	8,4		
N-12	N-12.3	87	1.000	9,3	NOR-12-2	2.000
N-12	N-12.4	86	1.000	9,5		
N-12	N-12.5	81	1.000	9,4	NOR-12.3	2.000
N-13	N-13.2	95	1.000	8,6		
N-11	N-11.1	92	1.000	8,7	NOR-11-1	2.000
N-11	N-11.2	88	1.000	9,2		
N-11	N-11.3	100	1.000	8,2	NOR-11-2	2.000
N-11	N-11.4	41	500	8,7		
N-13	N-13.1	52	500	7,5		
N-13	N-13.3	94	1.000	8,7	NOR-13-1	2.000
N-13	N-13.4	90	1.000	8,7		
N-14	N-14.1	73	1.000	9,7	NOR-14-1	2.000
N-14	N-14.2	65	1.000	11,1		
N-15	N-15.1	74	1.000	10,1	NOR-15-1	2.000
N-15	N-15.2	53	1.000	11,0		
N-16	N-16.1	69	1.000	10,4	NOR-16-1	2.000
N-16	N-16.2	77	1.000	10,2		
N-16	N-16.3	69	1.000	10,9	NOR-16-2	2.000
N-16	N-16.4	61	1.000	10,6		
N-17	N-17.1	84	1.000	8,1	NOR-17-1	2.000
N-18	N-18.1	64	1.000	11,3		
N-18	N-18.2	61	1.000	11,0	NOR-18-1	2.000
N-18	N-18.3	53	1.000	11,5		
N-17	N-17.2	70	1.000	10,9	NOR-17-1	2.000
N-17	N-17.3	75	1.000	10,2		
N-19	N-19.1	82	1.000	9,5	NOR-19-1	2.000
N-19	N-19.2	80	1.000	10,4		
N-19	N-19.3	92	1.000	8,8	NOR-19-2	2.000
N-19	N-19.4	89	1.000	9,3		
N-19	N-19.5	74	1.000	10,6	NOR-19-3	2.000
N-19	N-19.6	82	1.000	9,5		
N-17	N-17.4	73	1.000	10,2	NOR-17-2	2.000
N-20**	N-20.1	67	1.000	10,6		
Total			**43.000**			

* Area O-2 includes parts of both the priority area EO2 and the conditional reservation area EO2-West defined in the Maritime Spatial Plan 2021. However, the intended designation to the extent shown, as well as the expected capacity to be installed in area O-2.2, is dependent on the outcome of the spatial planning assessment, which results from Principle 2 of chapter 2.2.2 of the Maritime Spatial Plan 2021.

** The area N-20 corresponds to the conditional area EN20 of the Maritime Spatial Plan 2021. The intended designation is dependent on the result of the spatial planning assessment, which results from Principle 2 of chapter 2.2.2 of the Maritime Spatial Plan 2021.

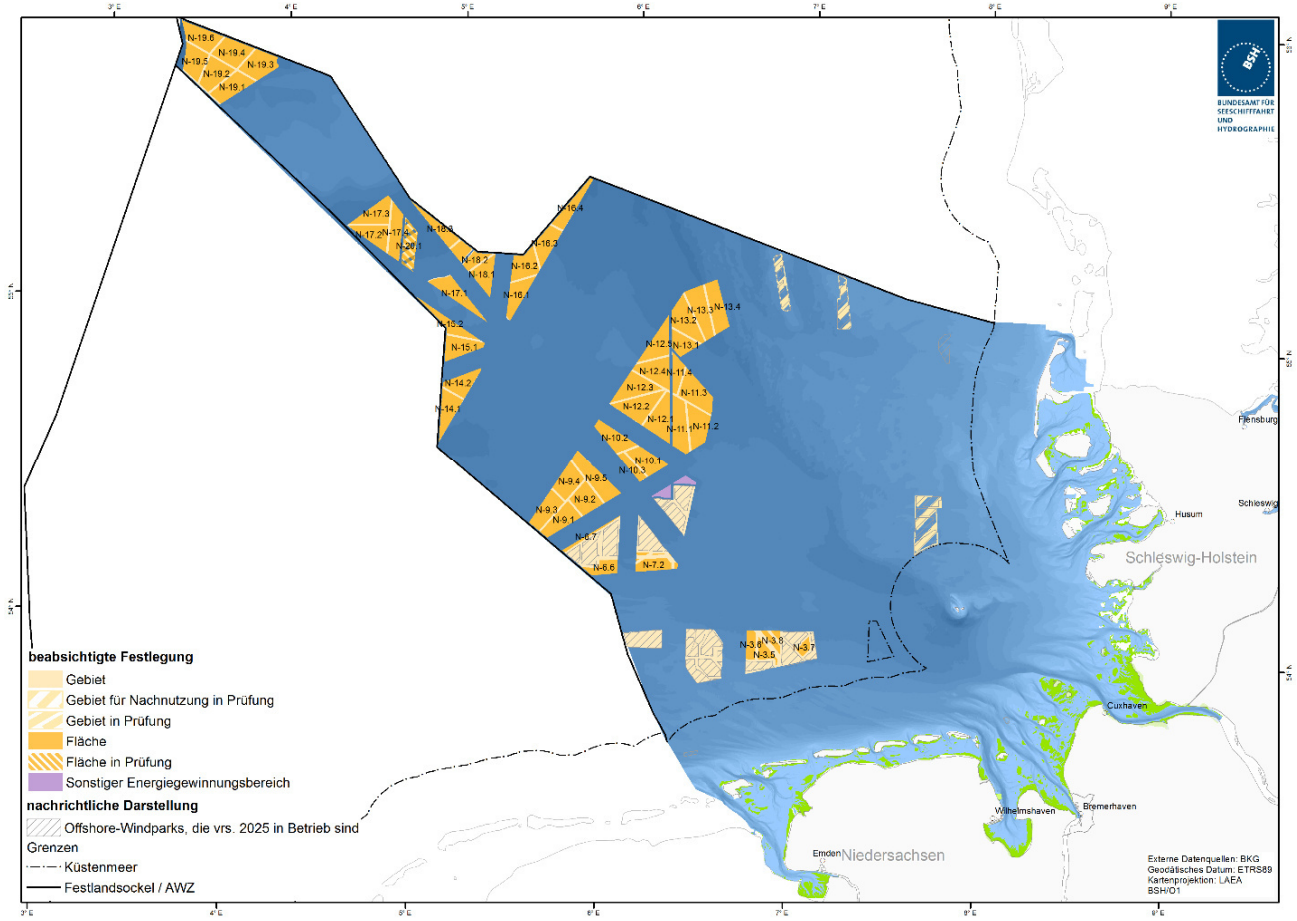


Figure 3 Intended designations of areas and sites in the EEZ of the North Sea

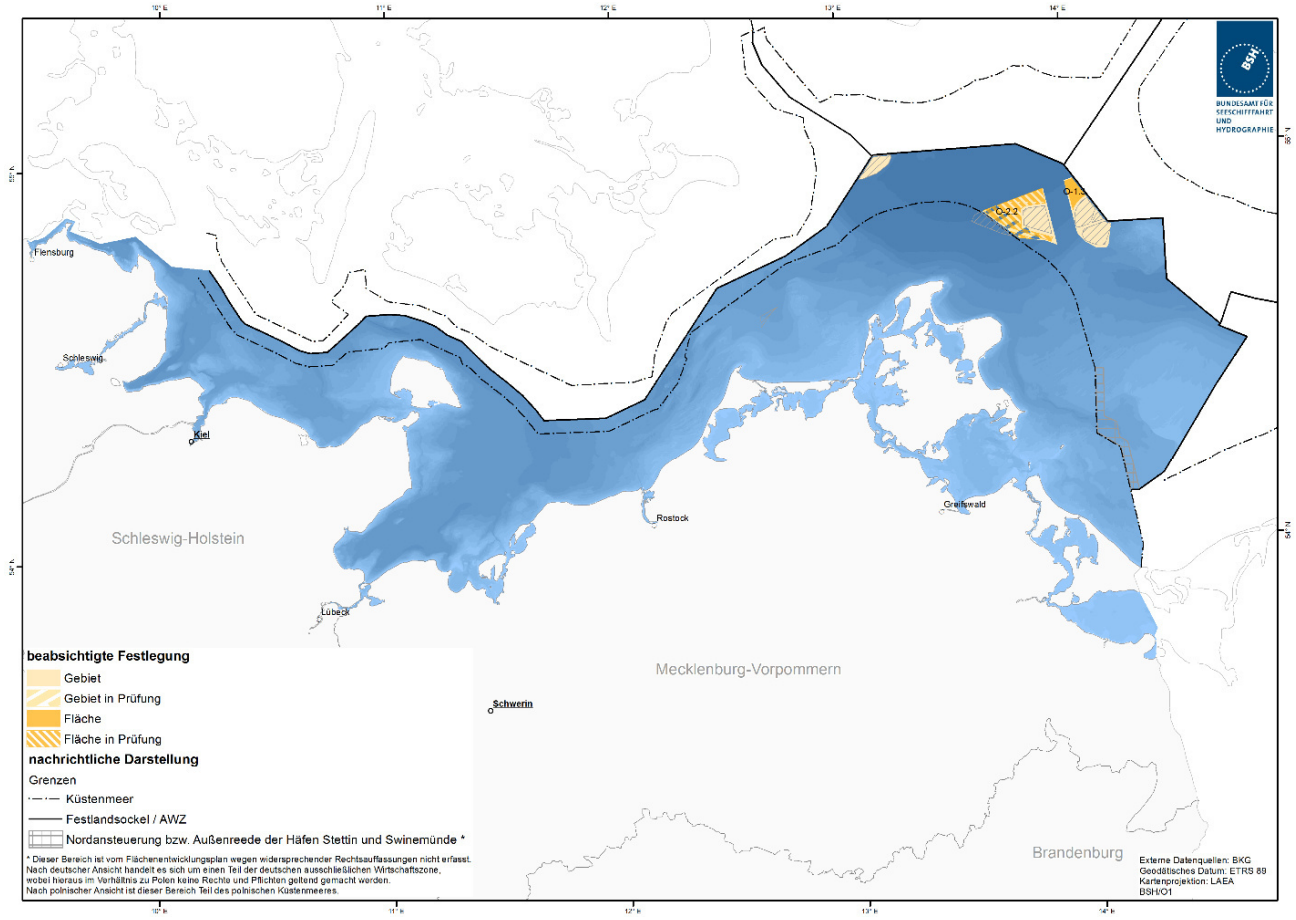


Figure 4 Intended designations of areas and sites in the EEZ of the Baltic Sea

Questions for consultation

Assumptions on decomissioning

F.1 What do you estimate is the expected operating time of existing offshore wind farms and grid connection systems? Do you consider it likely that the wind farms will be operated beyond the funding period of 20 years? What are your estimates regarding the maximum technical lifetime of wind turbines, platforms and cables?

F.2 What framework conditions must be observed when dismantling individual components (in particular foundation structures, cabling within wind farms, cable crossings? What procedures will likely be available for decommissioning wind farms in the period up to 2040?

F.3 What period of time is a reasonable assumption for the decommissioning and dismantling of a wind farm including all ancillary facilities?

F.4 After dismantling, do you consider it sensible to use existing components (e.g. foundation structures, platforms) in the context of subsequent use or should the aim be to completely decommission the existing wind farm? How do you prove the stability of the components in question (e.g. foundation structures) in the event of subsequent use?

Determination of expected generation capacity

F.5 Against the background of the modelling results set out in the first scientific interim report (available in German language only on the BSH website), and taking into account the expansion targets stated in the coalition agreement, how do you rate the intended designations with regard to the expected generation capacity?

Offshore grid connection systems

F.6 In the case of the NOR-9-3 and NOR-17-1 grid connection systems listed above, and given the distance between the areas and the required crossings with existing lines, do you consider a direct connection feasible or are transformer platforms required for these areas?

Assumptions on the model wind farm in the draft scope for the Strategic Environmental Assessment (separate document)

F.7 In your opinion, how appropriate are the assumptions for the framework parameters of offshore wind farms and grid connection systems as well as platforms for the Strategic Environmental Assessment against the background of expected technological development?

F.8 Given technological developments and increasing water depths, what are reasonable assumptions regarding the spatial requirements for foundations and scour protection? Is it reasonable to scale up the space required for monopile foundations? Which foundation variants seem realistic with increasing turbine size and water depth? Are there preferred foundations for the context of re-use? How should these foundations be assessed in terms of their spatial requirements compared to monopile foundations?