

# Biomass – availability and alternatives for use

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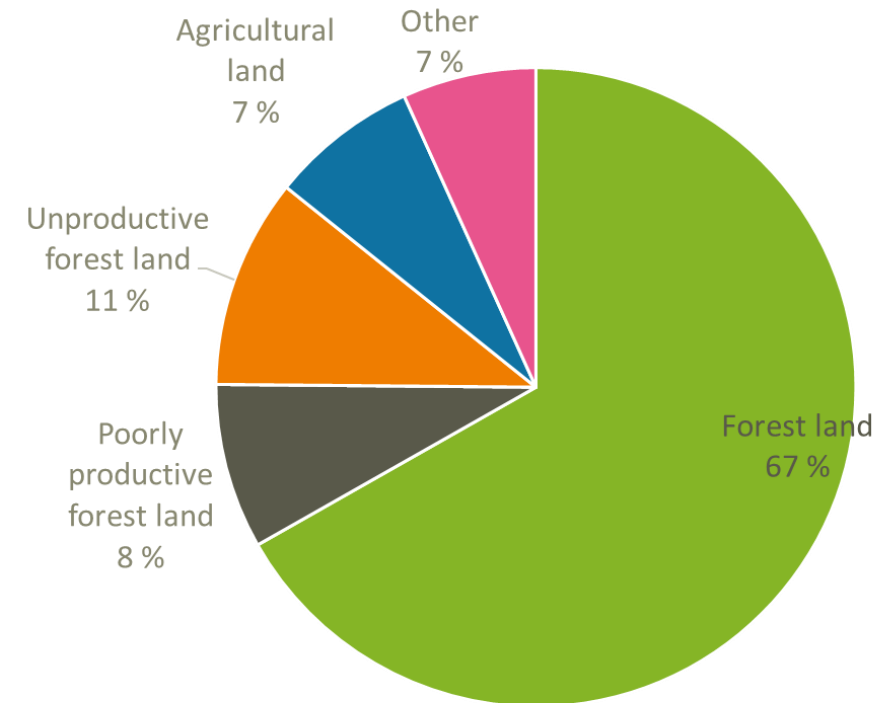
**NORDTEK 2023 – 51st annual meeting and conference**



# WHAT IS BIOMASS?

# Biomass

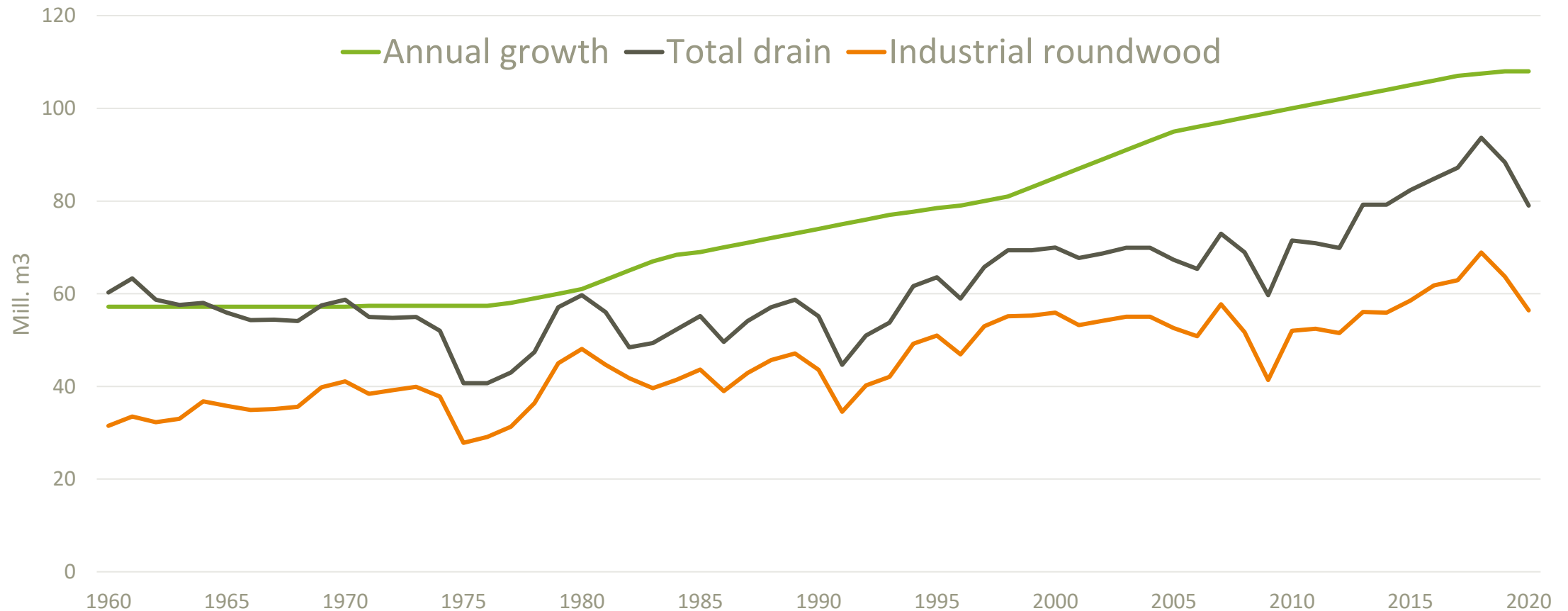
- Wood
  - 75% of Finland is covered with forests (67%+8%)
- Non-wood
  - Grown for energy or material
- Algae
- Forest residues, as branches, roots, stubs, ...
- Agricultural residues as husks, straw,...
- Industrial residues as citrus/apple peel, nut shells, ...
- Household waste



# AVAILABILITY OF BIOMASS (WOOD)



# The growth of Finnish forests is over 100 mill. m<sup>3</sup> per year



Collapse of Finland's  
carbon sinks –  
Less growth of forest  
and increased  
harvesting 2021

## Nya siffror bekräftar kolsänkans kollaps – skogens tillväxt var mindre och avverkningen större 2021

Publicerad 14.12.2022 13:37. Uppdaterad 20.12.2022 14:39.



Finlands klimatmål är beroende av att kolsänkan är stark. Också EU ställer krav på att utsläppen från Finlands markanvändningssektor ska minska.  
Bild: Jakob Lillas / Yle

# How can we restore/keep the carbon sinks?

- By **stop using wood** and **stop all forest harvesting**?
- “Save a tree, use steel”?
- Significantly **less harvesting** will lead to less growth of forests and **less carbon capture**
- Improve growth by e.g., fertilization
- Sustainable forestry needed



■ Kasvaessaan metsä toimii hiilinieluna eli sitoo ilmakehän hiilidioksidia.

■ Metsän kasvun hiivuttua se säilyy hiilivarastona.

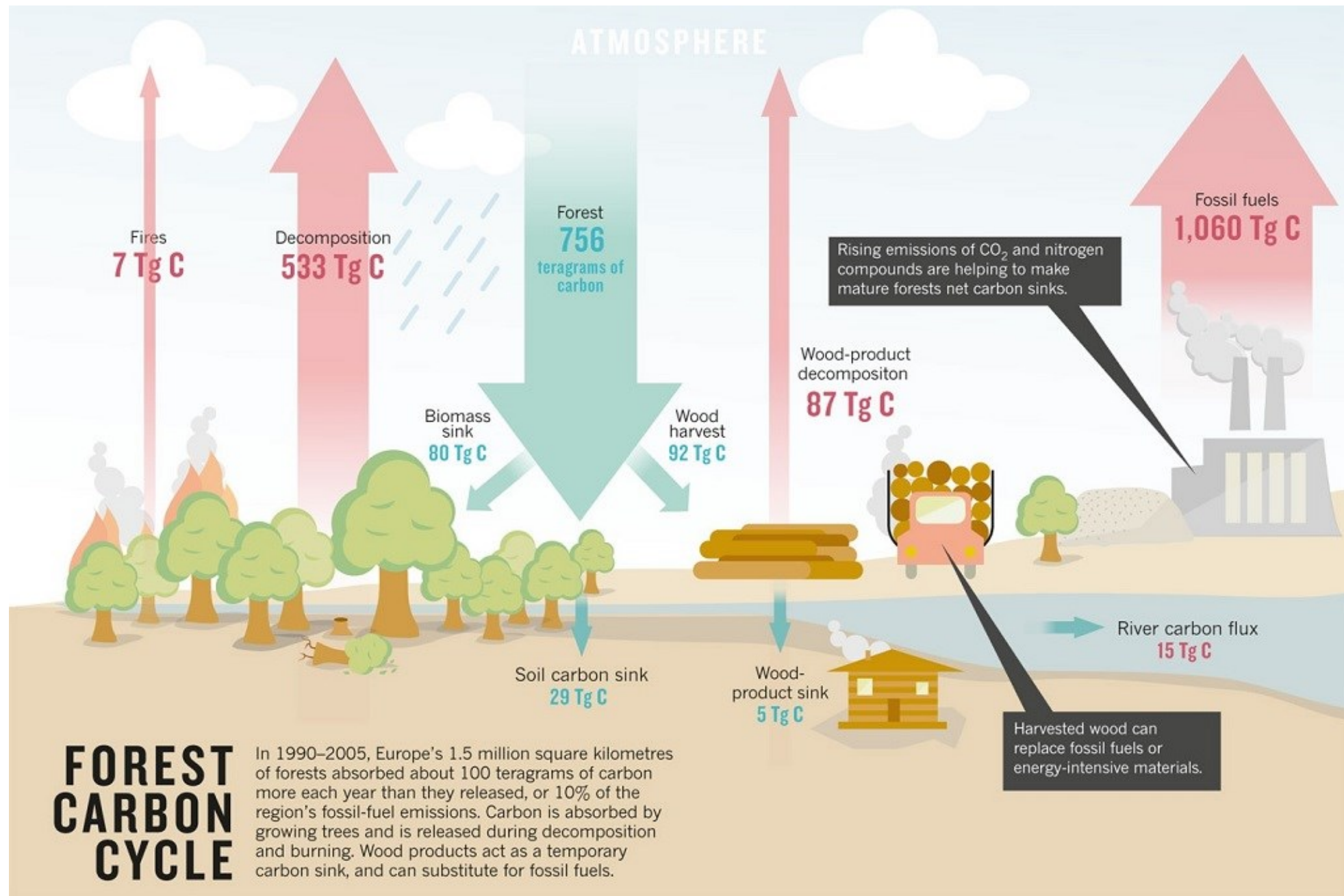
■ Harvennuksissa pyritään parantamaan hyvälaatuisten järeiden puiden kasvua, mutta voimakkaat hakkuut heikentävät hiilinielua.

■ Kestää tyypillisesti noin kymmenen vuotta, ennen kuin metsäekosysteemi kääntyy avohakkuun jälkeen jälleen hiilinieluksi. Aika riippuu puun kasvunopeudesta ja metsän viljavuudesta. Ennen kuin avohakkuun aiheuttamat maaperäpäästöt on kuitattu, kuluu vielä arviolta toinen vuosikymmen.

■ Avohakkuun jälkeen metsän hiilen-sidonta on olematonta, koska pienet taimet eivät sido merkittävästi hiiltä.

The Nordic forests are most effective in carbon capture when it is 30-60 years





Credit: S. Luyssaert et. al., [www.americanforests.org/blog/forests-carbon-sinks/](http://www.americanforests.org/blog/forests-carbon-sinks/)









# Summary - Availability of biomass (wood)

- We should take care of our forests, and use them in a sustainable way
- Many different types of forests needed
  - **Managed forest** to produce renewable material
  - **Old-growth forest** to preserve biodiversity
- We should not harvest more than the growth

# ALTERNATIVES FOR THE USE OF BIOMASS





Textiles



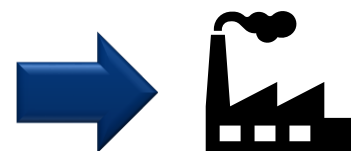
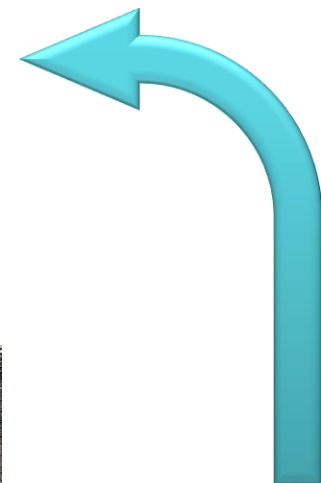
Heat & energy



Paper, board, packages



Sawn goods, ...



Pulp mill



Composites

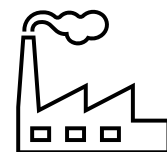
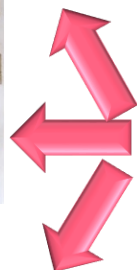


Tall oil products

i-PrOH soluble lignin-PF adhesive



Lignin as resin



Biorefineries



Chemicals,  
pharmaceuticals,  
material

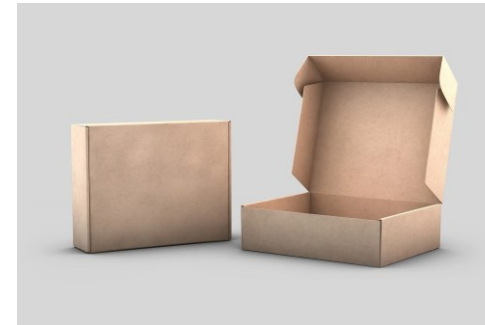
# Fibres – what are they and where are they used?



Softwood fibres



Paper, board and packages

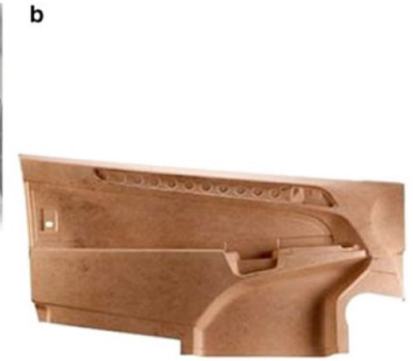


Composites



# Composites

- Fibres and resin
  - Terrasses
  - Car parts (doors, etc.)
  - Others



**Tweet**

The new kitchen utensils cut carbon footprint than plastic cutlery. || #seeit02019  
98% bio-based material. Ph





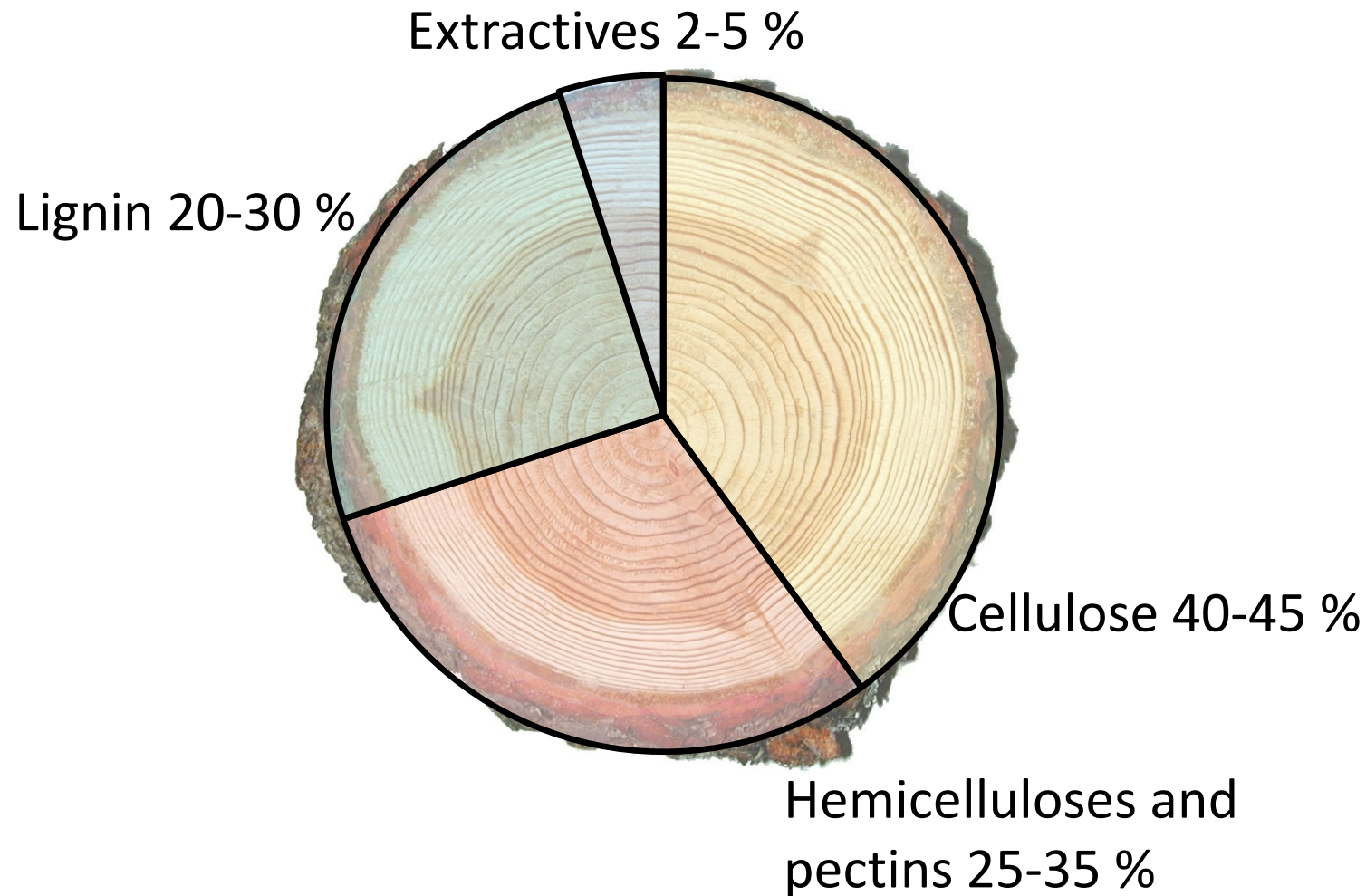
# Novel packages

- Eatable packages
- Barrier properties with renewable additive: as nanocellulose
- Conduction properties
- Smart packages
  - Ripe Sense®: changes colour by reacting with the aroma of the fruit, smart design,...
- Communicative packaging – bar- and QR(Quick Response)-codes



# WOOD COMPONENTS

# Components in wood



Larch

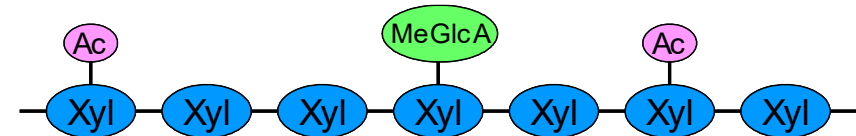
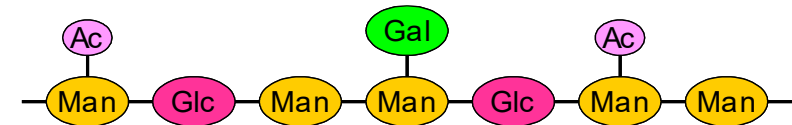
Data from  
PaperSci&Tech

# Polysaccharides – what are they?

Cellulose 40-45 %



Hemicelluloses and  
pectins 25-35 %





# Polysaccharides – where are they used?

## Tencel/lyocell



## Textiles

Viscose, rayon, tencel,...  
(albinigroup.com)



Cellulose derivatives  
Cellulose acetate, CMC,...  
(classicspeccs.com)



Xylitol  
(jenkki.fi)



Bioethanol  
(pixabay)





# Textiles from wood-based sources or reused textiles

- Traditionally: Viscose and Lyocell
- Many Nordic newcomers with improved technology:
  - Tree to textile, <https://treetotextile.com/>
  - Infinited fiber company, <https://infinitedfiber.com/>
  - Renewcell, <https://www.renewcell.com/en/>
  - Others including Spinnova, Ioncell, VTT+TUT (Biocelsol), Fortum (Bio2™ Textile), Metsä Spring (Kuura), Södra (OnceMore)



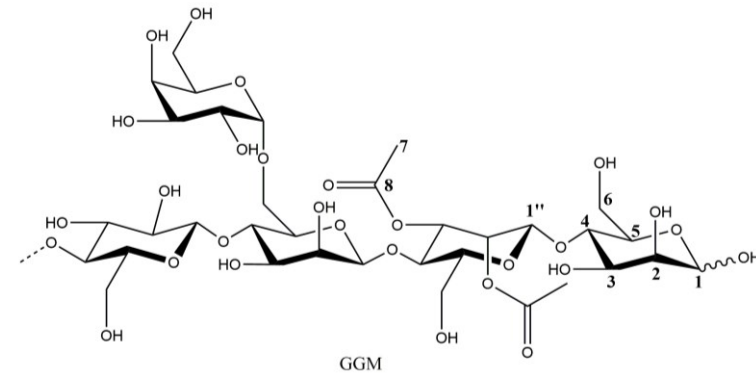
# Cellulose derivatives

- Wettex wet wipe
  - Regenerated cellulose and cotton fibres
- Cellophane
- Cellulose acetate → frames of eyeglasses, textiles, cigarettes, wound dressings
- Carboxymethyl cellulose
- ...

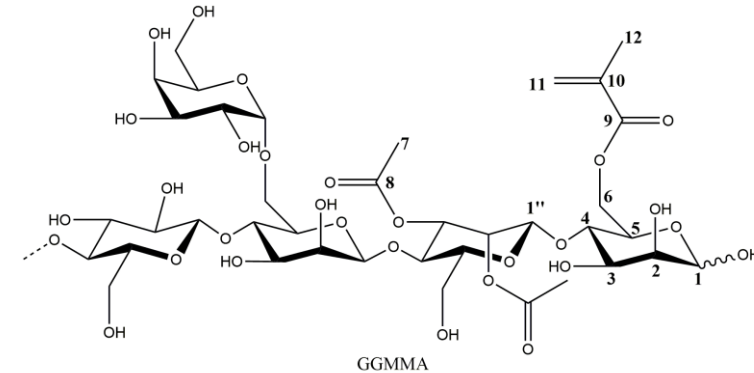




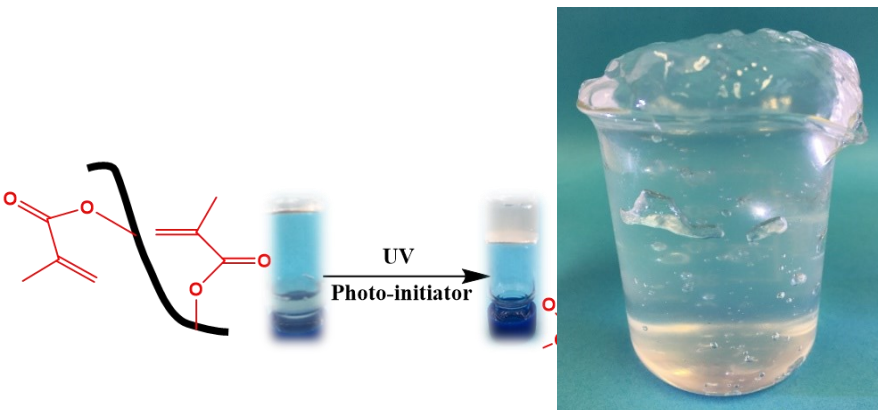
# Wood-based ink for use in 3D printing



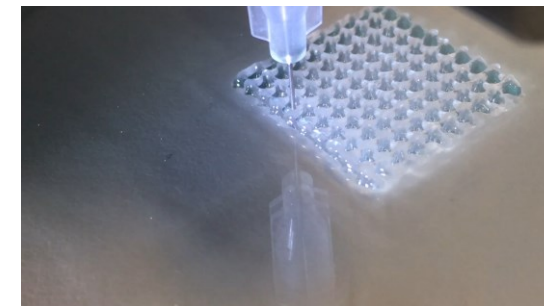
**Galactoglucomannan (GGM)**



**Metacrylated GGM (GGMMA)**

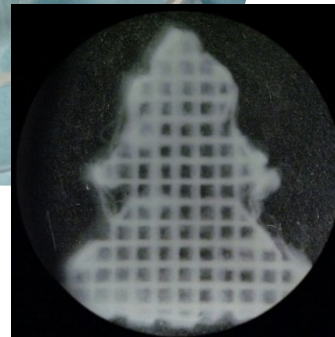
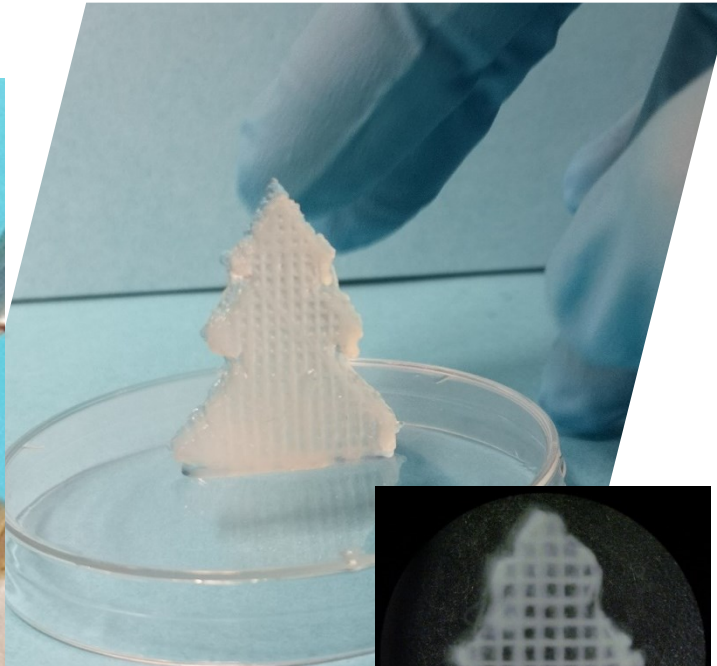


**Cellulose nanofibrils**

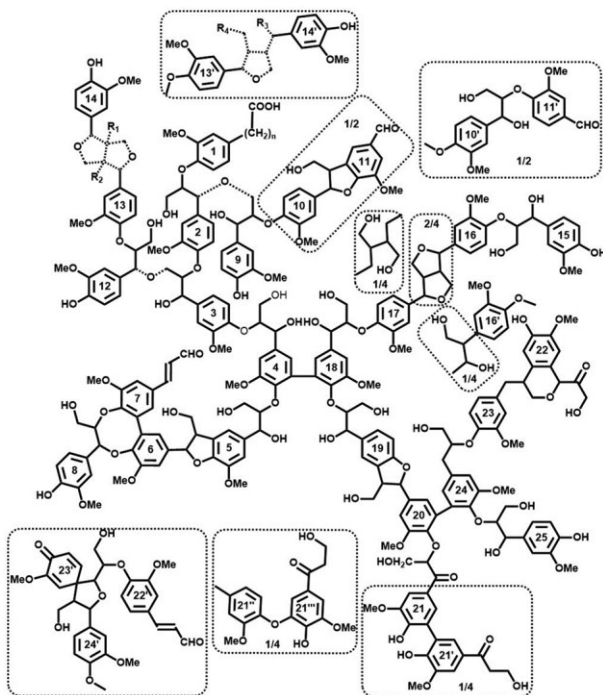


**Scaffolds with different stiffness**

# 3D printed constructs in complex geometry



# Lignin – what is it and where is it used?



Balakshin et al.  
Green Chem., 2020,22, 3985-4001



Wood vanillin  
(Borregaard.com, oetker.com)

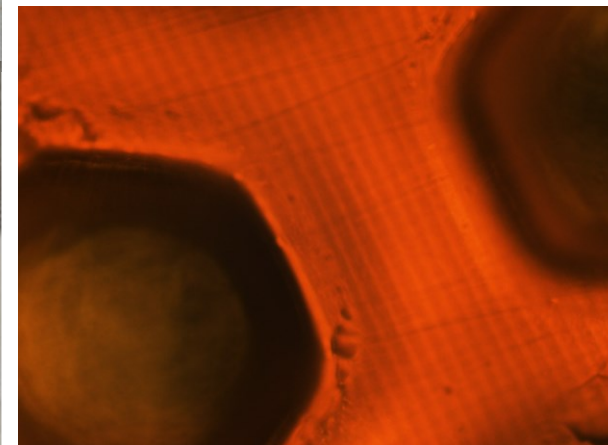
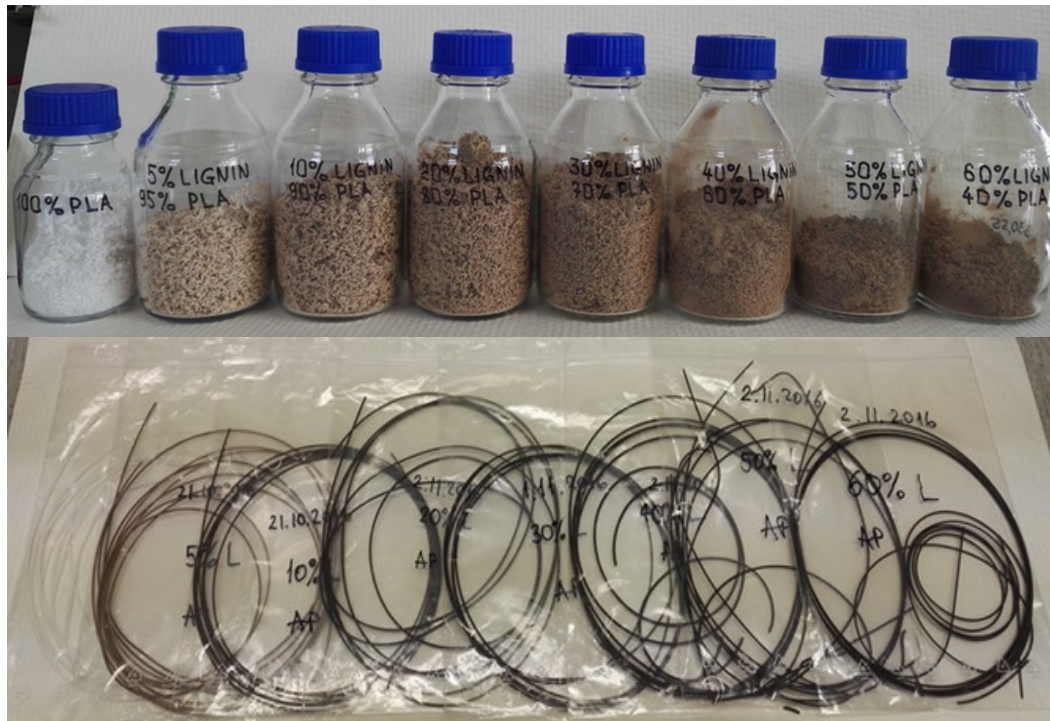


Dry wall/plaster board  
(puutoimi.fi)



# 3D printing

- Lignin and PLA (polylactic acid)
- More than half of PLA can be replaced with lignin





Contact

Products

Sustainability

☰  
MAIN MENU

🌐  
INTERNATIONAL

🔍  
SEARCH



## Stora Enso and Peab Asfalt test wood-based binder in asphalt



NEWSROOM → ARTICLES AND REFERENCE CASES → STORA ENSO AND

PUBLISHED 2 SEPTEMBER 2022

Stora Enso and Peab Asfalt paved an area of the Sunila pulp mill in Kotka, Finland, with asphalt in which part of the fossil-based bitumen has been replaced with renewable lignin from wood. Lignin, one of the main building blocks of a tree, is renewable and bio-based, and can be used as a responsible alternative for fossil-based binders in bitumen, for instance.

The new asphalt mixture was used to pave part of the wood field at Stora Enso's Sunila Mill and the road leading to the



Contact

Products

Sustainability



## Svevia paves with climate-smart lignin- based asphalt in Håbo, Sweden

NEWSROOM → ARTICLES AND REFERENCE CASES → SVEVIA PAVES WITH

PUBLISHED 21 SEPTEMBER 2022

Swedish road and infrastructure operator Svevia continues collaboration with Stora Enso in paving with lignin-based asphalt. The stretch, which is 1,7 kilometers long, is the longest stretch in Sweden that is paved with a climate-smart asphalt, where part of the fossil-based bitumen has been replaced with renewable lignin.

Lignin is a polymer that is part of the cell walls of plants and that gives wood its stiffness and mechanical strength. The properties allow lignin to replace part of the fossil oil-based binder called bitumen that is found in asphalt. Stora Enso's lignin, [Lineo® by Stora Enso](#), comes from Nordic forests with traceable origin, and is produced at Stora Enso's Sunila Mill in Finland. Stora Enso is the largest kraft lignin producer in the world.

# Lignin solvent fractionation

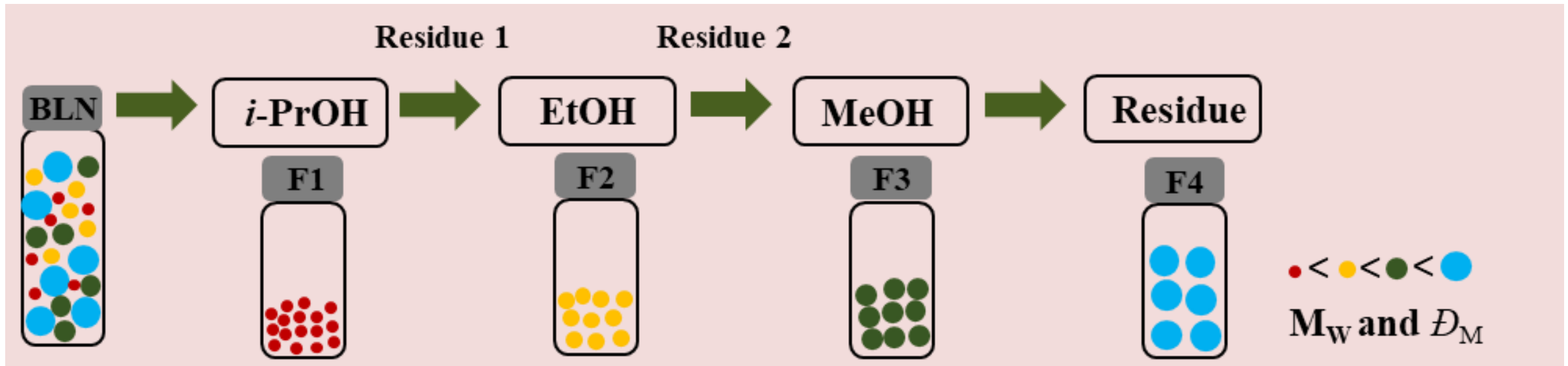


Birch

BLN biorefinery

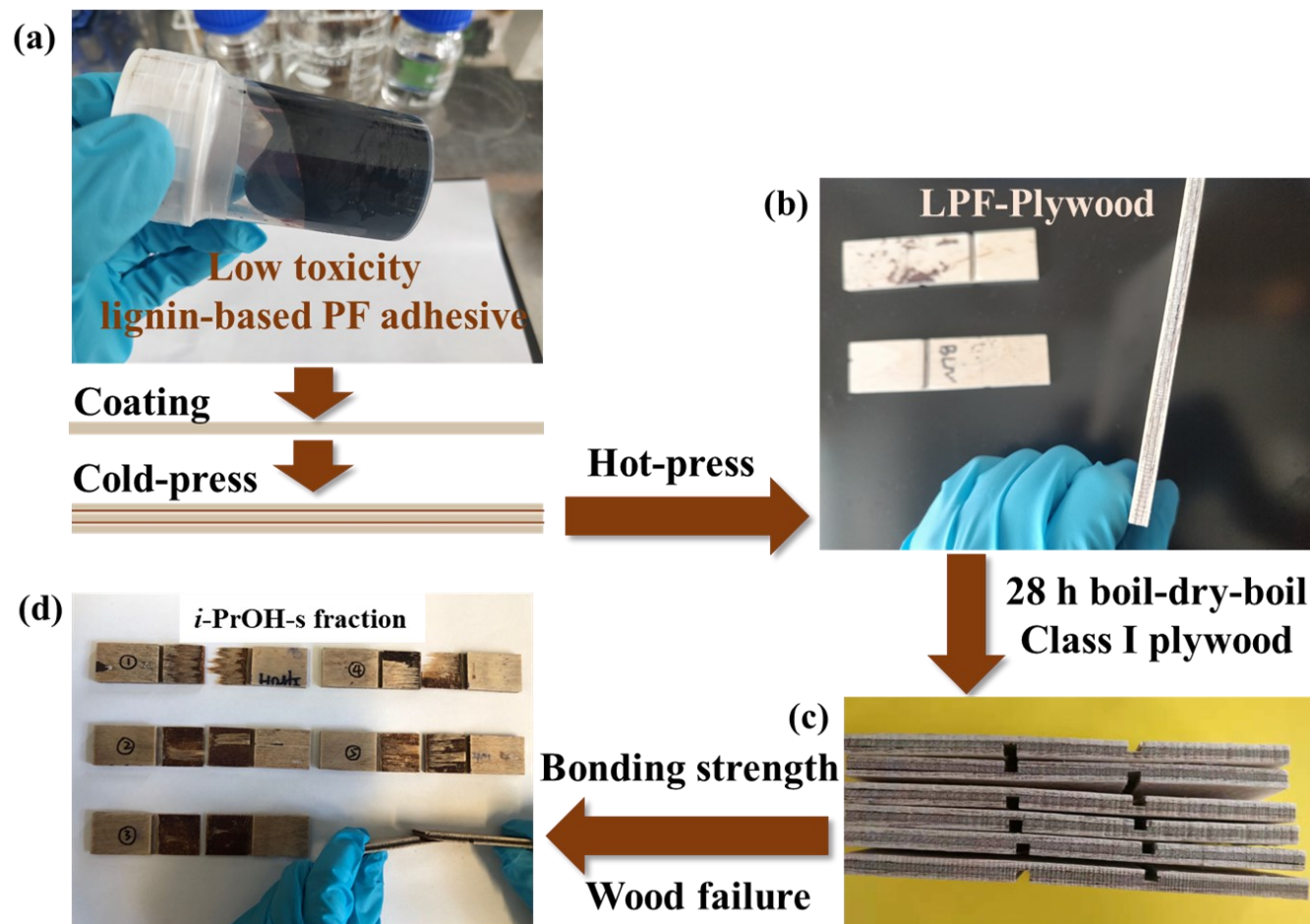


Technical BLN birch lignin





# Wood composites glued with lignin phenolic resin



L. Wang et al.,  
ACS  
Sustainable  
Chem. Eng.  
2020, 8, 35,  
13517–13526

A revolutionary bio-based furniture board, joint development by Koskisen and Stora Enso

PUBLISHED 21 SEPTEMBER 2022

Koskisen is a Finnish wood industry company producing sawn timber and panel products, such as furniture, and construction boards made of chip board. Koskisen uses Stora Enso's bio-based binder by Stora Enso, to replace fossil-based resins used in furniture boards. Both the furniture board raw materials and the binder are made of wood and sourced from the production process flows of both companies. The all raw materials of the Zero Furniture Board being bio-based.

# Extractives – what are they?



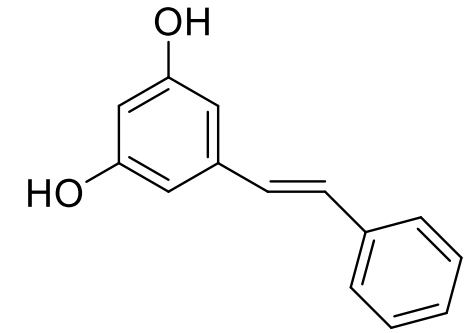
Volatiles  
Fragrance  
(purensoselect.in)



Oleoresin  
Protection  
(pixabay)



Fats and waxes  
Energy source  
(pixabay)



Phenols  
Protection  
(Pinosylvin)

# Extractives – where are they used?



Tar  
Impregnation  
(yle.fi)



Wood turpentine  
Solvent



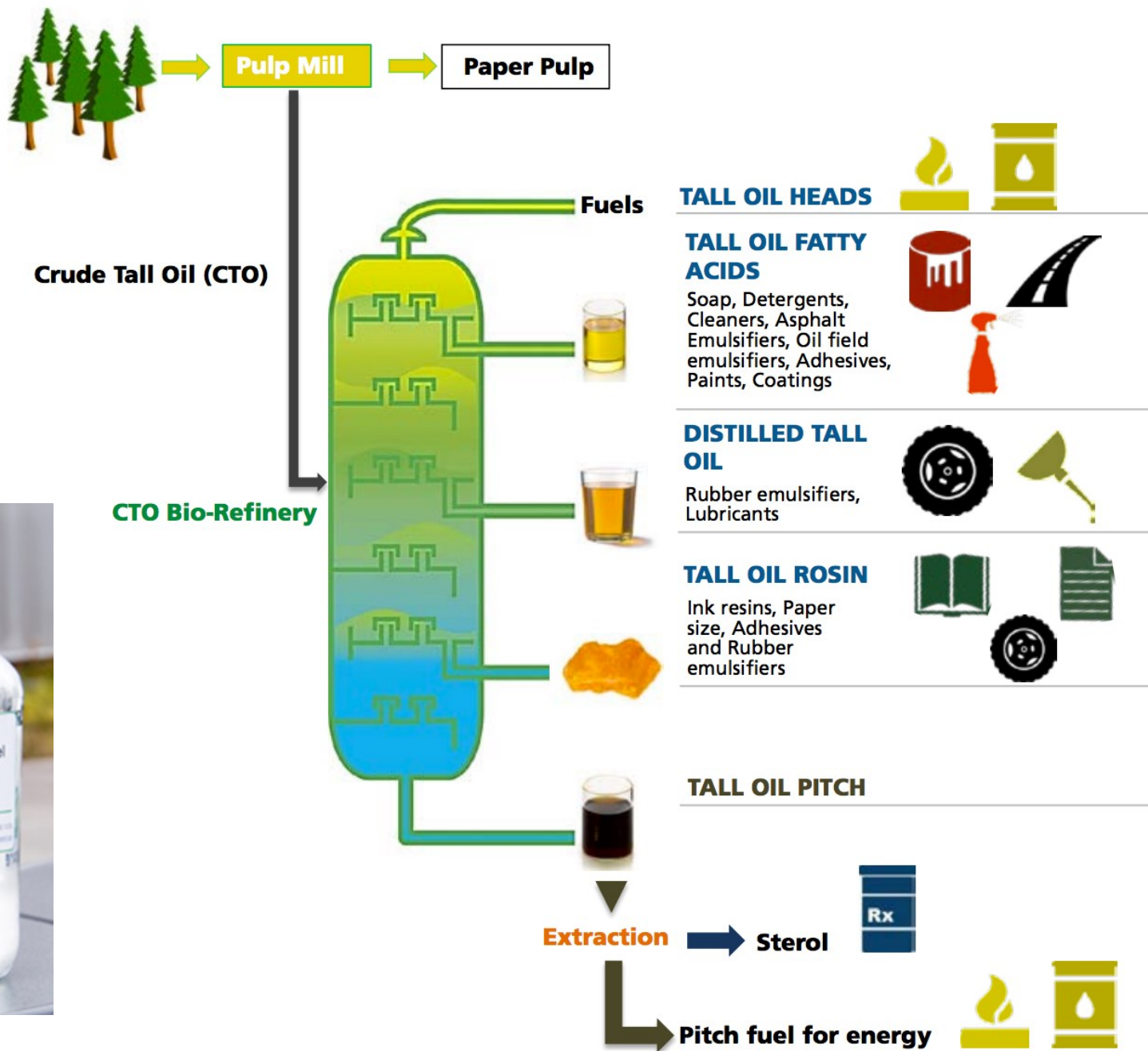
Resin salve  
Treatment of wounds etc.  
(repolar.com)



Tall oil soap



# Tall oil



# Lignans

- Sold as dietary supplement
- Regulates hormone balance



**AND MANY MORE PRODUCTS**



# Summary

- Should we use biomass?
- YES!
- Are there infinite availability of biomass?
- NO!
- What should biomass be used as?
- High-values materials and chemicals, as last stage to produce energy





EWLP2024.fi



EWLP 2024  
17<sup>th</sup> European Workshop on  
Lignocellulosics and Pulp

26-30 AUGUST 2024  
Åbo Akademi University  
Finland

**NMT**  
naturmaterialteknik

Call for papers will be  
announced in autumn 2023.  
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[EWLP2024@abo.fi](mailto:EWLP2024@abo.fi)

  
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