The kraft pulp mill a node in the future bio-based economy

Presentation by Peter Axegård

BIOFOR 2016. Session- Energy Efficiency and Biomass Conversion - Portrait of an Industry in Transformation

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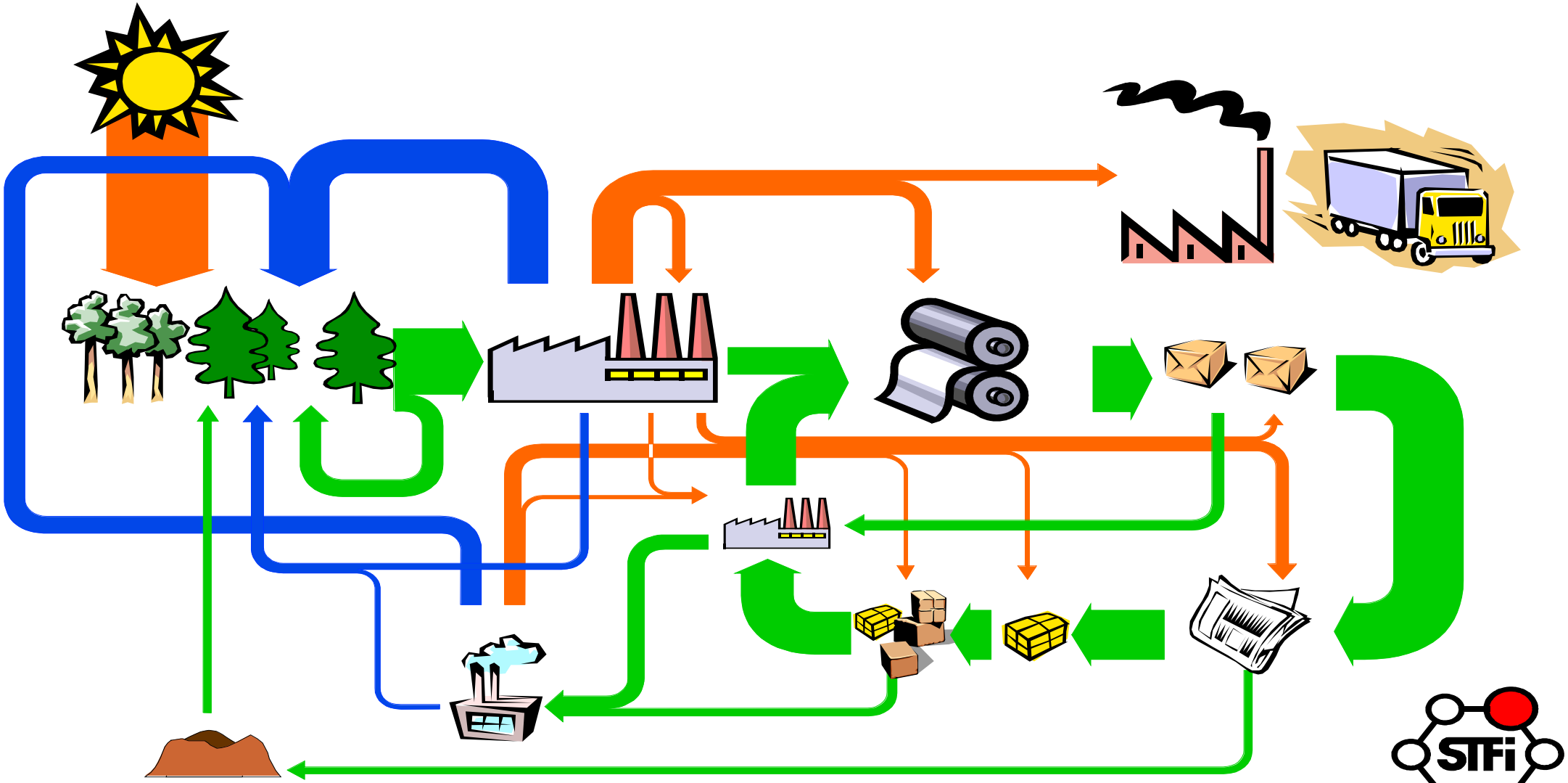
Ecocyclic pulp mill program vision 1996



Organisk substans Energi Oorganisk substans



$$6\ CO_2 + 6H_2O \rightarrow C_6H_{12}O_6 + 6\ O_2$$

Carbon dioxide	**+**	**Water**	**→**	**Carbohydrates**	**+**	**Oxygen**
1.5 kg	**+**	**0.6 kg**	**→**	**1.0 kg**	**+**	**1.1 kg**

The forest sector in Sweden

- Forest growth about 380 TWh/y
- Use about 200 TWh/y
- Pulp capacity 8 million t/y
- Export value 13 billion €/y

A comparison between Canada and Sweden

		Canada *	Sweden**
Total forest area	**million hectares**	**310*** **	**28*** **
Productive forest area	**million hectares**	**227**	**22**
Total wood volume	**billion m^3**	**33*** **	**3.4*** **
Volume harvested	**million m^3/y**	**148 (227)**	**86 (125)**
Harvested area	**hectares/y**	**594.000**	**860-0000**
Felling	**m^3/hectare**	**250**	**100**

* Natural Resources Canada, The state of Canadas forests, Annual Report 2014
** Swedish Forest Industries, Facts 2014
*** FAO Forestry Paper 163

A comparison between Canada and Sweden

		Canada *	Sweden**
Production pulp and paper	**million tonnes/y**	**24.7 (export 17.5)**	**14.4 (export 13.0)**
Production solid wood products	**million m3/y**	**66 (export 40)**	**17.5 (export 12.3)**
Employment		**216.500**	**69.000**
Gross export value	**billion/y**	**$ 28**	**€ 13**
Net export value	**billion/y**	**$ 19**	**€ 8**

* Natural Resources Canada, The state of Canadas forests, Annual Report 2014
** Swedish Forest Industries, Facts 2014
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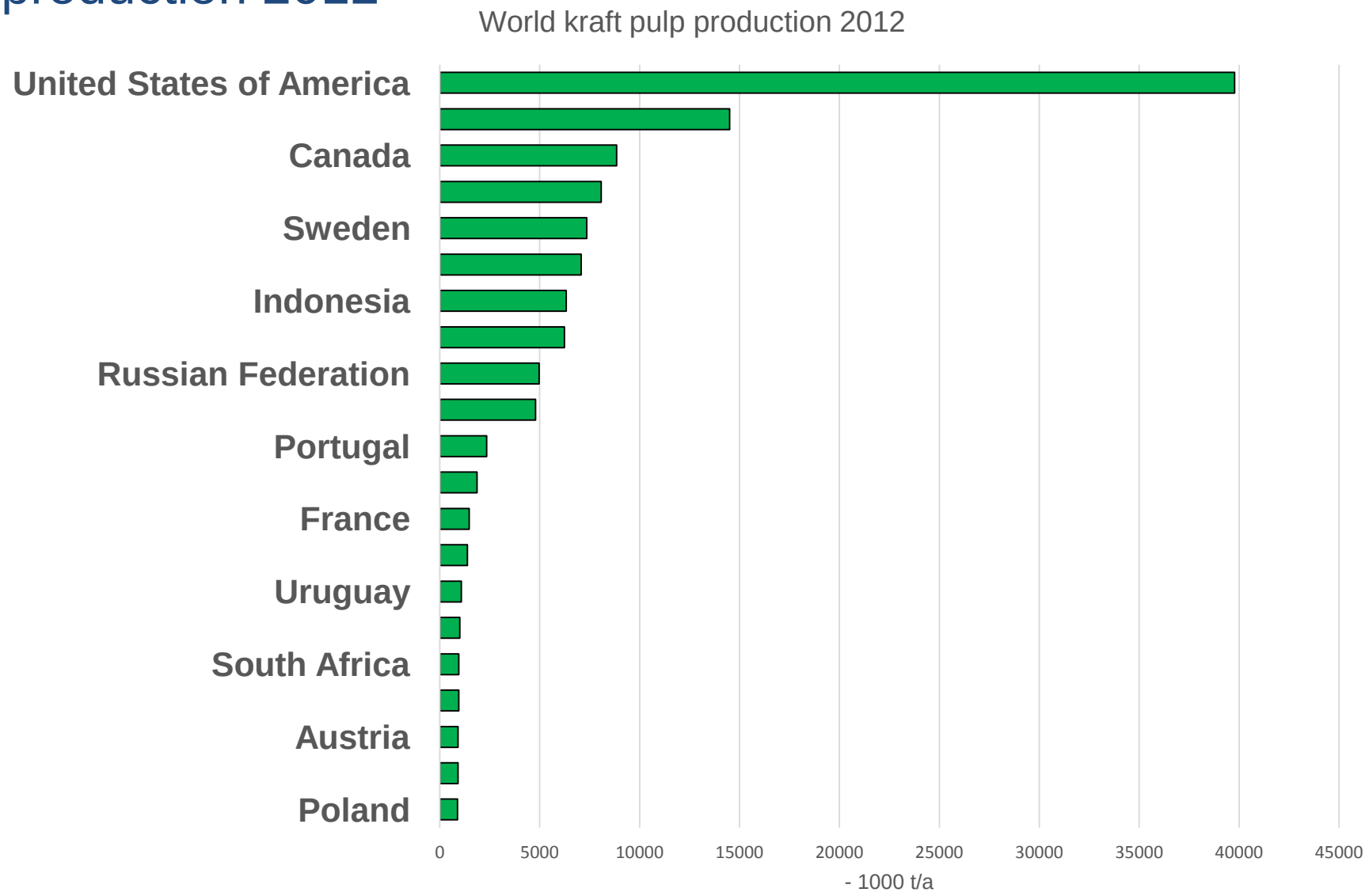
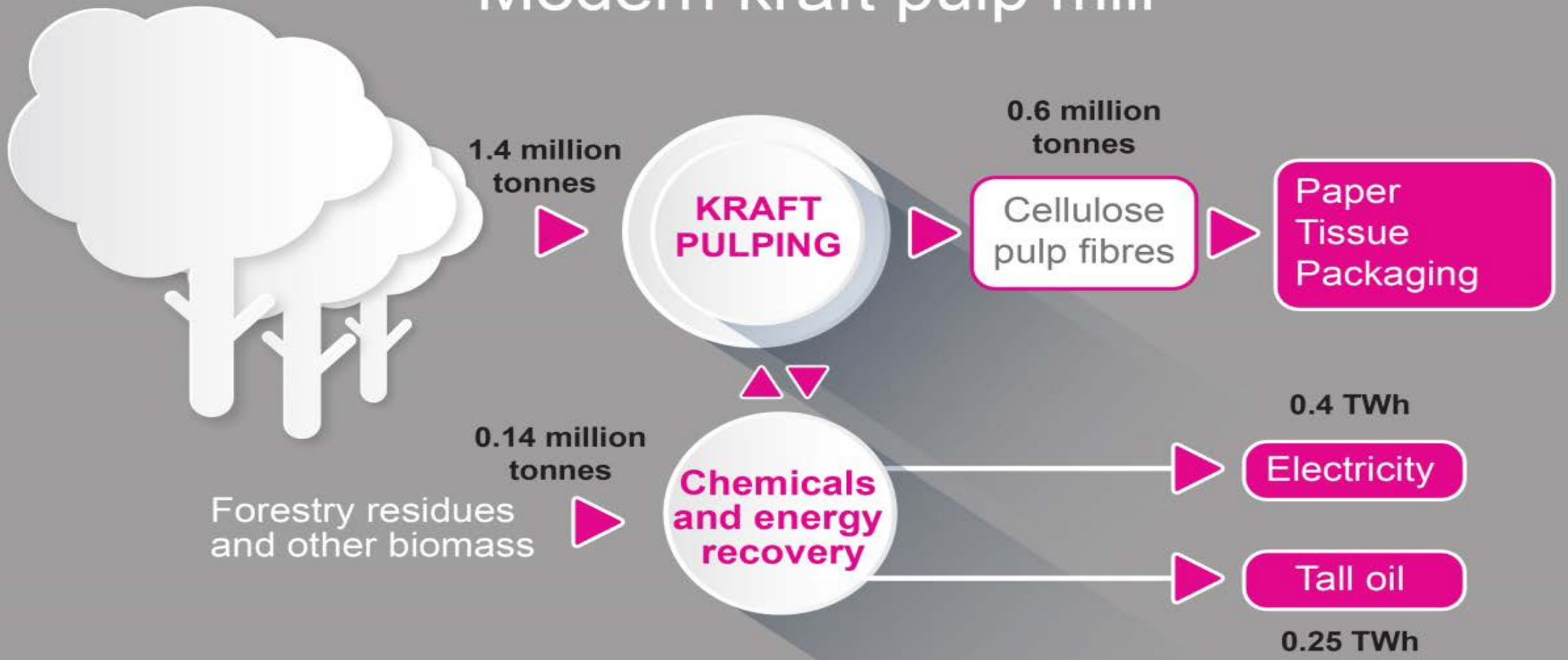
Kraft pulp production 2012



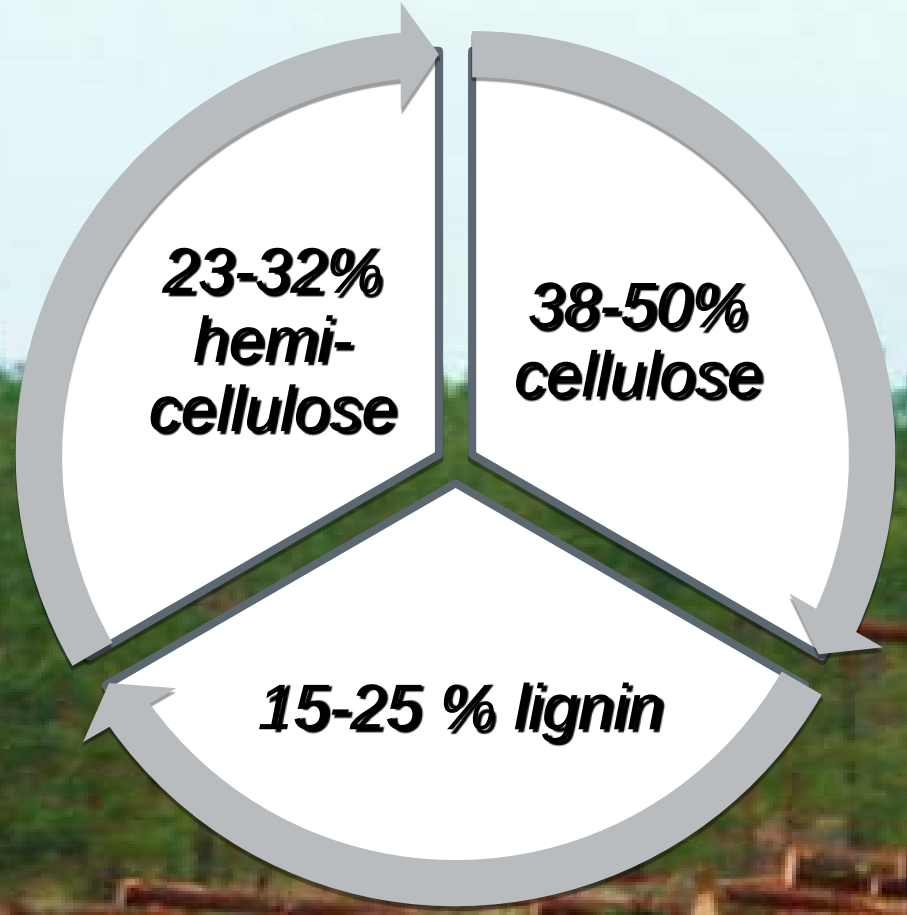
Source: FAOSTAT

The pulp mill biorefinery

Modern kraft pulp mill

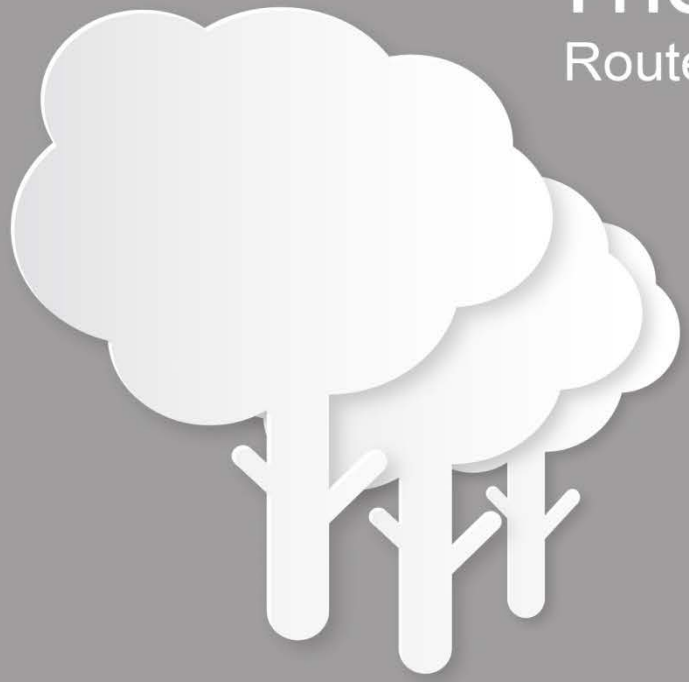


Attractive and renewable feedstock for biorefining



The kraft pulp mill biorefinery

Route A Cellulose



KRAFT PULPING

Cellulose pulp fibres

Paper
Tissue
Packaging

Celluloses

Textile materials

Advanced materials

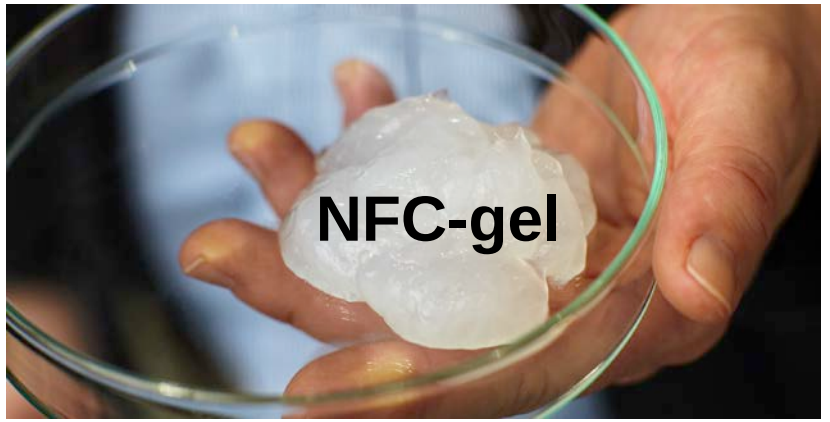
Speciality cellulose

Forestry residues and other biomass

Chemicals and energy recovery

Electricity

Kraft cellulose products

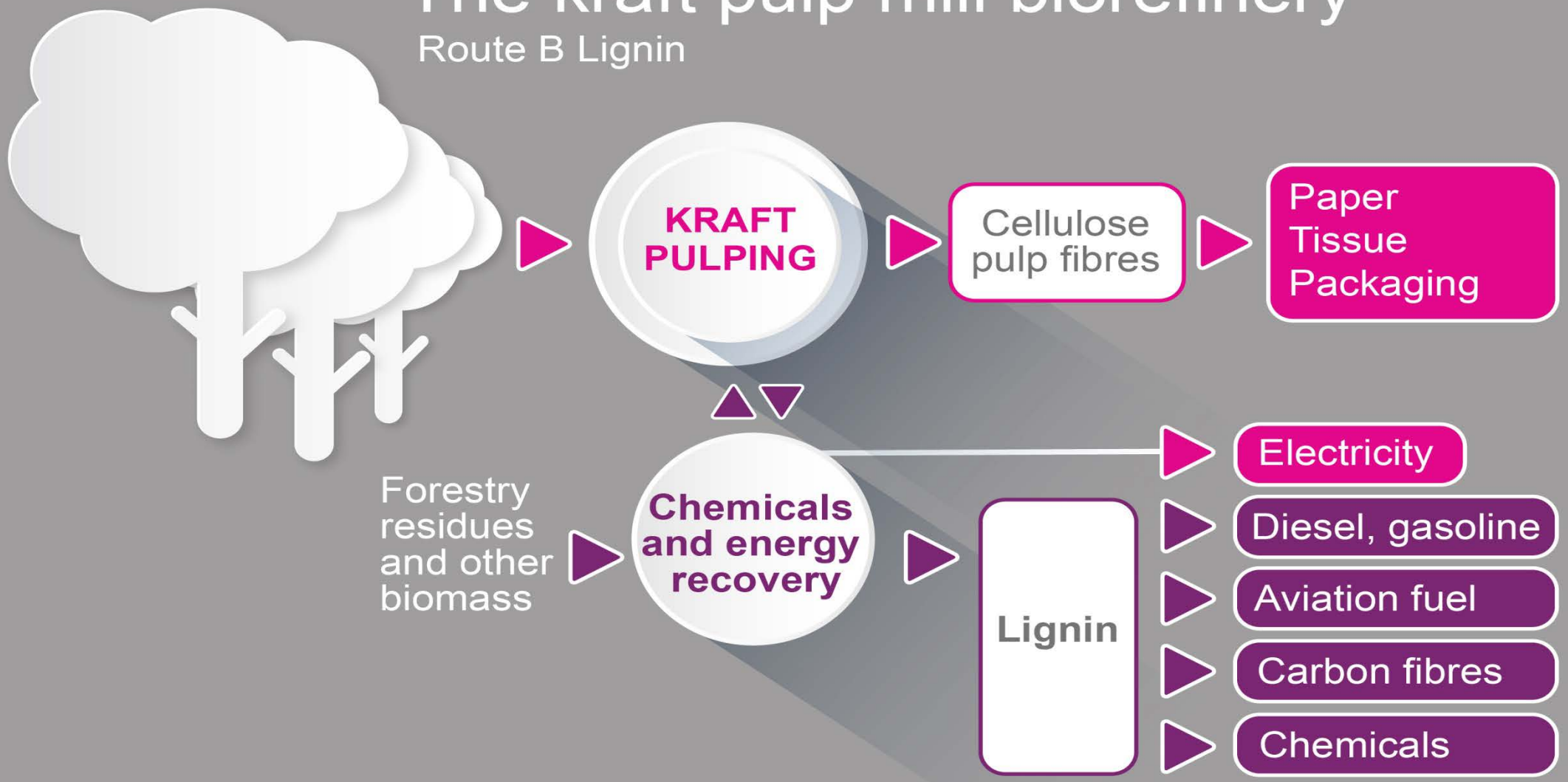


Textile fibres from regenerated cellulose

From wood to textiles without CS_2 or expensive solvents

The kraft pulp mill biorefinery

Route B Lignin



Two commercial LignoBoost installations

Domtar, Plymouth, USA
Start: Q1 2013

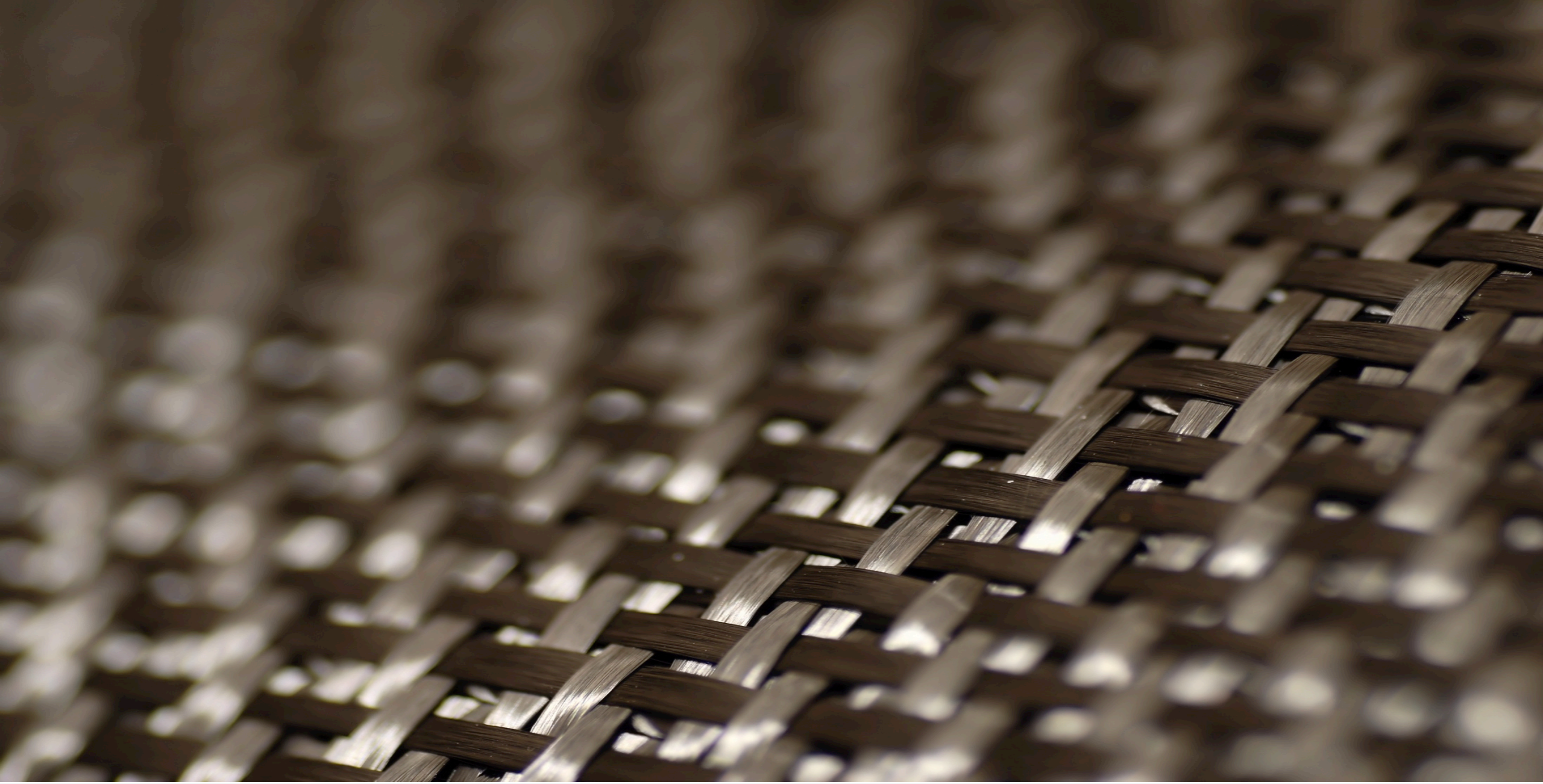
Pulp capacity: 466 000 t/y

Lignin capacity: 25 000 t/y (54 kg/ADt)

Stora Enso, Sunila, Finland
Start: Q1 2015

Pulp capacity: 370 000 t/y

Lignin capacity: 50 000 t/y (135 kg/ADt, 22%)



Tak av ligninbaserad kolfiberkomposit med ligninbaserat batteri

Nära samarbete

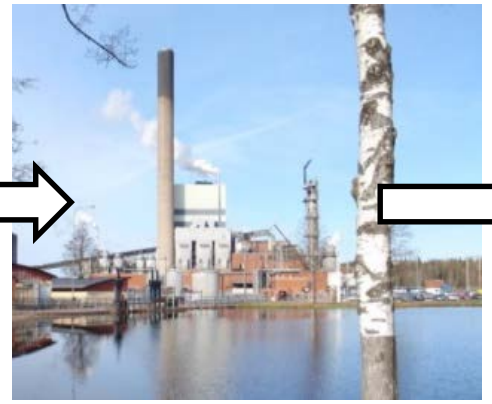
- Innventia
- Swerea-SICOMP
- KTH

Future light weight cars – carbon fibre from forest replaces steel

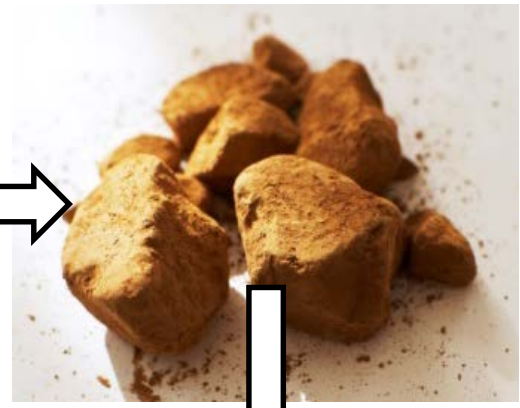
EU/BBI GreenLight Project 2015-2018

Renewable raw material

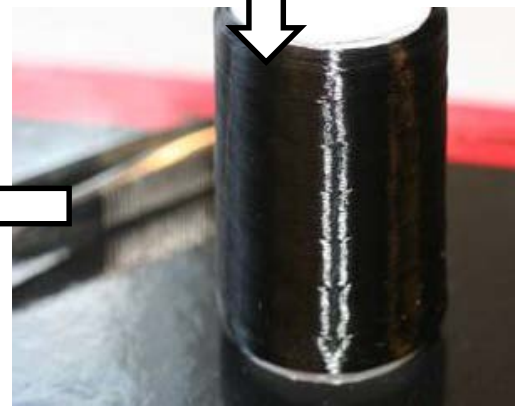
Kraft pulp mill



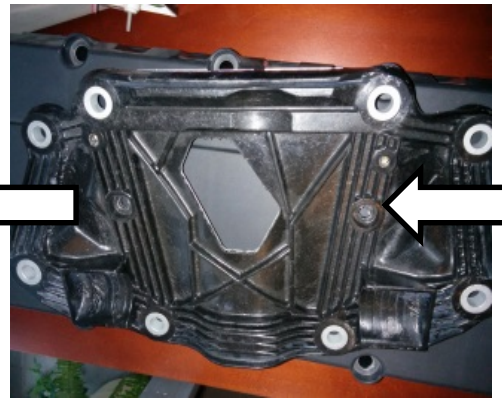
Lignin recovery



Lignin-fibres



CF reinforced polymer



End use

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SÖDRA

FASERINSTITUT BREMEN FIBRE

FOURNÉ MASCHINENBAU

stfi

swerea | SICOMP

NetComposites

BLATRADEN Advanced Composite Solutions

CRF

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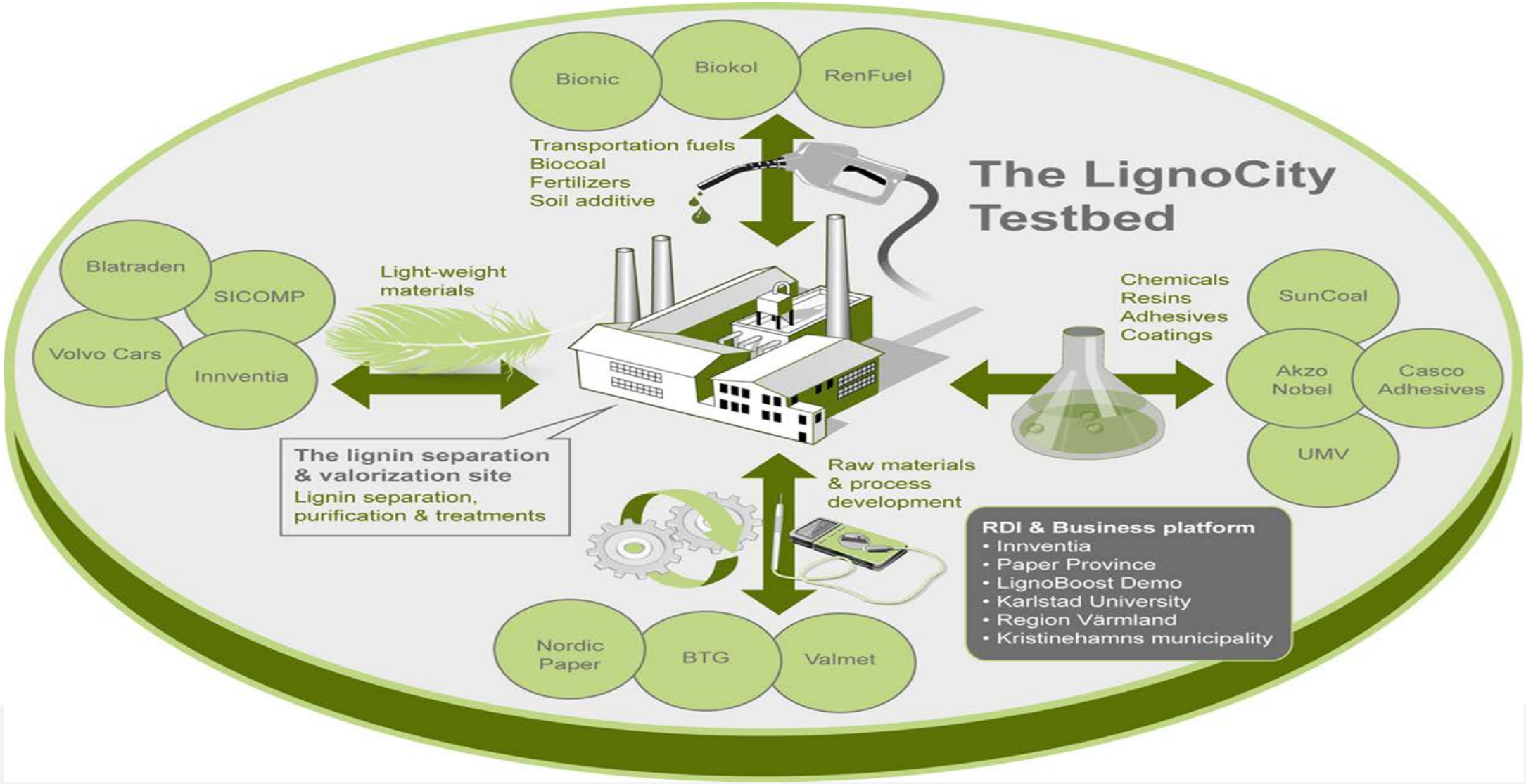
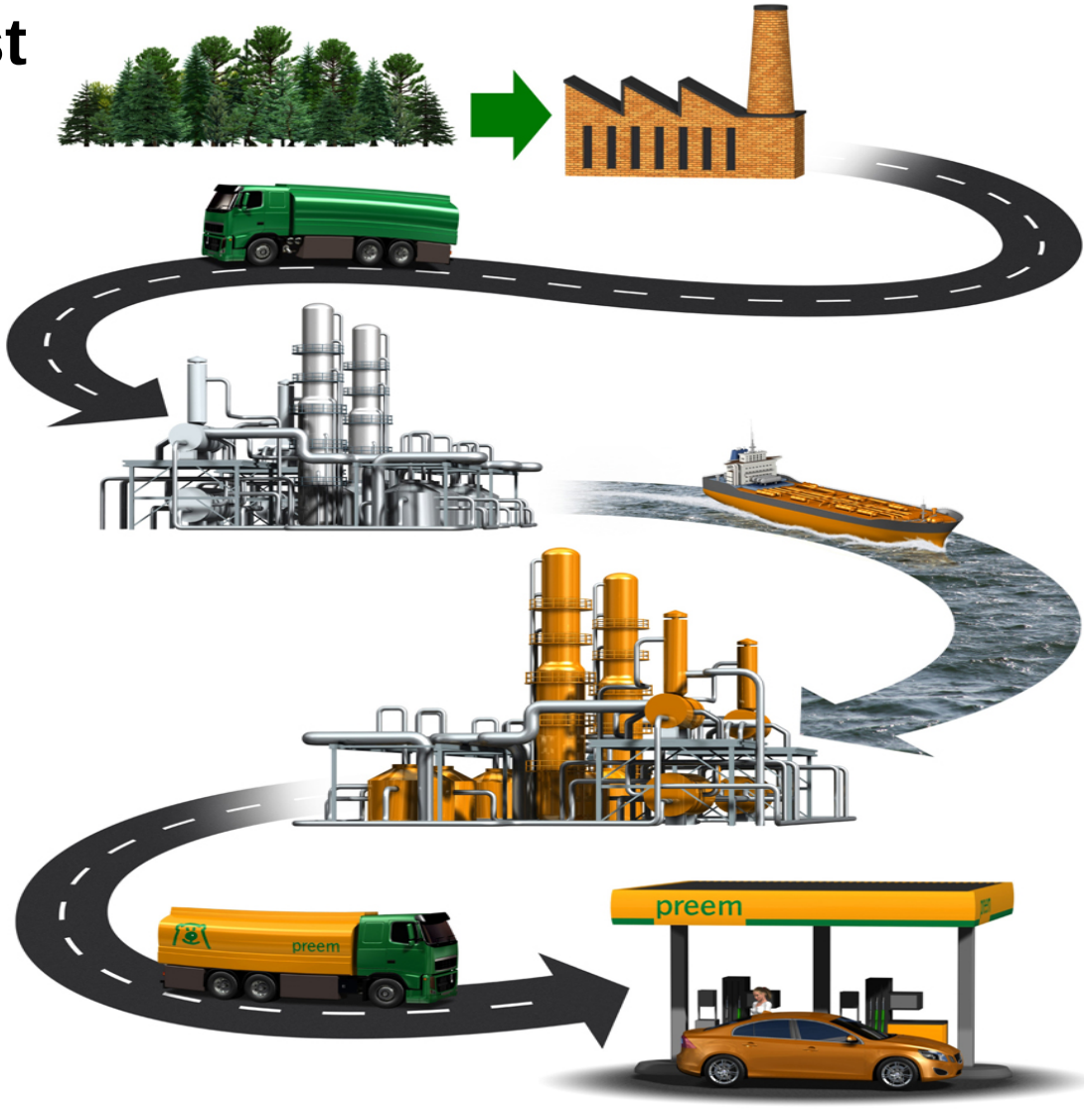
A Swedish industrial and regional initiative The LignoCity

Innventias lignin demo plant is the technical platform



Future gasoline and diesel from the forest

From the forest to the tank



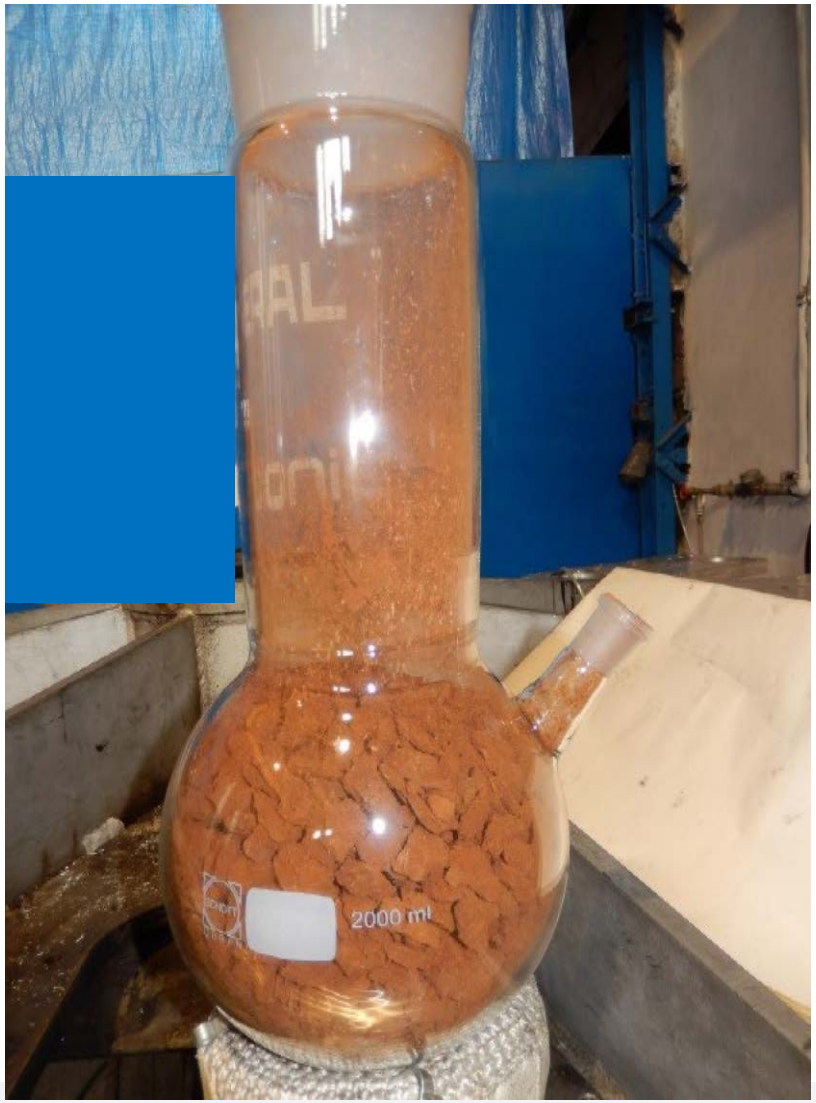
1. **Lignin from pulp mill black liquors**
2. **Lignin depolymerised to liquid form**
3. **Conventional gasoline produced in Preem`s oil refinery in Lysekil**
4. **Evolution gasoline – a conventional gasoline reduces CO_2. – emmissions and works in all gasoline engines .**

Turning lignin into bio-based aviation fuel

- Innventia is coordinating the recently launched Lignojet research collaboration project, which aims to establish lignin as a raw material in bio-based aviation fuel.
- The Swedish-Brazilian project is co-funded by VINNOVA, and brings together players throughout the entire value chain.

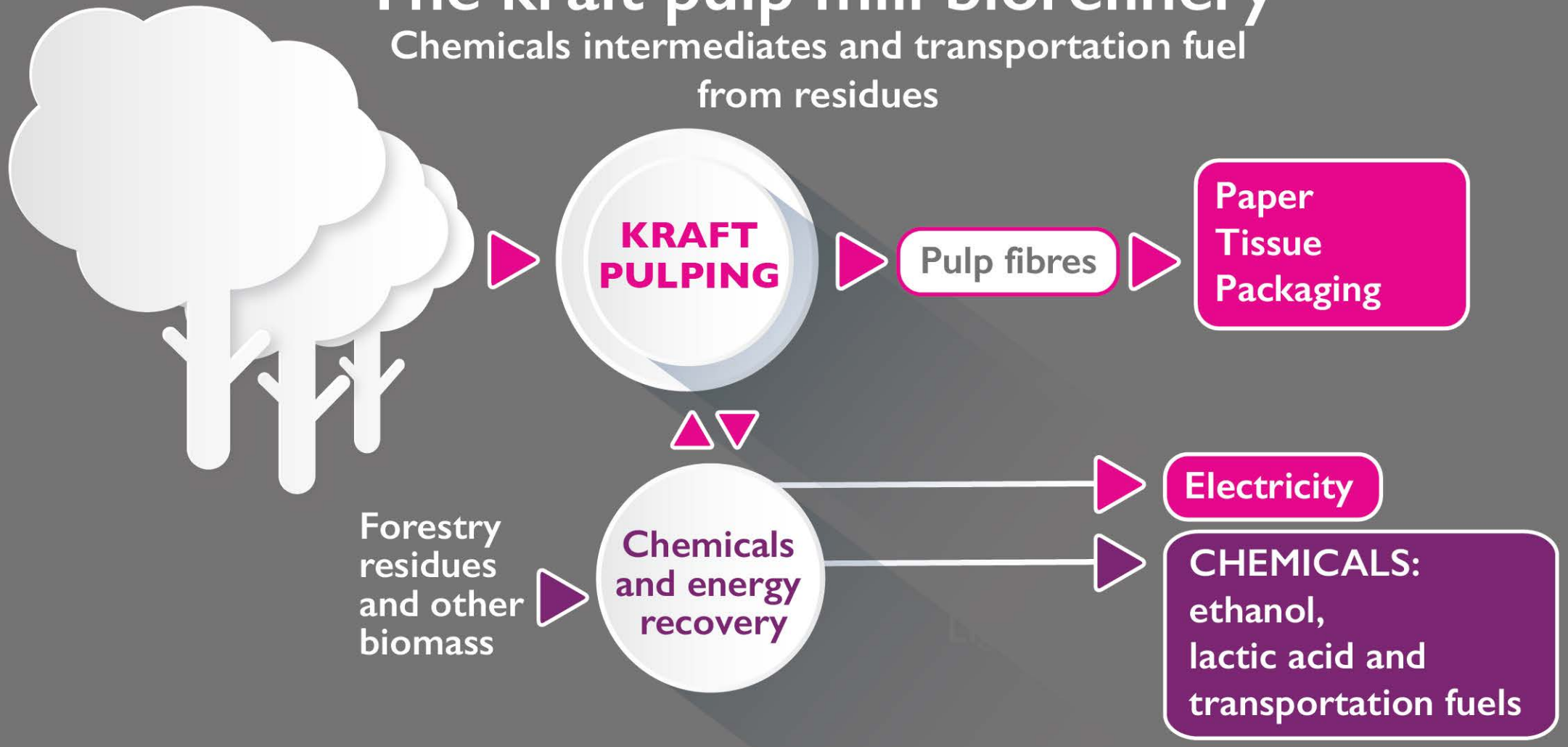
The project is bring co-funded by VINNOVA and will run until December 2016. In addition to Innventia, the Brazilian pulp producer Fibria, Karlstad Airport, LignoBoost Demo, Valmet and SP Process Development are also involved.

Biooil and biocoal from kraft lignin

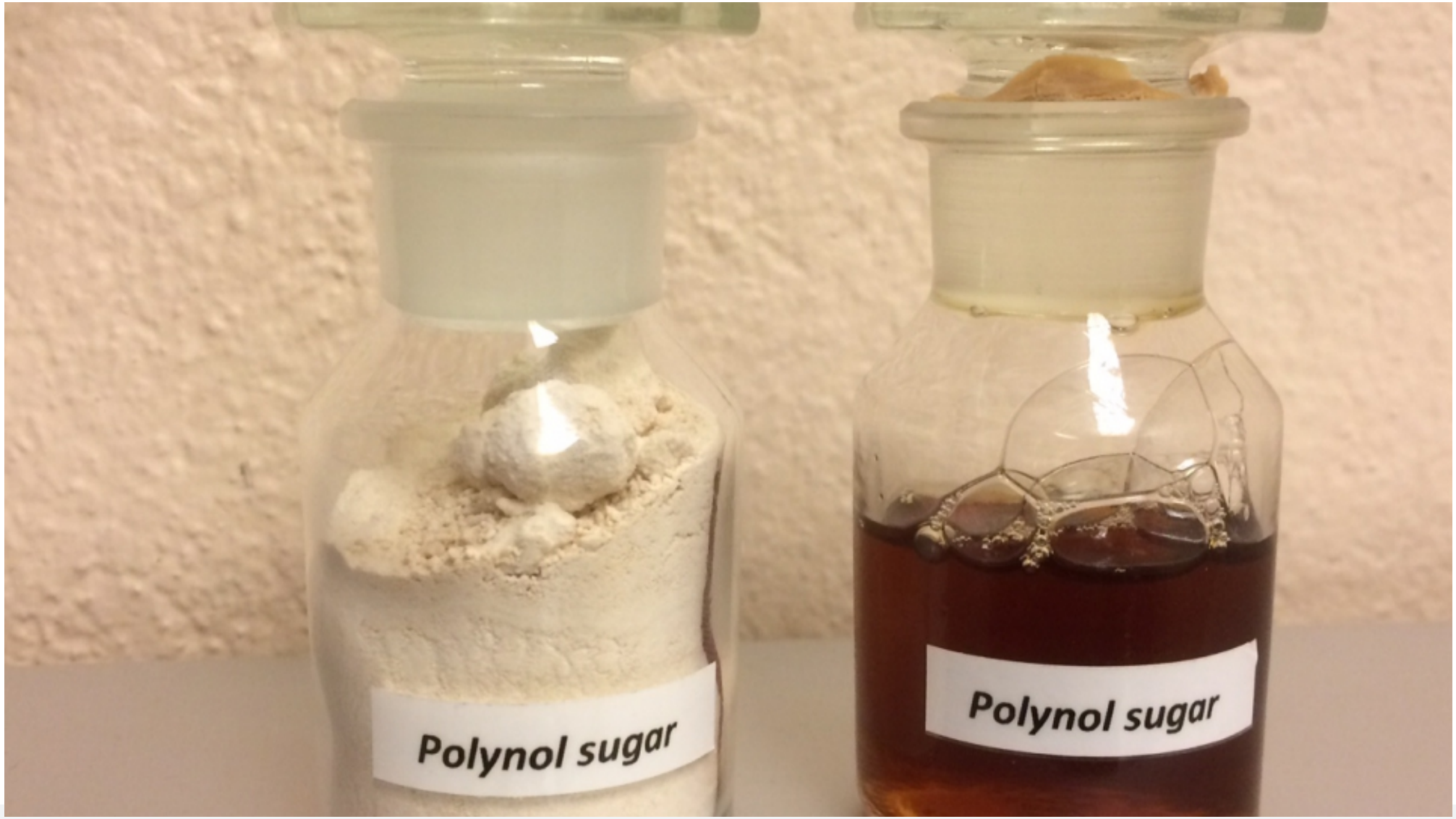


The kraft pulp mill biorefinery

Chemicals intermediates and transportation fuel from residues



2G socker från skogsråvara med alkalisk process



Nära samarbete

- Innventia
- SP Processum

Conclusions

- **Momentum for a forest-based economy**
- **Pulp mills are well positioned to be nodes for new value chains**
- **Countries with large forest assets and pulp mills will benefit**

Innventia

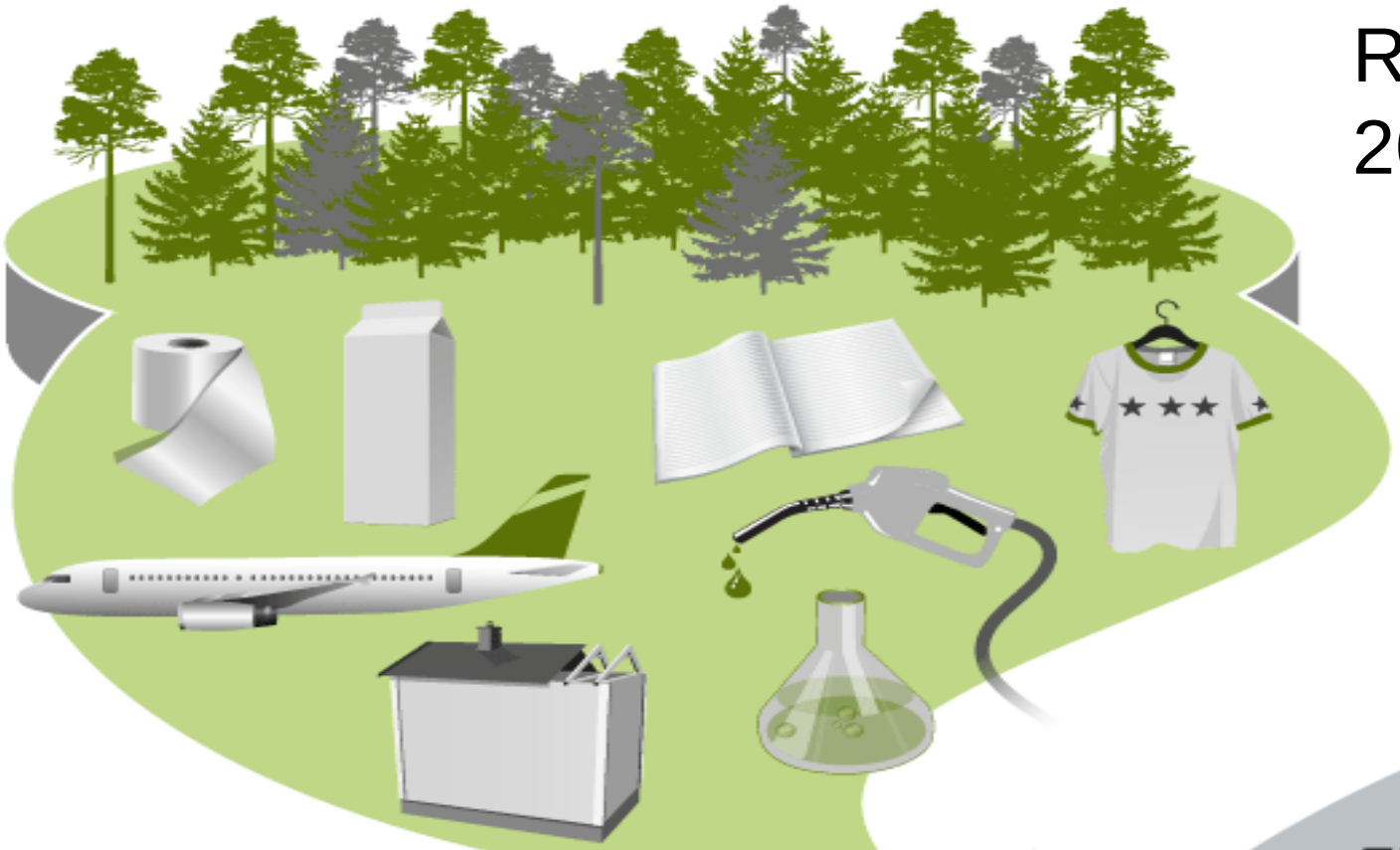
Boosting Business with Science

RISE-project Bioeconomy - main focus is on biomaterials

Total turnover 2014

Area	M€	%
Biomaterials	42	49
Food	14	17
Bioenergy	11	13
System aspects	9	11
Biochemicals	8	9

RISE-project Bioeconomy 2014-2015



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SP

SWEDISH ICT

swerea swedish research

RISE-project Bioeconomy - main focus on biomaterials

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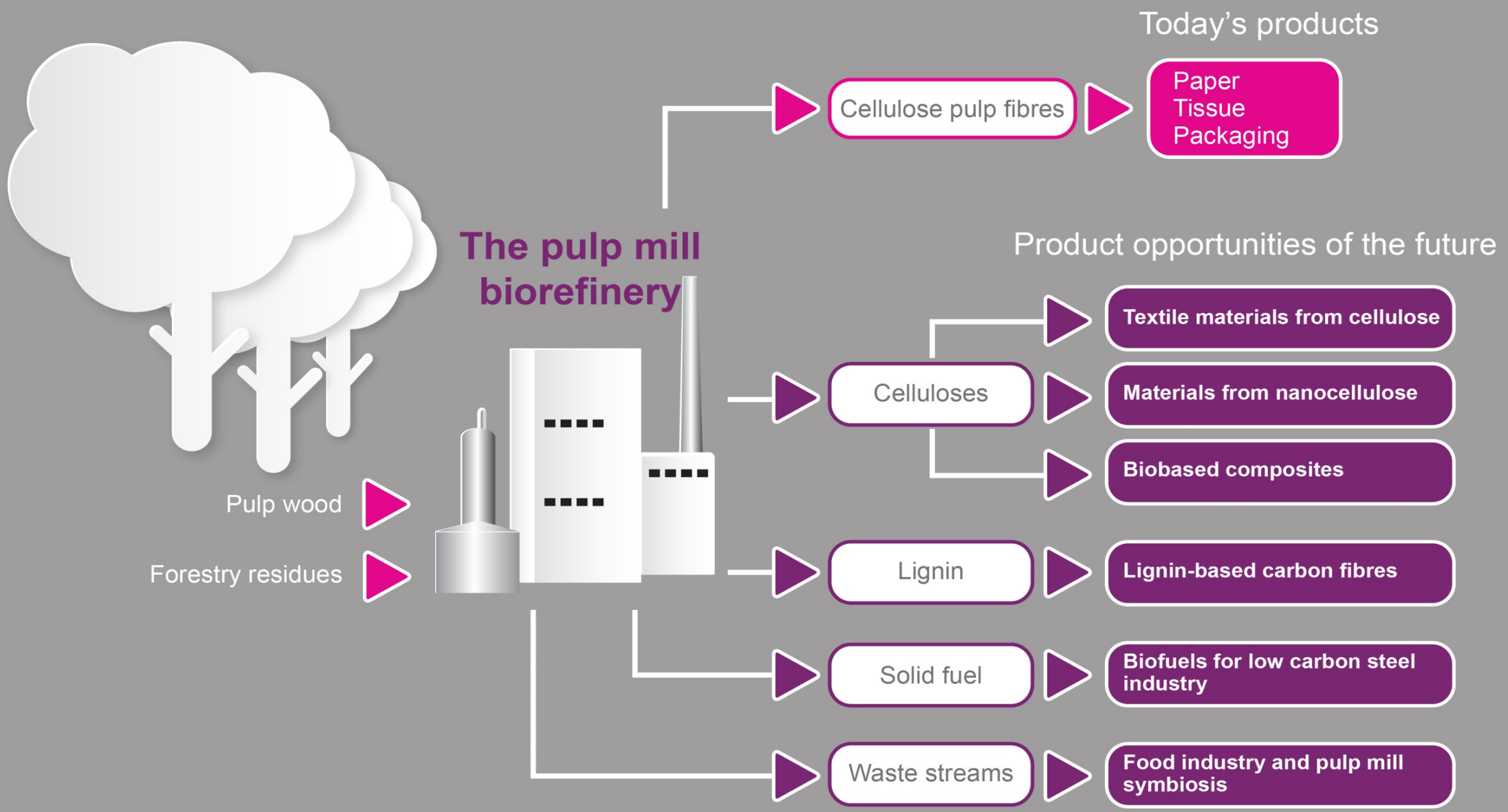
Biomaterials

Pulp, paper, board, packaging
Textile from cellulose
Nanocellulose
Carbon fibres
Bioplastics
Biocomposites
Building and construction


Today's products
Cellulose pulp fibres
Paper
Tissue
Packaging
The pulp mill biorefinery
Product opportunities of the future
Pulp wood
Forestry residues
Celluloses
Textile materials from cellulose
Materials from nanocellulose
Biobased composites
Lignin
Lignin-based carbon fibres
Solid fuel
Biofuels for low carbon steel industry
Waste streams
Food industry and pulp mill symbiosis

Roadmaps made in RISE-project Bioeconomy

Available at www.ri.se/om-rise/publikationer

1. The pulp mill biorefinery
2. Textile materials from cellulose
3. Advanced material from nanocellulose
4. Bio-based composites
5. Lignin-based carbon fibres
6. Biofuels for low-carbon steel industry
7. Food industry and pulp mill symbiosis
8. Sensors for improved resource efficiency


PULP
INDUSTRY:
at the core of
the bioeconomy
of the future

Save the date!
7th Nordic Wood Biorefinery Conference 2017