

# Next-gen biorefinery: From wood residues to bio-based ingredients for adhesives

## Fibenol's go-to industry solutions

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Fibenol

[fibenol.com](https://fibenol.com)



With woody biomass-based biomaterials, **Fibenol** empowers businesses to cut fossil feedstock dependency and progress toward the net-zero targets.



- Greener
- Cost-competitive value proposition
- Performance-competitive
- At scale
- Drop-in to existing
- Potential and flexibility for future





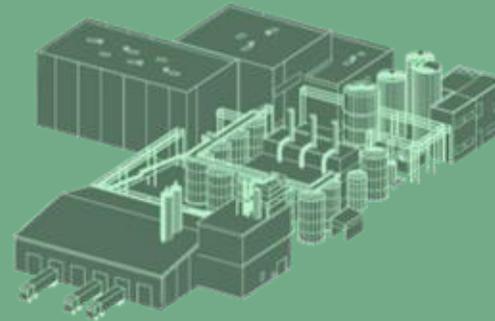
Biomaterials for a cleaner  
tomorrow

# Industry within planetary boundaries: Current capacity & milestones



Certified low-quality hardwood & wood processing residues

30 kt of feedstock



> 90% conversion wood to products



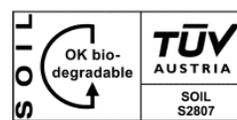
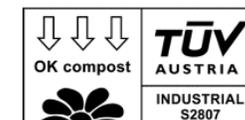
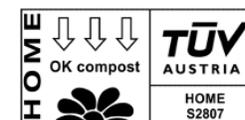
LIGNOVA™  
High-quality lignins  
6.5 kt dry/y



C5/C6 WOOD SUGARS  
20 kt wet/y



SPECIALTY CELLULOSES  
MCC on ton scale



# Our technology: Sunburst™ pretreatment

From solid wood residues to fluid wood slurry



Hardwood (birch)



Wood is made from 3 polymers:  
2 from **sugars**, 1 from phenol

...[glucose]-[glucose]-[glucose]-[glucose]...

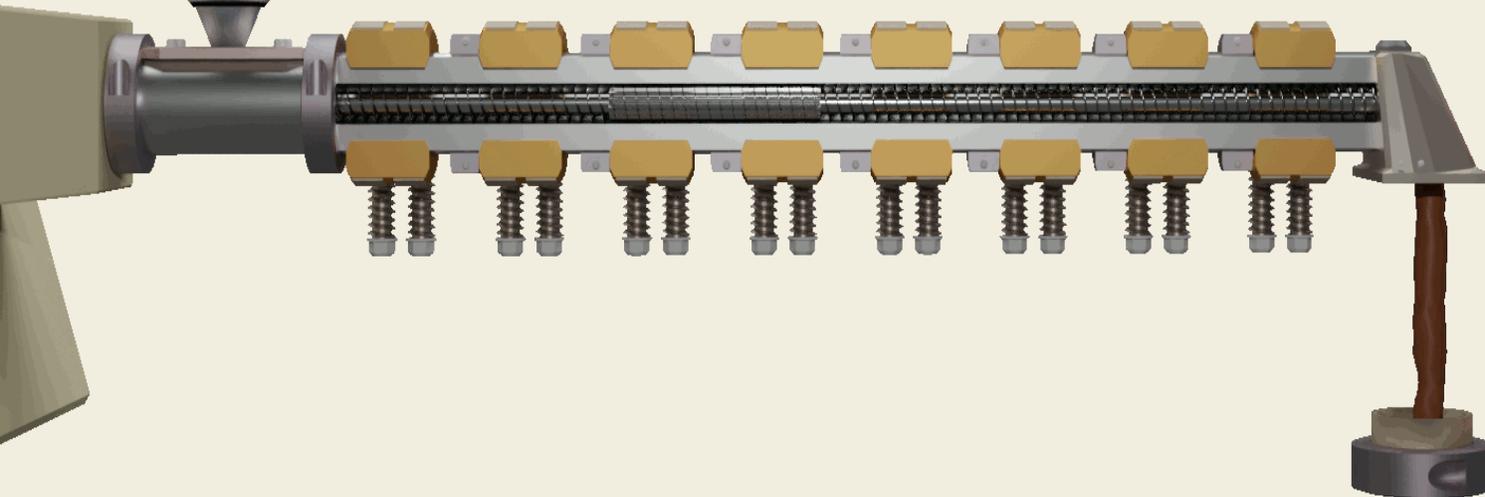
= cellulose

...[xylose]-[xylose]-[xylose]-[xylose]...

= hemicellulose

...[phenol]-[phenol]-[phenol]-[phenol]...

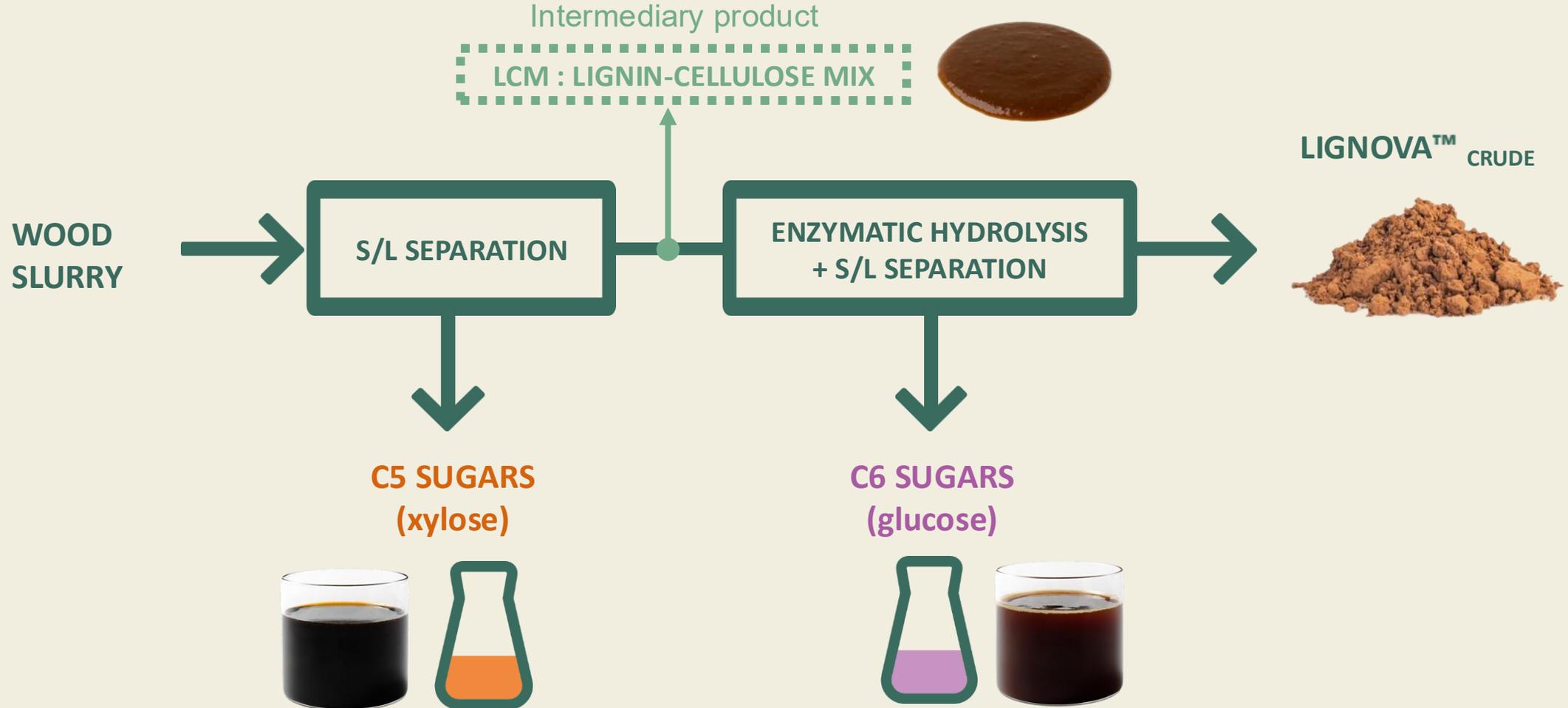
= lignin



“Wood chocolate”

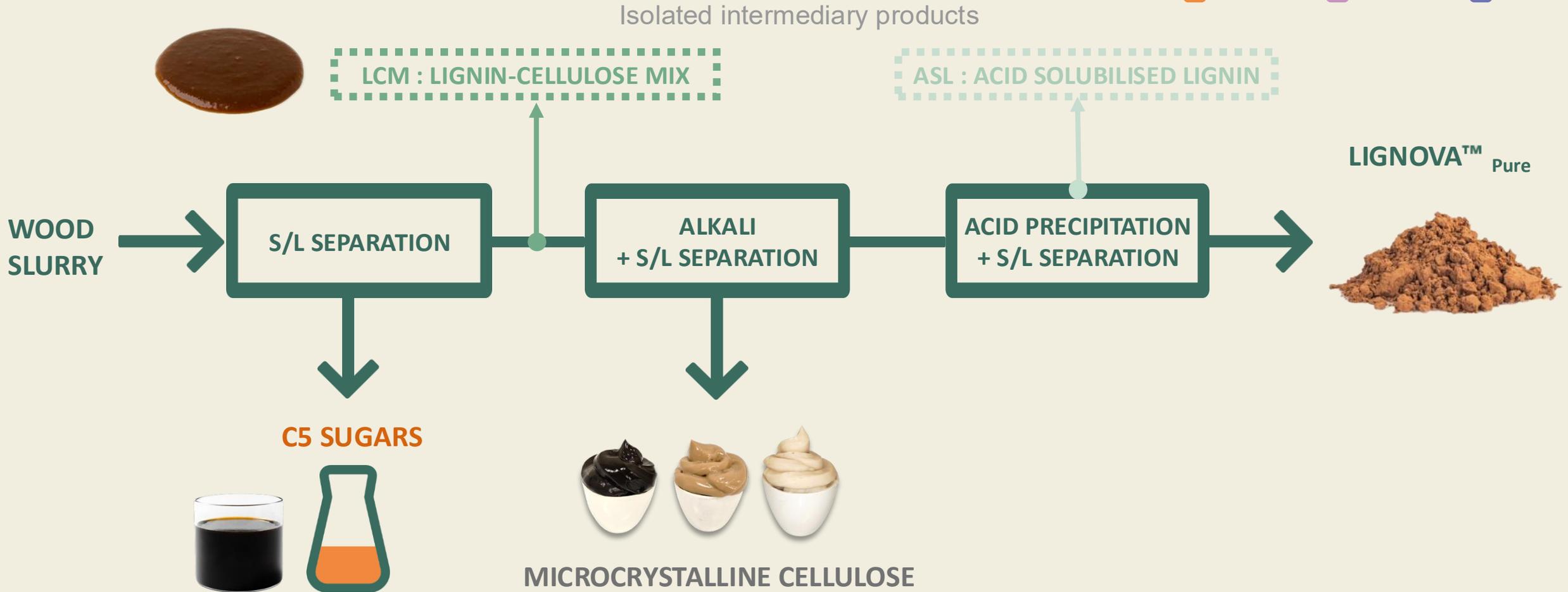
# Process snapshot

1<sup>st</sup> platform: LIGNOVA™ Crude (at scale)



# Process snapshot

2<sup>nd</sup> platform : LIGNOVA™ Pure (scaling-up)



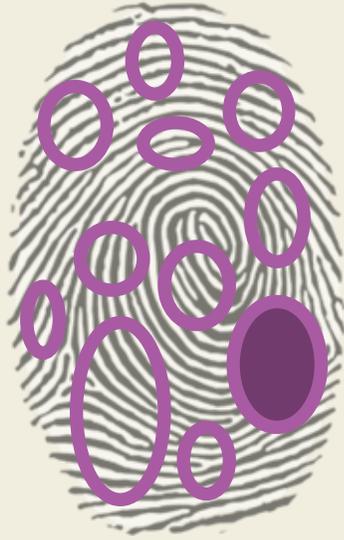
Fibenol

S/L : Solid/Liquid

# How do we address client needs and approach to lignin-based process control ?

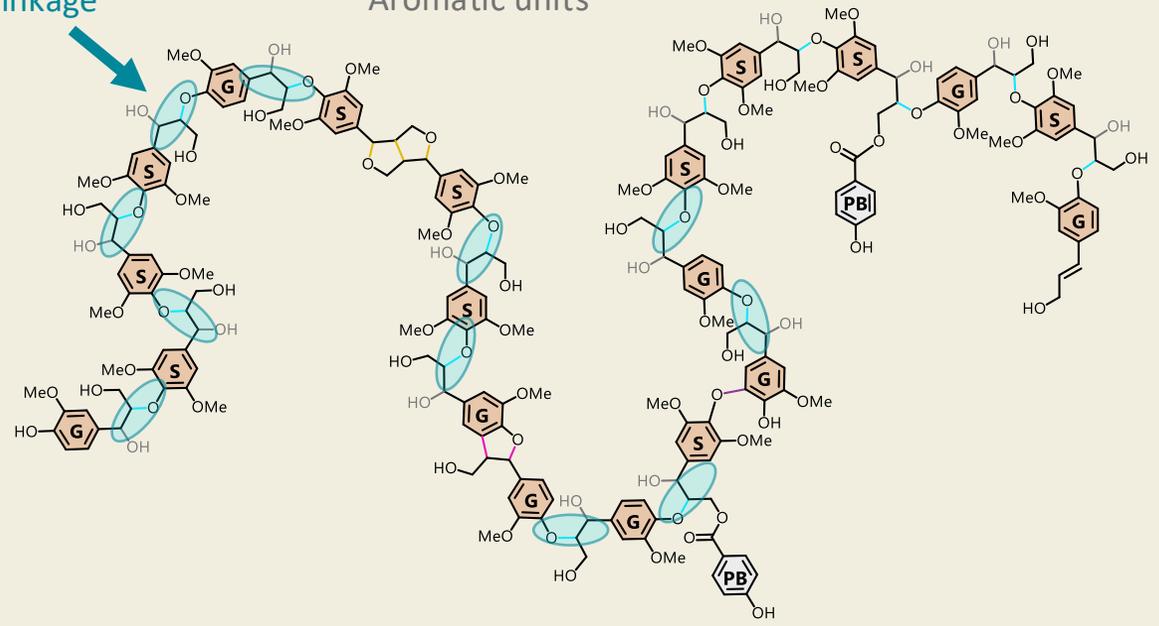


# Example of the $\beta$ -O-4 in Lignova

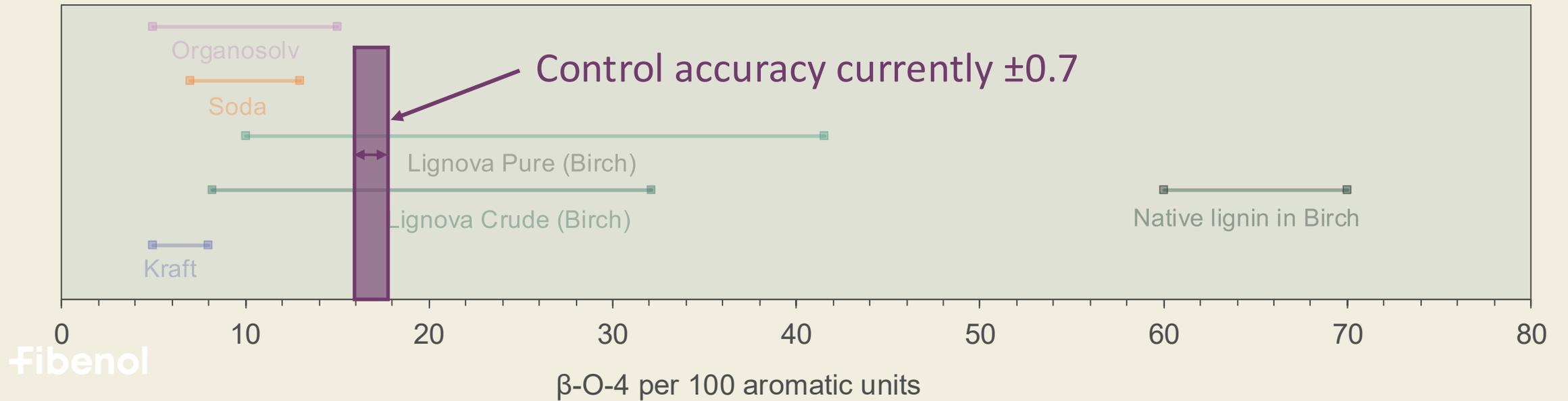


$\beta$ -O-4 linkage

Aromatic units



Example of a lignin molecule



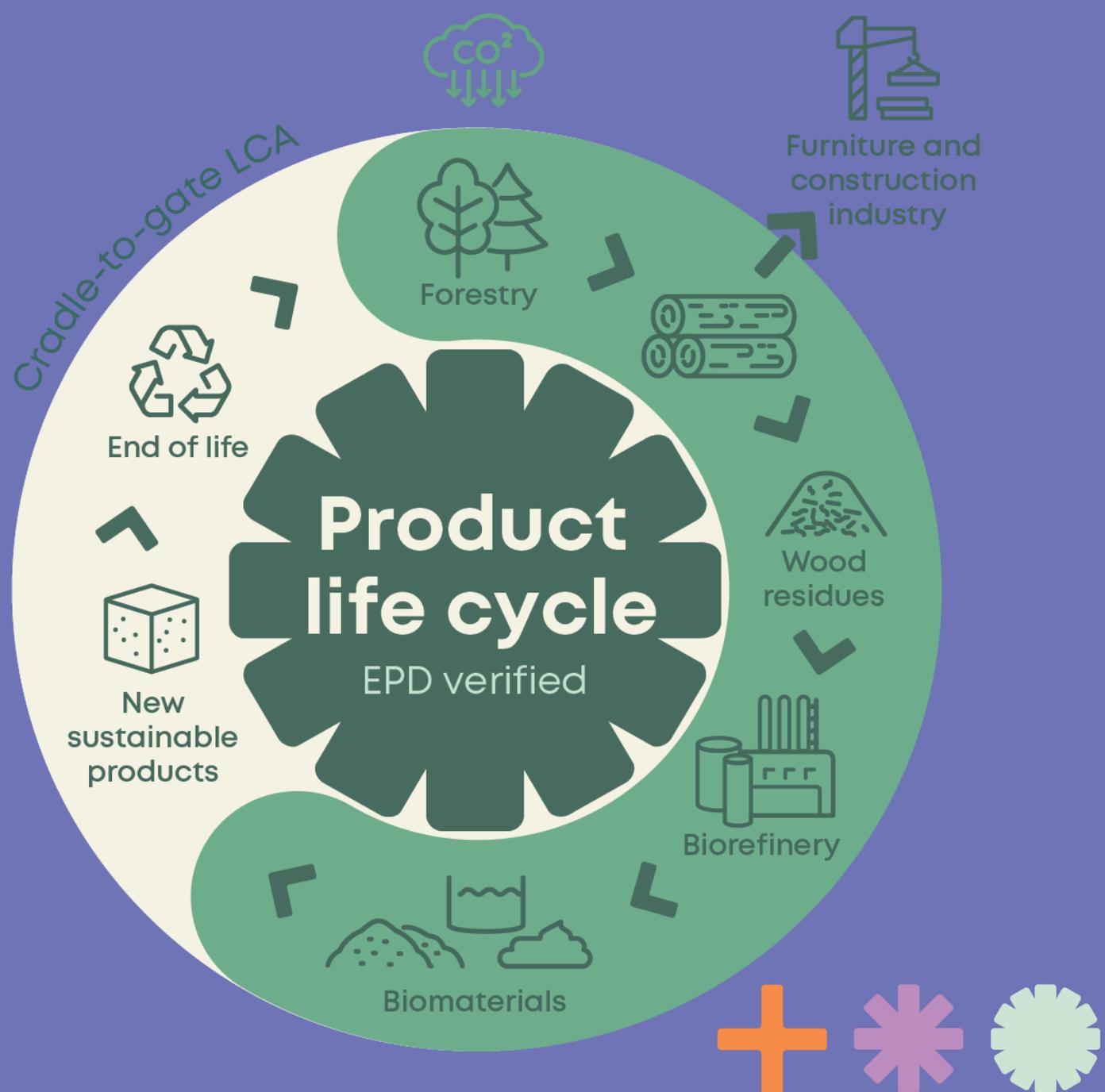
# Science based and data driven LCA

High quality primary data is key!

- + We need to move on from using database averages
- + Collaboration

Transparency!

- + NO to selective use of data
- + NO to questionable allocation methods



# Whatever biogenic or fossil consideration, our products have all low footprint + available EPDs.

	LIGNOVA™ 	C5 sugars 	C6 sugars 	Product Category Rules (PCR):	PCR 2021:03 Basic chemicals (v 1.1)
To-gate				UN CPC code:	3413 Phenols (→ lignin defined as main product)
GWP Fossil	0.332	0.334	0.292	unit:	1-kg dry matter
GWP Incl. Biogenic	-1.968	-1.126	-1.175	Software:	SimaPro 9.5
				Allocation:	mass (dry)
				Primary data:	operational data from 2021-2023
				Secondary data:	Ecoinvent v3.9
				Method:	EPD Method EN 15804 (in conformity of ISO 14025)
				Cut-off rules:	no cut-off rules applied

Climate change total, given in kgCO<sub>2eq</sub>/dry kg

Link to EPD: <https://www.environdec.com/library/epd9726>



# Adhesive circular applications, in-use resins



## Phenol-formaldehyde resins with Lignova™

- Lignova™ phenolic structure is the natural fit to replace phenol.
- 50% (industrial ready) to 100% (lab) phenol replacement or 20% PF substitution (drop in).
- up to -38% (fossil only) ; -67% (incl. biogenic) PCF reduction on the glue.

**Plywood, Impregnated papers, PF coating**



## Urea-formaldehyde resins with Lignova™ & LCM

- Lignova™ is not Kraft or Lignosulfate and might success where other streams failed before.
- up to 10% w/w urea replacement or 10% resin replacement
- from -7% (fossil only) to -26% (incl. biogenic) PCF reduction

**Particle board & fibreboard production**



## Dextrose replacement with sugar from forest

**Mineral wool binders**

# Adhesive application, future of bio-adhesive

Using less conventional molecules? Brand new system ?

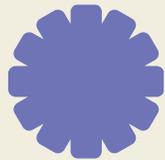


**Wood sugar as ingredient, building block**

That comes with crosslinkers



**Bio-Phenol source for epoxy systems**



**Functional additives, with Lignova™ and MCC**

- Rheology modifier
- Emulsifier / dispersion stabilizer
- Water, fire, UV resistance & antioxydant agent

**Wax emulsion, acrylic & vinylic resins, latex & SBR, polyurethan, etc.**

# Benefits using product from Fibenol



**No food competition**



**Verified and transparent LCA**



**No sulfur, pleasant smell**



**Produced in Europe**



**Industrially available**



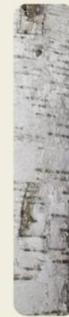
Are you ready to lead the way towards a  
cleaner future with Fibenol?

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**#fiberbeyondoil**