

Dutch Offshore Wind Market Update 2019



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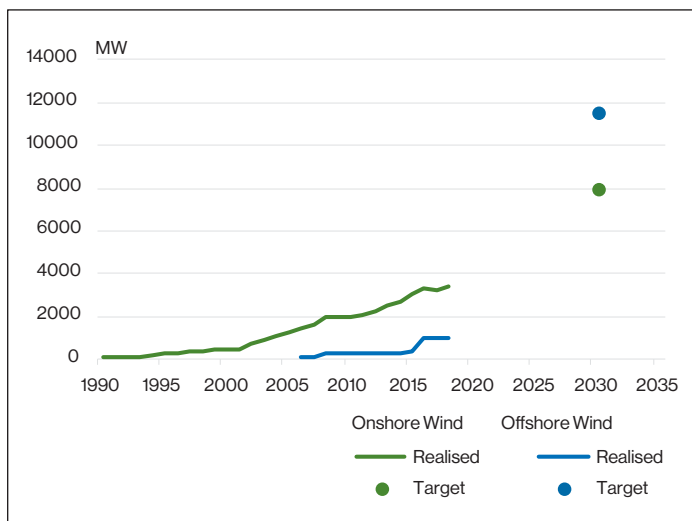
Energy

Dutch Offshore Wind Market Update 2019

Introduction and Background

About this report

Figure: Wind capacity and targets in the Netherlands



Source: Statistics Netherlands (CBS), Netherlands Enterprise Agency (RVO)

The Netherlands' offshore wind development is accelerating to meet the targets set by the government in the Dutch Energy Agreement six years ago. In terms of offshore wind capacity, the Agreement proposed that, in addition to the 1 gigawatt (GW) of installed capacity from operational offshore wind farms, an additional 3.5 GW should be realised through the Dutch tender system by 2023. A total of 49TWh of offshore wind is required to meet current CO2 reduction targets from the Dutch climate agreement, which would result in approximately 10.6 GW of total installed capacity by 2030.

This first Dutch Offshore Wind Market Update aims to provide an overview of important developments throughout 2018 and the first half of 2019. An annual update will serve as a progress report to monitor if the Dutch offshore wind rollout remains in line with the targets set by the Dutch government. The report highlights upcoming policy changes, market dynamics and aims to provide insight into opportunities for companies.

Guidehouse has a long track record in advising and working with many of the stakeholders involved in developing offshore wind in the Netherlands. Examples of our work include wind resource and energy yield assessments, market entry support, developing business cases, writing tender documentation and contract negotiations. The market update report was not funded by a third party. It was undertaken in close collaboration with the Nederlandse Wind Energie Associatie (NWEA), TKI Wind op Zee, and GROW as part of the company's contribution to the growth of the Dutch offshore wind industry.

We hope you find this report useful and are excited to contribute to the success of the Dutch offshore wind industry.

Benjamin Grunfeld
Managing Director
Guidehouse

About the organizations behind this report



Guidehouse is a leading global provider of consulting services to the public and commercial markets with broad capabilities in management, technology, and risk consulting. We help clients address their toughest challenges with a focus on markets and clients facing transformational change, technology-driven innovation and significant regulatory pressure. Across a range of advisory, consulting, outsourcing, and technology/analytics services, we help clients create scalable, innovative solutions that prepare them for future growth and success. Headquartered in Washington DC, the company has more than 7,000 professionals in more than 50 locations. Guidehouse is a Veritas Capital portfolio company, led by seasoned professionals with proven and diverse expertise in traditional and emerging technologies, markets, and agenda-setting issues driving national and global economies. For more information, please visit: [guidehouse.com](https://www.guidehouse.com)



The Nederlandse Wind Energie Associatie (Netherlands Wind Energy Association, or NWEA) is the Dutch voice of the wind industry. It actively promotes the utilisation of wind power in the Netherlands, on land and offshore. Among the members of NWEA are developers of wind parks, owners of wind turbines, manufacturers, constructors, research institutes, electricity providers, consultants, and maintenance companies. The activities of NWEA are aimed mainly at the national government. More information about NWEA can be found at [nwea.nl](https://www.nwea.nl)



TKI Wind op Zee (Top consortium for Knowledge and Innovation Offshore Wind) stimulates, connects, and supports Dutch organisations and knowledge institutes with the development and deployment of innovations to help speed up the transition to sustainable, reliable and affordable energy system, focussing on offshore wind. More information about TKI Wind op Zee can be found at [topsectorenergie.nl](https://www.topsectorenergie.nl)



GROW (Growth through Research, development & demonstration in Offshore Wind) is a consortium of around 20 leading and committed partners that have agreed on knowledge exchange and intense cooperation throughout the programme. They work to reduce the costs of offshore wind and to increase the value in the energy system and in the ecosystem. Research institutes and companies active across the entire offshore wind value chain will bring their innovations to the market. More information about GROW can be found at [grow-offshorewind.nl](https://www.grow-offshorewind.nl)

About key organisations in offshore wind development in the Netherlands



Netherlands Enterprise Agency

The Netherlands Enterprise Agency stimulates entrepreneurs in sustainable, agricultural, innovative and international business. It aims to improve opportunities for entrepreneurs, strengthen their position and help them realise their international ambitions with funding, networking, know-how and compliance with laws and regulations. The Netherlands Enterprise Agency is a government agency which operates under the auspices of the Ministry of Economic Affairs and Climate Policy. Its activities are commissioned by the various ministries and the European Union. The Netherlands Enterprise Agency runs several programmes and has different grant schemes available to support various business initiatives. More information about the offshore wind programme can be found at [offshorewind.rvo.nl](https://www.offshorewind.rvo.nl)



The Dutch offshore wind sector has a powerful story to tell. A story of wind and water. Companies, trade organizations and the government of the Netherlands collaborate to show the world that wind and water works. More information can be found at [windandwaterworks.nl](https://www.windandwaterworks.nl)

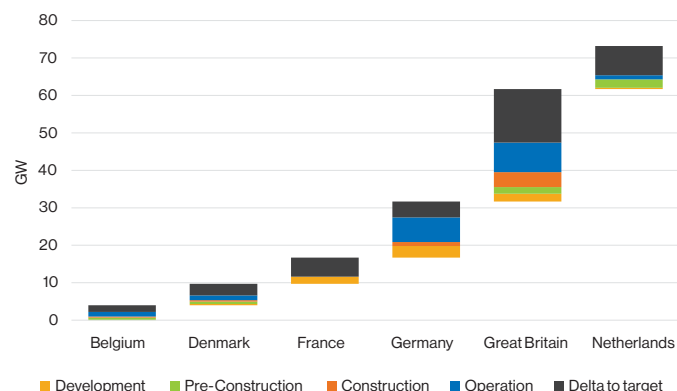


TenneT is a leading European electricity transmission system operator (TSO) with its main activities in the Netherlands and Germany. With over 23,000 kilometers of high-voltage connections we ensure a secure supply of electricity to 41 million end-users. TenneT is one of Europe's major investors in national and cross-border grid connections on land and at sea, bringing together the Northwest European energy markets and driving the energy transition. More information about TenneT can be found at [tennet.eu](https://www.tennet.eu)

Status and Expansion Targets

Position of the Dutch offshore wind energy market

Figure: Overview of European offshore wind status and targets



Source: Guidehouse analysis

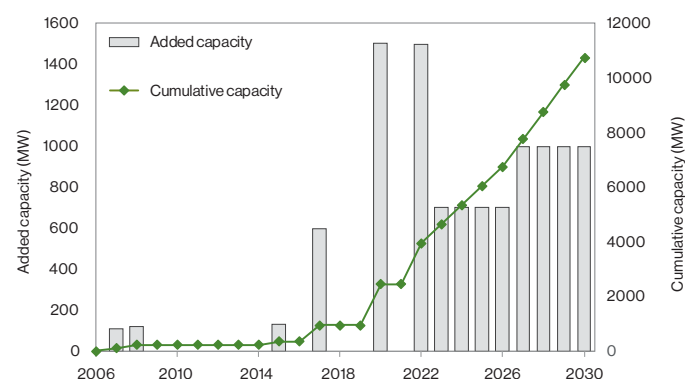
The offshore wind industry is expanding globally, with deployments starting in Asia and North America. Over the past three decades, nearly all offshore wind development occurred in Europe, particularly in and around the North Sea region.

The current total installed offshore wind capacity is 13 GW in the North Sea area. The current development trajectory would increase that to approximately 70 GW in 2030. With about 1 GW of projects in operation, the Netherlands is the fifth largest offshore wind market in terms of installed capacity, following the UK, Germany, Denmark, and Belgium.

The Dutch government has implemented several policy instruments to secure the industry's growth. The offshore wind rollout in the Netherlands is on schedule and in line with the Dutch Energy Agreement. It has 1.5 GW in pre-construction (Borssele I-V) and another 1.5 GW under development (Hollandse Kust Zuid I-IV).

Project overview and expansion targets

Figure: Projected offshore wind capacity increase



Source: Guidehouse analysis

The new offshore wind energy roadmap 2030 outlines nine development zones, of which five have been tendered and are under various stages of development. Development is progressing as planned. The first new projects are scheduled to come online in 2020 (Borssele I-V) and 2022 (Hollandse Kust Zuid I-IV), followed by a steady capacity increase until 2030.

Table: Project overview

| FULLY OPERATIONAL | | |
|-----------------------------------|---------------|-----------------------|
| Project | Capacity (MW) | Year of commissioning |
| Egmond aan Zee | 108 | 2007 |
| Prinses Amaliawindpark | 120 | 2008 |
| Luchterduinen | 129 | 2015 |
| Gemini | 600 | 2017 |
| PRE-CONSTRUCTION | | |
| Project | Capacity (MW) | Year of commissioning |
| Borssele I & II | 752 | 2020 |
| Borssele III & IV | 731.5 | 2020 |
| Borssele V (innovation site) | 20 | 2020 |
| UNDER DEVELOPMENT | | |
| Project | Capacity (MW) | Year of commissioning |
| Hollandse Kust Zuid I & II | 740 | 2022 |
| Hollandse Kust Zuid III & IV | 760 | 2022 |
| EARLY DEVELOPMENT STAGES | | |
| Project | Capacity (MW) | Year of commissioning |
| Hollandse Kust Noord V | 700 | 2023 |
| Hollandse Kust West VI | 700 | 2024 |
| Hollandse Kust West VII | 700 | 2025 |
| Ten noorden van de Waddeneilanden | 700 | 2026 |
| IJmuiden Ver I & II | 2000 | 2027-2028 |
| IJmuiden Ver III & IV | 2000 | 2029-2030 |

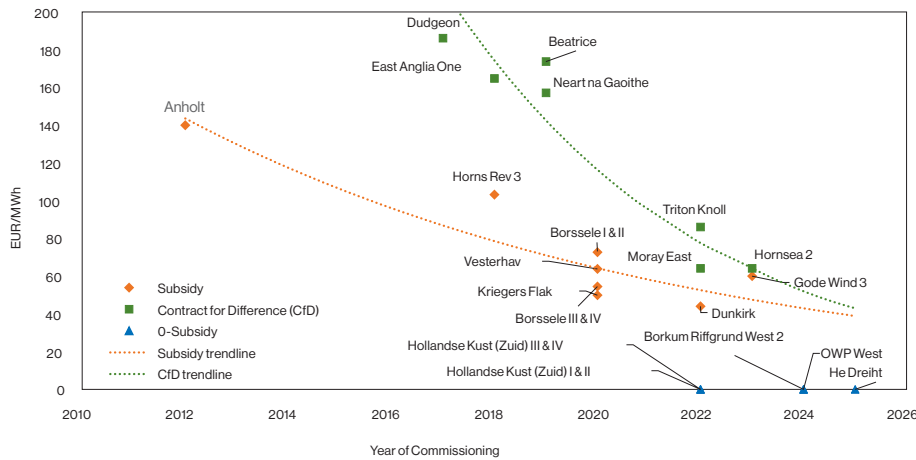
Source: Netherlands Enterprise Agency and Ministry of Economic Affairs and Climate (letter to Parliament 5 april 2019)

- As of the second quarter of 2019, there were four offshore wind farms fully operational totalling 957 MW. The last project built in the Dutch North Sea was Gemini, which became fully operational in 2017 as one of the largest projects in the world with 600MW of installed capacity.
- Construction process and commissioning of Borssele I & II by Ørsted will add 752 MW to the offshore wind energy capacity in 2020.
- Construction of Borssele III & IV by the Blauwwind consortium will begin in Q3 2019, Commercial operations of the 731.5 MW project is expected at the end of 2020.
- Construction and commissioning of the Borssele V Innovation Site by the Two Towers consortium is expected to take place in 2020.
- The Hollandse Kust Zuid sites are under development by Vattenfall. These first ever subsidy free offshore wind farms are expected to come online in 2022.
- Early development projects are allocated development areas. Tender rounds for these areas will continue between 2020 and 2025.

Tender System Specifications

Overview of latest developments

Figure: Offshore wind tender prices



Source: Guidehouse analysis

Note: Tender prices reflect the support level a developer would require under a certain incentive scheme and are not corrected for inflation. There is no 1:1 relation between the tender prices and Levelised Cost of Electricity (LCoE) from actual projects. For zero-subsidy projects it is not possible to determine the cost level as this is only known to the developer. The projects have therefore been included at €0/MWh which is the subsidy level, not the actual cost level.

The Dutch offshore wind programme uses a floating feed-in-premium scheme under the Netherlands Stimulation of Sustainable Energy Production (SDE+) tender and subsidy legislation. Successful companies with the lowest bid price that meet all the specified requirements win a 15-year subsidy grant and a 30-year permit to build, operate, and decommission the wind farm.

The first two subsidy free concessions were awarded to Vattenfall in 2018 (Hollandse Kust Zuid I & II) and 2019 (Hollandse Kust Zuid III & IV). These zero-subsidy bids were evaluated based on their qualitative merits regarding identification and mitigation of revenue, construction, and operational risks. The first ever zero-subsidy wind farm commissioning is planned in the Netherlands at the Hollandse Kust Zuid sites in 2022. Concurrently, Germany has held subsidy-free tenders and awarded the first project to be commissioned in 2024.

There are several elements that make zero-subsidy tenders feasible in the Netherlands:

- The cost of grid connection is attributed to the transmission system operator
- The certainty provided by the one-stop-shop principle of awarding concession, permit, and grid connection
- The country's established power purchase agreement market
- The good site conditions (limited water depths, high wind resources)
- The size of sites and their limited distance to shore
- Cost reduction realised throughout the supply chain

Tender rounds

Table: Offshore wind tenders in line with the 2013 energy agreement

| TENDER STATUS | TENDER YEAR | WINNER ANNOUNCED | OFFSHORE WIND AREA | DEVELOPER | STRIKE PRICE (EUR/MWH) | CAPACITY (MW) | OVERPLANTING (MW) | YEAR OF COMMISSIONING |
|---------------|-------------|------------------|------------------------------|--|------------------------|---------------|-------------------|-----------------------|
| Closed | 2016 | 2016 | Borssele I & II | Ørsted | 72.7 | 700 | 52 | 2020 |
| Closed | 2016 | 2016 | Borssele III & IV | Blauwwind (Mitsubishi, Eneco, Shell, Van Oord) | 54.5 | 700 | 31.5 | 2020 |
| Closed | 2018 | 2018 | Borssele V, Innovation Site | Two Towers (Van Oord, Investri, Green Giraffe) | - | 19 | - | 2021 |
| Closed | 2017 | 2018 | Hollandse Kust Zuid I & II | Chinook (Vattenfall) | 0-subsidy | 700 | 40 | 2022 |
| Closed | 2018 | 2019 | Hollandse Kust Zuid III & IV | Vattenfall | 0-subsidy | 700 | 60 | 2023 |
| Not started | 2019 | 2020 | Hollandse Kust Noord V | t.b.d. | t.b.d. | 700 | t.b.d. | 2024 |

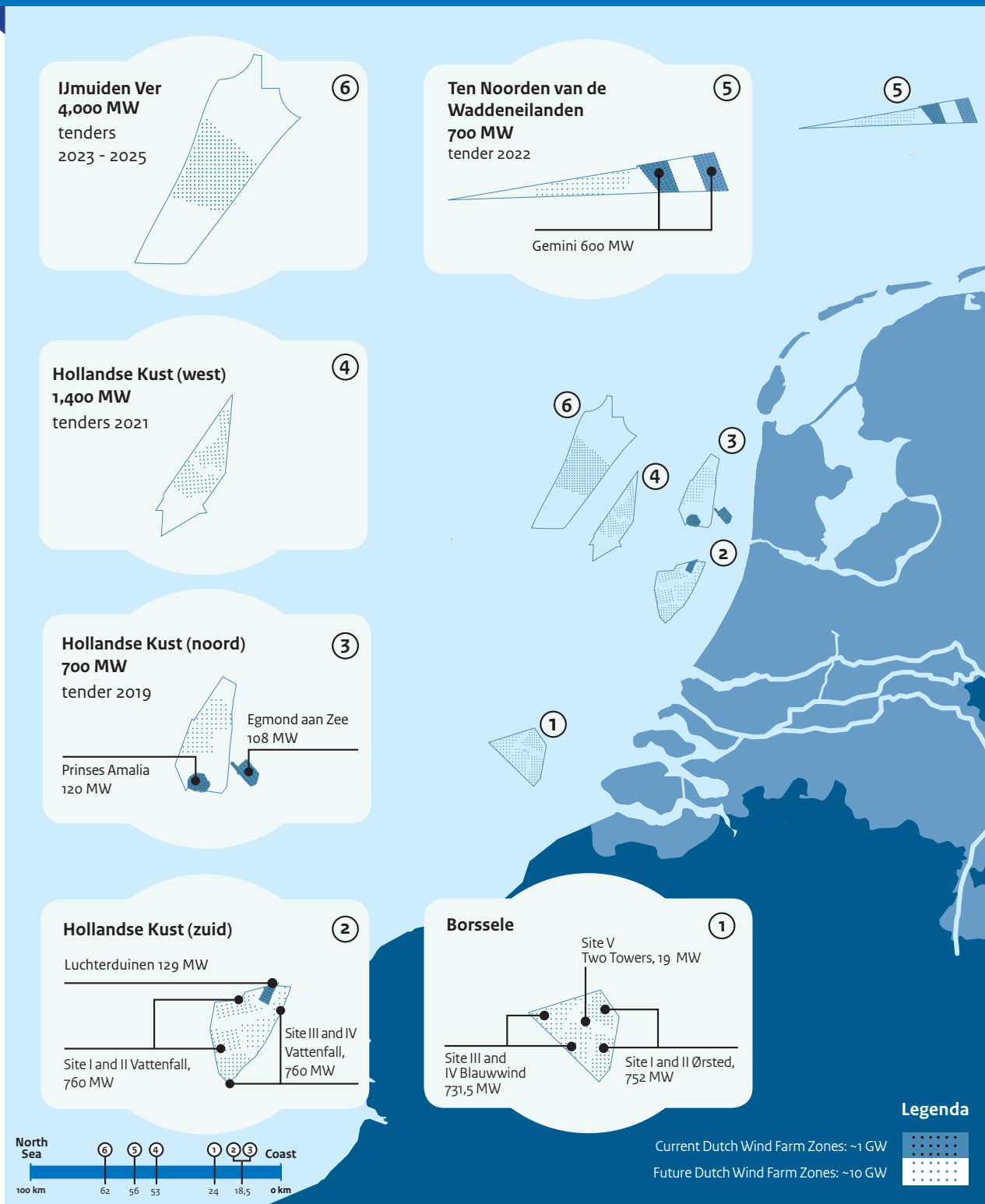
Source: Netherlands Enterprise Agency and Ministry of Economic Affairs and Climate (letter to Parliament 5 april 2019)

The Netherlands Enterprise Agency is executing the offshore wind energy subsidy and permit tenders on behalf of the Ministry of Economic Affairs and Climate Policy. The agency carries out preparatory site studies and surveys to stimulate competition. Risks to developers are further reduced by the joint award of building permit, access to the offshore and onshore grid connection (subject to the developer reaching agreement with the transmission system operator [TSO]), and, in some tender rounds, SDE+ subsidy.

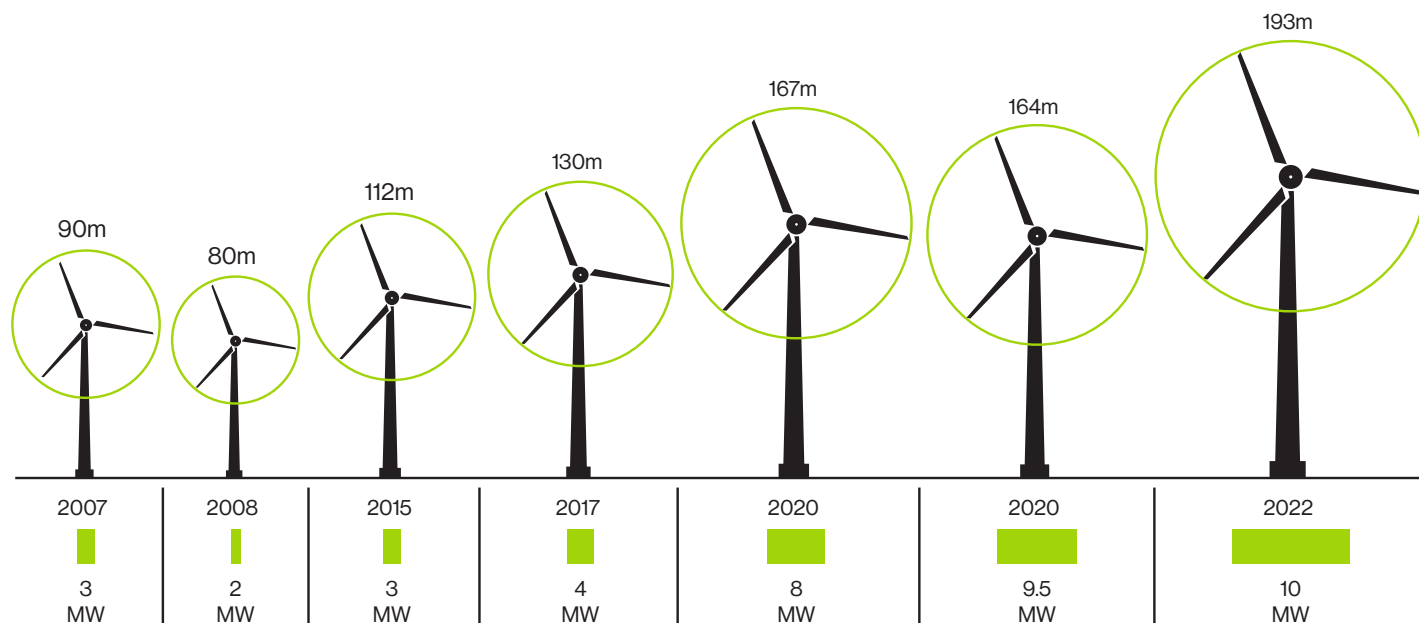
The following include upcoming rounds by year of tender publication, in line with the 2030 roadmap:

- 2021 Hollandse Kust West (1,400 MW)
- 2022 Ten noorden van de Waddeneilanden (700 MW)
- 2023 IJmuiden Ver I & II (2,000 MW)
- 2025 IJmuiden Ver III & IV (2,000 MW)

Dutch Offshore Wind Farm Zones



Turbine and foundation configuration



| YEAR | 2007 | 2008 | 2015 | 2017 | 2020 | 2020 | 2022 |
|--------------------|----------------|------------------------|---------------|----------------|-----------------|-------------------|----------------------------|
| Project | Egmond aan Zee | Prinses Amaliawindpark | Luchterduinen | Gemini | Borssele I & II | Borssele III & IV | Hollandse Kust Zuid I & II |
| Number of Turbines | 36 | 60 | 43 | 150 | 94 | 77 | 76 |
| Turbine Capacity | 3 MW | 2 MW | 3 MW | 4 MW | 8 MW | 9.5 MW | 10 MW |
| Turbine Supplier | Vestas | Vestas | Vestas | Siemens Gamesa | Siemens Gamesa | MHI Vestas | Siemens Gamesa |
| Turbine Type | V90-3.0 | V80-2.0 | V112-3.0 | SWT-4.0-130 | SG-8.0-167-DD | V164-9.5 | SG 10.0-193 DD |
| Rotor Diameter | 90m | 80m | 112m | 130m | 167m | 164m | 193m |

There are 289 offshore wind turbine generators (WTGs) installed and fully operational in the Dutch North Sea. The average nominal capacity for wind turbines in operation is 3 MW, which is expected to increase to over 6 MW by 2023. The projects under development will bring a notable increase in WTG size and capacity, more than doubling the output with the same number of turbines.

Monopiles are the only foundation technology implemented for all WTGs installed. The shallow Dutch North Sea waters and good soil conditions make this the most cost effective support structure design. The average water depth of operational wind farms is 25 m (18 m to 34 m). This number reaches 30 m for the projects under development, with maximum depth at 38 m in Borssele I & II and III & IV zones.

Wind Farm Ownership

Table: Key industry shareholders

| COMPANY NAME | FULLY OPERATIONAL IN NL (MW) | DEVELOPMENT IN NL (MW) | FULLY OPERATIONAL IN EU (MW) |
|-------------------|------------------------------|------------------------|------------------------------|
| Ørsted | 0 | 752 | 2976 |
| Vattenfall | 54 | 1500 | 1069 |
| Northland Power | 360 | 0 | 642 |
| Siemens | 120 | 0 | 411 |
| Partners Group | 0 | 329 | 198 |
| Eneco | 185 | 73 | 185 |
| Mitsubishi | 65 | 110 | 65 |
| HVC Groep | 60 | 0 | 60 |
| AL & HIF* | 60 | 0 | 60 |
| Shell | 54 | 146 | 54 |
| Van Oord | 0 | 80 | 0 |
| Green Giraffe | 0 | 7 | 0 |
| Investri Offshore | 0 | 7 | 0 |

*Alte Leipziger & Hallesche Investment Fund

Source: Guidehouse analysis

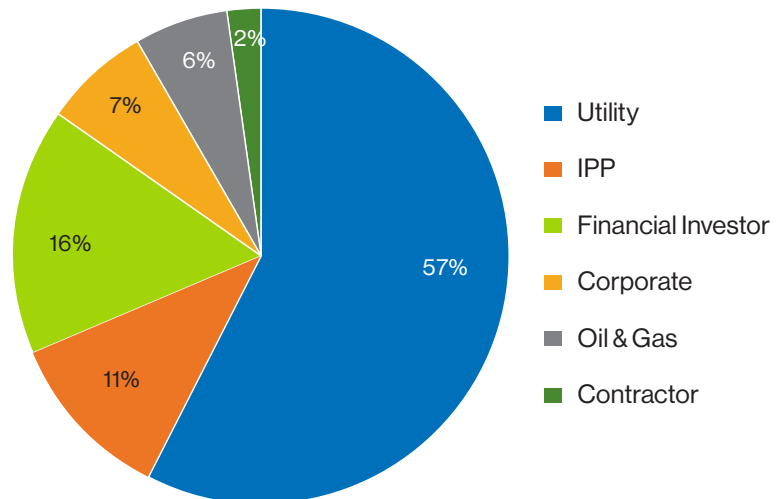
Note: Capacities are weighted by shareholding percentage.

The Canadian independent power producer Northland Power is the largest operational wind farm portfolio shareholder. However, the market leadership position will change with the rollout of Borssele I & II, developed by Ørsted, and Hollandse Kust Zuid I & II and III & IV, developed by Vattenfall. If both developers meet their commissioning planning, Ørsted will be largest operational wind farm portfolio holder in 2020 (with 752 MW) and Vattenfall will be largest by 2022 (with 794 MW) and 2023 (with 1554 MW).

Dutch-based companies Nuon, Shell, and Eneco led the early rounds of offshore wind development in the Netherlands. They are followed by international developers Northland Power, Ørsted, and Vattenfall, which have since entered the market. Dutch companies aim to stay competitive by means of vertical cooperation, i.e., partnership between developers and supply chain companies. A good example is the close cooperation of Eneco, Shell, and Van Oord, which are part of the Blauwwind consortium (constructing Borssele III & IV), and the Witwind consortium that bid on the recent tender for Hollandse Kust Zuid III & IV.



Figure: Breakdown of market shares



Source: Guidehouse analysis

Utility companies lead in the ownership of operational and under-development projects, in the Netherlands, with 57% of the market share. International financial investors with 11% and independent power producers (Northland Power) with 16% jointly control more than a quarter of the total market. The remaining 15% portfolio share is distributed among corporates, an oil & gas and low-carbon energy company (Shell), and a maritime contractor (Van Oord).

Dutch offshore wind farm ownership

Figure: Shareholder percentage per project

| Fully Operational | | | | | |
|------------------------------|---------------------|-----------------------|----------------|------------------------|-----------------------|
| Egmond aan Zee | 50% Shell | | 50% Vattenfall | | |
| Prinses Amaliawindpark | 100% Eneco | | | | |
| Luchterduinen | 50% Eneco | | 50% Mitsubishi | | |
| Gemini | 60% Northland Power | 20% Siemens | | 10% ALHIF ¹ | 10% HVCG ² |
| Pre-construction | | | | | |
| Borssele I & II | 100% Ørsted | | | | |
| Borssele III & IV | 45% Partners Group | 20% Shell | 15% Mitsubishi | 10% Eneco | 10% Van Oord |
| Borssele V (innovation site) | 33% Green Giraffe | 33% Investri Offshore | | 33% Van Oord | |
| Under development | | | | | |
| Hollandse Kust Zuid I & II | 100% Vattenfall | | | | |
| Hollandse Kust Zuid III & IV | 100% Vattenfall | | | | |

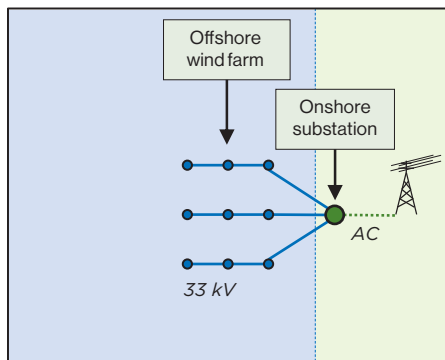
Source: Guidehouse analysis

Offshore Grid Status

Grid connection concepts and regulation in the Netherlands

Figure: Technical grid connection concepts

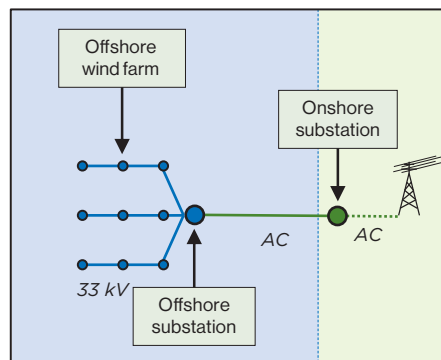
Direct AC system (33kV array)



Developer built grid connection:

- Egmond aan Zee

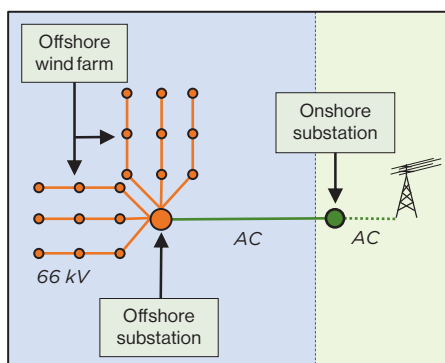
Collector AC system (33kV array)



Developer built grid connection :

- Prinses Amaliawindpark
- Luchterduinen
- Gemini

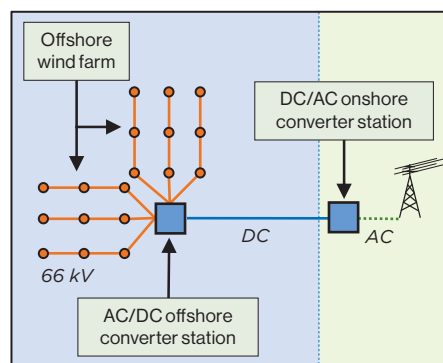
Hub AC system (66kV array)



TSO built grid connection:

- Borssele
- Hollandse Kust Zuid
- Hollandse Kust Noord
- Hollandse Kust West
- Ten noorden van de Waddeneilanden

Hub DC system (66kV array)



TSO built grid connection:

- IJmuiden Ver

Source: Guidehouse analysis

In April 2016, a 'TSO Built' grid development model was implemented in the Netherlands by an amendment of the Electricity Act 1998, where TenneT was appointed to develop and operate the future offshore transmission system. Prior to that, all offshore grid connections were built by offshore wind farm developers.

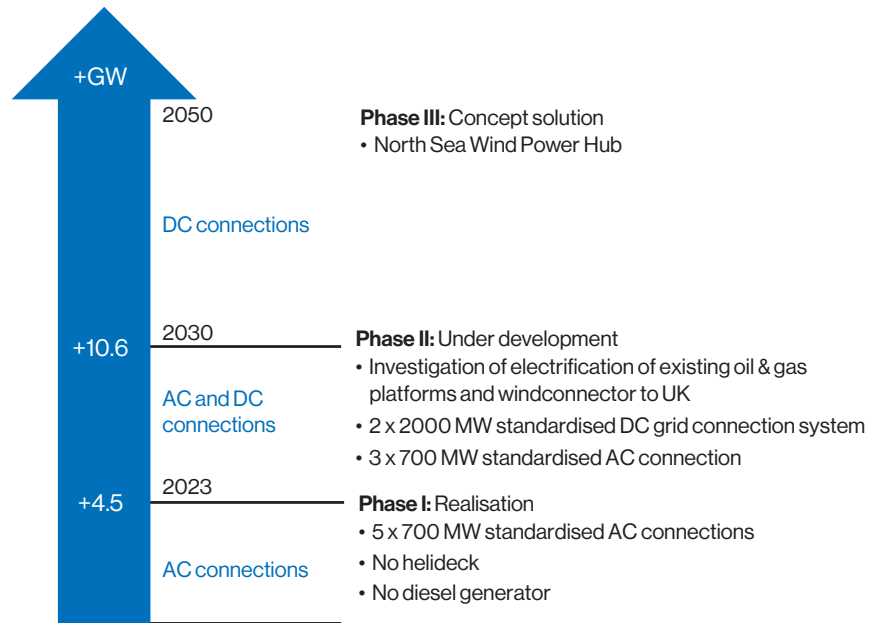
In accordance with the Dutch offshore wind programme to realise a total capacity of 4.5 GW by 2023, TenneT started developing five 700 MW standardised high voltage alternating current grid connections. The connections will transmit electricity from the Borssele, Hollandse Kust Zuid, and Hollandse Kust Noord wind farm areas to designated onshore connection points. The offshore platforms will transform the voltage levels from 66 kV to 220 kV and connect to the onshore substation via two 220 kV AC cables each.





Future outlook

Figure: Offshore grid development timeline



Source: Guidehouse analysis

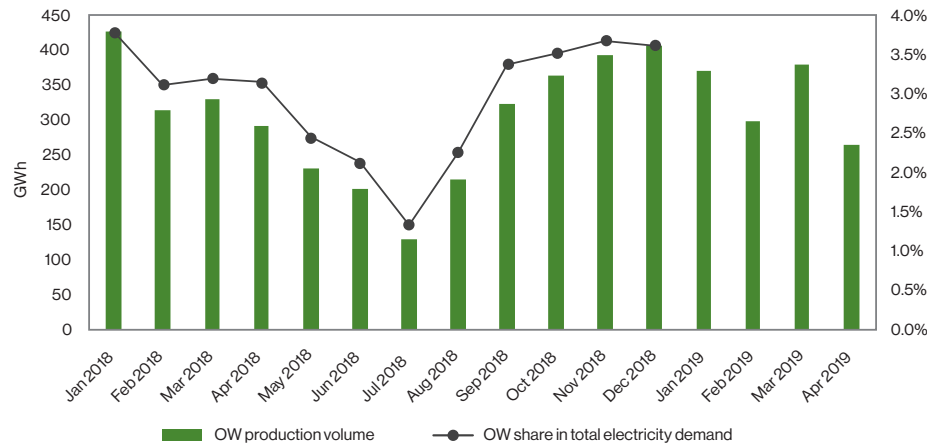
Connecting future offshore wind farms will require a different technical approach as the wind energy development zones will have greater capacity and will be located further from shore. To realise this, TenneT is executing a three-phase strategic plan, developing high voltage direct current (HVDC) technology solutions for far offshore grid connections.

In May 2019, it was announced that TenneT will connect 6.1 GW of new offshore wind farms to the Dutch high voltage grid between 2024 and 2030. TenneT will develop a world's first standardised 2 GW HVDC grid connection concept to facilitate secure and cost efficient grid integration.

Electricity Market and Power Production

Electricity production

Figure: Offshore wind production and share in total electricity demand



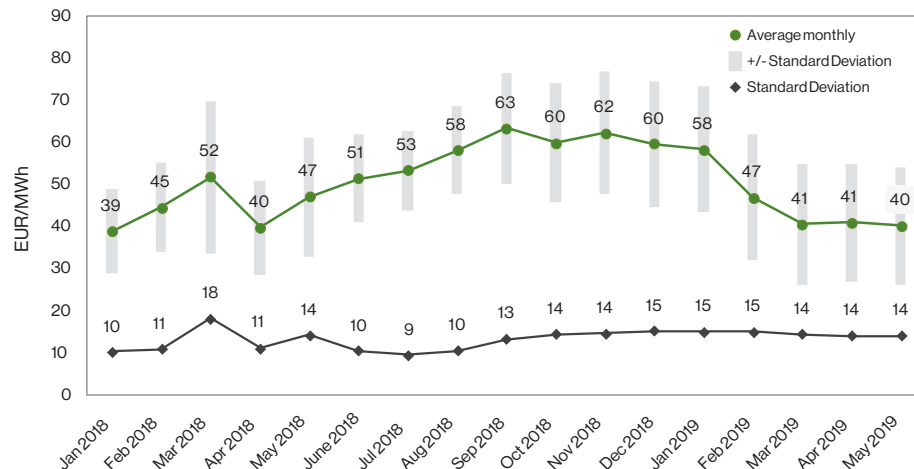
Source: CBS StatLine data

The owners of offshore wind projects that are realised after winning a zero-subsidy tender are exposed to a larger electricity price market risk. This is in contrast with SDE+ awarded projects, where much of the electricity price market risk was mitigated by the floating Feed-in-Premium. As the state of the electricity market becomes increasingly relevant, we describe some of the market's key metrics for the period of January 2018 up to April 2019 below.

Offshore wind electricity production volumes tend to follow seasonal weather patterns, which is evident for most months in the period January 2018 to April 2019. March 2019 was an outlier month, due to exceptionally strong winds (evidenced by a Windex factor of 146%). The average offshore wind electricity share in the total Dutch electricity demand in 2018 was 3.0%, with a monthly variation that closely follows the offshore wind electricity production. Due to unavailability of electricity demand volumes in 2019 from the same data source, the offshore wind share for 2019 months is excluded.

Electricity prices

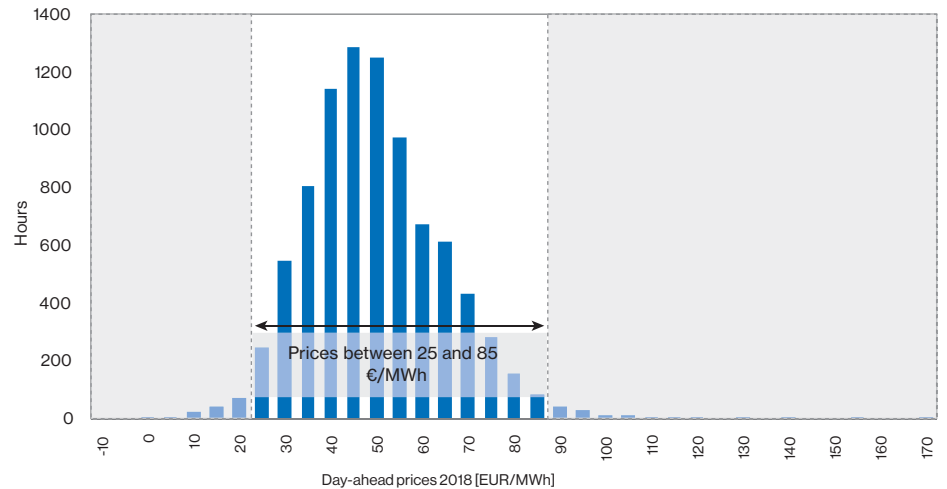
Figure: Electricity price fluctuation January 2018 – May 2019



Source: Guidehouse analysis of ENTSOE Transparency day-ahead price data



Figure: Annual average day-ahead electricity price in 2018



Source: Guidehouse analysis of ENTSOE Transparency day-ahead price data (2018 data only)

The monthly average day-ahead electricity prices vary and are in the range of €39/MWh to €63/MWh between January 2018 and May 2019, with a standard deviation over the full period of €15/MWh. The monthly standard deviation varied between €9/MWh and €18/MWh, levelling off from September 2018 onwards.

The hourly price volatility histogram (of 2018 prices) shows that electricity wholesale prices are in the range of €25/MWh to €85/MWh over 96% of the time. Price extremes are still rare, and no hourly negative (day-ahead) prices occurred in 2018.

The annual average day-ahead electricity price was €53/MWh, which in our understanding is higher than the Levelised Cost of Energy which new offshore wind farms in the Netherlands may achieve.

The development of the day-ahead electricity price and the capture price of offshore wind generated electricity are uncertain. Projects that do not have an SDE+ subsidy need to secure their revenue via other means. Currently, developers typically enter into long term power purchase agreements with large electricity offtakers. Guidehouse expects the PPA market to grow as more offshore wind is realised and the Dutch energy system further electrifies.

Innovation

Why and how innovation is supported

Key to the Dutch energy transition is the successful growth of its offshore wind energy industry, which is reflected in ambitious targets. To secure successful realisation of these targets and to support the growth of the Dutch supply chain internationally, a strong emphasis is put on technological innovation. Several wind energy research, development, and demonstration (RD&D) programmes have been established among research institutions, the private sector, regional municipalities, NGOs, and the Dutch government:

- **TKI Wind op Zee:** The consortium stimulates development and deployment of innovation by supporting partnerships, collaboration, and testing and demonstration of Dutch innovations.
- **GROW:** The Ministry of Economic Affairs and Climate Policy signed an agreement with the industry consortium GROW to strengthen innovation in offshore wind energy. GROW is a consortium of around 20 partners, that focuses around 11 programme lines covering the full value chain of offshore wind energy.

Innovation budget

In the 2013 Energy Agreement for Sustainable Growth, the Dutch government committed to ambitious levels of public investment to support RD&D in the clean energy sector.

The government stimulates offshore wind innovation projects through means of different subsidies. The total innovation budget is distributed across multiple programmes. In 2019, the budget available for innovation projects reached €223 million, out of which €80-€100 million (35%-45%) is accessible to offshore wind RD&D.

Investments in offshore wind innovation projects reached €70 million in 2018. These investments include €22 million innovation subsidy through the Top Sector Energy and the TKI Wind op Zee programme.

Major Dutch offshore wind innovation examples

Slip Joint Connection



Source: Delft Offshore Turbine (DOT)

The Dutch offshore wind industry has produced many scalable innovations as part of the RD&D programmes. A selection of recent innovation projects includes:

Slip Joint Connection: A new connection between the wind turbine and the monopile. This structure design allows for reduced cost and installation time due to the method of sliding the wind turbine over the monopile, creating a friction-based connection without the use of grouts or bolts.

Corrosion Fatigue Life Optimisation: The combined effect of corrosion and fatigue is an uncertain factor that influences the design and maintenance of monopiles. The objective of this innovation project is to build a deterministic model that describes interaction of corrosion (including microbiologically influenced corrosion) and fatigue and quantifies the influence of environmental factors on the subsea structures.

Underwater Blinds Against Piling Noise: An innovative technology that reduces underwater noise during the piling of monopiles by combining a blinds-like design and a curtain of bubbles that block certain sound frequencies. The technology will be used in constructing Borssele III & IV and Borssele V offshore wind farms.

Gentle Driving of Piles: The project aims to develop and test a new pile installation method based on the simultaneous application of low and high frequency vibrators.

Hydraulic Pile Extraction Scale Test: The project aims at better understanding the interaction between the pile and the soil to develop a hydraulic monopile extraction technique.

Corrosion Fatigue Life Optimisation



Source: Sif Netherlands B.V.

Wind Turbine Control Strategies: This project explores the strategy to control the rotor speed during heavy rain or hail computer simulations, modelling, and laboratory testing, therefore significantly extending the blade lifetime without electricity production loss.

Composite tower for light-weight and low-maintenance wind turbines: This is a 100 m tower made of glass fibre and reinforced plastic, which is 40% lighter than steel. Such a structure is easy to install and requires little maintenance.

Application of innovations in the Borssele V Innovation Site

In 2020, the Two Towers consortium, consisting of Van Oord, Investri Offshore and Green Giraffe, will realise the Borssele V Innovation Site. This is a small offshore wind site, which aims to achieve cost reduction and to create opportunities for entrepreneurs by enabling demonstration of innovations.

Two Towers consortium:

"We will implement several innovations at the Borssele V site which contribute to a cost-efficient realisation of the 2030 renewable energy targets and improve environmental standards. The innovations aim to ensure that monopile foundations remain the most cost-efficient foundation technology by reducing their production and installation costs.

The proposed innovations will minimise the steel weights and the offshore construction and operational handling time, while at the same time increasing the design lifetime. Revolutionary eco-designs for scour protection creates artificial reefs with a positive effect on the maritime environment, which contributes to achieving (inter-)national conservation objectives and an increased enthusiasm for large-scale roll out of offshore wind.

The following 5 innovations will be applied at Borssele V Site:

- 1. A Slip joint: a new type of connection between the monopile and transition piece by gravity and friction, without bolting or grouting, reducing the installation and maintenance costs.*
- 2. Impressed Current Cathodic Protection (ICCP) optimisation: Improving coverage of internal ICCP system and optimise water replenishment strategy to enhance the performance of the ICCP system and increase the design lifetime of the foundations.*
- 3. Automatic application method of Thermal Sprayed Aluminium: a new metallisation method that will increase the design lifetime of the foundations.*
- 4. An Oval Cable Entry Hole, a new shape of the cable entry hole in the monopiles that will lead to a reduction of the steel weight.*
- 5. Eco-friendly scour protection, testing the supply and outplacement methods for live European flat Oysters on the scour protection of the foundations.*

After installation, the innovations are monitored to demonstrate the performance and to gather data for further research."

Short Term Outlook

The Netherlands can look forward to an exciting year of offshore wind developments. Government and stakeholders are preparing new policy in the 2030 North Sea Strategy development process, which will give direction to the extensive developments in the North Sea both today and in the decades ahead. The revised Offshore Wind Act is expected to be ratified in the second half of 2019, which will introduce new concession award options for projects after Hollandse Kust Noord.

The international offshore wind community will gather in Amsterdam for the Offshore Energy 2019 exhibition in October, which will include a dedicated offshore wind conference and workshop by the Netherlands Enterprise Agency.

The upcoming year will see continuation of the successful offshore wind tender scheme: a tender for the Hollandse Kust Noord site is anticipated to open at the end of this year and close in Q1 2020. Guidehouse expects the Hollandse Kust Noord tender to be similar to the previous two tenders, where developers distinguish themselves by demonstrating an effective risk mitigation strategy. Subsequent tenders may be undertaken under the revised Offshore Wind Act, which includes the option of a competitive auction where developers pay for the concession rights. Under a competitive auction, developers will need to further increase focus on reducing cost levels.

Finally, the planning of the offshore grid and first offshore wind projects from the Dutch Energy Agreement are on schedule. This is a step in the right direction to meet national climate goals. Commissioning of Borssele I & II is planned for 2020, closely followed by the construction and commissioning of Borssele III & IV in the same year.

Steven Engels, General Manager Continental Western Europe Ørsted (Borssele I & II)

"We are on track to realise our wind farm Borssele I & II, which on completion in 2020 will be the biggest wind farm in the Netherlands. The electricity production is comparable with the electricity consumption of a million Dutch households. We will establish an O&M base in Vlissingen and work in close cooperation with the Zeeland region."

Roeland Borsboom, Project Director Blauwwind (Borssele III & IV)

"In a low subsidy, low contingency and rapidly maturing business segment, the only way to survive is execute and operate to perfection. With this way of working we will kick-off foundation installation in the fall of 2019."





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