

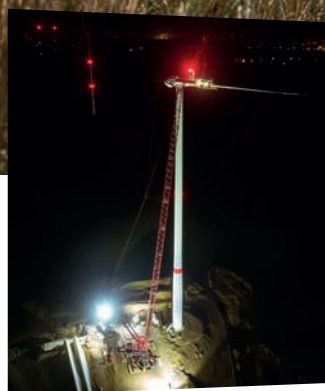


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Commissioning and start of construction

The Bietikow wind farm
has been on the grid since
June, and construction has
started in Wilstedt South
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Liebenau project: What's the way ahead following the Renewable Energy Act (EEG)?



The concept for continued operation of the existing wind farm: 2 turbines remain in place, 3 new turbines replace 5 existing turbines and 3 turbines expand the wind farm

-  Remaining turbines
-  Repowering turbines
-  Dismantled turbines
-  Wind farm expansion

The following question is the subject of intense discussion in Germany. What to do with wind farms no longer covered by the EEG after 20 years? Fundamental decisions have to be taken: continue operation, dismantle and restore the site or repowering? These are precisely the questions facing wpd's project team in the district of Nienburg in Lower Saxony for the Liebenau project.

The two wind farms Liebenau I and Liebenau II which have been producing green electricity for 17 years now, are located between Nienburg on the River Weser and Minden. While the first of them was commissioned in 2004 with five turbines and a total capacity of 4.25 MW, Liebenau II was connected to the grid in 2006 with a further two turbines and a total output of 1.70 MW. There is still some time before they reach an operating life of 20 years but the challenge was to set the stage for the future of the wind farm in good time.

The decision taken was as follows: The two turbines in the Liebenau II project will initially remain in operation. They are currently still under direct marketing and later they are to be marketed on the energy exchange as long as this is commercially viable. In the more southerly wind farm of Liebenau I, on the other hand, radical changes are on the agenda. The five

turbines there will be completely dismantled. Here repowering is the order of the day, replacing existing turbines with more modern, more powerful turbines.

The purpose of repowering is to generate more energy with fewer turbines at an established, widely accepted location with good infrastructure connections. In this case, however, repowering is not all. Rather the wind farm will be expanded at the same time. In the future, there will be four Vestas V126 (hub height 117 m) here and two V117s (hub height 116.5 m) each with a rated output of 3.45 MW. Three turbines will be assigned to repowering, the three others will serve as expansion. Negotiations are currently ongoing with the landowners for them to operate the turbines in the expansion area themselves. The new project will have one additional turbine and a total capacity of 20.7 MW by comparison with the 4.25 MW of the existing wind farm. It's almost logical that the project should have a new name in the future: Oyle-Bühren.

First and foremost, the project shows how well the individual locations and departments of wpd onshore work together. From the acquisition of the area via the permit department, construction department, turbine procurement and the financial department to the technical project management that shaped communication with the landowners and successfully initiated the necessary reports. The project itself is also characterised by an extremely close working relationship and continuity. The wpd team is made up of employees who were involved in the design of the existing turbines approved in 2001 as well as new staff. A combination that ensures that the project runs smoothly.

And this enabled us to achieve a permit for the Oyle-Bühren wind farm from the district of Nienburg in April. The call-for-applications will be held in the course of the year to enable construction to be subsequently planned and implemented. In around two years, the repowered, expanded wind farm is due to produce even more green electricity. A successful example of the continuation of a project that helps to further promote the energy turnaround.

The wind report: reliable data for the energy turnaround



A wind report serves to determine the potential of the wind and the possible energy yield at a potential location for turbines. So far so obvious. But be careful, there's a risk of confusion here. Because as much as we understand by this term on the one hand wind and yield reports prepared by external consultants, it is also sometimes applied to the yield estimates carried out by the site assessment department. Although they follow the same methodological approach and are thus subject to current directives (e.g. MEASNET, IEC 61400-12-1 or FGW TR6) and are usually of the same quality, they are not in fact carried out by an independent body and cannot be used as part of the financing process.

At wpd, too, the technical Site Assessment Department excels on account of its diversity: meteorologists, environmental scientists, engineers, energy and environmental technicians, experts in data controlling and analysis. Data monitoring at wpd functions as continuous quality control on the data gathered. This is carried out in the form of wind measurements at home and abroad, both in the icy far north near the Arctic Circle and beyond the equator.

The site assessment covers more than an analysis of the wind potential. It also includes all ways in which the yield might be reduced as a result of further circumstances pertaining to the location as well as specifications and restrictions. At wpd, Site Assessment works closely with the different specialist departments such as the department for landscape planning & environmental studies. This allows skills to be exploited and forces to be bundled which is conducive to extremely efficient working relationships.

It is naturally in no way sufficient for a wind report to stick a moistened finger in the air. The tool of choice, for example, is the classic wind measurement mast which is set up as a tubular or lattice tower and reaches heights of 80 to 150 metres. Devices such as an anemometer (wind speed) and a wind vane (wind direction) are used to collect data on several levels. In addition, other data such as the temperature and ice build-up are recorded, and in the case of off-shore measurements, marine data such as the height of the waves or tide levels.

While wind measurement masts at the location take direct measurements at the height relevant for the turbine(s), devices for remote investigation such as LiDAR or SoDAR determine conditions at the location in three-dimensional space from the ground. These systems register the wind movements by means of light waves (LiDAR) or sound waves (SoDAR). What all the measuring techniques have in common is that for a wind report, data usually have to be collected over a timeframe of at least one year. If data from representative, comparative wind farms can be used, measurements over a shorter period of half a year, for example, may be sufficient.

Quality ratings for the measurement and evaluation methods used are also included in the wind report. The forecast ultimately derived from all the parameters for the wind speeds and energy yields to be expected covers the probable service life of the turbines of up to 20 years. Assessment of the wind which may at first sight seem a simple exercise turns out to be a complex, demanding, long-term process. After all, the intention is for the turbines at the location to reliably produce copious green electricity over a long period of time.



Wind vane on the measurement mast in wpd's Nuolivaara project in Finland: The degree of icing is also monitored on the basis of the camera images



wpd is currently conducting wind measurements at around 70 locations in 15 countries!

Concession for generating electricity for five wpd projects in Poland

wpd has won the concession to generate electricity in Poland for a portfolio of five onshore wind projects with a total output of 102.5 MW. The green electricity generated can thus be freely marketed. The wind farms of Jarocin Koźmin, Słupca Kołaczkowo, Jarocin Wschód and Krotoszyn North and Krotoszyn South are located in the central Polish region of Wielkopolskie and were commissioned at the end of 2020. The projects won the contract in November 2018 in the course of an auction and were funded by the European Investment Bank (EIB) and Landesbank Baden-Württemberg (LBBW). Now they are all generating enough green electricity to meet the needs of 165,000 households. wpd was able to sign PPAs for the five projects with the Polish subsidiaries of ENGIE and Orange.



Official inauguration of the Jarocin Wschod wind farm with representatives of the PPA partner Orange Polska



wpd France continues to speed up

wpd onshore France sponsored this year's edition of the international cycling race „A travers les Hauts de France“, a regional professional race held in the north of France. The route described a loop around the two wpd wind farms „Montagne Gaillard“ and „Boule Bleue“, which were commissioned in 2014 and 2017 respectively. This loop had to be completed five times. Accompanying the sporting competition, the sponsorship and team presence on site were a perfect occasion for cultivating exchanges with residents and representatives from politics and business. Thus, the day showed how well wind energy has been accepted locally and has positively influenced local development.

wpd celebrates the commissioning of the Bietikow project and the start of construction in Wilstedt

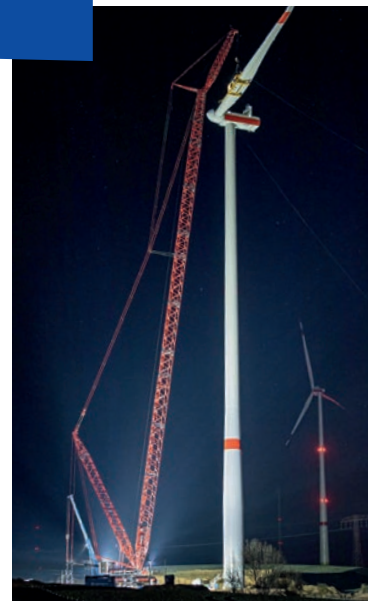
At the beginning of June, wpd was able to celebrate the commissioning of the Bietikow wind farm in Brandenburg's Uckermark. After the application for approval was submitted in October 2018, a permit for the two turbines, each with an output of 4.2 MW, was issued a mere 11 months later. The project was awarded the contract in October 2019. One and a half years later, the two turbines have now been connected to the grid.

After a long planning and development phase, the starting gun for the construction of the six turbines in wpd's Wilstedt South

wind farm was fired in the middle of May. In the first construction phase, roads will be built to the planned turbine sites, and crane and storage areas set up. Work will then start on the foundations for the turbines at the end of September 2021.

With a total capacity of 27 MW, this project will in future meet the annual electricity requirements of around 24,000 four-person households as well as saving approx. 64,000 t of CO₂ each year.

Bietikow wind farm at night



Project pipeline in the Philippines grows

wpd's project pipeline in the Philippines continues to grow, and it has joined the Aklan project led by the Swiss-Filipino developer Triconti.

The Aklan project is an onshore wind farm with a planned total capacity of over 75 MW. It will be built in a location in the North-West of the Philippine island of Panay and is likely to comprise 18 turbines. The wind farm will be connected

to the grid via a new transformer substation which will be built by wpd and Triconti for the Philippine grid operator. The farm is due to be commissioned in 2023.

wpd's entry into the growth market for renewable energy in the Philippines represents an important component in the company's strategy for Asia.



wpd facility
in Manila,
Philippines

*wpd operates in 7
further countries
in Asia*

414 MW for wind energy in North Macedonia

wpd Adria is planning a 414 MW project in the north of North Macedonia in the region between the towns of Kumanovo, Staro Nagoričane and Kriva Palanka. The Virovi wind farm is due to produce around 1,300 GWh a year in the future.

In accordance with North Macedonian law on strategic investments, Virovi has been awarded "strategic project status" which should speed up the development process going forward. wpd is the first company to achieve this status for a wind energy project.

wpd Adria has already realised four wind farm projects in Croatia, is also developing the Brajići project in Montenegro and has a pipeline of more than 1.2 GW in Croatia and Bosnia and Herzegovina.

wpd lending global support to the "Clean up the World" campaign



*Committed to the environment:
wpd team members collecting rubbish*

The company's employees advocate eco-conscious treatment of our living space. Employees of various wpd facilities have frequently participated in the global campaign "Clean up the World". This campaign which has been in existence since 1993 is part of the United Nations Environment Programme, and every year it supports measures

to clean up, preserve or restore nature with more than 35 million volunteers in over 130 countries.

For 2021, wpd has committed the company's facilities to global participation and is throwing its weight behind "Clean up the World" for an extended period between 17 and 26 September.

Gaining experience: going abroad for wpd



 Countries with a wpd facility

wpd's facilities around the world open up opportunities: many of our colleagues have already gained experience abroad for a limited period or indefinitely.

Anyone who goes abroad for their company has to cross some boundaries and enter terra incognita in some areas. At wpd, too, some employees have chosen this route. For them it was primarily the attraction of novelty that proved the deciding factor when the challenge was to transport the company's expertise to new markets, build local teams, initiate collaborations and take the first steps in project development. A profitable expansion of their professional horizons.

wpd is constantly on the lookout for staff to support the establishment of completely new facilities or the expansion of existing ones. A great opportunity for some employees to further their career and at the same time acquaint themselves thoroughly with a different culture, a new country, its people and their language. Sometimes, the differences from their home country are not so great, but not infrequently, major contrasts await them: a pulsating metropolis with unaccustomed throngs of people in close proximity, an unfamiliar culture or fascinatingly diverse natural vistas.

If such a drastic change in your lifestyle is on the agenda, you will be faced with a wide variety of challenges associated with making a new start, especially in a strange country. There will be many authorities to visit, made more difficult by the circumstance that there are regions of the world where even the best English won't be of any help with authorities, public bodies and certainly not in everyday life. And even if

you can use Google Maps, if you want to get from A to B, there are still some areas where there's no app to consult.

But whatever the different challenges, there is one factor above all others that will help you cope: the readiness of your new colleagues to rally round. Whether it's official hurdles, cultural traditions or linguistic barriers: advice and assistance can be found primarily from the people making up your new working environment. In many respects, you have to get used to leaving your own comfort zones. And this is precisely where contact with new friends and colleagues can be extremely helpful. You will normally make your first social contacts in your new living and working environment at the workplace. These are the people who will make you feel a little more at home so far away from your home country. And you still have Teams, Facetime and other programs for keeping in touch with family and friends.

When discussing this subject, you often run into appreciation of personal growth. All the exciting insights into different cultures and ideologies expand your own perspectives and make you more tolerant. It also helps you gain greater appreciation of the importance of family, friendship and camaraderie.

You often hear comments such as: "It's simply great that wpd offers you the chance to go abroad and gain wide-ranging experience of this kind." Or something like this: "It requires courage but it pays off and it's really valuable: great self-confidence, a lot of self-knowledge and not least how you can constantly make new contributions and deploy your skills in new ways."

One target, three candidates: wpd onshore France aiming for 500th MW

wpd onshore France has started the construction of its 500th megawatt in the portfolio. There are three candidates for reaching this impressive milestone: three projects that went into construction last summer. Since 2002, wpd has already realised 32 wind farms in France with a total capacity of 490 MW. The three projects currently under construction in different regions of the country will further expand the portfolio of wpd France.

In the North of France, we have the expansion of a wind farm already in existence. The „Avesnes 2“ project will add four new Vestas V126 turbines to the 36 MW „Avesnes 1“ park built in 2019 with its 11 Vestas V117 („Energie Iwuy“ with five turbines and „Energie Avesnes“ with 6 turbines). The project was open to crowdlending by residents: for a loan facilitated by private individuals that gives them a lucrative financial stake in the project. A house-to-house survey was also carried out last May which revealed the high level of acceptance enjoyed by the existing wind farm. A good 86% of respondents had no objections to wind energy or are positively disposed towards it. This seems to pave the way for further projects in this very windy region.

The „Chouy“ project with six Vestas V100 turbines and a total capacity of 12 MW is also located in the North of France. The project was originally initiated by a group of local farmers and is now being developed by wpd. Chouy is located in an historically significant region as the front line once ran here during the 1st World War. Together with the local authorities, wpd has made successful efforts to ensure that preserving memories can be reconciled with looking to the future. wpd solar France is currently in talks with

the municipal authorities for a solar project in the locality. A good example of local openness to renewable energies.

The „Saint Laurs“ project will contribute 18 MW to wpd's portfolio. Saint Laurs is located in the south-western region of Nouvelle Aquitaine and the planning comprises six turbines of type Nordex N131. Crowdlending is currently open for the residents for the project. A further feature of the project is that the permit does not specify the type of turbine. wpd was thus able to choose freely between different manufacturers and models in order to determine the best configuration for the project and location. The infrastructure with its many narrow roads offers special challenges for the construction phase. But the teams successfully mastering this stage, too.

wpd France has been active in the development of onshore and offshore wind farms as well as photovoltaic plants in France since 2002 and currently employs over 130 people. In the field of onshore wind energy, 204 wind turbines with a total capacity of over 490 MW have been installed. Currently, the team has projects under development with a scope of 1,500 MW. „Avesnes 2“, „Chouy“ and „Saint Laurs“ are the next ones approaching commissioning.

With the start of construction in the summer, all three projects are now heading towards commissioning. The growing portfolio demonstrates the strength in the French market for onshore wind energy: Things are continuing to progress well for wpd France.

Wind farm Avesnes 1, which will be extended by 4 turbines



Offshore construction and marine protection: hand-in-hand is feasible

The challenge when building wind turbines and wind farms is to respect nature and the environment, not least when erecting wind turbines at sea. Protection of marine life is already embedded in the permission process in the form of strict requirements. Besides the environmental compatibility test, concepts for comprehensive prevention and protection measures are obligatory. And development doesn't stop there.

During construction, the primary challenge is posed by acoustic emissions when pile foundations are driven into the sea floor. The Federal Maritime and Hydrographic Agency (BSH) responsible for Germany specified sound protection concepts as early as 2008 and defined a limit of 160 decibels at a distance of 750 metres. But it's a funny thing with limits. Not only are there different definitions depending on the country, specific, local conditions dictate that technical sound protection systems are not equally effective at every location and have to be adapted. Besides many other parameters, their efficiency depends on the design of the foundations, the nature of the soil, depth of the water, strength of the current, weather or other

During the construction of the Butendiek offshore wind farm, the combination of Large Bubble Curtain and Noise Mitigation Screen was used for the first time to minimize noise during the pile driving work

conditions pertaining on the day of installation.

wpd offshore solutions operates in various markets and thus has to engage with a wide variety of authorities and specifications, e.g. in France or Taiwan. Many species protection regulations must be strictly followed in one country while in another they may be forbidden altogether, the rules may be more loosely defined or may even have to be interpreted more strictly.

However, the focus is on developing technical solutions such as the so-called Big Bubble Curtain to minimise noise during the construction phase. Here small bubbles of air are permanently emitted from hoses laid in a ring around the construction site. This single, double or triple bubble curtain reduces the noise during pile-driving. In addition, there are further promising methods such as the so-called Hydro Sound Damper (HSD) or the Noise Mitigation Screen (NMS from IHC) in which the piling tool is protected by a sleeve. Another approach is to use ultra-quiet techniques such as suction bucket jackets. These structures look like upturned buckets and they are anchored in sedimentary layers using a suction procedure and negative pressure. There is no pile-driving here at all. This also applies to gravity-based foundations and floating systems with floating foundations embedded in the seabed.

When constructing the Butendiek offshore wind farm in 2014, wpd used the Big Bubble Curtain as well as a pile sleeve in water depths of around 20 m. This was the first project in Germany in which this combination was used and for the first time it proved possible to meet the German limit on a continuous basis. In wpd's current Yunlin project in Taiwan, a combination of systems is being relied on, a double bubble curtain and the HSD. Both soundproofing systems can be used variably and can thus be adapted to suit the conditions on site with very different water depths.

The offshore sector continues to work in intensive exchange with authorities and academic institutions around the world in order to further advance the developments initiated and make progress on new approaches. Climate protection is only feasible if it goes hand-in-hand with effective environmental and species protection.



wpd windmanager: a day in the control room

Bremen. The telephone rings. Marc Rosenkranz, Head of wpd windmanager's control room, looks at the display. He recognises the country code immediately. "Taiwan", he says. A service team from Houlong checks in.

The control room looks futuristic. Like a huge cockpit. The team here monitors all turbines in three shifts. With a staff of fifteen 24/7, round the clock. Worldwide. From Piteå to Taichung. The early shift has been working since 6 in the morning.

The control room can view every wind farm on its monitors. "If a report comes in, we can react immediately and initiate the necessary steps," says Verena Herold from the control room team emphatically. With a fleet of over 2,500 turbines, it's action stations on a permanent basis. In total, the team looks after over 60 different types of turbine.

The control room can see every status report on the fleet on its monitors. For example, such reports include shutdowns, service deployments or errors in connecting to a turbine.

Two turbines are at a standstill in Lapland in Finland. No cause for alarm. The ice detection system has identified icing. The rotor blades mustn't turn any more in that case. The idea is to prevent falling sheets of ice posing a risk to man and material.

A storm with high winds had announced itself in the afternoon for Croatia. "But it's looking good," says Kai Dümer from the early shift. If the wind speeds are too high, the turbines will automatically shut down. The

stresses are too high and the risk to the turbine and technical systems is too great.

A fault report appears on the next monitor.



The circuit-breaker in a delivery point substation has tripped. "Probably an overload response," says Herold. The team consults the grid operator. The control room switches the turbine on again via the built-in remote control system. No need for a field trip. The substation fires up again and with it the wind farm. That saves time and money.

An access control system in Schleswig-Holstein sends a report. Someone has tried to gain access to a turbine. Rosenkranz looks at the map: "Where are the field teams at the moment?" One team is at a wind farm about 30 kilometres away. The field vehicle sets off immediately. Later it turns out to be a false alarm.

An anomaly also occurs in Mecklenburg Western Pomerania. "No power, even though there's wind," says Dümer. One look at the turbine's parameters reveals that the sun is high in the sky. Shutdown due to shadow casting.

At the same time, colleagues from Taiwan check in: inspection of the wind farm completed. No special findings. The wind farm can start up again. It is 5.30 pm local time. End of the working day in Houlong. In Bremen, the time is 11.30 am. There's a shift change at 2.00 pm.

For the early shift, today is a comparatively quiet day. In total, the team has processed 287 events. In stormy times, the number can be far higher.

Around 2,500 turbines are monitored in the control room of wpd windmanager.



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