



Netherlands Enterprise Agency

# HOLLANDSE KUST

*where wind & water works*

NOVEMBER 2017

**PIETER VAN OORD**, CEO VAN OORD AND CHAIR OF IRO

## REASONS TO INVEST

## THE NETHERLANDS THE OFFSHORE HUB

### FINDING NEW WINDS

*“Lowering the cost of wind energy  
requires an integrated approach.”*

**wind &  
water  
works®**



# HOLLANDSE KUST

*a North Sea powerhouse of offshore  
wind ports and expertise.*

A hotspot for the global offshore energy and maritime industries, Hollandse Kust is the ideal base for your company to gain a competitive edge and capitalise on current and future plans for North Sea offshore wind development in the Netherlands and beyond.

With world-class port facilities already future-proofed for the immense logistical challenges of offshore wind development, the best in wind power R&D, and top class companies along the whole supply chain, Hollandse Kust is ready, willing, and able to support you in all you do.

So come join us - we understand just how wind and water works.

The city and Port of Den Helder



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If ever there was a place where wind and water work in perfect harmony, it's the Hollandse Kust of the Netherlands. This region has long been the leading offshore energy and maritime hub for Europe. Its heritage has been defined by its global strength in these sectors and, with the development of wind farms at sea now key to fulfilling the national energy agenda, that heritage will continue to play a critical role in the decades to come.

## *The innovations will become the norms of tomorrow*

As this publication clearly shows, the region's ports are amongst the best in the world. They already have fantastic logistics, infrastructure and supply chain services onsite to ensure Dutch and European offshore wind ambitions can be fulfilled cost-effectively and in good time. Its world-class wind research centres and knowledge institutes are working tirelessly with the industry on the innovations that will become the norms of tomorrow. There is local business support in abundance too.

And yet there is no complacency. Huge investments are being made at all levels to meet ever-growing demand for better services and massive increases in capacity. There are challenges, of course, none more so than ensuring the availability of a skilled workforce for the long term. But with such challenges come opportunities. With those opportunities in mind, welcome to you all.

# WELCOME TO A WORLD OF OPPORTUNITIES



Hollandse Kust

# A PLACE FOR OFFSHORE WIND, WORK, REST AND PLAY

Hollandse Kust is located along the west coast of the Netherlands and includes two of the country's most densely populated provinces, South Holland (Zuid-Holland) and North Holland (Noord-Holland). Both have long been renowned centres of excellence for offshore energy (including wind), marine industries, and R&D, but from this year, their position as leaders in the offshore wind industry is set to skyrocket.

In December 2017, the tender opens for 700 MW of a total 2100 MW in new offshore wind capacity planned in the North Sea (1400 MW in the Hollandse Kust (zuid) and 700 MW Hollandse Kust (noord) Wind Farm Zones). All 2100 MW will be fully operational by 2023, along with 1400 MW in the nearby Borssele Wind Farm Zone, which has already been tendered and is located just off the coast of the Province of Zeeland. This will bring the Netherlands total installed offshore wind capacity up to 4,500 MW. Under Government plans, though, that will increase further. From 2024 to 2030, a further 7 GW is planned, further out off the Hollandse Kust coastline.

Meantime, all Dutch ports are also well located for easy access to offshore wind projects under development in the North Sea by other countries, including the UK, Belgium and Germany. Combined, that all puts Hollandse Kust at the heart of Europe's offshore wind endeavors in terms of manufacturing, installation and maintenance, but also in terms of long term research and innovation to help drive down costs further and maximise output and efficiency in difficult North Sea conditions.

"It is predicted that demand for offshore wind energy will quadruple by 2020," says Loek Becker Hoff, Senior Account Manager for Cleantech at West Holland's regional economic development agency, InnovationQuarter. "The Dutch offshore wind sector is ideally positioned to overcome the challenges of the offshore wind roll-out and can deliver new technologies on a large scale."

Those challenges are many and so a successful roll-out of the planned wind projects requires the right people, skills, infrastructure, logistics, supply chain companies, innovation and education centres, and the right level of local, regional and national support. Hollandse Kust has all of that and more, with its towns, countryside and coastline already set-up to be a perfect place for those working in the offshore wind sector to call home. >>>

The coast and port of IJmuiden



ATTRACTIVE OFFERING

>>> “Everything is in place to be the ‘Offshore Wind Delta’ of the world,” says Becker Hoff, referring to the Rotterdam area of South Holland, which is home to Europe’s largest port. “We have the required space and facilities in our ports and the construction and maintenance can be sourced from this region too,” adds Koen Overtoom, CEO of North Holland’s Port of Amsterdam. Both ports, along with others along the Dutch coast, are increasing their already impressive capacity to serve the North Sea offshore wind industry to the maximum. “With an exquisite investment climate, a large market at the shortest nautical distance in a highly accessible and innovative area, with an extensive educated work-force, this is an attractive offering,” says Overtoom, confirming the significant, long term market opportunities for growth now available for those located in the Hollandse Kust region.

The Dutch offshore wind industry has already witnessed strong growth in recent years, with companies from the Netherlands involved in all offshore wind farms developed worldwide to date. “The Dutch position is specifically strong in the area of foundations,” says Becker Hoff. “Thanks to their strong maritime and offshore competencies, Dutch players have been able to deliver reliable and cost effective solutions for the design and installation of offshore foundations.”

Many of the leading companies in this respect are based in Hollandse Kust ports. “Van Oord and Boskalis are offshore dredging contractors that lead the offshore installation of turbines and foundations,” explains Becker Hoff. “Royal IHC designs and manufactures specialised vessels and equipment that enable cost effective installation of wind farms. In foundation manufacturing, typical offshore oil and gas players have entered. Sif is one of the largest suppliers of monopiles, for example.” >>>



Zandvoort aan Zee

A GREAT ESCAPE

For those in the offshore wind sector, Hollandse Kust is not just the ideal place for work - it’s a great place to live. Windmills, dykes, polders, villages, cities and beautiful coastlines abound, whilst the choice and standard of education facilities, entertainment centres, and overall quality of life is high, enabling residents and visitors to have the best of all worlds.

“Molded by ancestors through unrelenting labour, Holland north of Amsterdam has the best the country has to offer,” says a slightly biased Bjorn Borgers, responsible for Investments and Markets at development agency NHN (Noord-Holland North). “On the west coast, you will find the most beautiful beaches against the backdrop of the highest dunes, woods, heathlands, sea sand-reed and sand drifts. Beyond the dunes there are vast polders, which in the spring are covered with colorful fields of flowers. Perfect for long and enjoyable bike rides and hikes,” he says. “To the east, you can visit cosy cities and towns with picturesque canals... great for shopping, cultural outings and relaxing at an outdoor café, in between walking through the centuries-old alleys and beautiful streets.”

Everything is located conveniently nearby. “In forty minutes you can drive from the North Sea on the west to the IJsselmeer coast on the east and Amsterdam is located within a stone’s throw,” Borgers says. It takes just 30 minutes to get to Amsterdam and Amsterdam Schiphol Airport, making Noord-Holland well connected to Europe and the rest of the world.



The Dutch coast

Zandvoort aan Zee, one of the major beach resorts of the Netherlands, is also in North Holland. Known as Amsterdam Beach, it is located just half an hour by train from the centre of Amsterdam. The combination of beach, nature, wildlife, historic charm, racing (Circuit Zandvoort is a world famous race track in the middle of the dunes) and fun, makes Zandvoort one of the most lively and versatile towns on the Dutch coast.

NATURE LOVER’S PARADISE

The town is also surrounded by two impressive nature and wildlife reserves: Nationaal Park Zuid-Kennemerland in the north and the Amsterdamse Waterleidingduinen in the south. Nationaal Park Zuid-Kennemerland is great for hiking and cycling. Nature lovers have plenty of exploring opportunities in the Kennemer dunes. There is a rich selection of flora and fauna due to the great variation in landscape, while the park is also home to rare species of cattle such as aurochs, wisents and Polish konik horses. South of Zandvoort aan Zee, the Amsterdamse Waterleidingduinen forms another mesmerising dune landscape. The dunes function as filters for rainwater to supply the city of Amsterdam with clean drinking water. To protect and preserve the area, bicycles are prohibited, but walking is allowed everywhere, even off-track. This gives visitors plenty of chances to spot grazing deer and wild foxes. Apart from a dazzling population of over 3000 deer, the Amsterdamse Waterleidingduinen also has many remaining bunkers from World War II.

CITY ON THE SEA

Of course, South Holland also has plenty to do and see to ensure a healthy work-life balance. The city of Den Haag (The Hague), for example, is another major attraction for visitors from far and wide, and not just because it is the International City of Peace and Justice, home to the National Government and the Dutch Royal Family. Den Haag is the only major city in the Netherlands that lies directly on the sea, offering 11 km of beach and dunes, along with 2,200 acres of parks. With Scheveningen beach and world famous museums like The Mauritshuis, with its Goldfinch and Girl With The Pearl Earring, or the Gemeentemuseum with its Mondrian paintings, rest and relaxation are just around the corner in every part of this picture postcard city for hard working offshore wind workers.

Ranked highest on Local & International Connections in the 2017 EU Cultural and Creative Cities Monitor, the city is located centrally along the Dutch coastline and very well connected by air, train, road and sea. Rotterdam/The Hague airport is just 25 km away, whilst Schiphol airport is 45 km away. And in case you were unsure, Den Haag was recently voted by ECA International as the 12th best city to live in the world, with over 10% of the 500,000 people living there being expats. When you choose Zuid Holland as your business location, you get all the advantages of a unique delta region in the western part of the Netherlands, centred on the cities of Rotterdam and The Hague, strategically located at the gateway to Europe and within a stone’s throw of Brussels, the EU’s administrative heart. ●



>>> As we report on pages 14-19, these companies are joined by a host of other leading firms, large and small, both domestic and foreign, which have set up an offshore wind base in the region. Shell, Eneco, and Ørsted (the new name for Dong Energy) are examples of project developers here (all of whom are involved in the projects being developed in the Borssele Wind Farm Zone), whilst Huisman, VBMS, Mammoet, GustoMSC, NKT Cables, Damen, Seaway Heavy Lifting, Ampelmann Operations, Peterson, Bluestream and DHSS, are just a few of the other key players in the offshore wind supply chain that are based in Hollandse Kust. And the list continues



People at work in the port of Rotterdam

to grow as more and more opportunities open up. Meantime, the region is bursting with the best in offshore wind R&D, with world leaders in the field such as TU Delft, ECN, and TNO.

### JOB CREATION

All of this, of course, means job creation and economic growth. Nationwide, in 2014, the offshore wind sector's turnover in the Netherlands was €1 billion, according to Top consortium for Knowledge and Innovation Offshore Wind (in dutch: TKI Wind op Zee). The industry had 2150 people in direct full time employment (fte), up 12% on the year previous, whilst a further 4,000 indirect employments also resulted thanks to the offshore wind industry's growth. By 2021, some 12,000 people and by 2030, some 30,000 people will be in direct fte jobs within the Dutch offshore wind industry, many having transitioned from the oil and gas sector, according to TKI Wind op Zee forecasts.

Naturally, most of that employment is and will be located in and around the country's ports, where over the last decade a complete value chain has been developed specifically to install, operate and maintain offshore

wind farms. In the provinces of North Holland and South Holland alone, there are five main offshore wind ports: Den Helder, Amsterdam and IJmuiden in North Holland and Rotterdam (including Maasvlakte2) and Scheveningen/Den Haag in South Holland. In addition, three additional ports are in close proximity in other coastal provinces. To the south is Vlissingen in Zeeland, where Ørsted is establishing its O&M base for the Borssele Wind Farm Site I and II project. Along the north Dutch coast the two ports are Harlingen in Friesland and Eemshaven in Groningen.



Maintenance at a turbine in the Prinses Amalia Wind Farm

These ports and their operators are some of the biggest, best and most experienced worldwide, with the space, skills and logistical facilities able to serve Europe's offshore wind industry efficiently. As Peter van de Meerakker, managing director of the Port of IJmuiden, points out, his port started providing services to the offshore wind sector back in 2006, including the first three Dutch offshore wind farms, OWEZ, Prinses Amalia and Luchterduinen. "So we have a proven track record and over 10 years experience," he stresses. Peter Geertse, Commercial Manager at Port Authority Zeeland Seaports, also stresses the proven experience in offshore wind Vlissingen has, having played an important role in the construction and installation of wind farms in the North Sea for more than seven years now. Over thirty offshore wind projects have so far been facilitated from Vlissingen, with projects such as Aberdeen, Beatrice, East Anglia One, Merkur and Norther all relying on facilities in Zeeland.

All of Dutch ports are in the process of expanding their existing capabilities even further specifically for manufacturing, construction, installation, logistics, O&M, and innovation for the offshore wind sector. In this way, they will prove critical in helping bring offshore wind costs down whilst boosting output and efficiency. ●

# REASONS TO INVEST

Pieter van Oord  
CEO Van Oord and  
chair of IRO

Offshore wind development is a "tremendous opportunity to drive economic activity and employment in the Netherlands", says Pieter van Oord, CEO Van Oord and chair of the Association of Dutch Suppliers in the Oil and Gas Industry (IRO).

With a company philosophy of "Marine ingenuity", it comes as no surprise to find Van Oord at the forefront of the global offshore wind sector. Having been an early adaptor in making offshore wind one of its main activities - investing in specialised vessels and acquisitions - the Rotterdam-based company is without doubt one of the most experienced firms in the industry.

It provides all-round solutions, often as turnkey projects including engineering,

procurement, and construction (EPC), in order to assume full responsibility for projects on behalf of its clients. As well as transport and installation projects, Van Oord's offshore wind focus is on Balance of Plant (BoP), which includes all supporting components and auxiliary systems other than the wind turbines. To date, the company has worked on the construction of 35 offshore wind farms totalling more than 6 GW combined. That's almost half the total installed capacity worldwide.

And yet, that's just the start, says Pieter van Oord, the company's CEO. "The growth of the offshore wind industry gives us a tremendous opportunity to drive economic activity and employment in the Netherlands," he says. In 2016, as well as being part of the price-busting Blauwind II c.v consortium which won the contract from the Dutch Government for construction and operation of the Borssele III and IV wind farms in December, Van Oord was part of the team which completed construction of the 600 MW Gemini project. >>>





# “Offshore wind has become a mainstream energy source.”

>>> This comprises 150 Siemens 4 MW turbines installed in the Dutch North Sea, 85 km off the Groningen coast. With a value of more than €1.3 billion, it's one of the biggest EPC contracts in Van Oord's history. As well as being the main contractor, the company is also a shareholder, with a 10% equity stake in the project. The other shareholders are Northland Power Inc. (60%), Siemens Project Ventures (20%), and HVC (10%).

## SOCIETAL BENEFITS

Van Oord says Gemini is a “splendid example” of the positive economic contribution offshore wind power can make to society as a whole. “The project allowed us to leverage a total added value for society of more than 877 million euros,” he explains. “It created almost 450 jobs directly and, according to estimates, another 2,750 jobs across the entire value chain, from production to construction and maintenance.” He is clear on what these results show: “The Netherlands has a lot to gain by investing in and accelerating the development of offshore wind facilities.”

Gemini is a showpiece for Van Oord's marine ingenuity. Two of its (then) latest additions to its fleet, Nexus and Aeolus, were deployed on this project to show their outstanding abilities. Working with partner vessel Pacific Osprey, offshore installation vessel Aeolus was used

to install all 150 monopile foundations for the project in a record time of 3.5 months: one month earlier than scheduled. The cable-laying vessel Nexus started on the project in the summer of 2015, its first job after being launched. Together with multi-purpose vessel Jan Steen and cable-laying vessel HAM 602, Van Oord deployed a strong complement of exceptional offshore equipment.

Meantime, the company also used its FaunaGuard System (part of the Van Oord Guards programme) for the project during pile-driving operations. “As an expert in marine construction, we felt the need to explore

new methods to minimise the effects of our construction work,” says Van Oord. Faunguard, developed jointly by Van Oord and SEAMARCO (sea Mammal Research Company), uses a device with specialised underwater acoustics to safely and temporarily drive marine mammals and fish temporarily away from active construction zones. “During pile-driving operations for the Gemini Offshore Wind Park we proactively used this device to prevent potential hearing loss to porpoises.”

He continues: “We create innovative solutions that are valuable to our clients, our partners and other stakeholders. Marine ingenuity means, among others, creative thinking. We add value by combining our knowledge and experience with new work methods, specialised equipment and vessels.”

Another demonstration of this can be found in the 660 MW Walney Extension offshore wind project, which has been realised in the Irish Sea by Ørsted (the new name for Dong Energy). “While the installation vessel Aeolus normally stands on its legs, this project saw it perform floating installa-

tion work for the first time,” notes Van Oord.

## A GROWTH MARKET

There can no longer be any question about offshore wind energy's place in the world, he continues. “When we won the contract for the Borssele III & IV wind farms, we and our consortium partners – Eneco, Diamond Generating Europe (100% Mitsubishi Corporation) and Shell – showed that offshore wind energy can compete with all other forms of energy generation,” he says. The consortium submitted

a bid price of just €54.5 per MWh to secure 680 MW contract. As well as making it one of the cheapest offshore wind farms in the world, the bid was more than 50% below the price cap set by the Government and means that if the electricity price continues to develop as expected, the Blauwind project will no longer require subsidies at all within 7.5 years.

“The bid was won based on such factors as operational expertise, technical innovation, and larger turbines,” Van Oord adds. Preparation work for the project, which is due to become fully operational by 2020, is in full swing by the project partners. In May 2017, Van Oord signed the BoP contract for it.

The growing level of competition across the industry, operational experience, technological innovation, the lower cost of financing and bigger, more efficient, turbines, are all serving to drive down prices and turn offshore wind into a mature market. “It's clear offshore wind has become a mainstream energy source,” Van Oord says. Across Europe as a whole, €22.6 billion was invested in offshore wind development in 2016 to take global installed offshore capacity to 13 GW, he says. “By 2020, this figure will rise to 25 GW,” he adds. “There is a lot of interest in speeding up the transition to a cleaner energy system and offshore wind energy is showing especially strong growth.”

That growth translates into economic opportunity for local regions that bolster their supply chains and ready themselves to meet the challenges ahead. “Offshore wind could give our home base of Rotterdam a fantastic boost, specifically across the region and in the port, for example” Van Oord says. Right now, the Port Authority and the City of Rotterdam are working hard with industry to attract an innovative, competitive, full-scale supply chain to Rotterdam (see page 14). “But we've seen the positive impact that offshore wind projects can have on a region at other locations too. Examples include the UK's East Anglia Wind Farm, which had a favourable

effect on the ports and employment in the Province of Zeeland, or construction of the Gemini offshore wind farm, which benefited the Eemshaven region.”

## INNOVATION AND INGENUITY

Continued success will require solving the inevitable challenges that lay ahead – some known and some yet to reveal themselves. Most, if not all, will likely require the kind of innovation and marine ingenuity that Van Oord has at the heart of its business philosophy. Challenges are effectively opportunities for companies to become part of the supply chain. Van Oord itself is a partner in the PortXL start-up accelerator programme, which gives businesses “the opportunity to make a flying start” into the wind sector, whilst bringing new knowledge and energy into it, according to the Van Oord. “We joined as an enthusiastic partner, convinced of the added value that is evident even at an early stage.” Recently, Van Oord announced its collaboration with as many as five very promising start-ups. “One of these young entrepreneurs is Parable, a start-up specialising in safety training using virtual reality. They have been assigned by Van Oord to work on a simulation environment for offshore wind lifting operations.”

Van Oord's advice for other companies hoping to gain a foothold in the offshore wind industry is to look for areas requiring continuous improvement and innovation, as Parable has. “Think about new challenges like the creation of power hubs further offshore, or a large-scale interconnection between EU countries,” he says. “Or the opportunity to design the perfect storage solution. Perhaps batteries? Or hydrogen?” Challenges like these require investment, innovative thinking and ingenuity from all sides of the industry. As Van Oord's success in the industry shows, the rewards for doing so are high. ●

[www.vanoord.com/offshore-wind](http://www.vanoord.com/offshore-wind)  
[www.iro.nl](http://www.iro.nl)



# OFFSHORE HUBS OF PORT PERFECTION

Offering exceptional logistics and strong supply chain networks across both the energy and maritime industries, Dutch seaports border all offshore wind farms in operation, under construction, or under development in the United Kingdom, Belgium, Denmark, Germany and, of course, the Netherlands. All eight ports have a track record of serving the European offshore wind sector and all are expanding to meet future demand. >>>



Port of Scheveningen

>>> Over 70% of existing and planned European offshore wind farms are located in the North Sea, with an estimated long-term growth in capacity to 90 GW or more. With at least 3,500 MW of that planned for the Dutch Borssele and Hollandse Kust Wind Farm Zones by 2023 and the 7 GW planned for the period 2024-2030, investor confidence in the national market is high. Policy stability has laid the foundations for long-term prosperity, both in terms of business and regional economic growth, says Jacoba Bolderheij, CEO of North Holland's Port of Den Helder. "For a port such as Den Helder, there is a profitable role to play in offshore wind development, not only in the sense of money, but also in terms of regional employment and growth."

As well as the projects planned domestically, the Netherlands is strategically located to capitalise on almost all the wind development planned by its European neighbours too, most notably the UK, Germany, and Belgium. In fact, Dutch ports already serve these markets extensively, largely because costs for offshore wind farm development and operations and maintenance (O&M) are "very much distance driven", explains Bolderheij. The closer a port is to projects, the better. Of course, this is only so if the ports have the right services, facilities, and logistical set up. Without question, Dutch ports do, which is why they are proving so critical in the drive to reduce offshore wind's levelised cost of electricity significantly.

Located for direct access to the North Sea and offering great logistics for offshore operations be it construction, O&M, or decommissioning they are all deep-water ports that also have open access to inland areas and feature low tidal ranges. They offer manufacturers the space to assemble large wind turbines efficiently. They also have first-rate infrastructure and facilities such as reinforced quays, heliports,

and heavy mobile cranes, along with excellent transport links generally.

Overall, when it comes to meeting the logistical demands of today's offshore wind sector, Dutch ports regularly outperform many other North Sea ports because of the significantly lower in- and outbound logistical costs: on average, one third of the costs of other

*Dutch ports are all deep-water ports that also have open access to inland areas.*

European sites. Dutch ports also have solid track records and extensive experience serving the offshore energy sector, including wind, with comprehensive supply chain networks that are good to go.

"We, at Den Helder, have been an operations and maintenance port for the offshore industry for decades," Bolderheij says, noting the port has served the offshore industry for some 40 years now. "Thanks to that expertise and experience, we can play a major role in the roll-out of the renewables industry in the North Sea. And with our proximity to wind farms, and the lack of obstacles on entry to the

North Sea, the industry can make substantial efficiency improvements and cost savings."

Located just north of the Hollandse Kust (noord) Wind Farm Zone, Den Helder is a niche O&M port with outstanding pit-stop characteristics offering quick turnarounds, a fully equipped airport (one of the largest heliports in North Western Europe) completely geared

to the offshore industry, and over 200 companies working in offshore energy. Wind testing facilities such as ECN, the Royal Netherlands Navy, Wageningen Research Institute, and WMC are also located here.

Nonetheless, recognising that strength comes from unity, the port has joined forces with its regional neighbours, the ports of IJmuiden and Amsterdam, to offer the wind industry an even better, dedicated full service package, under the brand of North Sea Energy Gateway.

## STRENGTH THROUGH UNITY

Just 40 km away from each other, the ports of Den Helder, IJmuiden and Amsterdam compliment each other well. "For example, where Amsterdam has more space, we have the experience in the O&M," says Bolderheij. Ron Davio, Chairman of the Amsterdam. >>>



Port of Amsterdam



>>> IJmuiden Offshore Ports association agrees. “We see a synergy with the skills of the Den Helder area and businesses within the North Sea Energy Gateway.”

Port of Amsterdam CEO, Koen Overtoom, explains more. “Our natural role as a port is to combine, connect, optimise and invest in land use, logistics and innovation, and come to concrete results for our customers. If we take the North Sea Canal area as a whole, we can provide for the whole lifecycle of offshore wind including the electrical infrastructure and maintenance and conversion of work vessels,” he says. There are more than 70 expert offshore companies in the Amsterdam IJmuiden Offshore Ports Association, adding to the pool of expertise found in Den Helder. “The presence of that much technical, maritime and logistical knowledge in the area can result in a significant cost reduction within the offshore wind supply chain.”

Amsterdam Port plays a key role in cable logistics, production and installation support. “We have a cable terminal that provides the logistics

and equipment for transhipment, both ship-to-shore and ship-to-ship, and strategic storage for a number of European projects and main wind farm owners. This is quite unique,” Overtoom says. The tideless port has the infrastructure to enable the use of roll-on roll-off solutions for wind turbine transportation. “It is a smart, simple and cost effective solution for transportation of turbines to marshaling sites,” he explains. “One can use conventional ships and the method provides speed and quality in handling on the terminal.” Siemens used this method at Amsterdam Port for the inbound logistics of their 48 wind turbines for the 144 MW Westermeerwind project, for example. “Siemens now has two roll-on roll-off ships that are based on that same concept,” continues Overtoom. “It provides flexibility in unloading and site planning, is less prone to damage during loading and unloading, and is a fast method compared to heavy lift.”

For Den Helder, Triple-A sheltered locations called Marsdiep Quay and Paleis Quay extension will be made available from 2020 for offshore logistic activities, with both areas having direct access to sea without



Port of IJmuiden



Port of Vlissingen

obstacle. Both quaysides will provide berth to large heavy transport and crane vessels, cable laying vessels, seismic vessels, lift boats and wind turbine installation vessels. Meantime, a new inland harbour, Kooyhaven, has been opened recently to provide space with a direct connection, via inland waterways, to the outer port.

“We are in the process, together with regional partners, of investing in terminal space directly at sea,” says Overtoom of Amsterdam’s plans. “We have greenfield exclusively allocated for offshore wind, for large production sites with direct quay side access, including multimodal accessibility.” IJmuiden is also well set up for offshore wind, having provided assembly and construction services for three existing Dutch offshore wind farms already (OWEZ, Prinses Amalia and Luchterduinen) and from where O&M for them still takes place. “O&M services for current wind farms are orchestrated and operated from Port of IJmuiden by MHI Vestas, Eneco and NUON/Vattenfall,” says Peter van de Meerakker, the port’s managing

director. These companies work with Windcat Workboats and C-Ventus, amongst others, which are based at the port. “We invested in three boat landings that are used by several offshore O&M companies. We did that in collaboration with MHI Vestas and Eneco. Emphasis is on easy access and safety and we included three cranes on the boat landings. More recently we invested in a jetty to accommodate more transfer vessels. Compared to the high quay side, the jetty ensures a safer transfer for personnel.”

In the port’s de IJmond dock, there is a heavy quayside available, dedicated to offshore projects. “Our port has also been used as a base for work vessels for larger spare parts for the repair and maintenance of turbines. We have many suppliers and fabrication companies in the vicinity that cater to installation support of offshore wind farms. For example, already three monopole grippers were made and installed by Breman Offshore here in IJmuiden.” >>>



>>> In Zeeland, offshore activities for the ports of Vlissingen and Terneuzen, expanded towards offshore wind at the beginning of this century, with the handling and storage of monopiles and transition pieces. Peter Geertse, Commercial Manager at Port Authority Zeeland Seaports, explains: “Today, the region of Zeeland has a strong position in the offshore wind sector. The ports have been playing an important role in the construction and installation of wind farms in the North Sea for more than seven years now.” During this time, offshore wind activities have included (de)mobilisation operations and the construction of blade racks, transition pieces, monopile grippers, suction buckets, monopiles, pinpiles, tripods, jackets and even complete topdecks.



Port of Den Helder.

Over 30 offshore wind projects have so far been facilitated from Vlissingen, and more will follow. Aberdeen, Beatrice, East Anglia One, Merkur and Norther are just a few European offshore wind farms that will use facilities in Zeeland. The Vlissingen port area includes heavy-lift crane capacity, dedicated heavy-lift quays, seabed conditions that are ideal for jack-up installation and a 24 m deep pocket for semi-submersible operations. “The various companies in and around the port are a one-stop-shop for offshore wind farms. From its role as a storage facility for monopiles and transition pieces, Vlissingen has transformed into a full service location for offshore wind construction, and the goal now is to attract new activities in addition to the existing ones,” says Geertse.

EXPANSION AND GROWTH

Indeed, all the Dutch ports are investing to meet future demand. For Vlissingen, the next step will be offshore wind operations and maintenance activities, as the port is an ideal hub for offshore wind farms in the south-eastern part of the North Sea, says Geertse. “Crew, parts and equipment can be transferred swiftly by vessel and helicopter from Zeeland.” In fact, Ørsted recently announced it will establish an O&M base in Vlissingen for the Borssele Wind Farm Site I and II project, for which it won the Government tender in 2016. Meantime, energy logistics provider Peterson has plans for a passenger terminal at Zeeland Airport, just 3.5 km from the port of Vlissingen and a mere 15 minute flight from the Borssele offshore wind projects.

Another key step for the small province recently was the establishment of the platform Energy Port Zeeland. This platform focuses on closer cooperation between government, educational institutions and businesses involved in training, employment, research, innovation, profiling, communication and business development. “The platform should lead to new activities in the offshore sector,” says Geertse. “It is important to create a favourable business climate for these activities by, for instance, providing sufficient education to enable the supply of well-trained staff.” The platform has already lead to the start of a new company called Wind Technicians, a joint venture aimed at creating a pool of experienced and trained people for building and maintaining offshore wind turbines. “Now it’s a matter of inviting companies that want to join in this initiative. More than 80 different companies are already participating,” Geertse says.

Of course, as Europe’s largest port, the Port of Rotterdam, in the province of South Holland, is already a main energy hub for Europe, but its ambition now is to become the “Offshore Wind Delta of the world”. It already has plenty of companies involved in offshore wind (most in the Rotterdam Offshore Wind Coalition), first-class port facilities with space, quay length and depths plus open access to the sea, training and education facilities for offshore developments, and space for manufacturing, assembly, construction, maintenance and storage.

Like others, Rotterdam’s Port Authority is responding to the increasing demand for offshore wind and “off-the-scale specifications” from the sector by expanding. “Recently, an offshore location was created at Maasvlakte II with unmatched capabilities,” says Loek Becker Hoff, Senior Account Manager for Cleantech at West Holland’s regional development agency, InnovationQuarter. Maasvlakte II will be home to the Offshore Center Rotterdam (OCR), a dedicated business location for offshore wind companies currently under development. The OCR is being built directly on the deep water of the North Sea, on 70 ha of new (reclaimed) land. The first companies are expected to be able to move into the OCR in mid-2019.

“The creation of wind farms at sea is a huge growth market. This requires a specialised port area for the installation and maintenance of the farms, which we are currently realising on Maasvlakte 2. This is consistent with our efforts to be the offshore hub of Europe and play a leading role in the energy transition,” says Allard Castelein, CEO of the Rotterdam Port Authority.

In addition Maasvlakte II, existing locations will be re-developed and optimised specifically for offshore wind. The aim is to establish the entire supply chain in Rotterdam. The Rotterdam Offshore Wind Coalition is key in this. It comprises a host of leading companies, each renowned for their expertise and state of the art technology and services. By working

“The creation of wind farms at sea is a huge growth market.”



Sif at the ze Maasvlakte, Port of Rotterdam.

together, “Not a single project is too big, too complex or too challenging to handle”, the Coalition says.

Meanwhile, Seaport Scheveningen (the port of The Hague) is another full service port focused on the niche of offshore wind maintenance. The Hague has always had a strong position in the energy sector, home to North Sea operators like Royal Dutch Shell, Dana petroleum, Petrogas, Total E&P and globally operating engineering companies such as CB&I, Jacobs, Tebodin and Schlumberger. Major offshore wind players like Siemens and Dong Energy have offices here too, with a benefit being the proximity to the national government and knowledge institutes such as >>>



>>> The Netherlands Organisation for Applied Scientific Research (TNO), Leiden University and Delft University of Technology.

Like all the other Dutch ports, Scheveningen has unrestricted, direct access to the North Sea, and is hoping to expand its activities and services for the wind sector. Significantly, the sailing distance to the Hollandse Kust (zuid) Wind farm Zone is just 15 nautical miles. “The current real estate developments along the quayside, including warehouses, office space and berthing facilities, offer great opportunities,” it says.

To the far north of the Netherlands both Harlingen in the province of Friesland and Eemshaven in Groningen are also expanding their offshore wind activities. The Port of Harlingen is focused on the niche of offshore maintenance. While it is a relatively small port, Harlingen’s combination of large amounts of quay space for storage and offshore wind energy specialist companies - and a relatively favourable price/performance ratio - provides a sound business case for maintenance activities. The port is also part of the NNOW regional network, guaranteeing sufficient, cost effective, labour resources. Key dedicated offshore companies based at Harlingen include windpowercentre, SeaZip Offshore Service - part of JR Shipping, Abis Shipping. Meantime, Harlingen also leads the way with the first bachelor degree programme in offshore wind offered by the NHL University of Applied Science.

Run by Groningen Seaports, Eemshaven has become a base, marshalling and service port for offshore wind farms, especially those in the German neighbouring part of the North Sea. Meeting all maritime requirements to serve the fast moving sector of offshore wind, in recent years Eemshaven has become the backdrop to large-scale activities concerning the assembly and shipping of wind turbines. Monopiles, transition pieces, converter

stations, blades, tripods, and more were launched from Eemshaven for the Alpha Ventus, Bard Offshore I and Global Tech I offshore wind farms, amongst thers. Meantime, Van Oord selected Eemshaven for the Dutch Gemini wind farm, OWF (Boskalis/Volker Wessels) used the port for the Veja Mate wind farm, and Senvion for Nordsee One. Global Tech I, BARD Offshore and Gemini are all also maintained from Eemshaven. Currently General Electric uses Eemshaven as base and service port for its Merkur Offshore wind farm with 66 turbines one of the longest wind turbine parks in Germany.

Specialized stevedoring companies located at the port include Orange Blue Terminals, Sealane, Wagenborg, and Wijnne Barends , whilst specialist offshore service companies include Amasus, Brave-heart Shipping, DHSS, EMS Maritime Offshore, Siem, TenneT GmbH.

With the completion of the Beatrixhaven basin, which is dedicated specifically for offshore wind, Eemshaven has further strengthened its position as hub for the sector, according to

Erik Bertholet, Business Manager Logistics and Offshore Wind, Groningen Seaports. A heavy load quay (30 tons per m²) of 220 m is available. It is possible to position jack-up vessels directly in front of the quay and approx. 93 hectare is available for companies to establish their businesses.

Eemshaven could also serve the industry well should a proposal for at least 10 GW in the Dutch Wadden Sea get the go ahead. A research report by BLIX Consultancy, commissioned the province of Groningen, suggests the conditions in the Wadden Sea Area off the coast of Groningen are excellent. The realisation of more wind power production in the area above the Wadden Islands is part of Groningen’s offer, jointly made by the municipality of Groningen and the province of Groningen on March 8th, in response to the national government’s Energy Agenda. ●

## Harlingen leads the way with the first bachelor degree programme in offshore wind.



Port of Eemshaven



# EXISTING PORT AND MANUFACTURING INFRASTRUCTURE BASE

PORT OF AMSTERDAM	PORT OF DEN HELDER	PORT OF EEMSHAVEN / GRONINGEN SEAPORTS	PORT OF HARLINGEN	PORT OF IJMUIDEN	PORT OF ROTTERDAM	PORT OF SCHEVENINGEN	PORT OF VLISSINGEN / ZEELAND SEAPORTS
<p><b>Port basin characteristics</b></p> <ul style="list-style-type: none"><li>• Draught: 13.75 m SW / 14.05 m FW</li><li>• Access channel width: 45 m</li><li>• Tidal Range: max. dimensions governed by lock: beam 45 m x LOA 350 m. From 2019 beam 65 m x LOA 460 m</li></ul>	<p><b>Port basin characteristics</b></p> <ul style="list-style-type: none"><li>• Draught: Port entrance till quay 42: 9 m (till Moorman Bridge) - Quay 43 till 55: 7 m (after Moorman Bridge)</li><li>• Access channel width: 230 m</li><li>• Tidal Range: 1.80 m</li></ul>	<p><b>Port basin characteristics</b></p> <ul style="list-style-type: none"><li>• Draught: 14m</li><li>• Access channel width: 200 m</li><li>• Tidal Range: 2.5 m</li></ul>	<p><b>Port basin characteristics</b></p> <ul style="list-style-type: none"><li>• Draught: 7.5 m</li><li>• Access channel width: 40 m</li><li>• Tidal Range: 1.8 m</li></ul>	<p><b>Port basin characteristics</b></p> <ul style="list-style-type: none"><li>• Draught: 11 m LAT</li><li>• Access channel width: 120 m</li><li>• Tidal Range: 0.8 m</li></ul>	<p><b>Port basin characteristics</b></p> <ul style="list-style-type: none"><li>• Draught: 23.6 m</li><li>• Access channel width: 600 m</li><li>• Tidal Range: 1.2 m</li></ul>	<p><b>Port basin characteristics</b></p> <ul style="list-style-type: none"><li>• Draught: 7.5 m</li><li>• Access channel width: 100 m</li><li>• Tidal Range: 2.0 m</li></ul>	<p><b>Port basin characteristics</b></p> <ul style="list-style-type: none"><li>• Draught: 16.5 m</li><li>• Access channel width: 350 m</li><li>• Tidal Range: 4.5 m</li></ul>
<p><b>Quayside facilities</b></p> <ul style="list-style-type: none"><li>• Heavy mobile crane: available up to 1,200 ton</li><li>• Total length of quay for offshore: 1,700 m</li><li>• Loading capacity quay: 20 ton/m²</li><li>• Jack-up possibilities (limited); number of mooring berths for jack-up vessels: 3</li><li>• Multiple berths on request</li></ul>	<p><b>Quayside facilities</b></p> <ul style="list-style-type: none"><li>• Heavy mobile crane: 4 ton/m²; any loading capacity of mobile cranes is possible with adequate measures relating to the overall loading capacity of 4 ton/m² and even more on present heavy lifting platforms on the quay</li><li>• Total length of quay for offshore: 3,360 m, total length of quay: 7,630 m</li><li>• Jack-up possibilities (limited); number of mooring berths for jack-up vessels: (negotiable but no mooring berths as yet)</li><li>• Total length of jetty for service vessels: 695 m</li><li>• Test locations: not yet but negotiable</li></ul>	<p><b>Quayside facilities</b></p> <ul style="list-style-type: none"><li>• Heavy mobile crane: available</li><li>• Total length of quay for offshore: 3,360 m, total length of quay: 5,085 m (private and public quays)</li><li>• Loading capacity quay: 30 ton/m²</li><li>• Jack-up possibilities (limited); number of mooring berths for jack-up vessels: 10</li><li>• Total length of jetty for service vessels: 700 m</li><li>• Test locations: test turbines of Senvion 2-B Energy and Lagerwey at present 6 test locations for future offshore turbines available</li></ul>	<p><b>Quayside facilities</b></p> <ul style="list-style-type: none"><li>• Heavy mobile crane: available</li><li>• Total length of quay for offshore: 1,450 m</li><li>• Loading capacity quay: 4 ton/m²</li><li>• Jack-up possibilities (limited); number of mooring berths for jack-up vessels: 1</li><li>• Total length of jetty for service vessels: Negotiable</li><li>• Test locations: Available</li></ul>	<p><b>Quayside facilities</b></p> <ul style="list-style-type: none"><li>• Heavy mobile crane: available (third party)</li><li>• Total length of quay for offshore: 1.200 m</li><li>• Loading capacity quay: 16.5 - 23.5 ton/m², depending on position on the quay. Two concrete reinforced platforms are available at the waterfront, loading capacity: 700 ton/m²</li><li>• Jack-up possibilities (limited); number of mooring berths for jack-up vessels: 3</li><li>• Total length of jetty for service vessels: floating jetty system on conventional quay side and 3 boat landings for offshore wind service vessels</li><li>• Test locations: ECN test farm &lt; 35 km</li></ul>	<p><b>Quayside facilities</b></p> <ul style="list-style-type: none"><li>• Heavy mobile crane: available (up to 1,800 tons)</li><li>• Total length of quay for offshore: 6,500 m</li><li>• Loading capacity quay: min. 10 ton/m²</li><li>• Jack-up possibilities (limited); number of mooring berths for jack-up vessels: 8</li><li>• Total length of jetty for service vessels: on request at several terminals</li><li>• Test locations: available</li><li>• Graving docks: 6 (max 405 x 90 x 11.60 m)</li><li>• Floating docks: 6 (max 217 x 32 x 9.5 m)</li></ul>	<p><b>Quayside facilities</b></p> <ul style="list-style-type: none"><li>• Heavy mobile crane: available (third party)</li><li>• Total length of quay for offshore: 1,000 m</li><li>• Loading capacity quay: 20 ton/m²</li><li>• Total length of jetty for service vessels: on request</li><li>• Test locations: available</li></ul>	<p><b>Quayside facilities</b></p> <ul style="list-style-type: none"><li>• Heavy mobile crane: available</li><li>• Total length of quay for offshore: 4,740 m</li><li>• Loading capacity quay: Up to 15 ton/m²</li><li>• Jack-up possibilities (limited); number of mooring berths for jack-up vessels: &gt; 10</li><li>• Total length of jetty for service vessels: approx. 500 m</li><li>• Test locations: Not yet (negotiable)</li></ul>
<p><b>Port logistics</b></p> <ul style="list-style-type: none"><li>• Heliport: available onsite (Amsterdam heliport)</li><li>• Airport: 30 km to Amsterdam Airport Schiphol</li></ul>	<p><b>Port logistics</b></p> <ul style="list-style-type: none"><li>• Heliport: available</li><li>• Airport: 0-4 km to Den Helder Airport 80 km to Amsterdam Airport Schiphol</li></ul>	<p><b>Port logistics</b></p> <ul style="list-style-type: none"><li>• Heliport: ready in 2018</li><li>• Airport: 30 km to Groningen Airport 160 km to Bremen Airport 200 km to Amsterdam Airport Schiphol</li></ul>	<p><b>Port logistics</b></p> <ul style="list-style-type: none"><li>• Heliport: available (&lt; 10 km)</li><li>• Airport: 60 km to Den Helder Airport 100 km to Eelde Airport 100 km to Drachten Airport</li></ul>	<p><b>Port logistics</b></p> <ul style="list-style-type: none"><li>• Heliport: available at Amsterdam heliport</li><li>• Airport: 25 km to Amsterdam Airport Schiphol</li></ul>	<p><b>Port logistics</b></p> <ul style="list-style-type: none"><li>• Heliport: at the airport</li><li>• Airport: 10 km to Rotterdam-The Hague Airport</li></ul>	<p><b>Port logistics</b></p> <ul style="list-style-type: none"><li>• Heliport: available (&lt; 10 km)</li><li>• Airport: 25 km to Rotterdam-The Hague Airport 45 km to Amsterdam Airport Schiphol</li></ul>	<p><b>Port logistics</b></p> <ul style="list-style-type: none"><li>• Heliport: available at Zeeland Airport (3.5 km)</li><li>• Airport: 85 km to Antwerp Airport 130 km to Rotterdam-The Hague Airport 120 km to Brussels Airport</li></ul>
<a href="http://portofamsterdam.nl">portofamsterdam.nl</a>	<a href="http://northseaenergygateway.com">northseaenergygateway.com</a>	<a href="http://offshoreport.eu">offshoreport.eu</a>	<a href="http://harlingenseaport.nl">harlingenseaport.nl</a>	<a href="http://zeehaven.nl">zeehaven.nl</a>	<a href="http://portofrotterdam.nl/offshore">portofrotterdam.nl/offshore</a>	<a href="http://denhaag.nl/en/general/port-authority-and-traffic-control-centre.htm">denhaag.nl/en/general/port-authority-and-traffic-control-centre.htm</a>	<a href="http://zeelandseaports.com">zeelandseaports.com</a>



# FINDING NEW WINDS

An important part of the Energy Agreement of 2013 is to increase offshore wind energy generation capacity to 4,500 MW in 2023 whilst reducing costs by at least 40%. Longer term, the Netherlands expects additional offshore wind farms to be built cost-efficiently to meet the country's goal for a carbon free energy supply by 2050. These goals open up opportunities for companies in the supply chain to introduce new methods of working, new materials, technologies, and more. It will also require strengthening the industry's skills base and workforce.

"Lowering the cost of energy requires an integrated approach," says Michel Kurstjens, Chief Commercial Officer of Dutch firm Sif, which is a leading supplier of foundations for offshore wind turbines. "By pursuing scale efficiencies, implementing leading practices in development and operations, the supply chain has to increase its performance."

Sif, he says, is open to sharing its expertise and working with others in constructive partnerships. An example is its support of GBM Works, which is working on a method of installing turbines at sea which may be silent and accelerate the installation process by 25%. "More and more attention is given to practices and innovative approaches with the goal to enhancing workforce efficiency. For Sif this means using our 70 years of experience in steel processing and technical and commercial knowledge for engineering, building and installing whilst wind farms keeping the overall costs as low as possible. Together we are responsible for affordable sustainable energy," says Kurstjens.

Dutch experience and expertise in offshore wind spans engineering, infrastructure, fabrication, installation and operations and maintenance (O&M), and so the industry (domestic and foreign) needs to capitalise on this to make gains, he says. Meantime, opportunities for innovation are in areas such as standardisation of design, foundation types for deeper seas (e.g. floating foundations), lightweight materials, quicker installation methods, and environmentally-friendly piling methods (e.g. blue hammer). "Cooperation is essential in order to improve the process of bringing cost down," Kurstjens stresses.

Naturally, the company is taking measures in-house to meet growing demand and cost imperatives. "To value and invest in committed and qualified employees is the first important element," Kurstjens says. "Secondly, continuous improvement in our production capacity, both

in Roermond and in our new location at Maasvlakte 2, Rotterdam." Thanks to the expansion of its production lines, Sif can now produce four monopiles a week to ensure it always delivers on time. "In addition, the facility at Maasvlakte 2 has a unique deep sea quay side that enables installation vessels to load faster so the limited time of installation is used effectively."

## HUMAN CAPITAL CHALLENGE

Expanding facilities is one thing, though. Finding and keeping the people with the right skills is another. "There is great international demand for qualified personnel within the industry," explains Kurstjens. "Finding and training new staff is a huge challenge." At the same time, existing technical knowledge and skills must be secured, he says. Sif offers internal training into the field of rolling, welding and other specific work within its production lines. "By investing in people, our team is motivated and loyal," he says. >>>





>>> Jocaba Bolderheif, CEO of the Port of Den Helder, says the skills gap is not just in terms of construction and big infrastructure. It is a concern for O&M providers too. “There are not yet enough experienced wind farm maintenance people available to meet long term demand,” she says. “The availability of a work force educated in this particular field is a problem for the whole industry.”

Paul Boumans, Commercial Director of Falck Safety Services agrees. His message to the industry? “Ensure that human capital is not the limiting factor that prevents you from seizing the opportunities offered by wind energy. There should be an active policy to stimulate intake, education, ‘Lifelong Learning’ and lasting innovation in close cooperation between education and business.”

Boumans notes that whilst 4,000 people currently work in the Dutch wind sector, employment is expected to increase from approximately 12,000 jobs in 2023 to some 30,000 jobs in 2030. “The main challenge here will be to find suitable personnel for all levels,” he says. As many point out, a general shortage of technicians has been recognised. “This means fierce competition among employers in adjacent sectors looking for suitable personnel.” Boumans warns: “Without a targeted approach, opportunities for the Dutch economy will be lost.”

National initiatives, such as CAREER (a joint initiative by TKI Wind op zee and NWEA) and the ‘Nationaal Renewable Banenplan’ (National Renewable Jobs Plan), are critical. The latter is an initial co-operation between Redwave and Falck Safety Services, which has been joined by various parties. “There is a strong focus on re-training in the entire energy sector so as to contribute to the energy transition,” explains Boumans. “Employees from the traditional oil and gas industry are used for dismantling offshore platforms, but they may equally be deployed for dismantling (offshore) wind turbines, since the same competencies come into play here.”

Equally, local initiatives are important. Both Sif and Falck Safety Services are members of the Rotterdam Offshore Wind Coalition, for example. Here, the city and port of Rotterdam, the corporate sector and trainers cooperate in order to achieve successes in the offshore wind industry together and promote Rotterdam as offshore wind city. Den Helder has something similar. “Together with the schools in the region, the universities, colleges, etc, we are working very hard to change things so that in our region we can offer educated manpower,” says Bolderheij. “There is a programme called Tech@Connect which brings together training and education. With a supply base and the educational institutes, we bring that together to make sure that when the manpower question is there, we have a programme available which can tackle this problem in the long run.”

In Amsterdam, the Port Authority and partners like Techport (a public-private partnership working to attract and keep (potential) employees in the tech jobs) support innovation through initiatives such as the Mainport Innovation Fund. Meantime, a new vocational education programme is underway, says Koen Overtoom, CEO Port of Amsterdam. “We support the new vocational education programme, Wind Technician, that has been initiated by Amsterdam IJmuiden Offshore Ports and has been picked up by education institute Nova College and TechPort with input from the sector on their requirements.” He adds: “We would support and applaud if the curriculum of the Wind Technician is shared and used in other areas.”



SIF, people at work

Another initiative worth mentioning is GROW. Its founding fathers are Delft Offshore Turbine, ECN, Eneco, Lagerwey, LM Wind Power, Royal IHC, RWE, Shell, Siemens, Sif Group, TenneT, TNO, TU Delft, Van Oord, and Volker Stevin International. The GROW consortium works on realising two objectives. The first is to expand the role of offshore wind in the energy system overall by reducing costs and increasing value. The second objective is to strengthen the Dutch offshore wind sector. A direct effect of its research, development and demonstration projects will be the development of new products and processes. The hope is that these will enable the sector to deliver more competitive solutions for projects in the Netherlands, North-western Europe and global export markets. ●



TenneT, the Dutch electricity transmission system operator (TSO), has been charged with connecting 3500 MW of offshore wind capacity to the national onshore grid network by 2023. Of the total 3500 MW planned, 1400 MW is being built in the Borssele Wind Farm Zone, with 1400 MW in Hollandse Kust (zuid) and 700 MW in Hollandse Kust (noord). It's a big responsibility. As the official offshore grid operator for the Netherlands, not only is the TSO expected to take responsibility for making sure all the required technology and infrastructure is in place within the required timescales, it is expected to do so under a mandate to generate cost savings for the public purse.

# THE RIGHT CONNECTIONS

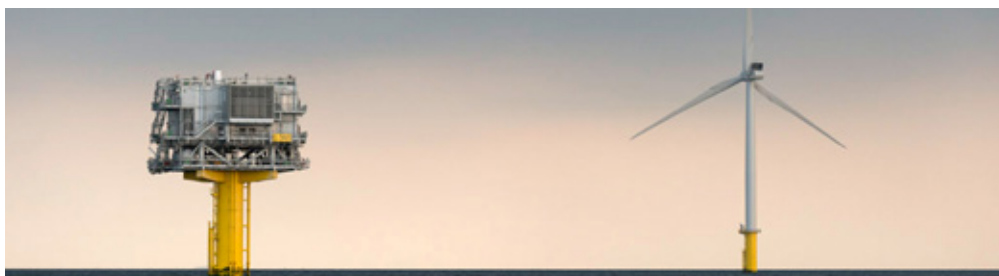
*TenneT brings the power of offshore wind to the people*

In line with the Government's timetable for the rollout of offshore wind, TenneT will connect the five planned 700 MW offshore wind farms using standardised platforms for each one. This solution creates economies of scale and means the Netherlands can integrate renewables into the energy system at minimum societal cost, says TenneT CEO Mel Kroon. "Because TenneT, and not individual parties with commercial interests, is responsible for all offshore network connections, we have been able to carry out standardisation leading to the desired cost savings for Dutch society," he says.

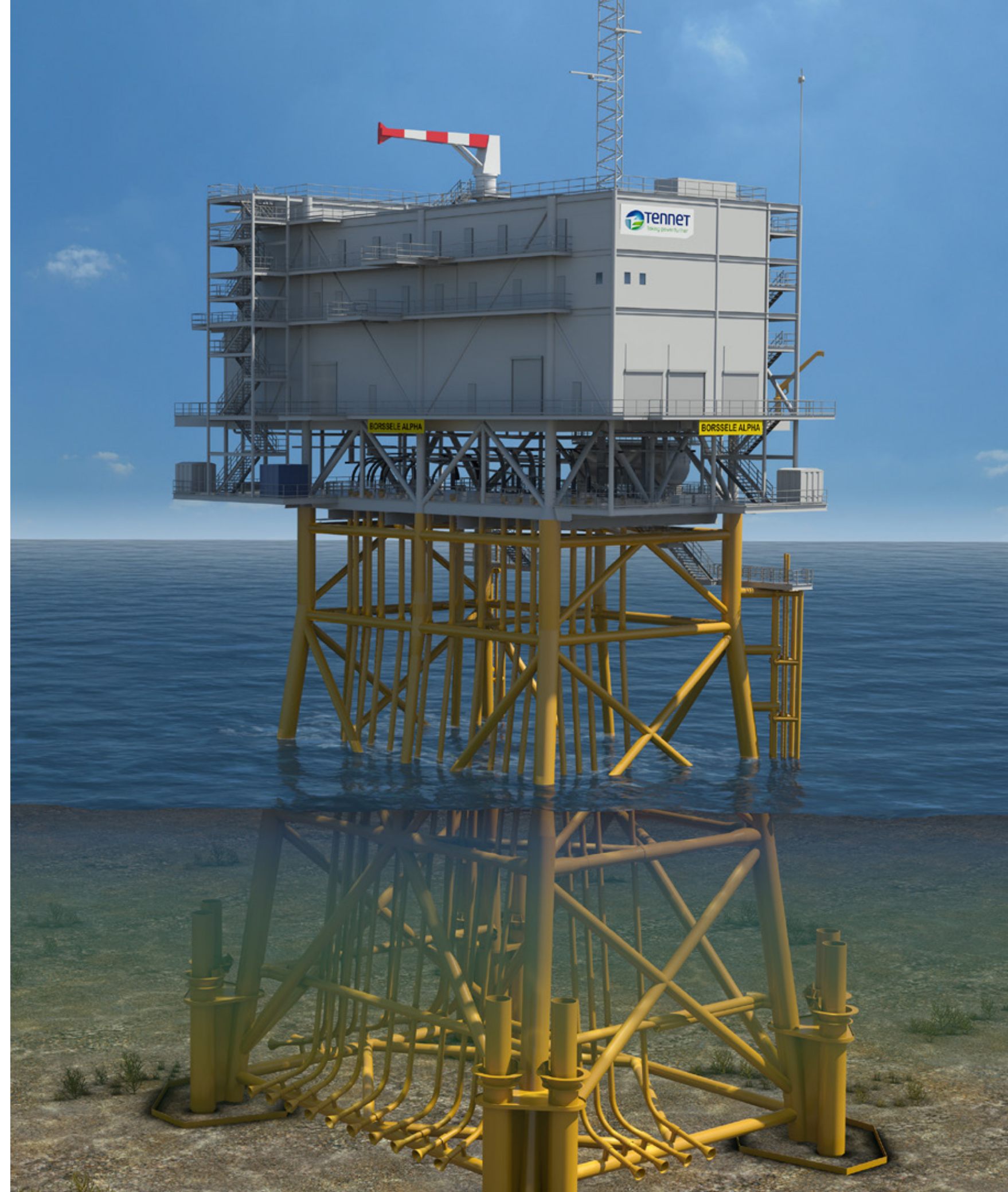
The TenneT platforms will be connected to the national Extra High Voltage grid with two 220 kV export cables per platform. Each cable has a capacity for 350 MW, which means these new substation platforms will have a capacity

of 700 MW, enabling them to cope with the output from each wind farm individually. However, in a world first, the cables' so-called "dynamic capacity" will be utilised. This means that a single cable can be temporarily subjected to a load of up to 380 MW. Meanwhile, 66 kV inter-array cables will be used to connect wind turbines to the platforms.

TenneT will bring the offshore wind energy onshore via the 220 kV cables to a high voltage substation, with electricity then fed into the national 380 kV high voltage grid (transformers will be used to convert to the voltage level from 220 kV to 380 kV). From there, the wind energy will be distributed to households across the country. >>>



TenneT's platform in a wind farm





SYSTEMS GO FOR FIRST PLATFORMS

>>> The two 700 MW platforms for the Borsselle projects are scheduled to be operational in 2019 and 2020 respectively. Work on these and the necessary transmission infrastructure (both offshore and onshore) is now in “full-speed construction”, says Marco Kuijpers, Senior Manager Offshore Netherlands at TenneT.

The TSO has awarded the construction contract for Borssele Alpha and Beta sub-station platforms to HSM Offshore, based in the Dutch city of Schiedam, South Holland. The firm will take on the engineering, construction, transport, installation, connection and testing the substations. The top deck of each platform will come in at a weight of 3,350 tonnes and be 25 m high (including cable deck), 45m long and 20 m wide. The jacket foundation structure for the platform will weigh 2900 tonnes and be 50 m high (at a water depth of 30 m), 28 m long and 20 m wide.

For design, engineering and procurement support, HSM Offshore has subcontracted Dutch engineering company, Iv Oil & Gas. The company is based in the South Holland town of Papendrecht, and will work with HSM on the integration of the TenneT High Voltage components and the balance of plant materials. The High Voltage control integration part of the work has been further sub-contracted to specialist energy infrastructure company Joulz, another Dutch company based in Rotterdam.

All of the Borssele export cables will be routed via the Western Scheldt river and will come ashore near the existing high-voltage substation at Borssele. The cables will be installed at a depth of 1 metre in the North Sea, and at a depth of 3 metres along the entire route in the Western Scheldt estuary, up to the point where they come onshore at Borssele. In most locations the cables will be installed at even greater depths to cope with possible seabed movements. The contract for the supply and installation of the land and subsea cables for Borssele Alpha and Beta was awarded to a consortium made up of NKT cables GmbH & Co. KG and VBMS B.V. (Boskalis). Other parties involved in the land substation works are Van Oord (ground works), Ballast Nedam (civil works), Movares (engineering). Meantime, Fugro is conducting the UXO survey.

For the Hollandse Kust (zuid) projects, the tender procedure for the sub-sea cables and platforms is underway, says Kuijpers, whilst the tenders

relating to the onshore substation will open in the near future. The grid connection infrastructure for the Hollandse Kust (zuid) projects will be operational in 2021 and 2022 respectively and will connect to the Maas-vlakte substation. For the Hollandse Kust (noord) project, the platform is expected to be operational in 2023. Its export cables will come onshore and continue going underground to a high-voltage substation expected to be either Beverwijk or Vijfhuizen. The route is still to be determined, says Kuijpers.

Developing the offshore grid involved a year-long intensive stakeholder consultation process which began at the end of 2014. The consultation focused on technical and planning issues concerning the design, construction and realisation of the offshore grid infrastructure. “That consultation session helped us tremendously,” says Kuijpers. “In theory, there could have been 10 different developers connecting to the five grid connection systems and each could have had their own requests and demands. So we said from the beginning that we wanted to have this standardised approach. That means every platform is the same and that,

for example, means that when it comes to something like maintenance, people always know where to go because we have the same equipment on every platform. Also, we can buy equipment such as transformers under a framework agreement, deliver to HSM and they mount it into the platform and connect it.” He points

out: “We had quite a big challenge to be as cost-efficient as possible and to save as much public money as we could.”

So the overall goal of the consultation was to optimise, together with project developers, the offshore grid configuration and realisation against minimum societal cost. Thanks to the feedback from developers, elements such as heliports were found to be unnecessary. “We were able to design a very lean platform based on the feedback,” Kuijpers says, adding that doing so helps reduce the levelised cost of electricity for offshore wind also. Meanwhile, thanks to consultation process and all the information made available by TenneT, developers were also able to present a strong business case to their own stakeholders and financiers, he adds.

“We did the same for the legal agreements,” he says, referring to the consultation process for the model agreements known as the Realisation Agreement and the Connection and Transmission Agreement. The model for these agreements will basically be the same for all winners of the

tenders. “We did the same for these because we do not want everybody to be able to negotiate their own conditions. We have to have a level playing field.”

LOOKING FURTHER INTO THE FUTURE

TenneT is not, of course, just working on solutions for the immediate future to 2023. Far from it. The Borssele and Hollandse Kust projects are only phase one of its current work programme, says Kuijpers. “We are also looking to the medium term, which for us is from 2024-2030, and this is phase two of our work programme.” This corresponds to the Netherlands’ Coalition Agreement, under which TenneT expects to support the connection of 7 GW of new offshore wind capacity, which would almost double the country’s total planned offshore wind capacity.

“We at TenneT have to start planning for that 7 GW now,” says Kuijpers. The 7 GW programme may be extended, he adds, because there is a lot of expectation for carbon capture and storage (CCS) use under the Government’s current ambitions. If CCS turns out to be unfeasible then offshore wind could possibly be expected to fill the gap. During phase 2 most probably also DC technology is also needed, due to the larger scale and further distance to shore.

Phase three’s focus is on the longer-term. A total of 180 GW in new EU offshore capacity is expected in the whole North Sea region

WIND FARM ZONE	OPERATIONAL IN	CAPACITY (MW)	CONNECTION LENGTH (KM)
Borssele Alpha	2019	700	Approx. 61
Borssele Beta	2020	700	Approx. 68
Hollandse Kust Zuid Alpha	2021	700	Approx. 48
Hollandse Kust Zuid Beta	2022	700	Approx. 40
Hollanse Kust Noord	2023	700	Under development

between 2030-2050. This huge number is a translation of the climate goals agreed upon in the Paris Agreement (COP21). At least 100 GW of that could be to be located in the North Sea. To meet the long-term EU goals, TenneT has a vision for a large European electricity system, using a ‘Hub & Spoke’ concept for large-scale North Sea offshore wind developments. This vision seeks to make CO<sub>2</sub> reduction targets feasible and affordable.

Central to the idea of this North Sea Wind Power Hub is building one or more ‘power link islands’ in the middle of the North Sea:

- to which numerous wind farms can be connected;
- from where the generated wind electricity will be distributed and transmitted over direct current cables to the North Sea countries, i.e. the Netherlands, the United Kingdom, Belgium, Norway, Germany and Denmark;
- in a location with relatively high and stable wind speed.

Kuijpers says this North Sea wind power hub will be further north than current projects and further offshore. Significantly, also Power to Gas technologies will be investigated, “so we have to look at that and other solutions to drill down on the costs.”

TenneT’s thinking is based on an island with a modular structure, with each module covering approximately 6 km<sup>2</sup>. This is big enough to provide space for connecting roughly 30 GW



Marco Kuipers, senior manager Offshore Nederland

of offshore wind capacity. The island will be expandable by adding one or two modules of 6 km<sup>2</sup> each. The possibility of building more than one power link island is also being investigated. Overall, the TSO expects the North Sea Wind Power Hub to be able to support the connection for 100 GW of offshore wind farms expected.

Significantly, with the same DC cables serving as interconnections between the energy markets of the North Sea countries, they will also be international electricity highways for international power trade: the Wind-connector. By 2050 then, the Hub could be supplying 70 to 100 million Europeans with renewable energy.

TenneT is working on the North Sea Wind Power Hub in partnership with its German counterpart (TenneT Germany), Energinet (Denmark’s national TSO) and Gasunie (Dutch natural gas infrastructure and transportation company). ●

For further information on TenneT and the Dutch offshore grid go to: [www.tennet.eu/netopzee](http://www.tennet.eu/netopzee) Also check [www.northseawindpowerhub.eu](http://www.northseawindpowerhub.eu)





# LEADING ON INNOVATION

Achieving the Netherlands' 2050 zero-carbon energy goal will not be easy, requiring innovation across all sectors, including offshore wind. The Government is taking proactive steps to help. Offshore wind is a young and innovative sector. Innovation is needed to reduce costs and to improve performance. In the Netherlands innovations is driven by government, industry and knowledge institutes and their intense cooperation.

Driving down the cost of offshore wind energy is a key goal of the Dutch nation's Energy Agenda. The first two tenders for projects in the current offshore wind programme - both in the Borssele Wind Farm Zone (BWFZ) - each resulted in record low prices for offshore wind development at the time. The Government has played its part in the cost reduction success, taking a leading proactive role in a bid to minimise risk and cost for developers. It has done this, for example, by firmly committing to a five-year offshore wind roll-out plan as well as looking towards the longer term 2050 horizon. This gives industry the policy stability investors require.

Moreover, it has assumed responsibility and costs for the site studies developers need to optimise their project designs. The state transmission system operator, TenneT, is also assuming responsibility and costs for building and operating the grid network and transmission infrastructure required (see page 22). Combined, this proactive stance has contributed significantly in driving overall project costs down substantially.

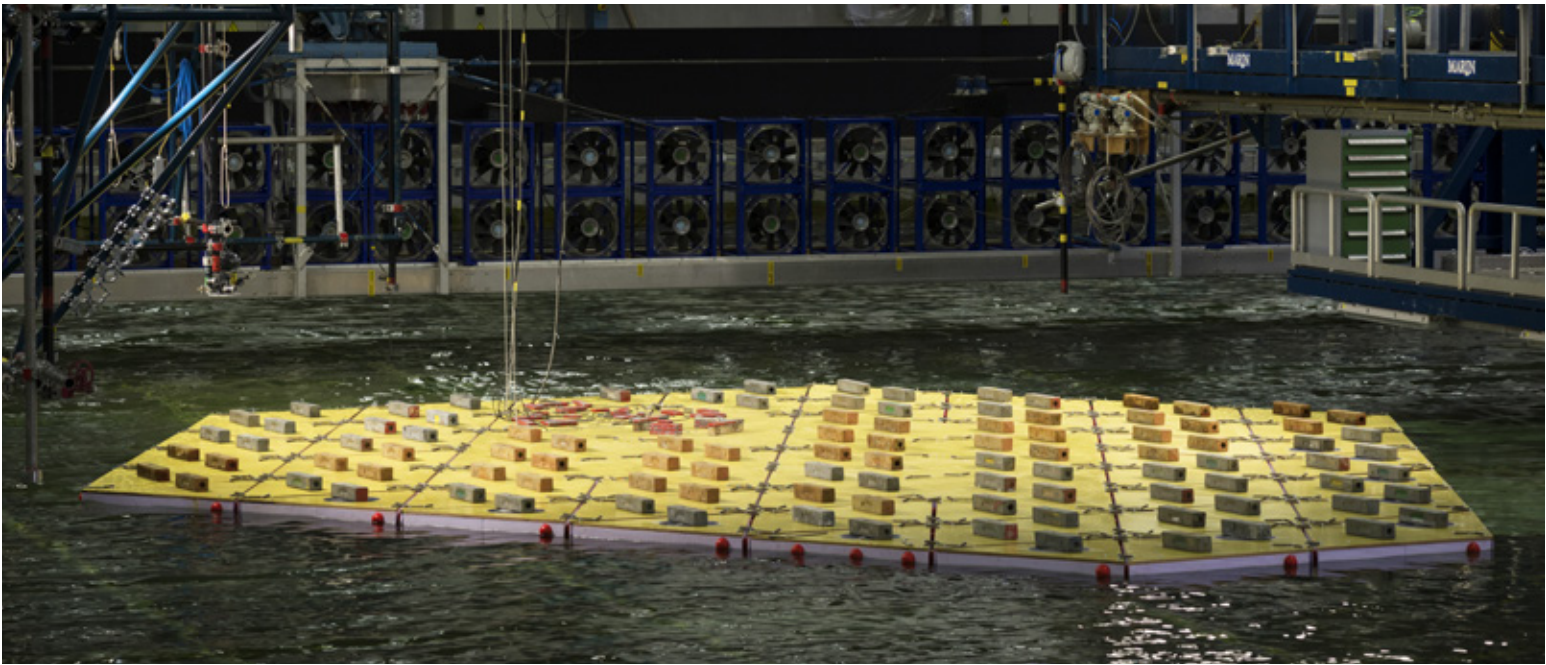
The Government and industry agree that further cost reductions are possible. There is much optimism that zero-subsidy bids will be realised for the upcoming 700 MW tender for Hollandse Kust (Zuid) Wind Farm

Sites I and II. Nonetheless, zero-subsidy development is not necessarily the same as long-term cost-effective sustainable power production and supply. To achieve this, innovations are needed in almost every sphere of the sector, including wind turbine technology, foundation design, installation procedures, operations and maintenance, and decommissioning. >>>



WMC specialises in stress tests.





Innovation at Marin by testing a floating island.

>>> The industry and R&D institutions are already working on such innovations. Indeed, some of the world's leading knowledge institutions and universities with a focus on energy R&D are based in the Netherlands. These include:

- The Dutch National Aerospace Laboratory (NLR)
- Energy Research Centre of the Netherlands (ECN)
- Maritime Research Institute Netherlands (MARIN)
- Deltares
- Delft University of Technology (TU Delft/Duwind)
- Knowledge Center WMC
- NIOZ, the Royal Netherlands Institute for Sea Research
- IMARES
- Netherlands Organisation for Applied Scientific Research (TNO)
- DOB-Academy

The Top consortium for Knowledge and Innovation Offshore Wind (TKI Wind op Zee) works closely with these R&D knowledge institutes, along with the industry (over 150 companies participating) and the Government to drive forward innovation work. Part of the Energy Top Sector policy and working as a public

private partnership, TKI Wind Op Zee was in fact specifically initiated to facilitate innovations that will help achieve the Netherlands' 40% cost reduction target for offshore wind. Beyond that, its mandate is to help ensure offshore wind power makes a substantial, affordable, reliable and socially responsible contribution to energy supply.

Transitioning innovations fully out of the laboratory environment into commercial reality is, however, a difficult and sometimes prohibitively costly exercise for suppliers and their R&D partners. The Dutch Government wants to help overcome this and help offshore wind reach a stage of true competitiveness with fossil-fueled power stations in terms of levelised cost of electricity. It is therefore inviting the industry to participate in a 20 MW innovation site tender at Borssele Wind Farm Site V (BWFS V). In doing this, it is working to provide the Dutch nation with a secure, sustainable and cost-effective source of clean electricity in line with the country's national aim to have a totally carbon-free energy supply by 2050.

With the innovation tender for BWFS V, the Government is again being proactive, providing

all the necessary site studies via the Netherlands Enterprise Agency (RVO.nl) and grid connection infrastructure via TenneT. This time, however, its goal is to help bring research and development (R&D) innovations currently at Technology Readiness Level 7 (ready for a system prototype demonstration in an operational environment) up to Technology Readiness Level 9 (proven in an operational environment) and thus fully to commercial reality.

The Government recognises that while taking technology through this stage is tough for any innovation, the costs and practicality of doing so for new large-scale offshore technology can be hugely prohibitive. In allocating space for a 20 MW innovation site within the borders of BWFS III, the major obstacles traditionally faced are immediately eliminated.

It means the innovations will be installed and operated in a true real-conditions environment, enabling them to fulfil the requirements to reach TRL 9 stage. Secondly, the costs of doing so are dramatically reduced: the required grid-connection and electricity transmission infrastructure is already planned for BWFS III and can easily incorporate the needs of the demonstration projects in BWFS V.

This therefore negates the need for completely independent infrastructure (cables, transformer platforms etc.) that would otherwise be required and avoids the huge cost that would arise from having to implement such infrastructure for just one or two turbines at sea.

By capitalising on economies of scale, innovative technologies can be transitioned from TRL 7 through to TRL 9 in the most cost-effective way as well as in the most accurate way possible. So for BWFS V, applications are invited from consortia to install, operate and maintain, one or two innovative turbines. Each turbine must have a minimum nominal capacity of 6 MW. There is no maximum capacity per turbine, but the maximum for the site as a whole is 20 MW, thus offering maximum flexibility. Eligible innovations are not just limited to the turbine itself but can relate to any aspect of an offshore wind system, incorporating foundation design, installation methods, operations and maintenance, or decommissioning.

The 20 MW planned is not just for show. The one or two turbines planned will be expected to contribute their full share of electricity supply to the Dutch national grid network in the same way the larger projects in the designated wind farm zones will. In doing so, they play their part in helping achieve the goals laid out in the offshore wind roadmap and, in the process, will become commercially viable proven technology that financing markets will be confident to support.

Importantly, cost will not be the overriding factor when it comes to judging bids. Rather, the one that contributes most to the Government's

overall offshore wind innovation objectives, including cost reduction, will win. Hence, a number of qualitative ranking criteria have been formulated in the new Ministerial Order for Innovative Offshore Wind Energy. Another key difference from other tenders is that, in addition to the project permit and SDE+ operating subsidy, an investment subsidy is also available, allowing for financing to be provided before the operating phase.

The Project and Site Description for BWFS V (Innovation Site) is now available on the [offshorewind.rvo.nl](http://offshorewind.rvo.nl), website of the Netherlands Enterprise Agency. It outlines all the tender rules, policy details and site study results required to help consortia prepare successful bids that could see their innovations brought to life in a real operating environment at BWFS V. ●

### FURTHER INFORMATION

- Netherlands Enterprise Agency (RVO.nl) [offshorewind.rvo.nl](http://offshorewind.rvo.nl) for site studies and [rvo.nl/windenergie-op-zee](http://rvo.nl/windenergie-op-zee) for grants and permits
- TKI Wind op Zee: [www.tki-windopzee.eu](http://www.tki-windopzee.eu)
- The Dutch National Aerospace Laboratory (NLR): [www.nlr.nl](http://www.nlr.nl)
- Energy Research Centre of the Netherlands (ECN): [www.ecn.nl](http://www.ecn.nl)
- Deltares: [www.deltares.com](http://www.deltares.com)
- Delft University of Technology (DUWIND): [www.tudelft.nl](http://www.tudelft.nl) and [www.duwind.tudelft.nl](http://www.duwind.tudelft.nl)
- Knowledge Centre WMC: [www.wmc.eu](http://www.wmc.eu)
- Netherlands Institute for Sea Research (NIOZ): [www.nioz.nl](http://www.nioz.nl)
- Netherlands Organisation for Applied Scientific Research (TNO): [www.tno.nl](http://www.tno.nl)



Delft Offshore Turbine (DOT): Study on the transmission of energy from the nacelle through water pressure.



Scour study at Deltares.



# KEY SOURCES OF INFORMATION AND HELP

## NATIONAL SUPPORT

Information and support from Government and national associations...

- **Netherlands Enterprise Agency (Offshore wind programme)**  
An agency of the Ministry of Economic Affairs and Climate, charged with implementing the Netherlands' offshore wind programme; grants, permits and site investigations: [www.rvo.nl/windenergie-op-zee](http://www.rvo.nl/windenergie-op-zee) and [www.offshorewind.rvo.nl](http://www.offshorewind.rvo.nl)
- **Netherlands Foreign Investment Agency**  
[www.nfia.nl](http://www.nfia.nl) or [www.investinholland.com](http://www.investinholland.com)
- **TKI Wind op Zee** [www.tki-windopzee.nl](http://www.tki-windopzee.nl)
- **TenneT** (Dutch Offshore Grid Transmission System Operator)  
[www.tennet.eu/netopzee](http://www.tennet.eu/netopzee)
- **Dutch Wind Energy Association (NWEA)** [www.nwea.nl](http://www.nwea.nl)
- **Wind Farm Site Decisions** [www.rvo.nl/windenergie-op-zee](http://www.rvo.nl/windenergie-op-zee) and [www.english.rvo.nl/offshore-wind-energy](http://www.english.rvo.nl/offshore-wind-energy)
- **Dutch Government offshore wind information**  
[www.rijksoverheid.nl/onderwerpen/duurzame-energie/windenergie](http://www.rijksoverheid.nl/onderwerpen/duurzame-energie/windenergie)
- **Holland Trade and Invest offshore wind opportunities**  
[www.hollandtradeandinvest.com/key-sectors/energy/publications/publications/why-explore-the-netherlands-for-offshore-wind-energy/o6/o6/why-explore-the-netherlands-for-offshore-wind-energy](http://www.hollandtradeandinvest.com/key-sectors/energy/publications/publications/why-explore-the-netherlands-for-offshore-wind-energy/o6/o6/why-explore-the-netherlands-for-offshore-wind-energy)
- **"Noordzeeloket"** information on North Sea, including offshore wind  
[www.windopzee.nl](http://www.windopzee.nl) and [www.noordzeeloket.nl/functies-en-gebruik/windenergie](http://www.noordzeeloket.nl/functies-en-gebruik/windenergie)
- **Holland Home of Wind Energy** [www.hhwe.eu](http://www.hhwe.eu)
- **The Association of Dutch Suppliers in the Oil and Gas Industry**  
[www.iro.nl](http://www.iro.nl)

## REGIONAL SUPPORT PARTNERS

Your ports of call for business success in Hollandse Kust...

- **Provincial administration of Zuid-Holland** [www.zuid-holland.nl](http://www.zuid-holland.nl)
- **Provincial administration of Noord-Holland** [www.noord-holland.nl](http://www.noord-holland.nl)
- **InnovationQuarter** InnovationQuarter is the regional economic development agency for Zuid-Holland. InnovationQuarter is the regional economic development agency for West Holland (the Province of Zuid-Holland). InnovationQuarter assists international companies in establishing their businesses in this unique delta region, finances innovative and fast-growing companies and facilitates (international) collaboration between innovative entrepreneurs, knowledge institutes and government. In this way, and in cooperation with the business

community and governmental partners like the cities of Rotterdam and The Hague, InnovationQuarter supports the development of West Holland to become one of the most innovative regions in Europe.

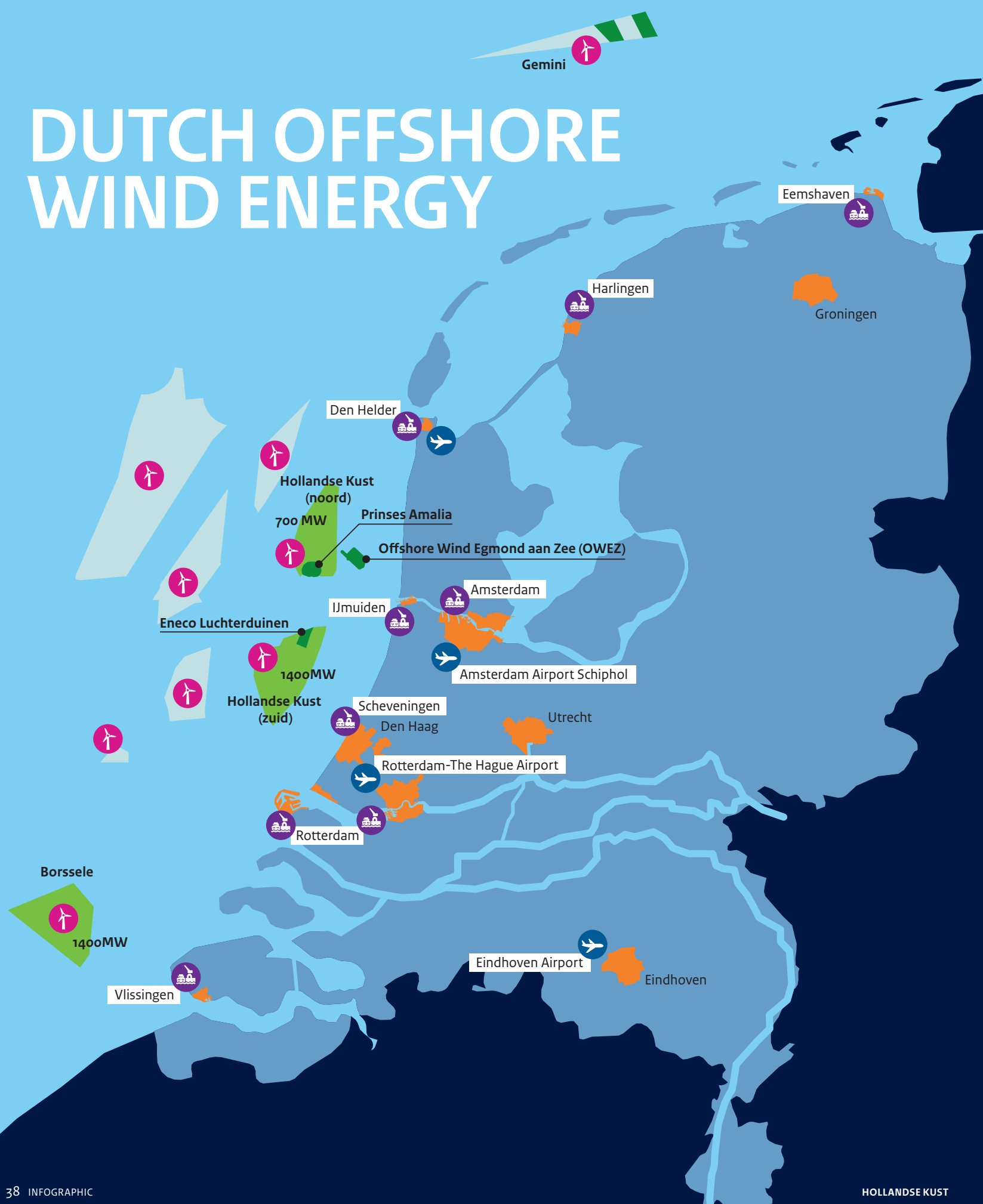
[www.innovationquarter.eu/english](http://www.innovationquarter.eu/english)

- **Amsterdam In Business (AIB)** AIB is the cooperation of municipalities in the greater Amsterdam Metropolitan Area. It provides a free service to assist foreign companies with establishing and expanding their operations in the Amsterdam Metropolitan Area and beyond.  
[www.iamsterdam.com](http://www.iamsterdam.com)
- **The Hague Business Agency** is a government funded organisation specialised in economic development, investment promotion and Foreign Direct Investment (FDI) within the West Holland region. It attracts international companies and organisations and assists them in establishing, expanding or relocating their (foreign) operations to The Netherlands. [www.thebusiness.thehague.com](http://www.thebusiness.thehague.com)
- **The Development Agency Noord-Holland Noord (NHN)** The NHN assists and supports anyone wishing to establish, invest or develop business in the greater Amsterdam area, north of Amsterdam. The shareholders of NHN are local and regional administrations. NHN can advise you in the site selection, organise site visits and introduce you to potential partners and authorities. [www.ofdutchorigin.com/invest/development-agency-noord-holland-noord](http://www.ofdutchorigin.com/invest/development-agency-noord-holland-noord) and [nhn.nl](http://nhn.nl)
- **Rotterdam Partners** Rotterdam Partners has the objective of strengthening the economy of Rotterdam and the region. It works for businesses, visitors and residents who are already based in the city or those who plan to visit or establish themselves in Rotterdam in the future. [en.rotterdampartners.nl](http://en.rotterdampartners.nl)
- **NOM** NOM is the foreign direct investment agency for the Northern Netherlands. With the Ministry of Economic Affairs and Climate as their main shareholder, NOM's goal is to assist companies setting up their business in the best possible way. [www.nvnom.com](http://www.nvnom.com)
- **Northern Netherlands Offshore Wind (NNOW)** NNOW is open to any company that is or wants to become active in offshore wind in the region. Besides networking, knowledge exchange and promotion and acquisition activities, NNOW also devotes attention to business development and training. [www.nnnow.nl](http://www.nnnow.nl)
- **Energy Valley** This acts as a networking organisation to stimulate information exchange and cooperation between public and private partners. [www.energyvalley.nl](http://www.energyvalley.nl)





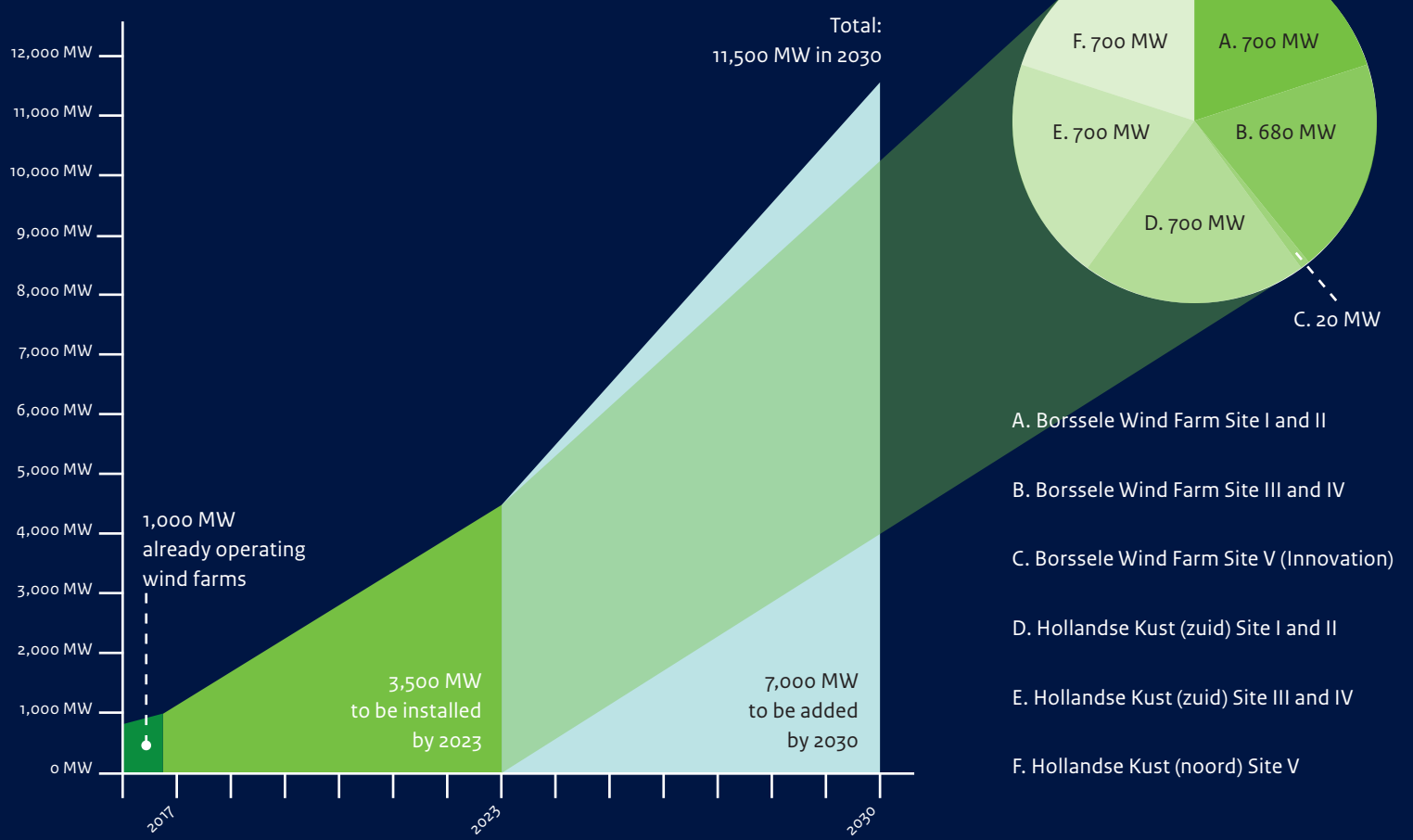
# DUTCH OFFSHORE WIND ENERGY



## LEGENDA MAP

- Port
- Airport
- Wind Farm Zone
- Dutch Wind Farms: 1,000 MW
- Wind Farms under development: 3,500 MW in 2023
- Designated Wind Farm Zones: 7,000 MW from 2024 - 2030

## DUTCH OFFSHORE WIND CAPACITY (OPERATING AND PLANNED)





# INDUSTRY GROWTH

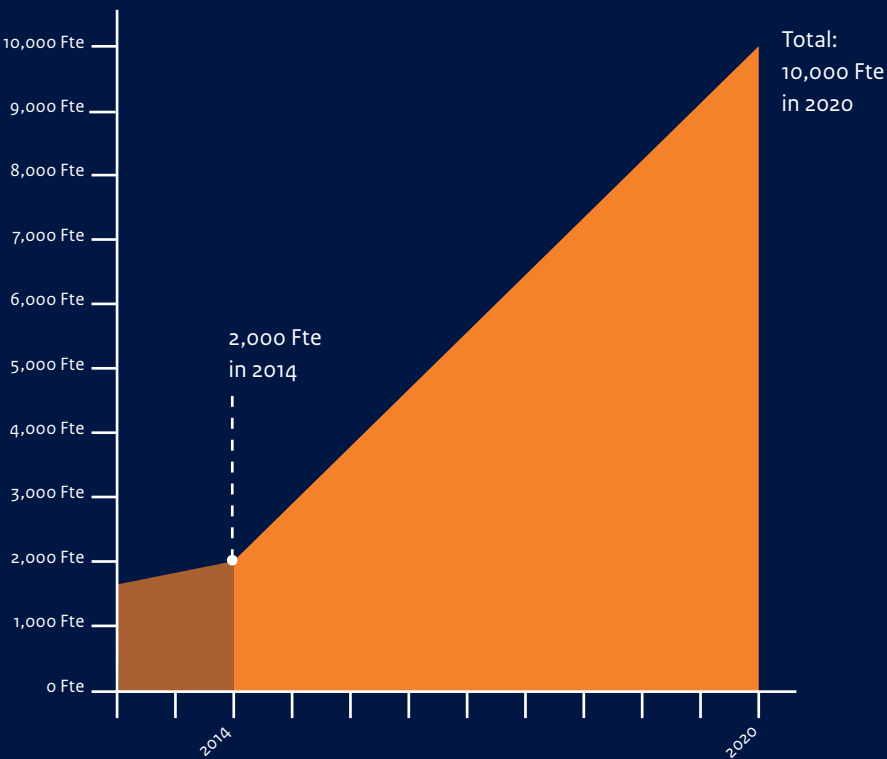
## Our values

- SHARING SAME VALUES  
high quality standards, sound engineering and construction
- HEALTH, SAFETY AND ENVIRONMENT IS TOP PRIORITY  
safe operations, optimised contribution to local ecology

## Our strengths

- EXTENSIVE TRACK RECORD  
contributed to almost all European offshore wind projects
- IN DEPTH KNOWLEDGE  
home to many innovations
- PRACTICAL EXPERIENCE  
from installation and the lab

DUTCH OFFSHORE WIND EMPLOYMENT (EXPECTED)



**Construction** (transport, installation, logistics) accounts for just **under 50%** of total offshore wind employment, with component supply the **next biggest employment sector** of the industry, followed by policy and research.

Netherlands forecast to be the **THIRD BIGGEST** offshore wind market in Europe by **2022** behind the UK and Germany (source: Roland Berger)

# ARE YOU READY TO BE PART OF THE DUTCH OFFSHORE WIND SUCCESS STORY?

Together we can make wind and water work in harmony - creating jobs, economic prosperity, and an energy future that is secure, sustainable, and sure to succeed.

Requests for tenders for Borssele Wind Farm Site V (Innovation) and Hollandse Kust (zuid) Wind Farms Sites I and II offshore wind projects will be opening soon. Find out all you need to know in the Project and Site Description documents now available for download at [offshorewind.rvo.nl](http://offshorewind.rvo.nl).

DUTCH OFFSHORE WIND TENDER SCHEDULE

Hollandse Kust (zuid) Wind Farm Sites I and II – tender round for <b>zero-subsidy bids</b>	December 2017
Borssele Wind Farm Site V – Innovation Site	January 2018
Hollandse Kust (zuid) Wind Farm Sites III and IV	2018
Hollandse Kust (Noord) Wind Farm Site V	2019



## WORKING TOGETHER = OFFSHORE SUCCESS





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