



**Sustainable
Composites**

A PARTNERSHIP BETWEEN THE NCC AND CPI

SusWIND



Assessing alternative materials for wind blades

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CATAPULT
High Value Manufacturing

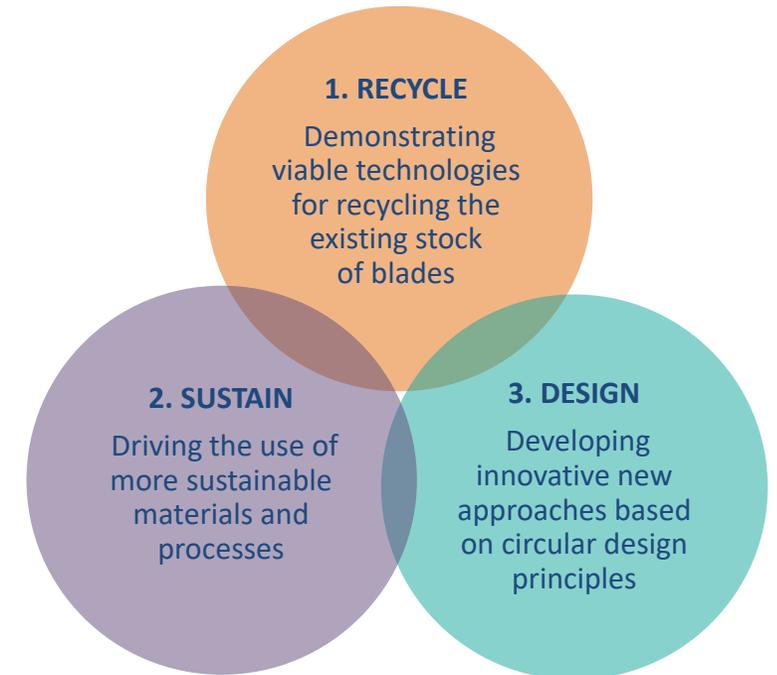
SusWIND PROGRAMME

The NCC's vision is for the wind energy industry to become zero waste across the entire lifecycle.

To enable this challenge to be met we require:

- **Reclamation** and **re-processing** technologies
- **Standards** and **certification** to classify recycled material performance
- Suitable **use cases** to demonstrate **value proposition**
- Establish **new design and manufacturing methods** to reduce waste and enable disassembly at EoL

This can be realised through **three distinct, but interdependent, themes of industrially-focused research and development.**

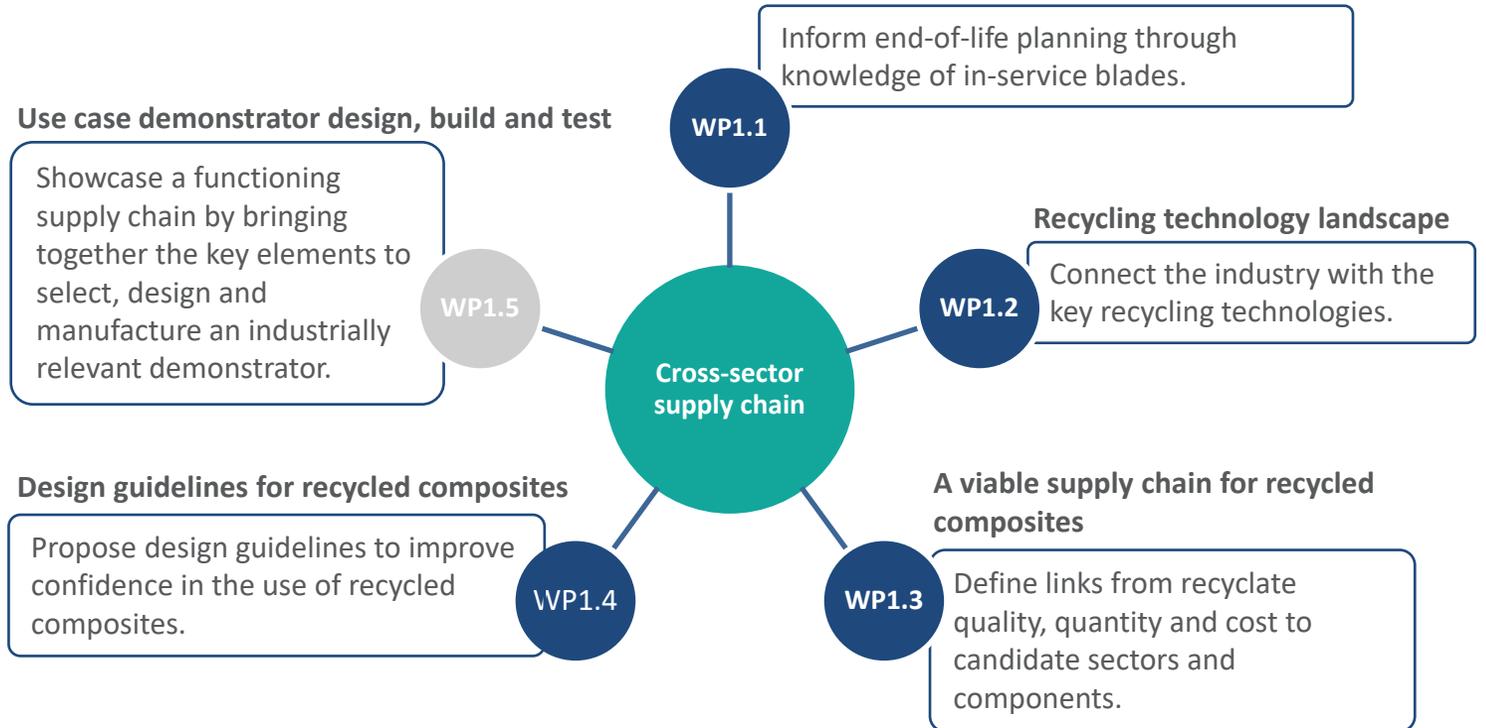


RECYCLE WORKSTREAM – CROSS-SECTOR SUPPLY CHAIN

The problem statement: How can “end of life” composite recyclate from turbine blades re-enter the value chain at the “start of life” of another composite structure?

The concept: A cross-sector value chain for reusing and recycling composites that diverts materials from landfill, instead transferring these valuable materials for use in other applications.

Our aim: To drive and support the creation of a viable cross-sector supply chain for recycled composites, we will:

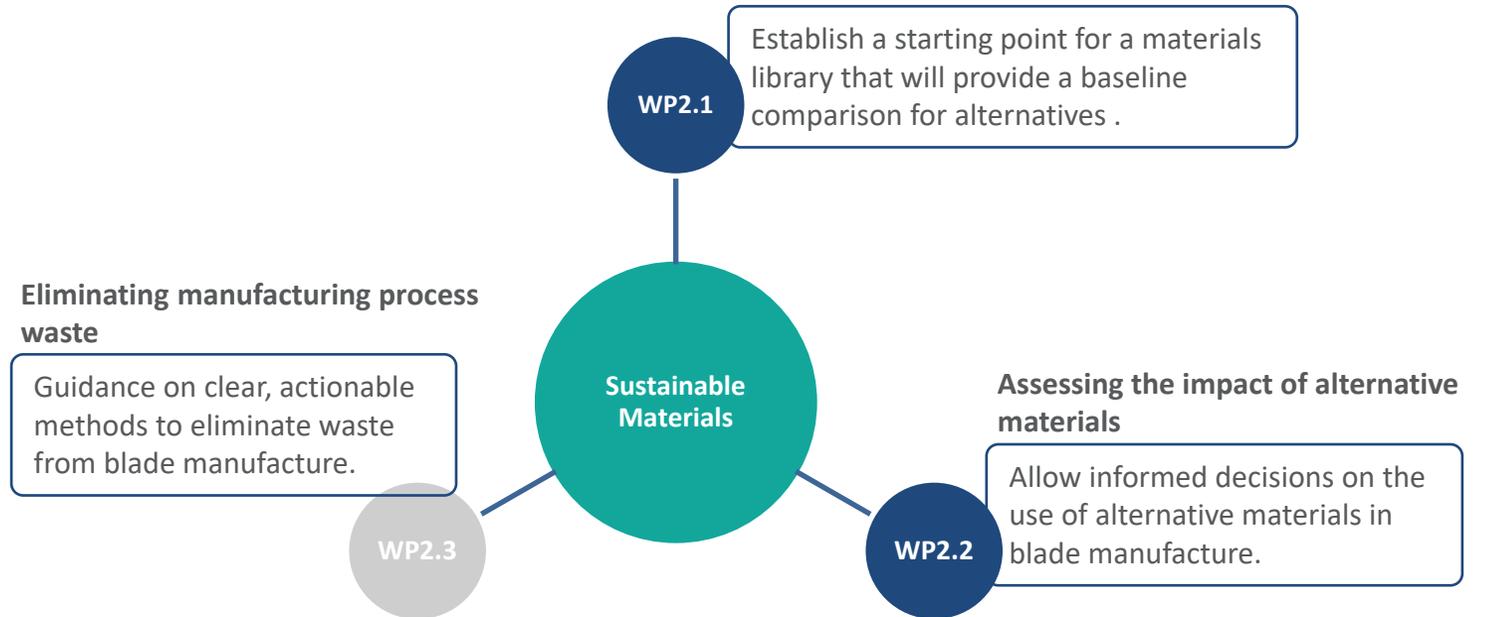


SUSTAIN WORKSTREAM – SUSTAINABLE MATERIALS

The problem statement: How can the introduction of more sustainable materials and processes reduce the environmental footprint of blade manufacture?

The concept: Alternative materials are assessed, via Lifecycle Analysis, for their environmental, economic and social benefits over traditionally-used materials. Clear development pathways need to exist for a new generation of materials to facilitate their implementation in sustainable blade manufacture.

Our aim: To facilitate the wider adoption of alternative, lower impact materials and processes, we will:

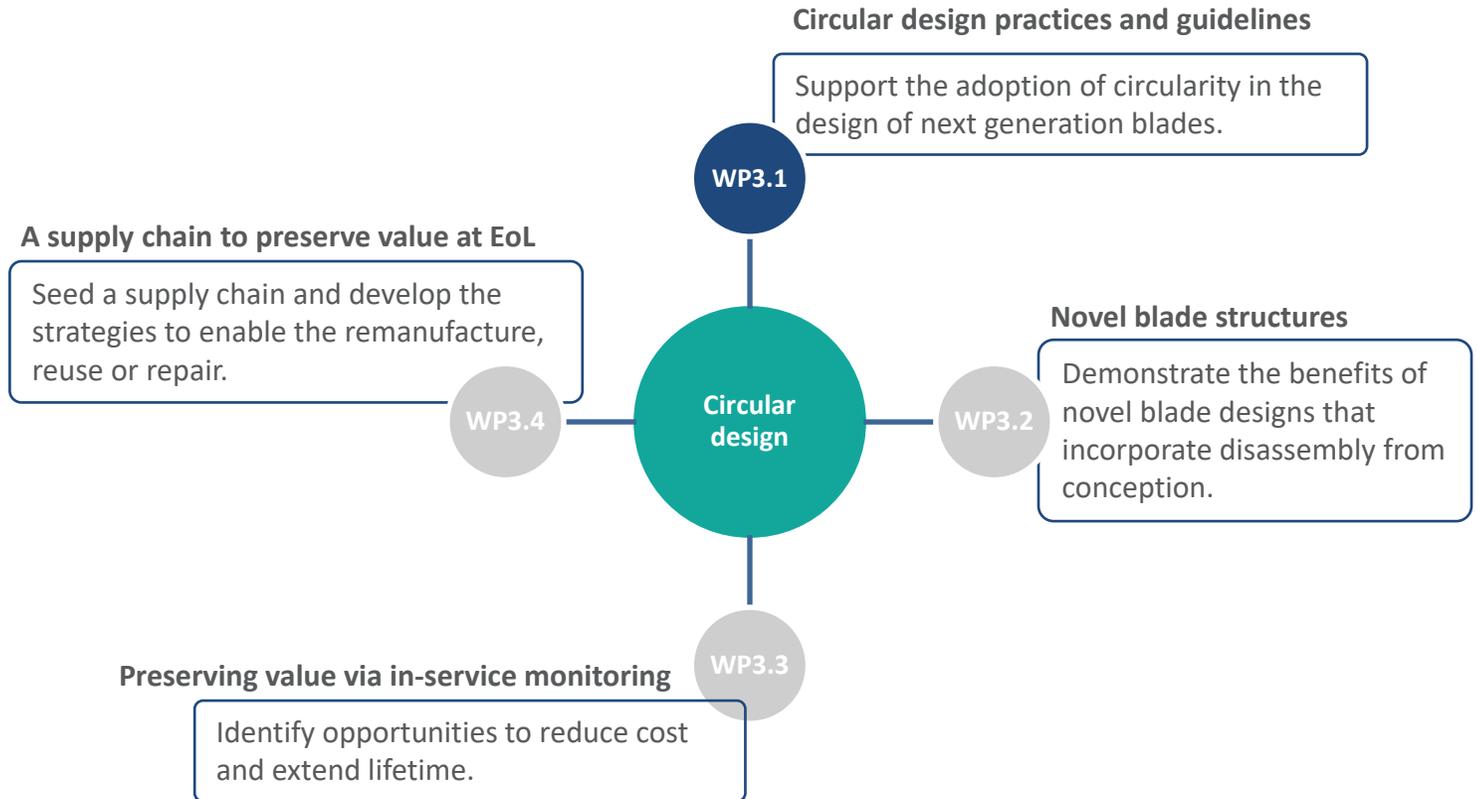


DESIGN WORKSTREAM – INNOVATIVE DESIGN

The problem statement: How can circular economy principles be embedded into design practices to eliminate production waste and enable disassembly for repair, reuse or remanufacture?

The concept: The adoption of circular principles that leads to a new approach to wind turbine blade design.

Our aim: To incorporate circular principles in the design of the blades of the future, we will:



SusWIND PROGRAMME PARTNERS



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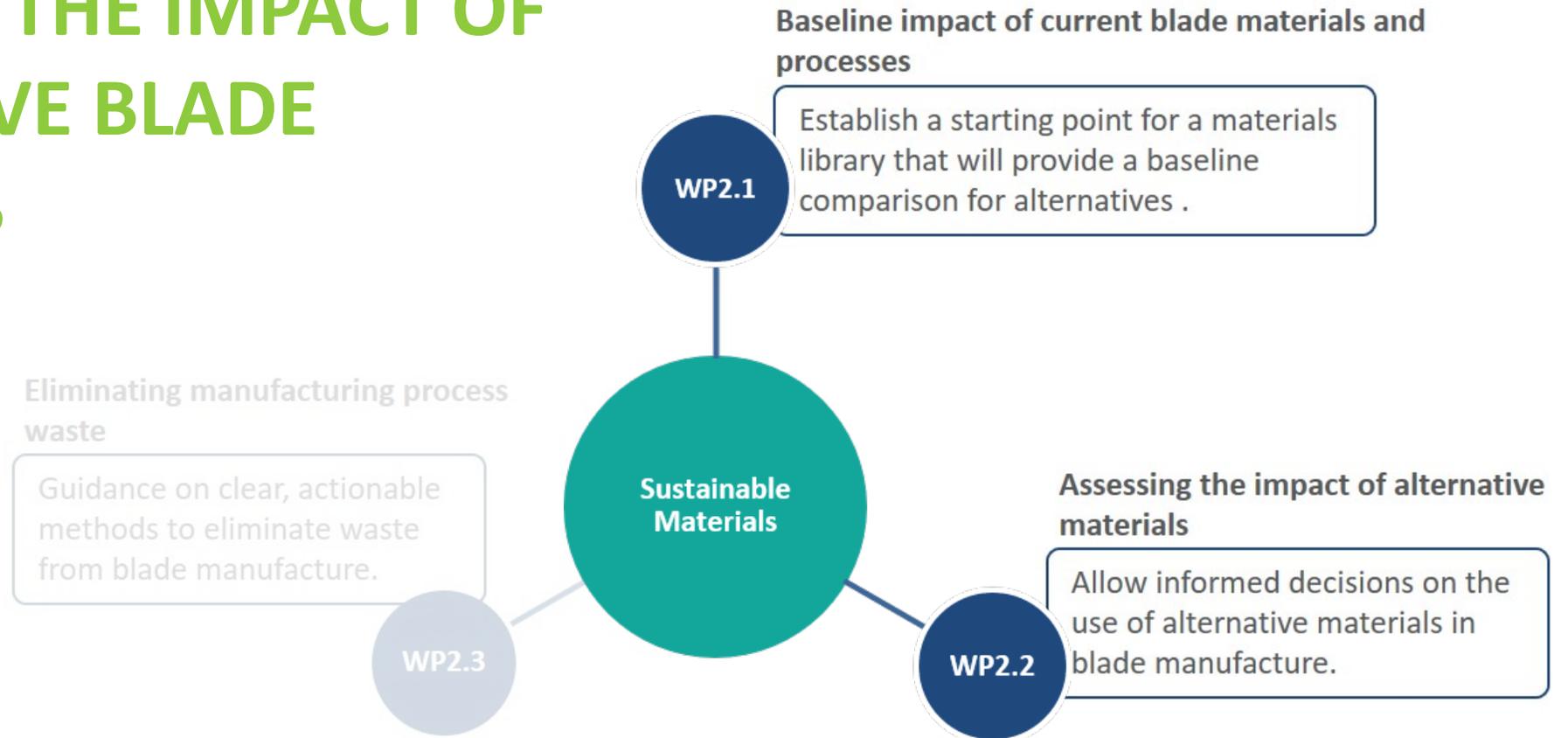


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For more info, your **NCC point of contact** is **James Lightfoot**
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ASSESSING THE IMPACT OF ALTERNATIVE BLADE MATERIALS

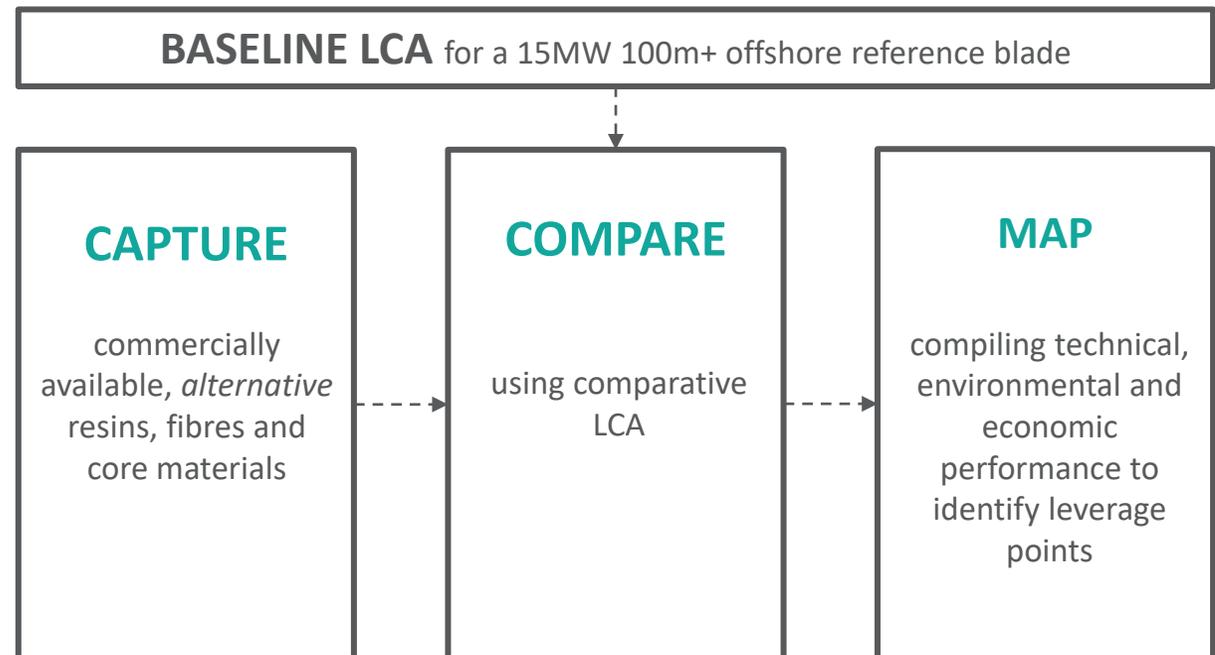




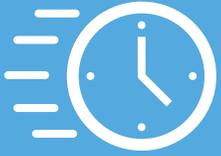
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CHALLENGE AND APPROACH

There are a **growing number of sustainable materials** being produced for composites that **adopt a variety of environmental impact lowering strategies** and are at **differing stages of development/certification**.



VALUE



Speed up the process of novel material adoption by the industry.



Support material developers to improve and develop their material offerings so they can be invested in and scaled for use in wind turbine blades. Help to understand where the 'pinch points' are for the adoption of their materials.



Encourage a materials supply chain where LCA and transparency takes priority.

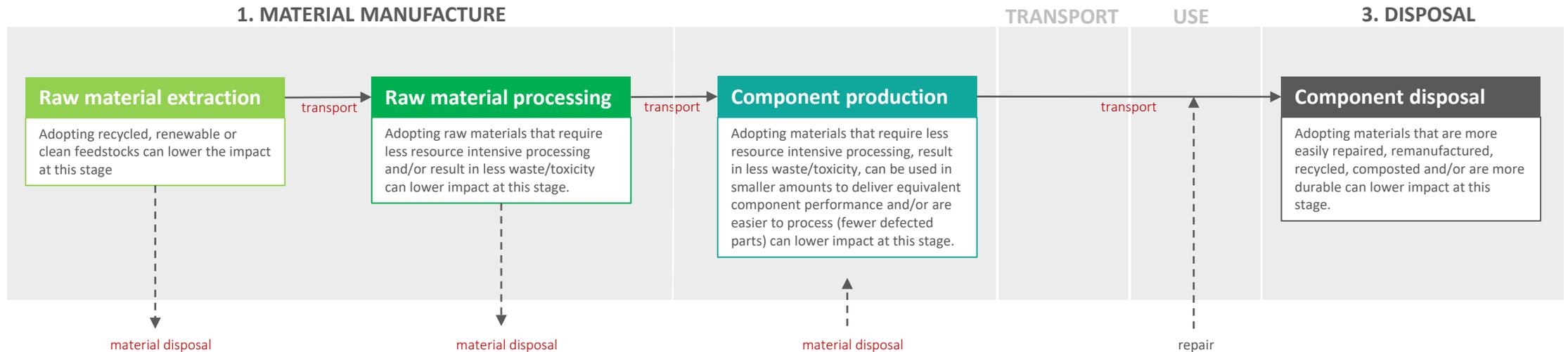


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MAPPING IMPACT LOWERING POTENTIAL ACROSS THE BLADE LIFE-CYCLE

To fairly represent a material's potential to lower environmental impact, it is important to:

- understand **where** in the turbine blade's life-cycle, a material's adoption enables environmental savings.
- ensure that the **system boundary** of our comparative LCAs include those stages.



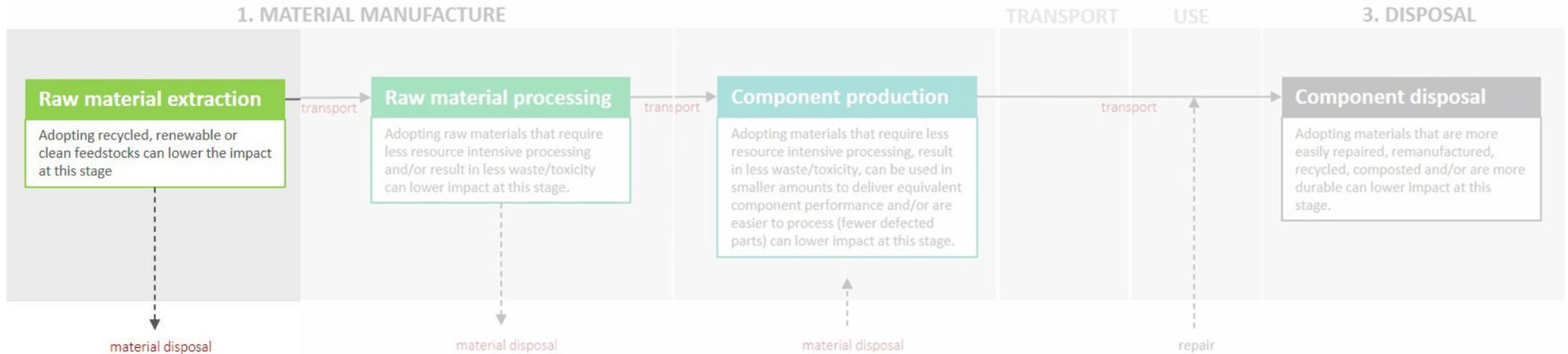
BIO-RESINS

Impact lowering potential:

- Reduces fossil fuel extraction
- Carbon sequestering or use of industry bi-products

CONSIDERATIONS FOR LCA:

- scope of cradle impacts
- impact categories considered



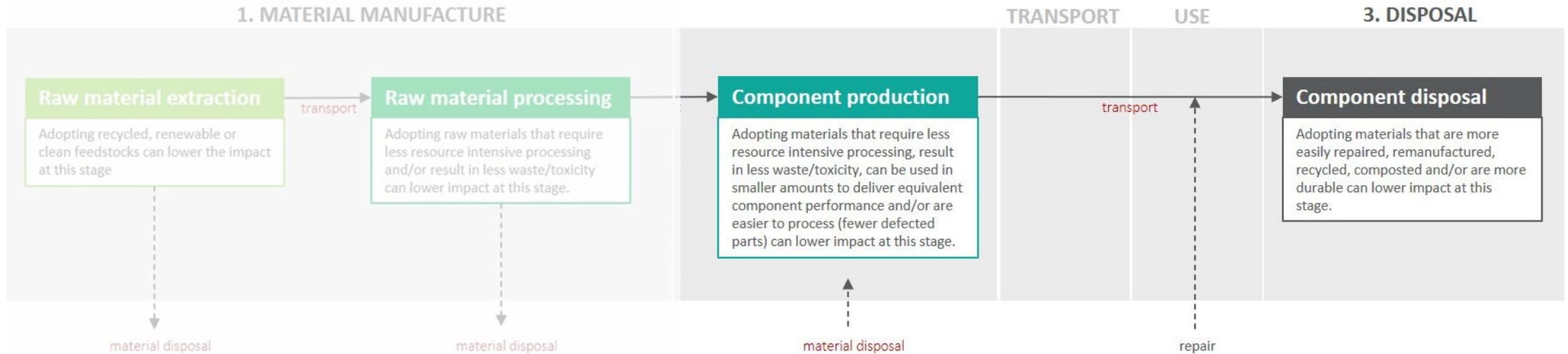
DEGRADABLE RESINS

Impact lowering potential:

- Fibre and resin recovery at end-of-life
- Enables remanufacturing or easy repair at end-of-life, during use in production
- Production waste can be easily recovered or remanufactured.

CONSIDERATIONS FOR LCA:

- Material second life can be complex to quantify if the system is not closed loop e.g. composite vs. metal recycling.
- End-of-life treatment and its impact is specific to each material



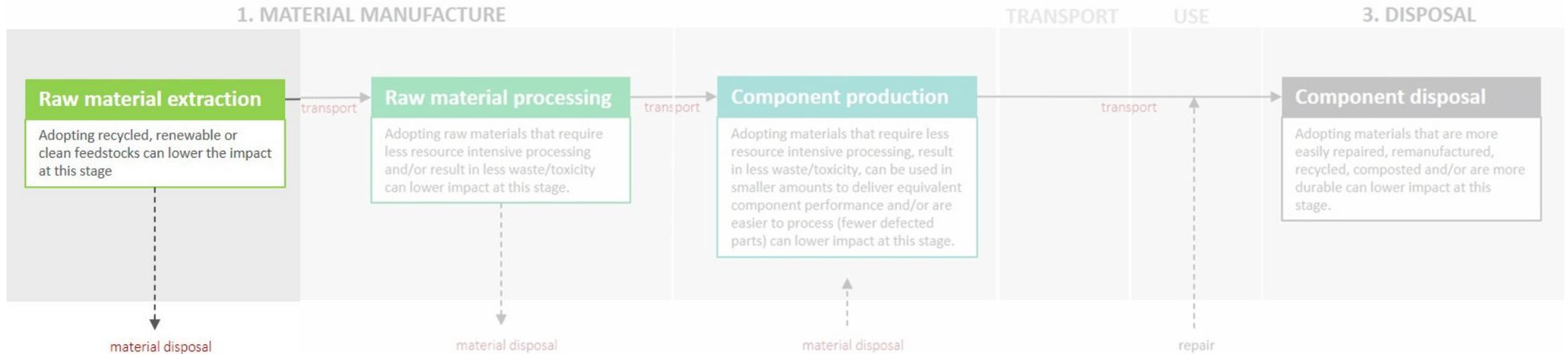
NATURAL FIBRES

Impact lowering potential:

- Renewable resource
- Carbon sequestering

CONSIDERATIONS FOR LCA:

- Material performance knockdown will affect blade design e.g. lay-up thickness. For comparative LCA, the functional unit (i.e. reference blade) must stay the same.



SUMMARY OF CONSIDERATIONS FOR LCA



Representative or cradle-to-grave LCA data, particularly for alternative resin systems is limited.



Comparative life cycle assessment will be carried out from cradle-to-grave to ensure that each alternative material's 'potential' is represented fairly.



Material decisions based on CO₂-eq and energy demand (kWh) impacts alone may be misleading. Other impact categories should be considered e.g. land-use, eco and marine toxicity etc.



For a long term assessment of future materials, end-of-life treatment (and impacts) will be specific to each material. Landfill should not be used as the baseline for end-of-life assessment.



Blade simulation is important for understanding how the blade BoM and therefore LCA impacts change when alternative materials are adopted.



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THANK YOU!

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