Advancing the energy transition: how material solutions help to accelerate wind power

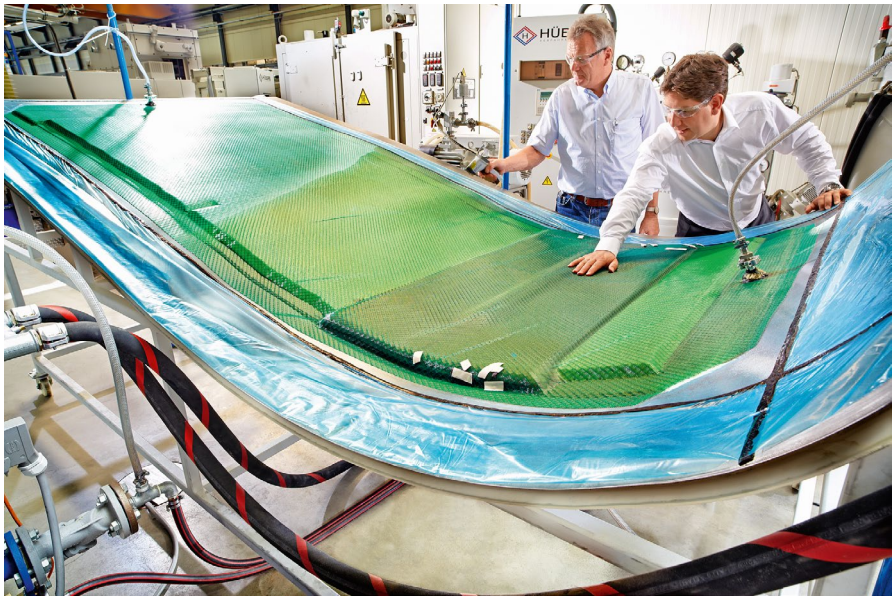
The rapid transformation of the industry cannot be overlooked. The winds of change come in more than a breeze, because in a world urgently seeking solutions to combat climate change, wind energy has emerged as a pivotal player. By 2050, a staggering two-thirds of the world's energy supply is projected to be sourced from renewables, with wind power expected to contribute an impressive 25%.

These figures demand an exponential growth rate and require a substantial increase in wind turbine installations. To that end, the wind industry recently celebrated a momentous milestone, surpassing 1 terawatt (TW) of installed capacity worldwide. This accomplishment equates to averting over 1.3 billion tonnes of CO_2 emissions annually. That's roughly the equivalent of South America's entire emissions. Yet this is merely the beginning of a grand endeavour, as the world strives to achieve net zero targets and stay below the 1.5°C global warming threshold.

According to recent reports by the Global Wind Energy Council (GWEC), wind power is projected to deliver close to another TW by 2030. This sounds like a herculean task, but it is nothing less than necessary. To meet the named global warming threshold, the world would need to halve its greenhouse gas emissions in the next seven years. To install another TW of wind power by then will take a remarkable feat. It would require the installation of 18,000 turbines per year, rising to 22,000 by 2030 and beyond. The sheer magnitude of this challenge necessitates unwavering political will and collaborative action, to fortify supply chains and drive exponential growth across the globe.

We can already see what such an action might look like. The Inflation Reduction Act in the US, the Green Deal, as well as the REPowerEU programme in Europe and the 14th five-year-plan in China all show the way and are expected to support the uplift of growth in the wind industry.

On the other hand, high logistics costs, inflationary risks, supply chain disruptions and delays in projects due to pending permits create a toxic mix. In certain locations and countries this mix will bring renewable energy companies to their limits in terms of economic viability. In addition, the recent energy crisis in Europe has contributed to struggles further up the value chain, including with the supply of raw materials for manufacturers in the steel and chemical industries.



Enter material solutions: the crucial catalyst for wind power optimisation

Material solutions are needed to facilitate a rapid energy transition. Combined with the right knowledge, available in the appropriate amounts in every region of the world. These actually help the industry in several ways. Firstly, material solutions help turbine manufacturers and park operators meet the challenges they face, enhancing turbine efficiency and annual energy production (AEP), reducing levelised costs of energy (LCoE), ensuring durability and low maintenance needs and costs, or end-of-life challenges such as recyclability.

Manufacturers of such materials, like the German chemical company Covestro, are energy intensive companies that need to become climate neutral themselves eventually too. Covestro is aiming to be operationally climate neutral by 2035. This applies to Scope 1 and 2 emissions, so those from its own production and from energy sources.

To achieve this, the company has signed several power purchase agreements (PPAs) to date with an overall volume of several hundred gigawatt-hours, to support the ramp up of renewable energy capacities. In the case of the Borkum Riffgrund wind park off the coast of Germany, the PPA the company signed with Orsted helped make it the first zero-subsidy wind park. By the end of 2023, the company estimates that around 18% of its global energy demand will be supplied from renewable sources.

When it comes to the potential use of excess renewable energy, hydrogen or subsequent ammonia are mentioned regularly. In fact, these materials are used by chemical companies like Covestro to produce materials such as resins or coating that, in turn, make wind energy generation more efficient.

Moreover, when looking at the end of life of wind turbines and wind blades in particular, the right combination of materials and appropriate technology to turn them back to their raw chemical components and make them fully recyclable is a feat that only the chemical industry can provide.

Covestro is currently exploring various routes, having proven chemical recycling processes for soft and rigid foam materials thus far. The company is able to turn used mattresses into components, so they can be used just like actual virgin raw materials. Full circularity in action, and in parallel, researching into how these methods can be applied to the resins used in wind blades.

Hybrid polyurethane (PU) resins, tailor-made for wind blades, enable the production of longer, more durable blades that maximise energy output and operational efficiency. Advanced manufacturing processes, such as vacuum infusion and pultrusion, harness the properties of these resins. These include low viscosity, high reactivity and excellent impregnation of glass and carbon fibers, resulting in faster, more cost-effective production cycles, as well as higher quality parts with less porosity and fewer defects.

Material solutions: the hidden, almost invisible champions of the energy transition

A lot of other materials are to support the growth of and requirements for wind turbines. The protection of wind turbine blades against the elements is vital for their longevity, efficiency and extending their service life. Protection can be achieved via various means: coatings, surface protection films or elastomer shells, to name just a few. These solutions shield blades and towers from the unforgiving forces of nature on- and offshore, including sun, rain, and hail, thereby increasing their lifespan and reducing maintenance costs.

The leading edges of blades need particular protection.. When a blade spins, the edges reach a velocity of several hundred kilometers per hour. At such speeds, a drop of rain, or worse yet, a grain of hail, can have the impact of a bullet. Coatings, films or elastomer shells, which protect these edges make a huge difference.

This applies not only to the blades; coatings provide erosion and corrosion protection for wind turbine towers as well. Faster-curing and longer-lasting coatings bolster productivity and longevity, with a greater number of towers able to be coated per day, and with less maintenance. Elastomer solutions for sub-sea cable protection are concealed even more. They reduce the risk of cable damage when the tides move them around the rough seabed, dozens of meters below the surface.

The rapid growth of the wind industry as a leading renewable energy source offers a chance to create a greener and more sustainable future. Material solutions play a crucial role in enhancing the core components of wind turbines. As global adoption of wind energy increases, these materials and the industries supporting them will drive the energy transition. They will stimulate the demand for renewable energy, utilise surplus energy effectively e.g., as hydrogen, provide advanced materials for more efficient turbines, and enable the reuse and recycling of materials, thereby promoting circularity in the industry.

www.covestro.com/wind