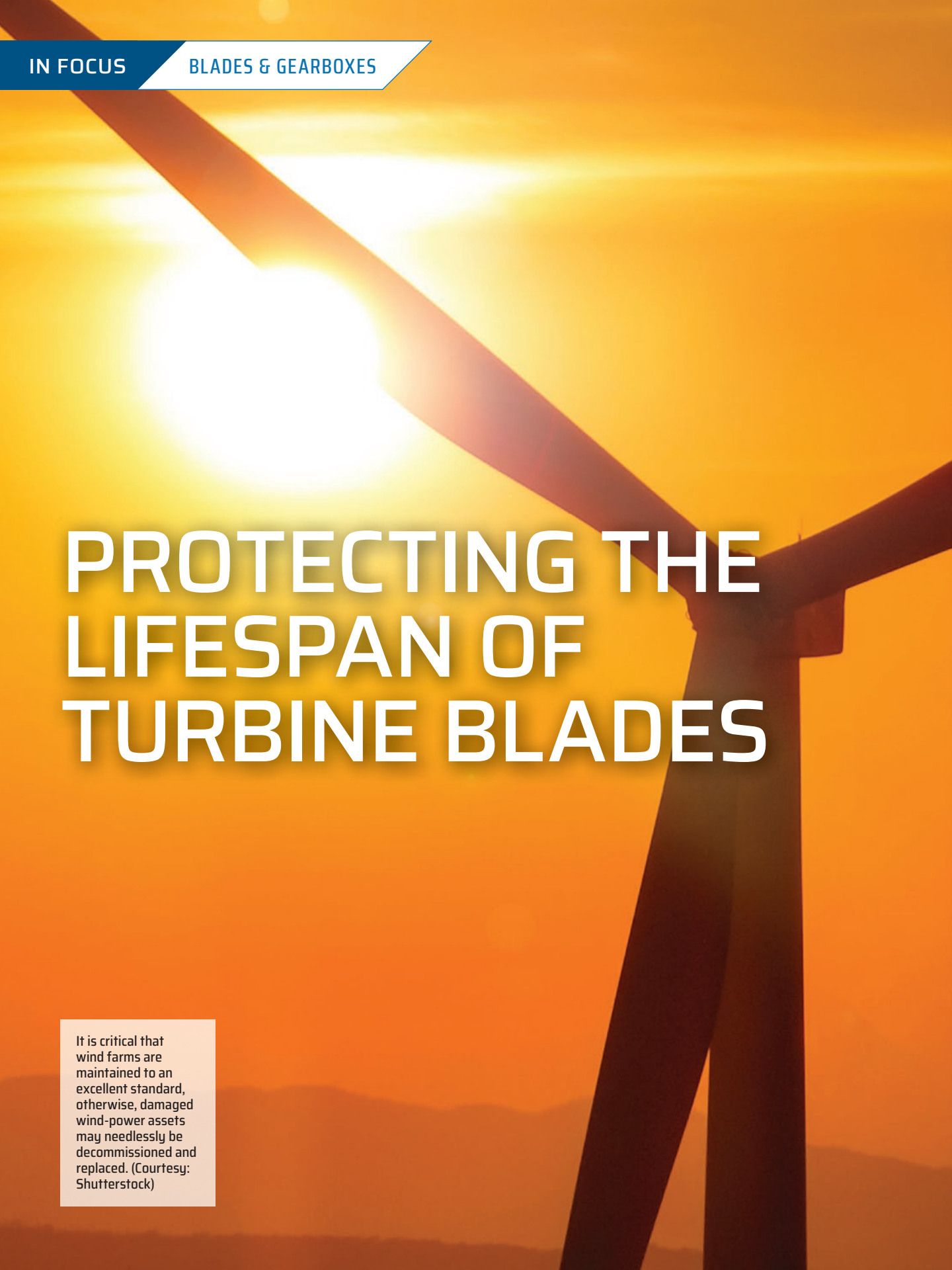
PROTECTING THE LIFESPAN OF TURBINE BLADES



It is critical that wind farms are maintained to an excellent standard, otherwise, damaged wind-power assets may needlessly be decommissioned and replaced. (Courtesy: Shutterstock)

With the use of polymeric leading edge protection, the lifespan of wind-turbine blades at a wind farm was extended more quickly and efficiently.

By CHLOE HIRST

There has been considerable growth in the wind-power industry over the past few years. However, further exponential growth of the industry is required in order to ensure that the net-zero by 2050 pathway (outlined in the Paris Agreement) is successfully reached.

In order to support this seismic growth, polymeric repair and protection technology has an important part to play. Designed to safeguard the integrity of wind-turbine blade leading edges for the long term, this technology plays a critical role in supporting this burgeoning industry.

RENEWABLE ENERGY ELECTRICITY GENERATION NEEDS TO REACH 79-96 PERCENT BY 2050

In order to achieve net-zero by 2050, according to a 2023 report from the world-leading authority on climate science, Climate Action Tracker: "Wind and solar sources in electricity generation will need to reach 57-78 percent by 2030, and 79-96 percent by 2050."

In 2022, this figure sat at 12 percent. Needless to say, a colossal scale-up of these industries is anticipated over the upcoming decades.

HOW IS THE SCALE-UP OF THE WIND INDUSTRY BEING FINANCED?

According to the International Energy Association: "Policy support remains the principal driver of wind deployment in the majority of the world." Indeed, over the past few years, several policies have been launched designed to drive forward the roll-out of renewables.

For example, in August 2022, the U.S. brought in the Inflation Reduction Act (IRA), which includes $369 billion of investment; in the European Commission's Green Deal Industrial Plan, $270 billion was pledged, and since the U.K. government's Ten Point Plan was launched in November 2020, more than 26 billion pounds of government capital investment has been mobilized.

POLYMERIC TECHNOLOGY SUPPORTS TRANSITION TO NET ZERO

Given the critical role wind power plays in the transition to a net-zero future, as well as the significant amount of capital being invested into the renewables industry, the wind-power sector is poised to experience considerable exponential growth in the upcoming decades. In order to support this growth, it is absolutely critical that windfarms are maintained to an excellent standard. Otherwise, damaged wind-power assets may needlessly be decommissioned and replaced. This process comes with a hefty carbon footprint as well as considerable financial expenditure.

As such, asset owners are investing in a simple yet extremely beneficial (both from a cost and environmental perspective) solution to extend the lifespan of wind turbines. This solution involves the use of polymeric repair composites and high-performance protective coatings to repair and protect key assets in the wind industry. This includes turbine blades, nacelles and generating components, turbine bases, towers and transformers, among other assets.

Figure 1: Leading edge protection of wind turbine blade using polymeric technology. (Courtesy: Belzona).

The use of this technology is based on a circular economic business model: repairing damaged assets rather than replacing them. In turn, not only does this mitigate the carbon footprint incurred during the replacement process, but it is also enables the asset owner to make significant financial savings as well.

LEADING EDGE PROTECTION

Polymeric systems such as the blade filler material, Belzona 5711 and the leading-edge protection coating, Belzona 5721,

Figure 3: Damaged wind-turbine leading edge. (Courtesy: Belzona)

are specially designed to repair damaged leading edges and protect them against rain erosion and impact damage for the long term.

In addition to the performance capabilities of these systems, maintenance engineers are investing in this technology due to the simple, in-situ application method and fast cure times the cold-curing systems facilitate.

In turn, this helps to keep downtime to a minimum and allows the turbine to be returned to service in the same day.

Belzona 5711, which is now supplied in a larger unit and more robust side-by-side cartridge, can be directly overcoated with Belzona 5721 in as little as 30 minutes at 20°C/68°F without the need for any additional surface preparation. At the same temperature, Belzona 5721 will be fully cured within five hours.

CASE STUDY: 42 WIND TURBINE BLADES REPAIRED AND PROTECTED

At an onshore windfarm in Denmark, 42 wind-turbine blades were exhibiting signs of severe erosion on the leading edges. Previously, the customer had used pre-formed shells bonded onto the substrate to provide leading edge protection. However, this process proved to be extremely time-consuming and expensive.

Therefore, the customer was seeking an alternative solution that would be financially viable and also ensure optimal operation for many years to come.

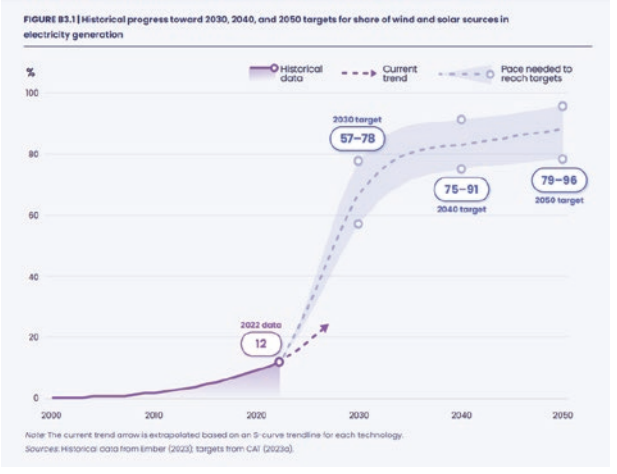


Figure 2: Historical progress toward 2030, 2040, and 2050 targets for share of wind and solar sources in electricity generation. (Courtesy: State of Climate Action 2023).

Figure 4: Leading edge repaired and protected with Belzona 5711 and Belzona 5721. (Courtesy: Belzona)

SPECIFICATION OF POLYMERIC LEADING EDGE PROTECTION SYSTEM

Based on test results, the ease of application as well as the high-quality finish that can be achieved, the customer decided to repair and protect the leading edges with a combination of Belzona 5711 and Belzona 5721.

The thixotropic paste, Belzona 5711, is specially designed to be applied in conjunction with the Belzona 5721 protective coating. This solvent-free LEP system is formulated for the in-situ repair and rebuilding of leading-edge erosion and impact damage on wind turbine blades.

SIMPLE APPLICATION METHOD

"Surface preparation was carried out on each of the 42 blades, followed by the direct application of 90 kilograms (198.4 pounds) of Belzona 5711 from self-mixing cartridges onto the blade," said Morten Sivertsen, general manager at AESSEAL Danmark A/S. "The repair area was then contoured using a piece of Belzona mixing board. Once cured, a visual inspection was conducted to ensure the application's readiness for overcoating with 144 kilograms (317.5 pounds) of Belzona 5721.

Using a short-bristled brush, this system was then applied to the leading edge and left to cure for 30-60 minutes. With three rope-access technicians carrying out the applications, on average, six to nine turbine blades were completed each day."

AESSEAL DANMARK A/S is a subsidiary owned by AESSEAL Plc and is the authorized Belzona distributor for the Denmark territory.

IN-SITU REPAIR ENSURED MINIMUM DOWNTIME WAS INCURRED

As the polymeric systems were applied in situ without the need for specialist tools or equipment, this ensured a fast and seamless application was carried out. Thus, this enabled the customer to make considerable financial savings as it mitigated the profit loss that can be incurred through lengthy periods of downtime.

SAFEGUARDING KEY WIND POWER ASSETS FOR THE LONG TERM

The scaling up of the wind power industry is absolutely critical in order to support the transition to renewable energy in keeping with the net zero by 2050 pathway.

By safeguarding key assets within this industry through the use of polymeric technology, asset owners can successfully bypass the environmental and financial costs associated with asset replacement.

Therefore, it could be argued that polymeric technology can play an intrinsic role in supporting this energy transition.

ABOUT THE AUTHOR

Chloe Hirst is the senior copywriter at Belzona Limited and is based in Harrogate, England. She gained a Bachelor's Degree (with Hons.) in media and communications (specializing in journalism) at Goldsmiths College, University of London. Hirst regularly writes case studies and thought leadership content featuring a variety of different industries, with a special focus on the renewables sector. In both 2023 and 2024, she won the Best Manufacturing Content Creation Specialist (U.K.) award as part of Acquisition International's Influential Businesswoman Awards. Established in 1952, Belzona is a leading company in the design and manufacture of polymer repair composites and industrial protective coatings for the repair, protection and improvement of machinery, equipment, buildings and structures. For more information, go to belzona.dk/en