

Tetra

Floating offshore foundations



Next level floating wind power

Unlimited offshore wind power

Floating wind power offers abundant climate-friendly electric power without geographical restraint.

The challenge for conventional offshore wind is that along most of the world's coastlines, the waters are too deep for bottom-fixed foundations. By moving beyond the 50-70 m depth limit of conventional offshore wind power, the accessible offshore potential will be expanded by a factor of 10, elevating offshore wind power to a global source of clean energy.

As the urgency to expand global clean energy capacity continues, floating wind power's moment has come. At Stiesdal Offshore, we have leveraged our combined experiences from decades of offshore wind engineering to create the Tetra concept, a radically innovative floating foundation technology.

Delivering on cost, speed, and volume

The Tetra foundation is the world's first fully industrialized floating offshore concept. It is based on factory-made modules assembled at quayside with maintenance-free joints to form a complete foundation. The application of mass-production methods in a factory environment reduces manufacturing hours radically, achieving a lean, fully industrialized floating foundation concept with low material costs and fast assembly.

The Tetra concept can be adapted to any turbine size and any water depth and is well suited to localization demands. By rethinking all aspects of the floating foundation design with industrialized production in focus, Tetra can maintain a fast assembly rate with up to two completed foundations per week.

“Floating wind expands the global offshore resource by a factor of 10”



The TetraSpar Demonstrator in operation: The world's first fully industrialized offshore foundation operating at 200m water depth at the METCentre test site off the coast of Karmøy, Norway.



Industrial manufacturing: TetraSpar components (yellow) are stored alongside offshore tower sections at leading off-shore tower supplier Welcon. Tetra leverages the existing offshore wind industry's supply chain.



Road transport: Tetra components are suitable for road transport. Here, the TetraSpar center column is leaving Welcon's factory, heading for the port assembly site.

The modular Tetra foundation concept

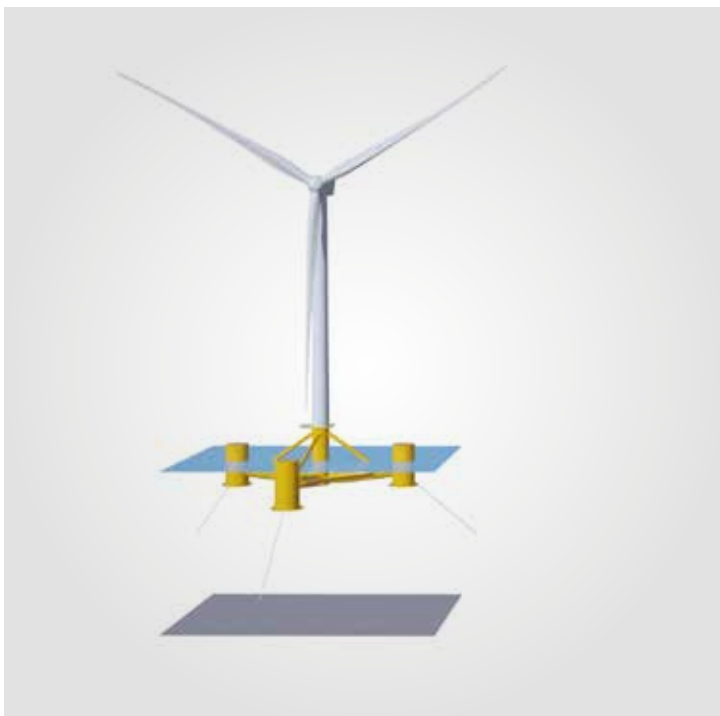
The defining feature of the Tetra concept is the assembly of factory-made parts with no manufacturing taking place at quayside.

This is accomplished with a modular, “building block” arrangement comprising of tubular steel modules.

Tetra’s modular components resemble wind turbine towers, the world’s lowest cost-per-kg steel structure. Manufacturing of the modules will typically take place at tower or monopile production facilities, applying automated processes and benefiting from the existing offshore supply chain.

All structural welds are implemented as longitudinal or circumferential butt welds suited for automated submerged arc welding. Surface protection is also carried out in a factory environment, and the result is high-quality, low-weight and low-cost foundation modules.

The modules are assembled at quayside. In general, no welding, painting, or similar processes form part of the assembly. The main component of the Tetra concept is the foundation itself, a tetrahedral structure assembled from modular, tubular steel braces.



TetraSub: Floating foundation in semisubmersible configuration. Suited for 50-1000+ m water depth.



The TetraSpar Demonstrator

The world’s first fully industrialized floating offshore foundation was assembled in the port of Grenaa, Denmark, and towed to Norway in July 2021.

The demonstration project achieved a range of world’s firsts, including the automated factory manufacturing of the foundation components, and the welding-free assembly at quayside.

The TetraSpar Demonstrator was also the world’s first spar foundation deployed from an ordinary shallow-water port.

The project was implemented in close cooperation with three major players in the energy sector: Shell, RWE, and TEPCO.



Read more at
www.stiesdal.com



The Tetra Triple-One Concept: The Triple-One Concept is Stiesdal's method for the supply of one gigawatt of floating offshore wind power capacity from one port in one season. The core enabler of the Triple-One Concept is the fast assembly of the Tetra foundation at quayside, coupled with onshore turbine installation. The drawing illustrates a model for assembly and deployment operations for the TetraSub that can achieve the Triple-One target.

Fast pin assembly

Fast and robust assembly takes place in the port of embarkation. The modules are assembled at quayside using Stiesdal proprietary connections. Port requirements are limited to a flat, level area at quayside for component delivery and assembly.



Quay-side installation with pin assembly of one of the three braces on the TetraSpar Demonstrator.

Shallow water launch

Tetra foundations typically have an unballasted draft of 8-10 m, including the turbine. This facilitates embarkation from ordinary ports, significantly enhancing the opportunities for local content.



Launch of the TetraSpar Demonstrator using semisubmersible BOA Barge.



Designed to deploy floating wind anywhere

The Tetra foundation concept has been designed to incorporate the lessons from the scaling journey of traditional offshore wind power.

For offshore wind, the primary drivers of scalability – and cost reduction – were the cumulative rewards of standardization and mass production. Add to that supply chain effectiveness.

Tetra's tested port assembly concept allows highly specialized suppliers to add their expertise to the execution of projects, and developers can maintain a geographically unrestrained supply chain strategy.

The unique features of the Tetra concept have been selected to facilitate large-scale floating wind power deployment:

- Low-cost production based on industrial manufacturing by existing supply chain
- Fast assembly in port using proprietary assembly methods
- Shallow unballasted draft that facilitates the use of local ports
- Easy installation of turbine on foundation using conventional onshore cranes

**Tetra foundation
weight range:**

175-250

tons per MW – depending on metocean conditions and turbine type

**Capability to
supply:**

80+

units from ordinary ports in a single season

The Stiesdal approach

At Stiesdal, we define ourselves by our ability to innovate with impact.

The Stiesdal Company was founded with the purpose of developing and commercializing technologies that have major impact on mitigating climate change. This purpose is fundamentally rooted in a conviction that more needs to be done, and that real impact can be achieved through innovation.

The creation of jobs is an additional and highly important purpose of the Company. Our aim is to positively impact and benefit local communities and to think job creation into our activities.

We pursue innovative solutions that are suitable for industrialization in the belief that cost reduction is the strongest single driver of clean technology implementation.

Our approach is therefore the same across all our technologies. To achieve true impact, we always strive for game-changing levels of cost reduction. We continuously challenge ourselves, questioning what it takes for every aspect of every technology to become the cheapest without sacrificing on safety or performance.

We know from experience that volume and scale are the ultimate cost-cutting factors, which is why we optimize all our solutions for standardization and modularization to achieve streamlined industrial processes and mass production.

No new technology leaves our design offices, laboratories or workshops without a clear strategy for industrialization. If an innovative technology promises to make meaningful impact on the decarbonization of society, it must be ready-to-scale from the very beginning. This is the path that gives innovation true impact. And this is what lies in our DNA.



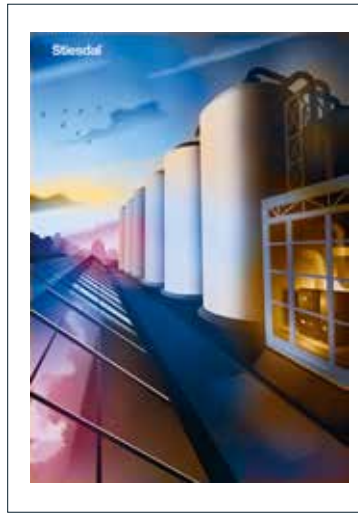
“Innovation with impact. It is in our DNA”



Stiesdal Offshore

Target: Unlimited low-cost offshore wind energy made globally available.

Means: The modular Tetra foundation concept, the world's first industrialized floating wind foundation.



Stiesdal Storage

Target: Firm power and energy security from renewables.

Means: The GridScale thermal energy storage system with 10 hours to 10 days capacity.



Stiesdal Hydrogen

Target: Application of renewable electricity across all sectors.

Means: The HydroGen electrolyzer unit for low-cost green hydrogen production.



Stiesdal SkyClean

Target: Affordable carbon capture and sequestration.

Means: The SkyClean system combining green fuel production and carbon capture and sequestration.

Stiesdal®

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