



Workshop on the Non-binding Guidance on Cascading Use of (Woody) Biomass  
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# BORREGAARDS TRANSFORMATION FROM A TRADITIONAL P&P COMPANY TO THE WORLDS MOST ADVANCED BIOREFINERY

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# Borregaard in a nut shell

1050

employees

100 (10%)

Employees in innovation

450 M€

annual sales

Production in

7 countries

5%

Innovation intensity



★ Head office, R&D and Sarpsborg Biorefinery    ⬡ Sales office    ● Technical services    ▲ Plant

# Turning all parts of the wood log into products

## The “LIGNIN COMPANY”

*Leading supplier of lignin based performance chemicals*

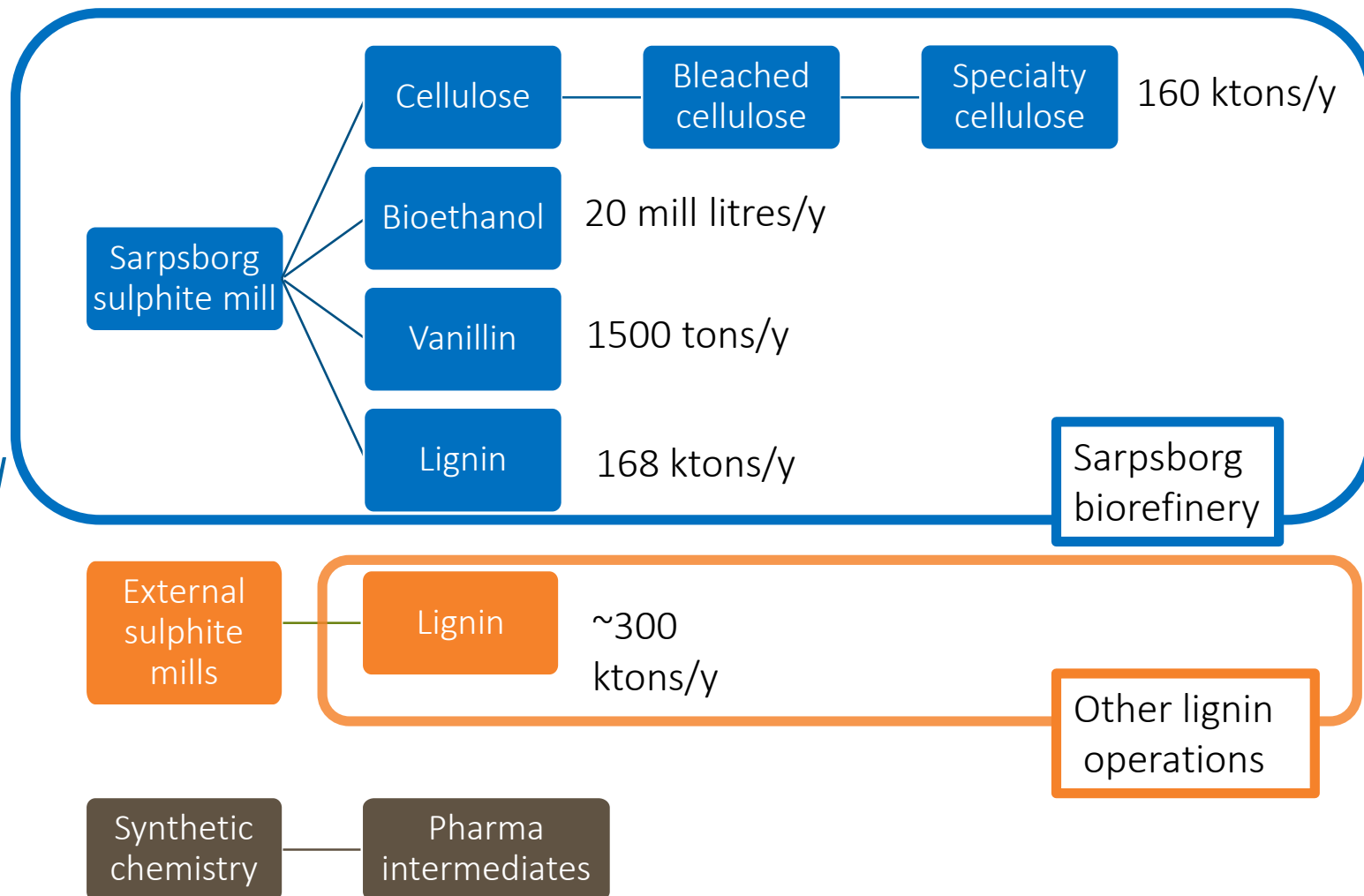
*Top 3 supplier of high quality specialty cellulose*

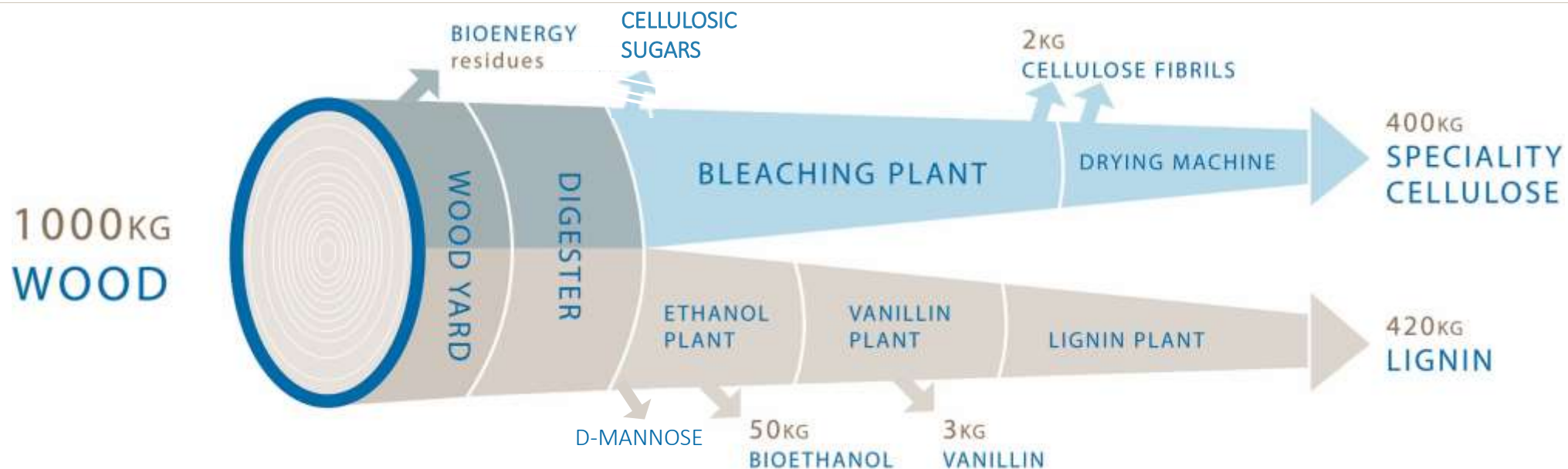
*Only supplier of vanillin from wood*

*The largest producer of ethanol from wood*

*Only supplier of microfibrillated cellulose (MFC)*

*Only supplier of defibrillated cellulose for food market*





## SPECIALTY CELLULOSE

Construction materials  
Filters  
Inks and coatings  
Casings  
Food/Pharma/Personal care  
Textiles

## LIGNIN

Concrete additives  
Animal feed  
Agrochemicals  
Batteries  
Briquetting  
Soil conditioning  
...  
..  
.

## VANILLIN

Food  
Perfumes  
Pharmaceuticals

## SPECIALTY SUGARS

Feed  
Pharma  
Cosmetics

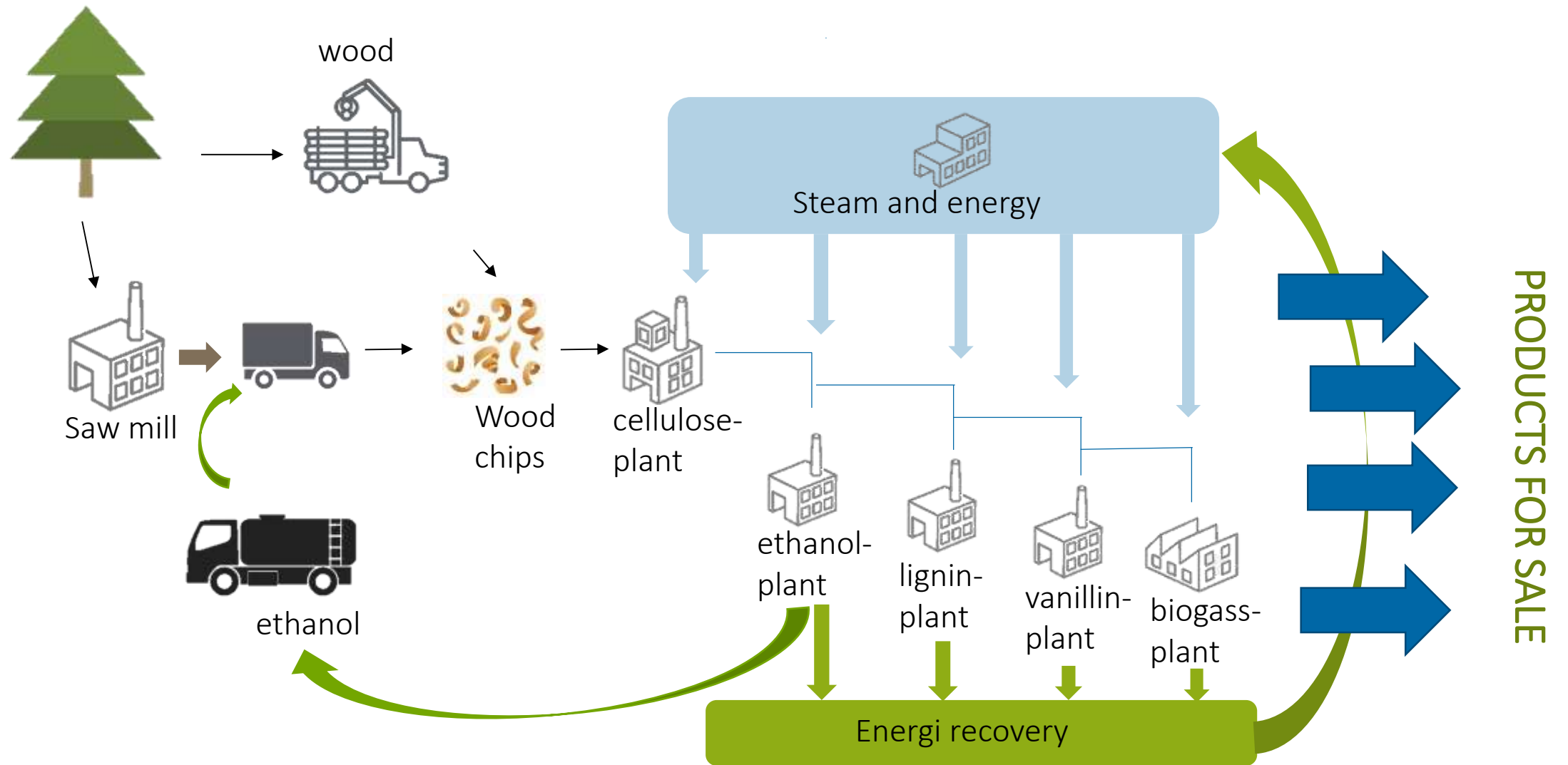
## BIOETHANOL

Pharmaceutical industry  
Biofuel  
Paint/varnish  
Car care

## CELLULOSE FIBRILS

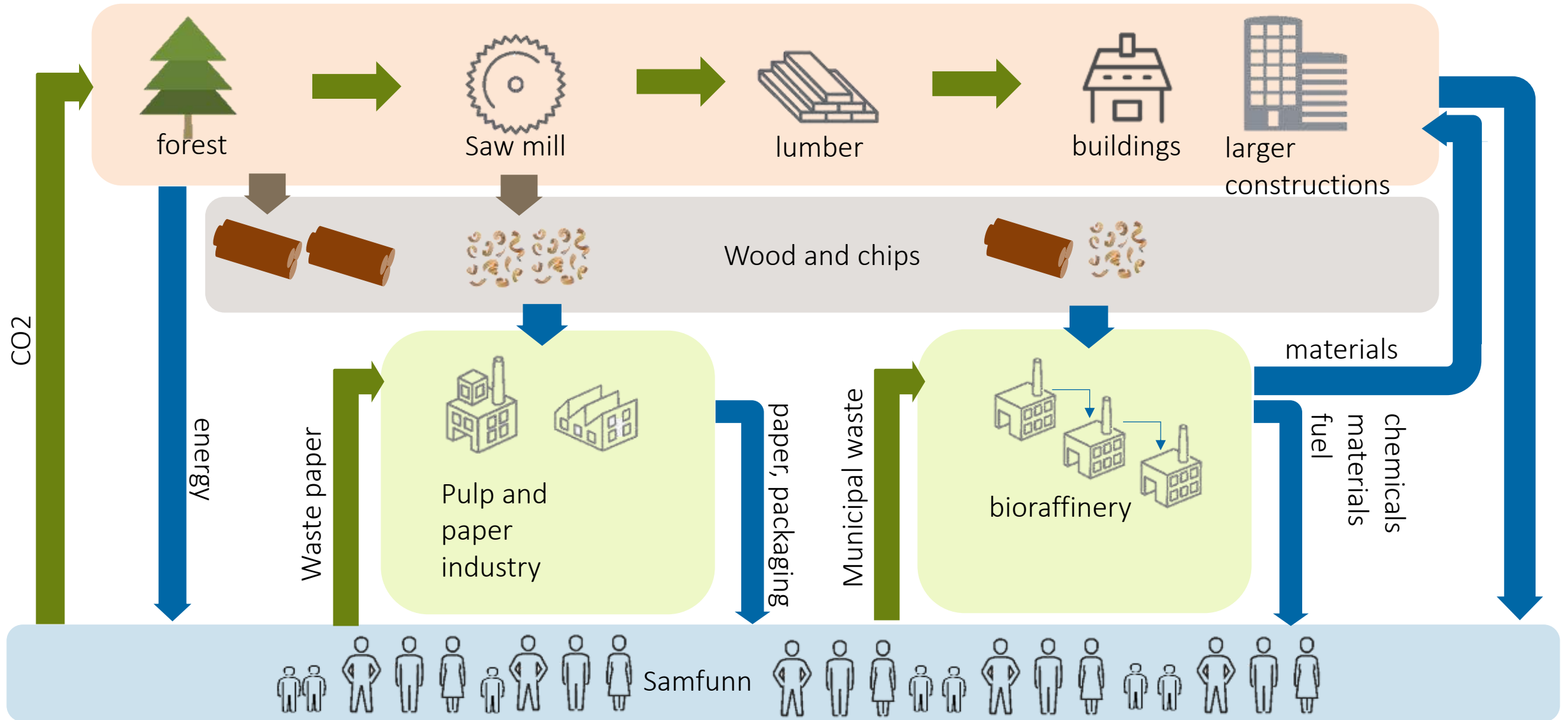
Adhesives  
Coatings  
Agricultural chemicals  
Personal care  
Home care  
Construction  
  
Food

# Borregaards internal circular economy

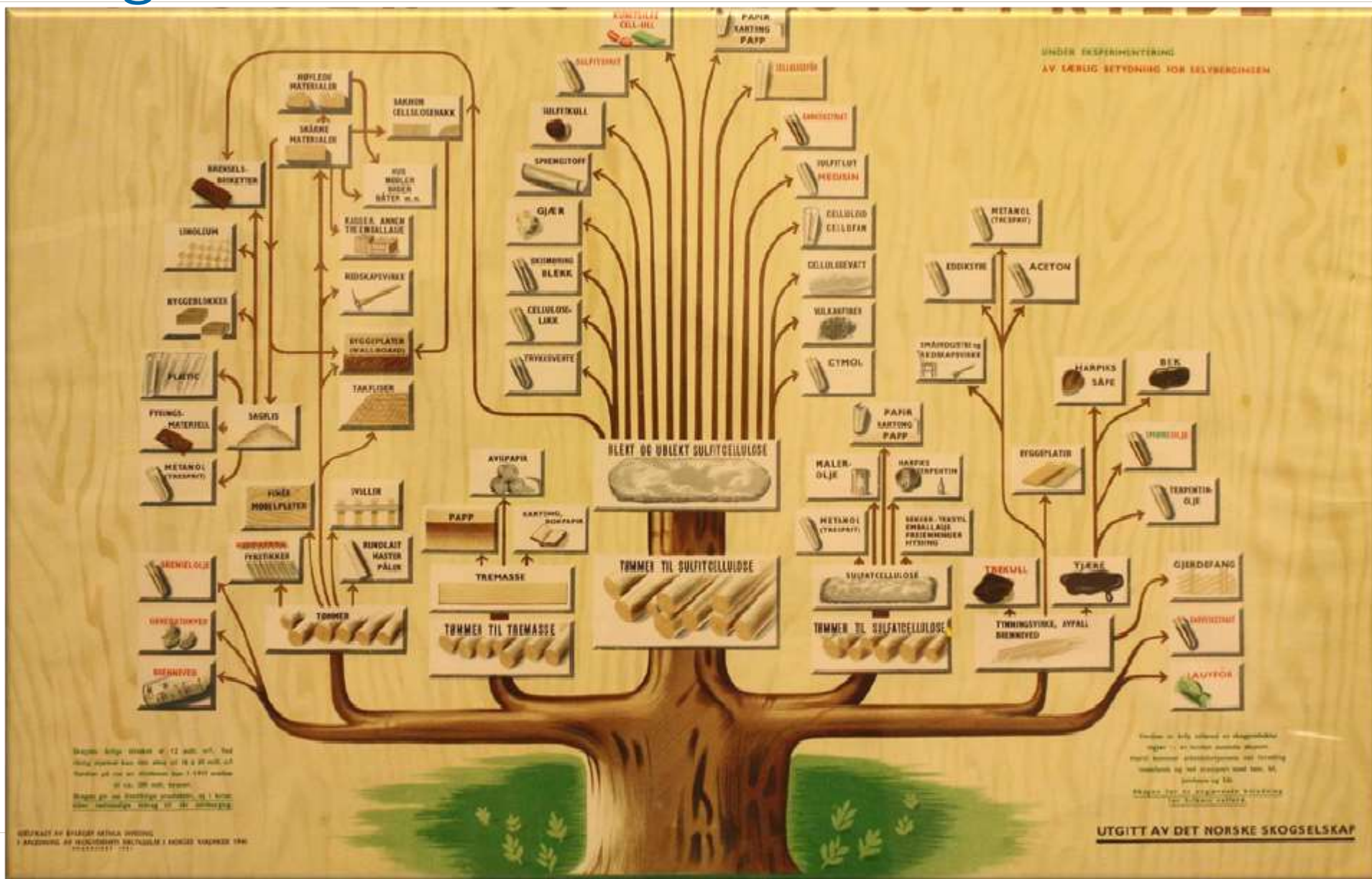




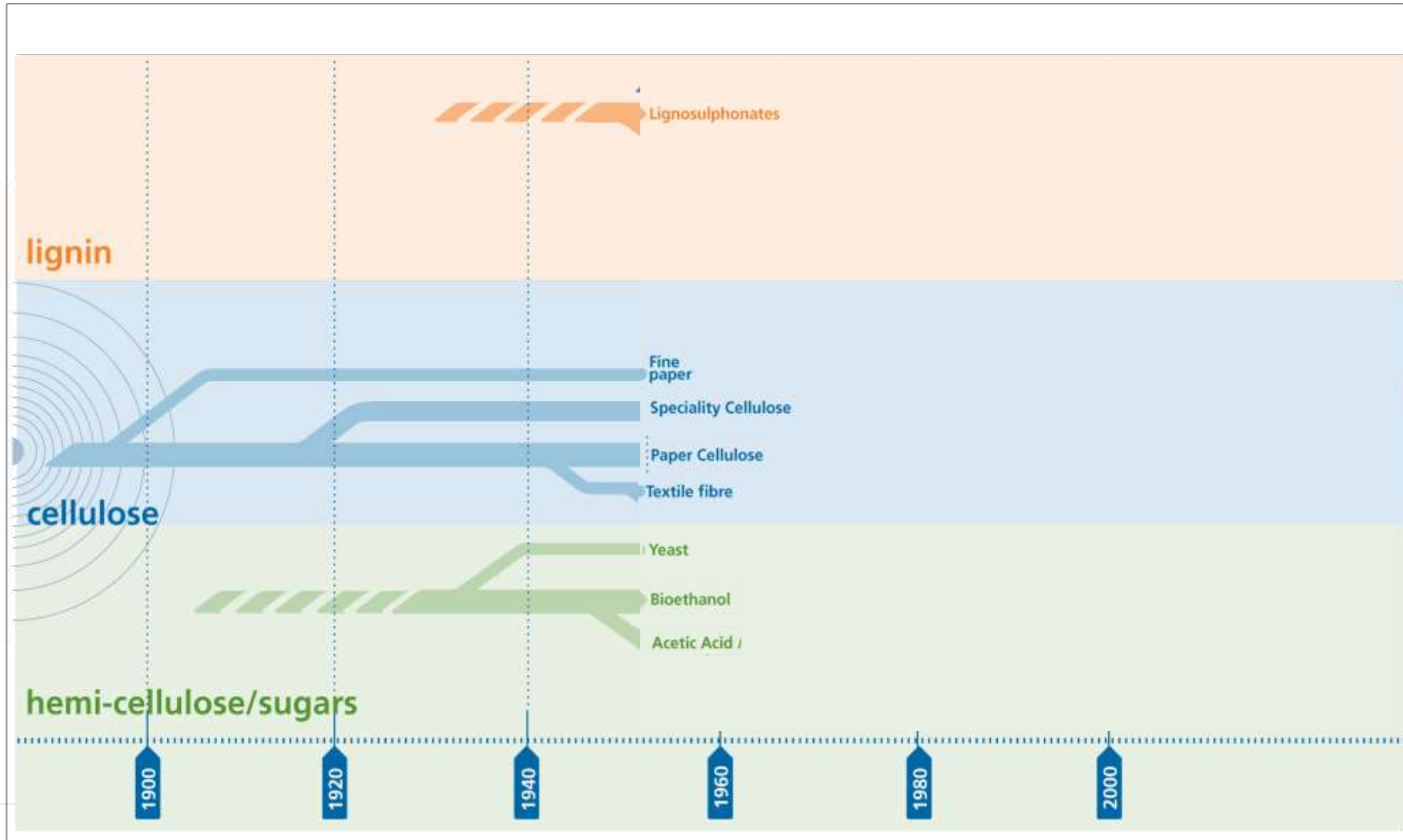
# Wood based industry – a circular industry



# Nothing is new - The forest as feedstock 1940



# Borregaards product line history



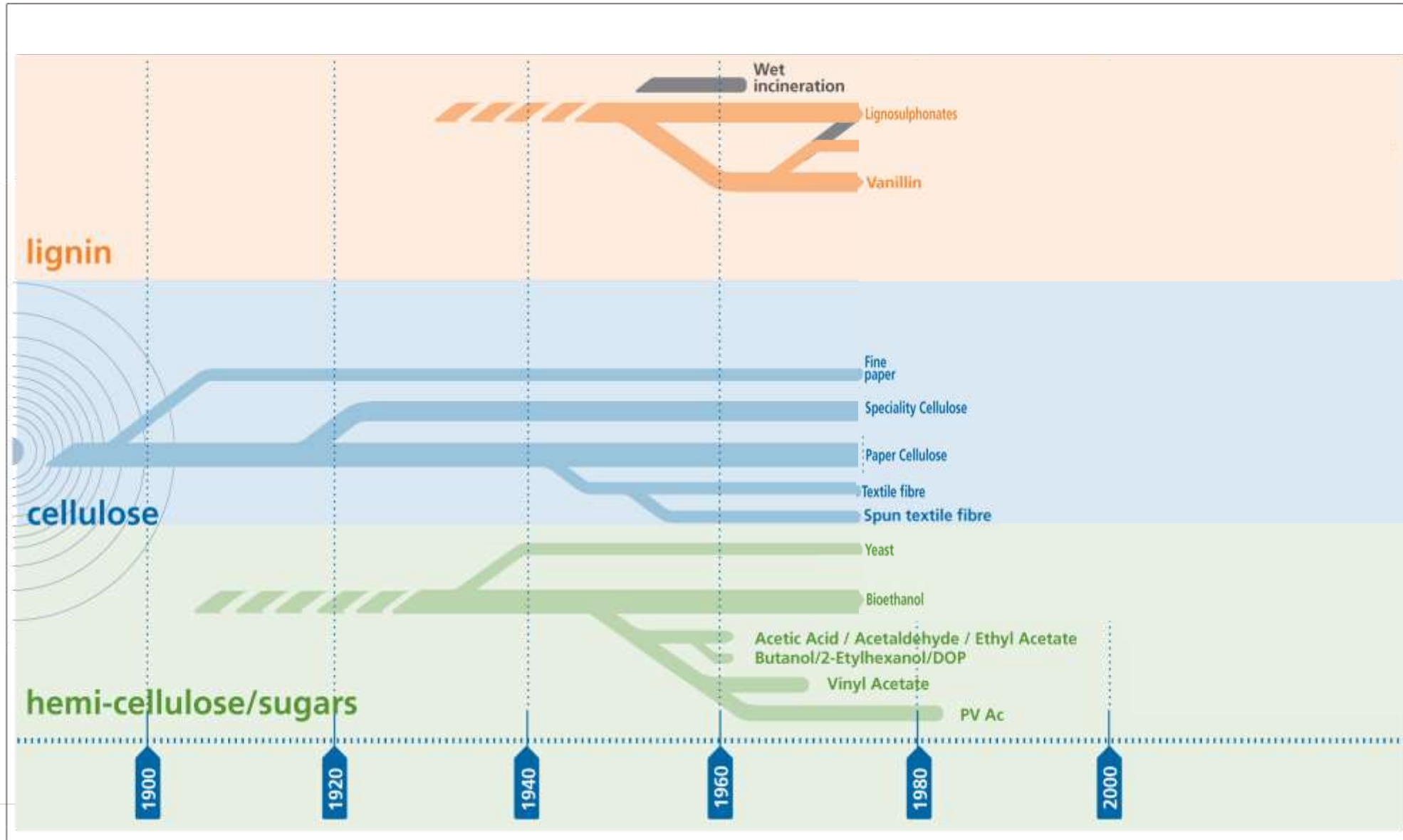


# 1950'ies: Limited access to domestic wood feedstock

- In the late 1950'ies limited access to wood → quotas on wood supply.
- No volume expansion in Norway
- Growth had to come from value expansion
- Borregaard: strategy: «squeeze maximum value out of each wood log» → **BIOREFINERY concept**

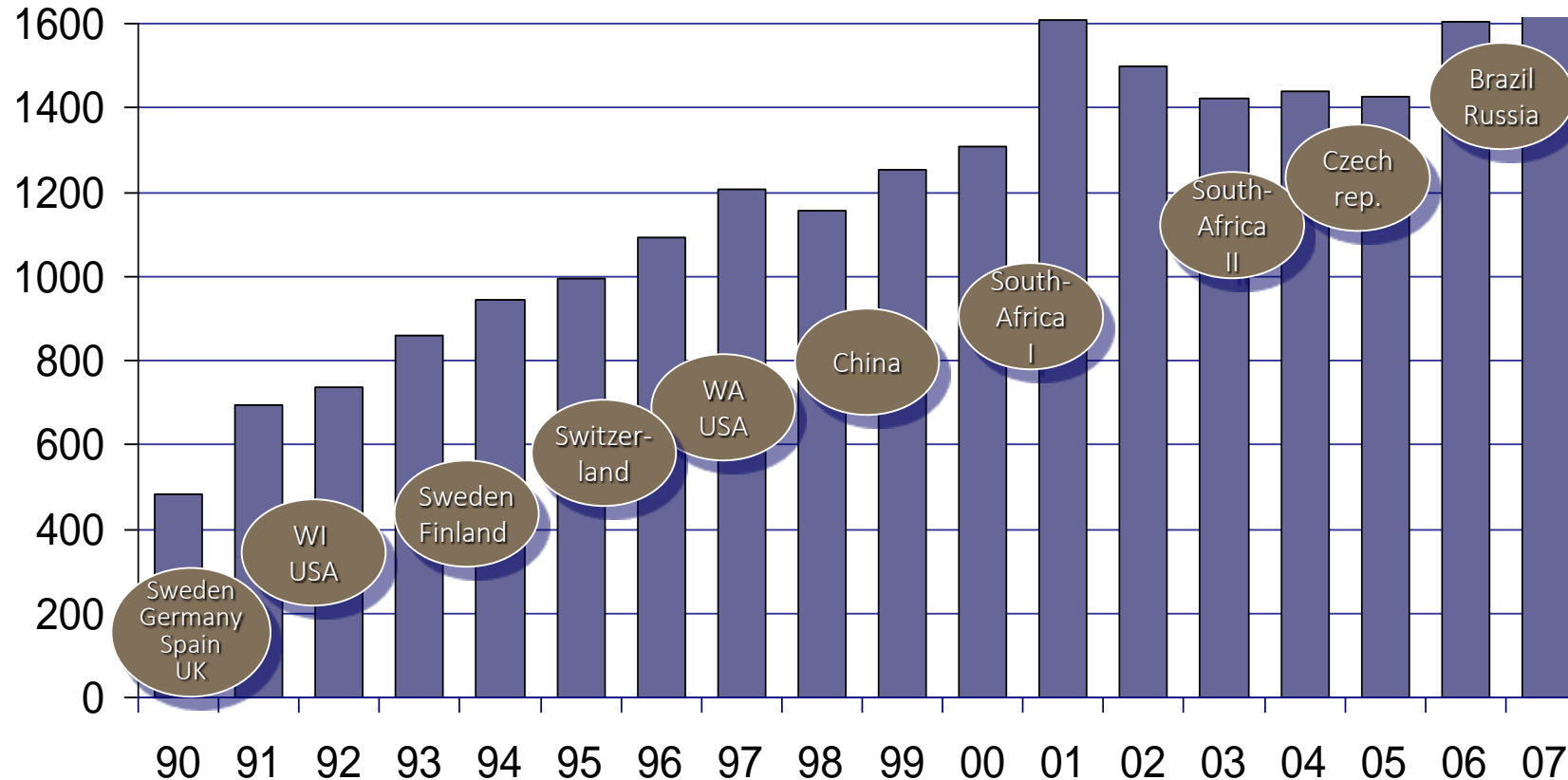


# Borregaards product line history



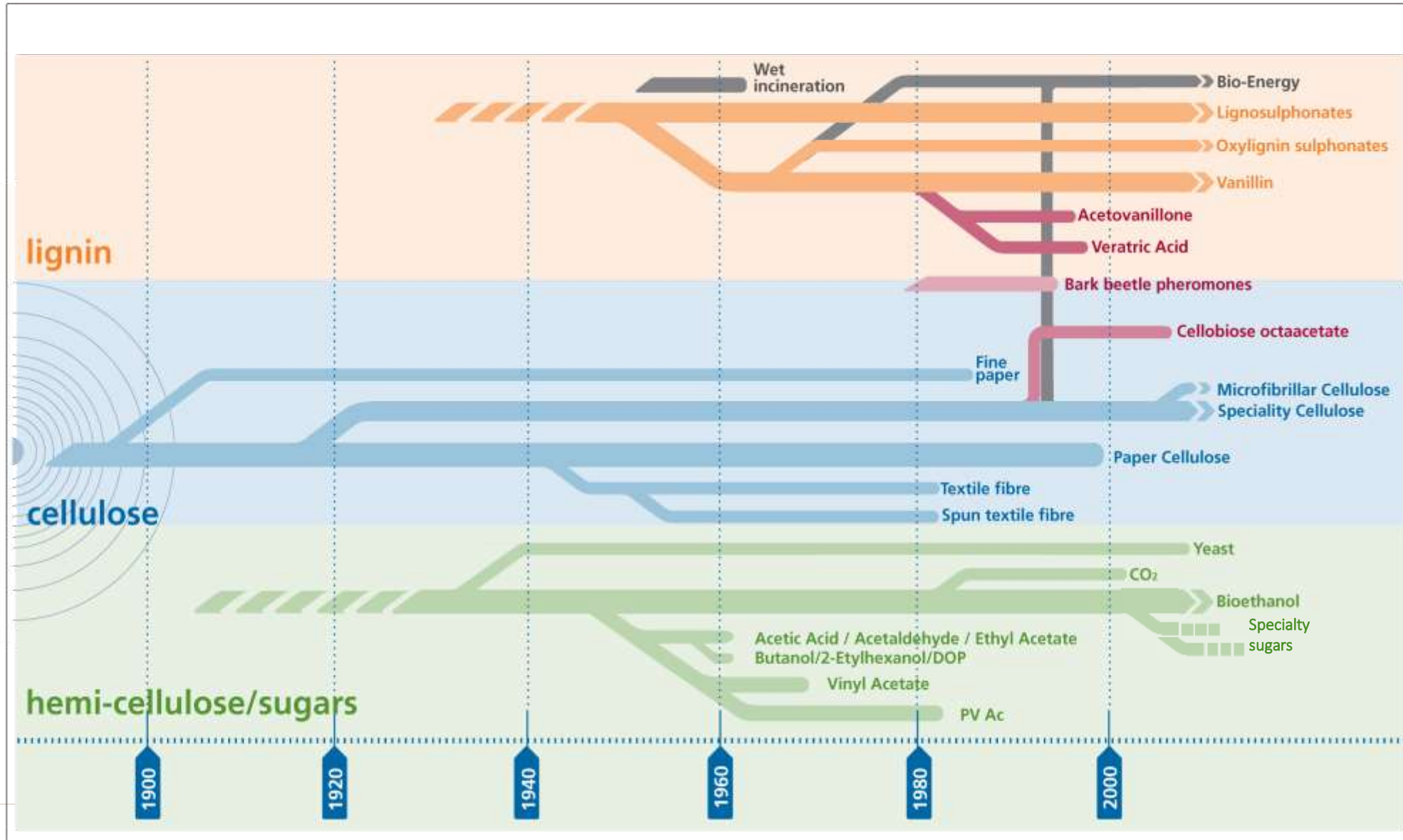
# Restructuring the world lignin market

Operating revenues  
NOK million



- Size to afford RnD
- Streamlining product lines
- Combined competences more than the sum of competences
- Market leader – attractive position

# Borregaards product line history



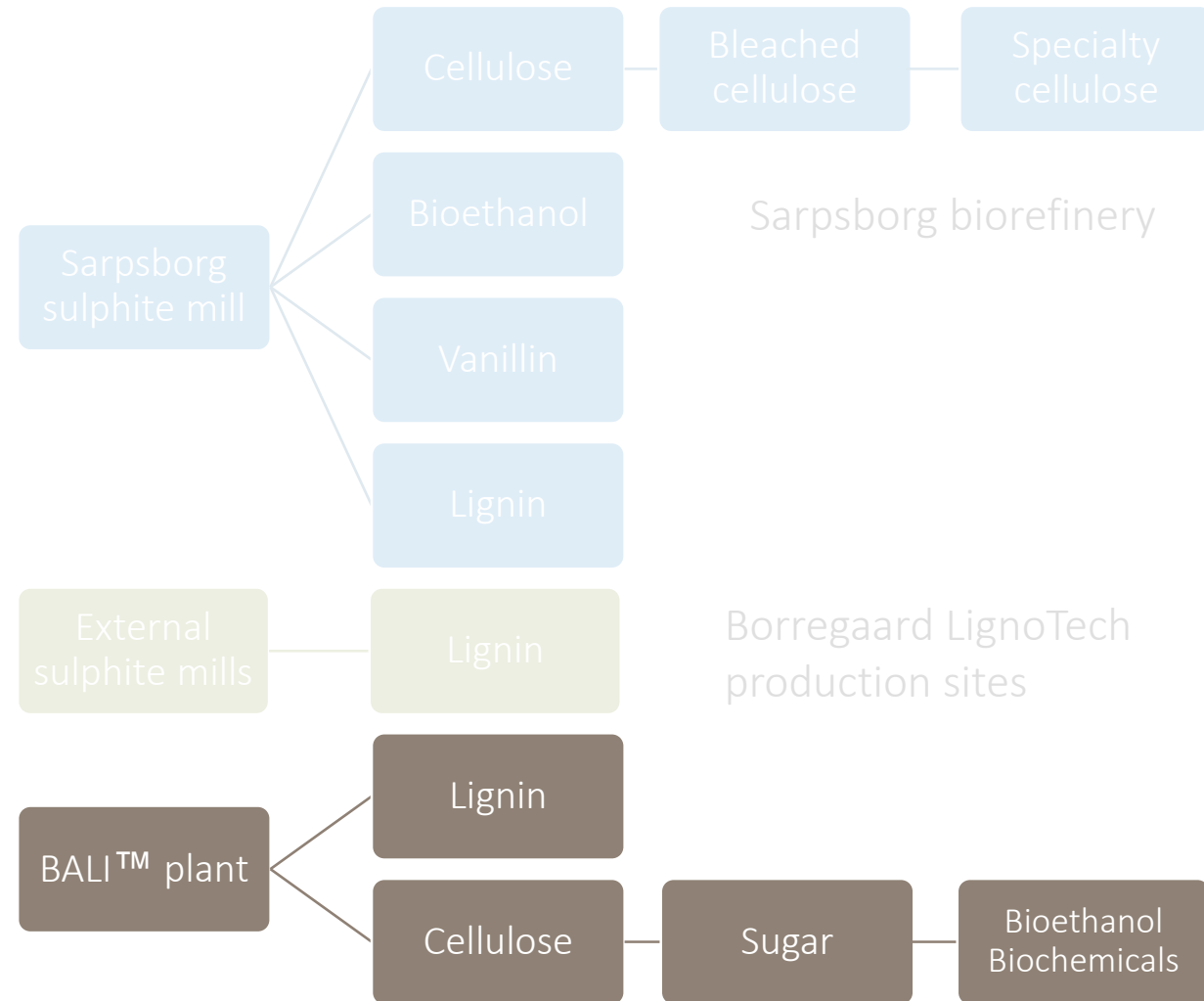


# SUMMARY

- Borregaard started as a conventional pulping operation
- Sulphite technology can not cost-competitive in the paper market (a burden and an opportunity)
- Sulphite technology is great for
  - specialty cellulose,
  - lignosulfonate performance chemicals
  - vanillin (only spruce)
  - ethanol
- Environmental issues and market conditions forced Borregaard to search for other strategies
  - «BIOREFINERY» long before the word was invented
- Strong financial owners from 1986 enabled restructuring of the global lignin market
- Strategy:
  - continuous efficiency improvements &
  - innovation

# The BALI project

- Decoupling of expansion of the the lignin operation long term and expansion of the cellulose production
- **Co-production** of lignosulfonates and sugars
- Biomass pretreatment and separation technology



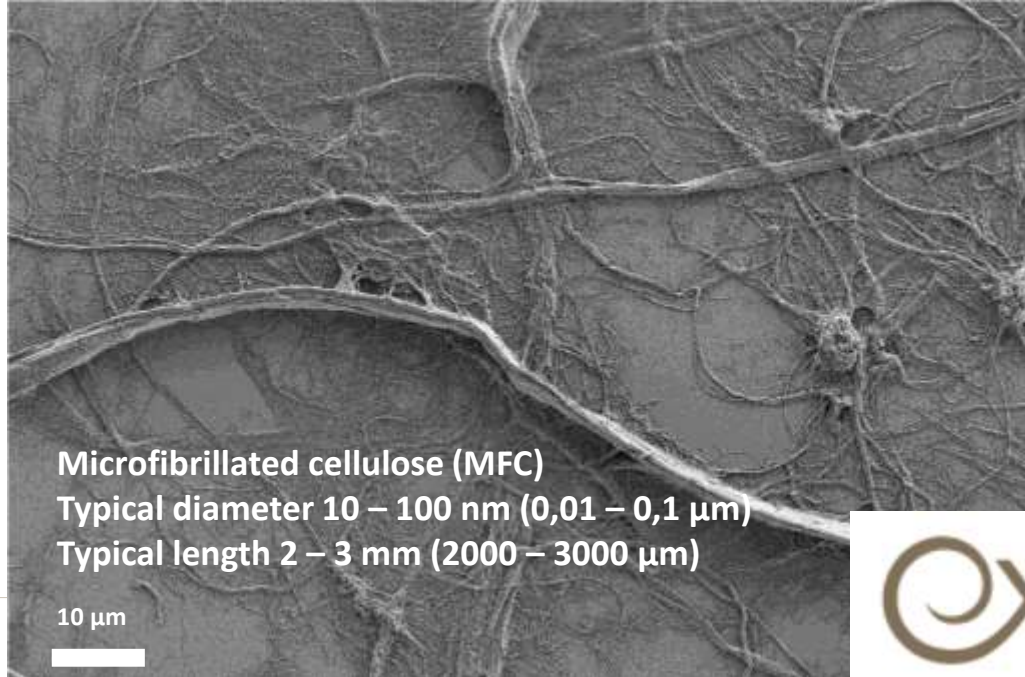
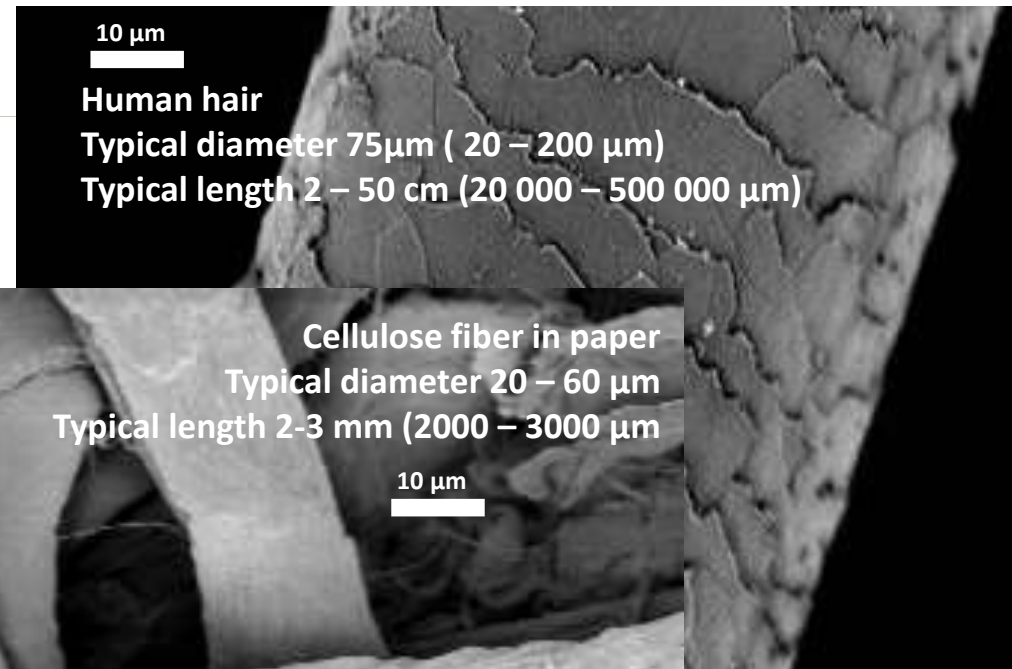
# Exilva Microfibrillated cellulose

## Microfibrillated Cellulose

Produced from Norway spruce

Still crystalline microfibers

Water dispersible, not water soluble



<http://www.exilva.com/>



# THE EXILVA INDUSTRIAL PLANT



<http://www.exilva.com/>

- New production facility
  - Capacity 1000 tonnes
  - Production started in Q4-16
  - Location: Sarpsborg, Norway
- Grant from BBI JU (EU H2020) as flagship project
  - 25 m€ over 3 years (May 2016-April 2019)



## Project details

|                             |                                 |
|-----------------------------|---------------------------------|
| <b>Type of action:</b>      | Innovation Action –<br>Flagship |
| <b>Value Chain:</b>         | VC2 – forest-based              |
| <b>Start date:</b>          | 01 May 2016                     |
| <b>End date:</b>            | 30 April 2019                   |
| <b>BBI JU contribution:</b> | €27.433.610,50                  |

## Consortium

Borregaard AS, Norway (coordinator)  
UNILEVER, United Kingdom  
CHIMAR, Greece  
OSTFOLD FORSKNING, Norway  
Royal Institute of Technology, Sweden  
Ayming, France, France

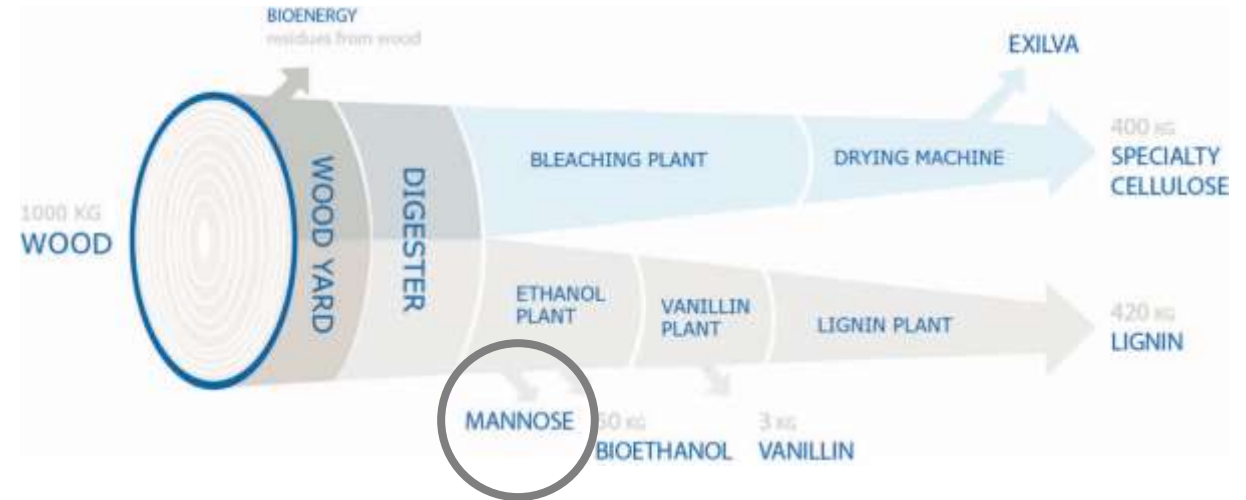
European project funded by the Bio Based Industries Joint Undertaking under the European Union's Horizon 2020 research and innovation programme under grant agreement N°709746





# Mannose process currently in pilot stage

- Raw material is Norway spruce (*Picea abies*)
- Process based on in-house IP
- Isolation and purification of mannose done in GMP certified pilot plant



# Samples of D-mannose available

- Process based on in-house IP
- Isolation and purification in GMP certified pilot plant
- 100 g samples available for testing
- Product specification:
  - D-(+)-mannose
  - Purity: >99%



# Sensefi Cellulosic Texture Enhancer & Dietary Fibre (sensefi®)

<http://www.sensefi.com/>

- Multifunctional dietary fiber
- Advanced texturizing
- Superior water binder & fat replacer
- Thickening, stabilizing and suspension
- Succulent texture and clean taste

