

EMPIRE ENGINEERING

An engineering firm specialising in the design of offshore wind turbine foundations

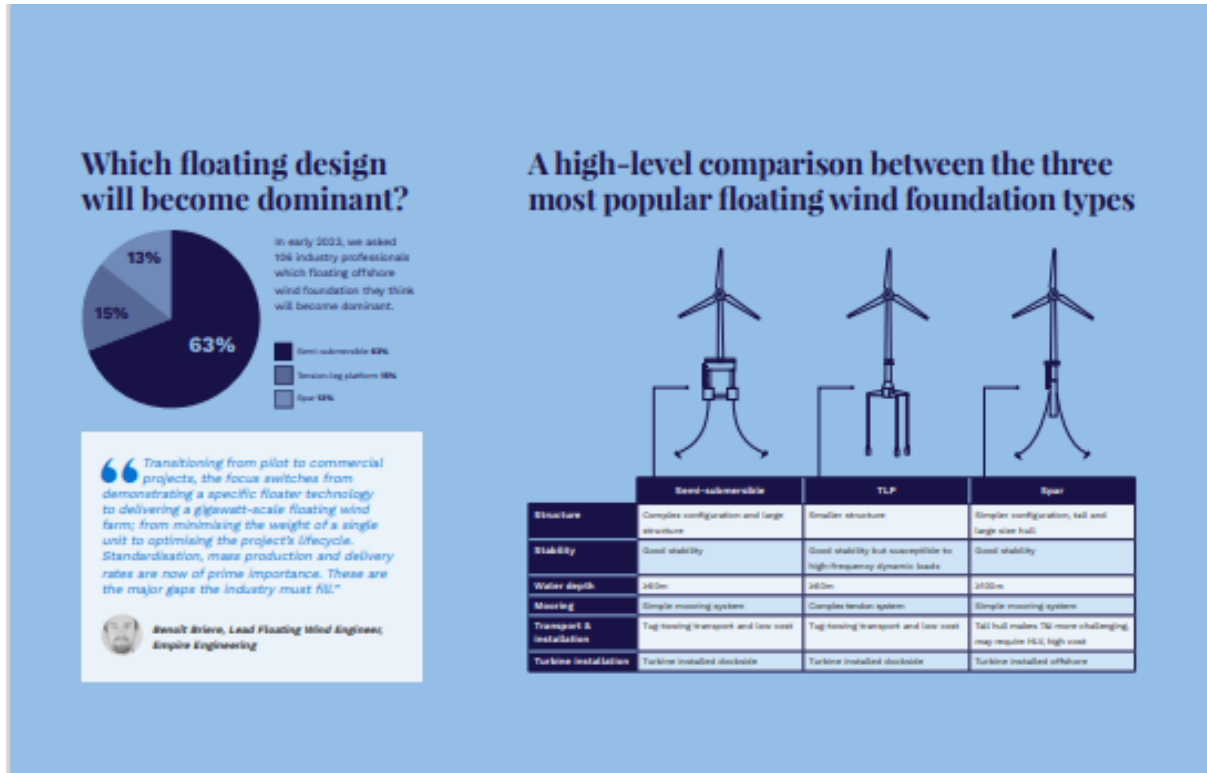
I structured and wrote the first edition of this 10,000-word report in 2021. I drew on a series of webinars and existing technical articles the company's team had written, filling the gaps by interviewing the relevant experts.

The goal was to create a marketing asset that would be informative to engineers new to offshore wind, as well as those investing in the sector or working in it in a non-technical capacity for the first time. It aimed to show the company's expertise and encourage those interested in the sector to join it.

The first edition was downloaded over 1,000 times and referenced in a number of industry articles and papers. The 2023 edition was updated significantly to reflect technical advances.

Working closely with the designer, we created a series of spreads which could work as stand-alone marketing assets.

Download the report



Choosing your foundation concept

When developing an offshore wind farm, selecting the foundation type is one of the most complex questions a developer has to consider at a very early stage. The fast-evolving offshore wind industry has provided plenty of options, including conventional foundation types and innovative ideas, but how do you make the decision?

The real question is, given your specific site and your choice of turbine, **what foundation type will yield the lowest life cycle cost at the lowest risk to your project?** There are literally hundreds of factors to consider, from local manufacturing capabilities to the availability of installation vessels.

In the concept design and selection phase, it's critical for developers to have a systematic way of listing all the potential risks and costs to consider so that foundation options can be assessed in a quantitative way. The weight of each factor can then be adjusted according to the demands of the project.

It's important to consider fabrication, transportation and installation, but at this stage there won't necessarily be a lot of details. If you do have the detail, consider it because it offers opportunities for optimisation that you don't often get this early on (*more on the benefits of life cycle design on p.30*). If you don't have the details you still need to consider how the big picture will be influenced by procurement strategies, political constraints or the fabrication capacity of a country or market.



Support innovation in foundation designs

As we've mentioned, full life cycle design is fundamental to optimising offshore wind foundation designs, but creating conditions that support innovation requires more than that. We believe there are plenty of opportunities for us as an industry to do it.

IMPROVED FEEDBACK LOOPS ACROSS THE LIFE CYCLE OF A PROJECT

On many wind farm development projects, the foundation design job ends when the design engineers send over the final detailed drawings. Foundation design teams often get limited feedback on their design decisions through the fabrication, transport, installation and commissioning phases of the wind farm's development, or indeed once the wind farm is in operation. Any feedback that is provided is often in the form of a written report.

More robust and visual feedback – like videos of key transport or installation processes, for example – would help foundation designers understand what works, as well as what unforeseen challenges their design decisions may have caused at other stages of the project.

This type of feedback, from the fabrication through to the maintenance phase, would enable designers to identify opportunities for improvement which could in turn benefit the developer if they work with them on the next project. That is one of the advantages that developers with in-house design teams have.

REPORT RESEARCH & WRITING

KEY CONSIDERATIONS

The list of key considerations is very similar depending on whether you're assessing floating or fixed foundation concepts. However, what will vary is the weight of some of these factors. For example, soil conditions and water depth will be less significant for floating than for fixed foundations on most sites. Whereas the depth and facilities of the marshalling harbour (where foundation components are assembled and launched) will be far more important for floating, where far deeper harbours are needed.

	Fixed foundations	Floating foundations
01	Water depth of the site	Marshalling port facilities
02	Composition of the seabed	Meteocean conditions
03	Meteocean conditions	The proposed turbines
04	The proposed turbines	Water depth of the site
05	Local fabrication capabilities	Composition of the seabed
06	Marshalling port facilities	Local fabrication capabilities
07	Transport and installation strategies (T&I)	
08	Operations and Maintenance (O&M) strategies	
09	Government regulations	
10	Financing and contracts	
11	Decommissioning concerns	



“I remember in my first week of working as part of a developer's team, I saw some videos of a cable pull in operation. It kind of blew my mind, because until that point I'd never really thought what a messy situation it is, with all the tools, all the equipment and all the people. When you're a designer, you have your crisp, clean 3D CAD model, and to see someone interacting with this "perfect" design – all the health and safety elements and the human aspect – really opened my eyes. I think that real-world aspect is often completely absent for designers. Having it could only improve the understanding and the relationship between the developer and the designer, and what designers are capable of.”

Nick Howard, Partner and Principal Engineer at Opix Engineering