Netherlands Enterprise Agency

Development Framework for Offshore Wind Energy

Commissioned by the Council of Ministers on 10 June 2022

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Development Framework for Offshore Wind Energy

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• Final delivery date set for completion of the part of the offshore grid for connection to the wind farms at Hollandse Kust (zuid) Wind Farm Sites I and II. See Section 4.2;
• The Government's designation on 8 December 2016 of the area between the 10 and 12 nautical mile zones in the Hollandse Kust (zuid and noord) Wind Farm Zones has been incorporated in Figures 1 and 4 as well as in Section 2.2.

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• Final delivery date set for completion of the part of the offshore grid for connection to the wind farms at Hollandse Kust (zuid) Wind Farm Sites III and IV. See Section 4.2;
• Sections 1.4, 3.3, and 4.1 updated for tenders already completed and the published Offshore Wind Energy Roadmap 2030.
• As they appeared to cause confusion, the terms “nominal capacity” and “installed capacity” in the text (particularly in Sections 3.5 and 3.6) have been replaced by “installed capacity” in accordance with the provisions and definitions of Wind Farm Site Decision III and Wind Farm Site Decision IV for Hollandse Kust (zuid).
• Text adapted to allow for the possibility of tenders without subsidy.
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• Final delivery date set for completion of the part of the offshore grid for connection to the wind farm at Hollandse Kust (noord) Wind Farm Site V. See Section 4.2;
• Amendments to the Offshore Wind Energy Roadmap 2030:
o Reference to specification of 49 TWh offshore wind energy in 2030 in the Coalition and Climate Agreements;
o Addition of the Hollandse Kust (west), Ten noorden van de Waddeneilanden, and IJmuiden Ver Wind Farm Zones;
o Addition of direct current concept for IJmuiden Ver;
o Addition of guaranteed transmission capacity of 2 GW for direct current concept for IJmuiden Ver;
• Removal of provisions for stepping-stone function and addition of "WindConnector" (Section 3.3);
• Changes in provisions to bring them in line with Metering Code (Section 3.10);
• Addition of provisions on nature-inclusive construction (Section 3.11);
• Clarification on delivery (date) provisions (Chapter 4);
• Update and clarification of provisions on service life (Chapter 5).

Updated Spring 2020, adopted by the Council of Ministers on 20 May 2020:
• Expected commissioning dates of wind farms in Table 1 adjusted to match the most up-to-date timetable (Section 2.2);

• In respect of direct current platforms in IJmuiden Ver, provisions have been added regarding:
o access and accessibility (Section 3.4);
o availability and guaranteed transmission capacity (Section 3.5);
o maximum power input (Section 3.6);
o connections (Section 3.7);
o electrical properties and protection (Section 3.8);
• Inclusion of the Minister's decision regarding efforts to make the direct current platforms in IJmuiden Ver suitable for a 'WindConnector' (Section 3.9, previously Section 3.4)
• Inclusion of the Minister's decision regarding efforts to make the alternating current platform in Hollandse Kust (noord) suitable for electrification of oil and gas platforms (new Section 3.10);
• Addition of completion procedure and dates for direct current connections in IJmuiden Ver (text and Tables 4 and 6 in Section 4.2);
• Delivery date adjusted of the offshore grid for Hollandse Kust (zuid), Sites I and II, as a result of the agreement on changing that delivery date between the permit holder of those sites and TenneT (Table 3 in Section 4.2);
• Amendment of provisions on the service life of the offshore grid (Chapter 5).

Updated May 2021 by the Minister:
• Final delivery date set for completion of the part of the offshore grid for connection to the wind farms at Hollandse Kust (west) Wind Farm Sites VI and VII. See Section 4.2;
• Text on the parliamentary debate on the bill to amend the Offshore Wind Energy Act (Wet windenergie op zee) updated. See Section 5.3.

Updated June 2022, adopted by the Council of Ministers on 10 June 2022:
• Amendment of Section 1.1 to reflect the increased target for offshore wind energy by 2030 of the fourth Rutte Cabinet and clarification of government role.
• Inclusion of an updated map of the Wind Farm Zones to which this Development Framework relates (Section 2.1);
• Addition to the Roadmap of (parts of) Wind Farm Zones from the Additional Offshore Wind Energy Roadmap 2030 Letter to Parliament (Section 2.2);
• Expected commissioning dates of wind farms in Table 1 adjusted to match the most up-to-date timetable (Section 2.2);
• Amendment of connection sites for IJmuiden Ver Wind Farm Sites I to IV in Table 2, based on preferred alternative choice, and addition of offshore grid connection sites for the Additional Offshore Wind Energy Roadmap 2030 (Section 3.3);
• Inclusion of option to conclude conditional transmission agreements (Section 3.5);
• Text about WindConnector generalised to hybrid connections (Section 3.9);
• Addition of making the alternating current platform in Ten noorden van de Waddeneilanden suitable for electrification of oil and gas platforms (Section 3.10);
• Requirements for suppliers included (Section 3.13).
• Texts regarding provisions for IJmuiden Ver direct current connections have been generalised to ensure they also apply to the direct current connections added for the Additional Offshore Wind Energy Roadmap 2030 (Chapters 3 and 4);
• Inclusion of the provision that, where required, TenneT may award contracts before final permits have been obtained (Section 4.2);
• Addition of the offshore grid for the Additional Offshore Wind Energy Roadmap 2030 in Table 4 and Table 6. Indicative delivery dates in Table 6 amended to reflect the most up-to-date timetable (Section 4.2);
• Chapter 5 (Service life and depreciation of the offshore grid) updated based on the amended Offshore Wind Energy Act (longer permit period).

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1 Why a Development Framework Offshore Wind Energy?

1.1 Rationale behind the Development Framework

The fourth Rutte Cabinet has set itself the target of achieving a reduction in CO2 emissions of at least 55% in 2030 compared to 1990.[1] In his letter about of the Coalition Agreement,[2] the Minster[3] indicates a drive towards a total installed offshore wind capacity of about 21 gigawatts (GW, this equals 21,000 megawatts (MW)) by 2030 to help achieve this CO2 reduction target. A planned approach, with a management role for the Government, will be necessary to make this a reality. Part of this approach is to oversee the construction of an offshore grid. To do this, it is preferred to work with a plan that includes investments for the offshore grid, comparable with the plans the transmission system operators draw up for onshore grids. However, the complicating factor is that the transmission system operator for the offshore grid and market parties cannot, in principle, independently evaluate the basic principles upon which their investment plan should be founded. After all, where and when wind farms can be constructed in the coming years and their size depends on Government policy.

Control by the Government is exercised through:
• The North Sea Programme,[4] which is part of the National Water Programme. Government designates Wind Farm Zones as part of the North Sea Programme;
• Wind Farm Site Decisions and wind farm permits issued under the Offshore Wind Energy Act. In addition, the Government coordinates the spatial planning procedures for construction of the offshore grid via the National Coordination Scheme (RCR);
• If necessary: subsidies under the Stimulation of Sustainable Energy Production and Climate Transition Decision (Besluit stimulering duurzame energieproductie en klimaattransitie);
• An Offshore Wind Energy Roadmap, in which the Government indicates when certain Wind Farm Zones, or parts thereof, will be developed. The Government developed and updated the Roadmap in phases, successively based on the Energy Agreement (2013),[5] the Climate Agreement (2019)[6], and the fourth Rutte Cabinet Coalition Agreement, informing the House of Representatives by means of several letters;[7]
• A Development Framework for Offshore Wind Energy, based on Section 16e of the Electricity Act 1998 (*Elektriciteitswet 1998*). This section stipulates that the following should, in any case, be included in the Development Framework:
a. The location of one or more wind farms;
b. The expected commissioning date of each wind farm;
c. The expected service life of wind farms;
d. The maximum capacity of each wind farm;
e. The minimum transmission capacity required for each wind farm;
f. The method of electrical connection method for each wind farm;
g. Planned delivery dates for parts of the offshore grid;
h. Future offshore wind developments that are taken into account when setting up the electrical connection.
Parts a to d above relate to the wind farms and summarise the letters from the Government regarding the Roadmap. Most of this can be found in Chapter 2 of the current Development Framework. Parts e to h relate to the offshore grid and are covered in Chapters 3 to 5.

Section 16e of the Electricity Act 1998 stipulates that the Minister defines this Development Framework.

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[1] Parliamentary Paper 35788, No. 77, Annex blg-1009826.
[2] Parliamentary Paper 32813, No. 974.
[3] In this Development Framework, the terms 'Minister' and 'Ministry' refer to the Minister and the Ministry responsible for offshore wind energy.
[4] The currently applicable version is the North Sea Programme 2022-2027, see Parliamentary Paper 35325, No. 5, blg-1022234.
[5] Energy Agreement for Sustainable Growth, 6 September 2013 (Parliamentary Paper 30 196, No. 202, blg-248998).
[6] Climate Agreement, 28 June 2019, Parliamentary Paper 32813, No. H, blg-890294.
[7] The Offshore Wind Energy Roadmap consists of two parts: one part until the end of 2023 (based on the 2013 Energy Agreement; see Parliamentary Paper 33 561, No. A/11) and another part for the years 2024 to 2030 (based on the Coalition Agreement and the (draft) Climate Agreement; see Parliamentary Paper 33561, No. 42 and Parliamentary Paper 33561, No. 48).

1.2 Objective of the Development Framework

The main objective of the Development Framework for Offshore Wind Energy is to create an outline framework for the design, construction, availability, and service life of the offshore grid.[8] It provides clarity in advance to offshore wind farm developers regarding the schedule and preconditions for the development of offshore wind energy in the Netherlands. Having clarity in advance is extremely important because, unlike the onshore high-voltage grid, the offshore grid is constructed specifically for offshore wind farms. As a result, choices made in terms of the design of the offshore grid generally have direct implications for the design and profitability of the connected wind farms. It is essential for offshore wind farm developers to be aware of these choices before they bid for a site in a Wind Farm Zone.

The Development Framework broadly outlines the functional requirements and the technical concept for the offshore grid that the wind farms are connected to. The basic principles and intended objectives here are always to minimise total costs for offshore wind energy, i.e. the combined costs of the wind farms and the offshore grid.

The Development Framework also defines the task of the offshore grid operator, TenneT.[9] Based on Section 16e of the Electricity Act 1998, TenneT is obliged to draw up a document every two years that shows the offshore grid investments needed to implement this Development Framework. This is to ensure TenneT completes the connection of the wind farms in good time. Partly on the basis of this Development Framework and prior to the construction phase of the offshore wind farms, TenneT is to conclude a Realisation Agreement and a Connection and Transmission Agreement[10] with the permit holders for the offshore wind farms, which further specify the technical details.

1.3 Assessment against the Development Framework

The third paragraph of Section 20d of the Electricity Act 1998 stipulates that the costs of investments made by TenneT for the offshore grid to implement the Development Framework will be included in the permitted incomes. This guarantees there will be no after-the-fact discussion of the extent to which investments made were useful and necessary. This shall not prevent the Netherlands Authority for Consumers & Markets (hereinafter referred to as the ACM) from monitoring and ensuring TenneT only recovers the rational costs for these investments.

1.4 Scope and updating of the Development Framework

The Development Framework relates to the offshore wind energy target of around 21 GW operating capacity by 2030.[11] The stipulations in the Development Framework apply to the Wind Farm Zones in the Offshore Wind Energy Roadmap; see Figure 1. The technical-functional specifications and the technical concept for the offshore grid apply to its entire service life. Where applicable, the Development Framework lays down specific stipulations for individual Wind Farm Zones and the parts of the offshore grid relevant to them. For example, Section 4.2 of this Development Framework sets the delivery dates for the parts of the offshore grid relating to the various Wind Farm Zones and the sites therein.

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[8] As stated above, the Government informs the House of Representatives separately by letter regarding the Offshore Wind Energy Roadmap, which indicates when certain Wind Farm Zones or parts thereof will be developed.
[9] On 5 September 2016, the Minister designated TenneT as the offshore grid operator.
[10] The contents of these agreements are known prior to the opening of the relevant tender.
[11] In the North Sea Programme 2022-2027, the Government decided to add a maximum of 10.7 GW to the original Roadmap 2030 for this.

The Minister will update the Development Framework should the situation require it. The basic principle here is that the functional specifications and the technical concept for the offshore grid do not change (in essence), so the standardisation (see Section 3.2) and cost savings that go hand in hand with this are ensured. This also gives wind farm developers certainty that they will not have to modify their design subsequently.

1.5 Content of the Development Framework

Parts of this Development Framework have already been laid down or are still being elaborated on in subsequent policy-making, such as the North Sea Programme, the Offshore Wind Energy Roadmap, and the Win Farm Site Decisions. The following parts have already been laid down:

• The sequence for development of the wind farms. This sequence shows the zones that have to be developed first and those that will follow subsequently. The sequence is as laid down in the Offshore Wind Energy Roadmap; Chapter 2 provides a summary of the Roadmap;

• The way in which the wind farms are connected to the onshore grid: via the offshore grid. TenneT connects the wind farms and constructs and manages an offshore grid for this, with a view to a planned implementation and the realisation of cost savings. The basic principle for the offshore grid is also laid down in the Offshore Wind Energy Roadmap.

These decisions have, in fact, already taken a broad outline account of the integral consideration of the costs of the wind farms, spatial aspects, and consequences for the offshore grid transmission system operator, as stated with regard to the Development Framework in the Electricity Act 1998. This Development Framework contains further elaboration of these broad outlines as well as a number of new elements. These elements are:

• Delivery dates for the various parts of the offshore grid; see Section 4.2 et seq. It is important that the connection for the wind farms is ready in time to prevent yield losses and damage to the wind farms. Overrunning the delivery dates set out in this Development Framework could be reason for TenneT to compensate the wind farm permit holder, in accordance with the provisions in Section 16f of the Electricity Act 1998;

• Further elaboration of the technical preconditions and functional specifications for the offshore grid. The Development Framework sets out the technical specifications with which the offshore grid must comply. These preconditions and functional specifications determine the technical design of the wind farms and thereby provide clarity and certainty for both TenneT and the offshore wind farm permit holders.

In doing so, this Development Framework specifies the technical preconditions and functional specifications that determine the design and costs of the offshore grid. The detailed implementation of the preconditions and specifications, as well as the creation of technical-operational agreements, will be done by TenneT, in close cooperation with interested parties from the wind sector. Ultimately, the technical details and technical-operational agreements will be included in the Connection and Realisation Agreement that TenneT and the wind farm permit holders will enter into and in the technical codes (the conditions based on Section 31 of the Electricity Act 1998);

• The expected technical service lives assumed for the wind farms and the offshore grid.

1.6 Creation of this Development Framework

Considering the importance of the Development Framework and the wider interests involved, the Development Framework has been prepared in consultation with TenneT, the wind sector (Netherlands Wind Energy Association, NWEA), ACM, and the ministries responsible for the North Sea, as well as the Ministry of Finance, which is a shareholder (on behalf of the state) in TenneT. An Internet consultation also took place prior to the first publication in 2016.

2 Sequence for development of the wind farms

2.1 Clustered realisation in designated Wind Farm Zones

During evaluation of the previous offshore wind tender round, it was concluded that there are cost benefits from developing offshore wind energy in clusters and when directed by the Government.[12] This was recognised when the agreements were made in the Energy Agreement, which are continued in the Climate Agreement and the Government's policy. In concrete terms, this means the realisation will occur in clusters per Wind Farm Zone as designated in the North Sea Programme. Sites are designated for each Wind Farm Zone by means of Wind Farm Site Decisions. Permits (and any subsidies) are issued using a tender procedure, in accordance with the Offshore Wind Energy Act.

For the phase before the Energy Agreement, Wind Farm Zones where wind farms can be constructed at lowest cost were established, based on calculations by Energy Research Centre for the Netherlands (ECN).[13] These are the Wind Farm Zones closest to the coast. The relatively short connections from the wind farms to the national high-voltage grid in particular, and the advantage that they can be installed using relatively cheap alternating current technology, ensure the costs per kilowatt hour for wind farms close to the coast are lower than for wind farms situated further from the coast.

2.2 Offshore Wind Energy Roadmap

The Offshore Wind Energy Roadmap provides the order in which the Wind Farms Zones will be developed. The realisation of offshore wind energy starts with the development of the Borssele (approx. 1.4 GW), Hollandse Kust (zuid) (approx. 1.4 GW), and Hollandse Kust (noord) (approx. 700 MW) Wind Farm Zones. These Wind Farms Zones are located relatively close to the coast and are connected with alternating current. These are followed by Hollandse Kust (west) (approx. 2.1 GW max), IJmuiden Ver (approx. 6 GW), Nederwiek (approx. 6 GW max), Ten noorden van de Waddeneilanden (approx. 0.7 GW), and Doordewind (approx. 4 GW max). The Government is expected to decide in 2024 on the final planning for Nederwiek, Site III, Doordewind, and Ten noorden van de Waddeneilanden based on the results of:

- The Offshore Wind Energy Connection – Eemshaven Programme (PAWOZ – Eemshaven). Here, possible cable routes through the Wadden Sea area are being investigated for the grid connections of both the Doordewind and Ten noorden van de Waddeneilanden Wind Farm Zones;
- An ecosystem study for the Doordewind Wind Farm Zone to identify the impact of future wind farms on the stratification of the seawater and the consequences of this for nature;
- Investigation into the optimum layout of the sites in the Doordewind Wind Farm Zone in relation to the gas production platforms still present and the shipping route to the south of it;
- Investigation into the possibility of permits being granted for the offshore grid cable route to Geertruidenberg for Nederwiek Site III. This route runs through the Natura 2000 areas of Voordelta, Haringvliet, Hollands Diep, and Biesbosch.

An investigation for Site VIII (0.7 GW) in the southern part of the Hollandse Kust (west) Wind Farm Zone is ongoing in the Exploration of Offshore Wind Energy Landing 2031-2040 (*Verkenning Aanlanding Windenergie Op Zee 2031-2040*, VAWOZ 2031-2040).[14] Landing energy requires sufficient connection capacity in the North Sea Canal Area, which, among other things, depends on the sustainability plans of Tata Steel. The Government is expected to decide on the final planning in 2024.

Table 1 and Figure 1 below summarise the sequence of developments of the Offshore Wind Energy Roadmap for the target of 21 GW by 2030.

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[12] Final report of the Offshore Wind Energy Task Force, May 2010. Please see https://zoek.officielebekendmakingen.nl/blg-65611.pdf.

[13] Parliamentary Paper 33 561, No. 12.

[14] Parliamentary Paper 33561, No. 52.

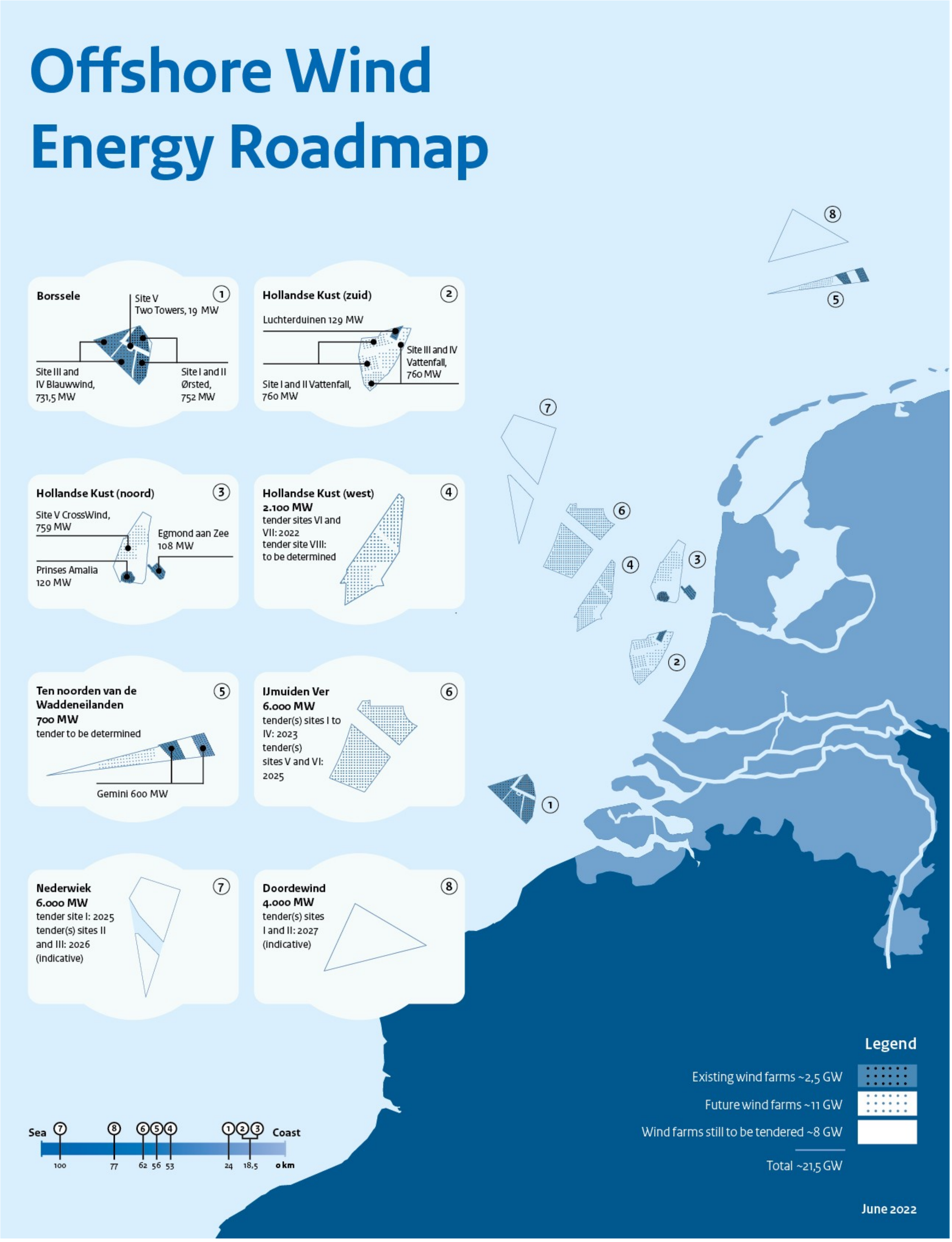

Figure 1 Wind Farm Zones within the Roadmap Offshore Wind Energy

Table 1 Sequence for development of offshore wind energy

Capacity (GW)	Wind Farm Zone, Site(s)	Tender for sites	(Expected) commissioning date of wind farm	Status
0.75	Borssele, Sites I and II	Implemented in 2016	2020	
0.75	Borssele, Sites III, IV and V	Implemented in 2016	2020	
0.76	Hollandse Kust (zuid), Sites I and II	Implemented in 2017	(2022-2023)	
0.76	Hollandse Kust (zuid), Sites III and IV	Implemented in 2019	(2022-2023)	
0.76	Hollandse Kust (noord), Site V	Implemented in 2020	(2023)	
approx. 0.7	Hollandse Kust (west), Site VI	Implemented in 2022	(2025-2026)	
approx. 0.7	Hollandse Kust (west), Site VII		(2025-2026)	
approx. 1.0	IJmuiden Ver, Site III	Fourth quarter of 2023	(2028)	
approx. 1.0	IJmuiden Ver, Site IV		(2028)	
approx. 1.0	IJmuiden Ver, Site I		(2029)	
approx. 1.0	IJmuiden Ver, Site II		(2029)	
approx. 1.0	IJmuiden Ver (noord), Site V	Second quarter of 2025	(2029)	
approx. 1.0	IJmuiden Ver (noord), Site VI		(2029)	
approx. 2.0	Nederwiek (zuid), Site I		(2030)	
approx. 2.0	Nederwiek (noord), Site II	2026*	(2030)	
approx. 2.0	Nederwiek (noord), Site III		(2031)	
approx. 0.7	Hollandse Kust (west), Site VIII	2026/2027**	TBD**	
approx. 0.7	Ten noorden van de Waddeneilanden, Site I	2026/2027*	(2031)	
approx. 2.0	Doordewind, Site I	2027*	(2031)	
approx. 2.0	Doordewind, Site II	2027*	(2031)	
Realised: Under construction: Scheduled:				

* The tender dates for these Wind Farm Zones are indicative. A final decision on the schedule is expected in 2024, based on the results of the Offshore Wind Energy Connection – Eemshaven Programme (PAWOZ – Eemshaven) for Ten noorden van de Waddeneilanden and Doordewind and the study into the landing for Site III of the Nederwiek Wind Farm Zone. It will then be clear which sites will be used for the 10.7 GW of the Additional Roadmap and which unused Wind Farm Zones or sites therein can be carried forward to the offshore wind energy challenge beyond 2031.

** The tender date for this Wind Farm Zone is indicative. Pending clarity on Tata Steel's plans currently under development to make the energy supply and production process more sustainable, further decisions will be made with regard to this matter. The decisions regarding the landing of the relevant section of the offshore grid will be related to this.

3 Method of connecting the wind farms

3.1 Background

The Energy Agreement stipulates that, where this is more efficient than a direct, individual ("radial") connection of wind farms to the onshore grid, there should be an offshore grid to connect offshore wind farms with the onshore grid, for which TenneT will be charged with responsibility.

As the Minister stated in his letter of 18 June 2014,[15] a study by Royal HaskoningDHV, commissioned by the Ministry, revealed the construction of an offshore grid, managed by TenneT, has advantages over radial connections. The advantages are in the areas of availability (security of supply), planning coordination, financing burdens, standardisation, and associated cost reductions from advantage of scale for purchasing, maintenance, knowledge development, and learning effects. This model also simplifies compensating grid fluctuations, flow management, and balancing supply and demand, while integral grid operation also leads to knowledge pooling and a clear distribution of tasks and responsibilities in the electricity system. This also means TenneT can take advantage of the knowledge and experience gained through its German offshore activities.

In the aforementioned letter, the Government takes the directional decision to legally appoint TenneT as the transmission system operator for the offshore grid. The Electricity Act 1998 contains the legal basis for the appointment of TenneT and elaborates on a number of issues. In anticipation of the appointment, TenneT was temporarily charged with the legal duty of carrying out preparatory activities for the offshore grid based on the Electricity Act 1998.

As a result of the above, TenneT identified the costs of realising the offshore grid to implement the Energy Agreement and of taking on responsibility for the connections between the wind farms and the offshore grid.[16] It was concluded that substantial savings are possible by making TenneT responsible for all offshore infrastructure. DNV GL (now DNV) subsequently validated the technical concept and cost substantiation on behalf of TenneT.[17] This report was reviewed by ECN on behalf of the Ministry.[18] Like DNV GL, ECN concluded that coordinated connection of offshore wind farms by TenneT would lead to lower public costs than individual connections. The Minister’s letters to the House of Representatives[19] about the costs of the offshore grid confirm this.

In September 2016, the Minister designated TenneT as the offshore grid operator.

3.2 Concept for the offshore grid

The basic principle behind the offshore wind energy assignment is to realise the wind farms in the most cost-effective manner. This is done by starting with a concept from TenneT for the offshore grid that is standardised as far as possible.[15] This concept uses substation platforms. In the case of alternating current platforms, approximately 700 MW of wind energy capacity can be connected to each platform.

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[15] Parliamentary Paper 31 510, No. 49.
[16] Vision for Electricity Grid Design and Roll-out Strategy, Future-proof Electricity Grid Optimisation, TenneT, 21 July 2014.
[17] Review of Electricity Grid Design and Roll-out Strategy for TenneT Offshore Wind Farms, public version, DNV GL, 14 May 2014.
[18] Public version of validation of DNV GL document "Review of Electricity Grid Design and Roll-out Strategy for TenneT Offshore Wind Farms", ECN-N--14-020, 11 August 2014.
[19] Parliamentary Paper 33 561, Nos. 15, 19, 21 and 25.

When using direct current platforms, the connected capacity is approximately 2 GW. The wind turbines in the wind farms are connected to the platform; see Figure 2.

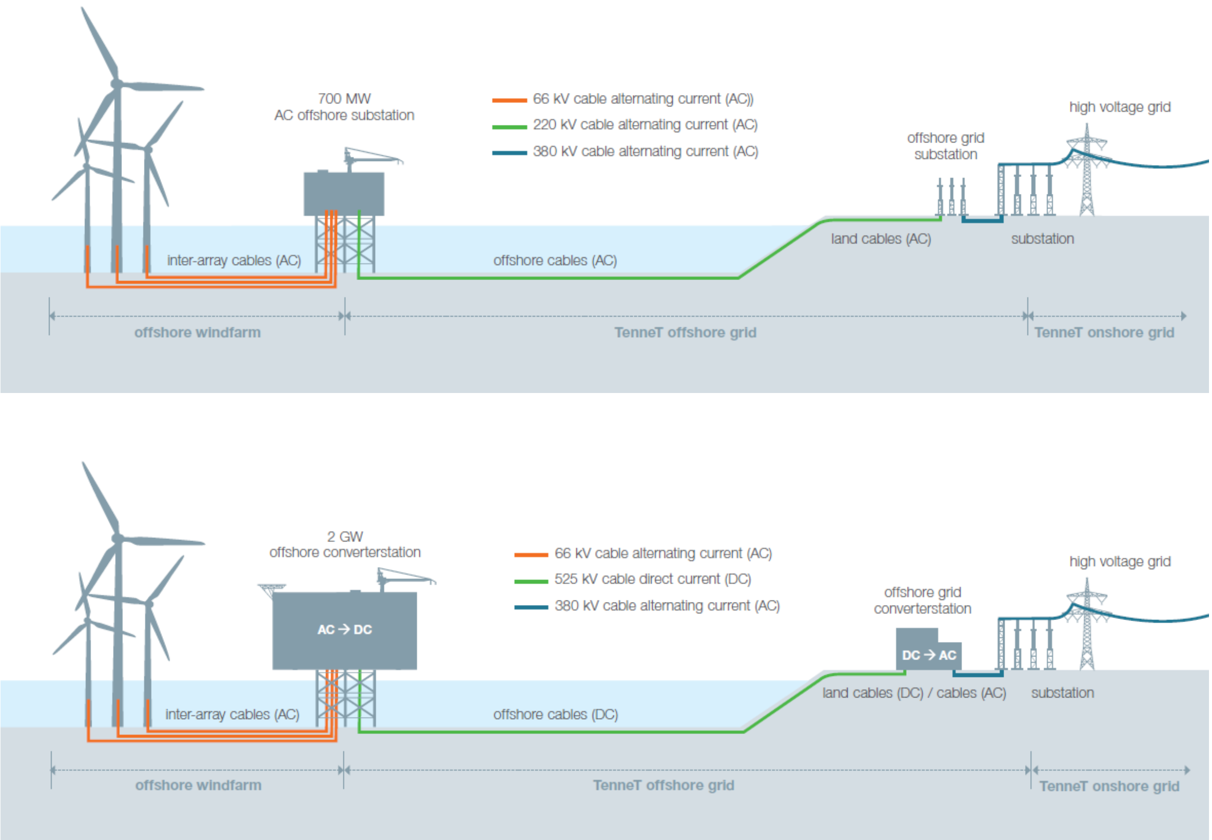

Figure 2 Schematic depiction of the grid – alternating current (above) and direct current (below)

The offshore grid comprises separate parts that connect the Wind Farm Zones to the onshore national high-voltage grid. These parts will be constructed in phases, so each will be completed in time to transport the electricity generated by wind farms connected to that part.

This connection method reduces the number of platforms required compared with the situation in which each wind farm is connected to the national high-voltage grid by an individual platform and an individual connection. In addition to cost savings, the standardisation and bundling of connections will also minimise pressure on the environment by limiting disturbance to the landscape. There will also be benefits with regard to availability and it will be easier to meet the timetable in the Offshore Wind Energy Roadmap.

This offshore grid consists of the platforms, sea-based (energy export) cables, onshore cables, and part of (the expansion of) an onshore substation. In cases where direct current is used, the onshore converter substation will also form part of the offshore grid. What are known as the inter-array cables, which connect the individual wind turbines to TenneT's platform, are not part of the offshore grid, but rather are part of the wind farm.

3.3 Connection locations and method

The cables from the Wind Farm Zones are connected to the onshore high-voltage grid at different locations. Table 2 below provides an overview. While still to be further investigated, the connection sites and cable routes for Hollandse Kust (west), Site VII, and the Ten noorden van de Waddeneilanden and IJmuiden Ver Wind Farm Zones were selected after a broad survey process (Exploration of Offshore Grid Landing, VANOZ[20] and VAWOZ 2030[21]) with early involvement by public authorities, companies, and civil society organisations. The selection was made following studies into the impact on technology, costs, the environment, and future-proofing options. This resulted in a geographically distributed connection pattern, with connection points preferably located close to industrial clusters on the coast and avoiding, as far as possible, the need for investments in the onshore high-voltage network.

In the VANOZ process, which was later reconfirmed in VAWOZ 2030, it was decided to use conventional electrical connections. Non-electrical alternatives, for example involving the generated electricity being converted to hydrogen offshore before being transported ashore by means of a pipeline, proved to be unrealistic within the time frame of the 2030 Roadmap. These types of concepts are still in too early a stage of development to provide sufficient scale or cost competitiveness. Non-electrical options could, however, be considered for the period after 2030.

Table 2 Locations for connection to the onshore high-voltage grid

Wind Farm Zone, Site(s)	**Onshore connection site**
Borssele, Sites I and II	Borssele
Borssele, Sites III, IV and V	Borssele
Hollandse Kust (zuid), Sites I and II	Maasvlakte
Hollandse Kust (zuid), Sites III and IV	Maasvlakte
Hollandse Kust (noord), Site V	Beverwijk
Hollandse Kust (west), Site VI	Beverwijk
Hollandse Kust (west), Site VII	Beverwijk, route yet to be determined
Ten noorden van de Waddeneilanden, Site I	Eemshaven
IJmuiden Ver, Sites I and II	Borssele
IJmuiden Ver, Sites III and IV	Maasvlakte
IJmuiden Ver, Sites V and VI	Maasvlakte
Nederwiek (Site I)	Borssele
Nederwiek (Site II)	Maasvlakte
Nederwiek (Site III)	Yet to be determined: Geertruidenberg
Hollandse Kust (west), Site VIII	Yet to be determined: North Sea Canal Area
Doordewind (Site I)	Yet to be determined: Eemshaven
Doordewind (Site II)	Yet to be determined: Eemshaven

[20] See Parliamentary Paper 33561, No. 48, blg-879079 and https://www.rvo.nl/onderwerpen/bureau-energieprojecten/lopende-projecten/hoogspanning/verkenning-aanlanding-netten-op-zee-2030.
[21] See Parliamentary Paper 33561, No. 52.

When determining routes for the (sea and land based) transmission cables for the offshore grid, physical and legal considerations, cost-efficiency, and consequences for the environment are taken into account as part of the State Coordination Scheme (RCR: rijkscoördinatieregeling). To this end, separate environmental impact assessments will be drawn up for the network connections (platforms, cables, and the onshore transformer and/or converter stations). The connection sites and cable routes will be determined by the Minister in a preferred alternative based on a comprehensive impact assessment which, in addition to environmental impact, also examines the impact of the alternatives in terms of cost, technology, and future-proofing. When deciding on a preferred alternative, the Minister will also take into account the responses of involved parties[22] to phase 1 of the environmental impact assessments and to the comprehensive impact assessment. Advice will also be sought from the independent Netherlands Commission for Environmental Assessment as well as the regional authorities (provinces, municipalities, and water authorities).

This Development Framework stipulates that the construction method for the onshore sections of the offshore grid must be in accordance with the "cabling method",[23] provided this is technically feasible. For the onshore parts of the offshore grid, any additional costs for underground construction are justified on the basis of the following considerations:

• Public support. The possible onshore substations are partly located in heavily populated areas, as a result of which the land routes of the offshore grid could have a major impact on the environment;
• Feasibility of the plan for realising the Roadmap and consequently the offshore wind agreements in the Energy Agreement, Coalition Agreement, and Climate Agreement. Previous projects for high-voltage connections have revealed that the lead time for integration procedures is considerable shorter because there is significantly less public resistance;
• Less space required and more flexibility in construction. An underground cable section requires less (protection) space than an above-ground section;
• Relatively short routes for the most part. The locations of the substation options being considered means the length of the land routes for the offshore grid will be limited. This minimises both total additional costs and technical consequences of cabling for the national high-voltage grid onshore.

For Wind Farm Zones connected to more than one platform, this Development Framework stipulates that the onshore sections for the cables from both platforms can be laid simultaneously if it limits environmental impact, is more cost-effective, or for other valid reasons.

Given the relatively short distance from the Wind Farm Zones to the onshore connection sites and the relatively limited size of the capacity installed, the offshore grid for the Borssele and Hollandse Kust Wind Farm Zones will be configured for alternating current. The same also applies to the Ten noorden van de Waddeneilanden Wind Farm Zone, although the distance from this Wind Farm Zone to an onshore connection site is at the limit of what is possible with alternating current. The IJmuiden Ver, Nederwiek and Doordewind Wind Farm Zones will be connected using direct current (HVDC) due to the relatively large distance to the onshore connection sites and the large capacity to be connected (approx. 4 to 6 GW each).

3.4 Platform locations and accessibility

This Development Framework stipulates that the locations of the platforms must be selected so they make an optimal contribution to lowering the total cost of the electricity generated by the wind farms concerned.

[22] Anyone can respond to the comprehensive impact assessment by means of an internet consultation.
[23] Cabling is understood to mean laying a high-voltage cable underground.

Account must also be taken of other relevant interests, including existing electricity network routes, pipelines, telecommunications cables, and interconnectors, as well as archaeological interests. The initial search areas for platform locations are determined by the designation of sites in the Wind Farm Zones, which is done for the Wind Farm Site Decisions. The final locations are laid down in the Water Act (*Waterwet*) permit for each network connection.
Depending on the final layout of the sites in the Wind Farm Zones and final locations of the platforms, it could prove that, for cost-effectiveness, spatial, or other reasons, following the preferred cable corridors of the North Sea Programme is not advisable.

3.4.1 700 MW alternating current connections
This Development Framework stipulates that the standard method of accessing the 700 MW alternating current platforms of the offshore grid is by ship.[24] To this end, platforms should have facilities to increase accessibility to them by ship under various weather conditions, enabling safe landing of ships and transfer of personnel and equipment.

Based on a study commissioned by TenneT[25], which was consulted on with the wind sector, this Development Framework stipulates that alternating current platforms will not be equipped with helicopter decks. This is based on the following arguments:[26]
• The platforms are located relatively close to the coast and ports, making time gained from accessibility by helicopter minimal.
• The amount of time when access by ship is impossible and a helicopter can provide added value is minimal, in view of the high availability of the offshore grid expected.
• Not having a helicopter deck results in cost savings of several million euros (both investment costs and operating costs, which combined make up approximately 0.1% of total costs).
• Increased space will be available for wind turbines, because there is no need for obstacle-free helicopter approach routes at the sites.
• The industry is increasingly using ships for offshore operations and maintenance activities instead of helicopters, due to the risk of serious accidents involving helicopters.

One possible disadvantage of the lack of a helicopter deck is that under unfavourable weather conditions (heavy seas) it could take longer to repair a fault in grid or in the connection between wind turbines and the offshore grid. However, the probability of this is small and does not outweigh the savings. Moreover, platforms will be equipped with a heli-hoist facility,[27] which enables individuals and materials to be transported to and from the platforms in cases of particular urgency or disaster.

TenneT makes further agreements with wind farm permit holders for access to its alternating current platforms in Realisation and Connection Agreements. The basic principle here is to ensure workable access by the wind farm permit holders, within safety restrictions, to equipment and systems they own and which are housed on the TenneT platform for reasons of cost-effectiveness.

The need for transport to wind farms and TenneT's alternating current platforms is reduced as much as possible by mostly operating these remotely. Therefore, for each wind farm, TenneT is making sufficient space available near the onshore substation to which the offshore grid is connected, as well as on the platforms themselves. This space will accommodate necessary computer and communications equipment as well as

[24] This is also understood to mean crew transfer vessels, platform supply vessels, and 'walk to work' solutions.
[25] High level review helideck and accommodation; Helideck and accommodation facilities on offshore platforms for wind farms, public version, DNV GL, Report No. 130112-NLD-R1, Rev. A-Public, 9 June 2015. See https://www.tennet.eu/fileadmin/user_upload/Our_Grid/Offshore_Netherlands/Consultatie_proces_net_op_zee/Technical_Topics/27_130112_NLLD_R_A_public_version.pdf.
[26] See TenneT consultation position paper "T.4 Access to platform", https://www.tennet.eu/fileadmin/user_upload/Our_Grid/Offshore_Netherlands/Consultatie_proces_net_op_zee/Technical_Topics/26_ONL_15-184-T4_Access_to_platform_PP_v2.pdf.
[27] A facility to allow people and (to a very limited extent) goods to be winched up and down from a helicopter.

facilities for the duplex data traffic. TenneT will enter into further agreements on this with the wind farm permit holders in the Connection and Realisation Agreements.

3.4.2 2 GW direct current connections

In view of the relatively large distances to the coast, before the consultation process, TenneT carried out an extensive study[28] on the planned 2 GW direct current platforms. This look into aspects such as offshore logistics and access to and exit from the platforms. Based on this study, this Development Framework has determined that a helicopter deck on each of the 2 GW direct current platforms is necessary and would contribute to minimising repair time in the event of failures and thus to higher availability of the connections. In addition to a helicopter deck, the platform will be fitted with facilities to increase accessibility by ship under various weather conditions, ensuring safe landing of ships and transfer of personnel and equipment.

The consultation process with wind farm developers suggested there is no added value in equipping platforms to become logistics hubs for them . The current trend in offshore wind turbine operations and maintenance is evolving towards the use of service vessels that do not sail back and forth between the wind farm and the coast on a daily basis, but rather remain at sea for long periods of time. Limiting access to the platform by third parties also contributes to a clear separation of responsibilities and to reducing additional investments. From a safety perspective, as well, it is preferable to minimise the number of hours spent on the platform.

The consultation process also showed it is possible to design the 2 GW direct current connections in a way that limits or prevents the platforms and the onshore substations being used to house equipment for wind farm developers. Note, TenneT does still provide space for this purpose.

As a result, wind farm developers would not require access to the platform or onshore station during normal operations. This contributes to a clear separation in responsibilities between TenneT and wind farm developers and to reducing the need for additional investments.

During construction and commissioning of the wind farms, and in the event of equipment failures, access to TenneT's platforms by wind farm permit holders is necessary. For maintenance operations and when dealing with breakdowns, it should be possible for people to stay on the platform. TenneT will come to further agreements in this regard with wind farm permit holders in the Connection and Realisation Agreements. Once a platform is fully operational, it will be operated as an unmanned platform.

[28] See footnote 22.

3.5 Availability and minimum guaranteed transport capacity

The benefits of constructing the offshore grid should, among other things, be reflected in higher availability (reliability) of the transmission capacity.[29]

3.5.1 700 MW alternating current connections

The alternating current platforms are each connected to the onshore high-voltage grid with two 220-kilovolt cables. This offers additional availability, reducing the risk of partial or total interruption of transport capacity. In addition, the electrical installation on the side to which the wind turbines connect is set up in such a way that, even if one of the 220-kilovolt cables or the transformers connected to it fail, the wind farms can be switched to another offshore transformer. This also provides additional availability, allowing at least half of the transport capacity to remain intact.

The Borssele, Hollandse Kust (zuid), and Hollandse Kust (west) Wind Farm Zones each contain several alternating current platforms. A connection between platforms in the same Wind Farm Zone will provide additional availability. A cost/benefits analysis commissioned by TenneT[30] shows the benefits of a 66-kilovolt connection outweigh the additional costs. This Development Framework therefore stipulates that there is to be a 66-kilovolt voltage level connection between the platforms in the aforementioned Wind Farm Zones. This will ensure high availability, and diesel generators will not have to be installed on the platform as a back-up facility to condition the wind turbines in case of power failure. This does not appear to be common in the sector, with a comparable level of availability of an offshore wind farm grid connection.

The minimum guaranteed transmission capacity of the offshore grid is 700 MW per alternating current platform, unless specific (location) circumstances make this impossible. For the offshore grid from IJmuiden Ver, Sites V and VI, if there is a (temporary) lack of sufficient energy demand or if there are not enough options to resolve congestion issues via redispatch, it may not be possible to simply feed wind-generated electricity into the onshore grid. This may result in TenneT entering into conditional Transmission Agreements, whereby less than the minimum 700 MW transmission capacity is guaranteed, or other measures are required. This must be specified before tenders for the Wind Farm Sites are opened.

3.5.2 2 GW direct current connections

The direct current platforms will each be connected to the onshore converter station via two 525-kilovolt cables and a metallic return. The onshore converter station is then connected to the national high-voltage grid. To ensure maximum availability, a bipolar configuration with a metallic return is used. The converter poles on the platforms can be cross-coupled to further increase availability.

[29] See the Vision for Electricity Grid Design and Roll-out Strategy, Future-proof Electricity Grid Optimisation, 21 July 2014, Review of Electricity Grid Design and Roll-out Strategy for TenneT Offshore Wind Farms, DNV GL, 14 May 2014 and the Public version of the validation of DNV GL document “Review of Electricity Grid Design and Roll-out Strategy for TenneT Offshore Wind Farms”, ECN-N--14-020, 11 August 2014.

[30] See the TenneT consultation position paper “T.12 Redundancy & Availability”, https://www.tennet.eu/fileadmin/user_upload/Our_Grid/Offshore_Netherlands/Consultatie_proces_net_op_zee/Technical_Topics/56_ONL_15-216-T12_Redundancy_availability_PP_v2.pdf.

For the direct current platforms in the Wind Farm Zones concerned, TenneT will further investigate whether interconnection of the platforms is advisable and efficient; see also Section 3.9.

The guaranteed transmission capacity for the direct current platforms is 2 GW per platform. For the offshore grid from IJmuiden Ver, Sites V and VI, if there is a (temporary) lack of sufficient energy demand or if there are not enough options to resolve congestion issues via redispatch, it may not be possible to simply feed wind-generated electricity into the onshore grid. This may result in TenneT entering into conditional Transmission Agreements, whereby the 2 GW minimum transmission capacity is guaranteed, or other measures are required. This must be specified before the tenders for the Wind Farm Sites are opened.

3.5.3 Distribution in case of reduced transport capacity

For both alternating current and direct current connections, the need to reduce the transmission capacity to less than the guaranteed amount could arise for reasons of grid safety or due to, for example, the failure of a cable or a transformer. This reduction takes place across the connected wind farms in proportion to the bandwidths stated in the relevant Wind Farm Site Decisions for the total installed capacity[31] per site. The capacity actually installed at a site is therefore not decisive. TenneT is to include conditions for the reduction in capacity in its Connection and Transmission Agreements.

3.6 Maximum power input from wind farms

From a cost-efficiency perspective, it could be beneficial to install more capacity than the guaranteed transport capacity. After all, the wind farms will not always run at full capacity, with the offshore grid transport capacity usually only partly used. By installing more wind power capacity ('overplanting'), more electricity can be generated and costs per unit of electricity (kWh) can be reduced.[32] This would contribute to achieving the intended cost reduction of offshore wind energy and Dutch carbon reduction targets.

There is, however, an optimum: at some point, during sustained periods of strong wind, generation from the installed wind capacity will exceed the guaranteed transmission capacity of the offshore grid to such an extent that an increasingly large proportion of the electricity can no longer be transported by TenneT. This could result in the need to shut down wind turbines. For each wind farm, however, this optimum capacity will depend on the type of wind turbine used, the space available for wind turbines, and the increase in wake effects.[33] This means it is not possible to specify a single optimum wind farm capacity.

3.6.1 700 MW alternating current connections

Based on consultation meetings between TenneT and the wind sector, the Minister decided in 2015 that the maximum installed capacity for wind farms is to be 760 MW per alternating current platform.[34] This maximum

[31] Installed capacity: the capacity of the production installation that can be used for the generation of renewable electricity under normal conditions and is guaranteed by the supplier during continuous use (not including the capacity to be supplied temporarily by a booster).

[32] Allowing overplanting could increase the total subsidy required (where applicable) for offshore wind energy on the one hand, but there will be an increase in electricity production on the other. The costs per kilowatt hour would decrease.

[33] This refers to the mutual capture of wind by adjacent wind turbines.

[34] In his letter of 19 May 2015 (Parliamentary Paper 33 561, No. 19), the Minister stated that 380 MW was the maximum permitted capacity for each 350 MW site, or 760 MW for each 700 MW alternating current platform. The possibilities for overplanting are different for the direct current platforms. This will be one of the subjects discussed during consultations with the wind sector in 2019. Decision-making in this regard will then be laid down in the relevant Site Decisions.

installed capacity is laid down in the Wind Farm Site Decisions for the individual wind farms. Given our evolving understanding about maximising energy yields from wind farms and wind turbines, the possibility that an increased overplanting margin will be permitted in future Wind Farm Site Decisions cannot be ruled out.

As TenneT has configured the (security of) components in the platform design for the maximum 760 MW capacity originally determined by the Minister, it is necessary in this Development Framework to lay down that the maximum power input from the wind farms at the transfer point on alternating current platforms is 760 MW.

How much of the power produced in excess of the guaranteed transmission capacity can be transported by TenneT to the onshore high-voltage grid is also determined by the capacity of the cables.[35] TenneT has investigated the possibility of briefly providing additional transmission capacity by temporarily increasing the load on the cables (dynamic loading) during high winds. This possibility relies, in part, on cooling the cables, which in turn depends on seabed conditions. The size and duration of this temporary extra transmission capacity will therefore vary for each wind farm. TenneT publishes data on this prior to each tender for Wind Farm Sites, so wind farm developers can make their own calculation of the expected availability of the temporary additional transport capacity.

The temporary additional transmission capacity is not a guaranteed offshore grid transmission capacity (as in the preceding section) and no rights may be derived in this respect. In the event of sustained overloading of the offshore grid, TenneT will ask wind farm permit holders to dial back the additional, non-guaranteed, capacity. If the connected parties do not comply with the instruction to reduce power output, TenneT will be forced to disconnect one or more 66-kilovolt connection (the inter-array cables) in order to reduce power output. As stated in Section 3.6, TenneT will include conditions for this in its Connection Agreement.

3.6.2 2 GW direct current connections

In the case of wind farms connected to a direct current platform, increased electricity production can also be achieved using overplanting. There is, however, a key difference compared to alternating current connections: Given the nature of the direct current equipment, a (temporary) power input higher than 2 GW cannot be achieved, unlike for alternating current platforms. For direct current platforms, the maximum power input is therefore equal to the guaranteed transmission capacity, which is 2 GW per platform. It is, however, possible to use overplanting to produce (and transport) more electricity when there are lower wind speeds, as long as the total electricity produced does not exceed the guaranteed transmission capacity (of 2 GW).

Because TenneT must take into account the load factor when designing the direct current platforms and cables, in this Development Framework it is necessary to determine the degree of overplanting it should take into account. In the consultation process with wind farm developers, a consensus was reached for a maximum overplanting percentage of 15%. This means TenneT must take into account a maximum installed wind capacity of 2.3 GW per direct current platform and the resulting higher load (load factor). The maximum installed capacity of the wind farms themselves will be laid down in the relevant Wind Farm Site Decisions.

[35] TenneT guarantees a transport capacity of 700 MW per platform, see Section 3.5.

3.7 Wind turbine and export cable connections

The transport capacity of the (the inter-array cable) connections from the wind turbines to the offshore substation is directly linked to the voltage level of cables used. Currently, the voltage level used in new wind farms is 66 kilovolts. This voltage level has cost and other advantages compared to the 33 kilovolts level used until recently. This was described in detail in the first version of this Development Framework published.

The Minister has therefore informed the House of Representatives by letter[36] that the voltage level for (inter-array cable) connections of the wind farms in the Offshore Wind Energy Roadmap will be 66 kilovolts. This applies to both direct and alternating current platforms. This also means the offshore grid must be suitable for connecting wind farms at a voltage level of 66 kilovolts.[37] The 66-kilovolt installation on the TenneT platform (substation), up to the physical connection point with the inter-array cables that are part of the wind farm installation, is therefore considered to form part of the offshore grid.

3.7.1 700 MW alternating current connections

As a result of opting for a voltage level of 66 kilovolts, approximately 60 to 70 MW can be transported per inter-array connection. This also limits the number of J-tubes needed to route inter-array connections to the platform. Theoretically, with a capacity of 700 to 760 MW per wind farm (in the case of alternating current) and a capacity of 60-70 MW per inter-array connection, at least 12 J-tubes are required. However, during TenneT's consultation with the wind sector, it became apparent that a higher number of J-tubes is needed to provide sufficient flexibility in cabling the wind turbines, including in sites that are less favourably located. For this reason, this Development Framework stipulates that alternating current platforms will be equipped with 16 J-tubes per 700 MW wind farm. As well as these 16 J-tubes, there should be an extra J-tube to allow for testing[38] and one J-tube for the cable connecting the two platforms in the Wind Farm Zone.[39] This brings the total number of J-tubes for the inter-array connection side to 18. The number of J-tubes for the 220-kilovolt connections is two per alternating current platform.

3.7.2 2 GW direct current connections

The number of J-tubes for the 66-kilovolt cables on the direct current platforms is 30 (28 of which are for wind farm permit holders). This is the result of the consultation process with wind farm developers and is based on the number of connection fields (see Section 3.8), the capacity per field (1250 amperes at 66 kilovolts), and the expected capacity of the connected wind turbines (12 to 20 MW per turbine). This number includes two extra J-tubes, which can be used as spares or for other possible future connections.

The 525-kilovolt cables require J-tubes for the connection to the shore and for a possible hybrid connection (see Section 3.9). As a result, 2 x 3 J-tubes will be required for the 525-kilovolt direct current cables and the metallic return as well as 2 J-tubes for fibre optic connections.

3.8 Electrical properties and protection

The system formed by the wind farms and the offshore grid should function as efficiently as possible so the yield of sustainable electricity is as high as possible.

[36] Parliamentary Paper 33 561, No. 19.

[37] Technical developments could make it opportune in the near future to use a voltage of 132 kilovolts for the inter-array cables. This is being investigated and requires a separate decision by the Minister.

[38] This is also understood to mean demonstration activities at an innovation site.

[39] This applies to the Borssele, Hollandse Kust (zuid) and Hollandse Kust (west) Wind Farm Zones.

3.8.1 700 MW alternating current connections

TenneT's alternating current platforms include the following facilities:

- A facility to compensate for the reactive power of the 220-kilovolt connections, in addition to the facility that exists for this in the onshore station;
- Reactive power compensation of the inter-array connection cables should be done using the capabilities of the wind turbines.[40] To this end, TenneT supplies a reactive current setpoint the wind turbines can meet. This is considered to be fine-tuning. TenneT controls the broad steps for reactive power compensation by switching coils or capacitors at the onshore station. If the connected wind turbines should unexpectedly be unable to meet the requirements drawn up by TenneT in relation to no-load reactive power compensation, TenneT will adjust the reactive power management to this situation. However, the permit holder still remains primarily responsible for the reactive power compensation of its cables and turbines;
- Sufficient fields to connect the inter-array connections to the platform, but not an unnecessarily high number so as to limit the risk of unused fields. Given the anticipated number of at least 12 (66-kilovolt) inter-array connections for each 700 MW wind farm,[41] TenneT's electrical installation will have to factor in at least 12 switching fields per wind farm. If a wind farm nonetheless wishes to establish more connections (maximum of 16), two cables will be connected to one or two switching fields. It must be possible to separate individual cable connections from the overall inter-array connection network on a single switching field, in case of a fault on one of the cables. There should be a separate circuit for wind turbines in an innovation site, if there is one. TenneT is to set out further agreements about the operation of the fields and circuits in its Connection and Transmission Agreement. During TenneT's consultation process, there was unanimous agreement that TenneT should perform this operation, as is current practice for onshore connections. This Development Framework therefore stipulates this choice.

To make optimum use of the standardisation concept, an electrical protection system, with the general functional specification standardised by TenneT, will be used for the inter-array connections. The ownership, operation and maintenance of this system will rest with TenneT. As the owner of this standard installation, TenneT will bear the costs of ownership, operation, and maintenance. TenneT will not pay for any deviations or additions to the standard installation for wind farms required by the permit holders.

3.8.2 2 GW direct current connections

The direct current platforms will contain the following facilities:

- Sufficient fields to connect wind farm inter-array cables to the platform, but not an unnecessarily high number so as to limit the risk of unused fields. TenneT will make 6 connection fields available for each 500 MW generator block. This means a total of 24 connection fields will be available for a 2 GW platform. Four additional fields will be able to connect two inter-array cables, to give a total of 28 inter-array cables. A lower limit of 625 amperes (meaning half of the capacity per field) will be used for each field to prevent underutilisation of connection fields. At the request of a wind farm permit holder, TenneT can make an additional (7th) connection field available per generator block. The costs of an additional connection field will be paid by the relevant wind farm permit holder.

[40] The European Code for Generators (Requirement for Generators) requires that contemporary wind turbines must provide reactive current compensation at around zero load.

[41] The tenders for the Borssele and Hollandse Kust (zuid) Wind Farm Zones related to 350 MW sites, but since the tenders for Hollandse Kust (noord), these have been 700 MW sites (for alternating current connections). However, the technical requirements stipulated by TenneT in its Connection and Realisation Agreements are based on a layout of 2 x 350 MW.

• The platform will not have any reactive power compensation facilities for the interarray cables. The wind farm permit holder will be responsible for ensuring there is no exchange of reactive power at the physical connection point.
• In situations where there is no wind and the permit holder cannot meet the above provision, TenneT will provide reactive power compensation. This will be regulated in detail in the Connection and Transmission Agreements Tennet concludes with the permit holder.

The permitted harmonic distortion is set out in detail in the Electricity Grid Code (*Netcode elektriciteit*). TenneT determines the permitted emission limits at each transfer point and distributes the harmonic space between the connected parties. Further technical details may be included in the Connection and Transmission Agreements that TenneT concludes with the permit holder.

As with the alternating current platforms, direct current platforms will also use an electrical protection system for the connections, with general functional specifications standardised by TenneT. Ownership, operation, and maintenance of this system will be with TenneT. As the owner of this standard installation, TenneT will bear the costs of ownership, operation, and maintenance. TenneT will coordinate the safety configuration with the permit holder in the Connection and Transmission Agreements.

Unlike the situation for alternating current platforms, it is not envisaged that permit holders will install additional protection systems on the direct current platforms. The protection system on the direct current platforms is more comprehensive and has (multiple) back-ups, so additional systems are not necessary.

3.9 Hybrid connections
For some time now, experts and policymakers have been considering the (eventual) interconnection of connections for the wind farms in the North Sea and hybrid connections: connections between offshore wind farms combined with a transmission between different countries.[42] This may eventually create a meshed grid in the North Sea. Such an international offshore grid can have certain benefits. The EU strategy for utilisation of the potential of renewable offshore energy[43] emphasises the crucial importance of developing a meshed grid to accelerate the roll-out of renewable offshore energy in a cost-efficient and sustainable manner. One characteristic of a meshed offshore grid are offshore energy hubs, which provide access to large-scale Wind Farm Zones far out at sea. Energy hubs from different countries can be interconnected.

Hybrid connections are an intermediate step between national projects and a fully meshed offshore energy system and grid. Hybrid connections and a meshed offshore grid require far-reaching coordination between countries and parties. Discussions are currently ongoing about the development of such a grid in the North Sea, among other things, as part of the political declaration for cooperation between North Sea countries signed in 2016,[44] which was extended at the end of 2021.

[42] A transmission connection between different countries is also called an interconnector.
[43] See https://eur-lex.europa.eu/legal-content/NL/TXT/PDF/?uri=CELEX:52020DC0741&from=EN.
[44] https://www.benelux.int/files/9016/3845/2539/NSEC_Political_Declaration_signed.pdf.

Combining a connection (grid connection) of a wind farm with a transmission function in a hybrid connection can result in enhanced capacity utilisation of the connection and at the same time yield cost and space savings for the interconnector: much of the required infrastructure has already been constructed for the grid connection of the wind farm in question, after all. Expanding the interconnection capacity would contribute to further market integration and therefore lead to social benefits, including more stable electricity price development, integration of sustainably generated electricity, system flexibility and security of supply. A specific study[45] into the effects of a hybrid connection with the United Kingdom confirms these social benefits.

The possibility of hybrid connections requires an anticipatory investment: space will need to be reserved on the 2 GW direct current platforms for the (in due course of time) connection of an interconnector. In addition, the high-voltage installation will also have to be made suitable for future expansion with a hybrid connection. The Minister has already decided that, on balance, the expected social benefits of a hybrid connection with the United Kingdom are such that anticipatory investments in the platforms for IJmuiden Ver are justified. No new analysis has been performed for the subsequent direct current platforms.

However, the possibility of creating an additional connection also provides the option to mutually connect direct current platforms in the future, separately from the interconnection function, and possibly also afterwards, in order to make the offshore grid more robust. The increased redundancy improves the security of supply. Further research will be required to make this possible, among other things, regarding whether and how HVDC circuit breakers should be integrated in the offshore grid. These are still in development.

To safeguard the robustness and flexibility of the offshore grid, this Development Framework stipulates that TenneT must take into account extra space for an additional connection in the standard design for all direct current platforms. An investment decision regarding the development of such an additional connection will be taken separately. Among other things, this will require agreement between parties that the European regulatory framework is suitable for the development of hybrid connections. In addition, Dutch legislation will have to be amended to allow the offshore grid to transport electricity other than the electricity that was produced on the wind farms connected to the offshore grid.

3.10 Electrification of oil and gas platforms

In the Offshore Wind Energy Roadmap 2030, the Minister set out the intention to investigate whether a number of oil and gas platforms could draw the electricity required for the facilities present on those platforms from offshore wind farms. Such electrical connections would contribute to reducing carbon dioxide emissions, nitrogen oxides (NOX) emissions, and particulate matter emissions that result from gas extraction, as well as to more efficient use of the offshore grid.

The electrification of gas platforms near the Hollandse Kust (noord) Wind Farm Zone through a connection to the offshore grid is a promising option. The Minister has decided that an anticipatory investment in two additional connection fields on the platform in Hollandse Kust (noord) is justified. On this basis, this Development Framework stipulates that TenneT should include two additional connection fields in the construction of the alternating current platform for Hollandse Kust (noord).

Near the Ten noorden van de Waddeneilanden Wind Farm Zone, gas extraction is also taking place and there is

[45] Economic appraisal of potential WindConnector developments. Pöyry, October 2019, see https://www.tennet.eu/nl/ons-hoogspanningsnet/net-op-zee-projecten-nl/programma-2030/.

a real interest in connecting to the offshore grid. In contrast to the Hollandse Kust (noord) platform, there is no space available on this platform for additional connection fields, as this space is being used for the reactive power compensation equipment required due to the relatively long export cable to the shore. Space can be created, however, by enlarging the standard platform design. This Development Framework therefore stipulates that TenneT must take into account two additional customer connections in the design of the alternating current platform for the Ten noorden van de Waddeneilanden Wind Farm Zone.

At present, the legislation does not yet allow TenneT to connect parties other than the offshore wind farm permit holders to the offshore grid. The Energy Act legislative process is being used to work on an amendment that will allow this. This amendment will also include the conditions for connection and tariffs for customers.

3.11 Measuring electricity yield

Agreements on measuring electricity yields from the wind farms are important for determining the wind farms' contribution to sustainable energy objectives and for the possible eligibility of wind farm permit holders' to the SDE+ subsidy. In view of the economic benefits, among other things, as a result of the logistics, the Electricity Metering Code[46] stipulates that parties connected to an offshore platform with a connection to the offshore grid and the operator of the relevant offshore platform (TenneT) jointly designate a metering manager for all the connections to the offshore platform concerned. The measurements of all the connections of a single wind farm will be combined to determine the amount of electrical energy (yield) at the point of feed-in to the public grid.

3.12 Shared services and nature-inclusive design

In addition to the wind farm operators and TenneT, other parties such as the Coast Guard, various port companies, and the Royal Dutch Meteorological Institute (KNMI) would like to make use of the opportunities offered by the TenneT platforms, for example, for taking measurements or for installation of communication tools. TenneT will be providing minimal facilities (space, antenna mast, fibre optic connection, electricity) for this purpose on its platforms and onshore stations for the necessary equipment, insofar as this is reasonably possible within the existing design. Rijkswaterstaat (the Directorate-General for Public Works and Water Management) will purchase these shared services and manage and maintain them. This will contribute to achieving the lowest possible social costs. Rijkswaterstaat is drawing up a business plan for this. Costs will be charged to the parties concerned, through Rijkswaterstaat.

To deliver on the commitment in the Climate Agreement to take additional broader measures to improve the conservation status of vulnerable species, taking into account their biotopes, and to reduce negative effects on the natural environment (such as biodiversity), TenneT will adopt a nature-inclusive approach to designing and constructing the offshore grid as much as is reasonably possible.
These measures should be proportionate to the efforts made by the wind farm permit holders, pursuant to a best-endeavours obligation or condition in the Wind Farm Site Decision concerned, to design and build the wind farm in such a way that it actively enhances the sea's ecosystem, helping to foster conservation efforts and goals relating to sustainable use of species and habitats that occur naturally in the Netherlands.

[46] As amended by a decision of the Netherlands Authority for Consumers & Markets of 14 May 2019, reference ACM/UIT/510948, amending the conditions referred to in Section 31 of the Electricity Act 1998 concerning responsibility for metering on connections to the offshore grid, Government Gazette No. 26779, 15 May 2019.

The measures to be implemented will be assessed for each project in terms of technical feasibility, risk, cost, and project-specific circumstances (project phase and location).

3.13 Requirements for suppliers

TenneT contracts market parties for the construction and maintenance of the offshore grid. This includes the construction of platforms, production of cables, and supply of high-voltage and other equipment.

The offshore grid is critical energy infrastructure. Any supplying parties involved in the offshore grid, either on their own or as part of a consortium, must therefore comply with the requirements and goals set out in the National Security Strategy 2019 and any updates, such as the midterm review 2021.

The Minister for Climate and Energy Policy will designate certain parts of the offshore grid (the 2 GW direct current connections) as critical or essential services in the context of protecting processes critical to national security. TenneT will comply with all resulting requirements when contracting suppliers.

4 Time frame

4.1 Wind farm commissioning timeline
To meet the political agreements on development of offshore wind energy as speedily as possible, it is important the wind farms are built and commissioned as soon as possible after the permit has been awarded. The various tender regulations stipulate that a wind farm must be fully operational no later than five years[47] after the (subsidy) decision.

4.2. Delivery dates for the offshore grid
To make full use of offshore wind, it is important the grid is ready on time and the wind turbines can be connected to it. At the same time, grid construction requires due care and a realistic timetable. With respect to planning and implementation, TenneT and the Ministry aim to ensure the necessary permits for offshore grid construction are irrevocable or final before TenneT awards the major contracts (e.g. for development of the platform and cable).

The development of the offshore grid for the IJmuiden Ver, Nederwiek, and Doordewind Wind Farm Zones will be accelerated to achieve the increased target for approximately 21 GW by 2030 within the context of reducing CO_2 emissions by at least 55% (see also Section 1.1). Due to the accelerated development and increasing pressure towards 2030 throughout the supply chain, TenneT will have to use a different procurement strategy. TenneT intends to bundle contracts for the construction/manufacture of platforms, cables, HVDC equipment, and onshore converter stations for several parts of the offshore grid.

It was already agreed in the Climate Agreement that, to achieve a higher CO_2 reduction target of at least 55%, TenneT would have to award contracts before final permits are obtained. Now this higher ambition has been set by the Government, this Development Framework stipulates that – to meet intended delivery dates for parts of the offshore grid stated in Section 16e of the Electricity Act 1998 under g – TenneT can award contracts before the final and irrevocable permits for the aforementioned sections of the offshore grid have been obtained.

This does not alter the fact that decisions on individual project budgets are made by the Ministry of Finance using project budget applications (PBAs) and the statutory processes that apply to them and that ACM determines the permitted income for TenneT as the offshore grid operator and assesses the inclusion thereof in TenneT's annually proposed rates in accordance with the legal procedures (see also Section 5.1).

4.2.1 700 MW alternating current connections
Based on the timetable for the tenders, the anticipated construction times for the wind farms, TenneT's experiences with building platforms, and experiences with the time required for permit procedures, Table 3 shows the offshore grid delivery dates for connecting wind farms for which a tender has already been issued or will be shortly.

[47] The basic principle is that the wind farms should be operational within four years after the (SDE+) grant has been obtained. Section 14 of the Offshore Wind Energy Act consequently stipulates that a permit can only be granted if, based on the application, a sufficiently plausible case has been made that the construction and operation of the wind farm can commence within four years of the date on which the permit becomes irrevocable. This entails advance evaluation of the feasibility of that time frame. To provide some freedom in the actual realisation to compensate for unexpected occurrences, it has been decided to adopt a period that is one year longer in the conditions relating to the decision. In the case of a subsidy, the subsidy term of 15 years starts after 5 years.

The delivery date is the day on which the relevant part[48] of the offshore grid is ready for the electrical commissioning of the connection for the wind farms concerned.

Table 3 Delivery dates for the offshore grid for alternating current connections

Site	Delivery of parts of the offshore grid
Borssele I and II	31 August 2019
Borssele, Sites III, IV, and the innovation site (V)	31 August 2020
Hollandse Kust (zuid), Sites I and II	31 December 2021
Hollandse Kust (zuid), Sites III and IV	31 March 2022
Hollandse Kust (noord), Site V	31 March 2023
Hollandse Kust (west), Site VI	31 March 2024
Hollandse Kust (west), Site VII	31 March 2026
Hollandse Kust (west), Site VIII	To be determined
Ten noorden van de Waddeneilanden, Site I	To be determined

This means the electrical installation on TenneT's platform has been built in accordance with the required functionality, as set out in this Development Framework, and is ready for the electrical connection of the wind farms, after which the testing and commissioning period for the wind farms at the aforementioned sites will commence. In addition, it must also be possible for duplex data traffic (data transmission) for SCADA and metering systems to take place between the areas TenneT makes available to the wind farm owner on the onshore substations and on the alternating current platform. These areas should be suitable for the intended purpose. It goes without saying that, on the delivery date, the cable between the relevant platform and the onshore high-voltage grid will also provide the minimum guaranteed transport capacity, with the connection to the onshore high-voltage grid being technically capable of transporting this quantity of electricity.

The Completion Certificate for the relevant part of the offshore grid is based solely on that part being ready in time, including the 66-kilovolt installation. This provides a clear delivery time and avoids waiting for the first moment when the full guaranteed transport capacity is actually used. After all, wind farms are usually commissioned in stages, so this could take months. The Completion Certificate will be issued by an independent expert on behalf of TenneT. A standard operating procedure for the Completion Certificate will be drawn up by TenneT and the independent expert, in consultation with the Ministry and wind farm developers. The chosen procedure and experience gained during delivery of the first part of the offshore grid (the grid connections for Borssele Sites I and II) serve as a basis for this.

If TenneT completes the relevant part of the offshore grid later than the stated delivery date, a right to compensation may arise for the wind farm permit holders under the scheme, in accordance with Section 16f of the Electricity Act 1998.

[48] The relevant part of the offshore grid is understood to mean the assembly of components that are required for the wind farm concerned to be able to function fully. For example, for Sites I and II of the Borssele Wind Farm Zone, this means that the Borssele Alpha platform to which the wind farms on these sites will be connected is ready, but that the Borssele Beta platform does not have to be ready yet.

The right to compensation as a result of late delivery expires at the time of delivery. After this time, there is only a right to compensation for non-availability of the offshore grid, in accordance with the aforementioned Section 16f. It is important to clearly mark this moment to avoid questions about what type of losses can be claimed (losses as a result of delay or as a result of non-availability).

4.2.2 2 GW direct current connections

The delivery of the planned direct current connections requires a separate procedure, given that, unlike alternating current connections, the entire wind farm needs to be connected and operational to allow testing of the direct current connections at full power. There is therefore greater interdependence between the offshore grid and the wind farms connected to it. Three dates are important here:

1. The date on which TenneT's platform is ready to receive the 66 kV cables from the wind farm (“cable pull in”). On this date, the offshore grid will be ready to power the wind farm and provide transport capacity. This is also when the test phase for the joint system (wind farm and direct current connection) begins. At this stage, transport capacity cannot yet be fully guaranteed. This date relates to an obligation on TenneT.
2. The date on which the wind farm permit holder(s) will have withdrawn all 66 kV cables on the platform and completed the connection to the platform. From this date, the wind farm must be able to supply its full capacity. Only then will the final part of the testing and commissioning phase start, i.e. testing at full capacity. This date relates to an obligation on the wind farm permit holder(s).
3. The date on which TenneT must have completed the entire offshore grid for the relevant Wind Farm Sites. Testing of the direct current connection will have been completed by this date. From this date, the minimum guaranteed transport capacity should be available. This is also the date on which a right to compensation may arise under Section 16f of the Electricity Act 1998, on the understanding that the right to compensation as a result of delayed delivery shall lapse upon delivery. After this time, there only remains a right to compensation for non-availability of the offshore grid, in accordance with the aforementioned Section 16f. This date relates to an obligation on TenneT.

Table 4 Delivery dates for the offshore grid for direct current connections

Site	**Platform ready for cable pull-in**	**Wind farm ready to supply full capacity**	**Delivery of direct current connection**
IJmuiden Ver, Site I	to be determined[47]	to be determined[47]	to be determined[47]
IJmuiden Ver, Site II	to be determined[47]	to be determined[47]	to be determined[47]
IJmuiden Ver, Site III	to be determined[47]	to be determined[47]	to be determined[47]
IJmuiden Ver, Site IV	to be determined[47]	to be determined[47]	to be determined[47]
IJmuiden Ver, Site V	to be determined[47]	to be determined[47]	to be determined[47]
IJmuiden Ver, Site VI	to be determined[47]	to be determined[47]	to be determined[47]
Nederwiek, Site I	to be determined[47]	to be determined[47]	to be determined[47]
Nederwiek, Site II	to be determined[47]	to be determined[47]	to be determined[47]
Nederwiek, Site III	to be determined[47]	to be determined[47]	to be determined[47]
Doordewind, Site I	to be determined[47]	to be determined[47]	to be determined[47]
Doordewind, Site II	to be determined[47]	to be determined[47]	to be determined[47]

4.2.3 Delivery dates in relation to tenders and commissioning of wind farms

Before publication of the tender regulations for the future wind farms, final delivery dates are laid down in Tables 3 and 4 of this Development Framework and announced to the bidding parties. Until then, Tables 5 and 6 show indicative delivery dates for parts of the offshore grid belonging to (sites in) Wind Farm Zones for which tenders will be held in the future. No rights can be derived from Tables 5 and 6.

After a tender for one or more sites in a Wind Farm Zone has been successfully completed, TenneT will consult with the wind farm(s) permit holder(s) on further agreements, including agreements on the timetable for construction of the wind farm(s) and the respective part of the offshore grid and the (joint) testing phase. If it follows from this that the commissioning of the wind farm(s) will take place considerably later than the delivery date for the respective part of the offshore grid, as stated in Table 3 or Table 4 (but within the time limit set out in the wind farm permit), TenneT may submit a request to the Minister for that part of the offshore grid to be delivered at a later date. TenneT will take into account the framework of the Public Procurement Act as well as programme-related aspects, among other things, when weighing up whether to submit such a request. A request of this nature should be accompanied by a declaration of no objection from the wind farm(s) permit holder(s).

Table 5 Indicative delivery dates[49] for the offshore grid for alternating current connections

Site	Indicative delivery of parts of the offshore grid
Hollandse Kust (west), Site VIII	To be determined
Ten noorden van de Waddeneilanden, Site I	First quarter of 2031

Table 6 Indicative delivery dates[50] for the offshore grid for direct current connections

Site	Platform ready for cable pull-in	Wind farm ready to supply full capacity	Delivery of direct current connection
IJmuiden Ver, Site I	First quarter of 2029	Third quarter of 2029	Fourth quarter of 2029
IJmuiden Ver, Site II	First quarter of 2029	Third quarter of 2029	Fourth quarter of 2029
IJmuiden Ver, Site III	First quarter of 2028	Third quarter of 2028	Fourth quarter of 2028
IJmuiden Ver, Site IV	First quarter of 2028	Third quarter of 2028	Fourth quarter of 2028
IJmuiden Ver, Site V	First quarter of 2029	Third quarter of 2029	Fourth quarter of 2029
IJmuiden Ver, Site VI	First quarter of 2029	Third quarter of 2029	Fourth quarter of 2029
Nederwiek, Site I	First quarter of 2030	Third quarter of 2030	Fourth quarter of 2030
Nederwiek, Site II	First quarter of 2030	Third quarter of 2030	Fourth quarter of 2030
Nederwiek, Site III	First quarter of 2031	Third quarter of 2031	Fourth quarter of 2031
Doordewind, Site I	First quarter of 2031	Third quarter of 2031	Fourth quarter of 2031
Doordewind, Site II	First quarter of 2031	Third quarter of 2031	Fourth quarter of 2031

[49] The precise delivery dates will be announced when the tender procedures for the relevant Sites are published.
[50] The precise delivery dates will be announced when the tender procedures for the relevant Sites are published.

5 Service life and depreciation of the offshore grid

5.1 ACM decision on the depreciation period for the offshore grid
ACM regulates TenneT's income and also determines the depreciation periods that TenneT is allowed to use to pass on the costs for the offshore grid.[51] ACM determines the depreciation period for each five-year regulation period in the Method Decision. The 2017-2021 Method Decision states that the depreciation period for the offshore grid is 20 years. In the 2022-2026 Method Decision,[52] ACM has extended the depreciation period by 10 years for the assets of the offshore grid operator for the wind farms for which permits still need to be granted, so the period has increased from 20 to 30 years. In concrete terms, this involves the Hollandse Kust (west) Wind Farm Sites and subsequent wind farms.

5.2 Required minimum service life of the offshore grid
Given the offshore grid supports the wind farms, the service life of the wind farms will initially determine the minimum service life for the offshore grid. This Development Framework assumes the offshore grid will be removed as soon as the connected wind farms are dismantled and removed after the end of their permit period. Whether new wind farms are subsequently developed in the Wind Farm Zones, for which the offshore grid can be reused, depends on developments in offshore wind (and the associated cost) in the next 30 to 35 years compared to alternative sustainable energy sources, as well as on the need and political will to implement incentives or other policies in this regard. These long-term developments are difficult to predict. An additional uncertainty is whether the limits of the technical design of the current offshore grid, with a maximum transmission capacity of 700 MW per alternating current platform and 2 GW per direct current platform and a voltage of 66 kilovolts for the connections, will be sufficient for future wind farms. Given the rapid technological development of offshore wind, it is conceivable that it may be wiser to completely replace or upgrade the entire offshore grid with state of the art technology at the time, or to transport the energy generated to shore using non-electrical means.

5.2.1 Matching the service life and permit period of offshore wind farms
Until the mid-2010s, the anticipated service life of an offshore wind farm was generally 20 years. This stems from the manufacturers' certified service life for wind turbines, which wind farm developers use in their business cases. An economic service life of 20 years was also factored in when determining the maximum amounts for the tenders with subsidy.[53] It was assumed the permit holders would have their wind farms continue to produce electricity for another 5 years after the expiry of the SDE+ subsidy period of 15 years.

Developments in offshore wind are evolving rapidly, with a clear tendency towards an increasingly longer service life for offshore wind farms. For example, the certified service life of the latest generation of wind turbines is 25 years[54] in many cases, while there are offshore wind farms still in use after 20 years.[55]

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[51] The ACM also assesses the efficiency of TenneT's investments and determines the translation of those investments into the costs that TenneT is allowed to pass on in the regulated tariff income. In addition to a reasonable return on investment, those costs include the depreciations and costs for maintenance and management.
[52] Method Decision for the Grid Operator of the Offshore Grid 2022-2026; Decision of the Netherlands Authority for Consumers and Markets as referred to in Section 42b(1) of the Electricity Act 1998. 16 September 2021.
[53] Parliamentary Paper 33 561, No. 19.
[54] The MHI Vestas V164-10.0MW is an example of this. See https://www.mhivestasoffshore.com/innovations/
[55] The first offshore wind farm in the world, Vindeby in Denmark, became operational in 1991 and was decommissioned in September 2017.

Section 15 of the Offshore Wind Energy Act stipulates that the period for which the permit applies is appropriate to the expected service life of a wind farm and the specific area to which the permit relates. The Wind Farm Site Decisions determine the actual permit period, which includes the periods for development, operation, and removal of the wind farm. The permits are based on the following assumptions:

- The construction of the wind farm will be completed in five years at most, starting from the date on which the permit becomes irrevocable.
- The wind farm may become operational from year 3 and may continue to be operational in the penultimate year of the permit period.
- The removal period may start from the sixth year before the end of the permit period and may continue into the last year of the permit period.

In practice, this generally means the operating period of an offshore wind farm is about five years shorter, but at least three years shorter, than the maximum permit period. Permits for the sites in the Borssele, Hollandse Kust (zuid), and Hollandse Kust (noord) Wind Farm Zones have been issued for a maximum period of 30 years. This means that the minimum service life of the offshore grid for these Wind Farm Zones is initially 27 years.

5.2.2 Longer permit period for offshore wind farms

The entry into force of the amended Offshore Wind Energy Act on 29 October 2021 means the aforementioned Section 15 was modified, with the maximum permit period for offshore wind farms changed from 30 years to 40 years. In addition, wind farm permit holders already awarded a permit with a term less than 40 years can apply for an extension of the permit.

A longer permit period for offshore wind farms means the lifespan of the offshore grid must also be longer. A distinction must be made between wind farms that have yet to be granted a permit under the amended Offshore Wind Energy Act and wind farms already issued a permit under this Act:

- Parts of the offshore grid for wind farms yet to be granted a permit under the amended Offshore Wind Energy Act can be made suitable for a longer service life at an early stage (design phase). Once the Bill was submitted to the House of Representatives (November 2018), this Development Framework stated that a different service life can be set for all or parts of the offshore grid with a view to possibly extending the permit period of the wind farms to a maximum of 40 years (Development Framework, version of November 2019). This was further tightened in the May 2020 Development Framework by requiring TenneT to take a possible service life extension of up to 10 years into account as efficiently as possible.
- For wind farms already granted a permit, the relevant parts of the offshore grid are already in use or at an advanced stage of development. It is more difficult to achieve a longer service life for these parts of the offshore grid, as adjustments in the design phase are no longer possible. A longer service life can only be achieved by adjusting the maintenance and replacement strategy. During the consultation for the aforementioned amendment to the Offshore Wind Energy Act, TenneT indicated it would be able to cost-effectively extend the service life of the offshore grid by a few years for wind farms already issued with permits. In this regard, the sooner parties (both the wind farm permit holder and TenneT) know what the ultimate service life will be, the more cost-effectively the maintenance regime can be set up. An extension to the permit can be requested from seven years after the original permit was issued.

Criteria established in accordance with Section 3(3) of the Offshore Wind Energy Act will be taken into account when granting an extension, including the importance of an efficient connection of a wind farm to a connection point.

So both the possibilities and impossibilities of keeping the offshore grid available for longer and associated costs will be taken into account before an extension is granted. Based on the signals at the time of the consultation about the technical service life of the already licensed wind farms and associated offshore grids, an extension covering the full ten years in advance does not always appear to be the best option. It may be that a shorter extension is more in line with the technical service life of some wind farms and would make it easier for TenneT to extend the service life of the offshore grid in a cost-efficient manner. Ultimately, suitable extension periods will therefore have to be decided on a case-by-case basis for each requested extension, taking into account all interests.

5.2.3 Requirements for the service life of the offshore grid

In view of the above, this Development Framework stipulates that the minimum service life of the offshore grid is 37 years for wind farms to be issued a permit under the amended Offshore Wind Energy Act, starting with the future wind farms in Hollandse Kust (west).

For the wind farms in the Borssele, Hollandse Kust (zuid), and Hollandse Kust (noord) Wind Farm Zones, this Development Framework stipulates that TenneT should take into account a potential service life extension as efficiently as possible. The precise scope of this will be determined once an application for an extension of the permit for the relevant part of the offshore grid has been submitted.

Specifically for the construction of hybrid connections (the combination of a connection to connect a wind farm and an interconnector stated in Section 3.9), it may be desirable to agree on a longer service life for the relevant part of the offshore grid. Once a decision has been made about a hybrid connection, any implications for the required service life of the offshore grid will be laid down in this Development Framework.

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