Dutch Offshore Wind Innovation Guide

Your guide to Dutch offshore wind policy, technologies and innovations

wind & water works

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Netherlands

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The Netherlands Enterprise Agency (RVO.nl) developed this offshore wind policy and industry manual which was commissioned by the Ministry of Foreign Affairs and International Trade as a deliverable of the International Clean Energy Program (ICEP) on export promotion in the renewables energy sector.

Dutch Design and 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 a growing number of countries, offshore wind has become a key element of national plans to reduce the carbon intensity of their grid at a competitive price.

Experiences in the Netherlands have shown that governments need to be proactive in order to successfully achieve affordable, large-scale offshore wind capacity, and reap the socioeconomic benefits that 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 are 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 2023 edition of the Dutch Offshore Wind Innovation Guide.

In this annual flagship publication, the public-private partners in the wind & water works campaign provide you with comprehensive overviews of the Dutch regulatory framework and Dutch supplying 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 the 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.

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Ministry of Foreign Affairs

wind & water works

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 decarbonized energy systems of the future.

Governments around the world recognize the role that offshore wind technology can play in kickstarting post-COVID economic recovery through large-scale investment, creating jobs and bringing economic development to coastal communities.

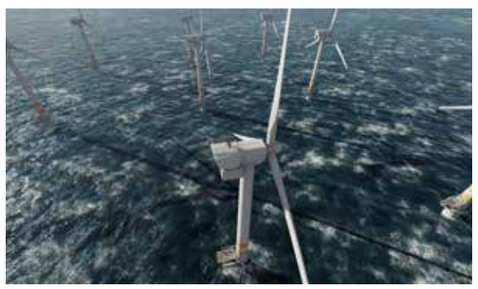
1.1 Global overview offshore wind development

As more countries in coastal regions plan to utilize their offshore wind potential, the Global Wind Energy Council (GWEC) saw the offshore wind market enjoying its best ever year in 2021. According to its Global Offshore Wind Report 2022, a total of 21.1 GW of new installations were added to the global capacity, bringing it to 56 GW.

China contributed nearly 17 GW (80%) of that offshore growth, the fourth year that China has led the way in new installations. Europe is the other only region which reported new offshore wind installations last year. The UK had a record year in 2021 with more than 2.3 GW reaching grid connection, making it the largest European offshore wind market in 2021, followed by Denmark (608 MW) and the Netherlands (392 MW). Outside China and Europe, two other countries recorded new offshore wind installations in 2021: Vietnam (779 MW, intertidal only) and Taiwan (109 MW). In the United States no offshore projects were built in 2021. However, the US offshore wind market continues to gain strong momentum in both state and federal waters.

In 2022, a total of 23 GW capacity of offshore wind projects is under construction. China is the most active single market with 7.8 GW under construction, followed by the UK (5.6 GW), Netherlands (2.3 GW), Taiwan (2.1 GW), France (1.4 GW), and Germany (1.1 GW). On a global regional level, Europe is still a market leader in offshore wind project construction with 49.5 per cent market share, followed by Asia (46.4 per cent) and the US (4.1 per cent). In the near future, Asia is set to take over the leading position from Europe as the world's largest offshore wind market. The other markets in the global top-five are: Germany, the Netherlands and Denmark.

Based on the latest industry forecasts and declared national offshore wind targets, GWEC expects that annual installations could reach 30 GW in 2027 and up to 50 GW in 2030, adding up to potentially 316 GW by the end of this decade and approx. 370 GW end 2031.



1.2 Europe's policy on offshore wind

The EU's Offshore Renewable Energy Strategy, issued in November 2020, sets out the goals of reaching at least 60 GW of offshore wind capacity by 2030 and 300 GW by 2050. Together with the UK and Norway, Europe could have up to 450 GW of offshore wind in operation by 2050. This implies a massive change of scale for the sector at an unprecedented speed. The current Offshore Wind installed capacity in the North Sea is just 15 GW and the supply chain produces only 3 GW of turbines to be added per year, a rate that is expected to reach 7 GW per year after 2030. To meet such ambitious targets, the EU and member states will also have to facilitate cross-border marine spatial planning, grid infrastructure development and, last but not least, both good permitting and PPA (Power Purchase Agreements) practices.

EU Fit-for-55 (2021)

To keep pace with the ambitions of the Paris Climate Change Agreement, the EU's Fit for 55 package aims to reduce greenhouse gas emissions by at least 55% by 2030, compared to 1990 levels. Under this strategy, offshore wind will become the number one source of electricity in the EU, taking optimal advantage of the potential in Europe's seas – from the North Sea and Baltic to the Black Sea, and from the Atlantic to the Mediterranean.

REPowerEU (2022)

In an effort to strengthen Europe's energy security and cut its reliance on Russian fossil fuels well before 2030, the EU launched the REPowerEU action plan in May 2022. For offshore wind, the EU calls for an additional 30 GW of offshore wind energy by 2030 to replace Russian fossil fuel imports before the end of this decade. This will be on top of the previous targets for offshore wind (60 GW by 2030 and 300 GW by 2050) already established in the Offshore Renewable Energy Strategy. Together with the UK and Norway, Europe could have up to 450 GW of offshore wind in operation by 2050.

Esbjerg Declaration (2022)

In response to this call Belgium, Denmark, Germany, and the Netherlands committed in the so-called Esbjerg Declaration to a joint offshore wind target of having at least 65 GW of generation capacity installed by 2030 and 150 GW by 2050. With this 150 GW pledge for 2050, the four EU member states have a joint target of half of the 300 GW capacity aimed for the entire EU by that time under the EU Offshore Renewable Energy Strategy, issued in November 2020. The four countries have also signed a declaration on realizing and advancing plans for energy islands in the North Sea, with one of the first steps being expanding the world's first energy island to its maximum potential capacity of 10 GW at 2040 at the latest.

1.3 Offshore wind policy development in the Netherlands

Today, the Netherlands is a front-runner in cost-efficient offshore wind development and installation. To reach this position, however, the Dutch had to overcome significant challenges. As with other countries, the potential offshore wind offers had long been recognized in the Netherlands. Even so, up to 2017 only a few offshore wind farms were actually built in the Dutch Economic Zone of the North Sea. Until then project developers were responsible for site selection and investigation, as well as having to go through the permitting process 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.

First acceleration phase: 4.5 GW in 2023 (Roadmap 2023)

However, in 2013, the conditions for offshore wind development changed significantly when a broad coalition of Government, employers' associations, trade unions, environmental protection organizations and energy companies, accelerated climate ambitions and agreed to kick-off the Dutch energy transition. The resulting Energy Agreement for Sustainable Growth (Energy Agreement) included ambitious provisions on energy conservation and targets to raise renewable shares in the energy mix to 14% by 2020 and 16% by 2023. Regarding offshore wind, the Government committed to setting up a Roadmap in order to assign and develop three offshore wind zones – Borssele, Hollandse Kust zuid (Dutch Coast south) and Hollandse Kust noord (Dutch Coast north) – in the Dutch sector of the North Sea, potentially increasing the offshore wind capacity by up to 4.5 GW in 2023.

Second acceleration phase: 11.5 GW in 2030 (Roadmap 2030)

In June 2019 the National Energy Agreement merged to a comprehensive National Climate Agreement under the then newly introduced Climate Act. With regard to offshore wind, three extra offshore wind zones were added for offshore wind development, raising the previous capacity target from 4.5 GW in 2023 to 11,5 GW by end 2030. Under the Roadmap 2030, the additional wind farm zones are Hollandse Kust West (Dutch Coast West, 1.4 GW), Ten Noorden van de Waddeneilanden (North of Wadden Sea Islands, 0.7 GW) and IJmuiden Ver (IJmuiden Far, 4 GW).

Third acceleration phase: 21 GW around 2030 (roadmap 2030+)

After taking office in January 2022, the current Dutch government committed to even more ambitious targets for offshore wind development. In order to meet the EU's goal

of reducing CO_2 emissions by 55 per cent by 2030 compared to the 1990 levels, the Government announced acceleration plans that nearly double the country's offshore wind target from the current 11.5 GW to approximately 21 GW of operating offshore wind capacity around 2030, equivalent to around 75 per cent of the country's current electricity consumption. In March and June 2022 the government subsequently disclosed the additional Wind Farm Zones and site specific tendering timelines for eight additional offshore wind farms with a total of at least 10.7 GW to be put out to tender before the end of 2027 and to be up and running around 2030. The eight new projects, located to the north and northwest of the Netherlands, include the IJmuiden Ver (noord) V and VI, each with a capacity of 1 GW, the 2 GW Nederwiek (zuid) I, the 2 GW Nederwiek (noord) II, the 2 GW Nederwiek (noord) III, the 700 MW Hollandse Kust (west) VIII, the 2 GW Doordewind I, and the 2 GW Doordewind II.

It is expected that the Netherlands will need at least 38 GW of operating offshore wind capacity to reach the climate-neutral status by 2050. This implies that the Dutch government plans to develop another16 GW of offshore wind capacity between 2030 and 2050. These efforts are already included in the Esbjerg Declaration in which Belgium, Denmark Germany and the Netherlands vowed to bring at least 65 GW of offshore wind by 2030 and 150 GW by 2050.

1.4 Results First Acceleration Phase: Roadmap 2023

Under the 2013 Energy Agreement and 2019 Climate Agreement, the Government spurred the actual development of offshore wind farms by issuing a steady roll out plan in 2017 – the 'Roadmap 2023' and in 2019 – the 'Roadmap 2030'. These Roadmaps set out the rollout sequence in which the Wind Farm zones and included sites will be developed, the projected generation capacity of the individual sites and the year of tendering for installation and operation. Under the Roadmap 2023, which had its final tender in 2020, there were successful tenders between 2016 and 2019 for five largescale offshore wind farms and one small innovation farm – divided over three designated offshore wind zones.

Borssele WFZ 1 & 2 (752 MW)

In 2016, the first sites in the Borssele Wind Farm zone, located 55 kilometres from the Port of Vlissingen, wer tendered. Fierce competition between companies in the public tender to secure the permit and associated subsidy to build and operate the wind farm (38 bids), resulted in achieving a far lower than anticipated price (max. 12.4 Euro cents per kilowatt hour), making the project at the time the cheapest worldwide. The permit and accompanying subsidy for the Borssele 1 & 2 offshore wind farm sites were won by Dong Energy (known today as Ørsted), based on a winning bid of 7.27 Euro cents per kilowatt hour. The offshore wind farm supplied power for the first time through TenneT's offshore grid in November 2020 and was officially opened in September 2021. Currently Norges Bank Investment Management (NBIM) is 50% co-owner of the Borssele 1 & 2 windfarm.

Borssele WFZ 3 & 4 (731,5 MW)

Towards the end of 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 BP contractor), won the second permit and subsidy to build and operate the Borssele 3 & 4 offshore wind farm sites, 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 second Borssele offshore wind farm was constructed and operated with a subsidy of just EUR 0.3 billion, meaning that it can potentially be operated without subsidy after 7.5 years. The originally anticipated subsidy was EUR 5 billion. The final wind turbine at the Borssele 3 & 4 offshore wind sites was installed in November 2020. Borssele III & IV are expected to 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 shareholders are Shell, Eneco, INPEX, Swiss Life Asset Managers and Luxcara.

Borssele WFZ 5 (19 MW)

The Borssele WFZ V site, designated as a small-scale demonstration site for offshore wind innovations, was won by the Two Towers consortium, comprising Van Oord, Investri Offshore and Green Giraffe in 2018. Situated within site III of the Borssele Wind Farm Zone, Borssele V features two Vestas 9.5-MW turbines and several innovations, one of which is a submerged Slip Joint, a new method for securing turbine foundations which has traditionally a flanged or a grouted connection, significantly reducing both installation costs and time. The design and manufacturing of the Slip Joint were certified by DNV GL in the autumn of 2019. Other innovations include Thermally Sprayed Aluminum (TSA), Impressed Current Cathodic Protection (ICCP) optimization, and oval cable entry holes. Finally, the seabed surrounding the two Borssele WFZ V wind turbines is fitted with eco-friendly scour protection.[1]

[1] Scour protection: rocks placed on the seabed around the foundations to avoid seabed erosion.

This technology is used to explore how nature and renewable energy generation can be mutually enhancing. Oysters will be 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. In June 2022 Van Oord has sold its shares in the Borssele V wind farm to Octopus Energy Generation, one of Europe's largest investors in renewables.

Hollandse Kust (zuid) 1 & 2 (760 MW) and 3 & 4 (760 MW)

In 2018 and 2019, Swedish Vattenfall won both tenders for building and operating the Hollandse Kust (zuid) wind farms, some 18 - 35 kilometres off the Dutch coast, in the area between The Hague and Zandvoort. The 1.5 GW Hollandse Kunst (zuid) project marks a series of firsts for the offshore wind industry.
Firstly, these will be the first wind turbines ever to be installed on a subsidy-free offshore wind farm seeing that Vattenfall is constructing Hollandse Kust Zuid without financial assistance from the Dutch government.
Secondly, the 140 Siemens Gamesa 11 MW wind turbines will be the largest and the most powerful commercial wind turbines to be installed on any wind farm in the world. The wind turbines have a rotor diameter of 200 metres and a total height from sea level to the top of the blade of 225 metres.
And thirdly, this marks the start of the turbine installation phase on what will become the largest offshore wind farm in operation once commissioned in the summer of 2023.
Last but not least, with a combined weight of 115,000 tons, the 140 monopiles are designed in such a manner that they do not require transition pieces. This design allows faster installation and cost reductions. Currently, BASF and Allianz are co-owners of the Hollandse Kust Zuid windfarms.

Hollandse Kust (noord) (760 MW)

In 2020 the CrossWind consortium, a collaboration between Shell (80%) and Eneco (20%), won the tender to build and operate the fifth and last offshore wind farm under the Roadmap 2023. This windfarm is located 18.5 kilometres from the coast of Egmond aan Zee in the Netherlands. As with the wind farms in Hollandse Kust (zuid), the 760-MW Hollandse Kust (noord) wind farm was also tendered based on zero-subsidy conditions. Similarly to Hollandse Kust (zuid), approximately 25 percent of Hollandse Kust (noord) is located within the twelve-mile zone of the Dutch territories. This means a seabed lease, as well as a rental agreement for the infield cabling, will be established between the wind farm operator and The Central Government Real Estate Agency and TSO TenneT. The consortium plans to have the Hollandse Kust (noord), featuring 69 Siemens Gamesa 11 MW turbines, operational by mid-2023 with an installed capacity of 760 MW, generating at least 3.3 TWh per year.

Apart from building and operating the wind farm, the CrossWind consortium also deploys a series of innovations (technology demonstrations), such as a floating solar farm, short-term battery storage, turbines that are 'tuned' to minimize the wake effect that turbines can have on one another, green hydrogen produced through electrolysis, and the combination of these individual measures to ensure a continuous power supply regardless of the wind. Furthermore, the monopiles are of a TP-less type, which means that they are designed in such a manner that they do not require transition pieces. The design is said to allow faster installation and cost reductions.

Last but not least, Shell Nederland and Shell Overseas Investments, both subsidiaries of Shell, took 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 hydrogen production will be powered by electricity coming from the Hollandse Kust Noord offshore wind farm which is expected to become operational in 2023, from when it will be generating at least 3.3 TWh per year.

1.5 Roadmap 2023: a kickstarter for energy transition

Looking back at the results of the Roadmap 2023, it is safe to conclude that the Energy Agreement proved to be a 'game changer' for the development of offshore wind in the Netherlands. Under the old policy up to 2013, there was little activity in offshore wind, with just under 1 GW capacity installed in total. With the more proactive current policy approach, a legal framework was introduced and a total of 3.5 GW has been successfully tendered between 2016 and 2019, with an additional 17 GW now scheduled under the revised Roadmap 2030+, which will result in a combined installed Dutch offshore wind capacity of approximately 21 GW around 2030. The cost of wind energy has even gone down substantially faster than targeted. In the Energieakkoord 2013 the 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 & II was already substantially lower than the target for 2020. The latest tenders for the Hollandse Kust Zuid and Noord resulted in prices even without subsidy, only grid connection cost are subsidized/publicly funded. In an evaluation of the Energy Agreement 2023, the independent Netherlands Court of Audit found that the costs for offshore have even dropped 80%. As a consequence also the expected subsidies have dropped substantially, from an expected maximum of 18 billion in 2015 to approximately 5 - 6 billion expected today. It proves the importance of a strong public-private process guided by the Government, whilst setting parameters for the pace at which the proposed new capacity will be developed, the maximum capacity of the wind farms, planning and zoning, site investigations and, last but not least, the grid connection. By regulating all conditions for the construction of the wind farms, the Dutch Government reduces project risk, financing and societal costs.

1.6 Kick-off Roadmap 2030: Hollandse Kust (west) Wind Farm Sites VI and VII

On 14 April 2022, the Dutch government kicked-off the current Roadmap 2030 by launching the tender for Sites VI and VII of Hollandse Kust (west) Wind Farm Zone (HKWWFZ). Located 53 kilometers from the coast, the Hollandse Kust West tenders will award permits to develop two individual 700 MW sites within the wind farm zone. The maximum number of turbines to be installed at each site is 60, with an individual rated capacity of at least 14 MW. Transmission system operator TenneT will construct two offshore platforms with two grid connections within the zone. If the winning bids go for a full build-out, the zones could have a total combined capacity of at least 1,680 MW. The project or projects are expected to be operational by 2025 - 2026. As with the previous tenders, the winning bidder will be selected on the basis of a comparative assessment. Under site specific rules of the tenders, to win the rights for Site VI, the bidders had to include ecological measures in their concept, whereas Site VII required investments and innovations which are beneficial for the Dutch energy system integration. A new element in this tender will be a one-off financial bid by a potential developer. The financial bid in this tender is capped at EUR 50 million. This means the maximum score for the financial bid is achieved if a developer bids EUR 50 million for the permit, RVO said. A relative number of points is awarded for a lower bid, in steps of EUR 2.5 million per point.

The competition for the rights to build and operate the Hollandse Kust West Site VI and/or Site VII, which closed on 12 May 2022, attracted bids from major developers such as Ocean Winds (joint venture ENGIE and EDP Renewables), RWE, Ørsted and TotalEnergies, Shell and Eneco, SSE Renewables and Brookfield, bp, and Vattenfall and BASF. The bidders for the Hollandse Kust West Site VI and/or Site VII included several innovative elements in their proposals. SSE Renewables and Brookfield will include a Power Purchase Agreement (PPA) in their bis, securing consumption of a large part of the electricity produced by the 760 MW offshore wind farm for a period of 15 years, which will then be used to power a range of innovative projects including electrolytic production of hydrogen and electric boilers. The partnership between Shell and Eneco, as well as the one between Ørsted and TotalEnergies, and RWE have included green hydrogen production in their Hollandse Kust West proposals. Vattenfall proposed the development of self-sufficient offshore hydrogen turbines to produce offshore hydrogen, so without any need to connect to the electricity grid. RWE and Dutch floating solar technology provider Solar Duck offered to test offshore floating solar parks with integrated storage in the company's bid for the Hollandse Kust West (HKW) site VII in the Netherlands.

2. The Dutch Way: Government regulations and tender system explained

As the global energy transition is well underway, challenges remain, which is certainly the case in the Netherlands too. However, the Dutch Government is committed to achieving the goals laid down in international agreements.
European climate targets have been enshrined in Dutch law and translated into a comprehensive Climate Agreement in which the public and private sectors and NGOs plotted a detailed transition path. This chapter explains the current Dutch Government approach as a transition path for the economic feasible deployment of offshore wind farms.
This comprises a 10-step approach, designed in close consultation with the wind energy sector.

2.1 Current Dutch offshore wind policy in 10 steps

Today's regulatory and tender framework for offshore wind, tackles the disadvantages of the previous policy approach, in place until 2013, when wind farm developers were responsible for site selection and investigation, permitting process and grid connection. In contrast, the current policy approach is much more proactive: by regulating conditions for the construction of the wind farms – i.e. exact location, a long-term tender schedule, clear consenting procedures and the State being responsible for offshore grid connections, – the Dutch Government helps to reduce pre-bid investment risks, financing and societal costs. To ensure trusted site survey data and environmental impact information, fair tendering and timely permitting, the Netherlands Enterprise Agency (RVO.nl) acts as the coordinating administrator (one-stop shop) under the Ministry of Economic Affairs and Climate Policy.

The current policy approach can best be explained in 10 steps, demonstrating a leading role for the Government and favorable market and tender conditions for project developers.

2.1.1 Step 1. Designating the wind farm areas

The Dutch legislative offshore wind framework starts with early spatial planning. Through the National Water Plan, the legal base of which is encompassed in the Water Act, the Ministry of Economic Affairs and Climate Policy and the Ministry of Infrastructure and Environment allocated the areas for future offshore wind farm development in the Dutch territory of the North Sea. Each area can include one or more wind farm sites. The development of offshore wind farms will be restricted to these areas; permits will not be awarded for wind farms outside these areas.

2.1.2 Step 2. Drawing Up Offshore Wind Farm Tender Roadmaps (rollout plans)

'In the Offshore Wind Energy Roadmap a schedule is provided for: the specific rollout sequence in which the Wind Farm areas and included sites will be developed, the projected installed generation capacity of the individual sites, and the year request of tendering for installation and operation. The law Wind Energy at Sea, on which the Roadmap is legally based, was introduced in 2015 in close consultation with the wind energy sector. The purpose of this law is to guarantee optimal efficiency in the use of marine space and provide a decade-long pipeline of tenders as an assurance for project developers.

So far, two offshore wind farm Roadmaps have been issued by the Government:

- **Roadmap: 2023**
  As planned under the National Energy Agreement (2013), in 2015, the Dutch Government published an initial Roadmap (2015 - 2023), aimed at adding a total of 3.5 GW of offshore wind power capacity by 2023. The Roadmap outlined plans for five offshore wind farms, all to be tendered between 2016 and 2019, with the last one expected to be in operation in 2023.

- **Roadmap: 2030**
  Encouraged by the successful rollout of tenders in the first road map, the Government released another Roadmap in 2018, outlining an additional 7 GW of offshore wind development before the end of 2030. The second Roadmap schedules the release of wind farms, with tendering between 2021 and 2026, with the last one in operation in 2030. The second Roadmap includes the zones Hollandse Kust (west), Ten Noorden van de Waddeneilanden and IJmuiden Ver.

- **Roadmap 2030+**
  After taking office in January 2022, the current Government committed to even more ambitious plans for offshore wind development, in order to meet the EU's goal of reducing CO_2 emissions by 55 per cent by 2030. The Government announced additional plans to nearly double the country's offshore wind target from the current 11.5 GW to approximately 21 GW of operating offshore wind capacity by 2030.

  The additional offshore wind capacity will be developed within newly designated, as well as within already existing zones. Newly designated zones (named Nederwiek, Iagelander and Doordewind) are to additionally accommodate 8 GW of offshore wind capacity, the reconfirmed areas IJmuiden Ver North (2 GW), and the remaining 700 MW zone within the southern part of Hollandse Kust (west) area will complete the extra capacity push.

2.1.3 Step 3. Conducting studies

Following the parliamentary approval for the Roadmap, the foreseeable offshore wind farm sites are subject to a comprehensive environmental impact assessment, leading to a ministerial wind farm site decision (to be explained in step 5). Also, a series of geo-physical site studies are executed in step 3.

Environmental impact assessment
To analyze and – if necessary – deal with the economic, social, and ecological impacts of the wind farm(s), the site decisions are legally subject to an environmental impact assessment (EIA), commissioned by the Netherlands Enterprise Agency on behalf of the Ministry of Economic

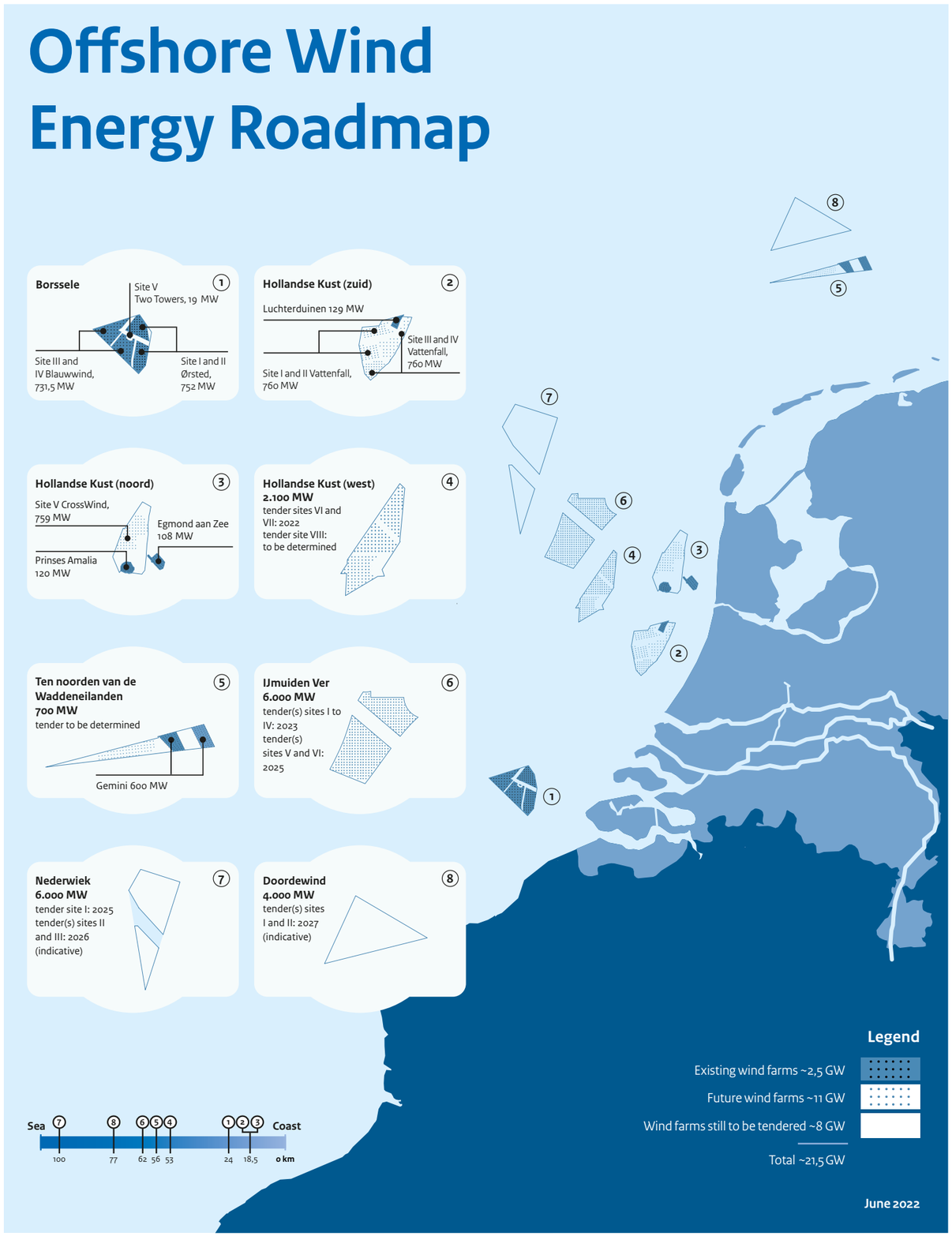


Figure 1. The areas for offshore wind development in the Dutch territorial waters (Economic Zone) of the North Sea are pictured in red

Affairs and Climate Policy and the Ministry of Infrastructure and Environment. The EIA results are published in the site decision (step 5), available for public inspection (and appeal), after which this becomes irrevocable.

Site studies
The Government also conducts a series of local site studies (investigating soil- wind- and water conditions). Examples are the meteorological and oceanographic survey, the soil survey, the ecological soil survey, the archaeological survey and UXO surveys. As with the EIA, the outcomes of these site data studies are made available for project developers to help with their FEED studies, enabling them to optimize project plans and submit competitive bids in the tendering (also see step 6). Project developers therefore do not have to conduct an EIA, nor perform their own site studies (or bear the associated costs for them) before deciding whether a project may be viable or not. The costs for these surveys is borne by the State and not the competing project developers. The Netherlands Enterprise Agency (RVO) will commission and publish the site data packages. All studies and investigations are officially and independently certified and quality approved.

For more information on offshore wind farm site assessment and selection, please refer to: www.windandwaterworks.nl/cases/offshore-wind-farm-site-assessment-selection).

For more information on minimizing environmental impact of offshore wind farm (installations), please visit: www.windandwaterworks.nl/cases/minimising-environmentalimpact

2.1.4 Step 4. Installing the grid connection

The Dutch national electricity Transmission System Operator (TSO) TenneT has legally been appointed to be responsible for the connection of the wind farms to the onshore electricity grid. As the planning and installation of this offshore grid network generally takes 8 to 10 years (depending on the distance, technique, and permit procedures and EIA), the grid installation decision is made as early as possible in the process. The permit for TenneT is made publicly available for inspection (and appeal) by all parties, after which it becomes irrevocable.

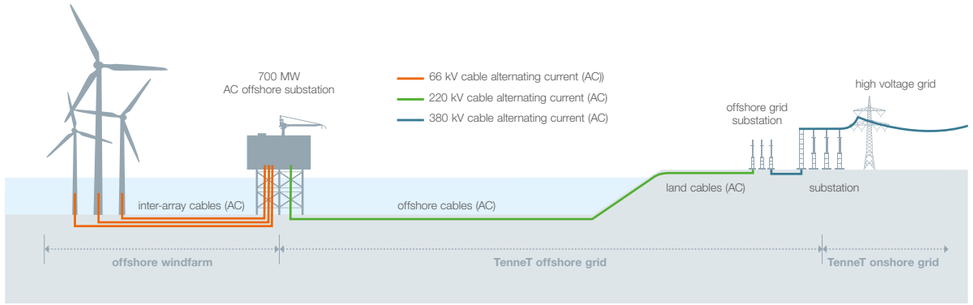


Figure 3 In case of relatively short distance to the onshore connection sites and the relatively limited size of the capacity to be provided, the offshore grid can be configured for alternating current (AC)

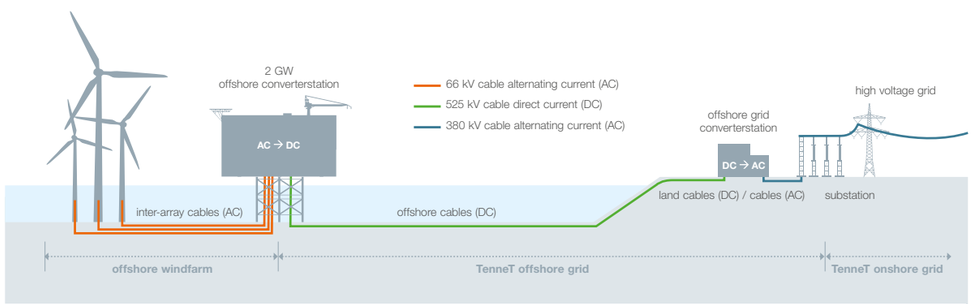


Figure 4 In view of the relatively large distance (70 km) to the onshore connection sites and the large capacity to be connected (approximately 4 GW), the IJmuiden Ver Wind Farm Zone will be connected using direct current technology (HVDC).

The choice of TenneT, as the offshore grid system operator, has clear advantages over individual grid connections installed by project developers. The advantages are both strategically (critical/ vital infrastructure for national security) as well as financially motivated. The financial advantages relate to economies of scale following standardization in substation design, purchasing, maintenance and knowledge development. Grid operation by TenneT also simplifies compensating grid fluctuations, flow management, and balancing supply and demand, whilst integral grid operation also leads to a clear distribution of tasks and responsibilities in the electricity system.

To create the cost-saving economies of scale, standardized AC substations with an individual capacity of 700 MW, have been designed to connect the wind farms to the national grid, using two 220-kV export cables.[2] As soon as 380-kV subsea cables become available, these will be utilized to further reduce the number of cables required.

In the event that DC substations are required (such as for the wind farm zone IJmuiden Ver, scheduled in Roadmap 2030), the connected transmission capacity is approximately 2 GW and an onshore converter station via two 525-kilovolt cables will be part of the offshore grid.[3]

The inter-array (infield) cables, which connect the wind turbines to the substation, remain the responsibility of the project developer. The wind turbines will be connected to the TenneT platform through 66-kV infield cables, making the Dutch offshore wind farms the first in the world to be connected by a voltage level of 66 kV instead of 33 kV.

Offshore grid development framework
To plan the public investments in the offshore grid, the Government provides guidance through a development framework. This framework outlines the design and construction of the offshore grid and its main functional and technical requirements. It also stipulates the tasks of TenneT as offshore transmission system operator, provides the sequence of the development of the sites and sets the timetable for commissioning the connection for the sites. On the basis of the development framework, TenneT draws up an investment plan every two years, setting out the envisaged investments, performance targets, deadlines and plans for capacity expansion. The investment plan needs approval from the Dutch regulator, the Authority for Consumers & Markets.

Connection & Transmission Agreement
TenneT and the offshore wind farm operators sign a Realization Agreement as well as a Connection and Transmission Agreement. The agreements set out the terms and conditions regarding the development of the connection for the wind farm, addressing aspects such as the basic design and technical specifications of the connection and the substation, as well as operational arrangements and the exchange of information between TenneT and the wind farm developer. In the event of a delay or unavailability of the offshore grid, TenneT is legally committed to compensate the wind farm owner for postponed or missed (subsidy) revenues from electricity sales and consequential damages.

For more information on offshore grid connection, please visit: www.windandwaterworks.nl/cases/offshore-grid-connection

2.1.5 Step 5. Consenting: taking the wind farm site decision

After all the above steps have been taken, the Government is now ready to publish the Wind Farm Site Decision (WFSD). The WFSD is the cornerstone of the Dutch Law Wind Energy at Sea. This law, which received final parliamentary approval in June 2021, stipulates that offshore wind farms can only be built after a permit, based on the site decision, has been issued. A WFSD is, therefore, the necessary consent required to build a wind farm. It specifies the location for the wind farm and the conditions under which it may be constructed and operated, taking into consideration issues such as ecology and decommissioning of the wind farm. These conditions can be related to wind turbines (minimum power, maximum tip height, minimum tip height) and infield cables (prohibited outside wind farm site boundaries). The site decision, however, leaves some flexibility for the design of the wind farm. This means that project developers have the opportunity to choose the latest technical innovations – within the natural and environmental framework – to develop and operate the wind farm at the lowest possible cost.

The site decision is subject to public consultation and potentially an appeal. At the end of the consultation and appeal phase, the Wind Farm Site Decision becomes irrevocable, meaning it is final and no further appeals can be made.

[2] Given the relatively short distance to the onshore connection sites and the relatively limited size of the capacity to be provided, the offshore grid for the Borssele, Hollandse Kust Wind Farm Zones and the North of the Frisian Islands Wind Farm Zone have been configured for alternating current (AC).

[3] In view of the relatively large distance (70 km) to the onshore connection sites and the large capacity to be connected (approximately 4 GW), the IJmuiden Ver Wind Farm Zone will be connected using direct current technology (HVDC).

2.1.6 Step 6. Organizing the tender

Once the WFSD is irrevocable, the Government starts the tender process, coordinated by the Netherlands Enterprise Agency. All tenders kick off with a Ministerial Order, outlining the tender rules for the relevant offshore wind sites. Examples of tender rules are the timing of the tender, the deadline for full commissioning of the wind farm, the maximum tender amount and base electricity price, the minimum and maximum capacity of the wind farm and tender eligibility criteria, and criteria for ranking the bids. After the tender closes, the Minister of Economic Affairs and Climate Policy will appoint the winner within 13 weeks, a period which may be extended by another 13 weeks if required. The award decision is subject to objection and appeal proceedings by competing tender participants. Objections must be filed within six weeks of the date of the tender award. Subsequent appeals can be filed within six weeks of the date of the decision concerning the objection.

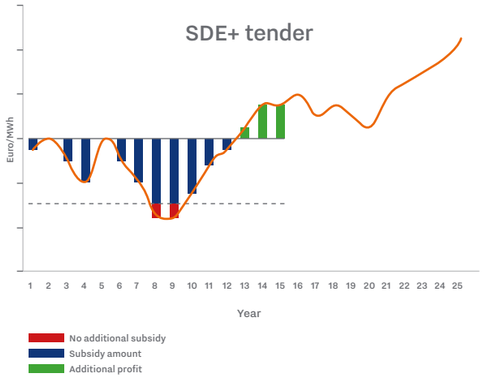
The current legislative tender framework distinguishes three optional tender models to select for future use: the tender based on lowest subsidy bid, best feasibility (+ financial) offer or highest auction price.

Model 1: Tender for lowest subsidy bid

In terms of this tender model with revenue support, used in 2016 for both Borssele WFZ tenders, the permit and associated subsidy are awarded to the party that tenders the lowest subsidy amount. The subsidy amount will be based on the so-called Stimulation of Sustainable Energy Production Scheme (SDE). The SDE offers an operating (premium feed-in-tariff) subsidy for renewable energy. Under this electricity price support scheme, producers receive financial compensation for the electricity they generate at times of low-cost prices for fossil energy, over a maximum period of 15 years. SDE compensates the difference between the production cost price of renewable energy (the “base amount”) and the cost price for fossil energy (the “correction amount”). Accordingly, the SDE contribution depends on the correction amount and, therefore, on the evolution of the energy price. Eligible tender applications will be ranked on the basis of the tender amounts, with the subsidy awarded to the one with the lowest tender amount.[4]

As an example (also see the graph below): the Borssele WFZ 3 and 4 tender in 2016 was won by the Blauwwind consortium (Shell, Eneco Group and others) with a winning ‘low’ of 5.45 Euro cents per kilowatt hour (‘auction price’ in graph below). For a maximum period of 15 years, the consortium will receive electricity tariff support (subsidy) in times when the wholesale market price (also called ‘correction price’) is below 5.45 Euro cents per kilowatt hour (pictured as blue bars in the graph). If the wholesale or correction price falls below a pre-set minimum cost price (also called ‘base electricity price’, 3 Euro cents per kilowatt hour in 2016), no additional subsidy will be provided (pictured in red bars). In the times that the future market price rises above the winning auction price of 5.45 Euro cents per kilowatt hour (green bars), no subsidies will be provided either, as the developer now profits commercially from the offshore wind farm.[5]

Future use of the subsidy tender will only be considered as a ‘backstop’ in the event of insufficient developer interest in the subsidy-free tender. If future Dutch offshore wind projects remain viable in a merchant environment, meaning that Offshore wind production costs are likely to be reduced to (less than) 5 Euro cents per kWh in 2024 and 3 to 4 Euro cents per kWh in 2030, the Government plans to remove the subsidy backstop from 2025 onwards.



[4] The maximum subsidy is based on the indicated capacity and the maximum number of full load hours of the offshore wind farm. The final subsidy payments are calculated per year, based on the actual amount of energy produced and the actual energy price. If the maximum production eligible for subsidy in a certain year has not been used, the remaining production capacity eligible for subsidy can be used in the following year. On top of the subsidy period of 15 years, another whole year can be taken to reach the remaining unused production eligible for subsidy, in effect stretching the subsidy period to a total of 16 years (forward banking). On the other hand, if production in a certain year exceeds the maximum production eligible for subsidy in that year, the excess production can be used in a following year if production is lower than expected in the later year, provided that this form of banking is restricted to no more than 25% of the annual production eligible for subsidy (backward banking).

[5] The Dutch SDE subsidy differs slightly from the popular Contract for Difference (CfD) mechanism, which many countries use to finance offshore wind development. CfDs provide both a guaranteed minimum price for the electricity generated to protect developers' project finance, as well as a financial reward (fee) if the wholesale price exceeds the strike price to compensate the Government. Project developers generally consider CfD to be the optimal system for revenue stabilization. However, the SDE model has the potential to be even more attractive for developer's project finance, as the Dutch subsidy system guarantees a minimum price, but demands no compensation fee when electricity prices are high. The SDE model is therefore sometimes also called a ‘One Sided CfD’.

Model 2a Subsidy free tender: best feasibility (comparative assessment)

Because of the strong interest and competition for the Borssele WFZ tenders, strike prices dropped rapidly. So much so that in 2018 and 2019, the Hollandse Kust (zuid) and Hollandse Kust (noord) tenders, permits could be granted subsidy free and based on a comparative feasibility assessment instead.12

In this tender model, applications will be subject to a differentiated feasibility assessment. The most important feasibility criteria in this model are the assurance of the actual wind farm construction/operation and the contribution of the wind farm to the national energy mix. Depending on the local specifics of the wind farm, additional criteria may apply when deemed relevant. Such specific criteria may relate to nature, aquaculture, fishery, safety, or shipping issues. For the 2022 tender Hollandse Kust West, additional ranking criteria were drawn on ecological innovation for Site VI and on system integration for Site VII. A team of independent experts – whose names will remain confidential to prevent potential interference by market parties – will be appointed to assess the quality criteria. The wind permit will be granted to the offer with the highest ranking.

As no subsidy is involved, the winning developer will not have to sign an implementation agreement with the Dutch State or provide a bank guarantee. However, to ensure the timely development of the wind farm(s) in accordance with the wind permit, the Minister has the authority to impose a penalty for non-compliance. The amount of such penalty will be proportionate to the loss incurred by the Dutch State as a result of the non–compliance and is expected to equal the applicable penalties in the tender scheme with subsidy.

Model 2b: Subsidy free tender: best feasibility + financial bid

Building on the experiences of previous subsidy-free procedures as described in model 2a, market competition between wind farm developers who apply for the same permit can further be promoted through the addition of a financial bid. This model was introduced for permitting the Hollandse Kust (west) sites VI and VII in 2022. Additional to the two main permitting criteria (the provided certainty that the wind farm will be built and the wind farm’s contribution to energy supply), a financial bid was added to the selection process. The financial bid in this tender was capped at EUR 50 million, meaning the maximum score for the financial bid is achieved if a party bids EUR 50 million for the permit. A relative number of points is awarded for a lower bid, in steps of EUR 2.5 million per point.

Model 3: Tender for highest auction price

As from 2021, use of the auction model is also a legal option for the Dutch Government. In this model, the winning auction bid is considered to be a ‘negative subsidy’ to cover (some of) the socialized costs of the grid infrastructure, the pre-development EIA and site studies and the costs of consenting. The specific procedure and timing of each auction will later be decided by the Government.

2.1.7 Step 7. Granting the permit

Immediately after winning the tender, the Government grants the permit for the construction, operation, and the removal of the wind farm. With this permit, the winning developer can immediately start constructing the wind farm. The permit states that the wind farm must be constructed within four (possibly five years) and is valid for a maximum of 40 years.

2.1.8 Step 8. Monitoring wind farm preparation

Once the wind farm developer is granted the permit, it must comply with its plan for the construction and operation of the wind farm as submitted in its tender bid. As stated in step 5, the permit remains flexible for innovation and therefore allows for certain permit changes in relation to the development or operation of the wind farm. This is to enable the use of the most up-to-date technology and pursue cost reductions through innovation. Examples of changes allowed to the production installations include the number of turbines of the production installation, the positioning of the turbines, the hub height, type of turbine and type of foundation. A request for an exemption must be accompanied by an explanation of the effect of the change on the aspects set out above, as well as by an amended wind energy yield calculation (if applicable). Any deviation from the original plan requires an exemption granted by the Minister of Economic Affairs and Climate Policy.

2.1.9 Step 9. Monitoring wind farm construction

The Directorate-General for Public Works and Water Management (Rijkswaterstaat) monitors the planning, construction, and operation of wind farms. The monitoring activities vary per phase. The planning phase mainly includes the assessment of the work plans drawn up by the permit holder. During the construction phase, inspections are performed via ships and aircraft of the Netherlands Coastguard and the State Supervision of Mines.

2.1.10 Step 10. Monitoring wind farm operation

The wind farm operation results in the generation of electricity. During the operational phase, the Directorate-General for Public Works and Water Management (Rijkswaterstaat) monitors the operations management and maintenance activities.[6] 4 After a maximum of 40 years, the wind farm will be decommissioned and removed. The permit is no longer valid after that period.

[6] Rijkswaterstaat is part of the Dutch Ministry of Infrastructure and Water Management and responsible for the design, construction, management and maintenance of the main infrastructure facilities in the Netherlands.

3. Wind & water works

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 more on the Dutch supply chain and showcase some of their recent export successes in the international target markets. The official partners of wind and water works are presented in the business catalogue in this Guide.

3.1 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.

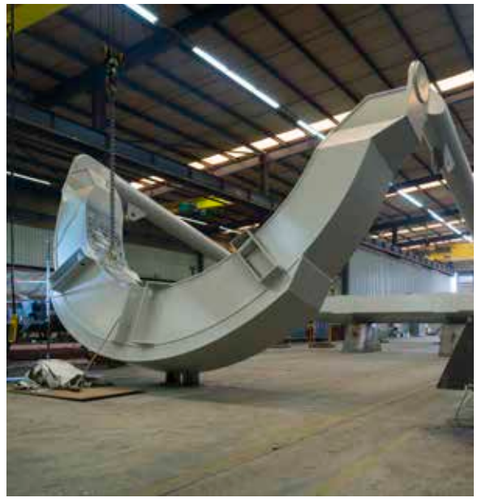
In the Netherlands, the Government has taken on the task of developing offshore wind energy in the Dutch North Sea itself. It has introduced a stable policy environment with clear project pipelines. There are flexible rules and regulations in place. High quality site data is provided by the Netherlands 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 neighbors 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 maximize the full global potential of offshore wind.

3.2 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.



3.3 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 Netherlands Wind Energy Association (NWEA). 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 at enhancing their international visibility and reinforcing their network as part of the international wind community.

3.4 Introduction to the next chapters

The next chapters will elaborate in more detail on the specific expertise the Dutch wind & water works partners can provide in the international offshore wind supply chain. The chapters follow the consecutive stages of the wind farm's lifecycle:

1. Feasibility, design and development
2. Construction and Engineering
3. Transport and Installation
4. Operations & Maintenance

To highlight the international track record of the Dutch expertise, a selection of recent export successes will also be presented in news items. These showcases are derived from international media coverage through industry news outlets, such as offshore WIND.biz by Navingo.

HHWE: 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

NMT: 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

NWEA: The Netherlands Wind Energy Association (NWEA) is the Dutch sector association working to increase sustainable wind energy on land and at sea. NWEA unites the wind sector in the Netherlands and accelerates the transition towards a renewable energy supply by spurring businesses and governments to invest in wind energy.

www.nwea.nl

4. Feasibility, design and 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.

4.1 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.

The Dutch consultancy experience in wind farm development mostly lies in contract management support and project management. Renowned project investment consultants include:

- AMSCAP (investment, strategic consultancy);
- Green Giraffe (investment consultancy, tender support);
- Rebel (financial consultancy, co-developer)
- Voltiq (debt and equity, transactions and modelling).

Renowned Dutch consultants in feasibility, site selections and project management include:

- BLIX Consultancy (contract and project management, tender and survey consultancy);
- DNV-GL Arnhem (contractor selection for project developers, certifications);
- IX Wind (project development consultancy);
- Outsmart (production optimization, offtake agreements);
- Pondera Consult (project developer, consultancy);
- Royal Haskoning DHV (feasibility, consenting, permitting);
- Ventolines (development, contracting, installation supervision, asset management).

In the news 2022

IX Wind and Foxwell Energy enter into long term cooperation for offshore wind in Taiwan

Source: windpower.nl

IX Wind, with its headquarters in the Netherlands, and Foxwell Energy, a subsidiary of Taiwanese renewables company Shinfox Energy, have officially entered into a cooperation. Entering this new, formal agreement ensures a long term commitment and stability in the realization of the Taiwan Power Company (TPC/Taipower) Offshore Wind Power Generation Phase II Project in Changhua County Waihai, Taiwan.

The project for Foxwell involves the full scope of engineering, procurement, construction, installation and operation and maintenance for the following years. Foxwell Energy is the first company in Taiwan to execute a full EPCI contract. The specific demands that are implied with a state owned company project can form a challenge, as well as complying with the Taiwanese local content demands.

Role IX Wind
In the past, IX Wind has already been executing the role of advisor for Foxwell and is leading the procurement of the Wind Turbine Generators. One of the new roles of IX Wind is expanding the Taipower Phase II OWF project team with experts, package leads and senior management. The experts that will be reinforcing the project team originate from both IX Wind, as well as from IX Wind's international network. Since December 2020 the project team has gone through significant developments. The team is expanded to continuously improve.

In the news 2022

BLIX To prepare Estonian Offshore wind farm

Source: Baltic Wind

Enefit, a developer, has signed a contract to prepare a conceptual engineering design for a wind farm in the Gulf of Riga. The project is co-financed by the European Union.

Margus Vals, a Member of Enefit's Management Board, said there is a strong demand for renewable electricity throughout Europe. "An increase in renewable energy production is crucial for the environment, consumers and national security. The offshore wind farm in the Gulf of Riga will play a key role in Estonia's energy supply and is in line with the government's green transition goals. Upon successful completion of the planning phase, the wind farm could begin production as early as 2028 and cover half of the electricity consumed in Estonia", said Vals.

The project will be prepared by the international engineering and consulting firm BLIX Consultancy. BLIX will analyze alternative wind turbine options, as well as foundations, substation and onshore solutions for the wind farm. The project will also provide technical solutions as input to the ongoing environmental impact assessment.

Albert van der Hem, Founder and Managing Director of BLIX Consultancy, said: "We will share more than 20 years of our experience in offshore wind development with Enefit and optimize the offshore wind farm project in the Gulf of Riga. We will incorporate not only relevant experience from recent offshore wind farm projects in northwestern Europe and Asia, but also from our recent assignments for clients in Estonia, Latvia, Lithuania, Finland and Poland".

4.2 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.

Dutch suppliers are renowned for the execution of environmental impact assessments and include amongst others:

- Pondera Consult (EIA consultant);
- Royal Haskoning/DHV (EIA consultant).

In the news 2022

Iberdrola and DP Energy Power Ahead with Large-Scale Irish Floater

Source: OffshoreWIND.biz

Iberdrola and DP Energy have appointed Royal HaskoningDHV together with Mott MacDonald to lead the production of an Environmental Impact Assessment Report (EIAR) for the Inis Ealga Marine Energy Park project offshore Ireland.

The 1GW Inis Ealga Marine Energy Park is located off the South Coast of Ireland.

Royal HaskoningDHV has been awarded the work as lead consultant, alongside Mott MacDonald as a partner consultant, which will be supporting the project from its Dublin and Cork offices.

“This announcement is a significant step in the proposed development of the Inis Ealga Marine Energy Park and a significant contributor to Ireland reaching its climate action goals,” Adam Cronin, DP Energy’s Head of Offshore, said.

DP Energy entered into a joint venture with Iberdrola in February 2021 for a 3 GW pipeline of offshore wind projects.

The Inis Ealga project is currently in its early development stage, with ecology surveys underway and site investigation surveys being planned.

Once operational, the floating offshore wind farm will generate enough green energy to power the equivalent of nearly 860,000 Irish homes. The project is programmed to be operational by 2030, the developers said.

“Royal HaskoningDHV are industry leaders in delivering Environmental Impact Assessment Reports and this, coupled with Mott MacDonald’s expertise and local knowledge, will enable us to complete this important project for the south west coast of Ireland. We look forward to working together in the years ahead.”

Royal HaskoningDHV and Mott MacDonald will deliver a full Environmental Impact Assessment Report to examine the potential impacts of the proposed development on the surrounding environment including sea, land, and wildlife throughout the project lifecycle from site investigations to construction and right through to operation and eventual decommissioning of the wind farm.

4.3 Ecological surveys

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).

Current Dutch suppliers include:

- Imares (ecological impacts on marine life);
- Robin Radar Systems (bird-detection systems);
- Wageningen Marine Research (WUR)
- (ecological impact on marine life);
- Bureau Waardenburg (marine biologist subsea research).

In the news 2022

Wind Turbines Offshore Netherlands Open to Sea Life

Source: offshore WIND.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.

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.

”If our expectations come true, it will boost biodiversity under water. Building with nature is the future. I am proud that we are working with Vattenfall on these kinds of innovative solutions, with which we provide our country with sustainable energy and strengthening nature at the same time,” said Erwin Coolen, Program Director at De Rijke Noordzee.

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.

4.4 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.

The Dutch have a long-standing strength in offshore site surveying, resulting from the involvement in oil and gas and other marine operations. Examples of Dutch suppliers are:

- Bodac (UXO survey, clearance);
- Deep BV (subsea data collection);
- Deltares (characterization of waves);
- Fugro (seabed analysis);
- Geomil (soil studies, cone penetration testing);
- MARIN (behavior research of vessels and marine structures i.e. floating wind power);
- N-Sea (asset survey and inspection);
- NjordIC (EOD, UXO services);
- Reaseuro (UXO survey, clearance) investigation);
- Royal Haskoning/DHV (wave, current and tidal installations, wind port design).

In the news 2022

Fugro to Work on New Irish Offshore Wind Projects

Source: offshoreWIND.biz

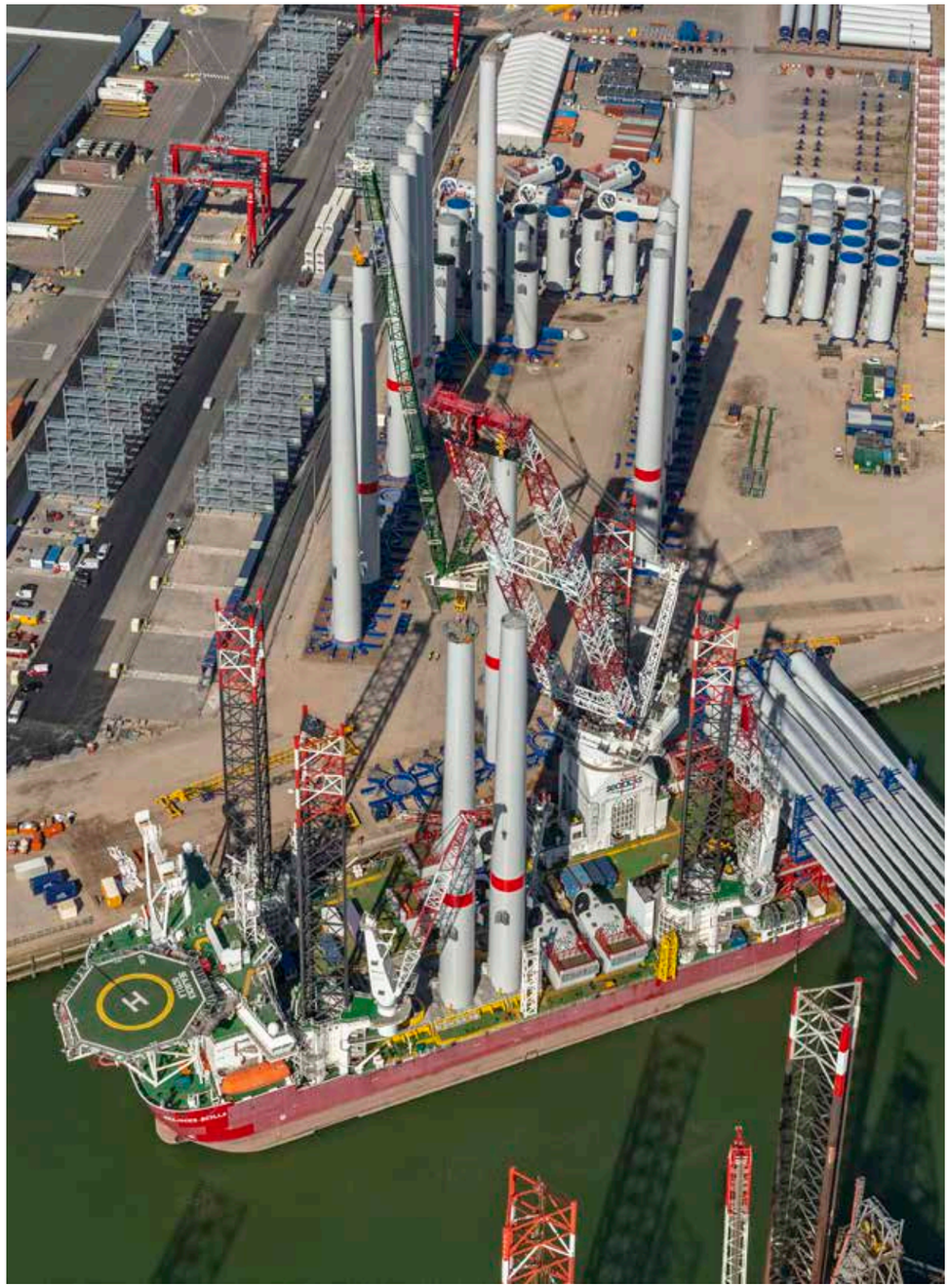
Fugro is set to kick off a geotechnical site survey campaign at the North Celtic Sea and South Irish Sea offshore wind projects at the end of July.

Supply vessel Fugro Voyager is in charge of carrying out the work which will include a downhole cone penetration test (CPT) and continuous sampling boreholes with geophysical logging.

Activities are expected to be carried out from 30 July until 30 September on a 24-hour basis, weather dependent.
The two offshore wind projects are being developed by Energia Group. The company decided back in 2019 to implement a EUR 3 billion investment program in Ireland's renewable sector, which included the offshore wind market as well.
The 800 MW North Celtic Sea project will be located between 10 kilometres and 25 kilometres off the Waterford coast. Green Rebel carried out at the project earlier this year.

The South Irish Sea wind farm, currently at the early stage of the environmental assessment process, is planned to have a generation capacity of between 600 MW and 800 MW.

Ocean Infinity just recently started a geophysical survey campaign at the wind farm site located at a minimum of 10 kilometres and up to 25 kilometres off the coasts of Wexford and south Wicklow.



5. 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.

5.1 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.

Examples of suppliers from the Netherlands are:

- Bosch Rexroth (turbine drive and control technology);
- C1 Connections (wedge connections wind turbines);
- Hetraco (special fasteners);
- Huikeshoven (mold heating rotor blades);
- LM Windpower (supplier of wind turbine blades)5;
- Pontis Engineering (rotor blade composite engineering);
- Sinus Jevi (electric heating system wind turbines);
- VDL Klima (turbine generator coolers);
- WE4CE (composite rotor blade design).

5.2 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. The foundation types are listed and briefly summarized below:

- Monopiles;
- Jacket and tripod steel foundations;
- Suction piles/ buckets;
- Gravity base foundations;
- Floating foundations.

Monopiles

To date, most offshore wind farms have steel monopile foundations, being selected in more than 60% of the worldwide offshore wind installations. The main characteristics in favor of monopiles are simplicity (easily standardized design to be manufactured in series 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 currently being deployed for deeper waters up to 60 – 70 meters.

In the news 2022

Sif Rolls Out First Dogger Bank Hardware

Source: OffshoreWIND.biz

The Netherlands-based foundation manufacturer Sif Group has completed the first several monopiles for the world's largest offshore wind farm under construction – the 3.6 GW Dogger Bank in the UK.

Sif manufactured the monopiles at its factory on Maasvlakte 2 in the Port of Rotterdam.

The monopiles produced will be installed on the 1.2 GW Dogger Bank A, the phase one of the the three-phased project. 95 units in total will be manufactured at Maasvlakte and delivered by Sif for Dogger Bank A. The monopiles have a diameter of 8.6 metres and will have an overall weight of 103,087 tons, Sif said.

Sif is also in charge of manufacturing and delivering monopiles for Dogger B and Dogger Bank C.

In total, the company will manufacture and deliver 277 monopiles for the project.

Besides the monopiles, Sif is responsible for the fabrication and supply of the primary steel for the transition pieces, and for the marshalling of all foundation components at its Maasvlakte 2 Rotterdam terminal.

Smulders, Sif's partner on the project, will manufacture the secondary steel and assemble, coat, and test the fully equipped transition pieces.

The foundations will be installed by OHT's newbuild Alfa Lift from 2022 to 2024.

They will support the GE Haliade-X 13 MW and GE Haliade-X 14 MW turbines scheduled to deliver the first electricity in 2023. The wind farm is slated for full commissioning in 2026.

Dogger Bank Wind Farm is a joint venture project between SSE Renewables and Equinor.

Monopiles not always an option

Monopiles are used for almost all European developments because of their low cost (simplicity of fabrication and construction) and their ability to be hammered or vibrated deeply into the seabed, consisting of either sand, silt, medium to hard clays – or a mixture. But many of the most promising areas around the world do not have such competent seabed stratum. They are instead characterized by soft marine clays, hard volcanic and sedimentary rocks, deep faulting, seismic activity, and loose deposits with liquefaction potential. This means that certain situations may require alternative foundation systems – including piled jackets, suction buckets, or gravity-based structures.

Jacket and tripod steel foundations

There are several non-monopile steel foundation concepts for deeper water projects for which monopiles are not a feasible option:

- Jacket: structures typically used in O&G sector but optimized for the Offshore Wind Farms. It has a Transition Piece platform on top and the main structure is made of legs, braces, and pin piles to anchor the complete structure to the seabed. It can have four or three legs.
- Tripod: three-leg structure made of cylindrical steel tubes. The central steel shaft of the tripod makes the transition to the wind turbine tower. The base width and pile penetration depth can be adjusted to suit the actual environmental and soil conditions.

There are no current Dutch suppliers with international interests known in this field.

Suction piles/buckets

In 2017, SPT Offshore (now part of DEME) launched a new wind turbine suction pile foundation concept, as an alternative to jacket foundations. The foundation involves a star-shaped transition piece that is positioned in between the three (or potentially four) suction piles and the mono tubular. The suction bucket foundation creates a vacuum to secure the foundation to the sea floor. Pumping air back into the bucket reverses the suction process and aids the removal of the structure.

This foundation is potentially cost saving as the mono tubular is inexpensive to fabricate, being some 3 times less expensive than jackets. Furthermore, the suction piles have several advantages, including fast and noise-free installation. Also, suction piles do not cause any shocks to the foundation, so that single piece installation up to the work platform is possible.

There is significant interest in suction piles/buckets as seabed connections as a means of lowering installation costs and the impact of piling on wildlife.

Gravity-based foundations
Gravity-based structures (GBSs) are assembled onshore and installed without the need for piling. This avoids some of the noise restrictions faced by some projects to limit the impact on marine mammals and eliminates the need for expensive heavy-lift vessels. Large quayside or dry dock facilities are required with heavy lift capabilities for manufacture. These are made from concrete or are steelconcrete hybrids. Requiring no piles and no specialized installation vessels, gravity-based structures maximize the use of both local labor and materials. They have the potential to be an attractive option for many locations in i.e. Asia.

Examples of suppliers from the Netherlands are:
- BAM Group (self-floating gravity based foundation);
- Monobase wind (gravity base foundations).
- Sif
- SPT Offshore

In the news 2022

First Suction Pile Jacket Installed at Changle Waihai OWF

Source: OffshoreWIND.biz

CCCC – First Harbor Engineering Company has installed the first suction pile jacket at the Fujian Changle Waihai offshore wind project in China.

CCCC installed the suction pile jacket on 21 February using SPT Offshore's SAPS007S suction spread.

The Netherlands-based SPT Offshore won a contract in August 2020 for the design and installation of suction pile jacket foundations at the project.

Dongfang Electric Corporation (DEC) will deliver the turbines.

The 300 MW Changle Area A will consist of 40 turbines, 15 of which mounted on suction pile jacket foundations, while the 496 MW Changle Area C will feature 62 turbines all set to be installed on suction pile jackets.

The wind farm is located in the east water area of Changle, Fuzhou City, 31–50 km from shore in water depths of 37 to 45 m, and is currently the farthest and deepest offshore wind farm in China.

5.3 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.

Examples of current Dutch suppliers are:
- CORROSION & Water Control BV (cathodic corrosion protection and anti-fouling);
- MME Group (cathodic corrosion protection);
- Trelleborg (inflatable grout sealing TP-foundations).

5.4 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 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.

Current Dutch suppliers include:
- TKF (subsea cabling).

5.5 Substations and foundations

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. An 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.

Examples of current Dutch suppliers/engineers are:
- Hapam (high voltage equipment for substations);
- Heerema Fabrication (jacket structures);
- Heinen & Hopman (HVAC systems substations);
- HSM Offshore (construction substations);
- IV Offshore & Energy (substation engineering);
- KCI (foundation, substation design). Transport and Installation

6. Transport & Installation

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.

6.1 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 mobilization/demobilization 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 the 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.

Today the Dutch have competitive contractors in the offshore wind turbine installation market. Examples of Dutch suppliers include:

- BigLift (heavy lift shipping);
- Boskalis (seabed preparation, installation of foundations & subsea cables, shipping);
- DEME (seabed preparation, installation of foundations & subsea cables);
- Heerema (installation of foundations & substations);
- Jack-up Barge (jack-up platforms);
- Jumbo Offshore (heavy lift shipping);
- Mammoet (lifting & transportation);
- Seafox (self-elevating jack-up vessels);
- Seaway 7 (installation of foundations & subsea cables);
- Van Oord ((seabed preparation, installation of foundations & subsea cables).

In the news 2022

Heerema to Install XL Foundations at He Dreiht Offshore Wind Farm

Source: OffshoreWIND.biz

EnBW has awarded Heerema Marine Contractors with the contract to transport and install the turbine foundations at the 900 MW He Dreiht offshore wind farm in the German North Sea.

The work includes the transport and installation of 64 monopiles and transition pieces.

During operations, Heerema will use the IHC IQIP double-walled noise mitigation system NMS-10,000 amongst other systems to reduce noise pollution, the company said.

The monopile foundations will support Vestas' flagship V236-15.0 MW wind turbines. He Dreiht will be the first project to feature this model, and the first wind farm to feature a turbine model with an individual capacity of 15 MW or more.

Located 90 kilometers northwest of Borkum and about 110 kilometres west of Heligoland, the subsidy-free He Dreiht is scheduled to go into operation in 2025. EnBW He Dreiht Project Director, Jörn Däinghaus said: "Heerema is a contractor with a high level of experience and excellent technological know-how. We look forward to working with Heerema to develop and install our first subsidy-free offshore windpark."

In the news 2022

Van Oord and Kajima Win Big Offshore Japan

Source: OffshoreWIND.biz

Kajima Corporation and Van Oord have been selected as the preferred Balance of Plant contractors for three offshore wind projects in Japan.

In December 2021 the Government of Japan selected three consortia, all led by Mitsubishi Corporation Energy Solutions, as the operators for three offshore wind power projects in Akita, northern Japan, and Chiba, near Tokyo.

These are the 391 MW wind farm near Choshi in Chiba, the 479 MW wind project off the coast of Noshiro, Mitane, and Oga in Akita, and the 819 MW project off the coast of Yurihonjo in Akita.

These three BoP projects cover the provision of all supporting components and auxiliary systems other than the wind turbines.

Yurihonjo will be the largest wind farm in Japan once built. Execution of this portfolio of projects will take place over several years and is expected to start in the second half of this decade.

Bokalift 2 installing jacket foundations at Changfang and Xidao. Source: Boskalis

In the news 2022

Boskalis Completes First Phase of Foundation Installation at Changfang and Xidao

Source: OffshoreWIND.biz

Boskalis has completed the first phase of the foundation installation work on the Changfang and Xidao offshore wind project in Taiwan.

Ten three-legged jacket foundations and the accompanying pin piles were installed at the site in the first phase of the project.
The final seven jackets in this phase were transported from the Port of Taipei and installed at the site by Bokalift 2 which had joined the project recently after undergoing a conversion from a drillship into a DP2 crane vessel.

The vessel's next mission will be the installation of the remaining pin piles and 52 jackets for this project, Boskalis said.

Earlier this month, the first of the wind farm's 62 Vestas V174-9.5 MW wind turbines was installed at the site some 15 kilometres off the coast of Changhua County.

Offshore construction at the project's two sites started last year and is expected to be completed at the beginning of 2024, when the wind farms are scheduled to be fully commissioned.

For more information on offshore wind farm installation, please refer to: www.windandwaterworks.nl/cases/balance-of-plant

In the news 2022

Van Oord Cracks US Market with Offshore Wind Contract

Source: OffshoreWind.biz

Van Oord has won a contract to transport and install wind turbines at an undisclosed wind farm offshore the East Coast of the USA.

The company will deploy the offshore installation vessel Aeolus on the project.

The turbine installation work is scheduled to start in 2023.

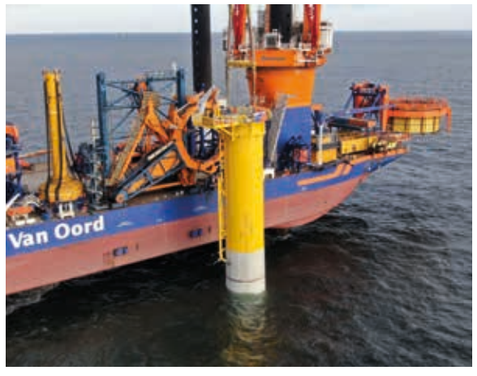
Van Oord said that this is the first contract for the company in the USA.

There are two offshore projects on the East Coast of the USA which are scheduled to enter the turbine installation phase in 2023.

The first project is the 804 MW Vineyard Wind 1 offshore Massachusetts. DEME Offshore US is in charge of transporting and installing the 63 GE Haliade-X 13 MW wind turbines at the wind farm. The installation vessel to be deployed on this project is the Sea Installer.

The second project is the 132 MW South Fork wind farm located 56 kilometres (35 miles) east of Montauk Point, New York, and some 30 kilometres (19 miles) southeast of Block Island.

South Fork is being developed by the joint venture partners Eversource and Ørsted and is slated for full commissioning at the end of 2023.



6.2 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 2022

Heerema to Install Dogger Bank C Offshore Substation

Source: OffshoreWIND.biz

Heerema Marine Contractors will transport and install the Dogger Bank C offshore substation under a contract awarded to the company by the Dogger Bank Wind Farm joint venture partners SSE Renewables, Equinor, and Eni.

For the third phase of the 3.6 GW Dogger Bank Wind Farm, Heerema will transport and install the project's 3,500-tonne jacket foundation, four main piles, and the 9,500-tonne offshore substation topside.

The company will perform offshore lifting to position the jacket foundation on the scour bed, using main piles to provide jacket on-bottom stability. The offshore substation will be lifted from a barge prior to the set-down on the jacket foundation.

"Installation of the offshore substation on the third phase of Dogger Bank Wind Farm will be a significant moment for our world-leading project. We welcome Hereema to our strong team of tier-one suppliers, and we look forward to working with them to install this innovative platform on the DBC site", said Steve Wilson, Project Director for Dogger Bank Wind Farm.

Heerema's Wind Director, Jeroen van Oosten, said: "Installing sizeable offshore substations is core business for Heerema Marine Contractors and we are looking forward to working together on the preparation and installation of Dogger Bank C".

6.3 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.

Dutch suppliers have a good track record in undertaking cable installation and/ or associated services, include amongst others:

- Boskalis Subsea Cables (cable installation);
- Blue Offshore (deck equipment cable installation);
- Crocworks (cable engineering);
- CP/NL Engineering (cable protection solutions);
- DEME Offshore Services (cable installation);
- ECE Offshore (cable lay engineering);
- Gouda Holland (cable management systems);
- MOVE Renewable (cable engineering, cable protection);
- N-Sea (subsea services, inspections, repairs);
- Oceanteam Solutions (cable logistics);
- Primo Marine (subsea cable engineering);
- Van Oord (cable-laying vessel Nexus);
- Visser & Smit Hanab (cable installation);
- VPI (Vos Prodect Innovations) (subsea cable protection);
- WIND Cable Service (cable equipment transport, storage, and rental services).

For more information on cable laying, please refer to: www.windandwaterworks.nl/cases/export-and-interarray-cable-installation

In the news 2022

Boskalis Wins Large Offshore Wind Cabling Contract

Source: OffshoreWIND.biz

Boskalis informed on 20 april 2022 that the company won a contract for the transportation and installation of export cables for an offshore wind project, classifying the contract value as "significant", which for Boskalis means it is worth between EUR 150-300 million.

The company said the project for which it will install the export cable lines was *"a large offshore wind farm development"*, but left the project and its client unnamed. Boskalis has also not disclosed the project location. The contract scope comprises ocean transportation of export cables with the use of in-house heavy transport vessels. The installation scope includes three 275 kV AC export cables with a combined total length in excess of 200 kilometres and will tie up one of the N-class cable laying vessels for at least nine months, the company said. Preparatory works will commence in the second half of 2023 and the cable installation works will commence in 2024.

"Boskalis' successful track record in offshore wind energy is founded in Europe and has expanded to Asia and the US. Boskalis' strategy is aimed at leveraging on key macro-economic factors and supporting the energy transition. With this project and through its client, Boskalis is advancing the energy transition by making offshore renewable energy available", the company said.

6.4 Installation tools

This sub-element 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, grapnels, 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 the 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.

Dutch suppliers have a good track record in installation equipment, associated services and include amongst others:

Cranes:

- Huisman Equipment (leg encircling cranes);
- KenzFigee (cranes, lifting equipment);
- SMST (offshore cranes);
- Bosch Rexroth (crane systems).

Lifting equipment:

- Enduro (lifting gear, softslings);
- Enerpac (hydraulic bolting tools, lifting systems);
- FibreMax (lightweight synthetic cables);
- Franklin (synthetic and steel wire lifting ropes);
- Hendrik Veder (hoisting and lifting equipment);
- Polarttech (bearings, cradle and pile gripper linings).

Hammers:

- Cape Holland (lifting and vibro hammering tools);
- Dieseko Offshore/ ICE: vibro hammers);
- Dutch Drilling Consultants (solid rock drilling tools);
- IQIP (lifting, piling equipment).

Customized installation equipment:

- Breman Machinery (piling templates, precision machinery);
- Eager-One (design & construction of lifting and handling equipment);
- Hetraco (special fasteners offshore wind equipment);
- Holmatro (hydraulic TP levelling, sea-fastening);
- JB systems (installation automation);
- Muns Techniek (customized hydraulic lifting systems);
- Royal IHC (dynamic outrigger frames);
- Seatools (installation equipment design);
- Solidd Steel Structures (steel constructions);
- Temporary Works Design (design support equipment systems);
- TMS (design, supply mechanical installations).

In the news 2022

Huisman Crane to Handle Largest Wind Turbines Onshore and Offshore

Source: OffshoreWIND.biz

Huisman has won a contract from Denmark-based BMS Heavy Cranes for the delivery of a 3,000mt Ringer Crane, with an option for a second unit.

The crane setup has been optimised for operations in the wind industry.

With the capability to lift components of 1,200mt at heights of up to 225m, and heavy structures of 3000mt at reduced height, the crane will ready BMS for installation of the next generation of wind turbines on and offshore and on floating foundations, Huisman said.

The delivery of the crane is scheduled for the second half of 2023.

Morten Kammer, CEO at BMS Heavy Cranes, said: *"We look forward to the ongoing cooperation with Huisman in the delivery of this crane. This asset represents a major step forward for BMS. With the capability to lift the world's largest turbines onshore we will be able to play an increasingly important role in the development of renewable, net-zero energy industries."*

The fully electrically driven crane is said to help reduce emissions and improve operational accuracy and energy efficiency ensuring its suitability for use in the renewable energy industry.

"We are passionate about designing large cranes and are grateful to BMS for the opportunity and their trust. We can't wait to see this mega crane in real life. We are happy to once again be applying our experience in a project that aligns with our vision of accelerating the growth of renewable energy production", David Roodenburg, CEO at Huisman, said.

In the news 2022

Eager.one to Equip Samkang M&T with Jacket Lifting Tool for Work in Asia

Source: OffshoreWIND.biz

Eager.one has been awarded a contract to design and supply the South Korean offshore wind specialist Samkang M&T with a remote-operated Jacket Lifting Tool (JLT).

The JLT will be able to handle jackets of up to 2500 tonnes that will be moved from the yard onto transport vessels.

According to the manufacturer, the JLT will be used for upcoming offshore wind projects in Asia.

This will be Eager.one's first project for Samkang M&T.

Samkang M&T is currently responsible for manufacturing and delivering a total of 52 jacket foundations for the Hai Long 2b and Hai Long 3 offshore wind farms in Taiwan. The delivery of the jackets is expected to be completed by December 2024.

In 2019, Danish offshore wind developer Ørsted signed a contract with Samkang M&T for the supply of 28 jacket foundations for the 900 MW Changhua 1 and 2a offshore wind projects in Taiwan.

6.5 Vessel design, ship building, deck equipment

Installation vessels

As already indicated above, 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 remotely operated vehicle (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.

Dutch contractors have proven expertise in designing and delivering all types of vessels. Examples of current Dutch suppliers are:

- Bosch Rexroth (jacking systems);
- C-Job Naval Architects (ship design, engineering and construction supervision);
- Damen (ship building);
- DEKC (vessel design, engineering);
- GustoMSC (design & engineering offshore vessels, jack-up's, floating foundations);
- KENC (noise mitigation design);
- Nevesbu (vessel design, engineering);
- Royal IHC (ship building, cable lay equipment, jacking systems);
- SeaOwls (ship building);
- Ulstein Design & Solutions BV (ship design, engineering);
- Vuyk Engineering (vessel and equipment design).

In the news 2022

NOV and GustoMSC to Work on Second Eneti Jack-Up Newbuild

Source: offshoreWIND.biz

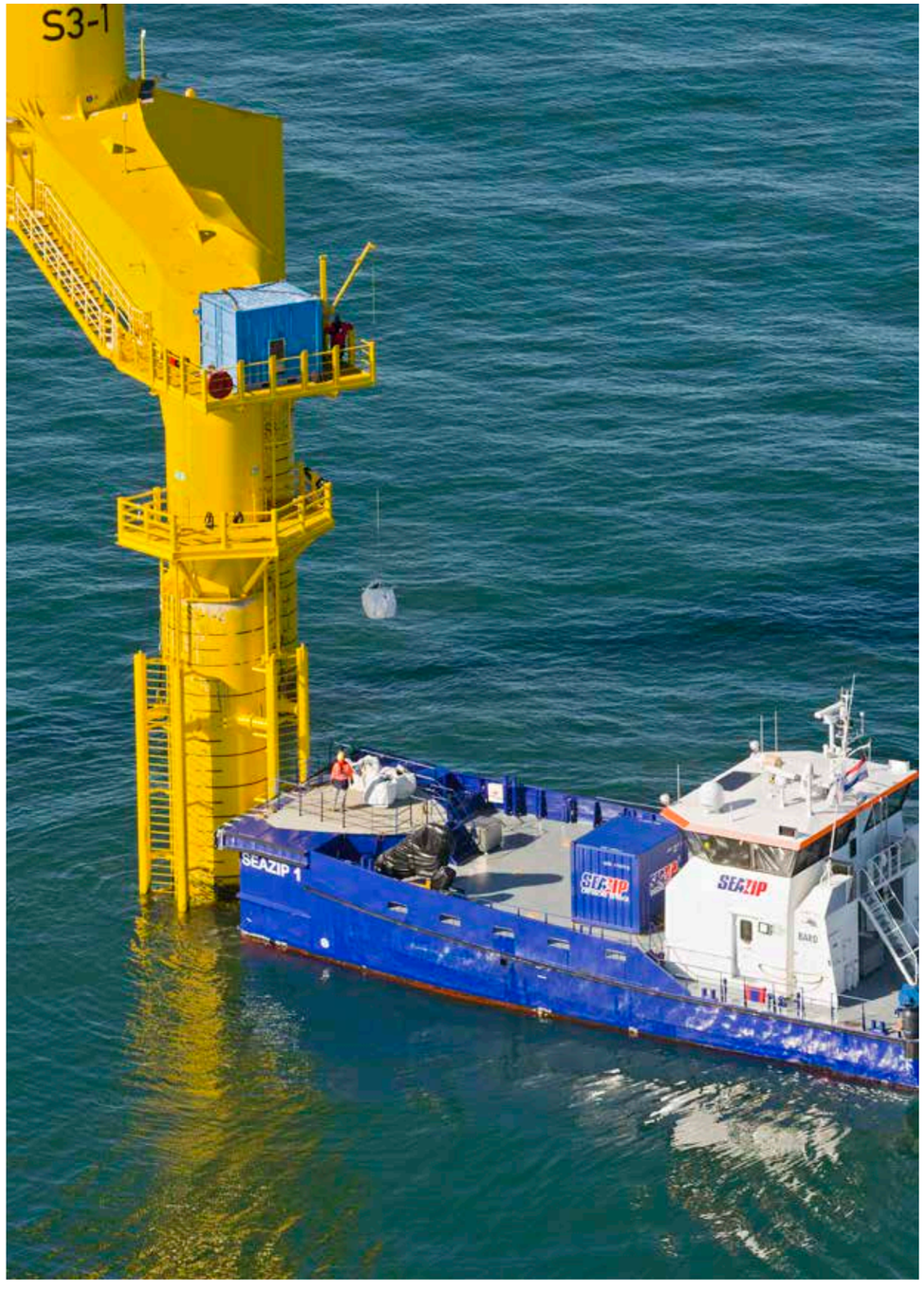
Texas-based NOV has once again been awarded contracts for the equipment and design of a GustoMSC™ NG-16000X wind turbine installation jack-up vessel for Eneti.

This will be Eneti's second next-generation jack-up vessel, and the contracts include an option for an additional jack-up vessel, NOV said.
NOV will provide the design and jacking system for the vessel, which will be built at the Daewoo Shipbuilding and Marine Engineering Co., Ltd. shipyard in South Korea. Delivery is scheduled for the second quarter of 2025.

Both of Eneti's wind turbine installation vessels are of the same series and are ready to carry multiple 20 MW turbine sets. The vessels have been designed with the option to adapt in the future, allowing them to operate on alternate fuels, NOV said.

The NG-16000X design includes the GustoMSC rack and pinion jacking system with a variable speed drive. The jacking system features a regenerative power option where the generated power is fed back into the vessel system. The design further incorporates a 2,600-ton leg encircling crane, ready to install monopile foundations and wind turbines. The vessel can install turbines at depths of up to 65 metres of water.

For more information on vessel design and innovation, please refer to: www.windandwaterworks.nl/cases/vessel-designand-innovation



7. Operations & Maintenance

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.

7.1 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 the owners to respond efficiently to failures when they occur and, where possible, to identify potential failures before they occur. The management of logistics (vessels, helicopters, personnel, specialist tooling and spare parts) is also an important part of the operations role.

For operations and maintenance, wind farm operators will typically look to use the nearest port that meets their specifications in order to minimize 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.

Examples of current Dutch CTV and SOV suppliers are:
- Acta Marine (fleet owner O&M services, crew transfer, tugs, survey, walk to work, etc.);
- Glomar Offshore (offshore support vessels);
- SeaMar (offshore support vessels);
- SeaZip Offshore Service (fleet owner crew and support vessels);
- Windcat Workboats (fleet owner crew transfer vessels).

7.2 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 sealings 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.

The Dutch have developed sophisticated logistics systems which can be applied to the specific challenge of offshore wind farms. Examples of Dutch suppliers are:

Walk to Work systems:
- Ampelmann (motion compensated walkways);
- BargeMaster (motion compensated feeders, gangways, cranes);
- Eagle -Access (electric crew and cargo access systems);
- KenzFigee (gangways, walk to work systems);
- Lift2Work (motion compensation platforms, gangways, cranes);
- Offshore Boarding (crew and cargo access systems)
- Safeway (motion compensated gangways);
- SMST (design and construction gangways);
- Zbridge (walk to work systems).

Rope access:
- Rope Access Noord (rope access inspection/ maintenance);
- Sky-Access BV (rope access inspection/ maintenance).
- Wave/tide monitoring & meteo:
- Mo4/ Mocean (wave, current forecasting);
- Radac (wave monitoring radar systems);
- Whiffle (meteo/forecasting).

Wind farm security, safety:
- Brady (identification, safety lables, signs);
- Boltlife (monitoring free bolted conncections);
- Intrepid Safety products (safety gates).

In the news 2022

KenzFigee Enters Chinese Offshore Wind Market, Signs Cooperation Agreement with CMIC

Source: offshoreWIND.biz

CMIC Ocean En-Tech Holdings Co. Ltd. (CMIC) and Dutch offshore lifting equipment provider KenzFigee have signed a strategic cooperation agreement targeting the offshore wind market in China with the offering of gangways and installation cranes.

The products such as gangways and installation cranes provide critical solutions and are presently available only after long delivery lead times and are in short supply for offshore renewable energy projects, said CMIC, adding that the strategic agreement would close the gap to meet the demand in the Chinese market for these products.

"The signing of the Strategic Agreement brings together the strengths of both companies to provide complementary factors of specialised technology, manufacturing capabilities, and project financing to fill an opportune supply gap", said **Jiang Binghua**, *CEO of CMIC.*

"The rich experience KenzFigee brings with its past operations and maintenance services in the North Sea and Southeast Asia will add significant value to the markets in China and the East Asian region".

KenzFigee offers crane and equipment services worldwide, supporting clients from equipment selection to product design, production, assembly, testing, installation, commissioning, as well as after-sales service and maintenance. The company has worked on several major offshore wind projects in Europe such as Neart na Gaoithe in France and Sofia offshore wind farm in the UK.

In the news 2022

SMST to Provide W2W Equipment For China's First SOV

Source: OffshoreWIND.biz

SMST has been awarded a contract to supply the first Service Operation Vessel (SOV) for the Chinese offshore wind market with its walk-to-work equipment.

Under the contract signed with the ZPMC shipyard, SMST will be responsible for the delivery of an Access & Cargo Tower with motion compensated gangway, also known as the Telescopic Access Bridge L-Series, for the new build SOV of Shanghai Electric Windpower Group.

"The integrated setup of the Access & Cargo Tower with elevator and telescopic motion compensated gangway secures continuous and stepless transfer of crew and cargo from vessel to offshore structure, also in severe weather conditions", said SMST.

The Chinese shipowner will contract the SOV, which has accommodation for 100 POB, for the maintenance of offshore wind turbines in China's Jiangsu and Fujian provinces.

In January, ZPMC and Ulstein Design & Solutions signed a ship design contract on two types of SOVs for Shanghai Electric Windpower Group.

The SOVs will have two different designs with Ulstein's X-BOW and X-STERN features and accommodation for 60 POB and 100 POB respectively.

With a battery installed, the vessels will provide a greener footprint when servicing the renewable energy segment, according to Ulstein.

In the news 2022

Ampelmann Cracks US Offshore Wind Market

Source: OffshoreWIND.biz

The Dutch offshore service provider Ampelmann has signed its first contract in the US offshore wind market under which the company will provide a Walk-to-Work (W2W) gangway system to the marine transportation and towing company, Otto Candies.

Under the contract, Ampelmann will provide an E1000 motion-compensated system to facilitate operations during the construction of Ørsted's South Fork, Revolution Wind, and Sunrise Wind offshore wind farms in the north-east US Atlantic.

This marks an important turning point for the company and will see the introduction of W2W to the American renewable energy sector, Ampelmann said.

The inspection, maintenance, and repair vessel Paul Candies, owned and operated by Otto Candies, will be fitted with the E1000 W2W system in the third quarter of 2023 to support the hook-up and commissioning of turbines.

The E1000 W2W system will also be used to lift cargo, equipment, and tools up to a tonne and the gangway's fuel transfer capabilities will allow for the testing of the generators and turbines.

South Fork is expected to be one of the first offshore projects built in the US when it becomes operational in 2023.

7.3 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 program for components nearing the end of their lives.

Equipment such as ROVs and support vessels is often rented and, in many cases, operated by a third party.

The experience of the Netherlands is especially relevant when it comes to asset failures. Examples of Dutch suppliers in repair services are:

- Bluestream (topside and subsea inspection, maintenance)
- C-Ventus (topside and subsea inspections, repair and replacement);
- DroneQ (windturbine drone inspections);
- ECE Offshore (cable inspection, repair) engineering)
- MOVE Renewable (cable, inspection, repairs);
- N-Sea Offshore (subsea inspection, maintenance, repair).

7.4 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.[7]

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.[8] Since the supply of finished wind farm components is relatively low, most ports in NL can be characterized as installation ports where the main wind farm components are stored and pre-assembly is completed before being loaded onto an installation vessel. Renowned installation ports in the Netherlands for offshore wind companies include Eemshaven, IJmuiden and Vlissingen. A notable exception is the port of Rotterdam where Sif has developed facilities for the 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
- Port of Amsterdam: www.portofamsterdam.com

7 This is in contrast to most UK ports, which are operated privately and make investment decisions based purely on commercial factors.

8 The reason for setting up an installation port (as opposed to transporting components directly from their manufacturing location to the offshore site) is to lower the logistics risks of a project by storing components closer to the wind farm site.

In the news 2022

RWE Adds DHSS to Kaskasi Team

Source: OffshoreWIND.biz

RWE has awarded a contract to DHSS for logistics at the Port of Eemshaven during the installation phase of its 342 MW Kaskasi offshore wind farm in the German North Sea.

Under the contract, DHSS will support RWE with regard to vessel agency services, port logistics, and storage.

Services will be managed from the DHSS support base in Eemshaven.

"With our set-up we are able to unburden the client during the project with a complete scope of required logistical services, delivered by one party", said Wim Schouwenaar, CEO of DHSS.

"While the offshore teams can focus on their tasks at the wind farm site, our experts assist with all kind of logistics of cargo and persons, in order to have a flawless execution of the construction of the wind farm."

A few days ago, the offshore substation topside was installed on its monopile foundation by the heavy lift, DP 2 installation vessel Gulliver, operated by DEME's subsidiary Scaldis Salvage & Marine Contractors.

Also, the first monopile was recently installed at the Kaskasi offshore wind farm. The work is being carried out by Seaway 7's Seaway Strashnov vessel.

Kaskasi is RWE's sixth wind farm off the German coast and is being built 35 kilometres north of the island of Heligoland.

The wind farm will comprise 38 Siemens Gamesa wind turbines, each with an output of up to 9 MW. Installation of the wind turbines is scheduled to start this summer.

RWE, together with Siemens Gamesa, will also equip a number of wind turbines with recyclable rotor blades.

Once all wind turbines are fully operational in the fourth quarter of 2022, Kaskasi offshore wind farm will supply the equivalent of approximately 400,000 households with green electricity.

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

8. Dutch offshore wind innovators

The main driver for growth in the offshore wind industry is the ongoing decrease in the so-called LCOE or Levelised Cost of Energy, partly driven by initial innovations in offshore-specific turbine designs and bespoke offshore wind installation vessels. These cost reductions have encouraged Government policy and financial support to the sector, in order to address the decarbonization of electricity production. Such efforts have, in turn, accelerated innovation, which has reduced costs, as well

Dutch public and private parties have teamed up to design, develop, build, and maintain high-quality offshore wind farms in the North Sea. Together, they are proving that offshore wind is a powerful solution to achieve the Dutch climate goals in a cost-effective manner. Through such cooperation, the Dutch offshore wind sector is also exploring ways of making offshore wind energy more competitive, for example, by developing more efficient production methods and increasing the yield and lifespan of offshore wind technology. Throughout the entire offshore wind supply chain, Dutch companies, academics and independent knowledge institutes conduct research into better and smarter solutions that can be applied in any offshore wind project worldwide.

This chapter lists the main offshore wind innovation actors in the Netherlands and highlights the latest cost-cutting and (near) market-ready offshore wind innovations with Dutch origin across the supply chain.

Empowering engineering and innovation 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. Visit: https://www.dob-academy.nl/service

8.1 Main innovation actors

TKI Wind at Sea (Wind op Zee)

The Dutch Government encourages product 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.

The Top Consortium Knowledge and Innovation (TKI)

Wind at Sea plays an important role in Dutch innovations in offshore wind. TKI Wind at Sea (Wind op Zee) 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. In addition, the Multi-annual Mission-driven Innovation Program (MMIP) focuses on three themes: cost reduction and optimization, integration into the energy system and integration within the environment. Visit: www.topsectorenergie.nl/en/ tki-wind-op-zee

Technical University of Delft (TUD)

TU Delft 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 the support structures, more reliable wind turbines and wind farm operations, and the optimization of the entire energy supply chain from wind to the grid, including the incorporation of the 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 program 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 the 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.

In the news 2022

More than Half of Kaskasi Foundations Now In

Source: OffshoreWIND.biz

Seaway 7 has installed all of the monopile foundations within its scope of work for the Kaskasi offshore wind farm and DEME Offshore just announced that its part of the project is progressing and that 22 monopiles are now installed at the 38-turbine offshore wind farm.

Seaway 7 installed the first monopile at the Kaskasi offshore wind farm site in Germany in early March, marking the first time a monopile was installed using dynamic positioning on a commercial project, a method Seaway 7 was developing over the past few years.

As all seven monopiles Seaway 7 was responsible for are now installed, CAPE Holland also announced that its Vibro Lifting Tool, the CAPE VLT-640 Triple, completed its work at the Kaskasi offshore wind farm under a contract signed with the offshore construction company in 2020.

“For the first time ever, flanged monopiles have been upended, lifted and vibrated with CAPE Holland’s patent pending flange clamping system. After a short learning curve, Seaway 7 used the CAPE VLT to drive a new type of monopiles with Self Expanding Pile Shoe (SEPS). Although the monopiles where not vibrated to end depth, new insights and data have been collected via a newly developed monitoring, logging and survey system”, CAPE Holland said.

The 342 MW Kaskasi offshore wind farm, also known as Kaskasi II, is located in the German North Sea, 35 kilometres north of the island of Heligoland.

8.2 Low noise monopile installation

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 minimizing noise while retaining (and preferably improving upon) the speed and efficiency of the traditional method.

CAPE Holland’s Vibro Lifting Tool (VLT)

The best way to reduce noise emissions is not to generate any noise in the first place, this is in brief the core concept of vibro driving as an alternative installation method. The Vibro Lifting Tool is a certified offshore lifting tool with the ability to upend and drive the piles quickly with reduced noise emissions. The tool is able to pick up a pile, upend it to vertical position, place it overboard and lift it to installation position. While driving down, it will automatically measure and adjust to the exact vertical position. All in one single operation, without the need to switch to another tool.

CAPE Holland’s Vibro Lifting Tool (VLT) is used to install the monopile foundations at the Kaskasi offshore wind farm in Germany, making it the first wind farm in the world using the vibro driving technique to install all monopile foundations to target penetration. One of the advantages of the VLT is that there is no need for additional noise mitigation techniques.

Further development, to enlarge the workability and reduce costs are the installation with VLT-U from a floating vessel using Dynamic Positioning and combining vibration and drilling technology to tackle any seabed quietly.

AdBm Noise Mitigation System (Big Bubble Curtain)

Installing wind turbine foundations in the North Sea – and many other places worldwide – almost always requires pile driving. Without precautionary measures this methodology impacts underwater marine mammals near the construction site. To protect marine life, underwater noise emission limits will almost certainly become an important requirement for future wind farm constructions worldwide.

Supported by TKI Wind at Sea, the Dutch companies AdBm Technologies and Van Oord and Technical University Delft developed and extensively tested the so-called Noise Mitigation System (NMS). NMS reduces underwater noise resulting from offshore pile driving of wind turbine foundations, meaning less disturbance for marine mammals. The NMS uses special acoustic resonators designed and produced by AdBm Technologies, which reduce the noise from pile driving. As a result of this technology, specific frequencies can be targeted which produce the most noise. In combination with a Big Bubble Curtain (air pockets that absorb the sound frequencies that produce the most noise during offshore pile driving) it works almost like window blinds, which can easily be raised and lowered. Another highlight of the Noise Mitigation System is the fact that waves and currents have virtually no influence on the system. This is due to the open yet robust design. The blinds simply go up and down.

The NMS meets the Dutch and Belgian standards (160 dB) – underwater noise limit for noise emissions at sea and turned out to be cheaper in the construction of offshore wind farms relative to existing systems.

Hydropower instead of steel ram

IHC IQIP's Blue Piling Technology reduces underwater noise levels by creating a gentler blow, when compared to conventional impact hammers, to install offshore monopiles. This is done through the use of a large volume of water, which delivers a longer blow duration on the monopile. Combustion throws up this water column (large water tank) and under the force of gravity, it falls back on the pile, hereby delivering two blows. This cycle is repeated until the pile reaches its desired depth.

With the ever-increasing demands for larger wind turbines located at greater depths, alternative driving technologies such as Blue Piling will eventually become essential. Firstly, because it can provide a noise-mitigation solution where deep water and strong currents make Big Bubble Curtains unfeasible to protect marine life (mammals). Expensive noise reducing equipment is no longer needed. Secondly, because the gentle blow of a BLUE Hammer can significantly reduce pile driving fatigue (compared to the traditional steel impact hammering) and, thirdly, because it can, notably, install monopiles even larger than the current XXL monopiles.

Therefore, even very large concrete piles can be driven with the technology, due to the absence of tensile forces which are damaging for concrete piles. Considerable scalability will allow the largest piles in the world to be driven using this new technology.

The Blue Piling System is expected to be fully operational and ready for commercial offer in 2021. It will be compatible with existing installation vessels and interchangeable with conventional and hydraulic hammer technologies.

8.3 Low cost monopile installation

Slip joint monopile installation

Another challenge is to optimize the process of connecting turbine towers to the foundations. Current methods use bolts or grout, both of which require regular inspections and maintenance. Several Dutch companies are working on more elegant and lower cost alternatives. One such innovation 'wedges' the tower into place, resulting in substantial savings in installation and maintenance costs.

One of the most outstanding examples of Dutch innovations in the field of offshore wind is the slip joint. This technology uses the tower's weight to 'slide' over cone-shaped monopiles, without having to use grout or bolts in a process which can save up to 20 million Euros in installation costs per wind farm. The Slip Joint therefore provides a rapid, simple, and safe installation solution. in combination with reduced maintenance for the duration of the project.

How the Slip Joint works

The Slip Joint connects a monopile and a transition piece by means of two conical sections placed on top of each other which can be produced using standard manufacturing methods. It is based on friction, with the weight ensuring firmness and stability. Installation takes place by sliding the wind turbine's foundation elements over the monopile, without having to use grout or bolts. The Slip Joint makes a submerged connection possible, allowing for a more balanced weight distribution between monopile and transition piece. As a result, the installation of larger foundations for the next generation of wind turbines is possible, using existing vessels.

The first ever offshore full-scale slip joint was installed at the Borssele V wind farm near the Dutch shore. It was the first time a submerged Slip Joint was used on a full-sized offshore wind turbine on a commercial basis.

TP-less monopile configuration

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, TP-less solution have also come into play because it eliminates a bolted (or grouted) connection, it allows faster installation and cost reductions such as inspection durations during the O&M phase.

In the news 2022

Sif Rolls Out First Hollandse Kust Noord TP-Less Monopiles

Source: offshoreWIND.biz

Sif Group has completed the first two of the 70 monopiles to be manufactured for CrossWind's 759 MW Hollandse Kust Noord offshore wind farm in the Netherlands.

With a combined weight of 64,356 tons, the 70 monopiles are designed in such a manner that they do not require transition pieces. The design is said to allow faster installation and cost reductions.

The TP-less monopiles, which are being manufactured at Sif's Maasvlakte facility in Rotterdam, will support Siemens Gamesa's SG 11,0-200 DD 11 MW wind turbines installed at the site some 18.5 kilometres off the coast of Egmond aan Zee.

Sif secured a contract with Van Oord, the Balance of Plant contractor for the project, for the fabrication and supply of monopiles in 2020.

The Hollande Kust Noord offshore wind project will be built and operated by the CrossWind consortium between Shell and Eneco, which won the tender in July 2020, without government subsidies.

The consortium plans to have the offshore wind farm operational in 2023, from when it will be generating at least 3.3 TWh per year.

8.4 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 2022

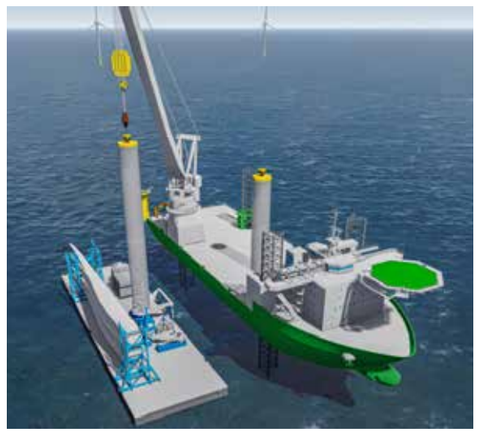
DEME and Barge Master Develop Feeder Solution for US Offshore Wind Projects

Source: OffshoreWIND.biz

DEME Offshore US and Barge Master have entered into a long-term agreement to jointly develop a Jones Act compliant feeder solution for the upcoming offshore wind projects in the USA.

DEME Offshore US has partnered with US company Foss Maritime in the development of the smart feeder barge concept to ensure that it is fully compliant with the Jones Act.

This solution is expected to enable the wind turbine components to be transported from US ports to DEME's specialised offshore installation vessels. When arriving alongside the installation vessel, the Barge Master motion compensation technology will ensure safe lifting operations – even for these giant components – and increases workability, DEME said. The barges will also be towed and pushed by US-flagged tugs.



8.5 Floating wind innovators

Floating offshore wind provides opportunities to move into deeper coastal waters and shallower waters with challenging seabeds, where fixed-bottom foundations cannot be deployed. The floating support structure consists of a floating platform and a platform anchoring system. The platform has a transition piece on top of which the tower is installed.

Although floating offshore wind still is in a pre-commercial phase, development activities as well as tendering activities have continued to accelerate in several markets. In its Global Offshore Wind Report 2022, GWEC expects that Europe will initially take a front runner position in floating offshore wind development, mainly instigated by the success of the UK's ScotWind seabed leasing round, where 15 GW out of 25 GW of sites awarded leasing contracts are for floating projects. Also in France, Greece, Italy, Norway, Portugal and Spain floating projects are getting on their way. By the end of the decade, GWEC expects South Korea, the UK, the US, Spain and Ireland to complete the top five global floating markets.

Floating wind turbine innovators

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 programs of in-house floating wind development, there is room for innovative SMEs. Several Dutch companies have already taken the challenge to further reduce the Levelized Costs of Energy while, at the same time, looking at farther offshore opportunities for floating wind. Some of them focus on developing integrated floating wind turbines, others focus on innovative floating foundation designs.

Examples of innovative Dutch floating wind turbine suppliers are:

- 2BEnergy (integrated 2-bladed downwind turbine and foundation supplier);
- Ampyx Power (airborne wind energy systems);
- Seawind Ocean technology (integrated 2-bladed upwind turbine);
- Touchwind (floating one piece rotor turbines).

Floating wind foundation innovators

Although floating foundations are already a proven technology in the oil and gas sector, platform designs for offshore wind, however, require adaptation to accommodate different dynamic characteristics and a distinct loading pattern, as 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 (levelized) cost of energy than fixed, as the floating foundations need to be assembled in port at the quay side and coastal areas, which requires it's own major supply chain investments in manufacturing sites and the 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 semisubmersibles, barges, tension leg platforms (TLPs), and spar buoys. Other potential advantages are the lower installation cost and the ability to standardize designs within and between wind farms.

Several Dutch companies are already involved in moving floating foundation technologies from the early concept stage through to commercial deployment. Examples of current Dutch innovators are:

- Blue H Engineering (floating foundation design);
- Bluewater (floating wind systems);
- Damen (hulls floating platforms);
- FibreMax (deepwater mooring ropes);
- GustoMSC/NOV (tri-floater foundation);
- Lankhorst (deepwater mooring ropes);
- Iv offshore & Energy (floating substations);
- MonobaseWind (design floating foundations);
- Mooreast (mooring ropes, anchors);
- SBM offshore (floating EPCI contractor));
- Sif Group / KCI the Engineers (tubulars floating platforms); and foundation supplier);
- SPT Offshore (floating wind anchors and moorings);
- Vryhof mooring (anchoring and deep-sea mooring solutions).

In the news 2022

Korean-Dutch Consortium Puts Model MSPAR Floater Foundation Through Paces

Source: OffshoreWIND.biz

The MSPAR floating wind turbine foundation has passed model tests and is now ready for Approval in Principle (AIP) and a full-scale prototype, according to South Korea's Daewoo Engineering & Construction and Netherlands-based Monobase Wind, which plan to roll out the prototype in 2023/2024.

The tests were conducted on a 1/44 scale MSPAR model at the Océanide facilities in South-East France and lasted for three weeks.

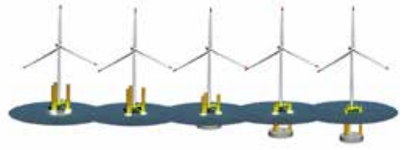
According to the developers, the results regarding the stability and behavior of the model during transport, installation and in-place conditions were well within industry standards and parameters and the concept is now ready for an Approval in Principle (AIP) and a full-scale prototype.

The companies, which signed a joint technology development agreement in December 2021, have fast-tracked the development of the concept and aim to complete Basic Design and certification principle by the end of 2022 and present a full-scale demonstrator to the market in the next two years.

The MSPAR foundation is a combination of a semi-submersible and SPAR designed for complete assembly at the quayside, tow-out using tugs, and an in-place draft of more than 70 metres.

The consortium also said that the MSPAR Floater is designed to allow for efficient logistics, maximum local content for fabrication, installation, and maintenance and includes a substantial reduction in CO2 emissions during transport and installation.

The MSPAR is planned to be able to support 15-20 MW turbines in water depths of more than 90 metres and harsh sea state and meteorological conditions.



In the news 2022

GustoMSC Completes Semi-Submersible Tri-Floater Foundation Model Tests

Source: OffshoreWIND.biz

GustoMSC has completed model tests of its semi-submersible Tri-Floater wind turbine foundation at the Océanide wave basin in South-East France.

The Tri-Floater model, hosting the 15 MW NREL reference wind turbine, was subjected to simultaneous wind, wave, and current loading in the wave basin.

According to GustoMSC, the aim of the tests was to demonstrate the suitability of the design for most of the floating wind sites currently being considered, including operational conditions the wind turbine would normally experience during its lifetime as well as extreme conditions it would endure during storms.

The floating offshore wind turbine foundation was also tested through an extreme sea state with a wave height of 13.5 metres and wind speed at the hub height of 190 kilometres per hour. The Tri-Floater "passed" the test and the results confirm the performance of the floating offshore wind turbine foundation in harsh environments, the company said.

Following the completion of the model test campaign, the Tri-Floater design reached Technology Readiness Level 4 ("technology validated in a lab").

In the news 2022

Dutch Company Working on Two Floating Wind Projects Offshore Northern Ireland

Source: OffshoreWIND.biz

Dutch marine engineering and offshore energy company, SBM Offshore, has taken the first step towards applying for a marine licence to build two floating wind farms offshore Northern Ireland.

SBM Offshore, which has set up a company named North Channel Wind to develop and build the projects, has completed site characterisation and commenced a scoping exercise in consultation with Northern Ireland's Department of Agriculture, Environment and Rural Affairs (DAERA).

The wind farms are planned to be sited in areas between 12 and 27 kilometres from the coasts of counties Antrim and Down, with the best location for grid-connecting the projects still being investigated.

The two wind farms, named North Channel Wind 1 and North Channel Wind 2, would be built in water depths of approximately 120 metres and are expected to have an installed capacity of 300 MW and 100 MW, respectively.

The number of units depends on the selected turbine model, meaning that SBM Offshore could install wind turbines of an output of up to 20 MW.

The floating foundations to be used are designed by SBM Offshore, which says its lightweight steel floating tension leg platform (TLP) is easily installable with light and standard means, and that it also has a reduced seabed footprint and is simple to decommission, leading to a a reduced environmental impact and a competitive cost of energy.

SBM Offshore is also developing two floating wind projects in the Celtic Sea, following an award by the Crown Estate last year.

In the news 2022

Bluewater to Test Its Tension Leg Floating Tech Offshore Norway

Source: offshoreWIND.biz 2022

The Marine Energy Test Center (METCentre) and Bluewater Energy Services have signed an agreement for a berth option to deploy an innovative floating wind system offshore Norway.

Bluewater has developed the Tension Leg Platform (TLP) type floating foundation to support offshore wind turbines cost-effectively and this project will showcase the solution in the deeper waters of the North Sea, said the developer. The company's floating system is planned to be installed in the North Sea offshore Karmøy, Norway, where it will produce renewable energy for the Norwegian electricity grid.

The floating wind TLP foundation was developed for the industrial deployment of wind turbines in floating offshore wind farms, with a focus on harsh environments. The foundation is scalable, lightweight, and supports wind turbines with minimal floater-induced nacelle motions, Bluewater said.

The tension leg mooring system has a small seabed footprint that could provide optimal use of the sea.

"Norway has a very good resource for floating offshore wind farms and we believe that our technology can play a key role in achieving energy transition goals in Europe and the rest of the world", said Bram Pek,, Business Development Manager at Bluewater Energy Services.

METCentre assists companies with facilities for the testing of new floating offshore wind technology. The test centre was recently awarded a concession for extending the capacity for demonstration projects. The test capacity at the centre's Karmøy site is six turbines and power export will be provided via a 66 kV subsea cable.

8.6 Offshore Wind to hydrogen innovators

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 – last but not least – can be transported through (existing) pipelines much cheaper 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.

Green hydrogen from North Sea wind energy can technically be converted directly at the source offshore (i.e. platform, artificial island, integrated in turbine) or at more distant onshore locations. Offshore conversion may become economically more attractive for far-from-shore projects, as offshore hydrogen pipelines will be cheaper, more robust and less complex to rollout and with less environmental impact on coastal areas than electrical cables. This transportation differential may well offset the higher cost of producing hydrogen offshore instead of onshore.

The Netherlands can currently be considered the international testing ground on green hydrogen production, given the following list of 'global first' demonstration projects in both onshore electrolysis and offshore electrolysis.

Onshore electrolysis: NortH2

In February 2020 Shell, Groningen Seaports, Gasunie, and the province of Groningen launched NortH2. This project aims to produce green hydrogen using electricity from about 4 GW of offshore wind off the coast of the Netherlands by 2030, and 10+ GW by 2040. The NortH2 partners intend to jointly establish a system of offshore wind farms, electrolysers, gas storage, and pipelines in order to convert offshore wind power into green hydrogen, store it and transport it to industrial clusters in north-western Europe. NortH2 will have a capacity of 1 GW in 2027, 4 GW by 2030, and 10+ GW by 2040 for electrolysis. This equates to 0.4 million tonnes of green hydrogen production in 2030, and 1 million tonnes of production by 2040. Since the beginning of the project, Eneco, Equinor, chemical company OCI and RWE have joined the consortium.

In the news 2022

Eneco and OCI Join NortH2 Offshore Wind-to-Hydrogen Consortium

Source: OffshoreWIND.biz

Energy company Eneco and OCI N.V., a global producer and distributor of hydrogen-based products, have joined the NortH2 green hydrogen consortium as collaborative partners.

Eneco is joining the NortH2 consortium of Equinor, RWE, Shell, and Gasunie as an investment partner. Groningen Seaports is a support partner on the project.

OCI, on the other hand, intends to develop the first integrated green ammonia and methanol value chains through large-scale green hydrogen supply by NortH2 to the company's plants in the Netherlands.

NortH2 is a large-scale offshore wind-to-hydrogen electrolysis project being developed in the Eemshaven area, the Netherlands.

The hydrogen will be produced for industrial sectors that are difficult to electrify, or for which hydrogen is a necessary raw material.

NortH2's aim is to have up to 4 GW of electrolysers and matching offshore wind capacity available by 2030.

NortH2 will continue to grow towards the production of 1 million tons of green hydrogen per year by 2040.

NortH2 has recently completed the second phase of the feasibility study, which shows that an integrated approach; from offshore wind farms, production, storage and distribution to ultimately the use of the green hydrogen; is technically and economically feasible. One other requirement is for the government to create the right policy framework, Eneco said.

OCI said that by joining forces with NortH2 the company will be provided with a stable and large-scale supply of green hydrogen which allows it to decarbonize its production processes and meet a growing demand from its customers in the downstream value chain for renewable hydrogen.

Onshore electrolysis: FlexH2

In April 2022, an international consortium of Shell, Van Oord, TKF, TNO, and DNVas wel as General Electric, ABB, VONK, Technical University of Eindhoven, and Technical University of Delft, kicked off the Shell-led research project FlexH2, which stands for Flexible Offshore Wind Hydrogen Power Plant Module.

In the news 2022

Dutch Offshore Wind-to-Hydrogen Project Ready to Take Off

Source: OffshoreWIND.biz

The Netherlands Enterprise Agency (RVO) has announced that the GROW consortium FlexH2 project was awarded a grant as part of the MOOI-SIGOHE tender scheme.

The Shell-led research project FlexH2, which stands for Flexible Offshore Wind Hydrogen Power Plant Module, intends to develop and demonstrate technology that will accelerate the scale-up of offshore wind to green hydrogen production and its integration in the energy system. FlexH2 is based on three key technological innovation pillars: a grid-forming offshore wind farm, a high-performance AC/DC solid-state transformer for large-scale electrolysers, and a multi-terminal hybrid HVDC transmission system and its energy system integration.

The proposed wind-to-hydrogen solution, which will be tested in laboratories at a Medium Voltage kW-scale, enables direct sourcing of renewable electricity to green hydrogen production. It is expected to be scalable and can be operated independently from a local or national power grid, thus reducing the time-to-market significantly by 5 to 10 years. The integration of the various proposed innovations – varying from the offshore wind turbines to the transport and delivery of the power to an onshore electrolyser – could reduce the cost of hydrogen production by at least 10 per cent and well before 2030, the consortium said. The results of this research project could provide the basis for the accelerated development of Power-to-H2 projects in the Netherlands.

General Electric, ABB, VONK, Technical University of Eindhoven, and Technical University of Delft will develop the electro-technical innovations. Shell, Van Oord, TKF, TNO, and DNV will use their expertise related to hydrogen electrolysis, balance of plant, market/flexibility, and key component design, transport and installation expertise, respectively.

Onshore elecytrolysis: Holland Hydrogen 1

In January 2022 Shell announced the construction of the Holland Hydrogen 1 project in the port of Rotterdam, a 200 MW electrolysis plant using electricity coming from the 760 MW offshore windfarm Hollandse Kust Noord by means of guarantees of origin. The intended start of production of the Holland Hydrogen 1 hydrogen project facility, which will cover two hectares, the size of three football fields, will be in 2024.

In the news 2022

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.

Offshore electrolysis: PosHYdon

The PosHYdion is the first offshore hydrogen project in the Netherlands. 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.

In the news 2022

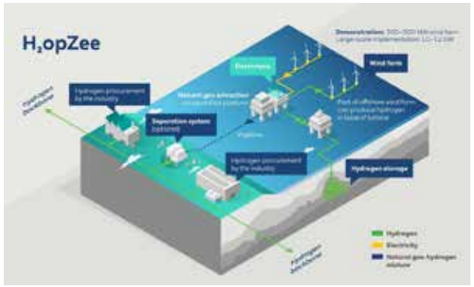
Work on Dutch Offshore Wind-to-Hydrogen Pilot

Source: OffshoreWIND.biz

The Netherlands Enterprise Agency (RVO) has awarded a subsidy of EUR 3.6 million to the PosHYdon offshore green hydrogen pilot project, allowing for the start of activities to bring the project to life.

The project, which will integrate offshore wind, offshore gas and hydrogen production, is the world's first offshore green hydrogen pilot on a working platform, according to the project consortium.

PosHYdon seeks to validate the integration of the three energy systems in the Dutch North Sea and will involve the installation of hydrogen-producing plant on the Neptune Energy-operated Q13a-A platform, located approximately 13 kilometres off the coast of Scheveningen (The Hague). Electricity generated by offshore wind turbines will be used to power the hydrogen plant on the platform, converting seawater into demineralized water, then into hydrogen via electrolysis.
The green hydrogen will be mixed with the gas and transported via the existing gas pipeline to the coast.
The 1 MW offshore electrolyser, to be delivered by Norwegian company NEL Hydrogen, will produce a maximum of 400 kilograms of green hydrogen per day.



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 sector of the North Sea. The companies plan to have the project up and running before 2030.

In the news 2022

Neptune Energy, RWE Unveil Offshore Wind-to-Hydrogen Project in the Netherlands

Source OffshoreWIND.biz

Neptune Energy and RWE have signed a Joint Development Agreement to develop a green hydrogen project which will use offshore wind energy for the production of hydrogen in the Dutch sector of the North Sea and an existing pipeline to transport the hydrogen to land.

The project, called H2opZee and supported by the Dutch government as an initiative of TKI Wind op Zee, consists of two phases.

In the first phase, the newly established consortium will perform a feasibility study and set up and an accessible knowledge platform, with an objective to start the roll-out of hydrogen at sea in the Netherlands. In the second phase, the project will be implemented, with the tender methodology yet to be defined.

H2opZee is a demonstration project which aims to build 300-500 MW electrolyser capacity in the North Sea to produce green hydrogen using offshore wind and to transport the hydrogen to land through an existing pipeline. The pipeline has a capacity of 10-12 GW, so it is already suitable for further roll-out of green hydrogen production at gigawatt scale in the North Sea, according to the consortium.

Sven Utermöhlen, CEO Offshore Wind at RWE Renewables, said that hydrogen was a gamechanger in the decarbonisation of energy-intensive sectors and that the H2opZee project was a world-first of this kind and scale.

9. Wind and 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 aims at enhancing international visibility, reinforcing the network and exchanging knowledge within the global wind community.

Become a Partner of wind & water works!
If you are interested to become a Partner, contact us via windandwaterworks@nwea.nl

Wind farm development

Project development

BLIX Consultancy

We are BLIX Consultancy: an independent consultancy company in onshore and offshore wind energy with offices in the Netherlands, Taiwan and South-Korea. It is our mission to accelerate the energy transition with enthusiastic and excellent teams in order to lower the cost of wind energy and optimise revenues.

Our consultants have been involved in the offshore wind energy sector since the start of the industry and worked in different phases of wind projects in several countries in Europe, Asia and the USA.

Services of BLIX include interim-management, project and strategic advice in all phases of a wind energy project: feasibility, development, engineering and contracting, construction, operation and maintenance and decommissioning.

Over the past 12.5 years, we have been involved in the realisation of over 20 GW of offshore wind energy worldwide, supporting governments, transmission system operators, energy companies and developers with tender- and contract management, LCOE studies, site investigations, package management, due diligence and setting-up O&M strategies.

BLIX
hands-on experience in renewable energy

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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."

DNV

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www.dnv.com

IX Wind

IX Wind is part of IX Renewables and has been supporting clients in all life stages of onshore wind power plants since 2004 and offshore 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, for which the inhouse optimisation tool SOMOS8 is utilised. By identifying key risks, optimising OPEX versus power production, and presenting more accurate cash flow projections, risks are minimalised and profits increased.

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

Since 2020, IX also has also taken full responsibility for decommissioning and repowering of wind power plants too. With an adaptive attitude and holistic approach, IX has key clients in Europe and Asia.

IX Wind

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www.ixwind.com

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.

Liberty Mutual. SURETY

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www.nationaleborg.nl

Pondera

Pondera is a consulting and project development firm working across all aspects of wind energy. Its projects are located offshore, near shore and onshore. Pondera's main clients are developers, grid operators, investors/lenders, manufacturers and (local) governmental bodies. A well known name in the Dutch wind energy market, Pondera's service range spans from a project's initialisation phase to the final construction and permit management. The fast growing company has its roots in spatial development and technical studies, and has expanded its expertise with legal and financial teams. This allows Pondera to play an integral consulting role in any wind energy project. Examples of its services are feasibility studies, metocean campaigns, cabling studies, asset management and project & construction management.

Pondera is involved in projects in the Netherlands, the British Isles, mainland Europe, Korea, Vietnam, the UAE and Indonesia.

Pondera has worked on iconic projects such as the development of the Haliade-X 12+ MW wind turbine, together with GE Renewable Energy. This is the world's most powerful offshore wind turbine to date, featuring a (2021 rated) 13 MW capacity and a 220-meter rotor. Together with Sif Holding, Pondera has developed the Haliade-X prototype testing location in The Netherlands.

PONDERA

marketing@ponderaconsult.com
www.ponderaconsult.com

Ventolines

Ventolines has a clear mission: we want a world in which renewable energy is of value to everyone. To achieve this, we develop, build, and manage renewable energy projects with the utmost attention and precision, keeping a keen eye on the interests of stakeholders at the same time.

With a staff of nearly 100 experts (U.S. & Europe), Ventolines has become a significant player in renewable energy in Europe, specifically in the Netherlands. Ventolines is providing services to all phases of wind, solar and storage projects: development, contracting, legal matters, system integration, construction, and asset management. It offers advice on Power Purchase Agreements, the electricity market, and stakeholder management, as well as financial and legal advice and technical due diligence in investment, divestment and financing transactions.
Our clients are potential owners of sustainable energy projects such as cooperatives, landowners, developers, investors, governments and energy companies.

The total installed capacity of our portfolio of projects exceeds 2 GW. Currently the company is involved in major onshore and offshore wind projects in the Netherlands adding more than 1,500 MW of installed power. This includes the country's largest onshore wind farm Windplan Groen (500 MW).

Ventolines

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Project research

Deltares

Deltas, coastal regions and river basins are appealing areas to live and work. The effects of climate change – such as sea level rise, land subsidence and erratic rainfall patterns – also represent threats. New, broad-based, solutions will be needed to live in these areas safely and sustainably.

Throughout the world, Deltares works on innovative solutions and applications for people, environment and society. 'Enabling delta life' is our mission and ambition. We apply our top-level knowledge with the aim of delivering innovative and sustainable solutions for global issues relating to water and the subsurface. Our distinctive profile combines open source software, advanced experimental research facilities and highly qualified and knowledgeable experts. Knowledge development and cooperation are important in our work.
All our contracts and projects, whether financed privately or from strategic research budgets, contribute to the consolidation of our knowledge base. We also believe in openness and transparency, as is evident from the free availability of our software and models. It is our firm conviction that sharing knowledge and innovative insights worldwide enables delta life. Government and business can draw on our work to develop their own solutions. Other knowledge and research institutes can contribute their own research results, further extending the knowledge base.

Deltares

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PONDERA

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Bureau Waardenburg

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

With over 130 employees, they work across the full spectrum of ecology and the impact to changes in the environment. BW has been involved with investigating the effects of wind energy projects on wildlife for over 20 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.

Bureau Waardenburg
Ecology & Landscape

info@buwa.nl
www.buwa.nl

Dutch Marine Energy Centre (DMEC)

DMEC is an accelerator for marine energy solutions. Marine Energy, energy generated from our oceans, seas, and rivers, is the world's largest untapped source of clean energy. By advancing innovation, mobilising capital and shaping policies, DMEC creates multipurpose energy solutions for a wide variety of markets.

DMEC
DUTCH MARINE ENERGY CENTRE

britta@dutchmarineenergy.com
www.dutchmarineenergy.com

The Rich North Sea

The Rich North Sea takes advantage of the unique opportunity which offshore wind farms offer to enhance nature in the North Sea.

We are helping our planet in two ways: renewable energy generation to stop climate change, and nature development for more biodiversity in the North Sea. The biodiversity of our largest nature reserve has been reduced by overfishing and diseases, leading to the disappearance of almost all natural reefs. If we want to bring back these reefs, active intervention is needed.

In close collaboration with the wind sector, offshore industry, and science we are building artificial reefs for oysters, tube worms, and Northern horse mussels at various locations in Dutch offshore wind farms. In so doing we help marine life thrive and investigate the ideal conditions for optimal nature development. The goal is to apply the acquired knowledge in all wind farms in the North Sea.

The Rich North Sea

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www.derijkenoordzee.nl/en/

Project, contract, finance support

Intramar 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.

INTRAMAR
INSURANCES International Insurance Brokers

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http://www.intramar.nl

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.

REBEL

Stephan.vanOs@Rebelgroup.com
www.rebelgroup.com

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.

chielvanrooijen@boltlife.com
www.boltlife.com

C1 Connections BV

C1 Connections has developed a new 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. The C1 Wedge Connection(TM) can be installed safer and faster than conventional connections and does not require maintenance, saving on OPEX. The C1 Wedge Connection(TM) allows direct CAPEX savings compared to all alternatives.

The C1 Wedge Connection(TM) has been certified by DNV.

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We produce fasteners from M5 till around M200, and other thread related dimensions! We’ve a large and widt 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.

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Robin Radar Systems BV

Our 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 tracking and classification of small objects . With more than 30 years’ of applied radar science, we are proud to have in our client environmental and Wind sector portfolio , international companies on shore and offshore as such as :Equinor, Orsted, Gemini, Bureau Waardenburg, Nina, 3birds, Bluebear, Rijkswaterstaat, Fino, Takkolluoto Wind farm, EVN, Luminus (EDF group), Wind Park Friesland, Woolnorth.

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Foundations

Foundation supply Bottom fixed

Sif Netherlands BV

Sif is leading in offshore foundations and delivers quality on time, safely and within the agreed budget. We make good on this promise because of our critical approach to the preliminary stage.

Our dedicated specialists optimize each project on design, feasibility, coating and logistics. We want to ensure our production and the installation processes are efficient and cost optimal by working closely with our clients.

The reduction of costs of offshore wind energy is primarily driven by innovations and efficiency improvements. The industry continues to find ways to increase the power generation of offshore wind farms.

Sif tracks the latest developments in turbine technology closely and investigates exactly what effect this will have on size, manufacturability and cost of foundations.

info@sif-group.com
www.sif-group.com

Foundation supply Floating

GustoMSC/NOV

NOV is a leading provider of technology and equipment to the global energy industry. GustoMSC, part of our Marine and Construction business, is recognized for providing reputable design & engineering consultancy for mobile offshore units and equipment. In close cooperation with our clients, we translate experience, science and technical knowledge into realistic & innovative ideas.

The performance of new and existing jack-ups, vessels and semi-submersibles is further optimized by our operational support and engineering consultancy. In this way, GustoMSC enables and supports safe and efficient operations at sea, contributing to a sustainable future.

Efficient and future proof solution for offshore wind feedering
GustoMSC is widely involved in offshore wind developments through the design of ever-increasing Wind Turbine Installation Vessel designs, larger jacking systems and cranes. In parallel, GustoMSC has been developing solutions for feeder options including the latest development of the Steady Top Feeder Vessel.

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www.nov.com/gustomsc

Component supply, engineering support

GustoMSC/NOV

NOV is a leading provider of technology and equipment to the global energy industry. GustoMSC, part of our Marine and Construction business, is recognized for providing reputable design & engineering consultancy for mobile offshore units and equipment. In close cooperation with our clients, we translate experience, science and technical knowledge into realistic & innovative ideas.

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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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www.mooreast.com

TNO Energy Transition

TNO, the Netherlands Organisation for Applied Scientific Research, was founded by law in 1932 to enable business and government to apply knowledge. As an organisation 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.

TNO innovation for life

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www.tno.nl/en

Substations, subsea cables

Component supply, engineering support

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

pr@heinenhopman.com
www.heinenhopman.com

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.

SoluForce®

info@soluforce.com
www.soluforce.com

Gouda Holland BV

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

b.erdtsieck@goudaholland.nl
www.goudaholland.nl

V&SH Offshore Solutions

V&SH Offshore Solutions is an offshore and onshore contractor, specialized High Voltage terminations and testing, cable repairs and outfitting of high voltage assets.

We perform a wide range of 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.

V&SH Offshore
a WTS Energy company

jonne.schortinghuis@vshoffshore.com
www.vshoffshoresolutions.com

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.

VPI

info@vos-prodect.com
www.vos-prodect.com

Transport and Installation

Balance of Plant contractors

Van Oord

We are a Dutch family-owned company with over 150 years of experience as an international marine contractor. Marine ingenuity is our signature and the spark that lights the spirit of our professionals. It drives our pursuit to make the world a better place for future generations. In 2018, Van Oord received the right to use the Royal designation. It crowns the 150 years of entrepreneurship, spirit and perseverance displayed by our predecessors and employees.

Our focus is on dredging, land infrastructure in the Netherlands, offshore wind and oil & gas infrastructure. Its head office is in Rotterdam. Van Oord employs 5,000 staff, who worked in 2019 on 200 projects in 44 countries. The fleet consists of about 70 vessels and a large amount of special-purpose and auxiliary equipment.

Climate change and the need to reduce CO2 emissions are drivers for the rising demand of renewable energy sources. With proven experience and an impressive track record, Van Oord is leading the way in the energy transition towards renewable energy by constructing offshore wind projects.

Van Oord
Marine ingenuity

area.off@vanoord.com
www.vanoord.com

Installation equipment supply

Cape Holland

CAPE Holland is the world leading provider of offshore Vibro piling solutions.

Its unique Vibro Lifting Tool (VLT) is a vibratory hammer and certified lifting tool hybrid, which is able to upend a pile, lift it to the seabed and start installing straight away. All this without any tool changes, guide frames or noise mitigation. This innovative cost saving equipment can greatly reduce installation times for pile installation on- and Offshore.

CAPE

anja@cape-holland.com
www.cape-holland.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.

DDC

info@ddcbv.com
www.ddcbv.com

Eager One

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

With over 40 years of experience, Eager.one has gained expertise in the design and construction of heavy mechanical equipment, consultancy in the area of complex lifting and transport, and state of the art design calculations.

Their in-house experts provide worldwide bespoke lifting and handling tools for manufacturers of heavy equipment, civil engineering contractors, lifting, transport and foundation companies and its clients in the offshore, process and renewable industry.

Project case
Eager.one has designed and constructed a game-changing lifting beam for Scaldis. This state-of-the-art lifting beam enables our client to work faster and safer, making use of the full capacity and capability of the heavy lifting vessel Gulliver.

EAGER.ONE

sales@eager.one
www.eager.one

Huisman

Huisman is a worldwide supplier of step changing technical solutions to the world's leading companies in renewable energy, oil and gas, civil, naval and entertainment markets.

Projects vary from stand-alone components to highly engineered integrated systems, from concept to installation and life time support. Huisman operations are divided between offices in the Netherlands, Brazil, China, Czech Republic, Norway, Singapore and the USA and facilities in the Netherlands, Brazil, Czech Republic and China.

Huisman
Equipped for impact

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

Holmatro

Mastering power
Holmatro products are all about the principle that only controlled power can be deployed effectively. We have expressed this vision in the slogan 'Mastering Power'. Holmatro hydraulic equipment and system solutions are used worldwide in rescue operations, industrial applications and special tactics operations. For over 50 years after the foundation of Holmatro in 1967, we keep honoring our traditional Dutch roots and represent innovation, quality and support.

Offshore Wind
Since the introduction of the TP levelling set in 2009, Holmatro has significantly expanded its product range for offshore (wind) applications. Besides hydraulic solutions to level and fixate wind turbine foundations such as transition pieces and jackets, we have proven ourselves in the field of cutting applications, sea fastening, deck handling and skidding solutions. Our tools are also used for lifting, weighing and positioning applications.

holmatro
mastering power

industry@holmatro.com
www.holmatro.com

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".

ENERPAC

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www.enerpac.com

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.

Muns Techniek BV

info@munstechniek.nl
www.munstechniek.nl

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.

Tetrahedron

info@tetrahedron.tech
https://tetrahedron.tech/

Polarttech

Polarttech has been a recognized manufacturer in the international polyurethane processing industry for more than 20 years. We are specialised in the development and production of sustainable polyurethane products, which we process in our own turning shop. Customer advice, extensive material knowledge, large stocks and fast delivery times have contributed to the enormous growth that Polarttech has been able to experience.

All our products are developed and produced in the Netherlands and then used worldwide in industries such as agriculture, machine construction, oil & gas and renewable energies such as offshore wind and solar energy.

Specialised in sustainable polyurethane solutions
Our sustainable polyurethane products are very widely applicable in this market and can therefore be found in all industries within this sector. From bearing pads and dampening pads that are essential for the transportation and installation of offshore wind farm components 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.

POLARTTECH

sales@polarttech.nl
www.polarttech.com

Solidd Steel Structures

Solidd 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

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.

Info@SinusJevi.com
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.

info@tms.nl
www.tms.nl

Installation/CTV/SOV vessel design, supply

GustoMSC/NOV

NOV is a leading provider of technology and equipment to the global energy industry. GustoMSC, part of our Marine and Construction business, is recognized for providing reputable design & engineering consultancy for mobile offshore units and equipment. In close cooperation with our clients, we translate experience, science and technical knowledge into realistic & innovative ideas.

The performance of new and existing jack-ups, vessels and semi-submersibles is further optimized by our operational support and engineering consultancy. In this way, GustoMSC enables and supports safe and efficient operations at sea, contributing to a sustainable future.

Efficient and future proof solution for offshore wind feedering
GustoMSC is widely involved in offshore wind developments through the design of ever-increasing Wind Turbine Installation Vessel designs, larger jacking systems and cranes. In parallel, GustoMSC has been developing solutions for feeder options including the latest development of the Steady Top Feeder Vessel.

info.gustomsc@nov.com
www.nov.com/gustomsc

CTV/SOV deck equipment supply

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.

info@barge-master.com
www.barge-master.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 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.
- The system is fully electric and requires a max. 75 KW from the vessel.
- 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.

EAGLE-ACCESS

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www.eagle-access.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.

SAFEWAY
MOTION COMPENSATED GANGWAYS

wva@vanaalstgroup.com
www.safewaygangway.com

Z-Bridge

Z-Bridge Operates a fleet of light weight offshore access system, called Bring-to-Work (B2W) system.

The B2W system is a light weight, fully motion compensated offshore access system, designed to deploy teams up to 6 persons per batch to any offshore structure. The B2W system can transfer personnel over a range from 10-22 meter above the point of installation. Furthermore, the B2W can be utilized as fully motion compensated 3 mT crane, to transfer cargo quickly and efficiently in rough conditions.

The lightweight and low COG of the B2W system, make it possible to right size the vessel it is operating from, reducing CO2 footprint, and cost level. The system can be operated from large CTV's or smaller DP-2 SOV's.

Z-Bridge
Bring-to-Work system

info@zbridge.nl
www.zbridge.nl

Operations & Maintenance

Services Operations

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.

BRADY

salesbenelux@bradycorp.com
www.brady.nl

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.

ISP
INTREPID SAFETY PRODUCTS

info@isp-products.com
www.isp-products.com

DHSS

DHSS unburdens customers by being the clients' eyes and ears at all times, being our clients' representatives on the ground, acting in their best interests on every issue. 24 hours a day.

From our A1 located support bases in strategic related ports, full coverage is granted - coordinating berthing, stevedores, transport and warehousing, arranging customs and immigration formalities, organizing security, liaise with pilots and Port authorities. As well as collaborating with a wide variety of supply-chain. Attending to the needs of the client, vessel master and crew.

As one single point of contact with an extensive qualified network.

DHSS

agencies@dhss.nl
www.dhss.nl

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).
D
roneQ 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.

DRONEQ
ROBOTICS

info@droneq.nl
www.droneq.nl

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.

info@vtn.nl
www.vtn.nl

Maintenance

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

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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www.granenergia.com

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.

info@ridderflex.nl
www.ridderflex.nl

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

OFFSHORE WIND SOLUTIONS
MANAGEMENT, PROJECT SUPPORT, INSPECTION & MAINTENANCE

part of

ROPE ACCESS NOORD
VERTICAL SAFETY, ACCESS & RESCUE

info@ropeaccessnoord.nl
www.offshorewindsolutions.eu

Trustlube

TrustLube designs, manufactures and installs automatic lubrication systems and monitoring systems for the maritime, dredging en food industry. TrustLube systems guarantee you will receive the exact dosage, at the correct location, at the desired time, using the correct 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 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 required less often, as are costly repairs. And that is exactly what you need in a world where delay is not an option.

TrustLube®

info@trustlube.com
www.trustlube.com

Crew/ staffing services

Atlas Professionals

Atlas Professionals has four decades of experience in providing high quality and competent personnel to the onshore and offshore industries.

We have worked hard to maintain and develop our pool of highly-qualified and accomplished professionals across all specialized disciplines. Our professionals, have a proven track record and skill set to compete alongside industry challenges.

Serving 15 specialist areas in the Energy, Marine and Renewables industries, each with its own standards and requirements. The Atlas organisational structure, work processes and, above all, our staff are focused towards providing optimal service to all of our clients in these specialisms.

Atlas Professionals

info@atlasprofessionals.com
www.atlasprofessionals.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.

Brunel

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IPS Powerful People

Since 1988 iPS is an international recruitment and crewing agency that combines experience, in-depth knowledge, and people to successfully serve businesses in the Maritime, Energy and Civil industries.

If you are our client or candidate we share your passion for the industry. Whether it is your Maritime, Energy or Civil construction job. iPS is your international service provider in the fields of crewing, secondment, recruitment, and payroll solutions.

Are you ready for tomorrow? In a revolving and always moving market we always need to be one step ahead. By collaborating with both candidates and clients we can work together toward the best solution for both. Following our company values we strive to be your recruitment partner of choice.

iPS
powerful people

info@ipspowerfulpeople.com
www.ipspowerfulpeople.com

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!

OCEANWIDE

personnel@oceanwidecrew.com
www.oceanwidecrew.com

Propakt

ProPakt is a self-service recruitment platform to efficiently search and contract experienced and certified Freelance Professionals from the Global Offshore Energy & Maritime Industry. ProPakt verifies certification, and keeps a Project administration related to the Freelancers. Streamlining invoicing inclusive of Payrolling Freelancers that don't have an entity. Search local to save (quarantine-) costs and lower your carbon footprint.

rzwinkels@propakt.com
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Colofon

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