


Engineering the economics of floating offshore wind

Words: Nicole Johnson Murphy, Jelte Kymmell, Alexander Overgaard and Elie Ronge

Much of the perceived risk in floating offshore wind lies in the turbine generator systems themselves. By simplifying platform design and delivering greater cost certainty, new concrete foundation systems are helping turn deep-water projects into a commercially viable reality.



Most investors with renewable energy portfolios place offshore wind in a complex risk category. When they hear 'offshore wind,' there is often a slight pause at the other end of the line. It is sometimes referred to as the red-headed stepchild of renewables. Investors tend to have a higher comfort level with assets on land, rather than sending crews and equipment out to sea.

Their prevailing questions for onshore and offshore projects are the same: How much will it cost? How long will it take to deliver a cash yield? Will it deliver long-term stable returns? But the cost risk for offshore wind is generally deemed higher. Is it really? And can it be mitigated?

Economics of foundations

ECO TLP Inc. has understood from the outset that offshore wind floating foundation design plays a pivotal role in a project's technical and financial success. The ECO TLP design offers developers of deep-water sites the opportunity to ensure healthy margins while minimising supply chain risks.

The design is the result of a clear understanding of the lifetime costs and cost risks of offshore wind floating projects. In the construction phase, the ECO TLP foundation is distinguished by its standardised design, enabling scalability and reducing the risk of domino effects across the supply chain.

During the operational phase, it offers a stable, low-maintenance platform designed specifically to minimise O&M costs associated with turbine components. This is achieved through highly innovative engineering of the motion response to wind and waves. These measures are critical to meeting the near- and long-term objectives of the offshore wind industry.

ECO TLP embodies advanced project cost forecasting for 200 to 3,000 m

Acknowledging the importance of a foundation design that not only performs well at sea but is also fast and scalable to fabricate is vital. Predictable delivery of safe, cost-effective foundations, in line with offshore wind development schedules, is at the heart of ECO TLP's DNA.

In the near term, developers focus on achieving high cash yields for investors, which means getting the power plant in the water, connected to the grid and generating power as quickly as possible. Along the way, developers need to control their exposure to fabrication risks to maintain investor confidence. The right choice of materials, their availability, the methods and skills required to execute fabrication, and the installation strategy and associated equipment should all be at the core of offshore wind foundation design.

In the long term, asset owners want robust, flight-to-safety projects with the lowest possible operational costs, maximising consistent power delivery over several decades.

Every engineering decision we make is tied to an economic driver found in our predictive parametric models, which provide both quantitative and qualitative insights into the fabrication and operation of offshore wind floating projects.

Predictive modelling has added a level of sophistication to offshore wind project planning in recent years. The ECO TLP suite of foundations applies that approach to standardised, cost-focused engineering for the offshore sector.

ECO GBS brings XXL WTGs from 50 to 100 m

ECO GBS is a slip-formed concrete gravity base structure for the 50 to 100 m water-depth range, designed to host XXL wind turbine generators in niche deep-shallow zones.

Commercially, the 50 to 100 m band opens the next wave of offshore lease areas. These are bottom-fixed-adjacent sites that monopiles can no longer reach economically and for which conventional floaters are over-engineered. ECO GBS offers an economical installation method that is unique among gravity base foundations since the GBS can be floated to the site with the nacelle and rotor already installed.

Standardising foundation design across both shallow and deep waters allows developers to leverage a single, proven concept, reducing project timelines, lowering engineering and certification costs and minimising the risks associated with bespoke designs. Our approach targets niche water depths with simplicity, driving reliability through established construction methods.

Our solution provides a similar design and fabrication method for the ECO GBS, designed for shallow waters of 50 to 100 m, and the ECO TLP, designed for deep waters of 200 to 3,000 m. This allows developers to use the same fabrication method for multiple wind farms. Standardisation will therefore result in fabrication using the same equipment, suppliers and key personnel as the previous project, which in turn results in a good understanding of realistic schedules and supply chain management. The engineering cycles required to obtain certification will also be more efficient, which can cut the relevant time of the overall development schedule.

We design gravity-based and floating foundation installations benchmarked against the reference class forecast for traditional steel fixed-bottom foundations and conventional concrete caisson construction, both of which provide robust cost and schedule data. This ensures we begin every project with realistic cost anchors and credible planning assumptions.

Our foundations support key milestones across the entire offshore project lifecycle, giving clients and investors greater certainty and control.

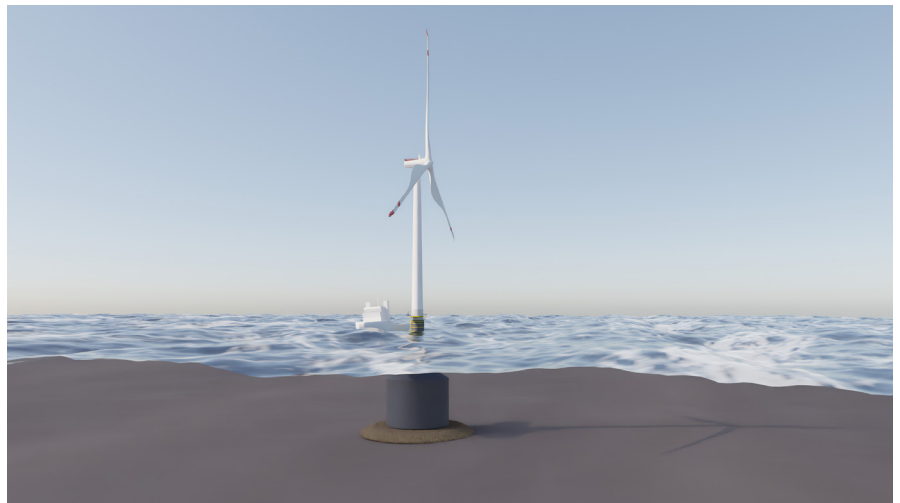
Our concrete foundation systems are engineered to deliver installed costs comparable to fixed-bottom wind projects, including foundations, tendons, anchors, deployment and turbine integration. The comparison is based on our cost estimate for the deepwater ECO TLP against industry data that is available about the costs of existing bottom-fixed wind farms. This is based on data in the TGS 4C offshore database. Achieving this cost parity is critical to unlocking investor confidence in deeper-water sites, enabling competitively priced power generation that ultimately determines project viability.

Ecology and endurance

Constructed primarily from marine concrete with inherently low Portland cement content, our foundations are designed for an asset life of 50 years as unpainted, durable infrastructure.¹

The foundations remain virtually inert in the marine environment. Positioned lower in the water column, they experience reduced marine growth on both the hull and tendons, compared to other floater types, helping to minimise associated regulatory burdens for marine growth removal. This can be a particular concern off coasts such as Japan.

The O&M costs for the floater are expected to be considerably lower than those of steel floaters, as concrete does not corrode and does not require painting. Some other systems also involve active systems for ballasting, which will require additional maintenance and potential risk of failure/



ECO GBS

downtime. We have no active ballast. The depth of our mooring connectors is also deeper than most steel floaters, resulting in less marine growth maintenance.

Based on motion response modelling, the impact of the reduced O&M costs on the turbine is expected to be even more relevant. The main reason is that the ECO TLP has a natural frequency in roll/pitch and heave that is above 25 to 30 seconds, well above the wave frequency bandwidth. This results in lower accelerations in the nacelle. Also, the number of cycles per year will be less. For all components that suffer from dynamic accelerations due to nacelle motions, this implies a significantly longer fatigue life.

Analysis indicates that components exposed to fatigue damage from nacelle motions could have a fatigue life up to ten times longer than other foundations with natural periods of around 5 to 6 seconds.

As a result, operational expenditure for both the ECO TLP foundations and the hosted equipment is expected to be significantly lower than that of alternative floating foundation systems.

Advancing the floating deepwater market with gravity-based foundation technology

ECO TLP and ECO GBS units share the same DNA: the concrete mix, the slip-form processes, the QA regime, the marine operations playbook, many of the supply chain agreements and the local-content footprint. These will all mature on commercial GBS sites with economics and low-risk factors that are bankable today, in preparation for floating wind.

The yard configuration and installation process that produce the ECO GBS are the same as those used to produce ECO TLPs. As deepwater floating wind advances toward industrial-scale buildouts, our process and supply chain will be a well-oiled machine.

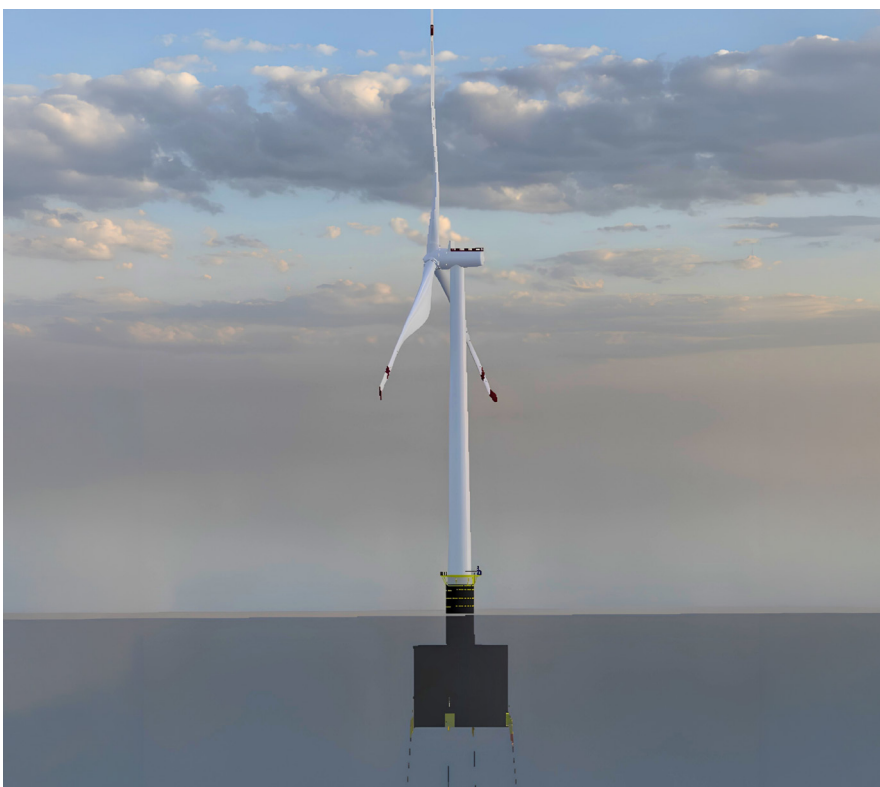
Back to the investor on the other end of the line

To attract investor participation in offshore wind, ECO TLP Inc. believes foundation designs must embody sound economics, ecology and endurance, delivering high cash yields and flight-to-safety projects with long-term stable returns.

ecotlp.com

Reference

¹ Durability of concrete in marine environments is well documented and tested at locations such as the Treat Island Extreme Exposure Station in the Bay of Fundy, near Eastport, Maine, a long-term natural weathering facility used since 1936 to study the durability of concrete, masonry and aggregates under severe marine conditions.



ECO TLP