

German Wind Power

The magazine on innovative technologies
and know-how of the German wind industry



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Aircraft Detection Lighting Systems

Is ADLS a solution or an added complication to balancing safety and lighting impact?

Rotor blade recycling

Rotor blades are difficult to recycle. Nonetheless smart processes are making it possible.

The wind power crystal ball

The regular model for wind power production has its limits. Are there any alternatives?

Including
**Contacts to
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Hermann Albers

President of the German Wind Energy Association (BWE)

Germany – A real life laboratory for transitional energy technologies

The German wind power industry is facing an upheaval, with the new government commencing work and the three government parties framing climate neutrality as their shared, unifying agenda. Germany will see an increase in importance as a central market for all technologies associated with the energy turnaround.

This quarterly outlook sets its sights on burgeoning innovations, where new procedures and technological systems are being implemented, as well as upon what developments the German wind power industry is undergoing. In doing so, we contribute to the transfer of knowledge and a climate neutral Europe.



Bernd Aufderheide

CEO of Hamburg Messe and Congress GmbH

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Photographer Michael Zapf



Klaus Liermann

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Industry News

A Strong Year

Get a look on how the world wide wind energy market has grown in 2020.

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Wind energy and forests protect the climate. Are forestry areas also suitable as wind turbine sites?

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What can be digitized will be digitized.

B2B platforms can accelerate the energy transition and open up new business opportunities.

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Ideas and Expertise from Germany

Rotor Blade Recycling

Rotor blades are difficult to recycle. Nonetheless smart processes are making it possible.

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Technology masters nature

Nature presents many challenges to wind power – but there are technologies to deal with them.

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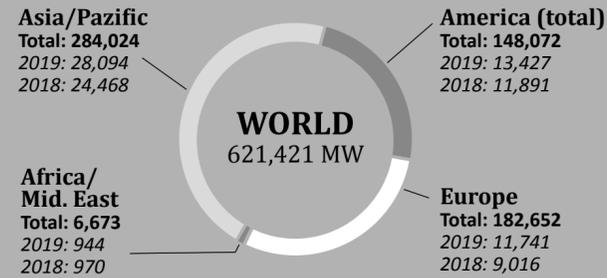
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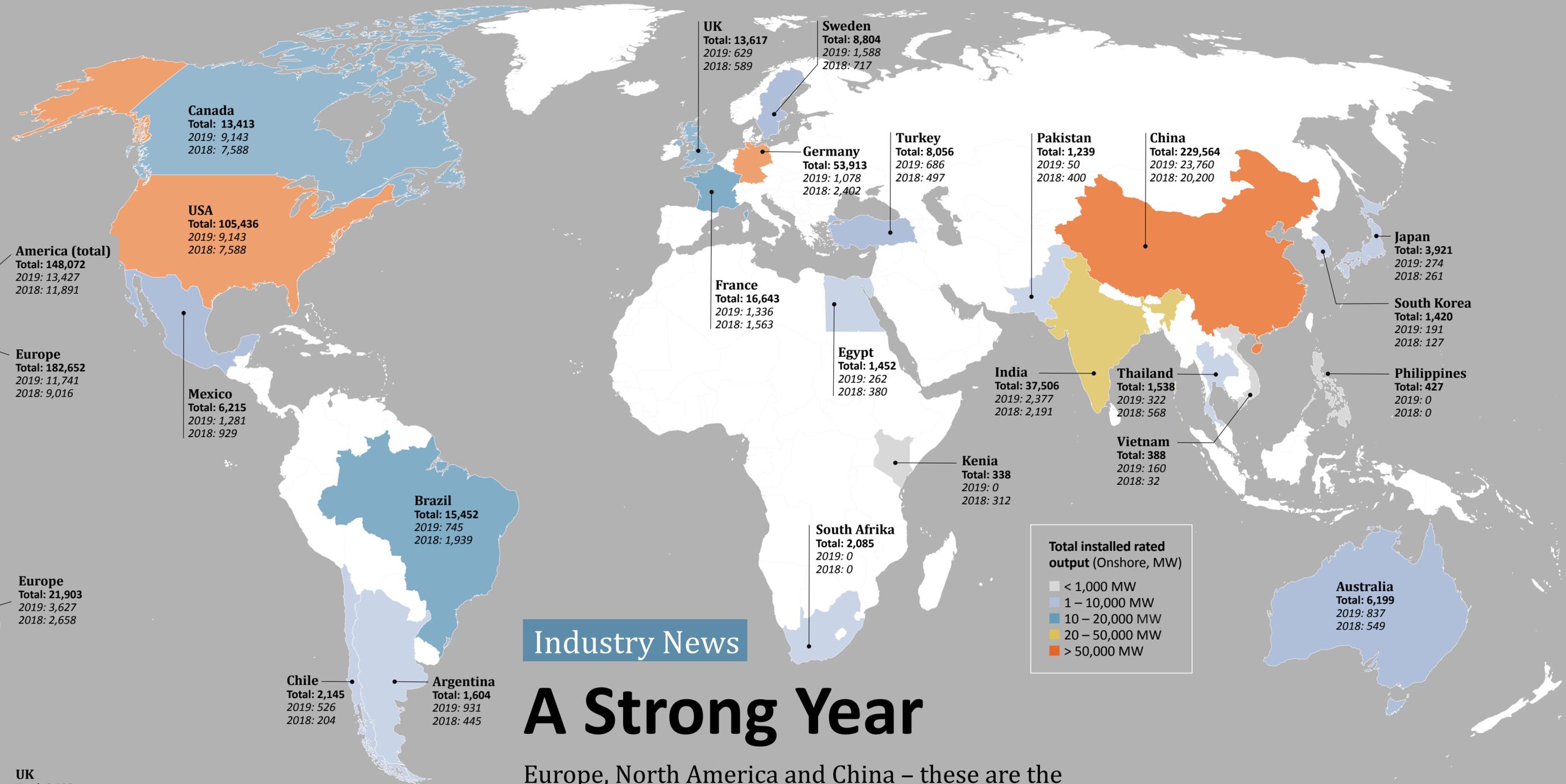
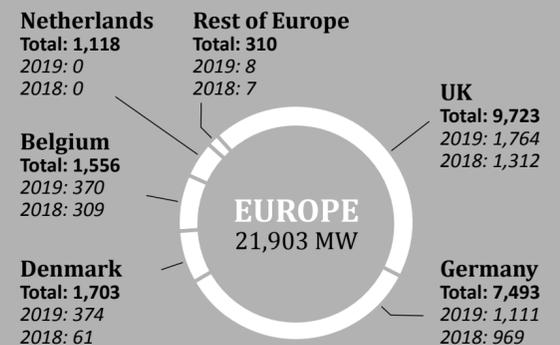
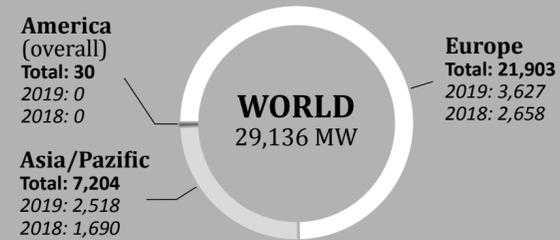
Onshore 621,421 MW

Additional 2019: 54,206 MW;
Additional 2018: 46,345 MW



Offshore 29,136 MW

Additional 2019: 6,145 MW;
Additional 2018: 4,348 MW



Industry News

A Strong Year

Europe, North America and China – these are the markets that drove onshore wind expansion in 2019, achieving a total additional capacity of 54,2 gigawatts. Despite the global uncertainty due to COVID-19, 2020 is set to be an absolute record breaker.



Industry News

Aircraft Detection Lighting Systems – A perspective

Is ADLS a solution or an added complication to balancing safety and lighting impact?



Wind turbine aviation lighting and marking continues to be a challenge with the need to meet aviation safety requirements while addressing light pollution. This is particularly relevant to on-shore developments where the light pollution is an issue. Although there are various methods employed to minimise the lighting with aviation authority approval, these have not always met environmental concerns.

ADLS is a system which detects the presence of aircraft in the vicinity of the obstacles that require aviation lighting and activates the lighting. The system must demonstrate a performance which provides sufficient warning to indicate the hazard and maintain safety.



Fig. 1: PSR ADLS Installation – Terma

Active Radar ADLS

Using active radar, sufficient radar coverage is achieved through the siting of a primary surveillance radar (PSR) with the wind park. PSR operates in isolation and requires no technical input from an aircraft for it to be detected. The radar siting is critical to ensure the timely detection of approaching aircraft and may require more than one radar to ensure all the relevant airspace is within line of sight depending on terrain.

Cooperative Surveillance ADLS

This means of detection and lighting activation uses cooperative surveillance already employed in air traffic management. Most aircraft are equipped with transponders which transmit data, either in response to a ground-based interrogator, or at pre-set time intervals. This data can include identity, position and altitude. The data is received by the ADLS antenna and used to activate the lighting. These systems are regulated through International Civil Aviation Organisation (ICAO) standards and can be Secondary Surveillance Radar (SSR) or Automatic Dependent Surveillance-Broadcast (ADS-B). SSR has several modes and the current

global standard is Mode S. This ADLS can use a dedicated interrogator to ensure any aircraft transmits the transponder reply, rely on nearby interrogators e.g. at airports, to initiate the responses or use the automatically transmitted information.

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Figure below:

The vertical and horizontal boundaries of the ADLS detection zone are shown, indicating a possible buffer zone to enable timely activation of the lights. The size of the zone has to be large enough to allow for a range of aircraft speeds and flight paths but restricted to avoid unnecessary activation.

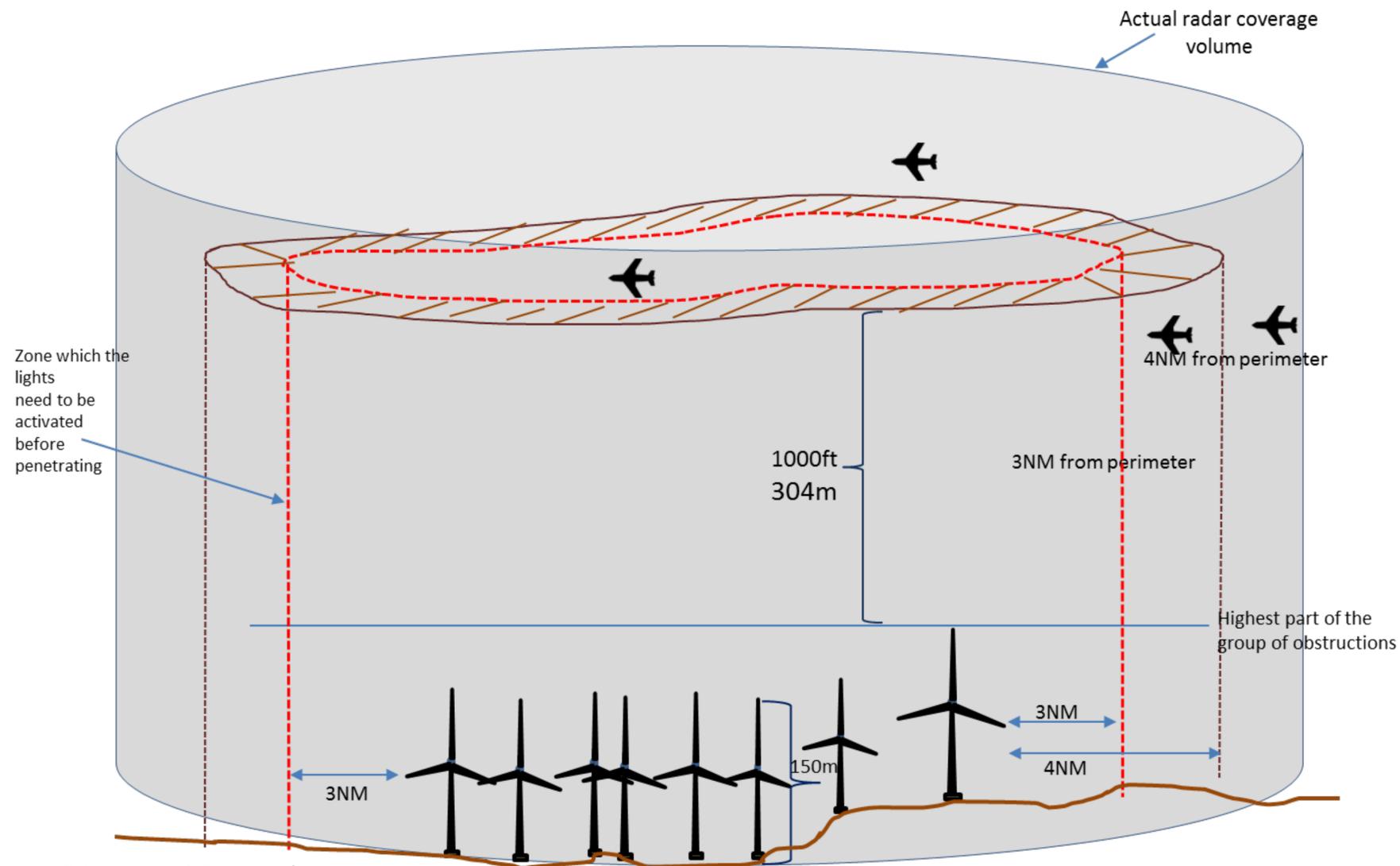


Fig. 3: Illustrative ADLS coverage for discussion purposes – UK CAA.

Performance and Coverage

ADLS must meet the safety requirement and the following diagram indicates the possible coverage requirements which could be applied to both PSR and SSR/ADS-B systems.

This coverage must ensure timely activation of the lighting, but must avoid an excessive false alarm rate to avoid inappropriate activation. The lights must remain illuminated until the aircraft has left the area of coverage.

Naturally, any aviation related system must be consistent with the ICAO requirements. The IEC has also developed draft Wind Turbine Lighting and Marking guidance which refers to ADLS.

Another ADLS technology is the **passive radar system**, which uses existing radio and television signals. This technology will be covered in the next issue of the German Wind Power Magazine.

Active Radar or Cooperative Aircraft Detection

There has been much discussion on the merits of both PSR and SSR / transponder methods of detection and activation. However, this depends on the operating environment and national requirements. Some key considerations are:

- potential cost differentials between solutions
- Coverage requirements in the airspace above a windfarm
- the need for planning consent for PSR installations
- Frequency management of PSR spectrum
- the impact of active interrogators on the SSR radio frequency environment
- Compliance with international standards
- the airspace and national regulatory framework, including transponder carriage
- Approval and safety case requirements



Author

Andy Knill

Aviation technical consultant
at RenewableUK

Clearly, whichever technology solution is adopted, it must be consistent with aviation regulatory, technical, interoperability and airspace principles and the aviation safety case.

Regulation or Voluntary?

The implementation of ADLS in both the on- and off-shore environments is already a reality in several States. However, in others, there is no clear policy. From a wind industry perspective, there is strong support for ADLS as a means of mitigation environmental lighting concerns but clarity on policy is needed. Although some States have mandatory requirements, there is a view that ADLS should be an option within the "toolbox" of solutions. This approach would ensure that the best options are adopted to meet the specific requirements rather than a "one size fits all" approach. In respect of the technical means of activation, the need to meet the safety case in the specific circumstances for each wind park development would suggest an approach of technical neutrality.

And so: The factors and issues are relatively complex but there is significant benefit from the use of ADLS as a potential mitigation. However, I am not convinced it should be a mandatory requirement for all developments as there are other less complex and more cost-effective solutions which can be employed in many circumstances. ADLS detection should be technology neutral in terms of national policy and allow the optimum solution to be employed consistent with national interests.

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**1.5 – 2.1
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1.5 MW

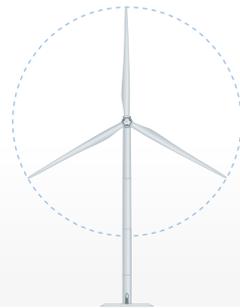


VENSYS 70
2.1 MW

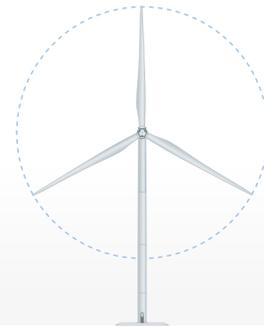


VENSYS 82
1.5 MW

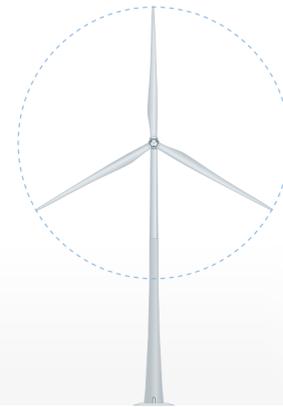
**3.5 – 4.1
PLATFORM**



VENSYS 115
4.1 MW

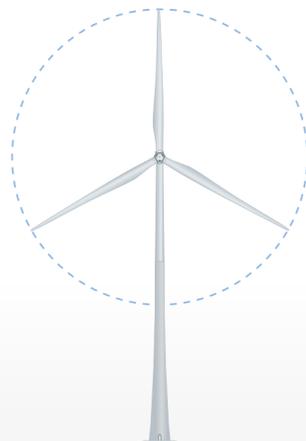


VENSYS 126
3.8 MW

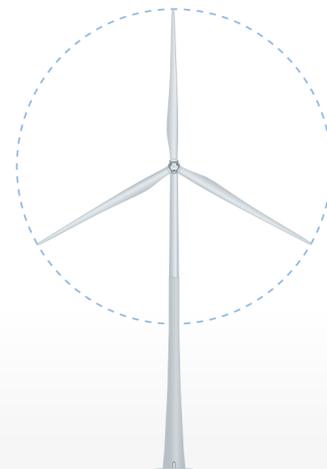


VENSYS 136
3.5 MW

**5S
PLATFORM**



VENSYS 155
6.2 MW



VENSYS 170
5.8 MW

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Forest and wind energy

Wind energy constitutes a key building block in the energy transition and is of crucial importance to climate protection. Are forestry areas also suitable as wind turbine sites?

Recent studies, such as those conducted by the Helmholtz Association of German Research Centres, have concluded that only one in five trees in Germany is actually healthy. Increasingly frequent droughts and increasing temperatures are stressing German forests, which makes the energy transition and climate protection all the more necessary and makes wind energy into an instrument with which we can protect our forests.

Given their rapidly deteriorating condition, experts are calling for a better preparation of forests to deal with climate change, which would include reforestation with location-appropriate tree species and breaking up and replacing monocultures with more resilient mixed forests. Yet this presents forest owners with some major challenges. The financial resources and personnel needed to repair damaged forests and promote forest conversion are often lacking. The wind energy sector could be an impor-

tant partner in this context. Whilst it is true that developing wind turbine sites in forests requires small-scale clearances, the environmental compensation that is required for this could contribute to the conversion of existing forests to more sustainable ones.

The numerous positive effects of wind energy infrastructure in commercial forests

Placing wind energy infrastructure in forests has other positive effects. Thanks to modern technology the wind potential above the forest canopy can be used efficiently. There is also very little conflict of use on forestry land. Forests act as shields to residential areas as they are largely uninhabited and often some distance from settlements. The tall trees not only have a shading effect but also dampen noise. At the same time, the essential functions of a forest, such as forest ecology, the forestry industry, recreation, and hunting, can continue unaltered.



Not "wind in the woods", but "wind in the forest"

What is colloquially referred to as "wind in the woods" could be better described as "wind energy in commercial forests", because forests comprising particularly valuable deciduous and mixed forests or protected areas of particularly high ecological value for humans and animals are excluded from use for wind energy in Germany. However, areas currently dedicated to commercial forestry should be taken into account when assessing their



©Silke Reents

suitability as wind power sites, particularly in federal states with a high proportion of forested areas and elevated, windy terrain. Constructing wind turbines in forestry areas does not always require tree clearances. Wind energy infrastructure can be installed in areas that have already been clear-cut to control pests or repair drought damage as well as on former military sites in forested areas, which minimises the impact on tree cover.

There are different types of forest each of which is subject to different protection categories and uses. A third of Germany's surface area is covered with forest and around 23.6 percent of the forested area is categorised as cultural or culturally influenced. Over 40 percent is classed as being in a semi-natural condition.¹ Those areas used exclusively for forestry may be suitable for wind energy infrastructure, which, in this context, can represent a complementary and sustainable use of natural resources.

¹ Bundeswaldagentur 2012 <https://bwi.info/>

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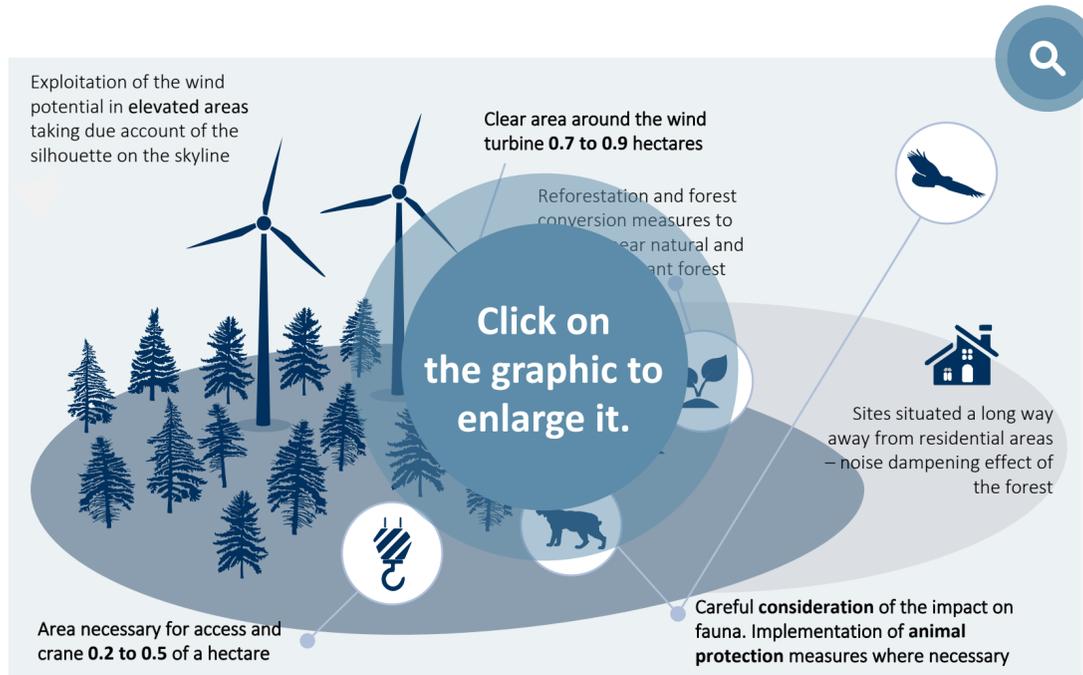


Figure: Wind use on forestry land, e.g., in pine forests and clear-cut areas © BWE

Forestry land is already being used for wind energy production in Germany

In Germany, 2086 wind turbines, or 7.5 percent of the total number of wind turbines, are currently situated on commercial forestry land and are generating slightly over 10 percent of the country's



Author
Hermann Albers
 President of German Wind Energy Association (BWE)

total installed wind power output.² However, forestry land can only be made available for wind energy production when given the corresponding designations, which is subject to stringent legal and planning requirements. The state authorities are responsible for approving wind energy projects. The use of forestry sites for wind energy generation is currently permitted in seven federal states, namely Baden-Württemberg, Bavaria, Brandenburg, Hesse, Rhineland-Palatinate, Saarland, and North Rhine-Westphalia, although the use of forestry land in the latter is only permitted if the need is proven and no alternative areas are available outside of the forestry land.

The expansion of wind energy in forestry areas has increased strongly over the past decade: 89 percent of all wind turbines currently located on forestry land have been erected since 2010. The trend towards "wind in the forest" is particularly noticeable in southern Germany. In late 2020 the majority of wind turbines were located on forestry land in Rhineland-Palatinate (467), followed by Hesse (456), Baden-Württemberg (334), Brandenburg (327) and Bavaria (297). Sixty-six new wind

turbines with a total capacity of 225 MW were erected in forestry areas throughout Germany in 2020. The largest increase in the number of wind turbines installed on forestry land in Germany was recorded in 2016 when 1016 MW were installed.³

² FA Wind (2021) Entwicklung der Windenergie im Wald, 6th edition, 2021 https://www.fachagentur-windenergie.de/fileadmin/files/Windenergie_im_Wald/FA-Wind_Analyse_Wind_im_Wald_6Auflage_2021.pdf
³ FA Wind (2021)



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LiDAR: the modern wind force measurement technology

An overview of measurement methods, technology, and the application of Doppler Wind LiDAR measurement devices.

Wind energy will be the most important component in our future renewable energy supply in the context of the EU's stated goal of achieving climate neutrality by 2050 and reducing CO2 emissions over the coming years. The measurement tasks required in advance for planning and optimising wind turbines and wind farms are continuously being redefined in response to market demand and the trend is towards higher and faster systems and more complex applications.

Because of the increasing hub heights, higher wattage classes, and wider rotor diameters of modern wind turbines, the contemporary wind force measurement masts, and the installed and calibrated sensors they contain (wind vane, cup, and ultrasonic anemometers) are reaching their logistical and economic limits. The cost of these wind force measurement masts, and the sometimes long and complex installations and approval procedures are

increasingly making this type of monitoring equipment seem unattractive. Cup and ultrasonic anemometers are particularly suitable for measuring wind speeds at a specific point at a given installed height and there are currently thousands of cup anemometers in use around the world.

Acquisition of data from ordinarily inaccessible parts

However, some novel and fascinating options have been available for several years that are based on modern and innovative LiDAR (Light Detection and Ranging) measurement technology. The LiDAR-based wind measurement principle is based on the emission of short, single light pulses, which pose no threat to eyesight, into the atmosphere at a fixed frequency, and the subsequent detection and analysis of the light that is backscattered by atmospheric aerosols. Commercially available LiDAR systems are increasingly being used to measure horizontal and vertical wind speeds and wind direc-

tion profiles. Mathematical functions are then used to calculate the wind speed's individual wind vector components (u , v , and w) after which the scalar, vectorial, or hybrid averages are determined.



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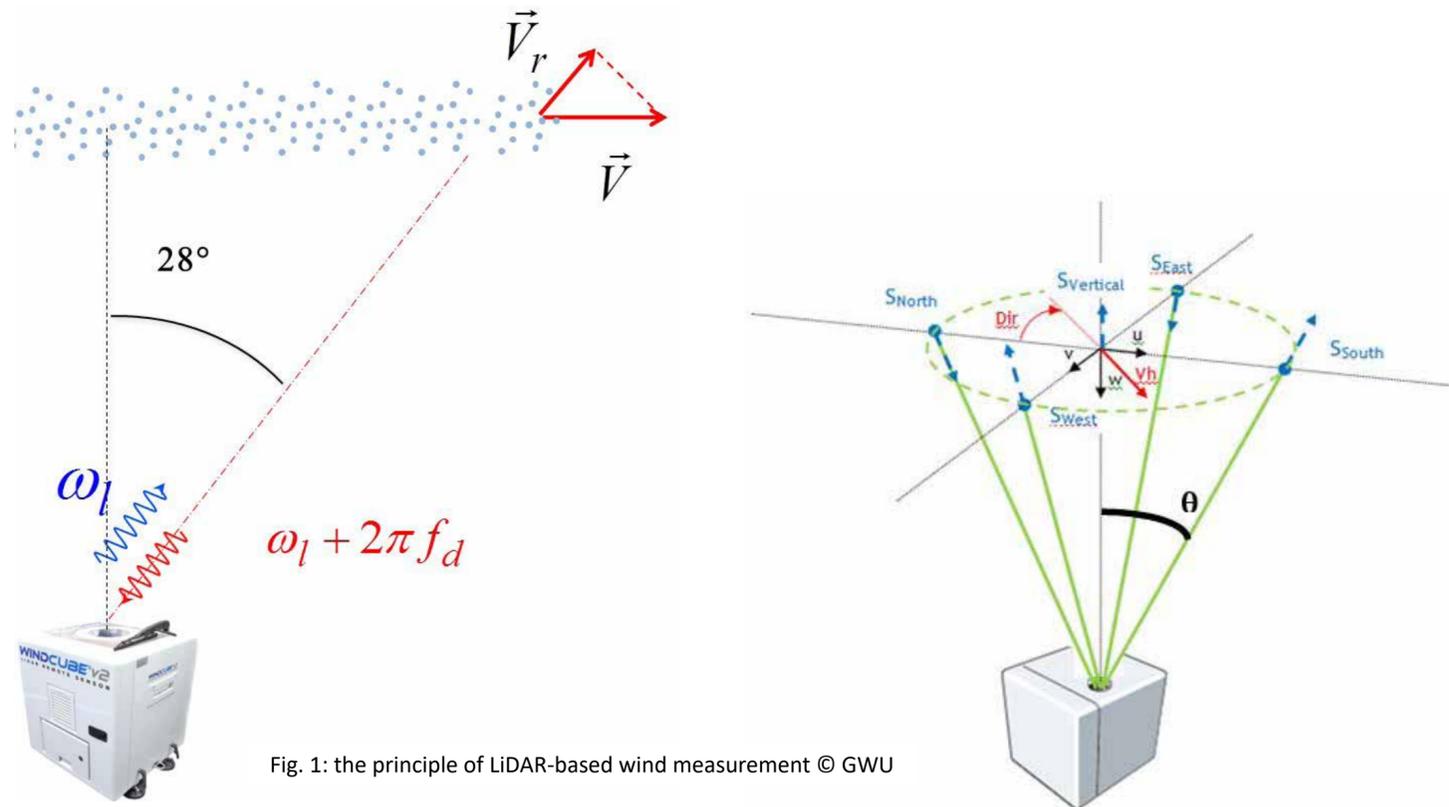


Fig. 1: the principle of LiDAR-based wind measurement © GWU

The major benefit of LiDAR-based wind measurement is the acquisition of data from ordinarily inaccessible parts of the extremely low-level atmosphere and the increased spatial representativeness of the measurement results. Contemporary wind LiDAR systems, WindCube type (Fig. 2 on the next page), are able to take continuous vertical wind profile measurements in the

40-300m height range and at up to 20 freely definable measurement heights. For advanced applications in the on- and offshore sector as well as in meteorology, more powerful wind LiDAR systems such as 3-D scanning Doppler LiDAR systems are used, which can measure wind data at a maximum range of **12-14km** and using over 250 freely definable measurement windows.



Fig. 4: WindCube Nacelle © GWU

Usable as trailers or as installed systems

Ground-based Wind LiDAR systems are robust and compact and can usually be transported or installed and later dismantled by just one or two engineers. Using a GWU LiDAR trailer (Fig. 3) with an integrated independent power supply makes the Wind LiDAR an ideal system for field use and for short-term monitoring (so-called quick looks) e.g. for site surveys or wind turbine power curve measurements. These systems have also been used for quite a while for long-term monitoring operations (>12 months) in compliance with the relevant guidelines. Wind LiDAR systems are also used in the offshore sector where they are installed on offshore platforms and measuring buoys.



Fig. 2: Doppler Wind LiDAR © GWU

LiDAR systems are also installed directly on wind turbine nacelles, (Fig. 4) where wind forces are measured at distances of **50-700m in front of the wind turbine** using up to 20 freely definable measurement windows. The systems are installed on a wind turbine nacelle depending on the task in hand, which may include such things as yaw misalignment, power curve measurements, or the nacelle transfer function. The system enables wind turbine operators and manufacturers to evaluate the performance of the turbines in an efficient and accurate manner. Their simple installation, lightweight hardware components, full integration capacity, and easy configuration processes ensure rapid value creation in any wind farm.



Fig. 3: GWU LiDAR Trailer with its own power supply © GWU

The best technology for precise wind measurement

These wind measurement systems provide precise analytical data with a high temporal and spatial resolution and can easily be installed or dismantled in a rapid and cost-effective manner in complex and/or wooded terrain without taking up much space. They are currently being used in wind farm planning and optimisation scenarios, follow-up investigations, and for local wind forecasts. Doppler Wind LiDAR technology is the best and cheapest way to measure the local 3D wind field to comply with the accuracy and quality requirements demanded of measurement technology.



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The wind power crystal ball

Three rotor blades, one tower and increasing efficiency through growth – the successful model for wind power production. But this principle has its limits. Are there any alternatives?

Innovations in the field of wind power are still too minor or too expensive to challenge the dominance of the horizontal-axis triple-blade. Yet there are still many niches that existing wind turbines are struggling to exploit in the quest for a 100% renewable future. A glance into the crystal ball of alternative wind power concepts.

Nano wind power for low wind speeds

The Triboelectric Nanogenerator (TENG) generates renewable electricity at wind speeds as low as 1.6 metres per second – a value at which operators of three-bladed turbines still take their rotors out of the wind. Developed in 2020 at the Chinese Academy of Sciences in Beijing, WindTENG consists of two thin plastic strips (consisting of polyvinylidene fluoride (PVDF) and fluoroethylene propylene (FEP)). Whenever a light wind causes them to flutter and touch each other, they exchange electrons, which causes a differential electrical charge in each of

them. According to the authors of the study, the triboelectric effect can be stored as an electrical charge with a conversion efficiency of 3 percent.

Despite maximum yields at wind speeds of 8 m/s, this is still a niche area, possibly sufficient to charge bicycle lights and mobile phones rather than providing a domestic energy supply. But if it is scaled up to several square metres, the technology could provide a quiet, low-maintenance energy source in cities and nature reserves. But that's not all: engineers are already aiming at 1000 watts.

Vertical axes for in-house operations

Wind turbines with vertical axes are usually considered to be ineffective small systems. The technology was developed to an economically relevant size for the first time in 2020 when Agile Wind Power erected a prototype in Grevenbroich with an output of 750 kW, although a rare combination



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of a strong turbulent wind gust and a change in wind direction broke off a rotor arm and set the commissioning date back to autumn 2021.

At heights of 100 metres and above, these are no front-yard wind turbines, and the Swiss manufacturer primarily designs them for independent power production in large companies, P2X projects, and sewage treatment plants. "It is easier to get them approved," according to Agile Wind Power CEO Patrick Richter: "Approval for traditional wind turbines is often withheld for noise or bird protection reasons – that's not the case with our vertical axis turbines." These slowly rotating turbines are extremely quiet, and birds can easily fly around them and installing them on lattice towers reduces complex logistics. The first models will be sold in late 2022, and series production is planned for 2024. The difference to earlier vertical axes is that the real-time pitch control prevents stalling even when the blades are rotating slowly. According to Richter, this series should reduce the cost of electricity from 6-8 cents per kWh to under 6 cents, which will make the tur-

bines economically viable for industrial customers who want to use them to produce part of the power they consume.

Kites in high-altitude wind to cover the base load

Without sufficient storage capacity, the fluctuations of photovoltaic and onshore wind power systems are preventing us from achieving a future based on 100 per cent renewable energy sources. The more hours these systems supply power per year, the better for the power grid, which is why wind kites with 5000 to 6500 full-load hours per year could make relatively constant high-altitude wind into a predictable energy source. SkySails launched a 200-kW kite on the market last year, and RWE announced a collaboration with the Hamburg-based company in 2021. SkySails is planning to market a 1 MW kite in two years. Electricity currently costs between 5 and 7 cents per kWh and, according to Stephan Wrage, CEO of the SkySail Group, SkySails is hoping to be able to sell it for "well below 5 cents" as of when they launch the 1 MW model.





The basic idea is not new: the kite's kinetic energy is transferred to the ground-based generator via a tether and the relatively light construction is particularly well suited to islands and off-grid installations. The kite can fly in wind speeds of 3 m/s and above and starts to produce more electricity than the turbine itself consumes as of wind speeds of 5 m/s. "Kites can still easily be installed in places where you can't get permission to install a conventional wind turbine," says Wrage. "We even managed to provide a good solution for the use of flight space in Schleswig-Holstein with a shared space concept." In combination with radar systems, he continued, the kite can quickly land from an altitude of about 800 metres whenever rescue aircraft come close.



Author

Jesko Habert
Ahnert & Enkel, agency for communications

Multiple rotors for manageable large turbines

In line with the square cube law the material volume of a wind turbine grows by the cube while the yield only increases by the square with the diameter. So far, it has been possible to solve this problem through an ongoing series of innovations in lightweight construction. But we are bound to come up against the physical limits at some point. The size of wind turbines is also limited by transport and access issues as well as acceptance by local residents.

As a Hamburg-based research project group known as X-Multirotor explains, multiple rotors could provide a permanent solution to the problem. It may also be cheaper to maintain 20 MW turbines when each comprises several small rotors on a single frame. But the development has been stalled since the Vestas prototype was developed in 2018. The only offshore twin plant that was trialled in 2020 was the "Nezzy2"-model (see page 49 for further information) made by EnBW and Aerodyn. However, there are plans to initiate test operations of a full-sized rig with an output of twice 7.5 MW in 2022.

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Innovative Projects

Get to know the German wind industry

On the following pages, a few German companies from the wind industry present their latest and most innovative products and services.





Fig.1: The Upending Tool – the biggest gripper in the world, developed for monopiles of up to 2,100 tons and 8 metres in diameter.

Innovative Projects **Advertorial**

Wind turbine installation tools: A firm grip

New tools for a safer installation of wind turbines – from super-heavy to ultra-lightweight

With the ever-increasing performances and size of wind turbines together with a call for faster set-up times the demands on load handling devices during assembly are also increasing. For safe gripping and lifting additional technical development is required. This is realised by SpanSet Axzion GmbH, Langenfeld, in cooperation with testing institutes.

Upending Tool – Giant Gripper for Offshore Projects

One of the most frequently used products in this environment is the "Upending-Tool" for lifting and erecting monopiles. The three-armed gripper with its six tongs carries flangeless monopiles of up to 1,800 tons. The basic design of the tool is always the same, but project-specific modifications are carried out by Axzion according to customer specification. The maximum configuration enables the lifting of flanged monopiles weighing up to 2,100 tons. The site in Neustrelitz, Mecklenburg-Vorpommern has been certified by DNV Norway for offshore operations.



SpanSet Axzion GmbH

The Upending Tool has a net weight of approximately 95 to 105 tons depending on the configuration and a load capacity of 2,100 tons. It has been developed for lifting and erecting piles and is serviced by Axzion Rental Services GmbH, Neustrelitz. With its three giant grippers it avoids deformation of the pile during the gripping and erecting process. A gripping force of more than 3,000 tons means monopiles with a maximum weight of 1,000 tons per unit can be taken. The "star" can be swivelled hydraulically so that the piles are gripped front-face and then erected.



SBI-Light Traverse 2.0 – also for high wind speeds

More flexible, robust and lighter than its predecessor, the new SBI-Light Traverse 2.0 presents itself as a single rotor blade assembly tool for wind turbines. In spite of its low net weight of only 13 tons, the SBI-Light can be used for controlled lifting even in wind speeds of up to 12 m/sec.

"The SBI Light 2.0 is our response to the challenges our customers are subjected to by demands for ever bigger wind turbines and continuously reduced set-up times. The new SBI Light 2.0 is easy and quick to assemble and will still function at high wind speeds of up to 12 m/sec. This is a considerable advantage when assembling rotor blades, as it increases their operation times", says managing director Andreas Höltkemeier.

Compatible with different kinds of rotor blades

The flexible hold-down device and the supports adjusted to the respective rotor blade have an optimised grip and protect the sensitive structure of the rotor blade against damage. To simplify adjustment to different kinds of rotor blades, Axzion offers this traverse in a telescopic design. In addition to the application lengths of 20 m there are adjustable lengths of 14, 16 and 18 m. Both the supports will follow the adjustment which means the points of contact are moved further to the outside when using the telescopic function. As a result, the pressure on the rotor blade is better distributed and deformation of the blades avoided. This increases process safety and prevents deformation and sagging of the blade point: A not to be neglected reduction of costs when setting up wind farms with a high number of repetitions.

With an optional self-adapting support system, the SBI-Light 2.0 adjusts much more easily to the different shapes of the rotor blades to be assembled. The new traverse can thus safely take on and handle diverse blade shapes with a blade weight of up to 30 tons. High flexibility and short set-up times



Fig.2: Using the latest in control technology, the Upending Tool can safely grip and erect even the largest monopiles.



Fig.3: The SBI-Light Traverse 2.0 is convincing due to its high flexibility and wind resistance.

All photos: SpanSet Axzion GmbH

when changing rotor blades makes this equipment particularly attractive for use during servicing of different wind farm sites.

The closed C-frame guarantees best possible stability. It avoids dropping the gripped rotor blade down the side and protects it against damage caused by robust handling in everyday site operation. Axzion has shortened the hook height of the traverse by 5 to 6m. This provides the user with more flexibility with regard to crane classification.

Axzion has also taken another look at logistics. "We have a large number of international customers. With its 12m transportation length, the SBI-Light can be easily transported in a 40-foot-container – an efficient solution for land as well as sea transportation", says Höltkemeier.

Environmentally friendly and maintenance-free

For particularly environmentally friendly assembly the SBI-Light 2.0 has been equipped with battery-driven electric motors. Compared to traditional systems it is maintenance-free. Even in temperatures of minus 10 degree Celsius the battery can work for up to 16 hours. A diesel generator is not required, and the traverse is independent of an external power supply. For 24-hour-operation a charging station with a replacement battery can be connected within a few minutes.



Brigitte Hürten

Press Officer at SpanSet

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Contact



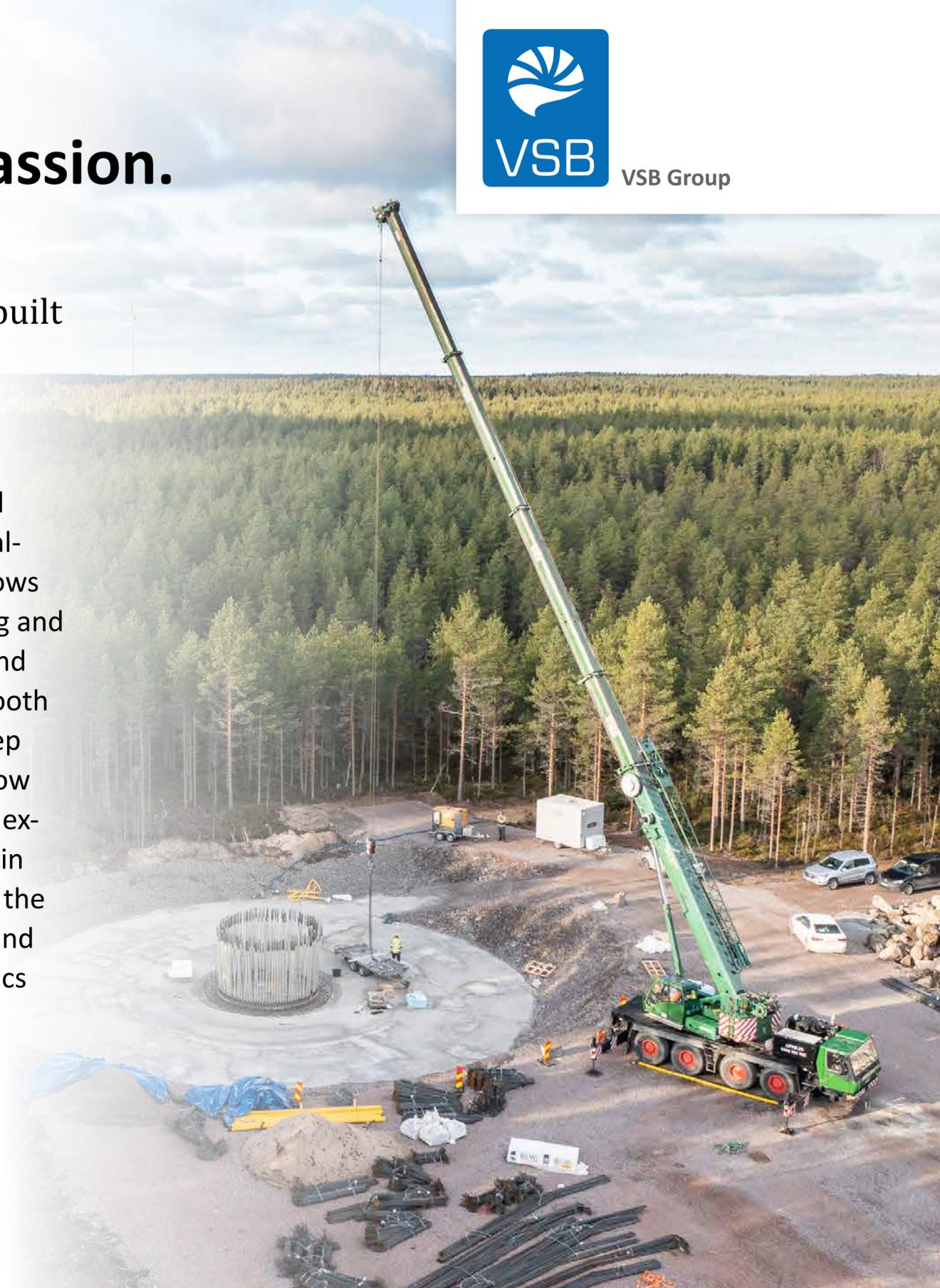
Project Planning: Wind is power – and our passion.

Climate protection coupled with business growth: VSBs wind farms are being built from Finland to South Korea

The global economy is booming. Many companies are reducing their environmental footprint and prioritising carbon-neutral production processes. Cities and municipalities also want to become climate-neutral, while increasing numbers of electric cars on our roads are cleaning up transport. We can only satisfy this hunger for energy with green electricity from wind and solar. In fact, one look at figures published by the International Energy Agency (IEA) in its 2021 World Energy Outlook shows there's no way around this. Zero emissions by 2050 is the goal if we are to achieve the 1.5-degree target of the 2015 Paris Agreement. From 2030, the authors continue, this will require more than 1000 additional gigawatts (GW) of wind and photovoltaic capacity annually. To achieve this, the IEA calculates that investments will have to more than triple over the next ten years.

We need more renewable energies quickly.

This mainly needs to happen in emerging and developing countries. A highly motivating challenge for renewable energy businesses. It shows what we as an industry have been demanding and demonstrating for decades: we need to expand faster, to make phasing out fossil fuels as smooth as possible, secure the energy supply and keep prices stable for consumers. It's why we all now have our hands full. And the VSB Group is no exception. Around 400 employees at 22 offices in Europe and Asia are taking our vision around the world and working to bring a pipeline of around ten gigawatts of wind energy and photovoltaics online in ten countries.



What does this have to do with the VSB Group as a project developer for wind and solar?

Renewable energies have been our core business since 1996. We have always been passionate about the power and potential of wind. Time and again we have reached the limits of our abilities because that all-important jolt that has to go through the ranks of the political decision-makers is sometimes still missing – and because bureaucracy often slows us down with tough permit procedures and a jungle of requirements. And, because protecting the climate takes more than "just" building a wind farm, as protecting the climate is related to the short-

age and equitable distribution of resources, and to equality of opportunity. Global warming is not only a threat to biodiversity, a cause of extreme weather events and environmentally destructive, it is also a danger to human health and affects drinking water and food supplies. In short, we cannot explain away climate change and there is no vaccine. Therefore we need people who get stuck in, companies that think outside the box and invest massively in research and development, but also a society ready to embrace new technologies and everyday strategies. This is our cause.



Wind in the forest: VSB Wind farm Trendelburg (Germany/Hesse, 23.1 MW total capacity, commissioning 2018) © VSB Group

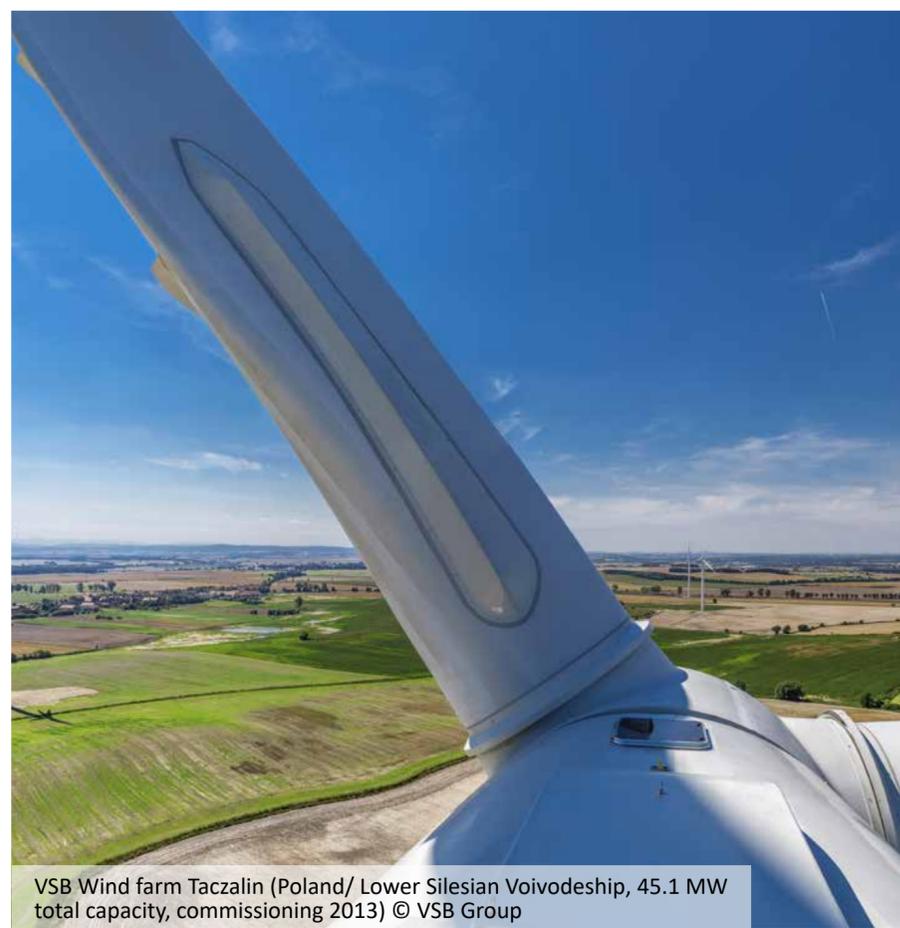


VSB Wind farm Wipperdorf/Pustleben (Germany/ Thuringia, 18.9 MW total capacity, commissioning 2017/2019) © VSB Group/Peter Horntrich

"We have to act now for the climate,"

argues **Frédéric Lanoë**. The Frenchman became the new CEO of the VSB Group, headquartered in Dresden, in June 2021.

He wants to use the wind energy company's leading position and the booming market to fight climate change.



VSB Wind farm Taczalin (Poland/ Lower Silesian Voivodeship, 45.1 MW total capacity, commissioning 2013) © VSB Group

25 years, 22 locations, 400 employees, one vision: 100 % renewable energies

VSB has been very successful over the past two decades. It has seen more than 700 wind farms and photovoltaic plants go online, above all in Germany, France and Poland. Now it is time to grow stronger across Europe and internationally. Today renewable energies are standard in almost every country. This plays into our hands as an industry, but also as a company that's been there right from the start. Since 2020, we have also had a strong partner on board, the Swiss Partners Group. We are working together at high speed on many new projects in our core markets and numerous other European locations such as Finland, Italy, Romania, Spain, Greece and Croatia. And we also have our foot in the door in Asia: Our team there has been developing wind farm projects for VSB in South Korea since 2019.

Current construction projects and repowering in Finland, Poland, Germany and France

Just over 100 megawatts (MW) are currently under construction. These include the Finnish wind farm Juurakko with 40 MW in the North Ostrobothnia region and a further 42 MW in Poland's Wielkopolska voivodeship. Besides Germany, France is a strong pillar in VSB's expansion of renewable energies. Having successfully entered the market there 20 years ago, we are contributing to the French energy transition from six locations with around 120 employees. This also includes numerous photovoltaic projects for businesses and municipalities. On the rise in France and a big topic in Germany for years: the dismantling and repowering of old wind turbines. In Saxony-Anhalt, we are now working on one of Germany's largest repowering projects ever. We aim to dismantle a total of 50 turbines, replacing them with 17 new, more powerful ones. This will see more than 110 MW of installed capacity connected to the grid by 2024. The result? Environmentally friendly electricity for a good 160,000 people and almost 200,000 fewer tonnes of CO2 emitted.

Frédéric Lanoë
CEO of VSB Group

Phone: +49 351 2118 3400

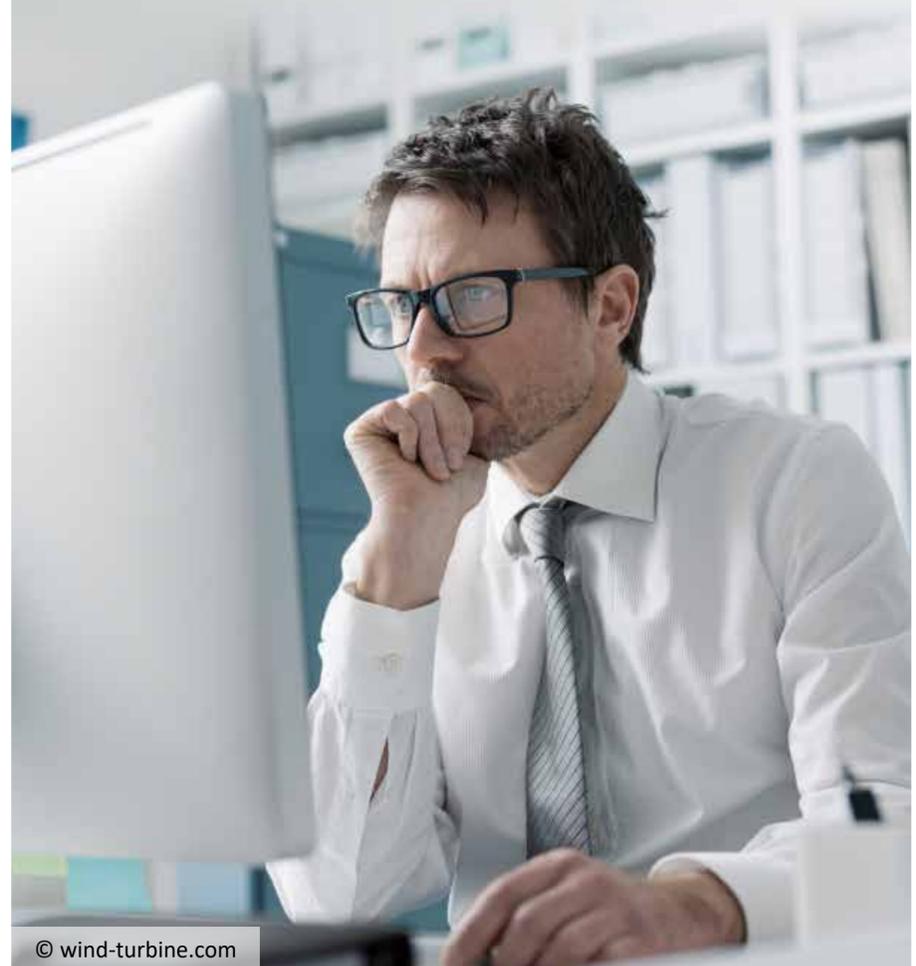


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percent of value creation will be transacted on platforms in 10 years. Leading business experts agree on this.



Innovative Projects **Advertorial**

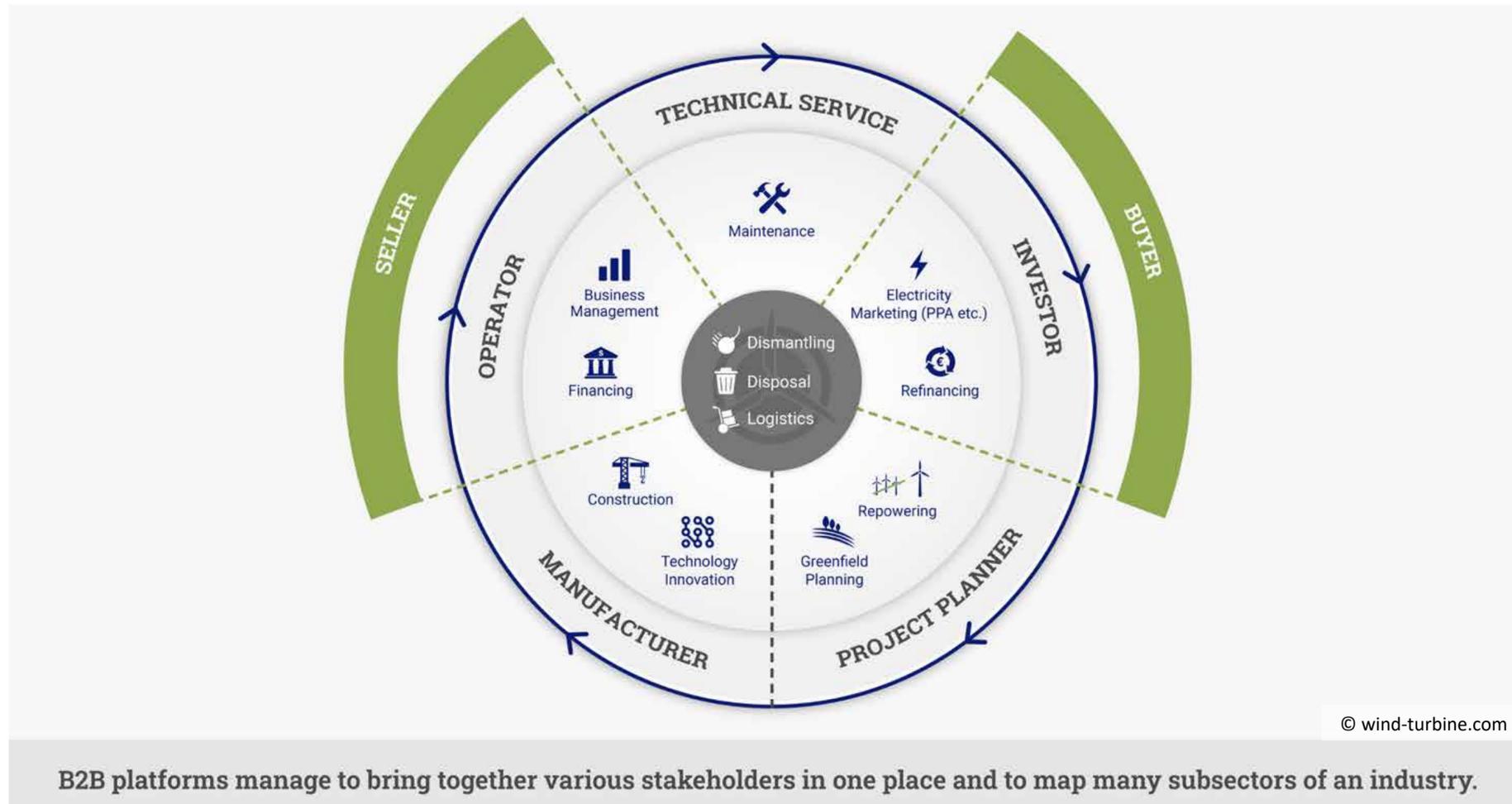
What can be digitized will be digitized.

How digital B2B platforms can accelerate the global energy transition and open up new business opportunities.

Amazon, Google, Facebook, Alibaba, Tencent ... it is enough to mention these five names to describe the market position and balance of power of digital business-to-customer platforms in a nutshell: Of the top 5 global digital B2C platforms, three are from the USA and two from China. But the truth is also that Europe's share of the platform pie is tiny.

The fact that B2C platforms and marketplaces have long since conquered the consumer side with their wide selection and price advantages almost makes one forget that there is also a B2B sector. Its digitalization still seems to be imminent if one looks at the numerous survey and study results. Now, one might wonder how modern it still is in the third decade of the 21st century to approach suppliers, manufacturers, service providers or customers with classic acquisition and sales channels – i.e., by telephone, fax, or e-mail.





B2B platforms: A game changer?

On the other hand, this situation also shows: there is a lot of untapped potential in the area of B2B platforms. It is the chance for European players not to let the platform parade pass them by this time, but to create something themselves and or at least develop their own platform strategy.

It's not a question of if but when, because platforms in the B2B sector are not just another sales channel – they fundamentally change the economy. Not to mention the processes that are simplified and accelerated with the help of digital technology: As intermediaries, they connect two

or more market participants or business partners with each other at eye level, simplify their interaction or even make it possible in the first place, for example, if one looks beyond national borders.

Fortunately, a flourishing platform ecosystem is currently emerging in Germany, which should benefit from the country's industrial strength: More than 30 per cent of the gross domestic product is a contribution from German industry. Accordingly, Germany's platform landscape is also shaped by this in its development. Another special feature of B2B platforms becomes clear: the extremely high degree of specialization.

What about digital B2B platforms in the renewable sector?

If we look at renewable energies, Germany, with its energy transition and many innovative companies, is considered a pioneer and frontrunner – especially in the wind energy sector. Therefore, it is perhaps not surprising, but all the more encouraging that the world's largest, international B2B platform for the wind industry does not come from the USA or China, but from "Good Old Germany".



"wind-turbine.com" is the plain and simple name of this platform, which is based in Gelnhausen, not far from Frankfurt am Main. The mission and vision of founder Bernd Weidmann is just as clear as the name of his platform: to further digitalise processes in the wind industry, to make them even more transparent internationally and to accelerate the energy transition.

"As a digital B2B platform, however, you generally don't act alone," says the founder. Since the German industry is traditionally organised in strong associations, the largest and most important industry association, the "German Wind Energy Association" (BWE), works together with wind-turbine.com. According to Weidmann, other important partners driving the development of the

platform are also the industry's leading international trade fairs, including HUSUM Wind and WindEnergy Hamburg.

More transparency and trust

"While there are many companies in the industry represented at the mentioned trade fairs, of course not all of them can be found, whether as exhibitors or visitors. With a platform that can be accessed from anywhere, we can, for example, additionally offer access to the international wind market to all those who do not have the time or opportunity to visit trade fairs," describes Weidmann.

But bringing together as many players as possible on one platform is only one of many goals that are being pursued. In addition to accelerating and simplifying processes, Weidmann's main goal is to make the market more transparent and to load it with trust. "When it comes to large transaction sums, such as the sale of one or more wind turbines, transparency is essential. We will lay the foundations for this with further digital innovations," says the platform founder.

From the beginning of 2022, for example, it will be possible to process transactions via the platform using an escrow service – worldwide, in any amount. In the future, even more digital applications for wind-turbine.com are in the pipeline. In this context, there is also talk of a planning tool: "Nothing is impossible. Why shouldn't it be possible at some point to digitally map all the planning steps of wind energy projects, e.g. forecasts or logistical processes? We are definitely thinking about this," explains Weidmann. It is not yet possible to estimate when this will be the case, but one thing is certain: what can be digitized will be digitized.

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CEO of wind-turbine.com

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Contact



Gear oils – raising the bar

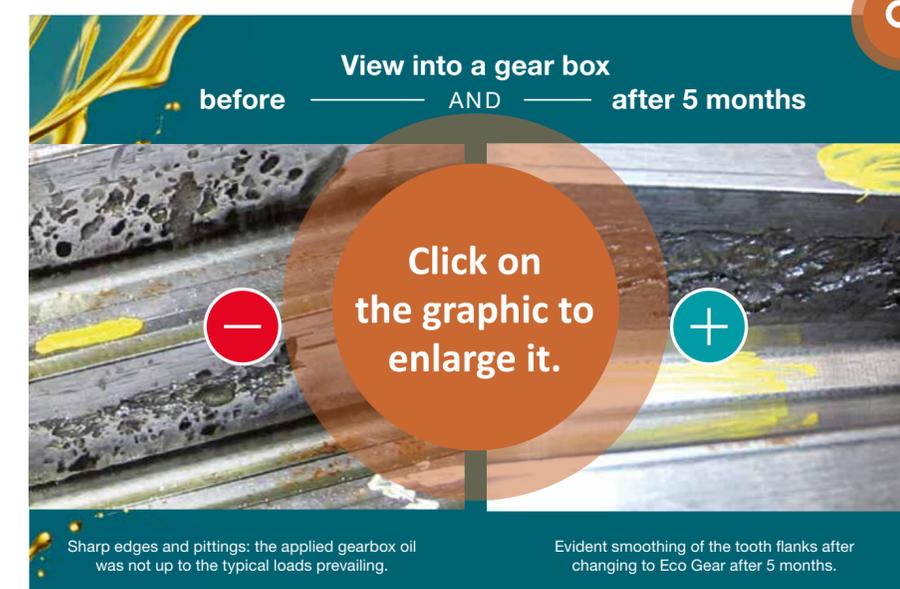
With increased demands, gear oil has advanced from an operating material to a construction element.

More compact designs, smaller oil volumes and constantly improved surface finishes place high demands on gear oil. Environmental influences such as highly variable wind forces, vibrations, fluctuating ambient temperatures and, especially in the case of offshore plants, moisture, make things even more difficult. The entire performance of a plant depends on high-performance lubricants. As a result, they now take on the role of a design element. The ADDINOL Eco Gear series was developed in close cooperation with leading gear manufacturers in the wind sector, producing high-performance gear oils that exactly meet the expectations of the operators:

- reliable protection against wear and corrosion
- highest operational safety
- long service lives
- low maintenance

Prevent gearbox damages and ensure the profitability of the plant

ADDINOL Eco Gear M and S cannot be compared with conventional industrial gear oils. Eco Gear M is based on mineral and Eco Gear S on synthetic base oils. Both versions contain the innovative Surftec® additive technology which adapts to the changing load conditions in the gearing and works in



symbiosis with the gear. ADDINOL Eco Gear M and S prevent micropitting and pitting as well as abrasive wear. According to FZG, the Research Centre for Gears and Gear Unit Design at the Technical University of Munich, "efficiencies are possible for gears when using ADDINOL Eco Gear which are otherwise only achieved with EHD (elastohydrodynamic) lubrication." This means ADDINOL Eco Gear almost reaches the ideal state of lubrication and is an effective formula against wear due to its Surftec® additive technology.

In pre-damaged gears showing clear signs of wear, material abrasion or even pitting, ADDINOL Eco Gear achieves reliable smoothing and long-term stabilisation of the tooth flanks thanks to its PD effect (plastic deformation).

Long oil change intervals for predictable maintenance times

The ageing of an oil filling is considerably influenced by the time of application and the temperature that the oil experiences during its use. In addition, any impurities have an accelerating effect on the oxidation behaviour of an oil. ADDINOL Eco Gear M and S contain selected antioxidants to neutralise oxygen compounds. They actively counteract the ageing process caused by oxidation. But that is not all: thanks to their extremely low friction coefficient the high-performance gear oils lower the temperature of the oil and thus delay the ageing process even further. The important role that temperature plays in the ageing of a lubricating oil is illustrated by the generally applied formula: A 10°C increase in temperature doubles oil ageing. So, every degree by which the oil temperature is lowered matters! After all, the lubricants for gearboxes in wind turbines must be fit to stay in use for as many years as possible.

ADDINOL Power Pack
Lubricants + service products + analysis ... all at one stop

ADDINOL Lab report
reliable analysis

ADDINOL service products
for maintenance and care

ADDINOL Industrial Gear oils
for reliable lubrication

©ADDINOL Lube Oil GmbH

"Technical advancement in aggregates and machines of course also has an impact on the lubricants applied and our research & development aims at ensuring trouble-free operation in all aggregates."

Christian Reschke,

Head of Research & Development at Addinol

360° service for oil and components

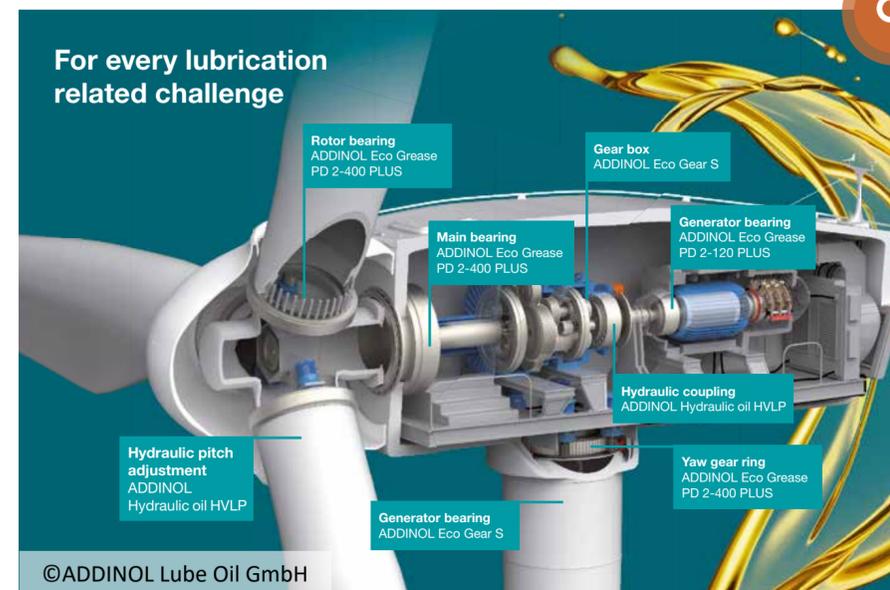
In order to minimise the risk of unscheduled downtimes and to safely plan necessary maintenance work, ideally the condition of the plant and its oil are monitored. Therefore, the application of ADDINOL lubricants in wind power plants is accompanied by the proven ADDINOL Analyses service. After an oil analysis by independent partner laboratories, the oil parameters are checked and evaluated by ADDINOL Application Technology engineers – individually and for each plant. Parameters such as oil condition and additive content allow statements on loads, possibly changed operating conditions and the further usability of the lubricants used.

At the same time, the analysed parameters reveal impurities and contaminations. Individual wear elements reflect the condition of the components and indicate possible malfunctions or damage at an early stage. In addition, combinations of different wear elements can often be useful indications for preventive maintenance and service. The ADDINOL Analyses Service thus allows plants to be monitored so that operators and service companies can optimise planned maintenance measures and respond to possible damage at an early stage.

"In the wind industry, our focus is mainly on gear oils that are tailored to the extreme conditions of wind turbines."

Christian Reschke,

Head of Research & Development at Addinol



The right lubricant for every application

ADDINOL lubricants are developed in our own laboratory in close cooperation with leading OEMs and institutes. Already today, we are preparing for future requirements. Our high-performance lubricants are construction elements at the cutting edge of technology. Their full potential is achieved in symbiosis with engines, drives, chains, bearings and hydraulic systems. They are developed and manufactured at the company site in Leuna, in one of the most modern lubricant factories in Europe. Through our competent partner network ADDINOL lubricants are in use in more than 100 countries and on all continents.

Steffen Homberg
Productmanager Industrial
Gear oils at ADDINOL

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Contact

Lead-free cables: The future for offshore wind farms

For the toughest conditions: optimized lead-free cable solutions for offshore applications from Prysmian Group

Wind power continues to emerge as one of Germany's key energy sources. Offshore turbines are being engineered for ever greater capacities, which presents new challenges for energy transmission in the turbines themselves and in offshore wind farms. Beside this, health and safety considerations are another important factor.

Offshore wind farms currently operate at 66 kV and are preparing for an upgrade to 132 kV. This places extremely high demands on the turbine installations as well as the associated cabling and connection equipment.

Prysmian Group offers a large portfolio of innovative cable solutions specified to meet these requirements. It invests on an ongoing basis in the development of cable technologies that reduce lead content, aimed at creating innovative and more efficient solutions.

For toughest conditions: optimized cable solutions for offshore

Under its brands Feltoflex® and Windflex® Prysmian offers cable solutions that withstand the toughest conditions on the high seas and the very specialized technical specifications of the wind industry. The individual elements are produced at



Prysmian Group Feltoflex®

various locations, all to extremely high standards and are made in Germany. The low bending radius of Feltoflex® cable saves space during routing – a feature that distinguishes it from other products currently on the market – and are also well suited to connecting offshore

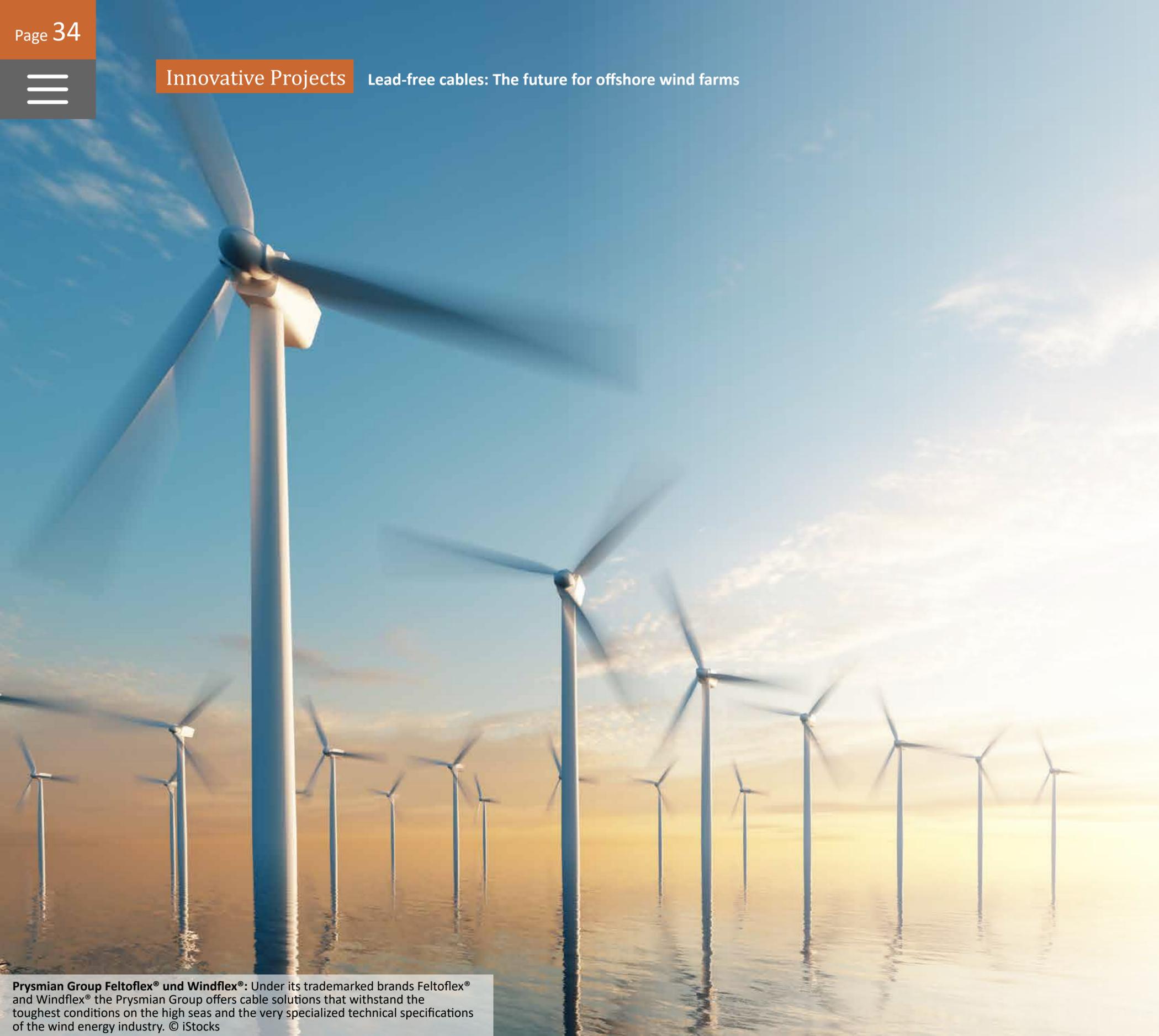
platforms with one another. An application that demands a high degree of flexibility as the platforms can move relative to each other.

Feltoflex® is used primarily in those cases where the cable cannot be attached directly to the switchgear. This is where the cable serves as a



Prysmian Group Windflex®

so-called dropper cable, securing the connection between the turbine and the network. One of the most notable benefits is its tight bending radii. This means it can be installed in extremely small spaces and significantly reduce costs.



Because the nacelle turns as the wind direction changes, the cables have to turn with it. Windflex® and Feltoflex® come into play where the cables run in a loop. This is where flexibility really matters in order to prevent potential mechanical damage and breaks. Several factors must come together, like thickness of sheathing, construction of energy conductor and the ductility and fire retardance.

The big advantages of the Prysmian range include their mechanical resilience and especially their outstanding torsional performance. They are also put through their paces to ensure they are robust enough to withstand extreme fluctuations in wind-speed and temperature. Windflex® and Feltoflex® cables can cope with temperatures from -40 to +80 °C. Windflex® cables are zero-maintenance and overwhelmingly wear-resistant.

The Windflex® product range was used for the first time in 2005 and has been running in those installations ever since without a single failure. The range is engineered to last the entire lifecycle of a platform, at least 25 years. Extensive internal testing provides the basis for first-class product quality.

On the road to lead-free solutions

The sector faces new challenges in areas such as wider obligations to declare hazardous materials. For instance, cable insulation materials have traditionally contained lead to enable lower material thicknesses. Therefore, the development of lead-free solutions is central to this field primarily because the metal is known to be toxic to reproductive systems, meaning all associated health risks must be avoided.

The shift away from lead content in cables means the industry is searching for materials that can replace the beneficial properties of those products. The key features are good mechanical characteristics such as wear-resistant sheathing, thermal

characteristics like heat resistance, thermal stability in the event of a short circuit as well as flexibility and the ability to strip the sheath easily. Alternatives include advanced solutions containing calcium and zinc stabilizers.

"The development of lead-free flexible High-Voltage cables for the use in offshore wind turbines is one of the most important innovations in our wind industry. On one hand higher and higher voltages levels are required on the other hand environment friendly products are demanded." Thomas Brandt

Prysmian has been producing medium- and high-voltage cables with lead-free insulation compounds for almost ten years and is a pioneer. The Prysmian Group passed the type test with 66 kV – a first in the field of high-voltage cable. The use of lead-free insulation is especially beneficial during harnessing, as working with leaded cables can expose people to toxic substances such as dust particles generated during sanding and grinding.

With regards to the cable and conductor industry, we anticipate that lead-free solutions will become standard throughout the sector as a consequence of heightening health-and-safety demands as well as lower administrative work associated with declaration obligations on the part of customers and manufacturers alike. The materials' mechanical properties must nevertheless be brought into line with health requirements and economic considerations – a challenge Prysmian is well-equipped to face with its decades of experience.

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Ideas and expertise from Germany

Rotor blade recycling: Innovative processes for demanding materials

Read Article 

Rotor blades are made of fibre composites that can only be recycled with a great deal of expertise. But smart processes are making it possible.



Operators, owners, and planning offices are considering dismantling wind turbines without replacing them, or choosing not to repower them. This is due to the discontinuation of state Renewable Energy Sources Act (EEG) subsidies in Germany, economic considerations that have to do with continuing operations, and even the development of scrap metal prices. Recycling turbine components is thus playing an increasingly important role. Motivated and innovative entrepreneurs are needed to develop environmentally sound ways to dismantle existing plant and implement holistic standards in line with a low-carbon solution.

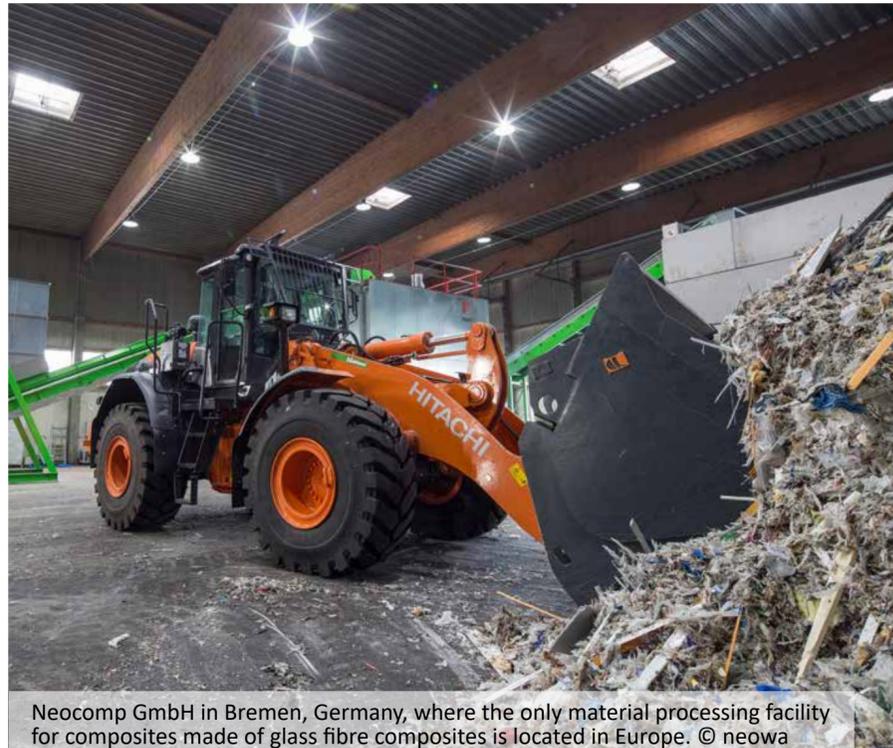
This will create space for indispensable framework conditions such as legal security, occupational health and safety, and sustainability. At the same time, the same entrepreneurs will have to close the information gaps that still exist among decision-makers, planning offices, demolition and waste disposal companies and owners when it comes to recycling the materials used in the production of wind energy. This particularly applies to rotor blades whose construction is complex.

Rotor blades: does a complex composition necessarily mean complex recycling?

Rotor blades account for only a fraction of the weight of a wind turbine but account for nearly a quarter of the manufacturing costs: high manufacturing costs are a major issue because the blades are subject to a high-frequency development process and also, to a lesser extent, generate a certain amount of production waste. This means that not only old disused rotor blades present a recycling challenge, but also the production waste, which comprises complex materials such as

- reinforcement fibres,
- a polymer matrix (consisting of thermosets such as epoxies, polyesters, vinyl esters, polyurethanes, and thermoplastics),
- sandwich cores (e.g., balsa wood),
- surface coatings (e.g., polyethylene and polyurethane) and
- metals (such as copper wiring and steel bolts).

Glass-fibre reinforced plastic (GRP) is used in numerous areas due to its positive properties. Because of its high strength, flexibility, and processing ease it is popular in the shipbuilding and automotive industry, as well as being used in the production of rotor blades for wind turbines. But, until now, the possibilities for recycling it have been limited. Dumping GRP waste in landfill sites has been prohibited in Germany since 2005 and incinerating it is only permitted to a limited extent.



Neocomp GmbH in Bremen, Germany, where the only material processing facility for composites made of glass fibre composites is located in Europe. © neowa

From demolition to recycling

The successful and economically responsible way to recycle wind turbines involves the following critical steps:

- Employing the right team for the wind turbine in question
- Removing the foundations, crane assembly areas, access roads, and subterranean cables
- Recycling rotor blades made of GRP / CFRP (glass fibre or carbon fibre reinforced plastics) and disposing of them correctly
- Direct sales and marketing support for selling the wind turbines
- Consultancy, market research, and regulatory support

Turning a rotor blade into cement

Once they have been dismantled, rotor blades are sawn up and transported in containers to pre-treatment sites where the solid metal components are separated out and the rotor blade fragments crushed down even more. This material is then transported to a factory, where other impurities are removed before being mechanically processed and

homogenised to produce a usable granular raw material substitute with a grain size of < 40 mm. The silicate contained in the glass fibre replaces sand in cement factories and the material is recycled to produce an intermediate product known as cement clinker, which is then mixed with gypsum and ground into cement. So, cement produced in this way can be produced without using sand which is scarce around the world.

Goldhofer

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This is still far from perfect, and a lot remains to be done ...

At this point, the most responsible way to recycle the silicate in the GRP involves the use of suitable process engineering and thermal pre-treatment within the cement factory although this is also the costliest way to recycle this valuable material both from an ecological and economic perspective. However, the end goal has to be to ensure that the fibres really are reused as part of a genuine circular economy. Both the paper industry and specialist carbon fibre processing firms are already showing how this can be done.

Involving private companies in this process presupposes an economic feasibility on a large industrial scale, which is precisely where the real challenge begins. The market price of carbon fibres, which is twenty-fold higher, as well as the

(economic) possibility of making investments that had previously not been considered profitable for fibre optic connections would seem to make a recycling process both compelling and economically reasonable. Nevertheless, so far, many entrepreneurs are not ready to also recycle glass fibre composites and to design these thermosets in a way that they can be used till the end of their life cycle. There is also still a lack of imagination when it comes to considering the use of glass fibres for other applications (such as furniture and kick plates) to give them a genuine "second life". Dealing with the increasing recycling demand will require an urgent rethink on the part of both the public and the economy.



Author

Frank J. Kroll
CEO of neowa



Decentralised energy generation 2.0

NRGSync's primary objective is to ensure independent energy production for the benefit of everyone with decentralised and versatile energy production technologies.

NRGSync develops small and large wind turbines which combine all the benefits of decentralised energy generation. Equipped with our PV foil and coupled with our patented technical wind solutions, we have developed unique systems over the years that stand out in terms of yield, cost-benefit and flexibility.

Whether it be a municipality, an industrial site, or the creation of entire infrastructure solutions through a suitable charging infrastructure, we make it all possible from a single source and 100 percent "Made in Germany".

Anjo: Energy supply for domestic residences

For our EMIWA "Anjo", all CE, EMC/EMC tests and all necessary DIN standards were complied with and certified. We have also complied with the legal requirement pertaining to noise emissions in residential areas, whereby a value of just 31db at full load was certified. All safety-relevant components have also been integrated, from overvoltage

protection through to the non-combustible storage cell used for our own storage batteries. As a contracting solution, including the coupling of PV systems for public and non-public buildings, tenant electricity models represent unique solutions for cities, municipalities, cooperatives, and management companies.



Anjo: Energy supply for domestic residences © NRGSync



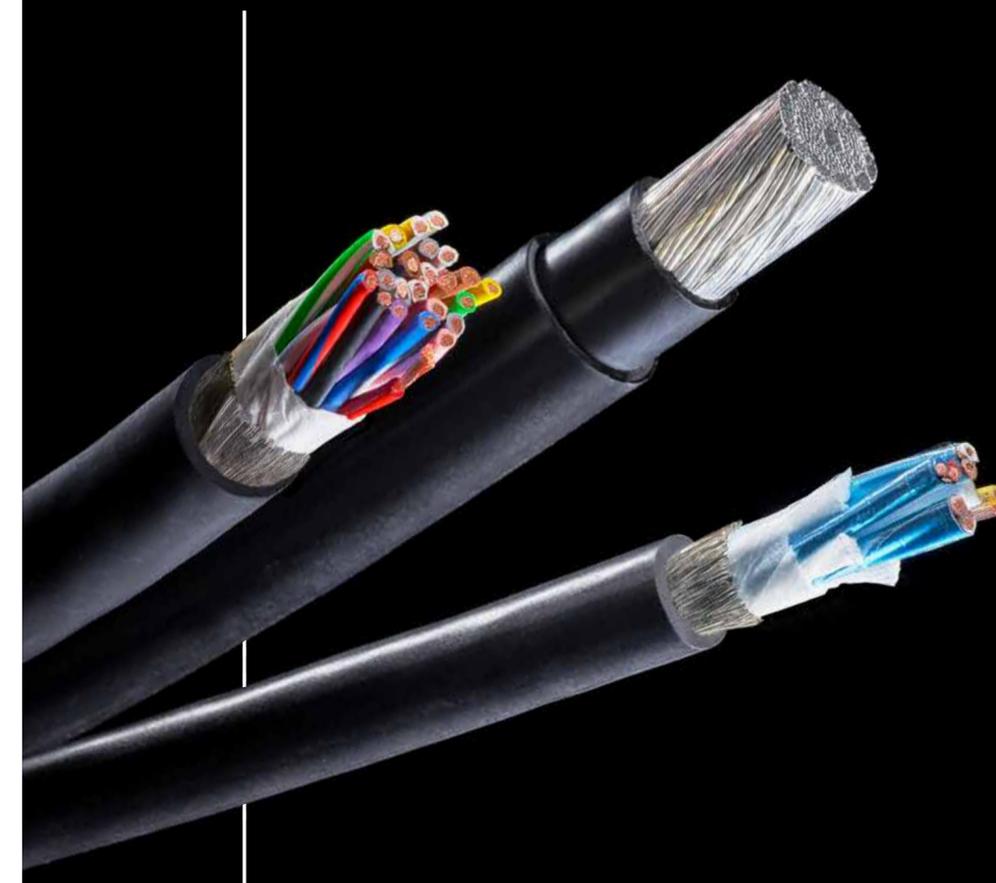
Liko: Street light and charging station in one © NRGSync

Liko: Street light and charging station in one

The huge potential of our EMIWA "Liko" lies in its simplicity: the system produces approximately 700 kWh of energy per annum, but only requires around 70 kWh per year for its own (dimnable) lighting.

Among other things, it can be used as a motion detector, a monitoring system and as a replacement for existing lighting points. We use the installed cables to bring together and store the excess energy. This excess energy can be used directly at the Liko for charging e-vehicles or made available at strategically important collective locations.

We set wind energy on the right path



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**(Channeling
POWER)** 

Hiroki: The wind turbine for the city centre

Like all our products, the EMIWA "Hiroki" - which means "big tree" – is a global first in the field of decentralised energy generation. The Hiroki can be installed in any built-up area and combines modern design with high performance at a height of between 40-50 metres.

It can produce between 780,000 and 1.23 million kWh of energy at ports, industrial sites, city-centre locations etc. The installed capacity is 3 MW. Totally new potential applications include integration in major charging stations or directly at filling stations for the production of green hydrogen.

Conclusion:

The German Start up NRGSYNC advocates a 100 percent energy transition and provides decentralised solutions for everything from domestic residences to industrial sites and municipalities. We welcome collaboration with other companies to help achieve this goal with our products. Our requirements are modest, but our values are all the more important. Which is why we are happy to work with partners who are also keen to advance modern energy production.



Author

Stefan Kaus
CEO of NRGSync





Ideas and expertise from Germany

Intelligent drone-based inspection of wind turbines

Automated visual inspections and contactless lightning protection (LPS) measurement for on- and offshore wind turbines

The regular visual inspections and lightning protection tests of wind turbines are essential for both safety and efficiency, but are also requirements for local regulations and insurance damage coverage. These are trained personnel intensive, are weather dependent and associated with long down times with resulting costs. These are personnel intensive, weather dependent and associated with long down times with resulting costs.

Wind turbines are permanently exposed to ever changing weather conditions so it is almost unavoidable that damage to the structure can occur. This damage, however, can be prevented or minimized within reasonable limits, if potential issues are detected at an early stage. Currently, LPS testing and preventative maintenance means long downtimes resulting in an expensive loss of production output. The biggest issue the operators have at the moment is the availability and capacity

of industrial climbers who are in huge demand. Operators often have no choice but to shut down the turbine for an extended period for these inspections even on very productive days.

There is a new alternative to this costly and time intensive maintenance. The method of using industrial climbers is increasingly being replaced by drone-based inspections.





Drones as an alternative method for inspections

In this method, the drone is flown alongside the rotor blades and tower by a highly trained drone pilot and takes images of the turbine during the flight. This image material is reviewed afterwards by an expert and possible anomalies are reported. Drone-based inspection is offered today as a service by some companies and can be booked as needed, similar to industrial climbers. Although this drone-based inspections of wind turbines takes

significantly less time than the usual manual climber inspections, it still has many stumbling blocks. For example, specialized pilots are needed, which means that the operator is again dependent on third-party resources and availability. In addition, during the flight, despite having a specialized pilot, it is difficult to fly close enough to the blades to obtain high-resolution images and it's almost impossible to maintain a constant distance, simply because of the height of the turbines and different weather conditions. Furthermore, a huge amount of overlapping redundant images are produced, which needs to be analyzed in a time-consuming process. There is still a need for optimising this method.

Autonomous drones in independent operation

For the first time, it is now possible to carry out an automated drone inspection independent of pilot skills. A new technology makes it possible for the drone to fly completely autonomously from take-off to landing, because the flight path is precisely calculated in advance. This procedure enables a reproducible and accurate inspection flight, as the inspection route is always the same for the same type of turbine.

TOP7

MAKING DRONES SMARTER.



by TÜV SÜD



Patent EP 3 596 570

Contactless lightning protection measurement and automated inspection

- visual inspection of rotor blades and tower
- patented, contactless lightning protection measurement
 - validated and verified by TÜV SÜD –
- automated, drone-based technology
- independent inspection without specialized pilot

TOPseven.com/en/demo

During the autonomous inspection flight, high-resolution images are taken, which can be analyzed almost in real time in the cloud. The images are optimized, processed and sorted in advance by AI before being presented to the inspector. The expert can use visual tools to closely inspect the surfaces and accurately measure and categorize damages, creating an automated modular anomaly report. This inspection process can be applied to both on-shore and offshore rotor blades and the towers.

New method locates possible damage points from lightning strikes

Additionally, there is a new alternative test method for lightning protection measurement (LPS) using a drone equipped with sensors to carry out contactless conduction measurement. This process is completely automated and can also be

used independently of visual inspections. The core idea of this patented process is the non-invasive injection of an electromagnetic field into the lightning protection conductor. The drone is equipped with a special sensor for e-field measurement and flies along the length of the rotor blade capturing multiple readings per second. The resulting data is evaluated using special filters and mathematical algorithms. The result is faster, more efficient, and more accurate measurements. This method can also precisely locate possible damage points which can then be repaired at later time.

Obviously, this alternative method of LPS testing needs to be certified by an independent organization make sure the test results are valid. This technology has been validated and verified by TÜV SÜD as a suitable alternative test method for a wind turbine's lightning protection system, extending from the receptors (lightning arrestors) to the blade flanges of the rotor blades, in accordance with the Technical Guideline of the German Wind Energy Association (BWE Guideline).

A new standard for wind turbine inspections

The drone-based inspection and contactless lightning protection measurement is a real alternative to the usual climber based methods. Almost anyone, from operators to technical managers to surveyors, can task their own servicing personnel with performing a visual inspection or lightning protection measurement, without the need for specialized training. This type of automated drone-based process sets a new standard in terms of precision, data quality and ease of use.



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Do you still have losses or are you already measuring?

Why the vibration-free operation of wind turbines is so good for your balance sheet.

The rotor as the central assembly for converting wind into electrical energy is responsible for the majority of the loads that are introduced into the wind turbine system. When calculating the operating and extreme loads, various input variables are taken into account up to certain tolerance values. These include wind speed and direction, turbulence intensity as well as the misalignment of the rotor blades and different rotor blade weights or unequal mass distribution in the rotor blades. If a turbine with the correct type class is selected for the site conditions during the planning stage and the turbines settings are regularly checked according to the technical specification, it can be assumed that the loads will remain within the calculated limits over the service life of the system. Thus, the performance curve specified by the manufacturer remains constant, no power curve performance losses are to be expected and the design life is achieved without major problems.

Imbalances lead to energy losses and damage to the wind turbine

But what happens if the tolerances for the pitch angles of the rotor-blades are exceeded or the rotor blade weights / mass distribution is not correct? Deviations in the rotor blade angles cause aerodynamic imbalances which lead to non-negligible underperformance and thus yield losses. Furthermore, the additional loads that occur and are not taken into account in the calculation cause considerable damage to components; mass imbalances have an equally damaging effect. The entire system is affected, but especially the components of the drive train and all roller bearings. Both types of imbalance can occur simultaneously, whereby the aerodynamic one must first be determined and eliminated before a mass imbalance can reliably be detected.



Measuring process with laser system © Windcomp

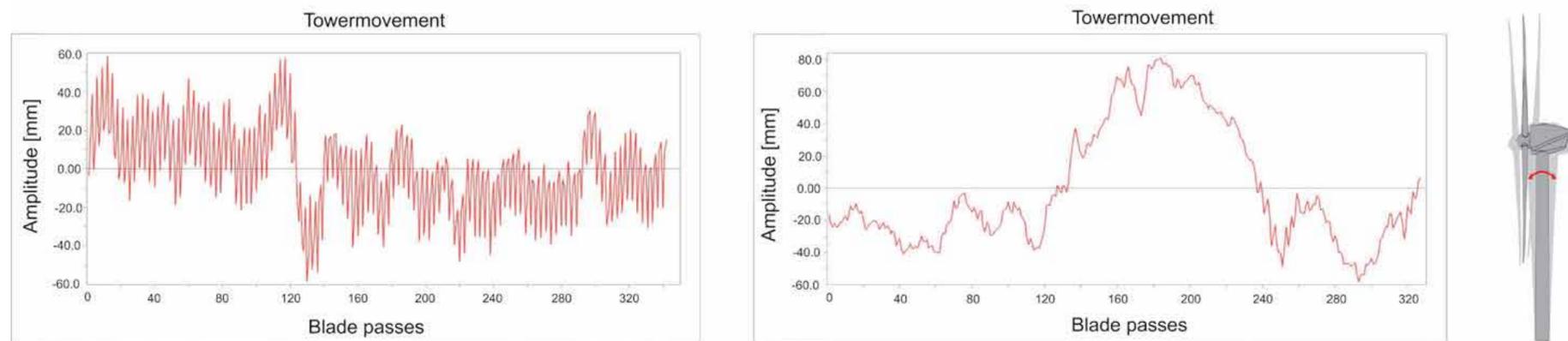


Figure 1: Harmful tower vibrations in a plant with a deviation of 2° (left) compared to the normal tower movements (right) © Windcomp

The amount of yield loss due to aerodynamic imbalance strongly depends on the turbine type, the rotor blade length and the rotor blade design. Based on targeted investigations and empirical values from wind farm operation, a conservative estimate is that at least 2 percent loss of annual energy yield per 1° blade angle deviation is to be expected. Based on the statistics derived from measurements, it must be assumed that approximately 30 percent of the turbines in operation have a blade angle error of >1°. Under unfavourable conditions, such as those that apply to turbines in the second or third row in the wind farm or at locations with increased turbulence, the loss factor can be significantly higher. For a 3 megawatt turbine at an inland site of medium quality, this roughly means a yield loss in the order of 10 - 15,000 Euros per year.

With steadily increasing turbine size, reduction in specific weight and increased efficiency, turbines become increasingly sensitive to inaccuracies in blade pitch as well as weight and mass distribution differences. The sensors installed in the latest generation of turbines can help to some extent, but they cannot replace external measurement.

There are various methods for detecting aerodynamic imbalances

Over time, various external methods have been developed to detect aerodynamic imbalances in wind turbines. A distinction is made between static and dynamic methods.

Static methods measure when the turbine is at a standstill, either by photographing the blade profiles or by scanning them with a laser.

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Relative pitch angles



Tower clearance



Tower oscillation



Twist angle



Radial splitting

A well balanced rotor results in:

- Better performance / higher yield
- Less tower stress
- Reduced maintenance costs
- Longer service-life of all components.



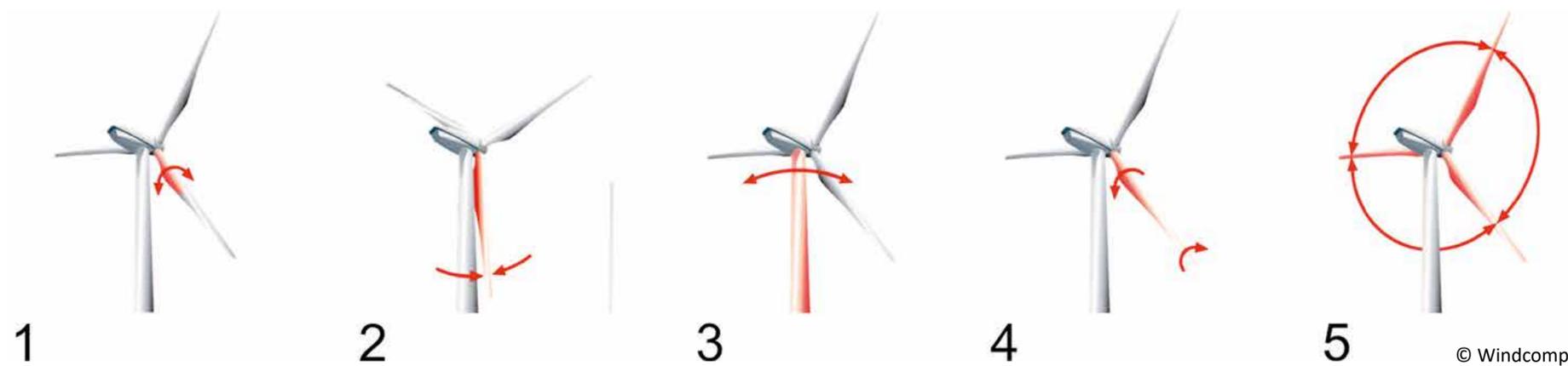
Dynamic methods measure during normal turbine operation either by recording the blade profiles by means of video or by scanning them with a laser. The static methods have a slightly higher accuracy, but do not provide any information about the behaviour of the system during operation. The video method also provides only limited additional information on the behaviour of the system in operation but is in any case more informative than the static methods.

Only the dynamic laser measurement method provides several additional pieces of information, such as blade deflection and the vibration behaviour of the tower, which can be used to estimate the extent to which the asynchrony of the blade angles affects the turbine. If there is no or only a small blade angle deviation, the additional information of the dynamic laser measurement method can be used to make a qualitative estimate of the presence of mass imbalance.

Imbalances are a cost factor – in form of yield loss and maintenance

For the turbine operator, it is advisable to have new turbines measured when they are commissioned and then regularly, at least during the periodic inspection, which should also be done for existing turbines.

Calculated over the service life of a wind turbine, imbalances represent a considerable financial burden in the form of yield loss and increased wear, the amount of which is disproportionate to the costs of regular re-measurement.



© Windcomp



Author

J. Dietrich Mayer
CEO of windcomp

1. Relative blade angle
2. Tower clearance
3. Tower movement
4. Twist angle
5. Radial sharing

"Only with a dynamic measurement method and with a measurement in real operating conditions the entire behaviour of the plant is visible." J. Dietrich Mayer

Technology masters nature

Whether it's bird flight or the open oceans, nature presents many challenges to wind power – but there are technologies to deal with them.

An increasing number of manufacturers are developing floating wind power platforms to enable them to access greater ocean depths. The energy giant EnBW and Aerodyn, a North German engineering company, both joined the quest to find a floating system in 2020 with an unusual new design known as the "Nezzy2", which consists of two rotors mounted on Y-shaped splayed towers mounted on a shared base, most of which is under water. Three floats and the rotor mast are attached to a flooded concrete base shaped like a horizontal Y. The structure is anchored to the seabed by steel cables. The main advantages of the design are that the floating foundation aligns itself with the direction of the wind and, according to the designers, the fact that the tower height is shorter than conventional wind turbines, which gives this model more stability in the water.

15 megawatts, semi-submersible

Aerodyn had initially tested an 18-metre-high 1:10 scale model of the system in a gravel pit lake near Bremerhaven and their engineers compared the operation with two- and three-blade rotors. The system was then tested for two months last autumn in the Greifswalder Bodden, a basin in the southwestern Baltic Sea, 650 metres off Vierow harbour: 180 sensors measured the turbine's behaviour in wind and waves and a storm surge occurred as if to order in October. "We had the chance to observe Nezzy2 lying stable in the water for one and a half days under extreme weather conditions," says Aerodyn managing director Sönke Siegfriedsen. Extrapolating the data to its actual size, the model was able to withstand the equivalent of 30-metre waves.



Test model of the floating wind turbine "Nezzy 2" (scale 1:10) in the storm near Vierow in Mecklenburg-Western Pomerania © Jan Oelker



Technicians collect data using the IdentiFlight technology. © NREL/Dennis Schroeder

Aerodyn and EnBW are planning to build a full-size prototype with a 15 MW output. "We want to use self-floating wind turbines in our international off-shore projects," says EnBW's Hannah König, Head of Wind and Maritime Technology: "which is why we are pleased to be providing support for the further development of this technology." The two companies recently announced that the 1:1 scale prototype will be tested in China as early as late 2021 or early 2022.

Brakes for the red kite

There are also new developments in bird conservation. Several manufacturers have recently developed effective systems for detecting medium-sized and large birds, which then either slow down the rotors (event-related shutdown) or use noise to scare the birds away (event-related deterrence). The benefits of the systematic braking and disruptive manoeuvre system is obvious: they could be used to develop new sites for wind energy in a nature conservation-compliant manner that have to date have been off limits for bird protection reasons. Detection systems could also be useful for existing wind turbines, where, for example, longer

complete shutdowns during breeding seasons are likely.

As soon as endangered bird species, such as red kites or white-tailed eagles, approach the rotor blades, they are detected by the system, which then sends a signal to the turbine control system and the rotor is put into spin mode. According to the Kompetenzzentrum Naturschutz und Energiewende (the German Competence Centre for Nature

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Conservation and Energy Transition or KNE), rotor blade tip speeds can be reduced to the point that the risk of killing these birds is minimised within 20 to 40 seconds. In fact, the German Federal Agency for Nature Conservation has confirmed that: "Some bird detection systems have reached a developmental stage that enables the automated, timely shutdown (putting into spin mode) of wind turbines to reduce collision risks." Several systems are either in the pilot or optimisation phase. An overview published by the KNE in June 2020 lists eight camera-based and three radar-based systems all in different stages of development.



The "Identiflight" camera system was developed in the USA. It detects birds at a distance of one kilometre and also identifies the species. © NREL/Dennis Schroeder

The IdentiFlight system, which comprises eight wide-angle cameras and a swivelling stereo camera and can detect large birds and birds of prey at a distance of one kilometre at a 360-degree angle in good visibility, is already being tested at several locations in Mecklenburg-Western Pomerania, Baden-Württemberg, and Saxony-Anhalt. This system, which uses artificial intelligence, needs only five seconds to recognise a red kite or a white-tailed eagle. The KNE cites initial evaluations of the trials at two locations: apparently the system was able

to detect red kites and classify them correctly at a distance of 700 to 800 metres in 90 per cent of cases, with a false positive rate of just two per cent. The false negative rate (whereby the system failed to sound the alarm) was just 10 per cent. ProBird's system, which is also camera-based, is currently undergoing trials in France and Germany. Initial results suggest that the false positive rate is 16 per cent, which is something the manufacturer is planning to optimise to lower the cost associated with unnecessary shutdowns.



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Ahnem & Enkel, agency for
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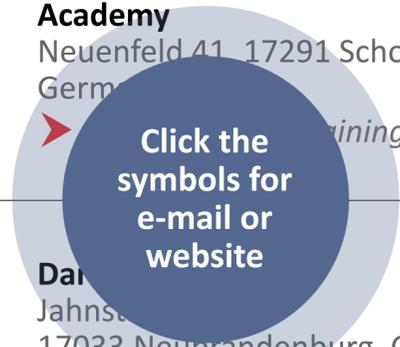

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German Wind Energy Association (BWE),
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Person responsible for content in accordance with
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Graphic idea and implementation

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Cover photo

© Paul Langrock

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The texts reflect the respective views of the
authors. These do not necessarily correspond
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Edition 1/2021 (December 2021)

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