Briefing

# How to build a competitive, circular UK wind industry

March 2026

green alliance...

## Introduction

The UK plans to scale up clean energy generation significantly through its clean power mission to 2030 and beyond. This will not only reduce reliance on imported fossil fuels and lower the cost of energy longer term but will also benefit people's health and the environment. It will continue the trend whereby UK wind farms helped to cut power prices by over a third in 2025.[1]

Achieving this scale of renewable energy requires a large increase in infrastructure, including grid upgrades and rapid construction of wind turbines, solar panels and energy storage. In this briefing, we focus on wind energy, which the government anticipates will remain the largest source of renewable energy, with onshore wind capacity doubling and offshore wind tripling by 2030.[2]

As with any energy infrastructure, a significant quantity of materials will be needed for these installations, including millions of tonnes of steel and concrete, hundreds of thousands of tonnes of valuable copper and aluminium, and smaller quantities of potentially harder to source critical raw materials.[3]

In this context, it makes economic and environmental sense to plan for the recovery and reuse of these materials when existing energy infrastructure reaches the end of its life. Putting policy in place now means the UK will maximise industrial opportunities from new remanufacturing and recycling. It will also minimise the economic and security risks of unstable supply chains for increasingly scarce resources in future.

The first generation of wind turbines, particularly onshore, are already reaching the end of their lives. Decades ago, when they were first installed, little attention was paid to end of life planning to ensure materials and parts could be kept in use at their highest value for as long as possible (the core

principle of a circular economy). As turbines are to be decommissioned in larger quantities, this oversight needs to be corrected, including through coherent and easily accessible regulatory guidance.

As part of the new Industrial Strategy and the forthcoming Circular Economy Growth Plan, the government has promised a Circular Economy Roadmap for Clean Energy Industries, expected in late 2026. This is an opportunity to provide much needed policy clarity and incentives to support a more circular wind industry in the UK, which will have employment, growth and environmental benefits.

This briefing is informed by research undertaken by the 'Regulations to Ensure Sustainable Circular Use at End-of-life for Wind' (RESCUE) Project, established to investigate current gaps and challenges for end of life management of wind industry infrastructure. The work has been funded by UK Research and Innovation and is led by the Offshore Renewable Energy (ORE) Catapult, in partnership with the Universities of Leeds, the West of England and Birmingham, as well as EMR and Ionic Technologies.

## A circular economy helps to meet rising demand

Wind turbines contain critical minerals, including rare earth elements for magnets in the newer generation designs. Increasing competition globally for these, as with all critical materials, means they are increasingly subject to export restrictions.[4] But these are not the only materials that need careful sourcing and handling, which the government has partially acknowledged in its new critical minerals strategy, 'Vision 2035'. This sets out a parallel and overlapping list of 'growth minerals', including copper, which is critical for cabling for turbines and in grids. It projects the UK will need 20 times more copper by 2035 than in 2024.[5] Aluminium is also increasingly used in wind infrastructure and its demand is expected to more than double between 2027 and 2030.[6]

The main materials used by weight, though, are concrete and steel. Floating offshore wind especially uses vast quantities of concrete. Even here, there could be challenges in accessing the materials; although research by RWE for Ore Catapult has determined that, for the growing floating offshore wind market in Scotland, domestic supply chains could meet most concrete demand (including low carbon). Adequate planning and investment could ensure any gaps are filled by 2030.[7]

According to the RESCUE project, the new materials needed to meet the wind sector's growth ambitions between 2024 and 2030 could amount to: 9-12Mt concrete, 12Mt steel, 500kt fibre reinforced composites, 400kt copper and 110kt aluminium.[8] As context, the UK's total steel production in 2024 was 5.6Mt, and most UK facilities cannot produce rolled steel required by the wind industry.[9]

At the same time as the demand for materials for new turbines is rising, old installations – many containing reusable resources – will be coming offline. Over the coming decades a growing proportion of material demand for new turbines could, in theory, be met from decommissioned wind turbines. However, this will only happen if new supply chains and facilities are developed in the UK; without these, the country will continue to have to rely on manufacturing facilities abroad.

Managing the flow of materials in supply chains, through to decommissioning, is not a future problem where action can be delayed until there is sufficient volume. Whether components can be reused in decades to come will be determined by design, planning, consenting and decommissioning guidance today, as well as the effective tracing of materials and efforts to ensure their continued use. Waiting another 10-15 years before acting on this will mean the UK misses the chance to embed circular processes to help secure the industry and develop new domestic suppliers that could contribute to growth, jobs and economic resilience.[10]

This matters for long term energy security. As the UK moves away from fossil fuels, the future security of the energy system will depend less on where fuel comes from and more on where the materials and components of renewable energy infrastructure come from and how they are managed through multiple uses. Unlike fossil fuels, materials and components of wind turbines could be reused and recycled many times, if systems enable it.

## The UK isn't well prepared

The wind industry often points out that techniques and technologies already exist to recycle 85 to 90 per cent of the materials in a wind turbine.[11] However, materials used in small quantities, such as critical raw materials, will not be captured by such a weight-based analysis. The high figure is largely due to the potential to treat high volume materials, ie recycling steel and other metals, and downcycling concrete (although, in practice, concrete foundations, especially for onshore wind installations, are mostly expected to be left in place).

Even the challenges of dealing with materials like composites in turbine blades are beginning to be resolved. For example, through new processes to recover glass fibre for reuse or repurposing for applications such as bridges or street furniture, though scalability of such measures remains unclear.[12,13]

The main challenge is not technology but the business case, particularly for remanufacturing, reusing and recycling lower value materials. No policy imperative exists to reuse turbine materials or components in the UK, and it can be time, labour, space and energy intensive to disassemble turbines and extract components without damaging them.

For some materials, the economic value is high enough for remanufacturing to be viable already. For example, analysis for the Coalition for Wind Industry Circularity has shown that remanufacturing just ten wind turbine components with well established supply chains including gearboxes and generators over the next ten years could create a UK market worth £9.6 billion.[14] But, for others, the market value provides insufficient incentive for companies (although trailblazers, like Renewable Parts in Scotland, are still finding a way to commercial success; see more below).

**End of life options for wind turbines**

| | What is it? | Examples | Commercial viability? |
|---|---|---|---|
| **Life extension** | Operating existing wind turbines for longer than originally planned, when safe to do so.[15] | Monitoring of wind turbines can show they are safe to use beyond their original expected lifespan. In Germany, many have been operated for up to eight years longer than expected.[16] The expected life of a wind turbine is 20-25 years, though this can extend to 35 with repair and renovation.[17] | Yes.<br><br>Continued operation means continued revenue for operators with minimal additional investment. |
| **Partial repowering** | Upgrading wind turbine parts (eg generators or blades), meaning infrastructure and | Partial repowering is common in the American wind industry where 12GW of onshore wind has | Yes.<br><br>Repowering can improve generation from a site by replacing out of date technology. |

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| | foundations may be reused.[18] | been partially repowered, according to the research and consulting firm Wood Mackenzie.[19] | Partial repowering is more suited to areas where grids cannot easily be improved and height restrictions mean larger turbines are not feasible. |
| **Full repowering** | Reusing a site, usually by replacing a large number of small wind turbines with a smaller number of large wind turbines, normally requiring new foundations and possibly new grid infrastructure. | Hagshaw Hill in Lanark was the UK's first commercial wind farm in 1995 and in 2025 became the UK's largest repowered onshore wind project. Capacity was increased over five fold, when the original 26 turbines were replaced by 14 modern models at an expanded site.[20] | Yes.<br><br>Repowering by replacing out of date technology with new, more efficient options, can increase generation and revenue. |
| **Reuse through refurbishing and remanufacturing** | Removing components and remanufacturing for future reuse. | Renewable Parts, a Scottish company, specialises in refurbishing and certifying a wide range of turbine parts for reuse by the wind industry.[21] | It depends on the component and supply chain development. Challenges include the cost of refurbished components, including in comparison to secondhand products that have not undergone any processing; also procurement practices, which favour new parts. |
| **Repurposing** | Direct reuse of materials or components in new types of infrastructure. | BladeBridge, an enterprise spun out from research led by Queen's University, is selling furniture, bridges and other durable products made from wind turbine | Possible.<br><br>Markets are only just emerging and it is not clear the extent to which they could make use of high quantities |

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| | | blades.[22] In the Netherlands, Blade-Made has repurposed turbine parts as playgrounds, benches, and sound barriers.[23] | of blades and other turbine parts. |
| **Recycling** | Breaking down components to separate out materials for recycling, then either using those in new wind turbine components or in a different product. | Metals can be recycled repeatedly and used in many different applications. Composites have been a challenge, but Strathclyde University and others are developing ways to recycle glass fibres from them, and Siemens Gamesa has developed a new resin for blades that it says will be recyclable.[24, 25] | Yes, for most materials, especially metals.<br><br>For wind turbine blades, many projects are still at the pilot phase, but there is a world first commercial scale plant being built in Norway. |

## Emerging trends as UK wind farms reach the end of life

### Partial repowering

This not very common in the UK yet, although there are some examples, including at Ness Point in Lowestoft, where a 20 year old turbine had its nacelle (generator housing) and blades replaced before coming back online.[26] The practice could play a much larger role in future, particularly in instances where height restrictions or challenges in changing grid infrastructure could mean full repowering is not an option.

### Full repowering

This is becoming an established practice, with more than 30 sites going through the process. Analysis by Regen suggests that repowering projects in the existing pipeline could deliver up to 690MW of additional capacity by 2035, with potential to grow further.[27] However, this is not guaranteed, with concerns that existing sites will struggle to repower if they require upgraded grid connections, because the National Energy System Operator has already identified other priority projects to connect to the grid. Planning and

consent processes could also hinder development, as well as social considerations, including community acceptability.

### Decommissioning

This is beginning slowly but, by 2035, Regen estimates over half of the UK's onshore wind capacity will be approaching the end of its life.[28] A standard approach to decommissioning has yet to emerge. Those interviewed by RESCUE researchers consistently emphasised the lack of a coherent and integrated decommissioning framework and noted widespread confusion over waste codes for blades, for instance, where the absence of a dedicated code creates discrepancies in how material is both classified and handled. Where it does exist, decommissioning guidance tends to focus on site restoration and waste management, with no mention of circular principles.

Historic planning permissions often only specified minimal requirements, such as a simple promise to decommission after 20-25 years. Worse, interviewees indicated that any decommissioning plans that do exist do not appear to be checked or enforced.

So while there are some instances of best practice emerging, where companies prioritise maintaining material value through parts harvesting, repurposing into new products and recycling, they are not yet universal. Some smaller operators appear to be deciding based on cost and may even use non-compliant disposal routes, which could include quarry dumping and onsite shredding, with material sent to incineration.

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## Emerging practices abroad are encouraging circularity

Other countries are powering ahead and embedding circularity in the wind industry. In the Netherlands, Business in Wind have been early movers. The company sources relatively young, used turbines that are still technically suitable for continued operation and then undertakes the detailed inspection and refurbishment of major components, such as hubs, generators and gearboxes, in controlled workshop facilities, before redeploying the turbines in new locations. It prioritises reuse and refurbishment, while components that cannot remain in energy generation are returned for repair and refurbishment or adapted for alternative applications, including community infrastructure such as playground equipment, sound barriers, bicycle parking and tiny house construction.[29]

One driver of this is landfill regulation. The Netherlands is one of several countries, including Germany, Austria and Finland, that forbid direct landfilling of composite materials such as turbine blades.[30] Under the third edition of the Netherlands' National Waste Management Plan, landfilling composite waste is banned in principle (although exemptions exist if the cost of alternative treatment is very high).[31] These restrictions create an incentive for alternative solutions, like those used by Business in Wind, rather than relying on landfill as the default option.

## UK incentives are missing

In short, the UK is not well prepared to make the most of the resources in existing wind turbines or ensure that the next generation will be circular from the start. Researchers at RESCUE have identified over 150 different policies, strategies and regulatory documents relevant to the wind industry and potential end of use processes.[32] Rules and processes that govern planning and decommissioning in general are multilevel, ranging from local authorities and devolved administrations, to central government ambitions and international regulations relevant to offshore developments. Clear guidance across all these levels is missing.

Extensive engagement with industry, regulators and local and national policy makers during the course of the RESCUE project suggested that, while there is nothing to prevent circularity in the industry regulations, there is also little to encourage it.[33] Participants noted that early opportunities to embed circularity, including in wind turbine and wind farm design and planning, have not been taken, with the following challenges:

**Data:**

- **Historical data:** little is known about the design specifications of the first generation of onshore wind turbines and many of the original manufacturers no longer exist.
- **Design data:** manufacturers of current wind turbines are not required by regulations to divulge design information and often lack supply chain data to know what different parts are made of.
- **Material flows:** although consensus is starting to emerge and more research is expected, there is limited understanding of the quality,

quantity and timing of material flows in the industry, which is needed to inform investment plans and prepare the business case for handling the increasing flow of materials.

**Planning:** circularity is largely omitted from planning processes.

**Funding:** for example, there is a lack of investment in building up supply chains for circularity.

**Confusion:** there is a widespread lack of understanding about end of life options and regulations as there are no public, formal or other widely accepted comprehensive guidelines for decommissioned onshore or offshore wind infrastructure.[34]

**Skills:** while a circular industry will require new skills in refurbishing, recycling etc, participants reported concern about the skills in government bodies and regulators, with additional capacity required for more proactive interaction with the industry to navigate complexity and implement policy and regulation.

The impacts of these challenges are coming to light as installations reach the end of their expected lifetimes. According to analysis from Regen, over half of the onshore wind infrastructure in Great Britain will approach the end of its expected lifespan and require decisions by 2035.[35]

## Three recommendations for the Circular Economy Roadmap for Clean Energy Industries

By the end of 2026, the government intends to set out plans to increase circularity in clean energy industries, including wind, offering an important opportunity to set a clear vision and ambitions. It is a chance to increase energy security in the current geopolitical context and protect against the negative impacts of waste and over extraction by keeping existing materials in use at their highest value for as long as possible.

## Recommendations

Three recommendations are clear from RESCUE's research:

## 1. Short term: Strengthen existing regulation and create guidance

Current regulations do not encourage circularity or even explicitly outline circular options. In fact, complex, multi-level governance arrangements muddle the responsibilities.

In the first instance, stakeholders consulted by the RESCUE project expressed strong support for guidelines to encourage circularity; as the first generation of wind turbines come offline, these are urgently needed. They must be flexible to account for the many different makes and models of wind turbines, often without much information available on their design or construction.

The government should collaborate closely with the industry on guidelines, to include:

- **A hierarchy of options.** Available technology choices should be outlined, including for life extension and repowering in the first instance. For handling end of life turbines, they should include harvesting parts for reuse and remanufacturing, as well as recycling lower down the hierarchy, and guidance should address logistics, including storage and land transport. Guidance could include a decision tree to enable informed decisions, beyond just waste management, and incorporate the cost estimates and environmental impacts associated with different treatment routes.
- **A summary of relevant regulations and governance bodies.** This should include descriptions of permitting processes for repowering installations.
- **Advice on auditing wind installations as they approach end of life.** Long before decommissioning, turbines should be assessed to understand what will be coming offline, including cataloguing the potential of parts to be reused and the quantity of materials needing treatment. This will allow asset owners to identify appropriate reuse opportunities and enable them to prepare for reuse, recycling or other treatments.

Regulators should be upskilled on options for reuse and remanufacturing so that, when they conduct site visits, they can advise operators on efficient reuse and refurbishment operations, not just recycling and waste management.

## 2. Long term: Set a strong vision and ambition for circularity

Between now and 2030, a massive increase in wind energy installations is planned. The forthcoming roadmap is a chance to embed circularity from the start and make sure the UK can benefit from a thriving circular economy for wind.

As well as addressing skills shortages in government, regulators and industry, this should include:

- **A clear plan to make the most of repowering**

  Full repowering is already practiced in the UK but could be further developed. To meet clean energy targets and wean the UK off fossil fuels with volatile costs, the government should assess the opportunities for both full repowering and partial repowering to contribute towards future energy provision. In particular, it would be worthwhile assessing opportunities for partial repowering where height restriction and grid connections make full repowering impractical. Partial repowering would enable existing sites to continue providing power and should offer some of the best opportunities to use reused and remanufactured turbines and parts. In particular, the government must ensure that planning and consenting processes enable businesses to take advantage of the potential available.

- **Circularity requirements**

  Across Europe, governments are increasingly adding circularity to their wind farm tender requirements. In Denmark, the 2024 offshore auction specified that blades have to be recyclable.[36] The UK should ensure material efficiency, durability, modularity and reuse are priorities, eg through design, procurement and licensing criteria. Consistently awarding longer leases would support durable design and encourage repowering to make the most of the licensed period. The Contracts for Difference scheme could also be used to encourage more circular and ethical supply chains: in its latest allocation round (AR7), the government introduced a Clean Industry Bonus to reward developers for investing in more sustainable supply chains by covering the difference in cost between such investments, compared to cheaper but less desirable choices. This scheme could be more explicit in promoting design for circularity, as well as using secondary materials and parts (at present it

only does so implicitly by promoting shorter supply chains and "more sustainable means of production").[37]

- **Targets for new wind turbine and wind farm circularity**

  Given the energy security and national resilience importance of growing the wind industry, the government should use its powers in the Environment Act 2021 to set targets to drive durability, reuse and refurbishment of parts, as well as recycling of end of life materials.[38] This would provide regulatory certainty for the industry to invest in circularity.

- **Investment through the National Wealth Fund**

  The industry should be offered affordable finance for circular economy products and services, via the National Wealth Fund. The fund has been tasked with supporting the government's growth and clean energy missions and one of its priority areas has been investment in waste infrastructure, but limited attention has been paid to supporting circularity, including in clean energy to ensure long term energy security. We recommend some of the fund is ringfenced to leverage private investment in clean energy circularity, including in reuse and remanufacturing activities, as well as recycling. The aim should be to build up domestic wind remanufacturing and recycling capability to enable resilient circular supply chains in the UK.

- **Data sharing across the lifecycle**

  In the EU, wind turbine parts will soon require digital product passports, including permanent magnets, steel and aluminium. The UK should follow suit to ensure compatibility across borders and should work with the industry to enable adequate information sharing along supply chains. This will facilitate decision making about end of life solutions and government strategy, as well as business and investment decisions, but it must not undermine the industry by revealing sensitive intellectual property at a time when it is concerned about foreign competition, eg from China.

## 3. Ensure coherent governance

The 2030 Clean Power Mission involves an unusual level of co-operation across government, and this should not stop in 2030. Guaranteeing future

energy security requires a long term plan to ensure the existence of the necessary supply chains, incentives and industries.

Relevant strategies and policy areas under different government departments must align and pull in the same direction. This means the 2030 Clean Power Mission and the Circular Economy Roadmap for Clean Energy Industries (each led by different teams in the Department for Energy Security and Net Zero) must build on the overarching Circular Economy Growth Plan (led by the Department for Environment, Food and Rural Affairs) as well as the recently published Industrial Strategy and the Critical Minerals Strategy (led by different teams in the Department for Business and Trade).

Buy-in is also required from the Treasury and the Ministry for Housing and Local Government, which leads on planning policy and could build on existing support for lifetime extension and repowering through the National Planning Policy Framework.[39]

Together, all these initiatives must align to exploit the full potential of circular opportunities, alongside primary manufacturing and foundation industries, and support the skills development and public investment to build a strong business case for investment in the UK.

Wind energy is a strategic industry and the government must prioritise its circular development. Doing so will lead to considerable benefits in terms of business development, environmental protection and national security. The Circular Economy Roadmap for Clean Energy Industries offers the government the opportunity to plan for and enable it to be a national success.

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## Endnotes

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[2] Department for Energy Security and Net Zero (DESNZ), 2024, *Clean power 2030 action plan*. According to the action plan, the goal for total wind capacity by 2030 is at least 70GW. For offshore wind, the installed capacity in 2024 was 14.8GW, which by 2030 is expected to rise to 43-50GW. For onshore wind, the installed capacity in 2024 was 14.2GW, which by 2030 is expected to be 27-29GW.
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[6] Ibid
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[27] Regen, 2026, op cit
[28] Regen, 2026, op cit
[29] Business in Wind, businessinwind.com
[30] Wind Europe, 2020, *Accelerating wind turbine blade circularity*
[31] Ministerie van infrastructuur en waterstaat, 2019, 'National waste management plan 3 (LAP3)'
[32] APM Velenturf and S Ma, 2026, 'RESCUE network regulatory database for a circular economy in the wind industry in the UK', University of Leeds
[33] The RESCUE project has collaborated with more than 270 people from over 100 organisations. Extensive research has involved: gathering 73 responses during the exploration phase consultation period; conducting four regional workshops around the UK, involving 90 participants from 65 organisations; holding two environmental regulator forums, with each involving 11-13 participants from between seven and ten organisations; conducting more than 30 case study interviews with industry and government; holding three regulatory process workshops with 40 participants from 24 organisations, as well as in-person and online regulator roundtables.
[34] Scotland has guidance on a common approach to decommissioning and restoration plans for onshore wind, issued by Natural Scotland in 2016, although as with many other planning conditions and most guidance, including for offshore wind, the focus is on site restoration. Source: Scottish Natural Heritage, 2016, 'Guidance on decommissioning and restoration plans for wind farms'
[35] Regen, 2026, op cit
[36] ERM blog, 20 September 2024 'Offshore wind tenders: how renewables project developers can gain the edge with circularity'
[37] Changes to the Clean Industry Bonus scheme are currently being consulted on. See: DESNZ, 2026, 'The contracts for difference Clean Industry Bonus consultation on contract changes for Allocation Round 8'
[38] The Environment Act 2021 gave governments in the UK the power to create producer requirements for purposes including increasing "the reuse, redistribution, recovery or recycling of products or materials". See: UK Parliament, 2021, 'The Environment Act 2021'
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