

Beyond expectations

CEPI Two Team Project

**BREAKTHROUGH TECHNOLOGIES FOR
THE FUTURE OF PAPER INDUSTRY**

Marco Mensink, Direktor CEPI –
Evropsko združenje proizvajalcev papirja



Breaking through to 2050

With our 2050 Roadmap to a low-carbon bio-economy, we outlined how the forest fibre industry is uniquely placed to contribute to a resource-efficient world.

Consumer trends, industrial integration and the impact of policymakers were all discussed. But the fact remained; breakthrough technologies are required in order to be future fit.

This is why we launched the Two Team Project. To generate and develop new ideas together with an element of competition.

So join us as we unfold the future. Take a glimpse of how the pulp and paper industry will look in 2050...

First we made the roadmap



- 80 %
CO₂

+ 50%
value

...It showed the way to the forest fibre sector
The Bioeconomy

We learned

In our technology assessment, the CO₂ reduction pathway to 2050 depends on

breakthrough technologies.

This is two investment cycles, or a maximum of two paper machines or boilers away. Breakthrough technologies have to become

**available
by 2030**

to be on time for 2050.



We started a competition



With great, but very different minds



They met in new inspiring places

Atomium in Brussels



Lenzing in Austria



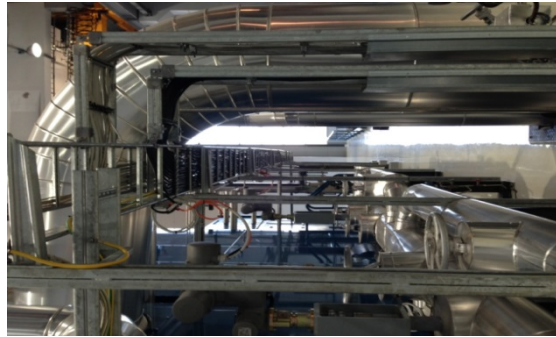
Tata in Holland



Repsol in Madrid



Fortum in Helsinki



BASF in Ludwigshafen



Finding inspiration “out of the box”



Textile



Food



**Non
woven**



Steel



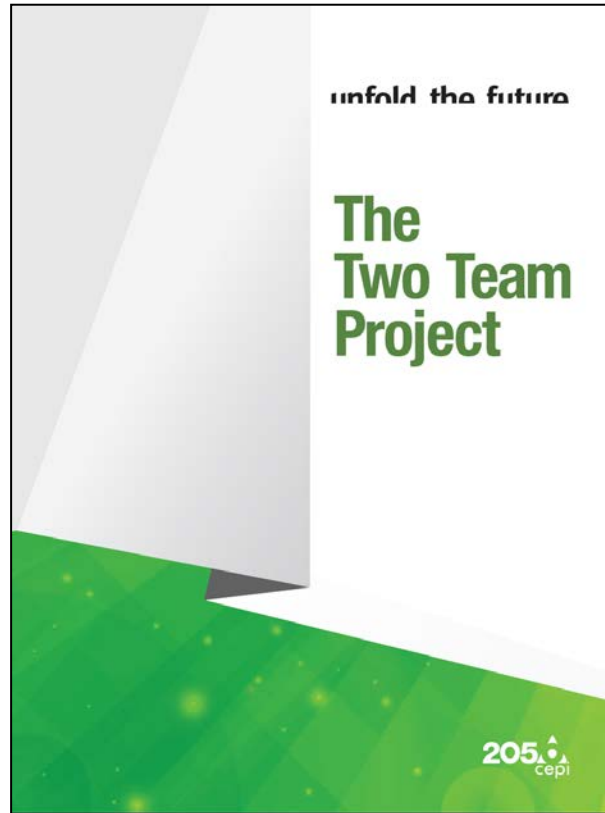
Nature



Others

The teams performed

Beyond Expectations



205
cepi

Eight concepts

Deep Eutectic Solvents **WINNER**


A ground-breaking discovery: Deep Eutectic Solvents (DES), produced by plants, open the way to produce pulp at low temperatures and at atmospheric pressure. Using DES, any type of biomass could be dissolved into lignin, cellulose and hemicellulose with minimal energy, emissions and residues. They could also be used to recover cellulose from waste and dissolve ink residues in recovered paper.



p16

Flash condensing with Steam **FINALIST**

Waterless paper production? Very nearly. Largely dry fibres would be blasted into a forming zone with agitated steam and condensed into a web using one-thousandth the volume of water used today.



p18

Supercritical CO₂ **FINALIST**

Neither gas nor liquid but somewhere in between, Supercritical CO₂ (scCO₂) is widely used in many applications, to dry vegetable, fruits and flowers, extract essential oils or spices. Suppliers for NIKE, Adidas and IKEA use it to dye textile. Coffee and tea have been decaffeinated with scCO₂ since the early 80s. We could use it to dry pulp and paper without the need for heat and steam, and why not dye paper or remove contaminants too, while we're at it?



p34

100% electricity **FINALIST**

Shifting pulp and paper production to energy-efficient technologies using electricity rather than fossil fuel power to generate heat will cut all CO₂ emissions as the power sector shifts to renewable energy. The sector would also provide a buffer and storage capacity for the grid, storing energy as hydrogen or pulp.



p28

Steam **FINALIST**

Using more energy to use less? You read it right. Using the full power of pure steam for superheated steam drying would save energy as most heat could be recovered and recycled. Steam will then be used as fibre carrier for making and forming paper.



p20

DryPulp for cure-formed paper **FINALIST**

Imagine a papermaking process that uses no water. This is it. Fibres are treated to protect them from shear, and then suspended in a viscous solution at up to 40% concentration. The solution is then pressed out and the thin sheet cured with a choice of additives to deliver the end-product required.



p22

Functional Surface **FINALIST**

The key to unlocking greater added value from fewer resources depends on a shift to producing more lightweight products, and selling surface area and functionality rather than weight. Advances in sheet formation and new cocktails of raw materials will lead the way to the lightweight future.



p28

The Toolbox to replicate **FINALIST**

What about the great ideas that never make it? Put together a combination of process, material and equipment innovations as a toolbox of stepping stones to 2050 and the pathway becomes clearer, boosting sector and investor confidence.



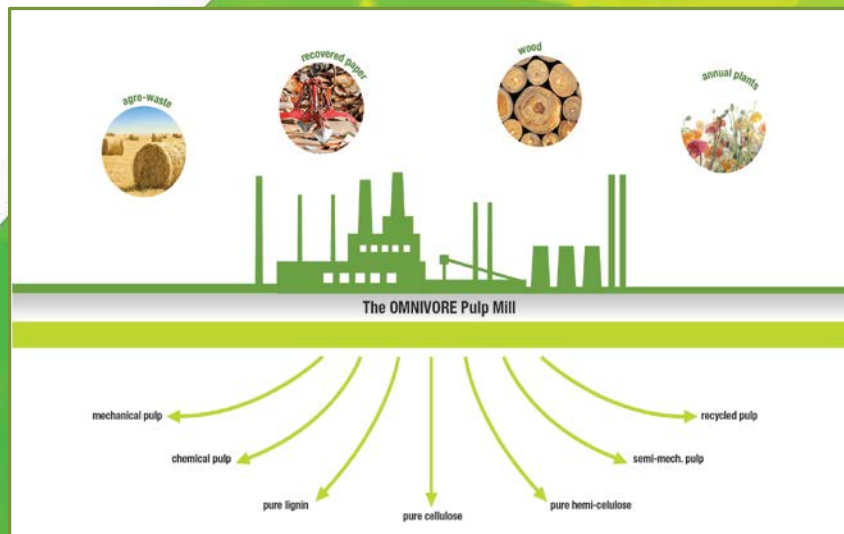
p30

FINALIST

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The CEPI
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CO₂

20%

Energy

40%

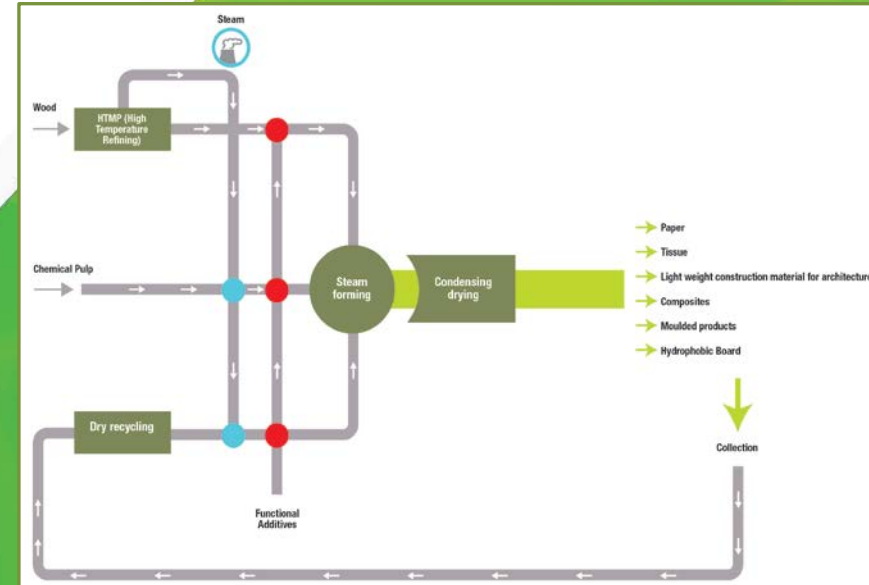


FINALIST

Flash condensing with Steam

Waterless paper production?
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The CEPI
**TWO
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CO₂

50%

Energy

20%

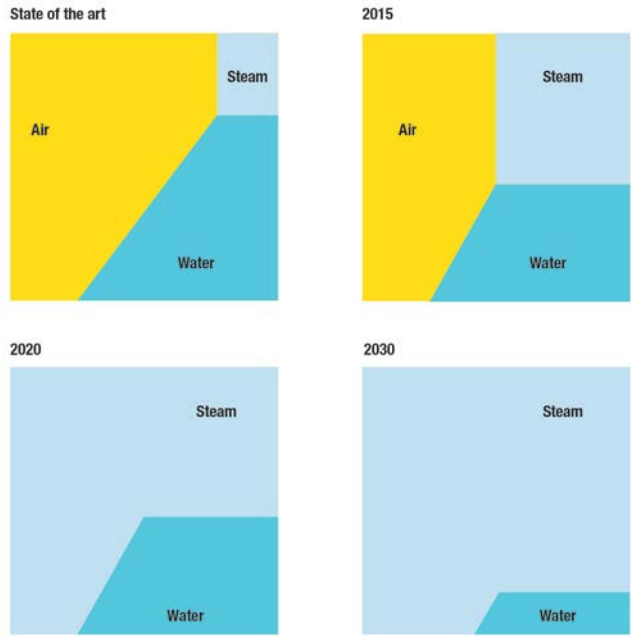


The CEPI
**TWO
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Steam

Using more energy to use less?
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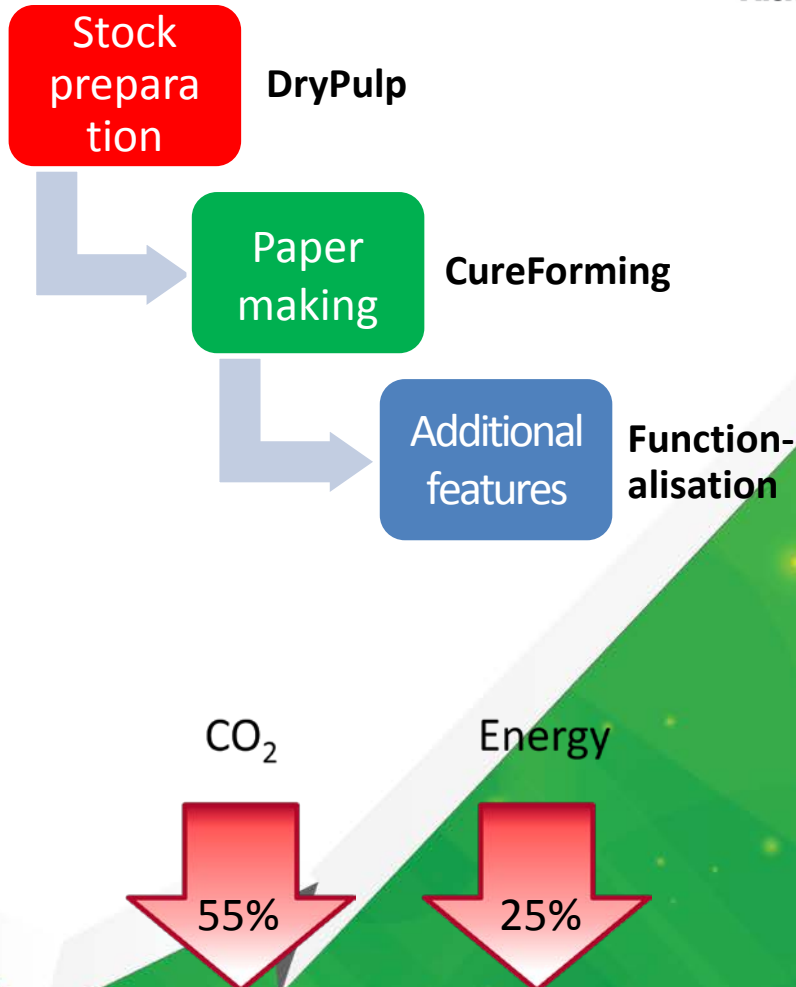


CO₂

Energy

50%

25%



DryPulp for cure-formed paper

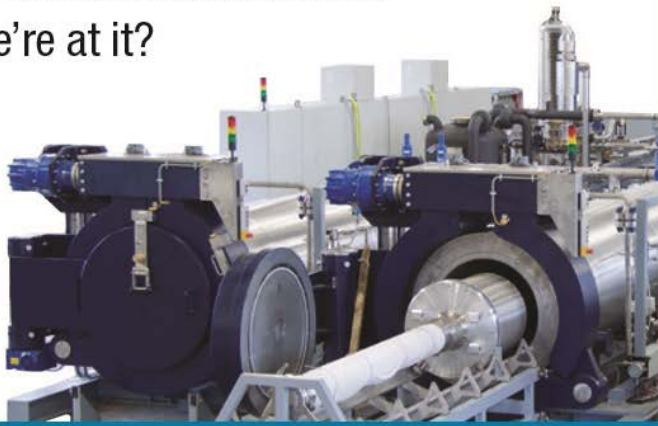
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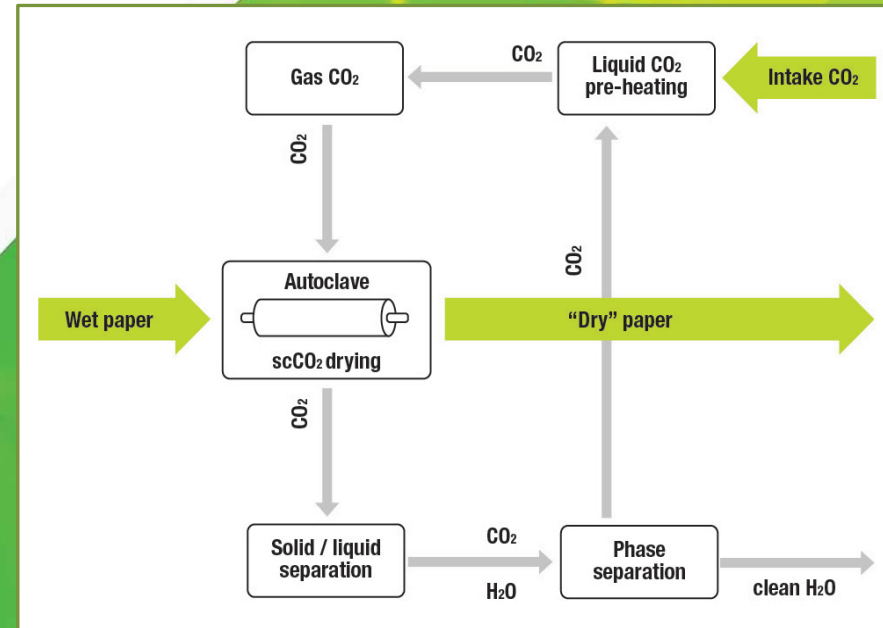
Supercritical CO₂



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CO₂

Energy

45%

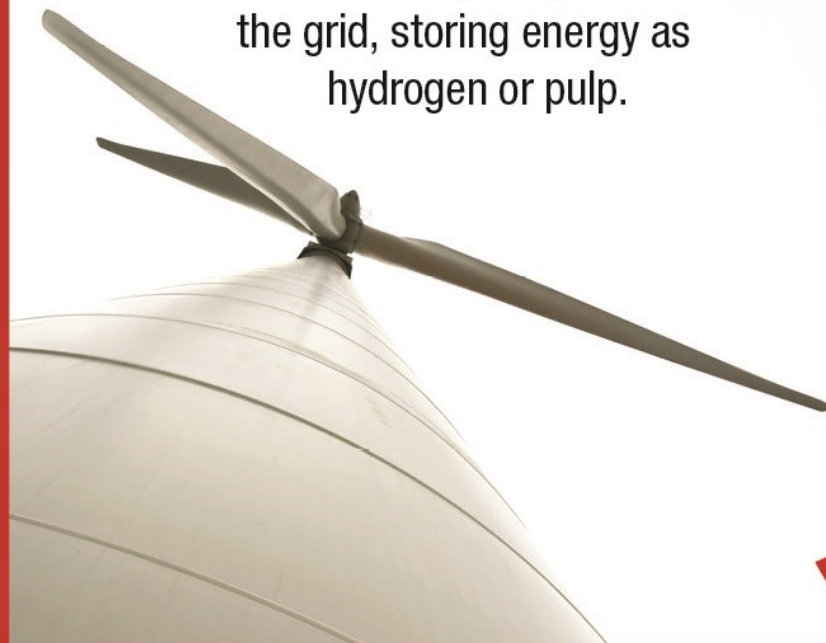
20%

The CEPI
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100% electricity

Shifting pulp and paper production to energy-efficient technologies using electricity rather than fossil fuel power to generate heat will cut all CO₂ emissions as the power sector shifts to renewable energy. The sector would also provide a buffer and storage capacity for the grid, storing energy as hydrogen or pulp.



CO₂

Energy

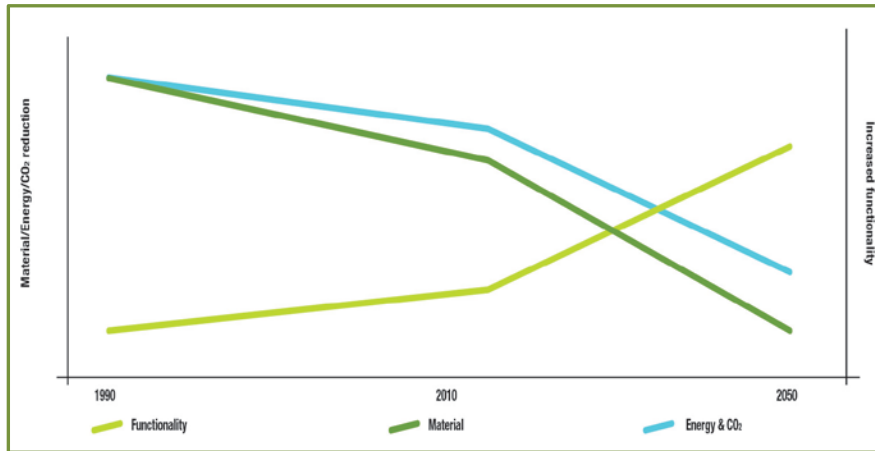
20%

20%



Functional Surface

The key to unlocking greater added value from fewer resources depends on a shift to producing more lightweight products, and selling surface area and functionality rather than weight. Advances in sheet formation and new cocktails of raw materials will lead the way to the lightweight future.



CO₂

Energy





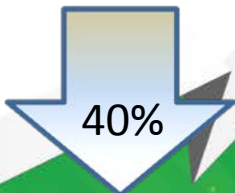
The Toolbox to replicate

What about the great ideas that never make it? Put together a combination of process, material and equipment innovations as a toolbox of stepping stones to 2050 and the pathway becomes clearer, boosting sector and investor confidence.



	Raw Material -Separate	Process	Product - Recombine	Wave	
2025	Pulp 4.0	<ul style="list-style-type: none"> Enzymatic treatment Shear compression Energy efficient thermo-mechanical pulping 	<ul style="list-style-type: none"> Stratification Foam forming Smarter automation 3D-printing 	<ul style="list-style-type: none"> Light weight Sandwich layers Limited customisation at end (paper printability / packaging durability) 	Extreme makeover TRL 6-8
2035	Sophisticated Biomass fractionation into lignin, cellulose and hemicellulose	<ul style="list-style-type: none"> Ultrasonic assisted refining Adsorption deinking New pulping processes 	<ul style="list-style-type: none"> Extrusion 4D-printing Ultrasound dewatering 	<ul style="list-style-type: none"> Thinner layers Manipulation of layers (print/ press/ glue" with biopolymers) Customisation down to part of end products (e.g. treat part surface with sound to obtain patterned functionalities) 	Master Chef TRL 3-6
2050	Biomass separation into molecules	<ul style="list-style-type: none"> Molecular folding 	<ul style="list-style-type: none"> 5D-printing 	<ul style="list-style-type: none"> Recombination at will 	TRL 1-2

CO₂



Energy



But more food for thought

The teams therefore propose that the sector reflects on the way it conducts measurements and statistics **and report in square metres as well as tonnes.**



Thank you!



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