



# RE-USE OF WIND TURBINE BLADE FOR CONSTRUCTION AND INFRASTRUCTURE APPLICATIONS

Alann André

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RISE Research Institutes of Sweden  
Materials and Production



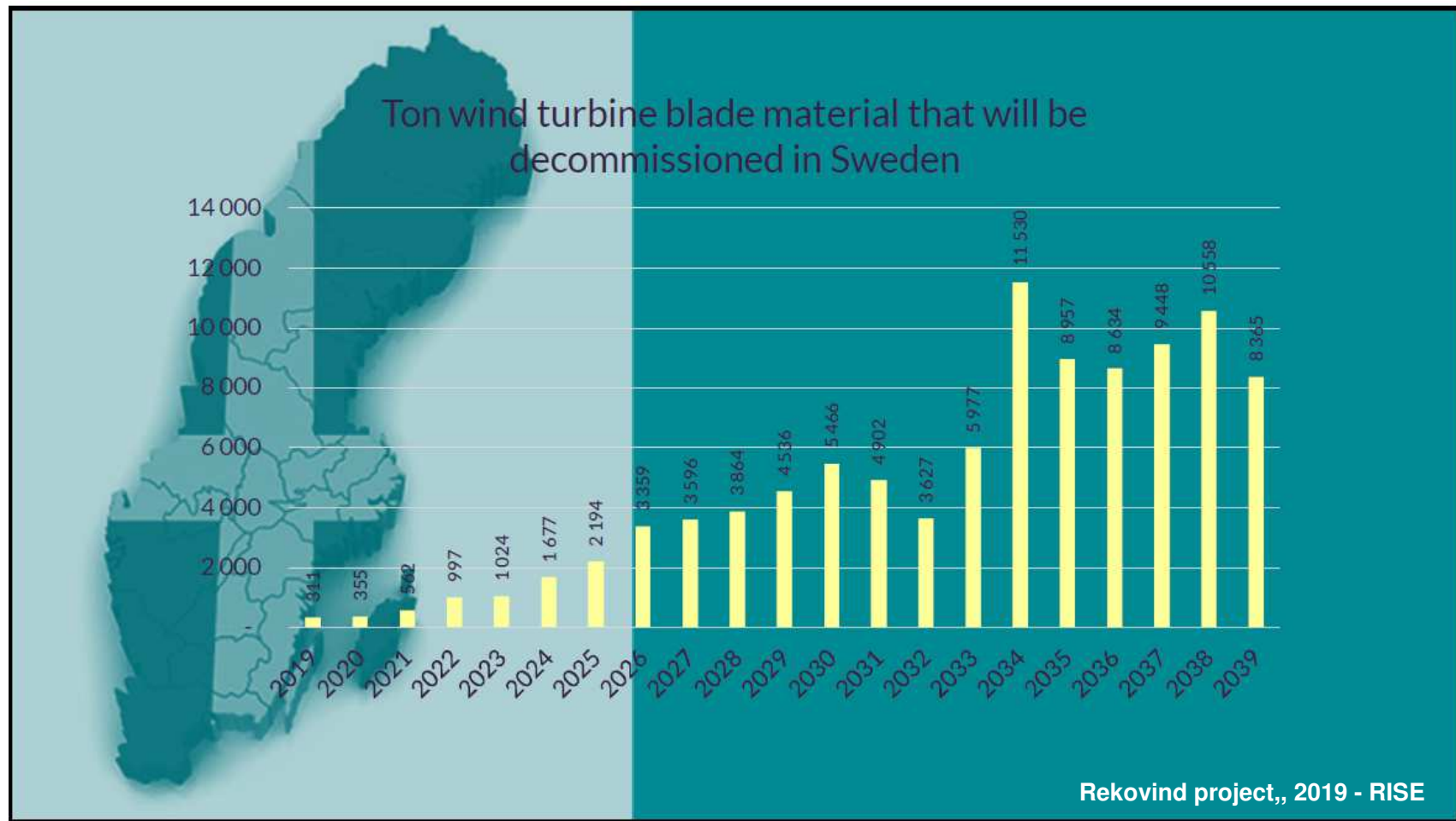
# ReUse FRP in infrastructure

*Our idea aims to promote sustainability in the infrastructure sector by Re-using durable and lightweight FRP materials*

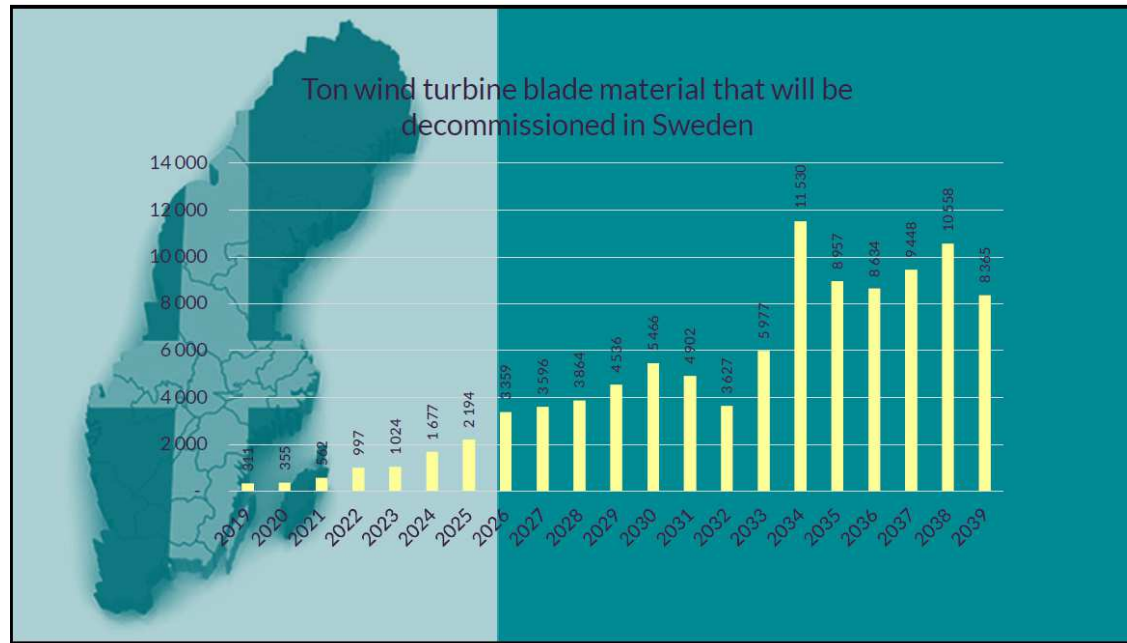
# Content

1. Why is the management of End-of-life wind turbine blade a challenge?
2. General approach that can solve that problem?
3. State-of-the-art in this area?
4. Our contribution
5. Conclusion and future work

# The Challenge



# The Challenge



***Find a solution for the tons of composite waste from the wind industry while new regulations and increased public awareness make old “solutions” obsolete***



# The Challenge

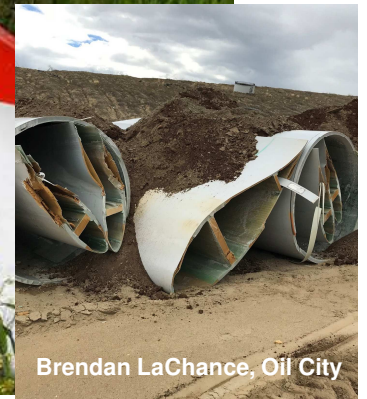
**36 000 blades** down in Europe within 5 years



Benjamin Rasmussen Bloomberg Green

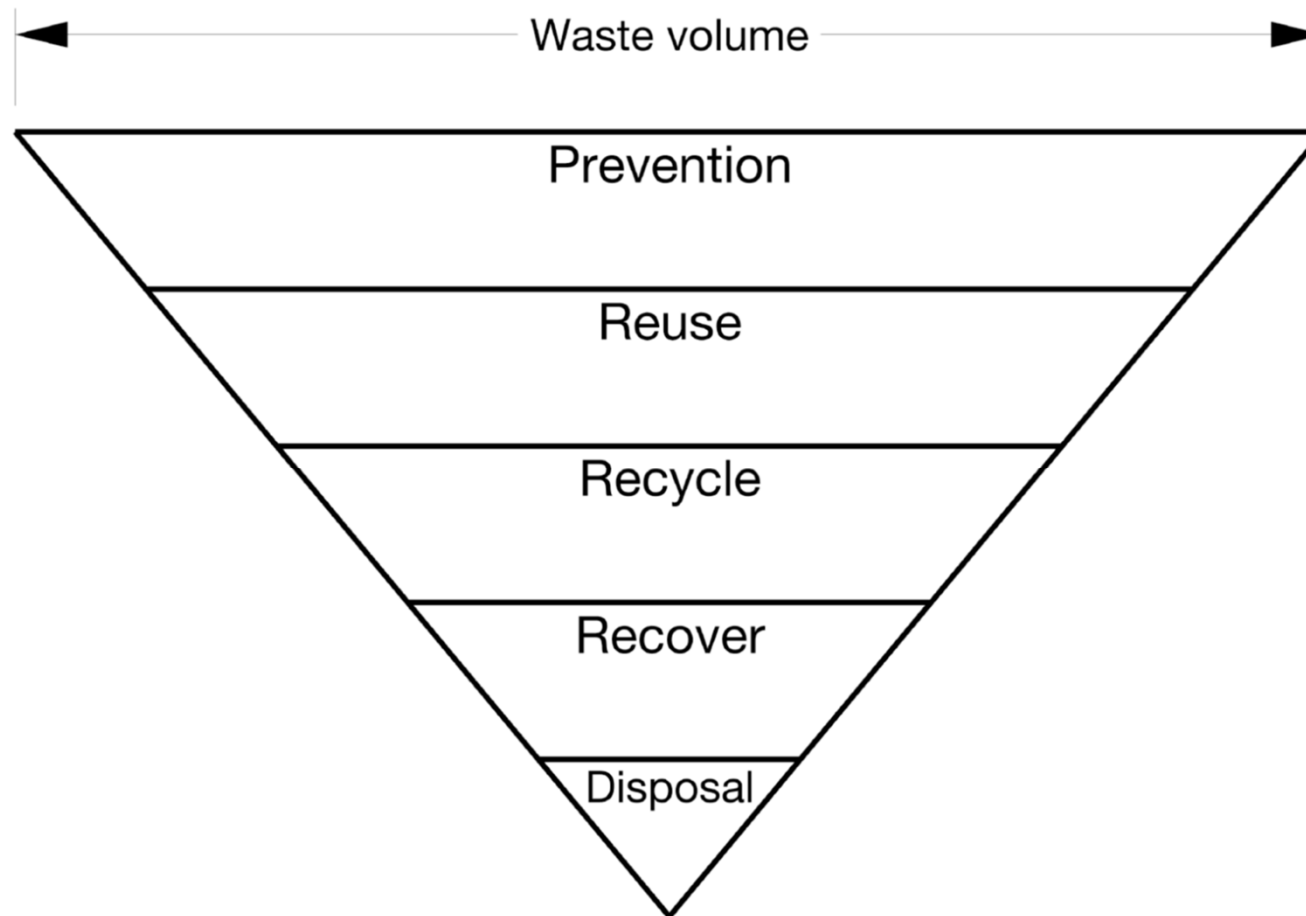


Anmet (Polen)

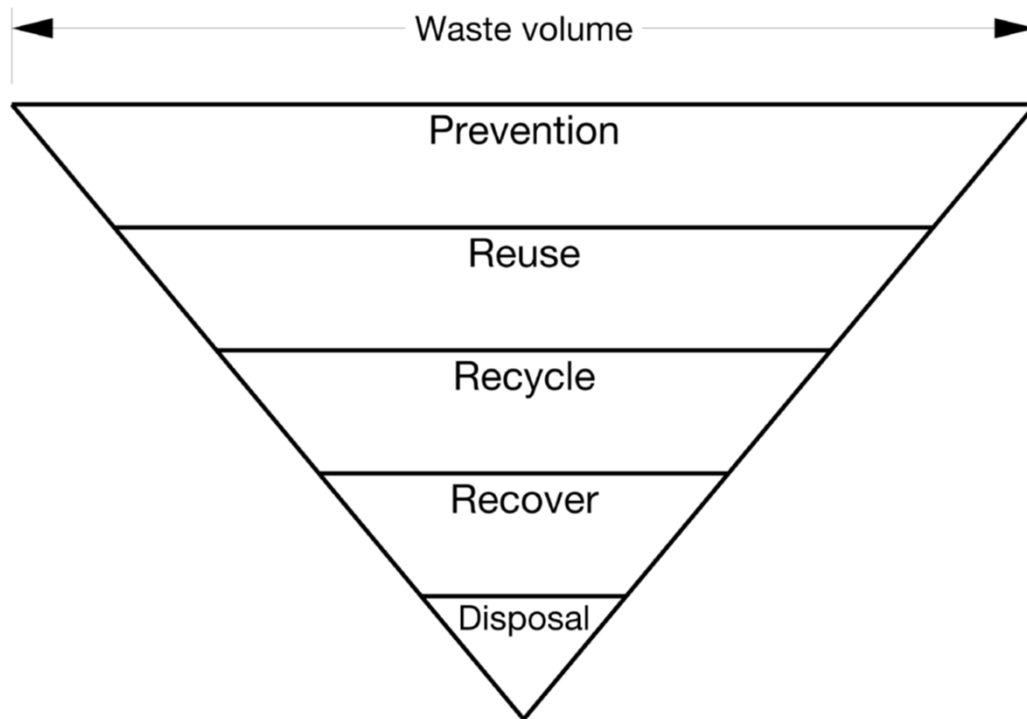


Brendan LaChance, Oil City

# What approach should we prefer?

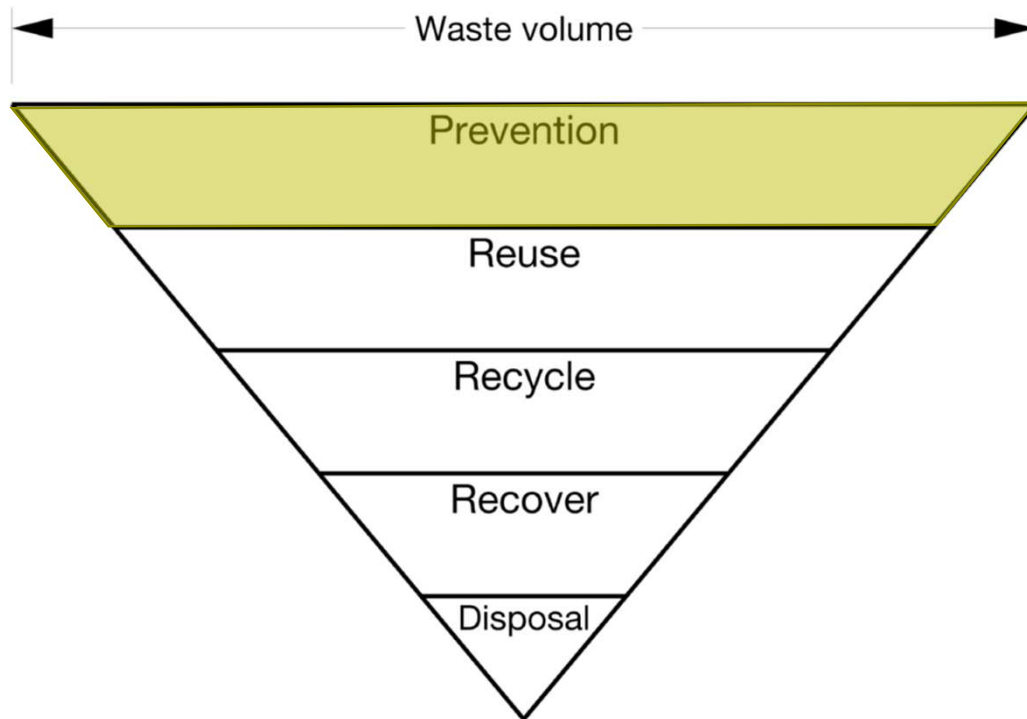


# What approach should we prefer?





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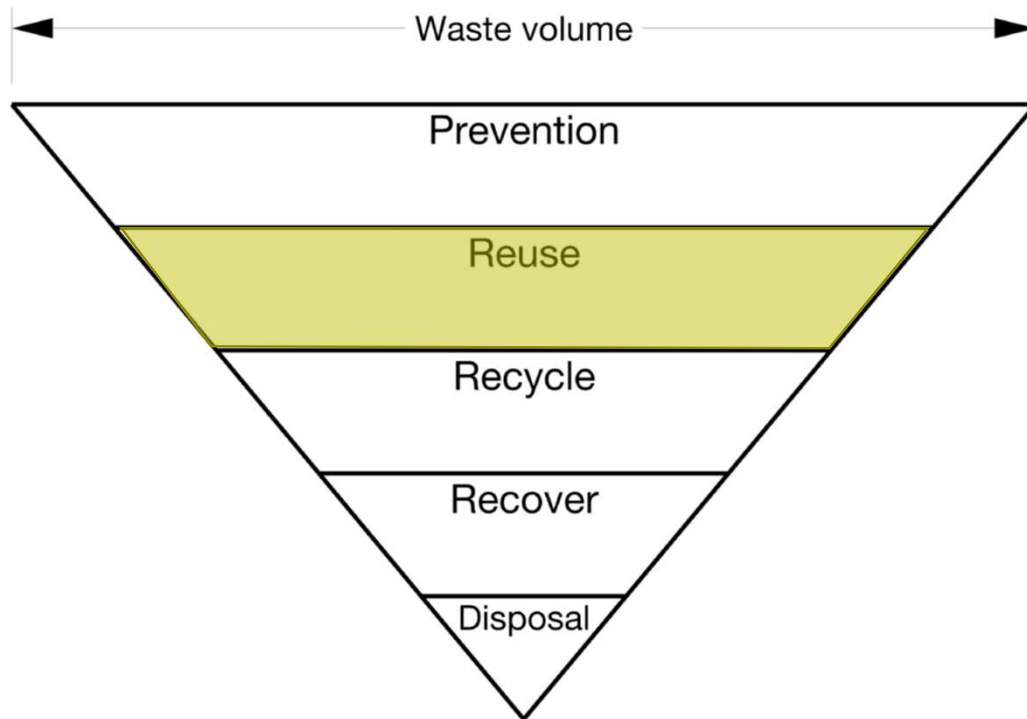


## PREVENTION

→ New design for next generation wind turbines

→ Great!  
... but not solving the problem of old generation coming to End-of-Life

# What approach should we prefer?

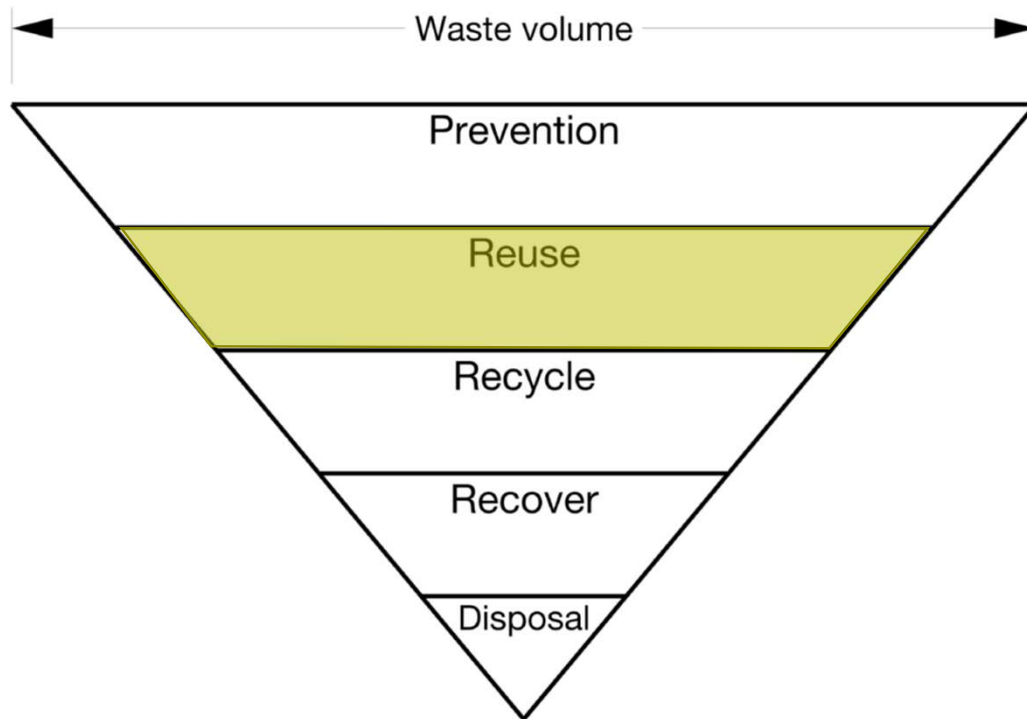


## REUSE

→ Second-hand market

→ Give to the blade a  
“Second life” in another  
application area

# What approach should we prefer?



## REUSE

→ Second-hand market

→ Give to the blade a  
“Second life” in another  
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# "Second Life" solution: State of the art

- → **Great potential within construction and infrastructure**
- Resource efficient solution - transform waste material into resource
- Uses material that goes to landfill/energy recovery
- Strong and durable material
- Low maintenance costs
- Replace high CO2 emission materials such as concrete and steel

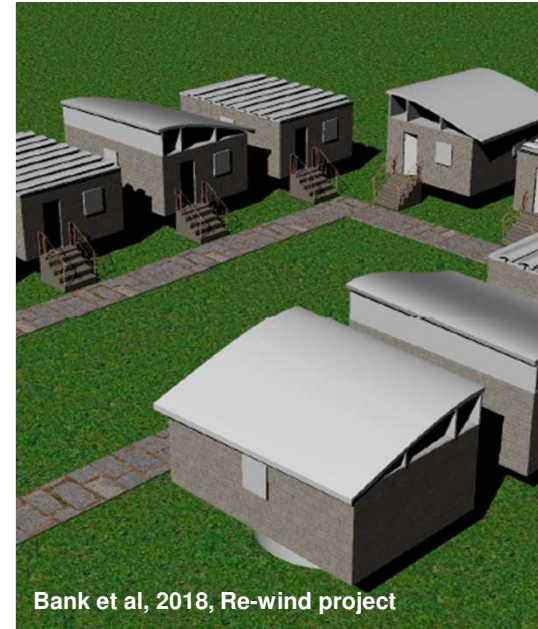
Materials for Wind Turbine Blades: An Overview

Mishnaevsky et. al. materials 2017

Bank et. al. Concepts for Reusing Composite Materials from Decommissioned Wind Turbine Blades in

Affordable Housing 2018

<https://www.windpowerengineering.com/mechanical/blades/recycling-wind-turbine-blades/>



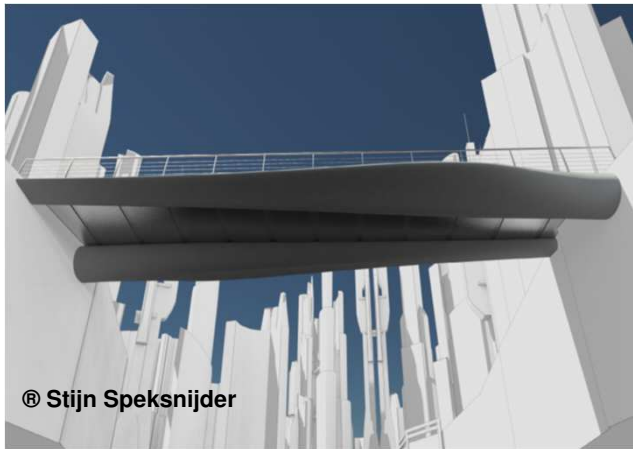
Bank et al, 2018, Re-wind project



© Denis Guzzo, Superuse Studios



# "Second Life" solution: State of the art – Focus on pedestrian bridge





# "Second Life" solution: Our contribution

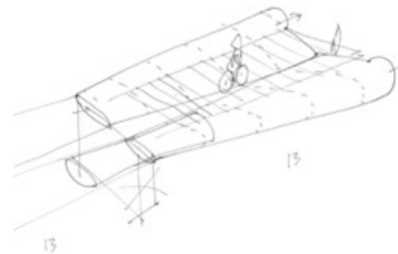
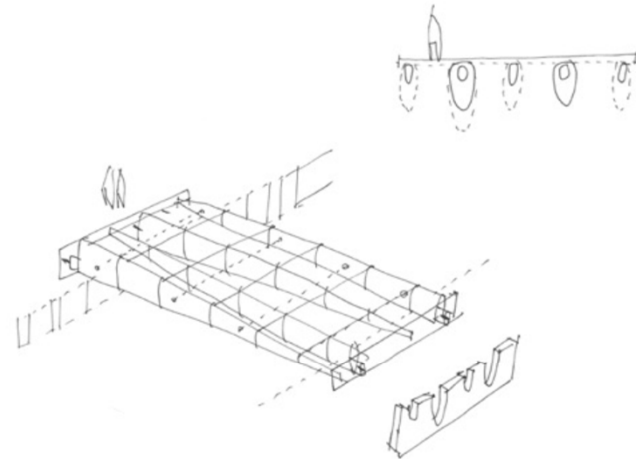
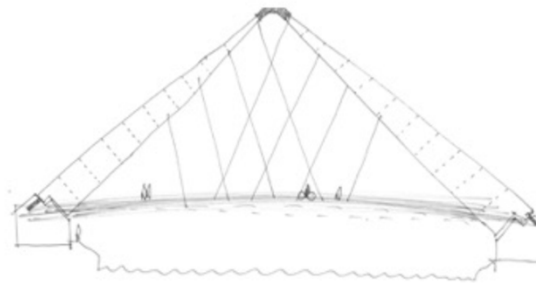
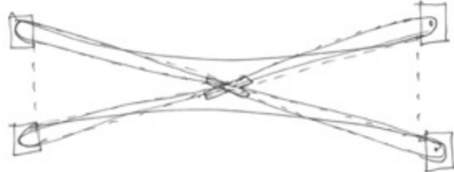
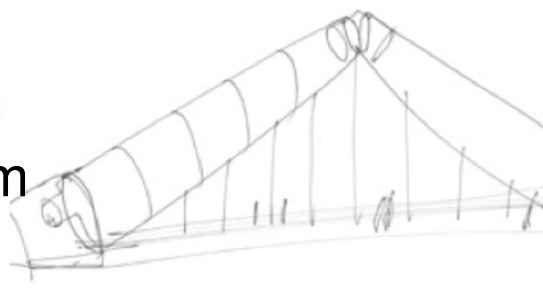
***Find a cost effective and viable solution to reuse wind turbine blades in innovative bridge designs and increase the lifetime of the blades.***

## Concepts generation

- Brainstorming
- 3D-printed blades for better visualization

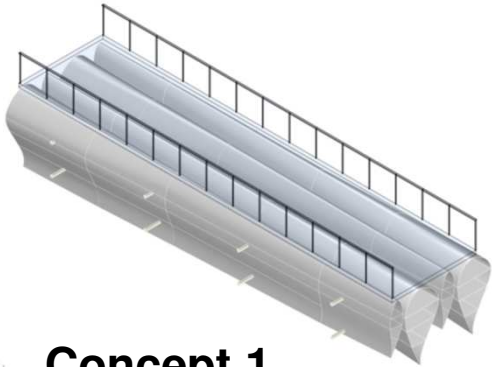
## Design parameters

- Bridge deck width: 4 m
- Span: 20 m

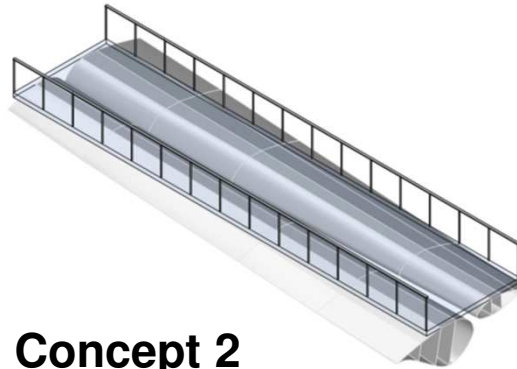


# "Second Life" solution: Our contribution

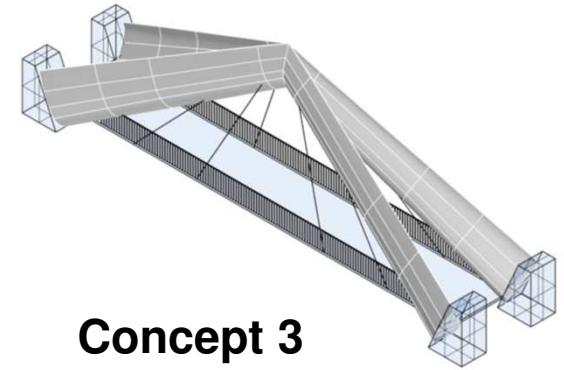
## Generated concepts



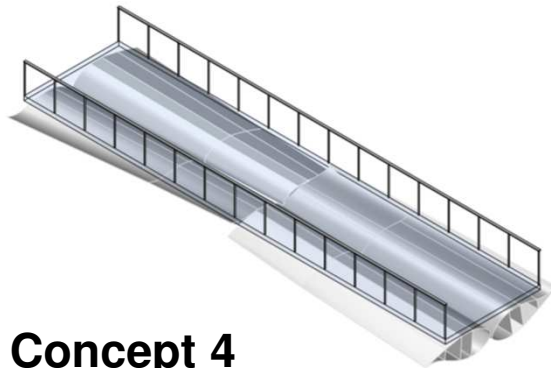
**Concept 1**



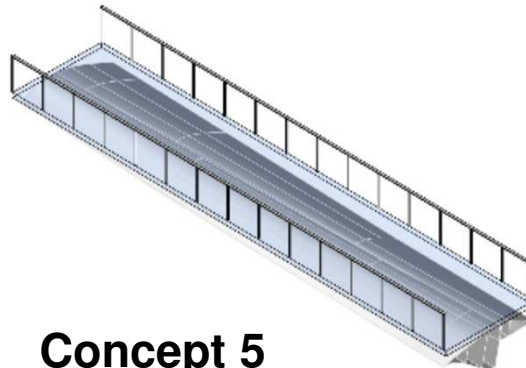
**Concept 2**



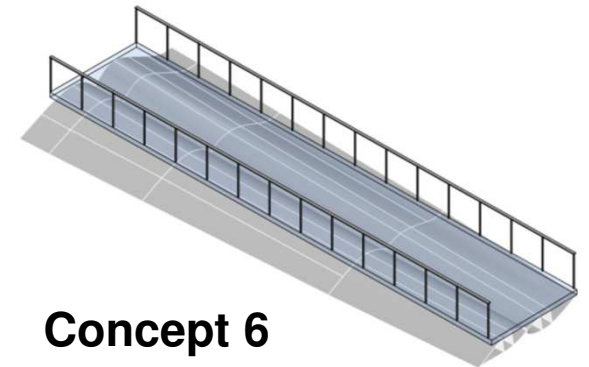
**Concept 3**



**Concept 4**



**Concept 5**



**Concept 6**

# "Second Life" solution: Our contribution

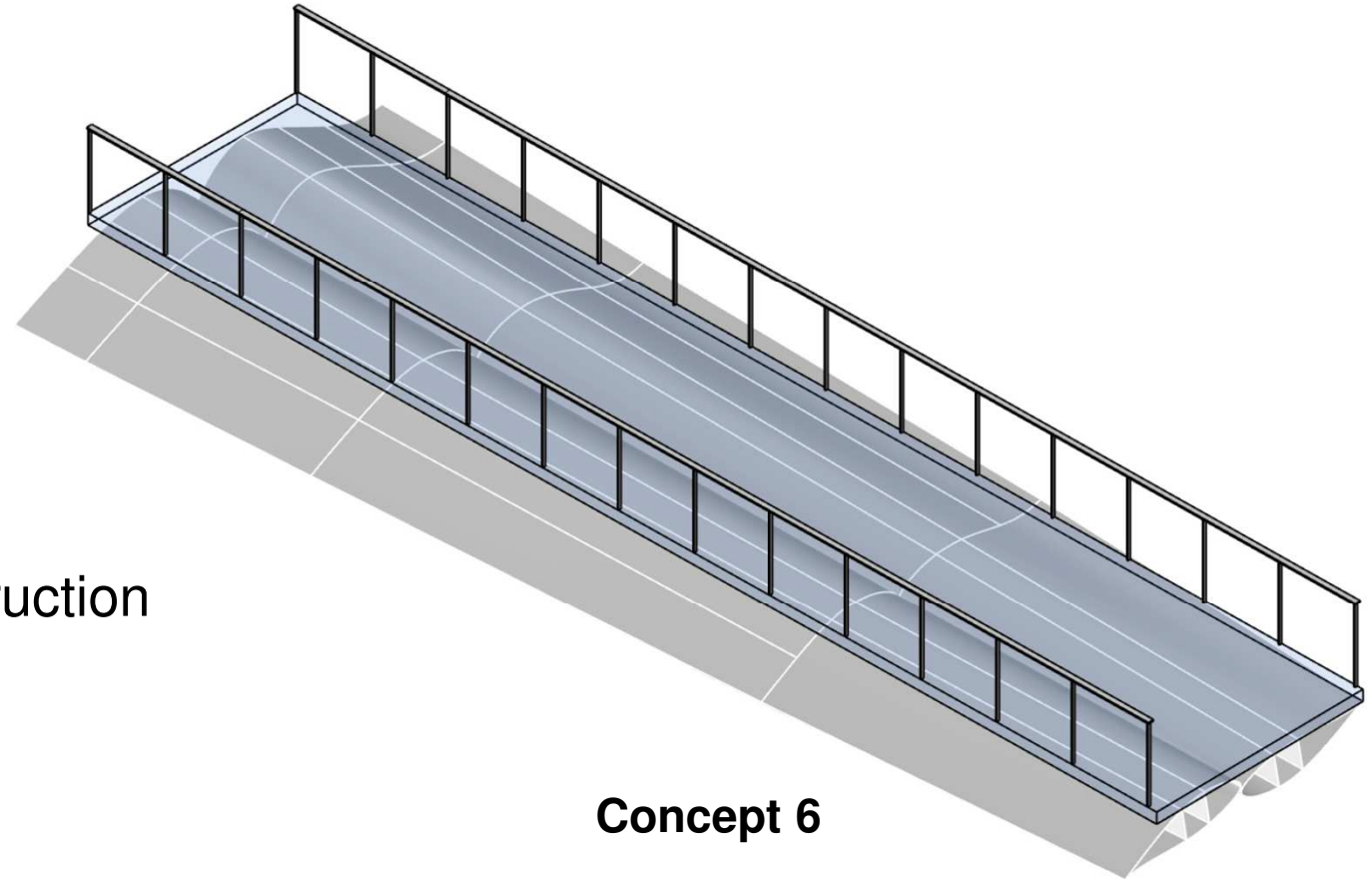
## **Concept Selection**

- Initial cost
- Manufacturability
- Maintenance
- Additional material
- Aesthetics
- Production and Construction  
(Transportation and  
Assembly)

# "Second Life" solution: Our contribution

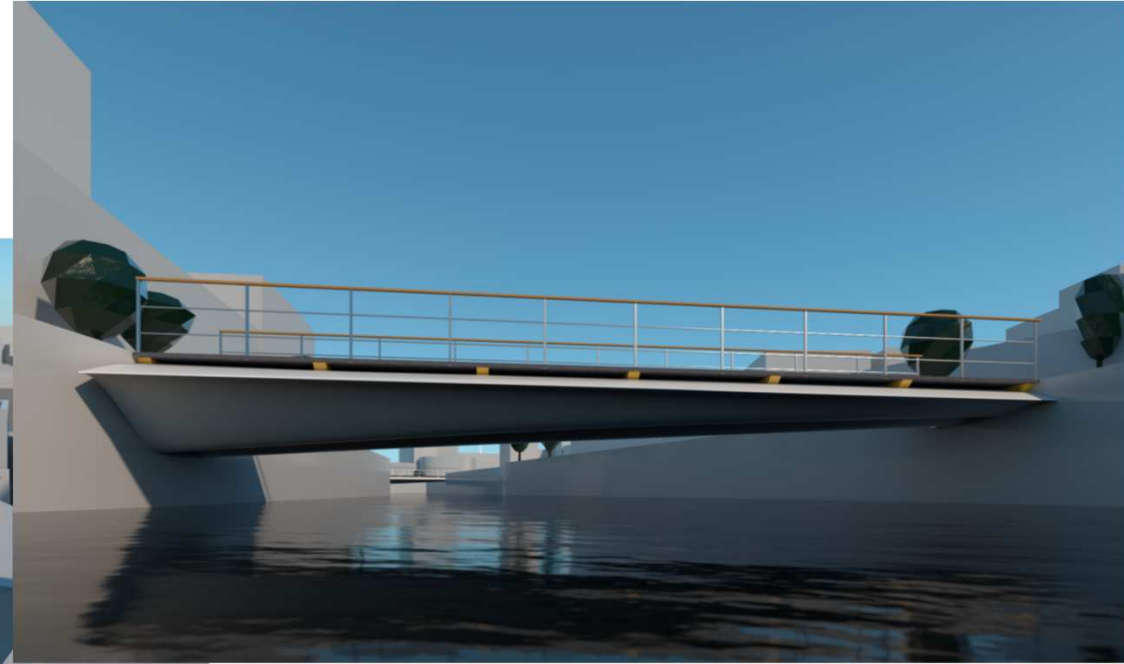
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**Concept 6**

## "Second Life" solution: Our contribution





# "Second Life" solution: Our contribution

## Further design

### **Bridge deck**

- Box section in FRP
- 80 mm high
- Spans 2 m

### **Connections**

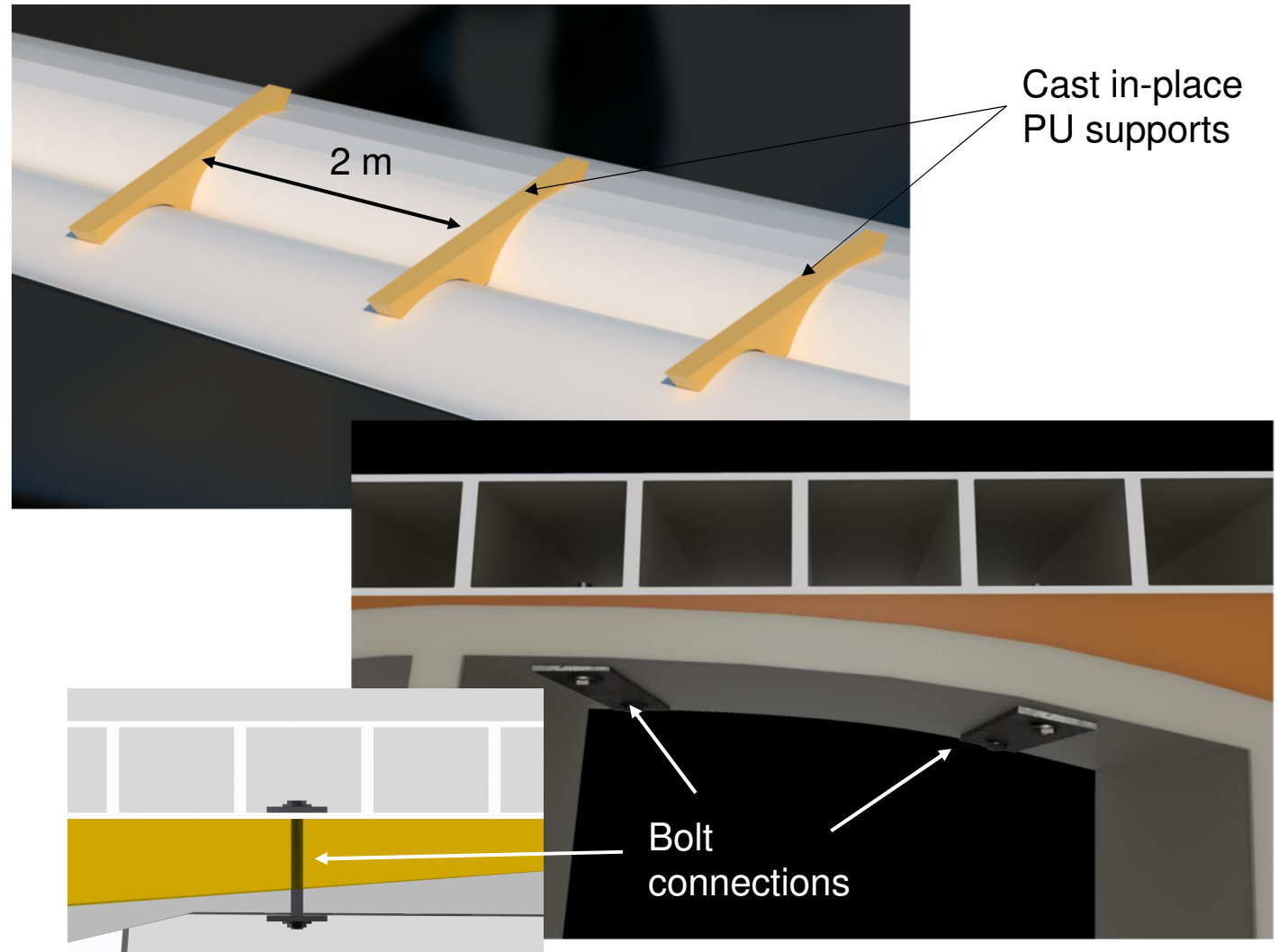
- Polyurethane
- Bolts

### **Railing**

- 1.4 m high

### **Supports**

- Elastomeric bearings



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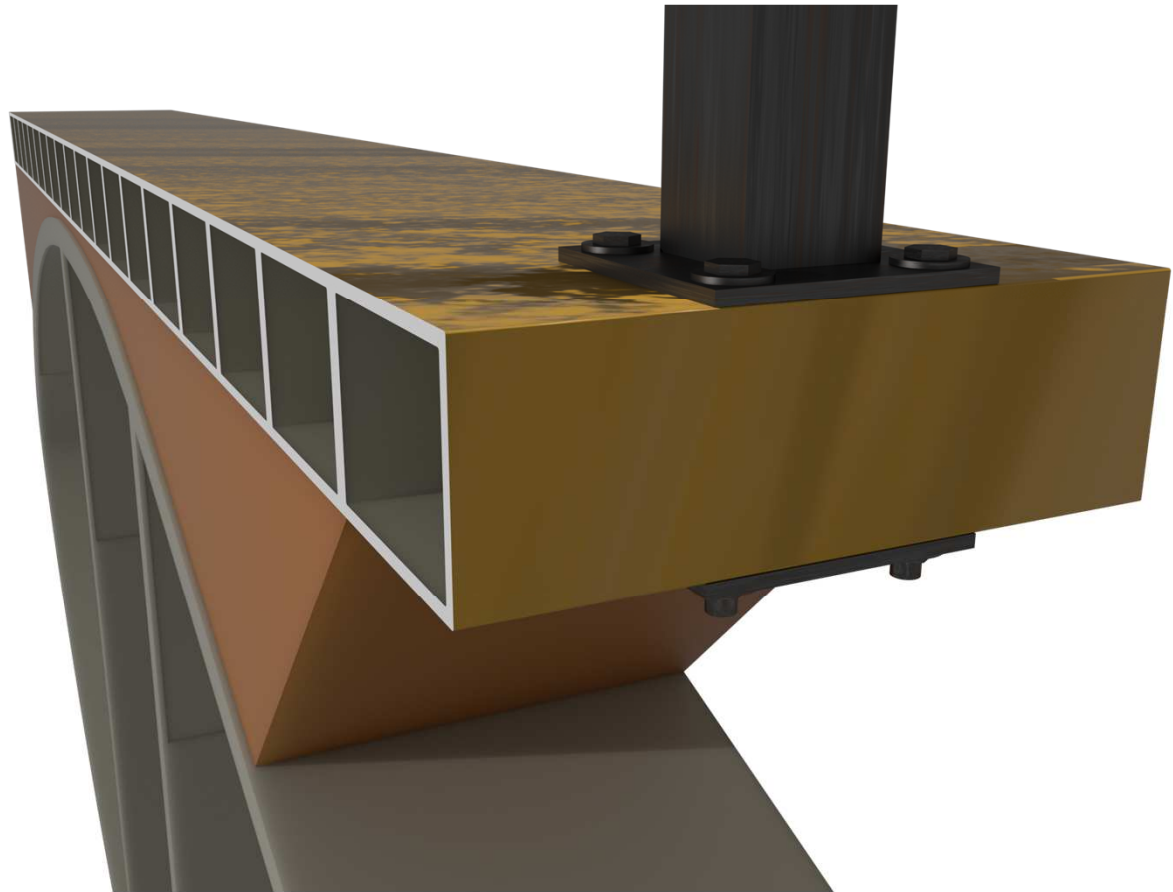
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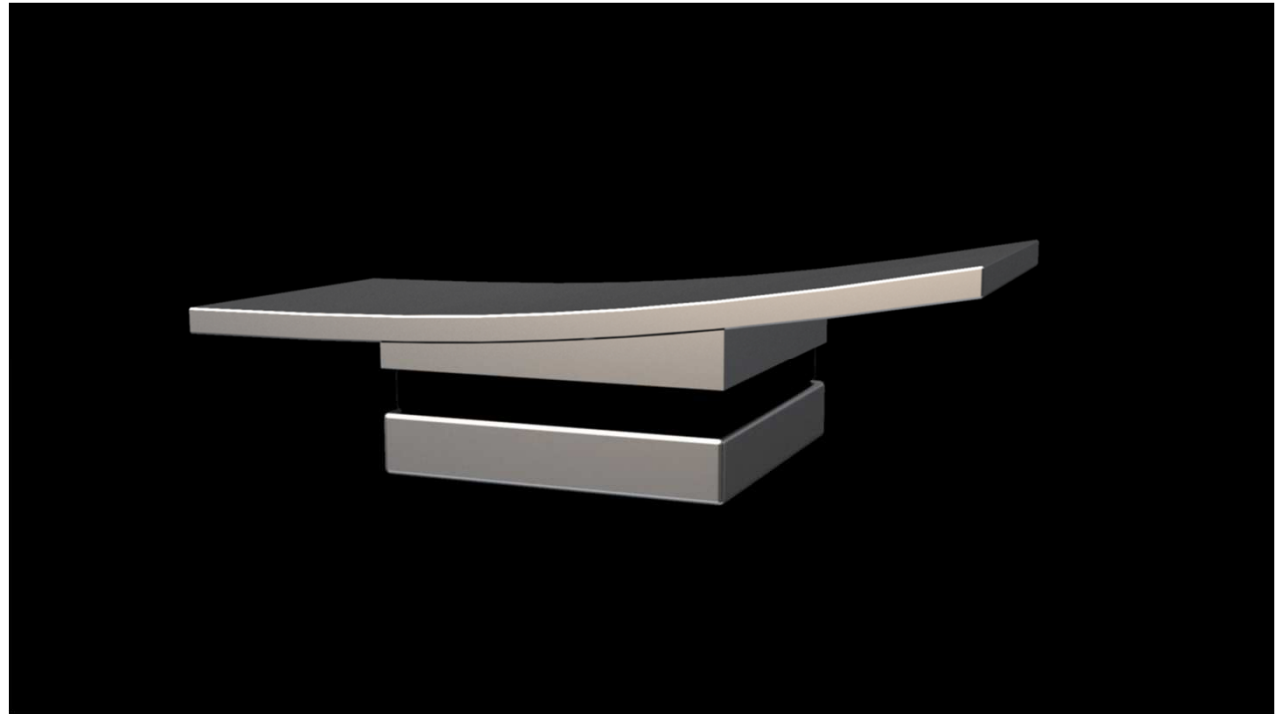
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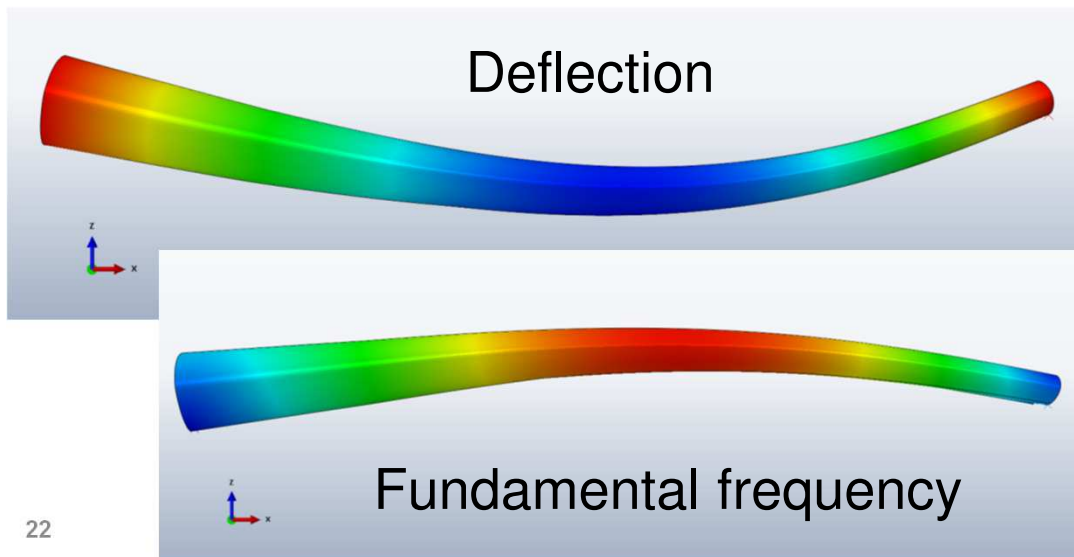
# "Second Life" solution: Our contribution

## Further design – preliminary analysis – Serviceability Limit State SLS

→ 1st choice for the design! However, models not available...

→ Open Source blade model SNL100-00 (100m) used instead

→ Downsizing to match a Vestas V90 (44m) + Sensitivity study



Thickness [%]	Deformation [mm]	$f_1$ [Hz]
25	27.52	3.42
33	18.96	3.50
50	12.77	3.88
	$\leq 50.0$	$\geq 5.0$

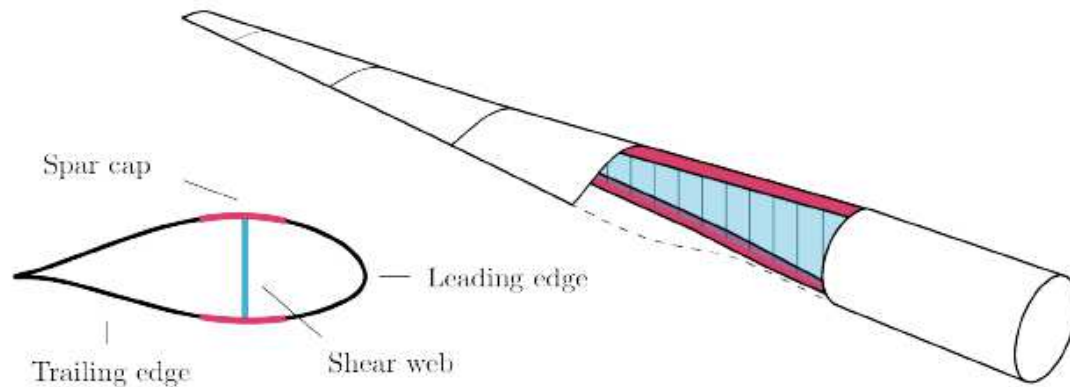


# "Second Life" solution: Our contribution

## Further design –

## **Recent analysis – Work around a real decommissioned blade**

→ Decommissioned NWP28.3 ATV blades, 24.5 m + 3.8 m tip

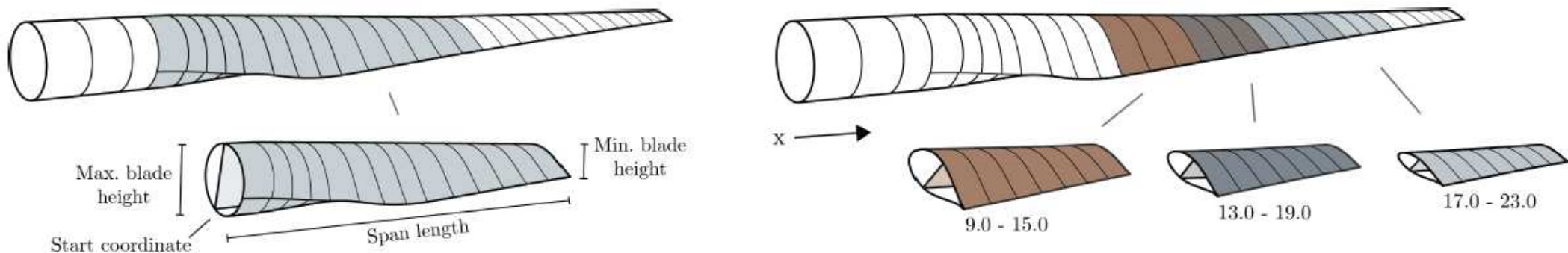




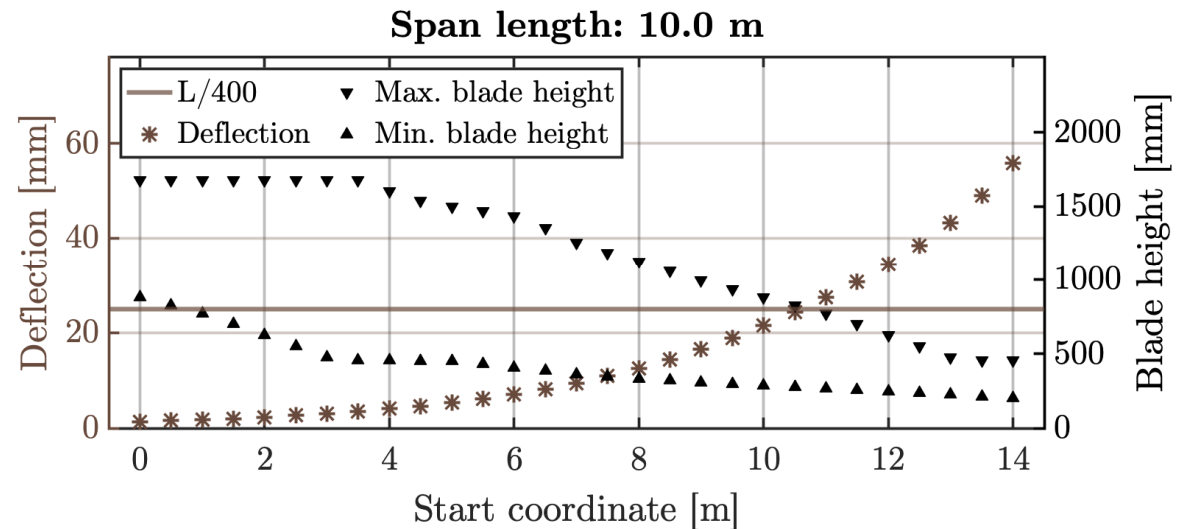
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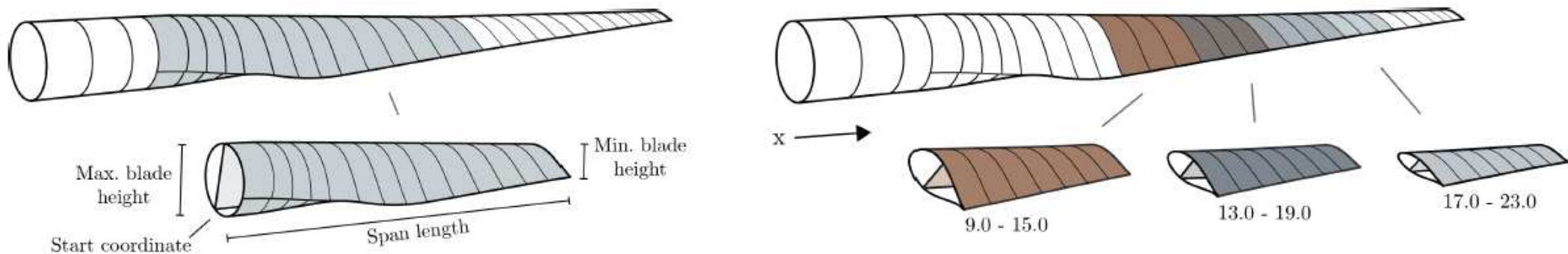
- Numerical models developed.
- Which part would be optimum to cut for a specific span?



# "Second Life" solution: Our contribution

## Further design –

## Recent analysis – Work around a real decommissioned blade



- Numerical models developed.
- Which part would be optimum to cut for a specific span?

Span length	Start coord.	Max. height	Deflection	Acceleration
6.0 m	18.0 m	333.7 mm	✓	✓
8.0 m	14.5 m	452.0 mm	✓	✓
10.0 m	9.0 m	993.8 mm	✓	✓
12.0 m	5.2 m	1485.0 mm	✓	✓
14.0 m	1.75 m	1675.0 mm	✓	✓
16.0 m	1.6 m	1675.0 mm	✓	✗
20.0 m	-	1675.0 mm	✗	✗

# Conclusion and future work

## **Our work and conclusions:**

- Preliminary design of a pedestrian bridge made of decommissioned wind turbine blades.
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- Regulation in place for FRP bridges and quality assessment of the blades
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## **Waste management**

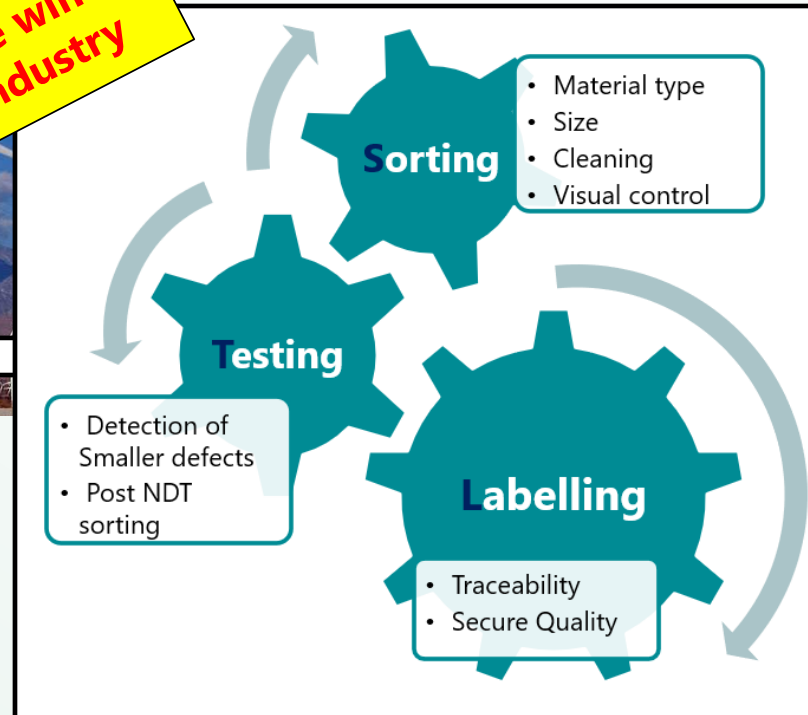
- Only postponed during the lifespan of the new bridge.
- Cost-efficient method to recycle the material is still needed.

## Tomorrows Infrastructure: SCCS Certified



The “wind forest”

Case study:  
the wind  
industry



Robust quality processes  
Circularity enabler

Sustainable,  
Circular,  
Cost efficient,  
Smart

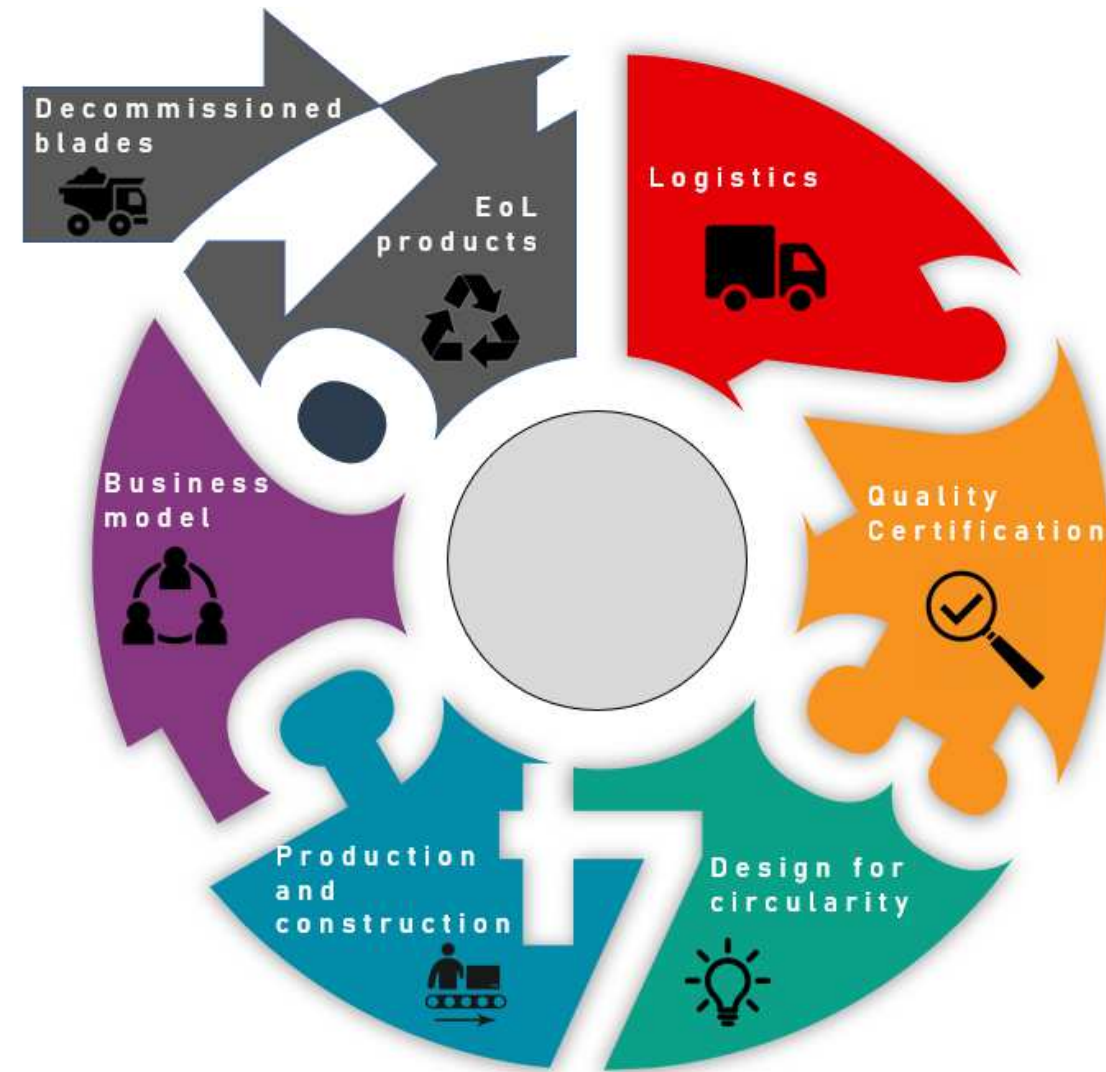


Blade2Bridge concept  
RISE/CHALMERS/SWECO, 2020

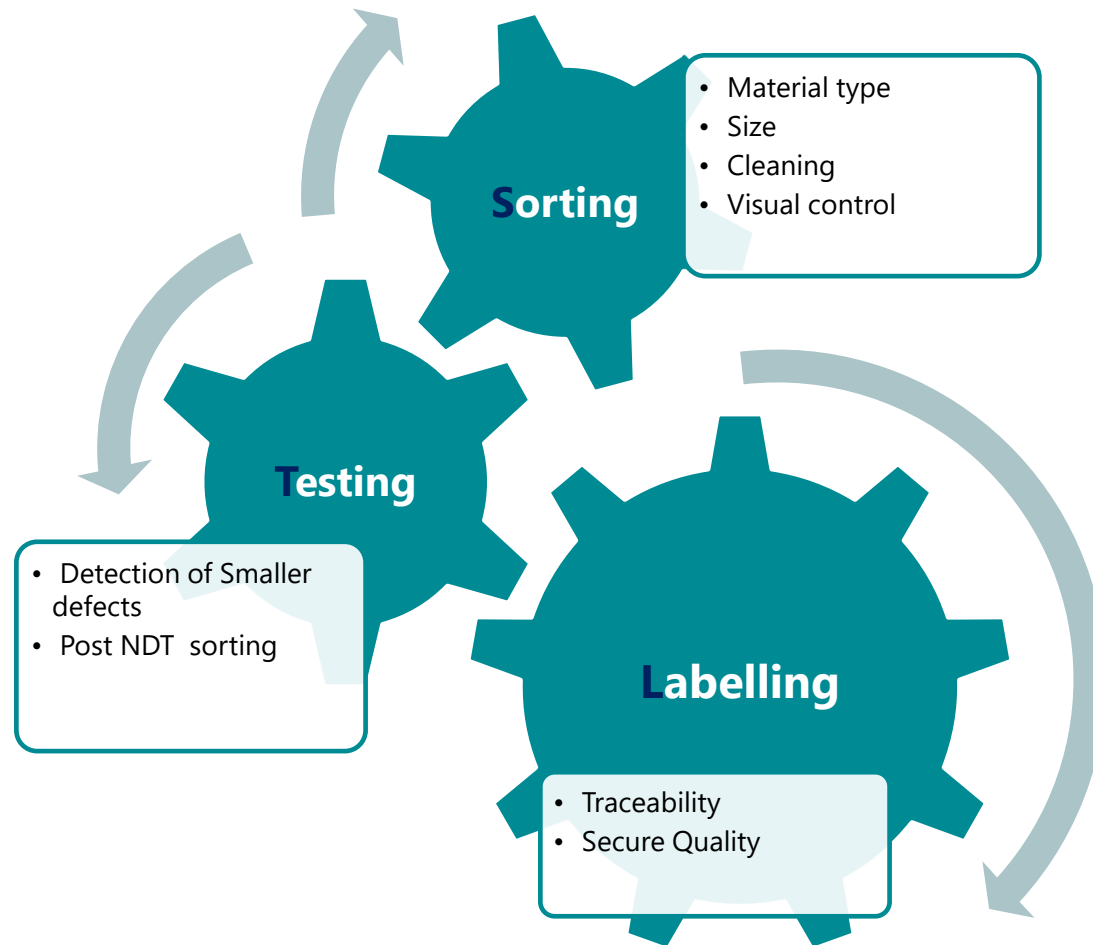
The next generation  
infrastructure

# The Challenge:

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# The Requirements:



***"A robust quality control and a adapted manufacturing process"***



# Thank you!

Alann André  
alann.andre@ri.se  
+46 10 228 49 74

**ReComp**

*Creating circular streams  
from GFRP composite waste*

**VINNOVA**  
Sweden's Innovation Agency

**RI  
SE**

**Alann André**  
Cecilia Mattsson  
Magdalena Juntikka

**SWECO** 

**Georgi Nedev**  
David Nygren



**Reza Haghani**  
Johanna Kullberg  
Johan Dahlén  
Christoffer Härnborg

**RI  
SE**





## CONTACTS

Alann André

[alann.andre@ri.se](mailto:alann.andre@ri.se)

+46 10 228 49 74

RISE Research Institutes of Sweden  
**Materials and Production**

