# WIND POWER



# **FICHTNER**

### OUR RANGE OF SERVICES

### LENDER'S ENGINEERING AND STUDIES

- Market analysis
- Feasibility studies
- Development of concepts
- Techno-economic analysis
- Technical due diligence
- Wind studies and energy yield assessments
- Review of financial model input
- Assessment of plant components
- Factory inspections
- Site investigation
- Site selection and micrositing
- · Review of wind measurement
- Grid integration and energy storage
- Investigation of sites and permit-relevant aspects
- Review and evaluation of project contracts
- Emissions trading with consultancy on CDM / JI / VER
- Environmental and social impact assessments in compliance
  with international standards
- Geological and geotechnical investigations
- Risk evaluation
- Analysis of operational data
- Acoustic and shadow flickering expertise

### ENGINEERING AND DESIGN SERVICES

- Conceptual design
- Technology selection
- Basic engineering
- Detailed engineering
- Design reviews
- Permit application management
- Interface management
- Project management

### SUPPORT DURING TENDERING

- Compilation of pre-qualification documents for tenderers, suppliers and subcontractors
- Drawing up tender documents
- Technical support during tendering
- Consultancy on power purchase agreements
- Consultancy in connection with privatization

### BID EVALUATION AND CONTRACT NEGOTIATIONS

- Bid evaluation
- Conducting technical clarification meetings and contract negotiations
- Assistance in drawing up contract documents

#### CONSTRUCTION AND COMMISSIONING

- Oversight of project execution with quality control
- Monitoring of project budget status
- Site supervision
- Acceptance tests: mechanical completion, provisional and final acceptance
- Progress reports
- HSE coordination
- Supervision of commissioning
- Verification of plant operation and performance ratio
- End of warranty inspection

### **OPERATION**

- Monitoring and optimization of plant performance
- Benchmarking of performance
- Examination of guarantee and performance claims
- Review of operating expenditure

# Engineering and Consultancy for Wind Farms – Worldwide

Fichtner is Germany's biggest independent engineering and consultancy enterprise for infrastructure projects in the fields of energy, water & sanitation, environmental protection, transportation, and IT. Since the 1980s, Fichtner has actively participated in the success story of wind energy.

### Many decades of experience

Fichtner commenced its activities in the energy sector back in the 1920s. Through numerous projects, our engineers and economists have gathered valuable experience in all aspects of sustainable energy utilization. Always ahead of state-of-the-art technologies, Fichtner participated in technology innovation processes at early stages of development. In the wind energy sector, Fichtner acted as owner's engineer for the first wind farms in Germany, provided instruction for capacity building in developing countries and advised the German R&D ministry for the initial wind energy market penetration program that led to the world's most successful feed-in tariff law for renewable energies, the EEG Renewable Energy Feed-in Law. And, finally, Fichtner has been an honorary member of national and international panels.

### International project teams covering all disciplines

Around the globe, the Fichtner Group can call on a network of highly qualified engineers and consultants. Our teams required for wind power engineering and consultancy services are recruited from various Group enterprises as well as from our German and international subsidiaries. Fichtner maintains branch offices in more than 50 countries worldwide so as to be close to clients and best address local planning regulations specifically for the infrastructure of wind power projects while, at the same time, generating local added value.

### Broad range of services for one-stop solutions

With our engineering and consultancy services, in the role of owner's engineer we support our clients in their wind energy projects over the entire value added chain – from initial project idea up to wind farm commissioning. We also offer the full scope of tasks for lender's engineering for project evaluation, due diligence reviews and implementation monitoring. This results in a profound knowledge of the specific interests of all stakeholders in the wind energy sector, with a good grasp of decision making processes and key performance indicators used by private and public investors. We are also fully familiar with the procurement rules of international financing organizations, local permitting processes, and the supply markets.

### Onshore References



#### Technical Consultant / Lender's Engineer

- <u>Project portfolio (300 MW), Central America</u>: Due diligence services, covering site survey, energy yield assessment, review of technology and design, project agreements, CAPEX and OPEX evaluations
- <u>Gulf of Suez (250 MW), Egypt:</u> Transaction advisory services comprising preparation of IPP tender documents, covering technical, commercial and legal conditions, followed by evaluation of bids and assistance in contract negotiations
- <u>Project portfolio (1,200 MW)</u>, <u>France and UK</u>: Due diligence services for a portfolio consisting of 45 projects that are in the construction, pre-construction and development phases
- <u>Development pipeline (500 MW)</u>, <u>Germany</u>: Due diligence services for 36 projects plus capability assessments of project developers and overall risk assessments
- <u>Plandište (100 MW)</u>, <u>Serbia</u>: Technical due diligence services for a private investor including review of contracts, permits and the available design
- <u>Project portfolio (450 MW), Scotland:</u> Detailed technical appraisal comprising reviews of planning status, construction contracts, time schedules, CAPEX, OPEX, wind assessment, energy yields and subsidy status (renewable obligation certificate) for each project
- Project portfolio (262 MW), UK: Technical due diligence, with perusals of operating and maintenance records and determination of availability for six operational wind farms in Scotland and Wales



### **Studies**

- <u>Gulf of El-Zayt (3000 MW)</u>, <u>Egypt:</u> Feasibility study for a major wind energy scheme including site suitability and estimation of sitespecific costs for generation, transmission access and grid integration
- <u>Shagaya (2000 MW), Kuwait:</u> Development of a master plan for a multi-technology renewable energy park with technical and financial consultancy services for KISR
- <u>Project portfolio (340 MW)</u>, <u>Turkey</u>: Electricity yield study for eight wind farms comprising modeling and evaluation of wind data with a long-term correlation and uncertainty analysis
- <u>Turbine manufacturer, Germany:</u> Wind and site assessment, comprising micrositing, energy yield forecasts, noise appraisals, and shadow flickering calculations as well as evaluations of site suitability for some seventy projects with an aggregate capacity of about 1,000 MW
- <u>Akmola Oblast (2 x 70 MW), Kazakhstan:</u> Feasibility study for two sites as a basis to decide which one should be further developed, encompassing concept, scheduling and cost estimate
- <u>Markgrafenwald (30 MW), Germany:</u> Feasibility study for a wind farm in the State of Baden-Württemberg considering all relevant influences, like wind conditions, micrositing, grid feed-in, environmental impacts, military activities and permits



Owner's engineering and monitoring of operation

- <u>Bisaccia (66 MW), Italy:</u> Owner's Engineering support during all phases from engineering to commissioning covering project management, design review, site supervision, quality control with inspections, spare parts selection and punch list resolution
- <u>Bogdanci (37 MW), Macedonia:</u> Support for tendering, contract award, site supervision and commissioning of 16 turbines including control systems, cabling and infrastructure; additionally Fichtner performed the CDM application process
- <u>Peralta (115 MW), Uruguay:</u> Inspection of 50 wind turbines, covering rotor, nacelle, tower and foundations, technical installations and crane hardstandings
- <u>Hybrid power plant (5 MW), Bahrain:</u> Analysis of market potential and preparation of design and tender documents plus contract management and site supervision for a wind / PV plant
- <u>Phu Lac (24 MW)</u>, <u>Vietnam</u>: Engineering and consultancy services covering tendering, contract negotiations and implementation as well as supervision of construction and commissioning





## Harnessing Wind Energy Onshore

Wind power is plentiful and produces no CO<sub>2</sub> emissions during operation. At locations with favorable wind conditions, wind farms are already competitive with conventional power plants. In recent years, of all the options for electricity generation from renewables, wind energy has achieved the highest rate of expansion.

Onshore wind farms are attractive thanks to their rapid capacity expansion and high technical availability. Additionally, the latest generation of wind turbines with large rotor diameters and greater hub heights can harvest the wind potential of previously unexploited locations even if wind conditions are less favorable. Fichtner has gained experience in wind projects in all types of terrain and topographies, such as coastal, inland areas, suburban, arid and desert zones, mountain ranges and in forested regions.

Wind power investments involve specific inherent challenges to which Fichtner is responding with dedicated management and design approaches. To support planning, micro-siting, energy yield forecasts and environmental impact analyses of wind energy projects, Fichtner makes use of powerful WindPRO / WASP as well as WindSim software packages together with CAD and ESRI's ArcGIS geo-information software system. Fichtner counts on its best practice know-how from numerous service contracts to develop project-tailored procurement concepts that meet the requirements of wind power investors, banks and supply markets. Additionally, local partners for international projects are recruited if special wind-related infrastructure for site access, power feed-in and operation management has to be planned, approved and executed.

Fichtner plans off-grid systems for small- and mid-scale installations, as well as hybrid systems like wind coupled with solar photovoltaics that are suitable for remote local power networks. Our experts render support by preparing, among others, techno-economic optimization studies on autonomous systems, system development, and sizing of energy stores and alternative energy sources.

### Offshore References





Technical due diligence of 588 MW Beatrice Offshore Wind Farm, Scotland On behalf of one of the owners Fichtner conducted a technical due diligence audit to support its assessment of this wind farm off Scotland's North Sea coast. Fichtner supported in the technical appraisal of the Beatrice project with reviews of environmental and planning compliance, electrical and structural/foundation design, wind yield analysis, metocean and seabed conditions, and marine logistics.

### Due diligence review of an offshore wind farm, Belgium

An investor reviews the possibility of acquiring a holding in a wind farm off the North Sea coast for which construction has already started. Fichtner provides due diligence services, covering reviews of project documentation with the existing due diligence report, the implementation schedule and wind energy yield assessments, to comment on and analyze the remaining risks.



### Owner's engineering support for an offshore wind project, Germany

A project developer is planning an offshore wind farm in the exclusive economic zone of the German North Sea. This will have an installed capacity of 400 MW based on wind turbines of the 5 MW class. As technical consultant, Fichtner assists with owner's engineering services, taking in review of contracts, project and risk management, permit application planning, as well as the development of concepts for logistics, operation and maintenance plus health, safety and environmental aspects.



### Project steering for 320 kV DC grid tie-in for offshore wind farms

In the German sector of the North Sea, TenneT TSO GmbH is implementing three projects to link offshore wind farms in the BorWin2, DolWin1 and HelWin1 clusters to the German EHV grid. This comprises in each case an offshore platform with cable connections to the wind farms, transformer and converter substations as well as switchgear plus operational and network management systems, both offshore and onshore. To support TenneT Offshore GmbH, a joint venture under Fichtner's leadership took on the project steering role.



#### Financial due diligence for investment in two offshore wind farms, Germany

A German utility is examining whether to invest in two offshore wind farms in the German North Sea. The two wind farms Bard I and Borkum West with 400 MW capacity are under construction and consist of eighty 5 MW wind turbines each, located 89 km and 45 km north of the German coast. Fichtner prepared a financial due diligence review and analysis of the intended investment, and provided advisory services in this regard.



## Harnessing Wind Energy Offshore

In comparison with onshore wind energy exploitation, offshore wind farms offer substantial advantages: significantly higher wind yields with higher capacity utilization, high energy-economic contributions thanks to the huge areas available for development, reduced visual intrusion and thus better public acceptance, plus project scales of several hundred megawatts.

As a result, economies of scale are exploited for capital expenditure with regard to planning, financing and operation. But, due to the high technical requirements and the complexity of the projects, to minimize costs and project risks, planning and project management have to be optimized.

The technical requirements are primarily the design of the foundations of the wind turbines and inter-array cabling, since the components are exposed to a highly aggressive environment and difficult ground conditions. This also includes environmental issues, like noise exposure during construction, encroachment on marine habitats or the impact on bird migration during operation.

Logistics is a key task when implementing these projects. Assessments of the impacts of heavy swell and high wind speeds are essential in the construction phase and difficult to predict. Due to the large distance from the coast, risk and associated costs are additionally increased. The availability and security of the supply chain is another important issue when considering marine logistics. After commissioning, reliable operation and judiciously selected maintenance intervals are vital to minimize downtimes and resulting loss of income. This requires – like for the construction phase – detailed schedule coordination.

At an early stage, Fichtner prepared for the strongly growing market for wind farms and supplemented its experience in planning complex energy facilities with specific offshore expertise. To directly serve the markets of the North and Baltic Seas, Fichtner Wind Energy GmbH was established in Hamburg. In collaboration with engineering consultants experienced in maritime civil engineering, offshore foundation construction and hydraulic structures, the Fichtner Group provides the entire bandwidth of specialist disciplines for offshore projects as owner's and lender's engineer.

### **FICHTNER**

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