

# Lessons learned from a wind turbine blade repurposing project



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## Re-Wind Network

University College Cork, Queens University Belfast, City University of New York, Georgia Institute of Technology, Munster Technological University

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[www.re-wind.info](http://www.re-wind.info)



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# Presentation Overview

- Re-Wind project background
- Creating the repurposing evidence base
- Lessons learned by Re-Wind
- **Lessons for the industry!**



Re-Wind Catalog Modeling and Graphics: Asha McDonald, Chloe Kiernicki, Mehmet Bermek, Zoe Zhang, Alex Poff, Sakshi Kakkad, Emily Lau, Franco Arias, Russell Gentry.

# Blade Repurposing: Rationale & Hypothesis

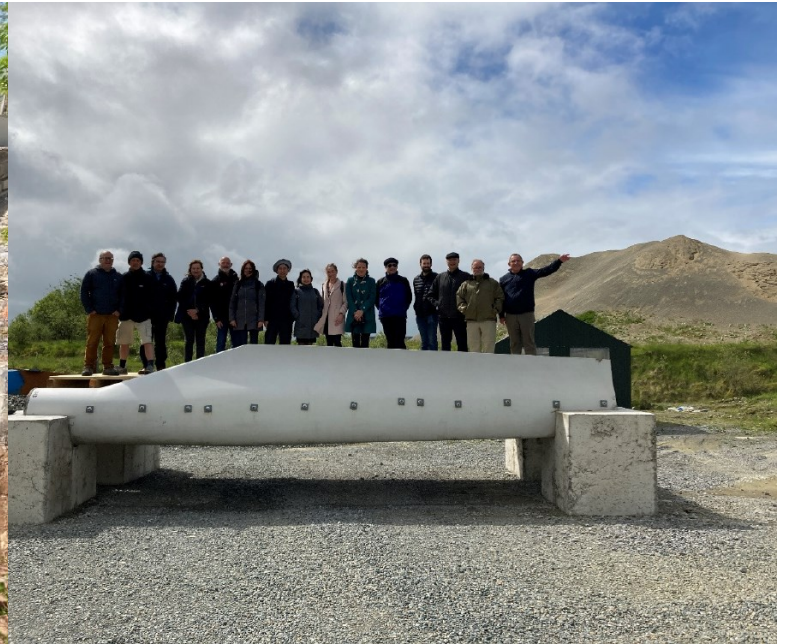
- Rationale: preserve blades' engineered value
- Repurposing EoL GFRP blades sits near the top of the waste hierarchy
  - Technically feasible
  - Environmentally sustainable
  - Socially and economically sustainable
- We need evidence!
  - Sustainable Development Goals



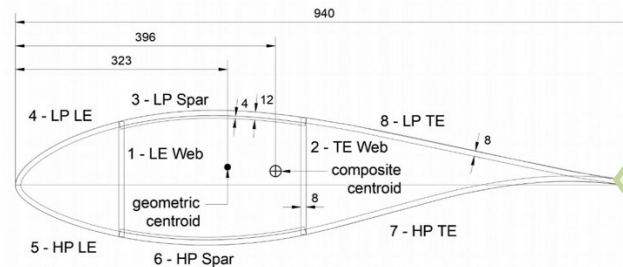
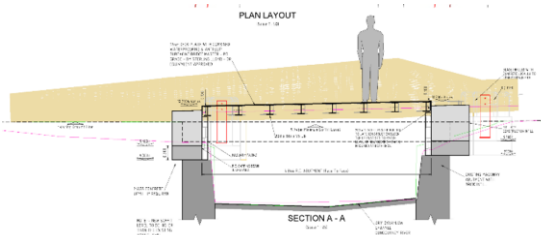
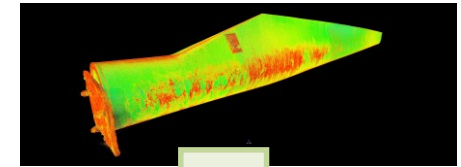
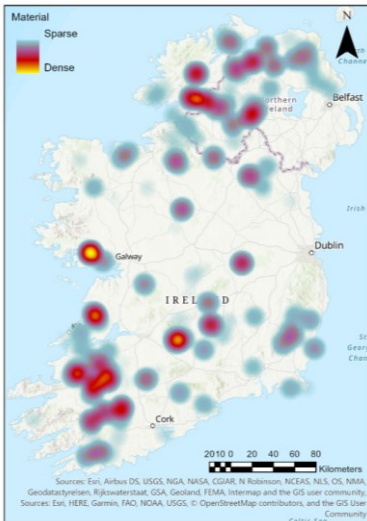
N29 blades at Everun Ltd, Northern Ireland

# Evidence Base: BladeBridge

- BladeBridge #2,  
Midleton, Rep. Ireland
- BladeBridge #3,  
Dunnamore, N. Ireland

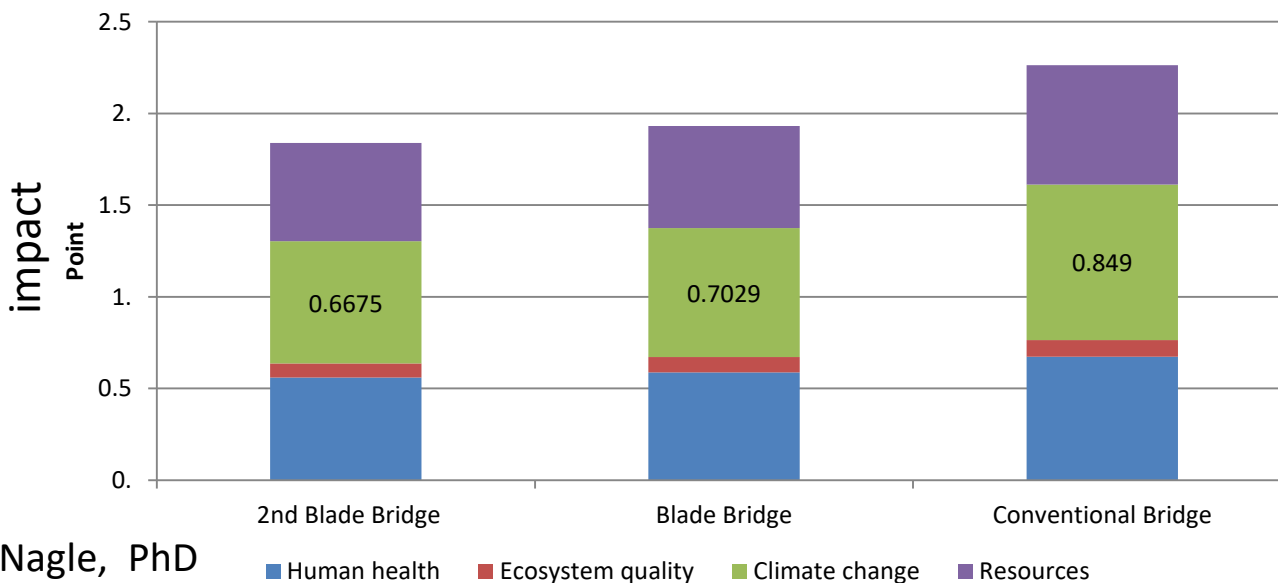


# Generating the evidence base: technical feasibility



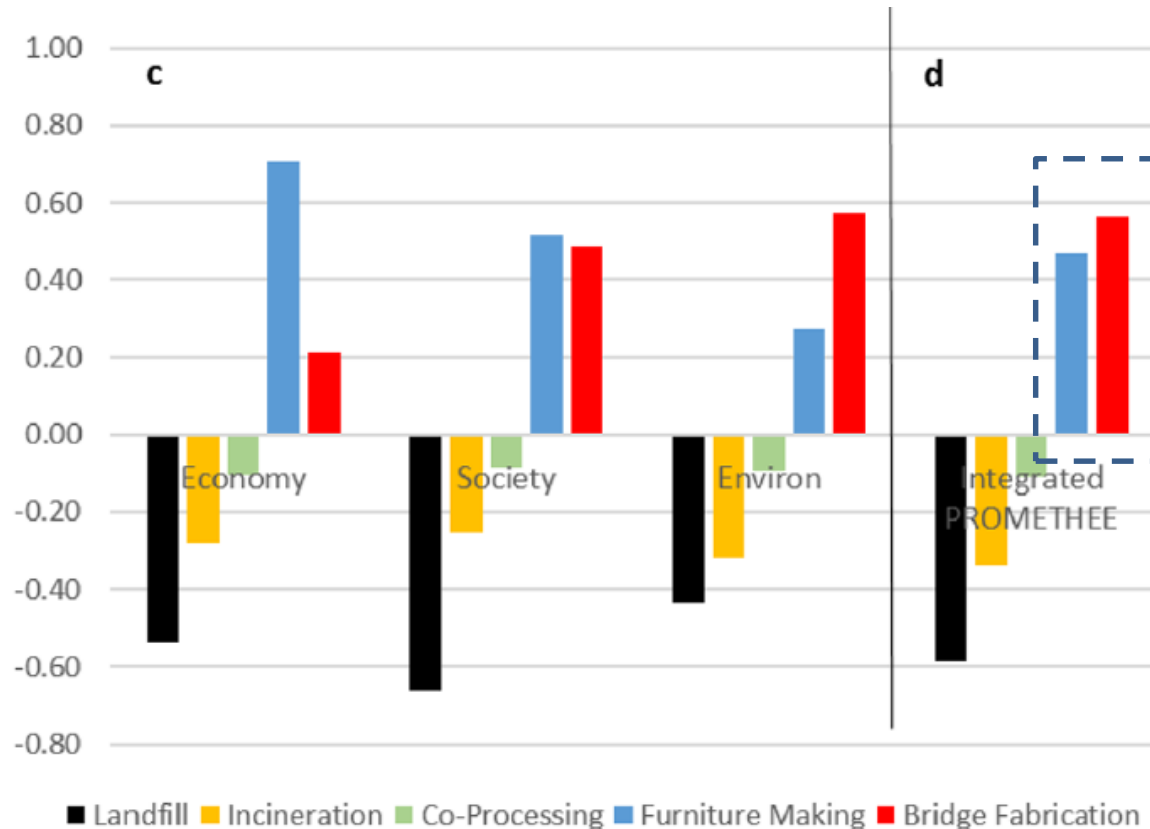
# Environmental Sustainability: Repurposing versus alternatives

- EoL LCA: blade bridge environmentally preferable to alternative EoL treatments: co-processing or landfill (baseline, not shown)
- Product LCA: 14% reduction in overall environmental impact compared to a conventional steel bridge. Material substitution, transport.



Angie Nagle, PhD  
Thesis, UCC (2022)

# Social Sustainability



Multicriteria decision analysis based on

- custom UN SDG indicators,
- LCA outputs, Delphi panels of experts

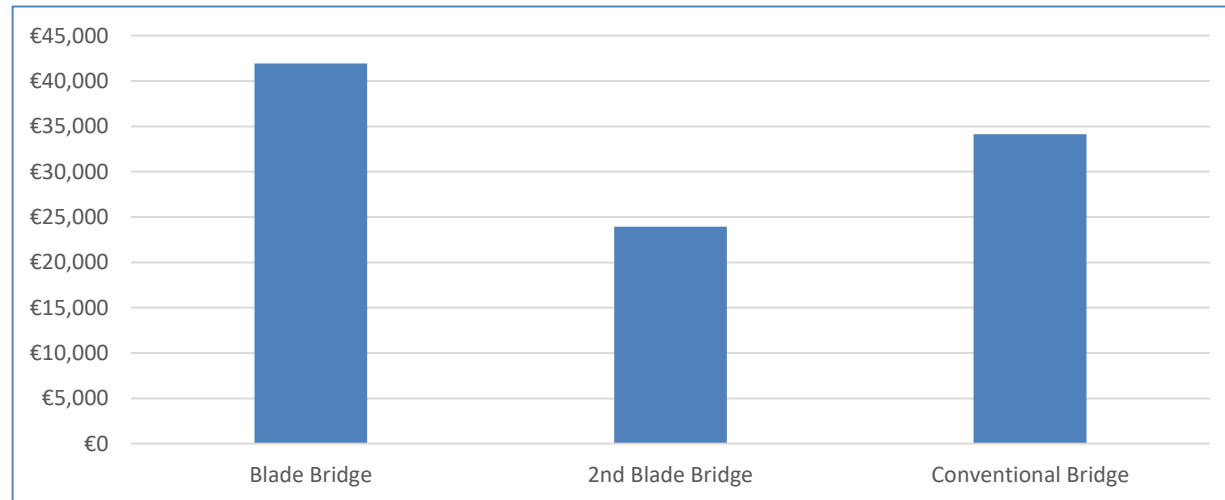
Decarbonising transport;  
Healthy lifestyles;  
Sustainable rural development

End-of-Life alternatives for wind turbine blades: Sustainability Indices based on the UN sustainable development goals

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# Lifecycle Costing of BladeBridge vs Conventional Bridge



- Learning by Doing: costs decrease for 2<sup>nd</sup> and subsequent bridges.
  - Design streamlining; less reverse engineering;
  - Client confidence : less over-engineering

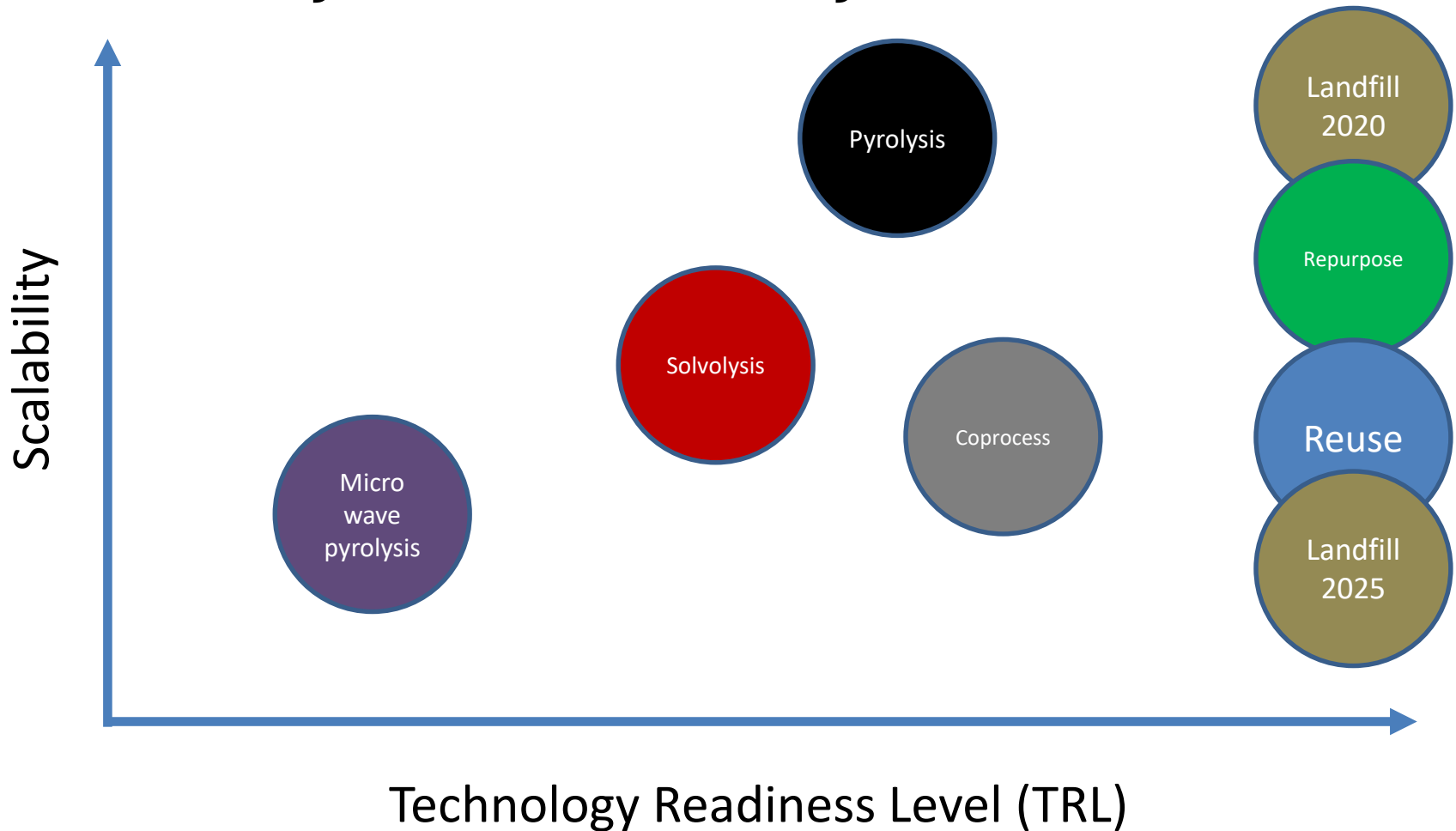
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some lessons learned

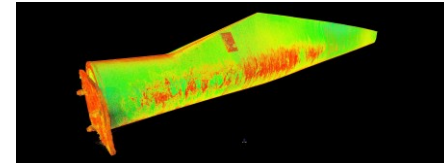
# Lesson 1: EoL GFRP blade solution maturity & scalability



# Lesson 2:

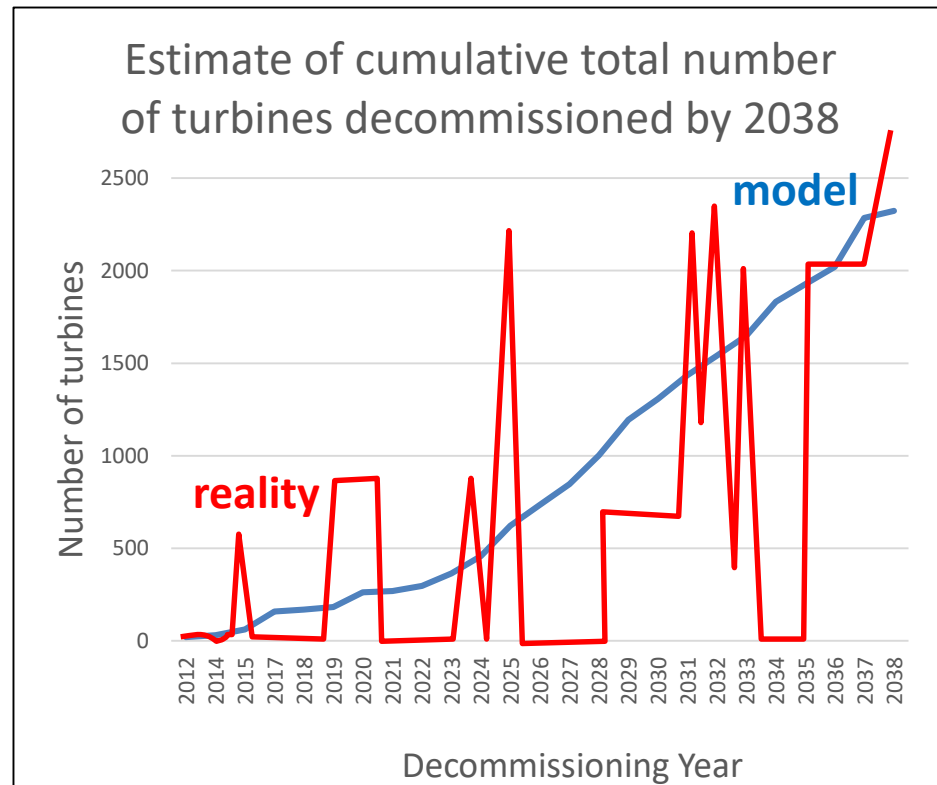
## Data (re)discovery adds cost

- Sourcing blades
- 3-D LiDAR scanning
- Geometry extraction
- Destructive and non-destructive testing
- Burnout tests
- \*\*\*FE modelling\*\*\*



# Lesson 3: EoL blade supply and recovered product demand are spiky

- Blade repurposing (and pyrolysis, and solvolysis...) is a **two-sided business**
- Temporal mismatch in supply and demand
- Solutions
  - Blade Brokerage
  - Blade Storage



Emma Delaney, QUB

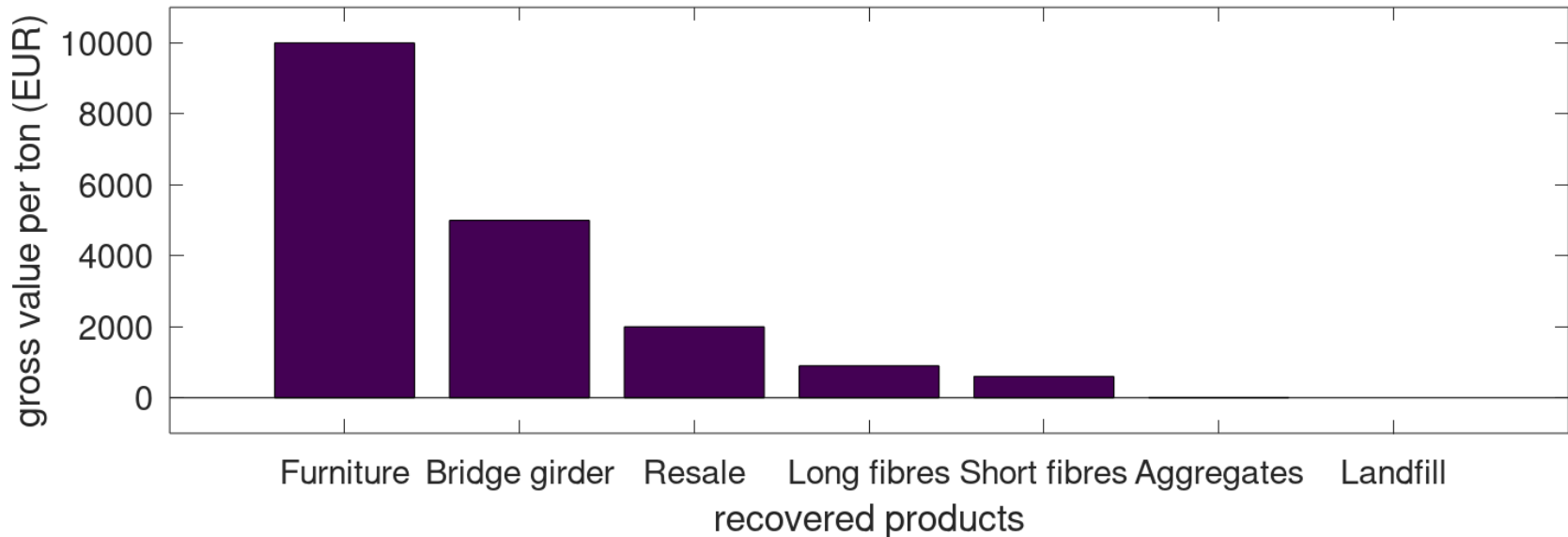
# Lesson 4:

## Location, location, location

- Transport emissions are important for all EoL solutions
- Transport costs for large blade sections versus small cuts
- Local repurposing retains and adds local value (enterprise, jobs, public acceptance, environmental benefits)



# Lesson 5: find the value



- Value is determined by the “other” side of the business model
- Costs are important but costs can reduce with scale-up and technical maturity
- Limited room to find value in some EoL solutions
- New products and new markets?



so... what can be done?

# How can OEMs facilitate repurposing?

- OEMs : share your data!
  - We need materials quantities, geometries, FRP layer specifications
  - 3-D LiDAR scanning, reverse engineering, FE modelling, certification, destructive and non-destructive testing, coupon tests, burnout tests...
    - all of these add costs!
  - Other EoL solutions also need this information
  - Legacy blade designs, no longer in production
  - Increase confidence in repurposed products

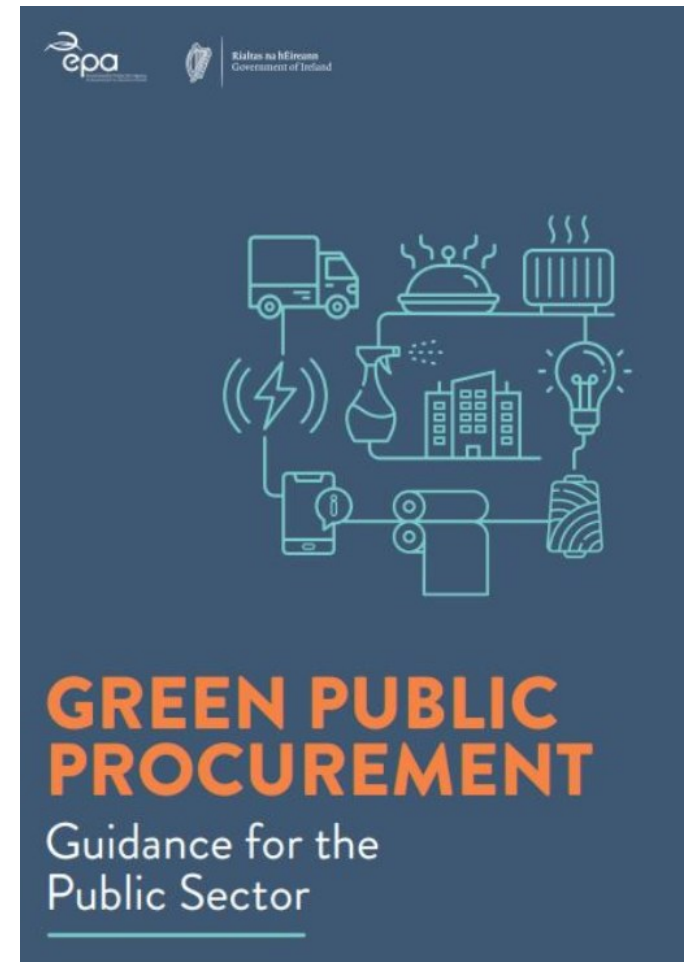


# How can operators and decommissioners facilitate repurposing?

- Develop partnerships, sign MoUs with repurposers and EoL solution providers
  - Involve EoL solution providers early in the decommissioning process : site works planning, access, equipment.
  - Sustainability requirements in tenders
  - Win-win scenarios saving money and increasing sustainability
- Data sharing : blade history, work orders, SCADA data, digital twins

# How can procurers facilitate repurposing?

- Two-sided business model: demand is the “other” business segment
- Extremely competitive markets even for high-value products such as bridges
  - Green & circular public procurement **mandates**
  - Certification, regulations and codes regarding use of recycled/repurposed materials



# Conclusions



- Repurposing EoL blades is technically, economically, socially and environmentally feasible and is scalable
- However significant barriers remain
- Co-operation and sharing information can bring down costs and improve outcomes for all stakeholders
- WindValue & WindLEDeRR projects
- BladeBridge Blade Repurposing Startup

# Thank you

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