

EXPANDFIBRE

Accelerating the development of sustainable bioproducts

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Metsäneuvoston seminaari 8.12.2020**

What is ExpandFibre?



ExpandFibre (2020-2024) is a 50 M€ R&D collaboration and an Ecosystem launched by Fortum and Metsä Group and co-funded by Business Finland. It focuses on upgrading pulp fibre, hemicellulose and lignin from renewable and sustainable sources of straw and northern wood into new bioproducts. Its ambition is to meet the growing demands for sustainable textile fibres and other added value biomaterials.

The **research and development in ExpandFibre**, aiming at producing new ground-breaking technologies and smart business concepts, is divided into **seven research themes**:



Textiles



Biocomposites



Packaging



Lignin products



Hemicellulose products



Sourcing & fractionation of straw



Other fibre products



ExpandFibre invites actors in these value chains to join in building a world-leading innovation ecosystem to eventually commercialize new bioproducts and green businesses

EXPANDFIBRE

fortum

Metsä

expandfibre.com

ExpandFibre Programmes & Ecosystem

Ecosystem Steering Group



Aalto University



BUSINESS FINLAND



ExpandFibre Ecosystem aims at developing novel bioproducts with a reduced environmental impact

Vision	New bioproducts based on sustainable biomass contribute significantly to the reduction of the negative environmental impact of our everyday lives
Mission	ExpandFibre Ecosystem strives to meet the growing demand for sustainable bioproducts by developing ground-breaking materials and technologies and smart business concepts

Short term objectives (2020-2024)

- Build knowledge-based **competitive advantage** among the ecosystem members
- Create/strengthen **test-beds for piloting** and proof-of-concept validations in the theme areas
- **Identify and fill in gaps** in the R&D landscape within ExpandFibre themes
- Create a thriving **business-driven innovation ecosystem for new biomass-based textile fibres**

Long-term objectives (2030 and beyond)

- Provide markets with new bioproducts that have **less than 20% of the carbon footprint** of the current products
- **Bring new revenue to ecosystem partners** through the increasing production and sale of new value-added bioproducts and technologies.
- Significantly **increase investments** into biomass-based value chains

Metsä Group

Purpose

Advancing bio-economy and circular economy by efficiently processing northern wood into first-class products

Vision

The preferred partner in developing sustainable business



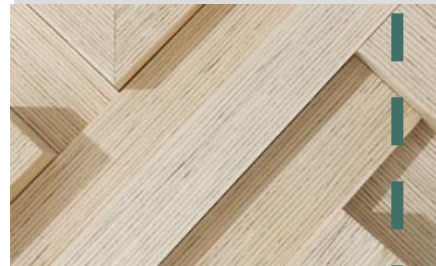
METSÄ GROUP | Sales* EUR 5.5 billion | Personnel 9,300 | Renewable energy 27,7 TWh

METSÄLIITTO COOPERATIVE | Group's parent company | Owned by 103,000 Finnish forest owners



METSÄ FOREST
Wood supply and forest services

Sales:
EUR 2.0 billion
Personnel:
840



METSÄ WOOD
Wood products

Sales:
EUR 0.4 billion
Personnel:
1,500



METSÄ FIBRE
Pulp and Sawn Timber

Sales:
EUR 2.2 billion
Personnel:
1,300



METSÄ BOARD**
Paperboard

Sales:
EUR 1.9 billion
Personnel:
2,400



METSÄ TISSUE
Tissue and Greaseproof Papers

Sales:
EUR 1.0 billion
Personnel:
2,700

METSÄ SPRING | Innovation Company

Participating in ExpandFibre

Fortum in brief



We are the largest electricity retailer in the Nordics and one of the leading heat producers globally. We have **2.5 million** customers.

96% of our electricity production is CO₂ free in Europe, **61%** in all operations

Our core

Hydro and nuclear
Combined heat and power production
Circular economy
Energy-related products and expert services

8300 professionals in the Nordics, the Baltics, Russia, Poland and India

2/3 of our power production is **hydro and nuclear**

Fortum Bio2X: mitigating climate change

Phases to reduce CO₂ emissions

1.

Electricity from solar and wind
Hydro and nuclear power

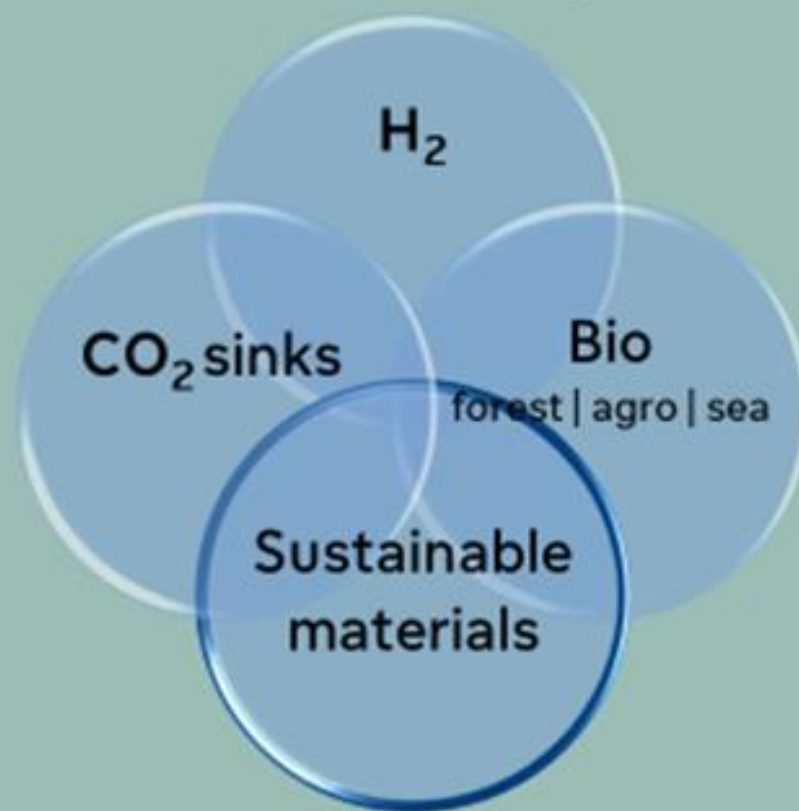


- Power production moving towards renewables
- Electrification of traffic
- Electrification of households



2.

Focus on industry



ExpandFibre connects to multiple R&D initiatives by Fortum and Metsä Group

Collaboration with Chempolis and construction of the biorefinery in India (Fortum)



Demonstration of sustainable straw-based textiles (Fortum)



Development of novel materials utilising recycled plastics (Fortum)



Development of a new 3D wood-based packaging product to replace plastics (Metsä)



Sourcing & fractionation of straw

Lignin

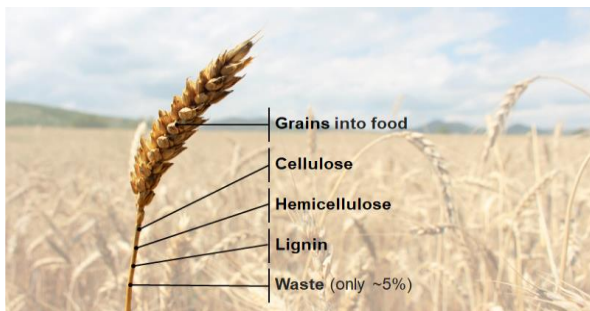
Hemicellulose

Textiles

Biocomposites

Packaging

Other fibre products



High material efficiency through fractionation (Fortum)



Converting hemicellulose and lignin into value-added products (Fortum)










Development of sustainable textile fibre from paper-grade pulp (Metsä)



Establishment of Paperboard and Packaging Excellence Centre in Äänekoski (Metsä)

R&D Themes and topics of the ExpandFibre Ecosystem

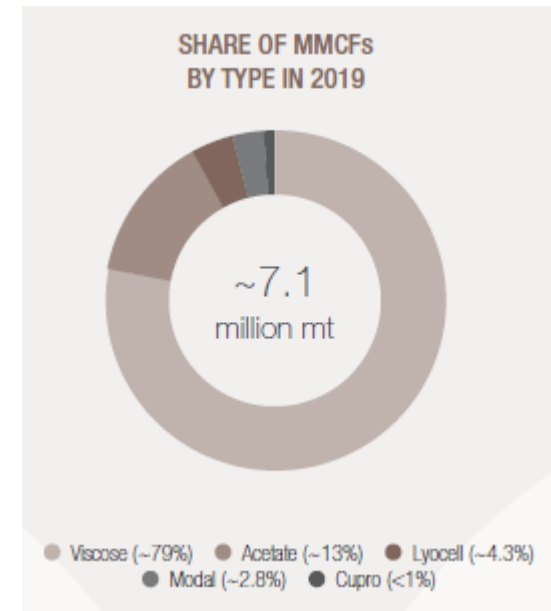
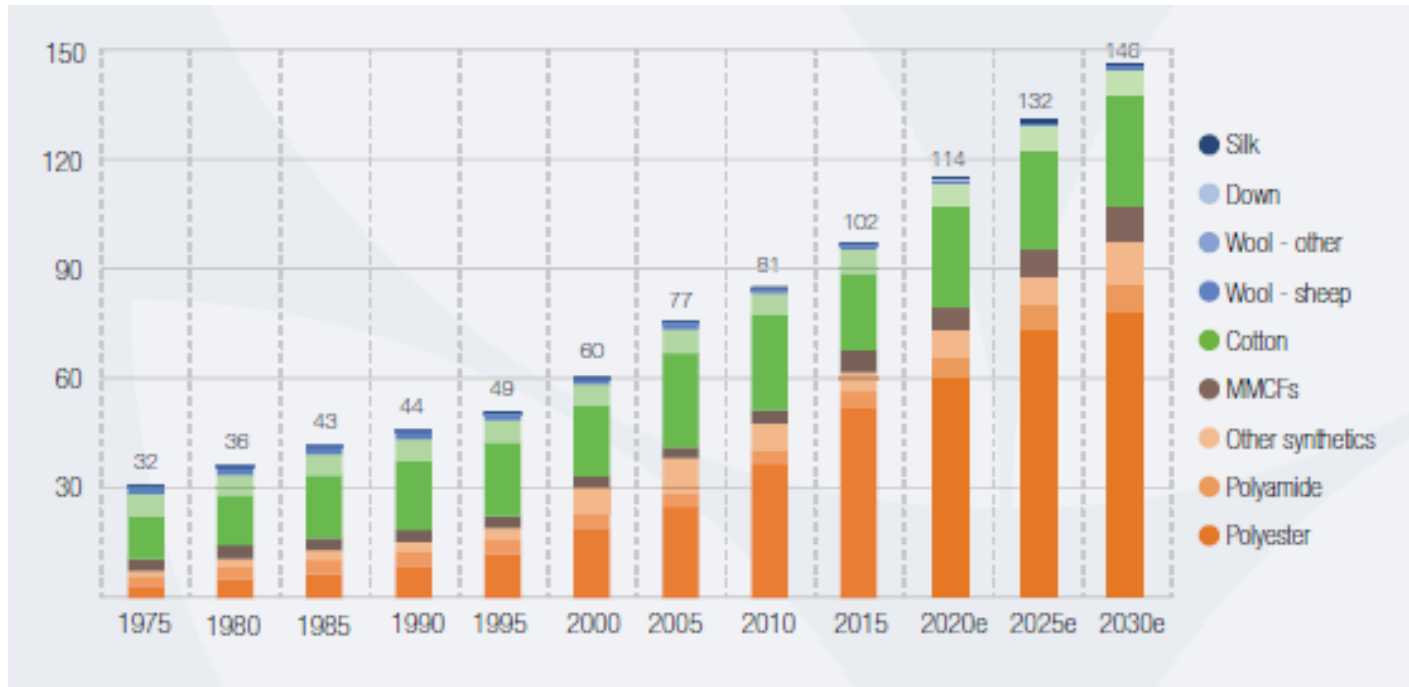
Straw and wood fibres as raw materials						
						
Textiles	Biocomposites	Packaging	Lignin products*	Hemicellulose products*	Sourcing & fractionation of straw	Other fibre products
<ul style="list-style-type: none"> • New, sustainable textile fibres for wearable textiles and nonwovens • Staple fibre analytics and performance testing • New staple fibre applications and post-treatment technologies • Recycling and traceability 	<ul style="list-style-type: none"> • Raw material processing and converting • Material properties • Recycling and end-of-life • Biocomposites containing fibres and lignin • All-cellulose composites & natural fibre polymer composites 	<ul style="list-style-type: none"> • New pulp-based plastic-replacing packaging solutions • Tools and processes for designing sustainable packaging • Barriers and binders based on natural polymers 	<ul style="list-style-type: none"> • Lignin fractionation for material applications • Lignin as functional ingredient for thermoplastics and bio-composites • Lignin dispersants • Lignin containing bio-composites <p>*) Especially for straw</p>	<ul style="list-style-type: none"> • Hemicellulose purification to food, feed and cosmetics applications • Chemically modified hemicellulose and C5 & C6 sugars for consumer products <p>*) Especially for straw</p>	<ul style="list-style-type: none"> • Sustainable agro value chains and linkages to food production • New fractionation technologies for processing of agro-residual raw materials 	<ul style="list-style-type: none"> • New materials based on pulp fibres for high-volume applications • Novel chemistry for pulp fibre modification • Functional structures from pulp fibres • Advanced 3D and 4D fibre processing methods • Hybrid materials containing pulp fibres
<p>Cross-cutting topics</p> <ul style="list-style-type: none"> • Replacing plastics • Digitalisation & measuring • Emerging technologies • Sustainability assessment • Design for circularity • Piloting and test-beds for new applications • Following regulatory environment 						

Vision for 2030

- **Investments** in commercial production of new bioproducts (textile fibres, biocomposites, other bioproducts, etc.)
- New bioproducts available to the markets with significantly **lower carbon footprint**
- Sales and/or out-licensing of **new technologies** related to new bioproducts
- **Professionals** trained for new bioproduct businesses
- **Sustainability awareness** increased throughout the value chains

Textile fibre market

MMCF = Man-Made Cellulosic Fibre

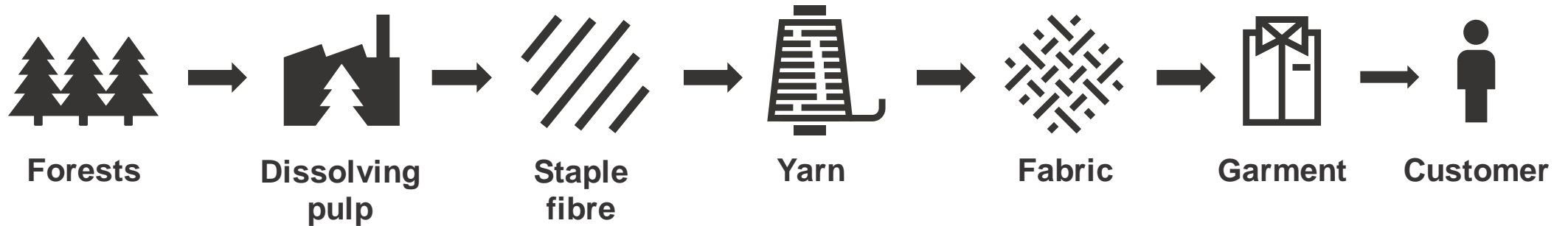


Sources: "Preferred Fiber & Materials Market Report 2020" by Textile Exchange and <https://hotbutton.canopyplanet.org/>

CanopyStyle Audit
Canopy's Hot Button
Ranking



Trends with MMCF



1. Virgin MMCF: In 2019, only 40-50% of wood used in MMCF production came from PEFC/FSC certified forests
 - Paper-grade pulp instead of dissolving pulp?
2. “Recycled” MMCF: In 2019, still less than 1% of all MMCF was based on recycled raw materials
 - Challenge: Typical textiles a blend of various fibres
3. Straw as a third feedstock platform
 - Agro residue to be used for fibre production, largely available globally (wheat, rice etc.)
 - Huge impact to CO₂ emissions, if collected and not burned in countries like India: If all agro biomass in the fields in the Delhi region’s **three states** could be used as raw material, we could replace **over 50%** of the global cotton production.

Fortum and Metsä Group textile fibre development



Fortum:

- Resource efficient fractionation technology development together with Chempolis
- Developing both paper-grade and dissolving pulp for textile fibres
- First fibre tests done using different fibre technologies and straw as raw material

Metsä Group:

- Today a major producer of softwood paper-grade pulp → Significant share sold to other companies for valorisation → Could a part of this be valorised to textile fibre by Metsä Group?
- MMCF technologies available today do not allow for production based on paper-grade pulp → need for new chemistry
- Ion liquid-based technology now at the beginning of demo phase (see pic). Demo plant owned 50/50 by Metsä Spring and ITOCHU
- The demo phase takes roughly 2 years

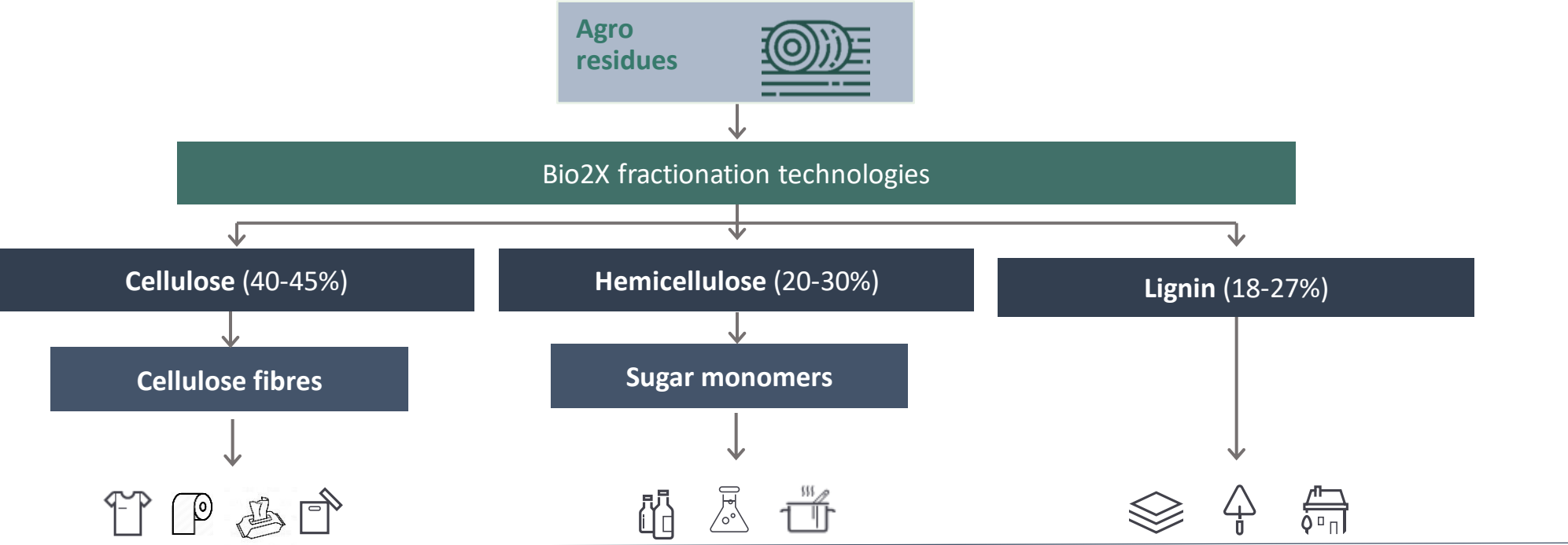


Wood-based 3D packages by Metsä Spring

- Metsä Spring and Valmet invest jointly approximately EUR 20 million in a new R&D project to develop a new added-value product for the forest industry
- Target is to convert wet wood pulp into final 3D fibre products without any intermediate steps in order to replace, for instance, packages made out of fossil raw materials
- The main raw material used to make the new products is renewable, sustainably-grown and pure Finnish wood fibre
- Greenfield pilot plant will be built in Äänekoski during 2021 to test the technical concept



Turning biomass into high-value end products



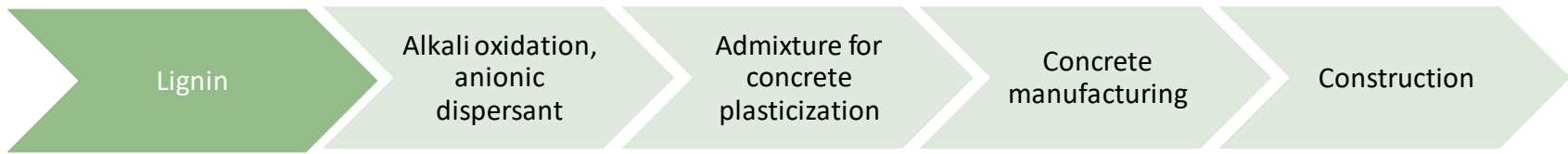
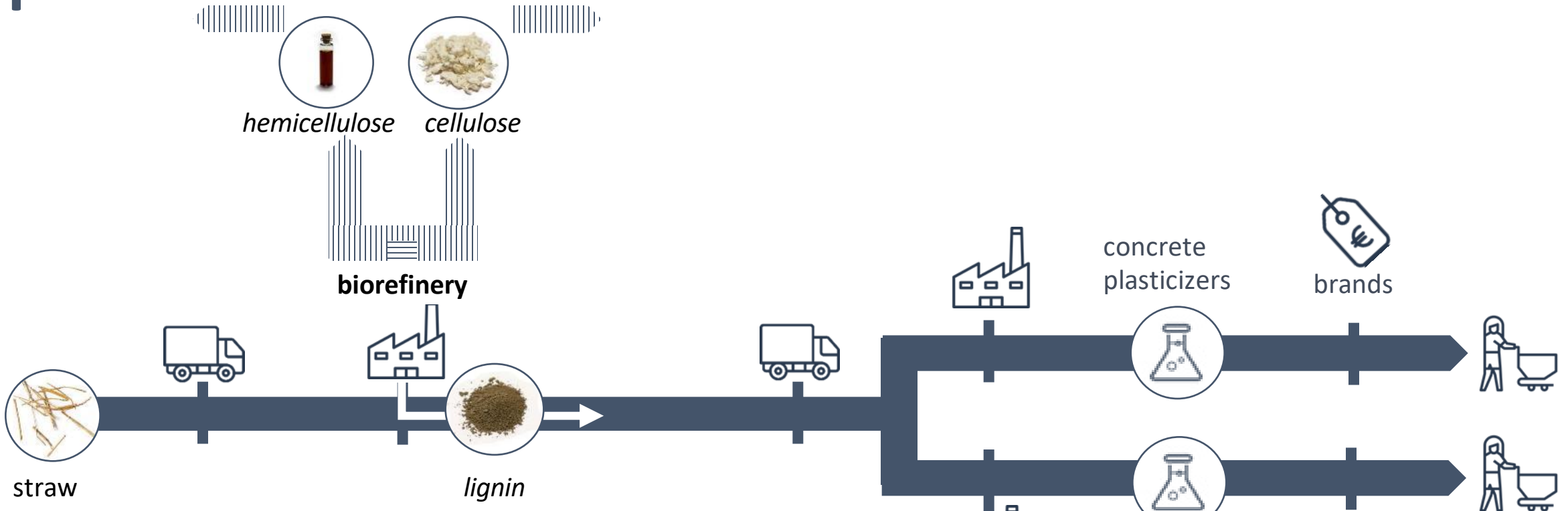
End products:

- Dissolving and bleached pulp for textile fibre, applicable to clothing and non-woven
- Bleached pulp for tissue
- Brown pulp for packaging
- Composites

- Xylose for foods and cosmetics
- Furfural, acetic acid
- Other chemical intermediates

- Bio-resins, adhesives, foams
- Concrete plasticizers, dispersants
- Thermoplastics
- Asphalt additive

Lignin: from local agro residue to global high-value products



Recycled plastics

- Fortum Waste Solutions operates a plastics collection (originating from households, farming and commercial facilities) and separation facility in Riihimäki
- Materials are separated into PE (LPDE and HDPE), PP and PET, and granulated.
- Granules are used as raw materials in different industrial applications, such as profiles, furniture, handles, kitchenware, pottery etc.
- Biocomposites is one of the theme areas in ExpandFibre, looking for ways to develop new, even more sustainable, light-weight materials combining recycled plastics and fibres from biomasses.



Join us to meet the growing demand for sustainable bioproducts – we need players from every part of the value-chain

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