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Your engineering partner for offshore wind projects

Offshore Wind

Sener's Engineering Capabilities

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Sener Group

*Sener is a privately-owned **engineering** and **technology group**, the largest of its kind in Spain.*

The Sener Group, founded in 1956, includes as main businesses: Aerospace & Defence, Mobility, Energy, Advanced Facilities and Data Centers.

Sener has significant experience delivering energy and industrial EPC projects. We are also able to analyze, contract, and manage production, assembly, and construction.

We have a long track-record developing new technology and applying it commercially in all our business lines, achieving large market shares worldwide.

*With a large and highly experienced engineering team of more than **4,500 employees**, we have a global footprint that covers all continents with a local presence in **18 countries**.*

Overview

Our offshore wind discipline provides solutions to various market challenges through **Greenfield Project Development, Engineering and Consultancy, Project and Construction Management, and R&D and Floating Technology development services**, like with the semi-submersible platform HiveWind. HiveWind is a modular semi-submersible platform for 15+ MW offshore wind turbines that is being developed and marketed by Sener and WindWaves.

Our offshore wind expertise is complemented by other Sener disciplines, including **Maritime Infrastructures** (capabilities and experience in **port engineering**) and Marine Design (marine design, supply chain management, and analysis and development of floating technology for turbines and electrical substations). We employ this knowledge to provide a wide range of services focused not only on the development of offshore wind farms, but also on the adaptation of the supply chain (specifically port and shipyard infrastructures) to the requirements for the deployment of this technology.

WHY SENER?

We are the **right engineering partner** for your offshore wind developments. Our **wide range of services through the offshore wind farm lifecycle is aligned with clients' needs** because of:

1. **our understanding of the offshore wind market,** focusing our knowledge, experience and innovation capabilities to overcome its challenges.

2. our profile as an **engineering consulting firm with EPC in our DNA**, due to the number of EPC we have carried on in other energy and industrial areas, which brings in concepts like design-to-cost, constructability and operability to our services.

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Our services

Greenfield Project Development Services

Support in early stages of greenfield projects.

Screening and Scoping Studies

A country-wide selection of optimal sites involving a full analysis of criteria, minimizing LCOE.

OWF Feasibility Studies and Conceptual Design

- Preliminary layout and alternative analysis.
- Energy yield assessment.
- Electrical Concept Optioneering.
- CAPEX and schedule estimations.
- Logistic arrangement evaluation.

Development Services

- Stakeholder engagement.
- Land management.
- Specification and procurement support.
- Survey scope definition.
- Assistance during permitting and grants.
- Ad-hoc advisory services.

ESIA and Surveys Management and Supervision

- Environmental surveys and site characterization campaigns.
- Environmental impact assessment and socioeconomic studies conducted by third parties.

Floating LIDAR Campaigns Management

- Design and supervision of the execution of floating lidar campaigns.
- Analysis of data and results reporting.

Consenting Process

Documentation preparation to complete permitting process as per national regulations.

Engineering and Consulting

Full cycle design and tailor-made services: feasibility studies, conceptual design, Pre-FEED, FEED, basic design and detailed design.

General Studies

- Metocean and wind resource studies.
- Layout optimization and energy yield assessments.
- Technical due diligences.
- Ground model definition and geotechnical interpretative reports.
- Risk management.
- Lifecycle cost model development.

Offshore Engineering

- Wind turbine selection, specification and integration.
- WTG foundations design (bottom-fixed and floating).
- Technology evaluation.
- Mooring and inter-array cable design.
- Numerical modelling and coupled models.
- Geotechnical engineering.
- Structural engineering design and load analysis.
- Cable routing, Cable Burial Risk Assessment (CBRA) and Trenching
- Suitability Assessment.

Onshore Engineering

- Landfall selection and onshore-offshore transition design.
- Design of transition joint bays.
- Onshore cable routing.
- Design of onshore substations.

Electrical Engineering

- Grid connection analysis.
- Power system and load flow calculations.
- Design of transmission and distribution lines.
- HV, MV and LV system design of onshore and offshore substations.
- Subsea cable selection and calculation.
- Single Line Diagrams (SLD).
- Equipment sizing and specifications.

Construction, T&I, O&M and Procurement

- Construction, T&I and O&M strategy, cost and planning.
- Supply chain appraisal.
- Marine operations engineering.
- Offshore wind vessels design and specification.
- Port screening, feasibility studies and design.
- Quality inspectors.

SCADA & Control System

- Communication network requirements and design.
- Cybersecurity strategy, guidelines, requirements, and design.
- SCADA for WTGs, floating platforms and offshore substation design.
- CMS and digital twin functionalities for predictive maintenance.
- CCTV and navigation aid specification and design.

Project and Construction Management Services

Owner's engineering, PMT/CMT services, EPCM and framework agreements for the different scope packages of an offshore wind farm.

Construction Site Activities

- Site management interfaces and inspections.
- Reporting and auditing.
- Final fabrication reports.
- Logistics interface management.

Commissioning Services

- Testing and commissioning services of several packages.

Quality Assurance (QA) and Quality Control (QC) Packages

- Quality assurance standards and specifications.
- Quality control in factory and on site.

Expedition Logistics

- Technical and planning support.
- Ports and installation supervision as owner's engineer.
- Maritime transport routes analysis.
- Marine services.

R&D and Floating Technology

Sener has experience developing its own technology, but also provides engineering services to its clients for the development of floating foundations, substations and other solutions.

Floating Technologies

- Substations.
- Foundations.

Hybridization & Other Solutions

Hybridization of floating offshore wind with other complementary technologies, like hydrogen, or new solutions that bring robustness to the floating offshore wind farms, increasing their availability or reducing costs.

Own Software

- Farmwise (layout optimizacion tool).

R&D Programs

We have participated in R&D projects such as Horizon calls (e.g., MarineWind), Float&M, ECOFOSS and DECIMAP. Sener is actively participating in research teams in offshore wind technologies.

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Greenfield Project Development Services

We provide services to help clients develop their greenfield projects under specific local regulations.

- **Screening and scoping studies**, doing a countrywide selection of optimal sites. It involves a full analysis of wind resource, bathymetry, seabed nature, environment, affected services, maritime traffic, aeronautical assessments, in order to select the best location and minimize LCOE.

- **Feasibility studies and conceptual design**, which includes preliminary layout analysis and yield assessment, alternative analysis, preliminary electrical calculations, CAPEX and schedule estimations, logistic arrangement assessments, etc.

- **Assistance during the permitting stage**, including services as stakeholder management; land management; specification and procurement support and supervision of engineering surveys, assistance during permitting (environmental, technical, grid connection, etc.) and subsidies (local, regional, state); and ad-hoc advisory services.

- Management and supervision during the **Environmental and Social Impact Assessment (ESIA)**: we manage and supervise the environmental surveys and site characterization campaigns, the environmental impact assessment and the socioeconomic studies conducted by third parties, integrating them into our design scope.

- Management of the **Floating LiDAR campaigns**, supervision of their execution, data acquisition and analysis and reporting of the results.

- **Preliminary project documentation preparation** to complete the permitting process according to national regulations.

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*Sener has provided permitting & development services for **over 25 projects in 7 countries** with an overall **capacity of around 15 GW**.*

Engineering & Consulting

*Our capabilities regarding offshore wind farm engineering cover all **design stages**, such as feasibility studies, conceptual design, pre-feed, feed, basic design and detailed design. Our services are customized to cover all aspects of a project, including wind turbine generators (WTG), offshore cables (Export & Inter-array), foundations (floating and bottom-fixed), mooring systems, onshore export cables, offshore substations, onshore substations and facilities, transport and installation, operation and maintenance (O&M), as well as SCADA and control systems. Our services include design, interface management, support to ITT and owner's engineering, depending on our client's strategy and, particularly, the detailed design and those packages where technicians develop the design of their scope.*

*We have **extensive engineering full-cycle experience**, from conceptual design to EPCM & commissioning, which allows us to **plan and make decisions early involving delivery, supply chain, yield and operational implications.***

*In our services, we are **technology agnostics** which allows us to analyze the technical and commercial feasibility (including production, supply chain and O&M) of relevant technologies developed by third parties.*

*We provide **tailor-made services according to the client's requirements and needs**.*

GENERAL STUDIES AND OFFSHORE ENGINEERING

Our offshore design services include studies such as:

- Metocean and wind resource studies.
- Layout optimization and energy yield assessments.
- Numerical modelling and coupled models.
- Design of technology solutions and due diligence.
- Mooring and inter-array cable design.
- Wind turbine selection, specification, integration and installation design supervision as owner's engineer.
- Anchoring and beaconing.
- Cable routing, Cable Burial Risk Assessment (CBRA) and Trenching suitability Assessment.

ONSHORE ENGINEERING

We can deliver engineering services for both offshore and onshore projects:

- Onshore cable routing.
- Transition joint bay design.
- Onshore electrical substation design, including civil works.
- Landfall selection and onshore-offshore transition design.

ELECTRICAL ENGINEERING

At the heart of every successful offshore wind project lies a meticulously designed electrical system. Our expertise in electrical and infrastructure engineering pertains to both sea and land transmission systems. This results in optimized yield, CAPEX and O&M efficiency. These services include:

- Calculation, sizing and selection of inter-array and export submarine cables.
- Specification of vessels for cable installation.
- Laying and protection for submarine cables.
- Inspection for works and as-built information for cabling works.
- Grid connection analysis.
- Overhead and buried powerline design.
- Concept Single Line Diagrams for offshore and onshore substations.
- Offshore and onshore substation layout based on site-specific location and general ambient conditions (topside electrical layout in the case of offshore substations).
- Electrical loss calculation.
- Shunt reactor sizing.
- Thermal calculations and sizing of main electrical equipment.

CONSTRUCTION, TRANSPORT AND INSTALLATION AND PROCUREMENT

The combination of our experience and capabilities in port engineering and engineering & consulting services in offshore wind make our services for port infrastructures encompass a wide array of offerings tailored to facilitate project execution, such as:

- Construction strategy definition and planning.
- Screening studies for port selection and feasibility studies for port infrastructure improvements. It includes port requirement assessment for the offshore wind market, including manufacturing and assembly, load-out and float-off operations, transportation & logistics of components, etc. Also, in-depth site assessments are carried out to evaluate port suitability and identify necessary modifications.
- Port and shipyard design (from port development plan and functional design, to conceptual and detailed engineering): quays, yards, storage facilities to accommodate heavy-lift equipment, vessels and offshore wind farm components, road/rail access and maritime connections, mooring and berthing structures, bearing capacity, water depths and drafts.
- Support in the engagement with port authorities.
- Supply chain appraisal, which includes component assessment (wind turbines, cables, anchors, floating platforms, jackets, monopiles, etc.) and national manufacturing potential.

We also provide construction and T&I (such as concept/process assessment and method statement/procedures) procurement and logistics planning, as well as cost and schedule studies and tailor-made services.

O&M

Sener has an O&M department with extensive experience in energy and industry projects, and we are taking part in R&D projects related to O&M, like Flowind, and involved in digitalization using digital twins and CMS.

We deliver O&M tailor-made services. Our capabilities include O&M Ports screening and assessment, O&M strategy and planning definition, O&M concept, O&M cost estimation, O&M method of statement /procedures and Operational modelling.

SCADA & CONTROL SYSTEM

Sener has an instrumentation and control department with ample experience delivering services related to control & SCADA system in energy and industry projects. Our services cover:

- Communication network requirements and design.
- Cybersecurity strategy, guidelines, requirements and design.
- SCADA (software and hardware) for WTG specification and design.
- SCADA (software and hardware) for the offshore substation specifications and design.
- Monitoring system and SCADA (software and hardware) for floating platform specification and design.
- Condition monitoring system for WTG, foundations, mooring lines, etc. for predictive maintenance.
- Digital Twin functionalities for predictive maintenance.
- Metocean or other offshore sensor specification and integration.
- CCTV specification and design.
- Navigation aid specification and design for construction and/or operation.
- We also provide the supervision (as owner's engineer) of the design developed by the related contractors, through the activities described above.

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Project and Construction Management

Sener delivers services in:

- *Owner's engineering.*
- *Project and construction management.*
- *EPC management (EPCM).*

For project and construction management services, we have developed **proprietary procedures and methodologies** to ensure our teams are deployed swiftly and effectively for our clients' assignments. Our services span the scope of the various packages of an offshore wind farm (wind turbines, foundations, export cables, etc.):

- **Construction site activities**, such as site management interfaces, site inspections, reporting, audits, final fabrication reports and logistic interface management.
- **Commissioning services** for different testing stages, from factory acceptance testing and site acceptance testing to final commissioning.
- **Quality assurance and quality control packages**, which includes quality assurance standards and specifications, quality control in factory and onsite, and package control inspections.
- **Expedition logistics**, covering ports and installation engineers, technical and planning support, maritime transport routes analysis and marine services.

Sener has already provided these services to Iberdrola, Avangrid and Scottish Power in a framework agreement contract, and to Cobra at the Kincardine Floating Offshore Wind Farm.

Floating technology and R&D Services

FLOATING TECHNOLOGY

We have know-how developing proprietary technology in energy, infrastructure, marine and aerospace, with a solid track record of commercial success and experience as a naval engineering firm, led by expert naval architects and ship designers and our 50+ years of expertise.
For offshore wind, we not only develop our own floating technology, but also provide **engineering services for developing our clients' floating technology**, from steel or concrete floating foundations to floating substations.
Our services cover everything from naval architecture and structural design to electrical and mechanical engineering, including topside design, auxiliary and firefighting systems, mooring design, CFD calculations, corrosion design and mooring and dynamic cable design.
We are currently developing:

- Floating platforms, like HiveWind, a modular steel semi-submersible platform for 15+ MW offshore wind turbines, through a JV of Sener and WindWaves. The development includes turbine integration, certification and production planning.
- HVAC and HVAC floating substations for different capacities (500-2.000 MW).

We have also executed due diligence and designs for concrete floating platforms, and we have carried out conceptual design with advanced calculations for bottom-fixed substations in Italy.
We are aware of the potential of **hybridization of floating offshore wind with other complementary technologies**, like hydrogen, **or new solutions that bring robustness to floating offshore wind farms, increasing their availability or reducing costs**. For this reason, we are investigating integrative strategies and capitalizing on the advantages of every technology, as well as their interdependencies. Modular distributed substations, H2 equipment for offshore green hydrogen production on floating platforms and other solutions.

R&D SERVICES

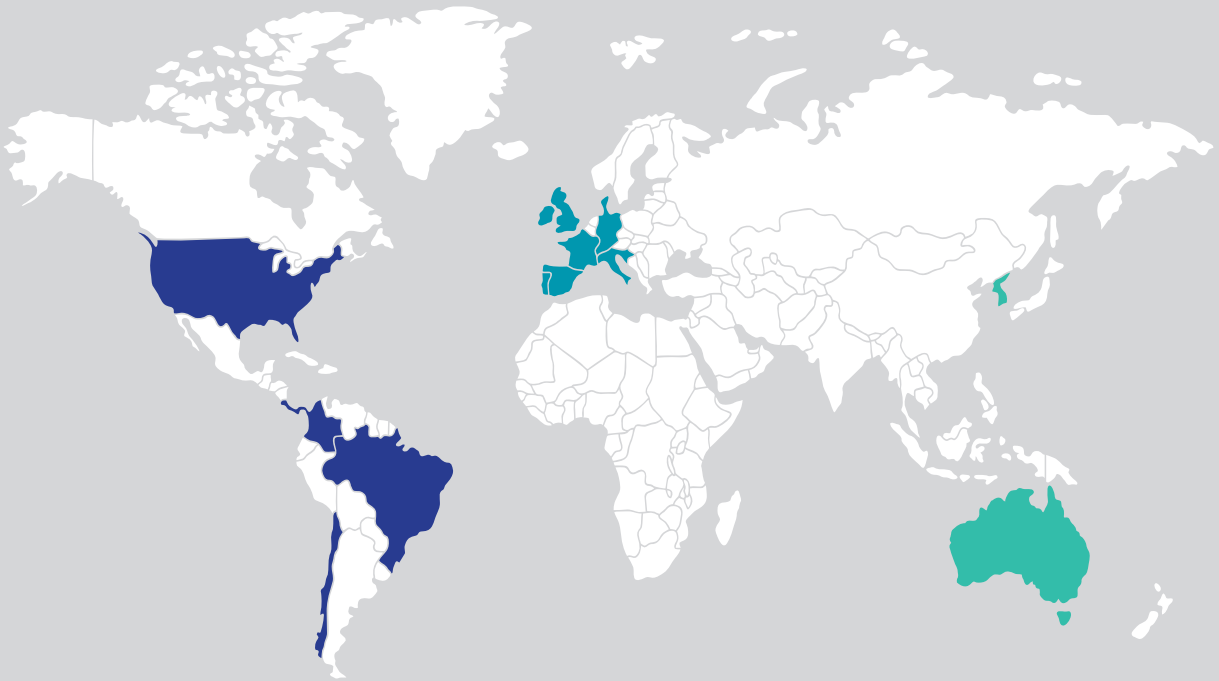
We have developed our own software, called FARMWISE, to define the layout of wind turbines, substations, and the laying of inter-array cables, based on generative design. This software defines and optimizes offshore wind farm layout from the early stages, considering production and its losses, electrical losses and LCOE results.
Our R&D services include offshore wind digitalization and floating technology engineering for platforms and substations.
We also take part in R&D programs, such as Project Horizon calls (e.g., MarineWind, coordination and support action oriented to market uptake measures for Floating Offshore Wind Technology), and collaborative R+D projects like:

- Float&M: focused on the challenges of operation and maintenance activities and digitalization of the process.
- ECOFOSS: floating substation design project led by Navantia and REE (Spanish TSO), currently in development.

Sener development. December 2023.

GLOBAL PRESENCE AND KEY PROJECTS

In offshore wind, we provide services to support our clients in their developments ***around the world.***



AMERICA

BRAZIL
- Pre-screening OWF development
- Scoping for three OWF

COLOMBIA
- Conceptual design of five OWFs
- Pre-Feed of two OWFs: Bergantín and Goleta, for BlueFloat

USA
- AVANGRID Framework Agreement
- Port requirements for OW construction study

CHILE
- OW potential pre-screening in the Strait of Magellan

EUROPE & AFRICA

SPAIN
- Permitting process for Tarahal OWF, Nordés OWF, Parc Tramuntana OWF and Tramlab
- Concrete floater design for 15+ MW: Hivelab

PORTUGAL
- Pre-screening OW

UNITED KINGDOM
- Kincardine Offshore Wind Farm, 50 MW - COBRA
- East Anglia OWFs in ScottishPower Framework agreement
- Construction study for concrete floating wind platforms in a Scottish Port

ITALY
- OW potential screening
- Conceptual design of three OWFs for Nadara&BlueFloat
- Conceptual design of Bluwind Pozzallo OWF

FRANCE & GERMANY
- Iberdrola Framework agreement: Saint Brieuc and Baltic Eagle OWFs
- Floating Foundations Early Engineering Studies and Baltic Eagle Floating Platform Supply ITT

ASIA & OCEANIA

SOUTH KOREA
- Engineering for Floating Offshore substation proposal

AUSTRALIA
- Pre-screening OWF development
- Project prefeasibility license for Greater Gippsland and Eastern Rise OWFs

Key projects

Parc Tramuntana
Spain

We provided screening and scoping, feasibility study and basic design services. We also managed the ESIA execution and planned and supervised its related campaigns. Sener is currently delivering LIDAR permitting and campaign supervision, land management and stakeholder engagement.

Pre-feed engineering works
Colombia

We carried out the conceptual design of two new Offshore Wind Farms (OWFs) in Colombian waters. These farms will be based on floating solutions. The projects include the Data Review, Site Characterization, Offshore Engineering (including turbines, platforms, substations, cables and onshore-offshore design), Electrical design, Onshore engineering, Construction and Installation Assessment, O&M Strategy and Cost estimation and Program.

Construction study for industrial delivery of concrete floating wind turbine support structures

UK

We provide professional engineering services for the Construction Study for Industrial Delivery of Concrete Floating Wind Turbine Supporting Structures. Our work focuses on adapting a UK port to manufacture concrete floating wind turbine foundations, considering two possible floating foundation concepts.

Kincardine

Scotland

We have been the owner's engineer in the Kincardine Project for Cobra, supervising the manufacture of the floating platforms, analyzing the technical feasibility of assembling the wind turbines and providing technical assistance in monitoring the plant.

HiveWind

We have delivered conceptual and pre-feed design services for the HiveLab project, the demonstration project of the HiveWind concept, and we are currently delivering feed engineering services for this technology.

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