NATIONAL COMPOSITES CENTRE

SusWIND

Annual Review

2023

Executive Summary

SusWIND is a collaborative innovation programme focused on creating a viable circular economy for wind turbine blades. To enable this future state, SusWIND and its partners are developing methods and tools for assessment and scenario planning for three key facets of a future industry: Reclaim, Adopt and Develop.

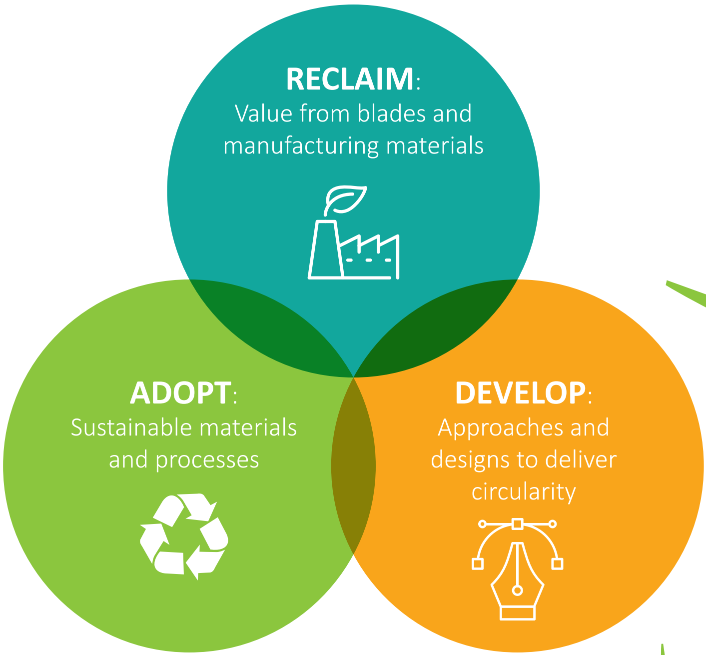

Figure 1 The SusWIND approach; three interdependent areas of focus to solve the challenges of end-of-life wind turbine blades.

- Demonstrating the technologies and required supply chain to reclaim the value from in service blades and manufacturing facilities using the lowest impact routes.
- Driving the adoption of more sustainable materials and processes for the next generation of products.
- Developing innovative new design approaches based on circular economy principles.

To help ensure these insights are given voice and converted into action, the programme has built a consortium of likeminded businesses from across the industry. SusWIND partners are collaborating in order to inform and evidence the investment cases and requests for policy and regulation needed to enable the creation and scaling of circular supply chains for turbine blades and composite materials.

Launched in 2021, SusWIND members EDF Renewables, Net Zero Technology Centre, SSE Renewables, Shell and Vestas have been joined this year by Total Energies, Owens Corning, bp and Scottish Power Renewables to form a membership core. This group is supported by programme-partners BVG Associates, Crown Estate, Crown Estate Scotland, Renewables UK, Zero Waste Scotland to form a collaborative and industry leading group.

A year of insights

The successful second year of the SusWIND programme created industry leading evidence that enables the bold decision making needed to deliver industrial transformation by:

Signposting a route to industrial circularity

- Identifying mechanical recycling as the most beneficial and viable route forward in the UK for today's fleet of glass fibre turbine blades.
- Evidencing the necessity of separate reclamation routes for carbon and glass fibre composites from wind turbines blades to create the most economic and environmental benefits.
- Identifying that the current low-TRL technologies show very limited promise in delivering a viable route to reclaiming value from Glass Fiber Reinforced Polymer (GFRP) but are promising for Carbon Fiber-Reinforced Plastic (CFRP) from technical, environmental, and economic perspectives.

Focusing the innovation agenda

- Prioritising reduced impact of carbon fibre manufacturing for future blade procurements and exploring strategies to reduce carbon fibre utilisation offer greatest potential gains.
- Maintain focus on developing resin chemistries whose reclamation processes are significantly less energy intensive than any known solution to date. This would target the 2nd largest value resource in modern blades.
- Innovate to increase resource efficiency for virgin glass fibre whilst also preventing excess environmental impact from the current crop of reclamation processes.

Ambition into actions

The next 12 months aims to convert insights into actions for policy makers, industry partners and the R&D community to move the industry forward. Based on the successful collaboration to date, the SusWIND partners recommend that industry and Government should:

Create enabling conditions for success

- **The wind industry needs to increase transparency between OEMs and owner-operators** to enable educated procurement decisions that will reduce through-life environmental impact.
- **Carbon fibre should be sourced from production facilities in locations with a low carbon energy grid mix.** This single intervention could reduce Global Warming Potential (GWP) by up to 27% with minimal technical risk.
- **Supply chain needs to develop services to separate and process blade materials in accordance with their value** to maximise environmental and economic benefits at end-of-life.
    - **Low impact recycling for low value materials** – mechanical recycling of glass fibre composites.
    - **High impact recycling for high value materials** – where present, carbon fibre composites should be recycled via processes that allow the reclamation of high-quality fibres and resin fractions.
- **Supply chain demonstration is required as a priority to focus development efforts** based on documented technological, environmental and economic performance as well as current legislative barriers.
- **Development of low-TRL technologies for glass fibre recycling should prioritise efforts to reclaim value from the non-fibre constituents, particularly the resin fractions.** Any investments should be assessed using the principles as presented in the SusWIND programme to ensure that the most suitable technologies are developed for composites recycling.
- **Manufacturers should aim to implement robust sorting of unavoidable waste while exploring less-impactful consumables.** These are critical actions to meet their zero waste goals and enable local supply chains to form around their requirements.
- **Provide demand signal to future supply chains for mechanically recycled blade materials** to increase investability of potential EoL solutions and incentivise supply chain action.

In the coming year SusWIND will develop the guidance and evidence it provides to guide stakeholders and give confidence to decision makers via:

Demonstration of reclaiming material value today

- **Demonstration of viable solutions** for the repurposing and recycling for end-of-life blades and manufacturing waste that have an end-to-end supply chain in the UK today.
- **Evidence to form the case for investment** to make mechanical recycling of GFRP commercially viable and seed a new UK industrial capability (as per example shown in Figure 2).
- **Facilitated opportunities to work with other industrial sectors** to scale-up demand for GFRP recycling. This will help reach commercially viable volumes and make mechanical recyclate cost competitive with virgin materials far sooner than current projection of 2035.

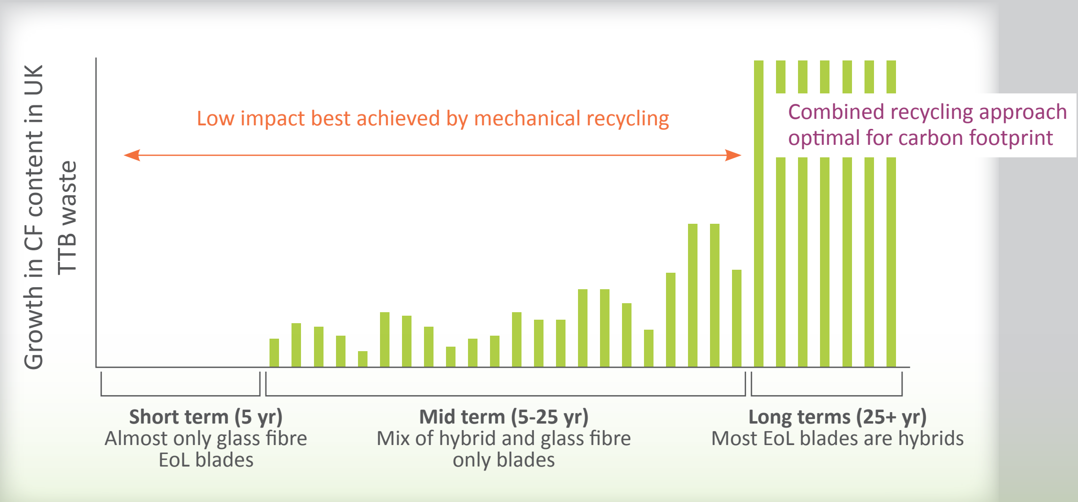

Figure 2 Example industrial scenario for wind turbine reclamation industry based on current understanding.

Insight founded on evidence

The successful second year of the SusWIND programme created industry leading evidence that enables the bold decision making needed to deliver industrial transformation. SusWIND is solution agnostic and aims to assess viable routes for technology to create positive change without bias.

The insights created can be usefully mapped on to the stages of a blade's life to better unpack what actions can be taken now, and what additional clarity is needed before action can be taken.

Sustainable start of life

Assessment of sustainability during blade manufacture is usefully divided into minimising the carbon footprint of structural materials comprising the blade and minimising the lost value of all materials throughout the process, both structural and consumable.

Minimising carbon foot print of blade structures

The peer-reviewed Life Cycle Assessment (LCA) conducted this year indicates that producing the structural materials accounts for 84% of the cradle-to-grave carbon footprint (measured as Global Warming Potential – GWP in equivalent kilograms of carbon dioxide) of a state-of-the-art turbine blade. The carbon fibre spar caps that enable longer blades of higher capacity turbines, represent less than 15% of the blade mass but contribute 60% of the blade GWP as seen in Figure 3b. This tension between turbine capacity growth and the carbon footprint of materials that enables it requires intervention to balance efficient generation and sustainability.

For future onshore blades opportunities to replace carbon fibre with high performance glass fibres (known as H-glass) will be explored in the next year of SusWIND. H-glass fibres are higher stiffness and strength than the E-glass fibres that are traditionally used in wind and also offer a similarly low material GWP. Onshore blades are projected to account for ~50% of total wind industry carbon fibre utilisation by 2030, and the shorter blades may allow the use of lower impact fibres to displace carbon fibre spar caps. SusWIND will explore the potential for the lower material GWP of H-glass fibres to be passed on to blade GWP when replacing higher performance carbon fibres in the spar cap.

At present large offshore blades are expected to require carbon fibre spar caps for the foreseeable future to achieve the performance characteristics and mass reductions that make 10+ MW turbines a reality. There are two potential routes forward to minimise the impact carbon fibre consumption has on blade carbon footprint: reduce the impact of producing carbon fibre and improve the structural efficiency of its use in future blade designs.

Given the long history of blade optimisation it is unlikely that significant improvements in structural efficiency will be realised without architectural change to future blades or rotors. This is an attractive area for future research but would be more appropriately addressed within a dedicated programme and complimented by the underpinning design tools and guidance on design for circularity that is planned for the next phase of SusWIND.

However, tangible progress in GWP reduction can be made for future products in material procurement decisions. The production of carbon fibre is energy intensive and at present a large fraction of the global supply is provided by suppliers in regions with high carbon intensity energy mix. **Transitioning carbon fibre production to regions where a low carbon energy grid is available (e.g. UK) from the baseline grid mix (global average) could reduce carbon emissions by as much as 27% per blade** according to scenario analyses conducted using the SusWIND LCA tool. This demonstrates the importance of scaling-up less energy intensive methods of carbon fibre production.

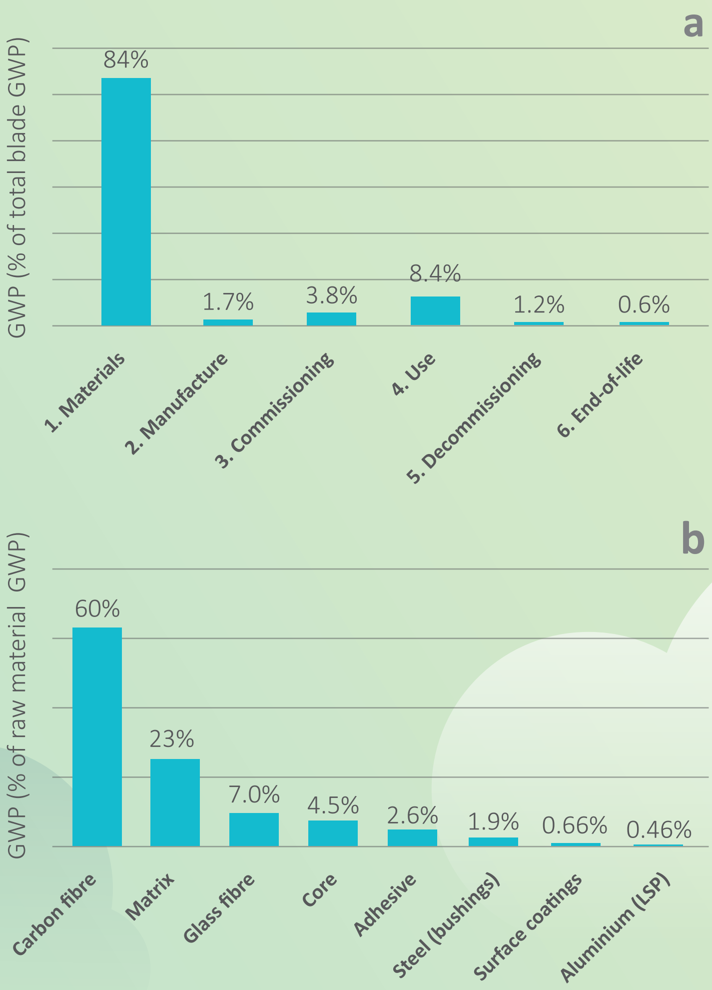

Figure 3 – a) Total GWP associated with each phase of the blade life cycle, b) Cradle-to-grave GWP of blade structural materials.

Retaining value from manufacturing waste

Manufacturing waste in the form of consumables, packaging and scrap structural material is estimated to be 26% of the final blade mass.

For the new generation of offshore blades this equates to over 15 tonnes of manufacturing waste being produced per blade. This degree of resource going to landfill and incineration is incompatible with a sustainable future for the wind industry, even though this waste stream contributes just 1.7% to the carbon emissions of the manufactured blade.

Both Vestas and LM Wind Power have set targets to be operating zero waste manufacturing facilities by 2040 and 2030, respectively, so finding solutions to minimise and then reclaim value from these unwanted material flows from across the value chain will be a vital part of them achieving these goals. When addressing these goals, the programme will focus on interventions that do not impact productivity to ensure that deployment targets for wind power and commercial success for OEMs are not impacted.

Through waste-mapping analyses, SusWIND identified both the types and quantities of waste generated (shown in Figure 5) and the elements of the process where improving material utilisation could yield reductions in waste. The following directions for action and further work were identified:

- Minimise and ensure recycling of packaging and backing paper as well as requiring low impact material selection.
- Optimise use of dry glass fibre in manufacture to reduce excess material and demonstrate viability of recycling excess cured material accessing the same supply chain as EoL blade waste.
- Implement effective and efficient sorting of consumable waste streams to minimise the barrier to viability of mixed polymer recycling.

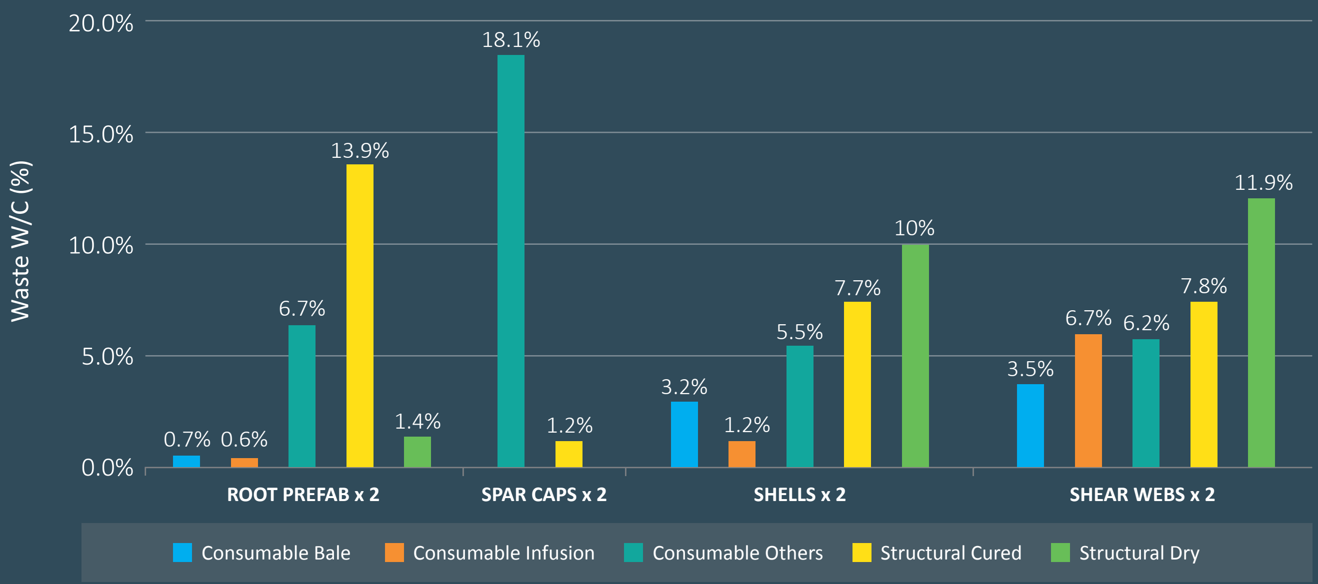

Figure 4 IEA 15MW reference blade manufacturing waste, given as percentage of major component mass.

Engagement with the waste management supply chain found limited commercial scale routes for recycling consumables (which account for 47% of the total waste). There is a significant opportunity to seed a supply chain to do this that would serve both wind industry and the wider composites industry, this will form part of activity as NCC initiates a cross-sector circularity programme.

Balancing energy production and sustainability during the turbine's operational life is critical to ensuring a commercially viable and sustainable wind industry

The use phase makes a significant contribution to the carbon footprint of an offshore blade. There are opportunities to reduce impact without increasing the cost of energy. For example, the supply chain for the reuse, refurbishment and repair of turbine components is maturing quickly in the UK. Championed by the Coalition for Wind Industry Circularity (CWIC), this supply chain can continue to expand to help extend the lifetime of current installations.

Our LCA work has shown the importance of considering environmental factors in a part of the life cycle that is dominated by economics. In particular, the blade GWP (expressed as kg CO_2eq per GWh) has been shown to be sensitive to two levers available to blade owners: blade lifetime extension and O&M frequency.

Lifetime extension is well known as the optimal solution from a circular economy standpoint and our work has quantified this view. **The results show that increasing service life can significantly benefit blade GWP, our analysis showing that with an increase of 25% in service life the blade GWP will decrease by 15%.**

O&M also has a notable influence on the carbon footprint of the blade for offshore deployments, with the results showing that varying O&M frequency by ±50% leads to a change of ±10% in GWP. This result is driven by different aspects, including number of vessel journeys and fuel burn, and can be applied to a variety of scenarios to quantify the benefits from improved efficiency in maintenance schedules, reducing downtime, remote monitoring and switching to more sustainable fuels.

Both aspects of the work conducted in SusWIND show how the environmental impact of decisions made during the blade lifetime can be quantified to inform better practice and improved efficiency to meet the challenge of Net Zero.

End-of-life: which processes should be deployed?

Preservation of value is imperative once blades reach their end-of-life. As material value is inherently linked with its performance it is critical to reclaim the material in a low impact manner whilst maximising its properties, therefore preserving its value.

As a result it is vital that the future industrial processes used to recycle large composite structures, such as turbine blades, reclaim both fibre and resin where it is sustainable and cost-effective to do so.

However, the UK is not operationally ready to process end-of-life turbine blades to reclaim value from glass fibre composites. The green shoots of an industry are present and will be demonstrated in SusWIND.

The requirements for both recycling technologies and a supply chain should be determined by the economics and sustainability needs of the wind industry. The asset owners should use a data driven approach to understand which technologies should be developed, upscaled and industrialised by the emergent blade recycling industry. For the EoL supply chain to function, the value associated with the reclaimable materials within blades and the benefits available to each actor in the chain needs to be understood. This covers every step from wind farm through to logistics, blade downsizing, repurposing or material reclamation and finally reprocessing into a consistent and marketable product.

SusWIND has deployed a rigorous data-driven approach to understand the requirements of the industry so that it can provide a demand into the technology owners. This industry pull is critical to form a supply chain that best meets the needs of the asset owners. By taking this end-to-end approach SusWIND is able to help define the industry's requirements and compare these against the capabilities of the various developmental recycling technologies to propose those that should be championed and upscaled.

When considering recycling, our technology landscaping and supply chain mapping activities made it clear that mechanical recycling and cement kiln co-processing are the only options at higher TRL but are still not available in the UK. Initial findings of a cradle-to-grave life cycle assessment of the blade incorporating various EoL options has shown that mechanical recycling and cement co-processing have the lowest GWP. For cement co-processing, however, the environmental impact depends heavily on the feedstock being replaced and will be the subject of further investigation in SusWIND.

Based on these results, SusWIND is recommending the following routes be scaled up and the supply chain built to support them:

A low impact reclamation for low value materials

- Where glass fibre reinforced composites are used in blades they should be processed via mechanical recycling or cement co-processing (if appropriate), as these routes are the lowest GWP options, highest TRL and are well suited to the all-glass fibre composite blades that will be coming to end-of-life in the next decade.

High value materials can be reclaimed via many routes

- High value carbon fibre composites should be separated from glass fibre composites and then recycled via pyrolysis or solvolysis. These technologies can reclaim a high-quality fibre and may in future reclaim the polymer fraction to offer additional benefits. Where this is done in conjunction with the recommended routes for glass fibre composites, this is termed "cement kiln+" and "mechanical+" (Figure 5).

- Processing carbon fibre composites separately from the glass fibre stream offers environmental benefit compared with combined processing. This is enabled through the offset of virgin material that is energy intensive to produce and holds true despite the use of a more energy intensive reclamation process.

- Carbon fibre reclamation technologies developing in other sectors still need to be proven for wind blades, however UK-based wind blade waste streams would not warrant a supply chain for approximately 15 years. Commercialisation of carbon fibre recycling and expansion of recycled carbon fibre reprocessing will require cross-sector collaboration to be viable.

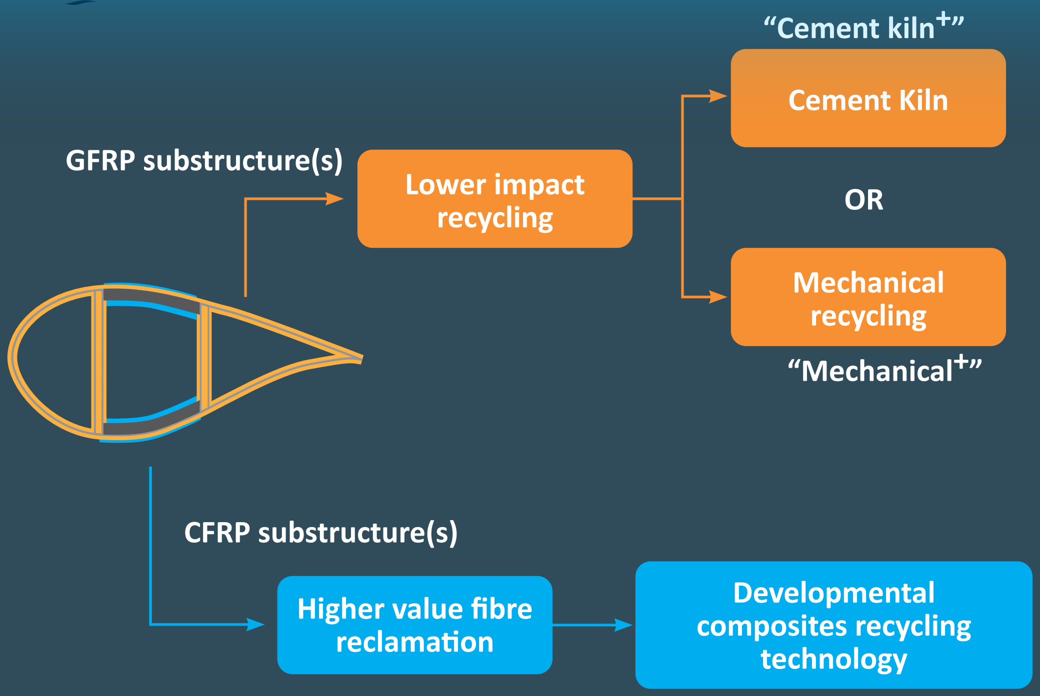

Figure 5 – SusWIND recommends separation based on material value and environmental impact of the EoL process.

To make this a reality, the enabling system needs to be defined and developed to prepare blades on wind farms for processing at a facility. The supply chain needs to make the following developments to be ready:

Targeted onsite (or near site) cutting techniques

- Necessary to isolate and remove carbon fibre composite sub-structures, such as spar caps.

Define the shredding requirements

- It is imperative that shredding is set up to provide feedstock for downstream processes that are governed by the industry pull.

Spar cap and root section shredding capability

- These sections are generally the thickest and strongest of the blade and the shredding equipment needs to be able to process them without a drop in throughput rate or excessive damage to the machinery.

Utilising existing infrastructure (where possible)

- To accelerate development of the supply chain, infrastructure spending should be limited to upgrades that minimise material loss and ensure compliance with H&S legislation.

Locality of supply chain

- Accurate identification of key capabilities within the supply chain with the aim of minimising the economic and environmental impacts of transporting blade materials.

Product disposal specifications (PDS) or materials passports (responsibility of OEMs)

- The efficiency of these operations will be greatly improved by the provision of blade specifications that detail each blade’s bill of material and internal structure. Without enough details the supply chain cannot separate material waste streams efficiently to enable a sustainable and cost-effective process. Whilst some PDS are being made available by blade OEMs in the DecomBlades consortium, the number of blade product lines referenced is severely limited and the material/structure data is scant. More transparency from the OEMs is required to increase the usefulness of these PDS.

Beyond the immediate need to stand up a supply chain for EoL wind blades, and other composite structures, it is important to ensure that the right recycling technologies are developed so that the highest value materials can be reclaimed at the lowest environmental impact. SusWIND has assessed the most prominent low TRL technologies aiming to answer the question of "should they be developed further?". SusWIND has carried out several quantitative assessments on a range of recycling technologies to answer this question.

Benchmarking of four low TRL recycling technologies – solvolysis, pyrolysis, steam pressolysis and high voltage fragmentation (HVF) – where each was provided with shredded feedstock from the same blade, found that there are large variations across the areas of interest: mechanical performance of reclaimed fibres, cleanliness of reclaimed fibres, economic outlook and environmental impact. The results of this study, some of which are summarised in Figure 7, show that there are significant developments to be made across all these areas before the technologies can be considered for composites recycling. HVF displayed a low carbon footprint and reclamation cost, however, it did not yield separated fibres during expected reclamation, even after significant energy input. The recyclate produced by HVF is similar to that of lower energy demanding mechanical methods, therefore the HVF does not meet the criteria for future development of higher value glass fibre composite recycling. Solvolysis and steam pressolysis, at the maturity and scale of the tests, were estimated to have higher cost and carbon footprint. It should be noted that both solvolysis and steam pressolysis showed significant improvements under conditions of higher processing rate, and there are ongoing research programmes to develop scale and rate.

Overall, it is clear from the work in SusWIND that there are three challenges faced by lower TRL recycling technologies: fibre quality, cost and carbon footprint. Both pyrolysis and solvolysis need to focus on reducing processing temperature and enabling the use of less aggressive chemicals, respectively, as well as developing a value proposition for reclamation of resin recyclates. While it may be possible to reduce the emissions associated with some of the processes through electrification (assuming renewable generation replaces natural gas), the cost can only be brought down through a combination of technology development that enables valorisation of resin recyclate and increase in scale. For this to happen, there needs to be clear line of sight to sufficient volume of EoL composites to provide a case for continued investment. SusWIND will continue this work and investigate the prospective end uses for the outputs of glass fibre composite recycling, working with the supply chain to ensure that there is a market for these products.

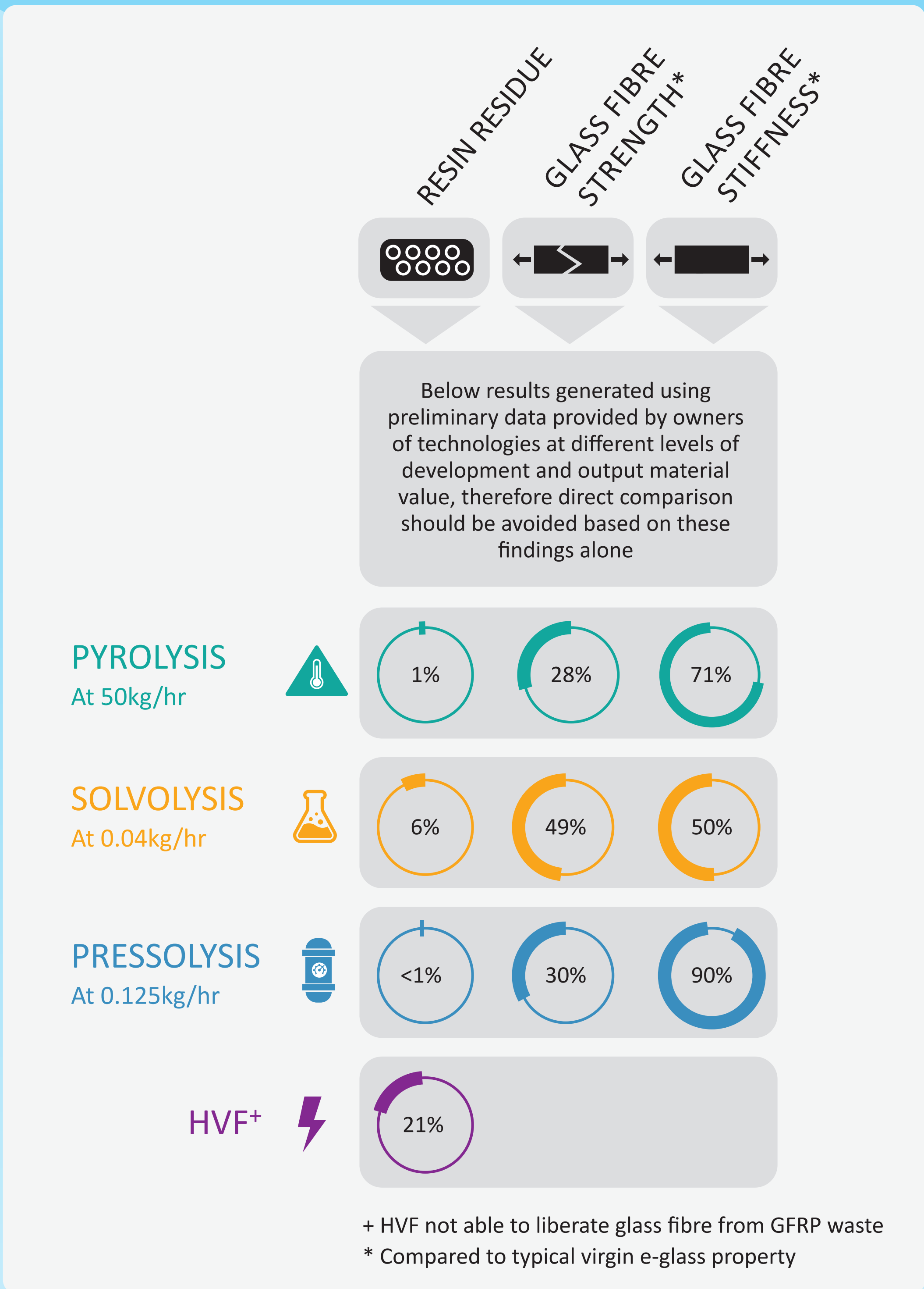

Figure 6 – The results of our investigation into prominent low TRL recycling technologies make it clear that significant improvements must be made in reclaimed fibre characteristics. These developments will need to be supported by clear environmental and economic benefit.

A through life approach

As part of taking a through-life approach to blade sustainability, SusWIND is developing a framework that brings together design optimisation, Life Cycle Assessment (LCA) and life cycle costing (LCC) to provide clear guidance on the performance, environmental and economic implications of materials or design changes.

Initial work has shown that it is possible to reduce the carbon footprint of the blade with targeted introduction of alternative materials while maintaining energy production. As Figure 8 shows, replacing glass fibres with natural fibres, such as flax and hemp, and resins with bio-resins or recyclable resin systems and then optimising the blade for GWP can lead to significant reductions in GWP and mass, while preserving annual energy production (AEP).

Incorporating a measure of circularity for alternative materials, via the Materials Circularity Indicators developed by Ellen McArthur Foundation, coupled with EoL options gives some insight into the potential for novel materials to boost circularity, as well as reducing GWP.

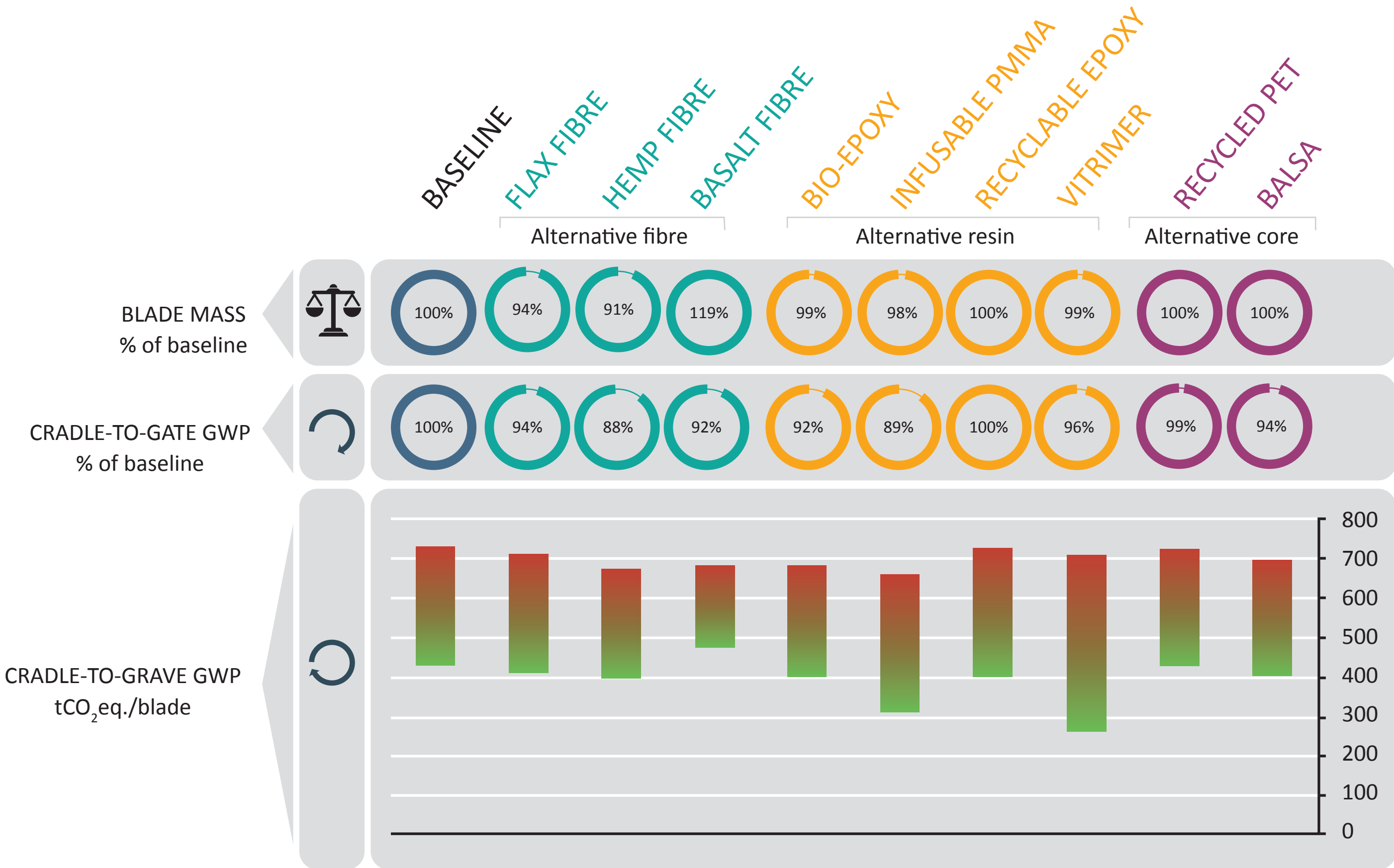

Figure 7 - Blade optimisation results show that it is possible to reduce the mass and carbon footprint of a 15 MW reference turbine blade with the introduction of alternative fibres, resins or core materials.

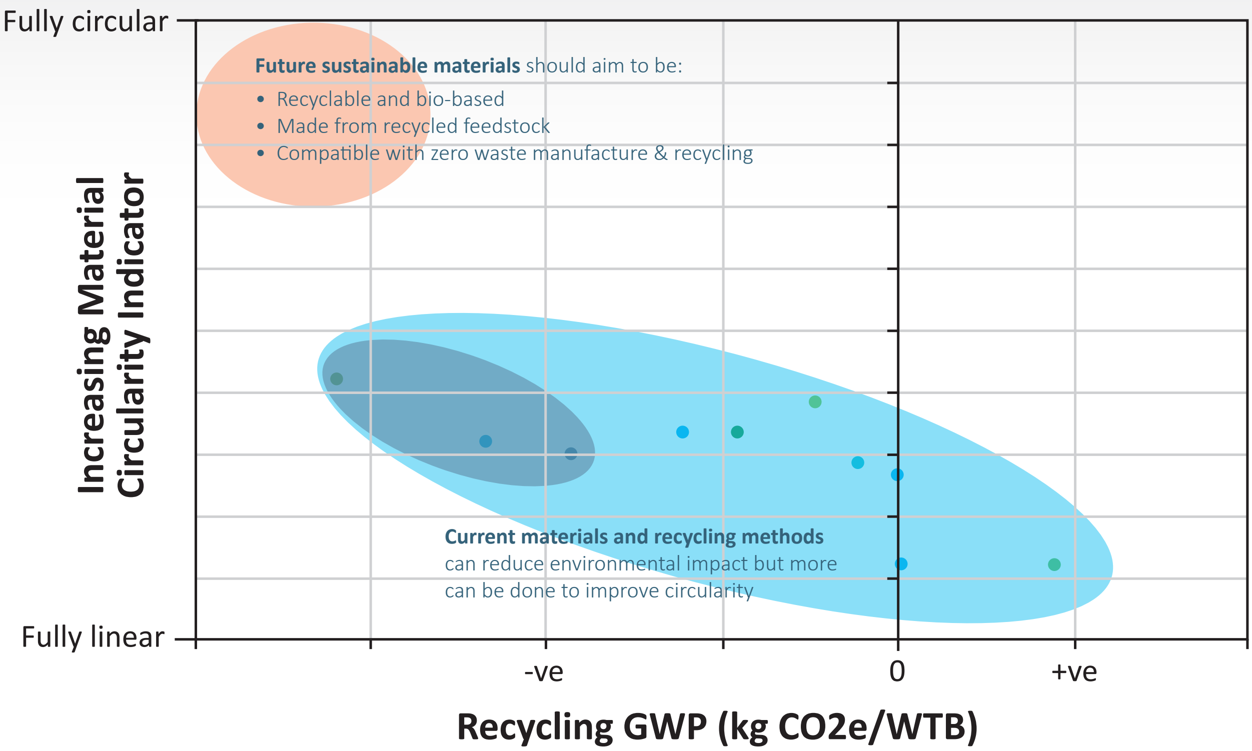

Figure 8 - Coupling the carbon footprint of various EoL solutions with a measure of circularity gives insight into the potential for alternative materials to reduce GWP and boost circularity.

Figure 8 shows how prospective recycling routes (light blue) and novel recyclable resins (dark blue) can reduce environmental impact but much more can be done to improve circularity. **The future of sustainable materials needs to aim for the orange area, that indicates simultaneously minimising carbon footprint and maximising circularity through recyclable, recycled and bio-based feedstocks.**

This is a very promising first step but sustainability is more than just novel resins and alternative fibre types. We are continuing to develop the approach to boost blade circularity and look beyond materials.

It is worth considering at what environmental and economic cost these kinds of measures can be implemented. There will be costs associated with any option, including the "do-nothing" approach. Even without policy that specifically targets blades, it is very likely that future legislation will aim to reduce the use of landfill and incineration. Additionally, there is the reputational risk for the industry from continuing to landfill blades, indeed, the wind industry is now world leading in setting corporate net zero and zero waste targets.

A key gap to be closed before the 'cost' of circularity can be defined is the development of the KPIs for a circular economy for wind. An industry-accepted understanding of the KPIs is required and will help determine at what cost circularity is implemented and where efforts should be focused. The full life cycle approach of SusWIND is able to concurrently consider multiple options and highlight solutions that do not compromise between what can be seen as conflicting objectives, such as keeping resources in use, preserving material properties or reducing embodied carbon.

The development of a robust set of KPIs for blade, and indeed turbine, sustainability and circularity is a critical step to providing onshore and offshore wind developers with the best practice to quantify the sustainability parameters in tender documents. This will be especially important when the Department of Energy Security and Net Zero's "non-price factors" are introduced to the landscape of Contracts for Difference. SusWIND is providing a route to codifying the LCA process for blades, and through use of the KPIs and standardisation of the SusWIND LCA developers can demonstrate sustainability metrics in a uniform manner, resulting in efficiency and cost saves across the board.

Recommendations

To date SusWIND has built a community of renewable energy stakeholders, from blade OEMs and their supply chain, blade owners and operators through to recycling technology providers. With over two years of work completed the headline recommendations from SusWIND are as follows:

1. The wind industry needs to increase transparency between OEMs and owner-operators to enable educated procurement decisions that will reduce through-life environmental impact.

2. Carbon fibre should be sourced from production facilities in locations with a low carbon energy grid mix. This single intervention could reduce the global warming potential of a blade by up to 27% with minimal technical risk.

3. Supply chain needs to develop services to separate and process blade materials in accordance with their value to maximise environmental and economic benefits at end-of-life.

    a. Low impact recycling for low value materials – mechanical recycling of glass fibre composites.

    b. High impact recycling for high value materials – where present, carbon fibre composites should be recycled via processes that allow the reclamation of high-quality fibres and resin fractions.

4. Supply chain demonstration is required as a priority to focus development efforts based on documented technological, environmental and economic performance, as well as current legislative barriers.

5. Development of low-TRL technologies for glass fibre recycling should prioritise efforts to reclaim value from the non-fibre constituents, particularly the resin fractions. Any investments should be assessed using the principles as presented in the SusWIND programme to ensure that the most suitable technologies are developed for composites recycling.

6. Manufacturers should aim to implement robust sorting of unavoidable waste while exploring less-impactful consumables. These are critical actions to meet their zero waste goals and enable local supply chains to form around their requirements.

To be truly sustainable, the wind industry needs to take these steps today while continuing to navigate towards design solutions and supply chains that are circular and sustainable by default. SusWIND will continue to provide solution agnostic, impartial and evidence based recommendations to support our partners in pursuit of this goal.

SusWIND - growing strongly in 2023

Composite materials are a key enabler for the success of wind energy and the role that it will play in delivering a low carbon global economy. SusWIND is continuing to grow, and is bringing together stakeholders across the composites industry and wind energy sector to look at every aspect of the wind turbine product lifecycle to achieve a sustainable future. Below are some of our new members that joined SusWIND in 2023.

bp

"Unlocking the potential of increasing circularity is embedded in our sustainability framework, and membership of SusWIND is another exciting programme that can contribute to our journey. As we develop our global offshore wind pipeline, we want to keep materials in use for longer and value them throughout their life cycle. Given the growing significance of wind power to the future of energy, it is vital that sustainability principles are embedded throughout the supply chain. I am excited about the potential for knowledge sharing with fellow members of SusWIND, as well as the innovative mindset that bp can bring to the table."

Giles Mackey, Head of Health, Safety and Sustainability for Offshore Wind, bp

TotalEnergies

"It's our ambition to be a world-class player in the energy transition and we're building our renewables business to generate more energy, with less emissions. That means carefully considering every component of our projects, making the best choices at the very start and then planning for the reuse or recycling of those parts when the time comes. We know that the work to reduce the future impact of our projects must be done now and success will have an impact not just on wind projects in the UK, but around the world. We're very pleased to be part of SusWIND and to contribute to, and benefit from, this critical programme."

Philippe de Cacqueray, Managing Director, Renewables UK for TotalEnergies

OWENS CORNING

"At Owens Corning, sustainability is fundamental to who we are and how we operate. The linear production model — sourcing raw materials, manufacturing products, and discarding those products at the end of their use – doesn't work anymore, for business or humanity. Finding viable, alternative re-uses for composite wind blades at the end of their operational lives is a critical part of our journey toward a circular economy, and we look forward to working with our partners in the SusWIND initiative to achieve this together."

Wouter De Clercq, Managing Director Composites Europe Owens Corning

"Our recent ScotWind leasing round has resulted in an exciting pipeline of offshore wind projects with the potential to make a major contribution to the energy transition. We're pleased to be joining the SusWIND programme and contributing to work to ensure the sustainability of the sector."

Ben Miller, Development Manager, Crown Estate Scotland

About the NCC

The National Composites Centre (NCC) is the UK's world-leading research and development facility; where innovators come when they need to make things lighter, stronger, smarter and more sustainable. Its key focus areas are Composites, Digital Engineering, Hydrogen and Sustainability. With access to 'beyond' state-of-the-art technology and the best composites engineering capabilities in the world, the NCC collaborates with customers to solve the most complex engineering challenges of our time.

Part of the High Value Manufacturing Catapult, the NCC works across all manufacturing sectors and has forged strong links with aerospace, energy, defence, space, construction, infrastructure, auto, rail, marine and biomedical. It works with organisations across the board from micro enterprises and SMEs to disrupters, the supply chain and OEMs, providing businesses with a de-risked environment to design, develop, test and scale their ideas and get them to market fast. For more information visit **www.nccuk.com**

SusWIND Programme

Composite materials are a key enabler for the success of wind energy and the role that it will play in delivering a low carbon global economy. SusWIND is bringing together stakeholders across the composites industry and wind energy sector to look at every aspect of the wind turbine product lifecycle to achieve a sustainable future.

Our Partners and Supporters

Offshore Renewable Energy Catapult - Delivery partner
Vestas
SSE Renewables
EDF Renewables
Shell
Net Zero Technology Centre
Total Energies
Owens Corning
bp
Scottish Power Renewables
The Crown Estate
Crown Estate Scotland
RenewableUK
BVG Associates
Zero Waste Scotland

Contact us

Contact us to discuss the programme in more detail and how you can get involved in this exciting initiative. We look forward to working with you to drive the successful outcomes we need to deliver the sustainable future we are all committed to achieving.

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NATIONAL COMPOSITES CENTRE

CATAPULT High Value Manufacturing

Sustainable Composites