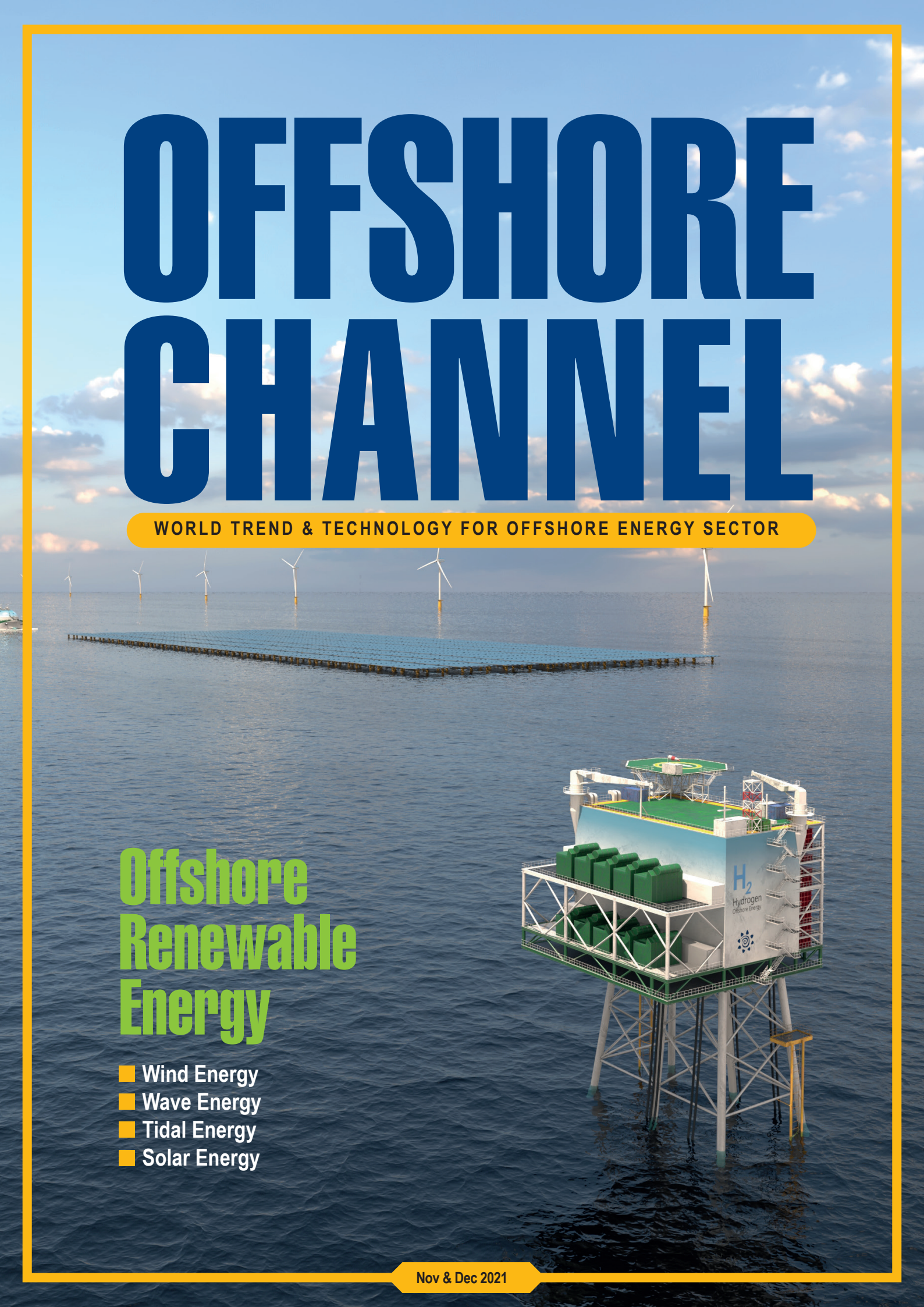
OFFSHORE CHANNEL

WORLD TREND & TECHNOLOGY FOR OFFSHORE ENERGY SECTOR



Offshore Renewable Energy

- Wind Energy
- Wave Energy
- Tidal Energy
- Solar Energy

Nov & Dec 2021

Farshid Ebrahimi
Responsible Director

Offshore renewable energy consists of many different sources that are abundant, natural and clean, like Wind, Wave , Tidal and Solar. Unlike traditional fossil fuels, this energy will never run out. Renewable energy is essential for reducing the potentially devastating effects of climate change, and protecting the natural environment for future generations. Offshore renewable energy includes offshore wind, wave, tide and solar, where the strength of the wind, the pull and rise and fall of the tides, and the movement of waves, produces a vast amount of power that can be harnessed by modern technology.

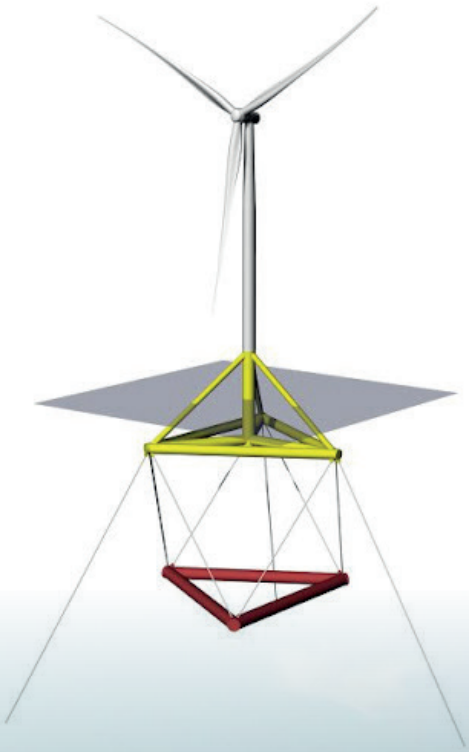
The energy of the oceans can be harnessed by modern technologies without emitting any greenhouse gases, making offshore renewable energy a potential cornerstone of the clean energy transition all around the world.

Offshore Channel Magazine reports on innovative engineering projects around the world, profiling the key players making a difference to the engineering profession. It's our flagship publication and our main channel for keeping our members up to date on what's happening at the offshore industry.

Offshore Channel Magazine is the flagship publication of the international Society of Professional Engineers. Published six times per year, Offshore Channel Magazine covers news and commentary on professional issues: licensing, engineering ethics, employment, legislative and regulatory issues, education, and many others that have a direct impact on professional engineers.

BOURBON SUBSEA SERVICES SUCCESSFULLY INSTALLED THE INNOVATIVE TETRASPAR DEMONSTRATOR FLOATING WIND TURBINE (FWT) IN NORWAY

BOURBON



After mooring lines installation in June, towing and hook up in July, Bourbon Subsea Services completed the offshore installation of the 3,6 MW TetraSpar Demonstrator Floating Wind Turbine at Metcentre Test site in Norway, by laying and connecting the power cable earlier this week. The wind turbine will be commissioned in the coming weeks.

This success demonstrates again Bourbon Subsea Services' expertise in managing Floating Wind Turbines (FWT) installation projects and its ability to propose innovative solutions to achieve new complex technical challenges while maintaining low costs. After having installed most of the semi-submersible Floating Wind Turbines from 2.5 MW to 8.3MW in Europe since 2011, BOURBON consolidates its leadership on the market and strengthens its track record with the installation of the first FWT prototype based on the innovative SPAR concept, designed by Stiesdal Offshore Technologies.

HEEREMA'S AEGIR COMPLETES GREATER CHANGHUA 1 & 2A SUBSTATION TOPSIDES LIFT FOR ØRSTED

After nearly 2,000 days of hard work (from initial investigation in 2016), Ørsted has successfully installed the first offshore substation topsides for the Greater Changhua 1 & 2a Offshore Wind Farms, Taiwan's first large scale and far-shore wind farms.

Together with their contractors – manufactured by Keppel and installed by Hereema – the teams demonstrated perseverance and overcame numerous challenges including lock-downs in Singapore during COVID-19.

This project marks the end of the transport and installation phase and leaving both offshore substations ready for the upcoming offshore commissioning phase before first power of the wind farm in 2022.

The Greater Changhua 1 & 2a Offshore Wind Farms are located 35-60 kilometers off the coast of Changhua County, has a capacity of approx. 900 MW, and will be capable of providing clean energy to one million households.

seaway 7

MAJOR MILESTONE AS FIRST SEAGREEN JACKET INSTALLED

The first turbine jacket foundation has been installed at Seagreen – Scotland's largest and the world's deepest, fixed bottom offshore wind farm.

Seaway 7 is managing the engineering, procurement, construction, and installation of Seagreen's 114 wind turbine generator foundations and approximately 300km of associated inter-array cables.

Offshore operations started last week when two jackets made their way on a barge from Global Energy Group's Port of Nigg in the Highlands of Scotland to the site 27km off the coast of Angus. It was met by the Saipem 7000 – the semisubmersible crane vessel which is used to lift the jackets.

This voyage marks the start of works for the 1.1GW Seagreen Wind Farm project site, a £3bn joint venture between SSE Renewables and TotalEnergies. SSE Renewables is leading the development and construction of the project, supported by TotalEnergies, and will operate Seagreen on completio

SSE BACKS UK'S LARGEST OFFSHORE WIND TOWER FACTORY TO BE BUILT IN SCOTLAND

SSE is providing substantial financial backing for a new state-of-the-art offshore turbine tower tubular rolling manufacturing plant in the Scottish Highlands with debt investment of £15 million, helping green light an investment of over £110 million in a new UK-based offshore wind manufacturing plant in the Cromarty Firth.

SSE's multi-million-pound debt investment makes it the largest single UK backer behind plans by Scottish-headquartered energy services company Global Energy Group (GEG) and leading offshore wind tower manufacturing specialist, Haizea Wind Group (Haizea), to build what will be the UK's largest offshore wind tower manufacturing facility at Port of Nigg near Inverness. The cost of the new facility, inclusive of rolling machinery robotics and a new blast and paint shop is £110-120m.

Nigg Offshore Wind (NOW) will be a giant, 450-meter-long, 38,000m2 factory, capable of rolling steel plate to supply towers in excess of 1,000 tonnes each and other products, to the booming UK offshore fixed and floating wind industry in the UK and abroad. As a strategic backer behind the plant, SSE Renewables will be placing manufacturing orders with the factory from its leading pipeline of large-scale UK offshore wind projects. SSE Renewables expects to announce a first order contract with NOW in the near future.

Once operational, the NOW plant will support the creation of up to 400 new full-time direct manufacturing jobs as well as more than 1,800 indirect jobs in the UK, with an estimated 1,100 of these in Scotland.

OFFSHORE CHANNEL

SUNFISH SUCCESSFULLY REBURIES EXPORT CABLE AT ENECO'S LUCHTERDUINEN WIND FARM

ANOTHER MILESTONE ACHIEVEMENT FOR JAN DE NUL'S INNOVATIVE INTERTIDAL TRENCHING VEHICLE SUNFISH

For the offshore wind farm Luchterduinen in The Netherlands, Jan De Nul was requested by Eneco to rebury a section of an existing export cable. To this purpose, Jan De Nul modified its in-house designed and fabricated intertidal trencher Sunfish and successfully reburied the nearshore section of the cable to a minimum depth of 2.5 metres below the seabed.

Due to morphological changes the export cable burial was over the last few years decreasing in depth within the nearshore section. To guarantee the cable will at all times remain sufficiently buried and thus protected, a reburial campaign was requested by Eneco.

Since the section of decreased burial depth was located in the nearshore zone, it was not accessible with typical offshore trenching vehicles nor could it be easily accessed from the beach. Jan De Nul offered Eneco the solution by mobilizing its intertidal trencher Sunfish. The Sunfish successfully lowered the nearshore part of the cable working up to 1 kilometre offshore and a water depth of 8.5 metres.

HISTORY MADE BY HEEREMA WITH OFFSHORE TESTING CAMPAIGN

Heerema Marine Contractors has tested its novel Rotor Nacelle Assembly (RNA) installation method offshore for the first time. Heerema performed the demonstration project in collaboration with DOT and the Delft University of Technology (TU Delft) to collect valuable operational data and test installation methods and durations.

Floating installation of wind turbine generators

The offshore wind industry is projected to produce 228 GW by 2030, enough to power over 68 million homes. To meet these targets, offshore wind turbines are progressively increasing in size and are being planned for installation in remote locations and deeper water depths. Due to these market developments, Heerema strategically developed the novel RNA method for the next generation of wind turbines.

The largest technical challenge when using a floating installation vessel is the relative motion between the vessel's crane and the geostatic foundation of the offshore structure. One specific point of attention within the RNA method is the blade installation, which has been identified as the most critical part of the turbine installation offshore for any vessel. To combat these challenges, Heerema has developed the guided root end positioning tool, known as the GREPT. This in-house developed blade assembly tool enables offshore handling and installation of blades safely and efficiently.

The development of Heerema's RNA method has been ongoing over the last two years and has been tested extensively within Heerema's Leiden Office based Simulation Center. This offshore test put the method into practice for the first time in Eneco's Prinses Amalia wind park, the Netherlands. The test results will be used to continue improving the RNA method within the Simulation Center.

FIRST TURBINE UP AT 1.1GW SEAGREEN

- Milestone reached in delivery of what will be Scotland's largest and the world's deepest fixed bottom offshore wind farm
- Turbine is the first V164-10.0 MW turbine installed globally and will be the most powerful offshore turbine in Europe once operational

Seagreen, which will become Scotland's largest and the world's deepest fixed bottom offshore wind farm once complete, has passed another momentous milestone following the successful installation of the project's first Vestas V164-10.0 MW turbine.

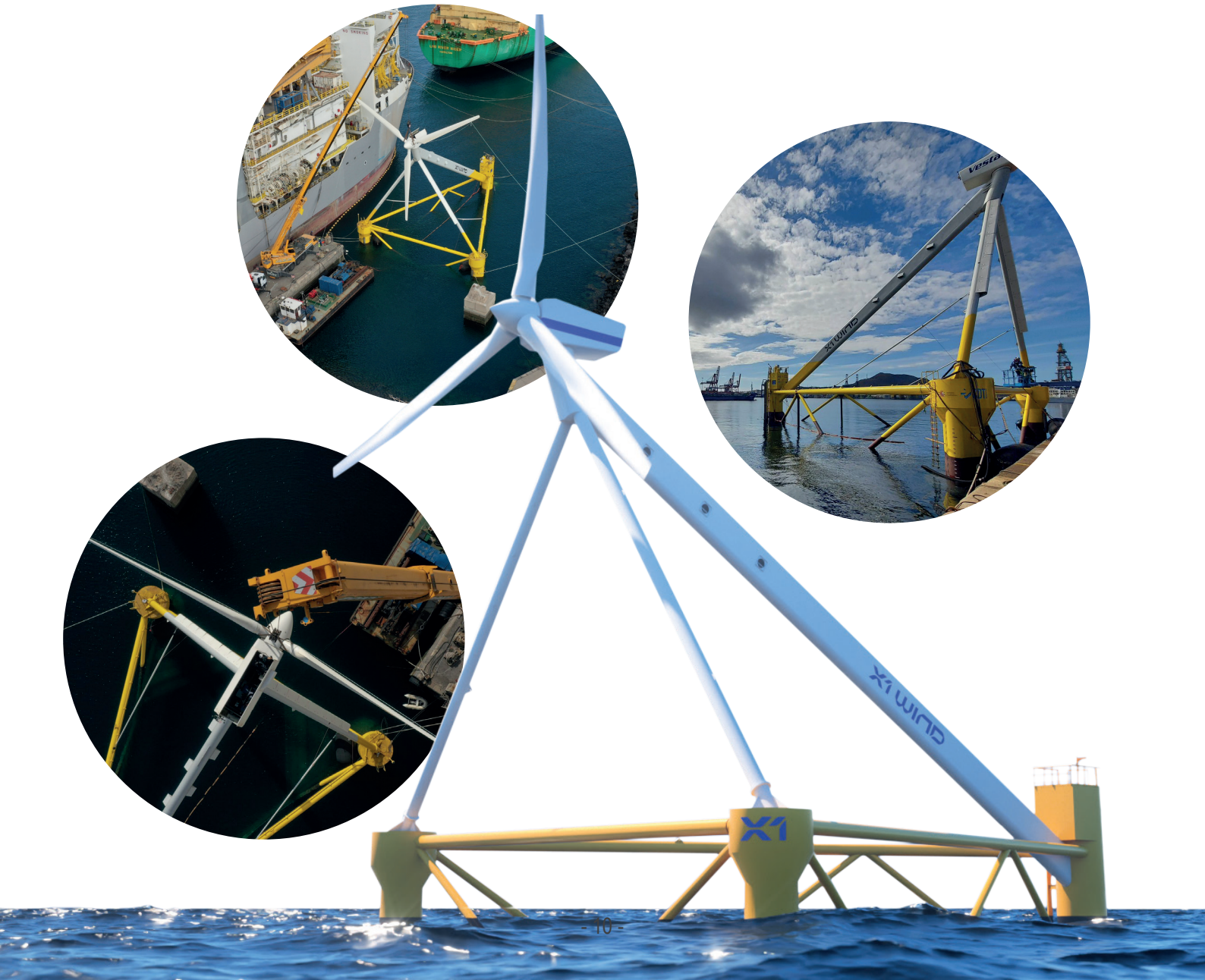
The installation of the first Vestas turbine in the North Sea off the Scottish coast heralds the start of the turbine installation phase which will see a total of 114 wind turbines installed across the project site. This turbine is also the first V164-10.0 MW turbine installed globally, and at 10MW will be the most powerful turbine currently installed offshore in Europe once operational in terms of power rating.

X1 WIND COMPLETES ROTOR ASSEMBLY FOR PIONEERING 'DOWNWIND' FLOATING PLATFORM

X1 Wind has completed the rotor assembly for its pioneering floating wind platform.

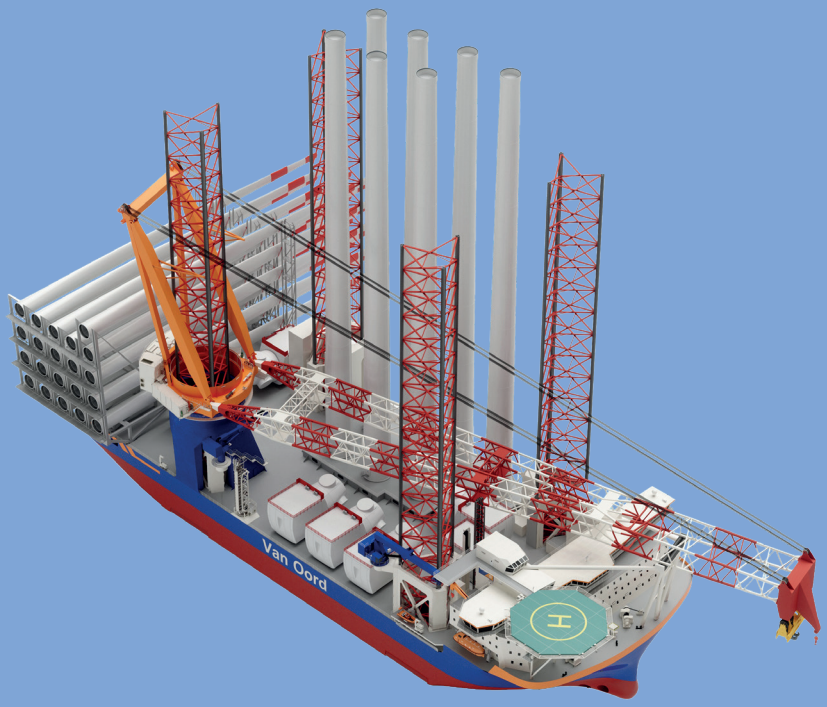
The firm's X30 prototype is now fully assembled in Las Palmas, Gran Canaria, ready for installation. Fitted with a specially adapted V29 Vestas turbine, the unique 'downwind' system is able to 'weathervane' and orientate passively with the wind to maximise energy yields.

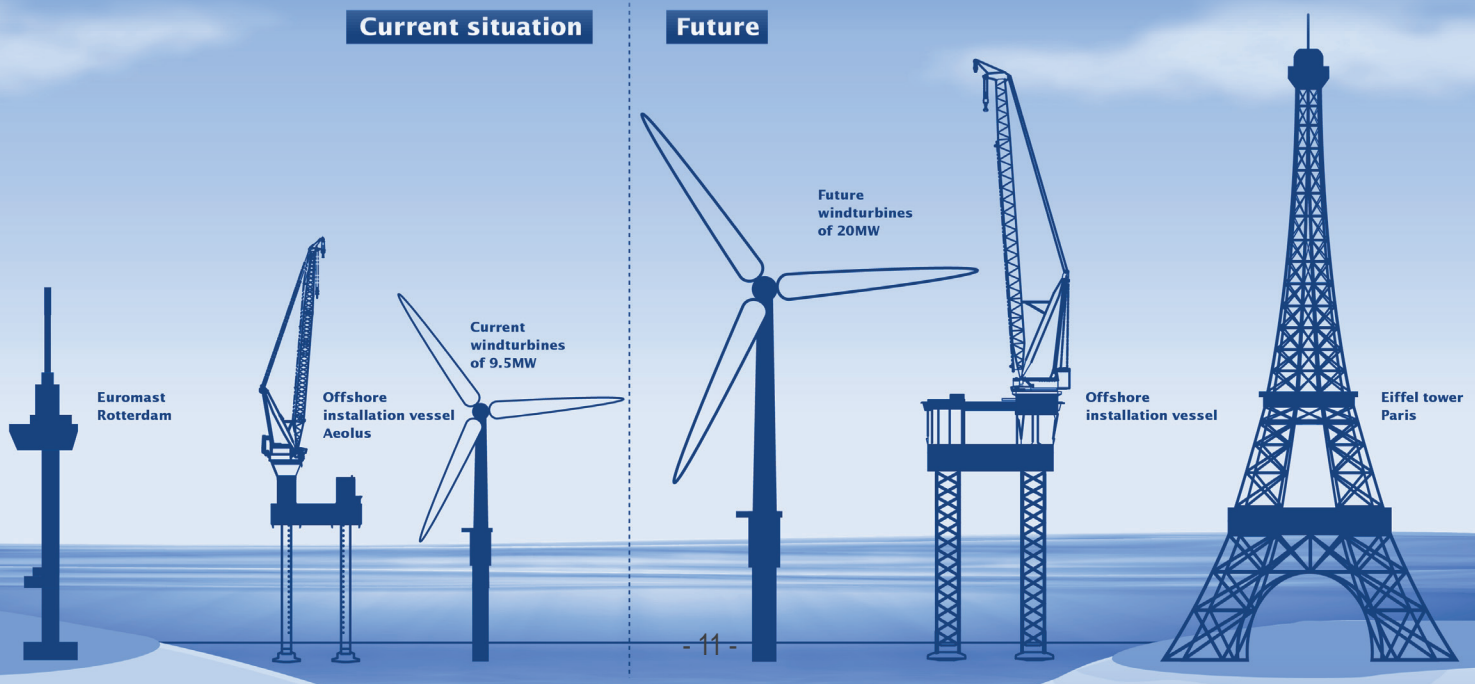
The novel 'tripod-like' platform also features greater structural efficiency, with a lighter and more scalable design, while minimising environmental impact on the ocean.



VAN OORD ORDERS MEGA SHIP TO INSTALL 20 MW OFFSHORE WIND FOUNDATIONS AND TURBINES

Van Oord has ordered a new offshore installation vessel to further strengthen its market position in offshore wind. The jack-up vessel can operate on methanol and install up to 20 MW wind turbines at sea with a very low CO2 footprint. The investment is in line with the increasing global demand for offshore wind farms. The ship is expected to enter the market in 2024.





FÉCAMP OFFSHORE WIND FARM

Bouygues Travaux Publics is in charge of the construction of the 71 gravity foundations on which the masts of the wind turbines of the Fécamp Offshore Wind Farm will rest.

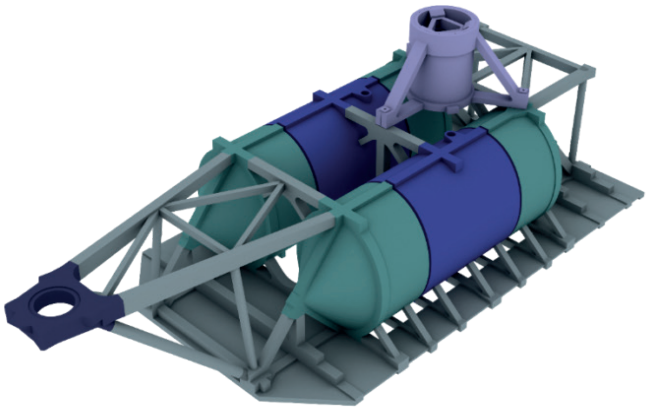
Also called “Gravity Based Structure”, the GBS is made in several parts: a radier (the base of the structure), six lifts, including the top ring at its highest point. Inside, a platform will house the electricity export components.

The structure weighs 5,000 tons and is 31 meters in diameter at its base. Its height, oscillating between 48 and 54 meters, depends on its location at sea.

Within the consortium of which Bouygues Travaux Publics is a member, #Saipem is in charge of the offshore installation of the bases and #Boskalis of the seat embankment,the installation of the protections and the ballasting of the bases.

DEMOSATH MANUFACTURING MOVES FORWARD

DemoSATH manufacturing works speeds up in the Port of Bilbao (Spain). The latest milestone has been the handling operation of the prototype. This consists on lifting, pivoting, and positioning the 6 precast elements that have initially been prefabricated. These elements compose the floaters of the platform and include 4 conical elements (2 per floater) and 2-cylinder elements (1 per floater).



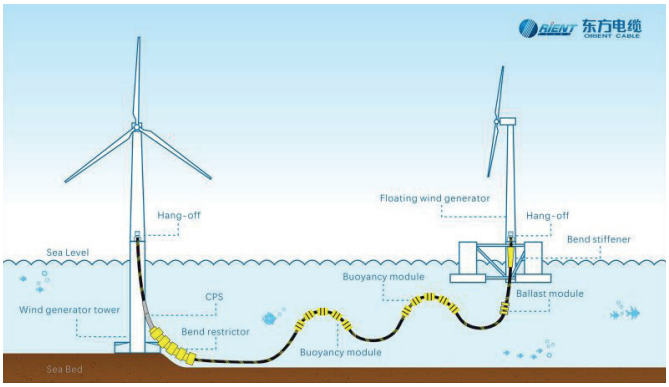
DemoSATH prototype consists of two hulls, each having three prefabricated segments. The positioning and pivoting maneuver of these pieces has been carried out using two cranes with capacities of up to 500 tons. These cranes have raised the pieces 14 meters high and have transported 150 meters away to the specific construction supports at the foundation slab that has been specifically designed and constructed for this purpose. It is remarkable that the floater positioning results had an error below 1 centimeter.

ORIENT CABLE (NBO) HAS SUCCESSFULLY COMPLETED DYNAMIC SUBSEA CABLE PROJECT ON EPCI BASIS FOR THE WORLD FIRST PILOT ANTI-TYPHOON FLOATING WIND TURBINE

Orient Cable (NBO) has successfully completed dynamic subsea cable project on EPCI basis for the world first pilot Anti-typhoon Floating Wind Turbine in China for China Three Gorges (CTG). This project will generate power of 5500 kilowatt per hour, serving 30,000 households with clean energy.

"We see this project as a typical case by working closely with the stakeholders engaged (#CTG,#MINGYANG,#WISON,#DNV) from the very beginning, to clear up challenges in difference scenarios and interfaces and select the best solutions for this project. A long-standing partnership, as a driver and commitment of NBO, do help to make a great success" , says Mr. Zhou Zewei, Chief Engineer of NBO.

On 1st September ,with the commissioning test being completed, it indicates the World's First Anti-typhoon Floating Wind Turbine, developed by China Three Gorges (CTG), successfully finished all the offshore work and is ready to connect with the 400 MW Yangxi Shapa III Offshore Wind Farm.



J.P. MORGAN AND HAVFRAM AS ANNOUNCE A SERIES OF NEXT GENERATION WIND TURBINE INSTALLATION VESSELS

The first vessels will be built at CIMC-Raffle's Yantai yard in China for delivery in 2024. The plan is to operate several vessels in the global offshore wind market with both traditional jack-ups for turbine installation as well as a cost-effective feeder-solution for the US market in particular.

The WTIVs have been designed and created by an experienced offshore wind team focusing on installation efficiency in partnership with Gusto MSC as ship designer and in close collaboration with leading offshore wind developers and turbine suppliers.

The design includes green technologies and lessons learned from more than a decade of experience from WTIV operations and offshore wind construction.

Havfram is a reputed offshore marine construction company and is known for its subsea construction capabilities, completion track record, EPCI capability and seasoned project execution team.

J.P. Morgan's Global Transportation group is an active developer, owner and operator of a broad range of air, sea, and land-based transportation assets. With a fleet of over 100 vessels, the group brings a deep knowledge base to bear in all shipping sectors.

Odd Strømsnes
CEO hos Havfram

SEAQUALIZE

WORLD'S FIRST INLINE ACTIVE HEAVE COMPENSATOR SUCCESSFULLY TESTED BY SEAQUALIZE, TOGETHER WITH VAN OORD

In no less than 62 hours of rigorous offshore testing, tech scale-up Seaqualize successfully completed offshore trials for its inline Active Heave Compensator (iAHC), the 'Delta600'. Together with testing partners Van Oord and nautical research institute MARIN, the offshore lifting tool was tested for fixed-to-floating, floating-to-fixed and floating-to-floating transfers of 300mT loads.

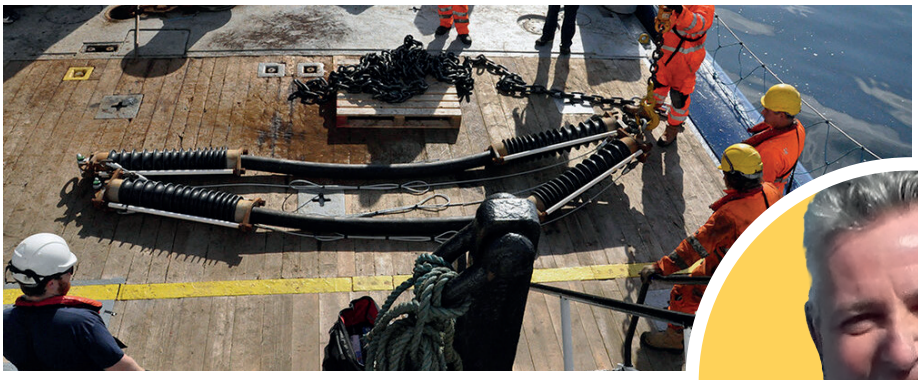
The Delta600 is DNV certified and ready for work.

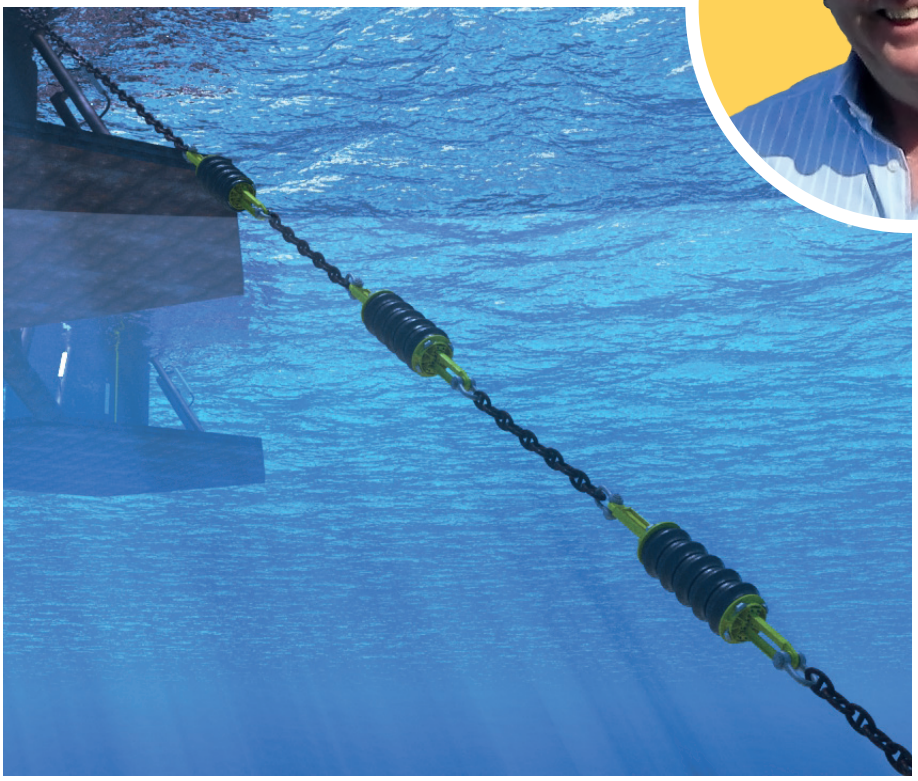
LOAD REDUCTION POLYMER COMPONENTS ON A EUROPEAN FOWT PROJECT

Purpose of TFI Polymer Mooring component:

- Reduces compliance
- Reduce peak loads
- Minimise cyclic loading

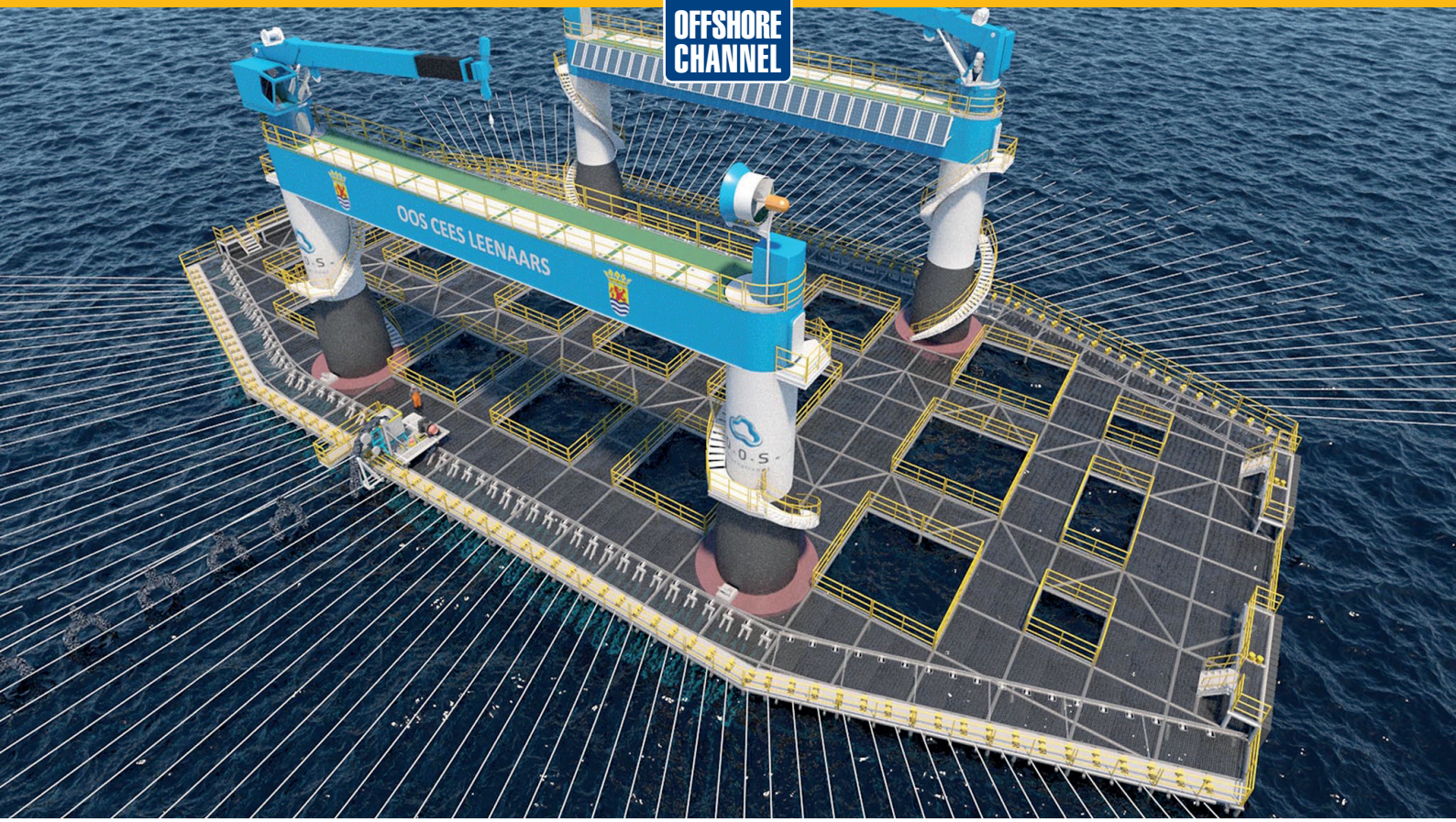
tfi MARINE





Noel Halloran, CEO

A battery-powered Wind Farm Service Operation Vessel (SOV) receiving electrical power, generated by a wind farm, and transferred by a Bluewater E-buoy. During charging, the vessel is moored to the buoy and power consumption by thrusters is minimized. This concept can assist wind farm operators to meet their Net Zero Carbon targets while ensuring the uptime of their wind farms.



OOS GROUP INTRODUCES THE SEMI-SUBMERSIBLE MUSSEL FARM (SMF)

The OOS Group has developed a Semi-submersible Mussel Farm (SMF) to grow mussels in the North Sea.

Mussels are traditionally grown in sheltered waters such as the Oosterschelde and the Waddenzee. However, due to a lack of nutrition in these waters, the production of mussels has declined enormously. Farming mussels in nutrition-filled seas can be a solution to maintain production.

In collaboration with the shellfish sector and mussel farmers, OOS SMF has developed the Semi-submersible Mussel Farm, suitable for growing mussels based on hanging culture at open seas.

By applying submersible technology, the breeding and harvesting location at open seas will be protected against waves and storms. A suitable location in deeper waters can be used for the largescale cultivation of mussels.

The design philosophy of the SMF is based on the floater/column design of the vessels OOS Serooskerke/Walcheren, enabling the SMF to be submersed in harsh environments at sea.

With this development, OOS SMF contributes to the maintenance and expansion of the shellfish sector, allowing multiple mussel farmers to use the SMF simultaneously with technical and logistical support from OOS.

The first unit, the OOS Cees Leenaars will measure 76 mtr. by 32 mtr. and wind, solar and current power supply is implemented to allow charging of the supply vessels collecting and transporting the mussels onshore. With this technology, OOS aims for Zero Co2 emissions.

In 2022, a pilot will start, and based on the outcome of this study the SMF will go into production. The expectation is that multiple “mussel farms” can be implemented along the coast of Zeeland.

OffshoreTronic

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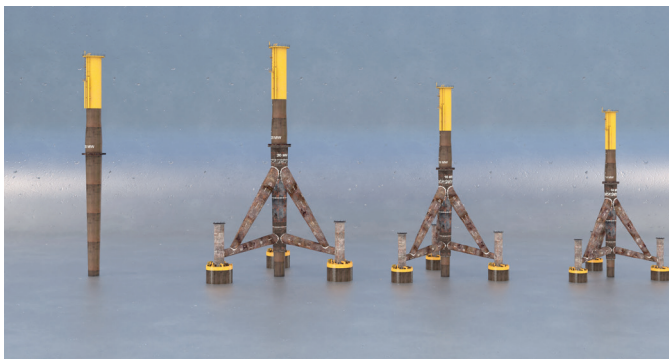
Tripod PLUS © Foundation, it will please our Clients 7

- All parts such as; Suction Bucket, Slip-joint, Monopile and Tripod are all proven installation parts & methods
- No needs for Pile -Hammers and needs for noise Mitigation with Suction Bucket installations
- Transportation limits, will be not longer a challenge as we handle and install Two smaller parts
- Scalable for the future, no physical restrictions on size and weight
- Simple and cost efficient Fabrication processes, smaller parts are easier to fabricate and handle
- Fast and riskless Offshore installations with existing Offshore wind Vessel fleet

Jeroen Berkhout
Founder and
Project Director
Offshoretronic



HUGHES
SUBSEA SERVICES LIMITED

Hughes Subsea Services Limited (Hughes SS) a leading subsea services provider, offering a range of services, as well as consultancy to the Offshore Oil & Gas, Offshore Renewables, Telecommunications, Power Generation and Marine Civil Engineering sectors.

The original company was founded in 2005 to provide a modern technological approach to the Subsea diving industry, and has since grown and expanded it's capabilities to cover Offshore Renewables, Civil Engineering, working at height, confined space and Remotely operated technologies to its subsea services portfolio.

Hughes SS has an International reputation for providing independent innovative and high quality services; our clients appreciate our flexible and responsive service delivering added value in the form of safe, reliable and cost-effective solutions.

We have an impressive track record serving the Offshore Renewable, Power Generation, Telecommunication, Large Civil Engineering majors, Independents, and Governmental bodies. Our strength and differentiator is in the technical excellence and attitude of our team: we employ highly experienced engineers with wide ranging competencies in subsea engineering, civil engineering and offshore construction above and below the water line.

We have the ability to work in partnership with our client›s needs in mind and assist them in any way we can through our management team and personnel on site to ensure every project is carried out successfully, right from the start.

NEW HYBRID VESSELS DELIVER IMPRESSIVE 20% EMISSION SAVINGS

Two leaders in marine electrification, Volvo Penta, and Danfoss' Editron division, have worked together to power two of the UK's first fully integrated hybrid electric crew transfer vessels (CTVs). The vessels have been in operation at an offshore wind farm for a month and are already making a positive environmental impact.

A recent announcement from COP26 was the promise of £160 million in new funding to support the building of floating offshore wind farms in Scotland and Wales. Although this is a significant win in the UK government's commitment to quadruple offshore wind farm capacity to 40 gigawatts by 2030, it also means that more CTVs will be needed to deliver supplies and transport workers to the offshore sites and so reinforcing efforts such as the Global Offshore Wind Alliance and other such creditable initiatives to come out of COP26.

MBM CONSULTANCY

MBM Consultancy has a strong core team of professional personnel. They are dedicated to the offshore and maritime sectors. With a diversified team enables identification of your operatives. In addition, all provided data is utilised in the process to deliver a project. Therefore, with MBM's diversified skill set, you are in capable hands. Above all, the aim is to reduce your project risks. In conclusion, MBM provides more knowledge. In other words providing Engineering for your immediate missing requirements. It is our pleasure to provide innovative, effective and efficient services that add value on any of your projects our client.

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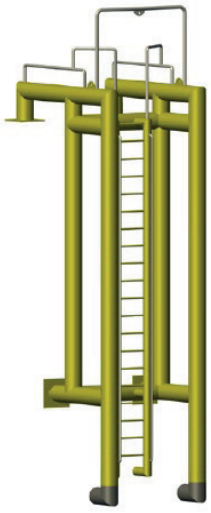
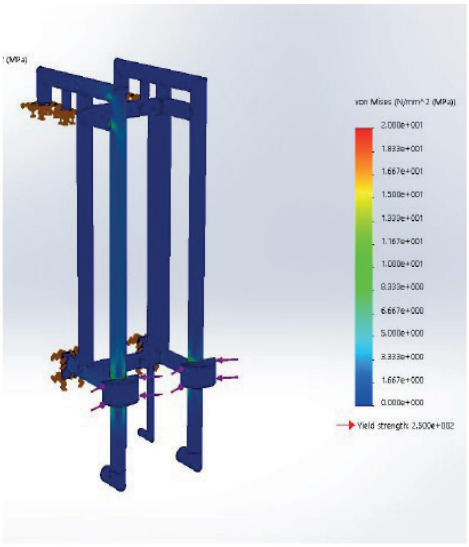
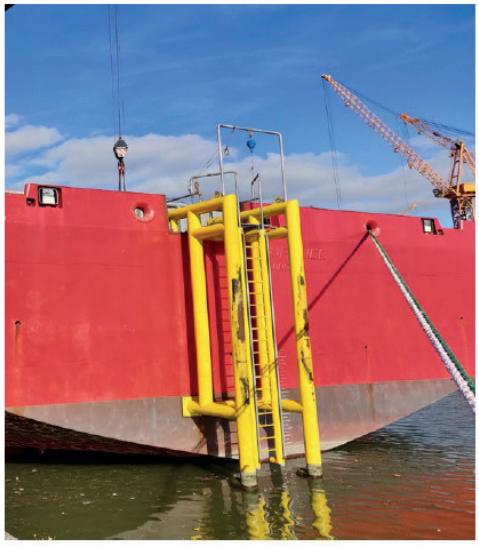






OFFSHORE WIND4KIDS

The story of a love affair from William Beuckelaers:

I am a civil and geotechnical engineer working on building offshore wind turbines.

When I turned 29 in January of this year, I received a toy wind turbine from my parents (for ages 8-14). I absolutely loved it, and to quote one of my Instagram posts: “Turned 29, but could be mistaken for a kid when playing with wind turbines”. The toy quickly became my background for all the video calls now that we are working from home.

The offshore wind sector has rapidly developed and there are now some floating offshore wind farms being constructed. On the Belgian coast, we have no plans to build floating wind turbines. So I set out to go for it myself, and build the first Belgian floating wind turbine using the toy I received for my birthday.

I started out by building a floating barge using things I had laying in my attic from my childhood. I added inflatable swimming bands (like the ones a child just learning to swim would use) to make it float and, voilà, it was ready for its first test. Snowstorm Darcy had just arrived in Belgium and most ponds in Brussels were frozen apart from one close to home that had running water. It was there I installed Brussel’s first floating wind turbine!

Two weeks later, we had a sunny weekend on the coast. I built another two supporting structures: a monopile and a spar buoy. I then drove straight to the Belgian coast with all my equipment, wellies, and a waterproof fishing suit. The sea water was still around freezing temperature, so I had to wear the fishing suit before going into the sea. The spar buoy proved difficult to install because I had to go quite deep into the sea in order to release the structure. But alas ... it floated! It was spinning! It produced the first electricity from a floating wind turbine on the Belgian coast!

Being a geotechnical engineer, I also wanted to build the foundations for the floating structures. I built a small lab in my attic where I installed a small sand container. I also created some suction anchors that I managed to install using a manual pump. Right now, (early March), it is still too cold at sea to install them offshore, but when the spring and summer arrive in Belgium, I will be able to dive into the sea to install them.

As I was putting time and energy into this hobby project, my family must have thought I was going crazy doing all this. I wanted to share this joy of building the structures, and so I decided to start OffshoreWind4Kids. The idea was to organise demo days, where children can build their own offshore wind turbine. If they experience the same joy as I do, perhaps they might be inspired to consider a future career in engineering?

For the demo days, I aim to teach as many girls as boys about offshore wind. I hope that this will also help girls to consider a future career in engineering. By encouraging girls, I want to support women in engineering.

OFFSHORE STRUCTURES UNDER EXTREME LOADS:

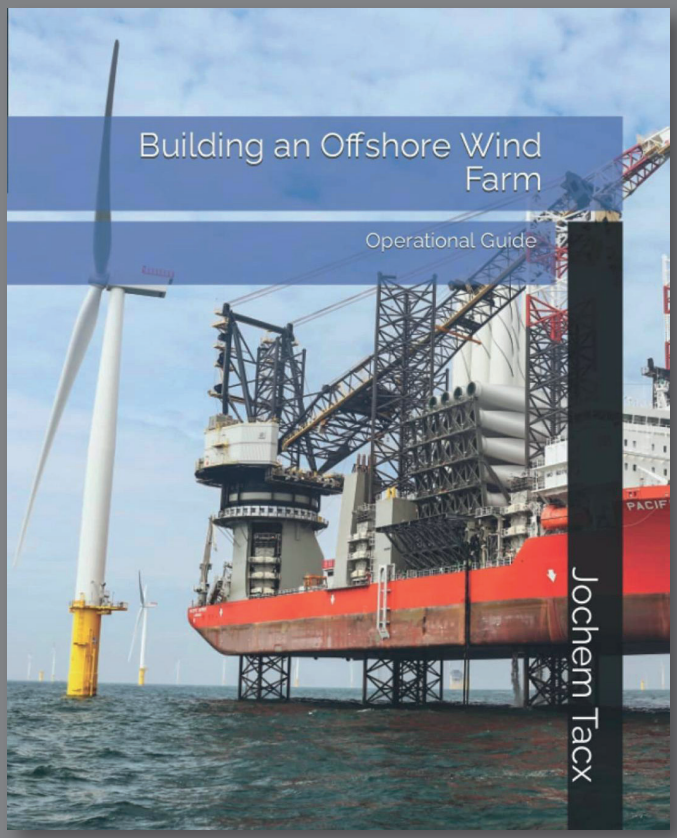
A METHODOLOGY TO DETERMINE DESIGN LOADS

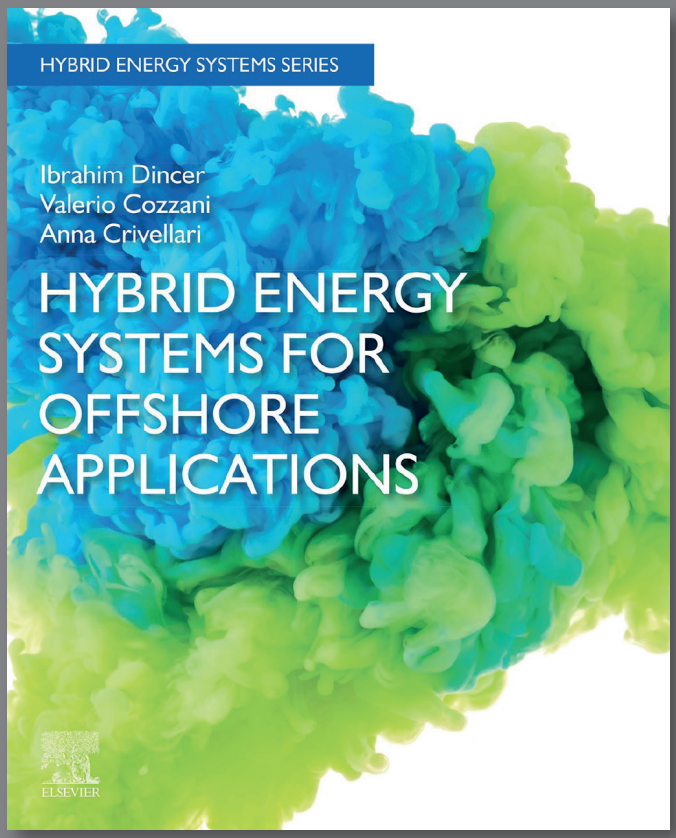
Abstract of Andreas F. Haselsteiner's doctoral thesis

The majority of the Earth's surface is covered by oceans. Waves, currents, and winds are phenomena that act as load requirements in the design process of any offshore structure. While there are many types of offshore structures such as bridges, oil platforms, or wave energy converters, one type of structure currently gets the most attention: offshore wind turbines, which are expected to become one of the main sources of future energy supply. They are typically designed for a design life of 20 or 25 years and therefore must withstand all environmental conditions that can reasonably be expected during this time. To evaluate a design, one estimates its structural response under given environmental loading. This requires a description of the expected environmental conditions and a method to decide which environmental conditions should be considered as design requirements.

This thesis addresses the design process of offshore structures. Engineering standards and guidelines describe the state of the art of this process and recommend models that shall be used to describe the environment and to estimate the extreme structural response. In particular, three design process steps where current methods can lead to problems are addressed: (1) Modeling the probability distribution of significant wave height; (2) modeling the joint distribution of wind speed and wave height; and (3) determining 50-year joint environmental extremes. New methods to deal with these three steps are proposed and evaluated. Finally, a case study on a 5 MW wind turbine is conducted.

Addressing the first step, this thesis shows that the long-term distribution of significant wave height can be modeled with an exponentiated Weibull distribution. The exponentiated Weibull distribution is a generalization of the common two-parameter Weibull distribution. It has two shape parameters, which provide the model with the required flexibility to describe the shape of the empirical distribution. In a study based on six wave height datasets, using the exponentiated Weibull distribution was evaluated. The distribution parameters were estimated with a weighted least squares method. The exponentiated Weibull distribution predicted the height of the highest 0.1% waves with a mean absolute error of 0.4±0.1 m (mean ± standard deviation over the six datasets) while the state-of-the-art method led to an error of 1.8±0.5 m.


Building an Offshore Wind Farm
Operational Guide
Jochem Tacx


HYBRID ENERGY SYSTEMS SERIES
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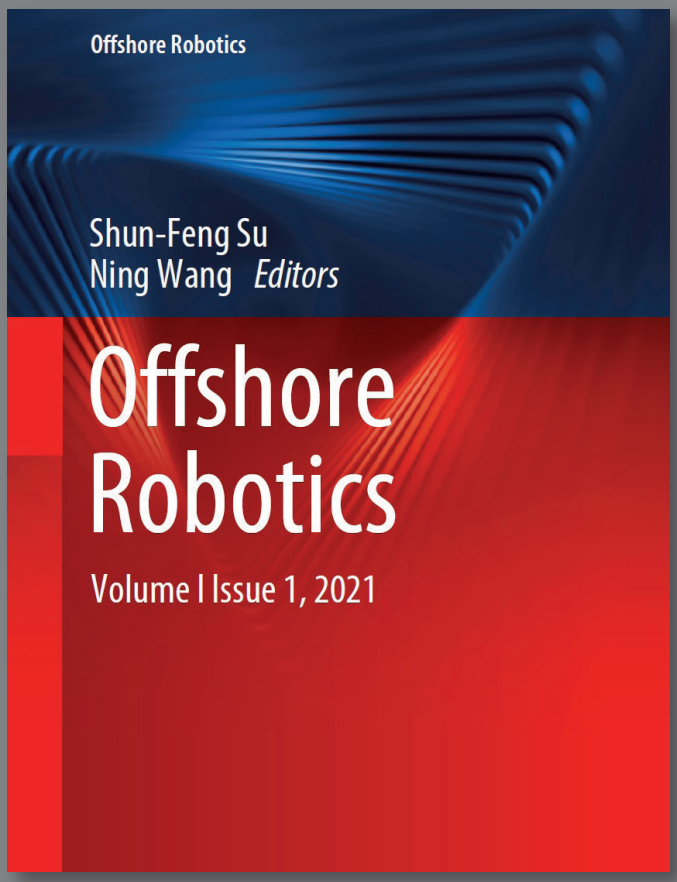
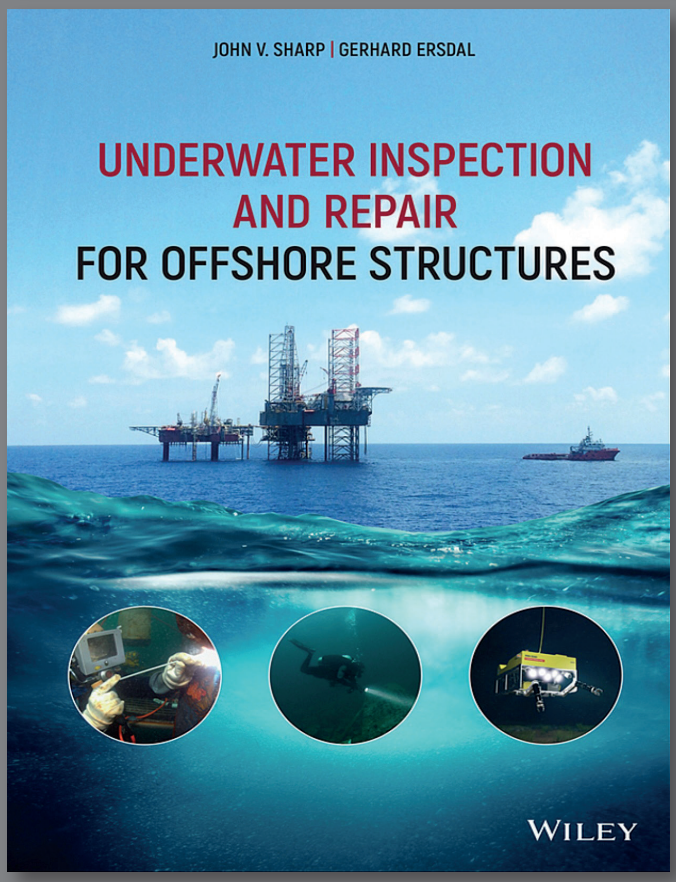
HYBRID ENERGY SYSTEMS FOR OFFSHORE APPLICATIONS
ELSEVIER


Offshore Robotics
Shun-Feng Su
Ning Wang Editors
Offshore Robotics
Volume I Issue 1, 2021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UNDERWATER INSPECTION AND REPAIR
FOR OFFSHORE STRUCTURES
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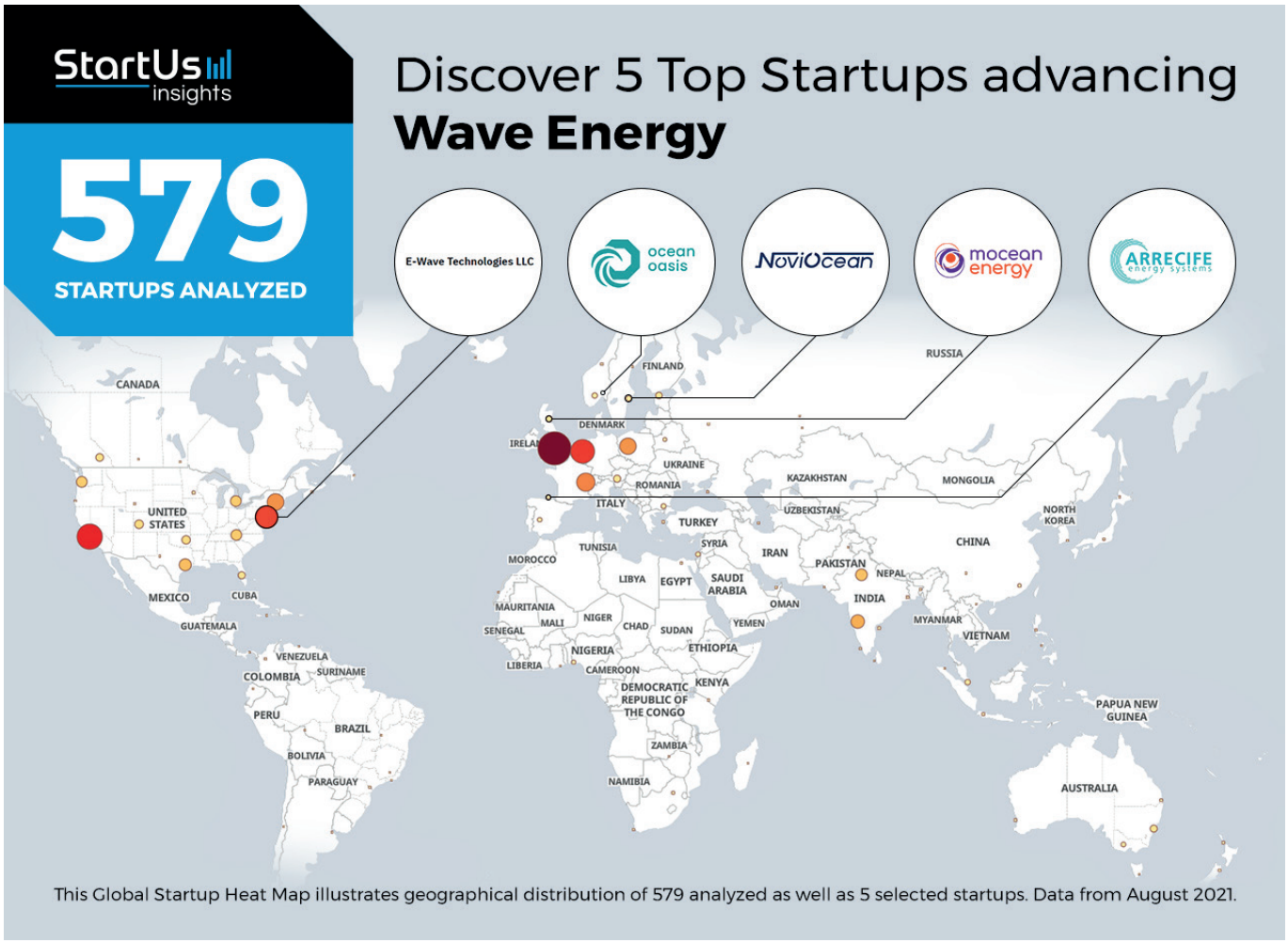
DISCOVER 5 TOP STARTUPS ADVANCING WAVE ENERGY

Global Startup Heat Map highlights 5 Top Startups advancing Wave Energy out of 579

The insights of this data-driven analysis are derived from the Big Data & Artificial Intelligence-powered StartUs Insights Discovery Platform, covering 2.093.000+ startups & scaleups globally. The platform gives you an exhaustive overview of emerging technologies & relevant startups within a specific field in just a few clicks.

The Global Startup Heat Map below reveals the distribution of the 579 exemplary startups & scaleups we analyzed for this research. Further, it highlights 5 energy startups that we hand-picked based on criteria such as founding year, location, funding raised, and more. You get to explore the solutions of these 5 startups & scaleups in this report. For insights on the other 574 wave energy solutions, get in touch.

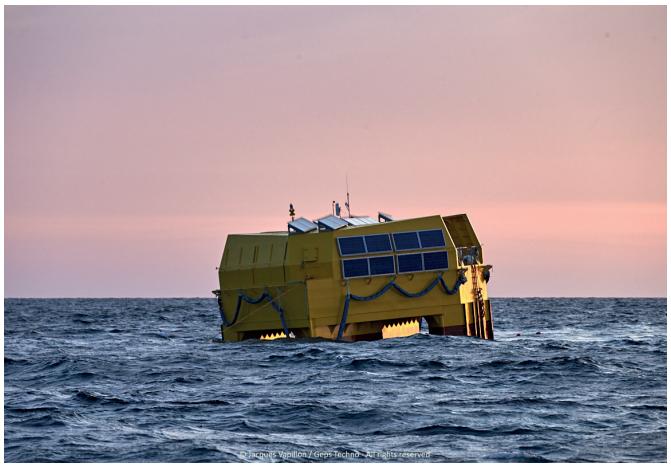


TRITON-C WAVE ENERGY CONVERTER HEADS FOR HAWAII DEPLOYMENT SITE

U.S.-based company Oscilla Power has sent off its new wave energy system – the Triton-C – to Hawaii, where it will be deployed offshore the Marine Corps base in Kaneohe to generate renewable power from the waves of the Pacific Ocean.

The Triton-C will be installed at the U.S. Navy's Wave Energy Test Site (WETS) site, a pre-permitted location that includes all required infrastructure, such as the subsea grid connection and moorings.

This is the first commercial-scale demonstration of the Triton technology, which has been under development for more than a decade with the support by the State of Washington, the U.S. Department of Energy (DOE) and private funders.



THE PROTOTYPE OF THE WAVEGEM® PLATFORM MOORED AT SEA

The first phase of sea trials for our wave and solar prototype is coming to an end.

After 24 months spent at sea on the SEM-REV site of Ecole centrale de Nantes, #WAVEGEM returned to the quayside in Nantes Saint-Nazaire Port, towed by ALMA KAPPA from ALKA MARINE.

The next steps for 2022:

Installation of the first device for the production of green hydrogen at sea for Lhyfe.

The implementation of the latest developments in our energy production systems.

The integration of an additional #sustainable resource: wind power.

SWEDISH ENTREPRENEUR FIGHTS CLIMATE CHANGE WITH THE POWER OF OCEAN WAVES

Jan Skjoldhammer is the founder and the creative mind behind the unique NoviOcean concept and CEO of Novige AB. Aside from the strategic decision-making and being the face of Novige AB, Jan has been deeply involved in all technical and practical issues related to the development, scaling up, and validation of the NoviOcean technology.

Tell us more about your company/organization

With oceans covering more than two thirds of the Earth's surface – and despite wave energy's enormous potential (theoretically, wave energy could meet the world's total electricity demand, according to the IPCC) – this powerful source of renewable energy remains mostly untapped.

Some of the reasons why ocean energy has not been deployed more commercially include perceptions around its reliability, simplicity and costs. However, each one of these can be addressed.

Reliability in ocean energy can be achieved by using technologies and systems that have been proven over time. Simplicity is an asset to ocean energy, as it allows for local production of parts and local maintenance. Of course, it's also crucial for ocean energy technologies to be able to compete economically with other renewables soon after entering the market.

That's where our company, Novige AB, comes in. We are a fast-growing cleantech startup which addresses these fundamental issues. We are developing a breakthrough wave energy concept called NoviOcean. With NoviOcean, our goal is to help fight climate change with profitable wave power. We focus on:

- Utilizing simple, light-weight and proven components that have been used for decades in the hydropower industry and other mature industries.
- Using a global licensing approach to locally manufacture and operate NoviOcean units.
- Achieving a lower levelized cost of energy compared to offshore wind after deploying 50 MW of NoviOcean capacity.
- Developing infrastructure platforms for future offshore hydrogen networks.

ECO WAVE POWER

The Company

Eco Wave Power Global (EWPG) is an innovative Swedish energy company, which has developed a patented, reliable, and cost-effective technology for turning ocean and sea waves into clean electricity.

The company's mission is to assist in the fight against climate change by enabling commercial power production from the waves. EWPG's common shares (ECOWVE) are traded on the Nasdaq First North in Stockholm and its ADSs (WAVE) are traded on the Nasdaq Capital Market in New York.

The Market

The World Energy Council estimates that the market value for wave energy is 1€ trillion worldwide, and that the potential global energy production from waves is estimated to amount to 29,500 TWh of electricity.

The International Renewable Energy Agency estimates that by using solely 2% of the world's 800,000 kilometres of coastline which exceed a wave power density of 30 kW/m, the global technical potential for wave energy is about 500GW of electrical energy, based on a conversion efficiency of 40%.

The Problem

According to the UN, energy production is the dominant contributor to climate change, accounting for 60% of global GHG emissions. The production of clean electricity from the waves will be an integral part of the world's renewable energy mix and a significant part of the solution against climate change.

To date, most wave energy developers focused on capturing the power of offshore waves, resulting in expensive and complex projects (which required using ships and divers for simple O&M activities), therefore struggling to commercialize. Whereas, Eco Wave Power has taken a completely different approach.

The Solution

EWP has developed a proprietary wave energy technology that is installed on existing marine structures (breakwaters, piers, jetties) and efficiently harnesses the power of onshore and nearshore waves. We keep it smart, simple and cost-efficient!

Competitive Advantage

Reliable - Most of the system is located on land and is not exposed to rough marine environment. The station is controlled and monitored by a smart automation system which detects storms and raises the floaters above the water level, for protection, when required.

Cost Efficient - Onshore installation, O&M and transmission costs are significantly lower than offshore ones. LCOE in commercial applications will be as low as EUR 42/MWh

Insurable - Reduced Capex and Opex and increased reliability allow full insurability by reputable insurance companies. Environmentally Friendly - No connection to the ocean floor and no environmental impact.

Business Models

BOO: EWP owns, finances and provides O&M for its power station. The electricity produced is sold to the grid in-line with a long-term PPA (up to 25 years). This model incurs a higher initial investment cost but provides a long-term recurring revenue stream.

BOT: EWP funds and constructs the power station, and then sells it to a 3rd party. The project's long-term fixed price revenue under PPA is expected to be attractive for institutional investors, who can pay a premium to purchase the station.

JV / Turnkey: EWP either sells the project to a 3rd party with a profit margin, or collaborates with strategic or financial partners who are willing to share the project risk with the company in the form of a joint venture. EWP may continue providing O&M

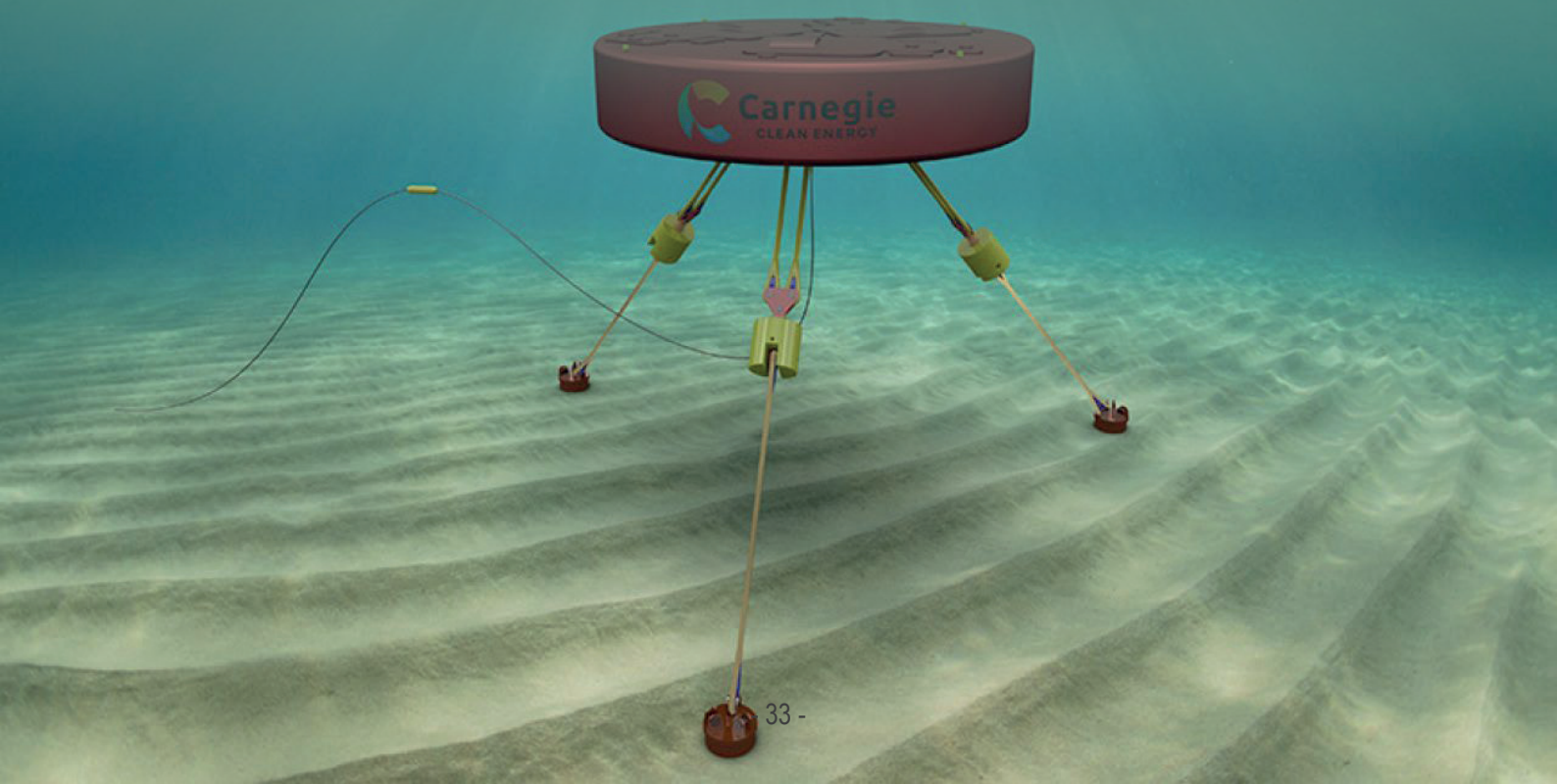
EUROPEWAVE PRE-COMMERCIAL PROCUREMENT (PCP) PROGRAMME

- Project Partners: CETO Wave Energy Ireland Limited, SAITEC Offshore Technologies, Yavin Four Consultants, DNV UK Ltd, IHCantabria and Julia F. Chozas Consulting Engineer
- Location: Europe

Carnegie, via its wholly owned subsidiary, CETO Wave Energy Ireland Limited, has been selected as 1 of 7 contractors to deliver Phase 1 of the €20m EuropeWave Pre-Commercial Procurement (PCP) Programme, a competitive programme to advance wave energy.

Carnegie has been awarded €291k (A$463k) for Phase 1 to deliver a CETO tank testing campaign and a CETO concept design for sites in Scotland and the Basque Country, subject to contract signing. Phase 1 will commence on 3rd January 2022 and run for 7 months.

With almost €20 million in funding for the 3 phases of the programme, which runs from 2022 to 2026, the EuropeWave PCP is a collaboration between Wave Energy Scotland (WES), a subsidiary of the Scottish Government's Highlands and Islands Enterprise and the Basque Energy Agency (EVE).



BLUE-ENERGY COMPANY USES THE POWER OF WAVES TO CREATE A GREENER FUTURE

CalWave aims to unlock the power of the ocean through its proprietary oceangoing device, which converts wave energy to electricity

Did you know that the electricity sector is one of the largest contributors of greenhouse gas emissions? CalWave is on a mission to combat those emissions.

The company, which is based in the San Francisco Bay Area, has developed an oceangoing device that generates sustainable energy by converting wave power to electricity, even under extreme sea conditions. Think of it as an offshore wind turbine, but with waves supplying the juice. “Sustainability is the driver of the entire project,” says CalWave Chief Operating Officer Dan Petcovic. “If you want a net-zero future, clean-energy generation is where that all starts.”

CalWave recently deployed its first unit in the Pacific Ocean off the coast of San Diego. Watch the video to learn more about how CalWave is working to address the effects of climate change.

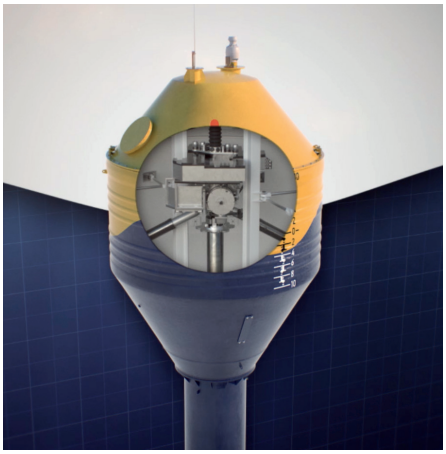
CORPOWER PORTUGAL SHARES WAVE ENERGY MISSION THROUGH COMMUNITY OUTREACH PROJECT

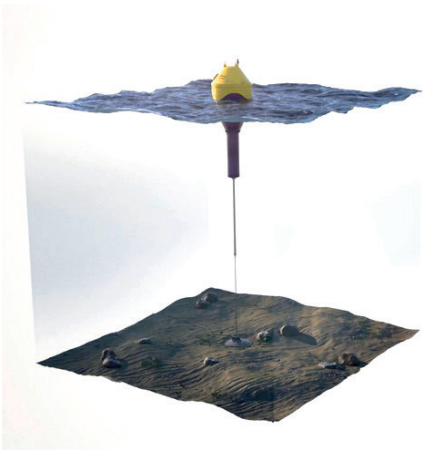
CorPower recently opened its Portuguese base to the public and school students to share its pioneering work in wave energy, and vision to support the future green energy transition.

The community outreach project took place over a two-day period in October as part of a broader tour organised by APDL (Administração dos Portos do Douro, Leixões e Viana do Castelo, SA).

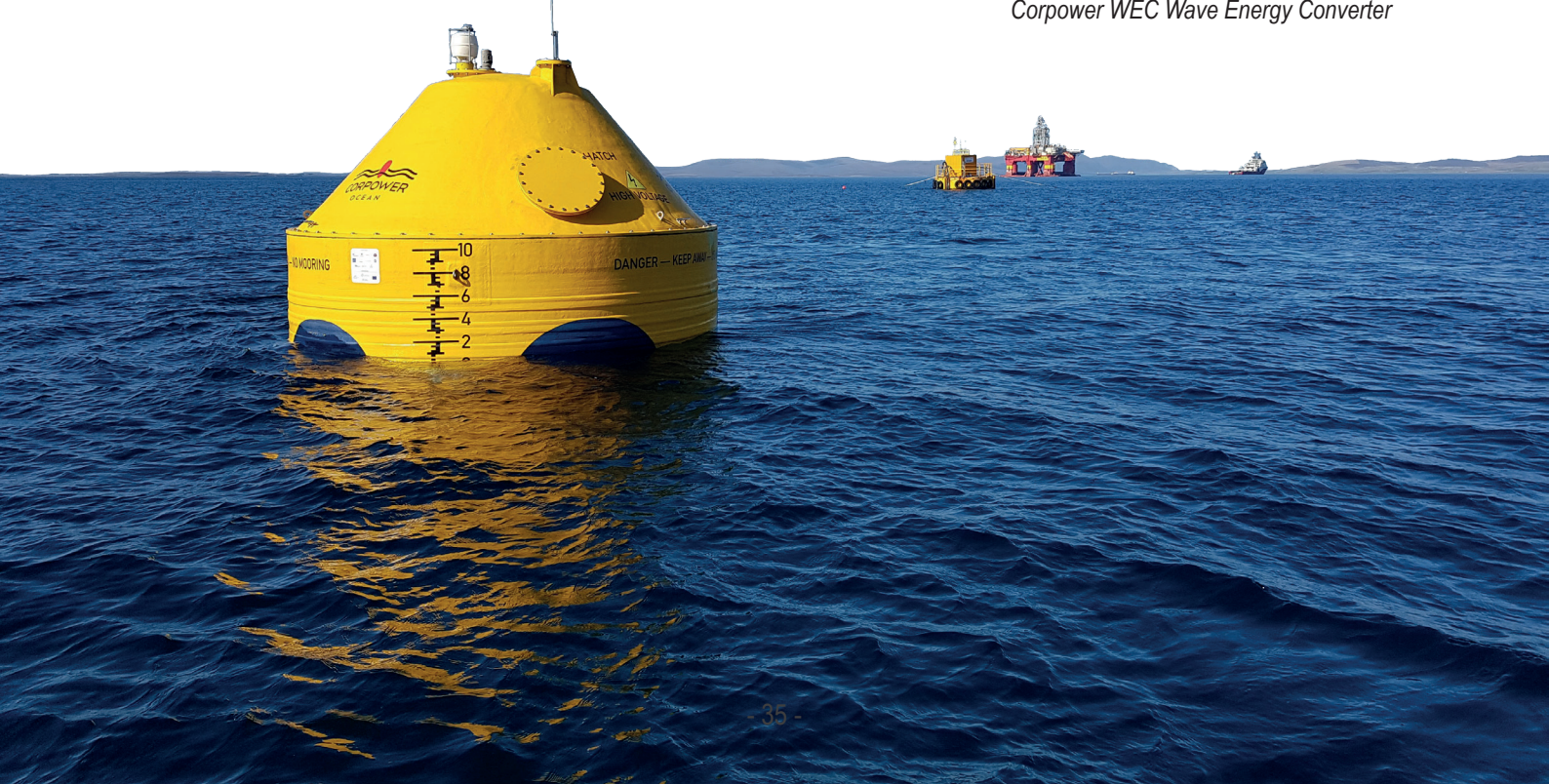
In Summer 2020, CorPower forged a deal with APDL, investing a total of 16million EUR to build a Manufacturing, R&D and Service Centre in the sea port, for widescale production of wave energy converters.

The recent open day afforded an opportunity to update the local community on rapid progress towards CorPower's first commercial scale demonstration, plus involvement in the €45million pan-European EU-SCORES Project aiming to deliver the world's first bankable hybrid offshore energy park – linking wave and wind power.





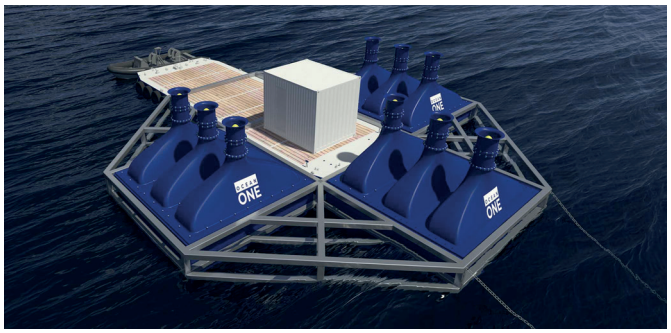
Corpower WEC Wave Energy Converter

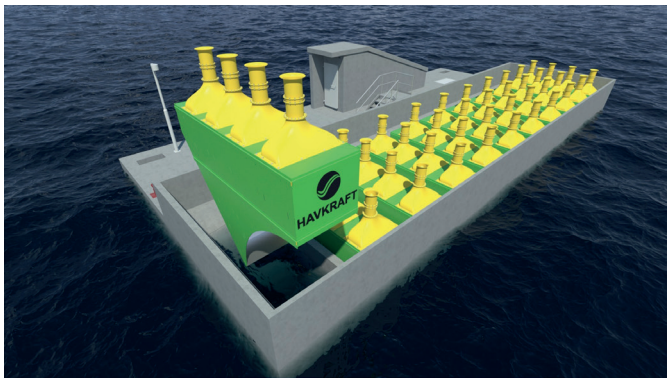


HAVKRAFT

Havkraft AS is tailoring wave energy solutions for clients based on our unique and patented Havkraft Wave Energy Converter (H-WEC). The technology is independent of both platform and materials, and it is completely scalable, making it possible to fit any customer requirement.

The OceanONE powerplant, the world's most efficient, nature-friendly, climate-friendly and cost-efficient wave power concep





Geir Arne Solheim
CEO Havkraft AS

WINGED 'SEA DRAGONS' CAN GENERATE ELECTRICITY FOR 25,000 HOMES

Swedish engineering firm Minesto, a spin-off of Saab, developed a series of tidal turbines, or "sea dragons", that look like submerged aircraft.

The company is running two of the winged machines in the waters of the Faroe Islands in the North Atlantic, where they generate electricity from the ocean's current.

The tidal turbines, or kites, are tethered to the seabed by 131-feet (40-meter) metal cables. This, as well as their 16-feet (five-meter) wingspan, allows each of them to glide through the water in a figure-of-eight pattern and generate enough electricity to power approximately 50 homes.

The principle is surprisingly similar to a flying wind turbine we reported on back in October, developed by Kitekraft. In a similar fashion to an aircraft, Minesto's winged turbines generate momentum and electricity via lift exerted by the flow of water, as opposed to air. Kitekraft's machines, meanwhile, provide the benefit that they can be reigned in during storms or extremely high wind conditions to prevent damage to the systems. Both of these company's systems can be deployed as fleets, with each of the machines tethered far enough apart that they won't collide.

Minesto

ORBITAL MARINE POWER TO FEATURE AT GLOBAL INVESTMENT SUMMI

Orbital Marine Power (Orbital) has been chosen as one of only twelve companies invited to take part in the Global Investment Summit (GIS), hosted by the Prime Minister and supported by members of the Royal Family, taking place 19th October in London.

Orbital recently built and launched the world's most powerful tidal turbine; the O2, from the Port of Dundee, with the unit now installed in the waters off the Orkney Islands in northern Scotland where it is feeding power into the UK grid. Orbital is focussed on commercialising its pioneering technology through larger scale projects containing arrays of turbines, both in the UK and abroad, with the business presenting a unique investment proposition in the rapidly expanding global market for clean energy.

SALE OF GREEN HIGHLAND RENEWABLES

SIMEC ATLANTIS ENERGY

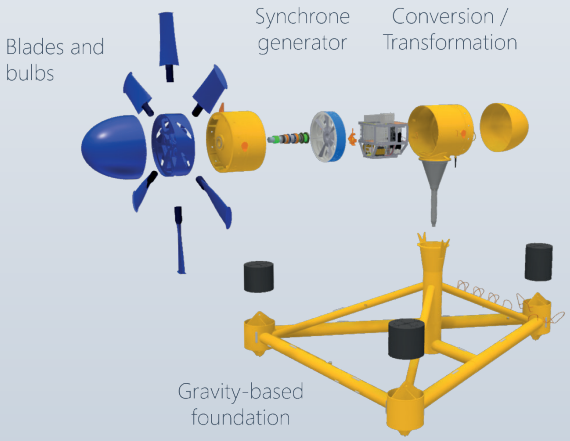
SAE announces that it has agreed the sale of its subsidiary Green Highland Renewables (GHR) for a total cash consideration of £3m, payable in full on completion. GHR has successfully developed and commissioned over 50 hydro schemes across Scotland. Under the terms of the transaction, VH Auslandsbeteiligungen GmbH (VHA) will acquire a 90% interest in GHR and Mr Alex Reading (General Manager of GHR until 9th December 2021) will acquire a 10% interest.

CO-DEVELOPMENT FOR THE PHARES PROJECT

Akuo Energy, first independant French utility for renewable energy production and SABELLA, pioneering actor in the tidal energy field, have signed their co-development agreement for the multi renewable energy project PHARES.

PHARES, coupled with other existing energetic projects, will allow 70% of renewable energy penetration for Ushant island in 2023.

Key facts about PHARES: multi-energy project with two tidal turbines Sabella D12 of 500 kW each, a wind turbine of 900 kW, 500 kW of innovative solar photovoltaïc solution and a storage capacity of 2 MWh, for a total installaed capacity of 2.4 MW.



OCEANS OF ENERGY WILL BUILD 1 MW OFFSHORE SOLAR OFF THE COAST OF SCHEVENINGEN

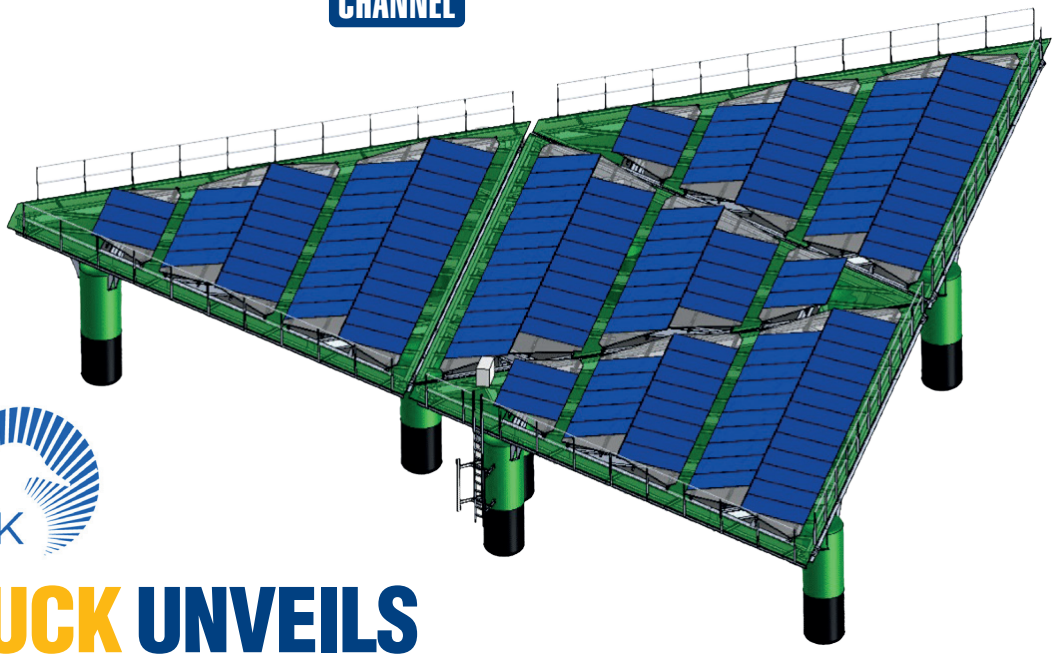
Expansion of world's first offshore solar system supported by parties such as Vattenfall

Scheveningen, The Netherlands; November 11, 2021 – Today Oceans of Energy and partners & observers announce the upscaling of the world's first offshore solar farm system 20 times and expand it to 1 MW (MegaWatt). In the coming years, the company plans to further scale up this system to 10 MW and then 100 MW. 100 MW is equivalent to an energy supply for 30,000 households. The expansion of the offshore solar system to 1 MW is supported by a public contribution from the Demonstration Energy and Climate Innovation (DEI+) arrangement, provided by the Netherlands Enterprise Agency (RVO).

"With the scaling up to 1MW we, together with our partners & observers, are taking another huge step towards a future in which the Netherlands can meet its full energy needs from renewable energy from its own sea and land. With only 5% of the Dutch North Sea, we can generate half of the entire Dutch energy requirement with offshore solar," says Allard van Hoeken, founder and CEO of Oceans of Energy.

He continues: "I am extremely proud of the Oceans of Energy team, of our partners & observers, the Dutch government and all parties that contribute to add this new and potentially largest form of clean energy generation to the energy mix in the Netherlands and worldwide. After all, half of the world's population lives in coastal regions."

More than twenty high-profile parties, such as Vattenfall and RWE Renewables, have joined this project as partners or observers. A full list of partners and observers follows at the bottom of the press releas



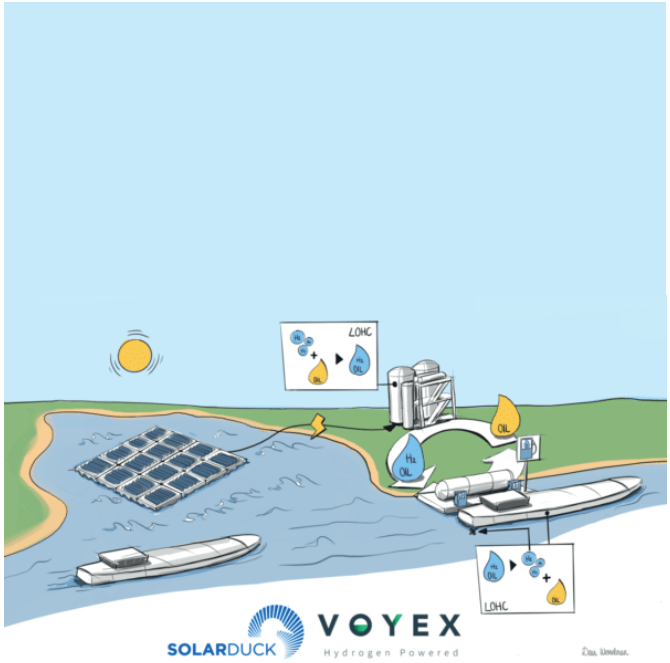
SOLARDUCK UNVEILS DESIGN OF IT'S OFFSHORE FLOATING SOLAR TECHNOLOGY

Dutch floating structure specialist Solarduck has built a pilot 65 kW floating PV array that will be connected to a 10 kW electrolyzer to produce hydrogen bonded with a liquid organic hydrogen carrier. The system is relying on the company's proprietary floating technology that resembles an offshore oil platform.

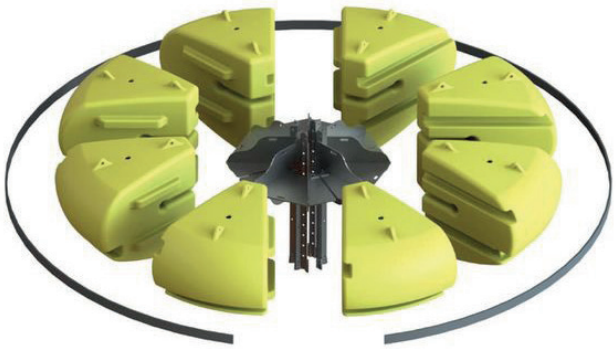
Dutch start-up Solarduck has unveiled the first demonstrator project relying on its floating structure technology for solar projects at offshore sites in estuaries, natural harbors and near-shore sites.

The first plant built with this technology is being deployed on inshore waters in the Waal (Rhine), the widest river of the Netherlands, near IJzendoorn, a village in the province of Gelderland.

According to the company, the 65 kW floating array will be connected to a 10 kW electrolyzer that produces hydrogen. The pilot project is being developed with Dutch hydrogen company Voyex, which specializes in the production of hydrogen bonded with a liquid organic hydrogen carrier (LOHC), an oil-like liquid that serves as a binding agent.



SINN POWER



We distribute our sustainable power generation technologies designed for harsh and maritime environments.

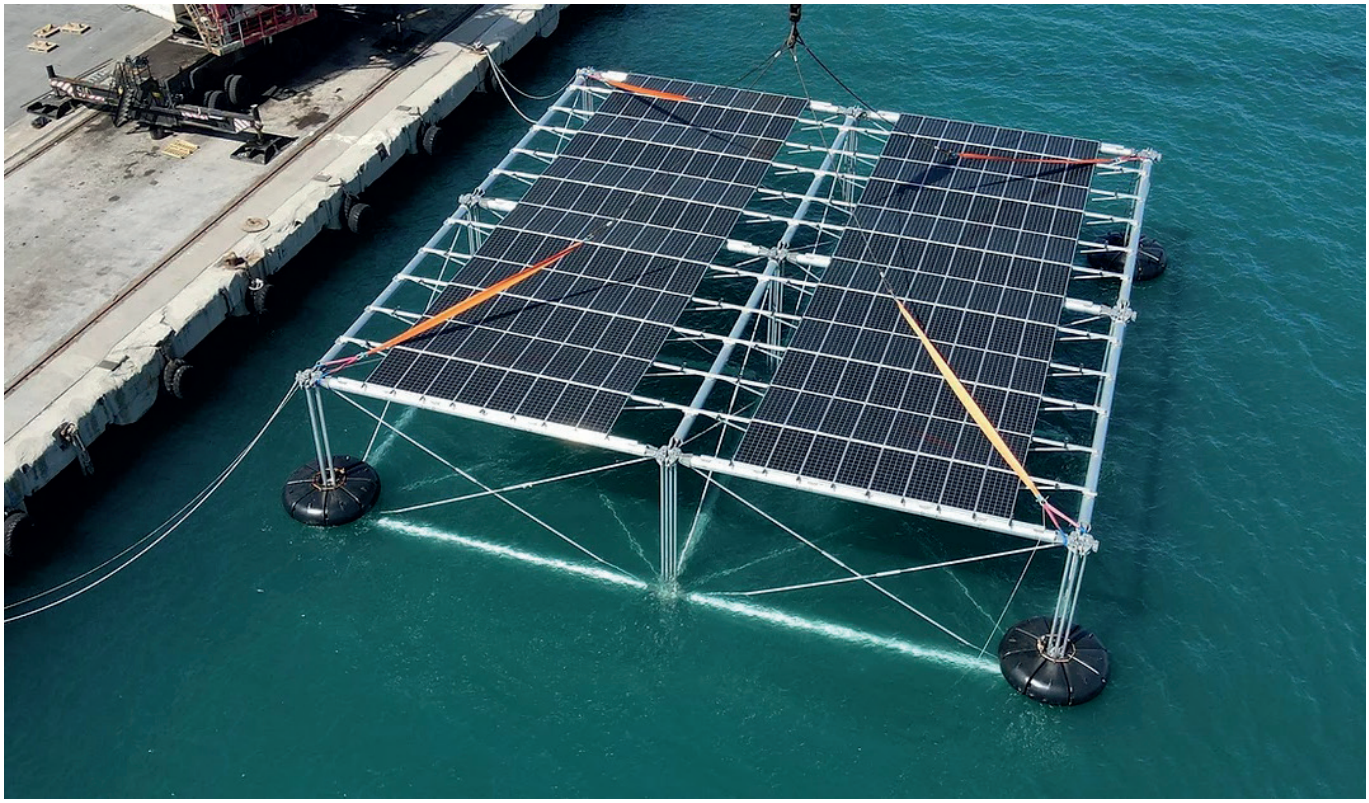
Using the scalable versatile floating platform and our power electronics, we provide the ideal components for our wave power plants.

In addition, these enable seamless incorporation of other sustainable generation technologies such as photovoltaics and small wind turbines into our systems.

We configure structural and electrical technologies individually assembled for your site and provide you with a one-stop solution up to grid feed-in.

SINN Power GmbH
Germeringer Str. 9
82131 Gauting
Germany

contact@sinnpower.com
+49 (0)89 9256 6192



FIDAR OFFSHORE ANIMATION COMPANY

FIDAR Offshore Animation

Hossein Eskandari CEO

Fidar Offshore Animation Company is ready to advertise your company with the best quality and the lowest price. In fact, we are a young and creative team that specializes in producing industrial animation (Offshore Energy Sector), Architectural animation, motion graphics and web design. The Fidar Offshore Animation works in the business world with the message “Pay less, Get the best”.

Fidar Offshore Animation offers:

- Lower prices
- Excellent quality and customer satisfaction
- On time Delivery

If you are convinced, contact me now

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