modvion™

MODULAR WOODEN TOWERS FOR TALL WIND TURBINES

This project has received funding from the European Union's Horizon 2020 research and innovation program.

Swedish Energy Agency

VATTENFALL

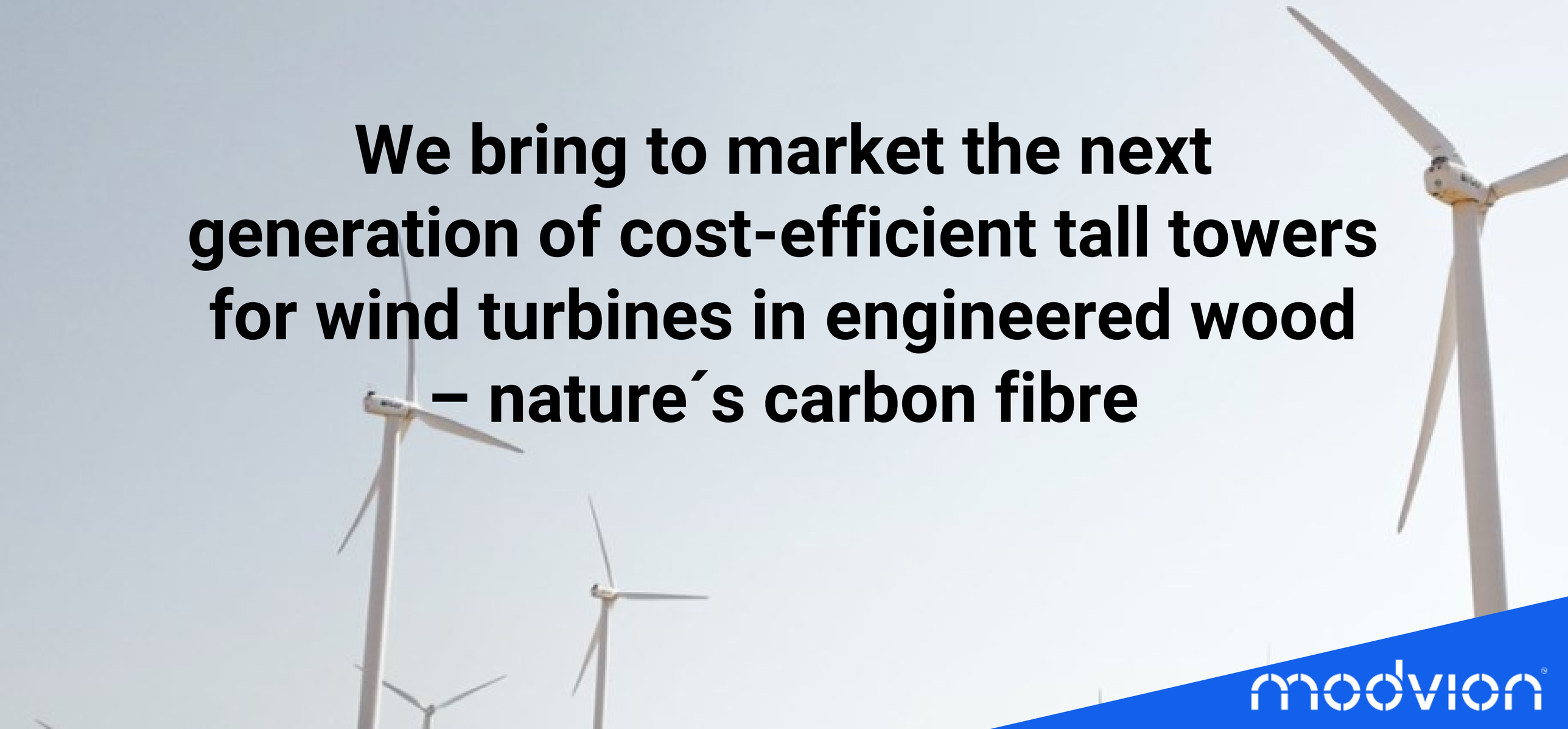
Vestas

enel

Our purpose

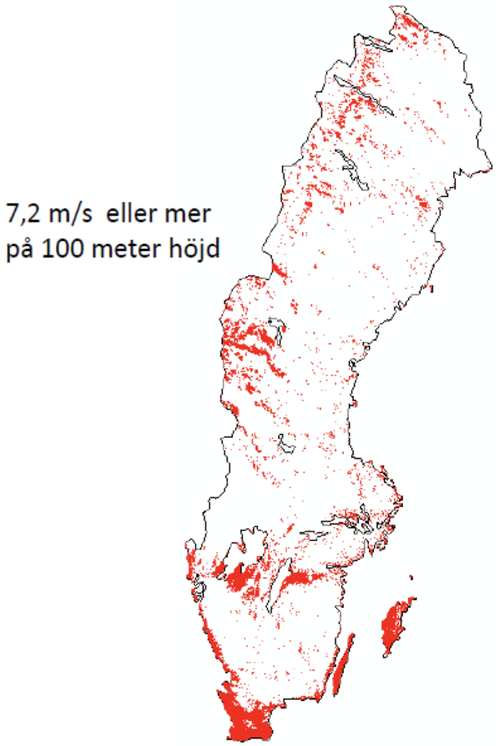
TO ACCELERATE THE TRANSITION TO RENEWABLE ENERGY & MATERIALS

We bring to market the next generation of cost-efficient tall towers for wind turbines in engineered wood – nature´s carbon fibre

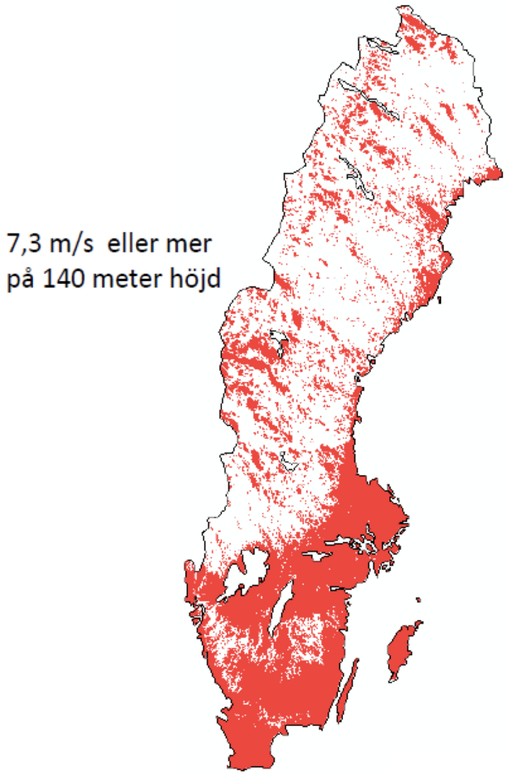


DEMAND FOR HIGHER WIND TURBINES

Promising wind power sites in Sweden at **100m** altitude.



Promising wind power sites in Sweden at **140m** altitude.



Swedish national television:
Wind power plants will become 250 m tall and 50% more efficient than today's generation

Source: Swedish Energy Agency 2019

Global market opportunity

WIND 35% OF GLOBAL ELECTRICITY 2050 ENABLED BY TALL TOWERS

2018 Global onshore wind: 560GW

2025 Sweden's 2nd electricity source

2027 Europe's largest electricity source

2050 Global onshore wind: 5 044GW
(IRENA 2019)

Power plants to reach 5 044GW:	2.2M	1.1M	750k	370k

IRENA
International Renewable Energy Agency

https://www.irena.org/publications/2019/Oct/Future-of-wind

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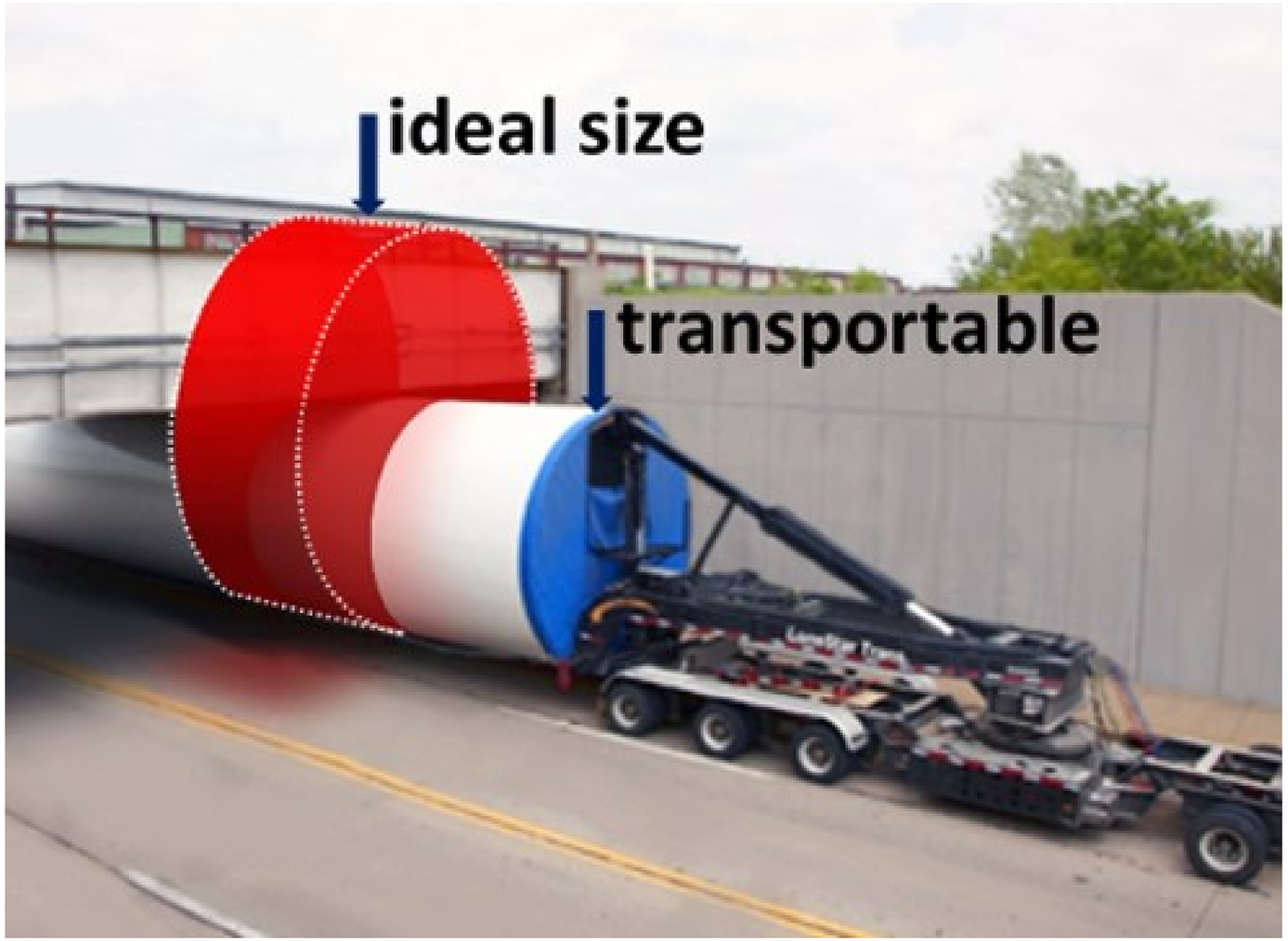
The problem

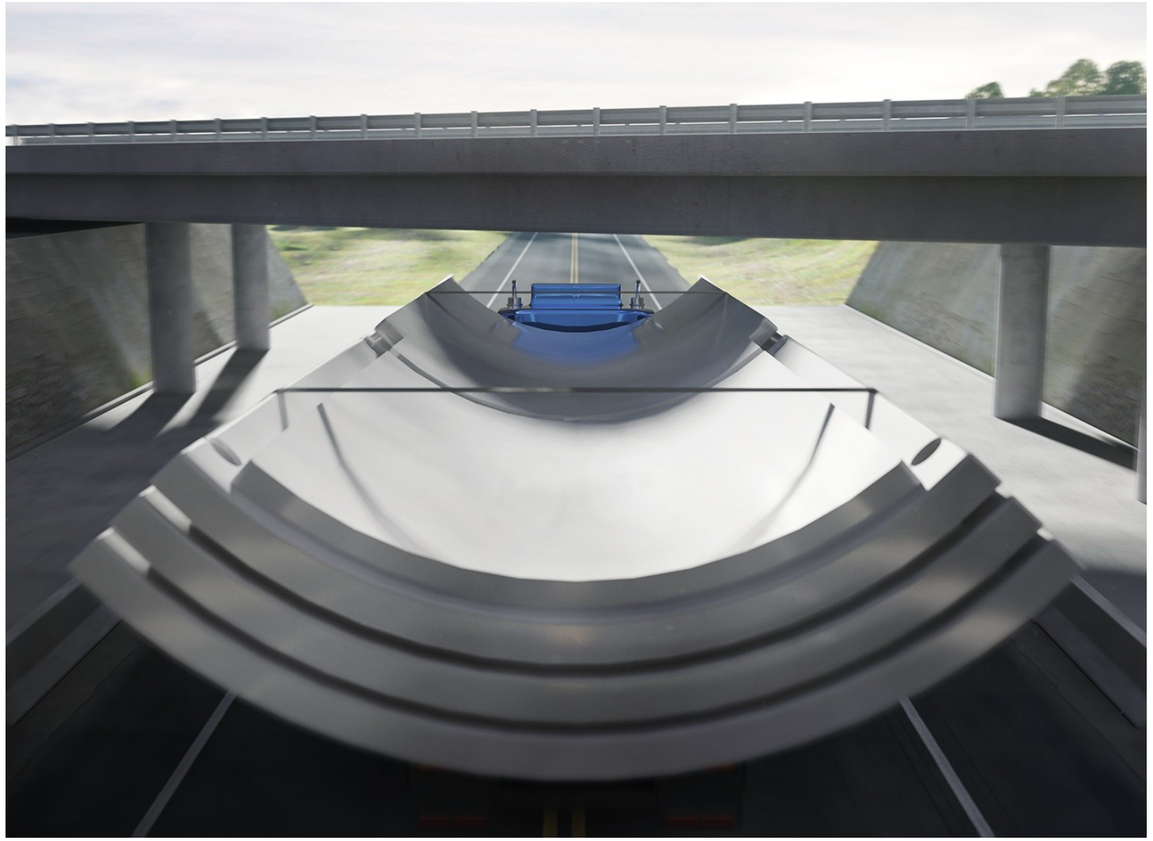
CONVENTIONAL TOWERS LIMIT GROWTH OF WIND ENERGY



- Today’s towers difficult to transport over 100m
- Market wants >150m
- Wind turbines grow, roads don’t

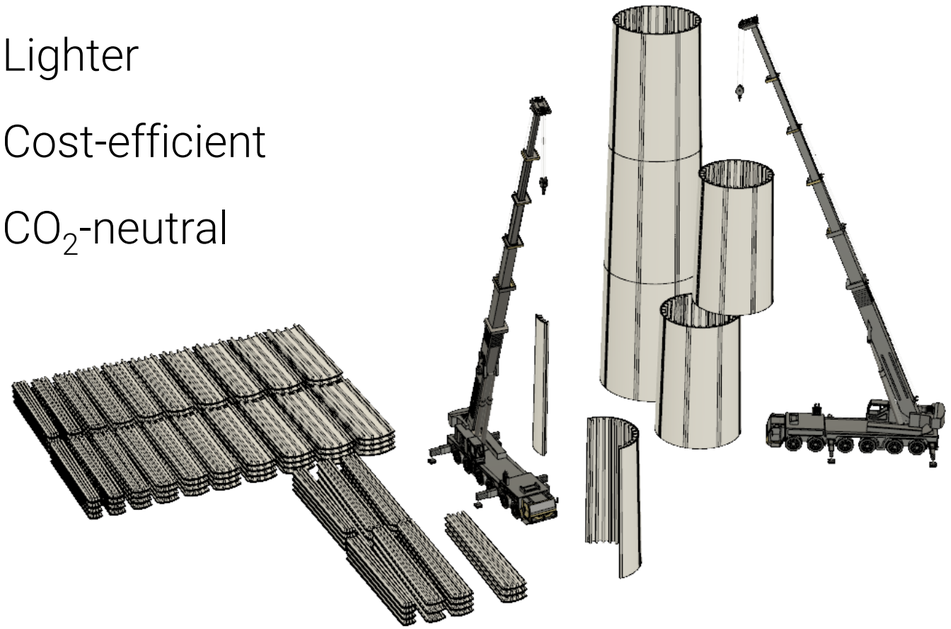
The solution

COST-EFFICIENT TALL TOWERS TO WIND TURBINE OEM’s



We offer:
TALL MODULAR TOWERS IN ENGINEERED WOOD

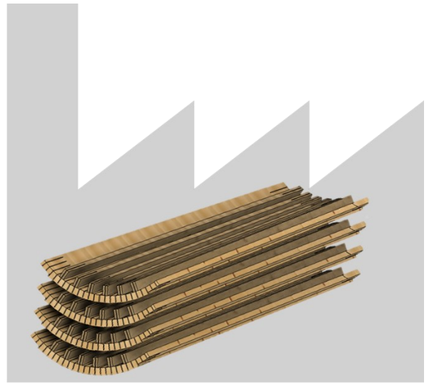
- ✓ Transportable
- ✓ Lighter
- ✓ Cost-efficient
- ✓ CO_2-neutral



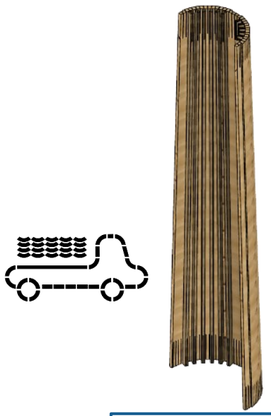
Innovation

NOVEL APPLICATION FOR NATURE'S CARBON FIBRE

- ✓ Load carrying shell structure in LVL wood
- ✓ Technology validation – 30-meter tower built spring 2020
- ✓ Strong IP protection – 1 patent & 7 patents pending
- ✓ Design basis assessment by TÜV SÜD

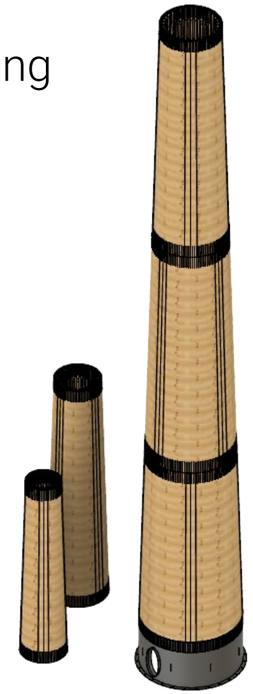


Modules
24x4m 10t

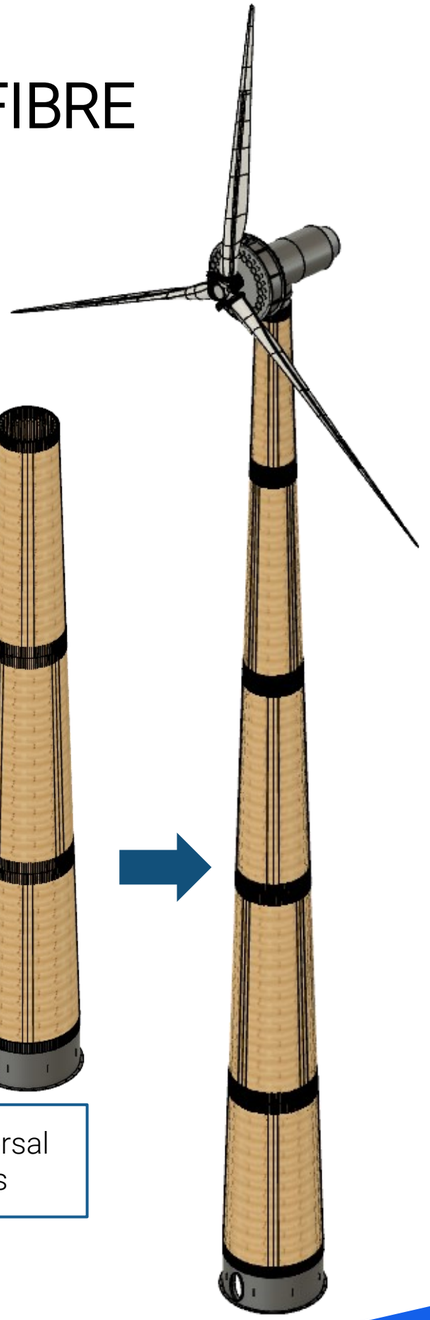


Longitudinal joints

Section
24x9m 60t



Transversal joints



STEEL VS LVL WOOD

SAME VOLUME

10N 1N

Steel 10x stronger

SAME STRENGTH

Wood 35% less weight
& 70% lower cost

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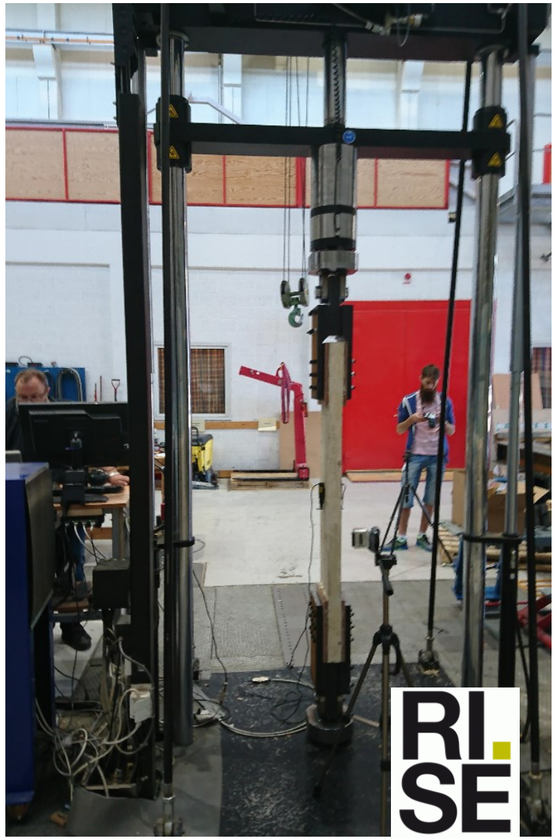
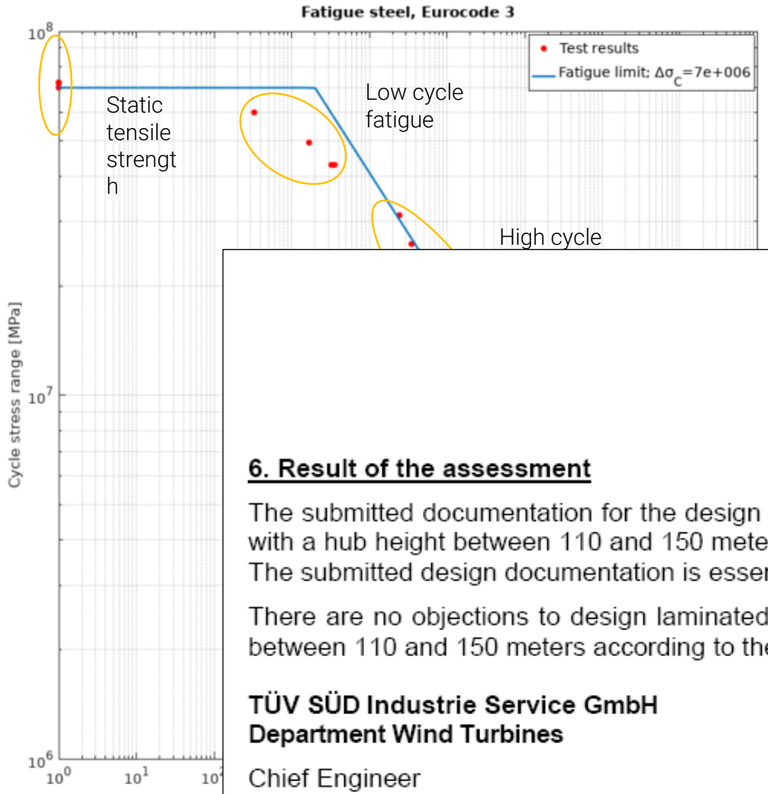
LVL MATERIAL

Current status

CERTIFICATION WITH TÜV SÜD – DESIGN BASIS ASSESSMENT ACHIEVED



Test of joint section for 150 m tower.



Industrie Service

6. Result of the assessment

The submitted documentation for the design basis for laminated wooden towers for wind turbines with a hub height between 110 and 150 meters meets the requirements of the standards /1/ to /3/. The submitted design documentation is essentially complete and correct.

There are no objections to design laminated wooden towers for wind turbines with a hub height between 110 and 150 meters according to the submitted documentation.

TÜV SÜD Industrie Service GmbH
Department Wind Turbines

Chief Engineer — S. Mayer

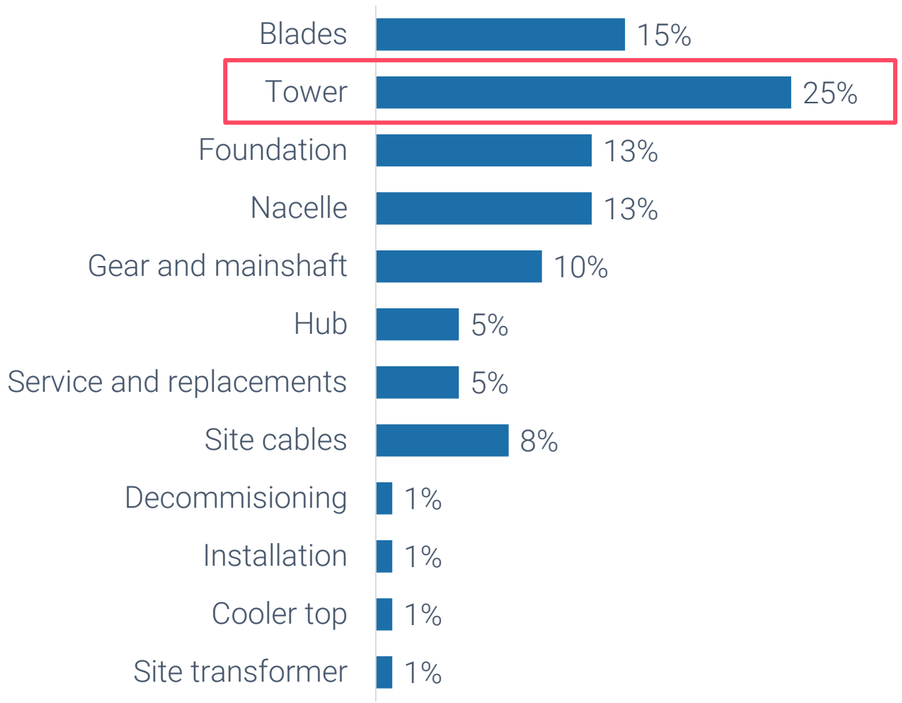
Expert Engineer — A. Felten

Design Basis Assessment is the first step towards the Component Certificate we will achieve with the first commercial tower installed in 2022.

Innovation

RADICAL CLIMATE IMPACT

Today's lifecycle wind turbine CO2 emissions



Producing Modvion's tower requires **90% less** CO2-emissions than a traditional steel tower of the same height. (RISE/Modvion)

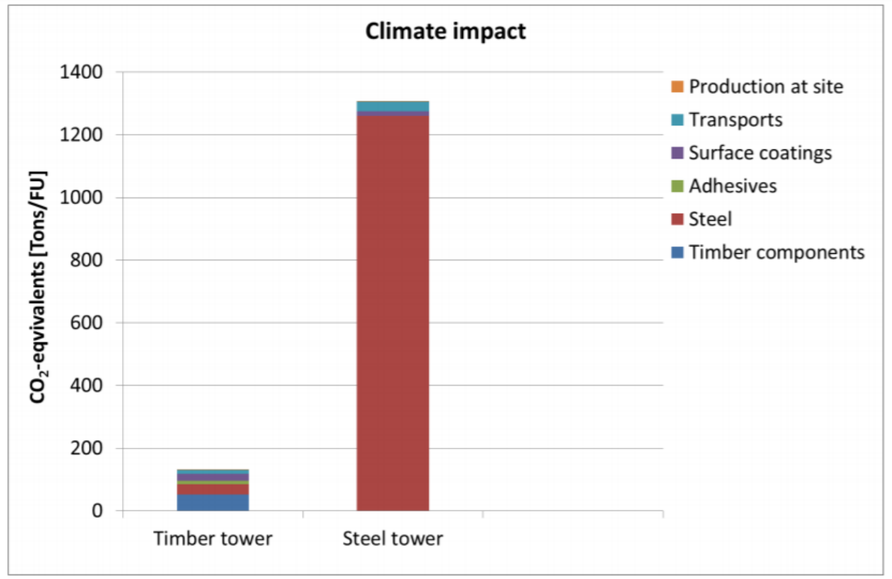


Figure 4. Climate impact for the product stage A1-3 and construction process stage A4-A5

On top of this, the **CO2 sequestration in wood** makes Modvion towers **carbon dioxide sinks**. (https://www.traguiden.se/om-tra/miljo/miljoeffekter/miljoeffekter/traprodukter-lagrar-kol/)

Ref: Bloomberg/Vestas
https://www.bloomberg.com/news/articles/2020-01-20/vestas-takes-most-radical-step-yet-toward-zero-turbine-waste?sref=tjWMZQal

RAW MATERIAL

LVL sourcing

Table 1.3. Global LVL production. Active manufacturers of structural LVL produce about 3.9 million cubic metres per year [4, 5].

Europe			North America			Asia & Oceania		
Manufacturer	**Mills**	**Capacity 1000 m³/year**	**Manufacturer**	**Mills**	**Capacity 1000 m³/year**	**Manufacturer**	**Mills**	**Capacity 1000 m³/year**
Metsä Wood	2	300	Boise Cascade	3	890	JNL	2	140
Steico	1	160	Weyerhaeuser	4	530	Carter Holt Harvey	1	100
Stora Enso	1	100	Lousiana Pacific	2	260	Nelson Pine	1	100
MLT	1	100	Pacific Woodtech	1	220	First plywood	1	100
Pollmeier	1	80	Roseburg	1	200	Wesbeam	1	60
LVL Ugra	1	40	Forex Amos Inc.	1	140	Keyteck	1	60
			Murphy	1	120	Shin Yang	1	20
			West Fraser	1	90			
			RedBuilt	1	70			
			Global LVL	1	20			
Total	**7**	**780**		**16**	**2540**		**8**	**580**

- Ample wood supply around the globe
- The Nordic forests alone could supply the world tower market with wood
- LVL production under ramp up
- Technology well spread globaly

LVL handbook Europe - https://www.metsawood.com/global/tools/materialarchive/materialarchive/lvl-handbook.pdf

First Installation

1 YEAR,
28 M/S WINDS AND
SWEDISH ARCHIPELAGO WINTER

Installation of our first tower on Björkö
outside Gothenburg spring 2020

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The innovation in short

THE NEXT GENERATION OF WIND POWER TOWERS

The problem

Low towers → low revenues
Taller power plants access better winds and can use larger turbines

Impossible logistics
Towers over 100 m are difficult to transport – the market want at least 150 m

Heavy tower constructions
Steel is strong but heavy. Tall steel towers are over-dimensioned to carry its own weight.

Expensive tall towers
The tower account for over 16% of cost of energy – forces developers to build lower

CO_2-intensive materials
Steel and concrete causes 12% of global CO_2-emissions (IEA 2018)

Our solution

High towers → high revenues
Better winds and larger turbines with taller towers gives more energy at lower cost

Simple logistics
Use standard road transports and enable construction at sites with limited access.

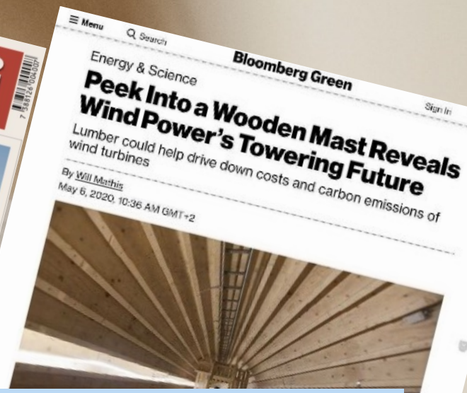
Reduced weight
LVL 55% stronger than steel per kg – reducing tower weight by 30%

Lower cost of energy
Lower tower cost compared to steel towers

Enhanced sustainability
Modvion avoids 2000 tCO_2 per 150 m tower

MODVION CURRENT POSITION

- Patented, demonstrated technology
- Proven world-class team
- Great market potential
- Customers ready to buy



2022
1ST COMMERCIAL TOWER

VARBERG ENERGI

Varberg 10 juni 2019

Avsiktsförklaring

Detta brev intygar att Varberg Energi har intentionen att stödja projektet Wind of Change genom att köpa demonstrationsvindkraftverket som byggs i projektet och stå för försäljningen av den elektricitet som produceras med kraftverket. En förutsättning är att projektet kan uppvisa en rimlig avkastning så att nedskrivningar av värdet undviks.

✓ LOI signed

2023 onwards
A 5000 MW pipeline

We believe that engineered wood materials and modular tower designs can have significant market applications in wind power. This could possibly be one enabler for our transition to a more sustainable energy system through growth in renewable production and climate smart energy solutions for our customers.

Yours sincerely,

Sandra Grauers Nilsson,
Vice President of Onshore Wind
Vattenfall Vindkraft AB

VATTENFALL

✓ LOI signed

✓ Collaboration with enel

✓ LOIs with several wind developers

2024 onwards
1st TIER SUPPLIER TO OEM

Vestas

08:00 - 18 Feb 2021

Vestas Ventures invests in wood technology start-up Modvion, to create sustainable products and low-carbon value chain

News release from
Vestas Wind Systems A/S

Aarhus, 18 February 2021

✓ Minority stake – no exclusivity

Discussions ongoing...

Discussions ongoing...

THE WORLD'S MOST CLIMATE FRIENDLY POWER

modvion

A Challenge

PRODUCTION RAMP-UP