August 2022

COREWIND LCOE Survey Analysis

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ABOUT THE SURVEY

The survey included 24 multiple choice questions. The survey covers factors that impact the LCOE. In total 25 companies completed the survey. Almost half were project developers. Consultancies and Certification bodies make up one-quarter of the answers. The rest is a combination of suppliers for specialised equipment (foundations, cables, moorings, anchors) and marine contractors.

1.1. FOUNDATIONS

Manufacturing

- The size and weight seem to not be a limitation for upscaling foundation designs, if it is cost effective to go for a larger turbine and thus foundation. The feasibility of this highly depends on the substructure type and fabrication area, but in principle there is no limitation. Experts suggest that concrete foundations are more easily scalable compared to steel ones.
- The number of days for manufacturing one foundation vary on a case by case, according to the logistics, construction and availability of manpower and materials. But most people agree it is possible to manufacture one foundation in less than 30 days (for semi-sub and spar). One of the main manufacturers of foundations today in Europe would be able to deliver up to 10 floaters a year (so approximately 36 days). Everyone agrees that commercial projects require a much faster delivery rate for floaters.
- **Workshop -** There is little knowledge about the exact amount of energy consumed for manufacturing one foundation. This data will be needed to improve the environmental footprint through Life Cycle Assessment (LCA). The only comment is that is the energy used is more than 100 kWh/ton and 10 litres/ton for a concrete semi-submersible.
    - *Can you provide an estimation of the energy consumed (electricity and fuel) during the manufacturing of one floating substructure fabricated in your facilities? Even if it is based on a metric other than weight.*
    - *If there is uncertainty, perhaps consider the ancillary means, i.e., how many trucks, cranes (lattice crawler, telescopic or tower) and other machinery is needed and how long?*

Design

- The lifetime of concrete foundations is 40-50 years. But extending the lifetime only makes sense if the wind turbine can be designed to operate for a longer period too. It is mainly developers and suppliers who think that concrete foundations have a longer lifetime. The consultancies and certification bodies consider it 25 years.
- **Workshop –** It is difficult to say which are the cost advantages (quantitative) of concrete foundations over steel. Qualitatively, concrete foundations require less increase for a large turbine compared to steel. And they can have a longer lifetime.
    - *What are the challenges to overcome in the construction of concrete towers? For example: tapper sections are more difficult to handle than using steel towers.*
    - *Is the offshore industry ready to introduce stiff-stiff towers in floating wind?*
    - *Do you think that a combination of concrete-steel tower is possible?*

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1.2. MOORING SYSTEM

- Deepwater mooring systems pose different technical challenges, but the most influential for the LCOE are the installation and O&M strategy. Experts think the manufacturing capabilities could be bottleneck.
- **Workshop -** There is an even opinion about the lifetime on mooring systems. Almost half of the experts think it can be longer than 25 years. This is mostly expected from fibre rope systems as opposed to steel chains. The second half think the lifetime is less than 25 years. So 25 years (median) could be a reasonable assumption.
    - *Do you think that lifetime's intervals proposed were too large?*
    - *For 25 years and above, is it something you expect to be achieved in the future, or this is something you are confident with for current projects?*
    - *For those who provided lifetime estimates, is the answer based on dedicated analysis (fatigue analysis, etc.)?*
- **Workshop –** Today drag-embedded anchors have been mostly used in floating wind farms. Drilled piles seem the preferred second choice. Moorings can and are chosen based on site conditions. Experts proposed other options not included in the survey, including torpedoes for deep waters and SBAs for clay.
    - *Does the turbine size and depth would influence the type of anchors?*
    - *Which anchor system do you expect to use when sharing mooring lines?*
- **Workshop –** Sharing mooring lines and anchors could reduce 1-15% the cost of mooring system per turbine. But people agree it is difficult to say as the project design parameters (i.e., turbine spacing, redundancy, etc.) influence the result. So, the cost savings have to be evaluated in each project.
- Which are in your opinion the drawbacks to apply the technology?
    - *Lack of matureness*
    - *Line failure can lead to a progressive failure and affect other FOWTs*
    - *Increase of cost of the anchors when using shared moorings.*

1.3. ELECTRICAL SYSTEM

- Deepwater dynamic cables pose different technical challenges, but the most impactful for the LCOE is design at wind farm level. Experts are most concerned about the lack of dynamic export cables.
- **Workshop -** There is an even opinion about the lifetime of dynamic cables. Half of the experts think it can be longer than 25 years, and the rest think it is less than 25 years. So, 25 years (median) could be a reasonable assumption.
- **Workshop –** Inter array and export cables major repair (replacement of one section) is likely to happen less than twice per lifetime. However, experts think inter array is likely to fail more frequently than export. The industry think current failure rates are high and should not be accepted.
    - *Which maximum power level do you expect inter-array cables to be requested to carry over the next 10 years?*
    - *What would be the greatest water depth do you expect inter-array cables to be deployed in the next 10 years?*
    - *Do you expect a greater level of dynamic motion at the FWT platforms than the floating export platforms?*

1.4. INSTALLATION

- **Workshop –** There is an even opinion about the time it takes to install offshore cables. Site conditions (like water depth) have a direct impact.

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- *What are the reference timings to install offshore cables, including to connect an offshore cable to the onshore substation?*

- It is possible to perform preinstallation of floating components in a sheltered area at sea. But the geometry and assembly of the foundation needs to be designed for this purpose and today most are designed to do it at ports. Most experts think this type of installation does not require secondary floating structures. But platforms with extra-flotation and stabilisation (optional) can be used. The use of sheltered areas at sea might be too complex and unfeasible, so it must be assessed on a project basis.

1.5. O&M

- Most companies carry out predictive maintenance on a yearly basis. Some do it twice a year. In some cases, it will be defined by the certification or turbine supplier requirements.

Self-hoisting or climbing cranes

- The development of self-hoisting or climbing cranes (which can be used for replacement of components) is mostly in prototype phase. And the main limiting actor is the environmental conditions, followed by the crane lifting capacity. One important challenge not included in the survey and mentioned by several experts is the turbine suppliers buy-in and their rigid requirements. Turbine suppliers are unwilling to adapt turbines for the use of self-hoisting cranes and there is no 'standard' design, so now every turbine has a tailor-made system making it an expensive solution.
- There is an even opinion about the cost per day of self-hoisting cranes. The median would be €100,000 per day.

Remote vehicles - ROVs and AUVs

- The use of ROV requires an additional vessel. A Support Offshore Vessel (SOV) is the most preferred, and it is mostly contracted separately. Only some ROV suppliers include the vessels in the offer.
- **Workshop** There is not agreement about the technology readiness level of Autonomous Underwater Vehicles (AUV). Opinions are evenly distributed between prototype or demonstration phase. The cost (CAPEX) of such system is also not clear as it depends on the purposed application. The median would be €100,000.
    - *What do you consider is the AUVs TRL (prototype of demonstrator)?*
    - *Can you provide an estimated cost?*

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