Sustainability Assessment of a Pedestrian Bridge made from Repurposed Wind Turbine Blades

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Environmental Research Institute

UCC University College Cork, Ireland Coláiste na hOllscoile Corcaigh

Science Foundation Ireland sfi For what's next

Overview

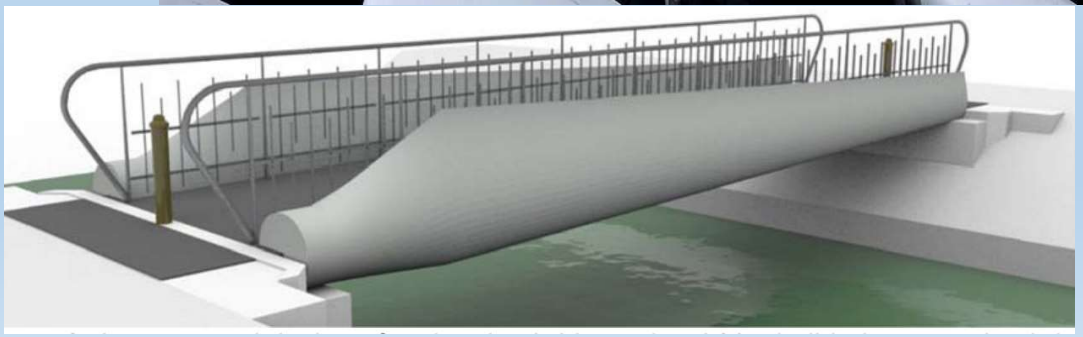
1. Re-Wind Project
2. Establishment of a baseline environmental comparison
3. Pedestrian Bridge Project in County Cork
4. Bridge LCA Results
5. Discussion around True Impacts
6. Recent Re-Wind work in the US

Re-Wind Project
Sustainable Repurposing of Discarded Wind Blades

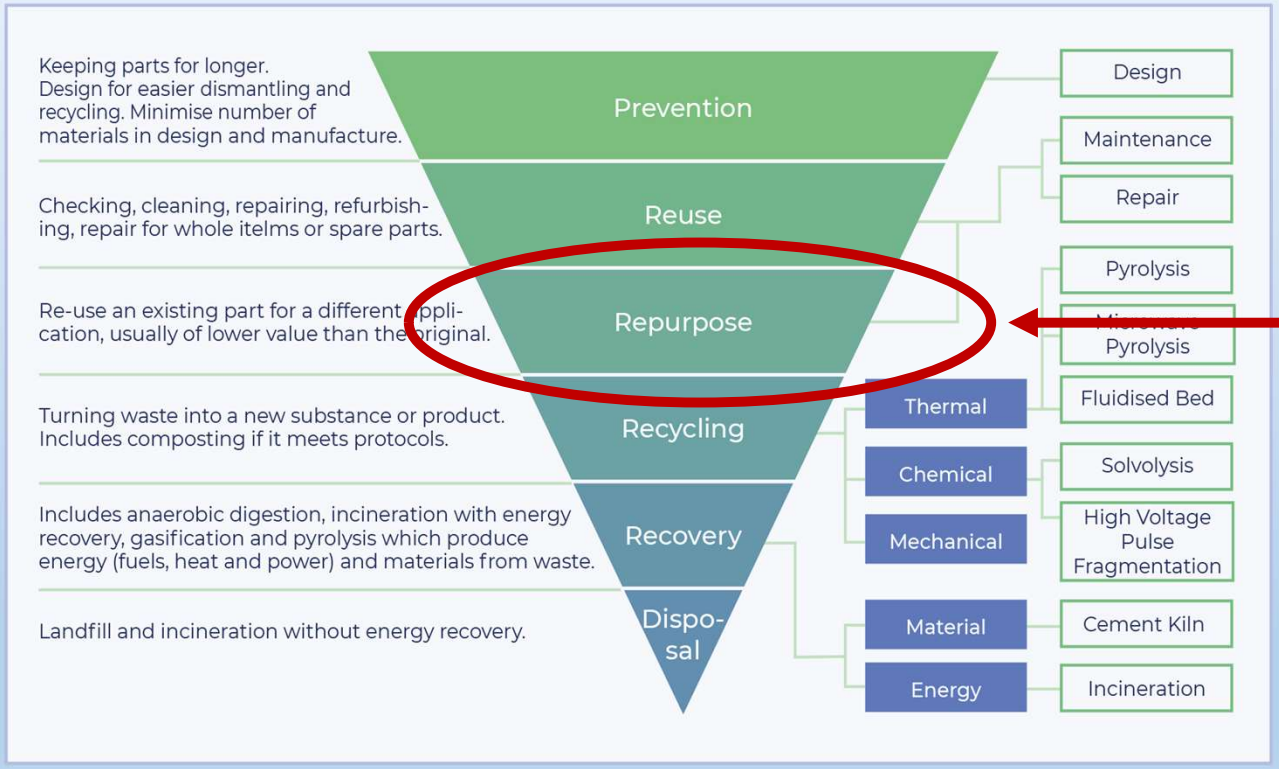
QUEEN'S UNIVERSITY BELFAST

Georgia Tech

UCC
University College Cork, Ireland
Coláiste na hOllscoile Corcaigh



EU Waste Hierarchy for Composites



Re-Wind Project is here

www.baxcompany.com/insights/circularity-of-polymer-composites/waste-management-hierarchy/

Establishing an Environmental Baseline for Re-Wind

- Literature review indicated co-process as most viable/sustainable
- LCA performed, modelled from process used at Neocomp/Holcim, with theoretical processing in Ireland
- 10% Overall Material Substitution*(Pickering, 2006)*, or 50-75% *(EuCIA, 2013)*

Re-Wind Project Baseline: Environmental impacts of co-processing Irish Blade waste in Ireland at 10% raw material substitution (Nagle, et al, 2020)

Raw Material Substitution

Fuel Substitution

Excellent Irish Opportunity Exists: Plans for Greenway bridges!

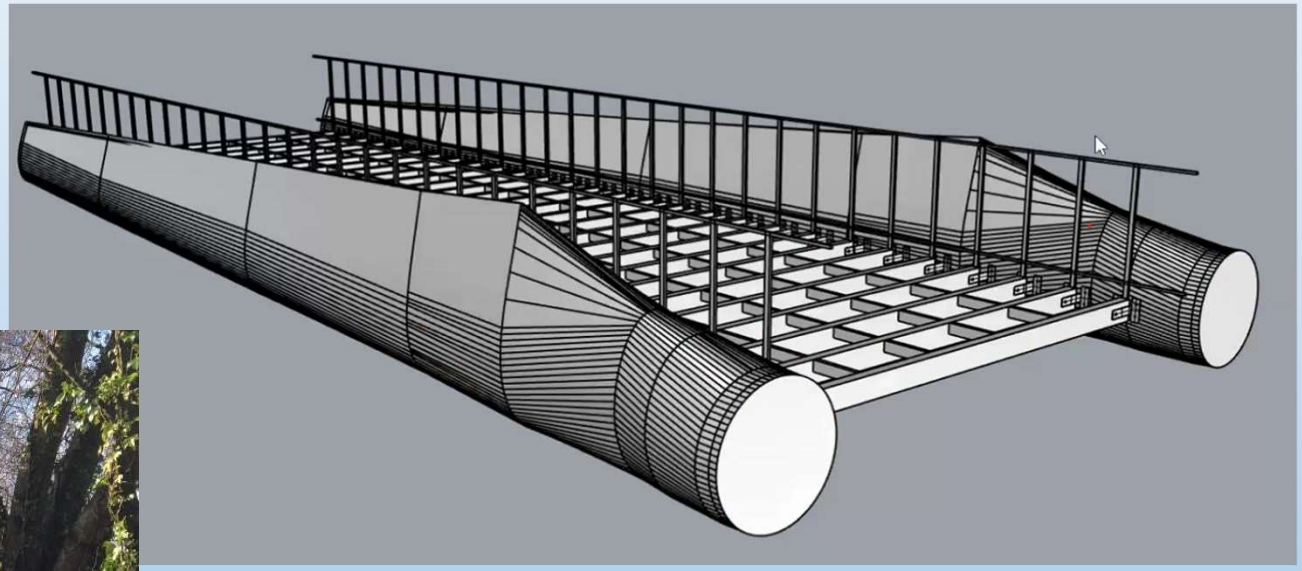
- €1 million/day allocated to cycle & walking infrastructure *(2020 Irish Program for Government)*

- SDG 12: Sustainable Consumption and Production - Ireland's Eurostat indicator for circular material use is the second lowest *(Clark et al, 2020)*

Cycle ways marked in green already exist, everything else is planned or under construction

Greenway Blade-Bridge Project

- 5.5m bridge using N27 blades
- Modelling estimates 5x FOS
- Strength testing on 3rd blade
- Development of fasterners
- Great enthusiasm & replicable

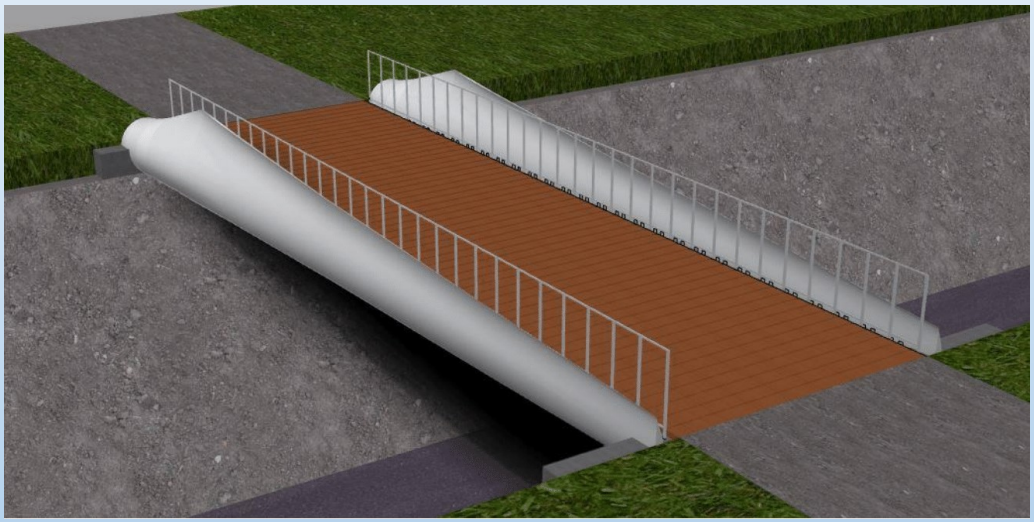


(Zoe Zhang, Re-Wind, Georgia Tech)

Cork County Council
Comhairle Contae Chorcaí

LCA Boundary Setting & Assumptions

Functional Unit: Disposition of 4500 kg blade waste over 60 years (Cradle to Grave)

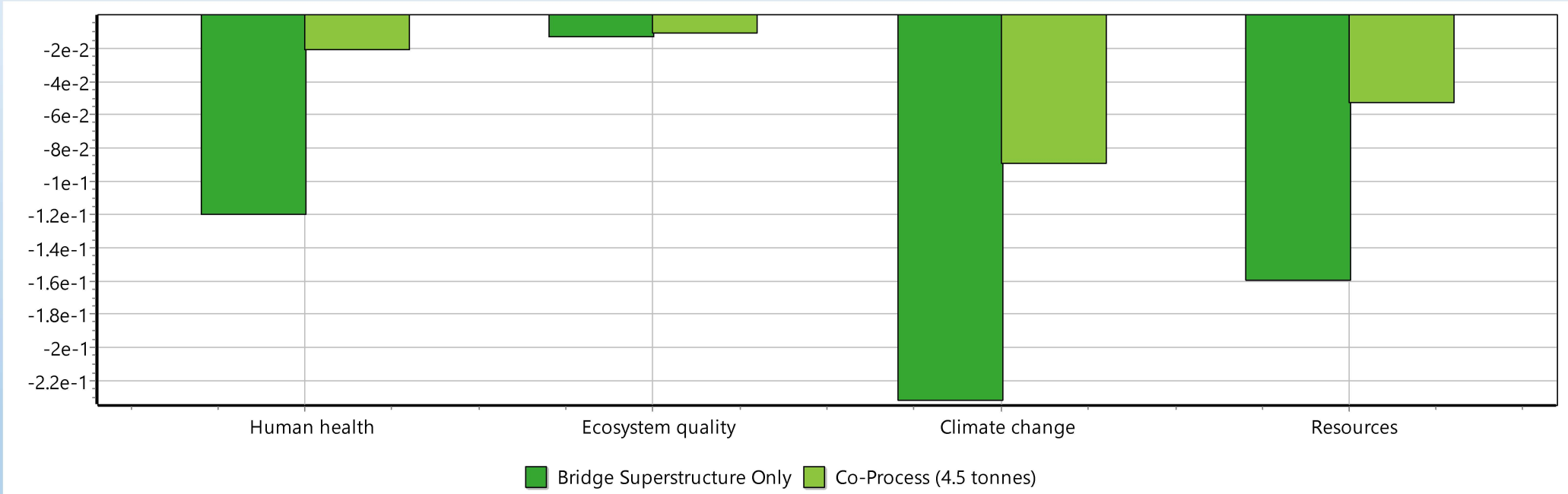


- Blades transported Belfast to Cork
- Lower 2/3 blade replaces steel girders made with partially recycled material
- Top 1/3 blade sent to landfill
- Blades coated in epoxy protective layer
- End of Life Plan: Co-processing of GFRP girders, recycling of hardware

Wooden decking material, abutments, and maintenance schedule assumed equal to bridge made with steel girders

LCA: Comparison of Baseline to Bridge Girder Substitution

Blade EoL as Blade bridge is more beneficial than co-processing.



Method: IMPACT 2002+ V2.15 / IMPACT 2002+ / Normalisation
Comparing 1 p 'Bridge Superstructure Only' with 1 p 'Co-Process (4.5 tonnes)';

LCA: Comparison of Baseline to Full Bridge

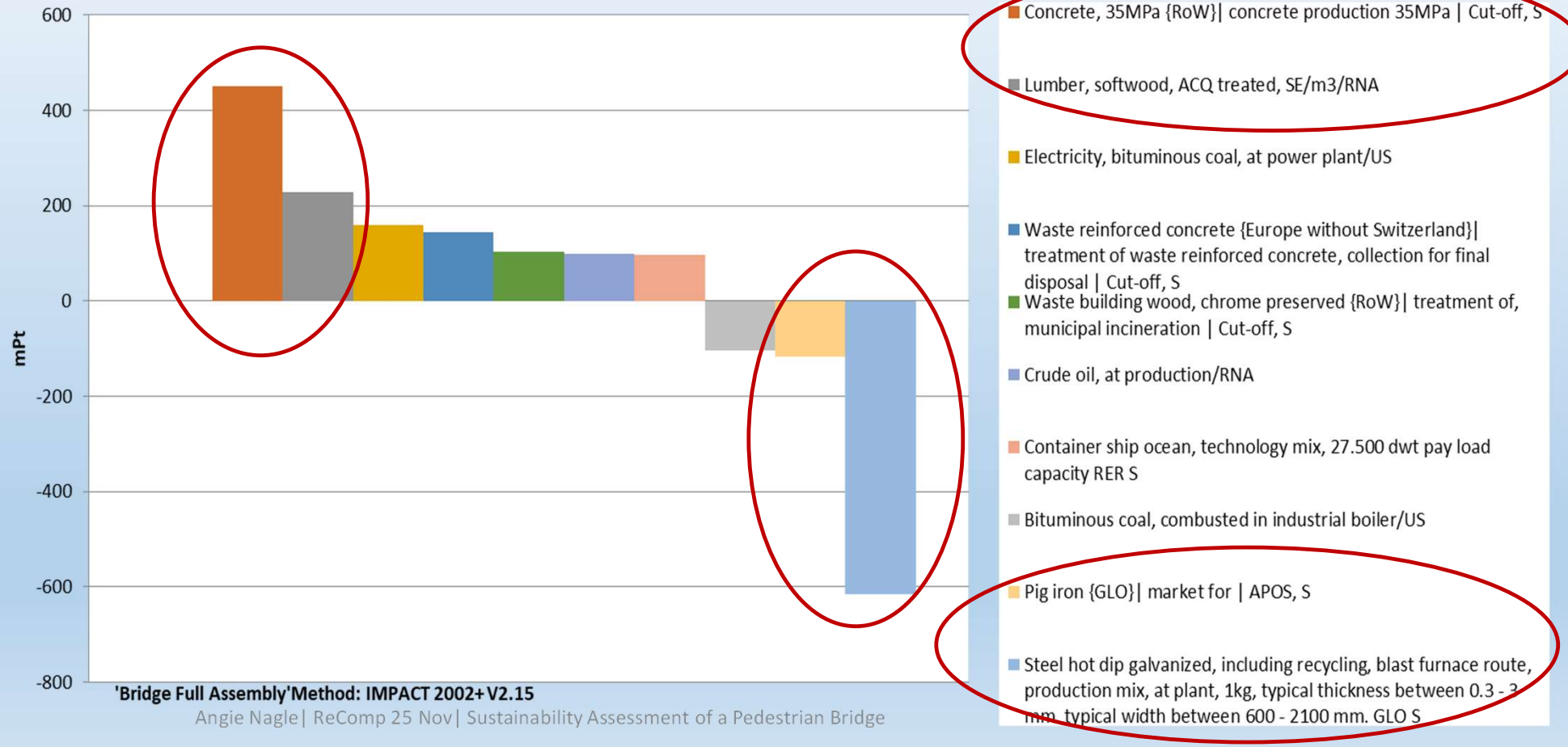
The full bridge assembly has more impact than the benefits gained in replacing the steel girders with blade waste

Method: IMPACT 2002+ V2.15 / IMPACT 2002+ / Normalisation

Comparing 1 p 'Bridge Full Assembly', 1 p 'Bridge Superstructure Only' and 1 p 'Co-Process (4.5 tonnes)';

LCA: Quantification of Total Bridge Construction

Steel Substitution gives greatest benefit, while concrete & lumber are greatest impacts



Discussion of Overall Impacts

Repurposing of wind turbine blades as girders for pedestrian bridges is environmentally better than the baseline disposal method of co-processing in a cement kiln.

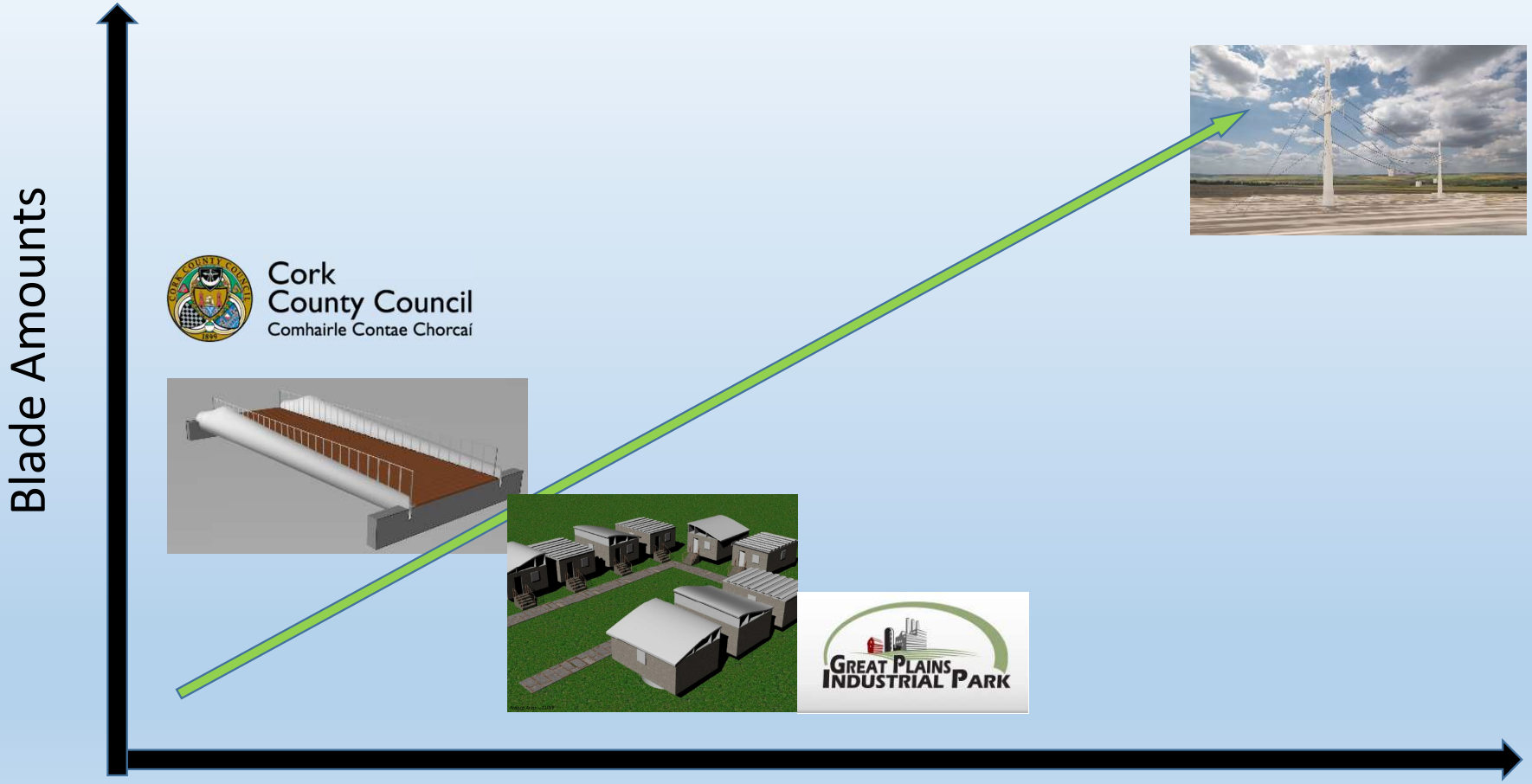
However, the positive impacts of this project are more likely in the awareness raising of **‘developing projects that can inspire and showcase the potential of a circular economy’.** Ellen Macarthur says: *Setting up exemplar projects in strategic places in the city can be an inspiring way to demonstrate what is practically possible...*
(Ellen Macarthur Foundation, 2019)

Blade Pole using Wind Blade

Market : Asset Recovery for Integrated Companies

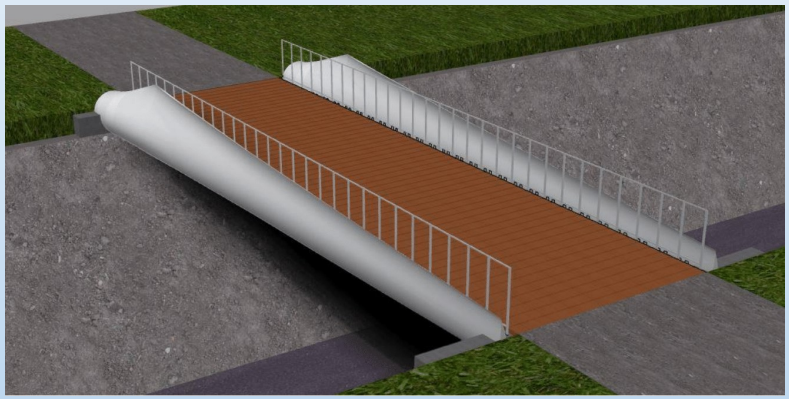
<1% of the Midwestern market would use 1,000 blades/ year

Blade Amount v. Timescale for Re-Wind Products



In Summary

Re-Wind Project creates sustainable repurposing ideas for blade waste



- Co-Processing is environmental benchmark for Re-Wind
- Cork County Council greenway bridge is better than co-processing of blade waste
- Pedestrian bridge model is replicable – good opportunity in Ireland!
- HV Transmission tower is a long term project, but opportunity for high utilization of waste

We'd love to hear from you:

- More discussion around Co-Processing & LCA
- Interest in our Pedestrian Bridge or Transmission Tower applications

Thank You!!

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https://www.re-wind.info/