



Wind Industry in Germany

ECONOMIC REPORT: An overview of the German wind industry

COMPANIES: Leading companies in the sector present their products and services

INDUSTRY DIRECTORY: Easy access to the right contact

2017



Wind Industry in Germany 2017

BWE INDUSTRY REPORT



Editorial



Dear Reader,

For the fourth consecutive year, cost-effective onshore wind energy has proven that it has the power to sustain a stable and significant increase in capacity on its home market of Germany, despite the pressures of gradually decreasing feed-in tariffs. Over the course of just four years, the installed capacity of onshore wind energy has grown by 35 % to 45,910 megawatts. Developments in turbine technology have made it possible to install highly efficient turbines across all regions of Germany in a way that optimally benefits the overall electricity grid. Offshore wind energy is also proving that the industry is keeping to its promises, with strong figures and, most importantly, a clear learning curve leading to reductions in cost.

Germany remains one of the most important markets for wind energy. At the same time, the growing success of the wind energy sector in the export market illustrates that it has grown into a vibrant and internationally competitive industry. The energy transition is by no means leading towards the process of deindustrialisation that some feared it would herald – instead, it is opening up new value chains. The path towards integrated energy – namely integrating transport and heating with renewable energies – that was tentatively set out in the German Renewable Energy Sources Act (EEG) 2017 will also inject new momentum into the industry. Power-to-heat is already a trend. Battery technology is becoming increasingly important, from single-family homes

all the way to industry, and continues to be driven forward in the context of sub-metered electricity. Power-to-chemicals is providing answers to the wishes of the chemical industry, and power-to-gas is contributing to the storage of renewable energy. Approving technological innovations and seizing the opportunities that they open up for Germany will remain one of the most important tasks in politics. This must be accompanied by a reorganisation of the tax and duty system in the energy sector.

The world of renewable energy is decentralised, and continues to be characterised by a large number of active players. Digitalisation is making it more and more easy for energy consumers to be independent, and Germany is well-positioned as this growing phenomenon comes to the energy world. Exportable concepts are being developed here. With business-to-business solutions in the economy, peer-to-peer or blockchain technologies for private households and commercial customers, and the growing importance of the sharing economy, we are seeing new business models and business relationships gain in traction at an increasing rate.

The German government made some important commitments in the Paris Agreement. The Climate Action Plan 2050 describes the steps by which renewable energies will become the foundations for Germany as a sustainably organised industrial nation. The wind industry will

need to face the resulting challenges aggressively over the coming years, and calls for tender are just one aspect of this. We will need to involve citizens as active participants, make further technological developments, advance system integration, and engage in partnerships with the industry, working jointly towards the best possible solutions to ensure a safe and cost-effective energy supply. The companies in the industry are well prepared.

The German Wind Energy Association (BWE), comprising more than 3,000 companies and over 20,000 members, represents the expertise and experience of the entire industry. In addition to the supplier and manufacturer industry anchored in German engineering, project developers, specialist lawyers, experts and appraisers, the financial industry, and companies from the fields of logistics, construction, service, maintenance, and storage technologies, the BWE now also includes electricity traders, grid operators and energy providers. This makes us one of the largest associations for renewable energy in the world, allowing us to represent the entire value chain in the sector. We are driving technological development forward in our advisory committees and task forces. Together, we will work towards a successful energy transition!

Yours,

H. Albers

Hermann Albers, President of BWE e. V.

Welcome



The energy transition is at an exciting stage worldwide. Showcasing a wealth of innovation and expertise, the German renewable energies industry is in the thick of it. And wind power is certainly playing a crucial role in the energy transition and climate protection as a whole, at both national and international level. Wind energy is not only booming in countries that are, like Germany, involved in the energy transition. This gives German companies a great opportunity to apply their extensive expertise and experience as well as creative solutions around the world.

The considerable success of the wind industry is far from unfounded; wind energy is an attractive option. Inexpensive to produce, it can compete with fossil fuels in many areas of the world. A total of 63 GW of wind power capacity were installed worldwide in 2015 – a record year for the wind industry, demonstrating just how important wind is to the energy system of the future. The German wind industry has successfully been applying its modern technologies abroad. This is also reflected in the figures recorded by wind turbine manufacturers: the export quota in 2015 stood at an impressive 65 to 70 %.

Globally, the wind industry creates jobs, wealth and growth. This is exactly what is needed to turn the energy transition into a sustainable, successful model. Various approaches need to be intelligently combined to ensure that the transformation process in the second phase of the energy transition can succeed on a technological, economic and social level. This is where wind power comes into its own within the context of the integrated energy transition: wind can generate energy not only for electricity, but also for the integrated heating and transport sectors. German companies must seize this opportunity by applying their system expertise, years of experience in international markets, and excellent reputation as providers of high-quality products and services. There is plenty of untapped potential, particularly in these new forward-looking business areas – in Germany, too.

The global wind power market will continue to boom as the full potential of the industry has not yet been exploited, including in previously neglected locations. In order to promote expansion, technological advancements are also required with regard to areas with low winds, the offshore sector, and the storage of energy. Even the increased use of tenders in securing funding for renewable energies has failed to harm the German wind industry: costs are falling, companies are becoming more innovative. This is how German companies are managing to assert themselves on the market against international competitors.

Thanks to its wealth of experience and vast network, the German Energy Agency (dena) provides support to German wind energy companies to ensure that they are able to successfully enter new foreign markets. Among other things, we perform analyses of international wind markets, implement pioneering projects, and contribute our expertise in organising networks and developing national and international markets. In collaboration with the German wind industry, we are striving to continue shaping the energy transition in an active and ambitious way and turning it into a top export worldwide.

Yours,

Andreas Kuhlmann,
Chief Executive of dena

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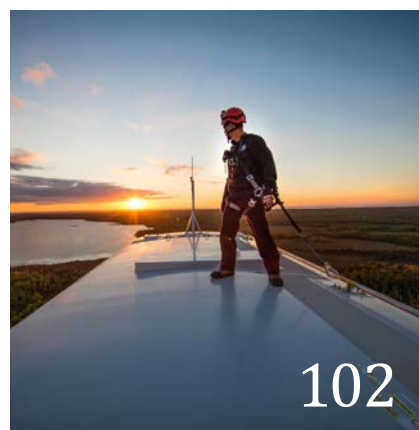
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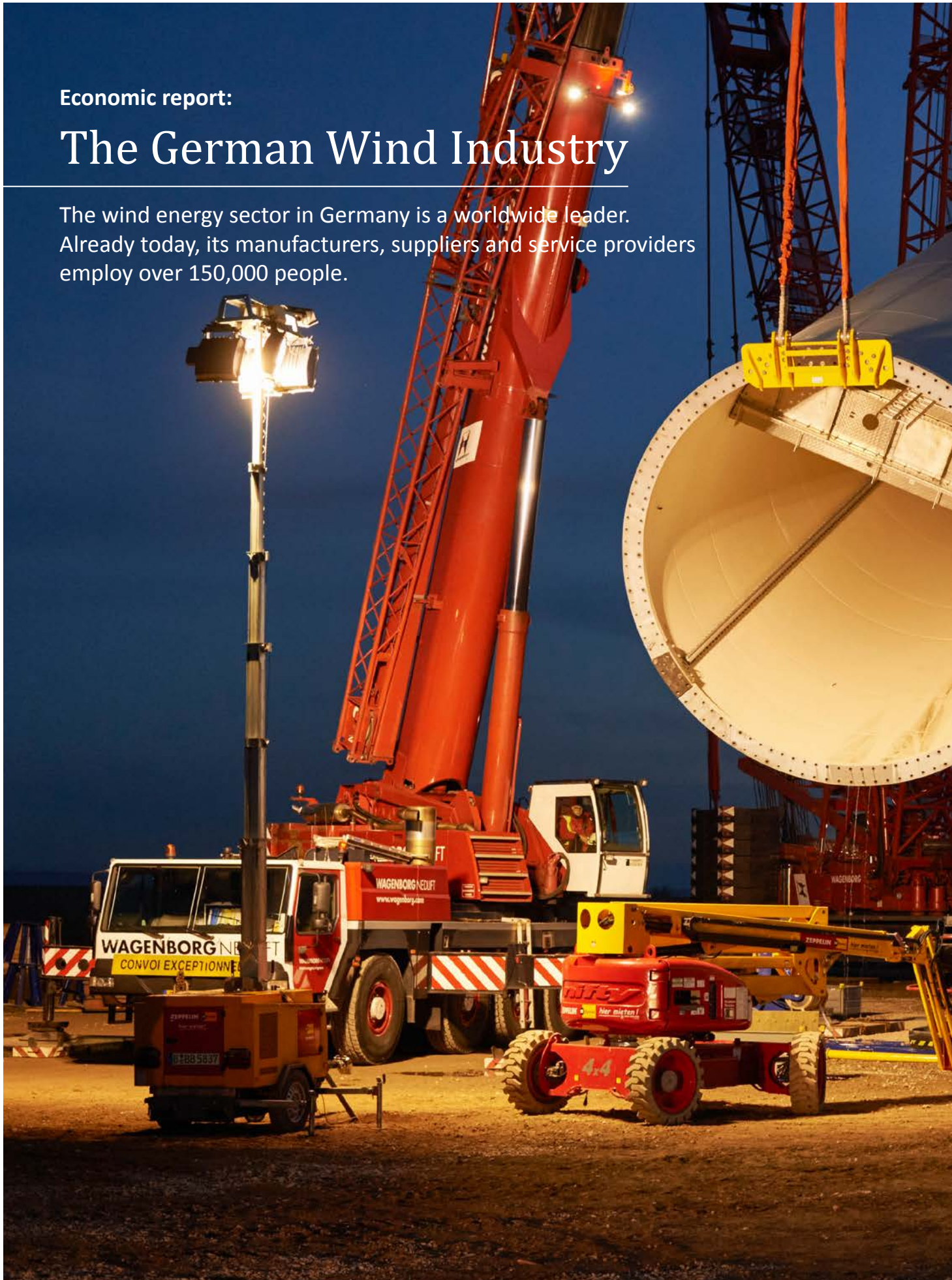
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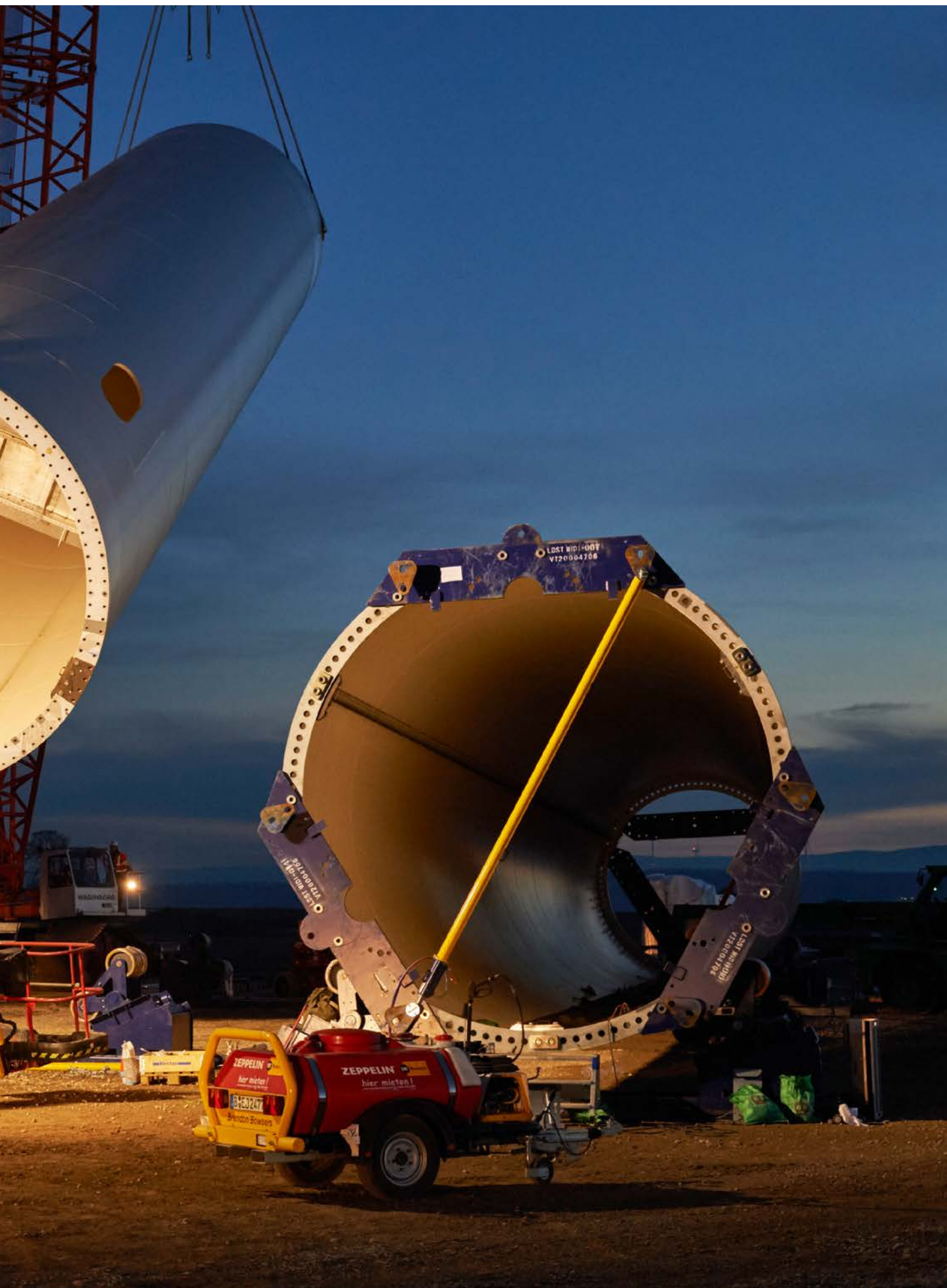
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Economic report:

The German Wind Industry

The wind energy sector in Germany is a worldwide leader. Already today, its manufacturers, suppliers and service providers employ over 150,000 people.





Strong growth for renewables worldwide

2016 was characterised by a strong expansion of wind energy in the western markets and considerably reduced costs for both wind and solar power. In the next 20 years, renewables will be the fastest growing sector in the international energy industry. The outlook for wind power is very positive.

In 2017 the IEA1 and BP Energy Outlook are drawing a picture heavily shaped by the growth in renewables in the period up to 2035. "Growth is being driven by increasing competitiveness," according to the BP Energy Outlook. Institutions that have historically been very closely connected to the traditional coal and oil industries are coming to the same conclusions. As a solid mirror of investment decisions and trends in the energy sector, Energy Outlook is therefore to be considered more as evidence of the increasing economic importance of renewables worldwide.

On the basis of different cost scenarios, BP shows that wind turbines in the USA today result in considerably lower power

generation costs than the coal-fired power stations competing in the energy industry. What is more, there are no external costs for climate damage and ultimate disposal. In China, the most economical wind farms are now neck and neck with coal. In both markets, by 2025 at the latest wind turbines will be cheaper. Energy Outlook calculates power generation costs over the lifetime of the turbines of around 4 to 6 US cents per kilowatt hour (kWh).

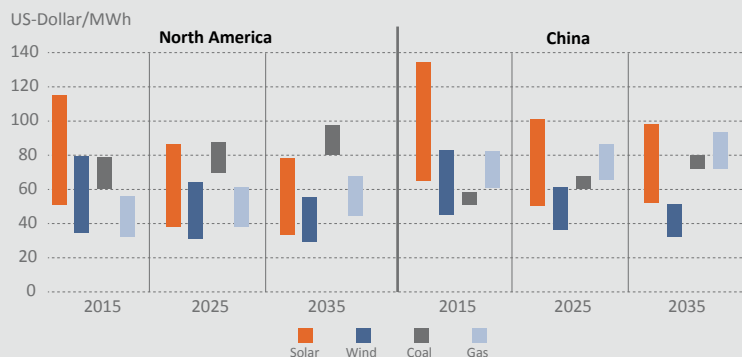
These cost assumptions in the BP study are currently being undercut already by both wind and solar. In America and North Africa, single wind farms have been built onshore with power prices of 2.7, 3.3 or 4.2 euro cents per kWh (see page 16). Solar power is also achieving similar

figures. In Europe, a German-Danish solar call for proposals at under 5.4 cents per kWh is causing a real stir. In the United Arab Emirates 2.7 cents per kWh has been targeted. Having been achieved in 2016 and 2017, the prices are considerably lower than the forecasts for the period from 2020.

And investments in the energy industry have relocated themselves accordingly. In Europe – the region with the highest share of renewables in the energy mix – in 2016 companies and states almost exclusively invested in constructing new wind and solar farms and biomass, hydropower and gas power plants. Conversely, generation capacities for power from oil or coal have been wound down (see figure). In the USA, wind has now overtaken both hydropower and solar power in terms of installed capacity, and is in fourth place for generation capacities, after gas, coal and nuclear.

The number of installations in the USA in 2016 was as high as this suggests: With 8,204 MW, wind power is only 400 MW below the record figure of the previous year (see page 12), while the first offshore wind farm was also commissioned off the east coast (see page 20). The wind industry in China has experienced something of a setback. Only 22,800 MW were added to the grid (30,000 in 2015). Experts cite problems with expanding the grid.

Solar and wind cheaper than coal



Cost of power over the lifetime of a plant: cost of capital, cost of connection to the power system, load factors for solar and wind and fuel prices are all taken into account. We are assuming CO₂ emission prices of 20, 40, 60 dollars per tonne of CO₂ for the years 2015, 2025 and 2035, respectively.

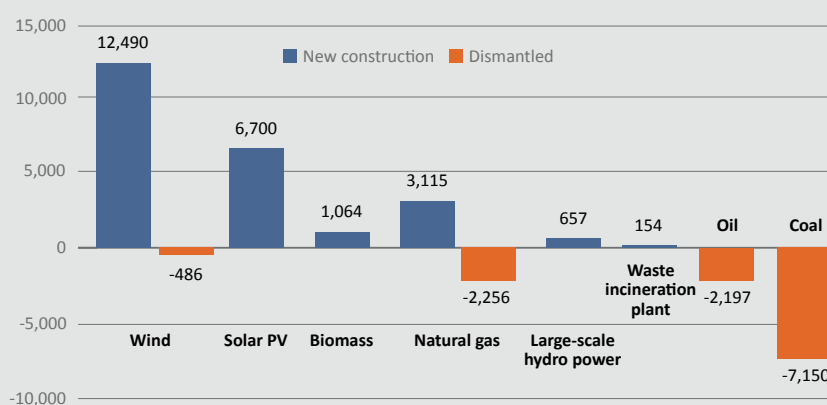
Source: BP Energy Outlook 2017



In Europe, the expansion of wind power continued at a high level, with 12,500 MW. Germany continued to be a strong market, with 5,443 MW of onshore and offshore installations, and the forecasts for 2017 and 2018 continue to be very positive (see page 14). By 2019, according to the government's figures, the expansion could then decrease to less than 3,000 MW.

In total, the Global Wind Energy Council (GWEC) expects a global increase considerably over the 60,000 MW benchmark in 2017. The manufacturers represented by the German Engineering Federation (VDMA) are somewhat more cautious, putting the figure more at 53,000 MW.

Europe: investing only in renewables and gas



Commissioning and dismantling of power generation capacity (2016 in MW)

Source: Windeuropa 2017. Figure: Ahnen&Enkel

Markets in the West showing a high level of stability

The markets in America, Europe and many parts of Asia are tapping in to the record installations of 2015. There was a clear setback in China. However, western manufacturers are affected to a lesser degree: The middle kingdom market has been closed to them ever since.

At 54,000 megawatts (MW) of installed capacity, the worldwide number of new installations is far below the record level of 65,000 MW in 2015. The setback in the Chinese market can be largely blamed for this change: the capacity of turbines installed in that country dropped from a good 30,000 MW to 22,800 MW. After the volatile growth of installations in the past three years, market observers believe that this is an initial breather: The grid capacity in China needs to catch up with the expansion of renewables, the demand for power in China is no longer increasing at quite such a rate of knots as recent years, and even the costs for feed-in tariffs for wind power have now been downsized, according to the Global Wind Energy Council (GWEC) in its current an-

nual report. However the government is sticking to its most recent five-year plan, which states that the cumulated wind power capacity will reach 210,000 MW by 2020. By the end of 2016 this figure was at 170,000 MW.

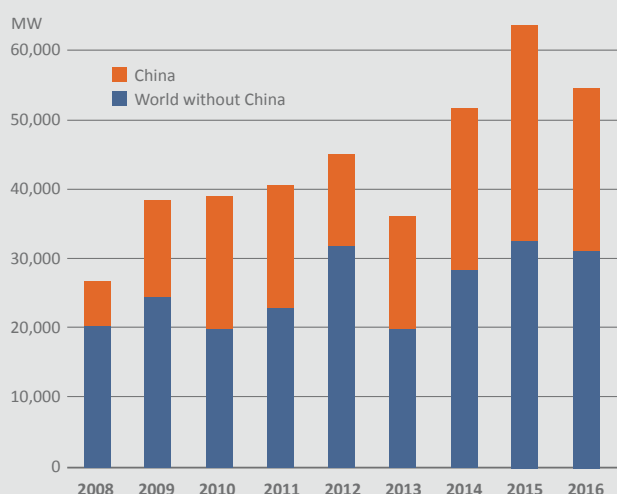
European, Indian and American manufacturers are less affected by developments in China. "China remains a largely closed market, and that's not likely to change much in the future either," says Matthias Zelinger, Managing Director of Power Systems in the German Engineering Federation (VDMA). He believes that the key markets for Western manufacturers will continue to be Europe, North and South America, and some individual Asian countries like India and Turkey.

Taken globally, wind power continued to expand strongly: Minus the expansion figures in China, globally 31,272 MW of new wind power capacity was installed. That puts 2016 right up there with the record years 2012 and 2013.

In the USA, 8,203 MW was added to the grid, only 400 MW less than 2015. The American Wind Energy Association (AWEA) is optimistic about the immediate future: At the start of the year, wind farms totalling 5,401 MW were being constructed, and another 1,288 MW were at an advanced stage of planning according to their records. It is expected that of this, at least 6,689 MW will be added to the grid in 2017.

At the start of 2017, the debate in the USA has been overwhelmingly shaped by the uncertainties of the Trump government. The new President has time and again expressed the view that climate change was invented by the Chinese government with the aim of damaging the US economy, while the Republican party has been sceptical about the international Paris Agreement. Yet at the same time, Republican-controlled states such as Texas and Iowa are clearly leading the charge for cumulated wind energy installations (with around 20,000 MW and 7,000 MW respectively). In particular, Rick Perry, the former governor of Texas, who was appointed Energy Secretary by Trump, has contributed to this state of affairs.

Wind energy: global market 2008–2016



Source: GWEC, various reports. Figure: Ahnen&Enkel

“Too much pessimism is not trendy” said FAZ at the end of 2016. In the meantime, the American Wind Energy Association has changed its communication strategy with the new government in mind: The central tenet is no longer climate protection. Instead the AWEA now emphasises that wind power is a cheap national source of energy that creates jobs, particularly in the “Rust Belt”. And it is these very people in the regions affected by the collapse of industry who were promised jobs by Trump during the election campaign. The fact that four of the five states with the strongest increase in wind energy are dominated by Republicans shows that the expansion of wind energy in the USA has traditionally been more a question of jobs and economic impacts and less about climate protection.

In Europe, the expansion of wind power continued at a high level, with 12,500 MW. According to Wind Europe’s data, the top five are Germany (5,443 MW onshore and offshore, see page 20), France (1,561 MW), the Netherlands (893 MW), the UK (736 MW) and Poland (682 MW).

In addition to these main markets, Turkey, with 1,387 MW, and India are also seeing strong growth. “On the subcontinent, an installation record of 3,612 MW was targeted. We will continue to see strong growth and even the first offshore projects in India in the years to come,” says Steve Sawyer from the GWEC. In particular, the Secretary General of the GWEC describes the market as “being in pretty good shape”. Sawyer expects to see high installation figures worldwide in 2017: the GWEC are predicting over 65,000 MW.



Republican states dominate wind power expansion in the USA

		Installed wind power		Dominated politically by
		MW	%	
1	Texas	20,321	25 %	● Republicans
2	Iowa	6,917	8 %	● Republicans
3	California	5,662	7 %	● Democrats
4	Oklahoma	6,645	8 %	● Republicans
5	Kansas	4,451	5 %	● Republicans
USA total		82,183	54 %	

Source: AWEA Wind Industry Report 4th Quarter 2016 from Feb. 2017.
Table: Ahnen&Enkel

Strong year and confident outlook for 2017

When looking at the figures for onshore installations, wind power in Germany has had the second strongest year in its history, while the long-term trend for growth continued for offshore farms. With added capacity totalling 5,443 megawatts, the onshore German market remains one of the most important in the world for the wind industry.

For the fourth consecutive year, the wind industry in Germany posted installation figures that are far above the average of the previous decade. With an addition of 4,625 MW onshore and 818 MW offshore, wind power remains the most important pillar of the energy transition in Germany. New installations demonstrate several trends: The technical development of taller turbines with larger rotor diameters is continuing. In 2016, newly installed wind turbines had an average hub height of 128 metres (+ 4 % compared with 2015) and a rotor diameter of 109 metres (+ 4 %). This means that even turbines in locations

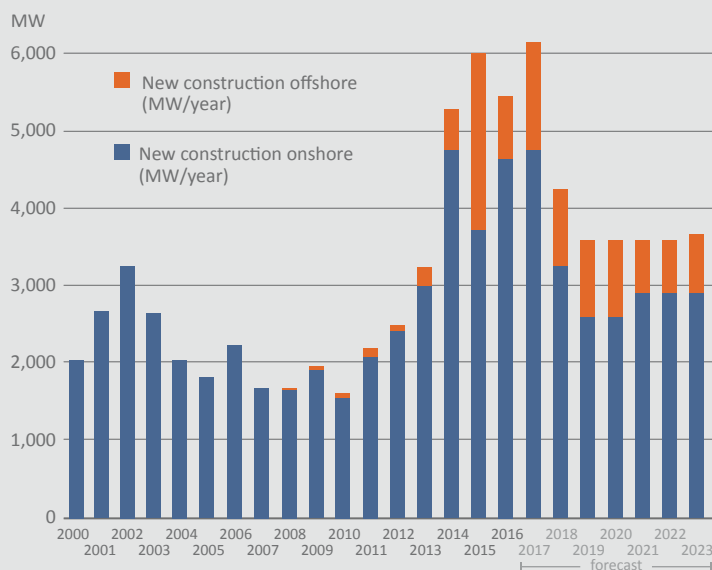
with medium to low wind speeds make economic sense despite falling feed-in tariffs and allows for expansion across the whole of Germany. This trend is also reflected in terms of regional distribution: in the early 1990s, around 90 % of the wind turbines in Germany were located in coastal states. Today, that share has dropped to 40 %. In 2016, for example, the southern German states of Baden-Württemberg and Bavaria were set up to generate more power (347 MW and 340 MW respectively) than the coastal state of Mecklenburg-Vorpommern (217 MW).

In Baden-Württemberg and North Rhine-Westphalia (564 MW), the political decisions that were taken back in 2011, in the aftermath of the Fukushima nuclear disaster and after German state elections, are now starting to take effect. "Providing land is the key to the expansion of wind power. At the same time, it shows just how long it takes for political decisions to take effect in regional planning," explains Hermann Albers, President of the German Wind Energy Association (BWE).

Industry representatives expect to continue seeing a high rate of onshore expansion in 2017 and 2018: according to figures by the German Federal Network Agency (BNetzA), permission for turbines with a total capacity of approximately 6,500 MW had been granted by the end of 2016. According to the transitional arrangements laid down in the German Renewable Energy Sources Act 2017 (EEG), these turbines can be put into operation by the end of 2018 and receive a fixed tariff for 20 years. It is expected that between 4,500 and 5,000 MW of wind power capacity will be installed in 2017. This value is expected to fall to 3,000 to 3,500 MW in 2018. After this, the expansion of onshore wind energy in Germany will be limited to 2,700 to 2,900 MW.

In May 2017, 800 MW of wind power capacity will be awarded to bidders through the new tendering system for the first time in Germany. It is expected that tariffs could fall to 6 cents per kilowatt hour or less. Tariffs currently stand at 8 cents per

Expansion of onshore and offshore wind power in Germany



Source: BWE 2017, VDMA 2017, Windguard 2017. Figure: Ahnen&Enkel

The next phase of the energy transition

Low costs and high fluctuations in electricity production and sector integration are giving companies in the wind industry the chance to develop new business models.

Part of the costs of producing electricity from wind power and photovoltaics and of power storage facilities fell drastically in 2016. At the same time, the share of renewable electricity on the German power grid is continually growing. The annual average stood at 32.3 % in 2016, despite it being a low wind year. During some hours, renewables covered more than 85 % of the country's energy needs. This fluctuation occasionally leads to high electricity surpluses, particularly on sunny or windy days, and can lead to wind turbines being shut down temporarily. At the same time, there are periods during which wind and photovoltaics generate very little power – in October and November 2016, for example.

This trend is set to last: the share of renewables is growing, the cost of production is falling. The highest attainable prices in the upcoming calls for tenders are capped at 7 cents per kilowatt hour (cents/kWh). The solar power tenders in late 2016 achieved only 6.9 cents/kWh on average. A well-documented German-Danish solar tender achieved a price of 5.4 cents/kWh. Production prices are falling for all renewables in Germany and worldwide (see figure).

The costs of storing energy are also falling. According to "Electrifying Insights", a McKinsey study published in early 2017, investment costs in lithium-ion batteries dropped by almost 80 % from 2010 to 2016, i.e. from \$1,000 to \$227 per kilowatt hour (\$/kWh) (see figure). The authors expect costs to fall to between 100 \$/kWh and 180 \$/kWh by 2020.

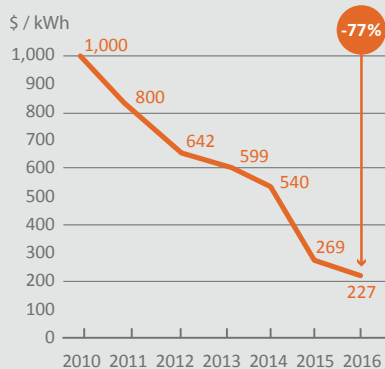
Energy companies are therefore increasingly developing new business models in three different areas: the compensation of fluctuations in the power grid, the use of electricity in the areas of transport and heating (sector integration), and the direct delivery of electricity to commercial and private end customers. In this way, they can benefit from the intermittently low energy prices in the energy exchanges.

The concept developed by Naturspeicher GmbH is particularly relevant to the construction of wind turbines. A subsidiary of the Max Bögl Group, the company has been building wind turbines that combine with water storage in southern Germany.

Under the wind turbines, there are large water basins that are connected to basins in the nearby valley and work like a pumped-storage power plant. Unlike in most traditional pumped-storage systems, the turbines used in this case can be regulated to work continuously in both directions. The power storage system will become cost-efficient by being built in combination with wind turbines and marketed in various different markets, such as the electricity balancing market, balancing group settlement, and quarter-hour, intraday and day-ahead markets. According to Naturspeicher, simulations of previous years have shown that the overall concept will become profitable with this kind of flexible marketing approach.

An experimental clause in the Renewable Energy Sources Act (EEG 2017), which was amended in 2016, gave the Federal Ministry for Economic Affairs and Energy (BMWi) the chance to approve new business models. This would in turn make it possible to continue operating wind turbines when the feed-in supply is halted due to grid overload if the power can be used directly on site in power storage facilities, in conversion projects such as electrolyzers (power-to-X), or for generating heat directly through a special immersion heater (power to heat). The BMWi has announced further provisions for improving integration between different areas of the sector. The key details and consequences of these provisions will be specified in regulations over the coming years.

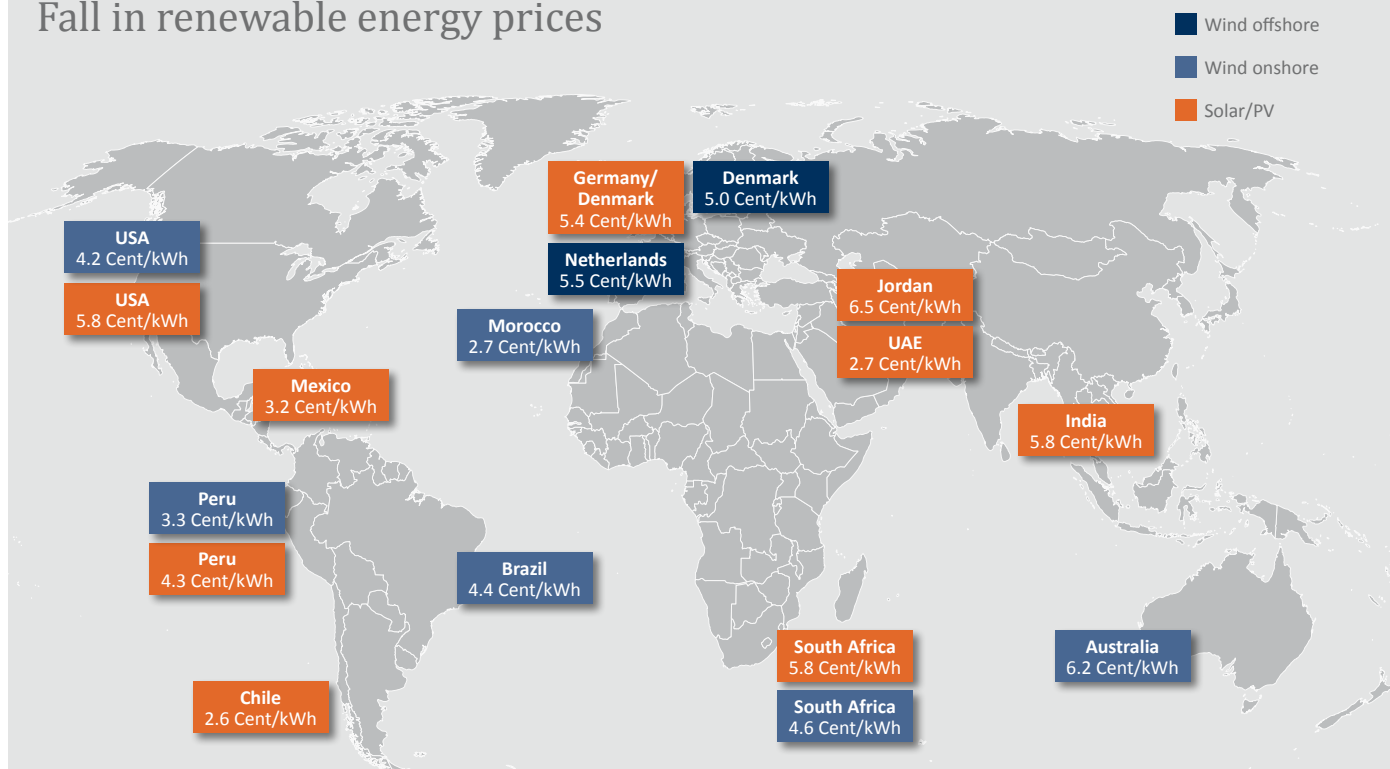
The cost of battery storage systems is falling rapidly



Source: McKinsey 2017, Electrifying insights: How automakers can drive electrified vehicle sales and profitability



Fall in renewable energy prices



Source: Agora 2017, "Die Energiewende im Stromsektor: Stand der Dinge 2016" (The energy transition in the electricity sector: the state of affairs 2016)

Reduction in tariffs for wind power

As of 2017, tariff pricing for electricity from wind turbines will be established by auctions. The feed-in priority and the guaranteed fixed tariff, however, will remain unchanged for 20 years. It is unclear how the various groups among the market participants will survive on the market in the medium term.

From the perspective of the German wind energy sector, 2016 was characterised by the political discussion surrounding the amendment of the Renewable Energy Sources Act (EEG). The EEG has been the key instrument for introducing renewables to the market since 2000 and is amended every two to three years. In previous years, amendments were made to at least the value of fixed tariffs, which, in the case of solar power in small rooftop systems, were reduced from around 57 cents per kilowatt hour in 2004 to 8 cents in 2012. The initial tariff for wind energy at the start of 2017 stood at 8.38 cents, with a basic remuneration of 4.66 cents. These rates were established by the German legislature on the basis of expenses reports.

The current law – the EEG 2017 – has changed the process involved in establishing tariff values. Rather than being set through an administrative process, feed-in tariffs are now established in an auction where the best bids are awarded the contracts. The highest price is capped at 7 c/kWh. There is no longer a distinction between initial and basic tariffs. A correction factor will be applied to the quality of the location (based on wind conditions) to ensure that bidders located on the coast, in the Alps and anywhere in between have a chance of winning the contract. According to analysts, this method will ensure that all locations have similarly good prospects for winning a contract regardless of local wind conditions. The system also encourages high hub heights, which yield even more electricity.

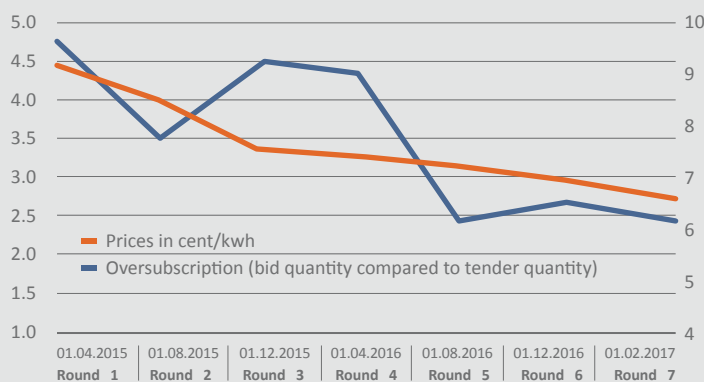
Tenders and fixed tariffs will coexist for the duration of the transition period. Any power plants that have not received approval in accordance with the Federal Immission Control Act (BImSchG) by 31 December 2016 can continue to expect a fixed feed-in tariff until the end of 2018. Depending on the date of commissioning, the tariff for the electricity they produce will be between 8.38 c/kWh (early 2017) and 6.97 c/kWh (late 2018).

Auction participants must produce a fully approved plan and provide a guarantee of €30 per kilowatt of turbine capacity. Already in charge of tenders for solar projects, the Federal Network Agency (BNetzA) is also responsible for conducting the auctions.

The precise effects on the German wind industry are difficult to predict. With regard to the foreseeably high expansion figures in 2017 and 2018 (see page 14), the VDMA speaks of a successful transition from an old to a new EEG, while the BWE fears that the expected cost reductions will mainly affect the diversity of actors in the medium term.

Indeed, the calls for tenders for solar projects conducted since 2015 clearly indicate a decrease in competition for the contracts. The volumes offered in the calls for tenders used to be 4.8 times higher than the tendered performance. By early 2017, this figure had halved to 2.4, indicating a decrease in competition among providers. The fall in prices, however, continues to be almost linear

Solar: Falling prices despite decreasing competition



Source: Federal Network Agency, various sources. Figure: Ahnen&Enkel



(see figure). Smaller companies such as cooperatives prevailed only twice among hundreds of successful bids.

In order to continue facilitating wind energy projects, the German legislature has made a number of provisions to support citizens' energy companies with a wind farm capacity of up to 18 MW. For example, when submitting a tender, they do not have to provide a certificate of compliance pertaining to pollution control and their guarantee provision is reduced by 50 %.

Calls for tenders for a total 2,800 MW are planned for each year from 2017 to 2019 (see table).

Calls for tenders and volumes, 2017–2019

Date	Tendered volumes (MW)	of which in the grid expansion area
01.05.2017	800	258
01.08.2017	1,000	322
01.11.2017	1,000	322
01.02.2018 and 2019	700	226
01.05.2018 and 2019	700	226
01.08.2018 and 2019	700	226
01.10.2018 and 2019	700	226

Source: BWE 2017: Handout – "Ausschreibung für Windenergie an Land"
(Call for tender for onshore wind energy)

Floating platforms soon to enter the market

The end of 2016 saw a surprisingly sharp reduction in the costs of offshore wind energy. In addition, floating foundations will soon enter the market, thereby making offshore wind power even more attractive worldwide.

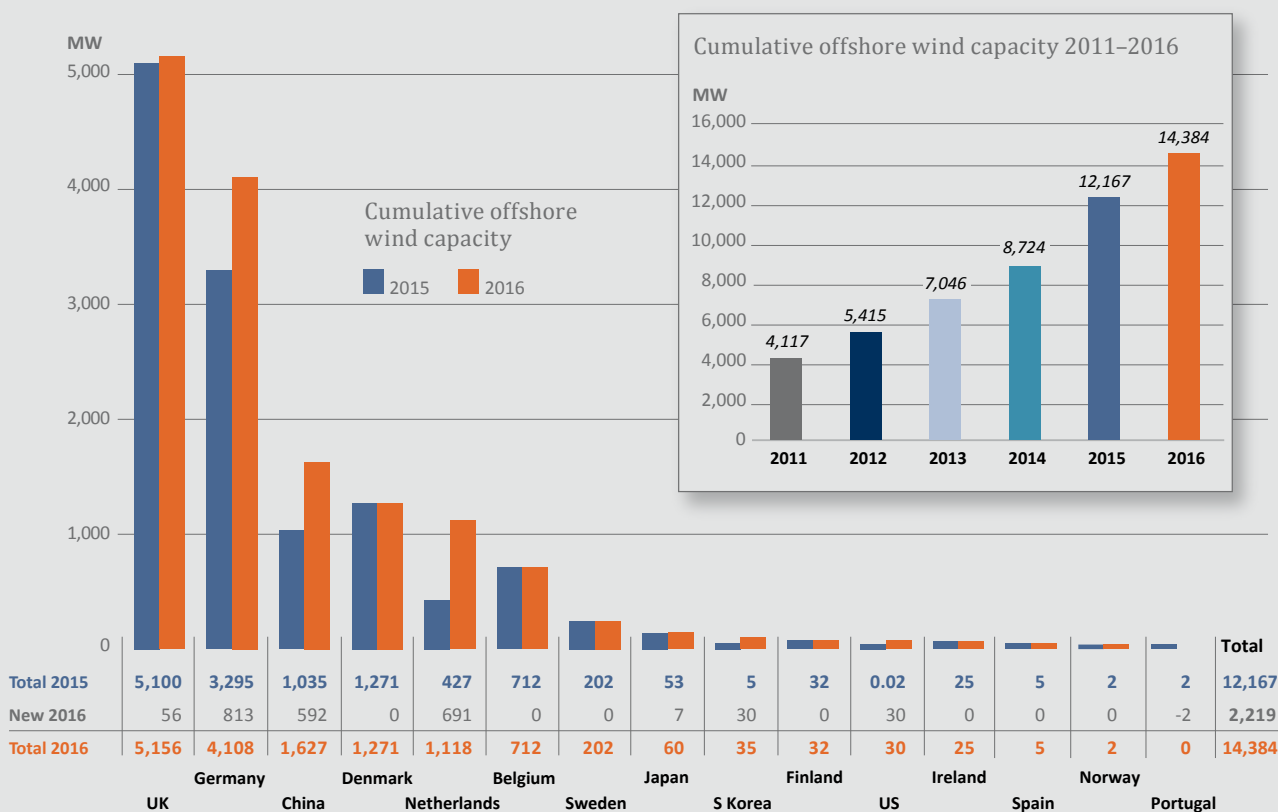
Europe continues to be the largest market for offshore wind energy by a long way. Facilities with a wind power capacity of 1,558 MW were newly installed in 2016, over half of which is produced in Germany (818 MW), with 691 MW in the Netherlands and 56 MW in the UK. At the end of 2016, 3,589 wind turbines were feeding 12,631 MW of electricity into the grid across Europe (see figure). According to

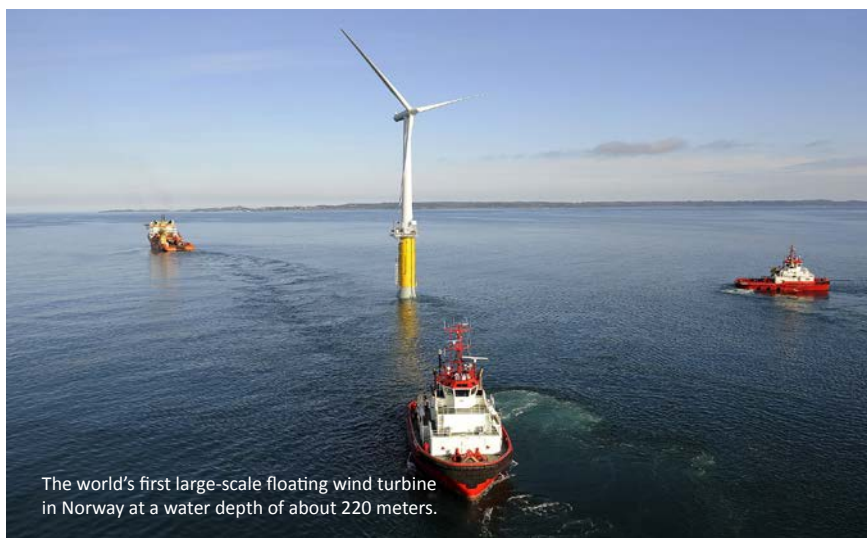
Wind Europe, the European wind energy association, investment decisions equal to a value of €18.2 billion were taken for another 11 projects.

There have been some positive developments in the USA, too. The Block Island 30 MW wind farm on the coast between Boston and New York came into operation in mid-December. In the same month,

the authorities approved another wind farm in the area with a capacity of 90 MW. Construction is set to start in 2019. According to developer Deepwater Wind, the sea areas designated for wind energy have a potential installed capacity of more than 1,000 MW. A number of European companies already have plans for US waters: Statoil (Norway) and Dong (Denmark) each plan to produce around 1,000

Offshore growing steadily





MW off the East Coast. The financing of these wind farms will be secured through tax credits in the medium term.

China, however, is lagging behind its self-imposed targets. Admittedly, the country fed 592 MW into the grid from offshore wind, but missed the government's goal of reaching 5,000 MW by the end of 2016 by a good 1,600 MW. Members of the government recently started challenging the target of 20,000 MW by the end of 2020, claiming that it is non-binding. According to Chinese experts, the figure for offshore installations with concrete plans stands at less than 200 MW.

China continues to be a closed market for European manufacturers, planners and investors, in both the onshore and offshore sectors. "As regards Asia, we are heavily involved in Taiwan and are looking at other markets, such as Japan," explains the spokesperson for Bremen-based company WPD, which is involved in offshore and onshore projects worldwide. There are concrete plans for the first offshore wind farm in Taiwan.

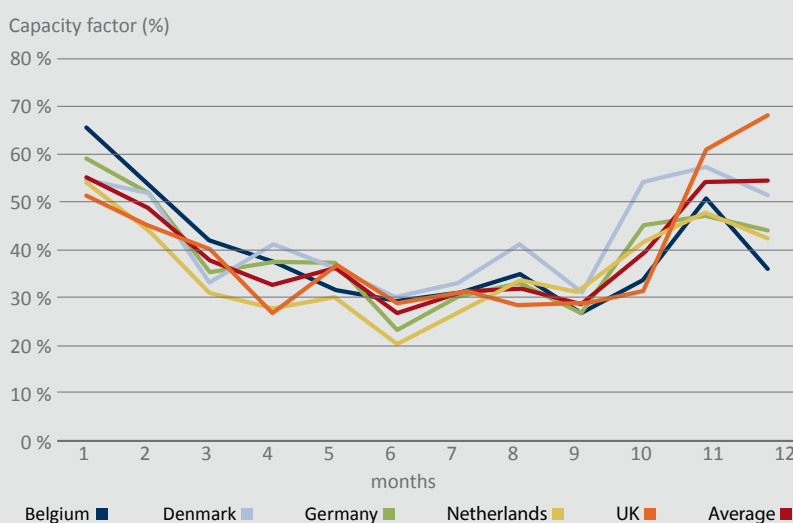
In Japan, there is a great deal of potential for developing new foundation technology. Given that the waters off the coast of Japan are very deep, floating platforms are often the only solution. Japanese manufacturer Hitachi is currently testing a 5 MW turbine off the coast of the dam-

aged nuclear power plant in Fukushima. Mitsubishi is testing a floating 7 MW turbine in the same location. In Europe, various manufacturers are already preparing for bringing this new technology onto the market. Statoil has announced that the first 30 MW wind farm consisting of five 6 MW turbines will be installed off the coast of Scotland in 2018. After a lengthy development phase, floating offshore platforms are now on the verge of entering the market.

Aside from any technical issues, it will mainly be the price that will determine whether or not the turbines will be installed. This is precisely what has managed to astonish industry observers about the offshore wind industry, which has long been criticised for being too expensive, in 2016 and early 2017: various auctions in the Netherlands and Denmark were won by providers with guaranteed power generation costs of 5 to 6 cents per kilowatt hour (c/kWh). Other calls for tenders achieved well below 8 cents. Upcoming calls for tenders in Germany are also expected to achieve prices significantly lower than the previous feed-in tariffs (calculated for 20 years) of 10 to 12 c/kWh.

In this way, the offshore wind industry could make a significant contribution to the energy transition from a financial point of view. The 2016 annual evaluation (see figure) shows that, in Germany, the production hours of an offshore wind turbine are 2.2 times as high as the average onshore turbine. The smaller degree of fluctuation in the supply of offshore wind energy makes it easier to incorporate it into power grids.

Consistently high power production



The capacity factors show the actual power production of the offshore wind farms against their maximum (installed) capacity. Windguard points out that, while monthly offshore capacity in Germany stands between 30 % and 47 %, this value fluctuates between 10 % and 30 % for German onshore wind turbines. In terms of power production, the contribution made by offshore wind is therefore particularly stable.

Source: Wind Europe 2017: „The European offshore wind industry“

Wind power puts big data to use

For wind power, digitalisation mainly means fast evolution in terms of condition monitoring, revenue management and maximising capacity. For energy supply as a whole, digitalisation means connectivity in a new, decentralised age.

Digitalisation and Industry 4.0 are among the most important key terms for industrial policy in 2017. What various different industries make of these terms, however, needs to be clearly defined.

The four largest wind turbine manufacturers based in Germany – Nordex, Siemens, Enercon and Senvion – associate digitalisation first and foremost with the fast development of the condition monitoring systems (CMS) introduced around ten years ago. This information was revealed in a BWE survey.

Modern wind turbines are almost always fitted with sensors now that transmit information such as performance data,

use of resources, and temperatures. For some years, they have also been able to record vibrations in the turbines. The vast amounts of data collected, i.e. big data, are becoming increasingly useful for reaching conclusions as regards the state of the individual components of the turbines, which traditional inspections have not been able to provide.

“In our turbine series we can attribute specific vibration patterns to specific errors,” says Siemens. The wealth of experience gained over the years has made it possible to diagnose highly specific errors, such as hairline cracks on a particular edge of a gear in the gear mechanism. In this way, the manufacturer knows how

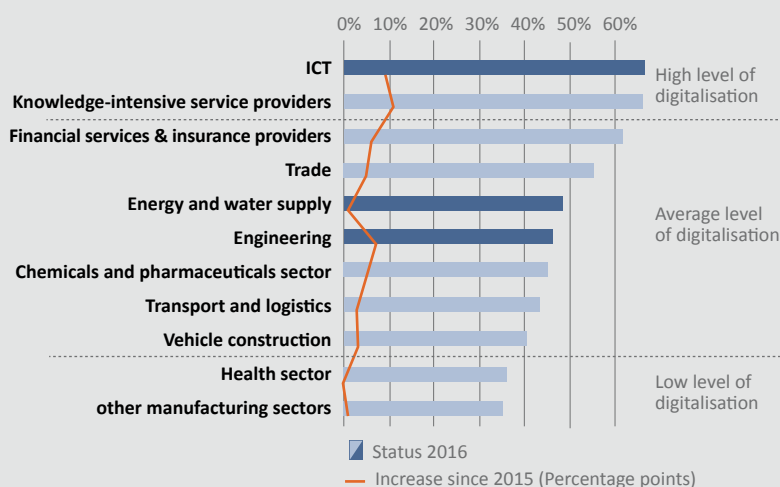
much longer the part is likely to last, and can manage the loads and service operations accordingly.

Digitalisation is therefore an important, efficiency-enhancing instrument, particularly in operating wind turbines. This is far from surprising, given that this area of remote maintenance via Internet-based and software solutions is part of the Information and Communications Technology (ICT) industry. From an overall economic perspective, this industry is also experiencing the highest rates of digitalisation (see figure). As regards actual production (mechanical engineering), digitalisation is taking place mostly in the construction of new plants under the guise of Industry 4.0, which aims to automate order and warehouse systems along production lines.

Digitalisation is also an important topic for any area in which the wind energy industry takes system responsibility for the overall energy supply, in terms of controlling network power plants from decentralised facilities and managing demand across the industry.

For example, digitalisation is an aspect of ENERA, a project run as part of the BMWi’s “Smart Energy Showcases” funding programme. The project aims to demonstrate that decentralised energies such as wind and solar can provide a region with renewable energy and thus guarantee the safety of the power grid. One of the requirements is to know how much energy all of the connected turbines generate

Digitalisation of the German industry



Source: BMWi, Digitalisierungsindex 2016 (Digitalisation index 2016), survey by TNS Emnid. Figure: Ahnen&Enkel



Siemens state-of-the-art wind service remote diagnostic center in Brande, Denmark.

and consume at all times and manage the network in optimum conditions – that is largely the task of developers from the ICT industry. A total of 40,000 smart meters will be installed initially. New

business models will also be developed on this infrastructure. The project involves public utility companies that already have plenty of wind energy experience and wind turbine manufacturers.

Attractive labour market in 2016

Official statistics should not cloud the picture: The latest data for 2015 show a slight reduction in the employment figures in the wind industry. But 2016 is expected to break the previous employment record set in 2014. Skilled workers with electrical expertise are in particularly high demand.



In 2015, employment in the onshore wind industry fell slightly for the first time since 2010. This decline was a result of the comparably low installation figures for the previous year: about one third fewer turbines were built in 2015 as in 2014 (just 3,500 MW), thereby reducing the

number of employees in the onshore wind industry to 100,000 (minus 10 %). Over the same period, the number of full-time employees in service and maintenance grew from around 21,000 to 22,000 (see figure).

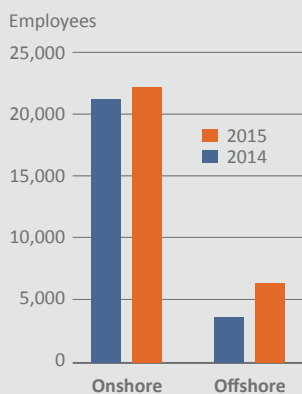
At a basic level, the offshore sector saw a similar trend: a slight decline in the number of full-time jobs in investment-related areas, but almost twice as many service and maintenance jobs (see figure).

Employment figures in the wind industry are determined by assessments of economic framework data, which mainly considers onshore installations, the number of German companies in the international market and price indices. In 2016, price levels did not change significantly and very few large companies and sites closed in the German wind industry. Siemens' plans to build new offshore wind turbines involving 1,000 employees in Cuxhaven

were verified at groundbreaking, but the project is not yet complete and will therefore not appear in labour market statistics until 2017/2018. In 2016, figures for the installation of wind turbines in Germany rose to 2014 levels, and the relevant markets in Europe, Asia and America also grew. It can therefore be expected that employment figures for 2016 will also reach or exceed those recorded in 2014, i.e. almost 150,000. The German Wind Energy Association (BWE) expects to see 135,000 jobs in the onshore sector alone.

This is good news for the labour market. Krischan Ostenrath of the Bonn Science Shop (WILA Bonn), which in 2016 published an analysis of advertisements for technical skilled jobs in this segment, explains that the need for skilled workers in the renewable energies industry has risen once again, despite a slight decline in employment figure in 2015. In the wind industry, for example, electron-

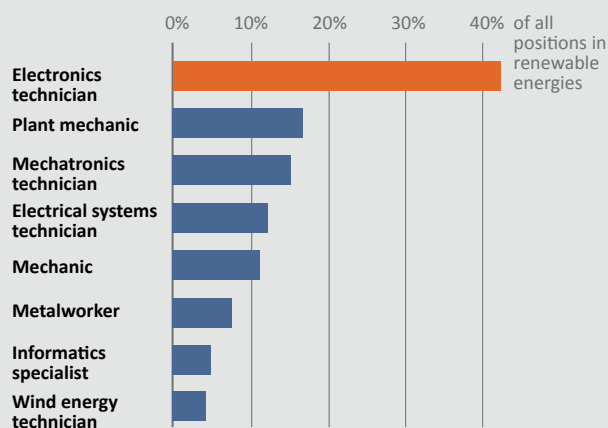
More and more employees in the service and maintenance sector

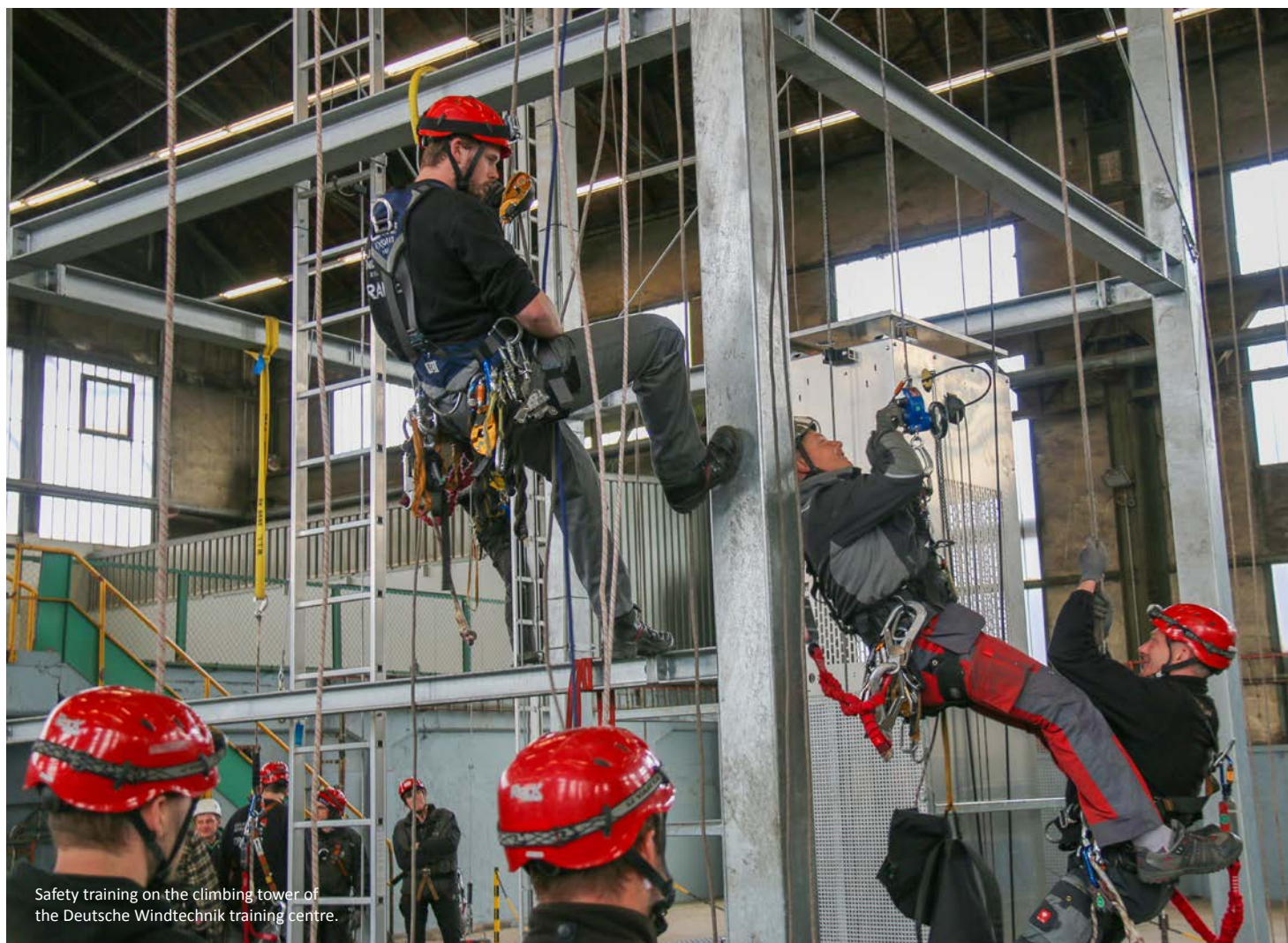


Source: BMWi 2016. Figure: Ahnen&Enkel

Electronics technicians wanted

Source: Wila Bonn 2016, "Technische Ausbildungsberufe im Bereich Erneuerbare Energien" (Technical skilled jobs in the area of renewable energies), assessment of job advertisements.





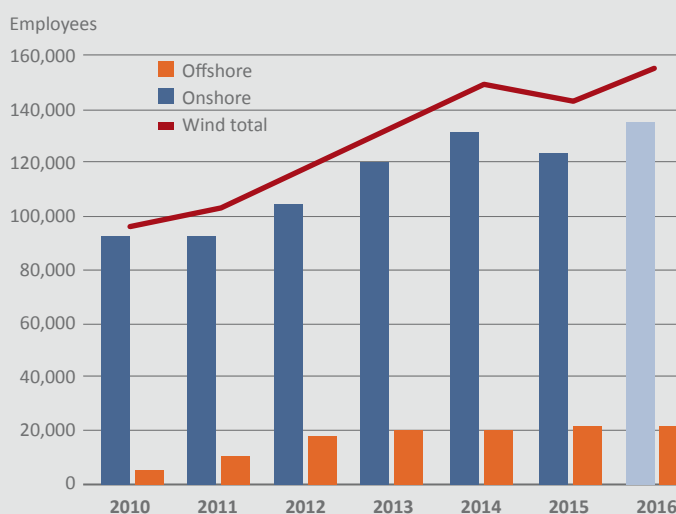
Safety training on the climbing tower of the Deutsche Windtechnik training centre.

ics technicians (42 % of all positions in renewable energies) and plant mechanics (17 %) are in particularly high demand (see figure). According to the analysis, the most sought-after additional qualification falls under the criterion “Professional experience” (60 %). In practice, this translates into the fact that the wind industry is seeking highly experienced technicians for the construction and maintenance of wind turbines who are able to work independently in small teams.

“Electronics technicians are sought-after in many different branches across Germany. The wind industry will continue striving to secure them over the next few years,” says Ostenrath. The advancing process of digitalisation will also fuel demand for IT and communications technicians. The renewables industry is also going to have to adapt to this.

Shortage of trained specialists continues

Low rates of onshore installation in 2015 reduce overall employment



Source: BMWi 2016; figures for 2016: Offshore simple continuation; Onshore according to forecasts by the BWE. Figure: Ahnen&Enkel

How quickly is the world giving up coal?

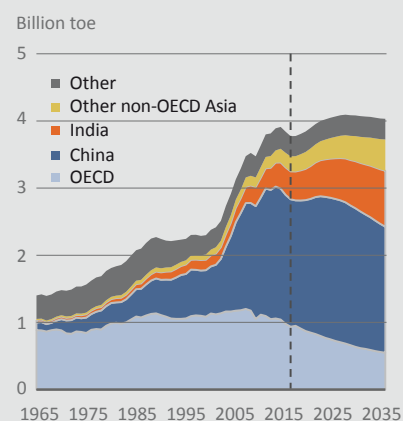
Moving away from coal-based power generation is crucial to maximising success in climate protection. Various different scenarios are currently being discussed in Germany. China, the country with the highest coal consumption, needs to cut down significantly. But will the recent US election slow the momentum of worldwide decarbonisation?

In Germany, the crucial role played by coal and lignite can be seen in the climate footprint. Even though renewables have expanded continually over the last 25 years and currently cover a third of the overall German energy consumption, CO₂ emissions in Germany have failed to decrease in recent times. In fact, there was a slight increase from 906 million tonnes of CO₂ equivalents in 2009 to 908 million tonnes in 2015. If this trend does not change significantly and quickly, Germany will fail to achieve its 2020 climate target of reducing that figure to 749 million tonnes, as established by the Federal Government. In early 2017, the Umweltbundesamt (UBA) determined the extent to which CO₂ emissions from coal-

fired power stations need to be reduced if Germany is to achieve its 2030 climate targets. The verdict: CO₂ emissions from coal-based power generation need to be reduced by about half, to 183 million tonnes. The agency is making various recommendations to policymakers with regard to achieving this, including introducing a national CO₂ surcharge, improving capacity management and limiting full-load hours for coal-fired power stations. Whatever the path taken to phase out coal, the share of renewables in the German power mix is to reach 50 % by 2035.

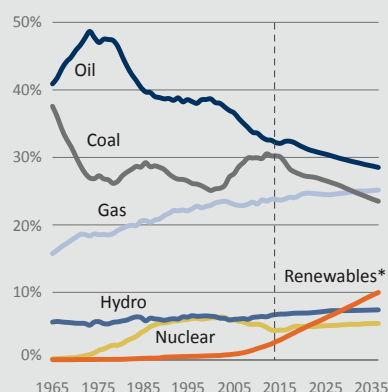
In line with Germany and the EU, the BP Energy Outlook 2017 also predicts a significant decline in the use of coal and a sharp increase in the use of renewables worldwide. According to the Energy Outlook, the share of renewables in primary energy production is set to quadruple by 2035 – reaching around 10 %. In the context of the Energy Outlook, renewables include modern solar, wind and geothermal technologies. The share of hydropower is set to stand at 8 %. The Outlook also suggests that the significant price reductions as a result of technological advancements (see page 16) are key drivers for the use of modern renewables. Energy market experts are expecting costs for solar energy to level off at under 6 c/kWh and the costs of onshore wind power to approach 4 c/kWh by 2035.

Coal consumption by region



Source: BP Energy Outlook 2017

Use of renewables quadruples by 2035



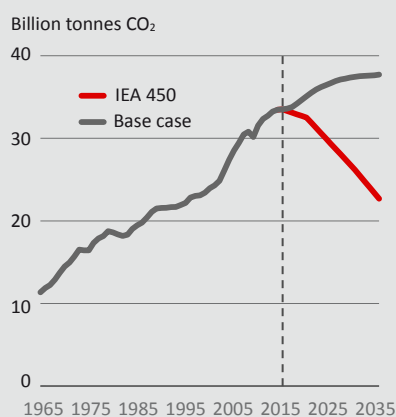
Source: BP Energy Outlook 2017

Today, the highest investments in renewable energies – particularly in wind turbines – are being made in China. At the same time, China will continue to be the largest coal consumer in the world for decades to come – and thus also the largest CO₂ emitter. BP analysts are expecting to see significant turmoil in the energy market. In China, coal consumption is not set to rise in the period up to 2035 and will remain more or less constant with current figures. In the OECD states, however, the use of coal will be cut by around half. Only in India, a country with large coal reserves, will the use of fossil fuels continue to grow beyond 2035 (see figure).



The decline in coal-based power generation is working in favour of the international community's goal to significantly reduce CO₂ emissions and limit global warming to 1.5 to 2 degrees. However, according to BP predictions, the share of fossil fuels in primary energy production will still stand at around 75 % in 2035 and the maximum levels of global CO₂ emissions will be reached after 2035 (see figure). According to calculations from the IPCC, scientific organisations such as MIT, and Greenpeace International, there needs to be a reduction of 40 to 50 % in the use of fossil fuels to prevent jeopardising the climate targets. This can be achieved by implementing a “fast transition” in the transport sector to electric engines and speeding up the phase-out of coal.

Two-degree target not yet in sight



Base case as an intermediate scenario against a scenario with 450 ppm of CO₂ in the atmosphere to be achieved if the target of 1.5 to 2 degrees is to be reached.
Source: BP Energy Outlook 2017

ACCEPTANCE

Taking local concerns seriously

Local residents are being afforded more of a voice in the German wind industry. At night, for example, the constantly flashing signal lights for aeroplanes could soon be a thing of the past.

According to representative studies carried out several times across the country, 86 to 93 % of Germans (depending on the specific question) were in favour of the expansion of renewables and the energy transition. These figures have remained stable for many years. And when people experience wind farms and solar installations through concrete plans, acceptance for these kinds of power plants tends to rise. People who already have experience of wind and solar farms are generally less worried about them than those who are completely unfamiliar with renewables (see figure). This is also down to the fact that the approval process for wind turbines closely monitors the effects they would have on local residents and whether the "burden" would be "reasonable" from a legal point of view.

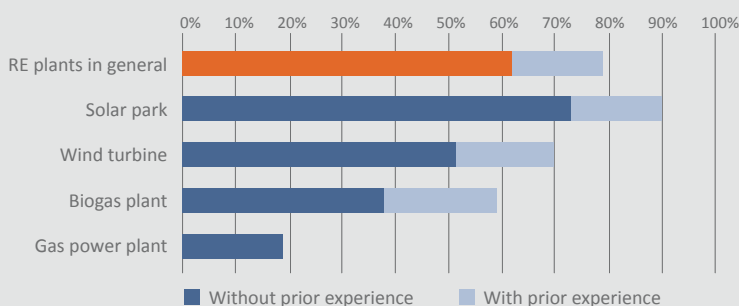


It is also clear that wind turbines bring about visible changes to the landscape, like most construction projects, and this can lead to concerns. According to Gundula Hübner, Professor of Social Psychology

at Medical School Hamburg and Martin Luther University Halle-Wittenberg, when it comes to wind power, people are mostly concerned about their impact on the landscape and any potential noise.

Approval of renewable energies and gas-fired power plants

I think power generation in the neighbourhood is "fairly good" or "very good".



Source: Survey by TNS Emnid on behalf of the Renewable Energies Agency, 1,000 respondents in Germany, as of 9/2016. Figure: Ahnen&Enkel

Regional planning authorities normally try to minimise the impact on the landscape by introducing special concentration zones. In German states, wind turbines can often only be built in specific areas that tend to make up 1 to 2 % of the total area of the state. And in order to make the turbines less visible against the backdrop of the local landscape, especially in conditions of average visibility, manufacturers have been using exclusively non-reflective colours on the rotors for several years.

The noise emissions of wind turbines are also being reduced by making the rear edges of the rotor blades sharper. Wind turbine manufacturers are currently



focusing on this as one of the key characteristics of their new series and models. Especially considering that “noise” is also a problem in terms of the energy balance, as noise is a form of energy loss, reducing the turbines’ yield.

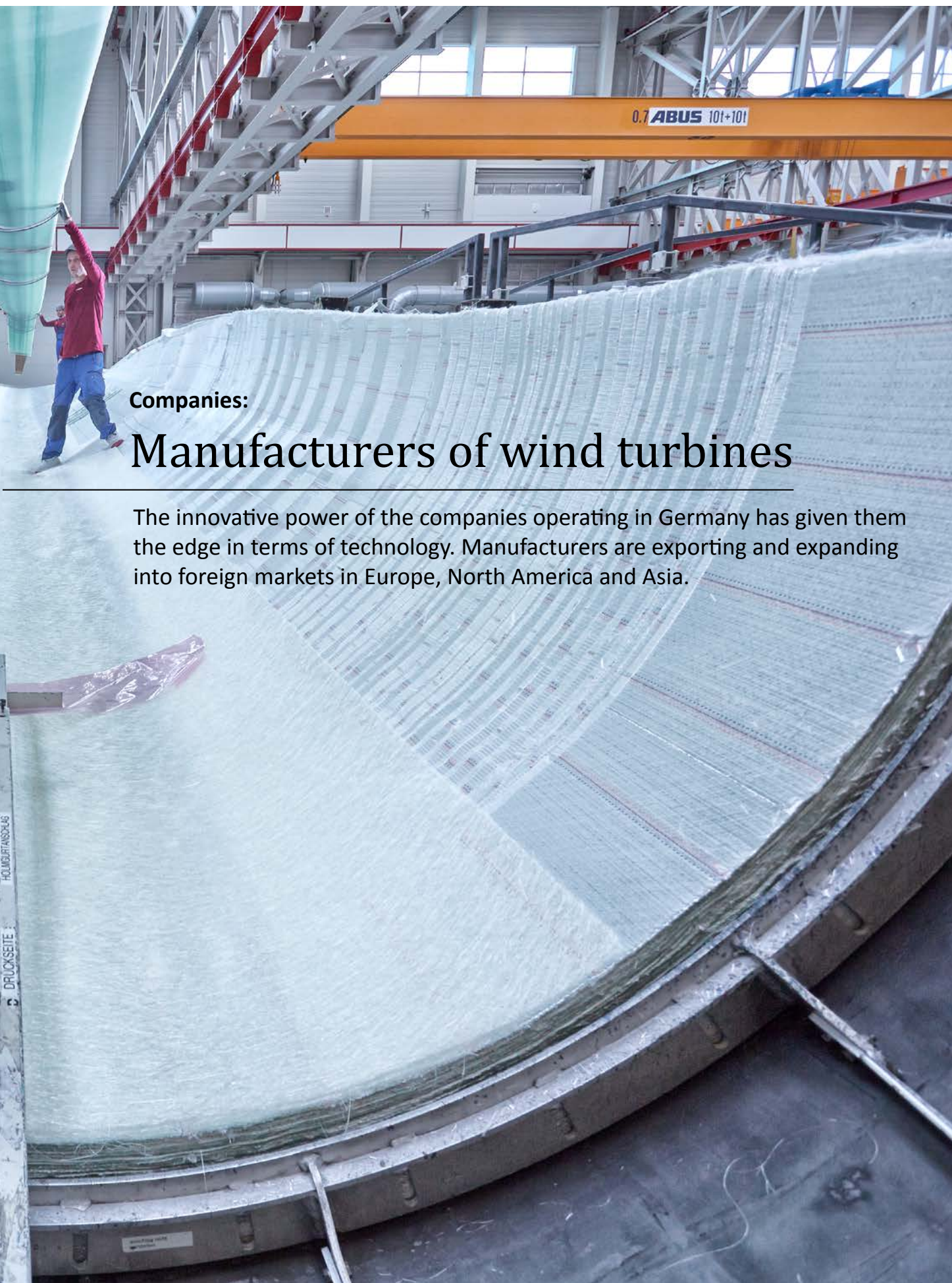
There has also been a radical change as regards the visibility of wind farms at night. Radar systems are now available for detecting approaching aircraft, which means that the signal lights required for flight safety will no longer be needed. The red warning lights will only be switched on if a pilot really needs to be warned about the obstruction. The turbines will remain completely dark for around 90 % of the night.

After the states of Mecklenburg-Vorpommern and Schleswig-Holstein required this kind of demand-based lighting for new installations built since 2016, in early 2017 the Conference of Environmental Ministers called for a uniform solution to be introduced across Germany. In Uckermark, a local wind farm planner announced in early 2017 that a radar system would be installed for all the wind turbines in the region (i.e. several hundred) and the night signal would therefore be switched off. This would appease one of the sharpest criticisms against the wind industry.

Beyond technical advancements, the German Wind Energy Association (BWE) also advises its members to inform

local residents about any planned wind projects in their early stages and to involve them in the process. The actual level of participation is determined by local opportunities and the wishes of the locals. Ranging from basic information to financial involvement, there are dozens of models currently in place, which are increasingly also required of wind farm planners by states and municipalities.





Companies:

Manufacturers of wind turbines

The innovative power of the companies operating in Germany has given them the edge in terms of technology. Manufacturers are exporting and expanding into foreign markets in Europe, North America and Asia.

ENERCON GmbH

Innovative products and a forward-looking company

Innovative technology, high reliability and good economic viability have characterised ENERCON wind turbines for more than 30 years. The German market leader has erected more than 26,500 turbines with a total rated capacity of more than 43.5 gigawatts (as of January 2017).



ENERCON GmbH

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 E-Mail **info@enercon.de**
 Web **www.enercon.de**
 Profile **Wind turbines (> 100 kW)**
 Category **Manufacturers**
 Turnover **€ 4.5 billion**
 Employees **18.000**
 Founding year **1984**

ENERCON has been one of the technology leaders in the wind power sector for 30 years. As the first manufacturer of wind turbines, the company used a gearless drive concept that is a characteristic of all ENERCON wind turbines. ENERCON is also at the forefront in other areas, such as rotor blade design, control technology and grid connection technology, and, with its wide range of technological new developments, proves its innovative strength time and again.

Continual research and development guarantee the ongoing success of the company. The same applies to production and service. All the key components, such as the rotor, annular generators and grid feeding system, are manufactured in-house. This vertical integration, which is unequalled in the wind energy industry, ensures the high quality and extreme reliability of ENERCON wind turbines. A customer-oriented service offering also plays a part in this, guaranteeing the operator 97 per cent technical availability of the turbines. This holistic concept sets high new standards in technology, quality and safety, and consolidates ENERCON's position as the German market leader.



ditions. They have a grid feeding system that is certified to the latest grid connection requirements. ENERCON wind turbines can therefore be integrated without difficulty into all supply and distribution grid structures. Furthermore, ENERCON wind turbines supply numerous features that support the grid.

True to the company's claim of „energy for the world“, ENERCON is driving forward supply with renewable energies worldwide. In doing so ENERCON is expanding its research and development, production and sales activities in line with demand. Internationally, ENERCON has a presence in the major markets with plants in Brazil, Sweden, Turkey, Portugal, Canada, France and Austria, as well as a globally decentralised service and sales network.

ENERCON's prudent, sustainable growth strategy guarantees its stability. In autumn 2012, the founding of the Aloys Wobben Foundation sealed ENERCON's independence, as well as the continuity of the company's direction. Company founder and owner, Aloys Wobben, donated his company shares to the foundation to cement the sustainable, future-oriented corporate strategy of ENERCON. The excellent financial standing of the ENERCON Group was recently confirmed again with an external rating from Euler Hermes Rating GmbH: The analysts gave ENERCON the rating „AA-“ for its creditworthiness and sustainability. This makes ENERCON significantly above the average compared to the overall economy. ENERCON customers can therefore rely on a high level of investment security, in addition to high-quality and reliable turbine technology.

The product portfolio comprises wind turbines with outputs from 800 to 7500 kilowatts. The latest model is the E-141/4.2 MW with a rotor diameter of 141 metres. Thanks to its performance-optimised blade profile, it achieves high yields even in the partial-load range. This means that the E-141 is destined to be installed at sites with a tendency to lower wind speeds. All ENERCON models boast reliable technology, low maintenance requirements and a long service life, thereby guaranteeing a high level of profitability for customers.

Thanks to the directly driven synchronous generator and innovative modular full-scale converter concept, ENERCON wind turbines have a wide range of technical options for adaptation to the grid con-



- 01 | Lifting the generator of an E-126.
- 02 | Single blade installation on an E-126.
- 03 + 04 | Erecting an E-126 in Lelystad, in the Netherlands
- 05 | E-126 EP4 Lelystad.

eno energy systems GmbH

novation for efficiency

Ever since it began manufacturing wind turbines, the name eno energy has stood for the very best in quality, flexibility and innovation.



01

The company has gained a reputation from its flexibility, innovation and a high level of quality awareness. Ever since the early days, eno has always placed a high value on its own research and development and the close links with specialist engineers, institutes and universities that they demand. This focus has enabled them to create a comprehensive portfolio of turbines at a high level for almost all segments with remarkable speed.

No sooner had the first generation of turbines, in the form of the 2 MW platform, demonstrated its high quality and exceedingly high technical availability, than the massive investments in its own vertical integration were brought to bear with the 3.5 MW platform. The ambitious company is offering particularly power-



eno energy systems GmbH

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E-Mail **info@eno-energy.com**
Web **www.eno-energy.com**
Profile **Wind turbines (> 100 kW)**
Category **Manufacturers**
Turnover **Approx. € 100 million**
Employees **Around 200**
Founding year **1999**

The eno energy group has been based in Mecklenburg-Vorpommern, Germany, since 1999. The company produces wind turbines with rated capacities from 2.05 to 4.0 MW and rotor diameters from 82 to 126 m for the onshore sector at its Rostock production site. The advances made in the area of service life by eno energy systems GmbH are only through working with renowned European suppliers. eno is also making headway internationally with subsidiaries in Sweden and France.



02



ful machines in the 3.5 MW class, with the eno 114, which is particularly suited to windy coastal sites, and the eno 126, designed for inland sites. The increased turbulence resistance of the machines listed in the IEC 2 wind class can result in a more compact wind farm. In 2017 the eno 114 and eno 126 will also be launched onto the market in variants with 4 MW capacity in the wind class IEC IIA, thanks to a performance update.

Servicing and maintainability, increases in efficiency, ensuring the long-term reliability of all components and the national and international requirements for grid connections were all aspects that were focused on during development. For all issues, eno energy can turn to an excellent network of advisers, insurers and suppliers and of course, their own many years' know-how in all areas of wind energy use.

The group has positioned itself on both the national and international markets as a planner, wind farm operator and supplier of services, maintenance and management, in addition to being a manufacturer. eno energy offers both end-to-end solutions such as the complete construction of wind farms as a general contractor, and all individual services, such as separate delivery of wind turbines. This flexibility makes the company a competent partner for communal investors and project developers both in Germany and abroad.

- 01 | Plauerhagen wind farm with eno 114
- 02 | Plauerhagen wind farm with eno 82
- 03 | Brusow wind farm with eno 114
- 04 | Nacelle of an eno 82
- 05 | Gearbox of an eno 114



FWT energy GmbH

A comprehensive worry-free package for international wind farm technology, with trade, service and production. FWT energy has enjoyed international success right from the outset. And no wonder – this dynamic player in the wind industry possesses the expertise of a Westerwald pioneer and employs motivated personnel whose market experience inspires confidence in operators and investors.



diverts the lateral and longitudinal forces directly to the main frame. A further benefit is the compact and lightweight construction of the nacelle. This simplifies transport, logistics and erection.

FWT 3000 – low weight achieves high yields

FWT is using the Winergy HybridDrive for the first time in the new FWT 3000. This combines a two-stage, medium-speed gearbox with a powerful synchronous generator. All the power runs via three 1-MW converters. This means that the FWT 3000 can be easily adapted to all international grid conditions.

This concept reduces the overall size of the construction to only 11.6 m long, 4.6 m wide and 4.0 m high, and it weighs just 105 tonnes – even with the integrated medium-voltage transformer. Because installation work at the site is kept to a minimum, it is possible to erect the turbine in less than a week.

As well as the 85 and 100 m tall tubular steel towers, the 120/140/170 m tall Ventur hybrid tower is also on offer. This combination of pre-stressed concrete components and a tubular steel section can be easily transported to the construction site and erected using climbing construction techniques in a short amount of time and with relatively little crane capacity.

The 120 m rotor ensures that maximum yields can be achieved even at low and

The FWT group is divided into the divisions FWT energy GmbH (manufacture and erection of onshore multi-megawatt turbines and repowering; global trading of components, buying syndicates, logistics and supply chain outsourcing) and FWT Service DE GmbH (manufacturer-independent servicing of onshore wind turbines, application engineering and farm optimisation). Active on the market since the start of 2013, the company has 100 employees and exhibited solid growth and substantial profits year by year.

The current range of FWT turbines:

FWT 2000: 2.0 MW capacity, 93 and 100 m rotor, hub heights of 85 to 141 m

FWT 2500: 2.5 MW capacity, 100 and 104 m rotor, hub heights of 85 to 160 m

FWT 3000: 3.0 MW capacity, 120 and 132 m rotor, hub heights of 85 to 170 m

All turbines are based on the innovative W2E drive train concept, which replaces the long, heavy main shaft with a large main rotor bearing. FWT turbines are significantly quieter to run, because this

FWT

FWT energy GmbH

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Fax **+49 (0)2664 99200-111**
E-Mail **henning.zint@fwt-energy.com**
Web **www.fwt-energy.com**
Profile **Wind turbines (> 100 kW)**
Category **Manufacturers**
Turnover **€ 42 million**
Employees **100**
Founding year **2013**



01 | The manufacturer-independent FWT Service DE is based on 20 years' experience of wind energy.

02 | An extremely compact drive train and the HybridDrive gearbox and generator combination mean that the FWT 3000 is both compact and lightweight.

03 | FTW turbines can be adapted to each site due to variable tower heights and rotor sizes.

04 | FWT delivered 22 units of FWT2000 to the EXPO wind farm at Kazakhstan.

05 | FWT also stands out from the competition with its unconventional tower solutions e. g. with lattice towers of up to 160 m or hybrid towers up to 170 m.

medium wind speeds. In its year-long test, the prototype confirmed the calculated annual yield of 6 million kWh at 5.0 m/s and 13.5 million kWh at 8.0 m/s.

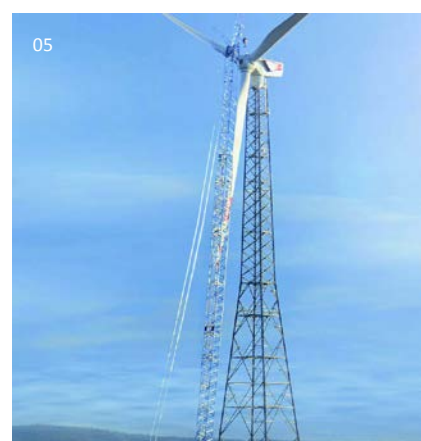
Manufacturer-independent service, innovative engineering and cost-cutting procurement

Based on its years of experience in the international wind industry, FWT is able to offer tailored service solutions, from a standard maintenance package right through to a full service contract. Close cooperation between the service and engineering divisions enables prompt and permanent solutions to problems, as well as turbine optimisations for greater operational safety and higher yields.

FWT Service ensures a high level of technical availability through regular maintenance. All work is carried out with original parts according to manufacturer specifications. The service portfolio also includes machinery, drive train and rotor blade servicing, as well as preventative

concepts, retrofits and remote control with comprehensive 24/7 monitoring.

Thanks to long-established contacts in the sector and excellent networking with the industry's major suppliers, FWT provides all components for W2E licensees and other manufacturers' turbines, and efficiently conducts even the most challenging projects. Cost reductions can be achieved by combining orders and taking advantage of the best buying conditions.



GE Renewable Energy

GE Renewable Energy serves the energy production industry by developing and providing technologies that support the efficient use of natural resources. It has built over 30,000 wind turbines that generate more than 50,000 megawatts of clean energy in total worldwide



GE Renewable Energy Onshore Wind

Address **Holsterfeld 16
48499 Salzbergen**
Phone **+49 (0)5971 980 0**
E-Mail **info_renewable.energy@ge.com**
Web **www.gerenewableenergy.com**
Profile **Wind turbines (> 100 kW)**
Category **Manufacturers**
Employees **approx. 1,000**
Founding year **2002**

GE has been in the wind energy business since 2002. It produces wind turbines in Germany, France, China, India, Brazil and the United States. The European head-quarter for onshore wind operations is located in Salzbergen, Germany, while the German head office for the offshore activities is in Hamburg.

In addition to a factory, the Salzbergen site houses a training center and a customer service center for the remote control of more than 5,000 turbines in Europe, Africa, Asia and Australia 24 hours a day, 365 days a year.

The current portfolio includes onshore turbines ranging from 1.7 to 3.8 MW as well as project management, product management, engineering, service and maintenance. In the offshore segment, GE has the Haliade* 150-6MW – a next-generation offshore turbine that combines virtually unparalleled size with a high power output. GE's 3 MW class

offers two rotor diameters of 130 and 137 meters, power ratings from 3.2 to 3.8 MW and hub heights between 85 and 164.5 meters.

The 3.8-130 is the perfect choice for higher wind regimes in Germany. To see how the dramatic evolution of a proven platform can compensate for declining renewable power tariffs, look no further than the 3.6-137, GE's most powerful model for low-wind locations.

Combining new and proven technologies, GE's 6MW direct drive offshore wind turbine is an ideal choice for tough weather and environmental conditions. The Haliade 150-6MW provides superior reliability and versatility thanks to the unique Pure Torque* design from GE and can lower the costs of offshore power generation. With its high energy yields from 150 m diameter rotors, the Haliade can supply enough clean wind power for around 5,000 households.



Wind turbines don't just use different technologies; they also have different operators. That's why GE Renewable Energy provides modular services and customized solutions tailored to customers' needs as well as many technological upgrades (for yield enhancement, cost reduction or grid integration).

Digital Windfarm: GE's Predix® is a software platform that connects to the industrial internet and allows operators to improve each individual wind turbine in order to optimize their wind farm as a whole. Applications developed on top of the platform can sustainably improve wind turbine performance and service productivity, providing a genuine customer benefit that can pay off quickly.



01 | European headquarters (Onshore Wind) in Salzbergen.

02 | The 3 MW-Class.

03 | Haliade* 150-6MW.

Nordex Acciona Windpower

The Nordex group offers powerful wind turbines for nearly all geographical regions across the globe.



a 20% higher-rated output than the N117/3000. For light-wind sites, Nordex now offers the N131/3600 with installed capacity of 3.6 MW, also raising the rated output by 20%, meaning customers can produce up to a 12% higher yield. The sound emissions of the N131/3600 are limited to a max. 106.4 dB(A). At 105 dB(A), the N117/3600 has the same sound emissions as the N117/3000. Nordex offers both machines with serrations, which reduce the sound emissions by an additional 1.5 dB(A) in each case.

In April 2016, Nordex merged with Acciona Windpower and now also offers the brand turbines from Acciona Windpower, which have operated successfully in a variety of climates and markets across the globe. From initial designs in 1999 to a complete product line today, ranging from 1.5 MW to 3 MW, with multiple rotor and tower combinations, a robust experience base is reflected in growth of sales and proven product evolutions.

Listed on the Frankfurt stock exchange TecDAX (ISIN: DE000A0D6554) Nordex SE is the management holding company with its headquarters in Rostock; the board and administration is based in Hamburg.



The Nordex group combines decades of experience in designing, constructing and operating wind turbines, delivering more than 21 GW of sustainable energy worldwide.

With the serially-produced multi-megawatt wind turbines of Generation Gamma Nordex N90/2500, N100/2500 and N117/2400, Nordex is able to offer high-efficiency turbines for onshore use. Since 2013, Nordex offers the Delta Generation with the N100/3300, the N117/3000, and the N131/3000 for strong, medium and light-wind sites.

For moderate-wind sites, Nordex has launched the N117/3600 with installed capacity of 3.6 MW, giving the turbine

Nordex Acciona Windpower

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22419 Hamburg**
Phone **+49 (0)40 30030-1000**
Fax **+49 (0)40 30030-1100**
E-Mail **info@nordex-online.com**
Web **www.nordex-online.com**
Profile **Wind turbines (> 100 kW)**
Category **Manufacturers**
Turnover **€ 3.4 billion**
Employees **5,000**
Founding year **1985**



The company boasts factories in Germany, Spain, Brazil, USA, and soon, India. The group produces its own nacelles, rotor blades and concrete towers, covering the whole technical value-added chain with its products and services, from identification of suitable sites, to system planning and technical implementation of wind farms. Even after installation of its turbines, the company continues to support its customers. It also offers a customised service for all of its wind



turbines, which ensures the hassle-free operation of the machines on a world-wide scale. The average availability of all turbines covered by its Service stands at 98%.

The group has installed more than 21,000 MW worldwide and has offices and subsidiaries in more than 25 countries around the world with a total global headcount of over 5,000 employees.

Senvion GmbH

Having constructed over 6,600 wind turbines, Senvion is one of the world's leading manufacturers in the onshore and offshore sectors and is continuing to develop its tried-and-tested technology. With 25 years of experience, the company sets new standards in terms of quality and innovation.



The company's experience and expertise goes back over 25 years. Since 20 January 2014 the company has been operating as Senvion. With its wind turbines in the 2 MW class, the MM82, MM92 and MM100, the company has set new standards. More than 4,500 of these groundbreaking onshore turbines are now producing electricity safely and reliably around the world.

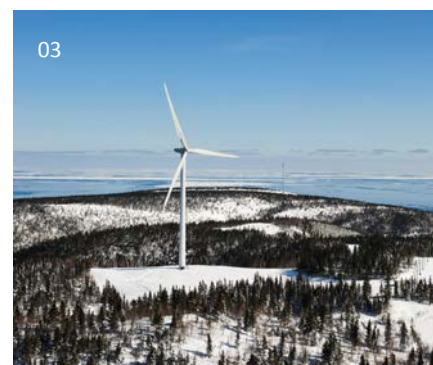
In order to produce high yields in the long term, Senvion continuously develops its tried-and-tested technology and optimizes the efficiency of its turbines. Since 2008, the company has been expanding its onshore portfolio with its 3.XM series. The turbines are based on the technology of the MM series and are available

SENVION
wind energy solutions

Senvion GmbH

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Fax **+49 (0)40 5555090-3852**
E-Mail **info@senvion.com**
Web **www.senvion.com**
Profile **Wind turbines (> 100 kW)**
Category **Manufacturers**
Turnover **€ 2.1 billion**
Employees **4,000**
Founding year **2001**

The international mechanical engineering company develops, produces and markets wind turbines with rated outputs of 2 to 6.2 megawatts (MW) and rotor diameters of 82 to 152 meters for almost any site. Senvion also offers its customers project-specific turnkey, service and maintenance, transport and installation as well as foundation planning and construction solutions. The company, which is headquartered in Hamburg, has around 4,000 employees worldwide and can draw on experience gained in the manufacture and installation of over 6,600 wind turbines throughout the world.



04



in different versions with a rated power of 3.4 and 3.2 or 3.0 MW. Depending on the specifications, the turbines are used at sites with high, average or low wind speeds.

Expansion of the 3 MW series

In order to offer customers the ideal turbine for every site, Senvion has expanded its 3 MW portfolio in 2016 again. With a 140 meters rotor diameter, the Senvion 3.6M140 Eco Blade Control (EBC) is the new reference for medium wind speed locations. The highly efficient 68,5 meters blade combined with integrated serrations allow high yields and a very low sound power level. With an operational lifetime of 25 years, the Senvion 3.6M140 EBC can reduce the levelized cost of energy. It is therefore particularly suited to the European markets of Senvion like Germany, France, Belgium, Poland and Italy.

Integrated management for wind turbines

Whether it's a standard maintenance contract or a full maintenance contract with optional availability or production guarantee, with its comprehensive range of servicing and maintenance activities with contract terms of up to 25 years, Senvion can offer every customer the right solution and guarantee long-term, reliable yields.

Tailor-made solutions

The company has grown from a small, North German niche start-up company to an enterprise that is active throughout the world. The profitable and reliable wind turbines are designed at the Senvion TechCenter in Osterrönfeld and manufactured at its Husum, Trampe and Bremerhaven plants as well as in Portugal.

The company aims to set new standards in terms of innovation and quality and therefore to put wind energy in a position to compete with traditional energy sources in the long term. This does not mean doing everything in a new or different way, but rather consistently developing and improving its portfolio of wind turbines.

05



01 | 3.2M114 in Neuenkirchen.

02 | 3.4M104 in Clauen.

03 | MM92 Reviere au Renard, Canada.

04 | MM92 Ancora wind farms in Portugal.

05 | 6.2M126, Nordsee Ost.

Siemens Wind Power GmbH & Co. KG

Wind power plays a key role in supplying electricity from renewable energy resources to society. Siemens Wind Power has more than thirty years of experience in the wind power business and offers rugged, reliable, and highly efficient wind turbines for every location and any wind class.



01

Direct drive technology has also proven itself in offshore projects: For example, 97 wind turbines with an output of 6 megawatts will be used in the German offshore wind farms Gode Wind 1 and Gode Wind 2.

In low-wind regions, the SWT-3.15-142 ensures a return on investment for customers. Its lightweight rotor blades use hybrid carbon technology that was developed together with LM Wind Power. With a rotor diameter of 142 meters and a hub height of up to 165 meters, the wind turbine can produce ten gigawatt hours of power annually even with average wind speeds of less than six meters per second.

360° care – 365 days a year

The service for wind turbines requires attention to detail and a long-term partnership. Siemens Wind Power offers its customers a modular portfolio and ultimate care when it comes to the construction and maintenance of their turbines. To accomplish this, the company relies upon the unique experience of its

SIEMENS

Siemens Wind Power GmbH & Co. KG Headquarters

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Web **www.siemens.com/wind**
Profile **Wind turbines (> 100 kW)**
Category **Manufacturers**
Turnover **€ 5,976 million**
Employees **approx. 15,200 globally**
Founding year **1980**

Onshore technology for every location and any wind class

With different tower heights, rotor dimensions, and power ratings, Siemens Wind Power offers the right turbine for every location and any wind class. The focus of every innovation is to reduce energy costs and increase the efficiency of the turbines.

The company focuses on gearless technology in its development work. In 2010 it introduced the first direct drive wind turbine with a capacity of 3 megawatts. As direct-drive onshore wind turbines, 3.6-megawatt turbines currently are setting the standard with regard to energy output as well as operating costs and flexibility.



02



employees, data-based insights into wind turbines operating worldwide, and the industry's leading logistics solutions specifically in the offshore area. The product portfolio is divided into four core promises: reliability, risk minimization, optimization, and know-how. This gives customers the opportunity to flexibly put together their own customized service package that will enable them to achieve the highest yields in their specific situation.

Number one in offshore technology

With more than 25 years of experience in the planning and implementation of offshore projects, Siemens Wind Power is a pioneer in wind power on the high seas. Since the construction of the world's first offshore wind park at Vindeby (Denmark) in 1991, Siemens has continued to refine and develop its products and expertise. Today the company is the clear global market leader in the offshore wind business with around 2,300 wind turbines with a total capacity of approximately 8,000 megawatts. Its customers rely on proven technologies designed to withstand the harsh conditions at sea.

The industrialization of the sector is playing an important role in minimizing risks and optimizing investments. The platform concept from Siemens Wind Power represents an important step in this regard. For use at sea, the 3.6-megawatt and the 4-megawatt wind turbines with the G4 platform based on geared technology as well as direct drive wind turbines of the 6–8 MW class are ideally suited for offshore use.

Siemens Wind Power in Germany

Siemens Wind Power has managed its international business from Hamburg since October 2011. The company headquarters is located there, as are its European sales employees. In addition, the EMEA headquarters (Europe, Middle East, Africa) for service is based in Hamburg and operates a Competence Center in Aachen. Additionally, service and sales employees serve customers from branch offices throughout Germany.

In June 2016, Siemens and Gamesa signed binding agreements regarding the merger of their wind business in order to create a leading global supplier of wind turbines.

01 | The new Cuxhaven offshore production facility: Starting in mid-2017, this site will manufacture nacelles for the new wind turbine generation of the 6-8 MW class.

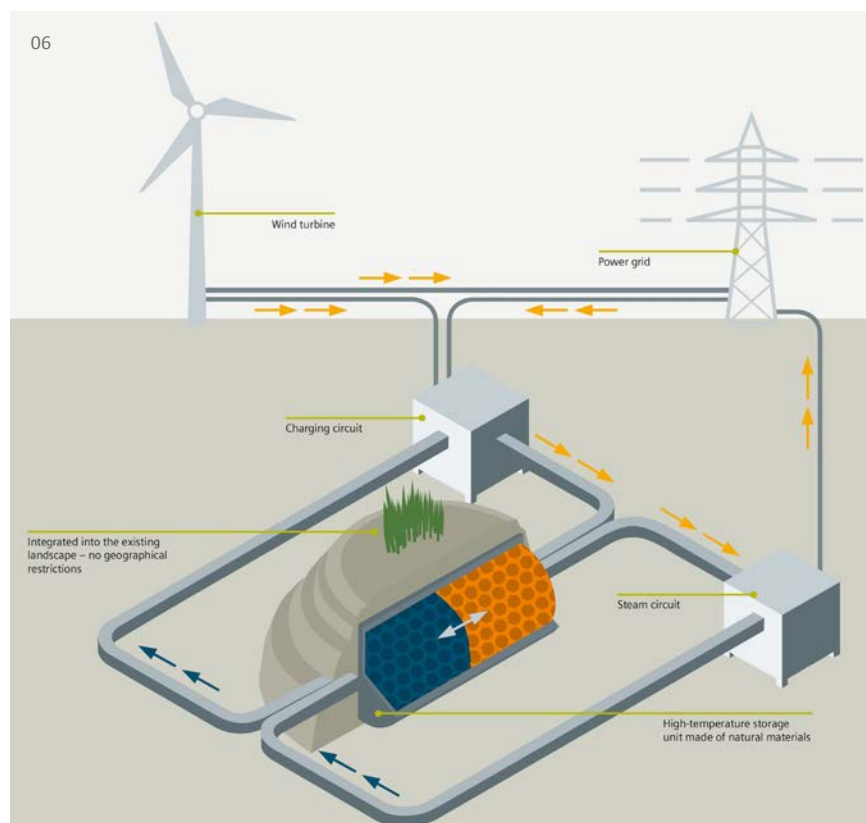
02 | Even at average wind speeds of six meters per second, the SWT-3.15-142 generates ten gigawatt hours of power every year. The new turbine is expected to go into serial production at the end of 2017.

03 | The Faraday service operation vessel has an innovative Ampelmann system that provides safe, effective access to offshore wind turbines.

04 | The Westermost Rough offshore wind park eight kilometers off the east coast of Britain. It consists of 35 wind turbines which generate a total annual output of 210 megawatts.

05 | The direct drive wind turbines in the Naundorf wind park between Dresden and Leipzig with a rotor diameter of 113 meters and an output of 3.2 megawatts each.

06 | An innovation in storage technology: The thermal storage solution for wind energy, which is being developed in Hamburg, is a joint project between Siemens, Hamburg Energie, and TUHH.



VENSYS Energy AG

More energy for our future

VENSYS wind energy technology thriving around the world

- 15,500 VENSYS wind turbines with 26.3 GW total rated capacity on the grid
- Three product lines with numerous rotor and tower variants
- High yields through optimum site adaptations for all wind classes

01



By the end of 2015, 1,900 of the 2.5 MW turbines had been connected to the grid and many more are at the planning and implementation stage in Europe, America and Asia.

The new 3 MW turbine plays a significant role. It is based on the technology of the 2.5 MW platform, but the generator has been further developed to produce a greater nominal output at a lower rotation speed. A prototype was operated at the Grevenbroich test field in Germany at the end of 2015. Further 3 MW turbines in Germany and France.

All platforms follow the VENSYS philosophy and offer the design-related benefits this entails. Its trademark is gearless wind turbines with direct drive and a permanent-magnet synchronous generator that achieves a high level of efficiency with minimal power loss.

The use of as few high-quality components as possible in a compact design with largely wear-free operation is a recurring theme. The turbines are characterised by high levels of availability and reliable, low-maintenance performance.

The advantageous positioning of all the power electronics, including the frequency converter and transformer, in the base of the tower is common to all product lines, as is the use of the lubrication-free, durable toothed belt drive for the triply redundant blade pitch control system.

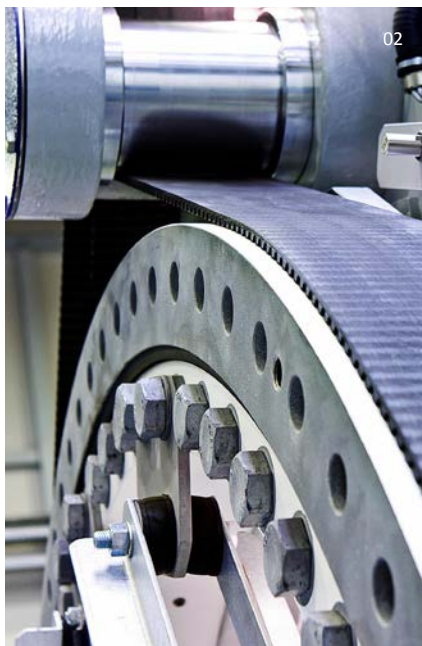
VENSYS Energy AG is the German pioneer in the development of direct-drive wind turbines. Together with its licensees, the company has an impressive 15,500 turbines installed around the world, which currently generate a total of 26.3 GW under a wide variety of grid and climate conditions.

VENSYS's renewed growth spurt on the European and international wind markets is the result of high demand for the 2.5 MW series and the continuing success of the 1.5 MW platform. The latter has been in production since 2003 and was the most frequently installed 1.5 MW gearless wind turbine right back in 2011. 11,000 of these highly robust and efficient turbines have been installed and have proven themselves even in extreme climates. 91% originate from Goldwind, VENSYS's largest licensee in China.



VENSYS Energy AG

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Fax	+49 (0)6821 9517411
E-Mail	s.baumann@vensys.de
Web	www.vensys.de
Profile	Wind turbines (> 100 kW)
Category	Manufacturers
Turnover	€ 100 million
Employees	150 in Neunkirchen, 90 in Diepholz
Founding year	2000



Platform-specific developments further promote the advantages of the turbine design.

For example, the passive air-cooling system in the 1.5 MW series enables reliable operation even in extreme environments. The active air-cooling system in the 2.5 MW/3 MW platform, which has a considerably higher rated capacity, is both simple and effective, protected against all outside influences in a closed circuit.



The innovative rotor bearing in the 2.5 MW series, using a single slew bearing, brings about a significant reduction of the tower head mass, despite an increase in capacity and rotor size.

For optimum adaptation to the potential wind yield, VENSYS offers all platforms with various tower systems and heights, as well as several rotor diameters.

The 1.5 MW turbine can be constructed with a 70, 77, 82 or 87 metre rotor diameter. A total of eleven variants with

hub heights of 61.5, 65, 70, 75, 85 and 100 metres ensure that sites with wind classes from Ia to IIIb are covered.

The 2.5 MW platform, which started out in 2010 as a prototype with a 100 metre rotor diameter, was expanded to include 109 and 112 metre diameters in 2012. Since 2013, VENSYS has also been constructing the 2.5 MW platform with a 140 metre high steel and concrete hybrid tower, which achieves optimum yields at IEC IIa and IIIa sites.

VENSYS turbines are manufactured both at the German headquarters and in the facilities of licensees. To stay competitive, the VENSYS construction department is constantly concerned with the implementation of new ideas for series with higher performance. Production of the 2.5 MW and 3 MW turbines is currently concentrated at the German site in Neunkirchen and the Goldwind production facilities in China.



01 | Vensys100 in Wagenfeld, Germany. Photo: Carlos Arias Enciso

02 | Pitch system with toothed belt drive. Photo: Carlos Arias Enciso

03 | Workshop in Neunkirchen, Saarland, Germany. Photo: Carlos Arias Encis

04 | Losheim-Britten wind farm, Saarland, Germany. Photo: Vensys

Vestas Central Europe

Systematic competitiveness

Efficient technology, operational excellence, low levelized cost of energy, multibrand service – Win tenders with Vestas



3 MW platform – Raising the bar for low-wind site performance.

Vestas Central Europe

Address **Kapstadtring 7
22297 Hamburg**
Phone **+49 (0)40 467 78 - 50 00**
E-Mail **vestas-centraleurope@vestas.com**
Web **www.vestas.com**
Profile **Wind turbines (> 100 kW)**
Category **Manufacturers**
Turnover **€ 10.24 billion**
Employees **> 21,800 worldwide**
Founding year **1985**

Vestas has been active in the German market since 1986 and to date has installed more than 7,600 wind turbines in Germany with a total capacity of 12.1 GW. The company includes the entire value chain and employs around 2,400 people in Germany. Vestas' focus on constant technological advancement increases the productivity of turbines and, at the same time, reduces the levelized cost of energy. Our aim is to develop the optimum system turbine for each site.

Perfect combination of efficient turbine technology, innovative tower concepts, modular options and flexible service offers

Our platform strategy combines innovation with established technologies. A comprehensively certified product portfolio of efficient 3-MW turbines, our proven Large Diameter Steel Tower (LDST) – including for tower heights of up to 166 m – operational excellence, and leading multibrand service are the perfect combination for success in the upcoming tendering system with Vestas as your partner. With almost 13 GW of installed capacity worldwide, the 3-MW platform offers a wide range of efficient wind turbines for the German market. Depending on the wind sites, our customers can choose between V112-3.3 MW, V117-3.3 MW, V126-3.3 MW, V126-3.45 MW and V136-3.45 MW. In addition, our modular system with two nacelle variants, different power and noise modes, and 13 different tower heights offers the optimal turbine for every site and every customer requirement. We also offer an extensive range of additional services on request, such as repowering or EPC (engineering, procurement and construction).

“With our fully certified 3 MW platform, our LDST tower concept – suitable also for large hub heights – our operational excellence and leading, independent service we are ideally placed to become the preferred partner in the German auction system”, says Knud Rissel, Vice President Sales Germany.



From cradle to cradle: Vestas supports repowering projects from the start

Repowering is an elementary part of the German market in order to achieve the ambitious expansion targets for renewable energies by 2030. With the increasing size of old turbines comes an increase in complexity too. Vestas helps customers to find a second potential use for their turbines – after all, wind turbines are at their most valuable when they can generate electricity.

EPC: Engineering, Procurement, Construction

One-stop solutions: globally tested, customised, modular.

The complexity of wind energy projects and the number of interfaces is continu-

ally growing. At Vestas, you get a range of one-stop solutions with clear benefits. Vestas uses its expert knowledge and skill to provide you with extensive support for your individual requirements, including producing transport studies, planning the electrical infrastructure, building access roads, crane sites and the transformer station. Vestas has been involved in numerous successful EPC projects. We build on this global experience and offer you customised solutions for your project in Germany.

A flexible, multibrand service for your investment in wind energy

As a life-long, fleet-wide service partner focusing on safety, quality and optimising yields, Vestas offers flexible service solutions that maximise the security of

our customers' investment in wind power. Our acquisition of independent service providers Upwind and Availon has helped us to further strengthen our service expertise. Together we are now the world's leading multibrand service partner. Vestas is responding to growing customer demand for a service partner who can provide an efficient, one-stop, multi-technology service. Preventive turbine service, supply of replacement parts, upgrades and smart data are all part of our offer.

About Vestas

Vestas is the global partner for wind energy solutions. We develop, manufacture, install and service wind turbines worldwide and have installed more than 82 GW in 76 countries, more than any other company in the world. Using leading smart data capacities, and drawing on an incomparable 71 GW of installed capacity under service contract, we use data for interpreting, forecasting and utilising wind resources, offering first class wind energy solutions. 21,800 Vestas employees work with our customers to implement sustainable energy solutions and a green future. The business unit Vestas Central Europe, headquartered in Hamburg, is responsible for the sale and marketing of wind energy solutions, as well as the installation and maintenance of wind power plants in Germany, Benelux, Austria, Russia, Eastern Europe, South Africa and Eastern Africa.



Vestas is the leading provider of multibrand service.





Companies:

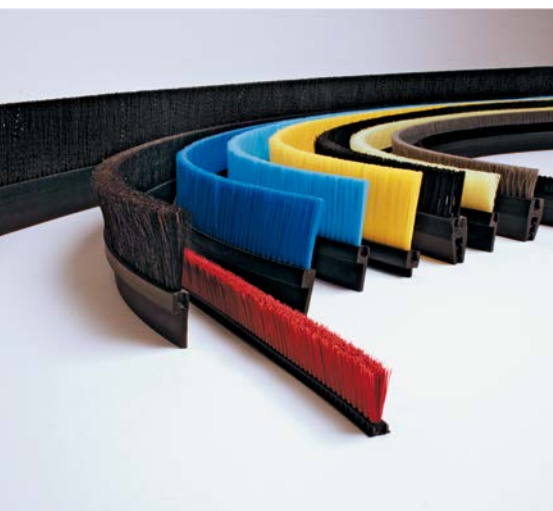
Suppliers

Manufacturers of wind turbines from all over the world buy systems and components in Germany. Years of experience of the operational side together with specific research and development projects to reduce manufacturing and operating costs and prolong service life are much in demand everywhere.



August Mink KG, Mink Bürsten

Reliable seals with flexible brush seals on wind turbines –
Know which way the wind is blowing!



Mink Bürsten develops sealing concepts with brushes in close collaboration with leading companies in the wind energy industry.

With its flexibility and numerous fibres that work at localised points, the brush has crucial advantages over comparable materials in terms of reliable protection from the effects of weather conditions, nesting insects, sand ingress or cold temperatures. At the same time, condensation can be allowed to escape, which cannot be done, or not to optimal effect, with rubber or foam. The optimal rotor speed of the wind turbine is controlled via the adjustable rotor blades. The inner or outer toothed pitch bearings are sealed with brush seals against corrosive media from the outside and against escaping grease from the inside. Because the fibres can be adapted for a very wide range of situations, gaps with high dimensional tolerances are reliably closed. Localised contact of the fibres prevents the colour from wearing off on the contacted components, as well as preventing the fibre

bundles from freezing solid. Profiles for inserting, screwing or riveting ensure very good durability.

At installation, a Mink brush can be cropped without costly tools. The manufacturing technology brings other advantages for sealing rotating components. Fibre slanting in the direction in which the component rotates significantly reduces wear and tear.

Our fibre solutions can be used for far more than just sealing!

Mink brushes reduce the noise level of your turbine:

- Robust fibres on the tips of the rotor blades reduce air turbulence
- Using a cleaning brush prevents operating noises from the azimuth brake

Conductive brushes absorb voltage:

- Lightning voltages are transferred from the brushes to the spark gap
- Brushes used for equipotential bonding offer an affordable alternative and are easy to install



August Mink KG, Mink Bürsten

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Web www.mink-buersten.com

Profile Seals & vibration control

Category Suppliers of mechanical components

Turnover € 48 million

Employees 410

Founding year 1845



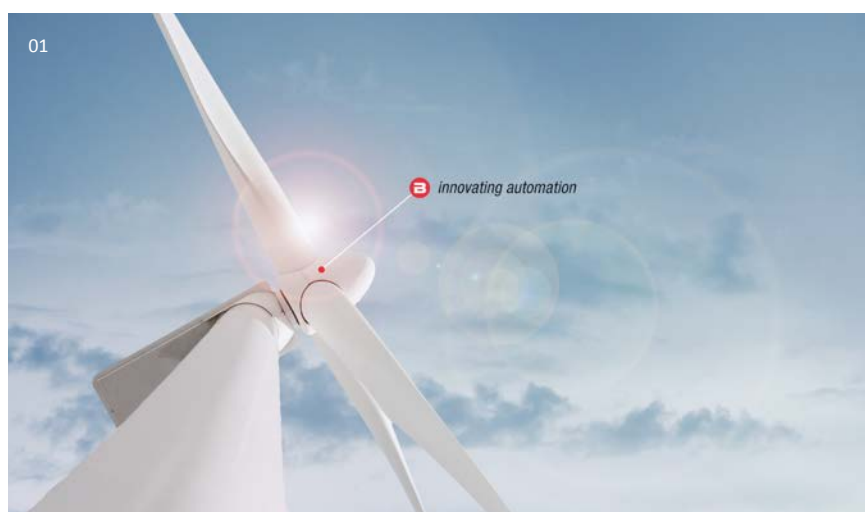
Flexible solutions with Mink brushes

- 1 | **Rotor** Mink brushes for sealing the gap on the electric pitch control of the rotor blades.
- 2 | **Nacelle** Mink brushes provide sealing concepts for all construction and assembly gaps in the nacelle's design.
- 3 | **Tower** Mink brushes as a flexible seal in the area between nacelle and tower. Mink brushes are highly resistant to UV radiation and ozone, as well as temperature fluctuations.

Balluff GmbH

Sensor solutions for wind power

Over 20 years' experience in the wind energy sector and continuous innovation are the distinguishing features of sensor manufacturer Balluff.



Offshore wind farms are the current trend. Their high energy yield and high level of acceptance make them a favourable option. But they also have to face extreme requirements in terms of structural robustness of the turbines. The objective of high level of availability can only be achieved if all components are fail-safe and extremely reliable.

As a long-term partner of the wind energy sector, Balluff and its global workforce of 3,200 employees are well aware of these challenges. Balluff sensors have been providing optimal and safe control of wind turbines for over two decades. Their exceptional reliability and robustness are the result of optimised development processes with integrated HALT tests (High Accelerated Lifetime Tests).

Identifying damage before a breakdown can occur is a must for costly wind turbines. This is why Industry 4.0/Internet of Things and Big Data are on the rise in the wind energy sector. Intelligent sensors and PSUs with heartbeat function, which not only record various parameters but also provide information about themselves and their condition, allow the gathering of detailed information on the state of a turbine.

Balluff is the just the place when it comes to future-proofing your equipment. Track and trace procedures, as used in all large-scale automotive plants, are the optimum solution by Balluff.

Solutions (selection) for:

- Angle and rotational speed detection
- Pitch adjustment
- Fill level measurement
- Network technology

01 | Balluff stands for 20 years of experience in the wind industry.

02 | All sensors used are HALT tested and provide optimal and safe control of wind turbines.

BALLUFF

Balluff GmbH

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Web	www.balluff.de
Profile	Sensors
Category	Suppliers of electrical and electronic components
Turnover	€ 366 million
Employees	3.200
Founding year	1921

Bachmann electronic GmbH

We automate wind energy: safely, flexibly and in a modular system

A secure future for your wind farm: Bachmann offers its customers around the world the most sophisticated automation solutions for the on- and offshore wind sector.



01 | Bachmann headquarters in Feldkirch, Austria.

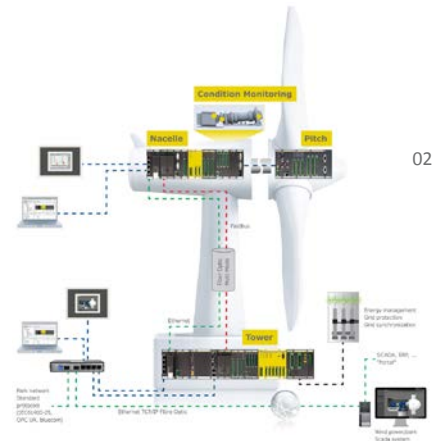
02 | Bachmann automation system for wind turbines.

Bachmann speeds up progress throughout the world in automation technology. The Bachmann Group was established in 1970 in Feldkirch, Austria, and employs over 450 people around the world. As a high-tech company our approach to development is systematic and our solutions are fully thought through. This makes us one of the leading automation partners in renewable energies, machine tools and marine sectors, and the number 1 automation specialist for the wind sector.

To date, Bachmann has automated more than 95,000 wind turbines, helping to save over 250 million tonnes of CO₂ each year. Our system solutions are open, safe, flexible and modular. Customers confirm our system availability of over 99.96 percent. Integrated condition monitoring and wind farm networking are just two product highlights of Bachmann. Our innovative solutions ensure efficient engineering for your wind turbines:

Operational control

- Turbines – Control/simulation
- SCADA wind farm
- Scalable from a single turbine to a wind farm
- Data models in accordance with IEC61400
- Communication based on standards such as OPC-UA



Power quality

- Grid measurement and protection
- Analysis with integrated data recorder
- Static and dynamic grid support
- Grid monitoring in accordance with international grid codes

Wind library/template

- Complete toolbox for turbine development
- Configurable software modules
- Object structure in accordance with IEC61400-25
- Event system and statistical evaluation

Wind farm networking

- Open communication interfaces
- Real-time networking via Ethernet-bluecom
- Standards in accordance with IEC61400-25, IEC61850, IEC60870-xx, DNP3 (and more)
- OPC UA to SCADA and operational control

Condition Monitoring Systems (CMS)

- Over 15 years of CMS expertise
- Over 6,000 CMS installed worldwide
- The world's first GL certification of a control-integrated CMS
- Customised retrofit solutions

bachmann.

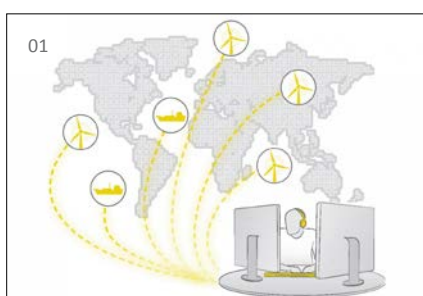
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Web **www.bachmann.info**
Profile **Controls, cables & switchgear cabinets**
Category **Suppliers of electrical and electronic components**
Turnover **€ 68 million (2015)**
Employees **more than 450**
Founding year **1970**

Bachmann Monitoring GmbH

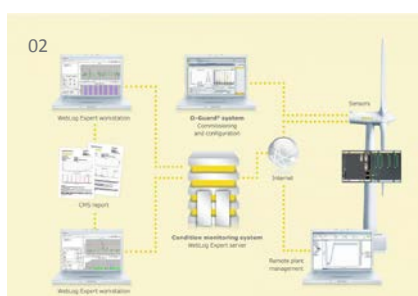
Condition monitoring systems for all manufacturers and types

Bachmann develops, produces and sells measurement systems for the condition-based maintenance of On- and Offshore wind turbines. These systems guarantee a high level of availability and a secure investment.



Bachmann Monitoring GmbH's **core expertise** is measuring and analysing vibrations, enabling it to closely monitor onshore and offshore wind turbines. The monitoring specialist – certified by Germanischer Lloyd and based at the technology hub of Jena/Rudolstadt in Germany for over 19 years – has been a subsidiary of Austrian company Bachmann electronic GmbH based in Feldkirch since 2011.

Intelligent solutions – The certified web-based CM teleservice (remote monitoring) is the key to efficiently monitoring decentralised turbines. Early identification and pinpointing of weak points ensures the reliable operation of turbines and increases yields on a sustainable basis. Condition-based maintenance based on structure-borne sound can be complemented by diagnostic functions, such as rotor blade and structural monitoring, as well as the drafting of expert vibration reports for the wind industry.



In addition to condition monitoring solutions (CMS) integrated into control systems, Bachmann also offers standalone CMS. These CM systems also enable reliable monitoring of main bearings, for example.

The „Omega Guard“ was additionally certified by Germanischer Lloyd in 2012 as a fully control-integrated CMS – a **world first**. This certification is unique in the market to date. All Bachmann CMS meet international standards such as IEC 61400-25-6. The compatibility of the information models and information exchange is always guaranteed and it is possible to incorporate CMS extensively into existing network structures and control systems.

International – Among approx. 6,000 equipped wind turbines, Bachmann currently monitors 3,900 onshore and offshore turbines worldwide. Its portfolio encompasses 25 different wind turbine manufacturers of approx. 79 different types ranging from 600 kW to 8 MW.



01 | Bachmann currently monitors 3,900 onshore and offshore turbines around the world.

02 | The Bachmann online CMS Ω-Guard® offers access to the condition monitoring data of every turbine from any online workplace worldwide.

03 | Top all-round care: Bachmann Condition Monitoring - the healthcare professionals for wind turbines.

bachmann.

Bachmann Monitoring GmbH

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Fax	+49 (0)3672 3186-200
E-Mail	vertrieb-monitoring@bachmann.info
Web	www.bachmann.info
Profile	Service, maintenance & repair
Category	Operation & service
Employees	55 (Bachmann electronic GmbH: more than 450)
Founding year	1998

Beckhoff Automation GmbH & Co. KG

1 framework bundles expertise from 10 years in the wind energy industry

The TwinCAT 3 Wind Framework bundles the industry expertise that Beckhoff gained in the automation of more than 50,000 wind turbines and makes Industry 4.0 concepts available for wind energy. The modular software package includes all functions and tools for wind turbines.

All basic functions are encapsulated as software modules in simple to use function blocks in TwinCAT 3 and provide a modular range of components for the programmer to choose from, simplifying the development of the application software. Apart from basic functions for operational management and state machine, there are software function blocks for event management, parameter configuration, user management, data connection, power and Condition Monitoring and simulation. The integrated "Big Data" database link enables the comprehensive acquisition, evaluation and provision of data from operational management, Condition Monitoring and power management in realtime.

All data are seamlessly recorded, summarised in the central controller and are available for detailed analysis, if required also via cloud-based services. This way, for example, signs of wear in individual components of the wind turbine that could lead to operational failure can be detected at an early stage, and the overall availability of the system increased.

The ready-made software modules and application templates are tried and

tested. In the same way as modifications to the hardware, individual software modules can be added or removed, and also retrofitted to adapt to changing needs. This makes engineering as simple as possible and the developer can focus on the actual system functions. The development process is also optimised by distribution across the team: development and tests on customer-specific modules can be carried out in parallel, thus further reducing the time-to-market. The con-

BECKHOFF

Beckhoff Automation
GmbH & Co. KG Office Lübeck

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E-Mail **wind@beckhoff.com**

Web **www.beckhoff.com/wind**

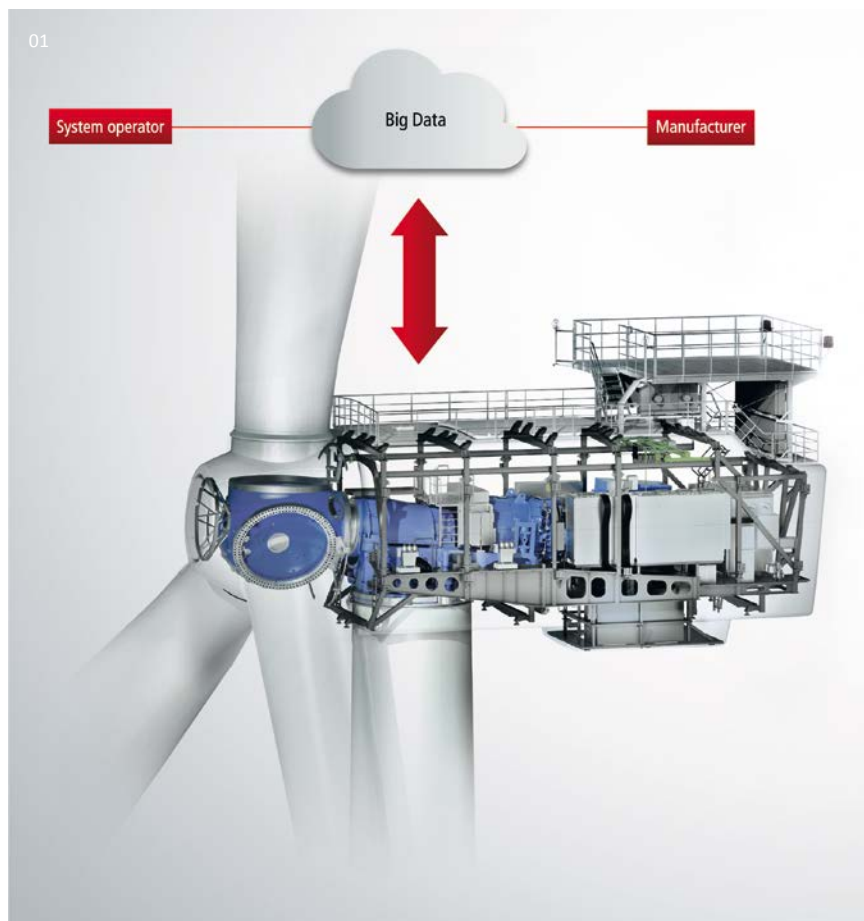
Profile **Controls, cables**
& switchgear cabinets

Category **Suppliers of electrical and**
electronic components

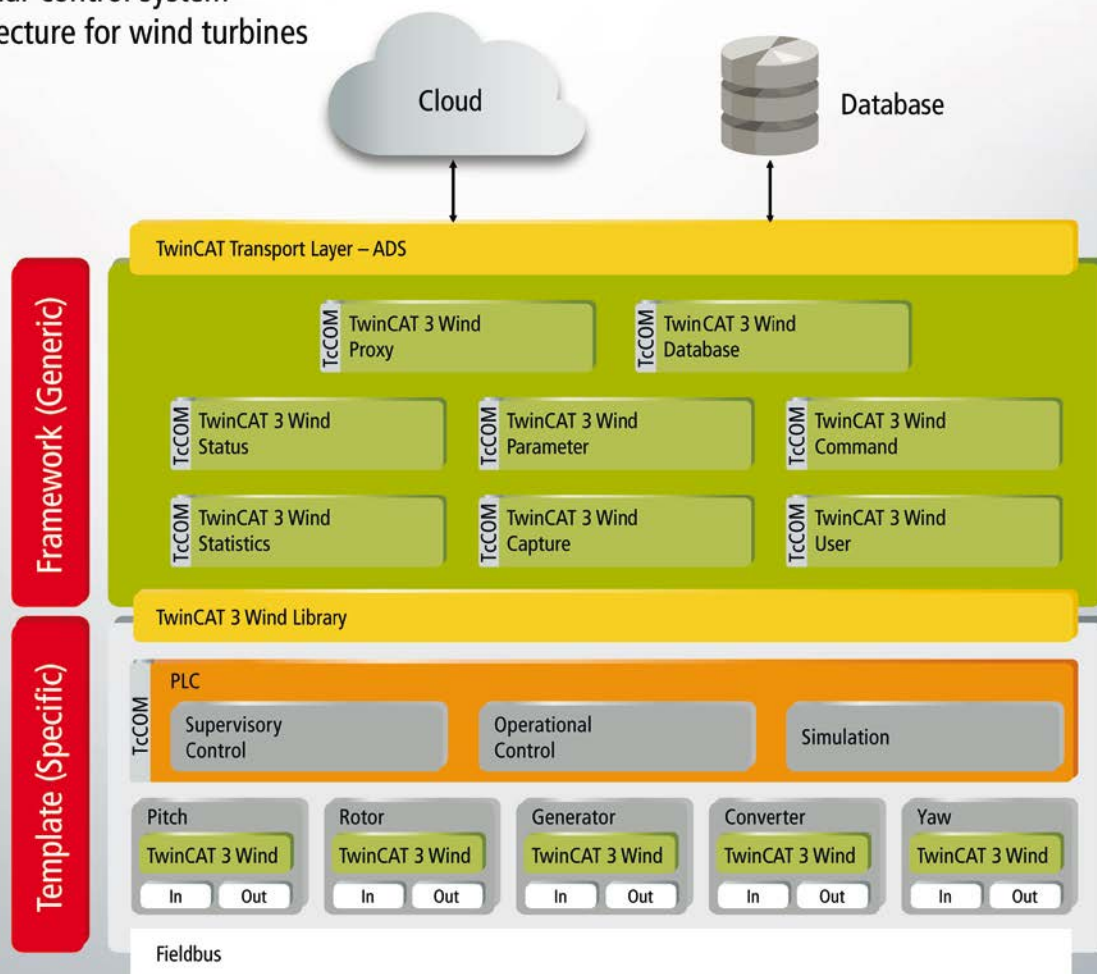
Turnover **€ 620 million 2015**

Employees **3,350**

Founding year **1980**



Modular control system architecture for wind turbines



02

sistent use of the TwinCAT modules and the uniform architecture of the subsystems create an application standard. This standardisation enables programmers to quickly familiarise themselves with the application and the source code, even if it was implemented by another programmer.

C/C++ and MATLAB®/Simulink® are available as programming languages in addition to IEC 61131-3 for object-oriented, modular programming. Following the Industrie 4.0 concept, the engineering process is automated and engineering tools can exchange data with one another. The programming of operational management software using the TwinCAT 3 Wind Framework is facilitated by a library and an application template. The library provides all functions of the Wind Framework as PLC function blocks.

The application template provides a modular architecture for the operational management software for wind turbines in the form of a PLC project, in which all required functionality of TwinCAT modules and functions is implemented.

Each subsystem of the wind turbine (such as pitch, gear unit, generator, converter, etc.) is represented by a self-contained object. In this way, the subsystems can be developed, used and tested independently. As a result, the subsystem software modules are interchangeable, as is already common practice in the mechanical modularisation of systems. This increases the quality, flexibility and reusability of the software, and reduces development time and costs.

In ongoing wind turbine operation, all information from the various TwinCAT modules is continuously transmitted in real-time to the database module. It is then saved in the database or retrieved from it via SQL procedures. The TwinCAT 3 Database Server manages the data in the database. Interfacing with the SQL database through the database module and the TwinCAT 3 Database Server enables efficient and compact data management based on a uniform, common format. The logging of all events and signals, and storing and loading the entire configuration of all objects enable detailed analyses.

01 | Universal data flow from the development to the optimisation of the wind turbine in operation by means of big data applications.

02 | Maximised flexibility: modular engineering for modular wind turbines.

DAFA Deutschland GmbH

DAFA Wind Solutions are developed using our experience within every field of business to your advantage in wind power. 75 years experience in the development, production and sale of foam, rubber and plastic products. DAFA Wind Solutions are developed using our experience within every field of business to your advantage in wind power.



Foam, rubber and plastic solutions – seal, absorb and protect

DAFA is a Danish family company with more than 75 years of experience in the development, production and sale of special foam, rubber and plastic solutions.

DAFA Wind

Our objective is to combine innovative sector-specific solutions.

DAFA Wind includes products that have been developed using our experience from every field of business for your advantage in wind power.

Nacelle

DAFA's nacelle solutions help structures and electronic components in the nacelle to withstand stress, to perform better and thus to last longer. Optimise your products using our solutions within sealing, mounting and acoustics.

Rotor blades

Our foam and rubber solutions help from the very beginning; enhancing the blade design so it lasts longer and assuring safe transportation from the factory to the construction site. DAFA's solutions are on hand for de-icing solutions and maintenance tasks as well.

DAFA CargoPro®

CargoPro is a range of innovative and protective solutions for transport and storage of blades, towers and equipment for wind turbines.

CargoPro is particularly suitable for transport and storage of wind turbine blades and consist of a range of tested and proven rubber mats and foam solutions.

DAFA RotaSeal®

Your best choice in protecting rotating components in the turbine against penetration of salt, sand, water or dust. Use RotaSeal to meet demanding requirements for the hub or tower.

DAFA Tower Foundation System

Formwork elements matching requirements guarantee low tolerances and safe processes on the construction site. By using the Tower Foundation System you achieve a noticeable increase in the efficiency of the formwork.



DAFA Deutschland GmbH

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57462 Olpe**

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E-Mail **info@dafa-germany.de**

Web **www.dafa-germany.de**

Profile **Seals & vibration control**

Category **Suppliers of mechanical
components**

Turnover **€ 54 million**

Employees **300 worldwide**

Founding year **1939**

01 | DAFA RotaSeal®

02 | DAFA CargoPro® Strap Pad

03 | DAFA Tip Protector



DEUBLIN GmbH

The power to your hydraulic pitch system

DEUBLIN rotating unions and electrical slip rings allow reliable media transmission between stationary and rotating systems. Approved technology combined with global availability makes it a preferred component for many leading wind turbine manufacturer.

For more than 60 years DEUBLIN have been internationally renowned for supplying high quality rotating unions worldwide. Manufacturing sites are located on four continents, North America, South America, Europe and Asia where 550 employees are dedicated to satisfying customer demands with fully developed and customized solutions.

Highly qualified engineers located in 17 subsidiaries and 50 distributors facilitate projects worldwide from enquiry through to delivery. Superb products, high quality standards and the worldwide organisation enable DEUBLIN to be a preferred first tier supplier to the wind industry.

The Rotating Union is a precision mechanical component which allows the transfer of pressurized fluids from stationary systems to rotating machinery. Rotating unions must be designed considering a wide range of media, viscosities, temperatures and pressure ranges as well as velocities. To DEUBLIN, being a partner in the wind industry means utilizing only specialized solutions that can meet highest expectations in terms of reliability and longevity. The rotating union is a critical component in the wind turbine hydraulic pitch control system.

Quality Environmental standards according to ISO 9001 and ISO EN 14001 are a cornerstone of our corporate culture. Deublin is an Authorized Economic Operator (AEO) offering lean logistic operation and secured customs clearance.



01 | DEUBLIN high precision rotating union dedicated to wind power installations.

02 | Deublin global production foot print.

02



DEUBLIN GmbH

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55129 Mainz**
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E-Mail **aschubert@deublin.de**
Web **www.deublin.de**
Profile **Hydraulic components**
Category **Suppliers of mechanical components**
Founding year **1969**

DHHI Germany GmbH

We Think In Gears

Gearboxes and components for wind turbines - engineered in Germany and manufactured in China. DHHI is well known worldwide for high quality in gearboxes, heavy machinery, and plant construction.



01 | Gearboxes developed in Germany, manufactured in China.

02 | The 6 MW main gearbox of DHHI is GL-approved.

03 | Core components for wind turbines from DHHI.



DHHI Germany GmbH is the German subsidiary of Dalian Huarui Heavy Industry Group Co., Ltd. (DHHI), a long standing large-scale enterprise based in China.

With its headquarters situated in Dalian on the east coast of China the DHHI Group has a nearly 100-year old corporate history. Five production sites, covering a total area of more than 2 million square meters, generate a turnover of up to 2 billion of USD per year.

DHHI's traditional product fields cover machinery for metallurgy and bulk materials handling, as well as cranes and port machinery of various kinds.

Key areas of growth are highly advanced castings and forgings, and gearboxes for several high-quality application fields. The main aim of development is the field of core components for multi-megawatt wind turbines. DHHI Group is one of the world's largest suppliers of components within the wind power industry.

DHHI Germany GmbH is developing and distributing gearboxes and components for wind energy turbines, as well as industrial and mobile units, which are manufactured by DHHI Group.

More information on DHHI Group can be found at www.dhhi.de.



DHHI Germany GmbH

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Fax **+49 (0)9721 47395-50**
E-Mail **info@dhhi.de**
Web **www.dhhi.de**
Profile **Gears**
Category **Suppliers of mechanical components**
Turnover **2 billion USD p.a**
Employees **6,500 permanent**
(Wind energy: 1,500)
Founding year **1914**

03

MAIN CORE COMPONENTS

Dalian Huarui Heavy Industry Group Co., Ltd.



DICHTOMATIK Vertriebsgesellschaft für Technische Dichtungen mbH

Any seal. Any time.

Specialist and consultant for the complete seal portfolio for wind power facilities (on- and offshore) from O-rings to highly complex sealing systems.



DICHTOMATIK offers special seal systems for wind turbines.

DICHTOMATIK – Sealing experience and competency for almost 40 years.

DICHTOMATIK's main task is to quickly provide the right sealing solution for any application. As part of its service, DICHTOMATIK has the largest inventory of technical seals in Europe on its 6,500 square meters of space. DICHTOMATIK also offers numerous services along with EDI, Kanban, KLT, VDA Label, VMI and the online ordering platform EASY. Its portfolio of products and services is continually improved and expanded. For decades, DICHTOMATIK has produced solutions for wind turbine manufacturers and their component suppliers. DICHTOMATIK is your experienced, professionally competent partner for

- Technical consulting and solutions in the selection of seals and materials
- Special solutions for particular applications
- Support and guidance from sampling to production readiness (incl. documentation)
- Development of installation proposals and seal geometries
- Prototype assembly
- Turned seals

In our work, the special requirements in the wind power field, such as harsh environmental conditions, cold climates, resistance to ozone and ease of installation, especially during service, are taken into consideration.

In Europe, DICHTOMATIK has eight facilities, which are located in Germany, England, Sweden, the Netherlands, France, Austria, Hungary and Italy. Outside of Europe, DICHTOMATIK maintains another six locations in the United States, Canada, Mexico, Australia, India and China. The local inventory plans are aligned with the needs of the respective markets and guarantee the fastest possible delivery.

DICHTOMATIK is part of Freudenberg Sealing Technologies, the leading sealing specialist for a wide variety of markets. In 2015, the company generated 2.3 billion euros in revenue with 15,000 employees.



DICHTOMATIK
Vertriebsgesellschaft für
Technische Dichtungen mbH

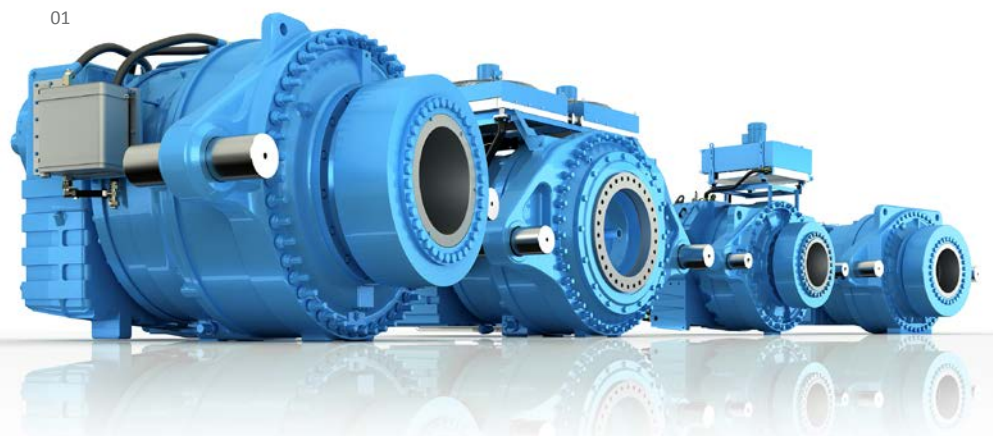
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E-Mail **mail@dichtomatik.de**
Web **www.dichtomatik.de**
Profile **Seals & vibration control**
Category **Suppliers of mechanical
components**
Employees **500**
Founding year **1978**

Eickhoff Antriebstechnik GmbH

Fastest prototype delivery in the wind energy industry

Eickhoff develops prototype gearboxes in less than 42 weeks, in close professional collaboration with its customers.

01



EICOGEAR® TRACK RECORD 18GW

01 | EICOGEAR wind turbine gearboxes.

02 | Eickhoff Wind Power GmbH in Klipphausen.

03 | Eickhoff service fleet.



Eickhoff Antriebstechnik GmbH

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44789 Bochum**

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E-Mail **getriebe@eickhoff-bochum.de**

Web **www.eickhoff-bochum.de**

Profile **Gears**

Category **Suppliers of mechanical
components**

Turnover **€ 315 million**

Employees **1,800 (group)**

Founding year **1864**

Since the boom in wind power at the start of the 1990s, Eickhoff Antriebstechnik GmbH has grown continually with the wind industry and has a great deal of technical expertise and industry experience. In close partnership with its customers, it continues to design and manufacture highly reliable and efficient gearboxes at its main production plant in Bochum. Gearbox solutions for individual customer turbine models have been in series production at its production site in Klipphausen near Dresden since 2009.

The ongoing trend for larger rotor blades means a continuous increase in torques for the gearboxes. Eickhoff offers its cus-

tomers the shortest development times for new gearboxes, enabling fast market access for wind turbines with new rotor diameters. At the same time, the German production sites react flexibly to changing delivery requirements and are thus able to run projects for turbine manufacturers particularly efficiently.

In order to meet the customer's quality requirements as well, all the relevant parameters of the gearboxes are tested on our own test benches and documented with the Eickhoff quality seal. All prototype gearboxes are also tested under extreme conditions (maximum overloads) and subjected to temperatures of -40 °C if cold weather suitability is needed.

The product portfolio also includes individually tailored service and maintenance concepts. These include services like repairs (our own and third-party gearboxes), maintenance, replacement gearboxes, spare parts and the gearbox diagnostics system E-GOMS, which was certified in 2004. In this way, we enable our customers to reduce their operating costs and response times and hence to optimise the availability of their turbines.



ELMEKO GmbH + Co. KG

Electromechanical components for the wind industry

ELMEKO develops and delivers tailored solutions „made in Germany“ for switchgear cabinet air-conditioning, dehumidifying, heating and lighting applications and accessories – also for wind turbines.



As a proficient partner for industry with decades of experience, ELMEKO manufactures and distributes innovative premium components „made in Germany“ for switchgear cabinet air-conditioning, lighting and accessories. Thanks to the close integration of engineering, manufacturing and marketing at our German plant, customised solutions can also be realised swiftly alongside the standard range.

Innovation, product quality and delivery dependability also make ELMEKO a convincing partner for the wind industry. Because our compact air-conditioners and dehumidifiers are based on Peltier technology, our heaters on PTC semiconductor technology and our lighting on LED technology, they can be installed in any position, even in the rotor hub of a modern wind turbine. With a long life and high vibration resistance, they are not only energy-efficient in operation but also maintenance-free because they incorporate no moving or sensitive parts.

ELMEKO components are used in towers, nacelles and hubs. Their deployment in electrical/electronic enclosures ensures reliable plant operation and high technical availability, even in the hot and cold conditions, high atmospheric humidity and widely fluctuating temperatures found in the world's different climate zones.

ELMEKO dehumidifiers, in particular, are predestined for use in wind turbines because they reliably remove the damaging condensate that can collect at night or in a deactivated turbine – even from rotating rotor hubs. Thanks to ELMEKO flexibility, the company also realises application-specific solutions on economical terms.

02



01 | With the calculation software DeltaT ELMEKO offers sound technical advice also for complicated projects.

02 | Switchgear cabinet heaters – made in Germany, also available with special mounting plates for wind turbines. (Photos: ELMEKO)



ELMEKO GmbH + Co. KG

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E-Mail **info@elmeko.de**
Web **www.elmeko.de**
Profile **Cooling & climatisation**
Category **Suppliers of electrical and
electronic components**
Founding year **2004**

Filtration Group GmbH

Systems and Components for Wind Power

In on- and offshore wind power systems and service platforms around the world, filtration and separation solutions from Filtration Group do an excellent job. All components and systems are continuously being developed, and are highly efficient and reliable.



01 | Oil filter module Pi 8300.



02 | EcoParts elements.



03 | Tower climate control system.

Filtration Group is one of the largest supplier for onshore and offshore wind energy systems.

For oil filtration in transmissions, e.g. an innovative oil filter module, spin-on-cartridges as well as filter elements and filter housings are employed. **Typical applications for Filtration Group filters include hydraulic systems for rotor blade adjustment, for azimuth control and for the drive train brake-generally as flange-mounted filters and air breathers.**

Furthermore, the **Filtration Group Eco-Parts program** includes an extensive range of filter elements for hydraulic applications that can be used to keep your wind energy system running over the long term. All EcoParts filter elements meet the mandatory DIN and ISO standards and come with all the prevalent industry approvals. **These products are specially manufactured, more cost-effective of our competitors – each alternative an original.**

The compact, ready-to-connect **filter Pi 8300** was developed for the specific requirements of lubrication systems of gears in wind power plants. Integrated drainage on the dirty and clean sides, ventilation in the filter cover, an easily accessible maintenance two-stage filter elements provide maximum cleaning performance an long term reliability.

With its extensive application expertise, in-house research and development, technical center, laboratory and design development, the Filtration Group offers its customers tailor-made filter components and process engineering solutions.



Filtration Group GmbH

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Web **www.FiltrationGroup.com/mahle**
Profile **Hydraulic components**
Category **Suppliers of mechanical components**
Turnover **€ 822.9 million**
Employees **5,200**

GEDORE GmbH

As a worldwide leading premium brand, we manufacture high-quality hand tools and specialty tools for safe and productive work – even under severe conditions.



01

Wind turbines have to withstand immense forces, whilst at the same time running efficiently and safely and ensuring a long service life. This means that a great deal of accuracy and diligence is essential during installation and maintenance. Above all, screw connections must be reliable and durable, which requires particularly sturdy and precise tools. As a proven and tested torque specialist, we offer first-class torque wrenches and equipment for this purpose which guarantee that screws are tightened safely and in a controlled way: for example the GEDORE high-torque cordless screwdriver for a power range from 90 to 6,000 Nm, as well as our GEDORE DREMOMETER torque wrench, the tripping accuracy of which even exceeds the specifications of the DIN/ISO norm.



02

01 | High-torque cordless screwdrivers for between 90 and 6,000 Nm.

02 | 3-in-1 power wrench bits with impact fix retention.

03 | GEDORE DREMOMETER EK torque wrench.

Smart solutions mean increased safety

Our product range also offers a variety of extremely safe and easy-to-use tools that facilitate working at great heights or in smaller spaces. When erecting wind turbines, technicians often have to use torque wrenches, power wrench bits and torque multipliers at the same time – which means handling three tools using only two hands.



03

We have developed a smart solution to overcome this challenge whilst reducing the risk of injury from falling parts:

Thanks to their integrated pin safety, our 3-in-1 power wrench bits with impact fix guarantee a secure connection. The pins are automatically pressed into the drill holes in the square drive when the ring is being secured, preventing them from getting lost. The ring can also be easily shifted using the double ring nut on the bit.

And that is just one example of how our tools make working on wind power stations easier, safer and more productive. True to our motto: Tools for life.

GEDORE
WERKZEUGE FÜR'S LEBEN

GEDORE GmbH

Address **Remscheider Str. 149
42899 Remscheid**
Phone **+49 (0)2191 596-900**
E-Mail **info@gedore.com**
Web **www.gedore.com**
Profile **Tools & machine tools**
Category **Suppliers of mechanical components**
Employees **2,500**
Founding year **1919**

Hailo Wind Systems GmbH & Co. KG

Ladders, servicelifts, climb assists, fall arrest systems and tower equipment from one source including installation and maintenance, GWO certified safety trainings, premium after sales services and much more.



Hailo Wind Systems – High Level Access Solutions.

As the inventor of the aluminium ladder, Hailo introduced the professional ladder system into wind turbines in Europe more than 50 years ago.

Today, Hailo Wind Systems is one of the world's market and technology leaders for safe and reliable access and climbing solutions. With our premium ladder systems, customized servicelifts, smart climb assist systems, modern fall arrest systems and much more, we provide everything for professional access systems in wind turbines.

Thanks to our own subsidiaries and manufacturers on 4 continents, our customers have access to competent contact partners and highly-trained service engineers worldwide.

As well as the comprehensive range of available services, our international and GWO-certified training center, the Safety And Rescue Academy (S.A.R.A.), with its fully equipped training tower, video tutorials and e-learning, sets the standards for all industry related safety training and other training courses.

Quality, reliability and safety always come first with all of our products and services. Always made to measure for our customers – worldwide.



Hailo Wind Systems GmbH & Co. KG

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E-Mail **info@hailo-windsystems.com**
Web **www.hailo-windsystems.com**
Profile **Access technology**
Category **Suppliers of mechanical
components**
Turnover **€ 35 million**
Employees **135**
Founding year **1947**

HELUKABEL GmbH

The professional cable solution for the wind energy sector

HELUKABEL® GmbH is one of the leading international suppliers and manufacturers of all types of cables, wires and accessories. We provide optimized and individual solutions for every application within a wind farm. Our full range ensures we can provide all necessary cables, torsion cables, data and network technology and accessories.

We will advise you on:

Nacelle: Increased oil and heat resistance, special solutions for the slip ring.

Loop: All torsion cables tested for 18,000 cycles in our HELUKABEL 20ft test tower.

Tower: Copper and aluminium cables, multi-wired and fine wired, special lift cables, fibre optic cables and fastening systems.

Great performance under all climate conditions: -55 °C - +145 °C for CCV and offshore applications, internationally approved according to UL, CSA, FT4, CE, VDE and WTTT. Our high-end model in the area of wind power is the WK 137-Torsion FT4 cable, which satisfies all the requirements of wind turbine manufac-



HELUKABEL WK series.

turers: from the increased rated voltage of 1.000 V – with UL/CSA approval over a large temperature range and without the use of halogen – to the demanding FT4 flame test of the CSA (Canadian Standard Association).

Moreover, the cable is also extremely resistant to abrasion, is ideal for offshore wind facilities and has been tested for its resistance to the aggressive oils used in wind turbines. With its WK POWERLINE ALU cable, HELUKABEL® is continually increasing its lead as a supplier of innovative products for the wind power industry. Thanks to its low weight and highly flexible design, an important gap in power cabling with aluminium conductors is closed. There is a great interest in the flexible aluminium cable of the POWERLINE series. As a result, the spectrum was further expanded. We are offering a com-

plete solution from 0,6 to 30 KV and from 2,5 to 400 mm². The specially developed connection equipment completes the product range.



HELUKABEL GmbH

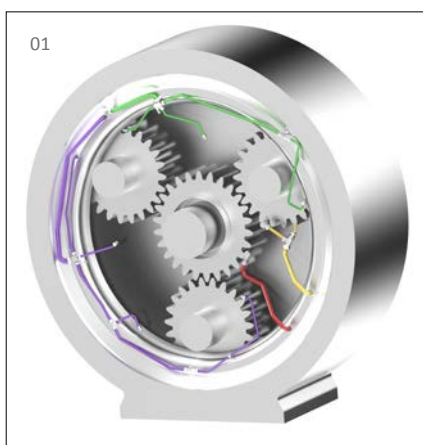
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Fax	+49 (0)7150 81786
E-Mail	info@helukabel.de
Web	www.helukabel.de
Profile	Controls, cables & switchgear cabinets
Category	Suppliers of electrical and electronic components
Turnover	€ 476 million (2015)
Employees	1,200
Founding year	1978



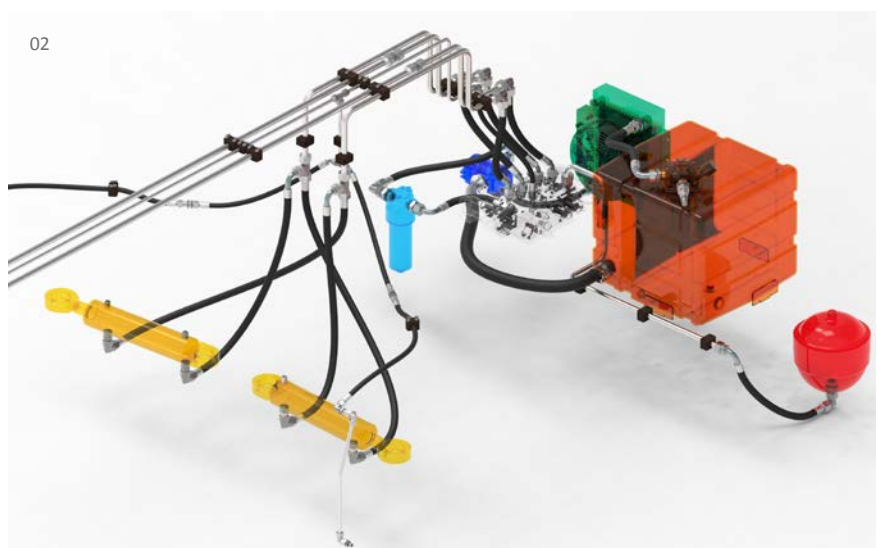
Interhydraulik company for hydraulic components

Development – Production – Service: Expertise under one roof

As a specialist in hydraulic connecting technology, Interhydraulik offers a diverse range of pipelines, hose assemblies and screw connections for use in wind turbines.



01 | Example of a pipe plan in the gearbox housing to lubricate the gearbox bearings.



02 | Construction of the entire hydraulic connecting technology in your 3D model.



Interhydraulik company for
hydraulic components

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E-Mail **info@interhydraulik.de**
Web **www.interhydraulik.com**
Profile **Hydraulic components**
Category **Suppliers of mechanical
components**
Turnover **€ 20 million**
Employees **190**
Founding year **1984**

We have been developing, manufacturing and distributing components for hydraulic connecting technology since 1984. As an owner-operated family business with over 190 employees around the world, today we are one of the leading system providers for hydraulic components in the fields of **mobile hydraulics** and **wind energy**.

Our passion for our customers' technical problems sets us apart. Our application technology means we can quickly develop **individual and intelligent product solutions** to a problem. Every project is supported from the development of the prototype to series production.

Our quality, experience and passion are not limited to mobile hydraulics. Our customers also include reputable companies in the field of wind energy, which have been using our products for many years all over the world.

Our products are also used on the **inside and outside of gearboxes**.

Inside the gearbox: Pipelines, lubrication lines, nozzles, oil reservoirs, distributors, holders

Outside the gearbox: Hose assemblies and pipelines, intake manifolds, distributors, compensators, special components, pre-assembled components

In order to protect hydraulic components against corrosion for longer, we are currently the only provider to use a **galvanising procedure free from chromium VI, nickel and cobalt**, which increases the **resistance to red rust to over 1000 hours** compared to standard galvanised pipelines (salt spray test). For the first time, components can also be galvanised **continuously from the inside** (advantageous for equipment with longer downtimes).

KTR Systems GmbH

Systems for Wind Power Technology

For more than 25 years KTR has been involved in the wind power industry and is a global market leader in the field of power transmission in wind energy plants. Customised systems consisting of couplings and torque limiters, but also brake and cooling systems are ready for deployment in wind power plants operating in the megawatt range.

As far back as 1988 KTR had already developed the first coupling for use in the wind power industry. With the RADEX®-N steel disc coupling we have had a coupling system on the market for over 15 years, that was specifically built for use in wind power plants and which has undergone continuous development since its inception. Currently more than 70,000 KTR couplings are used in wind turbines with a nominal capacity of up to 8MW, with thousands more added every year.

Our high-performance braking systems are used on the rotors and in the nacelle, to which end we provide products for three different applications: rotor brakes, yaw brakes and rotor lock. The systems are available in both hydraulic and electromagnetic versions.



Our large cooling units comprise of electric motors, fans and bypass systems. The cooling elements are made of weight-saving aluminium, whilst the fan cowling and frame are constructed in robust high-grade steel. In spite of their high performance, all cooling units are extremely compact. Cooling systems and motors intended for use in off-shore applications are treated with a special coating for off-shore environments, in order to protect them against the corrosive saline atmosphere.

Made for Motion – KTR

01 | More than 410 employees work at the headquarters in Rheine.

02 | Steel lamina coupling RADEX®-N with integrated brake system – specially developed for wind power plants.

03 | For use in offshore plants the cooling systems are coated with special protective paint.



KTR Systems GmbH

Address **Carl-Zeiss-Str. 25
48432 Rheine**
Phone **+49 (0)05971 798-0**
E-Mail **mail@ktr.com**
Web **www.ktr.com**
Profile **Couplings, brakes, cooler**
Category **Suppliers of mechanical components**
Employees **more than 1,100**
Founding year **1959**

The Liebherr Group

A Strong Partner for the Wind Industry

For more than 65 years, the Liebherr name has stood for excellent, benefit-oriented products and services. The Group is not only one of the world's leading manufacturers of construction machinery; it is also a major supplier in many other fields of engineering like the wind industry.



01 | From assembly to surface preparation of the rotor blades, Liebherr offers the matching solution for different demands of the wind industry.

02 | Liebherr LTM 1750-9.1 mobile crane installs the rotor star at a hub height of 80 metres.

03 | Heavy duty CAL 45000-1200 Litronic® offshore crane during the installation of rotor stars in the North Sea.

04 | Liebherr tower crane 1000 EC-B erects wind turbines in an extremely precise manner with a space-saving design.

Liebherr is a powerful partner for the wind industry and offers convincing solutions for a wide range of requirements: On the one hand, components manufactured by Liebherr are installed directly into wind turbines, on the other hand, the company's mobile, crawler, offshore and tower cranes, are for example, used for erecting wind turbines or for constructing wind farms.

Offering large diameter bearings, slewing drives, electric motors and hydraulic cylinders, Liebherr is the only manufacturer worldwide that can provide not only single components but entire systems for electromechanical and hydraulic pitch and yaw adjustment in wind turbines.

One of the major elements of cooperation with customers from all over the world is application-specific engineering to perfectly adapt each of the components. In the wind industry, Liebherr collaborates with nearly all leading turbine manufac-

turers and has so far equipped numerous wind turbines with its own components. The product portfolio comprises components for turbines from 800 kW up to multimegawatt offshore turbines.

With their innovative technology, high quality, profitability and longevity, mobile and crawler cranes from Liebherr own a leading position in the world market. For decades, they have also been proving their value in the construction of wind farms. As well as telescopic mobile cranes, Liebherr can also provide lattice boom mobile cranes and crawler cranes to erect wind power systems, in a variety of performance classes, specifically matched to meet the needs of the wind power industry. Liebherr keeps pace with the development of larger and more efficient turbines as well as the increasing hub heights by offering cranes with optimized performance and new jib systems, reaching higher lifting capacities.

LIEBHERR

**Liebherr-International
Deutschland GmbH**

Address **Hans-Liebherr-Str. 45
88400 Biberach an der Riss**

Phone **+49 (0)7351 41-0**

Fax **+49 (0)7351 41-265**

E-Mail **info.lho@liebherr.com**

Web **www.liebherr.com**

Profile **Crane companies, crane hire,
special transport, components**

Category **Transport & logistics**

Turnover **more than € 9,2 billion (2015)**

Employees **more than 42,000**

Founding year **1949**



Cranes on narrow crawler travel gears especially developed for the construction of wind farms can move on the narrow tracks from one unit to the next in full setup condition, meaning including jib and full ballast. This is especially economical, because the machine and equipment have to be mounted only once.

For erecting wind turbines with a hub height of 110 m or more in low-wind areas, Liebherr also offers specially developed tower cranes with lifting capacity of up to 125 t. They are mounted on the wind turbine and are configured in a way that the necessary lifting height can be

reached by guying the crane to the mast at one point only. The advantages are reduced space required by the crane, the ability to work despite high wind speeds and sensitive lifting of loads using Micro-move.

Liebherr also offers efficient solutions for the erection of offshore wind turbines. Heavy duty cranes from Liebherr for offshore applications are able to lift up to 3,000 t at more than 50 m outreach. Thereby Liebherr's offshore portfolio meets challenging requirements, such as the provision of diesel or electrical drive units, explosion protected cranes



and cranes for ambient temperatures between +40° C and -50° C. Liebherr cranes are not only used successfully for the construction of offshore wind turbines, but also on oil and gas platforms, for offshore construction, pipe-laying or subsea operations down to 3,600 m below sea level.

Experience the progress.

Max Bögl Wind AG

As one of the leading manufacturers of high-performance hybrid wind power plants with large hub heights, the Max Bögl Group has extensive know-how across the entire process chain including the project planning, construction, plant management and repowering of wind turbines.



Fortschritt baut man aus Ideen.

Max Bögl Wind AG

Address **PO Box 11 20
92301 Neumarkt i. d. OPf.**
Phone **+49 (0) 9181 909-11624**
Fax **+49 (0) 9181 905061**
E-Mail **wind@max-boegl.com**
Web **www.max-boegl.com**
Profile **Towers**
Category **Suppliers of large components**
Founding year **2011**

01 | The 160+ concept was first introduced with the construction of a 164-m hybrid tower for the Hausbay-Bickenbach project.

02 | The modified Max Bögl Hybrid Tower System completed on site to the usual quality standard in the mobile factory for international markets.

03 | Wind turbines with large hub heights and rotors, perfectly implemented with the Hybrid Tower System Max Bögl, enable high energy yield even on less windy, inland sites.

04 | The transportation of concrete components with a weight up to 62 tons is carried out by the in-house vehicle fleet, but also increasingly by ship.

With an impressive full-service package of innovative development and state-of-the-art production and assembly processes, Max Bögl has successfully won the custom of virtually all well-known European manufacturers of wind power plants.

The hybrid wind turbine towers, which were developed in-house and manufactured from reinforced concrete and steel at its production sites in Sengenthal and Osterrönnfeld (which have a capacity of 500 plants per year) ensure increased efficiency and a higher energy yield in inland areas.

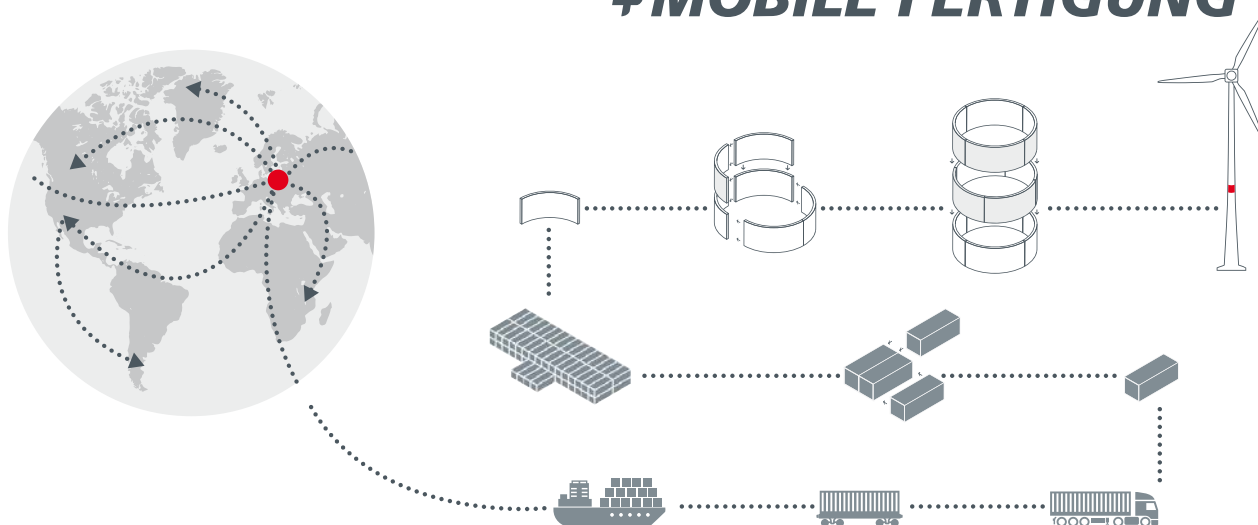
Experts and specialist knowledge in every discipline

A wind energy project is a complex undertaking. The success of the project depends on the experience and special knowledge of various specialists. Interfaces between project phases and project participants pose risks that can only be overcome by professional project management. Max Bögl Wind AG is a skilled, reliable and powerful partner, whether for selecting potential locations or testing the technical feasibility of existing project ideas.

Whether client or investor, once the decision to build a wind farm has been made, Max Bögl accompanies and supports you throughout the entire duration of the project as required. Therefore you can rely on the extensive know-how of the Max Bögl Group for the development, planning and implementation even of major wind

02

HYBRIDTUM SYSTEM MAX BÖGL **+ MOBILE FERTIGUNG**



farms. Taking into account all involved parties, in-house specialists develop a detailed project plan, gladly in conjunction with local engineering firms.

Complete product and service portfolio

Furthermore, Max Bögl expertly coordinates full construction site logistics and guarantees the safe transportation of concrete and steel segments using its own vehicle fleet and partner companies. On the construction site the assembly of the hybrid tower is prepared by advance road-building and cable construction. Foundations are built and the mounting system is established. Depending on the

location, the tower can be mounted by the innovation award-winning „self-climbing revolving tower crane“ developed in-house or with other mobile cranes. Experienced Max Bögl assembly teams then install the tower.

If requested by the customer, the Group can also provide the necessary assembly teams and equipment for installing the nacelle, the hub and the rotor blades. Dismantling of existing installations, repowering and all services related to the technical and commercial operational management of wind farms round off our portfolio.

Efficiency, quality and reliability, in conjunction with a high degree of value added and the use of qualified personnel, are the premises that characterise the all-round services provided by Max Bögl Wind plc and the company as a whole.



LAP GmbH Laser Applikationen

High-precision laser projection for rotor blade manufacturing

Laser based solutions from LAP support manufacturers of wind turbines worldwide. Production with composite materials may become faster, more effective and precise.



01 | Laser projection for rotor blade manufacturing.

02 | Laser outlines for precise positioning.
Source: LAP GmbH



LAP GmbH Laser Applikationen

Address **Zeppelinstr. 23
21337 Lueneburg**
Phone **+49 (0)4131 9511-95**
Fax **+49 (0)4131 9511-96**
E-Mail **info@lap-laser.com**
Web **www.lap-laser.com**
Profile **Rotor blades &
rotor blade materials**
Category **Suppliers of large components**
Employees **288 worldwide**
Founding year **1984**

Laser specialists since 1984

LAP is one of the world's leading suppliers of laser-based systems for projection and non-contact measurement. For more than 30 years, the company has been developing, manufacturing and distributing high-precision laser components and solutions for industrial and medical applications. One major focus is on laser projection systems for composite manufacturing in the aerospace, automotive and wind power industries.

For the wind power industry...

LAP provides a complete, laser-based positioning solution comprising laser projectors and projection software: LAP COMPOSITE PRO may simplify and accelerate the entire composite lay-up process. LAP CAD-PRO laser projectors display laser outlines based on CAD design data. This is more precise, faster and cleaner than using conventional physical templates and

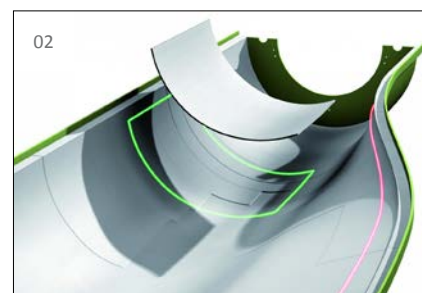
measuring instruments. The user-friendly projection software LAP PRO-SOFT 5 allows for an effective, consistent workflow from design to industrial production, with numerous CAD data formats being supported. LAP ensures perfect interaction by intensive partnerships with the leading CAD program manufacturers.

Proven in rotor blade manufacturing

LAP laser projection systems contribute to saving time and resources, improving process reliability, as well as increasing accuracy and throughput. LAP laser projection systems are deployed worldwide and used in rotor blade manufacturing by well-known wind turbine manufacturers. LAP's customers include companies such as Siemens, Vestas or TPI Composites.

Global presence

LAP operates globally from its production site in Germany. In addition, worldwide customer proximity is guaranteed by sales offices in the USA, Singapore and Shanghai. LAP also maintains an international network of sales partners around the globe.

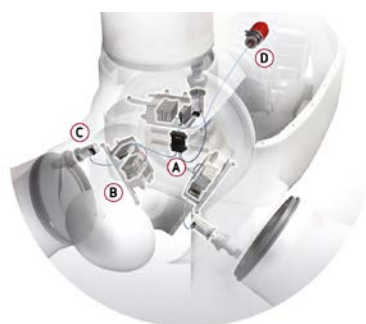


Moog

Moog is your proven partner for reliable pitch systems – significantly increased reliability and our modular system architecture with optimized hardware design help to significantly reduce unplanned turbine downtime.

Over the past decade, the substantial increase in installed renewable capacity has drastically transformed the global energy landscape. Renewables such as wind have become increasingly competitive. World-wide wind power is being harnessed to produce electric power. Ever larger and better performing wind turbines are being used to meet the increasing energy demand. Innovative technologies and mature products for onshore and offshore applications are highly sought after to ensure efficient output.

When it comes to reliability, we help you get the most out of your wind turbines. Our high reliable and low maintenance pitch system reduces turbine downtime and enables your wind turbine to generate more power, which reduces the Levelized Cost of Energy.



PITCH SYSTEM 3

Space-saving solution ensures safe and reliable performance

- (A) Pitch Interface Module
- (B) Pitch Axis Box (Pitch Servo Drive 3/Pitch Capacitor Module)
- (C) Pitch Motor

SLIP RING SOLUTIONS

Highly reliable power/data transmission

- (D) Slip Ring

Inside the Moog Pitch Control Solution.



With Moog's latest hardware design, pitch system related failures and unplanned downtime can be reduced by up to 50%. Moog's modular system architecture helps turbine manufacturers to optimize assembly time in the hub and minimizes the engineering effort in adopting our pitch system design for new turbines. Our high reliable modular components help asset owners to optimize their spare parts inventory and reduce downtime due to reduced scheduled maintenance.

Moog Services provides staff training worldwide and guarantees spare parts delivery and reliable, specialized service. All Moog technology solutions are designed for on- and offshore installations: Each pitch system, blade sensing system and slip ring solution meets the highest quality demands and stands for superior reliability at the highest level.

The Moog Industrial Group is a division of Moog Inc. and designs and manufactures high performance pitch solutions for wind turbines. Find out more about Moog at www.moog.com/wind.

MOOG

Moog

Address	Max-Born-Str. 1 59423 Unna
Phone	+49 (0)2303 5937 0
Fax	+49 (0)2303 5937 199
E-Mail	wind.germany@moog.com
Web	www.moog.com/wind
Profile	Controls, cables & switchgear cabinets
Category	Suppliers of electrical and electronic components
Turnover	USD 515 million (Moog Industrial)
Employees	almost 11,000 worldwide
Founding year	1951

NSK Deutschland GmbH

Partnership based on Trust - Trust based on Quality

For over 15 years NSK has been a partner of the wind industry and one of the main suppliers of roller bearings for wind energy gearboxes and bearings for main rotor shafts and generators.



01 | Main gearbox for wind turbines.
02 | Planet wheel gear and bearing.
03 | Main rotor shaft bearing.

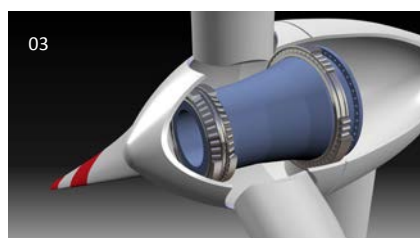
MOTION & CONTROL™
NSK

NSK Deutschland GmbH

Address **Harkortstraße 15
40880 Ratingen**
Phone **+49 (0)2102 481-0**
E-Mail **info-de@nsk.com**
Web **www.nskeurope.com**
Profile **Bearings**
Category **Suppliers of mechanical
components**
Turnover **Global: approx. € 8 billion**
Employees **Global: approx. 31,500**
Founding year **1916**

Combined know-how

Skills from sales and application technology are combined in the wind energy team – and also include the latest research results from our technology centres. Bearings are specifically designed using highly developed calculation and simulation tools. Our experienced engineers take account of load cycles, lubrication, deformation, thermal response and also



extreme and maximum conditions. This is the only way to produce a construction with cost-optimised components that also reliably function under maximum loads and have a long service life.

NSK wind standard

As the first manufacturer, NSK defined the pioneering wind standard U303 for roller bearings back in 2008 – including a one hundred percent traceability of the components of every single bearing and all essential processes. NDT methods (non destructive testing) are also available to avoid grinding burn, fractures in material and structural breakdowns.

Long service life with BOC (black oxide coating) and patented materials

BOC treatment of bearings prevents untimely bearing failures caused by white etching cracks (WEC). The patented special material AWS-TF (anti white structure-tough) is also available for high-level requirements and reliably prevents damage caused by WEC. Our STF material (super-tough) has proved ideal when it comes to increasing the load rating and service life, especially for contaminated lubricants.

PHOENIX CONTACT Deutschland GmbH

... more than just a terminal.

Phoenix Contact is a strong partner for the wind power industry thanks to an array of high-performance automation solutions, high-quality electronic components and innovative systems.

Phoenix Contact is the worldwide market leader of components, systems and solutions in the area electrical engineering, electronics and automation. The family-owned company employs 15,000 people worldwide and had a turnover of 1.97 billion euros in 2016. The corporate headquarters is located in Blomberg in central Germany.

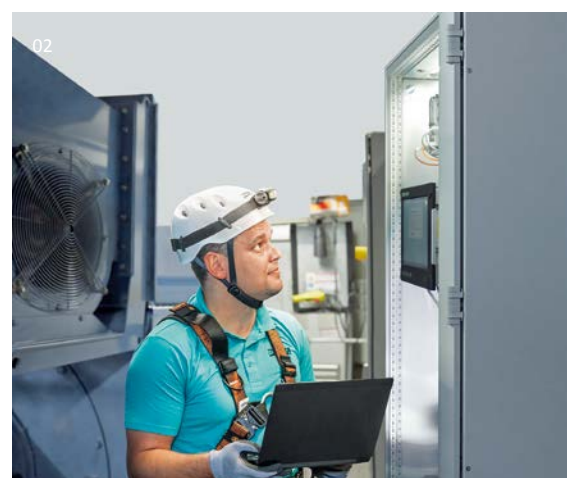
The Phoenix Contact Group has nine companies as well as 50 sales subsidiaries. In addition, the worldwide presence is consolidated by 30 representations in Europe and overseas. Worldwide production is occurring in nine countries with a high level of vertical integration.

Phoenix Contact is a veteran of wind energy with over 20 years experience in the field and one of the world's largest suppliers to the wind power industry. Both our electronic components and industry-specific systems and solutions are highly respected. Interface products, power supplies, monitoring systems and our wide range of surge protection components are well-established products in the industry, in addition to electro-mechanic components such as plug-in connectors and terminal blocks. We offer hardware safety solutions and comprehensive service and consulting competence in the area of safety technology. In addition to our high-performance control systems, we offer a software library tailored to the wind power industry in the area of automation technology. It allows you to create a cost-effective automation solution for your wind turbine.

Our understanding of being close to the customer is to be at home no matter where we are in the world and speak the language of the user. It also exemplifies our contribution to a business relationship on par with our partners.

01 | We round off our hardware range with comprehensive consulting and related services.

02 | Our secret to success with our partners is our service team with its many years of experience, pooled knowledge and skills, and tremendous flexibility.



PHOENIX CONTACT Deutschland GmbH

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Phone	+49 (0)5235 312 000
Fax	+49 (0)5235 312 999
E-Mail	windenergy@phoenixcontact.com
Web	www.phoenixcontact.com
Profile	Controls, cables & switchgear cabinets
Category	Suppliers of electrical and electronic components
Turnover	€ 1.97 billion (2016)
Employees	15,000 (2016)
Founding year	1923

Pilz GmbH & Co. KG

Ambassadors for safety

Safe automation components from Pilz increase the availability of your turbine, reduce downtimes and guarantee the safety of man and machine.

With products from Pilz your wind turbine is safe.



PILZ
THE SPIRIT OF SAFETY

Pilz GmbH & Co. KG

Address **Felix-Wankel-Strasse 2
73760 Ostfildern**

Phone **+49 (0)711 3409-0**

Fax **+49 (0)711 3409-133**

E-Mail **info@pilz.com**

Web **www.pilz.com**

Profile **Safety features & equipment**

Category **Suppliers of electrical and
electronic components**

Turnover **€ 288 million**

Employees **more than 2,000**

Founding year **1948**

As your safety partner, Pilz will supply you with reliable components and solutions that have been tried and tested in the wind energy sector. At the same time you will benefit from the simple integration of our security systems, remote diagnostics and servicing options, and a series of robust product types. Our portfolio includes certified solutions (TÜV/BG/CE/UL/CCC/GOST) for worldwide use, all of which comply with international standards, such as the Machinery Directive (2006/42/EC), IEC 61400 and the guidelines published by Germanischer Lloyd.

Safe automation – a worthwhile investment:

- Implement scalable, safe automation

solutions for new and existing wind turbines.

- Achieve optimum standardisation in the automation of both on- and offshore turbines.
- Reduce accident risk during operation as well as during maintenance and installation work.

Pilz solutions have clear benefits, particularly in the case of standard-compliant speed monitoring. We can offer for example our automation system PSS 4000 and the control systems PNOZmulti and PNOZ s30. They are scalable for various encoder combinations, achieving a safety level up to PL d and PL e.

The following can be monitored, among others:

- All safety-relevant plant values and states
- Overspeed of rotor and generator shaft, broken shear pin
- Rotor blade adjustment (pitch) and wind direction tracking (azimuth)
- Emergency stop pushbutton on the tower and in the nacelle
- Plant values such as temperature, pressure, vibration or electrical variables for plant protection

Pilz has many years of collective experience in the engineering safety consultancy sector – so why not place your trust in our expert hands? We'll support you through a range of services specially tailored to meet the needs of wind energy plant.

Prysmian Kabel und Systeme GmbH

The Prysmian Group is the world's leading manufacturer for cables for the segments energy, telecom, data and industrial.



01 | As the world's leading manufacturer we can offer you a full product range of cables.

02 | Pre-assembled cable sets.

03 | Our service for fitting / commissioning or maintenance / turbine monitoring.

Its certified quality management with a worldwide focus ensures that product quality is always at the highest level, from the procurement and production processes, right through to the delivery process. With a focus on sustainable and environmentally friendly production processes, the Prysmian Group ensures that the fundamental principles of sustainable energy concepts are also implemented in its own company.

Our integrated management system complies with DIN EN ISO 9001, IRIS, ISO/TS 16949, KTA 1401, DIN EN ISO 14001, DIN EN ISO 50001 and OHSAS 18001. These

are regularly monitored by independent experts.

As a world leader in special cables for wind turbines, we are able to manufacture products for the wind industry for all voltages or, if required, fully assembled cable sets in our German and international production sites:

Nacelle / Loop: Special cables (optional halogen-free / flame retardant) with increased oil, heat and ozone resistance, as well as optimized torsion properties.

Tower: Special cables (optional halogen free / flame retardant) for fixed installation with copper or aluminium conductors with excellent installation properties.

Wind farm cabling: From the low- and medium-voltage cables for the wind farm infrastructure, through to the high-voltage grid, we supply all cables for onshore and offshore applications.

In addition, we are able to supply cables as pre-assembled cable sets, as well as a service for fitting / commissioning or maintenance / turbine monitoring.

Prysmian Group

Prysmian Kabel und Systeme GmbH

Address	Alt Moabit 91 D 10559 Berlin
Phone	+49 (0)30 3675-4589
Fax	+49 (0)30 3675-5589
E-Mail	renewables.de@ prysmiangroup.com
Web	www.prysmiangroup.com
Profile	Energy & data transmission
Category	Suppliers of electrical and electronic components
Turnover	€ 7.5 billion
Employees	19,000
Founding year	1879



Ringspann GmbH

Innovative achievements have made RINGSPANN a leading manufacturer for Power Transmission Components, Clamping Fixtures and Remote Control Systems.



Photo: F.Schmidt – Fotolia.com

01 | Rotor brake

02 | Shrink disc

RINGSPANN®

Ringspann GmbH

Address **Schaberweg 30-34
61348 Bad Homburg**

Phone **+49 (0)6172 275-0**

Fax **+49 (0)6172 275-275**

E-Mail **info@ringspann.com**

Web **www.ringspann.com**

Profile **Hydraulic components**

Category **Suppliers of mechanical
components**

Turnover **€ 65 million**

Employees **Group 450**

Founding year **1944**

RINGSPANN customers include some of the most important international manufacturers of machine tools and systems as well as the aerospace industry.

From our headquarters in Bad Homburg, Germany, a world-wide network of subsidiaries and sales agencies ensure personal on-site service. Production and assembly plants in various countries provide rapid, reliable delivery.

With more than 70 years experience in research and design, RINGSPANN is a specialist for Power Transmission Components, Precision Clamping Fixtures and RCS-Remote Control Systems. Professional application engineering guarantees RINGSPANN customers optimum technical and economical solutions in the following product fields:

- Brakes
- Shaft-Hub-Connections
- Freewheels
- Overload Clutches
- Couplings
- Precision Clamping Fixtures
- RCS® Remote Control Systems

For wind turbines RINGSPANN offers the following customized products:

- Yaw Brake
- Rotor Brake
- Shrink Discs
- Cone Clamping Elements
- Precision Clamping Fixtures

Rittal GmbH & Co. KG

From rotor to tower: Rittal products are employed in all parts of a wind turbine. Rittal has supplied leading global system integrators and turbine manufacturers for many years.

Rittal GmbH & Co. KG, headquartered in Herborn, Germany, is a leading global provider of solutions for industrial enclosures, power distribution, climate control and IT infrastructure – as well as software and services. Systems made by Rittal are deployed across a variety of industrial and IT applications, including vertical sectors such as the transport industry, power generation, mechanical and plant engineering, IT and telecommunications.

Housings and enclosures from the „Rittal – The System.“ portfolio are ideal for all on-shore and off-shore wind power applications.

Highly robust AE compact enclosures protect pitch-control systems in turbine **hubs** to prevent malfunction. The AE range delivers exceptional resistance to corrosion, shock and vibration, helping wind power plants to operate reliably. Rittal's TS 8 baying enclosure system and SE 8 free-standing enclosures protect the controllers installed in **nacelles**. Efficient heaters and filter fan units condition the air. TS 8 enclosures provide effective protection for the inverters installed in wind turbine **towers**. Customer-specific configurations can be implemented quickly and easily



with standardised, modular components. Furthermore, all TS 8 models are rated IP 55 and Nema 12, and are UL certified.

The new Rittal Blue e+ units maintain optimum conditions inside the enclosures. Leveraging a hybrid cooling method, they can cut energy costs by as much as 75 percent. Rittal's modular Ri4Power system supports the configuration of low-voltage switchgear in compliance with relevant standards. Stainless steel and aluminium outdoor enclosures keep grid feed-in and monitoring components safe from harm. Rittal housings are highly corrosion-resistant and can withstand extreme weather conditions.

01 | Its "Rittal – The System." range covers housing and enclosure solutions, power distribution components, climate control systems, software and services.

02 | Due to their high quality standards, solutions from Rittal can be employed in every on-shore and off-shore application.



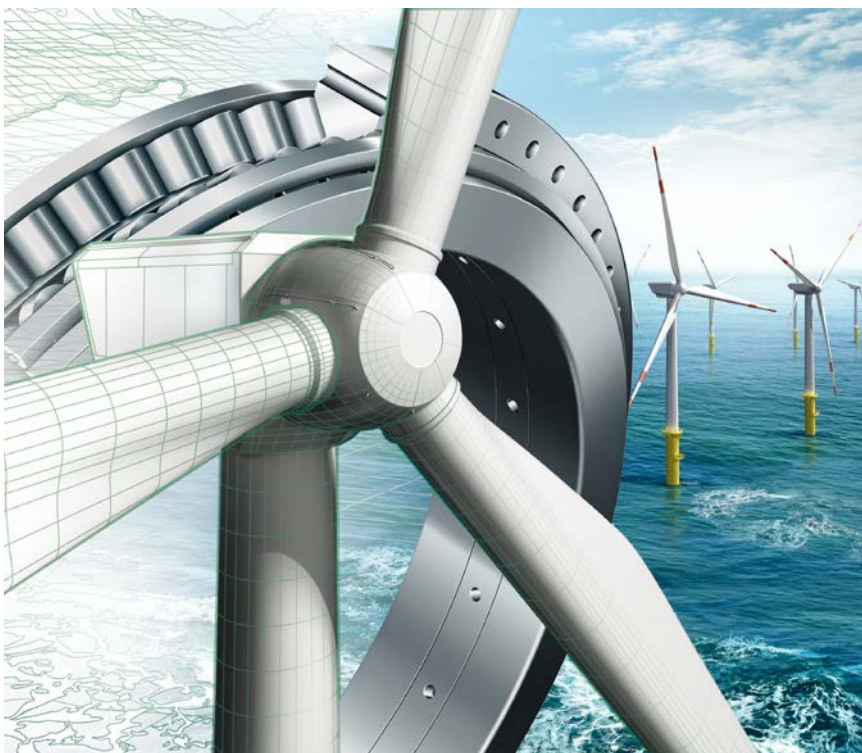
Rittal GmbH & Co. KG

Address **Auf dem Stützelberg
35745 Herborn**
Phone **+49 (0)2772 505-0**
Fax **+49 (0)2772 505-2319**
E-Mail **info@rittal.de**
Web **www.rittal.com**
Profile **Controls, cables &
switchgear cabinets**
Category **Suppliers of electrical and
electronic components**
Turnover **€ 2.2 billion in 2015 (F.L.G.)**
Employees **10,000 worldwide (Rittal)
11,500 (F.L.G.)**
Founding year **1961**

Schaeffler Technologies AG & Co. KG

Reliability made by Schaeffler

Schaeffler ranks among the world's leading manufacturers of rolling bearings. As a development partner for the sector we have been producing bearing supports for wind turbines for over 30 years. We offer the right bearing solution for every wind turbine and an integrated concept for safety.



Schaeffler Wind Power Standard

This new standard for products and processes means Schaeffler is ensuring outstanding quality and reliability and is offering the same high standards of quality as it is already successfully offering in the automotive and aerospace industries.

Optimal design with advanced calculation and simulation programs

Our specialists work closely with designers, manufacturers and operators of wind turbines. State-of-the-art calculation and simulation programs ensure optimal designs for bearings for wind power applications are produced. The entire system is considered starting from a single rolling bearing and its components, the adjacent construction up to the entire power transmission system, which is displayed and optimized using multi-body simulation programs developed in-house.

Realistic tests on Schaeffler's "Astraios"

One of the most modern, largest, and highest performing large-size bearing test rigs in the world, enables bearings of up to 15 tons and measuring up to 3.5 meters to be tested. Astraios simulates the real loads and moments that occur in a wind turbine. This means we are making a major contribution to shortening development times for wind turbines as well as making the design process more reliable and increasing the cost-effectiveness and safety of these turbines.

SCHAEFFLER

Schaeffler Technologies AG & Co. KG

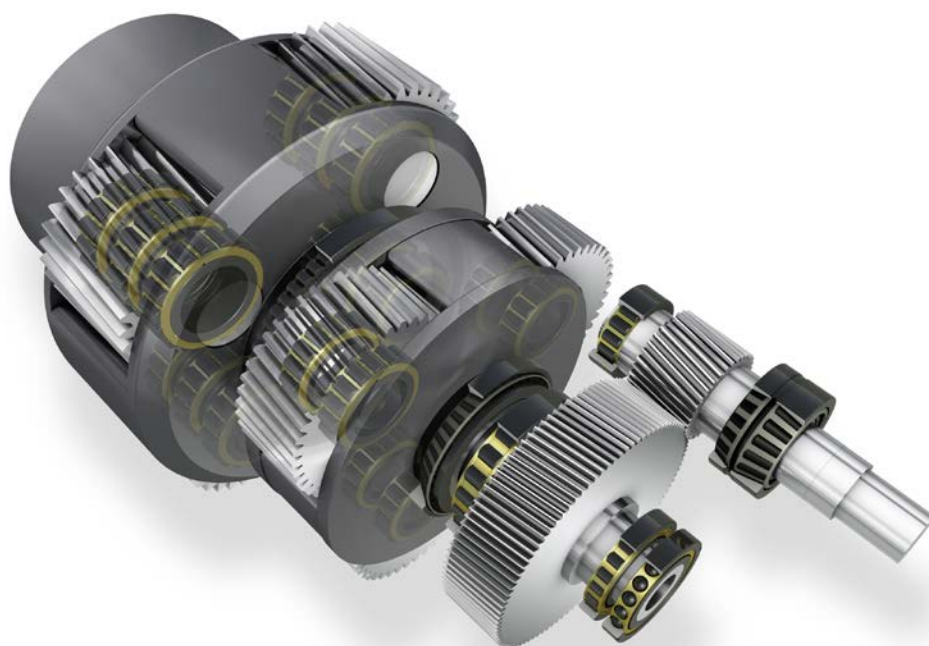
Address **Georg-Schäfer-Str. 30
97421 Schweinfurt**
Phone **+49 (0) 9721 91 - 0**
Fax **+49 (0) 9721 91 - 3435**
E-Mail **info@schaeffler.com**
Web **www.schaeffler.de/windpower**
Profile **Bearings**
Category **Suppliers of mechanical components**
Turnover **€ 13.3 billion**
Employees **85.000**
Founding year **1883**

The right bearing solution for every wind turbine

With our INA and FAG brands, we offer the right bearing solution for rotor shafts, gearboxes, generators, and nacelle and blade adjustment. Special greases, services and products for all aspects of maintenance and condition monitoring round out our program.

Reliability made by Schaeffler

Cost-effective wind turbines require reliable components. We offer an integrated concept for safety.



Prevent White Etching Cracks with Durotect B

Prevent WEC with Durotect B

Schaeffler has comprehensive testing facilities for creating white etching cracks (WEC), analyzing the causes and developing solution concepts for reducing the risk of WEC.

The solution that Schaeffler recommends is to use black oxide coated rolling bearings. The advantages that our Durotect B coating system offers include increased protection against WEC, which has been statistically verified by extensive experience in the field.



High plant availability due to condition monitoring

We offer products and services for all aspects of condition monitoring, e.g. remote monitoring and diagnosis, offline measurements, endoscopy, thermography and speed measurement. Thus maintenance operation costs can be reduced and the availability of wind turbines can be increased. Digitalization makes entirely new solutions possible in the field of maintenance services. With predictive maintenance, we are expanding conventional condition monitoring approaches by allowing users to look into the “turbine’s future” and thus opening up new possibilities for increasing efficiency and reducing the total cost of ownership (TCO).



01 | Increased reliability and cost-effectiveness for wind turbines. Astraios – one of the most modern, largest, and highest performing large size bearing test rigs in the world.

02 | State-of-the-art calculation and simulation programs ensure optimal designs for bearings.

03 | Bearings, condition monitoring and services – the right solution for every wind turbine <http://windpower.schaeffler.com>.

04 | Online condition monitoring – increased profitability due to permanent monitoring.

SCHÜTZ GmbH & Co. KGaA

The SCHÜTZ GmbH & Co. KGaA that was founded by Udo Schütz in 1958 has 4,000 employees at over 45 locations around the world. The broad spectrum of services offered by our group covers the areas of PACKAGING SYSTEMS, ENERGY SYSTEMS, INDUSTRIAL SERVICES and COMPOSITES.



SCHÜTZ

SCHÜTZ GmbH & Co. KGaA
Location Siershahn

Address **Schützstrasse 12**
56242 Selters
Phone **+49 (0)26 26 77 -0**
Fax **+49 (0)26 26 / 77 - 5 32**
E-Mail **info@schuetz-composites.net**
Web **www.schuetz-composites.net**
Profile **Wind turbines (> 100 kW)**
Category **Manufacturers**
Turnover **€ 1.4 billion**
Employees **> 4,000**
Founding year **1958**

SCHÜTZ has been producing lightweight construction materials and fibre-reinforced composite components for the aerospace industry under the brand name CORMASTER for more than 30 years. We are continuously expanding this company division with SCHÜTZ COMPOSITES, in order to successfully utilise the collective expertise and technical capabilities held by the company in the area of wind energy.

SCHÜTZ COMPOSITES, as part of the SCHÜTZ Group, develops and produces master models, moulds, prototypes, rotor blades and wind power plants at its Siershahn location in Westerwald. As an innovative manufacturer in the area of composites, the construction and production of operating materials and production facilities are an integral part of our comprehensive range of services.

Just like all the other divisions in the SCHÜTZ Group, SCHÜTZ COMPOSITES also possesses the ideal infrastructure for the development and production of its products. A 32,815 m² hall complex was specially built for the wind power sector, which houses all of the production steps under one roof. The continuous transfer of knowledge across the SCHÜTZ Group and direct access to the expertise of the more than 200 specialist employees in





the SCHÜTZ custom machine engineering and the CORMASTER aerospace sectors provides the best all-round conditions for ensuring optimum development and production processes. SCHÜTZ COMPOSITES thus possesses the full range of manufacturing capabilities – from model construction through to the finished rotor blade – all at one location. Naturally, SCHÜTZ COMPOSITES also offers all of the individual steps in the development and production processes for rotor blades – from model construction through to series production – as individual services.

SCHÜTZ COMPOSITES is ideally located from a logistical point of view directly next to the A3 motorway, just north of the Dernbach junction. Our factory in Siershahn, which covers an area of 137,000 m², can be easily spotted



alongside the motorway. And thanks to the availability of a further 170,000 m² of space next to the factory, there is also sufficient space for handling even larger series production contracts.

Siemens AG

Creating the most from wind

With wind equipment by Siemens, you can rely on products and systems designed for maximum performance and tried-and-tested under harshest operating conditions a thousand times. All components support seamless communication among each other throughout all levels – for your wind energy plants' maximum availability.

Creating the most from wind

As experienced partner in the wind industry, we offer optimally matched products and systems for the electrical engineering equipment of wind energy plants. Your advantage: Maximum availability and efficiency, low production and maintenance costs, time savings in terms of engineering and commissioning as well as minimized time-to-market. This facilitates rapid return on investment and allows for a long-term reduction of your cost of energy.

Minimized time-to-market

Using our intelligent software solutions for virtual prototyping and virtual testing, you can develop new wind turbines with optimized cost efficiency and rapidity – right down to market maturity. Practical tools support planning and ease and accelerate the engineering process. Also commissioning is sped up – thanks to matched components and ease of handling.

Maximum efficiency

Our standardized components and matched systems can be optimally combined with each other. This allows for your specification's easy and accurate implementation. Our components' efficient interaction is already ensured in advance by means of comprehensive system tests.

Maximum availability

Our components and systems support seamless communication among each other, throughout all levels. This facilitates the wind turbine's intelligent self-optimization as well as self-protection with extreme weather conditions. Furthermore, all plant parts can be consistently monitored and controlled for damage prevention – also remotely. Preventive maintenance allows for the minimization of downtimes due to repair and for the targeted planning of maintenance works.

Investment protection throughout the entire lifecycle

Standardized product ranges, high connection compatibility and comprehensive system tests as well as the proven industrial quality of all components ensure high investment protection. As global market leader in the field of automation technology, our experience enables us to ensure maximum product and production quality and to prove our excellence through the industry's customary certificates.

As regards spare parts, high downward-compatibility as well as long-term, global spare parts availability support rapid replacement and restart.

SIEMENS

Siemens AG

Address **Gleiwitzer Str. 555
90475 Nuremberg**

E-Mail **wind-equipment.industry@
siemens.com**

Web **www.siemens.com/
wind-equipment**

Category **Suppliers of electrical and
electronic components**

Employees **351,000**

Founding year **1847**



Siemens wind equipment portfolio
for wind turbines.



Our portfolio

- SIMATIC Wind Automation automation and turbine control systems, incl. wind-specific software, for efficient automatic wind turbine operation
- Industrial communication facilitates the control and monitoring of wind turbines and the coordination of entire wind parks; it ensures the safe and reliable interaction of all system components also under harsh operating conditions; the SCALANCE and RUGGEDCOM network components form the basis of the required data networks
- SIMATIC WinCC OA both represents a state-of-the-art SCADA solution for optimized operations control of (multiple) wind parks as well as a central service portal for wind turbines (Multilevel Wind SCADA Center)
- Generators for turbines with and without gear ensure optimum energy output coupled with maximum reliability
- The SIPLUS CMS condition monitoring system supports condition monitoring of wind turbines and predictive maintenance
- The products of the SIPLUS extreme range offer extreme ruggedness for applications in harshest environments
- Matched components for rotor blade adjustment and nacelle tracking facilitate the realization of intelligent pitch and yaw systems; SIMATIC automation systems, SIRIUS industrial controls and SINAMICS frequency converters form the basis for such application
- Industrial controls from the SIRIUS range ensure reliable switching, protection, starting and monitoring of motors as well as communication connection via IO-Link
- The products of the SENTRON range for low-voltage energy distribution offer perfectly matched protection, switching, measuring and monitoring devices
- SIVACON 8PS busbar trunking systems ensure optimum energy transport; NXPLUS C Wind and 8DJH 36 medium-voltage switchgear as well as our highly efficient GEAFOL cast-resin transformers and liquid-immersed distribution transformers facilitate reliable connection between wind turbine and power grid

Schraubenwerk Zerbst GmbH

Fasteners for wind turbines

We fasten your wind turbine components safely and reliably. Wind turbine and component manufacturers around the world rely on Zerbst screws and fasteners.



Sustainable production and sustainable business management are among the corporate principles of Schraubenwerk Zerbst GmbH. Products in the field of renewable energy and wind turbines are ideally suited to this philosophy and are a dynamically growing business segment for the company.

Tower construction: HV sets up to M72, ready for installation with preset friction coefficient.

Offshore: Screw fasteners joining wind turbines to the sea bed.

Rotor blade: Combination of cross bolts and specially designed thermo bolts, from smaller rotor blades to over 80m long rotor blades for offshore wind turbines.

Nacelle and components: Standard screws, specially designed screws and bolts in strength categories 8.8, 10.9 and 12.9.

Services and logistics: From the warehouse to punctual delivery to building sites around the world.

Coatings: Galvanised and lamellar zinc coated fasteners can be supplied as standard. In addition, customers can order whatever type of coating they require.

The Zerbst plant has been manufacturing high-quality screws and fasteners for 100 years.

Schraubenwerk Zerbst has been supplying screws made of high-quality steel to the automotive industry as early as the 1920s. At that time, 30 % of overall production was exported to the US, UK, India and the Netherlands.

Nowadays the plant in Zerbst is a highly sophisticated production plant for fasteners. In addition to an extensive product range for rail track technology, Zerbst supplies industrial screws and screw fasteners to many industries. Customers around the world from the crane industry, automotive engineering, mechanical and plant engineering, and chemical plant construction trust the Zerbst brand.

**SCHRAUBENWERK
ZERBST GMBH**



Schraubenwerk Zerbst GmbH

Address	Altbuchsland 22 39261 Zerbst
Phone	+49 (0)3923 713-0
Fax	+49 (0)3923 713-200
E-Mail	info@schraubenwerk.com
Web	www.schraubenwerk.de/ index_en.html
Profile	Bolts & fasteners
Category	Suppliers of mechanical components
Turnover	€ 50 million
Employees	200
Founding year	1919

SSB Wind Systems GmbH & Co. KG

All systems go! SSB Wind Systems is your system supplier for all pitch systems. Thousands of pitch systems worldwide, self-developed switch and control cabinets or on-and offshore solutions for WTGs: Just a few highlights from over 25 years of experience in the wind energy sector.



Perfect solutions for new generations

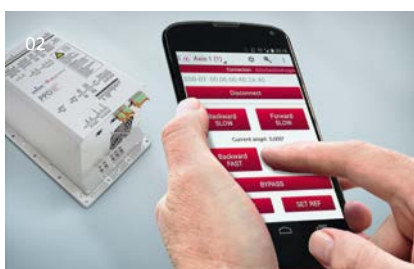
Since 1990, we have offered our technologies and know-how for onshore and offshore:

- Pitch systems (750 KW to 10 MW)
- Switch and control cabinets
- Service (upgrades & solutions, spare parts, training, support)

On this basis, we develop solutions so outstanding that, even over the long term, you won't ever have to worry about if and how they work. The fact that an entire generation will also benefit from your clean solution is not a side effect. It is rather the main objective driving all our actions.

Perfectly in tune: Our pitch systems.

From pitch drives to PerfectPitch Drive, our range of products is as comprehensive as a pitch system. A perfect combination of components, harmonized to deliver a complete solution: our Perfect Pitch System. Designed to fulfill your individual requirements and your wishes for WTGs up to 3.X MW and rotor sizes of up to 140 meters, a large part of our



system is comprised of the Perfect Pitch Drive as well as the Perfect Pitch Interface applications module. The integration of numerous functions within the Perfect Pitch Drive halves the total area of the pitch drive in the nacelle.

Not only do we consider pitch systems as a whole but we also develop and build them. This level of hands-on knowledge guarantees the highest quality and availability of your pitch systems.

Highest quality service: at eye-level

We don't just develop and build pitch systems. We maintain them too. Our service teams support you with commissioning, on-site services and spare parts procurement for all systems we deliver. Additionally our service offer includes the training of your service technicians and installers.



01 | New converter for electrical pitch systems have to be designed as well as for onshore and offshore wind turbines.

02 | In connection with PerfectPitch, SSB Wind Systems developed the first App for electrical pitch systems.

03 | All systems go! SSB Wind Systems is your system supplier for all pitch systems.



**SSB Wind Systems
GmbH & Co. KG**

Address **Neuenkirchener Strasse 13
48499 Salzbergen**
Phone **+49 (0)5976 946-0**
Fax **+49 (0)5976 946-139**
E-Mail **info.ssb@mail.nidec.com**
Web **www.ssbwindsystems.de**
Profile **Controls, cables &
switchgear cabinets**
Category **Suppliers of electrical and
electronic components**
Employees **300 worldwide**
Founding year **1970**

STEGO Elektrotechnik GmbH

STEGO heating elements, regulators, fans, lamps and accessories protect your sensitive electronic components from harmful climatic influences.



01 | STEGO Headquarters in Schwäbisch Hall.

02 | Semiconductor Fan Heater CSL 028.

03 | Electronic Hygrotherm ETF 012.



STEGO Elektrotechnik GmbH

Address **Kolpingstraße 21
74523 Schwäbisch Hall**

Phone **+49 (0)791 95058 0**

Fax **+49 (0)791 95058 45**

E-Mail **info@stego.de**

Web **www.stego.de**

Profile **Cooling & climatisation**

Category **Suppliers of electrical and
electronic components**

Founding year **1980**

STEGO products are used in all places where sensitive electronic components must be protected from humidity and other climatic influences. Heating elements, regulators, fans and STEGO accessories help you to optimise operating conditions and to reach maximum protection for your installations. So that you can be sure of lasting success!

Perfect thermal management. Since it was founded in 1980, STEGO Elektrotechnik in Schwäbisch Hall, Germany, has been developing, producing and selling an ever-growing range of products for the protection of electric and electronic

components. All STEGO products are aimed at reaching optimum climatic conditions in the most varied environments, ensuring that all sensitive components work reliably at all times.

Tried and tested temperature and humidity control systems ensure these optimised climatic conditions. If temperature and/or humidity are too low or too high, the necessary countermeasure is immediately initiated, for example a heater is turned on or a filter fan circulates cool air. A diversity of conditions such as the change from day to night, or particularly warm or cold regions, make climatisation an ever-increasing and challenging task. To meet this challenge, STEGO offers everything that is needed to protect sensitive components from corrosion and malfunction. Worldwide service supporting quality worldwide. STEGO's thermal management solutions are exported internationally and find use in the most diverse areas of application and climatic conditions.

02



03



thyssenkrupp Rothe Erde GmbH

Achieving greatness requires great work.

thyssenkrupp Bearings is the world market leader in the design and production of slewing bearings and a leading producer of seamless rolled rings.



Holistic mindset and technical skills

Dedicated specialists work closely with customers starting from the development phase to the final solution. With decades of experience in slewing bearings and rings our skilled employees apply the very latest manufacturing and testing methods alongside innovative in-house analysis tools. Testing takes place at our Research & Development Center on full-size equipment and under realistic conditions.

With dedication and expertise, thyssenkrupp Bearings is your partner to shape current and future market trends – challenge our know-how.

Slewing bearings get things moving

Rothe Erde® slewing bearings prove their worth every day as key design and connection elements in wind turbines, cranes, excavators and tunneling machines, to name only a few applications. This diversity of slewing bearings is reflected also in their dimensions, as we supply slewing bearings of up to 20 meters in diameter.



Seamless rolled rings keep everything in place

Rothe Erde® rings are an integral part of many diverse applications. They are used in slewing bearings, large gears, production plants, sprockets, wind turbines or pipeline construction and can have a diameter of up to 8 meters and can weigh up to 30 tons.

Our position

12 companies with a total of 17 plants in 10 countries demonstrate our global presence and represent our clear objective to be close to our local customers. Worldwide, 7,000 employees turn thousands of tons of steel into tailor made solutions every month.



thyssenkrupp Rothe Erde GmbH

Address	Tremoniastr. 5–11 44137 Dortmund
Phone	+49 (0)231 186-0
Fax	+49 (0)231 186-2500
E-Mail	rotheerde@thyssenkrupp.com
Web	www.thyssenkrupp-rotheerde.com/GB/index.htm
Profile	Bearings
Category	Suppliers of mechanical components
Employees	ca. 7,000
Founding year	1861

TOTAL Deutschland GmbH

More efficiency for your wind turbine

TOTAL offers high-performance lubricants for on- and offshore wind power plants. Due to the special formulation, they enable an extended oil change interval, lighter cold starts and increased plant efficiency.



TOTAL Deutschland GmbH
Vetriebsdirektion Schmierstoffe

Address **Jean-Monnet-Str. 2**
10557 Berlin

Phone **+49 (0)30 20276787**

Fax **+49 (0)30 2027796634**

E-Mail **rm.industrie@total.de**

Web **www.total.de/industrie.html**

Profile **Lubricants & lubrication systems**

Category **Suppliers of mechanical components**

Turnover **€ 15 billion**

Employees **3,100**

Founding year **1955**

TOTAL – a multinational energy company

TOTAL is one of the world's leading mineral oil companies. As an international oil and gas producer and supplier, TOTAL employs approximately 100,000 employees in more than 130 countries. TOTAL Germany GmbH is part of the group and operates around 1,200 service stations, making it Germany's third largest service station network. The company's extensive activities include the sale of lubricants, heating oil, aviation fuel, liquid gas, bitumen and special products. Furthermore, TOTAL also operates Europe's most modern refinery, the TOTAL Raffinerie Mitteldeutschland GmbH.

Applied high-performance lubricants

TOTAL is one of the world's leading suppliers in the industrial sector and covers almost all areas of application for highly specialised lubricants, grease and speciality products – from metal processing and food production to the operation of paper factories and even turbines. TOTAL works closely with well-known OEMs during the product development phase, and has already received OEM approvals for numerous products. TOTAL primarily operates in the chemical industry, the iron and steel industry, energy production, metal processing and plant construction, as well as the automotive and food industries.

Strong for the wind energy

TOTAL offers high-performance greases and oils for the wind power industry. You profit from extended oil exchange intervals and excellent protection of your plants.

With TOTAL as a partner you minimize your maintenance costs and avoid downtimes thanks to professional oil monitoring. The Carter SH 320 transmission oil from TOTAL is approved by the leading plant manufacturers such as Bosch Rexroth, ZF Wind Power, Winergy and Eickhoff.



Operational reliability and cost efficiency

The performance of industrial lubricants is crucial influence for the efficiency, reliability and resilience of machines and facilities. This in turn also has a significant impact on the company's productivity. With its TCO approach (Total Cost of Ownership), TOTAL sets high standards to optimise machine running time and reduce production and maintenance costs.

With the slogan "Committed to better Energy", TOTAL pledges itself to safety, health and environmental protection. Right from the beginning of new product development, the TOTAL research and development teams pays close attention to important parameters such as toxicity, emissions, biological degradability and product recycling.

Expert advice and service with additional benefits

The engineers at TOTAL have expert knowledge of the machines and plants – be it corrosion protection, heat resistance or protection against wear and tear. Our customers benefit from professional advice, expert application engineers and value-added services – from the rationalisation and organisation of lubrication activities, maintenance and laboratory analyses of your operating materials, to lubricant training for employees. With the help of the diagnostic system TOTAL ANAC Indus, the systems and lubricants are monitored when in use by customers, which also aids the optimisation of operational costs.

TOTAL not only provides specialised lubricants, it also offers comprehensive concepts for system optimisation. Our customers benefit from international know-how and individual and personal consultation at the local level.



U.I. Lapp GmbH

From tower to nacelle: Quality across the board

Fully integrated solutions: with Lapp Group, the wind power industry can fulfil all its cabling needs from a single provider.



In the Lapp Group's unique test facility cables up to 12 metres in length are tested under realistic conditions.



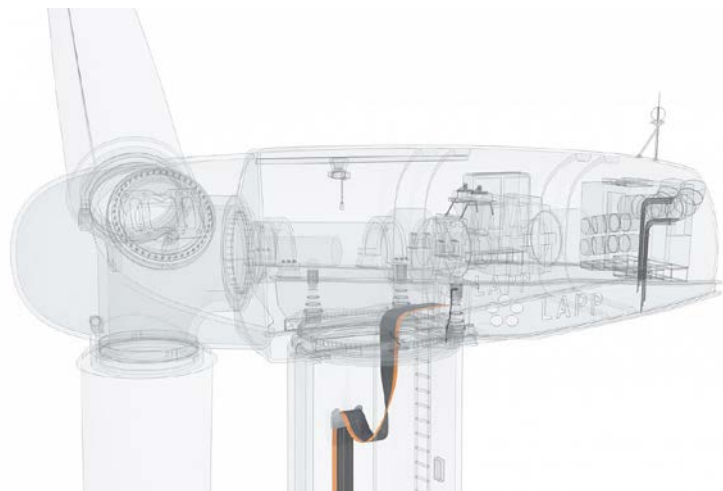
The Stuttgart-based Lapp Group is a leading supplier of integrated solutions and branded products for cable and connection technology. With brands such as ÖLFLEX® (connection and control cables), SKINTOP® (cable glands) and EPIC® (industry connectors), Lapp offers high-quality products and complete system solutions which meet the highly demanding requirements of wind turbine manufacturers. Ready-to-connect systems are manufactured in-house by Lapp Systems.

With its own, state-of-the-art test centre, the Lapp Group assures that its products are of the highest quality. Thus Lapp customers can be sure that systems function reliably with minimum downtimes. For this purpose, the Lapp Group operates a unique 16-metres-high test facility, in which cables up to 12 metres in length can be tested under realistic conditions as found in the loop of a wind turbine. This type of test facility where all fasten-

ing points for cables and conductors exactly match real-life conditions only exists in one other location in Europe.

Specifically for the wind energy sector Lapp has developed and tested cables which are flame-retardant, halogen-free and torsionable and which cover a wide range of temperatures. In combination with the SKINTOP® cable glands, which provide unrivalled vibration protection, Lapp offers a product portfolio that perfectly meets the industry's highly demanding requirements. Many of Lapp's products comply with common international standards.

With our own production sites in Europe, Asia, North and South America and a network of sales offices and logistics centres on all continents, we are always available to our customers wherever they are in the world – always working fast and to the same high quality standards.



U.I. Lapp GmbH
Andreas Müller

Address Schulze-Delitzsch-Strasse 25
70565 Stuttgart

Phone +49 (0)711 7838-3175

Fax +49 (0)711 7838-7330

E-Mail andreas.mueller@lappkabel.de

Web www.lappgroup.com
www.lappkabel.com

Profile Controls, cables &
switchgear cabinets

Category Suppliers of electrical and
electronic components

Turnover € 886 million (consolidated)

Employees 3,300

Founding year 1959

Weidmüller

Weidmüller – Your partner in Industrial Connectivity

As experienced experts we support our customers and partners around the world with products, solutions and services in the industrial environment of power, signal and data. We are at home in their industries and markets and know the technological challenges of tomorrow. We are therefore continuously developing innovative, sustainable and useful solutions for their individual needs. Together we set standards in Industrial Connectivity.

The Weidmüller Group owns manufacturing plants, sales companies and representatives in more than 80 countries.

01 | Operating wind turbines efficiently – optimum results with our automation solutions.

02 | Wind Bottom Box installation.



Weidmüller 

Weidmüller

Address **Klingenbergstraße 16
32758 Detmold**
Phone **+49 (0)5231 1428-0**
Fax **+49 (0)5231 1428-116**
E-Mail **info@weidmueller.com**
Web **www.weidmueller.com**
Profile **Condition Monitoring Systems**
Category **Suppliers of electrical and
electronic components**
Turnover **€ 696 million**
Employees **4,500**
Founding year **1850**

Winergy

Siemens AG

With over 125GW gearbox capacity supplied Winergy is the world's leading component manufacturer for wind turbines. Winergy offers gearboxes, couplings & service of 750kW–8MW and more.

01



01 | Winergy 8 MW Offshore Gearbox.

02 | Production processes according to VDA 6.3. quality standards.

03 | Extensive service portfolio incl. up-tower services.



Winergy – Siemens AG

Address **Am Industriepark 2
46562 Voerde**
Phone **+49 (0)2871 92-4**
Fax **+49 (0)2871 92-2487**
E-Mail **info@winergy-group.com**
Web **www.winergy-group.com**
Profile **Gears**
Category **Suppliers of mechanical components**
Founding year **1981**



In 1981, Winergy started to manufacture gearboxes specifically designed for wind turbines. Today, with more than 35 years of experience, Winergy offers the complete mechanical part for the drive train. To date we have supplied more than 125GW of gearbox capacity. Reliable, efficient and at low lifecycle costs Winergy gearboxes and couplings ensure that wind turbines all over the world convert wind-power into electrical energy.

To support your customers globally – you must be represented locally

Since Winergy's foundation, we have successfully implemented a globalization strategy and today operate production and service facilities in Europe, USA, India and China.

Quality is more than just a word to us – it is the essence of our products

The quality that we demand from our products is also reflected in our processes. Our customers all around the world benefit from our high-quality products and short delivery times. This is achieved with our comprehensive and fully inte-

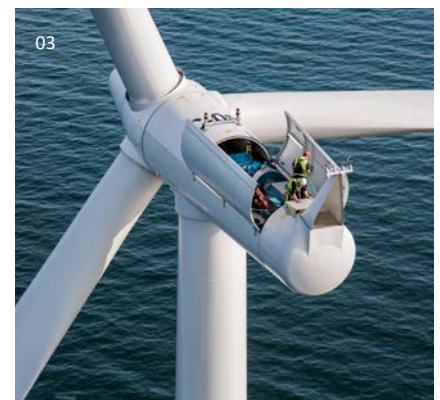
grated process management, lean operation and zero defect tolerance.

Our drive train components are as unique as your requirements

Detailed wind turbine specification is the foundation of individual drive train development. Winergy takes its long-term experience into account to develop cost-effective solutions that perfectly fulfill customer requirements. The result: Mechanical components which increase energy efficiency.

Reliable service solutions

We have service concepts that are individually tailored to the requirements of our customers. The objective is to ensure high availability of your systems, resulting in reduced operating costs.



Woodward Kempen GmbH

CONCYCLE Wind – Modular frequency converters for wind turbines up to 10MW.

Development, production and service for modular frequency converters into wind turbines in on- and offshore applications.

Reliable frequency converters with highest power density and maximum energy yield

For more than 20 years Woodward has been an independent and leading developer and manufacturer of frequency converters for wind turbines.

More than 16,000 installed frequency converters with a total power of up to 33,000 MW for on- and offshore wind turbines indicate the expertise and experience of Woodward in the wind industry.

Well structured processes and high quality standards of Woodward are an important success factor of the product lines itself and will have a significant influence to the very good market success of the Woodward customers.

Woodward's frequency converters are used flexibly as partial or full scale converters in the low voltage range as well as the medium voltage range in onshore and offshore wind turbine applications. With the modular and entirely liquid-cooled frequency converters Woodward is setting the benchmark in wind power technology.

CONCYCLE® frequency converters are smaller, lighter and more powerful. Its application allows different arrangements in the nacelle or tower installation and ensures highest reliability and optimal efficiency at high quality of the supplied energy. The intelligent controls of CONCYCLE® frequency converters meet all cur-



rent international grid code requirements for a high possible energy yield.

The global presence of Woodward ensures the active technical support over the product lifecycle and beyond. You can profit from practical Onshore and Onshore experience of our special skilled and motivated service team.

The development and application of the CONCYCLE® converter technology has played a substantial role in the success story of wind turbines in the multi-megawatt class.

01 | Woodward Kempen GmbH.

02 | Power Stack Testbay.

03 | Concycle Full Size Converter.



Woodward Kempen GmbH

Address	Krefelder Weg 47 47906 Kempen
Phone	+49 (0)2152 145-321
Fax	+49 (0)2152 145-468
E-Mail	Concycle@woodward.com
Web	www.woodward.com
Profile	Transformers, converters & power resistors
Category	Suppliers of electrical and electronic components
Employees	316 (Wind energy: 278)
Founding year	1996

ZF Wind Power

With more than 70 years of joint experience in wind energy, ZF Wind Power is a competent partner to the world's leading manufacturers of gear-driven wind turbines, offering gearboxes with capacities from 0.8 to 8 MW.



Intelligent Mechanical Systems

Wind power has been used for centuries to sail ships, mill grain and pump water. Since the late 1970's, wind turbine technology enables us to harness this energy source to generate electricity.

A commitment to innovation and quality without compromise has made ZF Wind Power a global leader in wind turbine gearbox technology. With reliable and efficient solutions, we help transform the global energy system and conserve precious resources.

Integrated Technology Leaders

ZF Wind Power is the result of a successful integration of three technology leaders, with the acquisition in 2011 by ZF of the former Hansen Transmissions and of Bosch Rexroth's wind power activities in 2015. The result is a winning combination of expertise, innovation and production efficiency.

A Proven Track Record

Since 1979, the ZF Wind Power manufacturing plants have shipped over 55,000 gearboxes, powering more than 100,000 Megawatt of installed wind capacity all over the globe.

A Next-Generation Gearbox Supplier

Our six state-of-the-art manufacturing plants in Europe, China, India and the US add up to an annual capacity of 18,000 MW per year. Excellence in sourcing, manufacturing, logistics, assembly and testing, and performing critical activities in-house: these are the key strengths enabling us to produce our multi-megawatt gearboxes efficiently in serial production, while maintaining the quality and reliability our customers expect.



ZF Wind Power

Address **Gerard Mercatorstraat 40
3920 Lommel/Belgium**

Phone **+32 (0)11 34 97 00**

Fax **+32 (0)11 34 97 10**

E-Mail **info.iw@zf.com**

Web **www.zf.com/windpower**

Profile **Gears**

Category **Suppliers of mechanical
components**

Founding year **1915**





Leading Wind-Turbine Gearbox Technology

ZF Wind Power makes the difference with high-quality customized solutions such as Integrated, Conventional, High Speed and Medium Speed gearbox designs.

Covering All Torque Ranges

By customizing all vital components, we are at the forefront of a trend towards more powerful turbines, operating reliably in the most challenging conditions. ZF invests heavily in research and development to deliver gearbox solutions that can handle the torque growth-curve induced in the drive train as turbine platforms are being equipped with larger rotors.

We Reduce The Cost Of Energy

Continuous innovations such as alternative bearing technologies and drive-train concepts, and optimizing system behavior of the gearbox in its surrounding structure, will further improve the Levelized Cost of Energy of wind power.

The Quantum Leap

Supported by our digital know-how and electronics competence, rapid developments in digitization will transform mechanical systems into smart solutions. Connectivity will make these “Intelligent Mechanics” perform better than ever before.

As a reliable partner on all continents, ZF supports its customers with custom-built solutions and services on a global scale.

A Greener Tomorrow

Making wind power the leading renewable energy source: that’s our commitment to the future.





Companies:

Service & logistics

Planning, finance, transport, construction and marketing.
The fields of planning and operation of wind turbines are
a continuous growth market in Germany.



ABO Wind AG

Project developer with more than 20 years of experience and 400 employees

We erect and maintain wind farms with commitment and competence.

Models for citizen participation, pioneer projects in electric storage and tourism projects complement our range of services.



01 | ABO Wind enhances acceptance of the energy transition by catering for tourism.

02 | Wind energy is firmly rooted in society, which is obvious during the very social wind farm celebrations of ABO Wind.

03 | Experienced engineers and technicians ensure optimum operation of the turbines.



Who we are

In 1996, Dr. Jochen Ahn and Matthias Bockholt founded ABO Wind. We have been growing steadily ever since and with an annual project volume of 300 million euro, we are among Europe's experienced project developers. ABO Wind currently plans and erects wind farms in six European countries and in South America. We already installed more than 600 turbines with a capacity of 1.300 megawatts.

We plan your energy

ABO Wind initiates projects, acquires sites, carries out commercial and technical planning, completes bank financing and erects turnkey wind farms and biogas plants.

Wind farm management

We take care of the technical and economic success of your wind farm throughout the entire lifecycle of a project. No matter whether it is maintenance, inspections, repairs, 365-days on-call service or technical management: we offer just the right modules.



Storage of wind energy

Among other things, the department „future technologies“ works on pioneer projects with the goal of storing wind power.

Tourism

We capture people's imagination with respect to wind energy. Interactive adventure trails and play areas in the vicinity of wind farms enable a sensual experience of wind energy and upgrade sites to tourist destinations.

Citizen participation

ABO Invest and its „Bürgerwindaktie“ (citizen wind share), initiated by ABO Wind, operates wind farms throughout Europe in order to produce electricity. 4,000 citizens as well as foundations and cooperatives have already participated. The portfolio of ABO Invest consists of more than 62 wind turbines and is steadily growing. The ABO Invest share (ISIN DE000A1EWXA4) is traded at the open market of Düsseldorf stock exchange.

ABO WIND

ABO Wind AG

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55262 Heidesheim

Phone **+49 (0)6132 8988-00**

Fax **+49 (0)6132 8988-29**

E-Mail **kontakt@abo-wind.de**

Web **www.abo-wind.com**

Profile **Technical & commercial
operational management**

Category **Operation & service**

Turnover **€ 300 million**

Employees **400 (Wind energy: 385)**

Founding year **1996**

Availon GmbH

United Wind Service

Technical know-how, modular service offers and high innovation power.

Availon, multibrand service provider create added value for wind energy projects worldwide.



Our quality as well as our environmental and work safety is subject to strict ISO 9001, ISO 14001 and OHSAS 18001, certified by DNV GL Group for our divisions in Germany - Rheine, Hamburg and Erfurt; and also in Italy – Rome and Spain – Madrid.

"Vestas" is a registered trademark of Vestas Wind Systems A/S, DK.

"Gamesa" is a registered trademark of GAMESA CORPORACION TECNOLOGICA, S.A., ES.

"GE" is a registered trademark of GENERAL ELECTRIC COMPANY, US.

Being part of the Vestas family since spring 2016, Availon – together with Vestas – is the globally leading fleetwide service provider. Our cooperation with customers is focused on their individual needs and wishes. Our offer ranges from flexible, modular service solutions right up to full maintenance. Multibrand service solutions, particularly for GE®, Vestas® and Gamesa® wind turbines are provided. Services include remote monitoring, cost-reducing upgrades and wind turbine optimisation as well as spare parts supply, including major components. We always focus on our customers' business case and added value for their wind projects.

We are now able to offer service solutions to even more customers with different wind turbines worldwide – from a single source. At the same time, Availon continuously increasing our technological know-how, and Vestas's innovativeness

helps us do so even further. All in all, a comprehensive competence spectrum which is unique in the industry:

- Bundled competences which satisfy a wide variety of requirements – always on the highest level
- Everything from under one roof thanks to the widest turbine portfolio in the industry
- Safety thanks to expertise and superlative engineering know-how



01 | Headquarters in Rheine, Germany.

02 | Multibrand service.



Availon GmbH

Address **Daimlerstraße 40
48432 Rheine**

Phone **+49 (0)5971 8000-1000**

Fax **+49 (0) 5971 8000-1009**

E-Mail **windservice@availon.eu**

Web **www.availon.eu**

Profile **Service, maintenance & repair**

Category **Operation & service**

Turnover **€ 62.7 million**

Employees **240**

Founding year **2007**

BayWa r.e. renewable energy GmbH

r.e.sponsible for your success.

BayWa r.e. is one of the leading providers within the renewable energy sector in wind power, solar, bioenergy and geothermal. Our many years of experience in the wind energy sector, in conjunction with a comprehensive service range, benefit customers and business partners alike.

01



BayWa r.e.
renewable energy

BayWa r.e. renewable energy GmbH

Address **Herzog-Heinrich-Strasse 9
80336 Munich**

Phone **+49 (0)89 383932-0**

Fax **+49 (0)89 383932-32**

E-Mail **info@baywa-re.com**

Web **www.baywa-re.com**

Profile **Planners & project developers**

Category **Planning**

Turnover **€ 1.02 billion (2015)**

Employees **1,000**

Founding year **2009**

A specialist in developing, planning, financing, building, managing and maintaining wind turbines, BayWa r.e. is a solid and experienced partner. BayWa r.e. offers a diverse range of services:

Project development and turnkey construction

BayWa r.e. has developed and implemented wind farms with installed capacity of over 1,000 MW worldwide.

With the EEG 2017 creating a potential point of tension, in the future partnership models between the parties involved will become increasingly important to ensure the ongoing success of projects. For this reason, we have developed various partner models which support community wind farms, public utilities and smaller developers in all project phases, as and when required.

The range of services includes:

- Site analysis and evaluation
- Land acquisition
- Acquisition of project rights at each development stage
- Risk assumption for projects under the EEG 2017
- Planning permission/implementation
- Turnkey construction as a general contractor
- Project structuring and funding

Technical and commercial management

As a service provider for investment funds, banks, international investment companies, municipal utilities and citizens' cooperatives, BayWa r.e. manages the technical and commercial aspects of wind and solar energy projects with total rated capacity of over 2,000 MW all over Europe.

The range of services includes:

- 24/7 monitoring through the control centre with multilingual staff
- Control of maintenance and servicing
- Manufacturer-independent operational management system
- Regional service staff for checks and immediate troubleshooting
- Servicing and maintenance work in medium to high voltage range
- DGUV V3 electrical equipment tests
- Contract and stakeholder management
- Accounting
- Budget and liquidity management
- Representation of the operator's assets

03



02



Direct marketing and energy trading

BayWa r.e. also offers electricity marketing for producers of renewable electricity generated from wind, solar, biomass and geothermal sources, as part of the market bonus model and in the electricity balancing market:

- Energy trading of renewable electricity: Generation forecasts, EEG energy trading, accounting group management, remote control
- Assumption of marketing risks
- Optimising revenue potential: Marketing in the energy balancing market and wholesale market
- Usage of own electricity and regional marketing models for electricity producers; processing via internal accounting groups and billing systems

Rotor blade services

As a certified and manufacturer-independent service provider, BayWa r.e. provides extensive services to optimise and maintain rotor blades of all manufacturers and performance categories:

- Servicing and maintenance of rotor blades, on site and at the factory
- Assessments, warranty inspections and periodic inspections
- Cleaning and sealing of rotor blades, as well as cleaning of nacelles and towers
- Distribution of used wind turbines
- Developing add-on components to optimise rotor blades
- Heavy-duty transportation fleet
- Disposal of rotor blades
- Replacement blade sets on stock

Planning and consulting

BayWa r.e. offers comprehensive technical consulting and planning services for renewable energy.

The range of services includes:

- Project evaluations and due diligence reports
- LIDAR measurements
- Yield and emission reports
- Feasibility studies
- Planning permission and management
- Planning implementation and monitoring construction
- Project management
- Optimising operation

Together with experienced employees from BayWa r.e., numerous customers and business partners have been able to realise the most appropriate solution for their business success. Moreover, backed by the financial strength of BayWa AG, BayWa r.e. is a reliable business partner for the long term.



04

- 01 | Campomaggiore wind farm (Italy).
- 02 | Gunzenhausen wind farm (Germany).
- 03 | Construction of Klågerup wind farm (Sweden).
- 04 | Heavy-duty transportation with our own fleet of vehicles.

BDO ARBICON GmbH & Co. KG

CLOSE TO THE WIND TOGETHER

Our industry team is your consulting partner for wind energy companies and projects in the fields of audit, tax consultancy, legal advice, corporate finance and IT.



Our team of wind energy experts:
Frank Reiners, Klemens Lücke, Michael Siefken.



BDO ARBICON GmbH & Co. KG Wirtschaftsprüfungsgesellschaft

Address **Moslestraße 3
26122 Oldenburg**
Phone **+49 (0)441 98050-0**
Fax **+49 (0)441 98050-180**
E-Mail **info@bdo-arbicon.de**
Web **www.bdo-arbicon.de**
Profile **Tax accountants**
Category **Finance & law**
Founding year **1995**

As a medium-sized audit firm, BDO ARBICON has regional roots as well as a strong national presence and excellent international links. Our team currently comprises 120 highly qualified experts in Oldenburg, Germany. At BDO, almost 1900 employees at 26 locations throughout Germany are available as partners to help ensure the success of our clients.

We have actively accompanied and helped shape the rise of the renewable energies sector since the early 1990s. We are a founding member of a supra-regional energy cluster and belong to the relevant industry associations within the BEE e. V. We use these strong networks to bring together knowledge streams and guarantee our clients a broad range of industry knowledge.

Our areas of expertise:

- Creation and audit of annual financial statements according to the HGB (German Commercial Code), IFRS and § 25 VermAnlG (German Investment Law)
- Design and structuring of closed funds
- Drawing up of prospectuses (VermAnlG, KAGB (German Law on Capital Investments) and WpPG)
- Advice on the implementation of citizens' energy projects
- Advice on requests for tenders
- Evaluation of EE projects in accordance with KAGB (recognised by BaFin)
- Due diligence
- Design and implementation of financing concepts
- Yield certificates

By working closely with BDO's energy management business centre, we are able to meet the challenges of both the conventional energy industry and energy-intensive industry. For technology questions, we rely on the expertise of BDO Technik- und Umweltconsulting GmbH. Thanks to its international network of nearly 68,000 employees in 158 countries, BDO always has the right contact for you.

Bohlen & Doyen GmbH

WE MOVE ENERGY

Offshore cable laying and installations: A powerful partner for maximum availability of offshore wind farms.



Bohlen & Doyen offers a comprehensive portfolio of services with regards to the offshore wind sector. Bohlen & Doyen is an independent service provider offering the following skill sets to maintain offshore wind energy.

Our services

- Submarine cable laying
- Submarine cable inspection (diagnostics, fault location and analyses)
- Submarine cable detection
- Submarine cable repair
- Service for substations and transformer platforms
- Service for wind energy plants

Submarine cable laying, grid connection and power connection components are the focus of our portfolio. Primarily this includes installation and maintenance of export and infield cables and the assembly of medium voltage and fiber optic network connections. Maintenance and repair work on the WKA and transformer platforms round off our portfolio. Our control center provides a 24/7 emergency service and is open 365 days a year. The coordination of service activities is carried out in the event of a fault without delay.



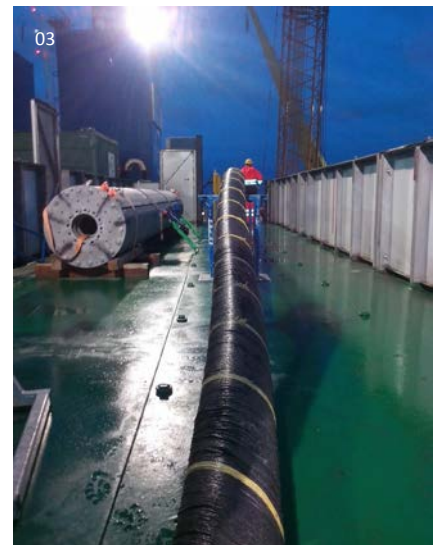
In German Waters

Bohlen & Doyen is considered an expert of cable laying in the tidal areas and in the sensitive area of the Wadden Sea. Our shipping fleet and the special, environmentally friendly equipment allows precise, economical laying methods at highly variable water levels.

Bohlen & Doyen deploys state-of-the-art concepts for maintenance to ensure maximum wind energy availability. Our main focus is on the medium voltage connection, the network connection components of the wind turbine and the transformer platforms.

Our service „Fast Response“

Damage to cables and components are expensive with regard to wind energy interruption. With our technical capabilities, the downtime of wind turbines and platforms can be significantly shortened.



01 | Cable laying barge BoDo Constructor.

02 | Accessing the topside.

03 | Cable on the barge.



Bohlen & Doyen GmbH

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Fax	+49 (0)4944 301-411
E-Mail	info@bohlen-doyen.com
Web	www.bohlen-doyen.com
Profile	Service, maintenance & repair
Category	Operation & service
Turnover	€ 190 million
Employees	1.900 (Wind energy: 80)
Founding year	1950

Connected Wind Services Deutschland GmbH

Service & Maintenance – Components – Spare parts

Connected Wind Services is Europe's leading independent service provider for wind turbines.



Connected Wind Services Deutschland GmbH

Address **Mühlenberg 19
25873 Rantrum**
Phone **+49 (0)4848 90128-0**
Fax **+49 (0)4848 90128-19**
E-Mail **info.de@connectedwind.com**
Web **www.connectedwind.com**
Profile **Service, maintenance & repair**
Category **Operation & service**
Turnover **€ 6.7 million**
Employees **190+**
Founding year **1987**

We are specialized in service and maintenance, large component exchange, gear refurbishment and spare parts. Furthermore we help wind turbine owners maximize their yield and protect their asset with our multi-brand, multi-skill approach – providing all you need from a single point of contract.



CUBE Engineering GmbH – Part of Ramboll

25 years of leading renewable energy projects. What makes that possible?
Our enthusiasm is what motivates us. It has shown us the way and been our constant companion now for more than 25 years.

CUBE Engineering is one of the top 20 companies in the world in the wind consulting sector. Its services are based on a quality management system (e. g. DIN ISO 17025) and produce certified and bankable results. CUBE Engineering has successfully accompanied more than 5,100 projects around the world with a total installed rated capacity of over 17,800 MW.

Skills

The portfolio of services includes management consulting (e. g. feasibility studies), wind assessments (e. g. LiDAR- and field measurements, wind assessment reports), planning and project management (e. g. due diligence, tendering and construction supervision), decentralized energy systems with electricity marketing (e. g. biogas, smart grids, wind-diesel-island hybrid systems), environmental impact and solar assessments, electrical grids and education and training. The company is regularly involved in national and international research programs to develop new products and advance the sector, which is still comparatively young.

References

At an international level, CUBE Engineering focuses on selected countries and mar-



kets in which current or future renewable energies have a significant share of the energy supply and security. This direction demands particularly professional and comprehensive project management, in connection with advice and training (e. g. capacity building) throughout the process.

CUBE is part of the Danish Ramboll-Group. With 13,000 employees and 300 offices in 35 countries around the world, Ramboll is a leading international engineering, design and consultancy company. Ramboll has a strong energy unit employing 800 specialists. More information: www.ramboll.com/energy

01 | CUBE Comic decentralized energy systems.

02 | Wind measurement, Sirt / Libya.

03 | Foundation work, Dorubantu / Romania.



CUBE Engineering GmbH – Part of Ramboll

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34119 Kassel**

Phone **+49 (0)561 288573-10**

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E-Mail **kassel@cube-engineering.com**

Web **www.cube-engineering.com**

Profile **Planners & Project Developers**

Category **Planning**

Employees **70**

Founding year **1991**

DAL Deutsche Anlagen-Leasing GmbH & Co. KG

DAL is part of the German Savings Banks Finance Group and is one of the leading providers of asset finance solutions in the energy, logistics and property industries in Germany.



01 | Whether new construction or repowering – visions become reality with DAL.

02 | Financing concepts for new energies. Smart. Future-proof. Quick response.



DAL Deutsche Anlagen-Leasing GmbH & Co. KG

Address **Emy-Roeder-Straße 2
55129 Mainz**

Phone **+49 (0)6131 804-0**

E-Mail **info@dal.de**

Web **www.dal.de**

Profile **Banks, financial institutions &
financial service providers**

Category **Finance & law**
Turnover **over € 1 billion p.a.**

Employees **250**

Founding year **1962**

We structure investment or financing projects for the long term, and work as an arranger to bring our customers' projects together with the financing strength of the German savings banks and Landesbanken, as well as our partner Deutsche Leasing AG. We establish new sources of financing and support financial diversification, both on a local and a national scale. The assets under management of around 12 billion euros and new deals of over 1 billion euros annually are full of more ideas and solutions which have been implemented in order to facilitate investments.



Core expertise in structuring and financing renewable energy projects

We were structuring renewable energy projects long before the introduction of the EEG. We therefore have many years of experience and extensive expert knowledge on the latest state of the art. As well as developing an optimum financing structure (project financing, leasing, hire-purchase) from a single source, we actively support our customers in networking, therefore optimising the project structure. On presentation of the basic key parameters of a wind project (onshore), we guarantee a quick response time for initial financing indications. Our mission is to improve the profitability of every project by optimising the integration of subsidised loans.

In order to provide our customers with extensive, individual consulting services, we have constantly extended our energy sector in recent years. Whether a new construction or repowering (onshore), we make our customers' visions a reality.

Deutsche Kreditbank AG (DKB)

At home in the sector with local networks

With almost 10 billion euros in credit volume, DKB is one of the largest financiers for renewable energy projects in Germany.

Facilities for using renewable energies not only need to be appropriately implemented, but have customised financing too. DKB knows the challenges of the sector and has offered financing solutions for a wide range of technologies, turbine types, project sizes and funding conditions for over 20 years.

Our experience, which includes over 2,000 financed wind turbines, 1,500 photovoltaic installations and 600 bioenergy plants, in addition to our own hydroelectric and storage projects, is a clear advantage for our customers. They can expect comprehensive technical know-how from our consultants who work alongside our financing experts in the customer teams. Our technical consultants include not only agricultural and structural engineers but notably process and environmental technicians too.

We aspire to know the full extent of renewables at least as well as the banking business. Working actively with professional associations on both a national and regional level is essential according



to our understanding. “We not only want to know the new general conditions of the sector but have an influence on them too,” explains Jörg-Uwe Fischer, member of the communications committee of the financing board in the German Wind Energy Association and head of the Renewable Energy Competence Centre of DKB.

DKB creates new sales and development opportunities while connecting the actors involved in its customer groups – farmers, turbine manufacturers, regional public utilities companies and national energy providers, as well as local authorities. We also create individual solutions within the sector, which, for example, involve citizens economically in wind and solar farms or local heating networks. Since 2004, DKB has initiated or supported almost 100 such public participation schemes.

01 | Jörg-Uwe Fischer, head of the Renewable Energy Competence Centre at DKB.

02 | DKB is the industry leader among all German commercial, state and regional banks.

DKB
Deutsche Kreditbank AG



Deutsche Kreditbank AG (DKB)

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Fax	+49 (0)30 12030-9902
E-Mail	joerg-uwe.fischer@dkb.de
Web	www.DKB.de/erneuerbare-energien
Profile	Banks, financial institutions & financial service providers
Category	Finance & law
Employees	about 3,200 (group)
Founding year	1990

Deutsche Messe AG

Integrated Energy Plaza at the world's leading industrial trade fair in Hannover, Germany, in 2017.



the increase, which creates significant challenges for the grids. Success and acceptance of renewable energies are highly dependent on how they can be stored or distributed in the future.

At the HANNOVER MESSE 2017, more than 1,200 companies will reveal how they are contributing to a secure and competitive energy supply. The Integrated Energy Plaza is at the centre of the event. This is where the energy system of the future will be presented – and where wind energy plays a prominent role. This sector will be on show in Hall 27 near other types of renewable power generation, including innovative storage technologies.

In conjunction with Partner Country Poland, HANNOVER MESSE 2017 will also offer an attractive market for the entire wind industry. Wind power is currently the most important source of green energy in Poland.

More than 220,000 industry specialists from around the world are expected at the HANNOVER MESSE. According to surveys taken in recent years, one out of every three visitors is interested in wind energy.



The wind energy industry meets in Hanover

The Integrated Energy Plaza at HANNOVER MESSE is an ideal platform for the wind sector to showcase itself under the slogan of „integrated energy“ and to demonstrate that it is an important part of the overall value chain in the energy economy. Decentralised power generation is on



Deutsche Messe AG

Address **Messegelände
30521 Hannover**
Phone **+49 (0)511 8934116**
Fax **+49 (0)511 8931122**
E-Mail **Marius.Westenfeld@messe.de**
Web **www.messe.de**
Profile **Trade fairs & conferences for
the wind energy industry**
Category **Other services**
Turnover **€ 330 million**
Employees **more than 1,000**
Founding year **1947**

Deutsche Windtechnik

International service for the entire system – onshore and offshore

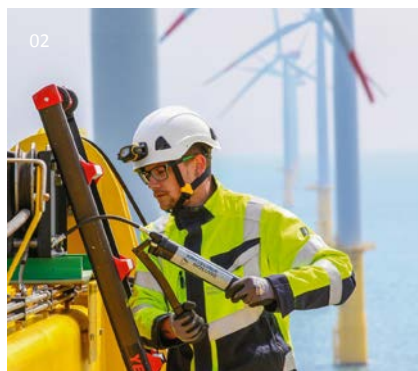
It's not only in Germany that there is a constant demand for independent service. Interest from operators for ISPs is growing continuously on an international scale. We are right at the center.



Expertise, flexibility and more value for lower costs – these are what set apart the quality of our service. With our diverse range of core competencies we are able to offer the full package of services from a single source. We now service over 2,850 wind turbines in Europe as part of permanent maintenance contracts (basic maintenance and full service). The ultimate objective is to secure technical systems operation as best as possible and operate in a cost-efficient way.

Based in Germany, at home in Europe

Our decentralised service network enables us to swiftly reach the customer, the wind turbine and spare parts warehouse. Our company's head office is based in Bremen, Germany. In addition, Deutsche Windtechnik is also becoming increasingly active abroad: locations in Denmark, France, the Netherlands, Poland, Sweden, Spain and the United Kingdom provide the foundation of high-quality systems maintenance in European countries outside Germany. We trade in spare parts of electronic components around the world.

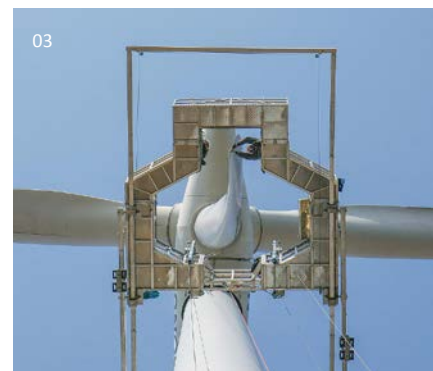


Maintenance from A to Z

Whether it is the entire wind turbine, the controlling system, nacelle, rotor or the foundations, from large components to the smallest electronic components, through to the substation – our team consists of experts who understand your wind turbine portfolio and can provide economical benefits from a service point of view. Onshore and offshore.

Our range of services includes:

- Full maintenance and basic maintenance (Vestas, NEG-Micon, Siemens/AN Bonus, Nordex, Senvion/REpower, Fuhrlander, Gamesa)
- Reconditioning and improvements
- Creation of expert reports
- Safety inspections
- Management services
- Offshore operations management
- Development and sale of spare parts
- Repowering



01 | More than 200 service teams operate for Deutsche Windtechnik internationally.

02 | Deutsche Windtechnik offers a complete, integrated service for offshore wind farms as well from foundation, to blade, to offshore substation (OSS).

03 | Special working platforms and rope-supported access methods enable safe access to the rotor blades.

**DEUTSCHE
WINDTECHNIK**

Deutsche Windtechnik	
Address	Stephanitorsbollwerk 1 (Haus LEE) 28217 Bremen
Phone	+49 (0)421 69105-0
Fax	+49 (0)421 69105-499
E-Mail	info@deutsche-windtechnik.com
Web	www.deutsche-windtechnik.com
Profile	Service, maintenance & repair
Category	Operation & service
Turnover	€ 110 million
Employees	865
Founding year	2004

DunoAir Windpark Planung GmbH

The energy transition comes first

As a specialist for the planning, construction and management of sites for wind turbines in Germany and abroad, DunoAir promotes climate and environmental protection.



01 | A relaxed glimpse of the future – wind farm festival in Weibern-Rieden.

02 | DunoAir-founder Arjen C. F. Ploeg.

03 | One of 14 wind turbines in Mastershausen.

We are a family-oriented company and safeguarding the future for the generations to come is important to us.

The energy transition is an important move towards a time when access to energy is clean, inexhaustible and affordable. This goal strengthens our resolve every day to commit ourselves to wind power.

DunoAir originally began with Arjen C.F. Ploeg as a project buyer. The company developed dynamically in the years that followed and successfully established itself on the market. With the creation of its own planning department in 2009, DunoAir Windpark Planung GmbH, we have finally become a successful full-service company covering the entire value chain. From planning and construction to operation, DunoAir covers all the relevant fields for implementing projects in a serious, prompt and reliable manner.

Qualified and motivated staff are particularly important. They are the reason that DunoAir was able to grow into an international company with offices in Germany, the Netherlands and Ireland, and with projects boasting a total installed capacity of 163 MW.

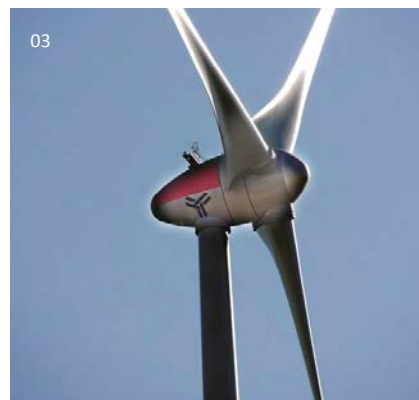
Communities and local companies are closely involved in project development and are kept regularly up-to-date. Transparency like this creates trust and forms the basis for good and sustainable collaboration, with a view to adding value at a regional level.

The DunoAir team looks forward to giving investors, planners and operators the benefit of its expertise. Contact us and discover a reliable partner for the successful implementation of your projects.



DunoAir Windpark Planung GmbH

Address **Brotstr. 1
54290 Trier**
Phone **+49 (0)651 99 98 89-13**
E-Mail **c.wuertz@dunoair.com**
Web **www.dunoair.com**
Profile **Planners & project developers**
Category **Planning**
Employees **10**
Founding year **2004**



The Koopmann Group

Professional services for energy suppliers

Condition based maintenance and repairs are carried out according to manufacturer instructions, and focus on operating conditions and the requirements of the equipment.

Onshore/offshore service profile

Our portfolio includes installation, maintenance, repairs, inspections, commissioning and delivery of turnkey distribution and switching stations.

We carry out both routine inspections and maintenance and repair following a fault. Our fields of activity include new installations of switching stations, cable sections and transformers up to 110 kV. The field of installation and assembly is extended with commissioning and repeat tests. This ensures that we can detect defects in good time, which occur due to the effects of ageing, external influences and due to assembly errors even years after commissioning.

Extensive equipment

Our equipment includes cable-monitoring cars including pre-locating and pin-pointing, partial discharge measuring systems, high-voltage testing systems up to 250 kV, the CPC 100 test system and measuring devices for insulation, transmission ratio, winding resistance and dielectric frequency response measurements to check transformers. In addition, there is also a high-performance measuring system, installed in a seaworthy container which enables the precise localisation of cable faults both onshore and offshore.



In our transformer service centre we offer repairs and maintenance of transformers as well as sales and leasing. Furthermore, we look after repairs and procurements of switching systems of various manufacturers.

As an experienced partner we are available for reliable and long-term operation of energy supply facilities.



02



01 | MV diagnostic vehicle, 100 kV partial discharge measuring system, high-performance measuring system, reflection measurements on HV cables.

02 | Business fields of the Koopmann group.

The Koopmann Group Headquarters

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49661 Cloppenburg**
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Fax **+49 (0)4471 84895**
E-Mail **info@hk-c.de**
Web **www.hk-c.de**
Profile **Service, maintenance & repair**
Category **Operation & service**
Turnover **approx. € 23 million**
Employees **134**
Founding year **1982**

EcofinConcept GmbH

Consulting, project development, investments and project placement

In the budding wind power industry, EcofinConcept GmbH is a very experienced, successful and independent company with a 100 % focus on renewable energy.



01 | Wind farm in Northern Germany.

02 | Guido Vieten and Christian Sperling, managing partners.

03 | Wind turbine in North Rhine-Westphalia.



financial and private investors, planning offices, operators and project developers. The experienced management team have extensive expertise both in terms of commercial knowledge and the necessary insight into the market and sector.

In **project development**, EcofinConcept offers a complete range of services for a successful project, from the acquisition of suitable sites, through project planning, to installation of the turbines. This is carried out in close collaboration with land owners, communities, public authorities and project partners. The company is not only interested in new wind farm sites, but also in **project optimisation** and **repowering of existing wind turbines**.

Brief **references** for the company and managing directors: Project management, project design, development, structuring, financing and/or marketing for more than 70 projects with a total investment volume of more than 585 million euros and an installed nominal capacity of nearly 360 MW.

The company's philosophy is to be able to offer tailored solutions in a **reliable, uncomplicated and professional** manner.

EcofinConcept GmbH
Erneuerbare Energien

EcofinConcept GmbH
Renewable Energies

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E-Mail **info@ecofinconcept.de**
Web **www.ecofinconcept.de**
Profile **Consulting & business consulting**
Category **Finance & law**
Founding year **2005**

EcofinConcept GmbH has been successfully operating in the wind energy sector for over 10 years.

EcofinConcept's **range of services** primarily includes project acquisition, project development and marketing, consulting, commercial due diligence, transaction support, securing of project financing, and the conceptual design of participation options.

Investment opportunities are available in entire wind farms and individual turbines. In the field of **consulting**, EcofinConcept works for energy supply companies,



EMD Deutschland GbR

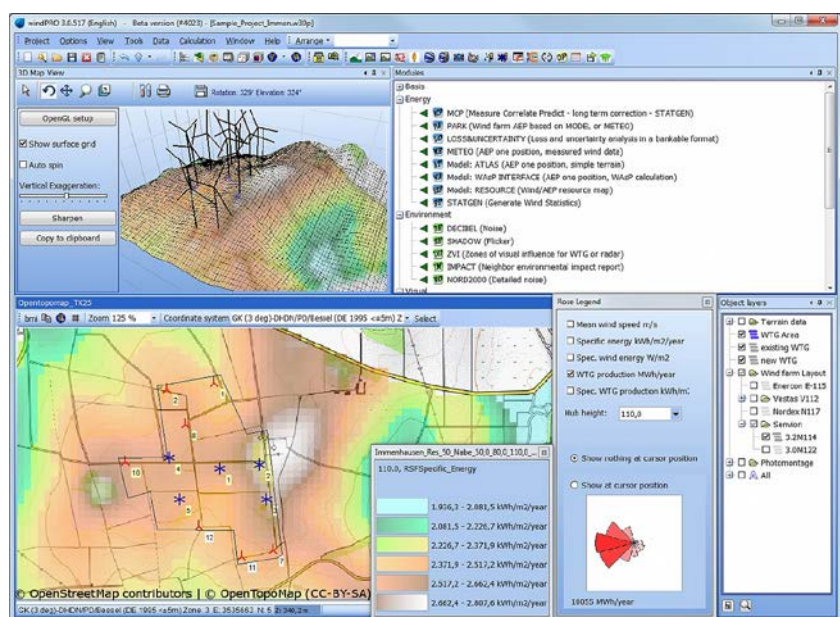
windPRO, windOPS, energyPRO, Training and Support

EMD Deutschland is the exclusive sales agency and training provider of EMD International A/S for Central Europe, the Balkan states and the German speaking countries.



windPRO – software for wind energy project design and planning

windPRO is a module-based software package suited for project design and planning of both single WTGs and large wind farms. windPRO covers different areas, from energy yield calculations via wind data analysis, performance checking and environmental impact calculations to grid connection calculation. With its integrated online data services, a user friendly interface and continuous development to integrate new research and knowledge, it is now the world leading software for wind energy project design. User groups include project developers, independent experts, WTG manufacturers, grid operators, banks and authorities.



windPRO 3.0 map window with wind resources and 3D view.



windOPS – web software for performance analysis of your wind farm

windOPS is a web-based wind power management and analytics software service developed for the daily performance monitoring and to compare, analyse and report operational and financial data for wind farm assets on a regular basis. Present and past operation data of WTGs from different manufacturers are shown in a unified view and summarized in a well-arranged portfolio view.



energyPRO – software for the simulation of distributed energy systems

energyPRO is the most advanced and flexible modelling software for combined techno-economic optimisation and analysis of a variety of heat, CHP, process and cooling related energy projects. In energyPRO you can model virtually any type of technologies from well-known, fossil fuel based production units to state-of-the-art renewables.



EMD Deutschland GbR
www.emd.dk

EMD Deutschland GbR

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E-Mail	emd-de@emd.dk
Web	www.emd.dk
Profile	Software solutions
Category	Other services
Turnover	> € 5 million (EMD Int.A/S)
Employees	7 (EMD Deutschland)
Founding year	1999

EnBW Energie Baden-Württemberg AG

Whether it be in the development, acquisition, construction or operation of wind energy installations – EnBW is active along the entire project value added chain independently and as a partner.

01



02



EnBW Energie-Baden-Württemberg AG is systematically expanding its commitment in the field of wind energy.

In 2010, EnBW put into operation the first commercial offshore wind farm in the German Baltic, EnBW Baltic 1. The EnBW Baltic 2 farm was officially commissioned in September 2015. We also intend to continue to expand our offshore portfolio in the North Sea. The decision to construct the EnBW Hohe See offshore wind farm has been taken, while the planning work for the Albatros offshore wind farm is being completed in parallel. In addition, EnBW is entitled to participate in the auctions for the transitional system according to the Offshore Wind Energy Act with the He Dreiht offshore wind farm project.

In the onshore segment, EnBW currently operates around 140 turbines throughout Germany with a total output of roughly 270 MW as at the end of 2016. EnBW's onshore team has its headquarters in Stuttgart and also has offices in Hamburg, Berlin, Trier and Erfurt. The goal of EnBW is to operate onshore wind energy installations in Germany with a total capacity of 1,000 MW by the year 2020.



**EnBW Energie
Baden-Württemberg AG**

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70567 Stuttgart

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E-Mail renewables@enbw.com

Web www.enbw.com

Profile Energy services

Category Energy services

Turnover € 14.3 billion (9.2016)

Employees 20,217 (9.2016)

Founding year 1997

03



01 | EnBW Baltic 2 offshore wind farm.

02 | EnBW Baltic 1 offshore wind farm.

03 | EnBW Westerheim wind farm.

Energiekontor AG

The Energiekontor Group plans and implements wind farms and solar parks in Germany, Portugal and the UK. With more than 25 years of experience, the company is a pioneer in its field.

The core competencies of the Energiekontor Group include the planning, financing, implementation and management of wind farms and solar parks. Since 1990, the company has planned and set up 590 wind turbines in more than 100 wind farms as well as two solar projects with a total rated capacity of about 875 MW in Germany, the UK and Portugal. The total investment volume for these projects is about 1.4 billion euros. The group has acquired a large number of windy and sunny locations for future projects.

As a pioneer in its field, Energiekontor is also committed to sustainable growth by opening up new foreign markets such as the Netherlands, France and the USA.



As an independent, medium-sized electricity producer, the Energiekontor Group has also been operating its own wind farms for a few years now: the Group's own wind farms make up around 30 wind farms with 238 MW in Germany, Portugal and the UK. These own farms generate a stable cash flow and make a significant contribution to the company's success. Energiekontor is also taking over and continuing the operation of wind farms situated in Germany to further expand the Group's own farms.

Energiekontor is also redesigning the areas of already existing wind farms and is developing projects with modern, powerful wind turbines as part of its repowering plans.

All Group-owned, sold and additionally bought wind farms are managed by Energiekontor AG. This includes 24-hour remote maintenance 365 days a year, as well as measures for technical optimisation.

Energiekontor was founded in 1990 in Bremerhaven by Dr Bodo Wilkens and Günter Lammers. The company currently employs more than 170 people.



Energiekontor AG

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E-Mail	info@energiekontor.de
Web	www.energiekontor.de
Profile	Planners & project developers
Category	Planning
Turnover	€ 191.3 million (2015)
Employees	about 170
Founding year	1990

ENGIE Deutschland AG – Windpark Betriebsführung

ENGIE – Innovative, renewable, efficient

The ENGIE Deutschland AG – Windpark Betriebsführung is a company of the ENGIE group, one of the leading energy companies worldwide.



01 | ENGIE Wind farm in Germinon-Vélie (France).

02 | ENGIE Wind farm in Karstädt Blüten (Germany).



ENGIE Deutschland AG – Windpark Betriebsführung

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E-Mail **andrea.kretzner@de.engie.com**

Web **www.engie-deutschland.de**

Profile **Technical & commercial
operational management**

Category **Operation & service**

Employees **152,000 (Wind energy: 10)**

Founding year **2006**

With around 3 gigawatts of installed capacity, ENGIE, the leader in the French wind power sector, is one of the largest operators of wind turbines in Europe. Our extensive experience makes us a reliable partner when it comes to developing, constructing, operating and servicing wind farms. To maintain a competitive edge, the wind experts at the German subsidiary ENGIE Deutschland AG – Windpark Betriebsführung draw on the company's international network – giving them an advantage that benefits not only our own 13 wind farms in Germany, but also the turbines that we operate for third parties.

Successful operational management hinges upon striking the right balance between the financial and the technical aspects. Our employees apply more than 20 years of industry experience to the development of needs-based and tailored operating and servicing concepts.

Key facts

- ENGIE Deutschland AG – Windpark Betriebsführung was founded in 2006.
- It has been based in Bremen's Überseestadt district since 2010.
- The company operates 175 onshore wind turbines in Germany, with installed capacity of approximately 300 MW.
- In our portfolio are wind turbines of following manufacturer: Enercon, Lagerwey, Nordex, Siemens and Vestas.
- The company belongs to ENGIE Deutschland GmbH – an experienced provider of services in the areas of technology, energy and service, with some 30 offices.
- In Europe, ENGIE operates some 8 gigawatt with renewable energies, of which approximately 3 GW each wind power and hydroelectricity as well as 0.5 gigawatt solar power.

Portfolio of wind farm services

- Technical and commercial operational management
- Optional extras (HSE, qualified electrician work, legal management)
- Planning services/repowering
- Direct marketing of electricity



envia THERM GmbH

envia THERM is characterized by many years of experience in energy production and as a heat supplier and energy service provider in eastern Germany. The company is looking for reliable partners for wind power projects for the implementation of the energy transition in the new federal states.



envia THERM is a wholly owned subsidiary of envia Mitteldeutsche Energie AG (enviaM), the leading regional energy provider in eastern Germany.

As a competence center for renewable energies, the company has a extensive knowledge and expertise in planning, building and operating power generation plants. envia operates power plants at 48 sites across eastern Germany, which generate energy from biomass, biogas, photovoltaics, hydropower and wind power.

Partnership of equals

envia THERM's aim is to actively shape the energy transition in eastern Germany. The company is especially keen on close, dependable collaboration with local players. Whether it is local communities, land owners, project planners or planning



associations – envia THERM stands for a partnership of equals.

The company takes special care to ensure the full involvement at an early stage of all leading individuals. In addition, envia THERM offers investment models tailored to the needs of citizens, local authorities and municipal utilities. And it's not only here that the company wishes to keep value creation local.

Competence center for renewable energies

envia THERM has in-depth experience of searching for, analysing and evaluating sites. The same goes for operating power plants – from contract management to direct marketing of the energy generated and repowering of wind turbines.

In addition to the in-house development of wind farms and cooperative ventures, envia THERM is also interested in the acquisition of project rights and purchase of power plants.

Local councils, municipal utilities and project developers in eastern Germany wishing to implement new projects in the field of renewable energy will find envia THERM a competent and reliable partner.



envia THERM GmbH

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Web	www.envia-therm.de
Profile	Technical & commercial operational management
Category	Operation & service
Turnover	€ 118 million (2016)
Employees	148 (2016)
Founding year	2006

Energiequelle GmbH

20 years Energiequelle

We have been implementing wind energy projects since 1997 – from scratch to grid connection and energy storage. With our teams of our engineers, technicians and business specialists we are also taking care of the commercial and technical management of the projects after commissioning. Our employees are located in Germany, France and Finland and together we are committed to a successful energy transition.



Energiequelle turns 20 – from start-up to international success

In 2017, Energiequelle will be celebrating its 20th anniversary. After twenty years in business, our company can look back on successful projects, continuous growth and innovative ideas. Yet everything began like a classic start-up story.

Energiequelle turns 20 – a reason to celebrate. Not just for the founding fathers, but for our whole team. Over the years, we have grown and have amassed a wealth of valuable experience. Yet even after two decades, we make sure that we still have our feet on the ground. We keep to our word and are passionate about our projects.

The first projects

With Michael Raschemann's wife, Doreen, the two initiators laid the foundation for what is now an internationally operating enterprise. Back then, the team generated the equivalent of 200,000 euros with four wind turbines – a successful start. More orders than expected started rolling in, so more and more staff had to be added to manage the various projects for customers. The offices in Bremen and Kallinchen were both kept so that employees would not need to relocate from their home base.

How it all started

That we are a company in the field of renewable energies is a fact that hasn't changed. But many of our current achievements and ideas – from full operational management to innovative energy storage systems – did not exist as yet in 1997, the year we started. Whereas other companies might have started up in garages, in the case of Energiequelle it was the kitchens of Mr Uecker and Mr Raschemann, the two men who established the company. From the very beginning, it was never confined to a single location. Joachim Uecker lived in Bremen, the Raschemanns in Kallinchen, about 20 kilometres south of Berlin.



Energiequelle GmbH

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E-Mail	info@energiequelle.de
Web	www.energiequelle.de
Profile	Planners & project developers
Category	Planning
Turnover	€ 130 million (2016)
Employees	200
Founding year	1997

Successfully managed growth

Today, we have around 200 employees working from our offices in Germany, France and Finland. We have connected more than 740 wind turbines with a total power capacity of 1,300 megawatts to the grid. In 2016, our annual sales revenue exceeded 130 million euros. In addition to wind turbines, we also install and manage photovoltaic and biogas systems. On top of that, Energiequelle installs and manages substations and implements innovative solutions for energy storage. Our portfolio of services has been significantly broadened over the past two decades.

Feldheim – a model to emulate

When it comes to storage solutions, attention invariably turns to one of the milestones in the company's history. Although Energiequelle has carried out many wind farm projects over the years,



Feldheim is still one of the most innovative concepts that we have ever planned and successfully implemented. Feldheim is the first village in Germany to become totally energy self-sufficient. Located in the state of Brandenburg, it covers its own demand for power and heat with a mixture of biogas, wind and solar energy. All of it is 'made by Energiequelle', which is something we are proud of.

What makes us different

Today, just like 20 years ago, solutions-based thinking and passion for what we do are part and parcel of how we operate.

Our company is helping to shape the energy transition, so we are playing our role not only in ensuring that our customers and partners are satisfied, but also so that future generations will inherit a healthy environment. We see ourselves as trailblazers in many respects. Our energy storage concept is unique. To advance this technology to the next level, we engage in and support science and research. We design tomorrow's energy. And behave as good partners and down-to-earth human beings at the same time. That has remained exactly the same as on the first day we started, twenty years ago.



Energiequelle founders Joachim Uecker and Michael Raschemann.

EWE ERNEUERBARE ENERGIEN GmbH

Gathering Momentum for Renewable Energies

EWE ERNEUERBARE ENERGIEN GmbH is the EWE Group's expert for the development, construction, and operation of wind farms. We provide productive partnerships for onshore and offshore wind.



01

Whether developing our own windfarms or cooperating with partners: We believe in the highest standards when it comes to quality, transparency, and equal footing. For a further expansion of onshore wind power we are looking forward to joint ventures with other developers, wind farm operators, investors, land owners and municipalities. In tight collaboration with the operators and investors EWE ERNEUERBARE ENERGIEN also repowers. Our goal is to lead existing wind farms to higher and renewed value added. At every wind force – you can count on our rich know-how and experience reaching back over two decades.



Developing wind farm projects is a complex business. As a partner for other developers and all experts who are working with wind power, we contribute extensive experience, reliability, and competence. We acquire projects that are already under development and also help partners to accomplish successful finalization of their projects.

Choose EWE ERNEUERBARE ENERGIEN as a professional and dependable partner for

- development of wind farms (the whole process from evaluating sites to the construction and commissioning of the wind farm)
- commercial management of wind farms
- technical management of wind farms
- further operational services

EWE ERNEUERBARE ENERGIEN GmbH

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Web **www.ewe-erneuerbare.de**

Profile **Planners & project developers**

Category **Planning**

Turnover **€ 130.5 million**

Employees **40**

Founding year **2013**

02



01 | Wind farm in Köhlen, Lower Saxony.

02 | Dr. Jörg Buddenberg and Alwin Schlörmann, Managing Directors of EWE ERNEUERBARE ENERGIEN GmbH.

FGH – Research Association for Power Systems and Power Economics

Your first point of contact for the grid integration of your generating plant – professional, reliable, experienced.



For the past 90 years FGH e. V. has been providing tailored R&D services for all aspects relating to electricity supply. As the first accredited independent certification body, today incorporated in the spin-off FGH Zertifizierungsgesellschaft mbH (established in 2015), we are a pioneer and market leader with respect to certified grid integration of decentralized generating plants. The portfolio includes certification of units and plants according to international grid codes, as well as certification of products and components such as storage solutions, power plant controllers and grid control units.

FGH GmbH provides electrotechnical engineering services for manufacturers, project developers and grid operators. These services include e. g. grid and system studies, planning and engineering of electrical layouts, configurations and components, engineering of mobile fault-ride-through (FRT)-testing laboratories and consulting services concerning grid integration of international projects. Furthermore, FGH develops individual software solutions for network planning and the collection and evaluation of disturbance data.



Our experience from the relevant standardization committees of FGW, DKE and IEC, together with our high level of methodological expertise, ensures that our customers receive the best technical accuracy. We constantly develop our methods in national and international R&D projects and share this knowledge regularly in seminars with industry experts.

01 | Experts for grid integration of renewable energy plants.

02 | FGH Group – Highest expertise in electrical engineering.

03 | Mobile FRT test laboratories (LVRT and HVRT).



**FGH – Research Association
for Power Systems and Power
Economics**

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E-Mail **hanna.johnen@fgh-ma.de**

Web **www.fgh-ma.de**

Profile **Certification**

Category **Experts**

Turnover **Approx. € 8.4 million**

Employees **80 (all companies)**

Founding year **1921**

Fichtner GmbH & Co. KG

Engineering and Consultancy for Wind Farms All Over the World

For decades, Fichtner has been using the experience it has gained in all aspects of sustainable energy generation and utilization to oversee all phases of onshore and offshore wind power projects.



01 | As owner's engineer, Fichtner assists in all technical and commercial aspects – for example for an 80 MW wind farm project in Jordan.

02 | As lender's engineer, Fichtner prepares due diligence reports – for example for a wind farm portfolio in Central America.

international investors and development banks as they are with local energy supply markets, tariff structures and permit application procedures.

Broad range of services

As owner's engineer, Fichtner assists its clients in all technical and commercial aspects, from initial project idea up to wind farm commissioning. As lender's engineer, Fichtner prepares due diligence reports and oversees project realization and commissioning.

Specific services

- Owner's engineer in all phases of onshore and offshore projects
- Geotechnics and morphodynamics
- Scour protection, jacking appraisals and pile dynamics
- Due diligences
- Layout and permit planning
- Wind measurements, wind studies and energy yield assessments
- Operation and maintenance concepts
- Inspections
- Assessment of remaining lifetime and lifetime extension

Fichtner is Germany's biggest independent engineering and consultancy enterprise for infrastructure projects in the sectors of energy, water, environment, traffic engineering, and IT.

Many decades of experience

Fichtner has been playing an active role in the success story of wind energy since the 1980s. For example, Fichtner as owner's engineer rendered consultancy services for the first wind farms in Germany, and advised the German Research and Development Ministry on its first wind energy program.

International project teams covering all disciplines

Today, the Fichtner Group offers a network of highly qualified engineers and consultants with expertise in all aspects of onshore and offshore wind energy. Fichtner's experts are equally conversant with the challenges of German and



FICHTNER

Fichtner GmbH & Co. KG

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Web **www.fichtner.de**
Profile **Planners & project developers**
Category **Planning**
Turnover **€285 million (Group)**
Employees **1,500 (worldwide)**
Founding year **1922**

GAIA mbH

Everything from a single source

Your professional partner for planning, development, project coordination, service and management of wind turbines and photovoltaic systems. Cogeneration, storage solutions and charging systems for e-mobility complete our portfolio.

The „Gesellschaft für Alternative Ingenieurtechnische Anwendungen“, GAIA mbH, is one of the pioneers in renewable energy in Rheinland-Pfalz. Our expertise is the planning and construction of wind and solar power plants as well as the development of individual sustainable energy concepts. Following the successful implementation of a project, we take over the management of wind turbines, wind farms and photovoltaic systems and offer service and maintenance. Cogeneration, storage solutions and charging systems for e-mobility complete our portfolio.

Established in 1999 by Dipl.-Kfm. Torsten Szielasko and Dipl.-Ing. Michael Wahl as an engineering company, GAIA currently employs 46 highly motivated and qualified

members of staff. Their work contributes to the transition towards a sustainable energy system, a form of practical environmental protection.

Integrated, sustainable, flexible

„Everything from a single source“ – The keystone of GAIA's business philosophy. We cover all processes in the development of wind and solar projects: From initiation to the turnkey handover to the operator, we take care of all aspects of project management. During every step we keep a close eye on the criteria of sustainability.

In addition we offer support to individual project elements or sub-projects. For example, the GAIA team monitors and maintains wind turbines by different manufacturers. They carry out various services, such as periodic inspections, management of on-site appraisals, cable sheaths and protection checks. We provide these services also for third-party systems. Cogeneration, storage solutions and charging systems for e-mobility complete our portfolio.



01 | Wind turbine in the Groß-/Kleinniedesheim wind farm. Commissioning of the wind farm in June 2016.

02 | Wind turbine in Alzey/Heimersheim, commissioned in December 2016.

03 | GAIA headquarters: An older building that now produces energy.



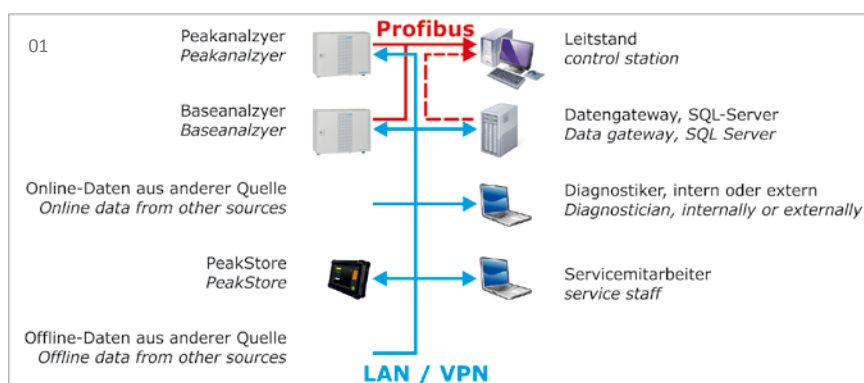
GAIA mbH

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Profile	Planners & project developers
Category	Planning
Turnover	€ 7.5 million
Employees	46
Founding year	1999

GfM Gesellschaft für Maschinendiagnose mbH

We keep your drive running!

GfM Gesellschaft für Maschinendiagnose mbH offers online condition monitoring, offline drive train diagnosis as well as gear endoscopy, blade bearing diagnostics and foundation monitoring.



02



The damage state of rolling bearings and gearboxes can be reliably determined by means of measured vibrations. This is normally done in the load operation of the system. It is not necessary to open up components. A short stop of the system is only required for offline measurements.

The GfM Gesellschaft für Maschinen-diagnose mbH offers:

- Online condition monitoring systems
- Monitoring service for Online CMS
- Online foundation monitoring
- Offline foundation measurements
- Offline vibration diagnostics
- Torque analysis
- Blade bearing diagnosis at WTG
- Offline measurement systems
- Diagnosis service for offline measured data
- Inspections / technical expert opinion
- Video endoscopy on gearboxes
- Trouble shooting
- Seminars

The CMS "Peakanalyzer" does not need a learning phase and only a relatively small support effort. This is achieved through the integrated DVS-analysis in the device which makes the analysis of irregularities largely automatic. During the development of the system and the method great importance was placed on data quality. Analysis occurs preferably in the order spectra which are created by resampling. Furthermore, it is possible to integrate a particle counter at the two- to 32-channel system for lubricant analysis. In addition, relevant events or conditions can be signalled.

The GfM is independent. There are absolutely no commitments to replacement part distributors, maintenance companies or insurance companies for drive engineering. The diagnosis and expert reports are therefore neutral.



GfM Gesellschaft für Maschinendiagnose mbH

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Web **www.maschinendiagnose.de**

Profile **Service, maintenance & repair**

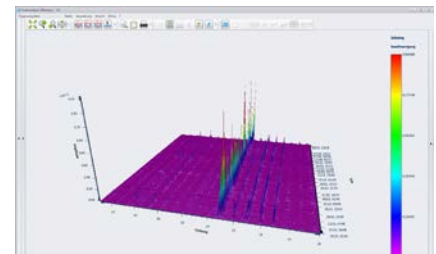
Category **Operation & service**

Turnover **€ 1.4 million**

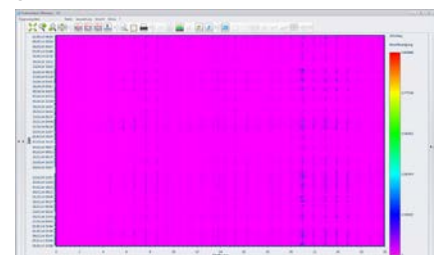
Employees **15**

Founding year **1999**

03



04



GMA-Werkstoffprüfung GmbH

GMA is your onshore and offshore partner for quality assurance, along all stages of a wind energy project from planning & development, manufacture & installation and the operation of plants or their components.

GMA-Werkstoffprüfung GmbH supports you in increasing the availability of your onshore and offshore wind farms. Our service portfolio includes quality assurance activities for manufacturers and suppliers of wind turbines and their components, during the transport and assembly process and as continuous monitoring, analysis and optimisation of turbines in operation.

Plant safety and problem-free operation

In order to optimise the yield of your wind turbines and increase operational safety, we continuously monitor the condition of your wind turbines and carry out remaining service life analyses, as GMA specialises in testing and inspecting wind turbines. With over 30 years' experience in materials testing and quality assurance, we are a recognised, certified and accredited service provider according to DIN EN ISO 17025 and Nadcap for the following services:

Non-destructive testing

- All components including rotor blades (ultrasound, surface crack, x-ray and eddy-current testing, phased array, thermography)
- Training and R&D centre of rotor blades
- Expert know-how for testing all materials including fibre-reinforced plastics

Destructive testing and sample preparation

- Development phase
- Material approval
- Verification of production processes



- Damage analysis (mechanical, analytical, metallographic materials testing)

01 | NDT Team with UT Scanner in action.

02 | Automated ILSS tests.

3D Measurement

- Geometry measurement with the accuracy of $0.05 + 0.01 \text{ mm/m}$
- Range of around 80 m

Control unit and controller optimisations

- Remaining service life analyses
- Structural health monitoring (acoustic emission and vibration)



A MEMBER OF MISTRAS

GMA-WERKSTOFFPRÜFUNG.GMBH

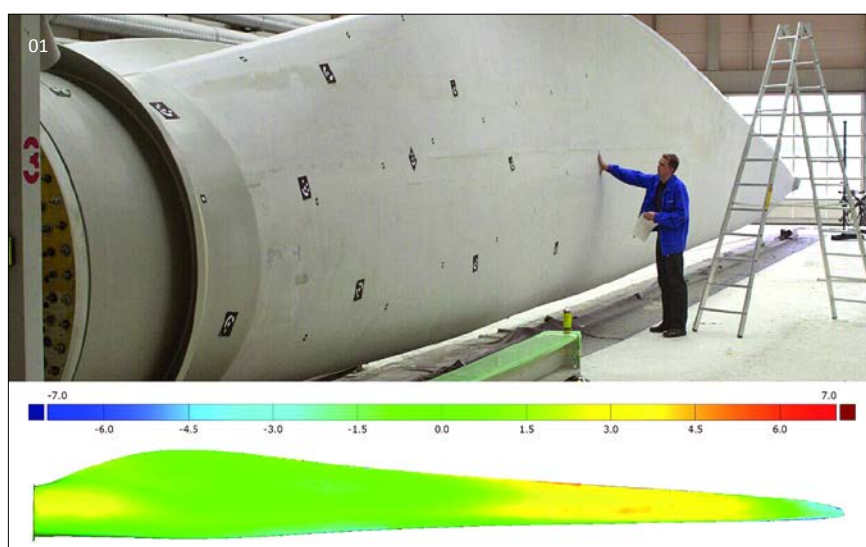
GMA-Werkstoffprüfung GmbH CFRP-Testing Center

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Web **www.gma-group.com**
Profile **Quality assurance**
Category **Operation & service**
Turnover **€ 59 million**
Employees **approx. 700**
Founding year **1984**

GOM GmbH

GOM – Precise Industrial 3D Metrology

Quick and flexible component tests and coordinate measurements for the wind industry



01 | Inspection of very large components with optical 3D coordinate measuring

02 | Monitoring of movement, stress and deformation



GOM GmbH

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Fax **+49 (0)531 39029-15**
E-Mail **info@gom.com**
Web **www.gom.com**
Profile **Quality assurance**
Category **Operation & service**
Employees **450**
Founding year **1990**

GOM is a global manufacturer that develops, produces and distributes software, machines and systems for industrial and automated 3D coordinate measuring technology and 3D testing.

The non-contact measuring systems from GOM are flexible and mobile tools for product development, quality assurance and maintenance in the wind industry.

Fast inspection of wind turbine components

Wind turbine components and production tools need to be manufactured accurately in order to guarantee long operation times. When manufacturing mold halves for rotor blades, GOM systems ensure precise dimensional stability. For flow-efficient profiles, shape and dimensions of rotor blades and turbines can be quickly digitized. The measured data can

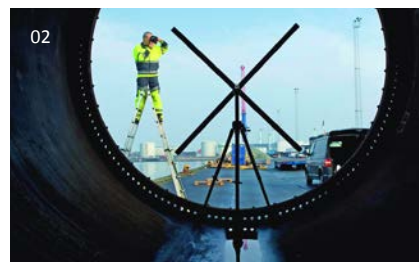
be compared with CAD or the master data set on a full-surface and point-to-point basis. They also provide a complete data base for reverse engineering and the reproduction of an optimal rotor.

Coordinate measurements on site

Optical 3D coordinate measurement by GOM is possible even under demanding conditions and on large components such as towers and nacelles. It allows individual construction components, such as assembly bolts and surfaces, to be quickly inspected and any problems remedied before assembly. This is also possible for offshore foundations and structures.

Deformation analysis

The dynamic monitoring of movement, stress and deformation is indispensable for analyzing components. GOM systems provide measurements for wind turbine structures under load, either at specific points or across the entire surface. They replace conventional position sensors, strain gauges and accelerometers and can be used for fatigue testing, for investigating the dynamic behavior of rotor blades and for gearbox testing.



greenmatch AG

The web-based investment software for renewable energy projects

With greenmatch you can model the financial part of your projects – independent of technology, project stage and country.

Value and compare renewable energy projects

Greenmatch offers you a highly flexible integrated financial model with certified, standardised algorithms. With greenmatch you can:

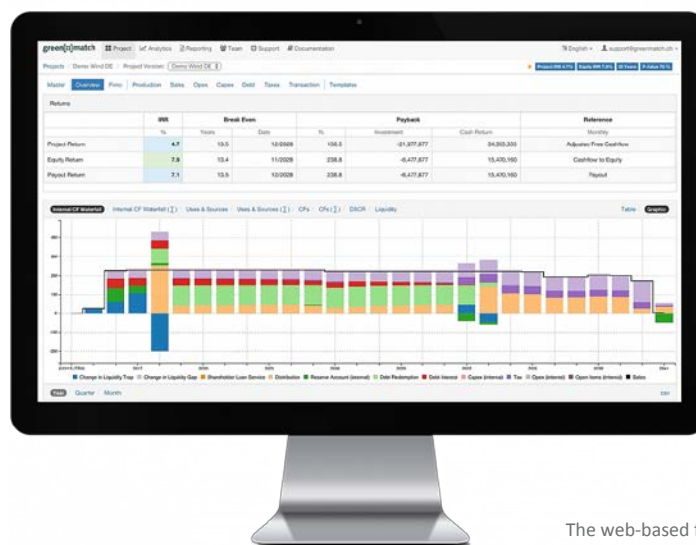
- calculate performance indicators
- structure project financing
- plan and optimise liquidity
- calculate scenarios and sensitivities
- aggregate projects to portfolios
- offer or search for projects on the marketplace

Solutions for project developers, investors, banks and advisors

Greenmatch combines the perspectives of all market participants on one single platform and allows for an efficient interaction. Thanks to the independent, certified financial model, discussions regarding deviations between the financial models of the buyer and the seller do no longer occur. Detailed risk analysis strengthens the trust of banks and accelerate the closure of the project financing. Thus, each market participant saves valuable time and can focus more on his key competences.

Gain competitive advantages thanks to greenmatch

- Cut your transaction costs
- Save time and avoid expensive errors
- Quantify the financial risks in a way that is both standardised and reliable
- Assess complex projects regardless of technology, project progress and country specifics
- Efficiently exchange information with relevant project stakeholders



The web-based financial modelling software for your renewable energy projects.

Explore interesting publications on our blog!

We frequently publish articles by experienced industry experts. They write about hot topics in the fields of renewable energies, project finance and digitalisation.

www.greenmatch.ch/blog

Try greenmatch for free!

Sign up for free and without obligation:
www.greenmatch.ch.

Follow us on social media!

Twitter: @greenmatch
LinkedIn: greenmatch AG

green[::]match

greenmatch AG

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4102 Binningen/Switzerland**
Phone **+41 (0)61 301 50 00**
E-Mail **info@greenmatch.ch**
Web **www.greenmatch.ch**
Profile **Software solutions**
Category **Other services**
Founding year **2013**

GÖRG Partnerschaft von Rechtsanwälten mbB

GÖRG is one of the leading full service corporate law firms and has many years' experience in energy regulation law in the energy industry, in the field of project development and with M&A transactions.



GÖRG Partnerschaft von Rechtsanwälten mbB

Address **Kennedyplatz 2
50679 Köln**
Phone **+49 (0)221 33660-0**
Fax **+49 (0)221 33660-80**
E-Mail **cschneider@goerg.de**
Web **www.goerg.com**
Profile **Lawyers**
Category **Finance & law**
Employees **270 lawyers
(22 in Energy Law)**
Founding year **1996**

With over 270 lawyers at its six offices in Berlin, Essen, Frankfurt am Main, Hamburg, Cologne and Munich, as an independent firm GÖRG advises on all core areas of commercial law.

Legal advice on energy law forms a core part of its activities. The energy law team at GÖRG has extensive expertise in the wind industry, both onshore and offshore. We support our clients with planning, financing, acquiring, installing and operating both onshore and offshore wind farms.

Our advice in the field of onshore wind energy covers

- legal consulting and providing support with regard to tendering procedures according to the Renewable Energy Sources Act 2017,
- checking and providing support with approval processes under public law,
- performing legal and tax due diligence,
- corporate and tax structuring of project companies and infrastructure companies,
- drafting, structuring and negotiating project agreements,
- drafting, structuring and negotiating purchase agreements (SPA and APA),
- transaction handling and supplementary corporate documentation,
- providing support with all issues related to energy regulation law (grid connection, grid usage, grid access),
- drafting and negotiating direct marketing agreements, agreements regarding the supply of emissions allowances and legal consulting, and structuring of trade with proofs of origin.

Our advice in the field of offshore wind energy covers

- legal consulting and providing support with capacity allocation processes with the German Federal Network Agency,
- legal consulting and providing support with regard to tendering procedures according to the Renewable Energy Sources Act 2017,
- providing support with the approval procedure,
- structuring and negotiating all supply, installation and other project agreements for the procurement of components of a wind farm and the installation and logistics agreements,
- corporate and tax structuring of project companies and infrastructure companies,
- legal advice for financing,
- support during (Europe wide) tendering procedures and the development of procurement law-related solutions in emergency situations, and
- ongoing advice during the installation and commissioning phase (contract and claim management).

GÖRG also provides advice on all aspects of energy regulation law (grid connection, grid access, regulation of grid fees, feed-in management, exceptions of particular infrastructures from the regulation, closed distribution networks/customer systems,



framework conditions for energy storage), energy competition law (effectiveness of long-term supply contracts or grid access agreements, price control, compliance advice and cartel fine procedures), energy contract law (creation and negotiation of electricity and gas supply contracts, of grid connection, connection usage and grid usage contracts, of energy trading contracts based on model contracts, e.g. EFET, of contracting models) and energy trading and the legal optimisation of energy procurement (savings of electricity price components, own supply concepts, marketing of balancing power).

Our energy law team also represents its clients at regulatory bodies and (arbitration) courts.

We represent energy companies, banks, financial institutions, suppliers, manufacturers, investors, developers, the public sector, energy traders and large energy consumers.

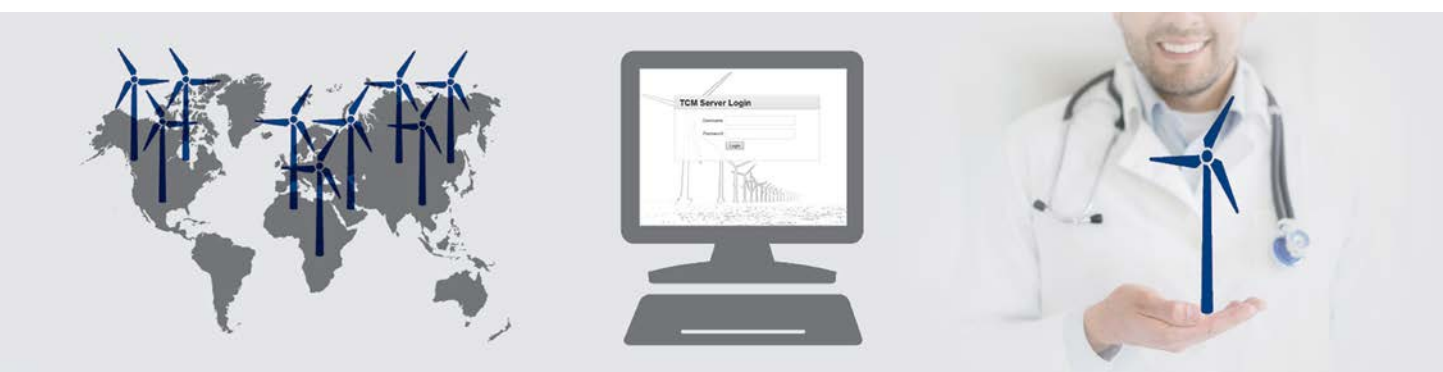
In addition to specialists in energy industry law, our team also includes experts from the fields of corporate law, taxes, financing, turbine manufacturing, real estate law, public commercial law and energy competition law.

Any questions? We are happy to respond.



Gram & Juhl

For more than 20 years, Gram & Juhl has supplied the wind industry with the TCM® (Turbine Condition Monitoring) solution. TCM® is now installed in more than 17,000 turbines worldwide.



Protect your assets and increase turbine uptime with TCM® Retrofit & Monitoring

In an industry that requires maximum uptime to generate profitability, it is easy to see how downtime can mean the difference between success and failure. The TCM® System gives you a complete overview of the condition of turbines in all wind farm sites. It will help you increase wind turbine production, reduce repair costs and improve cost efficiency of maintenance and services by:

- Predictive & Prognostic maintenance
- Optimization of spare part logistics
- Vibration measurement & Fault Detectability
- Health indicators & recommended actions

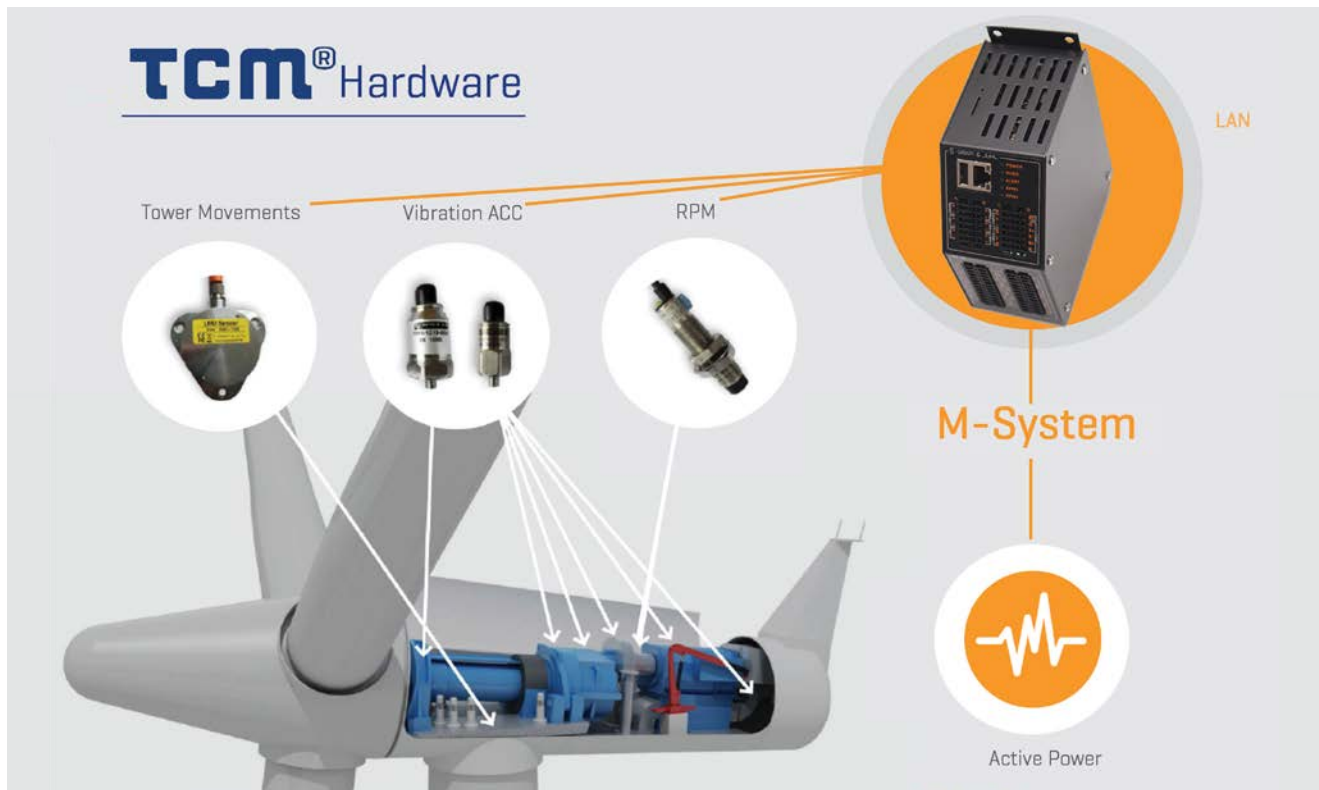
Five reasons to why you should install the TCM® system

1. Low initial costs which will pay back multiple times by just one saved gear box
2. Predict, prevent & plan: Save time and money with scheduled repairs and avoid failures
3. Maximizing profit for your investors by optimizing your performance and avoid turbine downtime
4. Get a complete overview of the conditions of your turbines by health indicators, and receive recommended actions
5. Access turbine condition knowledge through our user friendly TCM® Customer Portal

GRAM & JUHL

Gram & Juhl

Address **Technologiepark 4
26129 Oldenburg**
Phone **+49 (0)441 779 313 45**
E-Mail **zha@gramjuhl.com**
Web **www.gramjuhl.com**
Profile **Condition monitoring systems**
Category **Suppliers of electrical and electronic components**
Employees **25**
Founding year **1997**



TCM® Monitoring

With our highly qualified diagnosis specialists examining vibration analysis of the wind turbines, you can rest assured that your monitoring is in good hands. With TCM® Monitoring, you can quickly and easily identify impending failures in a timely manner. Timely alerts of turbine faults is critical for a condition monitoring system, equally important is the ability to get to the critical information and recommended actions about what the next steps should be.

Key benefits

- Cost effective alternative to In-House monitoring
- Optimizes daily work for O&M operators
- Early fault detection
- Open and transparent customer service
- Health indicators
- Lifetime extension

No two companies are the same – therefore we offer three different condition monitoring service levels so you can get the flexibility you need: TCM® Monitoring Basic, TCM® Monitoring PRO, and TCM® Monitoring PRO+.

TCM® CUSTOMER PORTAL

The TCM® customer portal is the gateway to your turbines, with secured online access to turbine information. Through the online and user-friendly TCM® Customer Portal our monitoring clients are able to login and obtain information on turbine conditions, according to the chosen TCM® Monitoring Service Level. Further information from the TCM® Customer Portal includes events and status summaries, e-mail notifications and graphs of health indicator, a description of the detected fault, and recommended actions to be taken. It also includes a time to reaction, letting you know how far you can stretch before taking action, and this way maybe combine action on one turbine with action on another, saving repair costs in the process.

TCM® Retrofit

TCM® Retrofit is a cost-effective turnkey solution for retrofitting turbines with a Condition Monitoring System (CMS). The TCM® Retrofit solution can effectively reduce the O&M costs and extend the turbine's lifetime.

Key benefits

- Easy plug and play installation with customized retrofit kit
- Integration with Control & SCADA-systems
- One TCM® system for multiple turbine marks
- Automated analyses and online alarms

TCM® Retrofit – Easy installation & simple to use

The TCM® Retrofit solution kit features Plug-and-Play installation with minimal downtime. It is a lightweight, easily mountable condition monitoring kit that can be customized to the individual brand of turbine.

The TCM® Retrofit unit is mounted through three easy steps:

- Mounting the accelerometer
- Pulling the cables and connecting it to the processing unit
- Do the commissioning

Greenwind

Green Wind Energy GmbH & Green Wind Operations GmbH

Planners and project developers & technical and commercial operational management. With the power of the wind, fresh wind knowledge and the mantra: One for all. All for you! we obtain the best results for our customers: from plans, technologies, contracts, and from ourselves.



New from old

We support our partners throughout the entire development process – until the rotors are able to start turning profitably. This includes the re-powering and renewal of old systems, such as the Klein-Mutz wind farm in Brandenburg where, in 2016, we removed two V80, 2 MW turbines and replaced them on the same plots of land with two V112 Vestas turbines, each producing 3 MW. This will more than double the yield and extend the service life by another 20 years.

Acting in a spirit of partnership

We work to maintain our contacts with land owners, such as municipalities and farmers, for the duration of the project and beyond. Which location is best at a political and human level and in terms of nature and the landscape? How do we bring together different interests to the benefit of everyone? Our employees think and act sustainably and in a spirit of partnership, without losing sight of profitability.

Perfect planning

A wind project can only benefit many if it is clean and planned in accordance with the new EEG (German Renewable Energies Act) requirements. Our financial management team checks whether the project makes financial sense. The complete cost and income analyses include optimised maintenance and leasing contracts, operating management costs and direct marketing. Every activity will be perfectly planned. The wind it requires is free!



Green Wind Energy GmbH (GWE)

With a strong local commitment, we develop wind power projects for private and institutional wind farm operators. Our team has the necessary capability and expertise to manage a project, from the identification of the land and the approval procedure through to the financing, construction and commissioning. We are currently constructing the Vormark/Prignitz wind farm in Brandenburg – one of the largest wind farms to be installed in Germany in 2017, featuring fourteen V126, 3.45 MW Vestas turbines.

Green Wind Energy GmbH Green Wind Operations GmbH

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Phone **+49 (0)30 351 28 86 30**
Fax **+49 (0)30 351 28 86 33**
E-Mail **berlin@greenwindenergy.de**
Web **www.greenwindenergy.de**
Profile **Planners & project developers
Technical & commercial
operational management**

Employees **25**
Founding year **2008**



Green Wind Operations GmbH (GWO)

Each installed wind turbine is an undertaking of its own. Smooth, efficient running requires the best technical and commercial management on behalf of the owner. Green Wind Operations fulfils all the requirements in both areas. Our continually growing portfolio is due to our visionary management and unconditional willingness to seek improvements. We manage all kinds of machine: from the tried-and-tested V52-850 kW Vestas and the 1.5 MW Enercon to the 3.3 MW prototypes by Nordex.



24/7 control room

The full potential of our technical management is based on detailed analyses and inspections and the internal evaluation of data, assessments and legal requirements. 2017 will be marked by the expansion of our central control room so as to be able to respond even more efficiently and quickly to any questions concerning the operation and 24/7 monitoring of the turbines.

Regional office

Greenwind teams are always on call and can be on site immediately where necessary. Since 2016, we now have our own site in North-West Brandenburg. The GWO regional office Groß Pankow currently co-ordinates the technical operational management. About 180 megawatts for the catchment area Prignitz are currently controlled.

Maximum yields

The resources and possibilities offered by Financial Management for generating the best-possible yields are often underestimated. To plan and manage turbines at business level, we use our expertise in liquidity and budget planning, the calculation of NSM outages, direct marketing and commercial due diligence. The most important point however remains direct, personal contact with the customer.

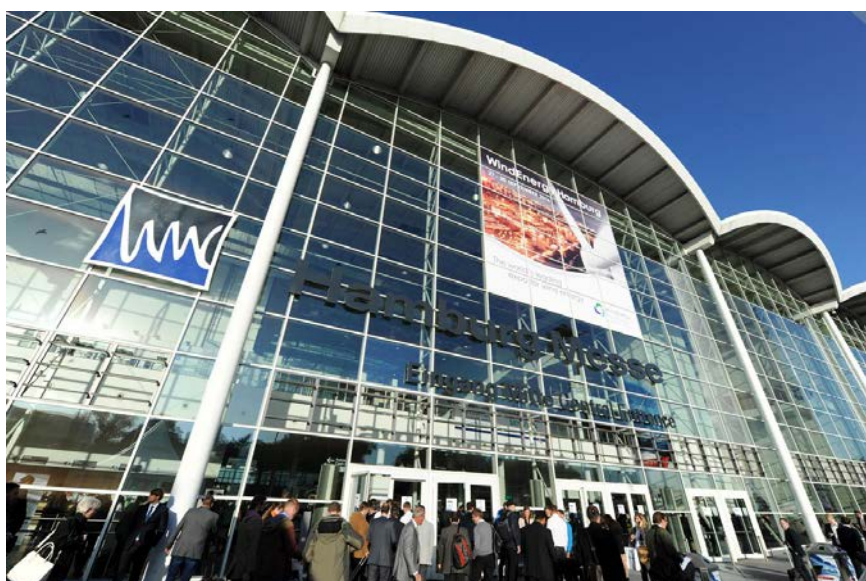
01 | In 2017, the Vormark/Prignitz wind farm built by Green Wind Energy will be one of the largest wind farms in Germany, featuring fourteen Vestas V 126, 3.45 MW turbines.

02 | Martin Kühl, managing director GWE and Manuel Lasse, managing director GWO.

Hamburg Messe und Congress GmbH

the global on- & offshore expo

The world's leading expo for wind energy



Maritime Industries Exhibition in Hamburg, enabling representatives of the offshore sector to expand their presentation by exhibiting at WindEnergy Hamburg, too.

The ideal conditions at the Hamburg Fair site enable manufacturers, component suppliers, service providers and utilities etc. as well as experts in storage solutions and systems integration of renewable energies to present their products, solutions and services to the international audience. The site benefits from state-of-the-art logistics and excellent transportation modes at the heart of Hamburg, which has established itself as the global wind industry capital.



The global on- & offshore expo

25 – 28 September 2018

windenergyhamburg.com

Round about 1,400 exhibitors and 35,000 international visitors from all parts of the world, numerous reports of successful business deals and development of new markets – that is the outcome of the world's leading expo for wind energy.

WindEnergy Hamburg is organised by Hamburg Messe und Congress in cooperation with Messe Husum und Congress. In September 2017 there will be the jointly organised wind fair in Husum – HUSUM Wind, which is focused on the national wind market.

Save the date for the next WindEnergy Hamburg taking place from 25 to 27 September 2018. In 9 exhibition halls products and solutions for the entire value chain of wind energy will be showcased – onshore and offshore.

For the global on- & offshore expo – WindEnergy Hamburg information and terms of registration are shown at windenergyhamburg.com/en/

In parallel the WindEurope Summit will be held again, with a high-powered programme including presentations by some 300 experts on current and future subjects of the industry.

The dates of WindEnergy Hamburg are close to those of SMM, the International



Hamburg Messe und Congress GmbH

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E-Mail **andreas.arnheim@
hamburg-messe.de**

Web **www.windenergyhamburg.com/en**

Profile **Trade fairs & conferences for
the wind energy industry**

Category **Other services**

Turnover **€ 111,5 million (2016)**

Employees **310**

Founding year **1972**

HUSUM Wind / The German Wind Exhibition / 12–15 September 2017

**Trade Fair and Congress for the German speaking Market
in Husum – Home of the Wind Industry**
Do Business – Create the Future.



Husum is known throughout the world as the cradle of the modern wind industry, and for the last twenty-five years, HUSUM Wind has been globally recognised as one of the wind industry's most important trade fairs.

One of the great advantages Husum has over its competitors is its location. Situated on Germany's North Sea coast, the North Frisia region is home to several leading turbine manufacturers and an army of supply businesses, as well as training facilities for service and maintenance engineers. This means that visitors to HUSUM Wind can also visit nearby wind farms, manufacturers and associated industries to see innovation and technology in action.

The concept of focusing the HUSUM Wind exhibition on the German wind energy market and its neighbouring regions was a great success in 2015 and will be continued. In 2017 two special exhibition areas have been made available. One focuses on all aspects related to "offshore wind", the other informs on and demonstrates

"sector and grid integration". In 2017, the partner country is North Rhine Westphalia, a partnership that will be filled with life in various ways.

From 12–15 September the key actors and decision-makers of the sector will once again meet old hands and new talents.

The HUSUM Wind Congress, running parallel to the exhibition, highlights innovations and developments within the industry both on and offshore, and is an important source of information about all the challenges facing the industry. Husum's attractive peripheral events also guarantee that in 2017 all attendees will be able to enjoy just that right balance of work and play which makes Husum so popular.

With over 87 % of the available space already booked, the future looks good for Husum and the wind industry as a whole.
www.husumwind.com

01 | HUSUM Wind has always been a well-attended business site for visionaries and hands-on decision-makers.

02 | HUSUM Wind Congress: Top-class speaker and much space for specialized exchange.

03 | HUSUM Wind – where longtime companions meet new guys and innovations. Where else?



HUSUM Wind / Messe Husum & Congress

Address **Am Messeplatz 12–18
25813 Husum**

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Fax **+49 (0)4841 902-246**

E-Mail **info@husumwind.com**

Web **www.husumwind.com**

Profile **Trade fairs & conferences for
the wind energy industry**

Category **Other services**

Employees **35 (Wind energy: 10)**

Founding year **1989**

innogy SE

innogy combines all the expertise you need for your wind energy project. As a project partner, we provide full, professional support throughout the duration of your project.



innogy SE

Address **Gildehofstraße 1
45127 Essen**
Phone **+49 (0)40 2094933022**
E-Mail **marcus.neumann@innogy.com**
Web **www.innogy.com/onshore**
Profile **Energy services**
Category **Energy services**
Turnover **€ 46 billion**
Employees **40.000**
Founding year **2016**

We have been involved in onshore wind energy for over 20 years. During this time we have developed, constructed and operated wind farms in Germany, Great Britain, the Netherlands, Poland, Spain and Italy. We are a driving force in this dynamic market and we are planning to grow further, together with our partners.

innogy is your complete service provider. We are your one-stop solution: From project planning, network and turbine construction to operational management and marketing. We offer financial security and equitable conditions.

Does working with innogy provide us with benefits?

Our ability to introduce project financing will give you additional flexibility and offer greater returns, whilst minimizing your risks. Our expertise with the Renewable Energy Sources Act 2017 (EEG) and the new auctions will benefit you directly.

Is your land suitable for a wind energy project? When does setting up a wind farm make good sense?

Securing land. A suitable site is the foundation of every successful wind energy project. As a land owner, benefit from the long-term advantages of the energy transition with regular lease income. Our experienced wind scouts operate across Germany to check out new sites. Our conditions are fair and the basis for a close, long-term partnership.

Approval planning. In conjunction with our experienced specialists, we develop economically practical, ecologically compatible and locally accepted projects that pave the way for a smooth approval process. We will be pleased to plan projects and create success in partnership with you.

Auction process. From 2017 the auction process will determine the financial support of electricity from renewable energies. Take advantage of our financial capabilities and the experience we have gained from success in various European tenders.

It's looking good for your project.
Together we can get over apparently insurmountable hurdles and make your projects a success.

Wind farm construction. As your local, on-site partner we are there to safely and reliably install your wind farm on-time and on budget. We will answer any questions you may have.

Grid connection. To ensure that electricity generated from renewable sources can be safely used, we offer operators of onshore wind farms a comprehensive service offering. We cover everything from planning and connecting the turbines to the grid to operational management of the network. Our know-how and full service provision will ensure that your investment pays.

What happens after construction?

Operational management. With our experience in technical management, we can exploit the full potential of your wind turbines and closely monitor operations – with everything customised to your needs. We will be your dependable partner for the entire service life of at least 20 years. Take advantage of our internal expertise, our extensive network and our continual development through digitisation, research and development.

Marketing. Do you want to maximise the profit from the energy generated by your wind farm? Let our experts show you how you can market the electricity generated more successfully by way of supported direct selling with additional revenue.



You can find your innogy contact on www.innogy.com/onshore or by calling us on: T +49 (0)40 2094933022



Jetstream Bosse

Ing.-Büro für Windenergienutzung

Dipl.-Ing. Peter Bosse

Your partner Jetstream Bosse, with more than 30 years of experience in the wind energy field, is happy to assist you with expert consulting and operational management of wind energy projects.



01 | Appraisal NX 90.

02 | Blade walk.



Jetstream Bosse Ing.-Büro für Windenergienutzung

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12101 Berlin**
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E-Mail **info@jetstream-bosse.de**
Web **www.jetstream-bosse.de**
Profile **Technical consultants**
Category **Experts**
Employees **7**
Founding year **1999**

Service – Expert consulting

Expert consulting in accordance with the latest technology and many years of professional experience are required for an informed and qualified condition assessment of your wind turbine.

We offer the following services:

1. Expert consulting (wind turbines)
 - Plant, project, commissioning or warranty inspections
 - Periodic inspections according to construction law every 2–4 years
 - Condition-oriented inspections
 - lifetime extension of wind turbines
2. Rotor blade assessment
3. Value reports
4. Damage assessment
5. Vibration control analyses of wind turbines
 - Rotor imbalance measurement
 - Machine diagnostics with mobile 10 channel CMS
6. Gear analysis – video endoscopy, oil and cog shape analysis
7. Inspection of power train alignment – single laser with continuous measuring mode (evidential)
8. Expert testing for PPE, ladder and arrester systems, cranes, chain hoists, cable winches
9. Due diligence, technical and economic consulting
10. Construction monitoring of wind energy projects

Service – Management

With approx. 100 wind turbines, we have been assisting operators and investors in managing 600 to 2,500 kW of output since 1999 with modern, 24/7 management. Thanks to Rotorsoft®, our customer-oriented and easy-to-use management software, all processes on the wind turbines are documented and quick reaction times guaranteed. Additional special turbines and manufacturer-related access software in our remote data monitoring allow direct access to the wind turbine for error analysis and targeted resource planning of the service.

Our strength! A highly motivated and well-qualified team available for you around the clock.



juwi Energieprojekte GmbH

Energy is here

We support you from start to finish in planning a successful project: finding the best locations, turnkey erection of turbines, and performing technical and operational management.



Competent and experienced partners:

We plan and install your wind farm

juwi is one of the leading specialists in wind and solar energy projects, and can provide complete project development and other services related to the construction and management of renewable power plants.

juwi was founded in 1996 in the Rhine-land-Palatinate region in Germany. Around the world, the juwi group employs some 1,000 staff with projects and subsidiaries on every continent.

Know-how for complex locations

Across Germany, juwi has installed 730 wind turbines with a rated capacity of over 1,750 megawatts – juwi has proven expertise, even in very complex locations with a hilly or forested terrain.

A pioneering partnership

Towards the end of 2014, the juwi group and the Mannheim-based company MVV Energie AG agreed on a pioneering partnership with the aim of creating a high-performance, safe and environmentally-friendly energy system. The result was a sustainable business model that covers the entire energy economy value chain.

Our strengths at a glance

- Long-term experience: we have been developing and managing wind farms since 1996
- Strong partnership with Mannheim-based MVV Energie, one of the largest German energy suppliers
- Complete range of services: from finding sites to installation
- Independence: Long-term cooperation with all major turbine and component suppliers
- Strong regional presence throughout Germany
- Participation of citizens and councils
- Confident business relationships with banks and investors
- High level of customer satisfaction with technical and commercial management
- Concept development and implementation of repowering projects

juwi group wind farms: from self-developed projects to general contractor for EPC projects, juwi is the competent partner.



juwi Energieprojekte GmbH

Address	Energie-Allee 1 55286 Woerrstadt
Phone	+49 (0)6732 9657-0
Fax	+49 (0)6732 9657-7001
E-Mail	info@juwi.com
Web	www.juwi.com
Profile	Planners & project developers
Category	Planning
Turnover	> € 500 million
Employees	ca. 1,000 (worldwide)
Founding year	1996

Kaiserwetter Energy Asset Management GmbH

IoT solution for Renewables

Kaiserwetter is an independent service provider for the asset, portfolio and risk management of renewable energy assets. The company uses big data analytics and the Internet of Things (IoT).



What does the digitisation of the renewable energy sector mean for Kaiserwetter? Answer: data-based and specific applications moulded into workable functions. The IoT is the driving force behind the global implementation of a standardised management system for energy farms. The company supports approximately 500 MW of wind farms and solar parks in Europe and provides the following services:

Asset Management

Our Asset Management, with its performance and financial unit, collects the production data of the generating units irrespective of the manufacturer. Customers are provided with the latest, customised reports, including all the relevant information such as production, finances and contract management, etc.

Portfolio Management

We use our tool Aristotle to map the technical and financial data from the asset managers in a tamper-resistant database. This means that in addition to the current data you also have historical data for horizontal and vertical analyses. This is particularly beneficial for customers in terms of the functions for financial data, such as a continual cash flow and budget analysis.

Risk Management

Risk Management evaluates data, identifies risks and can simulate relevant risk scenarios and safeguard a portfolio. Customers can access the Kaiserwetter Monte Carlo simulator and map complex sensitivities in order to establish relevant risk data for compliance-oriented business management.

Predictive Maintenance

Kaiserwetter will systematically advance the possibilities of the IoT when it comes to implementing predictive maintenance for renewable energies, allowing us to maximize plant availability while minimizing costs.



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E-Mail	tbr@kaiserwetter.eu
Web	www.kaiserwetter.eu
Profile	Technical & commercial operational management
Category	Operation & service
Turnover	€ 2.5 million
Employees	60
Founding year	2012

M.O.E. GmbH

Moeller Operating Engineering GmbH

M.O.E. is an accredited test laboratory and certification and inspection body, which offers services to ensure the reliable operation of wind turbines.

The main business areas of Moeller Operating Engineering GmbH are certification, measurement and inspection in relation to the grid integration of decentralised energy generators. Since the introduction of guidelines for the certification of generation plants in Germany, M.O.E. has been closely involved with their implementation and has gained accreditation as a certification and inspection body and a test laboratory from the German national accreditation body DAkkS. M.O.E. has developed a broad range of services which are constantly evolving with the customer's interests in mind, so that all plant integration services are available to the customer from a single source.

In addition to certifying plants, units and components in accordance with the relevant grid codes, M.O.E. also offers examinations of the mechanical, electrical and acoustic characteristics of wind turbines. In order to examine the design of components and thus assess the life time of wind turbines, the M.O.E. test laboratory carries out load measurements on the mechanical components and offers



The M.O.E. team in front of the company's headquarters in Itzehoe.

power performance tests. The inspection body also offers safety checks and inspections in accordance with German Social Accident Insurance (DGUV) regulation 3 to ensure plant and personal safety, and carries out regular inspections in compliance with the German Wind Energy Association (BWE) standard. Represented in three locations in northern Germany, the company has established itself as a highly qualified competence centre both within Germany and abroad, and is recommended by the German Association of Energy and Water Industries (BDEW).



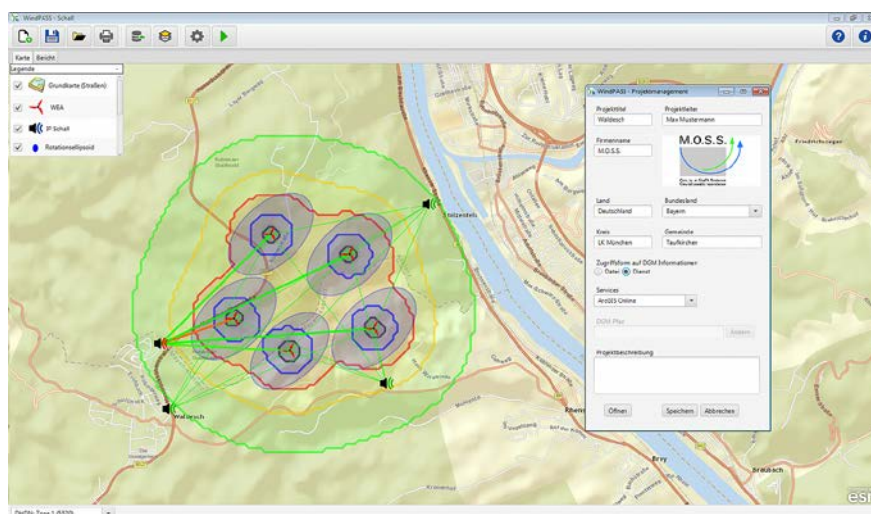
M.O.E. GmbH

Address	Fraunhoferstr. 3 25524 Itzehoe
Phone	+49 (0)4821 40636-0
Fax	+49 (0)4821 40636-40
E-Mail	info@moe-service.com
Web	www.moe-service.com
Profile	Certification
Category	Experts
Turnover	€ 4.9 million
Employees	78
Founding year	2009

M.O.S.S. Computer Grafik Systeme GmbH

Domain Specific Planning Application and IT Based Optimization of Planning Wind Farms

M.O.S.S. offers planning application services, as well as integration solutions and consulting services with respect to optimizing the processes of planning wind farms.



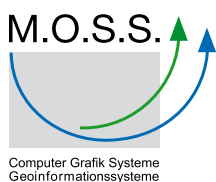
The WindPASS domain specific applications noise, project management and shadow.

WindPASS: Efficient domain targeted applications for planning wind farms based on ArcGIS

WindPASS comprises a set of domain specific solutions fine tuned to support the planning process of wind farms. Each WindPASS application runs on the desktop. It is targeted to a specific subject, tuned for fast startup, efficient execution of computations, and intuitive usability. The results comply with standards and approval regulations. The currently released WindPASS applications include project management, noise, shadowing and yield. Further applications are under development. When using multiple WindPASS applications at the same time changes at different wind power plants, locations of immissions and receptors will be immediately mirrored in all open WindPASS applications. This allows for evaluating diverse subject topics both separately as well as simultaneously.

Wind-PIA: Windpark Planning & IT Architecture

Wind farm planning is an iterative process. Intermediate results that have been considered reliable may have to be reevaluated. This reinforces the need for the project developer to use structured, standardized and closely interlocked workflows. Wind-PIA provides a standardized exchange of GIS and other data which renders the wind farm planning process more efficient. To achieve an optimized planning process the Wind-PIA identifies and removes technical, structural and organizational hurdles by reducing redundant work, eliminating data conversions and avoiding local or duplicated provisioning of data. This yields an up to 20 % efficiency gain in the planning processes for wind farms.



M.O.S.S. Computer Grafik Systeme GmbH

Address **Hohenbrunner Weg 13
82024 Taufkirchen**
Phone **+49 (0)89 66675-100**
Fax **+49 (0)89 66675-180**
E-Mail **erneuerbare-energien@moss.de**
Web **www.moss.de**
Profile **Software solutions**
Category **Other services**
Employees **65 (Wind energy: 10)**
Founding year **1987**

more energy GmbH

24 hours a day, 365 days a year!

The employees at more energy work around the clock evaluating the data provided through remote monitoring tools to detect and solve any increases in malfunctions.

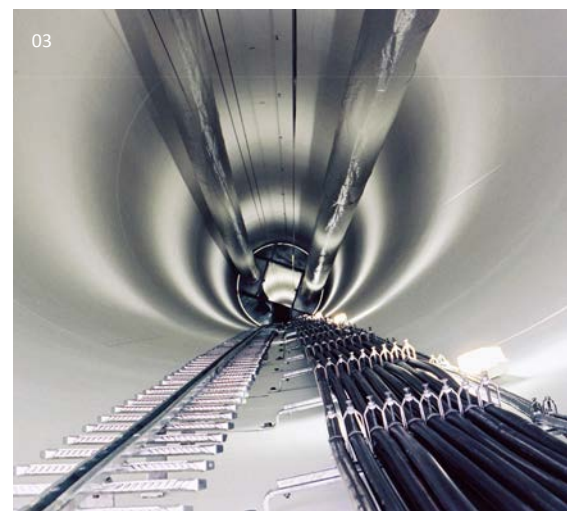


Effective, professional management is the key factor for achieving long-term, efficient operation of a wind farm. To reach this end, an intelligent coordination between ongoing operational monitoring and the necessary maintenance and inspection activities is essential to ensure the reliable functioning of the facility and thus a consistently high level of output.



At more energy, experts work in the operation of onshore wind farms who have been active as independent and objective service providers to the wind energy industry since the company's foundation in 2004.

All work processes and procedures at more energy are based on a strict and detailed system of quality management. With an expected investment life of 20 to 25 years for wind turbines, the typical manufacturer's guarantee of three years clearly does not provide a sufficient basis for the service and maintenance of a wind energy facility. The support of independent experts is needed who offer customized services to meet individual customer requirements and are always available to provide immediate assistance. As time goes on, the need for service and maintenance activities to ensure the continued profitable operation of wind energy projects will likely increase.



01 | Optimization of wind energy yields.

02 | Support services – 24 hours / 365 days a year.

03 | Periodic inspection.

more energy GmbH
Windpark Management

more energy GmbH	
Address	Breitscheidstr. 6 34119 Kassel
Phone	+49 (0)561 47519-50
E-Mail	info@more-energy.de
Web	www.more-energy.de
Profile	Technical & commercial operational management
Category	Operation & service
Turnover	€ 170,000
Employees	2
Founding year	2004

Muehlhan Deutschland GmbH

Renewables

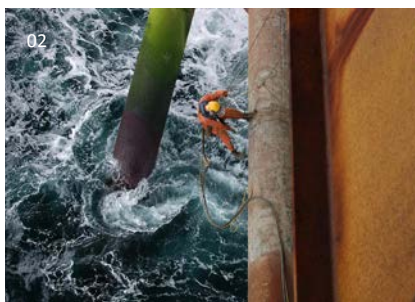
From inspection and advice via steel construction to surface manufacture and protection. We make use of new technologies and developments to offer professional service for wind turbines and structures.



Muehlhan Deutschland GmbH, a 100% affiliated company of Muehlhan AG, combines strong technical know-how in the wind energy sector and long-standing experience both on- and offshore. We offer a full service package for wind farm operators comprising inspection and consulting as well as repair and maintenance work for all surfaces (on- and offshore).

01 | Wind turbine onshore.

02 | Industrial climber offshore.



Our Service

Inspection and advice – onshore and offshore

Our inspectors determine the current condition of the surface protection of your wind turbines. They draw up a qualified report and, if requested, also plan the resulting repair and maintenance plan.

Surface protection – onshore and offshore

With our R&D department we develop customer-specific solutions in surface protection for all components, whether it's the foundation, the tower, the nacelle or the rotor blades of the turbine.

Our highly experienced staff carry out all required preparations for subsurface treatment and coating tasks to a high quality standard.

Specially developed beam and coating robots ensure increased economic efficiency in the production process.

Metal construction and welding work – onshore and offshore

In cooperation with our sister company we also carry out complex blasting and welding work according to the current standard. Here we can rely on our own production area which is equipped with the latest technology.

Access technology and industrial climbers – onshore and offshore

We work with the Muehlhan scaffolding company to resolve questions of access technology, or rely on our own division of „Industrial climbers“.

Leasing of employees – onshore and offshore

Our qualified personnel is at your disposal for existing or planned projects. With continuous education and training, we ensure that you can rely on the quality of our teams.

Our workforce includes:

- Metalworkers and welders with all certificates
- Experts in corrosion protection
- Industrial climbers assessed to IRATA and FISAT standard
- Experienced project managers

All employees have a current offshore approval.



Muehlhan Deutschland GmbH

Address **Zur Westpier 40
28755 Bremen**
Phone **+49 (0)421 693269**
E-Mail **bremen@muehlhan.com**
Web **www.muehlhan-deutschland.de**
Profile **Service, maintenance & repair**
Category **Operation & service**
Turnover **€ 218 million in 2014**
Employees **2,675 in 2014**
Founding year **1881**

N.T.E.S. GmbH Windkraftservice

Maintenance • Repair • Inspection • Optimization

Wind turbine service since 2000. Independent maintenance and repair across Germany using the latest technology and skilled employees.



N.T.E.S. GmbH Windkraftservice is a service provider in the fields of REPAIR, INSPECTION, OPTIMIZATION, THERMOGRAPHY and MEASUREMENT primarily for „Bonus“ and „Siemens“ wind turbines with capacities between 150kW and 2,3MW.

Working right across Germany, our highly skilled teams operate from four service stations at Bremervörde, Stedum/Hohenhameln, Stelle/Winsen an der Luhe/Erkelenz) in order to ensure flexibility and a fast response rate.

Over 15 years experience in wind turbine service form an ideal basis for achieving optimum results both in case of repair work and prevention through servicing or inspection. In a survey of operators by the German Wind Energy Association (BWE) we achieved an overall rating of GOOD (1.68) for the categories „regular service“, „unscheduled repair“ and „extraordinary service“.

An overview of our services:

Maintenance

- Carrying out annual/biannual maintenance work on wind turbines
- Transformer maintenance
- Blade maintenance
- 24-hour remote data monitoring and maintenance

Repairs

- 24-hour fault elimination service with remote data monitoring and maintenance
- Quick response time for repair work
- Large stock of replacement parts
- Inexpensive repairs thanks to our large stock of exchange parts

Inspections

- Blade inspection
- Blade reports
- Gearbox inspection + Repair
- Failure analysis

Optimisation

- Suggestions and implementation

Thermography

- Troubleshooting and prevention of breakdowns
- Documentation of the current condition

Measurements

- Laser-supported generator alignment
- Earthing measurement
- Bearing condition check

Other Component repairs

- Electronic components
- Small yaw gearboxes
- Our own engineering
- Development of new components:
 - Compensation systems
 - Hydraulics



N.T.E.S. GmbH Windkraftservice	
Address	Handelshof 8 27432 Bremervörde
Phone	+49 (0)4761 92612-0
Fax	+49 (0)4761 92612-99
E-Mail	wkas@ntes-service.de
Web	www.ntes-service.de
Profile	Service, maintenance & repair
Category	Operation & service
Employees	30 (Wind energy: 26)
Founding year	2000

Neas Energy GmbH

Neas Energy is an international energy-trading company focusing in particular on the trade and management of power from renewable energies and decentralised combined heat and power.

01



01 | HQ of Neas Energy in Aalborg, Denmark.

02 | Trading Floor.

Our goal is to offer project developers and operators in these fields the best possible marketing services. Neas Energy operates in the electricity, natural gas & CO₂ markets across Europe and offers numerous services to producers, consumers and wholesale partners.

At Neas Energy, all processes of the value chain are taken care of by our in-house staff. The company has its own trading floor, so that it can respond to all the changes in the various markets as quickly as possible. Additionally, we have in-house meteorologists who provide accurate weather forecasts. The software for monitoring and controlling the asset portfolio has been developed and updated by our experienced programmers for over 10 years. In order to implement special technical requirements, we have German-speaking contacts at all levels who can provide our customers with professional help at all times.

In close collaboration with the transmission grid operator and the Danish network agency, Neas Energy is heavily involved in the development of concepts (e.g. virtual power plant, control energy from wind turbines, etc.) that will secure the transition of the Danish energy market from conventional energy production to power from renewable production plants. The Danish energy market is one of the most innovative in the world.

Neas Energy GmbH, based in Hilden near Düsseldorf, is a subsidiary of Neas Energy A/S (Aalborg, Denmark). The company has offices in London, Stockholm and Hamburg as well as a trading office in Singapore. Across Europe, Neas Energy markets more than 5700 MW of installed capacity from wind, solar, hydro and biogas power facilities across Europe. The majority of these installations can already be managed from our 24-hour control room.



NEAS ENERGY

Neas Energy GmbH

Address **Schillerstraße 7
40721 Hilden**
Phone **+49 (0)2103 339900**
E-Mail **germany@neasenergy.com**
Web **www.neasenergy.com**
Profile **Direct marketers**
Category **Direct marketing**

NOTUS energy

Power on your side

NOTUS energy initiates and implements wind energy projects. The specialist covers the entire value chain and stands for certified service and creative solutions with its team of experts.

The Potsdam-based company has now planned and built over 500 wind turbines. NOTUS energy has achieved a lot since it was founded in 2001. 19,187 tonnes of sheet steel, 1,712 km of cables laid and wind farms over an area as large as 186 football pitches. Above all, company founder Heiner Röger thanks his highly qualified team of over 125 experts with a range of specialisations for these successes.

Services

Site acquisition

- Searching for and securing suitable wind priority areas
- Checking the areas for suitability for wind turbines
- Creating detailed site concepts with farm layout and wind farm configuration

Planning

- Approval procedure / planning permission procedure
- Assessments and studies of noise, shadows, turbulences, visualisations, environmental impacts, species protection
- Planning of the number and arrangement of wind turbines, access routes, grid connection and compensatory measures

Construction management

- Construction supervision and monitoring for our own and third-party projects
- Assumption of construction projects in every service phase and sub-areas
- Regular quality control, extensive construction documentation, creation of specifications
- Certification in accordance with DIN EN ISO 9001

General contractor

- Turnkey installation of wind farms and their infrastructure worldwide
- NOTUS energy network ensures high quality, competitive prices and reliable installation

Management

- Technical and commercial management of wind turbines
- Innovative solutions
- Direct marketing with the best premiums
- Switching authorisation up to 110 kV



01 | NOTUS turbine.

02 | Construction works with certified service.



NOTUS energy

Address **Parkstraße 1
14469 Potsdam**

Phone **+49 (0)331 62043-40**

Fax **+49 (0)331 62043-44**

E-Mail **windkraft@notus.de**

Web **www.notus.de**

Profile **Technical & commercial
operational management**

Category **Operation & service**

Employees **about 125**

Founding year **2001**

OSTWIND Group

Winning Energy Together

OSTWIND has successfully developed, installed and run wind farms for over 20 years.



We give Europe wings

Up until 2017, OSTWIND has developed, built and connected up over 500 wind turbines with a total capacity of 825 MW. With offices in Germany, France and the Czech Republic, the medium-sized company group sets highest standards in the wind power industry throughout Europe.

OSTWIND
An Energie gewinnen.

OSTWIND Group

Address **Gesandtenstr. 3
93047 Regensburg**
Phone **+49 (0)941 59589-0**
Fax **+49 (0)941 59589-90**
E-Mail **info@ostwind.de**
Web **www.ostwind.de**
Profile **Planners & project developers**
Category **Planning**
Employees **100**
Founding year **1994**

A fair wind for the energy transition

In addition to classic project management, this independent family business offers in-house operational management, innovative project services and attractive public investment schemes. OSTWIND Repowering replaces existing turbines with modern and higher performing units.

Energy from a single source

Whether as a project developer, implementation partner, service provider, general contractor or operator, whether in individual phases or across an entire project – the OSTWIND Group offers you the complete spectrum of value-creation through wind energy.



Wind is what we do

This is the reason why today the company group, with offices throughout Germany, is a preferred partner for citizen-owned wind farms, municipal utilities, energy companies, public service providers, and regional energy suppliers, i.e. for private as well as institutional investments for the future.

Project development in partnership

With new partnerships of equals and tailor-made cooperation models, OSTWIND creates the prerequisites for successfully implementing joint projects and for responding together to an increasingly competitive environment.

Wind makes profits

OSTWIND is the first choice for those seeking new energy for the future and the right choice when it comes to:

- securing suitable sites
- developing successful projects
- realising high-yield wind farms,
- securing your investment in wind power over the long term

**Wind is our strength –
why not make it yours too?**

Peter Lonsdorfer GmbH & Co. KG

Wind-energy oil service onshore/offshore: In use across Europe

Onshore and offshore gear and hydraulic oil changes, regardless of the manufacturer: experience throughout Europe on over 20,000 wind turbines makes us a strong partner.



Since our first system in 1994, we have continued to develop our technology and ensure it remains state-of-the-art with the involvement of internal and external experts. We meet the constantly increasing requirements of technology, occupational safety and environment protection.

We take health and safety very seriously. Beyond our specific obligations arising from BS OHSAS 18001:2007 certification, we are also subject to the additional regulations of the British Wind Association. For a reliable and trouble-free workflow, an „all-round, peace-of-mind“ package is essential.

We can offer you total oil and filter logistics via our own tank and high-rack store.

Oil analysis and filtering

All clean oil that we use is cleaned through one of our specially developed filtering procedures to the required cleanliness class of gearbox manufacturers according to DIN ISO 4406.

Offshore

We have already demonstrated our standards in the North Sea and Baltic Sea with one of our in-house systems. We guarantee a reliable and environmentally friendly service. Our partner shipping company has many years' experience in international offshore terrain.

Used oil

As certified disposal specialists, we are naturally able to take away and dispose of used oil, under the legal provisions applicable in each case.

Development and construction of filtering / filling stations

At the request of various customers, in recent years we have developed and constructed both mobile and static filtering and filling stations. We will be happy to advise you and to build a tailored system for you.

01 | Lonsdorfer oil-change trucks for oil changes up to a height of 150 m.

02 | Lonsdorfer oil technicians at work.

03 | Offshore oil changes off the Scottish coast.



**Peter Lonsdorfer
GmbH & Co. KG**

Address **Ostenfelder Straße 2-4
25813 Husum**

Phone **+49 (0)4841 991-0**

Fax **+49 (0)4841 991-30**

E-Mail **info@lonsdorfer.de**

Web **www.lonsdorfer.de**

Profile **Service, maintenance & repair**

Category **Operation & service**

Employees **85 (Wind energy: 13)**

Founding year **1945**

PNE WIND AG

Passion for Energy

Planning, realization, operation and management of wind farms.
International, onshore and offshore.



01 | Altenbruch wind farm, Lower Saxony
02 | Calau wind farm, Brandenburg
03 | Gode Wind offshore wind farm, North Sea



Overview

PNE WIND develops wind farms. From the first idea to the ongoing operation our services cover all phases in the development of a wind farm. To date, the PNE WIND Group (consisting of the brands PNE WIND and WKN) has realized onshore wind farms with a total output of more than 2,400 MW. Our activities currently span Europe, North America and South Africa. PNE WIND also develops offshore wind farms to the point when they are ready to be constructed. Borkum Riffgrund and Gode Wind count to our successfully developed wind farms on sea.

Wind farm development from a single source

Site acquisition, reports and studies on environment relevant determinants, approval procedures, project financing, construction management, grid connection, turnkey installation, operation and maintenance services, repowering.

Wind farm management

After commissioning we usually stay in charge of the technical and commercial management of the wind farms for our customers. We make sure the wind farm is serviced and maintained regularly and that it runs as efficiently as possible. The wind farms managed by us have a total capacity of approx. 1,400 MW.

Repowering after the end of the life cycle

Committed to the objective of sustainability, the PNE WIND Group replaces older wind turbines by means of more modern, more efficient systems. The modernization of the wind farm can lead to a considerable increase in output.

Partner for wind power planners

Owing to our extensive experience in the business of wind farm project development, we can act as a partner for other developers and all those who are planning with wind power. We will acquire projects that are already under development or we can help as a partner to complete the remaining steps to finalization together.



PNE WIND AG

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27472 Cuxhaven**
Phone **+49 (0)4721 718 06**
Fax **+49 (0)4721 718 200**
E-Mail **info@pnewind.com**
Web **www.pnewind.com**
Profile **Planners & project developers**
Category **Planning**
Employees **approx. 350**
Founding year **1995**



psm Nature Power Service & Management GmbH & Co. KG

Manufacturer-independent full-service provider: We offer you every aspect of technical and commercial management, plus servicing for wind turbines and solar plants.



Your full-service provider – for full success

At psm you have access to every service you require during the lifetime of your wind turbine or solar plant – from both a technical and a commercial perspective. As a manufacturer-independent company we always have both sides in mind. Because we know what makes sense from a technical perspective, we can always develop the most cost-effective solution for you. Profit from our years of experience as a service company for renewable energies.



We offer:

Wind power

- Technical management
- Maintenance and repair
- Repowering
- Replacement of large components
- Service for frequency converters
- Gear endoscopy
- Servicing transformer stations
- Commercial management
- Consulting

Photovoltaics

- Technical management
- Commercial management

Fully dedicated with a fair approach

The psm team – now around 120 strong – are genuinely enthusiastic about every project and give 100 percent, whether the task is replacing a gear unit or creating a profit forecast. What is particularly important to us? Open and honest communication with our customers: we say what we think. And we act when others are still talking.

Locally across Europe

The focus of our business is in Germany. We are represented here by an extensive network of locations and look after both wind turbines and solar plants in North Rhine-Westphalia, Saxony, Saxony-Anhalt, Rhineland-Palatinate and Schleswig-Holstein. We do, however, also have a local presence in southern Europe.



psm Nature Power Service & Management GmbH & Co. KG

Address	Juelicher Strasse 10–12 41812 Erkelenz
Phone	+49 (0)2431 9733-6
Fax	+49 (0)2431 9733-777
E-Mail	service@psm-service.com
Web	www.psm-service.com
Profile	Service, maintenance & repair
Category	Operation & service
Turnover	€ 10 million
Employees	120 (Wind energy: 100)
Founding year	1998

R+V Versicherung AG

R+V offers comprehensive insurance cover for wind turbines.

From planning and installation through to the operational phase, wind turbines require comprehensive insurance cover. This is now available all under one roof with R+V's new wind insurance concept.



R+V adviser Jan Kehnnappel (left) is a competent contact for Mr Petersen, an onshore wind farm operator.



R+V Versicherung AG

Address **Raiffeisenplatz 1**
65189 Wiesbaden
 Phone **+49 (0)611 533-98751**
 E-Mail **G_KompetenzZentrumEE@ruv.de**
 Web **www.kompetenzzentrumee.de**
 Profile **Insurance companies**
 Category **Finance & law**
 Turnover **€ 14.5 billion**
 Employees **15,100**
 Founding year **1922**

R+V is part of the German cooperative banking group Volksbanken Raiffeisenbanken (VR), making it part of a strong alliance. What we offer our customers, in addition to the latest products and extensive knowledge, is our local presence. Across the 1,000 VR banks and their 12,000 branches, our customers find a named contact for all their insurance matters. You can be sure that we are always there for you.

First-hand knowledge all under one roof – Competence Centre for Renewable Energies

As one of the largest insurers for renewable energy plants, R+V has over 30 years' experience in this field. To strengthen our position in the rapidly growing renewa-

bles market, we have bundled our knowledge and expertise in the Competence Centre for Renewable Energies. Our team of experts implements new product ideas across all areas and continuously develops the existing product offer.

Our staff are always identifying the latest trends in the fields of wind power, solar energy and biogas in cooperation with leading companies and associations. Helping you make sustainable use of our solutions well into the future.

R+V insurance solutions for your wind turbines

Wind turbine operators are making an important contribution to the success of the energy transition. This way of generating power is especially climate-friendly and particularly lucrative – provided you are sufficiently well insured.

From planning and installation to the operational phase, R+V offers comprehensive cover all under one roof with its new insurance concept especially for wind energy.

Let us join forces at the early stages of your project so we can offer you the very best support and advice.



RES Deutschland GmbH

Supporting renewable energies for 30 years

RES (Renewable Energy Systems) is the right choice for the energy supply of the future: the project developer has been a partner for renewable energy systems all over the world since 1982.

Headquartered in the United Kingdom, the RES Group is a family-run, independent company with a sustainable strategy for climate-friendly, local energy supply. RES has already implemented over 200 renewable energy projects of all sizes worldwide, with a total of more than 12,000 MW of installed capacity. RES covers the entire value chain – from development to operation.

RES in Germany: Enthusiasm and professionalism

Since 2013, RES has also been active in Germany and has the full technical and financial support of the RES Group. In fact, Germany is becoming a core market for RES in the field of onshore wind energy. The project developer also manages the entire value chain here – from securing sites to operation.

The planned growth is achieved through the development of its own projects, and also through cooperation with mainly small to medium-sized, regionally established project developers, to jointly use the strengths of both partners to succeed in the upcoming tendering system.

A strong alliance of regionally successful project developers in combination with the financial strength and international experience of the RES Group will also see success on the German market and drive the energy transition forward.



In the industrial energy storage segment, RES Deutschland is active as a project developer, EPC service provider and operator and owner of individual storage projects.

Above all, RES currently sees application fields for energy storage in Germany in the provision of primary control power or in projects to replace expansion measures in the distribution network.



RES Deutschland GmbH

Address	Rotebühlplatz 1 70178 Stuttgart
Phone	+49 (0)711 184 228 0
E-Mail	info.germany@res-group.com
Web	www.res-group.com
Profile	Planners & project developers
Category	Planning
Turnover	> € 1.150 million
Employees	> 1,000
Founding year	1982

Roever Broenner Susat Mazars GmbH & Co. KG

When it comes to the auditing and consulting of wind energy companies, we are your contact with comprehensive industry expertise.



Roever Broenner Susat Mazars is one of Germany's leading independent medium-sized auditing and tax consulting firms. Roever Broenner Susat Mazars Rechtsanwaltsgesellschaft mbH, a medium-sized law firm, is also a member of our group. 72 partners and more than 1,100 employees support clients in the areas of auditing, tax advisory, accounting & outsourcing, legal services, financial advisory services as well as consulting.

We are active in all regions of Germany with our nine locations in Berlin, Dresden, Düsseldorf, Frankfurt am Main, Greifswald, Hamburg, Cologne, Leipzig, Munich, Nuremberg, Potsdam und Stuttgart, thus in your vicinity.

We have particular industry expertise relating to companies in the energy industry and renewable energy sector.

Our main activities in this area are:

- Preparation of annual financial statements and audits according to the HGB (German Commercial Code) as well as IFRS
- Tax consulting and planning
- Energy law
- Structuring of funds/asset investments
- Drawing up and evaluating prospectuses
- Due diligence audits
- Contract composition and review
- Financial modelling
- Reference yield reviews
- Output certificates
- Financial structuring

As a part of the international integrated Mazars partnership as well as of Praxity Global Alliance Ltd, an association of independent auditing and advisory firms, we offer audits in accordance with international standards, consulting in international teams, international tax law and cross-border transactions (restructuring, the purchase and sale of companies, the outsourcing of activities).



Roever Broenner Susat Mazars GmbH & Co. KG
Wirtschaftsprüfungsgesellschaft
Steuerberatungsgesellschaft

Address **Alt-Moabit 2**
10557 Berlin

Phone **+49 (0)30 208 88-0**

E-Mail **gerhard.schmitt@mazars.de**

Web **www.mazars.de**

Profile **Tax accountants**

Category **Finance & law**

Turnover **€ 122.5 million**

Employees **1,100**

Founding year **1919**



RoSch Industrieservice GmbH

RoSch offers a variety of services for the wind industry, all from one source and 24 hours a day.

What gives RoSch the upper hand is a wide range of services combined with a qualified workforce that, thanks to constant further training, is always up to speed with the latest technology.

Regardless of whether it concerns design, erection, maintenance or repair – customers of Lingen-based RoSch Industrieservice GmbH get it all from the same source. The company does oil changes, cleans and changes filters, or tests and repairs flange connections. The RoSch range of services also includes erecting turbines and replacing gears and rotor blades. And always around the clock, because thanks to its 24-hour emergency helpline, customers can reach RoSch anytime of day or night.

RoSch not only supports operators with maintenance and repair services, it also helps manufacturers with design of special machine parts or producing technical drawings.

Always up to speed

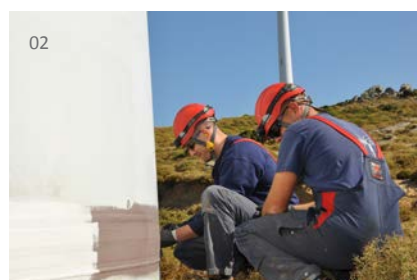
Managing director Maik Schlapmann places great store in employee qualification. Regular further training courses ensure that RoSch staff are always familiar with the latest technology and able to provide customers with highly skilled work, whether they be welders, mechatronics technicians, electricians, or mechanical engineers.

Schlapmann does also set high standards for the technical equipment. He knows that you can only provide work of the highest quality if you are fully abreast of all technical developments. The same applies for tools and equipment at RoSch. The company also pays special attention to work safety. DEKRA has certified RoSch in accordance with SCC and ISO 9001:2008.



01 | RoSch service vehicle in action.

RoSch has made a name for itself in the industry as a reliable partner with the right expertise. Numerous well-known customers place their trust in the quality work provided by RoSch. The company enables them to find flexible solutions, always adapted to meet individual needs. All this onshore and offshore, in Germany and abroad.



RoSch Industrieservice GmbH

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Fax	+49 (0)591 800990-19
E-Mail	info@rosch-industrieservice.de
Web	www.rosch-industrieservice.de
Profile	Service, maintenance & repair
Category	Operation & service
Turnover	approx. € 6.9 million
Employees	120
Founding year	2008

Roxtec

Certified protection for your safety

From a garage company to global market leader



Roxtec was founded in 1990 by Mikael Blomqvist in his residential garage in Karlskrona, Sweden. Thanks to the invention of Multidiameter, a solution that improved the process of sealing cable and pipe penetrations, our company experienced impressive growth. We maintained our entrepreneurial spirit, our customer focus and our strong core values. Today, we provide complete sealing solutions which withstand multiple risks for a variety of applications in many industries.

Global expansion

As a global company with a strong local presence Roxtec supports customers and their projects in more than 80 markets all over the world. Due to this worldwide presence we can provide customer proximity and on-site support especially in cross-border projects like within the field of Wind Energy.

A flexible sealing system

Roxtec sealing solutions for cable and pipes are certified and efficient by protecting against a variety of hazards from fire, water, explosions and electromagnetic interferences.

Keep your equipment dry

Protect your sites and substations against flooding, humidity and partial discharge. Maintain optimum operating conditions with Roxtec UG™ seals for cables and pipes.



Roxtec GmbH

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22143 Hamburg**

Phone **+49 (0)40 6573 98 0**

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E-Mail **info@de.roxtec.com**

Web **www.roxtec.com/de**

Profile **Service, maintenance & repair**

Category **Operation & service**

Founding year **1990**

01 | Installed R-frame to seal multiple cables

02 | Roxtec H3 150 UG for underground applications

03 | Roxtec R-frame

Statkraft Markets GmbH

As the market leader in direct marketing, Statkraft is a powerful partner with a comprehensive service offering.

Statkraft stands for technically and economically sensible integration of renewable power. With over 120 years' experience as a power plant operator and power trader, we are well-positioned to market renewable power production of larger and smaller facilities. In addition to our standard services, such as production forecasts, commercialisation of power in the spot markets and balancing, we also support our customers with a range of services that simplify everyday life in the energy sector. Upon request, Statkraft will manage the settlement and compensation payments with grid operators following feed-in management interventions (*Statkraft EisMan*). In the Statkraft customer portal you will be able to view all direct marketing services to which you subscribe and, since very recently, profit forecasts for your installations.

Grid stability through wind power

With our latest service *Statkraft Regel-Energie* operators of wind farms can contribute to the stability of the power grid and at the same time generate additional income. Statkraft takes care of the technical and operational prequalification



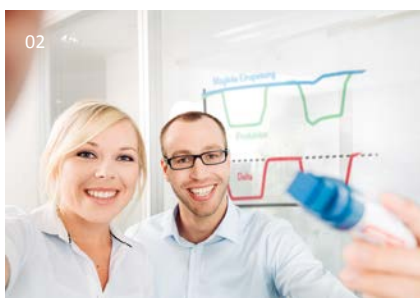
of your installations with the competent transmission grid operator and takes over the commercialisation in 4-hour-time-slices of the daily tenders.

As a reliable partner with well-founded expertise, we support our customers around the clock, 365 days of the year. The best yet is, Statkraft offers these services not only in Germany, but also in Belgium, France, UK, Netherlands, Turkey and in Scandinavia.

We hope we have piqued your interest. If so, we would be glad to explain how you can derive additional value from your plant.

01 | Market integration: We will make it.

02 | We do not rest on past achievements. We continuously develop renewable energy.



Statkraft Markets GmbH

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Phone	+49 (0)211 60244-000
Fax	+49 (0)211 60244-199
E-Mail	direktvermarktung@statkraft.de
Web	www.statkraftdirektvermarktung.de
Profile	Direct marketers
Category	Direct marketing
Turnover	€ 13.2 billion
Employees	463
Founding year	1999

THEOLIA Naturenergien GmbH

With fresh energy behind you

We stand out from the crowd – through performance, competency and our fascination with generating power from wind. This fascination is tangibly present in the range of services we offer.



Both our many years of experience and our comprehensive know-how are critical assets when it comes to commercial and technical operational management. THEOLIA's highly-skilled staff working throughout the entire value-added chain ensure that we are able to operate wind turbines from any manufacturer and in any performance class in a commercially and technically optimised manner. This is reflected in the 98 % availability we achieve for our wind power portfolio.

THEOLIA's proposition to customers is even more attractive. With higher levels of service orientation, quality, and safety, both commercial and private customers will find exactly what they need within our modular operational management package.

Having 89 wind turbines of our own we are familiar with the optimisation potential and the realities of wind farms as well as operational management requirements. This sets us apart from our competitors and we set a high benchmark for ourselves – all in the interests of our customers.

Take us at our word and contact us for a no-obligation quote or come and talk to us.

The THEOLIA team look forward to seeing you.

THEOLIA Naturenergien GmbH offers:

- Commercial and technical operational management of your wind turbines
- Accountancy services for your wind farm company
- A modular design principle to put together your personalised operational management package
- Merger & acquisition support, support with real estate and grounds management, and project planning
- Support with direct marketing activities, insurance, communication and repairs

With around 350 wind turbines and a combined energy output of 500 MW from third-party and company-owned plant distributed throughout Germany, THEOLIA is one of Germany's leading independent electricity producers and plant management companies.



THEOLIA Naturenergien GmbH

Address **Ulmer Str. 4
70771 Leinfelden-Echterdingen**
Phone **+49 (0)711 23860-0**
Fax **+49 (0)711 23860-99**
E-Mail **kundenservice@
futura-group.com**
Web **www.windparkbetreuung.de**
Profile **Technical & commercial
operational management
Operation & service**
Category
Employees **35**
Founding year **2000**

TÜV NORD EnSys GmbH & Co. KG

Full service provider for the wind industry

TÜV NORD certifies wind turbines to all international standards and regulations, evaluates specific site conditions and supports operation of wind turbines over their entire lifecycle.



With more than 10,000 employees and experts in nearly all technical disciplines, TÜV NORD Group is one of the world's largest technical service providers. We owe our leading market position to our technical competence and a wide range of services in the field of consulting, testing and certification in our business units of Mobility, Industry Services and International. We operate in over 70 countries worldwide.

Within the field of wind energy TÜV NORD offers services in certification, site assessment and inspection of wind turbines (WTG) and projects. TÜV NORD is one of the leading accredited certification bodies for wind turbines certifying on- and offshore WTG according to all major guidelines such as IEC, EN, GL, the Danish approval scheme, TAPS and BSH.

Type certification begins with the design assessment of loads, safety concept and all components of the WTG. Prototype tests then verify the assumptions made during design assessment and measure the power curve. On major components such as gearboxes and rotor blades, separate prototype tests are performed. The third mandatory part of certification is the evaluation of manufacturing with respect to the quality system and the implementation of the design requirements during production. Major components can also be certified individually.

Besides the well known type certification for manufacturers and project certification for project developers, all services for wind energy projects can also be offered as a one-stop shop. The entire range of project-related assessment services is available to wind farm planners, operators and providers of finance.



TÜV NORD EnSys GmbH & Co. KG

Address **Große Bahnstr. 31
22525 Hamburg**
Phone **+49 (0)40 8557-0**
E-Mail **windenergy@tuev-nord.de**
Profile **Wind resource evaluators**
Category **Experts**

UKA Group

Leading onshore developer

The UKA Group installs wind farms and their associated infrastructure in Germany and the USA. With over 330 wind turbines and around 800 megawatts of installed total rated capacity, UKA is one of the top 3 onshore developers in Germany.



**UKA Umweltgerechte
Kraftanlagen GmbH & Co. KG**

Address **Dr.-Eberle-Platz 1
01662 Meißen**
Phone **+49 (0)3521 72 80 60**
E-Mail **zentrale@uka-meissen.de**
Web **www.uka-gruppe.de**
Profile **Planners & project developers**
Category **Planning**
Employees **460**
Founding year **1999**

End-to-end solutions for generating energy locally

As an end-to-end supplier, the group carries out all services up to the operational handover of the wind farm.

Its sister company UKA Projektträger GmbH & Co. KG, headquartered in Lohmen (Mecklenburg, Germany) is responsible for the realisation of all construction

projects for the UKA Group. The high purchasing volume enables UKA-Projekt-träger to work particularly efficiently and offer its services to external customers as well – a win-win situation for everyone involved. External wind farm projects are supported right up to their completion in line with existing laws: from road and foundation construction through grid connection, complete building work and commissioning to the maintenance of

02

Implemented projects from 2014 until 2016

> 657,858 m² set-up area
and access routes
> this corresponds
to 2,530 tennis courts



> 166 foundations and wind turbines

> 1,192 kilometer of cable
> this is equivalent to the distance between
Flensburg and Garmisch-Partenkirchen



all official regulations and acceptance in line with the German Federal Immission Control Act.

As an expert for wind energy in forest areas, UKA has already put into operation several wind farms in commercial forests. UKA also successfully implements repowering projects.

With the commissioning of the wind farm, the subsidiary UKB Umweltgerechte Kraftanlagen Betriebsführung GmbH ensures that the turbines demonstrate optimal technical and economical performances for decades to come.

The UKA Group currently has around 460 employees at its sites in Meissen, Cottbus, Rostock, Erfurt, Oldenburg, Bielefeld, Hanover and Lohmen (Mecklenburg) and in the USA.

1 | Wind farm Parchim (Mecklenburg-Western Pomerania).

2 | Planning – construction – management: Full service from a single source.

3 | UKA sites.

4 | UKA service vehicle in action for the energy transition.

5 | Range of services of the UKA Group.



Umwelt Management AG (UMaAG)

Leading Player

Umwelt Management AG (UMaAG) is one of the leading players in the wind energy industry in Germany and has developed over 60 projects, built 379 wind farms and produced over 600 MW in volume in the last 20 years.



Umwelt Management AG (UMaAG)

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27478 Cuxhaven**
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Fax **+49 (0)4722 9109160**
E-Mail **info@umwelt-management.de**
Web **www.umwelt-management.de**
Profile **Planners & project developers**
Category **Planning**
Turnover **€ 1,000 million**
Employees **30**
Founding year **1998**

The Team

The Chief Executive Officers Uwe Leonhardt and Günther Conrad and their team of 30 experts focus on the successful development of Renewable Energy in the context of climate protection, healthy environment and species protection. A total investment volume of around € 1,000 Mio. has been generated in the last years.

Providing a Solid Foundation to Success

The successful business is based on long term experience, comprehensive knowledge of all aspects regarding building and managing wind farms and a proven adaptive capacity in the local and international environment combined with a friendly, but strong drive to success.

Services

Umwelt Management AG (UMaAG) offers the following services:

- Project Acquisition
- Project Development, Implementation and Management
- Financial Concepts, Procurement of Equity and Outside Capital
- Commercialization of Sustainable Energy
- Technical Services and Management
- Commercial Accounting
- Shareholder Support

Modern Technologies

The use of the latest technologies ensures efficient and effective project measurements and management on all levels, leading to a transparent flow of communication to investors, shareholders, banks and project partners.

Umwelt Management AG (UMaAG) believes in long term and trustworthy relationships and is looking forward to implementing new projects with existing and new partners in the Renewable Energy arena.



Member of the Board Dipl.-Wirt.-Ing. Günther Conrad (left) and Chief Executive Officer Dipl.-Kfm. Uwe Leonhardt (right).

Unternehmensgruppe Teut

Planning and operation of wind turbines

Everybody talks about the weather. We turn it into power!

Unternehmensgruppe Teut, with offices in Lindow / Mark and Berlin, has been designing, constructing and operating wind turbines since 1995. Wind is an unlimited source of energy. Wind power is an environmentally friendly form of energy production, which, due to recent events, has become indispensable for our future. Unternehmensgruppe Teut would like to contribute to the sustainable use of this energy source.

Unternehmensgruppe Teut has many years' experience, most of it involving projects in Brandenburg, but increasingly also in neighbouring states and in other European countries such as Switzerland and Austria.

Unternehmensgruppe Teut, with its 14 expert employees, offers a full range of professional services for successful wind energy projects. Our success can be seen in 33 implemented projects with 100 wind turbines and around 164 MW of installed capacity. We are currently planning 23 projects involving the erection of 155 turbines with a total of 450 MW.



Our goal is to create sustainable projects with satisfied owners, communities and investors, which for us means working together openly with all involved parties right from the beginning. We place great emphasis on openness and transparency throughout the planning process and also try to approach objections raised against wind power constructively and to give advice accordingly.

Our goal is to achieve something together with communities, such as more profitable land use, awarding building contracts in the region and implementing compensatory measures in communities.

We look forward to working with you!



01 | HST-Tower together with SIAG and Servion.

02 | Office in Berlin, an old rectifier factory.



www.teut.de

Unternehmensgruppe Teut

Address	Idastraße 20
	13156 Berlin-Pankow
Phone	+49 (0)30 555 7447-0
Fax	+49 (0)30 555 7447 99
E-Mail	jan.teut@teut.de
Web	www.teut.de/index.php
Profile	Planners & project developers
Category	Planning
Turnover	€ 2.5 million
Employees	15
Founding year	1996

Vattenfall Europe Windkraft GmbH

Successful partnership

A strong partner for your wind farm project.

Vattenfall is a strong and reliable partner with many years' experience in the energy sector. The systematic development of wind energy is a clear objective: By 2020, Vattenfall wants to double the production of electricity from onshore and offshore wind farms to more than 4 GW, and is investing more than 5 billion euros into this objective.

Vattenfall has a strong basis in Germany, which we would like to develop with partners on a regional basis. We want to develop ideas with you and successfully implement wind projects. We will define the scope of the project together. We're here to support you at whatever stage your project is at: planning, construction or in operation!



	Vattenfall Europe Windkraft GmbH
Address	Überseering 12 22297 Hamburg
Phone	+49 (0)40 2718 2005
E-Mail	annemarie.pausch@vattenfall.de
Web	www.vattenfall.de/windkraft
Profile	Planners & project developers operational management
Category	Planning, construction, operation
Employees	28,567 (Wind energy: approx. 800)
Founding year	2009

Our offer

- Individual co-operation models on a project basis depending on your needs and possibilities
- Complete project and wind farm management
- Entry at every implementation stage: Development – Construction – Operation
- Strategic support during the tender process based on many years' experience
- Financial support depending on need and openness to take risks
- Potential development of partnerships in other markets
- Individual investment models
- Innovativeness with optional business models such as combination with photo-voltaics or batteries, or direct selling
- Asset management expertise

Your benefits

- Risk minimisation through a partnership
- Successful joint implementation of your project
- Financial security and stability – including for your workers
- Development potential through access to other markets



3Energy Unternehmensgruppe

Smart energy concepts: From a single source – under one roof

We provide tailored solutions in the field of sustainable and local energy generation and supply.



Consisting of the specialist companies GEPRENET GmbH, eab New Energy GmbH, WKA Sachsen Service GmbH, 3E technology GmbH, Heliotec GmbH and 3E WKA System GmbH, the 3ENERGY Group is a full service provider of tailored solutions in the field of sustainable and local energy generation and supply. We cover the entire lifecycle of turbines and infrastructure – from planning and developing projects to implementation, maintenance, servicing, and economic operation through to dismantling and recycling.

While we work with a range of other renewable energy sources, our focus is on wind turbines and solar power plants. With over 600 MW of output from our projects and more than 25 years' experience, we are one of the leading companies on the market.

01 | 3Energy received the German/Norwegian business award for the wind farm project Midtjøllet in 2013.

02 | Assembly of wind turbines.

03 | Corporate headquarters of the 3Energy Group in Großschirma / Saxony / Germany.



An overview of our services

- Planning and implementation of sustainable and local energy generation plants (including wind turbines and photovoltaic systems)
- Management, maintenance and servicing
- Dismantling and management of old turbines
- Sales of used turbines as well as wind and solar farms, replacement components and spare parts
- Energy consumption measurement and evaluation, and optimisation and/or design of private consumption systems

04 | Controls are necessary. This includes a regular status survey in order to detect and fix defects at an early stage.



ENERGY

3Energy Unternehmensgruppe

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Fax	+49 (0)37328 898299
E-Mail	info@3energy.eu
Web	www.3energy.eu
Profile	Planners & project developers
Category	Planning
Employees	< 100 global
Founding year	1991

VDI Wissensforum GmbH

We know which way the wind is blowing

Annually we host 25,000 participants at our conferences, conventions, trade fairs, forums und seminars for further education of engineers, technical specialists and executive managers.

We know which way the wind is blowing!



Source: © iStock.com - cynoclub

VDI Wissensforum has been the leading specialist in further education for more than 55 years for engineers, technical specialists and executive managers. Annually we host more than 1,500 national and international events in almost any technical discipline.

Further education in the energy sector

We offer more than 200 courses for further education on energy topics.

Further information:

www.vdi-wissensforum.de/energie

Your specialist for wind power

We offer high-quality courses on technical and operative subjects.

We offer courses on the following topics:

Wind-energy engineering, electric systems for wind turbines, link to the grid and power supply, wind-measuring, operation and maintenance of wind turbine, development and design of wind farms, EEG 2017.

Our conventions and conferences:

Venue for manufacturers, producers, suppliers, operators, service providers and research institutes.

Major VDI-Wind-energy-event with two parallel conferences:

June 27-28, 2017 in Bremen, Germany

- VDI special-conference "Rotor blades of wind energy facilities"
- VDI special-congress "Oscillation of wind energy facilities"

Further information:

www.vdi-wissensforum.de/rotorblaetter

www.vdi-wissensforum.de/weiterbildung-energie/schwingungen-von-windenergieanlagen

Certificate course

Specialist engineer for wind-energy engineering VDI

The "Fachingenieur Windenergietechnik VDI" / Specialist engineer for wind-energy engineering VDI" is a qualification that includes practical experiences.

It includes six modules and finishes with a VDI-Certification exam and an accredited degree. The certification courses allow flexible time-management and planning as well as further individually personalized advanced studies.

Further information:

www.vdi.de/windenergie_lehrgang

VDI Wissensforum

VDI Wissensforum GmbH

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Fax **+49 (0)2116214-154**
E-Mail **wissensforum@vdi.de**
Web **www.vdi-wissensforum.de**
Profile **Education & training**
Category **Education & training**
Employees **>100**
Founding year **1957**

Ventotec GmbH

We create clean energy and new jobs.

Ventotec GmbH is one of Germany's leading end-to-end providers in the renewable energy sector. Founded in 1998, Ventotec has successfully established plants with a rated capacity of more than 750 MW in Germany and abroad at an investment volume of more than one billion euros.



agenda. With 62 MW of installed power this was once the largest wind farm in Europe; it is now being repowered. The first phase was completed 2015 with the commissioning of 27 new Vestas V112-3,3 MW turbines. In subsequent stages the number of wind turbines is to be increased to 65.

01 | Klettwitz wind farm in Schipkau/Brandenburg.

02 | Executive Directors of Ventotec Ralf Heinen and Helmer Stecker.

United we are strong – Based on this principle, Ventotec GmbH has been working successfully with ITEC International GmbH for over ten years. Together, this corporate alliance is able to cover the entire renewable energy spectrum.

Helmer Stecker and Ralf Heinen have been instrumental in developing this area. In addition to their positions as Executive Directors of Ventotec GmbH, they are also responsible for managing the renewable energy alliance from Leer.



Years of expertise

Ventotec GmbH was founded in 1998. Originally conceived as a traditional project developer, the company provides the whole range of services in the area of project planning. Over the last few years, the company has managed to successfully establish itself on the market as a vendor and marketer of renewable energy projects. Right at the start of this decade, Ventotec was able to skilfully manage foreign investors' growing interest in renewable energy projects, thanks to its many years of experience in project planning for closed-end funds. Now Ventotec is much in demand as one of the main German providers of wind energy projects and is in constant contact with important institutional investors within Germany and abroad. Ventotec is also responsible for the associated project funding.

In 1998 everything began with Klettwitz wind farm - once again at the top of the



Ventotec GmbH

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E-Mail	info@ventotec.de
Web	www.ventotec.de
Profile	Planners & project developers
Category	Planning
Turnover	€ 1.1 billion
Employees	80
Founding year	1998

VERBUND

VERBUND is one of the largest producers of hydro electricity in Europe and the German-speaking world. Today, the major challenge is the integration of renewables. We offer flexible product marketing, efficient storage and pool solutions, and impressive service concepts.



Individual solutions for existing and new turbines

Whether wind, water, photovoltaic or biomass, since 2016 direct marketing in accordance with the EEG is compulsory for new generating systems of 100 kilowatts or more. VERBUND Trading & Sales Deutschland, trading subsidiary of the largest electricity concern in Austria, carries out direct marketing of its green electricity for turbine operators throughout Germany.



As an experienced player on the electricity market, VERBUND has the required expertise to master the challenges in this dynamic environment in a cooperative way.

Our offer:

- Optimum green electricity marketing on intraday, spot and futures markets
- Many years' experience of producing forecasts
- Networking in virtual VERBUND power plant
- Registration and re-registration of turbines
- Participation in the electricity balancing market
- Individual contract periods

Benefits:

- Low prices thanks to optimum electricity marketing and flexible power stations
- Extra yield compared to EEG feed-in tariff

- Downtime remuneration if feed-in performance is reduced
- Financial security thanks to outstanding yields
- Personal contacts in Munich and Düsseldorf

VERBUND – Europe's green battery

With its flexible, 7,700 megawatt power plant, VERBUND is the largest producer of hydro-electricity in Austria and Bavaria. This is ideally supplemented by VERBUND's own wind farms and those marketed for third parties.

Flexibility products

The generation portfolio consisting of hydro and wind power is the basis for attractive flexibility products designed specifically for the requirements of the market. Where necessary, companies receive electricity, energy-related products and services, combined with innovative solutions for the efficient use of energy.

Verbund

Am Strom der Zukunft

**VERBUND Trading & Sales
Deutschland GmbH**

Address **Sonnenstraße 17
80331 Munich**
Phone **+49 (0)89 890 56 21933**
Fax **+49 (0)89 890 562 1950**
E-Mail **direktvermarktung@verbund.de**
Web **www.verbund.de**
Profile **Direct marketers**
Category **Direct marketing**

Volkswind GmbH

Production of clean and renewable onshore wind energy



Volkswind has been one of the leading wind energy producers in Europe since 1993. Its core business comprises the planning, projection, construction and operation of wind turbines.

Being a pioneer of the German wind energy business with over 70 realized wind farms Volkswind is nowadays one of the leading European developers and operators of onshore wind farms. This comprises a diversified portfolio with regards to geographies as well as clients.

After the take-over by the Swiss utility Axpo in 2015, Volkswind is even stronger positioned in the market for the further expansion and diversification of its project portfolio, also with view to regulatory changes in the energy market.

The Axpo Group produces trades and distributes energy reliably in Switzerland and in over 30 countries throughout Europe. Around 4500 employees combine the expertise from 100 years of climate-friendly power production with innovative strength for a sustainable energy future.

Axpo is a global leader in energy trading and the development of customized energy solutions for its clients. Axpo's energy know-how and its market and industry experience ensure a strong strategic partnership in the wind energy sector.

Besides a further expansion of the business activities in the core markets Germany and France this partnership comprises also the expansion of the operational management and asset management.



Volkswind GmbH

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Fax	+49 (0)4222 94138-99
E-Mail	info@volkswind.de
Web	www.volkswind.de
Profile	Planners & project developers
Category	Planning
Employees	approx. 80
Founding year	1993

vortex energy Holding AG

When know-how and passion go hand-in-hand, you get a dedicated all-rounder

For the last 13 years, the vortex energy group has developed, implemented, operated and marketed wind and PV projects. It is also a licensed service provider for electricity balancing, trading and sales in Poland.



NEUE ENERGIEN – WEIL ES UNSERE NATUR IST.

vortex energy Holding AG

Address **Obere Königsstr. 30
34117 Kassel**
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Fax **+49 (0)561 450798-15**
E-Mail **info@vortex-energy.de**
Web **www.vortex-energy-group.com**
Profile **Planners & project developers**
Category **Planning**
Turnover **€ 20 million**
Employees **80**
Founding year **2004**

Holding at eye level

In 2004 Heinrich and Till Jeske founded vortex energy. Father and son together laid the foundations for a constantly growing company that made the leap to a holding company in 2014. In addition to vortex energy Deutschland GmbH vortex energy Polska Sp. z o.o. is also part of the group. To date (December 2016), vortex energy has installed approx. 370 MW of wind capacity in Germany and Poland. The project scopes can extend from 1 to 21 turbines. Since February 2015 vortex energy has been licensed as a provider for electricity balancing trading and sales in Poland.

From green field to management

After completion of project development, which includes acquisition of suitable sites, analysis of wind conditions, approval procedures and selection of the optimal turbine type, financing concepts have to be developed and own/third-party capital procured. As a general contractor, vortex energy installs the grid connection with associated infrastructure and implements

turnkey wind farms. These farms are either operated by us, or are generally sold to investors. After commissioning, vortex energy offers technical and commercial management, as well as technical inspections.

Respect for nature

vortex energy boasts a flexible team, which approaches complex challenges in an uncomplicated way. Even projects with countless hurdles are possible, according to the vortex motto „There's always a plan B“. The team relies on intelligent networking, clear communication and reliable order processing. The eco power generated by vortex energy is 1,060 GWh, which supplies approximately 320,000 households, and avoids 567.138 t CO₂/year.

VSB Holding GmbH

Development . Planning . Construction . Project Acquisition . Repowering

For more than 20 years, we have been developing environmentally friendly and profitable solutions throughout the entire value chain of wind energy projects for our customers and partners.

The future of our energy supply is in renewables. This has been VSB Group's (formerly WSB) guiding principle since 1996. And it's been successful, too. From its head office in Dresden and regional offices in Erfurt, Osnabrück and Potsdam, the consultancy has become an international provider of wind energy and photovoltaic solutions. VSB adds value throughout the entire project life cycle, from securing land through approval planning and implementation. We also support your wind or solar farm through the tender process and are your partner for all areas of management during the operation phase. We offer these services in a package as a general contractor, and also as tailored individual services – you choose the services you need. We aim to provide premium, efficient project management, high-value components and excellent partners.

VSB implements environmentally-friendly projects, reducing CO₂ emissions by several thousand tonnes each year. We involve citizens at an early stage and comprehensively, build acceptance and arrange individual participation options.



With our partners, we help municipal councils and mayors to develop and implement energy- and climate-driven concepts. As a result, our energy projects are a success for the region in many ways.

A 200-strong team works hard to make our vision of 100% energy generation from renewables a reality. For example, we have already succeeded in connecting roughly 760 megawatts of wind energy and photovoltaic power to the grid.

To prepare for the electricity market of tomorrow, we are also focusing on solutions for matching demand and supply of renewable electricity.



01 | Regional Value Added: Wind farm Wölkisch (Saxony, 20,5 MW).

02 | Wind energy in accordance with nature and environment.

VSB Holding GmbH

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01069 Dresden**

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Fax **+49 (0)351 21183-44**

E-Mail **info@vsb.energy**

Web **www.vsb.energy**

Profile **Planners & project developers**

Category **Planning**

Employees **more than 200**

Founding year **1996**

Windwärts Energie GmbH

A company of the MVV Energie Group

With more than 20 years of experience Windwärts is one of the pioneers of the sector. As part of the MVV Energie Group it is contributing significantly to the energy transformation.



01 | In good hands: Windwärts has been developing, building and operating onshore wind energy projects for more than twenty years.

02 | Successful: Our management gets the best out of our wind farms.



Windwärts Energie GmbH
A company of the
MVV Energie Group

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30449 Hanover
Phone **+49 (0)511 123573-0**
Fax **+49 (0)511 123573-190**
E-Mail **info@windwaerts.de**
Web **www.windwaerts.de**
Profile **Planners & project developers**
Category **Planning**
Employees **95**
Founding year **1994/2014**

Experience in onshore wind energy

Our areas of business are project development, financing and implementation, as well as technical and commercial management of onshore wind turbines in Germany and France. In addition, the company offers construction and planning services (EPC), the re-powering of projects and partnerships with citizens' energy companies and other actors. The prominent focus in Germany is Lower Saxony, Schleswig-Holstein and Ostwestfalen-Lippe.



To date, Windwärts has connected 162 wind turbines to the grid, with a total rated capacity of 301 megawatts. Management takes care of a total rated capacity of 489 MW and ensures the highest possible yields.

Expertise and enthusiasm for the energy transition

Windwärts understands its trade, from locating suitable areas through to planning and the approval process, financing and constructing the wind farm to commercial and technical management over the entire service life of the turbines. The expertise of the 95 members of staff in all these areas is as much a central feature of Windwärts' work as the company's reputation for care and attention to detail. It helps to assess risks and eliminate the obstacles in complex approval procedures. And our staff always have one objective in mind, which feeds their drive and commitment: they want to make the energy transition a concrete reality at every location.

Strong implementation

Site owners, councils and investors benefit from this experience and motivation, as well as public utility companies and energy suppliers for whom Windwärts plans and builds wind turbines.

Since Autumn 2014, Windwärts has been part of the MVV Energie group, making it part of one of Germany's leading energy companies.

WKN AG

Renewable energies for today and tomorrow.

WKN AG has been one of the leading project developers in Germany, Europe as well as the US for more than twenty five years. The German wind experts always keep an eye on new markets.



WKN AG has been planning, developing, financing and building first-class wind farms since 1990. As one of the pioneers of the German wind energy scene the Husum-based company has been one of the leading developers for decades and is also represented on various international markets. The WKN team consists of renowned wind energy experts who consider each project as a new challenge and who strive to find the best possible solution by working closely with the project partners on site.

It was this pronounced pioneering spirit which took WKN to international markets very early on. Since 2007 the fruits of these markets have been harvested: large-scale wind energy projects have been built in the US, Italy, Spain, Poland as well as France, and many further projects are currently being realized. Needless to say that WKN consistently keeps an eye on new and further markets.

In all projects, WKN relies on long-term strategies and cooperation with local partners. Wind energy projects developed by WKN are being acquired by renowned major company groups, investment trusts as well as energy providers. WKN's business activities include site evaluation and development, planning, financing, turn-key construction and operation through to commercial and technical management of the wind farm. Up until the end of 2016, WKN AG had realized more than 1,350 megawatts of installed capacity in about 110 projects.

In mid-2013 PNE WIND AG, Cuxhaven/Germany became the WKN majority shareholder.

- 01 | Local heroes for international challenges.
- 02 | Wind farm Francofonte, Italy.
- 03 | Wind farm Kastorf, Germany.



WKN AG

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E-Mail	info@wkn-ag.de
Web	www.wkn-ag.de
Profile	Planners & project developers
Category	Planning
Employees	160
Founding year	1990

Wölfel Wind Systems GmbH

Experts for structural dynamics, acoustics and vibration reduction

Wölfel Wind Systems is focused on the production and installation of condition monitoring systems (CMS) for the reduction of vibrations and structure-borne noise for onshore and offshore wind turbines.



sions and immissions and our experienced rotor blade inspectors assist you in all matters related to fibre composites.

In addition, the experience gained in research and service projects is taken into account and incorporated in the development of specific products. The systems IDD.Blade® (for ice detection), SHM.Blade® (for condition monitoring of rotor blades) – both certified by DNV GL – and the active damper system ADD.Sound® (for the reduction of the tonal components in airborne noise) are impressive examples for the development of application-oriented solutions. Our damping system TMD.Tower reduces tower vibrations and thus increases the lifetime of your WT. Our latest technological innovation is SHM.Tower – a system for load monitoring and life cycle prognosis of your WT. It is easy to retrofit and energy self-sufficient and thus quickly made its way to international markets.

Wölfel Wind Systems – we transform measurement data into knowledge.

With this knowledge you are on the safe side and have economic success!

Ice detection or reduction of tonalities, structural health monitoring (SHM) of rotor blades, towers or foundations or rotor blade inspections – our products and services focus on engineering in the field of structural mechanics and on the dynamics of your individual wind turbine (WT).

In signal analysis, we combine our findings from Third Party Inspection and recurrent inspection with the measuring data from the WT. In the past decades, Wölfel has built up and extended a unique core competence in this field. We extract the really relevant technical information from the masses of data. We provide information about structural damage on the blade, the tower or the foundation, about fatigue loads and the related lifetime consumption of your WT. We measure sound emis-



Wölfel Wind Systems GmbH

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Web **www.woelfel.de**
Profile **Technical consultants**
Category **Experts**
Founding year **1971**

wpd windmanager GmbH & Co. KG

All services from a single source – that's efficient wind farm management.
Optimized operation of wind farms, guaranteed through our long-term experience and comprehensive market knowledge.

Since 1998, wpd windmanager have been managing all tasks relating to the commercial and technical operation of wind farms. All our clients benefit from a customised selection of wind farm services optimised for profitability. We currently employ more than 345 staff in around 340 wind farms at home and abroad, encompassing 1,870 individual turbines producing a total output of 3,720 megawatts.

Technical Management

Considering that rapid response times are key to minimising profit losses, our service entails a complete technical support package, the core of which is 24/7 monitoring directed from our central control room. Among other things, our technical operational management team is responsible for operational monitoring, documentation and the management of contracts and warranty agreements. Our certified specialists deal with all other technical wind farm issues. Experienced wind farm managers ensure the optimum operation of turbines on site and the implementation of all necessary measures.



Commercial Management

We have extensive knowledge of all matters relating to taxation, legislation, and accountancy. In conjunction with central contact persons, our comprehensive information management system quickly provides our customers with information tailored to their specific requirements. We also monitor deadlines and produce annual reports.

Additional Services

Our optional additional services, which are also available outside of a plant management contract, are designed to increase productivity and profitability even more. These cover such areas as information technology, Quality, Health, Safety, Environment (QHSE), wind turbine components, wind farm infrastructure, electrical engineering and consulting Onshore.



**wpd windmanager
GmbH & Co. KG**

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E-Mail **windmanager@wpd.de**

Web **www.windmanager.de**

Profile **Technical & commercial
operational management**

Category **Operation & service**

Turnover **€ 10 million**

Employees **> 345**

Founding year **1998**



A photograph of several wind turbines in a field. The turbines are white with red and white striped tips on their blades. In the background, there are trees with yellow autumn foliage. The sky is a clear blue. The text is overlaid on the top left of the image.

Companies:

Publisher and cooperation partners

Working closely with its cooperation partners, the German Wind Energy Association (BWE) publishes a comprehensive overview of the industry in a publication entitled “Wind Industry in Germany”.

Manufacturer and Supplier Board of the German Wind Energy Association (BWE)

The voice of the German wind industry

The Manufacturer and Supplier Board represents the wind industry in Germany. Including Enercon, Vestas, Repower, Fuhrländer and Nordex, approximately 97 % of manufacturers are members of the Board, in terms of market share in Germany.



German Wind Energy Association

Manufacturer and Supplier Board of the German Wind Energy Association

Address **Neustädtische Kirchstraße 6
10117 Berlin**

Phone **+49 (0)30 212341-210**

Fax **+49 (0)30 212341-410**

E-Mail **info@wind-energie.de**

Web **www.wind-energie.de**

Profile **Associations**

Category **Organisations &
public institutions**

Founding year **1996**

To its members the Board offers an exclusive platform for information exchange. Export strategies, trade fair participation and joint action in the political arena are regularly on the agenda.

In addition to turbine manufacturers, the Board also includes suppliers as they too depend on political framework conditions. The suppliers to the wind sector are a key element since a significant proportion of the added value in this sector of industry is created in these mostly medium-sized enterprises.

The results of the work carried out by the working group "Marking and Lighting of Wind Turbines" also demonstrate how successful the pursuit of a common goal can be among manufacturers and suppliers. The pilot projects initiated for a needs-based navigation light system on wind turbines led to standardization in system technology that applies to all companies involved in the "wind turbine" system.

To ensure there is a positive political atmosphere, representatives from the manufacturer and supplier sector regularly come together for Board meetings. Representatives from the world of politics are invited to take part in constructive meetings so that decision-makers gain a better understanding of the point of view of the wind industry. Insight into



the political decision-making process is of key significance to ensure that political requirements can be responded to appropriately in the future. The Board therefore acts as an interface between the wind industry and politicians.

A strong voice for the wind energy sector in the public arena and in politics is fundamental. It is important to give all stakeholders in the industry the opportunity to represent their interests in an association that comprises nearly 20,000 members.

- Would you like to be actively involved in shaping the political framework for wind power?
- Do you have an interest in the network of wind turbine manufacturers and their suppliers?
- Would you like to organize trade-fair stands and events together with other market participants?
- Do you need information at first hand?
- Do you want to further strengthen the expansion of wind power consumption and thus the German wind energy market?

Then become a member of the Manufacturer and Supplier Board!

Contact:

Bundesverband WindEnergie e. V.
 Wolf Stötzel, +49 (0)30 21 23 41 -130
w.stoetzel@wind-energie.de

The expert committees at the German Wind Energy Association (BWE)

Advisory boards – Forums – Working groups

At the BWE, operators, manufacturers, suppliers and service providers are organised into expert committees such as advisory boards, working groups and forums.



At the advisory board meetings, companies in the wind energy sector meet to discuss and resolve current issues and to develop long-term strategies concerning the most important issues in the industry. Within their specialist areas, they therefore function as an important exchange of information. The work carried out by these expert leads to position papers and statements; the standards developed then act as a guideline for the entire wind industry. Each advisory board has a chairman who sits on the federal executive board of the BWE, giving them a strong say in the association's policies.

Advisory board of operational managers

The advisory board of operational managers deals with all commercial and technical aspects related to wind turbine operation. Its members are also active in other associations to work towards guidelines.

Citizen's wind energy advisory board

The citizen's wind energy advisory board brings together operators of citizen's wind farms. Concerned with implementing the energy transition through citizen's and community-owned energy projects, it represents the interests of citizen's wind farm operators within the BWE.

Expert advisory board

The expert advisory board discusses and develops policies and procedural guidelines for the technical examination of wind energy systems.

Finance advisory board

The finance advisory board is open to all banks and financing companies with activities in the wind energy industry. It acts as a forum for the exchange of ideas between different companies, for example for the drawing up of rules for the financing of wind energy projects.

Investor's advisory board

The investor's advisory board is concerned with the quality of investment opportunities in wind farms. It analyses annual financial statements and collects important information on the financial situation and profitability of numerous wind farm projects.

Legal advisory board

The legal advisory board comprises over 90 lawyers and in-house legal counsels who together discuss current legal questions relating to wind energy. This involves the exchange of valuable information on current court cases. The latest legal proceedings are also discussed by the legal advisory board and written opinions submitted.



The expert committees at the German Wind Energy Association (BWE)

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Profile Associations

Category Organisations & public institutions

Founding year 1996

Manufacturer and supplier board

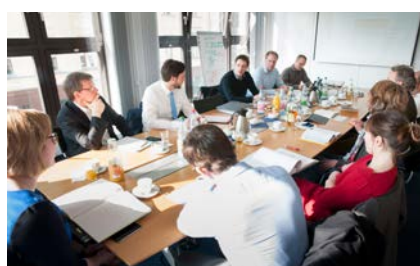
As the committee for the representatives of the wind energy industry, over 97 percent of German wind turbine manufacturers are represented on the manufacturer and supplier board. The Board works closely with the BWE on industry-related topics.

Operators' advisory board

On the six operator forums at the BWE, members exchange knowledge about each manufacturers' wind turbines. Operators of both individual and multiple wind turbines are organised in such forums. The speakers of the forums meet regularly to discuss their experiences in the operators' advisory board.

Planning advisory board

The planning advisory board is an important platform for the exchange of information by planning companies. Expert presentations accompany the discussion of major topics such as local and national planning laws, the future shape of the EEG, and European energy policy. Members support the positioning of the BWE regarding planning questions.



Scientific advisory board

As a forum for BWE members active in research and science, the scientific advisory board deepens current scientific discourses and establishes future research needs.

Wind consultant advisory board

The focus of the wind consultant advisory board is on improving onshore wind forecasts in Germany. Constant exchange of experiences and regular presentations on the topic are a foundation of its work, which particularly results in the definition of minimum standards for expert reports.

Working groups are established at short notice to deal with current issues and problems. They are organised across different boards, are able to act quickly, and can also hire external experts if necessary. Representatives from around 131 member companies are currently involved in working groups for public relations work, networks, radar, obstruction lighting, nature conservation and wind energy, rotor blades, foundations, and continued operation.

All 2,200 operator companies who are members of the BWE are organised in the operators' advisory board via operator forums. Of the 1,100 manufacturers, suppliers and service providers who are members, 220 companies are members of the boards of the BWE. Each board meets between 2 and 4 times a year. For further information on the work of the boards and working groups and to view the lists of members, go to: www.wind-energie.de/verband/fachgremien.

Bundesverband WindEnergie – Events & Corporate Publishing

Knowledge about wind – networking – qualification



The German Wind Energy Association - knowledge & networking

In addition to political work, knowledge & networking is a central impetus for the German Wind Energy Association. BWE has accompanied the economic and technical progress of the industry for many years with its education events and publications from which everyone, novice and expert alike, can obtain the latest information about the wind industry.

BWE events

Networking events bring together all the important players in the wind energy sector. Short talks by experts and company presentations get things off to a flying start, no matter whether the topic being discussed is a change to financing concepts or the latest turbine technology.

At the seminars, principles are passed on and solutions for the everyday challenges in the wind sector are talked through. Experienced speakers – frequently experts from the BWE expert committees – impart their knowledge about topics including project planning, production management and direct marketing. Particularly in 2016 BWE events have been highly sought after, so that companies can adapt to new business models. An overview of all events can be found here: www.bwe-seminare.de

The German Wind Energy Association – a strong partner

With around 20,000 members it is the world's largest association for renewable energies. For many years the BWE has been campaigning for a sustainable and efficient extension of wind energy in Germany, with ever greater success.

With its ambitious expansion targets, the wind power sector is the main driver behind the switch to renewables. Together with its members, the BWE is fully committed to continuing the success story of German wind energy and to ensuring that the vision of "100 percent electricity from renewable energy" in Germany becomes a reality soon.



Bundesverband WindEnergie – Veranstaltungen & Corporate Publishing

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Web **www.bwe-seminare.de**
Profile **Education & training**
Category **Education & training**
Founding year **1996**



BWE publications

In addition to events, the German Wind Energy Association is also packing its knowledge into countless specialist publications. For example, for the last 25 years it has published the wind energy handbook. Also known for providing a market overview, it offers an excellent overview of the facts, figures and data and the development of both the market and technology in Germany. Furthermore, in it you will also find the operating results of 2,500 German wind power plants.

BWE also publishes specialist publications devoted to topics from the fields of law, financing, service, project planning, and recently even small wind turbines. The knowledge gained through them can be utilised in important company decisions, thereby promoting the continued sustainable growth of the industry. You can find an overview of all BWE publications here:

www.wind-energie.de/shop

The industry directory

The wind industry sector report in Germany, which the German Wind Energy Association has circulated since 2010, developed from the BWE market overview. The economic report is the flagship for the entire sector, in which companies can present their services and products to a broad target group. The comprehensive address section means it is also a real reference book for anyone looking for partners in the wind industry. Accessible online as an industry portal at:

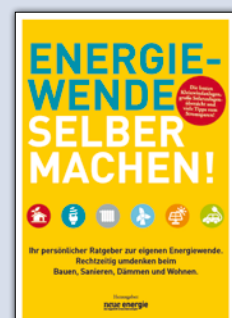
www.windindustrie-in-deutschland.de



Yearbook



Industry directory



Specialist guide

new energy

magazine for climate action and renewable energy

new energy is our bimonthly sister publication for English speakers. Between 6,000 and 10,000 copies of the magazine are distributed throughout Europe and the world, mainly in Brussels.



The magazine is characterized by well-researched analyses of markets, technology and policy, extensive country reports and portraits of pioneers – individuals, companies, municipalities or entire regions.

A team of around 50 authors from all around the world work with the main editorial office in Berlin.

Further information on
www.newenergy.info

Every edition of „new energy“ has the entire world of energy in its sights. The magazine reports on the use of renewables in generating electricity, heat and mobility, offering readers a monthly account of the latest market trends for wind, solar and bioenergy in Germany and globally. Particular focus is on wind energy.

new energy
magazine for climate action and renewable energy

new energy

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E-Mail **service@newenergy.info**
Web **www.newenergy.info**
Profile **Media & Communication**
Category **Other services**
Employees **10**
Founding year **1998**

The magazine regularly covers the latest trends in electromobility and storage, as well as the expansion of energy infrastructure in Germany and Europe. Climate protection and policy are just as much a focus as the traditional energy sources of coal, nuclear power, gas, oil and notable developments in the energy market. Every edition comes with information on new legal acts and bills, regulations and other rules.



Editor-in-Chief Jörg-Rainer Zimmermann

Deutsche Energie-Agentur GmbH (dena) – German Energy Agency

The competence centre for energy efficiency, renewable energies and intelligent energy systems. As the „Agency for the Applied Energy Transition“ we contribute to attaining energy and climate policy objectives by developing and implementing solutions both nationally and internationally.

We:

- are a neutral and competent point of contact at the intersection of policy and industry,
- identify key fields of action for policy and industry, support the development of suitable measures and help with their implementation,
- Initiate, facilitate and implement national and international projects based on more than 16 years of experience.

Our work is based on our strong expertise in conceptualising and successfully implementing projects.

Analysis and advice

The Deutsche Energie-Agentur (dena) – the German Energy Agency – is highly experienced when it comes to analysing and assessing markets and market segments for renewable energy technologies. This applies to Germany and globally, for example as part of the “German Energy Solutions Initiative” of the Federal Ministry for Economic Affairs and Energy (BMWi). dena supports the development and planning of measures as well as the development of foreign markets.



Source: ©shutterstock/WDG Photo

Networks

Between 2014 and 2016 dena actively worked to improve the social acceptance of onshore wind energy in Europe as part of the EU WISE Power project. The project established successful strategies, for instance on the basis of innovative participatory funding models. “Social acceptance pathways” is a toolbox with recommendations for project planners, grid operators, decision-makers at the local and regional level and representatives of civil society.

Lighthouse projects

Through the dena Renewable Energy Solutions programme (dena RES programme) of the BMWi’s German Energy Solutions Initiative, dena supports the implementation of lighthouse projects for renewable energies worldwide. The programme enables German companies to install their renewable energy technologies in representative locations overseas with a view to embedding themselves in an attractive target market.



**Deutsche Energie-Agentur
GmbH (dena)
German Energy Agency**

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Profile	Associations
Category	Organisations & public institutions
Turnover	20.1 Mio. € (2016)
Employees	190
Founding year	2000

Companies:

Industry directory

Around 450 addresses of leading companies in the wind industry.





Direct marketing

Direct marketers



BayWa r.e. Green Energy Products GmbH

Grillparzerstrasse 12a, 81675 Munich
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Fax: +49 (0)89 383932-5720
E-Mail: vertrieb-gep@baywa-re.com
www.baywa-re.com
EEG direct marketing, marketing of balancing energy services, biomethane trading, portfolio management and balancing group management, sale of green power and green gas.



Clean Energy Sourcing AG

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www.clens.eu/en
CLENS is one of the leading direct marketers and suppliers of green energy. Our innovative products support the market integration of renewable energies.



EWE TRADING GmbH

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EWE TRADING GmbH is a renowned direct marketer for renewable energies in Germany. We support operators of wind farms and solar parks across Germany in marketing their electricity.



Neas Energy GmbH

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www.neasenergy.com
Neas Energy is an international energy-trading company focusing in particular on portfolio optimization and management.



Nordgröön Energie GmbH & Co. KG

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Fax: +49 (0)4605 18848-20
E-Mail: tw@nordgroon.de
www.nordgroon.de
The mission of the company is to put into practice energy logistical optimisation, synchronisation and integration of renewable energies (keyword: virtual combined power station).



Statkraft Markets GmbH

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Statkraft is a major player in energy trading and a powerful partner in the field of direct marketing standing for technical and economical integration of renewable energy into the power market.



VERBUND

Trading & Sales Deutschland GmbH

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www.verbund.de
VERBUND is one of the largest producers of hydro electricity in Europe. In Germany, VERBUND is your partner for reliable electricity procurement, energy efficiency and direct marketing.

Forecasting services providers



enercast GmbH

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www.enercast.de
enercast enables the integration of wind and solar energy into electricity grids and energy markets by means of wind and solar power forecasts.



energy & meteo systems GmbH

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Fax: +49 (0)441 36116-479
E-Mail: mail@energymeteo.com
www.energymeteo.com
Diverse range of services for integrating renewable energy: wind and solar power forecasts, software "Virtual Power Plant" for remote control and marketing of decentralized production units.

Education & training

Education & training



EMD Deutschland GbR

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E-Mail: sales-de@emd.dk
www.emd.dk
EMD Deutschland, exclusive sales agency of the Danish software manufacturer EMD International A/S, arranges courses for the software products windPRO and energyPRO on a regular basis (www.emd.dk).



Wind assessment advisory board



Legal advisory board



Financing advisory board



Planning advisory board



**German Wind Energy Association
Events & Corporate Publishing**
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Wind knowledge – networking – qualification



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E-Mail: office@hseq-professional.com
www.hseq-professional.com
External onshore and offshore services: Work safety, health protection, fire protection (e.g. FaSi, SiGeKo), training courses (fire protection and first aid), SchuSiKos, HSE plans, risk assessment.



**KRAFTWERKSSCHULE E.V. (KWS)
KWS Renewable Energies Training Center**
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Tel.: +49 (0)201 8489-0
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E-Mail: info@kws-renewables.de
www.kws-renewables.de
As a leading training center, the KWS RENEWABLE ENERGIES TRAINING CENTER offers tailored training measures for all employees from the renewable energies sector, particularly wind energy.



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VDI Wissensforum GmbH

Safety training



Safety Training

3M Safety Training | Capital Safety
GWO-accredited trainings of Working at Heights, First Aid, Fire Awareness and Manual Handling.
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Tel.: +49 (0)40 54753734
E-Mail: hamburgtraining@capitalsafety.com
www.capitalsafety-training.de
3M Safety Training | Capital Safety: Full scope of GWO-accredited training courses. On/off-site.
7 GWO-certified training centers in EU. 1st mobile training unit worldwide accredited to GWO-standard.



Deutsche WindGuard
An der Weinkaje 4, 26931 Elsfleth
Tel.: +49 (0)4404 9875-100
E-Mail: alexander.treichel@windguard.de
www.windguard.com
Certified Safety Training for the onshore and offshore wind industry. GWO basic safety training and refresher, Helicopter Underwater Escape Training as well as training according to DGUV.



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Fax: +49 (0)421 62677-11
E-Mail: info-rt@deutsche-windtechnik.com
www.deutsche-windtechnik.com
The Training Center provides certified safety courses in accordance with GWO and DGUV. All relevant safety aspects are rehearsed in a realistic environment with experienced trainers.



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Fax: +49 (0)4662 89127-88
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www.offtec.de
Accredited provider GWO Basic Safety Training: Working at Heights, First Aid, Fire Awareness (according to German DGUV), Manual Handling/Sea Survival/HUET/Offshore First Aid/Technical training etc.



SHE Solution Bergmann GmbH & Co. KG
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E-Mail: info@she-solution.de
www.she-solution.de
SHE Solution offers comprehensive solutions for protection and safety at work. Our quality services range from providing convincing technical solutions to full service. Notice the difference!

Energy services

Energy services



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EEG direct marketing, marketing of balancing energy services, biomethane trading, portfolio management and balancing group management, sale of green power and green gas.



EnBW Energie Baden-Württemberg AG
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Whether in the development, acquisition, construction, operation or direct marketing of wind energy installations – EnBW is active along the entire project value added chain.



Manufacturer and supplier advisory board



Expert consulting advisory board



Investors' advisory board



Expert consulting advisory board



Scientific advisory board



Operators' advisory board

**GEWI AG**

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 INNOVATIVE, ECOLOGICAL, TOGETHER. GEWI AG –
 YOUR PARTNER FOR DIRECT MARKETING.

Certification**innogy SE**

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 innogy SE is a European energy company. With its
 focus on renewable energies, network & infrastruc-
 ture and sales, it addresses the requirements for a
 modern energy world.

**Landstrom GmbH & Co. KG**

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 Climate-neutral electricity and gas supply as
 one-stop-shop solution, direct marketing, service
 and consultancy across the entire spectrum of
 renewable energies in co-operation with Landwind
 at competitive prices.

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E-Mail: info@windguard.de
www.windguard.com

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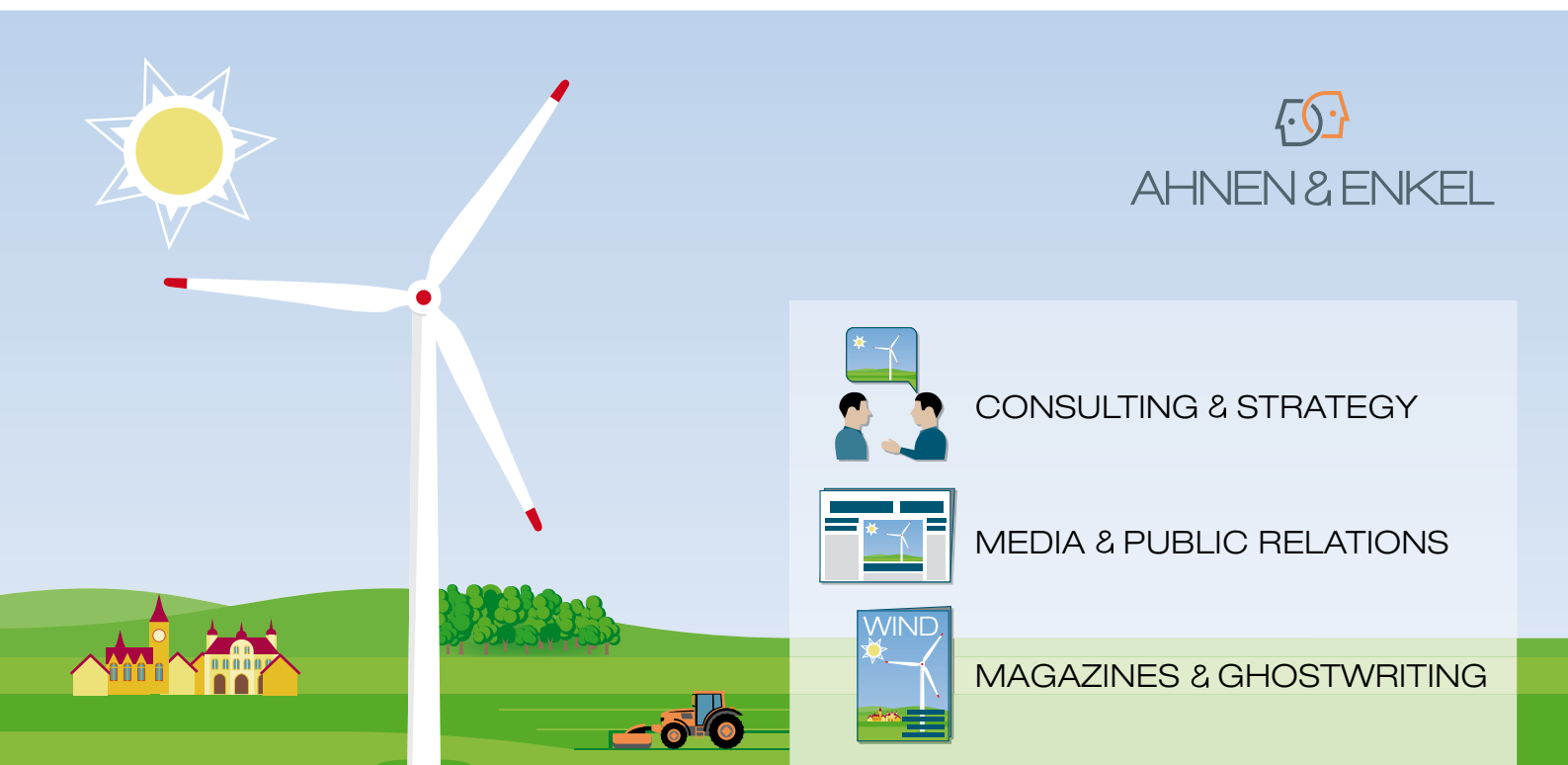
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