

RAMBOLL

FLOATING WIND

Floating offshore wind turbines enable clean energy production at deep water locations where bottom-fixed substructures are not economically feasible.

Floating Wind is a growing market entering the pre-commercial phase, featuring a large variety of floater designs from spars, semi-submersibles, and barges to tension leg systems. The technology, with its inherent importance of the complex interaction of wind turbine and floater dynamics, requires a multidisciplinary engineering approach and specific expertise. Ramboll has a well-established track record in industrial and R&D projects as a leading independent engineering consultancy in the field of floating offshore wind.

Our clients value our expertise and service portfolio that covers floater concept development and critical design reviews and risk assessments, substructure and mooring/tendon system design, integrated coupled analysis, consultancy regarding design for fabrication, and asset management tasks regarding floating-wind-specific O&M. Furthermore, Ramboll offers techno-economic project and market assessments and strategic advice for floating

wind farm developers.

We build on our competences as world leading in detailed design of fixed offshore wind foundations and our long-term experience with wind turbines, special purpose ships, floating offshore structures, mooring systems, marine operations and asset management. Our mission is to provide our clients with customised, tailored, cost-efficient, effective and industrialised solutions and services during the entire lifecycle of a floating offshore wind turbine project.

Our experience and competences

Ramboll is a truly independent one-stop engineering consultancy. We do not develop our own floating substructure design and are therefore not focused on a specific floater concept. Our synergistic floater team consists of experienced engineers in offshore technologies, wind turbines, structural design, coupled load analysis, monitoring, control, as well as in asset and risk management, and on-site inspection and supervision.

We follow proven offshore engineering principles and standards for safe, reliable and cost-efficient solutions. We avoid one-dimensional optimisations by considering all relevant technical KPIs, such as the floater's dynamic characteristics, and key cost drivers including fabrication, installation, operation and maintenance. Since 2007, Ramboll has been active in commercial floating wind projects. We participate in high profile R&D programmes and JIPs which aim at advancing floating wind technology and contributing to its commercialisation and industrialisation. With our multidisciplinary team, Ramboll supports its clients most efficiently in solving their project challenges.

For further information, please visit www.ramboll.com or contact us directly:

CONTACT

Denis Matha
Ramboll Energy
Tel +49 1515 8015 213
denis.matha@ramboll.com

Owner's engineer

As owner's engineer we support our clients as an independent engineering consultant with:

- Independent concept evaluation and selection
- Preparation of tender documents and tender evaluation
- Strategic consultancy
- Critical design reviews covering all phases: conceptual and structural design, mooring systems, numerical methods, transport and installation and fabrication (with schedule analysis, optimisation and cost-benefit analysis)
- Asset management
- O&M service strategy
- Risk assessments
- FMECA
- HAZID/HAZOP

As an independent third party, we support project viability, to avoid design errors, and fill client gaps in resources and in expertise to help reduce project cost and risk.

Design

Ramboll has expert knowledge in the design of floating wind turbines during all phases from concept development to workshop drawings. We offer:

- Feasibility studies
- Conceptual design
- FEED
- Floater detailed design (including integrated load analyses)
- Mooring design
- Tower design
- Controller design
- Component design (secondary structures, moorings, dynamic cables)
- Integrated coupled load analysis

We are well-prepared to support our clients in any design challenge. We draw on our proven customisable in-house and commercial software process chain, and our long-term experience with detailed design of fixed offshore wind foundations, special purpose ships, floating and compliant offshore structures, mooring systems, and wind turbine control systems.

Consultancy and supervision

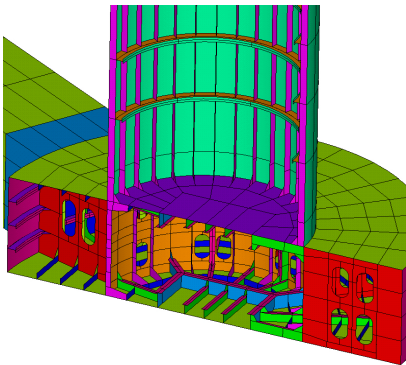
We provide consultancy services including:

- Due diligence (technical and commercial)
- Certification support
- Reference designs
- Planning of inspections and condition monitoring
- Structural health monitoring
- Market and concept assessments and strategic advice
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Based on our practical hands-on experience, we provide inspection and supervision services for:

- Fabrication/construction and factory acceptance tests
- Offshore transportation and installation
- Commissioning and decommissioning
- Marine operations (inspection, maintenance, repair)

As a dedicated and trusted advisor to our clients, we deliver tailored services to derisk floating wind projects, and to ensure their technical/commercial viability along with the best project results.



COMM. PROJECTS IN DESIGN OF FLOATING SUBSTRUCTURES FOR OFFSHORE WIND TURBINES

CUSTOMER

Project developers, concept designers

LOCATION

Atlantic, Mediterranean Sea, North Sea

PERIOD

2009 - now

SERVICE PROVIDED

Design of substructures and mooring systems; cost models, sensitivity studies; design reviews.

EUROPEAN H2020 RESEARCH PROJECT: LIFES50+

CUSTOMER

European Union

LOCATION

Sites in France, Scotland and USA

PERIOD

2015 - 2019

SERVICE PROVIDED

Ramboll leads work package on industrialisation and supports concept evaluation and risk assessment of 4 commercial floaters.

CARBON TRUST JIP: MOORING SYSTEM CHALLENGES / TURBINE REQUIREMENTS / FLOATER SCALING

CUSTOMER

The Carbon Trust, Floating Wind JIP

LOCATION

Site in UK

PERIOD

2017 - 2018

SERVICE PROVIDED

Analysis of mooring challenges (>40 concept designs; CAPEX/OPEX); Requirements of turbines; Impact of turbine scaling.