Breathing new life into ageing wind farms

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The global race to net zero is seeing an unprecedented drive to pursue offshore wind farm opportunities to ensure optimum operational integrity and longevity if they are to play their part in carbon neutrality goals by 2050

The global race to net zero is seeing an unprecedented drive to pursue offshore wind farm opportunities. According to the Global Wind Energy Council (GWEC), by the end of 2030, 270 gigawatts (GW) of offshore wind power is expected to be installed across the world, a whopping 91% increase on installed base globally compared to a decade ago.[1]

As we hear regular reports of new wind farms being constructed off our coastlines, it is easy to forget that this is an industry which is far from being in its infancy. The first known wind turbine used to produce electricity was built in Scotland in 1887. The first large-scale offshore wind farm in the world, Vattenfall Horns Rev 1 boasting 80 turbines, is nearly 20 years old.

According to Renewable UK, there are currently 185 operational offshore wind farms globally. This means that more than 4,700 turbines – 1,356 in UK waters alone – are being continually battered by the waves and wind in often remote and hostile environments. Such structures clearly require regular monitoring and maintenance to ensure optimum operational integrity and longevity if they are to play their part in carbon neutrality goals by 2050.

Growing pains

In 2009, the average nameplate capacity of a now 'teenage' European offshore wind turbine was about 3MW. This is expected to increase to 15MW over the next decade.[2] While larger turbines will generate more electricity, ensuring the commercial viability and efficiency of smaller, first and second-generation turbines is critical to keep up with the growing demand for electricity while installation of their bigger siblings is underway.

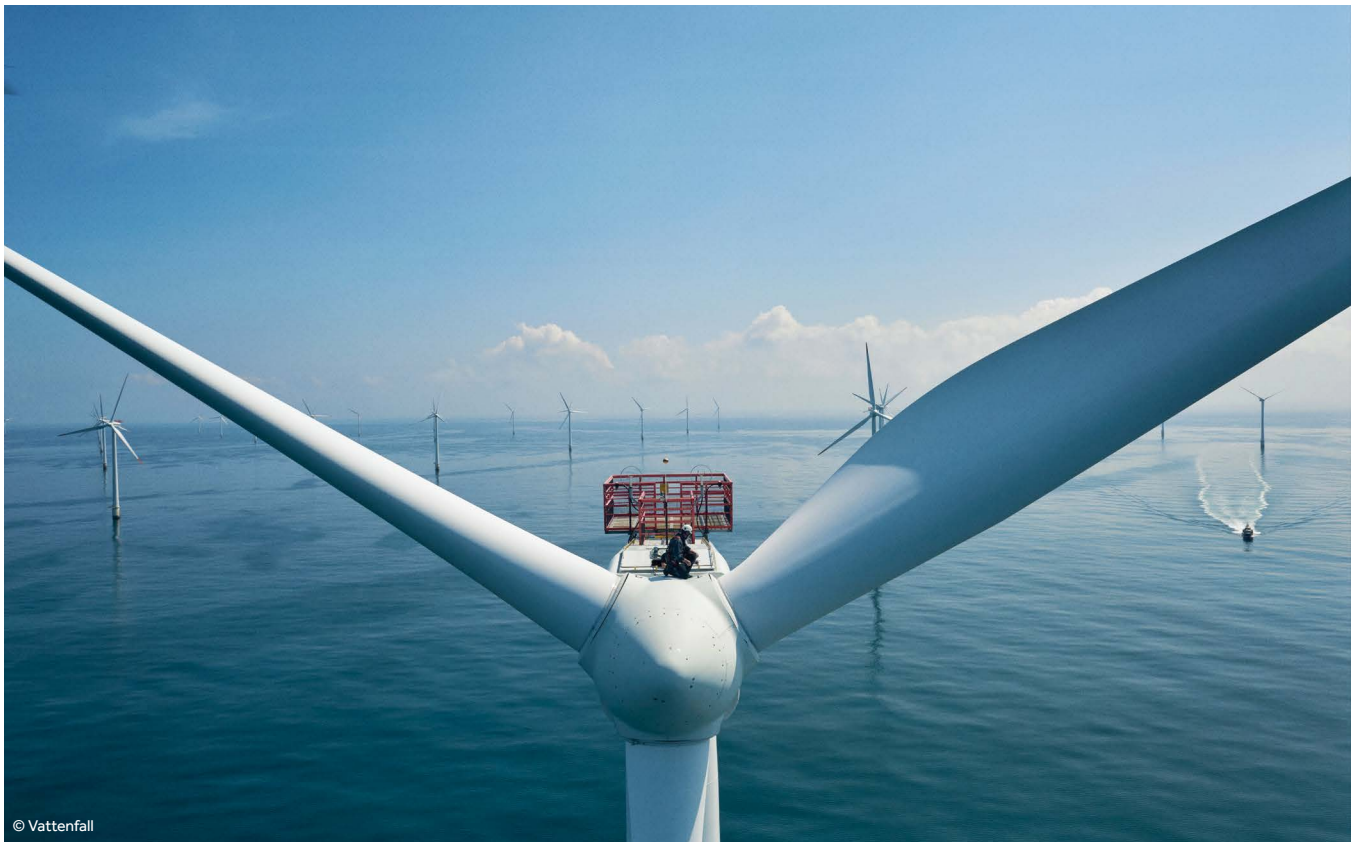
Innovative technology to understand the health status of last generation turbines, and to know when to administer preventative or protective measures, is the cornerstone of reducing operational costs, thought to be in the region of 60-80%, of operation and maintenance (O&M) activity.

Treating turbine troubles

There are two key cost components for the O&M of wind turbines which need to be minimised: those for scheduled maintenance and for unscheduled maintenance. If component failures lead to unscheduled stoppages, then the additional cost of lost electricity sales is incurred. That is why considerable efforts are being made to control and forecast such failures.

Using advanced digital tools, data collation and evaluation can influence and balance the need for both scheduled and unscheduled maintenance costs using trusted information from many parameters and variables such as the sea state or weather conditions. However, while the amount of data is plentiful, analysing and validating its relevance to widen operational windows, reduce risk to maintenance crew, and support improved cost-efficiency and ultimately decision-making, is challenging.

Since the 1950s, wave buoys have been the go-to technology to analyse the frequency, behaviour, and direction of waves in oceans across the world. However, as a single point of measurement on a wind farm site covering multiple square kilometres, their accuracy



Horns Rev 1: Keeping the turbines turning. Green energy remains the biggest opportunity to tackle climate change. Securing significant improvement in this vital area is viewed as the most important lever for the energy transition

and ability to share real-time information with multiple stakeholders, is being confronted. Likewise, the upkeep of the equipment itself is cumbersome and costly.

Miros, a provider of proven high-performance Internet-of-Things (IoT) sensors monitoring real-time sea state data, uses bathymetrical studies during the planning and development phase of wind farms to identify the most suitable sensor locations. Placing RangeFinder sensors for example, at specified turbine and Offshore Sub Station (OSS) locations across the wind farm site will not only allow for a more accurate weather forecast but will also provide a more precise holistic overview of the varying sea state conditions, unique to every individual wind farm. This allows for operators to make safer, more informed decisions especially in relation to O&M activities.

Whilst the Miros IoT solution is a no-brainer for ensuring hefty cost reductions and multiple operational benefits to new offshore wind farms, it can also retrofit smart technology into existing first or second-generation infrastructure where the access and sharing of data can be challenging. Strategically placed sensors will support safer and more efficient O&M planning, execution and life extension activities.

Offshore access and operational planning decisions are typically solely made using weather forecasts which are largely based on models with coarse grids and limited availability of high-quality, real-time and historical data.

Offshore wind OPEX modelling undertaken by the University of Strathclyde has shown on a typical modern offshore wind site (~ 500 MW to 1 GW scale) with multiple Miros sensors could provide an OPEX saving between £300k-£1million GBP and a reduction of 5% CO_2 emissions per annum.[3]

Smart, safe and secure sensor solution

In 2019, Miros began working with Vattenfall on Horns Rev 1, one of the Swedish developers' first-generation projects, offshore Denmark.

The Horns Rev 1 operations team had experienced difficulties with its wave buoy and was becoming disillusioned with traditional wave and weather forecasting provided by metocean vendors. Data accessibility and the means to share accurate real-time data with many stakeholders, including vendors and employees, within a safe and secure system, was also an issue and was hampering critical decision-making on necessary O&M, as well as planned life extension activity.

As a solution, Miros installed five wave radars plus one weather sensor across the project site as part of plans to extend operations to the end of this decade. Vattenfall was also keen to allow third party access to real-time sea state data to support relevant suppliers and stakeholders to analyse and improve daily operations.

Data is only one click away

The entire project team has quickly realised the operational benefits and cost savings of using the self-calibrating sensor technology. By adopting the Miros Cloud platform, the Vattenfall team is seeing a positive impact on the reduction of employee time and resources across several internal stakeholders i.e. Site Operations, SCADA, IT, Metocean, Asset Integrity, etc.

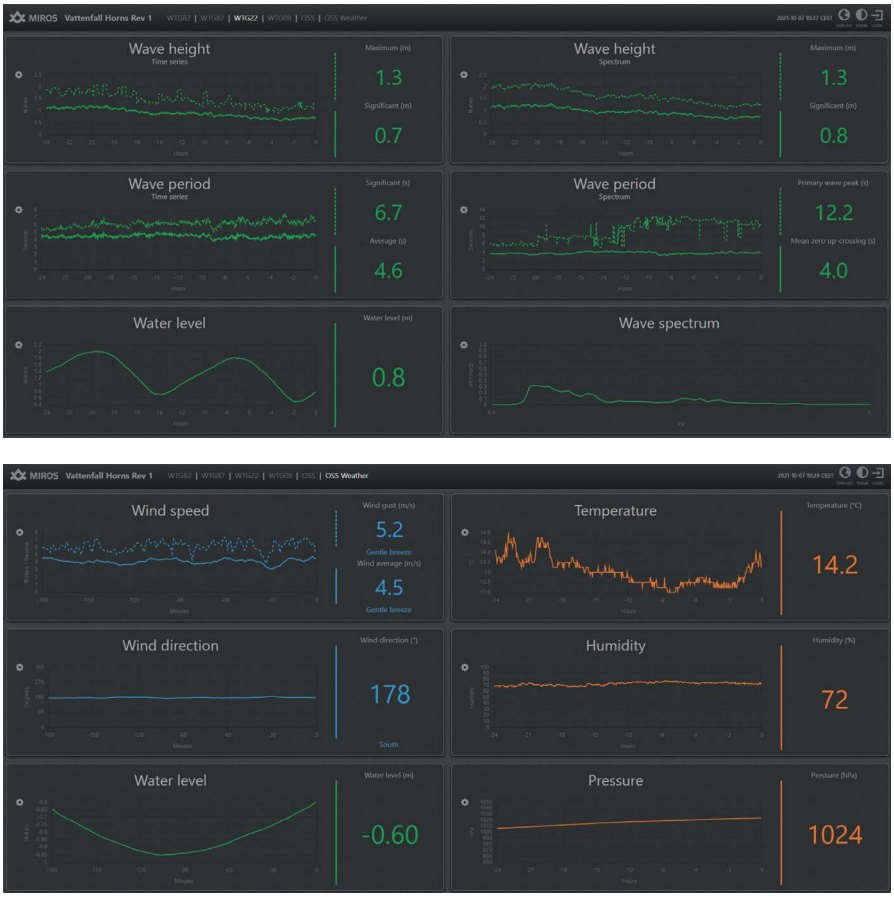
For example, a project manager based remotely and the operations manager at the marine operations base can simultaneously view the actual sea state conditions on-site on real-time dashboards, accessible anytime on any device. This directly impacts the decision as to when it is safe for personnel to be transported via crew transfer vessel (CTV) for conducting maintenance activities.

With the help of IoT-enabled Miros RangeFinder sensors, distributed across the wind farm, the team can easily see the variation in sea state across the entire site at any time. In certain scenarios, it is possible to perform maintenance in one part of the wind farm where the sea is calmer while weather conditions in another area may be more unfavourable to work in. Previously due to sole reliance on weather forecasts, there would be a high probability of waiting on weather. However, now having quick and easy access to real-time data also contributes to avoiding wasted or aborted vessel trips and therefore also contributes to the overall reduction of CO_2 emissions.

The benefits of improved communication of the sea state and weather parameters are also extended to the project's external stakeholders i.e. weather forecast providers, vessels, engineering consultancies, research programs, universities, etc., which could be up to 50 or more simultaneously. Meaning that whether they are working part or full time on the wind farm, being able to always have direct access to exactly the same data as their client, supports more collaborative, solid, and true working conditions. Public, live data from Horns Rev 1 can be seen at miros.app.

Enhancing knowledge and extending operations

The project has proven that the combination of appropriately chosen locations to source data from and full IoT capability is vital to facilitate real-time decision support, post-operation analyses, future planning, and long-term asset integrity calculations. For wind farm operators, this dynamic



With the help of IoT-enabled Miros RangeFinder sensors distributed across the wind farm, the various Vattenfall project teams can simultaneously view the actual sea state conditions across the entire site on real-time dash-boards, accessible anytime on any device. Live data from this project can be seen at miros.app

approach gives more influence and control on operations, while for service providers, it gives credibility and assurance that contract expectations can be delivered on schedule and importantly, on budget.

This 'plug and play' technology is achieved by IoT-enabled sensors providing data on the secure Microsoft Azure platform with access for all relevant parties in the Cloud. Data can be downloaded directly for reviewing, cross-referencing and sharing for an even more accurate picture of sea state and weather conditions and thereby optimising wind farm integrity, activity and planning.

Having multiple sensors across the wind farm will give a more holistic, accurate overview of what is happening at various locations. Not only will this reduce risk to personnel and O&M costs, they will also contribute to lowering carbon footprint, an essential step forward for the energy industry in its drive to lower emissions. From an operational perspective, rather than decommission wind farms and turbines, they can be refreshed and renewed.

Strengthening the circular economy

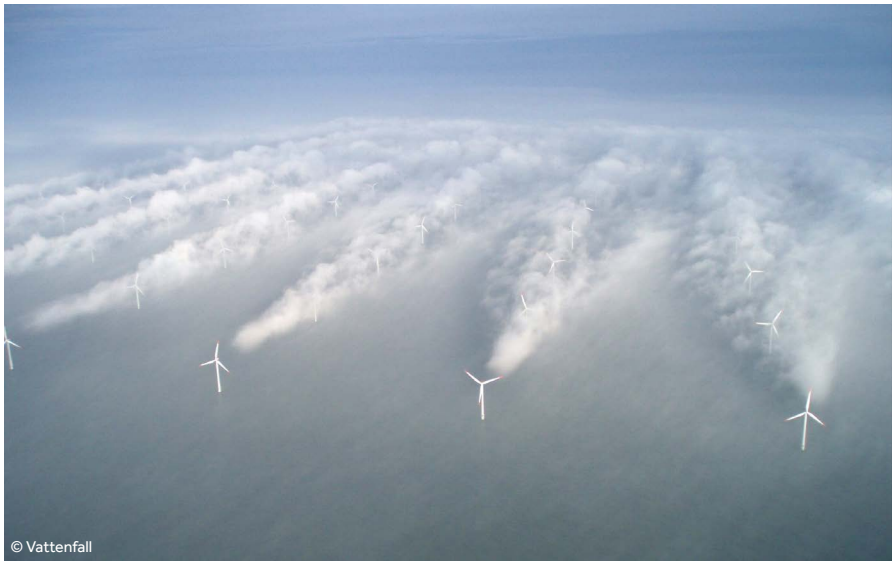
The GWEC 2021 report predicts that the volume of annual offshore wind installations will pass the 20GW milestone in 2025, increasing its share of global new installations from today's 6.5% to 20% within four years.

Such a vast leap for the sector must be met with fast-tracked innovation by its players to bring siloed entities together. Overthrowing the complex collection and sluggish dissemination of data by outdated equipment will lead to a process that is trusted, timely, secure and streamlined to bolster safe and sustainable operations.

Miros sensors do exactly that. We currently offer three distinct IoT-enabled sensors to the offshore wind market, the Wave & Current Radar, the RangeFinder and Wavex. Based on proven technology, evolved and tested exposed to the harshest marine environments over the last decades, these sensors successfully enhance digitalisation and support today's market requirements for smart 'plug and play' systems.

In addition, to contributing to reduced CAPEX and in turn reduced OPEX, Miros has also adapted its business model providing a Sea-State-as-a-Service (SSaaS) solution echoing the models of many digital platforms. This facilitates adoption of the solution from a business and procurement perspective where Miros instead takes on all operational risk of the system and provides purely the data, customisable to the needs of the client at a click of a button.

To encourage further cost reduction and safety onsite, Miros typically offers remote start-up configuration and client training as well as all maintenance, software upgrades, device management and technical support, which are included in an all-inclusive, low-risk monthly fee.



Horns Rev 1: Innovative technology to understand the health status of the last generation turbines, and to know when to administer preventative or protective measures, is the cornerstone of reducing the operational cost

Keeping the turbines turning

Green energy remains the biggest opportunity to tackle climate change. Securing significant improvement in this vital area is viewed as the most important lever for the energy transition.

According to DNV's Energy Transition Outlook, the share of offshore wind in total wind electricity generation will increase steadily, rising globally from 6% in 2019 to 40% in 2050. Most notably, for fixed and floating offshore wind farms, levelised costs will fall 44% and 80% respectively, boosted by improvements in O&M expenses reductions as experience with new technologies and the continuous rapid pace of installing and operating offshore wind turbines evolves.[4]

It is imperative that smart technologies can be easily and cost-effectively retrofitted to existing wind farms in continued support of turbine renewal and repowering as opposed to decommissioning and rebuilding.

In order to contribute to strengthening the circular economy to tackle the global climate crisis. How do you plan to expand the valuable lifetime of ageing offshore assets? What are your next steps? Miros would love to discuss experiences with all project stakeholders to understand and support your lifespan extension strategy.

https://www.miros-group.com/markets/renewables/

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With more than a decade spent working within the supply chain in the ever-evolving energy sector, Miros' Maggie McMillan has been riding the renewable wave since 2014. As a staunch advocate, and catalyst, for the continued rise of offshore wind, Maggie embodies Miros' commitment to enhance the safety, sustainability and performance of offshore operations.