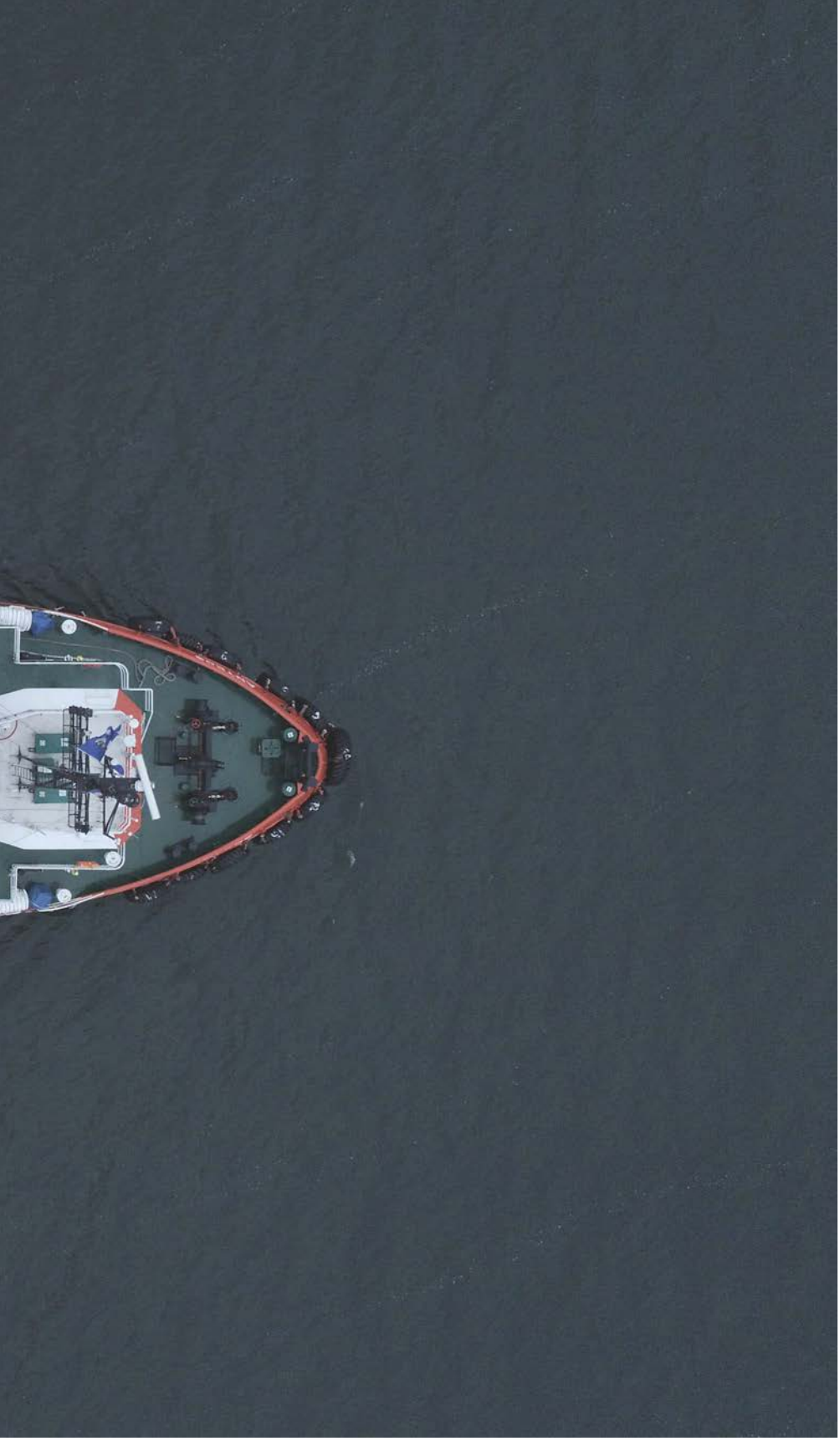
Taking the measure of offshore wind farms

Data is essential in helping optimise future wind farm design, allowing for improvements to the efficiency of operations during the construction phase and throughout its lifecycle. Collecting the data accurately is crucial, so we were keen to learn more about the technology that makes this possible, from Sergi Roma, Business Developer at EOLOS Floating Lidar Solutions.



PES: We're delighted to welcome you to PES Wind. We're looking forward to finding out more about EOLOS and with that in mind, perhaps we can begin with a short history of the company?

Sergi Roma: Thanks for the opportunity, we are pleased to be featured in PES Wind. EOLOS is one of the global pioneers in the collection and commercialization of wind, metocean and environmental data for the offshore wind industry. The data is measured through proprietary floating platforms equipped with state-of-the-art lidar technology to measure wind characteristics, and other advanced sensors for the characterisation of ocean currents, waves, water quality, marine fauna and birds, among others.

This data is critical for the design, construction and operation of offshore wind farms and is accurately measured during campaigns of typically a year or two, quality assured and then issued to the end client for their own scenario modelling.

EOLOS was founded as a start-up in 2014 by Rajai Aghabi, backed posteriorly by European-wide equity funders InnoEnergy and Swiss-based independent sustainable energy investor Prosum Capital. The company was a spin-off from Institut de Recerca en Energia de Catalunya (IREC), where the Floating Lidar FLS200 system was first developed and tested off the coast of Barcelona during the summer of 2012. In 2022, EOLOS gave entrance to its capital to Nazca Capital, a company focused on investing in small and medium-sized unlisted Spanish companies.

From a product point of view, two milestones have been crucial in the history of EOLOS. In 2015 the FLS200 reached Carbon Trust's Stage 2 certification, following a six-month validation campaign at RWE's IJmuiden offshore met mast, which was carried out by Carbon Trust under the Offshore Wind Accelerator (OWA) Wake Effect Floating Lidar Data Analysis Framework project.

Secondly and more importantly, in early 2022, with a track record of more than 40 measurement campaigns developed in 1 0 countries in Europe, Asia and North America, EOLOS achieved the Carbon Trust's Stage 3 certification. This is the most rigorous in the industry, attesting to the high reliability of its systems and accuracy of its wind data. EOLOS is one of only two global operators to have it.

Since 2014, the company has grown significantly, and special focus has been placed on personnel, expertise and fleet expansion, allowing a global presence and activity. This combination has been key in providing solutions to our customers all over the globe, combining EOLOS's technology and digital services with local marine operations partners in places like Europe, US, Korea, Brazil, India, Japan and the UK.

PES: Essentially, you provide products and services that enable data-driven decisions to reduce offshore wind energy costs, correct?

SR: We collect wind, metocean and environmental data for the offshore wind industry, for the characterisation of ocean currents, waves, water quality, marine fauna and birds, among others.

The wind, meteocean and environmental data captured is critical for the offshore wind project development, because the reliable data reduces a project´s uncertainty, financial risks and increases its bankability. In addition, this data will be crucial to optimise the wind farm design and will allow improvements to the efficiency of the operations during the construction and exploitation of the offshore wind farm.

PES: Uncertainty is something that operators are looking to reduce of course, so it is interesting to note that your floating LiDAR buoy has achieved Stage 3 certification. Can you explain more about that?

SR: The Stage 3 Certification demonstrates maximum level of data quality, system reliability, and lowest data uncertainty. In more detail, the Carbon Trust Offshore Wind Accelerator Roadmap for the Commercial Acceptance of Floating LiDAR Technology OWA Roadmap, defines three stages of maturity for floating lidar systems. These are Baseline, Pre-commercial and commercial.

Achieving Stage 3 certification is a very demanding process that requires several steps and data evidence from different campaigns and posterior analysis.

First, we had to fulfill the classification criteria, with the object of reducing measurement uncertainty estimates through classification of the floating lidar. Classification determines the sensitivity of the floating lidar's measurement accuracy to changing environmental conditions. Classification of the floating lidar requires at least three long type-classification trials, lasting 3 to 6 months.

Secondly, in addition to the three long type-classification trials, Stage 3 also requires at least three short unit-verification trials, lasting 1 to 3 months. Thirdly, Stage 3 requires at least five early commercial project deployments, using the same floating lidar type, where each deployment includes at least 12 months of uninterrupted data collection.

Finally, and most importantly, in all three cases above, all data collected are required to meet the best practice acceptance criteria for data availability and data accuracy Key Performance Indicators according to the OWA Roadmap.

PES: Are we correct in saying that Stage 3 signifies the highest possible level of availability and performance providing minimal levels of uncertainty in site specific measurements?

SR: Yes, in terms of availability the requirements are clear; 95% monthly system and at least 97% overall system availability and at least 85% and 90% monthly post processed and overall post processed data availability.

In terms of accuracy, EOLOS' uncertainty figures from short term verifications, long term verifications and long term classifications, the overall uncertainty levels of the FLS-200s will potentially lie between 2% and 4%, analogous to expected levels of uncertainty delivered by traditional anemometry.

PES: How has this been achieved?

SR: Putting strong effort, expertise and focus on the two aspects that our customers value more, which are technology and project execution.

The first one is related to our product and technology, the EOLOS FLS200. For that design, we have combined an extremely mature Lidar system, the ZX 300M from ZX Lidars, with a robust and tested electro-mechanical buoy allowing the entire system to operate collaboratively very well under harsh conditions and providing exceptional levels of reliability and performance.

Sergi Roma

The second aspect has been the focus on the project or campaign execution. Strong and strategic local partners working on the marine operations combined with EOLOS operations team expertise and effort has been crucial to execute all these projects all around the globe with minor incidents and exceptional results in terms of project safety, on-time delivery, quality and performance.

PES: It's a fairly unique group to be in too isn't it, with just a few companies achieving Stage 3 so far?

SR: As we described before, achieving Stage 3 is a very demanding and thorough process that requires technology, product and project

execution at the maximum level of quality and performance. Clearly, this is what our customers are requesting more and more in line with the global growth of offshore wind. By obtaining this maximum level of maturity, we are providing greater confidence. In addition, it allows us to place the floating lidar technology on the same level of maturity as other mature wind products or services.

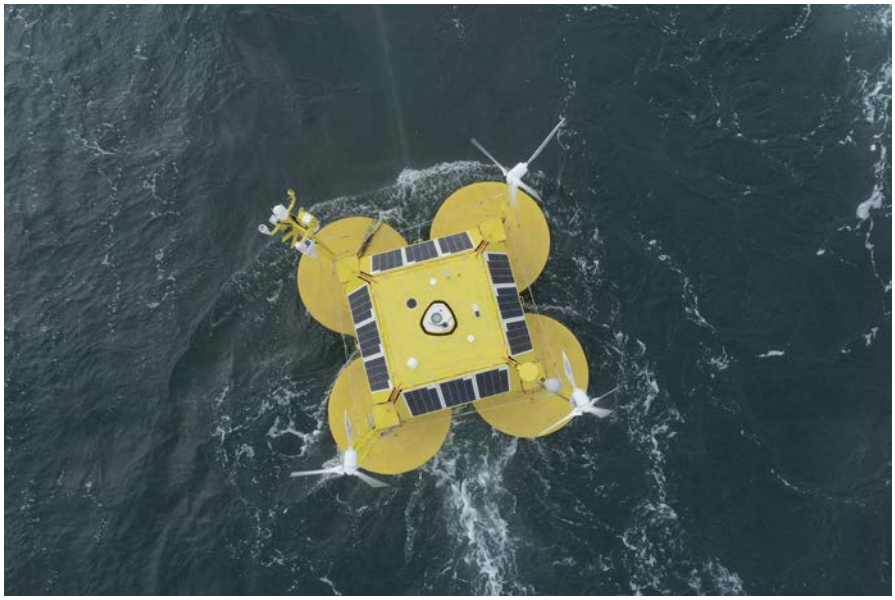
PES: The features and functionalities of your floating lidars go beyond wind measurements, don't they? What kind of thing can they measure?

SR: This is an interesting question. Wind measurement has been traditionally the most in demand service, especially during the preconstruction phase. But I would like to mention that the backbone of EOLOS is the capacity of operating a measurement system capable of providing solutions to any clients' requirements regarding their offshore projects.

In this sense, we are providing proven waves and current measurements, which are essential to determine site conditions and designing turbines, foundations, mooring and cables both for fixed and floating wind farms.

Another obvious field in which a floating platform like ours is able to add significant value is in regards to environmental monitoring. Permitting and consenting wise this is a sensitive aspect that needs to be handled at projects' early stages. At EOLOS, we offer environmental data services to our clients, by managing and elaborating the information gathered by incorporating wildlife monitoring systems, as well as a bunch of water quality sensors in our devices.

PES: What are the main benefits of these measurements? What problems are you helping to address?



SR: The benefits of characterizing the oceanographic conditions can be seen in a reduction in the uncertainty design fatigue levels. Our analysis accounts for around 5% in the fatigue potential reduction, therefore significantly impacting capex and opex magnitudes.

In terms of the environment, to monitor the presence of mammals for instance, it might become crucial to ensure the viability of an offshore project in some latitudes. It is reasonable then to assume that a developer would not put at risk a project by not monitoring such elements when it has the chance to do so, by taking advantage of an asset and infrastructure as it could with an EOLOS system already working in the lease area.

PES: How is the data received and stored? How easy is it to manage, analyze and share while minimizing uncertainties?

SR: EOLOS has a very strong and expert team focused on data management, analytics and science that is continuously working to ensure proper data retrieval, quality and reporting. It is clearly the department that has grown the most in recent years and will continue to do so in the future according to our customers' needs and requirements.

Data captured by our sensors is immediately encrypted in the buoy and then sent via different channels to our cloud. Depending on the site location, nearshore or far shore, we can use different communications systems like 3G or Satellite Iridium. Several cybersecurity methods, back-ups and redundancy systems are applied to guarantee data retrieval, availability and data privacy.

As soon as the data is in our cloud platform it is verified and post processed following three main criteria. Firstly, is a set of post processing algorithms to ensure data quality. The second stage includes all data analytics, visualization and reporting and finally, the third process is related to data science.

The capabilities of the cloud, and especially those related to big data management, analytics and science have been crucial to the growth of the digital capabilities at EOLOS. They allow the management of big and diverse sets of data coming from multiple sensors during long campaigns, ensuring data quality during the whole process and providing easy, interactive and custom tools for our customers to visualize, analyze and use the data and the related information.

PES: It sounds like the technology is already quite advanced but do you think there is still room for improvement? If so, in what areas?

SR: Yes, the technology has advanced in parallel to the huge amount of offshore wind projects developed during the last years. Nevertheless, there is always room for

improvement, and we have never stopped allocating resources to product development initiatives, both in terms of the design of features, operations or reliability improvement measures, as well as R&D programs.

In terms of product solutions, we identify opportunities in two areas. Firstly, mainly driven by a constant increase of new sensors and more data to be captured in order to have more information from the ocean. That requires advanced power, control and communication systems keeping or improving the same level of quality and reliability achieved so far.

We foresee oceanographic and environmental measurements as two fields in which technology and data management are liable to be further exploited. I strongly believe a floating system such as the EOLOS FLS200 is able to add significant value to offshore wind developers and operators in this regard.

Secondly is related to the capability of the digital services involving its data analysis and its connection with other sources of information that, when combined, can provide extra added value to our customers towards designing better offshore wind farms or to reduce the cost of exploitation of existing ones.

PES: How do you think market conditions will change in the next few years and are you able to adapt to new challenges?

SR: We expect a diversity of geographies, more complex sites and more demanding services coming from our clients, both in terms of performance, but also in terms of services catalogues and capabilities.

PES: What is next for EOLOS?

SR: We continuously work hard to incorporate clients' feedback and track record experience. In the last year, we have grown significantly in terms of personnel. We put a lot of detail in gathering the knowledge and skills to incorporate into our work force as this is the ground on which the company roadmap is based.

Next for us is to continue our roadmap based on project excellence, including local strategic alliances, product quality and reliability and finally data and digital services. All with the aim of adding value to our customers to ensure optimum and efficient offshore wind farms are developed worldwide.

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