Offshore wind turbine system that can be completely pre-assembled and pre-commissioned in controlled harbour conditions

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Credit: AI-generated image (disclaimer)

Although wind power is highly regarded as an important source of sustainable energy, the costs of installing the necessary turbines have

always been an obstacle to its widespread adoption. This is particularly true for offshore windfarms, which require large, high-tech wind turbines to be constructed – and maintained – in the oceans themselves.

Thanks to an innovative offshore wind turbine construction process developed by the ELISA project, this traditional barrier to the use of wind energy has finally been overcome. This innovation, the ELISA technology 5MW fully operational prototype, is located in the Canary Islands and is the first bottom-fixed offshore wind turbine completely installed without the need for costly and scarce heavy-lift vessels.

'The ELISA technology is a pioneer in the development of completely self-installing offshore turbines', says project engineer José Serna. 'The entire system is completely pre-assembled and pre-commissioned in controlled harbour conditions, enhancing the possibilities for industrialisation and minimising risks related to offshore assembly work.'

Telescoping technology

The ELISA 5MW prototype uses a gravity-based foundation, which essentially serves as a floating platform from which an automatically telescoping tower complete with wind turbine is anchored. Each unit – platform, tower and turbine – is completely assembled onshore. It is then towed to its open-water site using conventional tugboats, where the platform is secured and the tower raised.

'It's important to note that currently there are only three or four heavy-lift vessels in Europe capable of installing an 8MW turbine in waters deeper than 40 metres – and Europe leads the way in comparison to other developed markets', says Serna. 'In other words, this system will also be a key European export to such markets as the US and Japan.'

What's particularly unique about the system is that the telescopic configuration of the tower was designed to bring down the unit's centre of gravity, meaning the platform serves as a self-stable floating barge from which the crew can preassemble the entire system inshore. Being able to build the structure inshore, as opposed to the open and often treacherous waters of the ocean, brings a huge reduction in the human risks that so often accompany the assembly of open water wind turbines.

'This vessel-free installation capacity is not only a source of large cost reductions, but also a way to support the clear trend towards larger offshore wind turbines, a key step towards improving a wind farm's cost of energy', explains Serna.

Once tugged into its out-at-sea position, the platform is ballasted to rest on the seabed. Then when secure, the tower is lifted to its final position via cables and conventional heavy-lift strand jacks. These jacks start by lifting one level of the tower, and then are reused to lift the next level, and the next, and so on until fully built. Furthermore, the jacks are supported by the one below, which also guides the hoisted tube as it rises in a self-installing procedure where the tower itself is the only supporting structure required. And all of this is done from a single access platform.

Many advantages

'ELISA will allow for drastic cost reductions in the substructure supply and in the installation costs of offshore wind energy, which is set to play a strategic role in Europe's evolution towards a low-carbon and locally sourced energy mix', says Serna. 'As a matter of fact, the cost per MW of the prototype being developed is already below current market prices, despite all the investment required in auxiliary infrastructure and means whose complete costs have been dedicated to a single unit.'

According to Serna, the ELISA system can significantly reduce costs by

as much as 30-40 % compared to traditional solutions based on jackets or XL Monopiles. It also saves users on maintenance and upkeep – significant costs for turbines facing the brutal elements of the open sea on a daily basis.

Thanks to ELISA's robust, durable and fatigue-tolerant and maintenance-free concrete substructure, researchers claim the system will improve the integrity of the structure and reduce operational costs. As an added bonus, the system is noiseless and more environmentally friendly than steel alternatives with regards to its impact on sea life and carbon footprint.

More information: For further information, please see the project page on CORDIS: cordis.europa.eu/project/rcn/197175_en.html

Provided by CORDIS

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