

Wind turbine blades: Inside the battle to overcome their waste problem

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Credit: Jem Sanchez from Pexels

Wind-farm owners in Europe are holding off on scrapping their old turbines to maximize the power they can generate from them. That's the latest news from [a meeting](#) we recently attended on the industry's future.

Wind turbines are designed to last 25 years, but the calculus for owners appears to have shifted because of the [surge in electricity prices](#) due to the Ukraine war.

[According to](#) industry representative Wind Europe, only 454 megawatts (MW) of old turbines were decommissioned in 2022 compared to an expected 1.5 gigawatts (GW). That equates to more than 1,000 turbines whose lives have been extended in Europe.

Indeed, it is apparently the third year in a row in which decommissioning has undershot their expectations. Meanwhile North American turbine decommissioning fell year on year from 668MW to 276MW, we are told by the Global Wind Energy Council.

This creates a little more breathing room to solve a problem that has troubled recycling specialists for some time. Whereas most of a wind turbine can be recycled, [blades](#) cannot. They are mostly made from glass fiber or carbon-fiber reinforced plastic. Designed to be highly durable and hard, this material is very difficult to cut or grind.

At present, most old [blades](#) are either dumped in [landfill](#) or [incinerated](#). There had been capacity at a German plant to process them into cement, but this was [limited](#) and placed a very low value on the blades.

Around [8,000 blades](#) were expected to be retired in the US this year and [another 4,000](#) in Europe, amounting to some 40,000 tons of material. The final figure may now be lower, depending on how many wind farms are able to extend their planning permission.

Looking ahead, the global forecast for annual blade waste a decade from now is [about 200,000 tons](#).

Despite the current lull, that's a huge number of blades. And the figures

will only increase in subsequent years as the current generation are much longer and heavier than the last, which only adds to the waste problem.

Aspiration and reality

Wind-turbine blades take a lot of punishment. Like aircraft wings, they work most efficiently when they are smooth, but can be damaged from sand in the air, as well as lightning and rain. This explains their limited lifetimes.

[Europe](#) and [the US](#) have agreed a hierarchy of priorities for dealing with them, among other materials. High priorities include keeping them in use, designing them to last longer and repurposing. Then comes recycling, followed by incineration and finally landfill at the bottom of the list.

At present, however, the alternatives to the worst two options are very limited. Europe is [rapidly moving](#) to stop putting blades in landfill, so mostly incinerates them, since this at least produces some energy.

Repurposing

Repurposing is a growth area. This means cutting up blades and using the pieces to make new products. Blades have been used to replace the steel girders in bridges, for instance. [Researchers from](#) numerous universities recently teamed up with Cork County Council to do this for a [small pedestrian bridge](#) for cyclists and walkers to the east of Cork city.

They used three 14-meter blades from an old turbine (much smaller than the [50m blades](#) on today's onshore turbines). One blade was tested to destruction to estimate the strength of the other two, which then replaced the old girders.

The 5.5m bridge, which can support a 12-ton emergency vehicle, is the second of its kind, following [another in Poland](#). There is also one in [Draperstown, Northern Ireland](#) and another being built in Atlanta, Georgia.

There is also research into how to [make used blades](#) into [electricity poles](#). This takes advantage of the fact that the material doesn't impede phone or wifi signals. These structures don't need guy wires, meaning they take up less space and you don't need to rent so much land.

Among [many other possibilities](#) are animal-feeding troughs, bus and bicycle shelters, cattle partitions, glamping pods, housing materials, noise barriers, public furniture, railway ties/sleepers, thermal insulation and wave attenuators. Blades can also be re-purposed for [building materials](#) such as roofing and deep foundations, which happens to be our focus. We're always open to other possibilities, so do get in touch with suggestions.

New types of blades

There is a great deal of research into blade recycling. The big issue is separating the polymers from the binding resin. The two main methods involve heating them in an oxygen-free environment (pyrolysis) or separating out the resin using a solvent (solvolysis). Unfortunately, both produce fibers that are weaker than new ones and more expensive.

Manufacturers are developing resins that can be more easily recovered. There have recently been claims of success by [Siemens Gamesa](#), [General Electric](#) and [Vestas](#), yet none have given much detail about their methods, so the outlook is unclear just now.

Another possibility is to make blades from thermoplastic polymers—that is, plastics which can be made soft with heat. Unlike today's thermoset

polymers, these would be easier to repair and to make into new blades. Potentially they could be manufactured on site to avoid transportation.

[A 14-meter blade](#) is being tested in the US, which is very promising, but this is [less than one fifth](#) the blade length of today's biggest onshore turbines (let alone offshore turbines). If the tests are successful and can be scaled up, this could be a gamechanger.

It's also important to emphasize that wind-[turbine](#) blades are only part of the problem. There is also a great deal of fiber-reinforced plastic material used in boats and planes. These are only [being recycled](#) to a [very limited extent](#), so again there's a major waste problem.

For today's waste, the answer is push hard on repurposing. With any luck, the research into recycling will eventually make these problems a thing of the past.

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