



Wind energy

Increasing the value



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Project developers and governments face the challenge of reaping the potential of wind power. Because the realization of a wind farm involves years of preparation and the investment of considerable capital, project developers and investors naturally want to be sure that their project is likely to be a success. To facilitate the management of risk, KEMA has therefore developed a special integrated approach. From preliminary design to delivery and valuation, KEMA has the expertise and experience to help you make your project a success.



Our climate is changing. And the emission of greenhouse gases, such as CO₂, from the combustion of fossil fuels is a major contributory factor. A more environmentally friendly and sustainable energy supply relies heavily on the development of renewable energy technologies.

Furthermore, dependency on countries with major fossil fuel reserves is regarded as undesirable by many governments. Concerns on this score are adding impetus to the development of alternative energy technologies.

Around the world, national governments are therefore setting targets for the percentage of their countries' energy supplies that should be obtained from renewable sources. Wind energy is looked upon as one of the prime candidates for generating renewable electricity, as it is reliable, widely available and cost-effective.

Project developers, governments and local authorities, system operators and financial institutions face the challenge of realizing the potential of wind energy. At present, the key questions are where and how the wind farms should be built. Furthermore, as reliance on wind energy grows, the fluctuating nature of the power supply from this source will become an increasingly significant issue, which will have to be addressed. Last but not least, there is a need to determine the value of wind energy and to identify the best strategies for managing the financial and technical risks.

KEMA's consultants are ideally placed to help you chart the best way forward. Because we are familiar with every step of the process, from initial design to financing and delivery, operation and maintenance, we are able to precisely define the risks associated with any given course of action, and thus to enable you to arrive at properly informed decisions.

Project development

In many countries, wind farm development is a profitable business. Once a wind farm has been built it can become a reliable source of electricity and revenues. Getting to stage requires considerable effort and perseverance. Wind power projects require large investments in the beginning of the project, which are most often financed by financial institutions. Obtaining the necessary permits can be a cumbersome process, involving intricate legal aspects and involving many stakeholders. There are many aspects that influence the feasibility of a wind farm, such as the wind resource, grid connections, subsidies and tax credits, governments rules and regulations and wind turbine selection. KEMA has a proven track record for wind farm development and offers a complete package for the development from Greenfield to a completed wind farm.

- > Site identification. Finding the right location is the key factor for wind energy development. Based on suitable site selection criteria KEMA can assist you in finding these locations. We can provide computer visualizations and an environmental impact statement where necessary
- > Wind resource assessment. The main source of income is the wind farm energy yield. Unfortunately, this is also the largest source of uncertainty in the financial projections. KEMA gives you reliable estimates of the expected wind energy yield and its uncertainty using state-of-the-art tools
- > Basic wind farm design. KEMA's know-how guarantees that the design will meet all requirements, with maximum profit and economic life going hand in hand with a minimum impact on the environment. A layout of the wind farm is made in consultation with all parties concerned, using the available space as efficiently as possible
- > Financial advice. Prior to the realization of a project, KEMA outlines the most favorable financial options so you can take advantage of available tax facilities and get the best revenues from environmental credits. When concluding contracts for the sale of renewable energy, we negotiate the best possible price for you
- > Contracting. Anticipating the erection of a wind farm, KEMA provides support in assessing tenders and awarding contracts with an eye to value for money. Experience has shown that warranties, insurance and maintenance are important cost drivers and should be included in an integral assessment
- > Project management. During construction we monitor the quality of the components manufactured and installation operations at the construction site, in order to guarantee a maximum economic life and minimum maintenance costs



Vader Piet, Aruba

On the East coast of the Caribbean island of Aruba, the project company Wind Farm Vader Piet operates a 30 MW wind farm consisting of 10 Vestas V90-3.0 wind turbines. Financiers Nu Capital, Bright Capital and lenders led by Dexia requested KEMA to provide technical and economical expertise in the project during financial close and construction.

- > In a **technical due diligence**
KEMA assessed the financial risks related to project design, budgets and planning
- > As **owner's engineer**
KEMA ensured construction followed design documentation & contractual agreements, and witnessed construction, commissioning and testing
- > As **lender's engineer**
KEMA updates financiers on all project deviations with technical & financial impacts by monitoring project risk, time schedule and budget realization

KEMA has played an active role in offshore wind farm development from the beginning. Our activities include

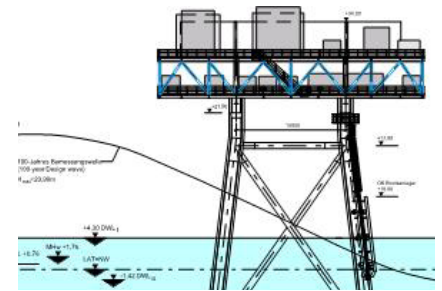
- > Wind resource assessments
- > Environmental impact assessment and permit applications
- > Grid integration studies
- > Financial risks of large scale offshore wind development
- > Due diligence on over 20 offshore wind farm projects
- > National measuring and evaluation programs
- > Offshore wind farm development

Value of wind energy

The value of wind energy does not equal the cost of wind power generation. The value of wind energy depends on the rules and regulations of the electricity market and subsidies or obligations set by the government. Furthermore, penalties may apply when electricity is not delivered according to schedule. KEMA has developed models to assess the value of power purchase agreements under various market and contract conditions. These models take into account the market conditions on the day-ahead market, intraday-market and the imbalance market. Scenario studies provide insight in the future market prices, and the influences of the fuel and carbon markets. The model calculations are an essential tool in negotiations between wind farm developers, utilities and banks as they provide objective information not only on the expected value of such contracts, but also on the risk profile connected to it and on the factors that influence these outcomes.

Due diligence

The development or acquisition of a wind farm requires a substantial investment. As an investor or financier you are interested in reducing technical and financial risks. KEMA offers independent, dedicated consultancy to help manage the risks by providing a solid basis for the investment decision or project finance. KEMA acts as an independent engineer for banks, energy companies and other related (co-)financing parties. We have vast experience in international due diligence projects not only concerning wind energy but also in combined heat and power projects, energy distribution and waste to energy projects. We have acted for blue chip banks, major utilities and wind farm owners.



Offshore wind put to practice

Our deep understanding of value and risk of offshore wind projects have enabled us to work with both large and small international clients in offshore areas in Germany, The Netherlands, Belgium and the United Kingdom.

Wind farm design and planning, energy yield calculations, permit applications, FEED study

- > Borkum West II, Nordsee Ost, Tromp Binnen, He Dreiht, Hohe See and more

Analysis, design and planning of electrical installations

- > Alpha Ventus, OWF Butendiek, Nördlicher Grund, Baltic 1, Kriegers Flak, Innogy Nordsee 1, Nordsee Ost, Nordergründe, Veja Mate and more

Due Diligence and technical advisor

- > Bard Offshore 1, Borkum West 2, GeoFre Baltic Sea, Sandbank 24, Ormonde Irish Sea, Nordergründe and more



Koegorspolder

One of the first projects realized by project developer WinWind is the 44 MW wind farm Koegorspolder in the southwest of The Netherlands. KEMA has been involved throughout this project from the pre-feasibility study until commissioning as the primary consultant.

KEMA was responsible for all technical and environmental aspects, technical turbine selection and grid connection. KEMA provides advise both at strategic financial level and at the nitty gritty detail level. Wind farm Koegorspolder started generating renewable kilowatthours by the end of 2007.

In a due diligence relevant value drivers, cost drivers and risk & controls are taken into consideration. As an independent engineer KEMA assesses all the important aspects for building and operating a wind farm, including

- > Technology
Modern wind turbines are reliable machines if they are operated according to the design specifications. In our Wind Turbine Generator assessment we include turbulence and wind shear conditions, complex terrain and wind farm induced effects, compliance with applicable safety certificates, manufacturer and EPC O&M contracts and warranties. For offshore application, reliability, availability and maintainability even play a more significant role in the process
- > Interconnection and grid review
Adequacy of the grid connection for the proposed wind turbines
- > Construction period arrangements
Assessment of the contracts including the scope of the contracts and the interfaces between contractors: EPC/O&M contracts, Power Purchase Agreements, Interconnection agreement, project schedule
- > Operational assessments
Assessment of operating and maintenance costs
- > Energy production assessment
Review of wind measurements, evaluation of the wind potential, calculation of the energy production of the wind farm, including levels of confidence
- > Environmental and permitting review
KEMA's experts review the complex of necessary permits, including environmental impact statements, environmental and planning permits, construction permits, and future regulatory and market developments
- > Project monitoring
During construction KEMA ensures that construction is handled in accordance with the design and contractual documentation



Benefit from our experience

- > Proven track record. Many clients have used our wind energy expertise in due diligence, assessments, certification, design reviews and construction support
- > 20 years of wind resource assessments. Onshore and offshore wind atlases for Europe, an electronic wind map, design of wake and wind farm models, research projects
- > Proven offshore project experience in design projects as well as due diligence
- > Owner's and Banker's engineer. Assessing the technical and financial risks in project development or project acquisitions
- > World-class tools. Extensive databases of end-user market and technical data, regulatory information and economic data, wind optimization software, financial models and market forecast tools

Why work with KEMA?

KEMA has decades of experience in the electricity sector. We are able to provide well informed answers to your questions. KEMA is a reliable, impartial service-provider active in the fields of business and technological consultancy, certification and testing. We possess the expertise, the facilities, the technology and the experience to assist on any aspect of wind energy. Our multidisciplinary teams provide active and critical support to help you think the issues through. This collaborative approach quickly yields tailor-made, practical solutions.

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