

Dutch Offshore Wind Innovation Guide

Your guide to Dutch offshore wind policy, technologies and innovations

Issue 2025



wind &
water
works

NL

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**Your guide to Dutch offshore wind policy,
technologies and innovations**

Issue 2025

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Dutch design & know-how in offshore wind

Thanks to rapid technological advances which have greatly reduced costs, offshore wind has become a mainstream source of renewable energy around the world. In the Netherlands it is expected that in 2030 75% of our electricity supply will be generated by offshore wind (required capacity of 21 GW).

In a growing number of countries, offshore wind has become a key element of national plans to reduce the carbon intensity of their energy supplies at a competitive price. Experience in the Netherlands has shown that governments need to be proactive in order to successfully achieve affordable, large-scale offshore wind capacity, and reap the socioeconomic benefits this industry offers. Thanks to clear policy and continuous innovation, the cost of offshore wind power in the Netherlands has fallen to the point where zero-subsidy bids are now submitted in competitive tenders.

Experiences with the Dutch policy framework and accumulated sector expertise is worth sharing internationally, especially in order to multiply the effects of international know-how in developing new offshore wind markets. It is therefore my pleasure to present you with the 2025 edition of the Dutch Offshore Wind Innovation Guide.

In this annual flagship publication, public and private partners in the wind & water works campaign provide you with comprehensive overviews of the Dutch regulatory framework and Dutch supply industries for offshore wind. The guide also highlights Dutch breakthrough innovations in offshore wind technologies and offshore wind-to-hydrogen development. The guide also includes press articles showcasing recent export successes of Dutch companies.

Last but not least, I am proud to recommend the wind & water works partners. All have their own unique expertise and experience, and are keen to help solve the challenges of the offshore energy transition. You will find their contact details in the business directory of this guide.

I hope this guide will be instrumental to foster collaboration between international off-shore wind ecosystems across the world to accelerate further innovations and technological advances required to meet our economic needs and climate ambitions at the same time.

I am confident this guide will prove valuable for other governments building their offshore wind sectors, as well as for international developers and businesses looking to identify new cost-reducing technologies and services in offshore wind.

Anne Le Guellec
Director International Enterprise Department
Ministry of Foreign Affairs of the Kingdom of the Netherlands



Netherlands Enterprise Agency



Ministry of Foreign Affairs



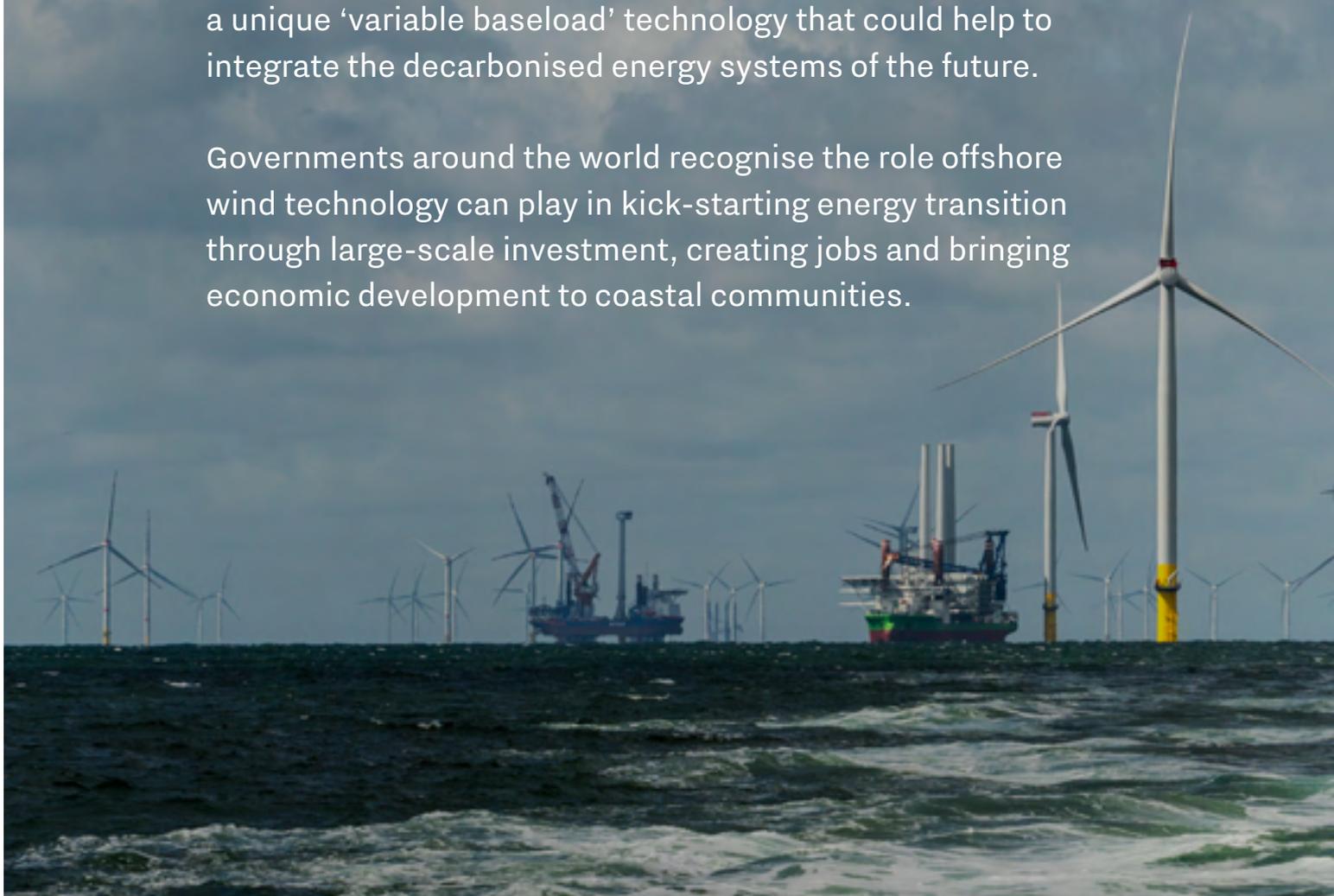
More info on:
www.windandwaterworks.com

1. Harnessing the wind

The Paris Climate Change Agreement, to which all countries in the world are signatories, seeks to maintain global warming at well below 2°C, and much closer to 1.5°C, above pre-industrial levels. To achieve this ambition, a vast expansion of renewable energy deployment is required on a global scale.

Offshore wind will become the main renewable energy source (RES) that is commercially deployable with vast untapped potential in the world's seas. Offshore wind has a higher capacity and more consistent output than any other variable RES, with the International Energy Agency describing it as a unique 'variable baseload' technology that could help to integrate the decarbonised energy systems of the future.

Governments around the world recognise the role offshore wind technology can play in kick-starting energy transition through large-scale investment, creating jobs and bringing economic development to coastal communities.





1.1 Global overview

As countries in coastal regions continue to utilise their offshore wind potential, the Global Wind Energy Council (GWEC) saw the offshore wind market enjoying its second best ever year in 2023. According to its Global Offshore Wind Report 2024, a total of 10.8 GW of new installations were added to global offshore wind capacity, bringing cumulative capacity to 75.2 GW. Still, GWEC labelled 2023 as a turbulent year for the offshore wind industry on both sides of the Atlantic Ocean. Challenges such as inflation, increased capital costs, and supply chain constraints created uncertainty in the sector. Despite the headwinds experienced in 2023, governments and developers remain committed to developing offshore wind and the global offshore wind market outlook in the medium term remains promising.

Asia-Pacific (APAC)

China led the world in annual offshore wind developments for the sixth year in a row with 6.3 GW added in 2023, demonstrating its capability to maintain stable growth in the new era of 'grid parity'. Three other markets commissioned new offshore wind capacity in Asia last year: Taiwan (692 MW), Japan (140 MW), and South Korea (4.2 MW), according to GWEC.

Europe

GWEC noted a record year for Europe in 2023, with 3.8 GW of new offshore wind capacity from 11 wind farms commissioned across seven markets accounting for most of the new capacity. The Netherlands commissioned 1.9 GW of offshore wind capacity in 2023, making it the region's largest market in terms of new additions, followed by the UK (833 MW), France (360 MW), Denmark (344 MW), Germany (257 MW), Norway (35 MW), and Spain (2 MW).

United States

In North America, offshore wind turbines were installed at two utility-scale offshore wind projects in the US before the end of last year, but no offshore turbines were commissioned in 2023. North America had 42 MW of offshore wind in operation at the end of last year, with all installations located in the US, according to GWEC.



1.2 Policy development in the Netherlands

Today, the Netherlands is the third-largest offshore wind market in Europe with 4.7 GW of offshore wind capacity in operation. To come to this position, however, the Dutch had to overcome significant challenges. As with other countries, the potential offshore wind offers had long been recognised in the Netherlands. Even so, up to 2013, only a few offshore wind farms were actually in development or in operation in the Dutch Economic Zone of the North Sea, due to a passive and reluctant policy approach. For example, project developers were responsible for projects with no guarantee projects would be approved. As a result, project developers faced high costs and risks before they could even apply for a subsidy. Indeed, out of 80 initial applications, just four offshore wind farms with a combined capacity of less than 1 GW were actually built in the Dutch Economic Zone of the North Sea by that time.

Shift to a more proactive and supportive approach

However, in 2013, conditions for offshore wind development changed significantly when a broad coalition of the Government, employers' associations, trade unions, environmental protection organisations and energy companies, accelerated climate ambitions and agreed to kick-off the Dutch energy transition. The resulting Energy Agreement for Sustainable Growth (hereinafter: Energy Agreement) included ambitious provisions on energy conservation and targets to raise renewable shares in the energy mix to 16% by 2023.

In response to the Energy Agreement, the Government introduced a more proactive and supportive regulatory approach through the implementation of a one-stop-shop approach for offshore wind development. State agencies took responsibility for offshore wind farm site selection and surveys, project requirements, tenders, environmental impact assessments, site decisions and more. In addition, TenneT developed the offshore grid. This enabled project developers to focus successfully on optimisation of wind farm designs and construction methods. Thanks to this new approach, pre-bid costs and associated risks have reduced and coordination between government entities has improved. Last but not least, timeframes for developing offshore wind farms have reduced significantly.

Main actors under the Dutch one-stop shop approach

For governance under the one-stop shop approach, roles were designated to the Ministry of Climate Policy and Green Growth the Ministry of Infrastructure and Water Management (Min I&W) and Transmission System Operator (TSO) TenneT. Their roles are briefly explained below.

- 1. The Ministry of Climate Policy and Green Growth**
The Ministry of Climate Policy and Green growth plans the multi-annual rollout of future offshore wind farms (roadmaps) and decides on the type of tenders (auction design). Its Netherlands Enterprise Agency (RVO) prepares and issues the permit, is responsible for conducting site studies, serves as the coordinator for the offshore wind tenders and is in charge of the publication of the tenders.
- 2. Ministry of Infrastructure and Water Management**
The Ministry of Infrastructure and Water Management (Min I&W) allocates areas for future wind farms together with the Ministry of Climate Policy and Green Growth. Rijkswaterstaat (RWS) is in charge of conducting the Environmental Impact Assessments (EIA) and preparing the wind farm site decisions (site localizations, permit conditions).
- 3. TenneT TSO**
TenneT has been legally appointed by the Ministry of Economic Affairs and Climate Policy as responsible for the offshore grid network, enabling state-owned connections between offshore wind farms and the onshore network. Tender winners receive the permit to build and operate an offshore wind farm and access to the offshore and onshore grid network.

1.3 Roadmap 2023 results

As planned under the National Energy Agreement (2013), in 2015, the Dutch Government published the first Offshore Wind Energy Roadmap, aimed at adding 3.5 GW of new offshore wind power capacity by 2023. The Roadmap 2023 outlined plans for four large-scale project sites across three designated Wind Farm Zones (Borssele, Hollandse Kust zuid and Hollandse Kust noord), all to be tendered between 2016 and 2019 and potentially taking the total Dutch offshore wind capacity up to 4.5 GW in 2023.

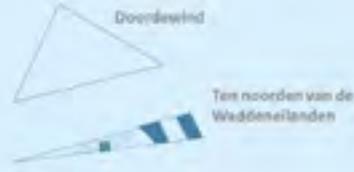
Under the Offshore Wind Energy Roadmap 2023, successful tenders in three designated offshore wind zones have been completed. These are: Borssele (Sites I & II, III & IV, and V) between 2016 and 2018, Hollandse Kust (zuid) in 2018 and 2019 and Hollandse Kust (noord) V in 2020. These offshore wind farm project sites and their tender specifics are presented in more detail.

2016: Borssele sites I - II (752 MW)

In 2016, the first tenders under Roadmap 2023 concerned Borssele Wind Farm Zone (BWFZ) sites I and II, further referred to as 'Borssele I and II', located some 55 kilometres from the Port of Vlissingen. The tender system was legally based on an electricity cost price auction under the Stimulation of the Sustainable Energy Production (SDE++) support scheme, which uses competitive auctions to award operational subsidies to renewable energy projects.

Offshore Wind Energy Roadmap

with cable routes from the offshore grid



Legend

- Offshore substation platform
- High-voltage grid connection
- Wind Farm Zones
- Wind turbines in future wind farm sites (indicative)
- First generation operating wind farms
- Wind Farms of Offshore Wind Energy Roadmap 2023
- Cable route in use
- Cable route awaiting permit
- Cable route final/under construction
- Cable route under investigation
- Hydrogen pipeline route under investigation
- Cable and hydrogen route under investigation

April - 2023

In this system the permit to build and operate an offshore wind farm will be awarded to the competing project developer that offered the lowest electricity price per MWh (strike price) for operational subsidy support (sliding feed-in premium) at times of low energy prices for fossil energy, over a maximum period of 15 years. There was fierce international competition in the public tender to secure the permit and associated subsidy to build and operate Borssele I and II (38 bids). This resulted in achieving a far lower than the anticipated price (max. 12.4 Euro cents per kilowatt hour), making the project the cheapest worldwide at the time.

The permit and accompanying subsidy for the Borssele I & II was won by Ørsted, based on a winning bid of 7.27 Euro cents per kilowatt hour. The offshore windfarm, comprising 94 Siemens Gamesa 8 MW turbines, supplied power for the first time through TenneT's offshore grid in November 2020 and was officially commissioned in September 2021. Currently, Norges Bank Investment Management (NBIM) is 50% co-owner of the wind farms at Borssele I & II.

2016: Borssele sites III - IV (731,5 MW)

Also in 2016, the Blauwwind consortium – comprising Partners Group (45%), Shell (20%), Diamond Generation Europe (full subsidiary of Mitsubishi Corporation, 15%), Eneco Group (10%) and Van Oord (10%, also being the Balance of Plant (BoP) contractor) – won the permit and subsidy to build and operate Borssele III & IV, featuring 77 Vestas 9.5 MW turbines, with a winning bid of 5.45 Euro cents per kilowatt hour. With Borssele III & IV, the subsidy savings were even higher than for the Borssele I & II projects which, at the time, was set to be the world's cheapest offshore wind farm. The offshore wind farm at Borssele III & IV was constructed and operated with a subsidy of just €0.3 billion, meaning it can potentially be operated without subsidy after 7.5 years. The originally anticipated subsidy was €5 billion. The final wind turbine at Borssele III & IV was installed in November 2020.

Borssele III & IV will produce around 3 TWh of electricity per year, enough to power the equivalent of 825,000 Dutch households, or to meet up to 2.3 per cent of total Dutch electricity demand. Today, Borssele's III and IV shareholder group includes Shell, Eneco, INPEX, Luxcara, Swiss Life Asset Managers, Nuveen Infrastructure and Octopus Energy Generation.

New auction type: comparative assessment

Due to the strong interest and competition for the BWFZ tenders, strike prices dropped rapidly. So much so that tenders for the remaining zones under Roadmap 2023 – Hollandse Kust (zuid) and Hollandse Kust (noord) – were expected to become subsidy free and could be based on

another auction type, namely a differentiated comparative assessment, instead. A new legal tender model was introduced to allow subsidy-free licensing. In this model, zero subsidy bids were evaluated on their qualitative merits regarding identification and mitigation of revenue, construction and operational risks. In this new tender model, the permit will be granted to the offer with the highest score in the ranking assessment.

2018/2019: Hollandse Kust Zuid (2 x 760MW)

In 2018 and 2019, Vattenfall won both tenders for building and operating the wind farms at Hollandse Kust (zuid) Wind Farm Zone (HKZWFZ) sites I - IV, further referred to as 'Hollandse Kust Zuid', some 18 - 35 kilometres off the Dutch coast, in the area between The Hague and Zandvoort. The combined Hollandse Kust Zuid project marks two major milestones for the offshore wind industry.

Firstly, these will be the first wind turbines ever to be installed on a subsidy-free offshore wind farm, as Vattenfall is constructing the combined project without financial support from the Dutch Government.

Secondly, as a combined project, this will be the largest offshore wind farm in operation in the world in 2023, able to produce enough green energy to power 1.5 million Dutch households a year.

Thirdly, the 139 monopile foundations are designed so they do not require transition pieces. This design allows faster installation and cost reductions.

Last but not least, it is worth mentioning that Vattenfall and France-based Air Liquide have signed power purchase agreements (PPA) covering 115 MW of capacity of the 1.5 GW Hollandse Kust Zuid. Contracted over a 15-year period beginning in 2025 and 2026, the PPA will bring the overall renewable power capacity available to Air Liquide to around 230 MW.

The 1.5 GW Hollandse Kust Zuid, operating 139 Siemens Gamesa SG 11 MW wind turbines since September 2023, is now co-owned by Vattenfall, BASF, and Allianz.

2020: Hollandse Kust Noord (759 MW)

In 2020, the CrossWind consortium – a joint venture between Shell (80%) and Eneco (20%) – won the tender to build and operate the fifth and last offshore wind farm under Roadmap 2023. The Hollandse Kust (noord) Wind Farm Zone (HKNWFZ) site V, further referred to as 'Hollandse Kust Noord', is located 18.5 kilometres from the coast of Egmond aan Zee in the Netherlands. With an installed capacity of 760 MW, the consortium plans to have the Hollandse Kust Noord project operational by the end of 2023. Comprising 69 Siemens Gamesa 11 MW turbines, it will generate at least 3.3 TWh per year, or enough to meet 2.8 per cent of current electricity demand in the Netherlands.

Similar to the Hollandse Kust Zuid wind farms, the monopiles in the Hollandse Kust Noord are also of a 'TP' less type, which means they are designed to not require transition pieces, enabling faster installation and cost reductions. As well as building and operating the wind farm, the CrossWind consortium is also deploying a series of innovations such as the installation and operation of a 0.5 MWp (megawatt-peak) offshore solar park inside the Hollandse Kust Noord wind farm. With offshore solar panels situated in between the offshore wind turbines, it will be possible to also produce energy on sunny but less windy days, thereby increasing the utilisation of the offshore power grid infrastructure. This is set to be the first offshore solar farm in the world to be installed, connected and operated within a wind park in high wave conditions. The offshore solar park will be provided by Dutch supplier Oceans of Energy in 2025, while the Hollandse Kust Noord wind farm is in operation since December 2023.

Another innovation is the introduction of the Baseload Power Hub, an integrated fuel cell system to convert excess wind energy to green hydrogen through an electrolyser and store it as green hydrogen that can be converted to electricity (via a fuel cell) when needed. It will also include battery storage for shorter-term power storage. The system will include a containerised fuel cell power solution with a peak power capacity of 1 MW to regenerate stable and dispatchable power. The Baseload Power Hub aims to reduce the problem of the variable character of renewable energy production (as the wind does not blow at all times). It will store energy and release it when demand exceeds the wind farm's output. Once installed, this will be the global first offshore combination of battery storage and round-trip hydrogen integrated in an offshore wind farm.

Furthermore, CrossWind partner Shell has also started working on a large-scale hydrogen project in the port of Rotterdam. This involves a 200 MW electrolysis plant to convert excess electricity produced at Hollandse Kust Noord site V to green hydrogen. The plant for the project, named Hydrogen Holland I, is said to become Europe's largest renewable hydrogen plant once operational in 2025. The electrolysis plant will be constructed on the Tweede Maasvlakte in the Port of Rotterdam and will produce up to 60,000 kilogrammes of renewable hydrogen per day. The hydrogen is planned to be transported through the HyTransPort pipeline, which will form part of the Netherlands hydrogen infrastructure. With a length of about 40 kilometres, it will run from the plant to Shell's Energy and Chemicals Park Rotterdam, where it will replace some of the grey hydrogen usage in the refinery.

Power Purchase Agreement (PPA) included

In February 2024, Google has signed corporate power purchase agreements (CPPAs) with Shell and Eneco for 478 MW of energy capacity at two offshore wind farms the partners jointly own in the Netherlands: Hollandse Kust Noord and Hollandse Kust West VI. Together with the existing power purchase agreements Google previously signed in the Netherlands, the two offshore wind farms will help the company's Dutch data centres and offices reach more than 90 per cent carbon-free energy in 2024.

1.4 Evaluation Roadmap 2023

Looking back at the results of Roadmap 2023, it is safe to conclude that the Energy Agreement in 2013 proved to be a 'game changer' for the development of offshore wind in the Netherlands. Under older policy up to 2013, there was little activity in offshore wind, with just under 1 GW installed in total. With today's more proactive and supportive policy approach, a legal framework has been introduced and a total of 3.5 GW was successfully tendered between 2016 and 2019. This resulted in a cumulative installed Dutch offshore wind capacity of more than 4.5 GW (4.7 GW) by end 2023. The cost of wind energy has also gone down substantially faster than targeted. In the 2013 Energy Agreement, cost reduction was initially targeted at 40% by 2020, compared to price levels in 2010. The target price for 2020 was set to €100/MWh. However, in 2016 the price level for Borssele I and II was already substantially lower than the 2020 target.

The tenders for sites in the Hollandse Kust Zuid and Hollandse Kust Noord resulted in bids without the need for subsidy, taking into account that grid connection is publicly funded. In an evaluation the independent Netherlands Court of Audit found that the costs for offshore have dropped more than 70% by 2018, compared to the reference price calculated in 2013 (15 cents/kWh) by Energy Research Center of the Netherlands. It illustrates the importance of a strong public-private process guided by the Government, whilst setting parameters for the pace at which proposed new capacity is developed, the maximum capacity of the wind farms, planning and zoning, site investigations and, last but not least, grid connection. By regulating all conditions for the construction of the wind farms, the Dutch Government reduces project risk, financing and societal costs.

Blueprint for other countries

International project developers generally acknowledge the introduction of non-price criteria in the tender system as a model for other countries' tenders. Involving system integration and integrating ecological innovation into the bid concept is a driving force for developers as well, in terms of looking at how to develop future offshore wind farms in the rest of the world.

1.5 Roadmap 21 GW

Encouraged by the successful rollout of the first Roadmap, the Government accelerated its offshore wind ambitions for 2030. Initially, in 2018, a new target of 11,5 GW installed offshore wind capacity by 2030 was set and a second Roadmap was released, including new Wind Farm Zones Hollandse Kust (west) (1.4 GW) and IJmuiden Ver Alpha and Beta (4 GW). However, due to increased EU climate ambitions and in response to and the subsequent REPowerEU call, the Government decided to further raise the country's offshore wind ambition from 11.5 GW to 21 GW of operating offshore wind capacity, equivalent to around 75 per cent of the country's current electricity consumption. The current Roadmap 21 GW includes new zones for offshore wind development, in particular IJmuiden Ver Gamma with a capacity of 2 GW, Nederwiek (zuid) I (2 GW), Nederwiek (noord) II (2 GW), Nederwiek (noord) III (2 GW), Hollandse Kust (west) VIII (700 MW), Doordewind I (2 GW) and Doordewind II (2 GW). Due to – amongst others – longer lead times for grid connections, and pressures on the supply chain, the Roadmap 21 GW is now expected to be completed by 2032.

New auction type: comparative assessment with financial bid

Under the Roadmap 21 GW, the winners of the tenders will also be selected based on ranking criteria in a comparative assessment. The assurance of the wind farm construction/operation and the contribution of the wind farm to the national energy mix are considered as the standard criteria. Additional criteria such as the impact on nature, aquaculture, fishery, safety, or shipping issues can be added, depending on the priorities set by the Government for a given site.

A new auction element however is the option for the government to include a financial bid for the right to build a wind farm in the ranking criteria. The financial revenue will be returned to the Dutch society to support the affordability of the energy transition. Another new financial tender element was that the costs for the site studies and environmental impact assessments are to be passed on to the winner of the tender. To prevent prohibited state aid in the form of avoided costs for studies made in preparing the permit (Wind Farm Site Decision), these costs are charged to the permit holder. These costs are therefore separate from the structural integration costs and the financial bid.

2022: Hollandse Kust West, site VI (760 MW)

Ecowende, a joint venture of currently Shell (60%), Eneco (10%) and Japanese energy utility Chubu (30%), won the permit for the construction and operation of the 760 MW Hollandse Kust (west) Wind Farm Zone (HKWWFZ) site VI, further referred to as 'Hollandse Kust West site VI'. Ecowende will construct and operate the 52 Vestas 15 MW

wind turbines without subsidy, but instead pay the maximum financial offer of €50 million. Together with the costs for the environmental impact assessments and location studies that are being paid by Ecowende, the financial return for the Government is about €63.5 million. As already mentioned, for the Hollandse Kust West site VI, limiting ecological impact was the main non-price criterion in the assessment of the applications for the permit. The winning design of Ecowende's offshore wind farm will be 'nature-inclusive', including a section where wind turbines are widely spaced so birds can fly between them safely. Furthermore, various piling techniques will be used to measure and minimise the impact on marine habitats and marine biodiversity will be fostered by placing reef structures on the seabed. The Hollandse Kust West site VI project is expected to be commissioned in 2026 and will be built more than 50 kilometres off the Dutch coast in the North Sea near IJmuiden. The offshore wind farm will produce enough electricity to meet approximately 3 per cent of the Dutch electricity demand annually, which is enough to meet the needs of one million households.

PPA's included

In December 2023, Eneco signed a long-term power purchase agreement (PPA) with Dutch supermarket giant Albert Heijn to supply the company with power from the 760 MW Ecowende offshore wind farm in the Netherlands. The 15-year PPA will help the supermarket chain to meet half of its power needs from 2027.

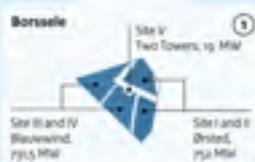
In February 2024, Google also signed a corporate power purchase agreement (CPPA) with Shell and Eneco for approx. 240 MW of energy capacity at Hollandse Kust West VI. Together with the existing power purchase agreements Google previously signed in the Netherlands, the two offshore wind farms will help the company's Dutch data centres and offices reach more than 90 per cent carbon-free energy in 2024. In July 2024, two other Dutch companies, both operating in the food and agro industries, Plukon and De Heus, have decided to buy electricity from Ecowende. Last in line, in September 2024, international chemical company LyondellBasell has agreed to purchase a portion of sustainable electricity generated by the Ecowende wind farm in the Dutch North Sea. The chemical company will get some three per cent of Ecowende's total capacity of 760 MW for the next 15 years from 2027 onwards. This amounts to around 103 gigawatt hours of green wind power per year and is equal to the annual electricity consumption of approximately 28,500 European homes.

2022: Hollandse Kust West, site VII (760 MW)

Oranje Wind Power II, a project company of Germany-based developer RWE, won the permit for the construction and operation of the 760 MW Hollandse Kust (west) Wind farm Zone (HKWWFZ) site VII, further briefly referred to as 'Hollandse Kust West site VII'. Apart from the financial offer of €50 million, Oranje Wind Power II performed best in the non-price comparative assessment on system

Offshore Wind Energy Roadmap 21 GW

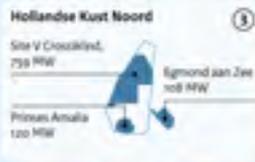
Borssele



Hollandse Kust Zuid



Hollandse Kust Noord



Hollandse Kust West



Uitsuiden Vier



Nederwiek



Ten noorden van de Waddenzellen



Doordewind



Legend

- Operational wind farms - 4.7 GW
- Wind farms under construction - 6.5 GW
- Planned wind farms - 10 GW
- Total - 21.5 GW



July 2024

integration, partly through its promise to convert surplus electricity into green hydrogen through a 600 MW onshore electrolyser. RWE also joined forces with Dutch floating solar energy supplier Solar Duck to incorporate floating solar panels with integrated storage to allow more efficient use of North Sea space as part of the company's bid for the Hollandse Kust West site VII.

RWE will also introduce flexible demand solutions in the project, such as battery storage for surplus electricity. The battery system, which will have an installed power capacity of 35 MW and a storage capacity of 41 MWh, will consist of a total of 110 lithium-ion battery racks that will be installed at RWE's biomass plant in Eemshaven and will be virtually coupled with RWE's power plants in the Netherlands. The battery project is an important step to optimally integrate the weather-related fluctuating offshore wind power generation of the 'OranjeWind' offshore wind farm into the Dutch energy system. Since July 2024, TotalEnergies has a 50 per cent stake in RWE's OranjeWind offshore wind farm in the Netherlands.

1.6 Latest tender

2024: IJmuiden Ver, sites Alpha, Beta (2 x 2 GW)

Following the successful auctioning of the Hollandse Kust West tenders, the sites in the IJmuiden Ver Wind Farm Zone, located 62 kilometres off the west coast of the Netherlands in the Dutch North Sea, were the latest to be issued for tender. To speed up the rollout in order to meet the ambitious climate targets and enable economies of scale for the offshore wind business community – the Government has decided to tender two large scale sites, named Alpha (2 GW) and Beta (2 GW). Both 2 GW sites were auctioned in a combined tender in the first half of 2024, making it the largest tender ever organised in the Netherlands. Tennet TSO will build three DC grid connections in the area, with three platforms that will have a 2 GW direct current connection to a land station. These are the first offshore wind farms in the Netherlands to be connected with a direct current connection. The third 2 GW site in the 6 GW IJmuiden Ver Wind Farm Zone, named Gamma, is expected to be put out to tender in 2025.

Auction type

Similar to the previous Hollandse Kust West tenders, the tenders for IJmuiden Ver Alpha and Beta were also based on a comparative assessment, including the option for competing developers to add a financial bid. And again the vast majority of ranking points (85%) were to be awarded to a predefined set of standard non-price criteria (i.e. assurance of wind farm construction and operation, contribution to the national energy mix, circularity and IRBC) and site-specific non-price priorities (i.e. ecology enhancement and system integration). Only a limited maximum of points (15%) could be awarded to an additional financial bid, when included in the tender applications.

IJmuiden Ver, site Alpha (2 GW)

Noordzeker, a consortium comprising SSE Renewables, Dutch pension fund ABP and its asset manager AGP won the development permits for the construction and operation of the IJmuiden Ver Alpha offshore wind site. In response to the main site-specific requirement, the contribution of the wind farm to the ecosystem of the Dutch North Sea, proposed several nature-positive measures, including a bird protection solution and artificial reefs for marine wildlife. Noordzeker's plan includes turbine and wind farm designs that contribute to the protection of birds. The winning bid of Noordzeker also included the design of the Alpha wind farm as a "living laboratory" in which more than 75 per cent of the wind turbines in the wind farm will have artificial reefs for muscles and other maritime animals.

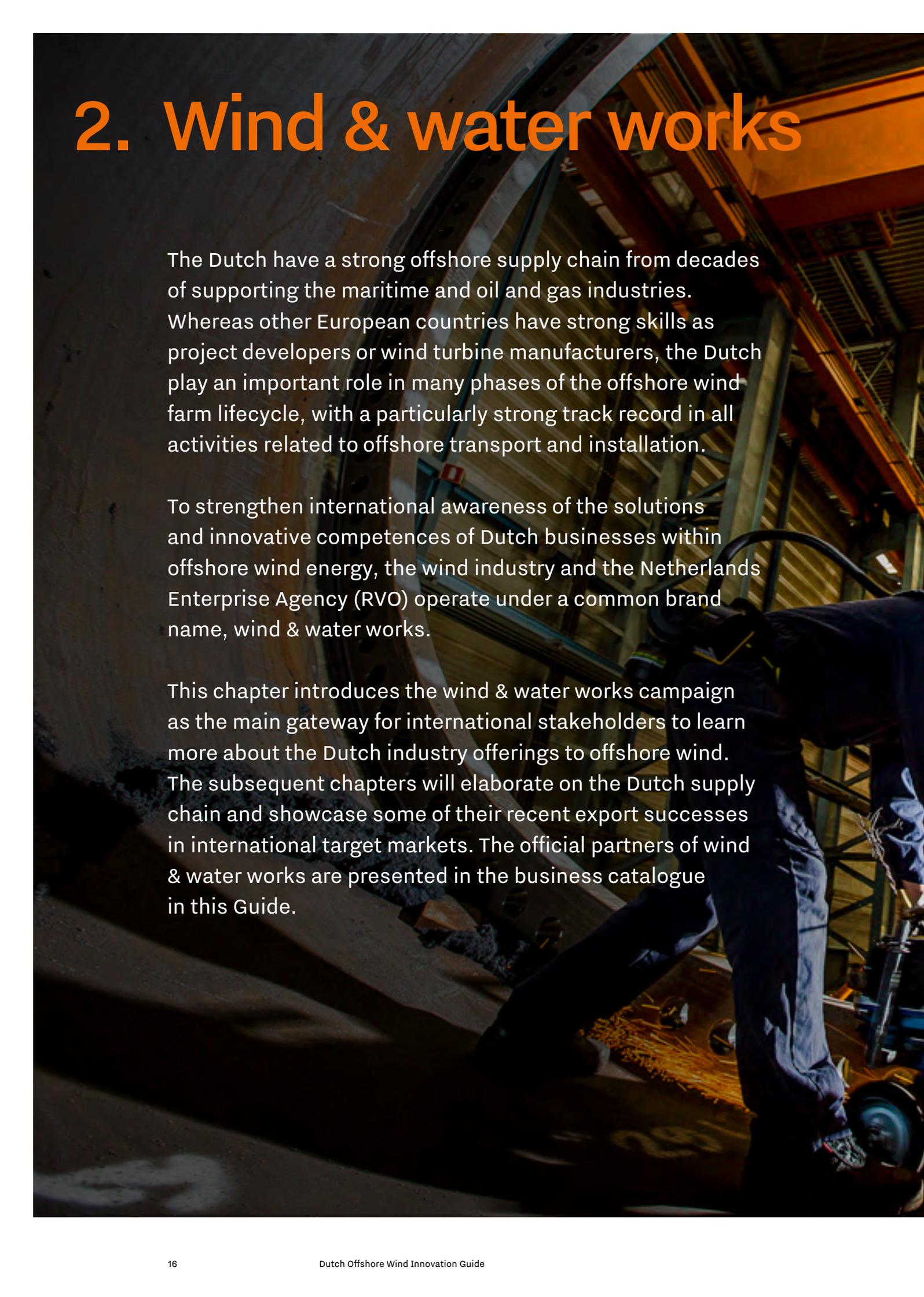
As part of the financial bid, Noordzeker will pay EUR 1 million a year for a period of 40 years, to the Dutch Government for the rights to build and operate the wind farms. The developer will also reimburse the costs for the environmental impact assessments and the offshore site characterisation studies (approximately EUR 40 million in total).

The IJmuiden Ver Alpha wind farm is expected to be commissioned in 2029 and will produce enough electricity annually to meet the needs of two million Dutch households.

IJmuiden Ver, site Beta (2 GW)

Zeevonk, a joint venture between Vattenfall and Copenhagen Infrastructure Partners (CIP), has been awarded the development permits for the IJmuiden Ver Beta offshore wind site. In response to the main site specific tender requirements for the Beta site, integration of the wind farm into the Dutch energy system and protection of the harbor porpoise during installation, the Zeevonk consortium will house an offshore wind farm which will be integrated with a 50 MWp floating solar plant offshore and a large-scale electrolyser at the Maasvlakte in the Port of Rotterdam to produce hydrogen using the electricity generated at IJmuiden Ver Beta. The electrolyser will have a capacity of 1 GW and, since the electrolyser will be built near the location where the offshore wind farm will be connected to the system on land, the electricity does not have to enter the national power grid first, which relieves pressure on the power grid. The plan also details measures to significantly reduce disturbance to marine mammals during construction of the wind farm. The Zeevonk joint venture also made a financial offer of EUR 20 million per year for 40 years and will also pay the costs of the environmental impact assessments and location studies of approximately EUR 20 million. Similar to IJmuiden Ver Alpha, the IJmuiden Ver Beta wind farm is expected to be commissioned in 2029 and will produce enough electricity annually to meet the needs of two million Dutch households.

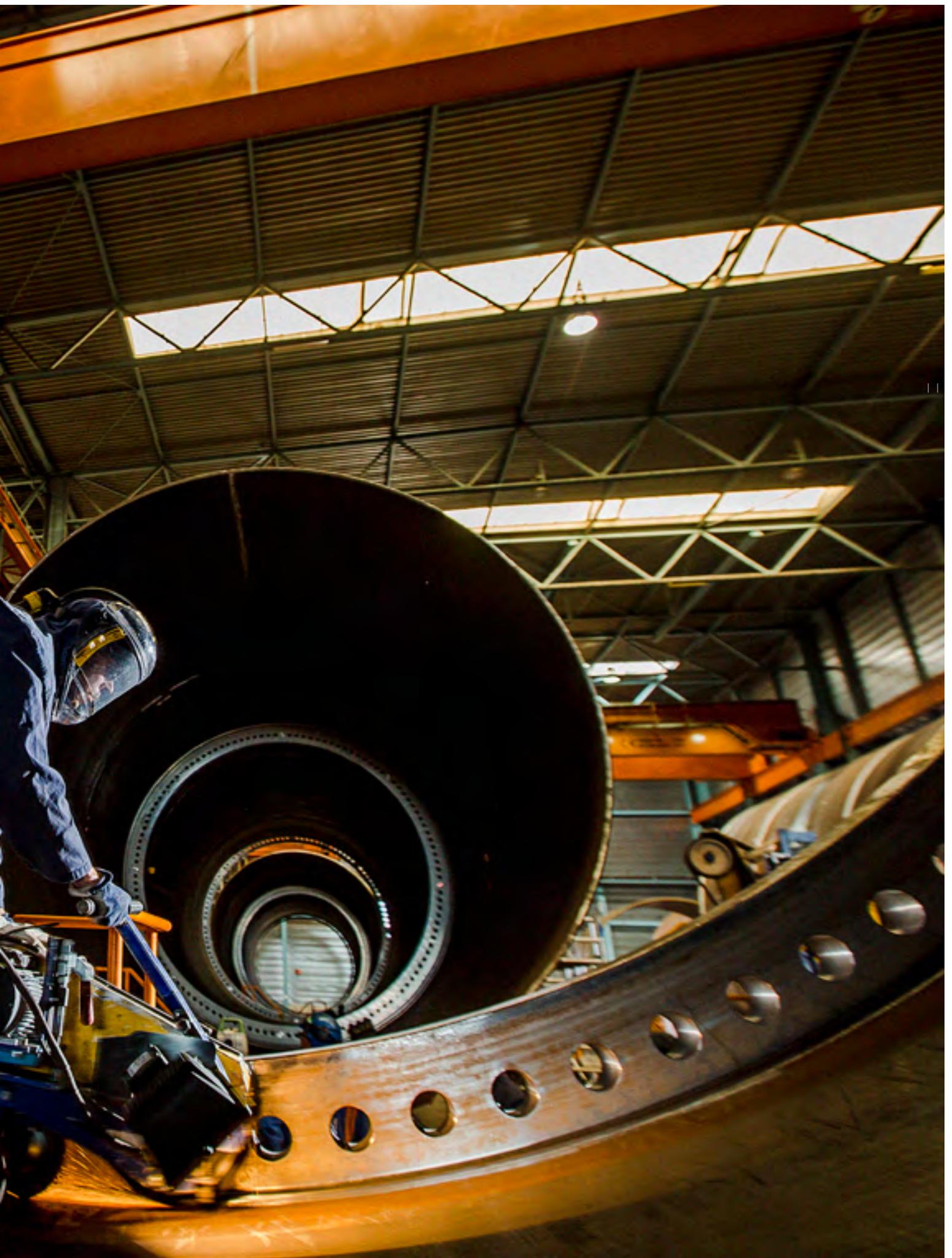
2. Wind & water works

The background image shows a large industrial facility, likely a wind turbine manufacturing plant. The scene is filled with complex metal structures, pipes, and machinery. A worker in a dark uniform is visible in the lower right foreground, working on a component. The lighting is dramatic, with strong highlights and deep shadows, creating a sense of scale and industrial activity.

The Dutch have a strong offshore supply chain from decades of supporting the maritime and oil and gas industries. Whereas other European countries have strong skills as project developers or wind turbine manufacturers, the Dutch play an important role in many phases of the offshore wind farm lifecycle, with a particularly strong track record in all activities related to offshore transport and installation.

To strengthen international awareness of the solutions and innovative competences of Dutch businesses within offshore wind energy, the wind industry and the Netherlands Enterprise Agency (RVO) operate under a common brand name, wind & water works.

This chapter introduces the wind & water works campaign as the main gateway for international stakeholders to learn more about the Dutch industry offerings to offshore wind. The subsequent chapters will elaborate on the Dutch supply chain and showcase some of their recent export successes in international target markets. The official partners of wind & water works are presented in the business catalogue in this Guide.



2.1 An experienced Dutch supply chain

For centuries, Dutch companies have worked offshore gaining a deep understanding of the specific conditions above and below sea level that can make or break a project. That experience means the Netherlands is home to some of most successful and innovative offshore wind businesses, maritime companies, and research institutes in the world. Our supply chain is a strong one with global reach and it's here to help you develop your own offshore wind industry with confidence.

In the Netherlands, the Government has taken on the task of developing offshore wind farms in the Dutch North Sea itself. It has introduced a stable policy environment with

clear project pipelines. There are flexible rules and regulations in place. High quality site data is provided by the Netherlands Enterprise Agency to prospective developers of designated wind farm sites. Transmission system operator, TenneT, is responsible for all grid connection infrastructure. Meantime, Rijkswaterstaat grants consents for wind farm sites and monitors environmental impact. This approach provides greater certainty for developers, increases investor confidence, and has been proven to foster innovation and drive down overall costs for offshore wind projects. Combined, this array of Dutch private and public sector expertise can provide international neighbours with the right solutions for offshore wind in different site conditions around the world. We have proven experience working in the global wind industry to support its growth in a proactive, sustainable, and successful way and we are willing to share the lessons learned. Through the wind & water works gateway, our aim is to share this expertise and forge strong international partnerships to ensure the successful development of the offshore wind sector around the world. We are ready, willing, and able to work with you, so let's connect to maximise the full global potential of offshore wind.

2.2 One-stop information Portal

At the heart of the wind & water works campaign is the one-stop offshore wind information portal: www.windandwaterworks.nl and associated social media channels via #windandwaterworks. Featuring the latest offshore wind news, project showcases and company profiles, the website shares Dutch expertise and provides practical information to help other countries successfully develop their offshore wind markets.

Through the wind & water works gateway, Dutch businesses share their expertise and forge strong international partnerships to ensure the successful development of the offshore wind sector around the world. Meanwhile, wind & water works also provides news and updates on export opportunities for Dutch companies hoping to increase their international activities. Dutch presence at international events and trade missions as well as public-private partnerships aimed at enhancing international trade are all featured. Company profiles and business links are also included under the Partners section of the website. More than 60 companies from across the Dutch wind industry have joined wind & water works as a partner already.

We will continue to welcome additional partners and add new insights and information across the website as the wind & water works campaign gathers momentum.





2.3 Founding fathers of wind & water works

Wind & water works is a public-private partnership between the Dutch Government and leading business associations in offshore wind: Holland Home of Wind Energy (HHWE), the Association of Dutch Suppliers in the Offshore Energy Industry (IRO), Netherlands Maritime Technology (NMT) and the Trade Association for Wind Energy NedZero. The main goal is to inform and establish relations with stakeholders in the international offshore wind community. Through sharing of Dutch knowledge, experience and innovations, the wind & water works stakeholders aim to enhance their international visibility and reinforce their network as part of the international wind community.



Holland Home of Wind Energy is an independent exporters association representing the interests of Dutch wind power companies abroad. HHWE's mission is to initiate and support marketing and promotional activities that will positively influence the image of the Dutch wind energy sector on emerging wind energy markets.

www.hhwe.eu

IRO: the Association of Dutch Suppliers in the Offshore Energy Industry is an independent non-profit organization that supports and promotes the interests of Dutch suppliers within the offshore energy industry.

www.iro.nl

The Netherlands Maritime Technology trade association represents Dutch shipyards, maritime suppliers and maritime service providers in the fields of (inter)national trade, Innovation and Human Capital.

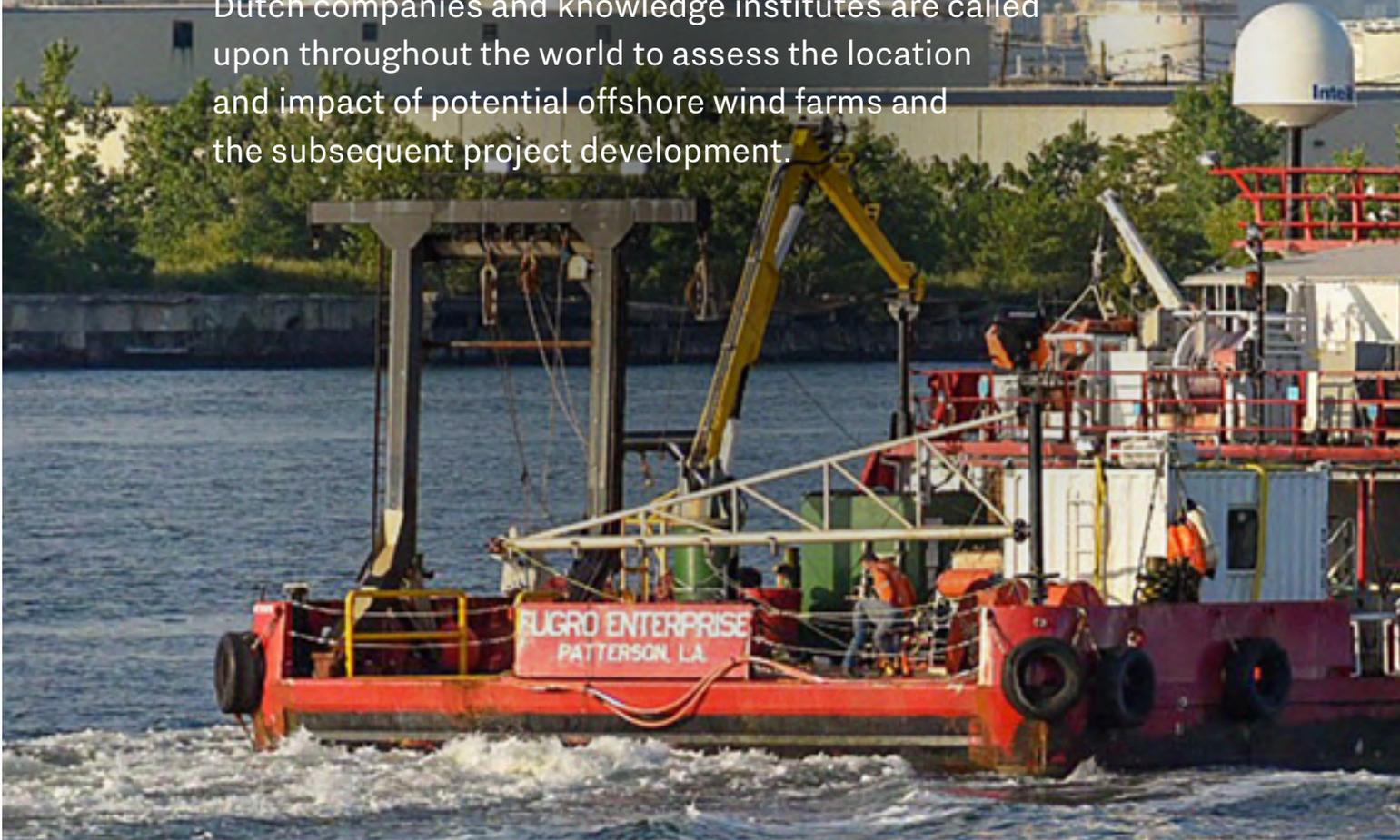
www.maritimetechnology.nl

Nedzero is the Dutch sector association working to increase sustainable energy and to accelerate the transition towards a renewable energy supply by spurring businesses and governments to invest in renewable energy.

www.nedzero.nl

3. Feasibility, design & development

In many international markets, especially those without any spatial planning for wind farm zones, the first step for project developers towards a new offshore wind farm is to find the right location. As potential offshore wind farm sites need detailed technical, financial, and environmental assessments, specialists are needed across all stages of the development process. And although only few international offshore wind farm developers, such as Shell, are headquartered in the Netherlands, Dutch companies and knowledge institutes are called upon throughout the world to assess the location and impact of potential offshore wind farms and the subsequent project development.





3.1 Development and project management

Although most wind farm utilities develop the initial offshore wind farm concept in-house during the pre-Front End Engineering Design stage (or pre-FEED), many consultancy and project management services are often subcontracted to third parties. Support includes legal advice, financial advice, planning, consenting, engineering consultancy, risk management and logistics.

Dutch consultants are internationally renowned at this early stage of project development in terms of consenting and development services and project management. A wide range of services are already provided by Dutch consultants to the development and project management area, such as legal and financial services.

In the news 2024

Yooshin, Pondera Performing Consultancy Work for Korean 600 MW Offshore Wind Project

Source: OffshoreWIND.biz

Wando Geumil Offshore Wind, the company developing the 600 MW Wando Geumil offshore wind farm in South Korea, whose majority shareholder is KOEN (Korea South-East Power Company), has awarded a contract for operations & maintenance (O&M) strategy consultancy services to Yooshin Engineering Corporation.

The consultancy project, which started at the end of last year, includes the classification and definition of O&M services, required technology and equipment, technical manpower planning, benchmarking and handover strategies when going from the EPC to the O&M phase.

The Netherlands-based Pondera has teamed up with DWT and OutSmart to carry out the work. For the local vessel acquisition strategy, the renewable offshore brokers from GRS will support Pondera and DWT with a market screening. Pondera, DWT and OutSmart will also dive into training programs for securing technical manpower, the consultancy said.

The Wando Geumil offshore wind project is proposed to be built in Wando-Gun, South Jeolla Province, South Korea. The 600 MW offshore wind farm is planned to comprise 40 V236-15.0 MW wind turbines for which the developer signed a preferred supplier agreement with Vestas last year. The delivery of the turbines is expected to begin in the fourth quarter of 2025, with commercial operation scheduled for the third quarter of 2026, according to Vestas's press release from March 2023.

In the news 2024

Ventolines Joins Estonian-Latvian Joint Offshore Wind Project Team

Source: OffshoreWIND.biz

The Dutch company, Ventolines, has won a public tender to consult the team behind the Estonian-Latvian cross-border offshore wind project, ELWIND, in executing the next practical steps in de-risking the offshore areas.

By winning the tender and signing the agreement, Ventolines took the position of technical consultant for the 1 GW ELWIND offshore wind project. The total amount of the contract is EUR 300,000, excluding VAT.

According to the agreement, the main responsibility of the Dutch company will be to help the ELWIND team prepare the technical and environmental studies that form a major part of the predevelopment activities Estonia and Latvia are committed to, according to ELWIND.

"For the needs of Elwind, the company will provide support in the preparation of procurement documentation for the environmental impact studies," said Jānis Ločmelis, head of the Elwind project department of the Latvian Investment and Development Agency.

As part of the environmental impact assessment (EIA), the impact of the wind project on nature, animals, and socio-economic impact, including shipping lanes, will be analysed. Technical studies will also be carried out. Research is expected to start this year and is planned to last until 2026.

According to the Investment and Development Agency of Latvia, special attention will be devoted to determining the wind farm's potential impact on the national defense capabilities and taking the necessary compensation measures in case the impact is detected.

ELWIND is an Estonian-Latvian cross-border offshore wind project for which the countries started discussions in December 2019.

The governments of Latvia and Estonia already selected the locations in their respective parts of the Baltic Sea where their joint project will be built.

In November 2023, the Latvian Cabinet of Ministers determined that the planned target capacity of the offshore wind farm on the Latvian side of the ELWIND project will be up to 1,000 MW.

The tender for the rights to develop the project is scheduled to be held in 2026. ELWIND is expected to enter the construction phase in 2028 and be commissioned by 2030 at the earliest.

3.2 Environmental impact assessments

Offshore wind farm developers have to cross critical path items, such as environmental and social impacts that need to be assessed in terms of public scrutiny and comment, subject to legal challenges. Examples of environmental impact relate to birds, bats, fish, and marine mammals (noise mitigation) during the development process. Other topics relate to aesthetic considerations, decommissioning requirements, and the impact on tourism, fishing, navigation, and transportation that arise in the planning, construction, and operation of an offshore wind project. Environmental surveys establish the distribution, density, diversity, and number of different species such as benthic, birds and marine mammals (acoustic impact during offshore piling). These studies take place early in the development process to provide information for the environmental impact assessment (EIA).

3.3 Site investigations

During the site selection, developers also call upon specialists to carry out site investigations, including geotechnical and geophysical studies to identify suitable locations for the wind farm and cable routes. These investigations identify seabed topography and locate unexploded ordnance. Further geophysical surveys are often completed post-consent and pre-construction to determine turbine locations, foundation design and cable routes. Environmental studies such as wildlife impact assessments are sometimes combined with the geophysical surveys. Site investigations are required at both the wind farm location and at the proposed onshore and offshore cable route and the onshore substation site. Depending on the survey type, the contract may involve both data collection and analysis, such as geotechnical surveys, or data collection only, where analysis is performed by the developer in-house, for example, meteorological and oceanographic (metocean) data. Geophysical surveys include bathymetric, cable route and unexploded ordnance surveys. These surveys plot the surface topography in support of the wind farm design and installation engineering.



In the news 2024

Fugro to Gather Metocean Data for Ørsted's Australian Offshore Wind Farms

Source: offshoreWIND.biz

Ørsted has selected the Dutch geo-data specialist Fugro to carry out a floating LiDAR measurement campaign for its Gippsland offshore wind farms in Australia.

For twelve months, Fugro's SEAWATCH Wind LiDAR Buoy will measure wind, wave, current, and meteorological parameters to help assess the viability of Ørsted's wind farms located off Gippsland in Australia's state of Victoria.

Metocean data will be transferred in real time to give the client early insight into site conditions, followed by monthly reports.

"This is a key step in getting our Gippsland project development well and truly underway. By developing a deep understanding of the metocean conditions, we will be able to design a world class project to maximise the amount of green energy and value delivered for Victoria", said Ørsted.

The SEAWATCH Wind LiDAR Buoy captures high-accuracy measurements of wind speed and direction up to 300 metres above sea level.

According to Fugro, the system was the first to gain a Stage 3 rating in line with the Carbon Trust roadmap for the commercial acceptance of floating LiDAR technology.

Ørsted was one of the first companies to secure a feasibility licence for offshore wind projects proposed to be built offshore Gippsland.

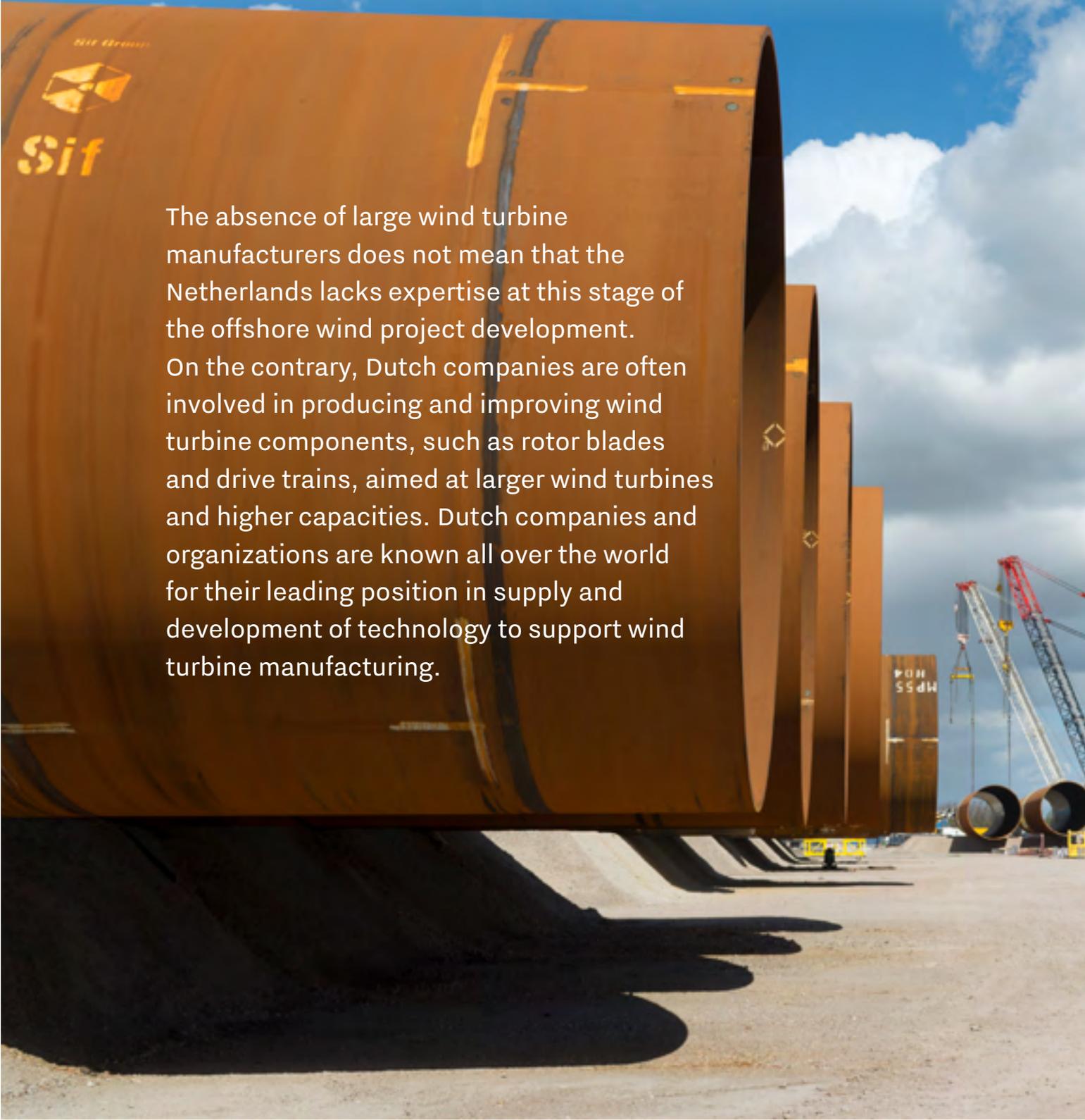
The licences provide the Danish company with site exclusivity to develop the two offshore wind sites.

The project sites are located between 56 and 100 kilometres from land off the coast of Gippsland.

Ørsted estimates the cluster has the potential to generate a combined 4.8 GW of renewable energy, which can eventually power the equivalent of four million Australian homes.

The potential capacities for the project are 2.8 GW in licence area 1 and 2 GW in licence area 2.

4. Construction & Engineering



The absence of large wind turbine manufacturers does not mean that the Netherlands lacks expertise at this stage of the offshore wind project development. On the contrary, Dutch companies are often involved in producing and improving wind turbine components, such as rotor blades and drive trains, aimed at larger wind turbines and higher capacities. Dutch companies and organizations are known all over the world for their leading position in supply and development of technology to support wind turbine manufacturing.



4.1 Turbine component supply, engineering

Wind turbine manufacturers can best be seen as system integrators: designing the overall system and components such as nacelle, rotor and the tower, then assembling the components (mostly at the offshore site), which it may manufacture in-house or source from suppliers externally.

4.2 Turbine foundation supply

Turbine foundations are one of the main elements of any offshore wind farm, accounting for over one fourth of the total equipment cost. Developers select a foundation type depending on the water depth, seabed conditions, wave and tidal loading, and turbine loading, mass and rotor speed.

Monopiles

To date, most offshore wind farms have steel monopile foundations, being selected in most of the worldwide offshore wind installations. The main characteristics in favor of monopiles are simplicity (easily standardised design for series manufacturing without the need for high-end 3D cutting and welding technology) and adaptability (more easily adaptable to different installation site characteristics, avoiding the need for a large amount of field data).

The most common design has been a cylindrical monopile that is first driven into the seabed, with cylindrical transition piece mounted over it and grouted into position. The purpose of the transition piece is to provide access arrangements (these welded appurtenances would not survive the piling activity) and levelling of the tower base interface. Increasingly large designs, with XL units up to 2.000t or more, are currently being deployed for deeper waters up to 60 – 70 metres.



In the news 2024

Equinor, Polenergia Finalise 100-Monopile Order with Sif

Source: offshorewind.biz

Netherlands-headquartered Sif Group has signed the final contracts with Polenergia and Equinor for the supply of 100 monopiles for the Bałtyk II and Bałtyk III offshore wind farms in the Polish Baltic Sea.

Manufacturing of the monopiles is scheduled for the second quarter of 2025 with completion in 2026.

Sif Holding N.V. said *“These are the first projects under the framework agreement we concluded with Equinor in support of the expansion of our manufacturing facilities in Rotterdam. We look forward to cooperate with Equinor and Polenergia and to make these projects a success as ones of the first projects in our new manufacturing set-up.”*

The agreement marks a final step following the reservation agreement signed by the two parties for the supply of the monopiles in April 2023.

The two wind farms of 50 units each will have a total capacity of 1,440 MW and will be located in the Polish exclusive economic zone of the Baltic Sea, about 37 kilometres and 22 kilometres from the coastline near Ustka and Łeba.

Recently, the developers of the offshore wind farms also finalised contracts for the supply of wind turbines.

Bałtyk II and Bałtyk III will feature 100 Siemens Gamesa SG 14-236 DD wind turbines.

The offshore wind farms are expected to produce first power as early as 2027 while the commercial stage of their use is planned a year later.

In the second phase of the development of the Polish offshore wind sector, Equinor and Polenergia are also implementing the Bałtyk I project.

An offshore wind farm with a capacity of up to 1,560 MW will be located approximately 80 km from the coast near Łeba.

All three Bałtyk wind farms will have a total capacity of up to 3 GW, providing green energy to over four million households, according to the developers.

4.3 Sealing, corrosion protection

Foundations for wind turbines and offshore substations require solid steel protection and bolting fixation, as bad sealings and corrosion can cause severe damage that is both expensive and difficult to repair.

4.4 Subsea cables

Subsea cables deliver the power from the turbines to the onshore grid. Array cables connect the turbines to an offshore substation from which the power is transmitted to an onshore substation via high voltage (HV) export cables. The array cable technology is well established and has been extensively used in the power and oil and gas industries. To date, array cables have predominantly been medium voltage (MV) and rated at 33 kV. Dutch offshore wind farms will be connected through 66 kV cables, and this is expected to be a rapidly growing market elsewhere over the coming years. Export cables from substation to shore have a significantly higher capacity than array cables, ranging from 132 kV to 245 kV. Export cable installation takes place early in the construction schedule and there are potentially long lead times. It is therefore one of the first Tier 1 contracts placed.

Export cables can either be HV alternating current (HVAC) or HV direct current (HVDC). Most export cables to date have been alternating current (AC), but as future projects tend to be further from shore, it is likely to lead to greater use of direct current (DC) systems.



In the news 2023

Dutch Company Nets Greater Changhua 2b & 4 Cable Deal

Source: offshorewind.biz

The Netherlands-based Twentsche KabelFabriek (TKF) has been awarded a cable supply contract from Ørsted for the 920 MW Greater Changhua 2b and 4 offshore wind farms in Taiwan.

The contract scope includes the supply and termination of close to 200 kilometres of inter-array cables and other cables including accessories and connectors, all operating 66 kV for the Greater Changhua 2b and 4 offshore wind farms.

“We are honoured that Ørsted has selected TKF for its prestigious Greater Changhua project, and we are looking forward supplying green energy to the Taiwanese households through our state-of-the-art inter-array and other cables”, said TKF.

The contract announcement follows Ørsted's final investment decision, taken in March 2023.

The wind farms are now under construction and are set to be some of the largest offshore wind projects in Asia Pacific.

The Greater Changhua 2b and 4 offshore wind farms will comprise around 65 wind turbines with an individual capacity of 14 MW, installed some 35-60 kilometres off the Changhua coast.

LS Cable & System is responsible for the supply of high-voltage subsea for both projects.

In 2018, Ørsted secured 920 MW of grid capacity for the offshore wind farms in Taiwan's first competitive price-based auction with no mandatory local content requirements.

Two years later, the developer signed a corporate power purchase agreement (CPPA) with Taiwan Semiconductor Manufacturing Company Limited (TSMC) for the offtake of the full production from Changhua 2b and 4.

4.5 Substation platforms

Modern commercial-scale offshore wind farms have at least one offshore substation, incorporating electrical components such as reactive compensation systems, switchgear, transformers, back-up generators and converters where required. HVAC electrical systems have been the most common solution to date. For projects that are built further offshore, however, there is cost benefit in using HVDC systems due to a reduction in electricity losses.

Offshore substation electrical systems are mounted on platforms (topsides). Offshore substation platforms are large complex steel structures. A HVAC offshore substation platform weighs up to 2,000 t and may include a helipad and emergency accommodation. HVDC substations are much larger, with masses of up to 15,000 t. Substation manufacturing is analogous to shipbuilding and offshore oil and gas platform fabrication. Both monopile and jacket foundations have been used to support these.

Substation supply can be divided into the supply of electrical systems and the supply of the structures. Electrical systems comprise transformers, reactors switchgear, power electronics, cables within the substation and control and auxiliary systems. Offshore substation structures include the offshore platform and associated structures for access and accommodation, and the substation foundation. Both monopile and jacket foundations have been used to support these.



In the news 2024

More than 25 Pct of Offshore Wind Platforms in EU Designed by Dutch Engineering Company

Source: offshoreWIND.biz

Dutch engineering company Iv has designed more than a quarter of all offshore wind platforms in the European Union, the company said on 9 July, citing information from a WindEurope report.

Of the 19 GW of offshore wind energy the EU had installed at the end of 2023, Iv has worked on offshore platforms for around 5 GW of projects.

The engineering company's designs can be seen, among others, at offshore grid connection sites for Dutch 1.4 GW Borssele offshore wind farms, the Borssele Alpha and Beta platforms, as well as German offshore grid connections DolWin1 and HelWin2 where Iv delivered the design of the Dolwin Alpha (800 MW) and Helwind Beta (680 MW) platforms.

The company is also working on two platforms for TenneT's new grid connections in the North Sea: IJmuiden Ver Beta and IJmuiden Ver Gamma, currently the largest converter platforms in the world, with a capacity of 2 GW each.

Iv will also design one of the platforms for a new offshore wind area in the Netherlands, Nederwiek.

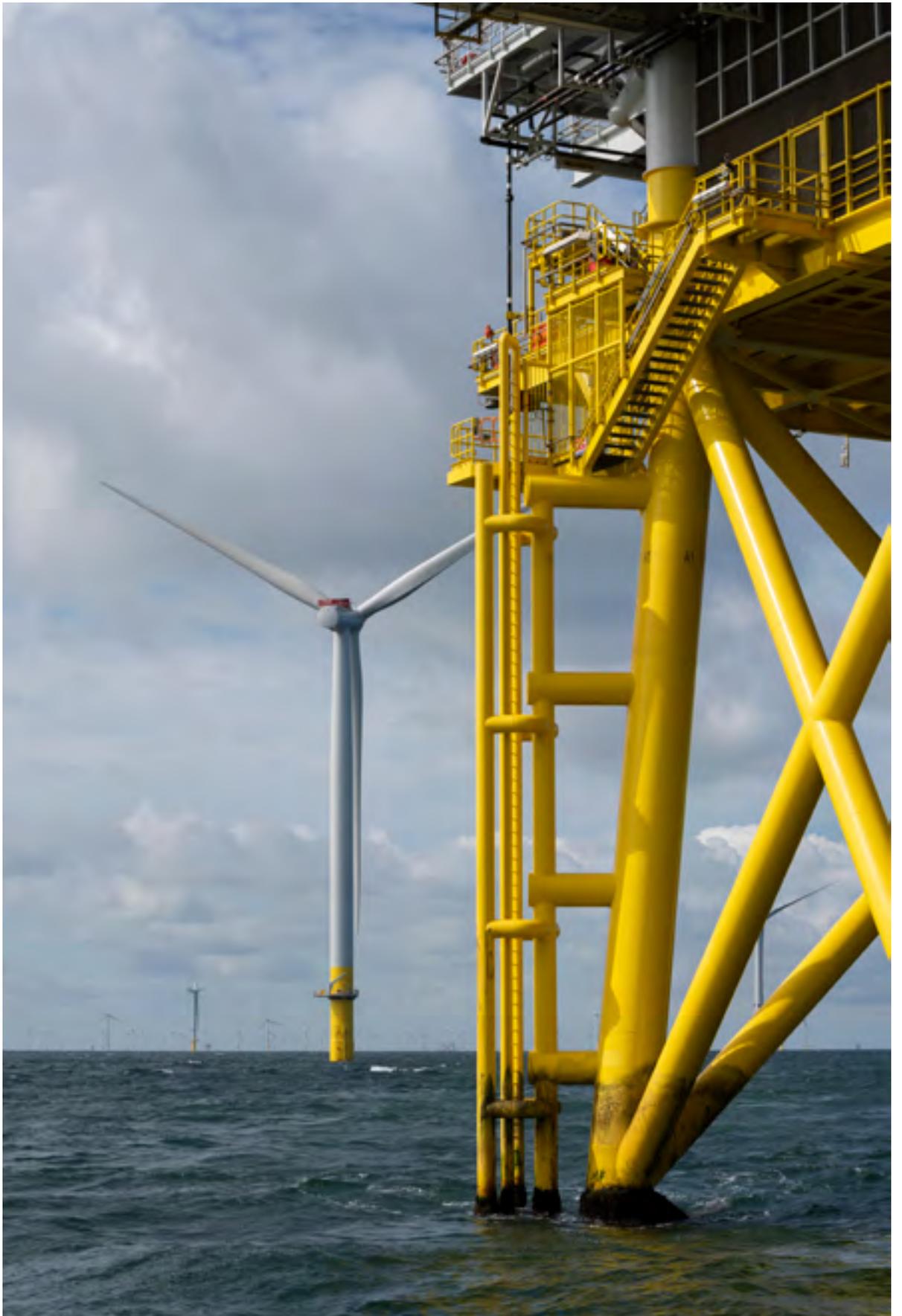
"Iv is the only engineering company in the Netherlands with this level of experience and expertise," the company said in a press release on 9 July.

Outside the Netherlands, Iv is working on three platforms that will be installed in the German Baltic Sea: Ostwind 3 and Gennaker East and West.

The company has also secured a contract for the Thor offshore wind farm in Denmark.

And outside the EU, Iv designed the platform for the Sofia offshore wind farm in the UK, which will be installed this year.

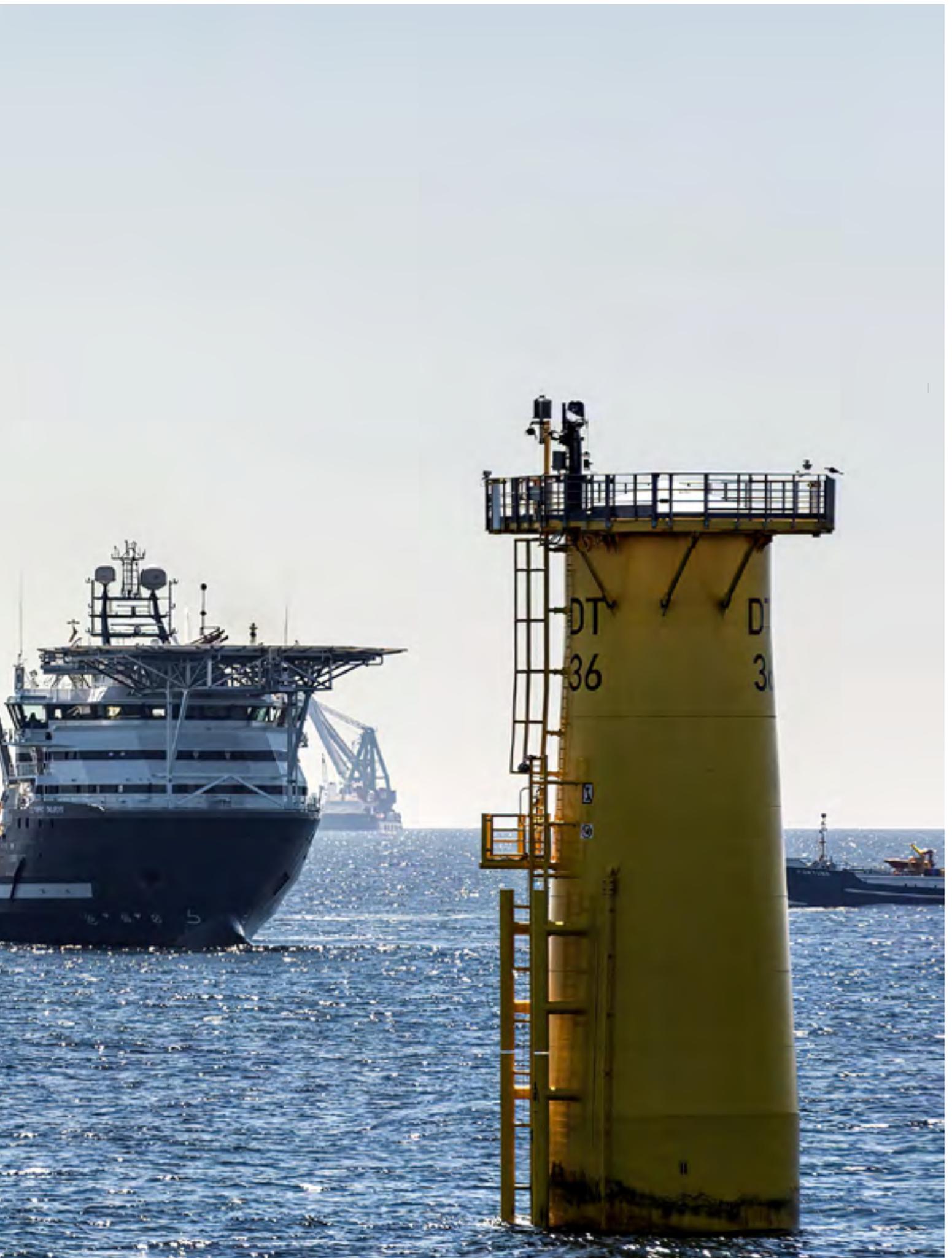
The Dutch company will also provide the design for 3.4 GW of AC modules for the Princess Elisabeth Energy Island off the coast of Belgium.



5. Transport & Installation

A large-scale offshore wind turbine installation project in the North Sea. In the foreground, a massive blue and yellow steel structure, likely a turbine nacelle or tower section, is being hoisted by a crane on a specialized installation vessel. The vessel has 'Danish OSS' written on its side. In the background, several other wind turbines are visible, some fully installed and others under construction. The sea is a deep blue with whitecaps, and the sky is a clear, pale blue.

The Netherlands has a large and internationally renowned offshore services sector. Traditional Dutch offshore oil and gas contractors and dredging companies are now also world leaders in the installation of offshore turbines and foundations. With their strong market position and expanding track record, they offer either transport and installation or Balance of Plant packages, depending on the preference of the developer. In various partnerships and consortia, these companies also focus on faster development, higher efficiency and environmentally friendly installation methods for turbines and foundations.



5.1 Turbine and foundation installation

Turbine installation is undertaken by main contractors using jack-up vessels which transport wind farm components from port to site. Recent projects have mostly used vessels which are purpose built for offshore wind. It takes two to three days on average to install a turbine, including transit time, weather downtime and mobilisation/ demobilisation time. The turbine installation is undertaken by the original equipment manufacturer (OEM) but the vessel is often contracted by the developer. Turbine installation may well be part of a full balance of plant contract.

For foundations, vessels may either transport the structures from port to site and undertake the installation or remain onsite with foundations transported to the site using feeder vessels. Some jack-up vessels are used for both turbine and foundation installation. Others are floating heavy lift vessels, which may be used for substations as in other maritime sectors. For jacket foundations, deck space is the limiting factor for vessel choice, whereas for monopile foundations it is increasingly the crane capacity. It takes about three days to install a monopile and five days on average to install a jacket foundation, including transit time, weather downtime and mobilization/demobilization time.

The oil and gas industry is the origin of Dutch expertise in turbine installation. As the offshore wind industry has matured, the vessels used have become increasingly bespoke and many are exclusively used in offshore wind.

In the news 2024

Heerema's Thialf Soon to Install First He Dreiht Foundations Offshore Germany

Source: offshorewind.biz

Construction work has started on one of Germany's largest offshore wind farms, the 960 MW He Dreiht project. In the next few days, Heerema Marine Contractors' crane vessel, Thialf, will install the first foundations at EnBW's offshore wind farm, being built in the German North Sea.

The He Dreiht offshore wind farm is located approximately 85 kilometres northwest of Borkum and about 110 kilometres west of Helgoland.

Heerema Marine Contractors, the company responsible for the transportation and installation of 64 monopiles and transition pieces under a contract signed with the developer in April 2022, will install the first foundations in the next few days using its semi-submersible crane vessel (SSCV) Thialf.

According to previous information, during the operations, Heerema will use the IHC IQIP double-walled noise mitigation system NMS-10,000 amongst other systems to reduce noise pollution.





In the news 2024

Van Oord to Install Windanker Offshore Wind Turbine Foundations, Inter-Array Cables

Source: offshorewind.biz

Iberdrola has contracted Van Oord for the installation of wind turbine foundations and the supply and installation of inter-array cables for the Windanker offshore wind farm that the Spanish renewable energy company is building in the German sector of the Baltic Sea.

Under the contract, the Dutch offshore construction specialist will transport and install 21 XL monopiles and transition pieces for the 21 Siemens Gamesa 15 MW wind

turbines. Van Oord will also be in charge of the design, supply and installation of the wind farm's inter-array cable grid. For the installation of the monopiles, Van Oord will deploy its heavy-lift installation vessel Svanen, which is no stranger to offshore wind construction in the Baltic Sea, having already worked on the Baltic 2, Arkona, Danish Kriegers Flak, and Baltic Eagle offshore wind farms, the latter being also a project by Iberdrola.

By the time Svanen is deployed on Iberdrola's third offshore wind farm in the Baltic Sea, the vessel will have undergone a major upgrade to handle the next-generation monopile foundations.

For the installation of 29 kilometres of inter-array cables at the Windanker project site, Van Oord will use its cable-laying vessel (CLV) Nexus, with the trencher Dig-It tasked with burying the cables to the required depth.

Windanker is expected to enter full operation by the end of 2026.

5.2 Substation installation

Offshore substation electrical systems are mounted on platforms. These structures are often similar to offshore oil and gas platforms, as is the installation process, although substations are typically in shallower water. Most topsides have typically been installed with a single lift from a barge. Both sheerleg (two-legged lifting device) and heavy lift vessels can undertake the lift from the barge. Substation foundations may be either jackets or monopiles, and the installation of these may form part of the turbine foundation installation contract and use the same vessels.

Current Dutch suppliers are basically the same as those for the turbine and foundation installation.

In the news 2024

Heerema Seals Transportation and Installation Deal for Polish Offshore Wind Farms

Source: offshorewind.biz

Heerema Marine Contractors has been awarded contracts for the transportation and installation of monopiles and transition pieces, as well as offshore substation jackets and topsides for Bałtyk II and Bałtyk III offshore wind projects in Poland.

The contracts were signed with MFW Bałtyk II Sp. z o.o. and MFW Bałtyk III Sp. z o.o., each a joint venture project owned 50 per cent by Equinor and 50 per cent by Polenergia.

Under the contracts, Heerema Marine Contractors will be responsible for the transportation and installation of 100 monopiles and transition pieces, sourced from European fabrication yards and installed in the Baltic Sea.

The monopiles will be provided by the Dutch company Sif, which will also collaborate with its consortium partner Smulders to manufacture the transition pieces. In addition, Heerema will handle the transportation and installation of offshore substation jackets and topsides.

For these operations, the company plans to utilise its heavy lift vessel Thialf. According to Heerema, the Thialf's *“advanced capabilities and motion compensated gripper frame make it ideally suited for the complex and demanding tasks associated with these large-scale offshore wind projects”*.

The firm signed reservation and preliminary work agreements with MFW Bałtyk II and MFW Bałtyk III for the transport and installation of wind turbine foundations and an offshore substation in April this year.

The Bałtyk II and Bałtyk III offshore wind farms will each have 50 Siemens Gamesa SG 14-236 DD wind turbines making up for 720 MW of installed capacity per wind farm. The offshore wind farms are expected to produce first power as early as 2027 while the commercial stage of their use is planned a year later.



5.3 Cable laying

Cable installation can be undertaken either in a single lay and burial process using a plough, or through a separate surface lay and subsequent burial approach using a jetting tool on a remotely operated vehicle (ROV). Installation of array cables is more challenging due to the large number of operations involved, with a pull-in at each foundation. For nearshore installations, shallow-draft barges are often used, whilst large-scale projects further from shore typically use dynamically positioned cable ships. Export cables are typically installed as a single length of cable and thus larger vessels are used with the necessary storage. Unlike turbine and foundation installation, success in the cable installation market is driven as much by technical capability and track record as it is by vessel capability.

In the news 2023

Boskalis Wins ‘Large’ Baltica 2 Cabling Contracts

Source: offshorewind.biz

Boskalis has been awarded contracts by PGE Polska Grupa Energetyczna and Ørsted for the transportation and

installation of the export and array cables for the Baltica 2 offshore wind farm in Poland, classifying the contract value as “large”, which for Boskalis means it is worth more than EUR 300 million.

The project scope comprises the transportation and installation of 107 array cables with a total length of more than 150 kilometres in addition to four 275 kV export cables with a total combined length of nearly 300 kilometres.

In addition to the laying of the export and array cables, Boskalis will carry out seabed preparation activities including the levelling of the seabed, pre-trenching, and the removal of boulders.

Upon completion of the cable installation activities, the Netherlands-headquartered company will protect and stabilise the cable protection systems (CPS) with the placement of rock.

Boskalis will deploy two cable-laying vessels, a construction support vessel, a subsea rock installation vessel, and a trailing suction hopper dredger. The cables will be installed in a pre-cut trench using the multi-mode Megalodon plough deployed from Boskalis' construction support vessel *Falcon*.

Preparatory works will commence in 2025 and the transport and installation activities are planned to start in 2027.



5.4 Installation tools

This section covers the lower tier activities which are undertaken in support of the primary (Tier 1) installation contracts. Equipment used during installation includes:

- Cranes for loading components on the quayside;
- Sea fastenings and racks for securing components in transit;
- Foundation piling equipment such as templates, hammers, and handling equipment;
- Cable installation equipment such as carousels, tensioners, grappels, trenching and burial tools, and cable retrieval tools;
- Turbine installation equipment, such as cranes and yokes.

Equipment such as cranes and cable-handling equipment may be bought by the installation contractor and permanently installed on the vessel or rented from a supplier. There are some elements of installation equipment that are designed and manufactured based on the needs of the specific projects. Examples include sea fastening equipment, blade racks and pile-handling tools.



In the news 2024

DEME Takes CAPE Holland Equipment to US for Monopile Installation Offshore Virginia

Source: offshorewind.biz

Dutch company CAPE Holland has secured a contract with DEME for foundation installation equipment that will be used at the Coastal Virginia Offshore Wind (CVOW) project site in the US.

Under the contract, CAPE Holland, part of Venterra Group, has provided its CAPE VLT-640 Quad spread and a separate CAPE VLT-640 unit to the Belgian offshore construction contractor.

As reported earlier, DEME's vessel Orion is en route to the US from Scotland, where it was deployed for monopile installation on the Moray West offshore wind farm, for which DEME also utilised CAPE Holland's equipment.

The monopiles for the 2.6 GW CVOW, set to be the biggest US offshore wind farm and one of the biggest in the world, have a diameter of 8.5 metres and weigh up to 1,500 tonnes.

They will be driven through the first layers of the sea floor using the CAPE Vibro Lifting Tool, mitigating the risk of pile run.

The monopiles will then be driven to final penetration using an impact hammer.

The CAPE VLT-640 Quad system will be accompanied by a separate CAPE VLT-640 unit to facilitate the pile-run-free installation of jacket pin piles for the wind farm's three offshore substations, according to CAPE Holland.

The installation equipment provider also said that, in addition to its technical ability, the CAPE Vibro Lifting Technology offered a quieter and more environmentally friendly alternative to traditional pile driving methods.

Alongside CAPE Holland, other Venterra Group companies are also involved in the CVOW project, including INSPIRE Environmental which is providing post-construction marine growth monitoring on structures and benthic monitoring on the research project turbines.

Dominion Energy's 2.6 GW Coastal Virginia Offshore Wind will have 176 Siemens Gamesa 14 MW wind turbines and is expected to be in full operation in 2026.

In the news 2024

TWD, Seatools Outfit Green Jade for Hai Long Piling Work

Source: offshorewind.biz

As construction work has started on Taiwan's 1 GW Hai Long offshore wind farm with the vessel Green Jade installing the first jacket foundation pin piles, TWD and Seatools each revealed their contracts for the provision of pre-piling and piling equipment and services with the vessel owner, CSBC-DEME Wind Engineering (CDWE).

The Hai Long joint venture, comprising Northland Power, Yushan Energy, Mitsui & Co., and Gentari, announced the official start of offshore construction on 11 April and CDWE said on 12 April that Green Jade had already installed pin piles at five locations.

On 16 April, the Netherlands-based TWD (Temporary Works Design) informed that the company was responsible for designing most of the pin pile installation equipment on the heavy lift vessel.

This includes the design of a subsea self-levelling pre-piling template which is currently the largest and most complex of its kind in the industry, according to TWD.

The company also designed the pin pile sea fastening, with three sets of four piles stacked vertically, each with its own upending hinge, and was also involved in the design of sea fastening for the impact hammer.

On 17 April, another Dutch company, Seatools announced that it was responsible for the design of the pile template's metrology and control system, including all mechanical, electrical, hydraulic, and software components.

Seatools' scope covered hydraulic and mechanical systems dedicated to template levelling and precise pile positioning, and an advanced metrology system that ensures that pile installation is achieved with accuracy that meets stringent tolerance requirements, according to the company.

As the project uses both a vibro hammer and an impact hammer for pile installation, Seatools performed a detailed evaluation to confirm the equipment's structural integrity and operational reliability under the varied loads imposed by both the vibratory and impact methods.

The offshore wind farm, being built in the Taiwan Strait around 50 kilometers off Taiwan's west coast, will comprise Siemens Gamesa SG 14-222 DD wind turbines and is expected to be operational in 2026.





In the news 2024

Offshore Construction Coming Up on 1 GW Hai Long, CAPE Holland to Supply Vibro Lifting Tools

Source: offshorewind.biz

The installation of pin piles for the jacket foundations on Taiwan's 1,044 MW Hai Long offshore wind farm is expected to start in March. CAPE Holland has been contracted to supply its CAPE Vibro Lifting Tools to CSBC-DEME Wind Engineering (CDWE), whose vessel Green Jade will be installing the piles.

CDWE signed a contract for the transportation and installation of the foundations, turbines, and offshore substations for the three offshore wind farms making up the Hai Long project in 2022. For the pin pile installation, CDWE will deploy its vessel Green Jade, the first offshore heavy lift DP3 installation vessel built in Taiwan, which debuted on the Zhong Neng offshore wind farm last year.

The Dutch supplier of foundation installation equipment, CAPE Holland, will provide its pile-driving system, for which the company says was designed for efficient and quiet installation of offshore foundations.

The Vibro Lifting Technology (VLT) allows for upending and lifting, including the handling of the pre-piling template and pile driving to the required depth.

CAPE Holland says its VLT was selected for the installation to mitigate the risk of pile run and to improve installation efficiency by not requiring a separate upending tool.

On Hai Long, CDWE will first use CAPE VLT-640 Single for the installation of the pin piles and the tool will then be converted to a tandem version for the installation of the foundation piles for the project's offshore substation.

The 1,044 MW Hai Long project will comprise two offshore wind farms, 532 MW Hai Long 2 and 512 MW Hai Long 3.

The project is being developed in three phases as Hai Long 2 has been split into two smaller offshore wind farms, the 300 MW Hai Long 2a and the 232 MW Hai Long 2b.

The 1,044 MW Hai Long will have 73 Siemens Gamesa SG 14-222 DD wind turbines, installed on three-legged jacket foundations approximately 45-70 kilometres off the Changhua coast in the Taiwan Strait, in water depth between 41-56 metres.

The project, expected to be commissioned in 2025/2026, is owned and developed by Hai Long Offshore Wind, a consortium comprising Northland Power, Yushan Energy, Mitsui & Co., Ltd., and Gentari.

5.5 Vessel design, ship building, deck equipment

Installation vessels

As already indicated, there are basically two main vessel options for steel foundation installation: a jack-up vessel, mostly used for turbine installation; or a floating vessel, often with components fed using a separate floating vessel. Turbine installation on all existing commercial-scale projects to date has been undertaken by a jack-up vessel, to provide sufficient stability for the nacelle and rotor lifts.

Subsea cable installation can be undertaken using either a single lay and burial process with a plough or using a separate surface lay with subsequent burial, using a jetting tool operated from a ROV. Array cable laying is considered a more technically challenging process than export cable-laying due to the large number of operations that are involved and the cable pull-in interface at each foundation. Export cable-laying vessels tend to be larger with cable carousels with a higher capacity to enable a single length of cable to be laid from substation to shore, where possible.

Support vessels

The sort of support services required during installation includes cable route surveys and clearance, support vessels such as crew transfer and guard vessels, diving, ROV operations, grouting and several marine operations, including vessel modifications, logistics, certification, weather forecasting and planning. Many of these services are delivered by small and medium sized companies.

In the news 2023

NOV and GustoMSC Tapped for Second Havfram Mega Jack-Up

Source: offshorewind.biz

NOV has once again signed contracts with CIMC Raffles to supply a GustoMSC™ NG-20000X self-propelled wind turbine installation jack-up vessel design for Havfram's second vessel on order at the shipyard.

The NG-20000X-HF vessels are among the largest wind installation jack-ups in the industry, NOV said. They feature a 3,250-ton heavy lift crane and can install foundations up to 3,000 tons and wind turbines with tip heights over 300 metres in water depths up to 70 metres.

The vessel's large carrying capacity is said to reduce the vessel trips required per development, thereby improving project economics, and reducing carbon emissions per installed megawatt.

Like the vessel currently under construction under the first contract, Havfram's second self-propelled jack-up vessel will be equipped with the NOV variable speed drive rack and pinion jacking system, including the latest regenerative power system technology that feeds the generated power back into the vessel's system.



In the news 2024

Damen to Build Another Methanol-Ready CSOV for TSSM

Source: offshorewind.biz

The Netherlands' Damen Shipyards has signed a contract with Ta San Shang Marine (TSSM) for the construction of another Damen Commissioning Service Operation Vessel (CSOV) 9020, that will be deployed on offshore wind farms in Taiwan.

The second CSOV will be built in Vietnam, with a delivery date planned for the end of 2026.

The 90-metre-long vessel will provide accommodation for up to 120 people on board working on the offshore wind farms during their construction and operational phases.

These personnel will reach their workplace via a motion-compensated gangway.

The new CSOV will be equipped with a diesel-battery hybrid power generation system and will be fully methanol-ready, said Damen.

When the new vessel is delivered, TSSM, a joint venture between Japan's Mitsui O.S.K. Lines and Taiwan's Ta Tong Marine, will have a fleet of three Service Operation Vessels (SOVs).

The first vessel, TSS Pioneer, was delivered in 2022. The second, TSS Cruiser, is a Damen CSOV which was ordered in November 2023 and is scheduled for delivery at the end of 2025.

"We are grateful that TSSM has selected Damen once more as the builder of the newest CSOV in their fleet. Last year, we welcomed TSSM into the Damen-family with the CSOV 9020 TSS Cruiser and since then we have further strengthened and intensified our relationship. We look forward to a continued, fruitful, and long relationship with TSSM," said Damen Shipyards Group.





In the news 2024

Acta Marine's New CSOV for French Offshore Wind Market

Source: offshorewind.biz

Acta Marine, the owner and operator of construction service operations vessels (CSOVs) for the offshore wind industry, will deliver one of its four CSOVs currently being built in Turkey under a French flag.

The fourth vessel in Acta Marine's fleet currently under construction at Tersan Shipyard, CSOV Acta Pegasus, will fly the French flag, the Dutch company said in June.

Acta Pegasus is an Ulstein SX216 design and features an optimised hull form and the ability to use (e-)methanol as the main fuel.

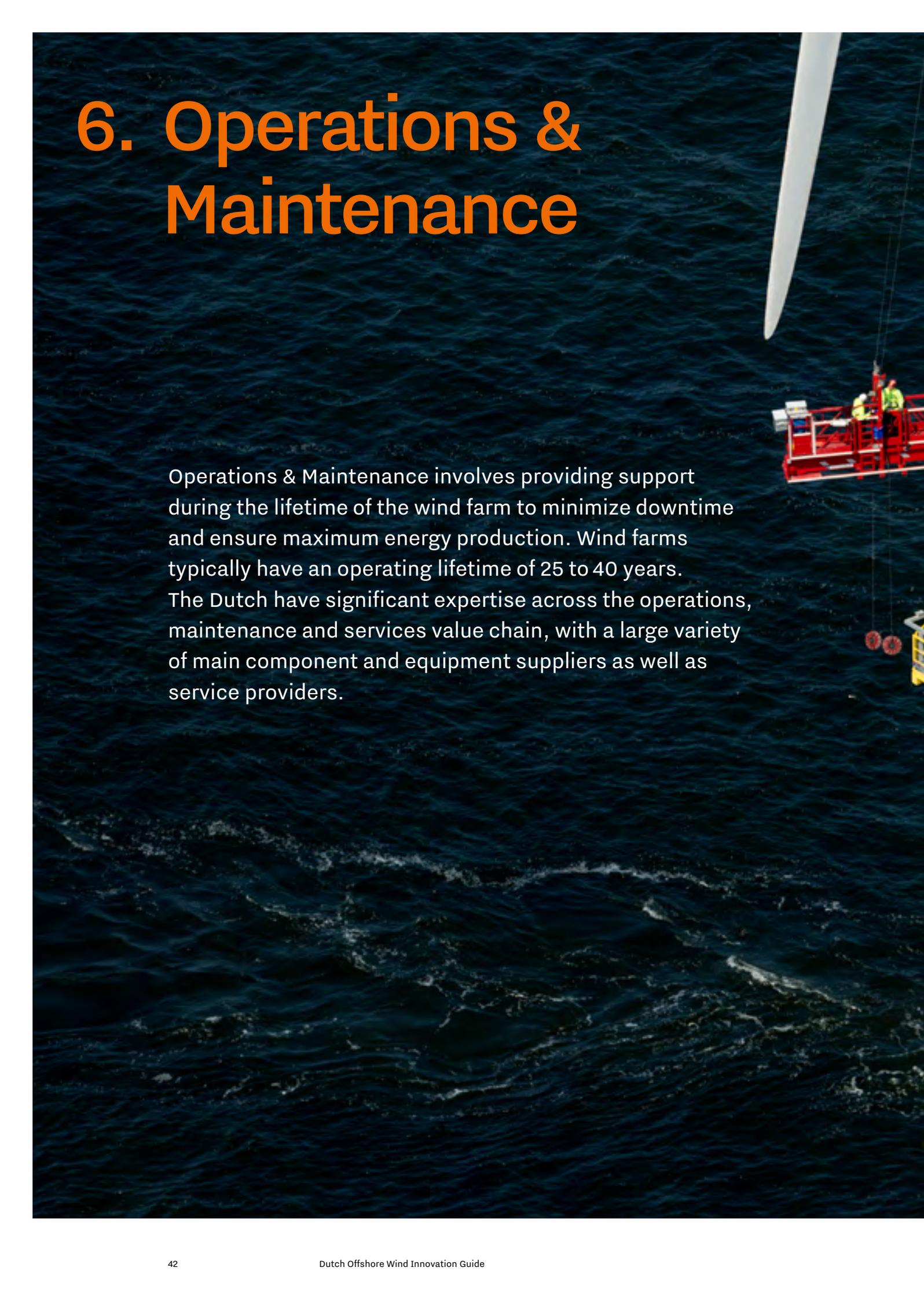
The CSOV has a length of 89.9 metres, a beam of 19.2 metres, and can accommodate up to 135 people on board.

It features a walk-to-work motion-compensated gangway, a 3D-motion compensated crane for cargo transfer, and it can carry a daughter craft for in-wind farm transfers.

"Given our growing position and operations in the French market, we will invest in recruiting and training a team of highly skilled French maritime professionals to operate this state-of-the-art vessel.

"By employing local talent, we aim to support the French workforce, foster local expertise, and ensure the highest standards of safety, hospitality, and efficiency in our operations," Acta Marine said in a press release on 24 June.

6. Operations & Maintenance

An aerial photograph of an offshore wind turbine maintenance platform. The platform is a red metal structure with railings, floating on the dark blue, choppy surface of the ocean. Several workers in high-visibility yellow and orange gear are visible on the platform. A large white blade of the wind turbine is suspended in the air above the platform, held by cables. The background shows the vast expanse of the ocean under a clear sky.

Operations & Maintenance involves providing support during the lifetime of the wind farm to minimize downtime and ensure maximum energy production. Wind farms typically have an operating lifetime of 25 to 40 years. The Dutch have significant expertise across the operations, maintenance and services value chain, with a large variety of main component and equipment suppliers as well as service providers.





6.1 Operations

The day-to-day operation of a wind farm is managed from an onshore base. Activities include day-to-day workflow management and data gathering and analysis. This allows owners to respond efficiently to failures when they occur and, where possible, to identify potential failures before they arise. The management of logistics (vessels, helicopters, personnel, specialist tooling and spare parts) is also an important part of the operations role.

For O&M, wind farm operators will typically look to use the nearest port that meets their specifications in order to minimise travel time and make the best use of weather windows. Vessels and equipment are therefore an essential component of this sub-element and an area where Dutch suppliers have significant expertise.

Crew transfer vessels (CTVs) typically provide transport for technicians and spares from the onshore base to offshore wind farms less than about 90 minutes transfer time from port. Some wind farms supplement CTVs with full-time helicopter support, for transporting technicians when the task in hand does not require heavy tools or spares, or when sea conditions are severe. Spare parts are stocked in onshore warehouses.

Service operations vessels (SOVs) are larger than CTVs, with a greater capacity, and are typically used for wind farms more than about 90 minutes transfer time from port. They are effectively a floating OMS base, accommodate between 60 and 90 passengers and contain workshops and storage for equipment, consumables and spares.

6.2 Maintenance

Maintenance and inspection services include both planned (and unplanned) visits to wind turbines and their foundations for the purposes of inspection maintenance and repair, performed by the wind farm's usual staff and equipment. Turbine maintenance typically involves a planned visit to each turbine once or twice a year. During these visits, technicians carry out inspection and maintenance activities, including checks on oil and grease levels and a change of filters, checks on instruments, electrical terminations, the tightness of bolts and statutory safety inspections. Foundations for wind turbines and offshore substations require structural inspection and maintenance on a regular basis, as bad seals and corrosion can cause severe damage that is both expensive and difficult to repair.

The oil and gas industry has developed a wide range of solutions for safe access to offshore structures. Inspection and repair activity is high within the North Sea sector with a high number of skilled and experienced technicians.

In the news 2024

‘World’s First’ O&M Campaign Using Heavy-Lift Cargo Drones Underway at Dutch Offshore Wind Farm

Source: offshorewind.biz

Ørsted has deployed heavy-lift cargo drones (HLCDs) for maintenance work at the Borssele 1&2 offshore wind farm in the Netherlands. This is the first time heavy-lift cargo drones are being used in an operational campaign, according to the company which tested the concept in 2023 at its Hornsea One offshore wind farm in the UK.

At the 752 MW Dutch offshore wind farm that has been in operation since 2020, the 70-kilogram drones will transport cargo of up to 100 kilograms from a vessel to all 94 wind turbines. The campaign now underway at Borssele 1&2 is being performed to update some critical evacuation and safety equipment in each of the turbines.

A drone can complete a task that typically takes several hours in minutes, according to Ørsted.

Using drones for cargo transport at Borssele 1&2 will reduce costs and time as there is less work disturbance since wind turbines do not have to be shut down when cargo is delivered, according to the developer.

Drones also prevent risk, making it safer for personnel working on the wind farm, and minimise the need for multiple journeys by ship, reducing carbon emissions in the process, the company pointed out.

In the news 2024

Ampelmann and Seaway7 Partner on Their First US Offshore Wind Project

Source: offshorewind.biz

Dutch offshore access provider, Ampelmann, has received an order from Seaway7 to supply an E5000 gangway, which will support the construction of a major US coast offshore wind project.

The order not only marks the first collaboration of Seaway7 and Ampelmann in the Americas but will also see the first tour of duty of the E5000 outside of Europe, said the Dutch company.

According to Ampelmann, the E5000 is the biggest motion-compensated system in the world. The gangway has a lifting capacity of 4,600 kg.

Based on the proven technology of the E1000, it can switch between crane and gangway mode in less than a minute.

Because of its high cargo-bearing capacity, the E5000 is well equipped to lift heavier generators, including fuel and cables, that are required for larger wind turbines.

This is not the first time Ampelmann secured work in the US offshore wind market. In March 2023, the company signed six new contracts for the supply of its E1000 and A300 gangways. The gangways were used to assist in the hook-up, cabling, and commissioning of turbines on Vineyard Wind and South Fork Wind projects.



6.3 Inspections, repairs

Unplanned service involves technician visits to a turbine in response to an alarm reported on the wind farm supervisory control. Large vessels are needed to undertake the removal and replacement of major components, such as turbine blades or gearboxes, during operation. This may occur following a failure or as part of a replacement programme for components nearing the end of their lives. Equipment such as ROVs and support vessels is often rented and in many cases by a third party.

In the news 2024

Bluestream to Perform Remedial Campaign at Two German Offshore Wind Farms

Source: offshorewind.biz

Vattenfall and Stadtwerke München have awarded Dutch company Bluestream Offshore, an OEG Renewables business, a contract for a remedial campaign on the DanTysk and Sandbank offshore wind farms in the German North Sea.

Bluestream will provide specialist subsea and topside services for the remedial campaign which will run for around 35 days. The work includes the replacement of Impressed

Current Cathodic Protection (ICCP) systems that prevent corrosion in the metal structure of the turbine foundation and tower, replacement of various reference cells, debris removal and sonar transponder exchanges.

The company will charter the Go Electra multi-purpose service vessel with air dive spread and a Seaeye Tiger observation class remotely operated vehicle (ROV) to carry out the work.

Located west of the island of Sylt, DanTysk and Sandbank offshore wind farms each have a generation capacity of 288 MW.

DanTysk offshore wind farm comprises 80 Siemens Gamesa 3.6 MW turbines that have been in operation since 2014.

Sandbank offshore wind farm, which has been in operation since 2016, has 72 Siemens Gamesa 4 MW turbines.

6.4 Port development, logistics

The availability of waterside (port) infrastructure is a prerequisite for much of the necessary new coastal manufacturing, assembly and installation infrastructure to deliver the anticipated offshore wind farms. Facilities may either be developed for manufacturing and installation activities, or as standalone installation facilities. Most Dutch ports are in public ownership and their investment decisions can consider the wider local economic benefits of a project, as well as the direct port revenue. This is in contrast to for example some UK ports, which are operated privately and make investment decisions purely on commercial factors.





Manufacturing and/or Installation

All larger NL ports have timely developed master plans that incorporate offshore wind installation facilities to contribute to the installation of commercial scale wind farms in the Dutch economic zone of the North Sea. Since the supply of finished wind farm components is relatively low, most ports in NL can be characterised as installation ports where the main wind farm components are stored and pre-assembly is completed before the components are loaded onto an installation vessel. In the Northern part of the Netherlands, the port of Eemshaven plays an important role regarding assembly and shipping activities of wind turbines. This resulted in a long track record: successively Alpha Ventus, Bard Offshore I, Borkum Riffgat, Borkum Riffgrund I, Trianel Windpark Borkum, Global Tech I, Gemini, Gode Wind I & II, Veja Mate, Race Bank (UK), Nordsee One, Borkum Riffgrund II, Merkur Offshore, Hohe See, Albatros, Trianel Windpark Borkum II, Hornsea Two and Kaskasi. Currently Eemshaven accommodates three offshore wind projects simultaneously: wind farm Hollandse Kust Noord, Gode Wind III and Borkum Riffgrund III.

Renowned operations and maintenance bases for offshore wind in the western part of the Netherlands companies include IJmuiden (Hollandse Kust (zuid), Hollandse kust (west) and Vlissingen (Borsssele). A notable exception is the Port of Rotterdam where Sif has developed facilities for manufacturing of monopile foundations.

For more information on the specifics of the Dutch offshore wind hubs, please check:

- Port of Amsterdam: www.portofamsterdam.nl
- Port of Den Helder: www.portofdenhelder.eu
- Groningen Seaports: www.groningen-seaports.com
- Port of Harlingen: www.portofharlingen.nl/en
- Port of Rotterdam: www.portofrotterdam.com/offshore
- North Sea Port: www.northseaport.com
- Port of IJmuiden (Zeehaven IJmuiden): www.zeehaven.nl/en

For more information on port logistics, please refer to: www.windandwaterworks.nl/cases/port-developmentand-logistics



7. Dutch offshore wind innovators



The main driver for growth in the offshore wind industry is the ongoing decrease in the so-called Levelised Cost of Energy (LCOE), partly driven by initial innovations in offshore-specific turbine designs and a bespoke offshore wind supply chain. These cost reductions have encouraged Government policy and financial support to the sector, in order to address the decarbonisation of electricity production. Such efforts have, in turn, accelerated innovations, not only to further reduce costs, but also to minimise the ecological impact of offshore wind farms during installation and operation.

7.1 Dutch R&D actors

The Netherlands has a strong focus on innovations in the offshore wind industry, supported by knowledge institutes such as the Technical University Delft (TU Delft) and Netherlands Organisation for Applied Scientific Research (TNO), and by organisations like GROW, TKI Offshore Energy /Topsector Energie (Energy Innovation NL) that aim to bring actors together and initiate innovations and advise policy makers.

Some of the main R&D actors are listed below.

Topsector Energy/ Energy Innovation NL

The Dutch Government encourages energy transition innovations through tax benefits, innovation credit and (EU) grants. The Government also works together with the private sector, universities and research centers, in so-called Top Sector Alliances for Knowledge and Innovation (TKI) to support business sectors, such as the energy sector to get innovative products or services on the (inter)national market.

TKI Offshore Energy

The Wind at Sea programme plays an important role in Dutch innovations in offshore wind. TKI Offshore Energy boosts and facilitates offshore wind innovation in collaboration with RVO through research, development, and demonstration. The aim is to allow offshore wind energy to make a major contribution to the energy transition.

Technical University of Delft (TUD)

TU Delft (TUD) is involved in research into new materials and structures for offshore wind turbines, applying newly developed insights in the fields of wind loads, fluid mechanics and control engineering. TUD focusses on new concepts designed to reduce the loads on support structures, more reliable wind turbines and wind farm operations, and the optimisation of the entire energy supply chain from wind to the grid, including the incorporation of electricity from wind power plants within the European power grid.

Dutch innovation actors translate this knowledge into innovations for (amongst other things) wind turbine components and rotor blades and the so-called 'balance of plant' components such as foundations, substations and cables.

GROW

GROW is a joint research programme in offshore wind that initiates research and accelerates innovations. The consortium includes around 20 leading and committed business and academic partners that cooperate closely to conduct joint research. GROW partners work together to reduce the costs of offshore wind and to increase the value of wind energy in the energy system and the ecosystem. Furthermore, GROW creates the visibility of the projects and the partners involved by showing the innovative capacity of the Dutch offshore wind sector, such as through the SIMOX project.

TNO

TNO unit Energy Transition, Wind Energy Department – formerly known as ECN Wind Energy – has been active in wind energy for more than 40 years. It is the flagship of Dutch Research & Development on Renewable Energy and is one of the global leading knowledge institutes in the field of wind energy. The Wind Energy Department focuses on research/B2B collaboration in:

- wind turbine and foundation design, both bottom fixed and floating;
- wind farm design/wind turbine and wind farm control;
- energy system integration of large scale (wind) generated energy; power to X;
- installation and operations/maintenance strategy/ approach.

DOB Academy

Empowering engineering and R&D excellence through energy education is also important in the highly multidisciplinary field of offshore wind. Dutch offshore energy education institute DOB-Academy trains national as well as international officials and industry professionals through lectures, classroom workshops, online modules and seminars. This enables people from different backgrounds to speak a common language, which is essential in a multidisciplinary field such as the offshore industry.

7.2 Low cost piling innovations

Until now transition pieces have been traditionally included in monopile foundations. However, as the offshore wind industry develops, continuous improvements in offshore installation procedures, techniques and technology, means TP-less solution have also come into play. These eliminate a bolted (or grouted) connection and allow faster installation and cost reductions, for example, through reduced inspection durations during the O&M phase.



In the news 2023

Shell and Eneco Back at Sif for More Transition Piece-Less Monopiles

Source: offshorewind.biz

Ecowende and Sif Holding will collaborate on the construction of Ecowende's offshore wind farm Hollandse Kust West site VI, located about 53 kilometres off the Dutch coast, near IJmuiden.

The collaboration for this project between the offshore wind farm developer, a joint venture of Shell and Eneco, and Sif Holding dates to February 2023 when Sif announced having taken a final investment decision on the expansion of its manufacturing facilities in Rotterdam.

At that occasion Ecowende, as a launching client for the expanded factory, committed to participate in its financing through an Advance Factory Payment. The project was already in Sif's order book for 70 kilotonnes but with the signature of the final contract is now firm for production in 2025.

Sif will be responsible for the manufacturing of the 52 extended monopile foundations that will have no transition pieces, but secondary steel components, and that will have

a total weight of approximately 70 kilotonnes.

Transition piece-less monopiles were successfully applied by Sif in earlier projects offshore the Netherlands, including the Hollandse Kust Noord project for Crosswind, another joint venture of Shell and Eneco.

In this transition piece-less design, the secondary steel components like boat-landings, ladders, main access platforms, and internal platforms will be connected to the monopile foundations once these are installed at sea. The secondary steel components will also be delivered by Sif in the same contract.

Ecowende, together with partners such as Sif, intends to set a new ecological standard for building and operating wind farms in the North Sea, with minimal impact on the natural habitat of birds, bats and marine mammals, and with a thriving underwater world.

Ecowende, said: *"Building a wind farm in harmony with nature is an important condition for eventually achieving the ambition of 70 GW of offshore wind energy by 2050, within the ecological limits of the North Sea."*

Ecowende will implement various innovations and larger-scale measures to mitigate the negative effects of the wind farm on the local ecology and to stimulate positive effects. For Sif, this implies for example that the monopiles are designed for low noise installation methods and that they can support various wildlife detection and monitoring devices, above and below the water line."

7.3 Low noise piling innovations

Foundation installations, in particular, are receiving a lot of R&D attention. The traditional installation method uses hydraulic impact hammers, which create underwater noise, potentially damaging nearby marine life and ecosystems. Dutch innovations are aimed at minimising noise while retaining (and preferably improving upon) the speed and efficiency of the traditional method.

In the news 2024

Ecowende to Install Three Monopiles at Dutch Offshore Wind Farm in ‘Silent Mode’

Source: offshorewind.biz

Ecowende, a joint venture between Shell and Eneco, and the Dutch company GBM Works have signed a contract for deploying GBM's noise reduction technology for the installation of three monopiles at the offshore wind farm Ecowende will build at Hollandse Kust West (HKW) Site VI in the Netherlands.

GBM has developed an installation method called Vibrojet that combines vibrations on the top of the monopile with GBM's jetting technology inside the monopile, which makes the installation more silent and thus minimises the impact on marine life, according to GBM.

Ecowende and the Vibrojet developer also highlighted that the technique is more efficient as it allows monopiles to be installed quicker, compared to the traditional impact hammer, as well as deeper, compared to using a Vibro-hammer only.

For GBM Works, the contract represents the first application of Vibrojet on a commercial project.

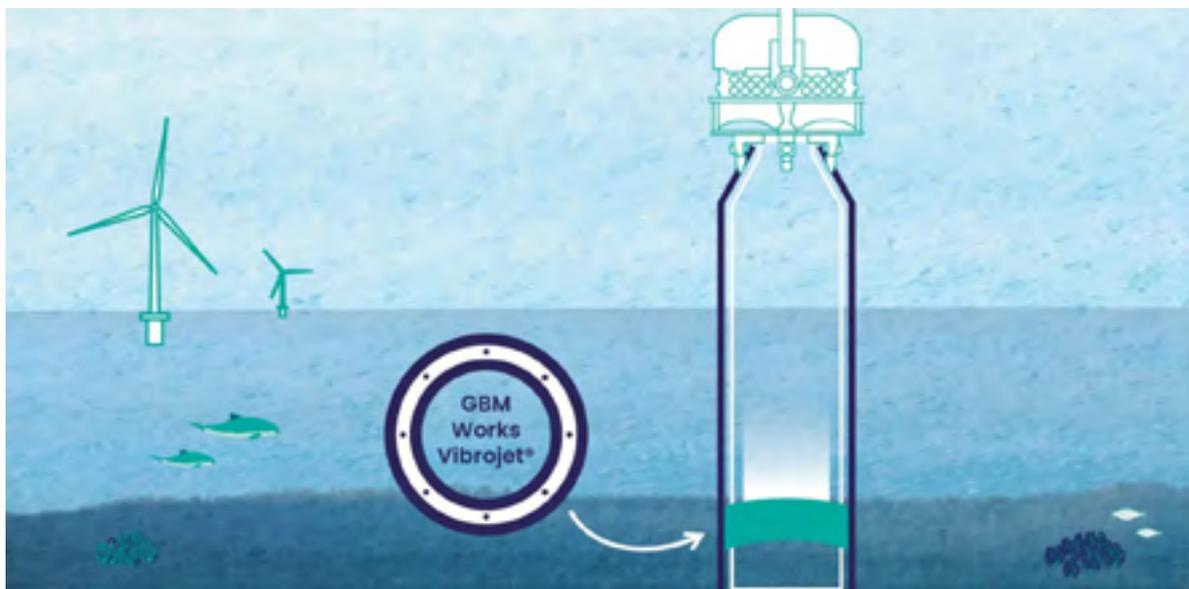
GBM Works is also participating in the SIMOX project on sustainable installation and decommissioning of XXL monopiles for large next-generation offshore wind turbines.

The scope of the contract for the installation of the three monopiles at Ecowende's offshore wind farm using Vibrojet includes, amongst others, engineering and manufacturing of the jetting system and offshore support during the installations.

To execute the HKW VI project, GBM Works is also working closely with Ecowende's partners Van Oord, Sif, and Ramboll, the project's contractors for the installation, manufacturing and design of foundations.

Shell and Eneco secured the development rights for Hollandse Kust West VI in December 2022. Last year, the joint venture unveiled plans for the 760 MW offshore wind farm to be built "in harmony with nature, with minimal impact on birds, bats, and marine mammals".

In September 2023, Ecowende partnered with Waardenburg Ecology, the largest ecological consultancy firm in the Netherlands, to develop a comprehensive ecological programme for the offshore wind farm.





In the news 2024

IQIP Launches New Piling Technique for Noise-Compliant Installation of Largest Monopiles

Source: offshorewind.biz

The foundation and installation specialist, IQIP, has put their newly developed piling technique EQ-Piling in action, which the Dutch company claims allows for the noise-compliant installation of even the largest monopiles.

Conventional impact piling is an established method for installing large monopile foundations at the required depths, but it generates noise that can be harmful to marine life, said the company with headquarters in Slidrecht, the Netherlands.

According to IQIP, the challenge they faced was to achieve the required force to overcome soil resistance while reducing noise levels.

EQ-Piling is said to meet this challenge by employing a newly developed technique featuring a prolonged impact force characteristic.

The method utilises a large water tank as a drop weight. The tank, containing up to 1,700 tonnes of seawater, is raised by

hydraulic cylinders and released from the drop height setpoint.

The water tank falls onto buffer cylinders which transmit the impact force to the pile, dampening it to extend the impact time.

The impact time is 15-20 times longer than that of conventional piling, resulting in a smooth energy transfer to the monopile and reduced noise levels, said the Dutch company.

Unlike conventional methods that rely on impact force, EQ-Piling generates a pushing force. The technology ensures that developers, governments, and contractors can now work in full compliance with environmental regulations, according to the company.

Pile fatigue is reduced by up to 90 per cent, allowing the pre-installation of secondary steel fixings.

Reduced or eliminated noise mitigation measures can lower the foundation and installation project costs, decrease risks such as project interruptions, and cut CO2 emissions and energy consumption by reducing the need for vessels, IQIP added.

In July, Heerema Marine Contractors demonstrated a noise reduction of 24 decibels (dB) during installation work at EnBW's He Dreiht offshore wind farm in Germany, where the offshore construction specialist employed a noise mitigation spread with equipment supplied by IQIP.

7.4 Balance of Plant innovations

Because of a strong history in maritime oil and gas operations, Dutch companies have built significant expertise in the global transportation and installation of offshore wind farms. This also translates into several innovations for 'Balance of Plant' components related to turbines, foundations, substations and cables.

In the news 2023

Key role for Dutch motion-compensation systems in US feeder vessel operation

Source: Offshore Wind Journal

A motion-compensation system developed by Barge Master and heave-compensation technology from fellow Dutch company Seaqualize are playing an important role in the construction of the first commercial-scale offshore windfarm in the US.

Developers Avangrid and Copenhagen Infrastructure Partners (CIP) confirmed earlier this month that the first wind turbine for the Vineyard Wind 1 offshore windfarm had been installed.

The GE Haliade-X wind turbine is the first of 62 turbines that will be installed at Vineyard Wind 1. It was installed by DEME Offshore from the vessel Sea Installer, which was equipped with a Heave Chief 1100 developed by Seaqualize in the Netherlands, which is said to be the largest active heave-compensation system in the world.

The HC1100 compensates for heaving motions when components are being lifted from the deck of Foss Offshore Wind's feeder barges, which are supplying Sea Installer with components. The HC1100 works in tandem with a motion-compensation system developed by Barge Master, which helps to ensure tower sections for the turbines can be lifted safely from the barges.

Together with the heave compensation tool installed on Sea Installer's crane, which compensates for the vertical movements during lifts, the twin systems enable seamless, safe lifting and significantly enhance the weather window during which turbine installation operations can proceed.

Barge Master developed the 'Heavy Feeder' system specifically for use on Vineyard Wind 1, to compensate for the weight and height of the tower sections of the GE Haliade-X wind turbines. The Barge Master system compensates for weights of up to 1,500 tonnes in sea states of up to Hs 2.5 m.

The hydraulic cylinders and drive and control systems for the Heavy Feeder were delivered by another Dutch company, Van Halteren Technologies. Van Halteren Technologies engineered, manufactured and delivered the drive and control systems for the platform, including the hydraulic power units, roll and pitch cylinders, docking cylinders, manifolds and controls.

A fourth Dutch company, TWD was responsible for the detailed engineering of the platforms and foundations.

Van Halteren said two Barge Master systems are being used to install wind turbines for the Vineyard Wind 1 project, the Heavy Feeder platform and a Barge Master T700, which has a long track record in lifting, drilling, and feeder operations.

The Heavy Feeder compensates for roll and pitch; the Seaqualize heave-compensation solution in the hook of the crane on Sea Installer assists in eliminating motions as components are lifted from the deck of the feeder barge and as the lift proceeds.



In the news 2023

Siemens Gamesa and Huisman Launch Solution to Stabilise Wind Turbine Blades During Installation

Source: offshorewind.biz

Huisman and Siemens Gamesa have developed a solution to stabilise wind turbine blades during installation, but also nacelles and tower segments. The solution, called the Travelling Load Stabilising System, is universally applied in heavy-lifting cranes and can mitigate operational downtime and increase the integrity of the delicate wind turbine components, according to Huisman.

The system functions as an integral part of the crane and could be operated from the crane's cabin as well from an optional walk-around box (WAB).

The new solution consists of a combination of two pairs of tuggers working in unison to control the position of the load.

By approaching the load from two different directions, the system provides significantly more control than a conventional single pair of tuggers. A specially designed control system holds the actual position of the load, resulting in a much stiffer restraint, and therefore a higher position accuracy compared to conventional tugger systems that rely on constant tension. In case of an unexpected overload, the system will give way but will return to its position setpoint when the force drops below the threshold again.

In the news 2023

Huisman Rolls Out Wind Detection System for Safer Blade Installation

Source: offshorewind.biz

Huisman has launched a newly developed system that enables crane operators to anticipate and react to approaching wind speeds, gusts, and direction during the installation process of wind turbine blades.

The system, called Wind Gust Buster, assists crane operators and lifting supervisors when working with the installation of large objects at considerable height, by providing information on the incoming wind 360° around the boom tip.

Measurement of the incoming wind, with up to 10 km distance, is done by application of a LiDAR system on the crane's boom tip, scanning the horizontal area.

The measurement data is post-processed by the crane's automation system and can be shown to both the crane operator as well as to other people involved, such as on the crane vessel's bridge.

A typical prediction window is five to eight minutes ahead of the wind gust coming in, which should allow sufficient time to make the "go or no-go" decision for mating a blade to a nacelle.



8. Dutch Floating Wind Innovators

Developments in wind turbine technologies as well as in bottom fixed foundations, installation, access, operation and system integration have enabled moves into deeper waters, farther from shore, to reach sites with better wind resources. However, these turbines, rooted in the seabed by monopile or jacket foundations, are still restricted to shallower waters with maximum water depth up to 60-70 meters.

This is a major limitation, as some of the largest potential markets for offshore wind, such as Japan and the US, have few shallow-water sites. Scaling up offshore wind markets undoubtedly requires offshore wind turbines to move into deeper waters with higher wind resources. Therefore, floating foundations are potentially a game-changing technology to deliver a next generation in offshore wind.

Floating foundations offer the offshore wind industry important new opportunities since they allow access to sites with deep water and far from shore. The first full-scale prototypes for floating wind turbines have been in operation for several years, with three main designs being tested: spar buoys, semi submersible and tension-leg platforms.



8.1 Floating wind turbine innovations

As there is (as yet) currently no clear path for a leading floating wind turbine or foundation technology to reach utility-scale commercial deployment and only a few international OEMs have publicly announced programmes of in-house floating wind development, there is room for innovative SMEs. Several Dutch companies have already taken the challenge to further reduce the LCOE while, at the same time, looking at other offshore opportunities for floating wind.

Some of them focus on developing integrated floating wind turbines, others focus on innovative floating foundation designs.

In the news 2023

Mitsui O.S.K. Lines Invests in Dutch Floating Offshore Wind Turbine Tech

Source: offshorewind.biz

Japanese shipping company Mitsui O.S.K. Lines (MOL) has revealed that it will invest in Dutch floating wind technology developer TouchWind and will obtain a minority share in the company.

TouchWind is developing a floating wind turbine with a tilting, angled one-piece rotor. A small-scale prototype was installed in May at Fieldlab Green Economy Westvoorne in the Netherlands.

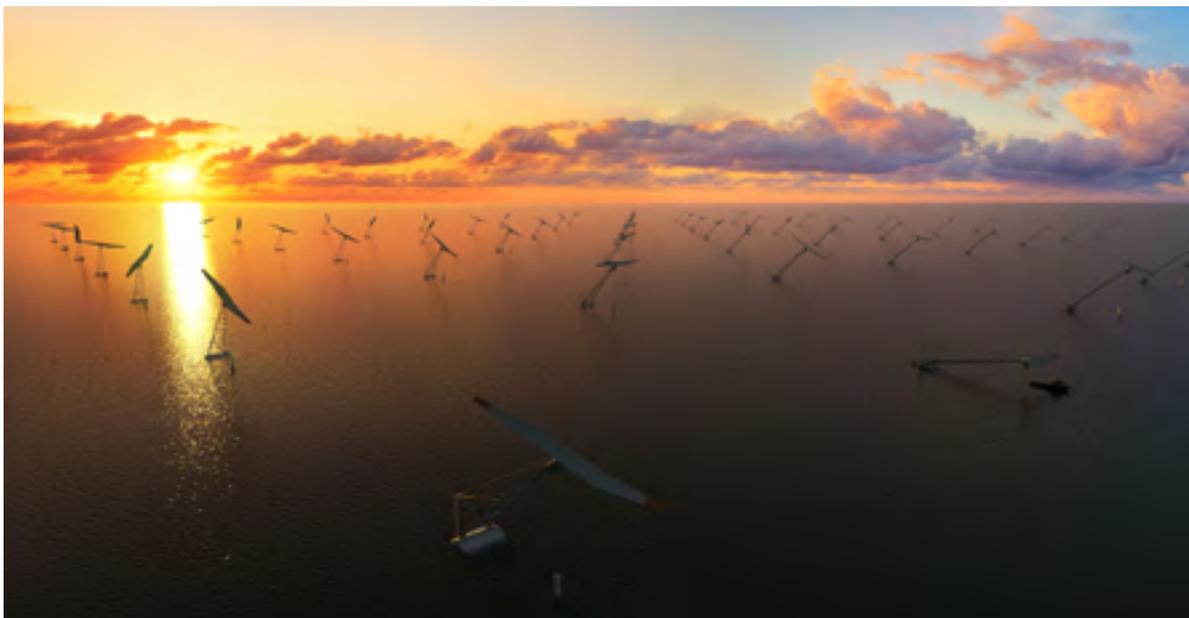
The prototype has a rotor diameter of 6 metres and will be tested at the location for the installation, mooring and anchoring, as well as for the ecological impact on the location at the lake.

With a financial investment, field testing of TouchWind's tilting angled one-piece rotor floating wind turbine can be expanded as well as new research into positive wake effects, said the companies.

"Field testing with a 6m diameter rotor is in full preparation at the Oostvoorne lake in the Netherlands. With MOL as a shareholder and their investments we can speed up our testing programme, prove our technology and reduce time to market," said TouchWind.

Last year, the two companies signed a memorandum of understanding (MoU) for the joint development of floating wind technology with a primary focus on the further development of TouchWind's one-piece rotor floating wind turbine.

"We are pleased that we can continue the journey with TouchWind and have become a shareholder of the company as we see exciting potential in their technology," said MOL.



8.2 Floating wind foundation innovations

Although floating foundations are already a proven technology in the oil and gas sector, platform designs for offshore wind require adaptation to accommodate different dynamic characteristics and a distinct loading pattern. This is something that has already occurred, to a great extent, for fixed-bottom foundations, including monopiles, jackets and gravity based designs.

Currently, floating wind farms still have a higher (levelised) cost of energy than fixed, as floating foundations need to be assembled in port at the quay side and coastal areas. This requires it's own major supply chain investments in manufacturing sites and related infrastructure. Still, there is growing confidence that they could be competitive by 2030, also because floating designs can partly be facilitated from existing oil and gas technologies such as semi-submersibles, tension leg platforms (TLPs), and spar buoys. Other potential advantages are the lower installation cost and the ability to standardise designs within and between wind farms.



In the news 2024

ABS, FibreMax Enter Collaboration on Floating Wind Mooring Tech

Source: offshorewind.biz

The US-based classification organisation American Bureau of Shipping (ABS) and Dutch synthetic mooring solutions provider FibreMax have signed an agreement to collaborate on stiffness-driven mooring tendons for the floating offshore wind market.

Under the agreement, ABS will provide qualification for FibreMax's fibre and small rope testing.

The classification organisation will evaluate test methods for accuracy in predicting the parameters needed to perform representative analysis, focusing on stiffness.

FibreMax's part of the agreement will see the mooring solutions specialist provide expertise on stiffness, based on the company's Parallel Wound Technology (PWT).

ABS has performed certification and classification for several floating wind projects and technologies, including WindFloat 1, the first semisubmersible floating offshore wind turbine, and turbines at the WindFloat Atlantic floating wind farm off Portugal, and has classed and performed statutory reviews for Kincardine, the world's largest grid-connected floating offshore wind farm, located in Scotland.

Earlier this year, FibreMax signed a Memorandum of Understanding (MOU) with RWE to advance the development and support of synthetic mooring technology for floating wind.

Under the MOU, RWE and FibreMax will work together on research and development, as well as the exploration of innovative methods to further reduce the cost of mooring solutions for (ultra) deep water and local production opportunities.

9. Offshore Wind Ecology Innovators

An underwater photograph showing a sandy seabed with sparse green algae. A silver fish is swimming in the upper left, and a crab is visible in the lower right. The scene is dimly lit, typical of an underwater environment.

To ensure the sustainability of renewables sourced from oceans, benefits must be maximised while addressing potential negative impacts on ocean ecosystems. Negative impacts could arise in the form of habitat loss, animal-aproduced by sea cables, which may impact aquatic species. Dutch experiences indicate that offshore wind can actually support biodiversity through artificial reefs, fish aggregation devices and other measures, as can be seen at one of Tennet's cable crossings (pictured here).



9.1 Introduction

The Netherlands is a pioneer in the field of environmental protection in relation to offshore wind farm development. The Dutch Government challenges competing project developers to include pioneering innovations to protect the natural habitat of birds, bats, marine mammals, and the underwater world in their offshore wind farm auction bids in an effort to set future ecological standards ecological standards for building and operating offshore wind farms.

This chapter highlights ecology and nature-inclusive related measures and innovations in offshore wind farm development, to be introduced by project developers that have been awarded development permits in the Dutch offshore wind farm auctions with a focus on ecology and nature enhancement.

9.2 Borssele, site V

In 2018, Borssele WFS V (BWFS V), designated as a small-scale demonstration site for offshore wind innovations, was won by the Two Towers consortium, comprising Van Oord (currently Octopus Energy Generation), Investri Offshore and Green Giraffe. Situated within the Borssele Wind farm III, the 19 MW innovation site features two Vestas 9.5 MW turbines and several innovations. The innovations related to ecology include the seabed surrounding the two wind turbine foundations is fitted with eco-friendly scour protection. This technology is used to explore how nature and renewable energy generation can be mutually enhancing. Oysters have successfully been placed on the protective layer of rock on the seabed to improve erosion protection as well as biodiversity and the natural habitat for aquatic wildlife.



9.3 Hollandse Kust Zuid

In 2018 and 2019, Sweden's Vattenfall won the tenders for building and operating the wind farms at Hollandse Kust (zuid) sites I-IV, some 18 - 35 kilometres off the Dutch coast, in the area between The Hague and Zandvoort. The combined 1.5 GW Hollandse Kust (zuid) project includes a series of innovation tests related to circularity and biodiversity for the offshore wind industry.

First, three of the 140 Siemens Gamesa 11 MW wind turbines at the Hollandse Kust wind farm offshore the Netherlands are fitted with recyclable blades. Conventional blades are made with resin which is fused with fiberglass and carbon to create the blade's structure. The resin only dissolves by exposing it to a combination of high temperatures, high pressure, and special treatments. This requires a lot of energy and is therefore expensive, and the quality of the various materials decreases due to these extreme conditions. Siemens Gamesa's RecyclableBlades use a new type of resin that dissolves when the blade is immersed in a bath containing a heated, slightly acidic solution.

Second, all 140 of the wind farm's turbine monopile foundations are manufactured with elliptical openings located above the seabed and just below the water surface, which are approximately 30 centimetres by 1 metre in size. The openings are envisaged as water replenishment holes in the hollow foundations of the wind turbines. These holes ensure that the water in the foundation flows well and is refreshed. The openings are also expected to allow fish and other sea life such as anemones, crabs, and shrimps to enter the wind turbine foundations and potentially use them as shelter or to find food. This is the first time the structure of a turbine itself is included in nature-inclusive wind farm design,

Third, boulders and rocks of varying sizes were used during the construction of scour protection and artificial rock reefs were added at several scour protection sites to make them more attractive to a wider number of fish, crabs and crustaceans.

Finally, the project has also incorporated enhancement measures, including a double bubble screen to dampen underwater noise during pile driving to limit the impact on harbour porpoises.

Wind Turbines Offshore Netherlands Open to Sea Life

Source: offshorewind.biz

Offshore wind developer Vattenfall and De Rijke Noordzee (The Rich North Sea) are jointly investigating the effect of water replenishment holes in wind turbine foundations on the surrounding sea life.

The research is being carried out on Vattenfall's 1.5 GW Hollandse Kust Zuid wind farm, the world's first subsidy-free offshore wind farm. Hollandse Kust Zuid will also become the world's largest operational offshore wind farm once commissioned in 2023.

All 140 of the wind farm's turbine monopile foundations are manufactured with elliptical openings located above the seabed and just below the water surface, which are approximately 30 centimetres by 1 metre in size.

The openings are envisaged as water replenishment holes in the hollow foundations of the wind turbines. These holes ensure that the water in the foundation flows well and is refreshed.

The openings are also expected to allow fish and other sea life such as anemones, crabs, and shrimps to enter the wind turbine foundations and potentially use them as shelter or to find food.

De Rijke Noordzee has already carried out the first measurements at the site and the research is expected to continue.

The investigations are focused on assessing whether the living conditions, such as oxygen content and temperature, are suitable for the development of marine life in the foundations.

The investigations will also cover the differences between the conditions inside and outside the foundations, as well as how marine life will develop in this environment over time.

According to Vattenfall, this is the first time research is being carried out to determine how water replenishment holes can improve marine life at offshore wind farms.

The project is also supported by the Royal Netherlands Institute for Sea Research (NIOZ) and Wageningen Marine Research (WMR).

9.4 Hollandse Kust West, site VI

In December 2022 Ecowende, a joint venture of Shell and Eneco, won the permit for the construction and operation of the 756 MW Hollandse Kust (west) WFS VI project, located more than 50 kilometres off the Dutch coast in the North Sea near IJmuiden. As part of its winning bid in the innovation challenge to limit ecological impact, Ecowende offered to build a 'nature-inclusive' offshore wind farm that will be in harmony with nature, with minimal impact on birds, bats, and marine mammals.

Specific measures include increasing the height of the lowest tip of the rotor blades, creating a corridor to Natura 2000 area by placing the turbines extra far apart, and an option to bring the turbines to a standstill that adapts to the flight movements of birds in the wind farm. This way, Ecowende expects to minimise the number of bird and bat collisions.

The company will also apply several innovative techniques that will help the underwater world to flourish. Biodegradable reef structures are being constructed using fruit trees sourced from Dutch fruit farms. These tree reefs offer a place for fish to shelter and reproduce. Ecowende will also install various forms of eco-friendly erosion protection and the oyster larvae network will be expanded to spread the native flat oyster population.



Ecowende and Partners to Advance Wildlife Monitoring at Offshore Wind Farms

Source: offshorewind.biz

Ecowende has teamed up with Robin Radar Systems, MIDO, and DHI to implement a framework for bird and bat monitoring at its offshore wind farms.

The technologies, which include Robin Radar's MAX bird and bat radar systems, DHI's sensor integration and artificial intelligence (AI) species recognition solution MUSE, and MIDO's power-generating floating platform FLORA 1 will be deployed at Ecowende's future offshore wind farm in the Netherlands.

Together with partners, Ecowende, a joint venture between Shell, Eneco, and Chubu, intends to set a new ecological standard for building and operating offshore wind farms, with a minimal impact on the natural habitat of birds, bats, and marine mammals, and with a thriving underwater world, the joint venture said.

To enhance Ecowende's data collection, the three-dimensional (3D) MAX Radar Systems operate every day of the year and in all weather conditions, simultaneously tracking and organising data into one informative and intuitive interface.

Mitigating the risk of collision, or even implementing shutdown-on-demand (SDOD) when necessary, depends on an extensive understanding of bird behaviour, according to Ecowende.

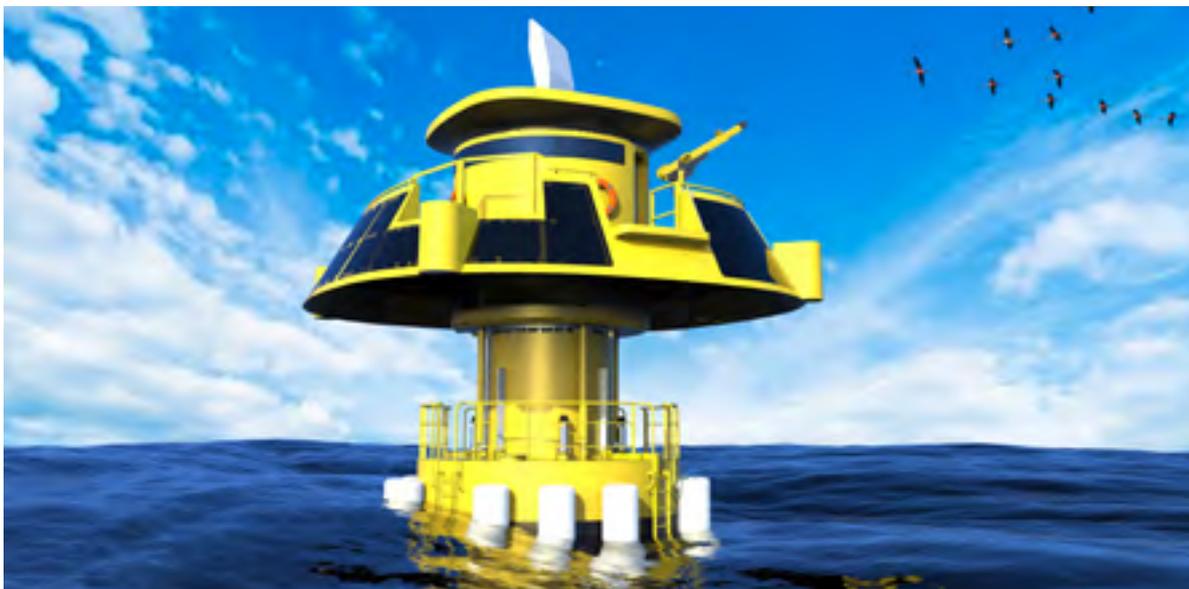
The FLORA 1 floating platform has been designed for offshore installation and is equipped for autonomous operation because of its power-generating nature, by using a complementary mix of wave and solar power and battery storage, allowing for uninterrupted data collection by the MAX Radar System on the platform.

Even more data can be gathered automatically, such as a count of the actual bird species being observed, by integrating the MAX with robotic cameras using DHI's MUSE solution, according to Ecowende.

DHI's AI-based algorithms automatically identify the species of birds of concern and locate bats in the wind farm zone and can automatically send signals to advise on slowing down individual wind turbines if a priority species of bird or bat is in danger of collision.

Shell and Eneco secured the development rights for Hollandse Kust West VI in December 2022. Last year, the joint venture unveiled plans for the 760 MW offshore wind farm to be built "*in harmony with nature, with minimal impact on birds, bats, and marine mammals*".

In September 2023, Ecowende partnered with Waardenburg Ecology, the largest ecological consultancy firm in the Netherlands, to develop a comprehensive ecological programme for the offshore wind farm.





In the news 2024

TenneT Installs Artificial Reefs at Hollandse Kust West Alpha Offshore Netherlands

Source: offshorewind.biz

The Dutch-German transmission system operator (TSO), TenneT, has placed several artificial reefs at the Hollandse Kust West Alpha offshore transformer platform in the Dutch North Sea.

The platform will connect the Ecowende consortium (Shell/Eneco) wind farm to the high-voltage grid.

In collaboration with Equans/Smulders, TenneT placed two types of artificial reefs near the offshore substation jacket to find out which form works best.

The artificial reefs are part of a series of ecological measures by TenneT to monitor and encourage nature around offshore wind farms.

Attached to one frame are six so-called reef cubes. These are hollow square blocks made of nature-friendly recycled material with round holes in the walls, said TenneT. On the other steel frame are six reef balls, a similar structure but in the shape of a ball.

“The purpose of the trial is to investigate which shape – ball or cube – works best in the waters off our coast. The hollows provide protection for young fish, but are also intended to increase the structure’s bonding surface. In this way, we hope to provide a suitable place for numerous other animal and plant species in addition to juvenile fish, crabs and lobsters,” said TenneT.

“These artificial reef structures are meant to stimulate marine life. With these, you create potential spots where coral and algae settle. Earlier research shows that fish, crabs and lobsters like to visit these spots for shelter and to look for food.”

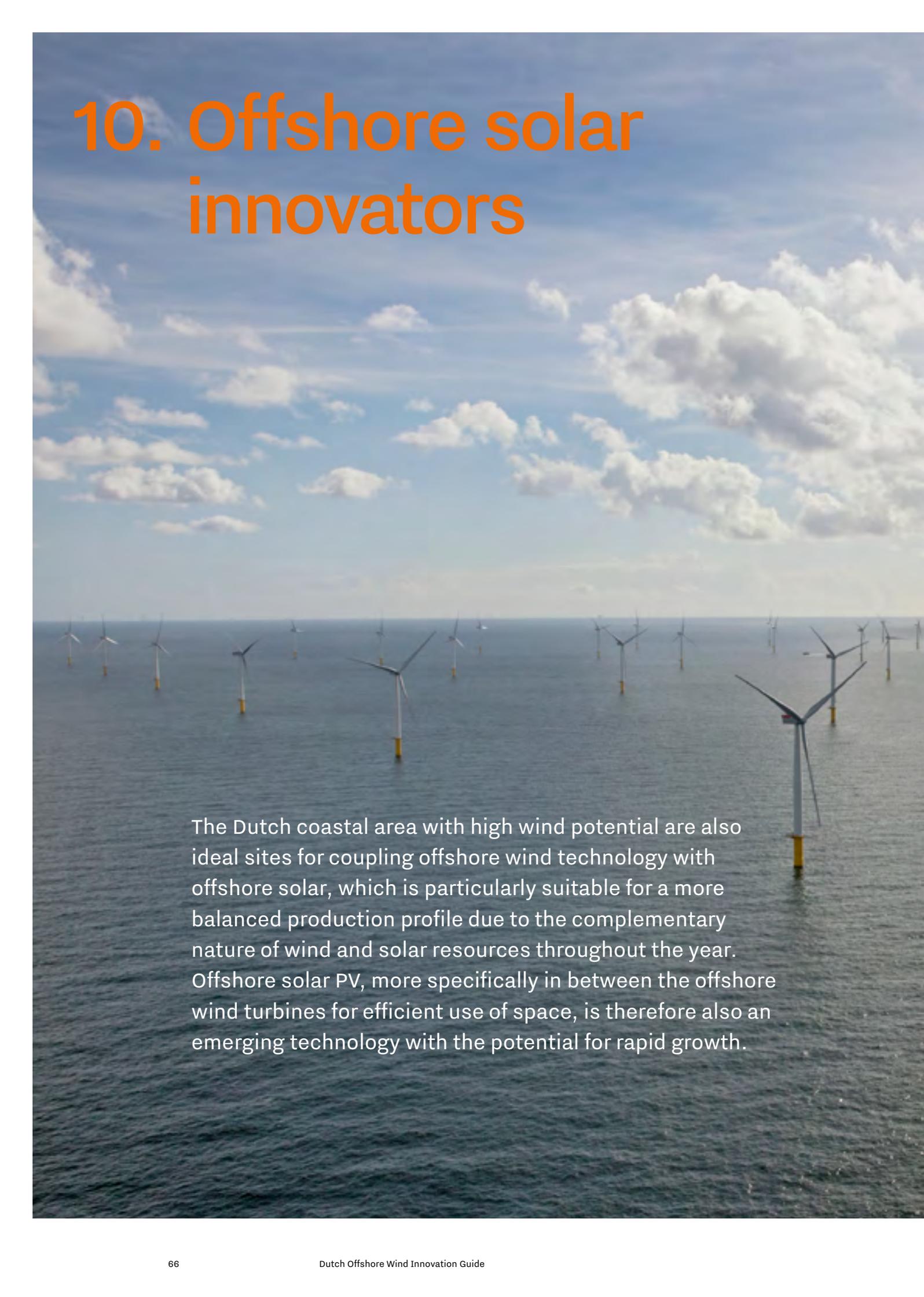
According to TenneT, visible differences are not expected for another three years or so.

“Until then, we monitor annually whether the diversity of life forms around the artificial reefs and fish hotels increases,” TenneT said.

9.5 IJmuiden Ver, site Alpha

In May 2024 Noordzeker, a consortium comprising SSE Renewables, Dutch pension fund ABP and its asset manager AGP, won the development permits for the construction and operation of the IJmuiden Ver Alpha offshore wind farm site. In response to the ecosystem innovation challenge as the main site-specific requirement, Noordzeker focused on making a positive contribution to nature, for which the developer proposed several nature-positive measures, including a bird protection solution and artificial reefs for marine wildlife. Noordzeker’s plan includes turbine and wind farm designs that contribute to the protection of birds. The plan also includes measures that are expected to significantly reduce disturbance to marine mammals during construction and operation of the wind farm. Last but not least, the winning bid of Noordzeker also included the design of the Alpha wind farm as a “living laboratory” in which more than 75 per cent of the wind turbines in the wind farm will have artificial reefs for muscles and other marine animals.

10. Offshore solar innovators



The Dutch coastal area with high wind potential are also ideal sites for coupling offshore wind technology with offshore solar, which is particularly suitable for a more balanced production profile due to the complementary nature of wind and solar resources throughout the year. Offshore solar PV, more specifically in between the offshore wind turbines for efficient use of space, is therefore also an emerging technology with the potential for rapid growth.



10.1 Introduction

The Netherlands stands out as a global frontrunner in the field of co-locating offshore wind and offshore solar. The Dutch Government challenges competing project developers to include pioneering innovations to integrate offshore solar in their offshore wind farm auction bids.

This chapter highlights offshore solar innovations, to be introduced by project developers that have won development permits in the Dutch offshore wind farm auctions with a focus on co-locating offshore solar plants.

10.2 Hollandse Kust Noord

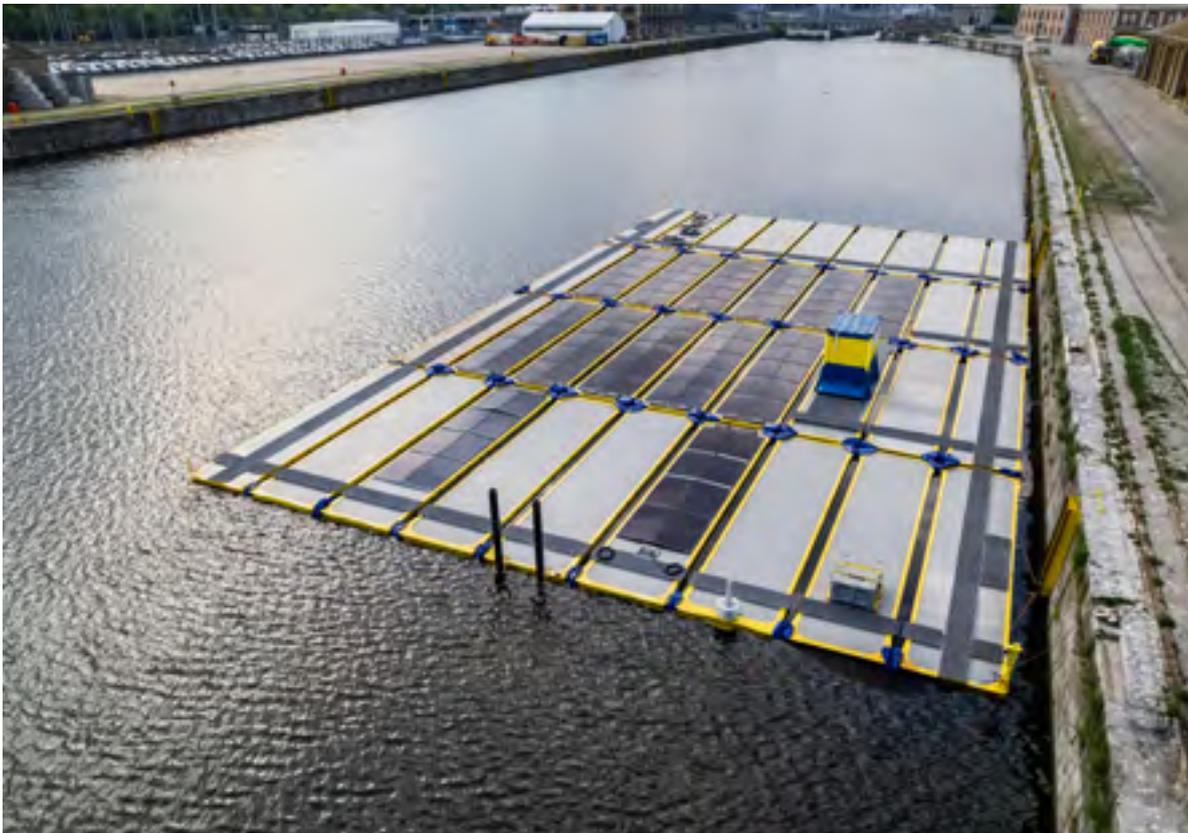
In 2020, the CrossWind consortium – a collaboration between Shell (80%) and Eneco (20%) – won the tender to build and operate the 760 MW Hollandse Kust (Noord) offshore wind farm, located 18.5 kilometres from the coast of Egmond aan Zee in the Netherlands. As part of its winning bid in the system integration innovation challenge, the Crosswind consortium offered to develop 0,5 MW offshore solar power farm. The offshore solar farm will be the first in the world to be connected, installed, and operated within a wind farm in high wave conditions.

Dutch offshore solar start-up Oceans of Energy has been awarded the contract for installing and operating offshore solar farm inside the Hollandse Kust Noord offshore wind park.

Rather than heavy structures above sea, which are normally used for offshore technology, the 0.5 MW floating solar power farm is based on the so-called ‘high wave’ design, a lightweight, wave-riding technology devised for hostile marine environments. In order to withstand high waves and rough seas, it uses an innovative floating pontoons system combining rigid and flexible structures that allows it to ‘ride’ on waves. The system is designed to withstand waves up to 14 meters.

In January 2023, an Approval in Principle was delivered to Oceans of Energy for the pontoon and mooring system by international laboratory testing, inspection and certification body Bureau Veritas. In October 2023 a statement of conformity for the basis of design of the offshore solar technology was provided to Oceans of Energy by international certification body DNV.

The 0.5 MW offshore solar farm will be realized in 2025, while the wind park will be operational by the end of 2023.





In the news 2023

Oceans of Energy to Build Offshore Solar Array at Hollandse Kust Noord Offshore Wind Park

Source: offshorewind.biz

Oceans of Energy has been awarded the contract for installing and operating offshore solar farm inside the Hollandse Kust Noord offshore wind park being developed by CrossWind, a joint venture between Shell and Eneco.

This is set to be the first offshore solar farm in the world to be connected, installed, and operated within a wind farm in high wave conditions.

The offshore solar farm will be realized in 2025, while the wind park will be operational by the end of 2023, according to Oceans of Energy.

With offshore solar added to offshore wind, it is possible to also produce energy on sunny but less windy days and hence increase the utilization of the offshore power grid infrastructure.

The solar panels will be situated in between the offshore wind turbines, an efficient way of sharing the sea space.

Oceans of Energy, said: *“We are very pleased that Crosswind and their shareholders Shell and Eneco have trust in Oceans of Energy for realizing this first off amazing project.”*

“We will add offshore solar to offshore wind. Our performance and our system will be key for the success of the innovational part of the offshore wind farm. This is a large responsibility as Hollandse Kust Noord will function as an example for combined offshore wind and solar parks in the future.”

The project has many first-offs, including being the first wind park in the world with an offshore combination of battery storage and round-trip green hydrogen produced from offshore wind power on a megawatt scale.

Once constructed, the offshore wind farm will be generating at least 3.3 TWh of clean energy per year.

10.3 Hollandse Kust West, site VII

In November 2022, Oranje Wind Power II, a project company of Germany-based developer RWE, won the permit for the construction and operation of the 760 MW Hollandse Kust (west) WFS VII project, located more than 50 kilometres off the Dutch coast in the North Sea near IJmuiden. As part of its winning bid in the system integration innovation challenge, RWE offered to integrate a 5 MW offshore solar system with integrated storage as part of the offshore windfarm. Another innovative and scalable offshore solar concept will be realized, designed to withstand extreme offshore conditions such as high waves, strong winds and a corrosive environment. RWE selected Dutch-Norwegian offshore floating solar start-up SolarDuck as exclusive provider to install and operate a 5MWp floating offshore solar park.

The offshore solar park typically consists of interconnected triangular platforms with three large vertical cylindrical floaters, to float three metres above the water and follow the waves like a carpet. The triangular floating structures measure 16 x 16 x 16 meters, and multiple triangles can be flexibly connected together to form large megawatt-sized solar power plants. This structure can withstand large waves (>5m) and high wind speeds (>30m/s). The design also allows to keep critical electrical components dry, clean and stable, and ensures the integrity of the semi-submersible structure, while allowing safe operations and minimal maintenance. SolarDuck's technology also enables the floating solar platform to rotate to face the sun continuously. SolarDuck's triangular-shaped platform has received the world's first certificate for offshore solar by Bureau Veritas. When completed in 2028, it will be the largest hybrid offshore solar power plant in existence.

In the news 2024

Work Starts on World's Largest Floating Solar Project, Part of RWE's OranjeWind

Source: offshorewind.biz

The Nautical SUNRISE consortium partners have commenced the project whose goal is to facilitate research and development of offshore floating solar systems and its components. The project aims to integrate a 5 MW offshore floating solar system within RWE's OranjeWind, a wind farm to be built 53 kilometres off the Dutch coast.

Research and development on the offshore floating solar (OFS) systems and its components of the EUR 8.4 million project, supported by EUR 6.8 million of the Horizon Europe programme, kicked off in December 2023.

The project will enable the large-scale deployment and commercialisation of offshore floating solar systems in the future, both as standalone systems and integrated into offshore wind farms.

The project aims to design, build, and showcase a 5 MW OFS system using the modular solution of the Dutch floating company SolarDuck.

With RWE providing the investment for the installation and deployment, the system is planned to be electrically integrated, certified, and located within RWE's 800 MW OranjeWind offshore wind farm in the Netherlands.



10.4 IJmuiden Ver, site Beta

In May 2024, Zeevonk, a joint venture between Vattenfall and Copenhagen Infrastructure Partners (CIP), won the development permit for the 2GW IJmuiden Ver Beta offshore wind site. In response to the main site specific innovation challenge for the Beta site, integration of the wind farm into the Dutch energy system, the Zeevonk consortium will also build a 50 MWp floating solar farm within the offshore project site. The floating solar farm Vattenfall and CIP plan to install at IJmuiden Ver Beta will have ten times the capacity of the first such project at Hollandse Kust, site VII (OranjeWind).

In the News 2024

Vattenfall, CIP to Integrate Large-Scale Floating Solar, Green Hydrogen Systems with New 2 GW Dutch Offshore Wind Farm

Source: offshorewind.biz

The Zeevonk joint venture between Vattenfall and Copenhagen Infrastructure Partners (CIP), which has been awarded the 2 GW IJmuiden Ver Beta offshore wind area in the Netherlands, will also build a floating solar farm

within the offshore project site and install a large-scale electrolyser in the Port of Rotterdam to use the electricity generated at IJmuiden Ver Beta to produce green hydrogen.

Vattenfall and CIP laid out a plan to build a 50 MWp floating offshore solar farm at the offshore site, similar to what RWE plans to do at OranjeWind, a wind farm for which RWE secured the permit in the Dutch tender for Hollandse Kust West areas in 2022.

The floating solar farm Vattenfall and CIP plan to install at IJmuiden Ver Beta will have ten times the capacity of the first such project at Hollandse Kust West Site VII.

“The introduction of a 50 MWp floating offshore solar farm is the next step in the development and further upscaling of offshore solar, compared to the 5 MWp floating solar farm that is currently [constructed] off the Dutch coast.

Combining solar and wind means that the available space is used more efficiently. Another benefit is that solar and wind complement each other and are able to share the same grid connection, which results in a more efficient use of the power grid,” the Zeevonk joint venture states in a press release issued after the results of the IJmuiden Ver tender were announced on 11 June.

The two partners also plan to install a large-scale electrolyser at the Maasvlakte in the Port of Rotterdam to produce hydrogen using the electricity generated at IJmuiden Ver Beta.



11. Offshore wind to hydrogen innovators

An aerial photograph of an offshore wind turbine platform in the middle of the ocean. The platform is a complex of steel structures with a green helipad on top. The water is dark blue with some whitecaps. The sky is a pale, hazy blue.

Hydrogen from renewables as a clean-burning gas that emits only water at the point of combustion, will be key in achieving the world's post-2050 climate goals. Green hydrogen can decarbonize heavy industry (steel, chemicals, refineries etc.) and long-distance shipping and aviation, can be readily stored in salt caverns or depleted gas fields to counteract the effects of renewable intermittency and can be transported through (existing) pipelines much cheaper – and with less coastal landing impact – than electricity cables. In Northwestern Europe, offshore wind is the most suitable renewable energy source for direct coupling of large-scale electricity generation to industrial-scale hydrogen production.



11.1 Introduction

The Netherlands is a pioneering market for offshore wind-to-hydrogen, as the Dutch Government challenges competing project developers to include system integration innovations such as industrial scale electrolysis and battery storage systems in their offshore wind farm auction bids.

The Netherlands is set to become the global first large scale offshore wind-to-hydrogen producer in the world. In March 2023, the Dutch Government selected an area north of the Wadden Islands, offshore from the Groningen province, for the development of a 700 MW offshore wind farm for the on-site production of 500 MW hydrogen to be transported to land from around 2033.

This chapter highlights the integration of green hydrogen and battery storage into offshore wind and grid infrastructure, to be introduced by project developers that have been awarded development permits in recent Dutch offshore wind farm auctions with a focus on system integration.

11.2 Hollandse Kust Noord

In 2020, the CrossWind consortium – a collaboration between Shell (80%) and Eneco (20%) – won the tender to build and operate the 760 MW Hollandse Kust (Noord) offshore wind farm, located 18.5 kilometres from the coast of Egmond aan Zee in the Netherlands. As part of its winning bid in the subsidy free innovation challenge, the Crosswind consortium offered to develop an integrated fuel cell system to convert excess wind energy to green hydrogen through a 2.5 MW electrolyser and store it as green hydrogen that can be converted to electricity (via a fuel cell) when needed. It will also include battery storage for shorter-term power storage. The system will include a containerized fuel cell power solution to regenerate stable and dispatchable power. The so-called Baseload Power Hub aims to reduce the problem of the variable character of renewable energy production (as the wind does not blow at all times). It will store energy and release it when demand exceeds the wind farm's output. Once installed in 2025, this will be the global first offshore combination of battery storage and round-trip hydrogen integrated in an offshore wind farm.

In the news 2023

Netherlands Chooses Site for World's Largest Offshore Wind-to-Hydrogen Project

Source: [offshorewind.biz](https://www.offshorewind.biz)

The Dutch Government has designated an area for what will become the world's largest offshore hydrogen production project. That area is Ten noorden van de Waddeneilanden (the North of the Wadden Islands), identified earlier for offshore wind development and deemed most suitable for providing 500 MW of electrolysis capacity and for the transport of hydrogen to land.

The project, which is said to mark the first application of offshore hydrogen production on a large scale, is planned to be operational around 2033.

The Ten noorden van de Waddeneilanden site, marked as having a potential capacity of 700 MW, will be auctioned off in 2026 or 2027, with a commissioning year set as 2033.



In the news 2024

Italian Company to Assemble 2.5 MW Offshore Electrolyser for Hollandse Kust Noord Wind Farm

Source: offshorewind.biz

CrossWind, a joint venture between Shell and Eneco, has contracted Fores Engineering, a subsidiary of the Rosetti Marino Group, to assemble the 2.5 MW offshore electrolyser that Elogen will deliver for the now-operational Hollandse Kust Noord offshore wind project in the Netherlands.

Fores Engineering's scope includes detailed engineering, procurement, assembly, onshore yard integration, and commissioning assistance with the 2.5 MW offshore electrolyser package. The contract covers the assembly of the electrolyser package and its associated Balance of Plant (BoP), including a water treatment plant, hydrogen purification system, and control and telecommunications systems, delivered in collaboration with the French company Elogen.

CrossWind ordered a Proton Exchange Membrane (PEM) electrolyser with a power of 2.5 MW from Elogen, part of the Gaztransport & Technigaz (GTT) group, at the beginning of last year. In July 2023, the developer awarded a contract for the construction of an offshore green hydrogen production and storage plant, called the baseload power hub (BLPH), to the Italian Rosetti Marino.

The complete green hydrogen plant will consist of four interconnected container-like modules that will be mounted on the BLPH platform.

Rosetti Marino is currently building the baseload power hub at its construction yard in Marina di Ravenna, Italy. The company will complete, test, and transport the platform offshore for installation at the Hollandse Kust Noord wind farm by Rosetti by July/August 2025.

Hollandse Kust Noord is located 18.5 kilometres off the coast of Egmond aan Zee and has 69 Siemens Gamesa SG 11.0-200 DD wind turbines. The 759 MW offshore wind farm, which went into operation on 20 December 2023, is expected to produce at least 3.3 TWh of electricity, which corresponds to 2.8 per cent of the electricity demand.

CrossWind describes the project as *"one of the Netherlands' most innovative offshore wind parks"* as it plans to integrate not only the green hydrogen production plant but also floating offshore solar panels and battery storage into the project.

Onshore electrolysis: Holland Hydrogen 1

In January 2022, Shell announced the construction of the Holland Hydrogen 1 project in the Port of Rotterdam. This is a 200 MW electrolysis plant using electricity from the 760 MW Hollandse Kust Noord offshore wind farm, also known as Crosswind, by means at guarantees of origin.

The intended start of production of the Holland Hydrogen 1 facility is 2026. The facility will cover two hectares, which is equivalent to the size of three football fields.



Shell to Start Building Europe's Largest Offshore Wind-to-Hydrogen Plant in Netherlands

Source: offshorewind.biz

Shell Nederland and Shell Overseas Investments, both subsidiaries of Shell, have taken the Final Investment Decision (FID) to build Holland Hydrogen I, which is said to be Europe's largest renewable hydrogen plant once operational in 2025.

The 200 MW Holland Hydrogen I electrolysis plant will be constructed on the Tweede Maasvlakte in the port of Rotterdam, the Netherlands, and will produce up to 60,000 kilograms of renewable hydrogen per day, Shell said.

The hydrogen production will be powered with electricity coming from the 759 MW Hollandse Kust Noord offshore wind farm, which is being developed by the CrossWind consortium of Shell and Eneco and is scheduled to be put into operation next year.

The hydrogen is planned to be transported through the HyTransPort pipeline, which will form a part of the Netherlands hydrogen infrastructure, with a length of about 40 kilometres that will run from the plant to Shell's Energy and Chemicals Park Rotterdam, where it will replace some of the grey hydrogen usage in the refinery.

This could partially decarbonise the facility's production of energy products like petrol, diesel, and jet fuel. As heavy-duty trucks are coming to market and refuelling networks grow, renewable hydrogen supply can also be directed toward these to help in decarbonising commercial road transport, Shell said.

Thyssenkrupp Chlorine Engineers is responsible for the engineering, procurement, and fabrication of the Holland Hydrogen I plant that will be based on their large-scale 20 MW alkaline water electrolysis module.

11.3 Hollandse Kust West, site VII

In November 2022, OranjeWind, a project company of Germany-based developer RWE, won the permit for the construction and operation of the 760 MW Hollandse Kust (west) WFS VII project, located more than 50 kilometres off the Dutch coast in the North Sea near IJmuiden. As part of its winning bid in the system integration innovation challenge, RWE offered to convert surplus electricity into green hydrogen through a 600 MW onshore electrolyser. The innovative project – which will also include floating solar panels, batteries and 225MW of electric boilers to produce heat for district heating and industrial users – won the non-price tender after the Dutch Government called upon potential developers of the offshore wind zone to submit new solutions for fully integrating all the electricity generated into the national grid. The world's first purpose-built offshore-wind-to-hydrogen project is due to become fully commissioned in 2028.



In the news 2024

RWE Installing Ultra-Fast Battery Storage in Netherlands, Part of OranjeWind Offshore Wind Project

Source: offshorewind.biz

RWE has started building an ultra-fast battery storage system with an installed capacity of 7.5 MW and a storage capacity of 11 MWh on the site of its power plant in Moerdijk, the Netherlands, as part of the OranjeWind offshore wind project that involves system integration solutions.

Owned by RWE and TotalEnergies, the 760 MW OranjeWind will establish new ways to integrate renewable energy generation into the Dutch energy system through electrolysers, smart charging stations for electric vehicles, e-boilers, and battery storage systems.

This aligns with the tender requirements for the Hollandse Kust West (HKW) VII site, where the wind farm will be built, which RWE secured in the tender held in 2022, with TotalEnergies joining the project in July 2024.

Last year, RWE initiated the construction of a utility-scale battery storage system at its biomass plant in Eemshaven, also in connection with the OranjeWind project. That storage will have an installed power capacity of 35 MW and a storage capacity of 41 MWh, and will consist of a total of 110 lithium-ion battery racks that will be virtually coupled with RWE's power plants in the Netherlands.

For the battery storage system at the site of its Moerdijk power plant, RWE is installing lithium iron phosphate (LFP) batteries in three shipping containers. The storage system will be connected to the high-voltage grid via the existing grid connection and will be able to provide balancing energy instantaneously.

The system is set for commissioning at the end of 2024 and the OranjeWind offshore wind farm, to be built 53 kilometres off the Dutch coast, is expected to start producing renewable electricity in 2027.

In the news 2024

TotalEnergies Buys Into RWE's Dutch Offshore Wind Farm to Produce Green Hydrogen

Source: offshorewind.biz

RWE and TotalEnergies have entered into an agreement under which TotalEnergies will acquire a 50 per cent stake in RWE's OranjeWind offshore wind farm in the Netherlands. TotalEnergies said it would use its share of the electricity from the 795 MW OranjeWind to produce green hydrogen.

With half of the generation capacity of the 759 MW offshore wind farm, TotalEnergies plans to power 350 MW electrolyser projects that will produce about 40,000 tonnes of green hydrogen annually, which the company will use at its refineries in Northern Europe.

The move falls within TotalEnergies' goal of decarbonising its European refineries' hydrogen and cutting its CO₂ emissions by around 5 million tonnes per year by 2030. The green hydrogen produced via electrolysis using OranjeWind electricity will replace the hydrogen currently consumed there and will avoid the emission of approximately 400,000 tonnes of CO₂ per year, according to TotalEnergies' press release from 24 July.

The OranjeWind offshore wind farm at HKW Site VII is the first system integration project of this kind in the Netherlands, with the requirement for combining energy systems set by the Dutch Government in the tender itself.

11.4 IJmuiden Ver, site Beta

In May 2024, Zeevonk, a joint venture between Vattenfall and Copenhagen Infrastructure Partners (CIP), won the development permit for the 2GW IJmuiden Ver Beta offshore wind site. In response to the main site specific innovation challenge for the Beta site, integration of the wind farm into the Dutch energy system, the Zeevonk consortium will house an offshore wind farm which will be integrated with a 50 MWp floating solar plant offshore and a large-scale electrolyser at the Maasvlakte in the Port of Rotterdam to produce hydrogen using the electricity generated at IJmuiden Ver Beta. The electrolyser will have a capacity of 1 GW and produce green hydrogen to help decarbonize industries and transport. Since the electrolyser will be built near the location where the offshore wind farm will be connected to the system on land, the electricity does not have to be fed into the national power grid first, which relieves pressure on the power grid. The IJmuiden Ver Beta wind farm is expected to be commissioned in 2029 and will produce enough electricity annually to meet the of two million Dutch households.

11.5 Innovation in Offshore electrolysis

To accelerate innovation in offshore hydrogen production, TKI Offshore Energy promotes and supports innovation projects related to research topics such as optimising seawater purification, direct hydrogen production from seawater, off-grid hydrogen production and decentralised hydrogen production efficiency.

PosHYdon

Since the second half of 2024, PosHYdon is the first operational offshore project in the Netherlands where green hydrogen actually is being produced from offshore wind on an operational gas platform (Q13a-A) operated by Neptune Energy, approximately 13 kilometres off the coast of Scheveningen.

Green electricity generated by offshore wind turbines from the Luchterduinen wind farm powers the hydrogen plant on the platform, converting seawater into demineralized water, then into hydrogen via electrolysis. The green hydrogen will then be mixed with the natural gas and transported via the existing gas pipeline to the coast. The 1 MW offshore electrolyser, delivered by Norwegian company NEL Hydrogen, will produce a maximum of 400 kilograms of green hydrogen per day. The purpose of the pilot is to gain experience of integrating working energy systems at sea and the production of hydrogen in an offshore environment.

The Dutch state participates actively in PosHYdon through its satellite Energie Beheer Nederland (EBN).

In the news 2024

PosHYdon green hydrogen pilot initiates onshore testing

Source: Offshore Energy

The PosHYdon project, the world's first pilot that aims to produce green hydrogen on an operational gas platform in the North Sea, is progressing as planned with the commencement of the onshore test at the premises of InVesta in Alkmaar.

The project announced the kick-off of the onshore test on May 8. Following the testing period onshore, the electrolyzer will be transferred offshore to Neptune Energy's Q13a-A platform, 13 kilometers off the coast of Scheveningen (The Hague).

The first offshore hydrogen production is planned for the fourth quarter of 2024.

The project, which will integrate three offshore energy systems – offshore wind, offshore gas, and offshore hydrogen – for the first time on Neptune Energy's Q13a-A platform. This production platform is the first fully green electrified platform in the Dutch North Sea.

The green hydrogen will be blended with the gas and transported to the coast via the existing gas pipeline. To this end, the Ministry of Economic Affairs and Climate Policy has increased the blending specifications from 0.02% to 0.5% hydrogen. The 1 MW electrolyzer will follow the wind profile of the Luchterduinen wind farm.

The consortium behind the project comprises 15 public and private organizations: Nel Hydrogen, InVesta, Hatenboer, Iv-Offshore & Energy, Emerson, Nexstep, TNO, Neptune Energy Netherlands (Eni), Gasunie, Noordgastransport, NOGAT, DEME, TAQA, Eneco and EBN.



Offshore electrolysis: H2atSea (H2opZee)

In February 2022, Neptune Energy and German offshore wind developer RWE announced an offshore wind-to-hydrogen demonstration project in the Dutch North Sea. The companies plan to have the project up and running before 2030.

In the news 2024

H2SEA Studies Monopile-Based Structures for Hydrogen Offshore Wind Turbines

Source offshorewind.biz

Dutch engineering company H2SEA, in cooperation with the Delft University of Technology (TU Delft), has performed an assessment of monopile-based support structures for hydrogen-producing offshore wind turbines.

H2SEA says that one of the main questions was if decentral hydrogen production on a monopile-based support structure of an offshore wind turbine would be structurally feasible.

The goal was also to define the differences in support structure geometry and assess the changes in the design methodology of an offshore wind turbine support structure, including a decentralised hydrogen production platform.

The assessment was based on a 15 MW reference turbine in a water depth of 45 metres in the F3 sector of the North Sea.

To obtain platform mass, dimensions, and rotational inertia, H2SEA and TU Delft selected and listed all required systems, and made an optimised platform layout and mass estimation. For the design of the platform support beams, gravitational loads and extreme wind gust loads were taken into account. The selection of the support structure concept was performed using a multi-criteria analysis, H2SEA says.

Furthermore, an analytical fully dynamical model was constructed in Maple for fatigue assessment. The structure was simulated by the equations of motions, including airy wave force, rotor damping, topside and platform mass and rotational inertia, embedded length and homogeneous soil stiffness. The Maple model was used to simulate the dynamic behaviour of both structures, determine the first and second natural frequency, and present displacements and overturning moments in these two mode shapes.

Finally, a fatigue damage calculation including 500 combinations of wave height and period was performed, for a 25-year lifetime.

The Dutch engineering company has already been involved in hydrogen projects, including the H2opZee demonstration project, for which Neptune Energy and RWE awarded a contract to H2SEA back in 2022 for a feasibility study for the hydrogen platform concept design and engineering.

For the H2opZee project, H2SEA's sibling company Enersea was awarded the pipeline concept design work and Siemens Gamesa the concept work for wind turbine systems.



12. Wind & water works business partners

Wind & water works highlights the Dutch offshore wind energy sector around the globe via trade events, consulates, NBSO network and embassies. Wind & water works represents Dutch Government, businesses and knowledge institutes in the wind sector.

The platform is designed to enhance international visibility, reinforce the network and enable an exchange of knowledge within the global wind community.

Find your business partner in the directory or contact us via windandwaterworks@nedzero.nl.



12.1 Wind farm development

Project development

AFRY

AFRY is a one-stop shop engineering consultancy for offshore wind projects, encompassing the full project lifecycle, including strategic advice, development, contracting, financing, construction, operations and maintenance. Moreover, we offer full bid support and tender management, that proved to result in winning offshore concession tenders.

Our proficiency in offshore wind is demonstrated through eight prominent knowledge clusters: Environmental Impact & Permitting, Site Investigations & Wind Resource Assessment, System Integration, Nature-Inclusive Design, Package Management & Owners Engineering, Floating Wind, Electrical Grid Integration and Contracting & Procurement. These knowledge clusters and areas of expertise collectively reinforce our capacity to deliver comprehensive solutions that address every aspect of the offshore wind value chain.

The seamless integration with AFRY's industry recognized divisions and business units like Management Consulting, Transmission & Distribution and (PtX) Process Engineering ensures that we provide a unique approach that goes beyond solely offshore wind farm development.

AFRY has a global track record assisting governments, developers, TSO's, investors and supply chain parties which has given us a thorough understanding of governmental processes/procedures, market developments, project development and supply chain dynamics. Drawing from this experience, AFRY is your ideal partner from early feasibility, throughout development, up to commissioning and beyond.



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DNV

DNV is an independent assurance and risk management provider, operating in more than 100 countries. Through its broad experience and deep expertise DNV advances safety and sustainable performance, sets industry standards, and inspires and invents solutions.

Whether assessing a new ship design, qualifying technology for a floating wind farm, analysing sensor data from a gas pipeline or certifying a food company's supply chain, DNV enables its customers and their stakeholders to manage technological and regulatory complexity with confidence. Driven by its purpose, to safeguard life, property, and the environment, DNV helps its customers seize opportunities and tackle the risks arising from global transformations. DNV is a trusted voice for many of the world's most successful and forward-thinking companies.

In the energy industry

We provide assurance to the entire energy value chain through our advisory, monitoring, verification, and certification services. As the world's leading resource of independent energy experts and technical advisors, we help industries and governments to navigate the many complex, interrelated transitions taking place globally and regionally, in the energy industry. We are committed to realizing the goals of the Paris Agreement, and support our customers to transition faster to a deeply decarbonized energy system."



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IX Renewables

IX Renewables has been supporting clients in all life stages of onshore wind power plants since 2004, and in offshore wind since 2006. IX excels in bridging the gap between technical, commercial, and legal worlds.

As owner's and bank's engineer, the company's services include contract management, risk assessment, and O&M strategies. By identifying key risks, optimizing OPEX versus power production, and presenting more accurate cash flow projections, risks are minimized and profits increased.

As techno-economic advisor and consulting engineers, IX ensures our client's capability to make well-informed decisions, for example, through due diligence and procurement services.

In 2020, the full responsibility for decommissioning and repowering of wind power plants was added to the Index of services. From our offices in the Netherlands, Taiwan and Japan, we serve our clients with an adaptive attitude and a holistic approach.

IX Renewables, your global renewable energy partner.



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Liberty Mutual Surety

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Nationale Borg is now Liberty Mutual Surety

Since October 2019, Nationale Borg is part of Liberty Mutual Surety, a unit within Liberty Mutual Insurance, the largest surety in the world. With underwriting offices in 18 countries and bonds issued throughout the world, Liberty Mutual Surety has the ability, experience and resources to underwrite all types of contractors and corporations for local, regional, national and multinational customers.

Your company will not be burdened with capital being blocked

Working with Liberty Mutual Surety in the Netherlands offers you major advantages. In principle, we will not ask for collateral to cover your guarantee risk. We work on the basis of trust. A Liberty Mutual Surety guarantee, therefore, should not block any of your financial space leaving you free to deploy your working capital optimally. We specialize mainly in issuing performance guarantees and advance payment guarantees, as well as in issuing guarantees regarding import duties and excise duties.



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Pondera

Pondera is a globally operating consulting and project development firm. Since the company's start up in 2007, we have been supporting clients in developing onshore and offshore renewable energy projects. Pondera's well recognized track record dates back to one of the world's first offshore wind farms. In recent years our expertise in renewable energy generation has expanded into energy conversion (e.g. green hydrogen) and energy storage (e.g. utility-scale grid batteries).

We offer over 15 years of experience in technical and commercial consultancy. Through the years, our total project portfolio increased to 16GW of installed capacity. Pondera's experts are skilled to identify and mitigate risks at an early project stage. We provide strategic advice and hands-on delivery support to projects in all stages of the project life cycle, from the initial feasibility phase through concept design, licensing, contracting, construction to successful operations.

Pondera has worked on iconic projects such as the development of the Haliade-X 12+ MW wind turbine, one of the world's most powerful offshore wind turbines, featuring a 14.5 MW capacity and a 220-meter rotor. Together with Sif Group and GE Renewable Energy, Pondera is now working on Amphytrite, an offshore demo project. The objective is to contribute to affordable large-scale green hydrogen production at sea, thereby supporting decarbonization and accelerating the energy transition.



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Ventolines

Ventolines – Moving Forward with Renewable Energy

Ventolines is an integrated service provider in the renewable energy sector, with a clear mission: we aim for a world where renewable energy projects deliver value for everyone.

We optimise value for our clients in the energy transition by guiding them through the successful development, realisation, and operation of renewable energy and system integration projects.

We offer expertise across all project stages, from early development to repowering. Our strength lies in our integrated approach, delivering tailored solutions that meet our clients' ambitions and needs, while staying aligned with market trends and societal expectations.

Founded in the Netherlands in 2007, Ventolines has grown into a company of over 100 experts. Together, we have realised more than 2GW of renewable energy capacity for our clients and manage over 1.5GW in asset portfolios. We are proud to have played a major role in some of the

Netherlands' most significant renewable energy projects, including Windplan Groen and Windpark Fryslân. Internationally, we are involved in numerous onshore, nearshore, and offshore projects across several countries.

Driven by a vision of a future where renewable energy moves everyone forward, we are expanding into international markets, including Ireland, the USA, Scandinavia, and the Baltics. In doing so, we support communities worldwide, create investor value, and contribute to a sustainable, affordable energy system.



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Project research

Deltares

Deltares is a not-for-profit, world-leading, and mission-driven Dutch knowledge institute for water and the subsurface. We work throughout the world, and we are guided by the major societal issues, for which Deltares' knowledge is indispensable. This is what drives our highly qualified workforce of 800 colleagues, which is comprised of over forty different nationalities.

The challenges for offshore wind energy lie in scaling up, ecological impact, multifunctional use, and balancing the needs of a growing number of stakeholders. Deltares collaborates with industry and other knowledge institutions on research and advice on ecological and technical aspects, such as hydrodynamics, geology, foundations, cables, corrosion, and impact on the ecosystem. The future generation of wind farms will face new installation challenges in deeper and increasingly more hostile environments. Whether you are an offshore contractor, energy utility, or engineering company, we can assist you throughout your design, installation, operation & maintenance, and decommissioning phases.

We develop knowledge and tools for the industry that mitigates and minimizes risks to guarantee safe, reliable, sustainable, and cost-efficient operations. We are always actively looking for (industry) partners to collaborate on Joint-Industry Projects to further accelerate achieving the ambitious global targets related to the energy transition.

Deltares

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Fugro

Fugro is the world's leading Geo-data specialist. Through integrated data acquisition, analysis and advice, Fugro supports clients in mitigating risks during design, construction and operation of their assets at sea. With our 'triple A' approach, we add value throughout the complete asset life cycle by reducing uncertainty and client exposure to subsurface risk. We contribute to a safe and liveable world by delivering solutions in support of the energy transition.

With our team of dedicated experts, specialised assets and cutting-edge digital technologies, we offer our services to a broad spectrum of clients.

For over 25 years, Fugro has provided solutions for the development of offshore windfarms. We support our clients leveraging our long-standing relationships as they grow their renewables business. We offer a wide range of site characterisation and operations and maintenance services such as soil investigations and geoconsulting for wind turbine foundations and integrity assessments to support life-time assessments. Our growing fleet of uncrewed surface vessels (USVs) and remotely operated vehicles is leading the industry transition to more sustainable operations. With a 95% reduction in carbon emissions, safer operations and access to real-time data, USVs and remote and autonomous solutions play an important part in a successful energy transition.

FUGRO

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Geomil Equipment

For over 85 years, Geomil has been developing and manufacturing Cone Penetration Testing (CPT) equipment, enabling high-quality and effective geotechnical site investigations. CPT data is fundamental for reliable offshore soil profiling as it sets the basis for cost effective project realization.

The most commended Geomil systems are the Manta-100, Manta-200, Orca-90/125 and Marlin-120.

- Geomil Manta's are seabed CPT systems which can operate anywhere from shallow to deep waters. At the heart of the Manta is the unique Continuous Drive System (CDS), providing unrivalled push capacity. The latest addition to the product range is a Seismic Source Frame allowing for seismic CPT.
- The Orca is a downhole CPT and soil sampling system compatible with most common drill rigs. The Orca can provide real-time data and has proven to ensure high efficiency and repeatable test data.

- The Orca can be supported by a Marlin seabed template.
- All Geomil offshore equipment is modular such that key components can be used with different systems in the portfolio.

Geomil is looking for partners with the ambition to develop the market for offshore wind, using CPT technology. We are specifically interested to collaborate with:

- Geotechnical companies.
- Survey companies with an interest to step into geotechnics.
- Vessel owners with the ambition to equip their vessel for CPT.
- Companies interested to act as a (service) reseller.

Geomil equipment

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Maritime Research Institute Netherlands (MARIN)

MARIN is a globally recognised top institute for maritime research. Our mission is 'Better Ships, Blue Oceans': we stand for clean, smart and safe shipping and sustainable use of the sea. We do this as an independent knowledge partner for the maritime sector, government and society. We offer integrated solutions, from concept development and design to operation, making optimal use of our model testing facilities, computer simulations, simulators and full-scale measurements. In developing, applying and sharing our knowledge, we stimulate innovation and global collaboration. The knowledge and involvement of our people are our strength.

In the future we will continue to support our mission, focusing on an even stronger base of knowledge, reliable tools and modern facilities. With this strengthened base we will optimise the entire maritime operation, the ship, the (floating) wind turbine as a system and the human role in this. Our knowledge and ideas will stimulate the development of a safer and cleaner shipping industry, as well as encourage the sustainable use of the ocean for the extraction of energy, food and raw material and the development of cultivated life and autonomous systems at sea.



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Pondera

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Periplus Group

Over the past 20 years the Periplus Group has provided specialized IT-solutions, personnel and know-how in the field of hydrography and related disciplines.

Besides the "traditional" expertise on hydrographic issues, we focus on providing our clients with high quality software, consultancy services and project support. We can provide your Offshore Wind project with expertise in geology, geophysics, engineering support, underwater archaeology, GIS, data processing and subsea data management.

Periplus Solutions employs a team of software developers specialized in solutions in the geographical domain. We are ideally positioned to develop software for the marine environment. Combining this with our roots in hydrography, we have developed our innovative online subsea data platform GR:Dit which is designed to help you to visualize and analyse asset-related offshore subsea data. GR:Dit utilizes a combination of historical information and inspection results to provide you with comprehensive tools to assess the condition of your assets within their environment. GR:Dit is the ideal platform to store all your subsea data and to perform Burial Assessments for cables. GR:Dit is used by Windfarm Operators in The Netherlands, Belgium and Germany serving a total of 4GW in Offshore Wind generating capacity.

At Periplus we are proud to have been involved in 300+ projects in the Offshore Wind, Oil&Gas, Dredging, Construction, and Government sectors.



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concept design, licensing, contracting, construction to successful operations.

Pondera has worked on iconic projects such as the development of the Haliade-X 12+ MW wind turbine, one of the world's most powerful offshore wind turbines, featuring a 14.5 MW capacity and a 220-meter rotor. Together with Sif Group and GE Renewable Energy, Pondera is now working on Amphytrite, an offshore demo project. The objective is to contribute to affordable large-scale green hydrogen production at sea, thereby supporting decarbonization and accelerating the energy transition.



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Dutch Marine Energy Centre (DMEC)

DMEC (Dutch Marine Energy Centre) is an accelerator and knowledge centre for offshore renewable energy (ORE) solutions. As a non-profit organisation, we advance innovation, support market development and further policies for ORE development. With this integrated approach, we create multipurpose energy solutions including marine energy, offshore storage and nature-positive designs for a wide variety of use cases.

We work closely together with key private and public ORE players and advise corporates on the uptake of ORE sources to create sustainable growth. By combining our technical and financial expertise, our models on ORE technologies, and our industry insights, we are the go-to partner for developing ORE solutions that fit specific market needs.

In our accelerator, we lead and partner in international innovation projects, covering the entire trajectory from concept to commercial deployment of ORE solutions.

As coordinator of the EU-funded flagship project EU-SCORES, we, together with the project consortium, are advancing innovations to demonstrate the co-location and technical integration of ORE sources, such as offshore wind, wave energy, and offshore solar.



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Witteveen + Bos

Witteveen+Bos is an engineering and consultancy firm headquartered in the Netherlands with a staff of around 1,500 professionals operating worldwide. We have a proven track record in the onshore and offshore wind sector for over a decade, delivering engineering and environmental consultancy services.

Clients value Witteveen+Bos's multidisciplinary approach and recognise it as one of our distinctive qualities. Our scale means we can form tailor-made teams of in-house experts to achieve the best possible solution every time.

Our offshore team consists of more than 120 academically trained professionals with combined experience on over 100 projects.

Our services in the offshore wind sector include:

- Feasibility Studies
- Environmental Impact Assessments (EIA) and Permitting
- Metocean Studies and Wind Resource Assessments
- Nature-Inclusive Design
- Floating Wind Technology
- Geosciences and Geotechnical Engineering
- Foundation Design
- Cable Design and Installation
- Grid Connection and Integration
- Logistics and Supply Chain Management



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Waardenburg Ecology

Waardenburg Ecology, founded in 1979, is an independent consultancy firm for research, advice and design in the field of ecology, nature restoration and landscape.

With over 150 employees, they work across the full spectrum of ecology and the impact to changes in the environment. Waardenburg Ecology has been involved with investigating the effects of wind energy projects on wildlife for over 25 years, both offshore as well as onshore.

Since 1992, they are leading in the use of innovative radar technology for bird research. In addition, they have 40 years of knowledge on hard-structure biodiversity. This knowledge, combined with professional scientific divers, innovative camera techniques and practical creative mindsets, enables them to identify opportunities to enhance biodiversity, like ecofriendly scour protection.



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Project, contract, finance support

Bird & Bird

Bird & Bird is an international law firm which supports organisations being changed by the digital world or those leading that change. We combine exceptional legal expertise with deep industry knowledge and refreshingly creative thinking, to help clients achieve their commercial goals. We have over 1400 lawyers in 31 offices across EMEA, North America and Asia Pacific, as well as close ties with firms in other parts of the world.

We believe we have one of the leading international renewable energy practices in the world and are continuously ranked as the most active legal advisers on both renewable energy M&A and project transactions in Europe. We are an international cohesive and expert team who understand how to work together to complete renewables projects to international investor standards.

In the Netherlands, our Energy team is trusted by clients for their energy industry knowledge and ability to solve complex problems through deep sector expertise and specific technical abilities. We provide tailored and commercially oriented advice and assist our clients in high profile ground-breaking and complex transactions and projects such as multi-billion offshore wind parks, (combination of) large solar parks and battery storage systems, hydrogen facilities and innovative projects such as nuclear technology and blockchain enabled energy projects.

Bird & Bird

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ESP Renewables

ESP Renewables is a project- and consultancy company formed from a common goal, to come together to share knowledge and expertise.

Our professionals believe, when we are working together, continuously developing our skills, providing the right services to our clients, and expanding the organization with professionals, we can create impact in the renewable industry together.

We always work in a safe and sustainable environment for our professionals and stakeholders.

Building a trusting network of consultants with experience in the renewable energy industry, where we value integrity, long-term partnerships and delivering quality always keeping in mind we are on the journey to net-zero.

'Strength by Knowledge' is our motto, where we believe in the connection within our network to be able to provide the knowledge you need. We have been involved in both onshore and offshore wind farms, solar energy and hydrogen power, always keeping in mind the journey to net-zero and developing a sustainable future together.



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Flux Partners

Flux Partners, an advisory company founded in 2014 with tender management, non-price criteria, contract management and sustainability as core competencies, is committed to realize healthy energy and infrastructure projects for its clients. We deliver high-quality and hands-on tender and sustainability advice over the width of the energy transition, including offshore wind, grid and port infrastructure, subsea cables, and hydrogen.

Achieving lasting impact, achieving sustainable results. Our committed team of 90+ advisors constantly considers how things can be done even better. Our clients include developers and contractors, energy system operators, (local) governments and technology providers.

We participated in hundreds of non-price criteria plans for public tenders and have a strong track record in wind.

Flux, headquartered in the Netherlands, operates in Europe and beyond.



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Intramur Insurances

INTRAMAR insurances was found in 1994 to service suppliers and contractors in the (offshore) energy industries. From the office based in the offshore port of Den Helder, the dedicated INTRAMAR team is able to provide services for a Clients working worldwide.

Facing the complexity of energy contracts, Clients can rely on the specialists at INTRAMAR to obtain tailor made advice and adequate insurance solutions.

Particular with respect to requirements regarding Offshore Liability, including contractual liabilities, employers liability, products and professional liability, the experienced brokers will be at your service to respond with expert advice. Insurance certificates as proof of insurance are supplied to all Clients, stating the major insurance and contractual elements like Principals as co-Assureds, waiver of subrogation rights, etc.

Further, for all kind of your precious (subsea) equipment, vessels, tools, etc. the INTRAMAR team is able to arrange comprehensive cover within the timeframe required.

Last but not least, INTRAMAR will be happy to arrange cover for your personnel, hired staff, etc. as required for all specific working locations, including cover for medevac from offshore locations and cover for high risk areas.



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www.intramar.nl

OutSmart

Are you interested in predicting the short and long-term costs of your wind and solar project? It may seem challenging, but at OutSmart, we excel in this area. As experts in the field, our primary focus lies in the operational phase of your projects, performing our services 24/7, 365 days per year. We provide support to investors, owners, fund managers, and industrial off-takers, helping them effectively operate their assets and optimize returns.

Since 2008, we have been at the forefront of the energy transition. Our operations span across the Netherlands, Germany, Belgium, Taiwan and the United Kingdom. The market recognizes us for our extensive knowledge and experience in the operational management of both onshore and offshore renewable energy projects.

Our team consists of >40 specialized employees, each proficient in their respective disciplines, such as technical analyses and advises, technical and commercial reporting, marine and flight coordination, as well as Permit to Work, HSE and IT management. We collaborate closely with partners on technical solutions for wind turbines and solar parks. Drawing from our experience, we understand how to accurately predict and influence efficiency in the short and medium term.



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Rebel

Building on our experience in infrastructure, we started our renewable energy practice in 2008. We apply our financial, economic and strategic expertise in renewable energy sectors such as wind energy (offshore and onshore), district heating and cooling, water, geothermal energy, biomass, biogas, solar and energy efficiency.

Rebel provides the complete package of financial advisory services for all stages of offshore wind projects. We support clients with financial modelling, project structuring & contracting, arranging debt and equity, strategic advisory, mergers and acquisitions and concession tenders.



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12.2 Wind Turbines

Component supply, engineering support

Boltlife BV

Boltlife specializes in ultrasonic bolt load measurements and procedures for closing bolted ring flange connections. Our procedures cover all critical bolted connections used in wind turbines and supporting structures.

We offer consultancy, training, tooling, remote support and technical personnel during the preparation, installation and operational phases of a project.

Our methodologies offer solutions that can be implemented at any point in time during the lifetime of your turbines. Boltlife provides you with fully documented and traceable insights in the quality of the bolted connections in your project.

Our basic service consists of project preparation, training and supervision for local technicians complemented with QA/QC and reporting from the data generated. Quality, efficiency and safety are the key words for our procedures. Reduce 40 to 80% in offshore time and eliminate the use of heavy hydraulic equipment during the O&M phase while increasing the quality and lifecycle of the bolted connections.



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C1 Connections BV

C1 Connections is the developer of the novel connection technology, the C1 Wedge Connection (TM) to connect large wind turbine components such as the connection between monopile and transition piece and the connection between foundation and tower.

The C1 Wedge Connection(TM) has a higher ultimate and fatigue capacity than conventional connections and has track record with several connections in the largest wind turbines in the world.

The C1 Wedge Connection(TM) can be installed significantly safer and faster than conventional connections and does not require maintenance, saving on OPEX. On average the connections is 50% lighter than the conventional L-flange connection and enables further optimizations in tower and foundations, thereby directly enabling large CAPEX savings compared to all alternatives. The C1 Wedge Connection(TM) has been certified by DNV.

C1 Connections supplies the fasteners for the C1 Wedge Connection to the industry and offers engineering services to design and integrate the C1 Wedge Connection into wind turbines.



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www.c1connections.com

EJ-Projects B.V.

In 2007, Eric Jansen founded EJ-Projects B.V., specialising in Integrated Design and Analysis services. With a strong technical background in aerospace, turbo-machinery, and wind energy, he focuses on computational mechanics, including loads engineering, aeroelasticity, control engineering, aero- and hydrodynamics, and structural dynamics.

EJ-Projects offers comprehensive, independent technical consultancy services, emphasising scientifically robust and technically sound solutions for dynamic load scenarios in aeromechanical systems and wind energy conversion. The extensive project portfolio includes collaborations with established OEMs and startups on diverse product development initiatives.

A key service is Integrated Load Analysis (ILA), which addresses the life-cycle of wind turbines and their bottom-fixed/floating foundations - from design to certification and maintenance. This process employs numerical simulations, accounting for factors like met-ocean

conditions, active control, and load-carrying component dynamics. All analyses adhere to international guidelines and regulations, ensuring compliance with turbine class and site-specific requirements.

Additionally, EJ-Projects pursues advanced research and development to develop troubleshooting models for innovative turbine and foundation concepts. This enhances the ability to provide cutting-edge solutions, driving innovation and technical de-risking.

Overall, EJ-Projects is committed to engineering excellence, leveraging expertise in model-based design and certification to deliver transformative solutions in the wind energy sector.



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Hetraco

“We make special fasteners an experience”

We produce fasteners from M5 till around M200, and other thread related dimensions! We've a large and wide variety of raw-materials on stock. These materials are standard steels, high pressure, high temperature, stainless steel till the nickel alloys. We're able to produce orders with delivery date the same day and can offer small quantities.

Our company is also experienced with all Classifications like Lloyd's, Bureau Veritas, etc.



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www.hetraco.com

LiftWerx Europe

Based in North America and Europe, LiftWerx provides turnkey services for Wind Turbine major repairs. We use fully-electric crane-less technology to perform the following types of repairs: Main Bearing Exchanges, Gearbox Exchanges, Generator Exchanges, Blade Exchanges, Pitch Bearing Exchanges and Yaw Drive Exchanges. We perform work on turbine types such as Siemens, Vestas, Gamesa, Senvion, GE and more. LiftWerx is the world's first contractor to offer crane-less technology for offshore wind turbines. Our technology avoids the use of large jack-up barges and specialized heavy-lift vessels. By using proven crane-less technology which can be deployed from small vessels, large corrective repairs can be performed at a much lower cost and in high wind speeds. Our solution is safe, efficient, and reliable.



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Pentas

Pentas is one of the most modern and advanced companies in Europe in the field of producing plastic products by rotational moulding. We have 11 rotational moulding machines and 8 milling machines. Since our establishment, in 1975, we see technology as the basis for the optimal delivery of customer-specific plastic products.

We consist of a team of 150 professionals with a heart for technology and are very committed to the world around us. So we look beyond technical specifications. We want our products to perfectly match the customer's requirements, while also taking into account the end user and the impact of our products on the environment.

Among other things, Pentas produces large water tanks for offshore wind turbines to create a dampening effect against vibrations in the tower.



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Pontis Engineering

Pontis Engineering is a leading international company, active in the rapidly growing industry of advanced composite products.

We specialize in integrated engineering solutions for the development of large fiber reinforced composites, excelling in innovative power, cost effectiveness and quality. To this end we supply a wide range of services covering the entire process from conceptual design to (serial) production and transportation.

We add value to our partners by leveraging on our extensive industry knowledge and network, highly expertised workforce and international presence. Our services cover various growth markets for advanced composites, including the wind power, aerospace, transport and marine sector. With over 20 years of experience in composites, a dedicated in-house design team and our worldwide network of engineers, materials suppliers and knowledge institutes, we are your highly qualified partner in developing state of the art composite structures.



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Radac

We are Radac, a technology leader in radar-based wave measurement. Since 1996, our Delft-based Dutch company has developed unique sensors to monitor the ocean surface. Our wave radar operates without water contact, moving parts, or the need for calibration, making it a maintenance-free device.

Offshore operations are significantly impacted by weather conditions. Highly accurate, real-time wave data is crucial for determining optimal weather windows during which operations can be performed safely. Waves, in particular, contribute to project downtime, as work can only proceed within specific wave conditions for safety reasons. While wave measurements are often taken from transformer platforms or turbines, Radac also provides radars for vessels such as pipelaying, survey, and construction ships.

With the growing size and capacity of offshore wind turbines, stress and fatigue analysis are becoming increasingly important. Accurate wave data at the turbine's location is invaluable for conducting these lifetime analyses.

Our flagship product, the WaveGuide 5 Direction, is a truly unique system—Radac is the only company offering this technology. This directional wave radar precisely measures wave direction, height, period, and tide, while also presenting the 2D-spectrum. It's available in a motion-compensated (roll-pitch-heave) version, making it suitable for floating wind turbines.

At Radac, innovation and high quality are in our DNA. Want to learn more about our solutions? Feel free to contact us.



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www.radac.nl

Robin Radar Systems BV

Robin Radar's mission is to provide actionable information that increases safety and security for both humans and birds. We do that by combining purpose-built radars with unique software algorithms. We are Robin Radar Systems: technology leader in the tracking and classification of small objects. With more than 30 years of applied radar science, we are proud to have in our environmental and wind sector client portfolio, international companies onshore and offshore such as: Equinor, Orsted, Gemini, Waardenburg Ecology, Nina, 3BIRD, Bluebear, Rijkswaterstaat, Fino, Takkolluoto Wind farm, EVN, Luminus (EDF group), Wind Park Friesland and Woolnorth.



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Torc-nology BV

Torc-nology BV is a customer and service-oriented organization specializing in providing high-quality solutions for the safe and efficient tightening of bolted connections. Our core competencies include the sale and rental of torque tools, as well as development and design, maintenance, repair, calibration, and comprehensive consulting and service.

Logistics Expertise

As a rental service provider, Torc-nology is flexible and versatile. We swiftly provide the necessary tools to our clients for a day or offer fully equipped containers with all the required tools for extended periods. With our extensive experience as rental experts, we understand the logistical challenges involved. We are aware that tools often need to be quickly available on-site since demand can be challenging to predict. Management is facilitated through software, which also tracks and documents maintenance and inspection intervals.

Custom Solutions by Our In-House Engineers

Torc-nology recognizes that the right solution is not always readily available. This is why we maintain our own engineering department, comprising mechanical engineers, plant engineers, and torque specialists. They design solutions at both the detailed and system levels, including support arms for torque tools. Additionally, we internally design and calculate offset gearboxes and hydraulic links.



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www.torc-nology.com

We4Ce – The Rotorblade Specialist

Since 2008 We4Ce is the only remaining independent rotor blade design company of the Netherlands for onshore and offshore blades.

Where the core business started with complete blade designs from aerodynamic performances up to structural blade design and certification, already from the start it expertized itself in the blade root to turbine connection. This connection technology, called the We4Ce bushing is implemented in thousands of wind turbines already with great success. The success story of this is extending itself now also to existing blades suffering from loose inserts/ bushings.

Latter technology is referred to as “Re-FIT technology” and makes the blades that presently suffer from loose inserts to last longer: instead of creating waste the vision of We4Ce is to refurbish.

A second technology to offer is AdapTIP. This technology for sure will become a new demand for future blades to be ordered, where the tip part of the blade can be exchanged rapidly for maintenance and optimum power control. The first application is scheduled for early 2024 for reaching a Technical Readiness Level (TRL) 7.



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Integrated Wind turbine concepts

Touchwind

It's TouchWind's mission to make wind energy affordable, everywhere and for everyone. TouchWind's unique tilting angled one-piece rotor floating wind turbine can handle wind speeds of up to 70m/s and allow more compact floating offshore wind farms. This leads to an enormous increase of the energy potential for offshore wind farm by using the TouchWind concept. Next to this, maintenance can be carried out quicker and safe during harsher weather conditions.



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12.3 Foundations

Foundation supply Bottom fixed

Sif Netherlands BV

Sif is a pioneer in the field of offshore foundations. With 75 years of experience, technical ingenuity and the daily commitment of our craftsmen and women, Sif has acquired a leading position in the supply chain for offshore wind farms. Our main product, the monopile, is the most common and most economical solution for installing offshore wind turbines. By delivering quality on time, safely and within the agreed budget for years, we are co-determining the speed with which the energy transition can take place. We have proven this: Currently, there are 2,400 Sif foundations anchored in the seabed. We are proud of that, because they are crucial for achieving our objectives in the energy transition.

Global politics faces a huge challenge: the energy transition. Sif lays the foundation needed for this – literally and figuratively. Sif dares to lead the way and not only to propagate its mission and vision, but also to follow through with actions. 20.2 million households already receive power from offshore wind turbines that stand on our foundation. Sif's monopiles enable these turbines to supply power under all circumstances; And that while the wind can blow at a speed of 70 km/h and the waves can reach a height of 6 meters. The energy transition builds on Sif.



Sif

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www.sif-group.com

Smulders

Smulders is a multidisciplinary and international organisation with a passion for steel and sustainability. Our facilities are located in Belgium, the Netherlands, Poland and the UK. We take care of full engineering, manufacturing and systems integration projects – Manufacturing a sustainable world. Our portfolio includes buildings, bridges, high-voltage pylons and other projects across the energy transition, predominantly offshore wind farms.

The whole world is our field of action, and we are the European market leader when it comes to building the foundations and substations for offshore wind projects. A mix of passion for steel and the drive and know-how to be a sustainable pioneer in the industry. Innovative too, which has made us evolve from a pure steel construction company to a systems integrator (EPC - Engineering, Procurement, Construction). With our own electrical/mechanical engineering department, we can design and build offshore projects completely in-house (turnkey).

We have track record of over 2,500 transition pieces, 160 jackets, 3 floating foundations, and 40 substations.

Central base of operations

In 2023, Smulders acquired a production and assembly site in Vlissingen: Smulders Projects Netherlands. Vlissingen is the perfect base to e.g. further develop our offshore activities. At this strategic location, we assemble bridges, as well as substations (AC and DC) and their jacket foundations. This waterfront site offers plenty of potential to realise our further growth ambitions.



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SPT Offshore

SPT Offshore is a Business Unit within DEME Offshore specialized in suction pile foundations and anchors. In our 25 years of existence, we were involved in the design, supply and/or installation of over 1,000 suction piles, including 118 wind turbine foundations up to 10 MW.

Suction pile installation is silent. The installation force is generated by water pressure difference hence a minimum of energy is required to install a suction pile foundation. Suction pile structures can be fully decommissioned and even be reused. Combined with the one-piece lift solutions it can be considered as the most energy effective and silent foundation solution.

For floating offshore wind suction pile anchors will be on many occasions the most advantage solution. As suction piles anchors combine the following advantages, besides the noise free and fast installation:

- Large holding capacity also in vertical direction for tension leg moorings
- Multiple anchor lines to one anchor
- Shallow foundation design in case limited sediment layers above bedrock are present.



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Foundation supply Floating

GustoMSC

The pioneers of offshore engineering

GustoMSC is part of NOV, a leading provider of technology and equipment to the global energy industry. We design and engineer advanced mobile offshore units and provide reliable offshore equipment. With our experience, scientific knowledge, and technical expertise, we are committed to transforming innovative ideas into practical solutions. This commitment includes optimizing the performance of new and existing assets through operational support and engineering consultancy services. By collectively exploring the complex landscape of offshore energy, we maximize our customers' potential, contributing to the world's sustainable energy industry.

Our design portfolio features Wind Turbine Installation Vessels, Blade Installation Vessels, Feeder Vessels, Floating Offshore Wind Foundations, and related equipment like jacking systems and heavy lift cranes. In addition, we provide a variety of services for operational units and equipment, including engineering project support, asset upgrades and major conversions and aftermarket activities. Our engineering consultancy offers industry-leading expertise in areas such as site-specific or dynamic positioning analysis, earthquake-response analysis, and vessel-impact analysis.

Based on our expertise and track record GustoMSC is well positioned to support clients in conceiving and realizing dedicated and integrated solutions to meet today's challenging requirements of the floating and fixed offshore wind markets.



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- Shallow foundation design in case limited sediment layers above bedrock are present.



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Component supply, engineering support

Circular Covers by CCM B.V.

Circular Cover Manufacturing is a truly Dutch designer and fabricator of new kinds of monopile hardcovers. Our hardcovers are an essential piece of equipment during the construction of offshore wind farms. The hardcovers are tailor-made and can be adjusted to meet the most challenging key performance requirements of any project. CCM hardcovers are made of high-quality materials, do not require any maintenance and are price competitive.

We've got you covered

The innovative design and the used materials ensure a pleasant working environment for all on- and offshore personnel. Natural ventilation on top ensures the flow of fresh air into the working area which also prevents the growth of moulds. All the installed hatches are translucent, can be easily removed, safely stored, and reinstalled because of the lightweight materials used. Our design is also strong enough to allow the hardcover to be lifted with only three slings, even when stacked. The covers can be mechanically connected and can be lifted and stacked, up to five pieces. The construction of these stacks is also suitable for transportation on seagoing vessels. Due to these advantages Vattenfall has chosen CCM hardcovers for the 'Hollandse Kust Zuid Offshore Wind Farm'.



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GustoMSC

GustoMSC is part of NOV, a leading provider of technology and equipment to the global energy industry. We design and engineer advanced mobile offshore units and provide reliable offshore equipment. With our experience, scientific knowledge, and technical expertise, we are committed to transforming innovative ideas into practical solutions. This commitment includes optimizing the performance of new and existing assets through operational support and engineering consultancy services. By collectively exploring the complex landscape of offshore energy, we maximize our customers' potential, contributing to the world's sustainable energy industry.

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Finsulate

Finsulate provides an environmental friendly, non-toxic and easy to clean anti-fouling solution for bottom fixed and floating offshore wind foundations. By applying specialized short fibers to the structure's surface, Finsulate minimizes the attachment of marine organisms, such as mussels and barnacles, thereby preventing accelerated wear and tear and ensuring long-lasting protection for the structures. With its advanced adhesive technology, Finsulate offers a lifespan of 20-30 years.

The growth of marine organisms on submerged structures poses significant challenges, including difficult and time-consuming inspections, with cleaning accounting for over two-thirds of inspection costs. However, Finsulate's innovative solution addresses these difficulties and simplifies inspection processes and substantially decreases associated costs.

In addition to offshore wind power structures, Finsulate is suitable for various other offshore wind related equipment,

including Anchoring Cables, Crew Transfer Vessels (CTV's), Tugs, Service Operation Vessels (SOV's), and Wind Turbine Installation Vessels (WTIV's). Not only is Finsulate environmentally friendly, but it also lowers operating costs and saves valuable time.

With a proven track record in ship applications and through a successful Offshore Wind demonstration project, Finsulate is a reliable and smart choice for offshore structures, offering exceptional longevity.



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Heerema Engineering Solutions

Heerema Engineering Solutions (HES) is an engineering and consultancy firm focusing on the offshore construction of renewable projects. We aim to create new solutions and add value to sustainable offshore projects by translating our theoretical knowledge into practical solutions. HES plays a key role in offshore renewable projects from early phase development through the entire life cycle to decommissioning.

Our approach combines years of engineering experience with automation to deliver reliable, relevant solutions for our clients. By engineering the tools of the future, we can focus on the successful delivery of renewable projects worldwide. Examples of HES' work include developing robust and cost-effective construction strategies for clients, assisting in solving industry challenges related to floating offshore wind, and applying our engineering and operational knowledge to design components and equipment.

Our core team of around 40 colleagues specialize in the offshore (renewables) industry and provides various engineering disciplines. We look forward to bringing inspiration and innovation offshore to achieve our mission of using *our deep understanding of working at sea to create new solutions that accelerate the world's transition to green energy.*



**ENGINEERING
SOLUTIONS**

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<http://hes.heerema.com>

Selmers

"Selmers delivers tailor-made process solutions for the handling, cleaning, and coating of steel objects. Their advanced focus lies in the integration of mechatronic equipment, robotics, and a high degree of automation. Specializing in surface treatments for conduits, pipes, profiles, monopiles, and wind towers, Selmers stands at the forefront of the pipe industry. Their rich legacy, spanning over 50 years, underpins their global leadership position.

Selmers' holistic approach encompasses robust in-house engineering capabilities across all relevant disciplines. A notable strength is their expertise in IT/OT integration, supplemented by a state-of-the-art data management software platform and immersive VR simulations.

Mooreast Europe BV

Mooreast is a designer, manufacturer and supplier of mooring systems. Providing services worldwide, Mooreast is a leading company for total mooring solutions under different classification, various load and soil conditions. Predominantly active in the offshore oil & gas market, Mooreast has a leading role in providing mooring systems to the offshore renewable energy market. International services are provided by Mooreast since 1993 to engineering companies (FPSO/CALM), drilling contractors, dredging, -installation and pipe lay contractors as well as operators. Mooreast works with two production locations (Netherlands and Singapore) to serve the project's best logistic and timely delivery.

Anchors

Mooreast supplies its own design MA5 and MA7 drag embedment anchors used in various applications with classification authorities.

Buoys

Mooring buoys, surface buoy; Mooreast has developed its own design and provides standardized types and special design with different layout to fit the project.

Rental

A rental fleet of anchors, buoys and mooring lines is available for immediate supply and special design equipment will be considered upon request.

Rigging

The newly established rigging department is providing hoisting materials, wire rope- and synthetics slings, shackles and connectors of major brands and keeps stock of commonly used size and types. Material testing is provided by the newly installed testing bed up to 600 mT.

MOOREAST

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Driven by a deep-rooted commitment to sustainability, Selmers strives to produce solutions that conscientiously conserve our planet's resources. This ensures the safe and sustainable use of vital resources like oil, biogas, hydrogen, water, and wind energy. It is Selmers' enduring ambition to be more than just a service provider; they aim to be a trusted partner that significantly elevates their clients' operational excellence."



mail@selmers.com
www.selmers.com

TNO Energy Transition

TNO, the Netherlands Organization for Applied Scientific Research, was founded by law in 1932 to enable business and government to apply knowledge. As an organization regulated by public law, TNO is independent: not part of any government, university or company.

Since April 1st 2018, the Energy Research Centre of the Netherlands, ECN, has joined forces with TNO and has become TNO Energy Transition.

ECN (Energy research Centre of the Netherlands) has been the Netherlands flagship R&D and services centre for sustainable energy technologies. In the field of wind energy, ECN was a true pioneer and technical authority. It's internationally leading position has been built up through 40 years of dedicated investment and experience. At present as TNO Wind Energy, in-depth knowledge of the whole wind power plant system is combined with world leading full scale test facilities and accredited measurement experts.

Today, TNO Wind Energy's core mission is to reduce the cost of offshore wind energy. This is achieved by applying innovative solutions in the industry and driving ground breaking R&D forward. TNO Wind energy supports companies at the design, implementation and operational level.



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Tree Composites

Tree Composites introduces the TC-joint, a novel technology based on composite as an alternative to the complex welded joints in multi-membered tubular structures. We provide solutions to realise dynamically loaded structures with higher fatigue resistance. Additional advantages include substantial steel reduction, lower pricing, reduced carbon footprint, and simultaneous increase of structure manufacturing speed at the construction site.

In 2020 we incorporated Tree Composites to bring this technology designed by TU Delft to the market and obtained a statement of feasibility issued by offshore certification body DNV. The team currently consist of 15 people that bring together experience in offshore wind structures, composite design and composite manufacturing.

The TC-joint is applicable to a wide variety of industries, but we put our efforts in the industry where we can make the greatest impact, offshore structures. Continuous effort is put into reaching new levels of certification, developing new tools and knowledge. From this point on, we look forward to develop our joint technology to its full potential: paving the path towards more sustainable renewable energy.



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Trelleborg

Trelleborg Infrastructure's polymer sealing and damping solutions are built on decades of craftsmanship. When it comes to offshore wind, immersed tunnelling, dredging, water infrastructure, noise and vibration isolation, and high-performance special projects, the operational capability of our solutions are assured at the highest level. We have unrivalled global reach, with feet-on-the ground local presence, cross-industry expertise and in-house end-to-end solution capabilities, combining to improve integrity, sustainability and efficiency, and accelerate performance across projects.

Trelleborg Marine and Infrastructure's industry-leading solutions for offshore wind foundation seals are built on deep expertise and design knowledge to help you calculate the right specifications with accuracy and precision. Whether you are developing your first designs or innovating on your previous successes, our experience of working alongside contractors and subcontractors ensures that we deliver product excellence and support within your timelines.

Trelleborg, when failure is not an option. We are proud to have been the trusted supplier for more than 3600 Foundation Seals in offshore wind over the last 15 years. Next to these seals we focus on providing solutions to the offshore renewable energy market with grout seals, airtight deck seals, MP/TP flange seals, Tower seals, compression seals, inflatable seals, self-activating seals, anti-vibration solutions, shock pads, fenders, flexible mooring systems, installation & inspection.



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FibreMax

In the realm of offshore wind solutions, FibreMax emerges as a true game-changer. This Dutch company has set itself apart by introducing an innovation that is revolutionizing the industry; parallel endless wound fiber cables.

What makes this product truly exceptional is not just its uniqueness, but its wide-ranging applications.

FibreMax's patented cables have found their way into a multitude of sectors, from (offshore) cranes to tidal energy projects, yacht rigging, and the mooring of floating wind turbines, XXL Monopiles. Their versatility knows no bounds.

One of FibreMax's key strengths lies in its highly automated production process. This not only ensures precision but also enables them to scale up effortlessly, even on a global scale, to meet local content requirements which will de-risk projects significantly.

However, it's not just about automation and versatility. FibreMax's cables are engineered with impeccable precision, require no maintenance, are impervious to corrosion, are a remarkable >80% lighter than conventional steel cables and can be made from circular fibers.

These attributes make FibreMax cables the go-to choice for the most demanding on-and-offshore applications, where durability and performance are non-negotiable.

FIBREMax
World's *strongest* cable...

info@fibremax.nl
<https://fibremax.nl/>

Delmar Systems

Delmar Systems is the trusted partners to most offshore energy industry's leaders, delivering innovative and customer-focused anchoring and mooring solutions. We are committed to the highest standards of safety, integrity, and respect to the environment. We are proud of our legacy and impeccable track record over our combined 100 years, always delivering value in everything we do.



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12.4 Substations, subsea cables

Component supply, engineering support

24shore

24shore offers a comprehensive cable storage and management solution, addressing both offshore and onshore requirements. The company supplies a range of cable storage equipment, including the Modular Cable System (MCS), Offshore and Onshore Turntables, and Baskets. Operating under the umbrella of the XELLZ Group, 24shore specializes in project logistics management, ensuring transparent control throughout the entire project lifecycle.

Their cable solutions encompass rental, storage, handling, transport, transshipment, and engineering services. Notably, 24shore has introduced an innovative solution called ReelFrame™ for cable loading and transport. This patented innovation allows for longer cable lengths on a single drum for transportation and eliminates the need for mobile cranes during loading and offloading, resulting in a remarkable 45%+ reduction in CO₂ emissions in the logistics aspect of projects.

In addition to their transport solutions, 24shore boasts the Project Logistics Control Centre (PLCC), a central hub for managing complex projects, handling communication, documentation, tracking, contracts, and more.

24shore places a strong emphasis on the value-driven nature of logistics in projects, aiming to reduce costs and environmental impact significantly. Their experienced team, combined with a robust IT platform, ensures the successful closure of projects with efficiency and innovation at the forefront.



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BEZEMER GROUP B.V.

Bezemer Group B.V. is a privately owned rental and sales company, active in the marine and offshore energy industry worldwide. Bezemer provides pulling and lifting solutions with a small footprint, using hydraulics, based on proven technology.

As a leading global winch expert, Bezemer supplies a wide range of cable-pulling equipment. Their services include:

- Linear winches
- Drum winches
- Roller & anchor fairleaders
- Various wire-handling equipment

With more than 60 years of knowledge and experience, Bezemer is committed to being the safest and most reliable supplier for infrastructural projects globally.

Bezemer is also instrumental in offshore wind projects, Bezemer recently provided mooring winches for the South Fork Offshore Wind Farm and Revolution Wind in the USA. They also offered winches to support during the landfall of the export cables for the Iles d'Yeu and Noirmoutier and Hollandse Kust West Beta offshore wind farms.

Additionally, Bezemer has developed an innovative offshore floating wind concept, where Bezemer's winches are used to install, tension and test moorings for floating wind turbines. This concept offers a low CAPEX and environmentally friendly alternative to current installations, which typically rely on powerful anchor handling tugs that are scarce and consume large amounts of hydrocarbons.



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Blueoffshore

The company

Blue Offshore is a Dutch subsea installation contractor founded in early 2010. Our company provides world-wide solutions for subsea cable installation to international clients. We provide support from the conceptual design stage to engineering, construction, installation and commissioning for offshore subsea cables, flexibles and umbilicals. We stand for highly qualified individuals with proven track records, modular and flexible equipment, strategic and operational best-in-class partners.

Our services

Our team assists customers with world-class innovative standalone solutions to suit their particular project needs. This service includes:

- Design and engineering
- Project management
- Installation equipment
- Offshore construction

Modular Basket Carousel

Our team has developed the world's largest Lloyds Register-certified subsea product installation equipment. The equipment consists, among other, of a modular Basket Carousel and has variable product carrying capacities to suit project requirements up to 5000 metric tonnes. The flexibility and modularity of the system will reduce costs and risks through:

- Flexible product installation schedules
- Product storage and transportation
- Shorter mobilisation and demobilisation schedules
- Increased choice in fit-for-purpose floating platform types to suit best project requirements rather than generic solutions.



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Gouda Holland BV

Gouda Holland is manufacturer and supplier of cable ladders, cable trays and supporting material. Also installation of our own materials is optional.



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HSM Offshore

EPCIC CONTRACTOR OF CHOICE FOR MULTI-DISCIPLINARY OFFSHORE WIND PROJECTS SINCE 2002

Since completing the world's first HV Offshore Substation for the 160 MW Horns Rev A project in 2002, HSM Offshore Energy has become a leader in delivering EPCIC (Engineering, Procurement, Construction, Installation, and Commissioning) projects. Over the past 22 years, our expertise has driven remarkable growth, reflecting the evolution of the offshore wind industry.

From 160 MW to 1,060 MW, and from 900 MT to 5,300 MT topsides, HSM Offshore Energy has expanded its fabrication capabilities and now operates two dedicated construction yards, delivering projects throughout Europe and the Baltic Sea.

HSM Offshore Energy's dedicated teams possess vast experience in project management, engineering, and offshore construction, ensuring seamless delivery from the initial design phase through to the final installation.

By partnering with the world's leading developers and operators, we continue to power the future of offshore wind with sustainable and innovative energy solutions. With a proven track record of reliability, safety, and excellence, HSM Offshore Energy is at the forefront of the growth of the offshore wind industry, helping to shape a cleaner, more sustainable energy future.



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Heinen & Hopman engineering

Heinen & Hopman was founded in 1965 in the Netherlands as a family business by Melis Heinen and Cees Hopman. Heinen & Hopman has become a leading specialist in the maritime sector. With a global network of 50 subsidiaries, we are able to offer the highest quality of service and products to our clients at all times in all places. HVAC is very important to assure continuous operation of the offshore wind park. Herein we focus in Offshore High Voltage Stations as well as Windfarm Installation vessels to maintain the right indoor climate, temperature and humidity level.

HVAC for offshore substations

HVAC is very important to assure continuous operation of the offshore wind park. Every down time due to technical failure means a decrease in the supply of electrical energy, and thus revenue. By using HVAC equipment of the highest standard, we provide durable and reliable installations. We understand that service visits should be kept to a minimum as visiting an offshore wind farm is slightly more costly than paying a visit to a docked ship. Therefore, we make sure our HVAC systems are low-maintenance. Therefore we use high quality materials – like stainless steel and titanium – to avoid corrosion and guarantee the lifetime of the platform. Harsh environments also require specialized preventive maintenance to minimize the risk of early failures. Our MRO department is specialized in preventive maintenance work and offers customized HVAC maintenance contracts. The offshore wind industry knows 'prevention is better than cure' and to ensure optimal operations of the OHVS regular maintenance on the HVAC cooling system is to be carried out.



HEINEN & HOPMAN

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IV Group

We believe in technology. With the right engineering knowledge, you can produce smart designs and achieve major gains. This is what we are good at. Iv has worked on delivering innovative solutions for transport and handling projects, onshore and offshore for many years. We provide designs that enable the end-customer to carry out their process as efficiently as possible: we execute everything from creating plans to producing detailed designs and workshop drawings. The complex and innovative nature of our projects requires unique knowledge of steel and mechanical engineering, imposes stringent requirements on quality and calls for a great amount of creativity and passion.

Iv-Consult is a multidisciplinary engineering company providing design and consultancy services in the fields of offshore transport and handling, heavy industrial structures and yard handling. We offer our professional services worldwide and aim to exceed our clients' expectations.

We offer a full design package for offshore and onshore projects, from conceptual design through to detailed design, including the workshop detail drawings, weight reconciliation, (offshore) inspections and 3D-scanning. Our engineers are goal-oriented and passionate about their work. At Iv-Consult we are filled with excitement when we are challenged by technically complicated projects.

We offer the following disciplines for offshore services:

- Structural engineering
- Mechanical engineering
- Weight reconciliation
- 3D-scanning
- Logistics

We offer this in these markets:

- Wind energy
- Decommissioning
- Transport & Installation
- Tools & Equipment



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Interdam

As an early entrant to the offshore wind market, InterDam developed a range of weight-saving products that comply with the DNV-ST-0145 standard for offshore substations. InterDam's G21 light-weight sandwich panels provide the most cost-effective solution for internal and external walls of offshore wind substations. As well as reducing topside weight, InterDam's panels are easy to transport and are easy to install.

InterDam also used its extensive offshore experience to develop a range of fit-for-purpose fire doors that maximize lifespan and minimize maintenance in harsh offshore conditions. Our weather-tight, durable fire doors can be applied both in substations and in the Transition Pieces of the wind turbines.

We have supplied our products to over 70 number of OSS and HVDC platforms worldwide for major operators as Ørsted, TenneT, EnBW, Iberdrola, EDF, Vattenfall, RWE and Parkwind.

Design, engineering, fabrication, supply and installation of architectural products for the Offshore SubStations or HVDC platforms.

- External wall panels
- Internal wall panels
- External double sealed doors
- Internal doors
- External windows
- TP/MP Doors



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Reynard Solutions

We perform a wide range of offshore high voltage activities for the connection and maintenance of offshore wind assets, covering array, export or interconnecting cables. Our track record covers a multitude of wind farms and substations. We employ the largest team of HV specialists in the industry. All our staff receive proper and project-specific in-house training and certification prior to every new project.

As a result, our professionals deliver the highest quality of work in shortest amount of time, with an outstanding safety record.

Reynard recently became part of the WTS Energy Group, thereby enlarging its global presence creating the ideal combination of a contractor's mind-set with the flexibility of a large global workforce. Early involvement with our clients is therefore the key to joint success. As experts in our field, we jointly work towards reducing offshore downtime and risks. These time-saving measures are engineered during preparation phases where team optimization and smart solutions are scrutinized to reduce offshore operation time. For the benefits of both our clients and ourselves.

We are aiming to combine three goals – helping our clients become successful while improving the environment at the same time and create a well-trained local workforce. Our aim is simply to become the best jointing company in the world.



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Primo Marine

Since more than 2 decades we advise our clients on major subsea power cable projects, contributing to the greenification of the world's energy supplies. We offer a unique combination of academic knowledge and a long history of field experience to provide smart solutions.

As trustful advisors we provide confidence from boardroom to backdeck level in new or existing subsea infrastructure projects, ensuring your interests are protected by balancing cost, risks and technology over the lifetime of the assets.

We are passionately guiding our clients on technical, contractual & commercial matters related to

interconnectors, export systems, offshore wind farms, new technologies like hydrogen, CO₂ pipelines, floating wind, offshore solar and other smart developments beyond the horizon.



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Seekable

Seekable is an Amsterdam-based startup specializing in advanced technology solutions for the submarine cable industry. We are developing a tracking solution for the detection of submarine power cables, coupled with the simultaneous accurate estimation of their burial depth.

Our innovative tracker, powered by sensors, data analytics and AI, provides real-time and accurate tracking capabilities to optimize cable monitoring. The survey instrumentation uses magnetic data in conjunction with a model that encapsulates the marine environment to determine the relative position of the cable. Seamless integration with all standard offshore survey software is possible.

Regular monitoring of cable position and burial depth can reduce the potential for physical cable damage, which can result in costly downtime. Our team of skilled engineers, researchers and industry experts have worked together to develop an innovative submarine power cable tracker. We are driven by the belief that our solutions will not only improve operational efficiency by reducing cable downtime, but also contribute to the sustainable development of the renewable energy sector.



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SoluForce

There are many initiatives to help our society towards a carbon-free economy. However, there are still quite a few challenges to overcome. Our solution: providing a safe, sustainable, cost-efficient and, above all, quickly deployable infrastructure for local hydrogen distribution. SoluForce is the originator and technological leader in long length high pressure Reinforced Thermoplastic Pipe systems (RTP, also known as Flexible Composite Pipes or FCP). They are used for many applications, such as hydrocarbons, hydrogen, water, offshore and mining. It is completely flexible, fully corrosion-free, does not suffer from hydrogen embrittlement and is quick and simple to install.

Based on proven technologies, it can be the perfect accelerator to achieve local green hydrogen distribution in a fast, flexible and cost-efficient manner. Moreover, the CO₂ footprint of producing the SoluForce pipe is only a fraction of that of a traditional steel pipe, which is an important aspect in an ambition towards a CO₂ neutral industry.

The SoluForce RTP system has been certified for hydrogen applications up to 42 bar of operating pressure. Unique in the world of hydrogen transport and a global first. This significant milestone has a major impact on the feasibility of hydrogen projects, and is a new step towards a sustainable energy mix.



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TKF

At TKF, we specialize in delivering cutting-edge cable solutions for the offshore energy sector. Our extensive experience and focus on innovation enable us to provide high-performance subsea cables that are essential for offshore wind farms and other marine projects. With the launch of our new factory in Eemshaven, we've expanded our capacity to manufacture and supply cables optimized for harsh offshore environments, ensuring reliable power transmission and connectivity in the most challenging conditions.



TKF CONNECTIVITY SOLUTIONS

www.tkf.nl

Vos Prodect Innovations (VPI)

With over 60 years of experience in the offshore business, Vos Prodect Innovations (VPI) can be seen as one of the pioneers in the field of subsea cable protection systems, cable hang-off systems and many other associated solutions for subsea cable manufacturers and installers. Within the industry, VPI has gained a reputation of quality and has been trusted with numerous projects worldwide.

VPI offers a complete system, which includes the cable protection system and the hang-off systems, as a universal package, that has been tested extensively. As the cable protection system serves to protect and stabilize subsea power cables, the hang off-system secures the electricity cable during the installation on a wind turbine and securely locks the cable after final installation. VPI contributes to a greener world by investing in a sustainable future. Offshore wind farms have become incredibly important and can be seen as a crucial factor in the process of sustainability. We at VPI are ready to support in this.

VPI is your preferred partner in the renewable energy market, providing tailor-made subsea solutions for cable manufacturers and installers. VPI offers preliminary installation support as well as opportunities to attend 'training days', to experience first-hand the ease of assembly and installation for our product range.



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12.5 Transport and Installation

Balance of Plant contractors

Ballast Nedam

Ballast Nedam is a Dutch construction and development company which has a rich history in designing and building offshore wind farms. Our experience dates back to 1993 when we completed our first wind farm projects in Dutch waters. Until today, we have installed over 500 foundations and other infrastructure for wind turbines across Europe that still generate large amounts of sustainable energy every day.

As an experienced managing EPCI Contractor, Ballast Nedam is active in the design and construction of unique Balance of Plant solutions, for offshore wind foundations and cabling. Our focus is on specialty projects which often require one-off solutions, for instance in difficult soil conditions or nearshore locations. While difficult soil conditions require unique foundation concepts, nearshore locations have limited water depth or are located in the surf zone near the beach. These locations are not accessible to everyone and require specific approach and equipment. Other specialties of Ballast Nedam include among others gravity base foundation projects. We complete the offshore wind lifecycle by offering dedicated decommissioning solutions for end-of-life wind farms

Our strength lies in combining the knowledge of all involved parties in the supply chain, a project can only be completed successfully through intensive cooperation with the client and subcontractors. Together with our partners, our teams look for solutions that meet every unique situation.



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Mammoet

Mammoet offers solutions for any heavy lifting or transport challenge, helping the world to grow safely and efficiently, moving towards a sustainable future.

We are the world's largest engineered heavy lifting and transport company, with around 140 branches worldwide and around 6,000 colleagues.

To deliver lower-cost offshore wind energy, we manage complex global supply chains, throughout all land-based scopes.

We help move fabricated components from production to storage, then storage to vessel, as quickly as possible, clearing space for the next batch to be manufactured.

Boskalis

As a leading global dredging contractor and marine services provider, Boskalis offers a unique combination of experts, vessels and services. Maintaining the highest safety and sustainability standards, we deliver innovative and competitive all-round solutions to our clients.

For the international offshore energy and renewables sectors we offer an unparalleled range of specialist services as either a service provider or a lump sum contractor for the execution of offshore energy projects.

Within the offshore wind industry Boskalis has a successful track record in providing services throughout every phase of a project. We perform geophysical and geotechnical surveys of the seabed. We take care of transport and installation of the offshore wind turbine foundations such as (XXL) monopiles and jackets for both floating and fixed offshore wind farms. We install and bury export and array cables, and install rock to protect cables and prevent scour damage to offshore foundations. Once the wind farm is operational, we offer long-term subsea inspection, repair and maintenance services (IRM). With our knowledge and experience in the removal of offshore structures we are well positioned to remove offshore wind turbines and cables after their useful life.



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www.boskalis.com/offshore

By managing the entire seaborne transport and storage scope, including load-in and load-out, sea fastening, shipping agents and port marshaling, we reduce project interfaces and risk.

The world's largest cranes help us to assemble turbines close to the quay, where the process is most efficient – funded by operational budgets. We also launch smaller floating foundations this way, with larger types driven onto semi-submersible vessels.



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Seafox

Seafox strives to be world's first choice offshore support jack-up company in the energy industry, meeting and exceeding customers' expectations by offering safe offshore services through global expertise and local knowledge.

For over 30 years we have been managing our offshore support jack-up units around the world providing accommodation, catering, and housekeeping services to the offshore energy sector. Our versatile fleet is able to support both oil & gas and wind related operations such as platform and Offshore Substation hook-up and commissioning services, maintenance activities, well testing and workover operations, transport and installation, plug and abandonment, and decommissioning.

We are determined to providing innovative, safe, and reliable solutions for all our clients active in the offshore energy sector through operational excellence. Therefore, the Seafox units come with a professional crew who has a strong operational philosophy and heritage. Seafox is a dedicated and professional organization with a strong focus on quality and safety on all levels. Our shore-based staff as well as our own marine crew consist of highly-qualified, fully-trained, and quality & safety-conscious professionals that together with our clients endeavour to provide a steady, reliable, and more and more environmental friendly energy spectrum.

Seafox is certified by DNV Register Quality Assurance for:

- ISO 9001 Quality Management Systems
- ISO 14001 Environmental Management Systems
- OHSAS 18001 Occupational Health and Safety Management Systems for the Operations and Management of a fleet of jack-up offshore support units



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www.seafox.com

Van Oord

We are a Dutch family-owned company with over 150 years of experience as an international marine contractor. Our dedication to marine ingenuity drives our commitment to creating a better world for future generations.

Working closely and safely with our clients and stakeholders, we specialise in developing innovative and sustainable solutions. The growing world population demands more space, enhanced maritime transport infrastructure, and better coastal protection due to climate change challenges. Meeting the rising energy demand while reducing global CO₂ emissions necessitates a transition to renewable energy sources, and offshore wind is a key contributor to achieving climate targets worldwide.

With over 20 years of proven experience and an impressive track record in constructing offshore wind projects, Van Oord is leading the way in the energy transition. As an offshore wind contractor, we focus on the entire lifecycle of offshore wind farm development, including designing and engineering wind farm infrastructure, the installation of subsea foundations, electrical infrastructure and offshore wind turbines, as well as heavy maintenance and repair. Our commitment to safety, innovative solutions, the expertise of our employees, and specialised offshore wind equipment significantly contribute to the further build-out of offshore wind energy.



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Van den Herik

Van den Herik is a family business of hydraulic engineers in heart and soul. The passion for working with water originated in 1946. The company has now grown into a multi-disciplinary enterprise with over 200 employees, that is strong in both hydraulic engineering projects and the detection of conventional ordnance. Van den Herik is versatile, sustainable and innovative.

With our seagoing fleet (like Trailing Suction Hopper Dredgers, Backhoe Dredgers, self-propelled Grab Dredger, pontoons, self-propelled Hopper Barges) we have a unique position in the market. Our vessels are, like our company, big enough to make impact, and small enough to be highly maneuverable and flexible. We can take care of offshore and nearshore works like dredging, trenching, backfilling, protection of cables and installations with scour protection

of every type. Our design department can assist in calculating and designing the right and most effective scour protection solutions. Recently one of our self-propelled hopper barges has been equipped with a new operating system for the bottom doors to enable precise and dosed rock dumping. With our own survey vessels we are always capable to work with real time data of the working area.



VAN DEN HERIK
SLIEDRECHT

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Installation equipment supply

Broekman

Partner for all your offshore & heavy lift needs

Looking for a specialist that can handle your non-standard products? Broekman Logistics has a state of the art terminal that facilitates the handling, assembly, storage, and other value added activities for your complex and overweight cargo.

The operational terminal activities related to handling cargo like generators, turbines and oil rig parts are probably the most challenging and complex task in logistics. That is because offshore and heavy lift items do not come in standard sizes. Most of them cannot be separated and many are too large to fit into standard containers. Which is why our customers – primarily in offshore, energy and mining sectors – appreciate our flexibility in fulfilling their specialised needs.

Offshore & heavy lift services

Our offshore & heavy lift services include:

- Handling almost all types of breakbulk, heavy lift and out of gauge cargo.
- Indoor storing and assembling, modifying and lashing your cargo.
- Warehousing (20,000 m² indoor and 40,000 m² outdoor).
- Mobilising and demobilising vessels.
- Lifting possibilities with overhead cranes up to 700 tonnes and a floating crane with 1800 tonnes lifting capacity.



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www.broekmanlogistics.com

CAPE Holland

We are passionate about piling; we continuously improve the performance of pile installation and removal: faster, easier, smoother and more sustainable. We love to make impact and contribute to good vibrations. Our customers' offshore oil, gas and wind projects are of the greatest significance. These mighty constructions require solid foundation, and we are there to support them with the smartest piling equipment and all our knowledge, skill and craftsmanship. At CAPE Holland we proudly build on six generations of piling experience. We get the job done!

Above all, we are solution providers. We think in possibilities. Whether we need to be creative in sourcing the proper equipment for you, or the situation requires an 'out-of-the-box' approach. We are the pioneers in offshore vibro driving. Our work includes research, design, and engineering.

Since its first commercial project in 2015, the CAPE VLT (Vibro Lifting Tool) has accumulated an extensive track record with highly efficient upending, positioning installation and extraction of offshore and nearshore piles. Using various CAPE VLT configurations and pile clamping systems a large range mono-, pin-, jacket-, and anchor piles have been installed. The CAPE VLT has also been used for removal of piles during test and decommissioning projects.



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Dieseko Group

Vibro Monopile Installation Equipment

Dieseko Group, based in the Netherlands, is the world leader OEM in vibrohammer technology. We have designed, built and used these hammers and related auxiliaries for the past 50 years. The products are sold, serviced and rented worldwide from the head office in the Netherlands, branch offices in Australia, China, Poland and USA and through an extensive dealer and agent network. Dieseko also offers this technology for offshore installation & decommissioning projects.

Dieseko recently developed and built the GIANT 2000, a vibrohammer capable of upending and installing XXL monopiles. It has been built according to Dieseko's philosophy and experience that we build-up in the past 50 years and will be deployed in its first commercial OWF project in 2024. Patented details in the design such as variable damping elements and the modular built elements allow the hammer to be modified exactly to your job.

DIESEKO GROUP

INNOVATIVE FOUNDATION EQUIPMENT

www.diesekogroup.com/markets/offshore/
info@diesekogroup.com

Dutch Drilling Consultants

Dutch Drilling Consultants (DDC) is specialized in large diameter drilling. DDC owns a large fleet of pile top drilling rigs to execute the drilling works.

DDC is active in different markets varying from onshore, near shore to offshore and renewables. DDC drills foundations for offshore wind farms, bridges, jetties, oil/gas platforms and ventilation shafts for tunnels.

Drilling is our core business, also we can act as a consultant. We have our own in-house engineering department for the best integration of our services for your foundation drilling projects. Furthermore we supply skilled drilling personnel. Our office is in Waddinxveen, the Netherlands and our yard is in Ridderkerk, near the Rotterdam harbour. At the yard we assemble the constructions and prepare the equipment for transport to projects all over the world.



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Eager One

Eager.one, based in Utrecht (NL), is active in the field of heavy mechanical engineering and fabrication services with specific know-how in systems for (offshore) heavy lifting and special transport.

Since its establishment in 1979, Eager.one has specialized in the engineering of lifting, handling and installation equipment and methods. Nowadays, Eager.one also supports its clients in the engineering of complex lifts and designs and constructs custom-made mission equipment, enabling efficient and safe operations, particularly in the offshore wind industry.

Our engineering experts provide bespoke lifting and handling tools to contractors worldwide for the mobilization, transport, and installation of offshore wind farms. Projects are completely taken care of, from concept study, engineering, and fabrication, to testing, commissioning and aftersales support.



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Enersea

Enersea and its sister company H2SEA offer consultancy, project management and engineering services for the offshore Renewable Energy (Wind & Hydrogen) and Hydrocarbon market. We combine excellent client insight with high quality engineering (management), enabling us to increase the value of our client's investment. Clients vary from innovative start-ups to developers, owners and suppliers of installation vessels and equipment. Our effective and adequate design decisions result in on time delivery with feasible and practical solutions.



Email
www.enersea.nl
www.h2sea.nl

Enerpac

Enerpac Tool Group is a premier industrial tools and services company serving a broad and diverse set of customers in more than 25 countries.

The Company's businesses are global leaders in high pressure hydraulic tools, controlled force products and solutions for precise positioning of heavy loads that help customers safely and reliably tackle some of the most challenging jobs around the world.

The Company was founded in 1910 and is headquartered in Menomonee Falls, Wisconsin. Enerpac Tool Group trades on the NYSE under the symbol "EPAC".



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FibreMax

In the realm of offshore wind solutions, FibreMax emerges as a true game-changer. This Dutch company has set itself apart by introducing an innovation that is revolutionizing the industry; parallel endless wound fiber cables.

What makes this product truly exceptional is not just its uniqueness, but its wide-ranging applications.

FibreMax's patented cables have found their way into a multitude of sectors, from (offshore) cranes to tidal energy projects, yacht rigging, and the mooring of floating wind turbines, XXL Monopiles. Their versatility knows no bounds.

One of FibreMax's key strengths lies in its highly automated production process. This not only ensures precision but also enables them to scale up effortlessly, even on a global scale, to meet local content requirements which will de-risk projects significantly.

However, it's not just about automation and versatility. FibreMax's cables are engineered with impeccable precision, require no maintenance, are impervious to corrosion, are a remarkable >80% lighter than conventional steel cables and can be made from circular fibers.

These attributes make FibreMax cables the go-to choice for the most demanding on-and-offshore applications, where durability and performance are non-negotiable.

FIBREMax
World's *strongest* cable...

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<https://fibremax.nl/>

GBM Works

GBM Works is an innovative, groundbreaking company passionate about accelerating the energy transition. We are developing and commercializing silent installation and decommissioning method for offshore foundations that reduce the environmental impact on marine life.

Our main technology is the Vibrojet®, an innovative silent installation and decommissioning method for offshore windfarm foundations. Using a combination of vibrations, on top of the foundations, and water jetting, close to the bottom, the Vibrojet® minimizes internal friction during installation making it more efficient.

In comparison to the Impact-hammer, the Vibrojet® can install foundations faster and with significant noise reductions, making the use of expensive noise mitigation measures unnecessary.

In comparison to Vibro only, the Vibrojet® can install foundations faster and deeper, widening the range of applications where the method is suitable.

At GBM Works, we are committed to providing sustainable and cost-effective solutions for the offshore wind industry. By minimizing environmental disruption and enhancing installation and decommissioning efficiency, our technology plays a critical role in advancing the global shift towards renewable energy.

We are excited to collaborate with partners and clients who share our vision for a cleaner, more sustainable future. If you're looking for innovative, environmentally friendly solutions for offshore foundation installation or decommissioning, we invite you to get in touch with us to explore how GBM Works can support your projects.



info@gbmworks.com
www.gbmworks.com

GustoMSC

GustoMSC is part of NOV, a leading provider of technology and equipment to the global energy industry. We design and engineer advanced mobile offshore units and provide reliable offshore equipment. With our experience, scientific knowledge, and technical expertise, we are committed to transforming innovative ideas into practical solutions. This commitment includes optimizing the performance of new and existing assets through operational support and engineering consultancy services. By collectively exploring the complex landscape of offshore energy, we maximize our customers' potential, contributing to the world's sustainable energy industry.

Our design portfolio features Wind Turbine Installation Vessels, Blade Installation Vessels, Feeder Vessels, Floating Offshore Wind Foundations, and related equipment like jacking systems and heavy lift cranes. In addition, we provide a variety of services for operational

units and equipment, including engineering project support, asset upgrades and major conversions and aftermarket activities. Our engineering consultancy offers industry-leading expertise in areas such as site-specific or dynamic positioning analysis, earthquake-response analysis, and vessel-impact analysis.

Based on our expertise and track record GustoMSC is well positioned to support clients in conceiving and realizing dedicated and integrated solutions to meet today's challenging requirements of the floating and fixed offshore wind markets.



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www.nov.com/gustomsc

Holmatro Industrial Equipment

Founded in 1967, Holmatro Industrial Equipment is worth over +55 years of experience with high pressure hydraulic tools & systems. We are proud that after all this time we are still a MADE in The Netherlands company with inhouse research & development, engineering and production. We aim to provide you with the most safe, reliable, durable and ergonomic solution for your application, delivering high-quality products, excellent service and great customer care.

Offshore Winds Systems & Services

Over the last decades, Holmatro Industrial equipment has built a proven track record providing various solutions for the Offshore Wind Industry. In our way of work, partnership is key. Most projects were developed & executed in close cooperation with the developer, engineering companies and installation contractors Besides hydraulic solutions to level and fixate wind turbine foundations, such as transition pieces and jackets, we have supplied various systems in the field of cutting, sea fastening, deck handling and skidding solutions.

Your reliable choice in demanding circumstances;

- Transport
- Installation
- Maintenance
- (Onsite) service
- Decommissioning.



industry@holmatro.com
www.holmatro.com

Huisman

We are Huisman. A family-owned business, built on innovation. Huisman is a worldwide supplier of step changing technical solutions to the world's leading companies in the energy sector.

Our products range from large capacity cranes up to highly engineered installation tools, to optimise every stage of installation and operation of offshore wind farms.

The history of Huisman is one of setting new industry standards. Of making impact, since 1929, with step changing technical solutions that vary from stand-alone components to highly engineered integrated systems. From concept to installation and lifetime support. With our design philosophy, we have created equipment that is significantly lighter than the market standard. The result is equipment that reduces the required payload and size of the vessel, reduces the need for fuels and is easy to maintain.

With our passionate workforce and worldwide production, service and sales facilities, we are equipped for impact in these times of transition..



info@huisman-nl.com
www.huismanequipment.com

Hycom

HYCOM, part of the HYDAC Group, specializes in Hydraulic (sub)systems and components for seamless operations of offshore- and offshore wind applications.

With decades of experience since 1973, we have perfected our expertise, ensuring our systems are tailored to meet our client's needs, unmatched performance, and reliability of applications in the harshest marine environments.

We deliver custom made drive- & control systems for Monopile handling tools, Cable handling tools, piling/drilling templates, offshore access systems, subsea equipment and offshore mooring systems.

Innovation

In the field of Jones act compliant o/w solutions we design and produce systems for motion compensation systems, seafastening systems and Offshore mooringsystems for feeder barges.

This last one is an 6 or 8-line mooring setup to enable offshore mooring of a feeder barge to a jack-up vessel. The mooring spread consist out of several spring lines and breast lines connected to winches. The breast lines are foreseen with an in-line heave compensation system consisting out of a hydraulic cylinder and sheaving to compensate for barge motion. The hydraulic system uses nitrogen gas as pretension spring and hydraulic throttle valves to provide additional damping.



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KenzFige

KenzFige is a well-established lifting and service specialist of high-end equipment for the marine, offshore and wind energy industry.

Established in 1836, KenzFige has designed and built more than 4,500 cranes, lifting and handling solutions that fit the specific needs of its clients in the most demanding conditions. Based on our decades of experience, focus on innovation and client requirements, KenzFige has become a leading supplier and service provider of reliable and durable high-end lifting solutions for the worldwide marine, offshore and wind energy industry.

As part of the energy transition, KenzFige delivers a temporary and modular nacelle-mounted up-tower crane solution for safe, smart and efficient on- and offshore win turbine component exchanges & repairs. The use of this innovative up-tower crane technology lowers O&M costs, reduces ground preparation requirements, and increases the working window.

Hydrauision

Hydrauision operates worldwide as a versatile total supplier of hydraulic, electrical and hybrid drive technology. With over 50 years of knowledge and experience, we design, manufacture, maintain, overhaul and rent hydraulic and electrical drive and control systems for numerous companies in which drive technology plays a role. These companies find in Hydrauision the partner for whom no challenge is too great.

Hydrauision develops and realizes a wide range of (complex) systems: power packs, winches, charging systems, skidding systems, jack-up systems, offshore access systems, refrigeration units, manifolds, spooling devices and safety platforms.

These systems find their way worldwide in many sectors; from the dredging sector to the food industry and from the offshore wind industry to the steel industry.

Share your challenge.



Driven by technology

info@hydrauision.com
www.hydrauision.com

The experienced professionals provide design, engineering expertise and a variety of services, to support clients increasing operational efficiency and to minimize downtime of equipment. At KenzFige we take care of clients during the whole life cycle of the equipment: from creation to disposal.

KenzFige is headquartered in Zaandam, the Netherlands and has a branch office in Aberdeen, United Kingdom.



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Muns Techniek BV

Muns Techniek is a system integrator for hydraulic systems and electrical controls. With over 30 years of experience we offer integrated solutions for projects in the Offshore and (Maritime) Industry.

From stand-alone applications like hydraulic winches to complete turn-key projects such as jack-up systems (for WTIV), Muns Techniek is your ambitious partner to integrate ever increasing technical demands into reality. Working close with our customers is the key-factor for our daily business.

Always trying to be innovative, and never losing track of the Total Cost of Ownership. Muns Techniek combines the best components available in the market to simplify your system and the integrated controls. It is one of our strengths. With state-of-the-art solutions like our in-house developed Human Machine Interface we keep serving our customers at the highest level. Muns Techniek invests continuously in research and development and in the training and ongoing education of its employees.

Muns Techniek has proven to be able to contribute from the initial concept to the final commissioning and operation of a project. Muns Techniek aims to develop solutions which are not only durable, but which also contribute in making processes economical, flexible and fully automated.



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Polarttech

Polarttech has been a recognized manufacturer in the international polyurethane processing industry for over 20 years. We are specialised in the development and production of sustainable polyurethane products for industries such as the offshore wind.

All our products are developed and produced in the Netherlands and then used worldwide in industries such as the agriculture, concrete industry, food industry, infrastructure, machinery and machine tools, offshore & energy and transport.

Specialised in sustainable polyurethane solutions

Our sustainable polyurethane products are very widely applicable in the offshore & energy market and can therefore be found in all industries within this sector. From bearing, dampening and support pads that are essential for the transportation and installation of offshore wind farm components (such as monopiles and wind blades) to tensioner track pads that are used in cable and pipe laying projects.

All over the world our products are being used in a tough offshore environment, wherein the materials are successfully exposed to the changing conditions on a daily basis.



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www.polarttech.com

Seaqualize

Seaqualize is a young Dutch offshore tooling company, which builds and rents out the world's most sophisticated Balanced Heave Compensation (BHC) tools, to be placed in any standard heavy lift crane hook: The Heave Chief. It offers full vertical position and load control (Active Heave Compensation or "AHC") for delicate heavy loads: stabilizing floating lifts, quick lift loads from deck to prevent re-hits or gradually introduce loads to minimize harmful dynamic loading: Don't worry about heave anymore, we've got that covered.

Seaqualize tools upgrade any standard heavy lift crane to facilitate safe and controlled lifts out in the open ocean, without waiting for weather: floating to fixed (e.g. floating crane installations), fixed from floating (feeder barge operations from a jack up vessel) or floating to floating (installations onto floating foundations).

Seaqualize tooling helps clients minimize their risk of weather delay, and offers them full control and higher safety levels during the handling of turbine components. Both first two commercial scale windfarms built on the

US East coast, chose to use the Seaqualize Heave Chief for their operations, making it the most proven technology in the market. By 2025, Seaqualize will have executed ~1.000 floating feeder barge lifts for a total of out in the open ocean, for a total of ~175.000mT.

The current fleet of tools range from ~300mt to max 1100mT capacity, with new machines planned for ~1500-2000mT WTG components, and for the heaviest future foundations, up to 4500mT. The tools are Li-ion battery powered, with minimal crane interfaces and can operate ~12hrs on a single charge. We offer a wide range of simulation analyses which can be customized to run any offshore lifting operation, and jointly investigate lifting hazards, calculate workably for a specific operation or train operators.



BALANCED HEAVE COMPENSATION

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www.seaqualize.com

Sinus Jevi Electric Heating & Load banks BV

With fabrication locations in the Netherlands and Denmark Sinus Jevi Electric Heating BV is your go to specialist for Industrial Heating systems and Load Banks. Founded in the 1920's we rely on a century of experience. We have a thorough understanding of the offshore industry and its demands turning every project into high quality solutions for your challenges.

- Standardized Heating equipment such as Water-, Fan-, Space- and Winterizing Heating are the basis of our product lines. For process Heating we offer Gas- and Liquid- Heaters such as Natural Gas Super Heaters (LNG), Nitrogen Heaters and Glycol Re-boilers.
- Our Load Banks are applied to Offshore Cranes, Winches, Cable- and Pipe-Lay equipment and numerous other applications. We offer both Air- Cooled as well a Water Cooled- Load Banks.
- We produce both Anti- as well as De-Icing Heaters for Windmill Blades.
- Duct heaters for HVAC and High Temperature application complete the portfolio.
- Our scope of supply includes Control Panels specific for Heating applications.
- Apart from ATEX- and IEC-Ex- certified equipment we produce equipment compliant to the regulations of recognized bodies such as DNV-GL, BV and Lloyds.
- We design to ASME and EN13445 standards.
- Sinus Jevi is ISO-9001 and ISO-14001 Certified.



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www.SinusJevi.com

Technical Maritime Services

TMS is a developer and manufacturer of mechanical installations. Our practical and innovative know-how results in unique products that excel in terms of efficiency, flexibility and reliability. Our clients are mainly renowned international contractors in the offshore field.

TMS translates, by concept designs, client requirements into the complete engineering package and delivers turnkey solutions including installation and commissioning. We have our own production facility with waterfront access, where assembly and/or testing activities can be executed.



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Solid Steel Structures

Solid Steel Structures is specialized in mechanical turnkey projects. Solidd employs a wide range of specialists for the design, engineering, execution and management of turnkey projects, such as bridges, lock gates, cranes and offshore applications.

Having all steel construction facilities under one roof, creates maximum flexibility and added value for our clients. From cutting and welding up to machining. The majority of our projects are finalized on site, our service squad is ready to perform all types of support including onsite machining.

The climate change affects everyone in the world, therefore we feel responsible in contributing to a better and greener future. The company roots go back to the mid-fifties. Our experience in shipbuilding, infrastructure and offshore projects provides a solid base to accomplish tomorrows challenges.

Today's offshore machinery require a high level of standards and certifications. We maintain and expand this knowledge through continuous education and training of our highly qualified specialists.



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www.solidd.eu

Tetrahedron

Tetrahedron launched a novel crane for the installation of the next-generation of offshore wind turbines. This novel crane is developed specifically for the offshore wind industry. A new motion principle exchanges unused extensive reach for useful height.



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https://tetrahedron.tech/

Teijin Aramid

Teijin Aramid is a global leader in high-performance aramid fiber, a subsidiary of the global Teijin Group. We partner with industries to make ambitious ideas a reality. Specializing in high-performance aramid fibers, our materials help companies across sectors like automotive, aerospace, marine and offshore, push boundaries with stronger, lighter, and more durable materials.

At Teijin Aramid, we are dedicated to empowering our partners in the offshore energy industry to drive the transition to renewable energy. By working together, we co-create solutions that not only meet today's challenges but set new standards for performance and sustainability. Our products Twaron® and Technora® deliver lightweight strength and long lasting performance in every climate ensuring superior offshore mooring and deep sea installations in all conditions.

Our strength lies not just in our advanced materials but in our people. With over 40 years of experience in applying aramid technology in new and impactful ways. Our motivation is to deliver the best possible solutions, ensuring that offshore projects are not just successful, but transformative.

TEIJIN ARAMID

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www.teijinaramid.com

Tillen BV

Tillen BV, based in De Meern (Utrecht-NL), is a leading provider of heavy mechanical engineering and fabrication services, with a strong focus on systems for heavy lifting and transport, both onshore and offshore.

Since our founding in 2007, we have specialized in the design and development of advanced lifting, handling, and installation systems. Today, we offer our clients customized solutions for complex lifting projects and supply mission-critical equipment to ensure safe and efficient operations, particularly in the offshore and renewable energy sectors.

Our team of engineers delivers tailor-made solutions for the mobilization, transportation, and installation of offshore wind farms, among other major projects. We manage every aspect of a project, from concept studies, design, and fabrication, to testing, commissioning, and after-sales support.

With our expertise and personalized approach, we guarantee reliable and cost-efficient lifting and handling tools, trusted by contractors worldwide.



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https://tillen.com

TWD

TWD is an engineering company specialized in method engineering and equipment design. By continuously developing our expertise, we strive to help contractors safely build their projects on time and within budget. Problem-solving, dedication, and teamwork are in our DNA, through which we deliver the fit-for-purpose engineering solutions for transport, installation, and construction projects.

Thanks to our multidisciplinary engineering teams, we are experts in tackling market-specific challenges and deliver state-of-the-art solutions. This has strongly positioned us in the markets of Offshore Wind, Heavy Lift and Transportation, Heavy Civils, and Vessel Outfitting.

TWD's services include Method Engineering, Structural and Mechanical Design, Geotechnical Engineering, Marine Engineering, Drive and Control Engineering, Project and Fabrication Management, Measurement and Testing, and Soft Engineering. Our creative, flexible, and cost-effective approach makes us the perfect partner for your next engineering project.



sales@twd.nl
https://twd.nl/

Installation/CTV/SOV vessel design, supply

Damen Shipyards Group

Damen Shipyards Group has been designing, building and repairing ships for all sectors of the maritime industry for nearly a century. We support the offshore sector in all its forms with a range of products designed in response to client and market feedback. Today, our offshore portfolio covers the entire range of small to medium sized vessels for the full spectrum of offshore activities.

With first-class, strategically located facilities, including the Damen yard in Galati in Romania, partner yards in the Far East or building locally to Damen design and under Damen supervision, Damen delivers vessels both from its proven, standardised series, tailored to individual client requirements via modular options, and fully customised, engineered-to-order projects, including complex, specialised vessels, offshore construction and fabrication works.

Damen's stated aim of being the world's most sustainable shipbuilder means it is committed to ever-increasing levels of sustainability in its products and operations. Its investment in diverse R&D programmes, often working in collaboration with other industry partners, has led to the development of numerous innovations that improve efficiency and lower fuel consumption and emissions during both the construction and operation of our products, thus minimising their environmental impact.

DAMEN

info@damen.com
www.damen.com

Ulstein Design & Solutions B.v.

We are a leading ship designer with proven track record in the offshore wind industry. We design game changing ships for the offshore energy market. Sometimes brilliantly simple, sometimes sufficiently complex.

ULSTEIN provides best-in-class solutions, combining a pragmatic design approach with extensive naval architectural skills and market knowledge.

Working together as a team, we push for sustainable solutions, developing state-of-the-art and fit-for-purpose ship designs that are cost-effective, safe, comfortable and providing an efficient working place for the crew.

IHC Offshore Energy

Connecting the future of energy. IHC Offshore Energy has the knowledge and experience to rise to the global challenges facing the offshore industry by providing reliable and advanced vessels, equipment and services. With our extensive knowledge and experience, and through our passionate colleagues, we provide a competitive edge to our customers.

IHC Offshore Energy is fully equipped to provide offshore industries such as Renewables and Telecoms with superior solutions based on our market-leading expertise. With a proven track record in delivering sustainable offshore systems, including pipe and cable lay equipment, subsea vehicles and a wide range of integrated vessels, we can provide standard or tailored solutions to improve operational efficiency and allow for a more sustainable performance.

With our experts working on a global basis, we guarantee a local presence and industry-leading support on every continent. In addition, our responsive spares and services team has a wealth of operational experience to support maximising the productivity of vessels and equipment.

IHC Offshore Energy is part of Royal IHC. As we navigate new waters, our aim remains unchanged: to discover the smartest and safest way forward for both our customers and our people.

Together, we create the maritime future.

 **Offshore Energy**

offshoreenergysales@royalihc.com
www.royalihc.com/offshore-energy

For over 100 years, the family owned ULSTEIN Group has been associated with innovation and quality in design and delivery, meeting the demanding marine challenges by embracing change and identifying opportunities.



ULSTEIN®

udsbv.info@ulstein.com
www.ulstein.com

Vuyk Engineering Rotterdam B.V.

A synergy of three maritime engineering specialisms is represented at Vuyk Engineering Rotterdam.

Vessel Design and Conversion

Our department Vessel Design and Conversion focuses on (concept, basic and detail) design and conversion of work vessels.

Equipment Design and Upgrades

Our department Equipment Design and Upgrades specialises in developing advanced mission equipment. We find solutions for complex issues or upgrades to facilitate high performance operations.

Operational Engineering

The department Operational Engineering focuses on optimizing efficiency and safety of maritime operations with development of methods, design of temporary steel structures, sea fastenings, hydrodynamic analysis and workability studies.

Solving your maritime challenges

Our three disciplines are working together as one team, enabling us to provide our customers complete design packages. Vuyk Engineering Rotterdam has all the in-house expertise to support innovative projects in various maritime markets: dredging, subsea, offshore wind, renewables and the heavy lift market.



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www.vuykrotterdam.com

CTV/SOV deck equipment supply

Ampelmann

Ampelmann is the leading offshore access provider that delivers safe and efficient access solutions to the global offshore energy sector. Its innovative approach to offshore access has propelled the company forwards as a key global player with strong local presences in Europe, Africa, the Middle East, Asia Pacific and the Americas. Ampelmann's diverse portfolio of modular and energy efficient gangways is tailored to meet every local and global demand, providing reliable and consistent access to offshore installations in a variety of sea states and weather conditions.

The company's growing fleet of gangway systems includes solutions for crew change, cargo and decommissioning operations in the offshore oil and gas, wind and floating wind markets. The company operates on a full-service business model and provides its renting and buying clients with trained operators, the possibility to train client operators, 24/7 operational support and digital management tools to improve uptime and ensure maximum efficiency during offshore operations.



sales@ampelmann.nl
www.ampelmann.nl

Safeway

Safeway designs and fabricates motion compensated gangway bridges and with its Safeway Seagull-type sets a new standard for motion compensated systems.

With year-round workability at 20+ meter above sea level, Safeway redefines the state of affairs in offshore access solutions.

Extensively tested and based on proven technology, the application of an additional roll compensation actuator provides a spectacular reduction of overall gangway motions.



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www.safewaygangway.com

Barge Master

Barge Master is dedicated to improving offshore workability. We provide motion compensation systems that help our clients to avoid weather downtime and remain in charge of their operations and schedules. We see motion compensation as the perfect technology to keep the load still, the equipment stable and the people safe. Our systems eliminate the need for bigger ships and provide a cost-effective solution for offshore operations. With motion compensation, working at sea becomes almost as easy as working on land.

Our Platform can be installed on any large vessel to serve as a working base for any kind of equipment. By eliminating the motions of your vessel, the platform effectively turns your deck space into a perfectly stable working area. As a result the operations can continue even in adverse weather, enabling you to stay on top of the execution and timeframe.

Our Gangway provides continuous access to any offshore structure. This motion compensated gangway ensures safe and efficient transfer of crew irrespective of weather conditions. Making the system truly unique are its distinctive safety features, such as triple redundancy and the anti-tip-slip.

The Barge Master Crane enables controlled lifting operations in high sea states, making it possible to work at sea almost year-round.



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www.barge-master.com

Bridges2000

Innovative connections for offshore wind

BRIDGES2000 is a leading Dutch company that provides innovative, safe, and custom-made solutions in the field of bridges, gangways, and pontoons. Active in the civil, maritime, offshore, and events industries, BRIDGES2000 is known for its reliable products and fast deliveries, meeting the highest safety standards.

With decades of experience, BRIDGES2000 is perfectly positioned to apply its expertise in the rapidly growing offshore wind industry. The challenges of this sector, such as complex offshore installations and harsh weather conditions, require reliable and flexible solutions. This is where BRIDGES2000 excels. By combining their knowledge of maritime and offshore connections with a strong focus on innovation, BRIDGES2000 delivers bridges and gangways that are safe, fast, and tailored to offshore wind projects.

Breman Machinery B.V.

Extreme Precision

Breman Machinery B.V. has the experience to make your wishes become reality. Our team of 130 well-experienced employees has the knowledge to create workpieces of extreme sizes with maximum precision. We have a good record of projects for Oil and Gas companies, Mechanical Engineers, Aerospace companies and Industrial firms. We do not turn down any challenge.

Capacity

The welders of high-quality steel, like S460-S690, Duplex etc., are qualified by Lloyd's Register or DNV for all welding positions. With 30 milling, boring and turning machines we have the possibility to offer unique services. Our largest boring machine has a range of X=26.500, Y=10.000 and Z=2.500 and the largest turning machine can handle a length of 16.000 mm. Our preservation department can protect your projects with different painting systems. The workshops in Genemuiden have a surface of 21.000 meters with a height of 25 meters. The crane capacity is up to 320T. Our location is beside open water, which means we have a direct connection to the international ports.

Quality

High quality is one of our most important standards. We work according ISO9001, ISO3834-2, EN1090-1 and VCA**.



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www.breman-machinery.nl

The mission of BRIDGES2000 is to create safe connections that ensure efficiency and safety in any situation. They operate with a distinct Dutch work ethic: practical, reliable, and focused on quality. Their solutions, produced in-house, meet the specific needs of clients and can be certified if required.

Our solutions can be used to establish a safe connection between the accommodation platform and cable collection station and wind turbine TP during construction and maintenance.

With international ambitions and the capability to support projects worldwide, BRIDGES2000 is an ideal partner.



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www.bridges2000.com

Eagle-Access

The EAGLE-ACCESS system is a revolutionary new Offshore Access system, capable to transfer People and Cargo at the same challenging conditions.

The revolutionary new concept is the answer to the market requirements of access to all platforms without the need for modifications. With our new developed EAGLE-ACCESS system, recently successfully tested during sea trials, we can work from almost any DP2 vessel. This opens the market for vessel owners interested in the offshore wind industry to work with a state-of-the-art fully electric system. We can work from smaller vessels and due to positioning on the aft there will still be sufficient deck space for cargo, TLQ's etcetera.

Main characteristics

- Flexibility in height 0 – 24 meter
- Cargo transfer up to 1 ton that can be remotely released to improve safety and efficiency.
- The system is fully electric and requires a max. 75 KW from the vessel.

- The horizontal reach is 27 meter where the system can be installed on the aft of the vessel allowing for a 270 degrees vessel heading freedom.
- EAGLE can be operated by your own on board qualified crane operator, additionally trained on the EAGLE-ACCESS Academy.
- All this is possible from a smaller vessel, hence lower investment cost, while improving safety, workability and comfort.



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SMST

SMST is a well-established supplier of equipment to the offshore industry, with a strong focus on the renewable sector (Offshore Wind). SMST's products provide solutions for the safe and efficient transfer of people and cargo, for worldwide offshore operations.

Through the unique combination of in-house design and engineering expertise, production facilities, testing capacity, worldwide installation and service, SMST delivers high quality engineering and product solutions that are distinctive in the offshore market.

In addition to prioritizing safety and efficiency, the products feature a modular design that offers maximum flexibility to the operations for the international offshore partners. For the offshore wind sector, SMST has developed a complete system package, which includes a range of gangways adjustable for various heights, modular offshore cranes which can be equipped with various knuckle booms and active heave- and (3D) motion compensation, and special handling equipment.

SMST is committed to delivering high quality solutions along with comprehensive services and training. The company continuously improves its products and services to meet evolving industry standards, driving innovation and taking the industry to the next level.



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www.smstequipment.com

Z-Bridge

Discover Z-Bridge's cutting-edge "Bring-to-Work" Offshore Access System, engineered to enhance operational flexibility while significantly reducing costs in the offshore industry. This advanced system features a telescopic arm mounted on a fully motion-compensated pedestal, supporting landing heights from 8 to 21 meters. It eliminates the need for expensive and bulky pedestals, offering a more streamlined solution. The system efficiently transfers teams of up to 6 people or 1000 kg of cargo via a trolley, with an integrated crane capable of lifting loads up to 3000 kg for material transfers both on deck and to offshore structures.

Compact yet versatile, the Bring-to-Work system is ideal for smaller vessels, opening new opportunities in the offshore access market. It also optimizes deck space on larger vessels, maximizing efficiency for people and cargo transfer in various projects. Z-Bridge brings extensive international experience, having successfully operated with major contractors in high-stakes environments such as Heavy Lift Vessels, the O&M market, and cable installation support, where safety, reliability, and efficiency are crucial.

Available for project rental and long-term lease, the system is designed for 24-hour quick mobilization, integrating seamlessly into any vessel. Explore how Z-Bridge can support your offshore operations by visiting www.zbridge.nl or join us in IJmuiden for coffee and a VR-simulator experience to see our system in action.



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12.6 Operations & Maintenance

Services Operations

Acta Marine Profile

Established in 1970, Acta Marine works in a broad scope of maritime sectors. Our background is in shallow water projects, but in these four decades we have developed our skills to include a variety of tailor-made services for clients working throughout the maritime sector.

We operate globally; supporting clients in three main areas. Coastal Infrastructure, which comprises dredging, coastal defence, port and marine construction and aquaculture. Offshore Wind industries, emerging renewable energy markets, and the Oil & Gas industry.

Our focus is on building long-lasting relationships with our clients and maintaining the long-term continuity of our services. This includes continuous investment in the welfare and training of our personnel as well as in upgrading and maintaining our fleet.

Our fleet includes DP Multicats, Walk-to-work vessels, Tugs, Crew Transfer Vessels, Multipurpose & Survey Vessels, and barges. We own over forty vessels, which help our clients achieve their goals of safe and effective operations, in addition to long-term sustainability and productivity.

At the core of the company is a team of approximately 250 committed and reliable professionals. It is their dedication and expertise that has built our reputation. And it is their passion that makes Acta Marine a company with clear goals for the future.



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www.actamarine.com

AE Wavehexapod

Company was founded in 2021 by three experienced entrepreneurs. Johan Paulides, Frank van Bodegraven and Lucas Nijman. They have developed a wave generator.

Wave energy converter

The Wavehexapod is a hexapod with 3 buoys and 6 generators. The generators hang from a fixed suspension mechanism to a larger submersible that can hold up to 9 hexapods. With the hexapod we can follow the waves as best as possible to extract energy from them. Both in the up and down movement and the horizontal movement. During a storm, the hexapod is pulled out of the water to prevent storm damage.

The Wavehexapod is suitable for offshore wind infrastructure (both greenfield and brownfield), but also as an electrifier for oil and gas platforms. The wave hexapod uses robots as generators that they have made offshore proof, making the wave hexapod a product that can be easily scaled up. All parts within the Wavehexapod are standard products. This latest robot expertise can also be used to apply robots offshore in other offshore applications, such as wind turbines and offshore ships. The Wavehexapod has also developed a special cable connection for floating solar and oil platforms.



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www.wavehexapod.com/

Brady Corporation

Speeding up maintenance in a safe and efficient way to maximise power generation and supply, Brady Corporation offers a wide range of reliable identification and safety tools to support highly efficient maintenance professionals complete fast machine interventions in a safe way.

Our solutions include full service Lockout/Tagout, inspection management software and tools, reliable, on-site printable safety signs and floor marking,

and cable and component identification labels that stay attached and remain legible.



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www.brady.nl

Amphibious Energy

Amphibious Energy is an pioneering Dutch company based in Delft, which are dedicated to delivering sustainable energy solutions to the offshore and maritime industries. Established on the principles of innovation and environmental responsibility, we are at the forefront of the energy transition, revolutionizing the way remote and offshore operations are powered.

Innovation at the Core: The EnergyPod

Our flagship innovation, the EnergyPod, embodies our commitment to greener, more efficient offshore energy. This modular system integrates solar panels, wind turbines, and energy storage to provide a consistent and eco-friendly power supply. From offshore oil and gas platforms to remote aquaculture facilities and offshore wind farms, the EnergyPod reduces environmental impact and operational costs while bolstering reliability.

Digital Transformation for Efficiency

Amphibious Energy leads the way in digital transformation within the off-grid energy sector. We seamlessly blend IoT connectivity and data analytics into our solutions, enabling real-time monitoring and optimal energy management. Our technology empowers you to make data-driven decisions and reduce downtime.

Your Sustainable Energy Partner

Amphibious Energy is more than a solutions provider; we're your partner in sustainability. We're dedicated to minimizing carbon footprints, enhancing cost-effectiveness, and ensuring the resilience of your offshore and maritime operations.



info@amphibiousenergy.com
www.amphibiousenergy.com

Fibersail

Fibersail is a technology company focused on enhancing wind turbine performance through advanced blade monitoring. Our innovative shape sensor measures the deflection and curvature of blades in real-time, optimizing rotor efficiency, minimizing operational risks, and extending turbine lifespan. By focusing on blade shape rather than strain, Fibersail offers precise control over turbine performance, leading to reduced maintenance costs and improved reliability. Our solution is designed for easy retrofitting and cost-effective deployment, contributing to a smarter, more competitive wind energy industry.



info@fibersail.com
<https://fibersail.com>

Brand Energy & Infrastructure Services

With locations surrounding the North Sea, Brand develops access, insulation and coating plans around your specific offshore oil, gas and wind energy assets. Our solutions are based on a multidisciplinary approach to ensure that your operations continue safely, smoothly and with minimum downtime. The specially trained Brand operatives support the world's most renowned offshore clients.

With over 45 years offshore experience Brand support its clients by delivering tailored solutions, and providing method statements ensuring a safe, effective and timely execution of the work. Avoiding conflicting areas through integrated planning and execution using a ONE-team approach.



nl@beis.com
www.beis.com

Clarksons Port Services

Clarksons Port Services (CPS), a division of Clarksons, specialising in supporting marine and port operations. With over 50 years of experience, CPS has become a trusted and integral part of the supply chain, offering comprehensive integrated logistics services. Operating from 24 offices across The Netherlands, UK and Northern Ireland, CPS is committed to delivering the highest standards in logistics for the Offshore Wind industry.

Our services include:

- Port Agency
- Port Call Planning & Scheduling
- Quayside Logistics Management
- Project Logistics
- Helicopter Chartering
- International Freight Forwarding
- Warehousing & Distribution
- Supply Chain Management
- Customs Clearance & Consultancy
- Bunker Supply
- Crew Change Management
- Voyage Agency Services

One single point of contact with the experience and an extensive network to support your requirements.



cps@clarksons.com
clarksons.com/port-services/

DroneQ Robotics

DroneQ Robotics is a next-generation Unmanned Vehicle System Operator & Integrator, where operational processes and autonomy are important factors for operations in the air, on land, on water and underwater! Areas of activity include Unmanned Aerial Systems (Drones), Unmanned Surface Vessels (USV) and Remotely Operated Vehicles (ROVs).

DroneQ Robotics has more than 20 years of maritime experience and has roots in offshore, civilian sub- and surface construction and maritime Disaster & Incident Response. Tasks performed include drilling support, pipeline and cable laying support, construction and decommission activities and inspections of oil and gas production installations, pipelines, cables and surface and other subsea installations with UAVs and ROV's (Remotely Operated Vehicles) or underwater drones.

DroneQ Robotics is specialised in Offshore Energy services such as Long Distance Cargo Drone Logistic services, Incident & Disaster Response, drone and ROV Inspection and surveying of Offshore wind turbines, production platforms and other offshore installations.



info@droneq.nl
www.droneq.nl

DUC Marine Group

Pioneering Offshore Innovations

DUC Marine Group epitomizes Dutch expertise and innovation in the offshore wind sector. As a Netherlands-based maritime service provider, we pride ourselves on a legacy of technical excellence and unwavering commitment to sustainability. With decades of experience, we have evolved as an indispensable partner for offshore wind ventures, spanning underwater services, salvage operations, and infrastructure development.

Our inventive approaches in engineering and subsea constructions empower us to provide cost-effective and efficient solutions, even amidst the most challenging maritime conditions. Moreover, our eco-conscious methodologies support the preservation of our seas while advancing the energy transition.

In the dynamic realm of offshore wind energy, we stand as your trusted ally. DUC Marine Group embodies Dutch ambition: marrying technological advancement with maritime tradition. Discover why we set the gold standard in the offshore wind sector.



info@ducmanriengroup.com
www.ducmarinegroup.com

Føn Energy Services

Føn Energy Services is an independent service provider to the offshore energy sector. With solid industrial backing from The IKM Group and Akastor (majority owned by the Aker group) and DISA International, Føn is industrializing and digitizing the offshore wind industry.

Through a combination of engineering and advisory services in early-phase and a fully integrated O&M offering, Føn Energy Services aims to bring down the levelized cost of energy for developers and operators. We consider digitalization and industrialization as the keys to unlock additional value and secure improved risk distribution across the value chain.

2024 has been a busy year for Føn. In May 2024, Føn entered the Dutch offshore wind market through an acquisition of C-Ventus Offshore Wind Service. Shortly after this, the new joint company secured its' largest ever offshore wind contract to date with a tier-1 developer.

Today, Føn Energy Services is present in Norway (Oslo and Stavanger), The Netherlands, Denmark and The UK and currently employs more than 110 people.



contact@fonenergyservices.com
info@c-ventus.com

H2M

Lightweight Offshore Accommodation Modules

H2M provides a wide range of lightweight offshore accommodation and workspace modules to the oil & gas, maritime and renewable energy industries. Our system is based on modular build, therefore we can provide almost any type of module. Our product range contains several designs of offshore lightweight accommodation modules. We manufacture all our modules to the highest industry standards; DNV 2.7-1, EN 12079 and ATEX, including compliance with IMO/SOLAS regulatory requirements for A60 fire protection.

Full Service provider

H2M can deliver a full service solution, what includes engineering, transport, installation, hook-up, commissioning and service during the period of use. We are able to provide everything that's required to ensure that the modules are ready for a comfortable stay. On several projects we have provided our clients with stairs and walkways, power-packs, water treatments systems, hook-up materials and several structural requirements.

H2M Specials

H2M is not only a rental company for accommodation modules, we are also able to manufacture all kind of custom build containers for rent and/or sale. Some examples of the various possibilities are: workshop containers, storage containers, satellite TV/internet containers, freshwater maker containers, sewage treatment containers and service containers.



info@h-2m.com
www.h-2m.com

Jungle AI

Jungle AI specializes in AI-driven solutions that optimize machine performance by improving uptime and reducing downtime. Their products, like Canopy and Toucan, leverage real-time data from machines to predict failures, enhance operational efficiency, and prevent unplanned outages. Jungle AI caters to industries like wind, solar, manufacturing, and maritime, offering actionable insights that boost production and efficiency without the need for additional hardware or complex setups. Their advanced, unsupervised learning technology helps businesses prevent failures and maximize the performance of their machinery.



sales@jungle.ai
www.jungle.ai

Intrepid Safety Products BV

Intrepid Safety Products BV (ISP) is the European distributor for self-closing safety gates, manufactured by Intrepid Industries Inc. TX, USA.

Since 1980, 600.000+ gates have been supplied to refineries, chemical plants, paper mills, automotive, offshore, and marine environments. These polyurethane gates have proven to be the most reliable solution to protect people against accidental falls through guardrail openings.

Beside self-closing gates ISP supplies a range of different safety related products. ISP always strives to make its products simple and effective at a fair price.



info@isp-products.com
www.isp-products.com

MEP

Voice Communication systems

MEP provides systems for Wind Farms which allows Voice communication from onshore and offshore control rooms with helicopters, ships and local staff.

This is essential to guarantee safety of staff, be able to warn ships which are sailing too close to the Windfarm or guide helicopters.

Maritime and Air Traffic solutions

MEP was founded in 1989 and has a long history in both Maritime and Air Traffic Voice communication solutions. We are proud to state that several major seaports, many Airports, Coastguards and offshore Wind farms are using our system.

One complete solution for an offshore Windfarm

Communication is often an afterthought when designing Offshore Wind farms. MEP has developed an easy to install solution which allows safe communication with all parties involved.



info@mep-info.com
www.mep-info.com

Next Ocean

Next Ocean has invented the vessel motion radar. It predicts waves and resultant vessel motions for the upcoming 1-3 minutes, enabling crew to avoid moments of high waves and motions for critical operations.

Using traditional X-band radar we are able to 'see' the waves 3 minutes ahead of time. Applying the laws of physics, naval architecture and hydromechanics principles our algorithms predict the ship's responses. These predictions are continually cross-checked against the measured motions which provides a real-time verdict on the reliability of the predictions.

In Offshore Wind construction and maintenance projects, crews on SOV's, cable laying vessels, pipe laying vessels, decommissioning vessels and many other types of vessels first use the calculated wave spectrum to position their vessel and then the real-time motion predictions to decide the right moment for the critical step in the operation.

Our mission is to minimise accidents resulting from unexpected ship motions. When things get rough, we can see the motions coming our way ahead of time. Day or night, rain or fog, it makes no difference for the radar or the algorithms.

When lives are at stake and serious accidents are a constant risk, relying on wave statistics only is not good enough. Until around 2019, there was no alternative. Now there is: motion radar from Next Ocean, making a deterministic, real-time, DNV approved prediction that you can rely on.



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www.nextocean.nl

N-Sea

N-Sea is an integrated total subsea solutions provider in Survey, IRM & Construction, Subsea Cable Repair & Installation, and UXO ID & Disposal.

We deliver total solutions for subsea infrastructures and assets that meet the needs of our clients and the international oil, gas- and renewable industries, considering a safe environment.

We want to create a sustainable business and increase our profitability through solid project management and full client awareness.

To realise this ambition we develop our organisation to the level of best in class being fully synchronised with our ambition and strategy by contributing to the following key success factors constantly:

- Qualified and engaged people
- Long term client relationships
- Strategic partnerships
- Innovative solutions
- Safety and quality 100%
- Visible presence
- Full control over marine assets



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Peterson Energy Logistics

Our services:

- Port services / stevedoring
- Ship agency
- Procurement
- Warehousing and distribution
- Materials management
- Customs formalities
- Consultancy services
- Integrated logistics
- Freight forwarding
- Fourth party logistics
- Marine planning and assurance
- Onshore site establishment
- Supply chain control tower
- Storage of large components

Our global locations:

- USA
- Guyana
- Netherlands
- UK
- Trinidad & Tobago
- Qatar
- Australia



info@onepeterson.com
energylogistics.onepeterson.com

SeaMar

SeaMar is a Dutch family business operating worldwide, carrying out activities for offshore projects. We provide shipping related services, ranging from vessel supply, agency & logistics, to vessel management. We are personal, switch quickly and are customer oriented with a “No-Nonsense” approach. Offshore energy and shipping is our field of activity for our integrated range of services.

Offshore support vessels

With a legacy built on expertise, state-of-the-art vessels and a forward-looking approach, we offer a comprehensive range of shipping services. Our fleet meets the demanding challenges of the offshore industry.

Vessel Management

As vessel owners we understand efficient management of vessels is crucial. With SeaMar at the helm of your vessel management, you can focus on growing your business.

Agency and logistics

Committed to efficiency, reliability and customer satisfaction, we offer services with local insights and support with a global perspective. Our team possesses knowledge of maritime operations, regulations and local practices. Our network spans key ports throughout the Netherlands.

Guard and chase vessels

Guard vessels play a crucial role in maintaining maritime security. We have an extensive track record in providing guard vessels for offshore wind, wreck & shipping lane protection, decommissioning and seismic support.



info@seamar.nl
www.seamar.nl

Sensing360

Sensing360 is a leading provider and partner to help to make rotating equipment smart. Our next level monitoring optical solutions are used for design to increase reliability, for condition-based monitoring for early failure detection and for reliability-based maintenance and process control to make decisions on measured risks of failures and increase operation efficiency. We add load and torque to the mix of monitoring rotating equipment. This crucial operating parameter in combination with optical sensors, results in more reliable, higher quality and more precise data for bearings, shafts and (planetary) gearboxes. Designing, monitoring and controlling rotating equipment is a lesson in how much you really know about your equipment and the accumulated severity of its operating condition. The severity of the operating condition is mainly characterized by the various loads acting on your equipment. Only from a fraction of the loads, the payload, the revenue is derived BUT all accumulated loads will consume remaining useful life and will act as a risk for your operation. Our solutions that allow optimize performance by controlling the payload. We provide you with the real-time load data that allows you to monitor and optimize the operating conditions by minimizing the unwanted load. We provide real time actionable load data to improve the performance of your rotating equipment and mitigate the risk of unplanned down time. Interested in optimizing your equipment? Please contact us!



info@sensing360.com
www.sensing360.com

VTN Veiligheidstechniek Nederland

For 40 years VTN Veiligheidstechniek Nederland has been supplying and maintaining high quality personal protective equipment that increases the safety of people in dangerous work situations and environments. We can rightly call ourselves a leading total supplier for, among others, the fire department, police, defence and industry an offshore in the Netherlands.

VTN is also specialized in the production of breathing air systems for a broad range of applications in the chemical and petrochemical industries.



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www.vtn.nl

Tarucca

Tarucca provides AI and Data Science services and consultancy for the wind energy and hydrogen sectors, specializing in condition and structural health monitoring for wind turbine blades and hydrogen installations.

We partner with energy producers, asset owners, maintenance companies, manufacturers, and research institutes to leverage industry insights for your business. Our data science team excels in descriptive, time, frequency, and modal analytics, allowing us to extract valuable insights from complex time series data. We identify patterns, visualize trends, and uncover hidden correlations to support informed decision-making in complex systems.

In addition to data exploration, we apply advanced Machine Learning techniques to time series data, developing predictive models that forecast trends, detect anomalies, and optimize system performance. This expertise is crucial for enhancing operational efficiency and system reliability.

Our condition and structural health monitoring system for wind turbine blades uses optical sensors to accurately measure vibrations and strains, providing real-time data on blade health. This data enables wind farm O&M teams to implement predictive maintenance, reducing costs, increasing green energy production, and extending blade lifespan.

Tarucca actively participates in research projects like Eemshaven (V90), AIRTuB-ROMI (with TU Delft, TNO, Eneco, and Vattenfall), and ReliaBlade2 (with TNO and Shell). We're also developing a digital twin to assist in damage detection and structural health monitoring of wind turbine blades, enhancing maintenance strategies and overall system performance.



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www.tarucca.com

Whiffle

Whiffle is a leading provider in ultra-high-resolution weather data using Large Eddy Simulation (LES).

Our advanced LES technology seamlessly integrates comprehensive weather and environmental data, turbine specifications, and obstacle information to provide you with accurate insights into every aspect of your wind project such as wind resource assessments and yield calculations, including turbulence, (far) wakes, blockage and wind farm cluster effects. This solution is available through Whiffle Wind, a user-friendly web application, or via our bespoke consultancy services, providing flexibility and expert support tailored to your project's needs.

For wind power forecasting (day ahead and intraday) our approach combines the power of our LES model with the latest advancements in artificial intelligence and machine learning to deliver precision in both day-ahead and intraday forecasting.

Our weather model runs on graphic processing units (GPUs), allowing large areas and high resolutions to capture local turbulence and underlying processes and conditions in the atmosphere. Our technology delivers benefits in many economic sectors, but our primary focus is on the renewable energy market (wind and solar energy), making sustainable energy production more predictable and reducing the costs of weather risks.



info@whiffle.nl
www.whiffle.nl

Maintenance

C-Cube

C-Cube International B.V. is a technology company that can prevent unplanned unavailability of assets by detecting corrosion at an early stage. This enables maintenance managers to plan preventive maintenance and determine the scope of work in a data-driven way.

Maintenance can be very invasive and costly. The aim is to reduce maintenance costs, extend service life and prevent traffic disruption. Ultimately, the solution we offer also leads to a reduction in CO₂ emissions through more efficient maintenance and life extension due to corrosion risk management.

Our Corrosion Monitoring System (CMS) technology is capable of accurately measuring corrosion degradation and corrosion rate with applications in sectors such as the offshore industry. The CMS is a permanent sensor that collects real-time data for lifetime modelling. Our technology is able to make predictions on when corrosion will start

and generate the rate of visible corrosion over time. This results in extended asset life, effective risk management, cost-efficient inspections, cost savings, promotion of sustainability and data-driven decision-making.

If you would like more information about our technology, we warmly invite you to contact th@ccube.nl for a no-obligation introductory meeting.



jw@ccube.nl
www.c-cube-international.com

Digitaleon specializes in AI based Smart Maintenance solutions

Smart maintenance solutions often send all data to the cloud. But let's face it: it's not always easy to set up and maintain a constant, stable internet connection. Now you don't have to. We work with a new generation of solutions that send as little data as possible to the cloud and develop these solutions in collaboration with you. Unlike other solutions on the market, we place microcomputers on your systems to do the analysis locally. That way, only necessary data is sent to the cloud, such as when an alarm indicates something needs to be replaced.

Digitaleon offers you a complete package for AI-based smart maintenance: from identifying challenges in the maintenance process to rolling out a complete product. Contact me today and find out how we can optimise your maintenance process using AI and ML-based AI. Together, we will ensure a better and more efficient future for your business—you will be amazed by the possibilities.



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www.digitaleon.com

GranEnergia (STRATUS Energy BV)

Founded in 2011, GranEnergia is an integrated offshore energy services company, headquartered in Brazil. GranEnergia operates DP3 Semi-submersible Safety and Maintenance Vessels (UMS). These vessels have been operating in Dynamic Positioning since 2014 in Brazil and West Africa, with excellent performance.

Besides Offshore Accommodation Units, the GranEnergia group of companies has an extended Oil & Gas services portfolio to support its client Offshore and Onshore operations.

With approximately 1,000 offshore staff, well-equipped support bases and significant fabrication and storage capacity, the GranEnergia Group delivers innovative and integrated life cycle solutions in the fields of offshore maintenance and repair, logistical services and infrastructure facilities to both local and international clients in the offshore energy sector.



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Corrosion & Water control BV

CORROSION has been in the business of protecting offshore wind farms, vessels and onshore applications since 1993. From our humble beginnings in the small town of Moerkapelle in the Netherlands, we've grown into an internationally recognized leader in creative, sustainable, state-of-the-art solutions in corrosion and cathodic protection.

CORROSION is market leader in protecting wind turbine foundations in an environmentally friendly way by using ICCP. Our highly sophisticated ICCP and ICAF systems are utilized by companies large and small around the world, protecting their valuable assets and equipment in even the toughest and most demanding conditions. We're proud of the quality of the products we offer and the level of service we provide.

Excellence is born of experience and expertise, and our unique research laboratory at our global headquarters in Moerkapelle is the beating heart of our company. It's where we test and develop new products and services, enabling us to lead the way in creating innovative anti-fouling and corrosion solutions. Over the last three decades, we've expanded not just in terms of what we do, becoming a major global player in anti-fouling and maritime protection, but also geographically, with successful subsidiaries everywhere from Germany and France, to China and Vietnam.



info@corrosion.nl
www.corrosion.nl

Ridderflex & Plastics BV

Ridderflex develops and produces essential components of rubber, plastic and polyurethane, gaskets and sealing products for the offshore industry. Ridderflex believes in possibilities. A technical problem is a challenge for our team: what is the best way to help you? We will always find the best solution for your specific requirements, using all our knowledge and experience of materials, machining operations and applications. We look beyond standard materials and products.

Ridderflex products

Our rubber, plastic and polyurethane products are essential for the offshore industry. Ridderflex supplies amongst others: plastic sliding plates and strips, wear parts, rubber strips, dampening pads and even stinger rolls linings. Ridderflex excels in the production of customised products. Ridderflex: small enough to be flexible, big enough to solve your problem.

Polyurethane specialist

As a polyurethane specialist, Ridderflex's strength is producing polyurethane products. Our tensioner track pad linings, stinger roll linings and cross-overs are indispensable for the installation of pipelines, cables and umbilicals. We can adapt the material properties to the application of the product. There are no other materials in our product range, that are so flexible and versatile. Experience shows us that PU products can be the solution to numerous technical problems.



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TrustLube

TrustLube designs, manufactures and installs automatic lubrication systems and monitoring systems for the maritime, dredging and food industry. TrustLube systems guarantee you will receive the exact dosage, at the correct location, at the desired time, using a precise quantity with the right product! This way you prevent downtime. And your business always moves smoothly.

Customized lubrication systems for builders of offshore wind farms

Jack-up rigs, crane ships and walk-to-work vessels that are used to build and maintain offshore wind farms all have their own unique characteristics. Thanks to our many years of worldwide experience in the maritime world, we know exactly which external influences your ships, installations and platforms are exposed to. Our AISI316 stainless steel systems defy seawater and other influences. As a result, maintenance is reduced and uptime improved drastically. And that is exactly what you need in a world where delay is not an option.

Xtreme Lubricants

TrustLube Xtreme Lubricants offer high-quality solutions for use under extreme conditions, such as maritime environments.

All lubricants are developed to improve the sustainability. There is a type of Xtreme Lubricant for every application.



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www.trustlube.com

Rope Access Noord

Rope Access Noord (RAN) is a multidisciplinary Dutch company specialized in working at heights, depths and difficult to reach places. Our work consists of inspection, maintenance and repair on on- and offshore installations that can only or more easily be reached by our rope techniques and tools. Next to these activities we also create safe entrances, set up rescue plans, perform technical rescue, provide training on how to work safely on height and in confined spaces and we map the integrity (in co operation with our partners in drones and 3D scanners).

For our activities in the offshore wind market we created a sub division: Offshore Wind Solutions. From this division we offer experienced and internationally trained Offshore Wind technicians supported by our back office consisting of a Planner, Material Manager, QSA Manager and Technical Manager.

Our technicians maintain large components and/or small electronic parts on the entire wind turbine: foundation, rotor blades, transition pieces, substations and nacelle:

- Visual inspections: periodic physical or drone inspections (MPI, UT, VT, ET)
- Instrument inspections: periodic NDT (PCN level 2 & USM) and paint inspections
- Maintenance: rigging & lifting (rope access hoisting), bolting, welding, coating, painting, cleaning and mounting
- Training, advise & instruction to junior Offshore Wind Technicians



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www.offshorewindsolutions.eu

Crew/ staffing services

Atlas Inexco

Atlas Inexco specialises in global recruitment and workforce solutions, with a focus on the energy and marine sectors. Our primary mission is to connect highly skilled professionals with companies operating within these industries.

With a significant international presence, we excel at sourcing skilled engineers, technicians, supervisors, project managers, and other experts, both for onshore and offshore projects. Our unwavering commitment to safety and industry compliance ensures that the professionals we place consistently meet the highest standards.

In addition to traditional recruitment, we offer comprehensive workforce solutions, including training and development programs. We take pride in our ability to match top talent with the specific needs of our diverse client base, which includes offshore energy firms, maritime organisations, and engineering companies.

At Atlas Inexco, we understand the unique challenges and demands of the energy and marine sectors. We work hard to provide tailored workforce solutions that drive success for both professionals and clients. Our dedication to safety, compliance, and excellence in talent acquisition has established us as a trusted partner in these dynamic industries.



Atlas Inexco

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Oceanwide

Oceanwide is an international provider of diversified through a network of offshore recruitment agencies spread throughout Europe and the USA. Our services as an agency mainly focus on recruitment for Maritime and Offshore/Energy industries. Our organization's main goal is to facilitate the perfect match between the talented new generation looking for their dream job and the values and skills employers are looking for. This is how our offshore recruitment agency thrives!



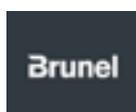
personnel@oceanwidecrew.com
www.oceanwidecrew.com

Brunel Energy Europe BV

Brunel is an international group, operating from our network of more than 100 branch offices in over 40 countries.

We currently work on many of the worlds largest projects in the following sectors: Renewable energy, Oil and gas, Mining, Infrastructure, Automotive and Life Sciences. Services provided include Perm Recruitment, Contracting & Secondment, Technical Training, Talent Acquisition, Staff Secondment, Offshore Recruitment, Career Industry Training,

Global Mobility services including New location start up, Project Management, HSE, Third Party Vendor Inspection, Commissioning.



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IPS Powerful People

Empowering the full potential of both people and businesses has driven us since 1988. Navigating our professionals and clients through an ever-evolving world, we provide specialized global expertise and solutions for recruitment, (cross-border) employment and project management within the Maritime, Renewables, Offshore, Tunnelling, and Civil Industries. Committed to sustainability, we ensure that our staff, professionals, and clients thrive today and are prepared for a better tomorrow.

To create a better tomorrow together, we believe in harnessing expertise. As your trusted HR business partner in the industry, we envision tomorrow's challenges today. Anticipating your future needs with global, tailored, cutting-edge solutions, we connect talent with opportunities and prioritize the sustainable provision of the most valuable asset, People! By empowering professionals on their developmental journeys and offering specialized data driven expertise and solutions, we enable our clients to focus on their core business.

IPS Powerful People - Empowering a better tomorrow.



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www.ipspowerfulpeople.com

Atlas Professionals

Atlas Professionals is an international recruitment company specializing in Energy, Marine & Renewables industries. Operating globally, we strive to create a reliable, agile and sustainable business environment where our Professionals can secure the career they deserve and our Clients having means to access the best talents our industries have to offer. We do this by offering bespoke solutions – along with comprehensive recruitment planning that covers everything from work visas to payroll, and from compliance to safety inductions. Taking strength from our impressive track record and dedication for excellence, Atlas Professionals continues to be an influential recruitment company that does not shy away from innovating, refining, and progressing – evident by development of our landmark programmes such

as the Zero Harm initiative and the Greenhand Programme. With more than four decades of experience under our belt, Atlas Professionals is dedicated to ensuring that we are always at the frontier of everything related to personnel recruitment and business solutions in Energy, Marine & Renewables industries.



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www.atlasprofessionals.com

TOS | Crewing & Ship Delivery

We are TOS, a loyal and authentic family business founded in 1992 in Rotterdam. Today, we are a trusted maritime service provider, connecting people from around the world, empowering and helping them find pleasure in their work. Our business is a people business. We proactively support clients in finding a flexible workforce and effective personnel solutions worldwide. We supply the very best people in the maritime, onshore, offshore & wind energy sector.

- Nautical Crew: Officers, Engineers, AB's and Catering staff
- Construction Crew: Foremen, Riggers, Gangway Operators, Electricians and Crane Operators
- Maintenance Crew: E&I Technicians, Turbine Technicians and Mechanics
- Supervisors: Lifting and Offshore construction
- Project Staffing
- Turnkey Ship Delivery

In recent years, we've specialised in building and maintaining teams for offshore wind installation and decommissioning projects in the North Sea, German Bight, America, and Asia. Our teams are used to working together and are trained to meet the highest industry standards.

We take care of these teams' recruitment & selection, training, and planning in close cooperation with our clients. By entrusting TOS with these HR services, our clients gain flexible and cost-efficient solutions for their project teams.



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www.tos.nl

ProPakt

Are you looking for additional Freelance Project Personnel (or work) as:

- Commercial Diving (Air, Saturation, Diver, Technicians, Supervisors)
- Remote Operated Vehicle (ROV) operators and technicians
- Hydrographic and Geotechnical Survey engineers and Party Chiefs
- Rope access technicians
- Offshore Construction managers and Client representatives
- Selected deck and offshore administrative personnel

ProPakt is the transparent self-service recruitment platform to efficiently and cost-effectively search and contract experienced, certified and verified, Freelance Professionals from the Global Offshore Energy & Maritime Industry. Either contract direct for personnel with entity or via a payrolled structure for personnel without entity. Search local to save costs and lower your carbon footprint. Download required verified certification once you are in agreement with each other and enjoy a flawless invoicing procedure which relieves the burden of bookkeeping. Register via our website.

Do you rather manage your own personnel, but still in Excel sheet status? Choose for ProPakt-Private, the customized personnel management software for a private company experience with dedicated, customized cloud-based infrastructure, including employee self-service to maintain their profile and certification.



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www.ProPakt.com

12.7 Port Logistics

AYOP (Offshore Energy Association)

AYOP (Offshore Energy Association) unites companies, regional governments, and organizations that are active in the offshore energy sector. We operate primarily in North Holland, with the ports of Amsterdam, Den Helder, and IJmuiden as key hubs. With over 125 members, AYOP covers the full spectrum of the industry – from seaweed to helicopters.

The challenges for offshore wind energy in our region are substantial with the North Sea and the upcoming wind farms in our backyard. And collaboration in this is key. That's why we look for shared opportunities for our members, share knowledge, and focus on possibilities and potential. We do this through joint trade show visits, networking events, an online community, and by actively promoting the offshore energy sector.

By joining forces, we can accomplish more.



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<https://ayop.com>

North Sea Port

North Sea Port is a West European port that extends for more than 60 kilometers, 9.100 hectares, and across two countries: Belgium and the Netherlands. Because of its location at the North Sea, the port is directly accessible by sea-going vessels, benefitting global trade.

Its central location in Europe makes North Sea Port a logistics hub through which goods flow smoothly to all corners of Europe. North Sea Port is also part of the North Sea-Rhine-Mediterranean and North Sea-Baltic transport corridors, which ensure that goods can be delivered quickly and efficiently by rail, road, and/or inland shipping to their final destination.

Its location, multimodality, and diversification in goods make North Sea Port an important European port: the third most important in terms of added value and tenth in terms of freight traffic.



www.northseaport.com
contact@northseaport.com

Port of Eemshaven | Groningen Seaports

Eemshaven is a major energy hub, producing around a third of the Netherlands' energy with an installed capacity of 8,000 MW. It hosts several large power stations and high- and medium-voltage stations, ensuring a stable energy supply. The port features three operational power stations, a new floating LNG terminal, two undersea high-voltage cable connections to Norway and Denmark, and 111 onshore wind turbines.

A Leading Offshore Wind Port

Eemshaven plays a key role in offshore wind farm construction and turbine maintenance, positioning it as a leading port in the North Sea offshore wind industry. In 2020/2021, the port supported transport and installation work for Hornsea Two, the world's largest offshore wind farm, and in 2024, it facilitated the installation of the He Dreiht wind farm while TKF opened a cable factory in the port.

Impressive Track Record

Since 2009, Eemshaven has been a pivotal location for wind turbine assembly and shipping, building an impressive track record with projects like Alpha Ventus, Gemini, Gode Wind, Hornsea Two, and Hollandse Kust Noord. Currently, Eemshaven serves as the base port for Denmark's Thor wind farm, its 23rd offshore wind project. With numerous future offshore wind projects planned, Eemshaven is set to maintain its critical role in the renewable energy sector.



e.bertholet@ groningen-seaports.com
www.groningen-seaports.com/offshore

12.8 Offshore Solar

Oceans of Energy

Oceans of Energy brought Offshore Solar in High Waves from a (perceived) impossibility to a reality!

Oceans of Energy B.V. (OOE) was founded in 2016 and is the first company in the world that installed and maintained an offshore solar farm system in high waves. OOE has full focus and dedication on the development of offshore solar because using the offshore space for solar opens the possibility of the generation of abundance of clean energy without using land space. Half of the people on the planet live near a coastline and they will all benefit from this.

OOE delivers the hardware (product supply) and the construction (project delivery) of offshore solar projects followed by the lifetime asset management (lifetime operations & support services). Furthermore, OOE is world leading in ecological research concerning offshore solar and its interactions with the environment, and we develop capabilities for project development, project financing, and consenting.

OOE offers offshore solar farms in standard sizes of 3 MWp (125x125 meter), 12.5 MWp (250x250 meter), 50 MWp (500x500 meter) and 200 MWp (1000x1000 meter).

Oceans of Energy

www.oceansofenergy.blue
offshore.solar@oceansofenergy.blue

SolarDuck

SolarDuck provides the world with clean solar energy using advanced technology. SolarDuck is a Dutch-Norwegian company focused on floating offshore solar panels and has strong roots in the maritime industry. The company was founded as a spin-off from Damen Shipyards (the largest shipbuilder in the Netherlands). Since then, SolarDuck has worked tirelessly towards its vision of electrifying the world with floating offshore solar panels. SolarDuck generates offshore solar energy using unique, advanced technology that is fully scalable to meet specific local requirements worldwide. The company offers a sustainable solution to meet the growing demand for energy, especially where the need for decarbonization and limited land space means that the solution lies in ocean space. SolarDuck's technology provides an attractive value proposition in a wide range of use cases, from islands in the sunbelt to hybrid offshore energy parks in the North Sea, including the Netherlands.



<http://solarduck.tech>
info@solarduck.tech

12.9 Offshore hydrogen

H2sea

H2sea is a pioneering company at the forefront of green hydrogen innovation. H2sea specialises in concept design & engineering and offers procurement, construction, installation and commissioning services through strategic partnerships.

Key Achievements:

1. Platform Development: H2sea has designed central and semi-central hydrogen platform concepts with capacities ranging from 50 to 1000MW, showcasing its ability to scale green hydrogen production at sea efficiently and effectively.
2. Structural Assessments: In collaboration with TU Delft, H2sea has carried out a structural assessment of monopile-based support structures for offshore hydrogen Wind Turbine Generators.
3. Off-Grid Breakthrough: H2sea has achieved a significant breakthrough in off-grid offshore hydrogen production enabling stable green hydrogen production using electricity from off-grid offshore windfarms.
4. Pipeline Strategies: For offshore energy pipeline operators NGT and NOGAT, H2sea have devised innovative strategies for repurposing existing offshore pipeline infrastructure for hydrogen transport, facilitating the seamless integration of green hydrogen into existing energy networks.
5. Cost Reduction: A recent H2sea study demonstrates that the costs associated with Energy Storage Systems (ESS) on offshore hydrogen platforms can be reduced by an impressive 75%, further enhancing the economic viability of our solutions.

H2sea teams up with sister company Enersea, a top tier offshore engineering firm.



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More information

Interested in offshore wind development in the Netherlands? Visit us at www.windandwaterworks.nl. If you are interested to become a Partner, contact us via windandwaterworks@nedzero.nl.



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