



ABTCP | 49º Congresso e Exposição
2016 | Internacional de Celulose e Papel
 49th Pulp and Paper International Congress & Exhibition

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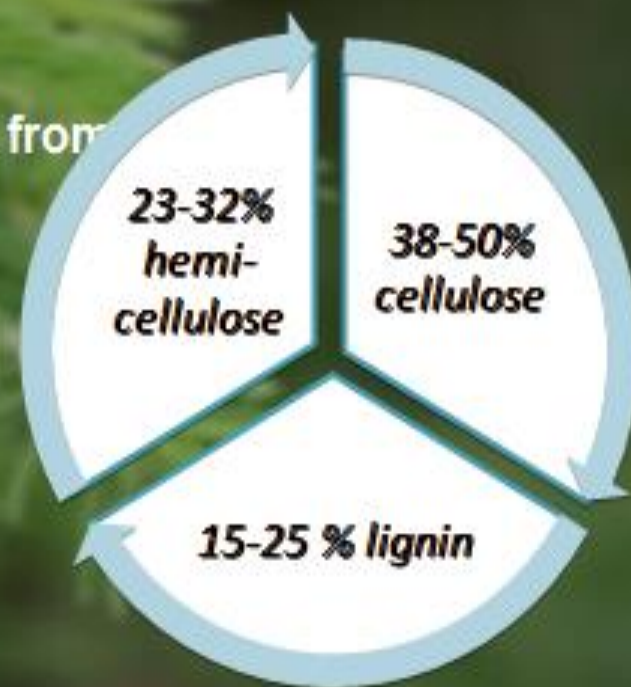
Global trends in pulp mill biorefining

Dr Peter Axegård
 Vice President Bioeconomy Strategi



Innventia's – Business idea

- Innventia carries out R&D, based on raw materials from the forest, for clients along entire value chains
- Pulp, paper, tissue, board and packaging
- Bioenergy, biochemicals and biomaterials



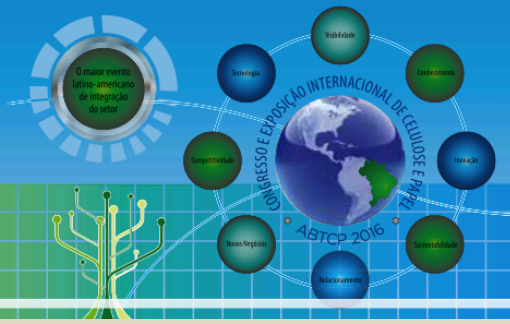


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InnRP 2015/17 – 34 companies from 14 countries

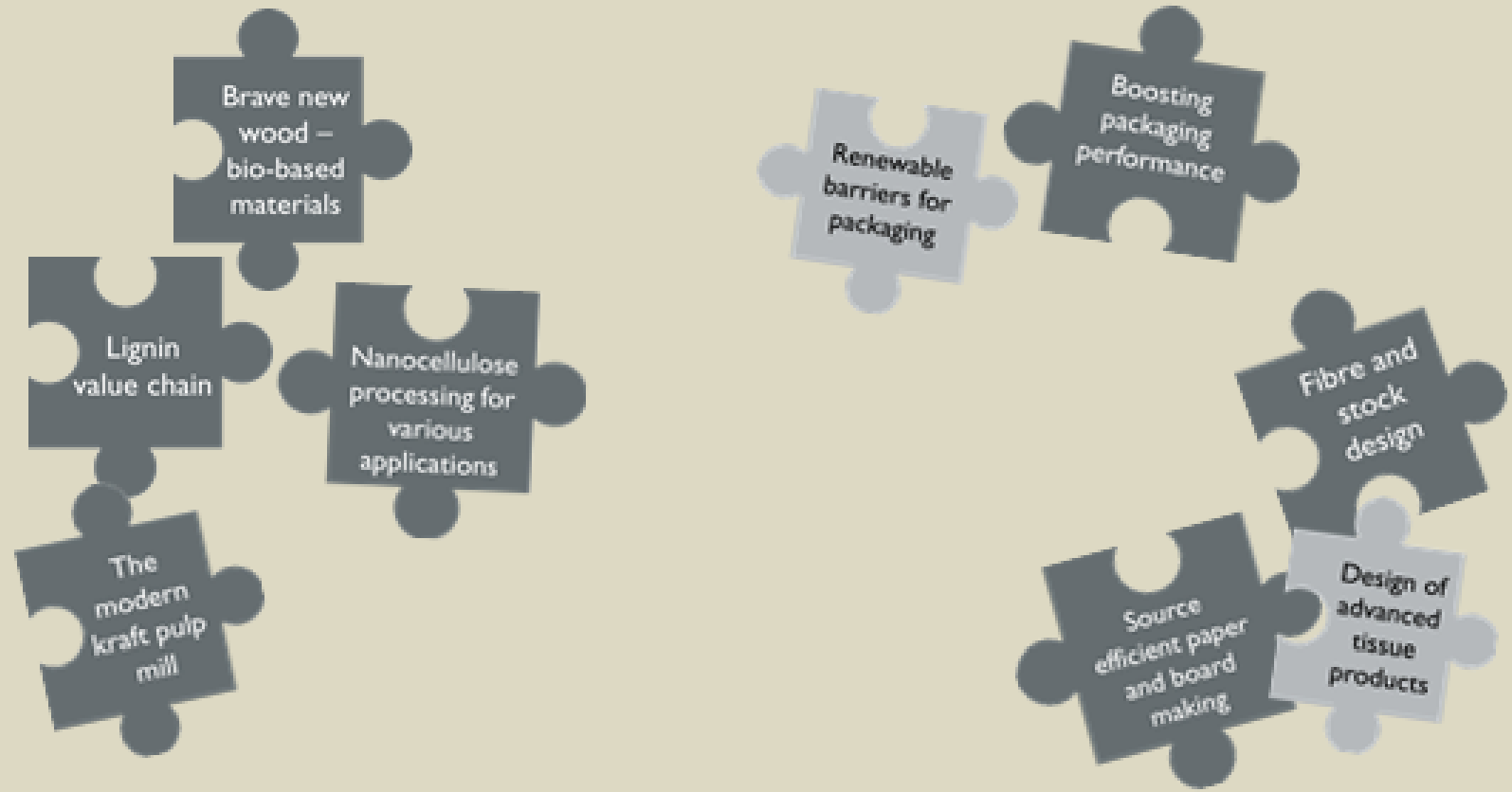


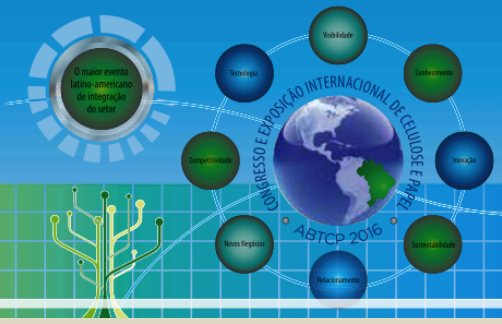


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Innventia Research Programme 2015/2017



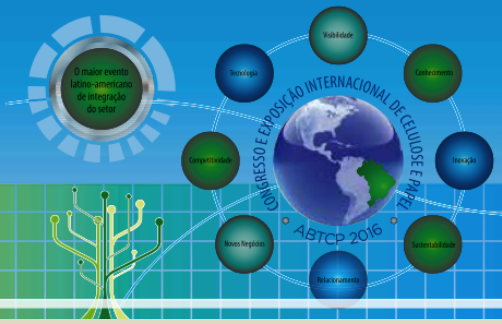


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Major challenges for the pulp and paper industry

- Changing consumer behaviour - Declining demand for paper
- Risk for overcapacity on pulp and paper

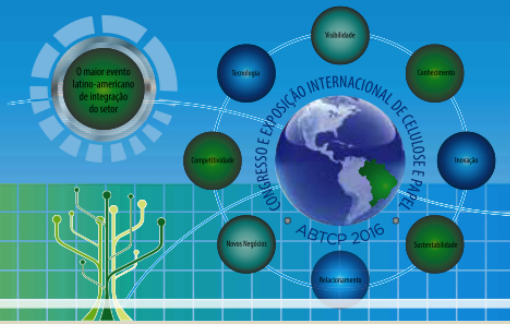


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Industrial infrastructure with many opportunities

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- Highly efficient logistics system
- Large and energy efficient infrastructure
- Possibilities to repurpose the pulp and paper mill infrastructure
 - Pulp mills - wood and plant polymers
 - Paper mills - planar products, paper for energy storage, solar cells, textiles etc.

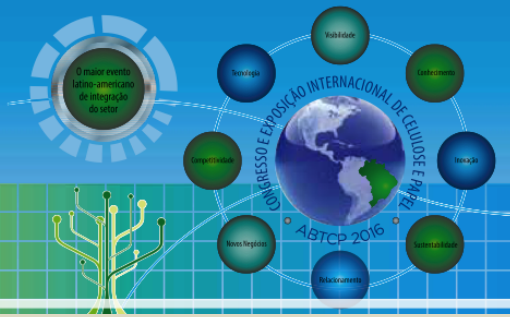


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2013 **2014**

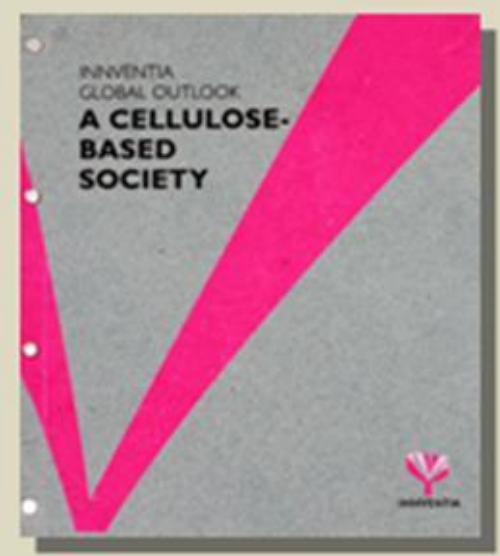


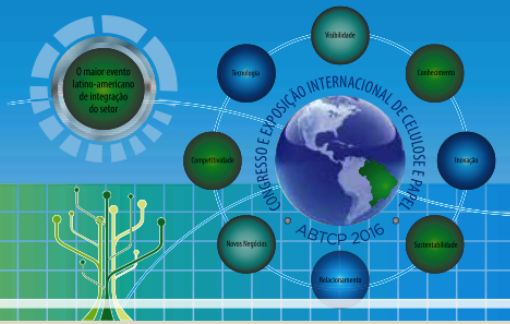


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2013 **2014** **2016**

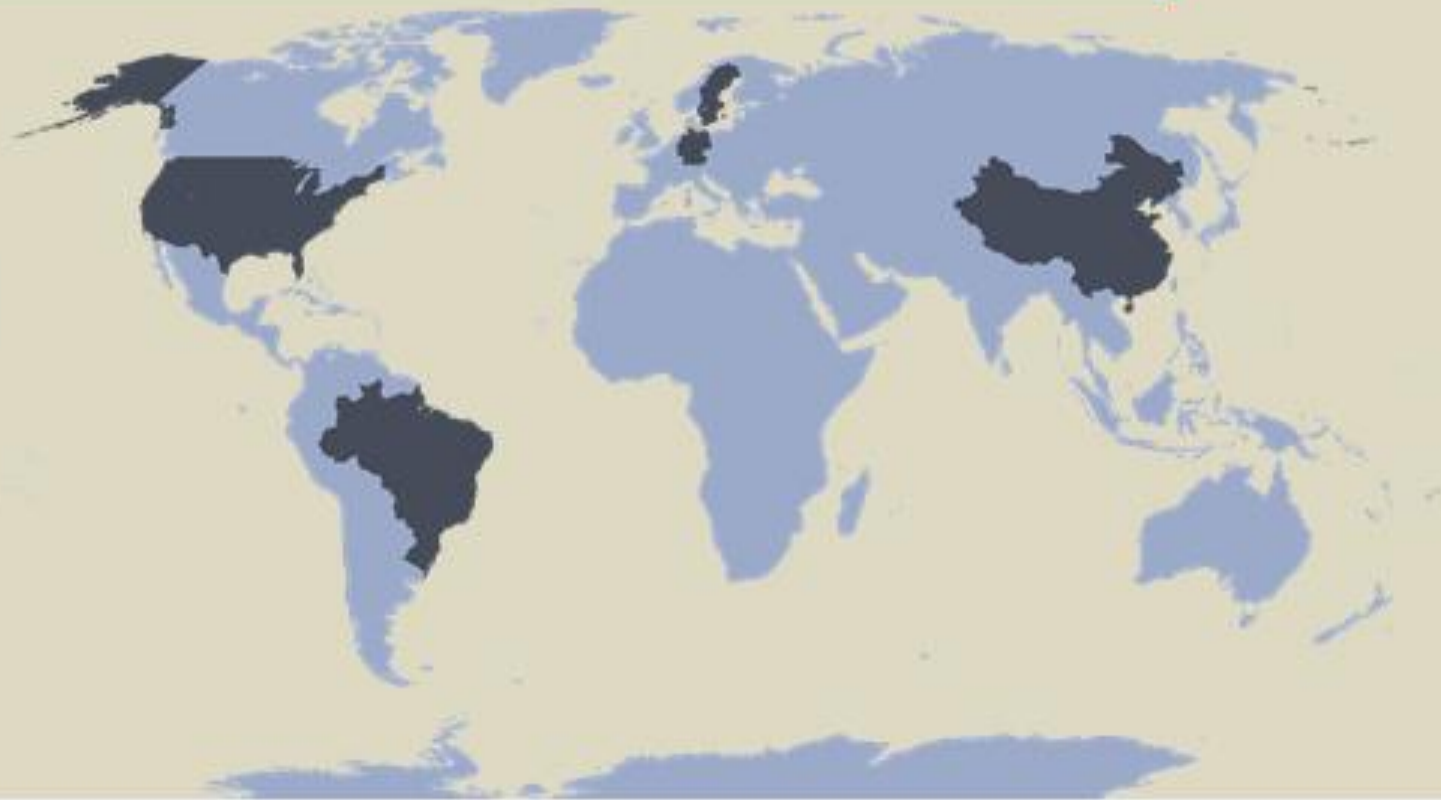


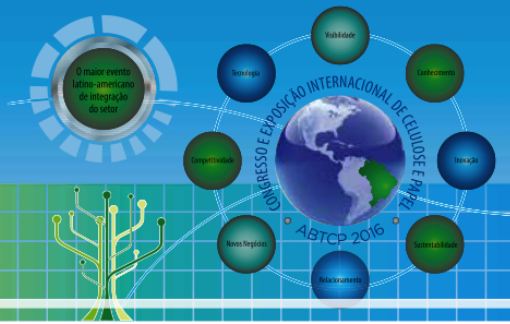


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Innventia International Consumer Survey

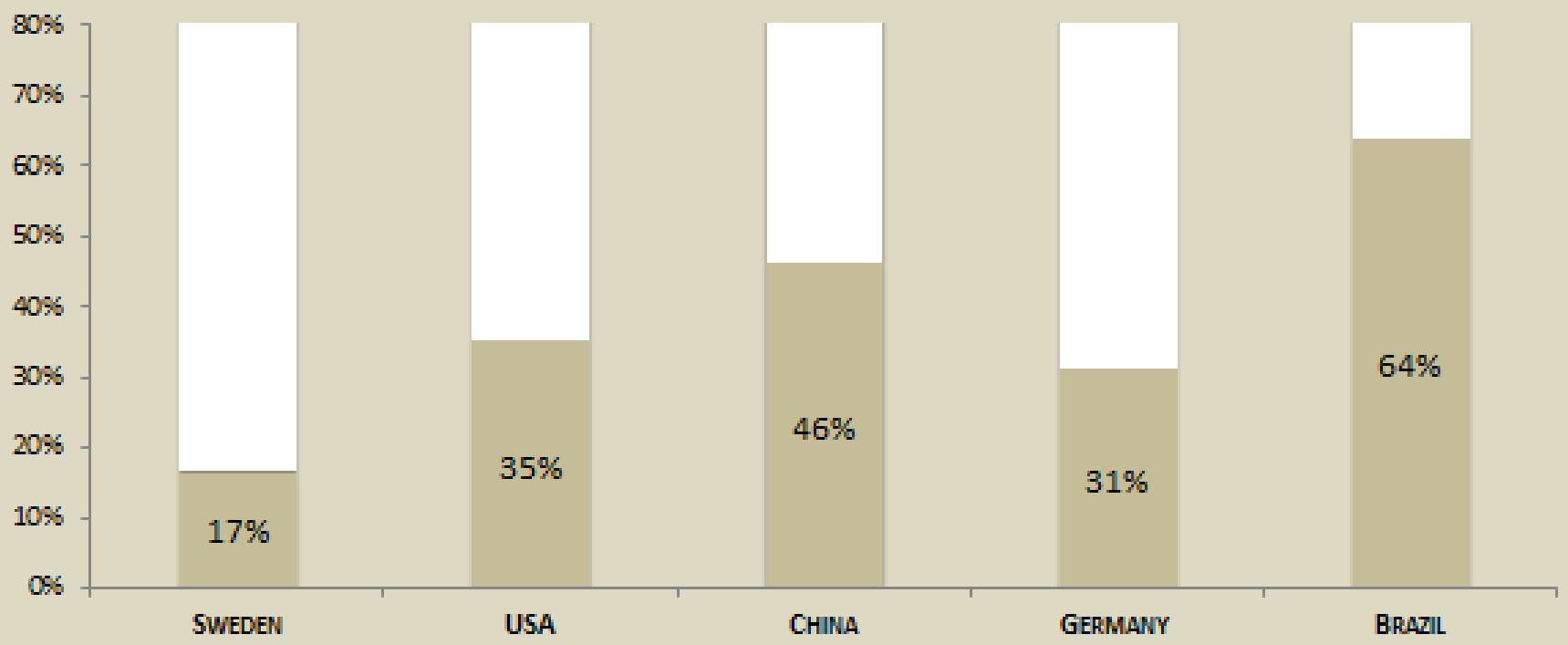


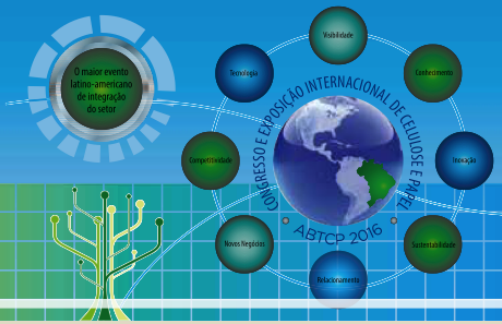


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Care a lot about the environment



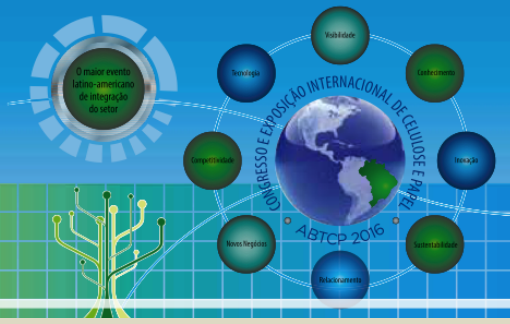


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Who is responsible for the environment?

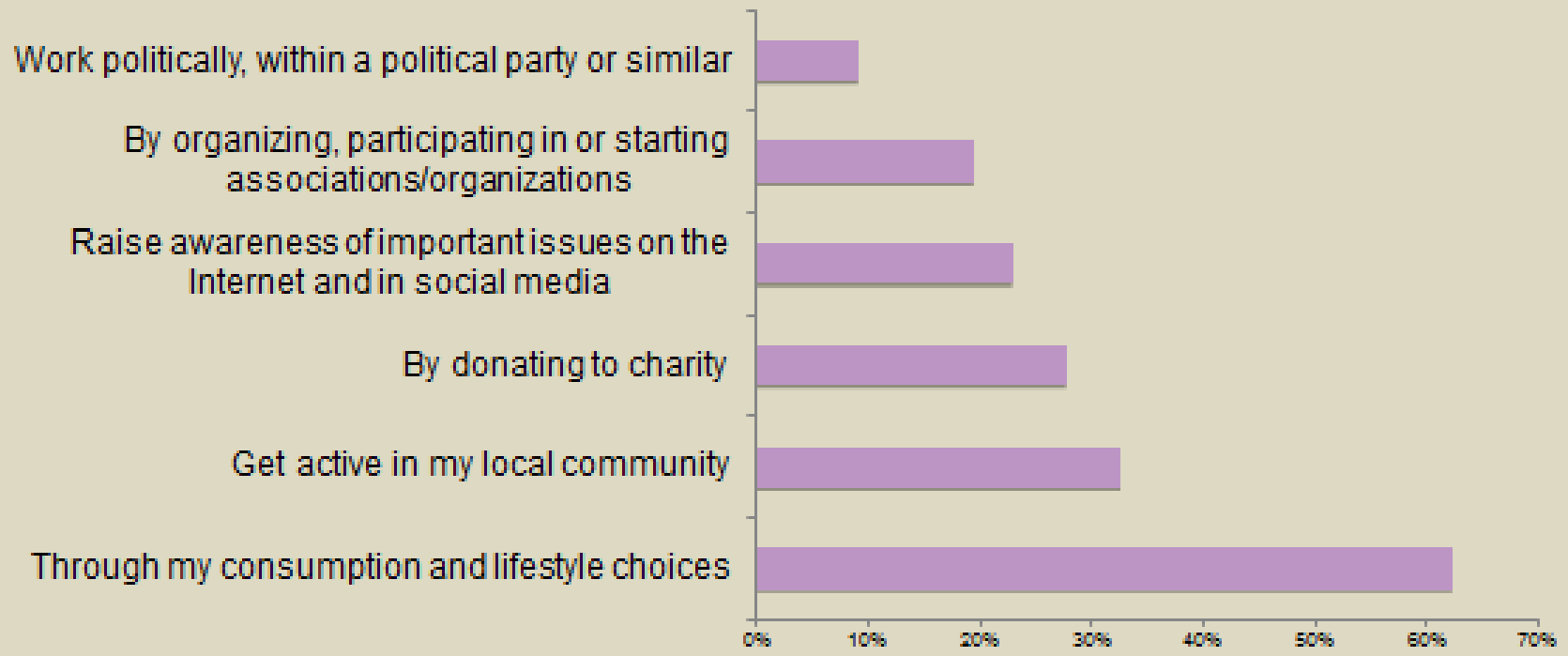


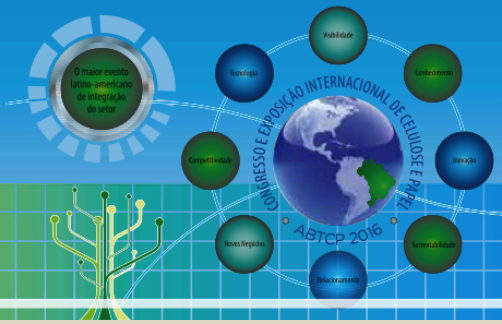


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How do we make the world a better place?

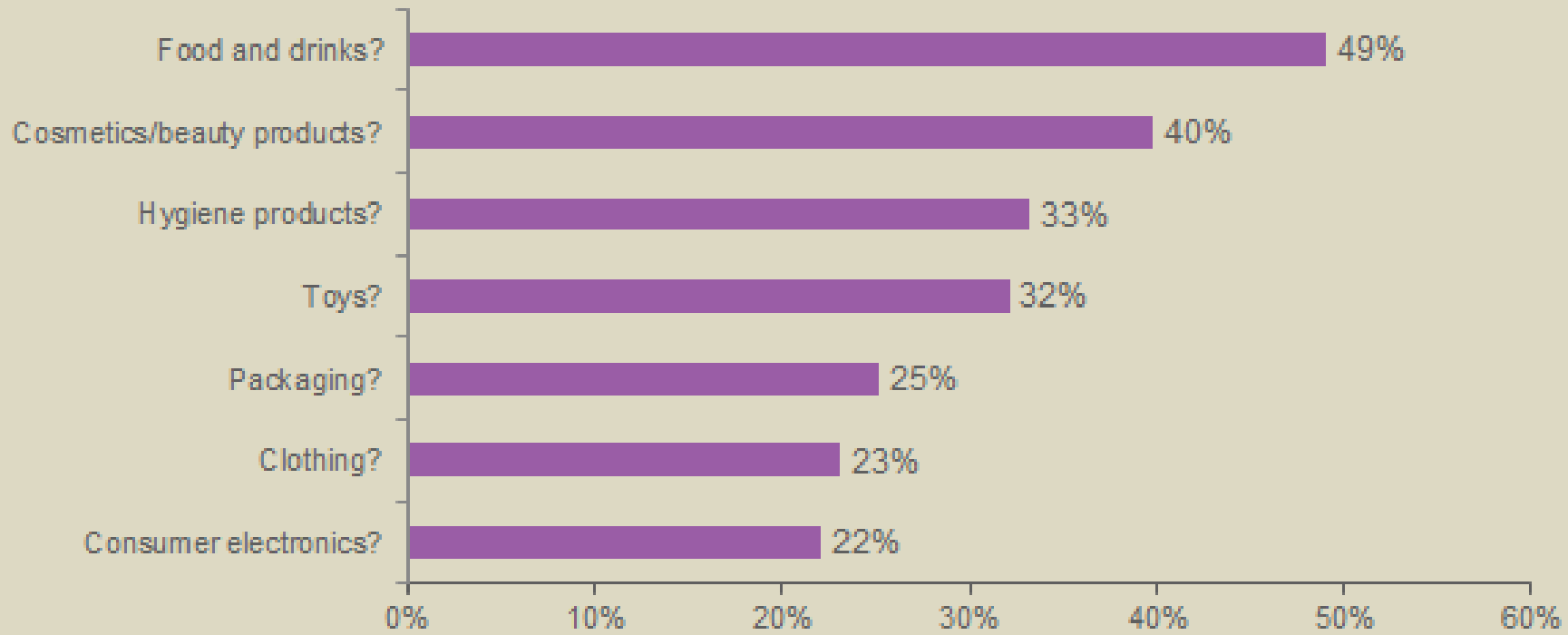


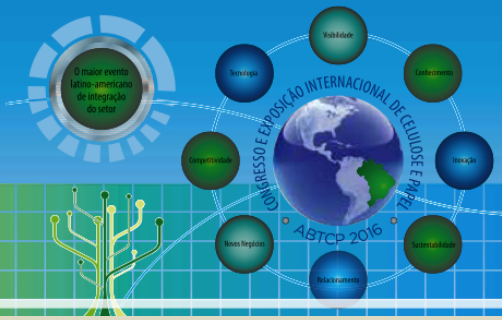


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Are you worried about dangerous chemicals in...

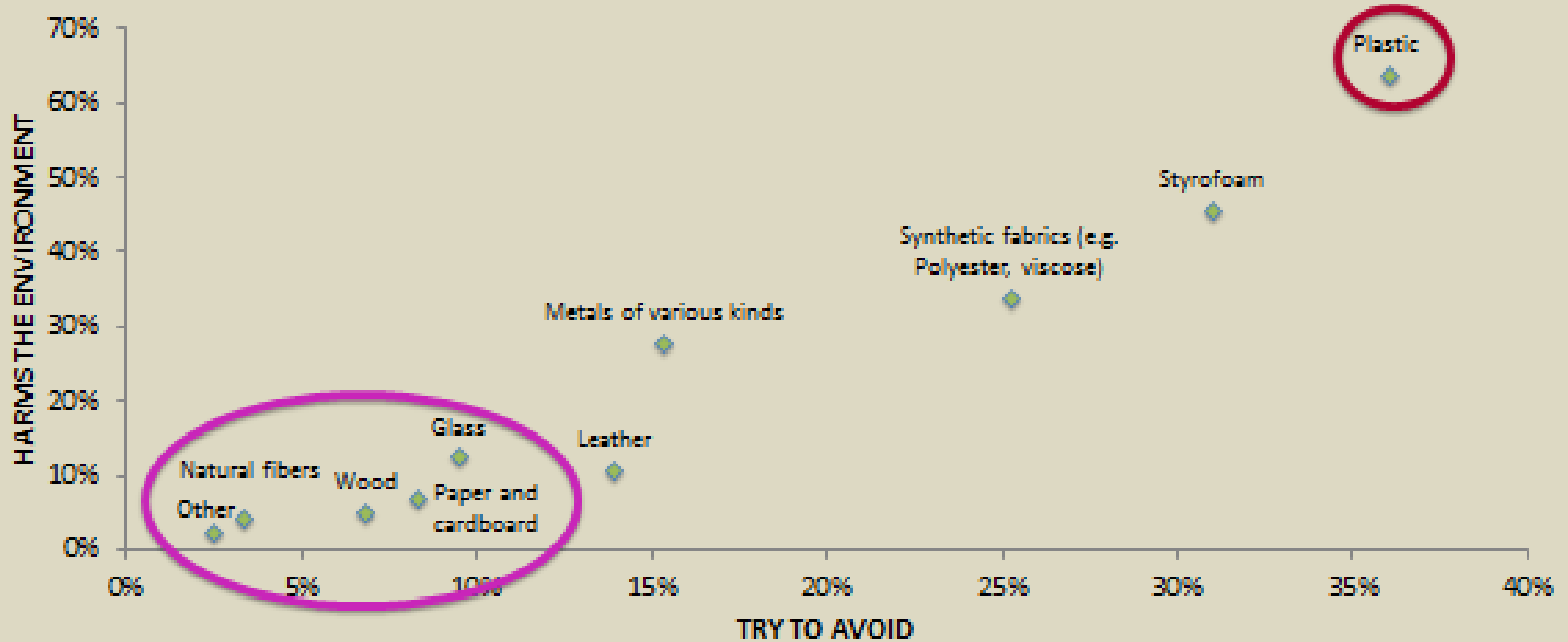


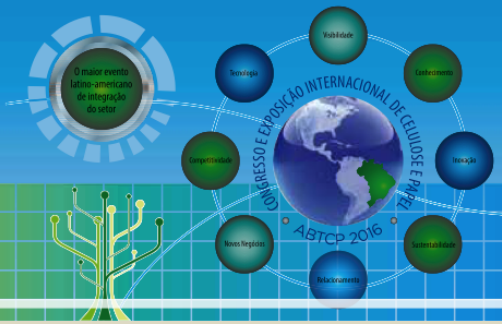


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If it harms the environment, we try to avoid it!





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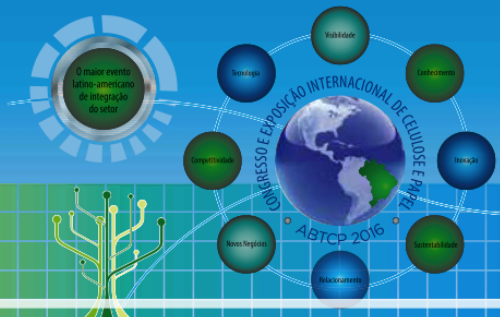
Attributes for materials

Reliable

Qualitative
 Lasting
 Authentic
 Pleasant
 Timeless
 Eco-friendly

Exclusive

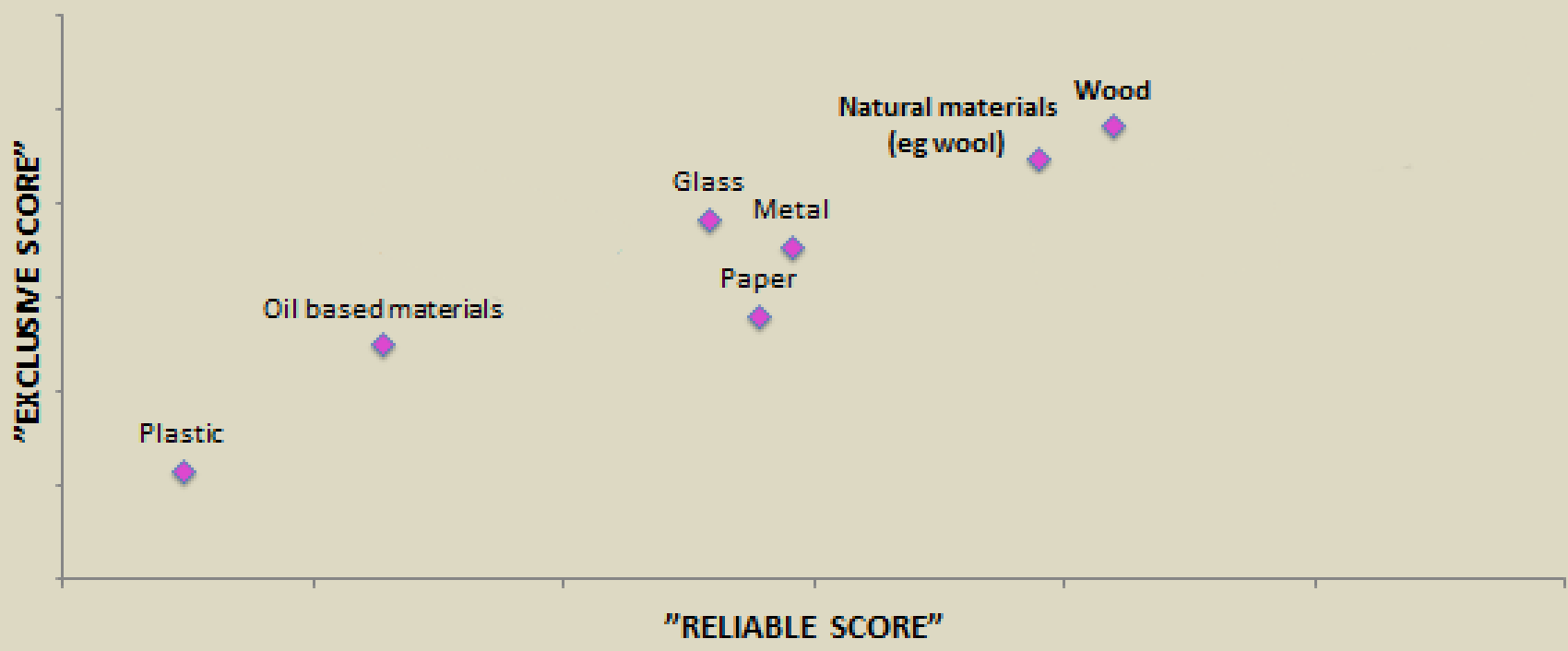
Modern
 Fun
 Exciting
 Advanced
 Formal
 Traditional
 Beautiful

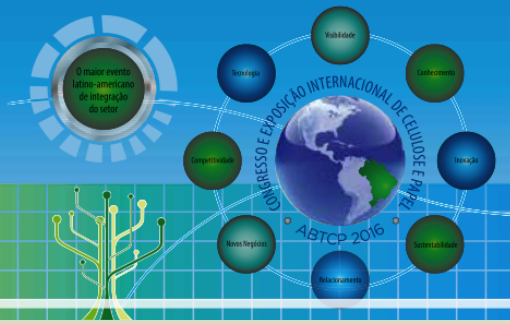


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Reliable and exclusive?

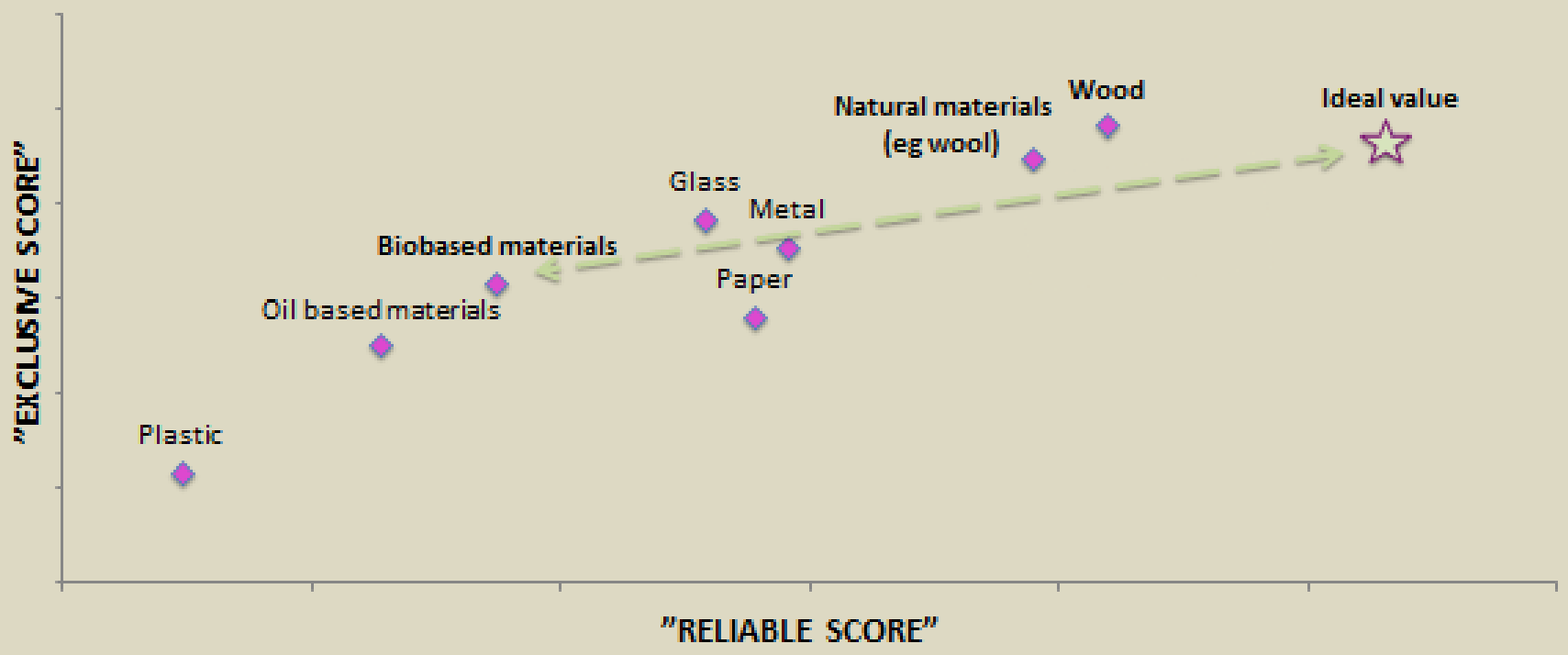


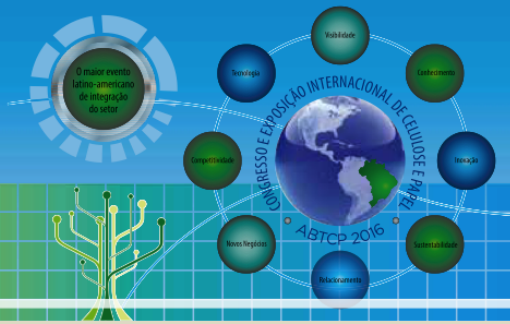


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Biobased not as reliable as natural

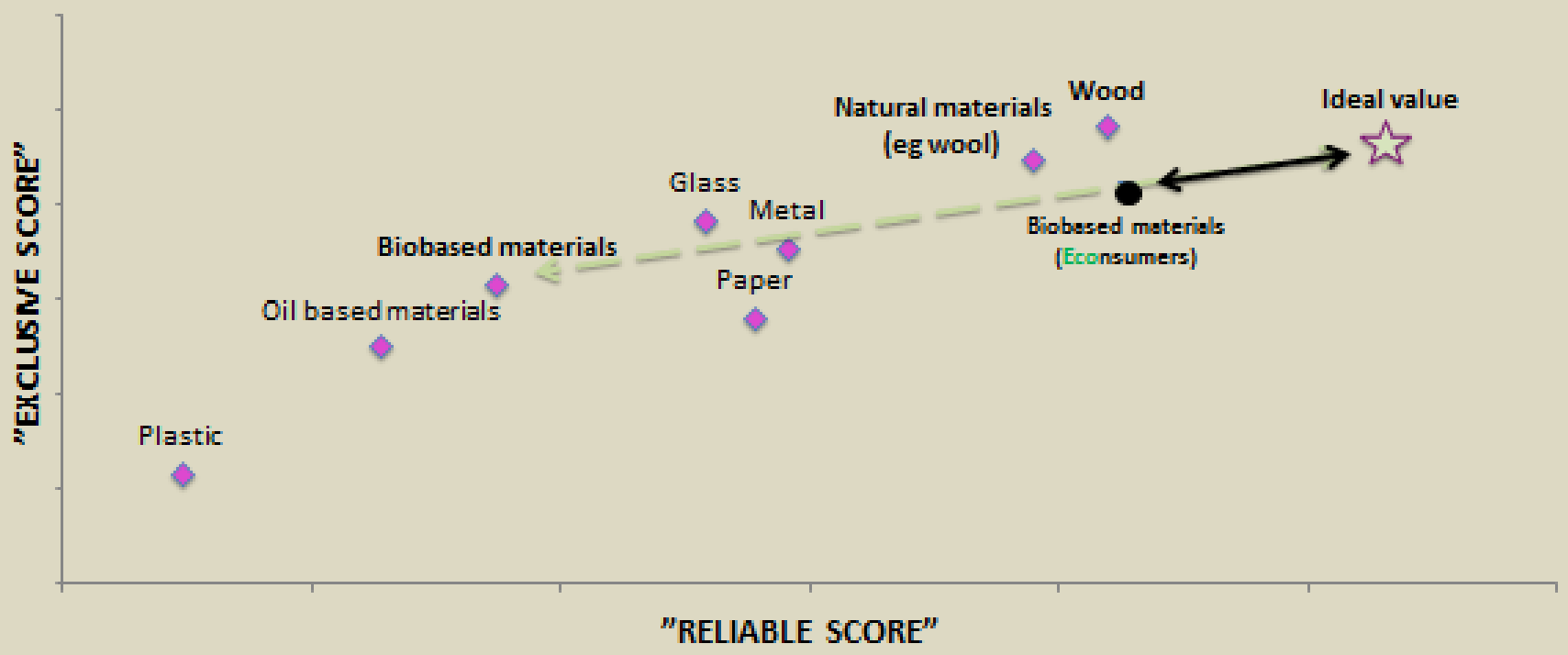


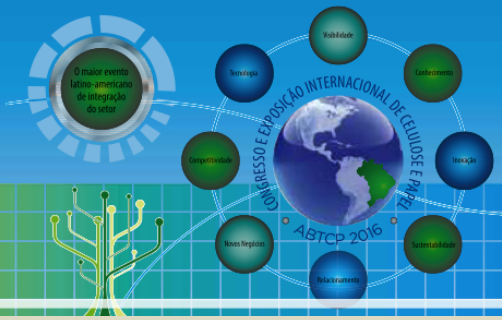


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Eco-consumers like biobased

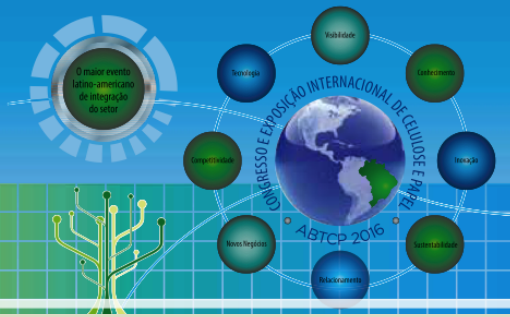




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Forests are becoming to be a more important resource in the production of materials and products for which we today use oil, plastic, glass, or metals.



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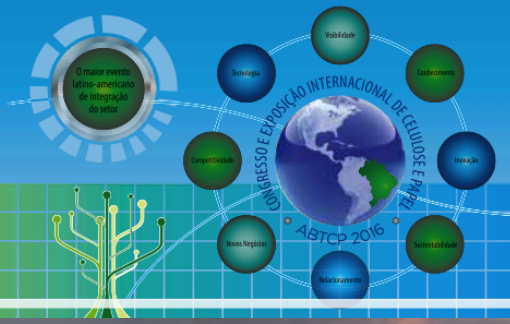
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Carbon dioxide + Water → **Carbohydrates + Oxygen**

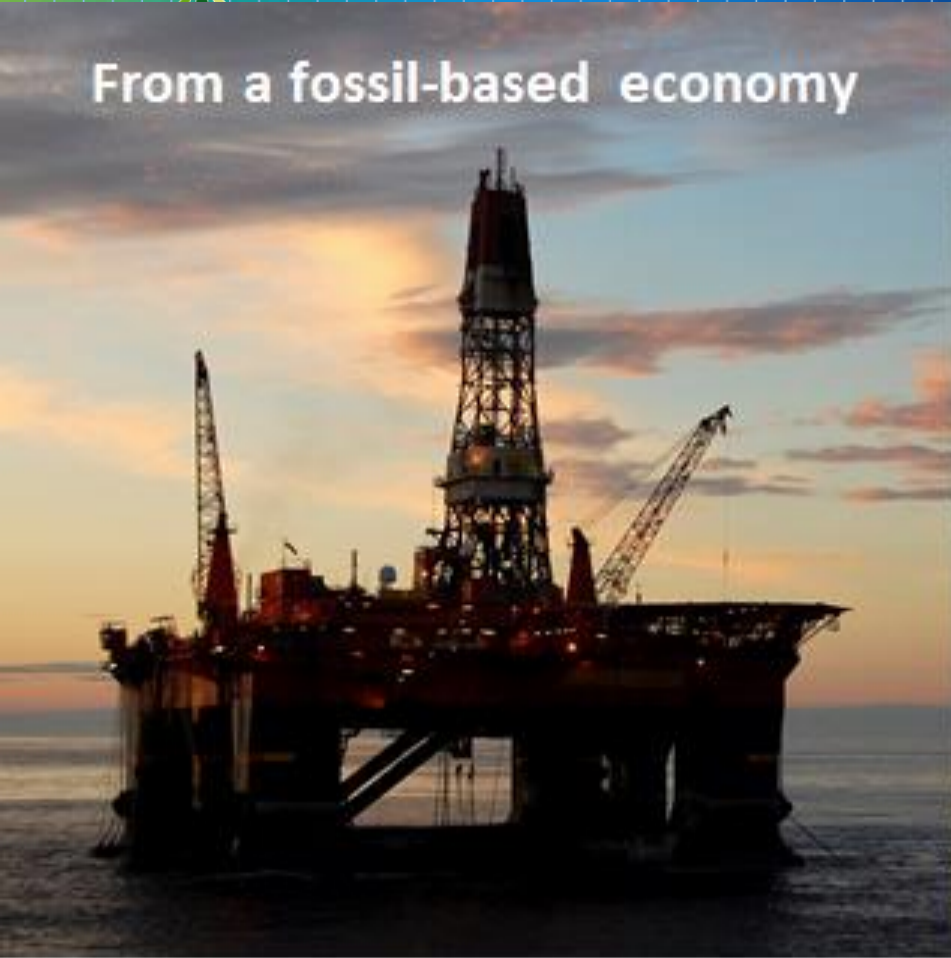
1.5 kg + 0.6 kg → **1.0 kg + 1.1 kg**



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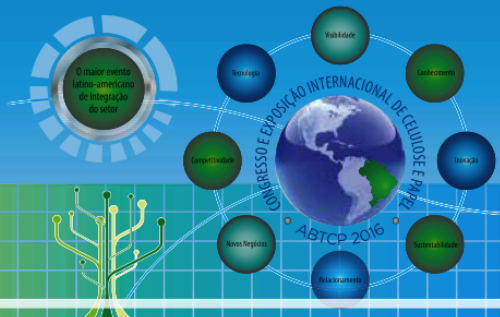
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From a fossil-based economy



To a bio-based economy





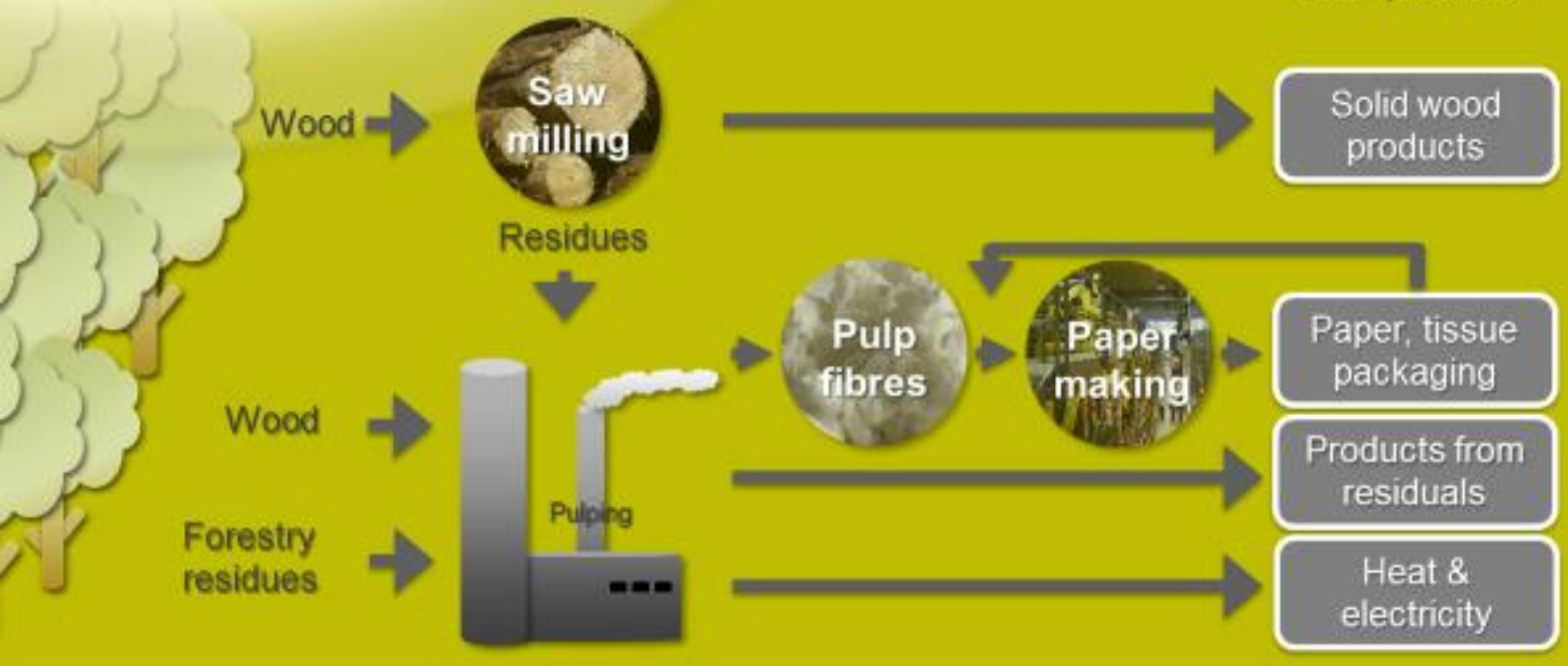
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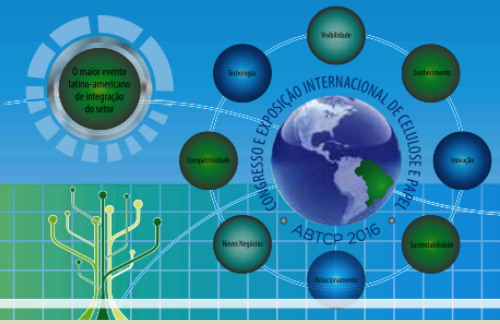
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Current forest industry

CO2 uptake

CO2 from used products





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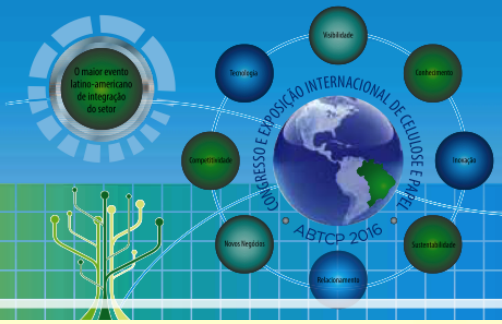
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Power Paper - Vision for energy storage



Inventia, KTH, Acrea, UU

Image: Thor Balkhed



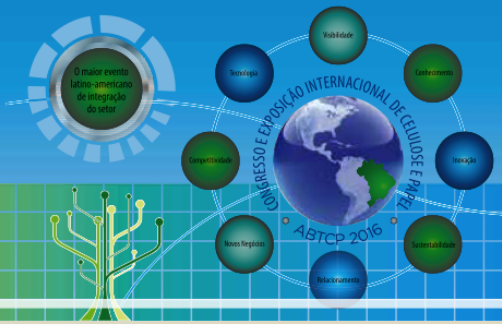
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Example of modern kraft pulp mill

Annual flows for a modern kraft pulp mill





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Industrial infrastructure with many opportunities

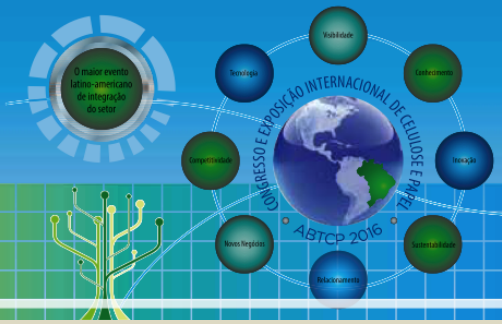
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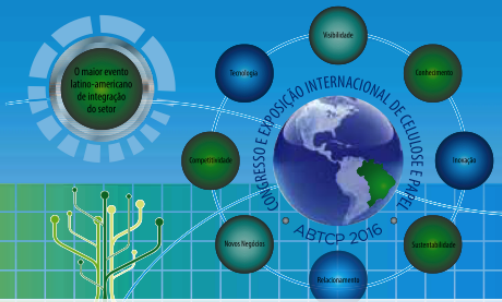


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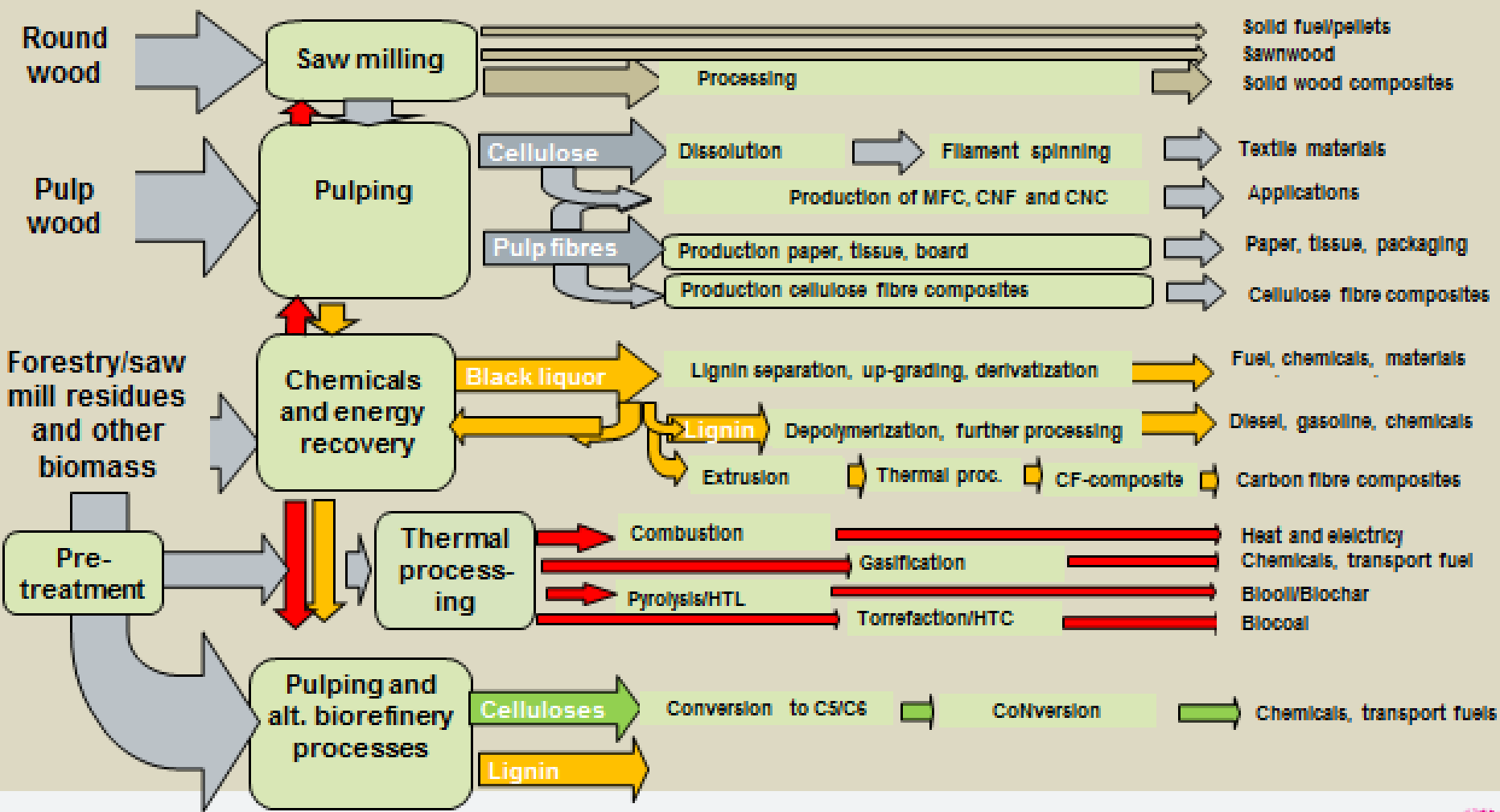
Principal technology platforms for new bio-products

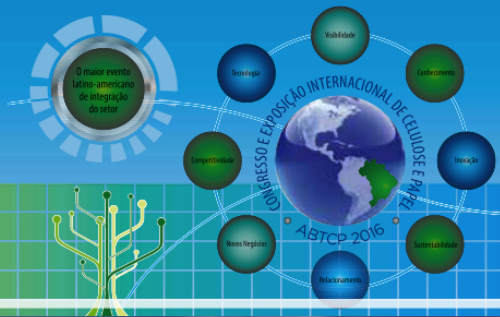
- CELLULOSE
- LIGNIN
- THERMAL
- SUGAR
- COMBINATIONS



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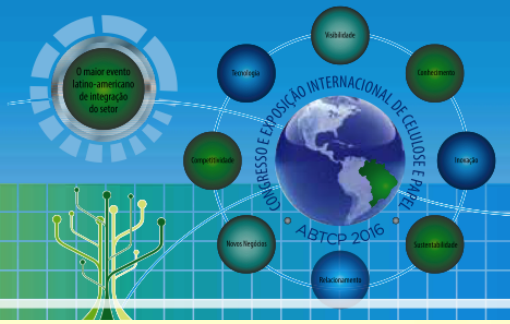


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Pulp mill integration

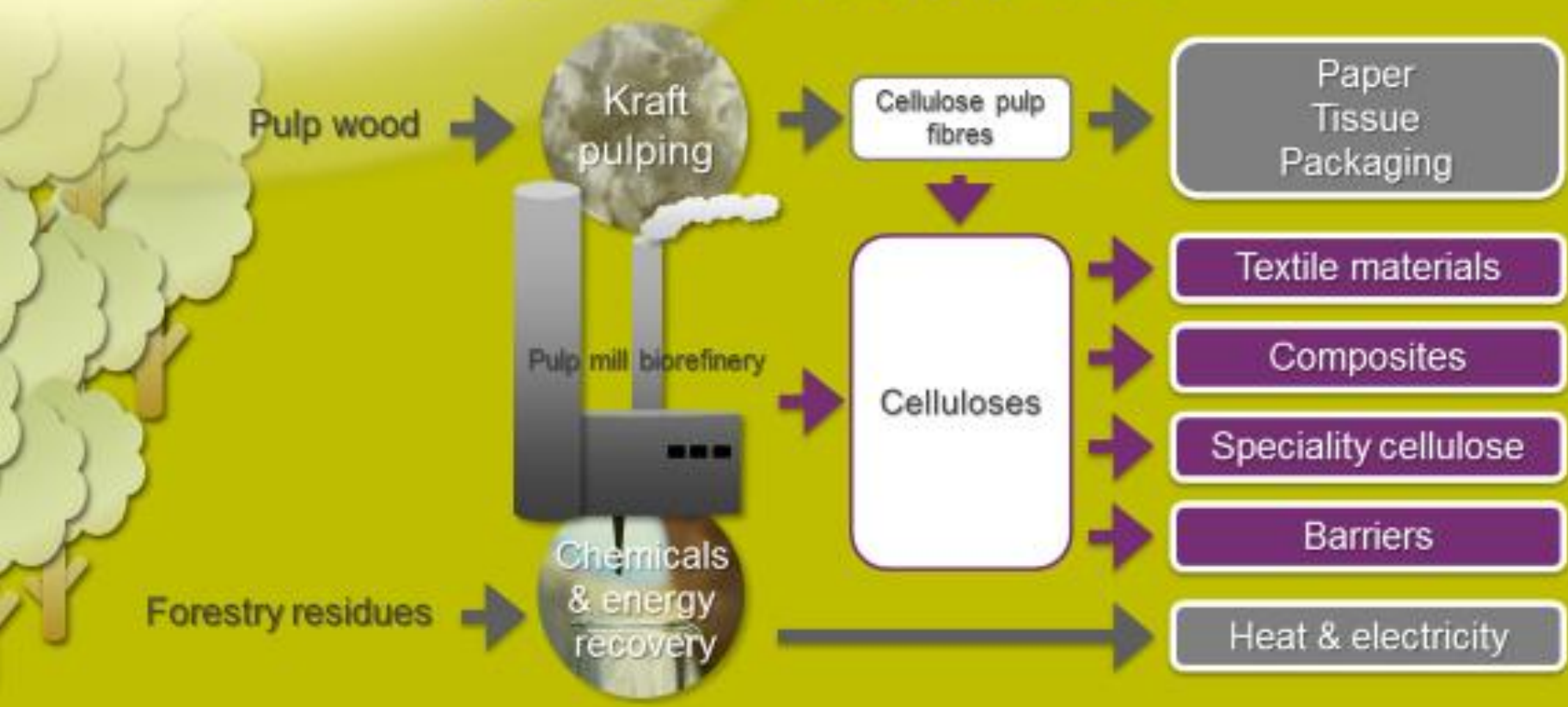


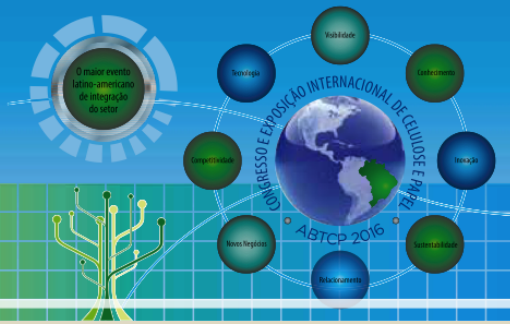


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Cellulose value chains

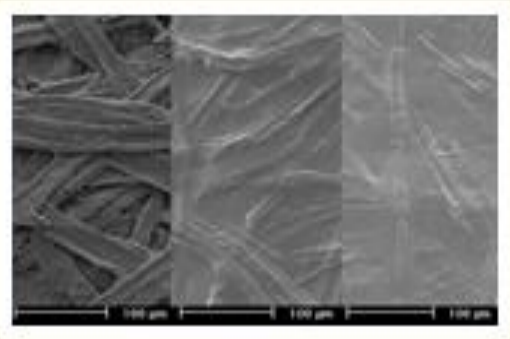




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Nanocellulose (NFC) - Potential for many applications



Paper and board

- Strength
- Bulk
- Coating
- Barriers



New materials

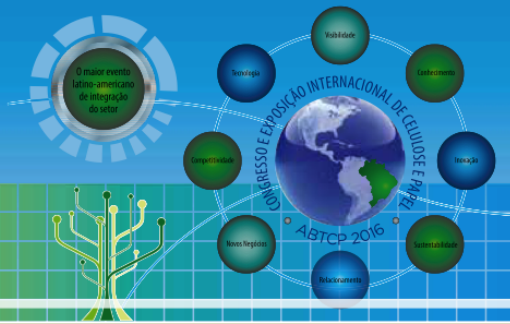
- Nanopapers
- Composites
- Films
- Foams



Other applications

- Food
- Cosmetics
- Paint
- Life science



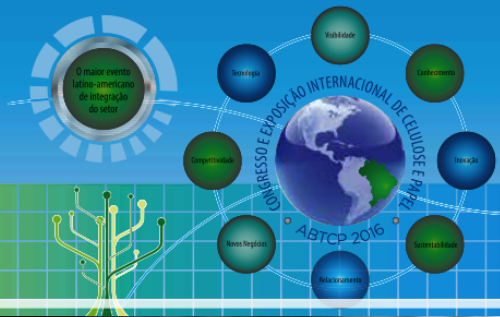


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Wood to textile fibres with with pulp mill chemicals





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Adapted pulp

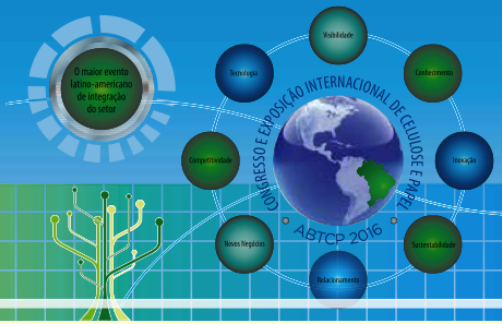
Forest cellulose based textile fibres produced in pulp mills

Production of adapted pulp

Dissolution

Fibre spinning

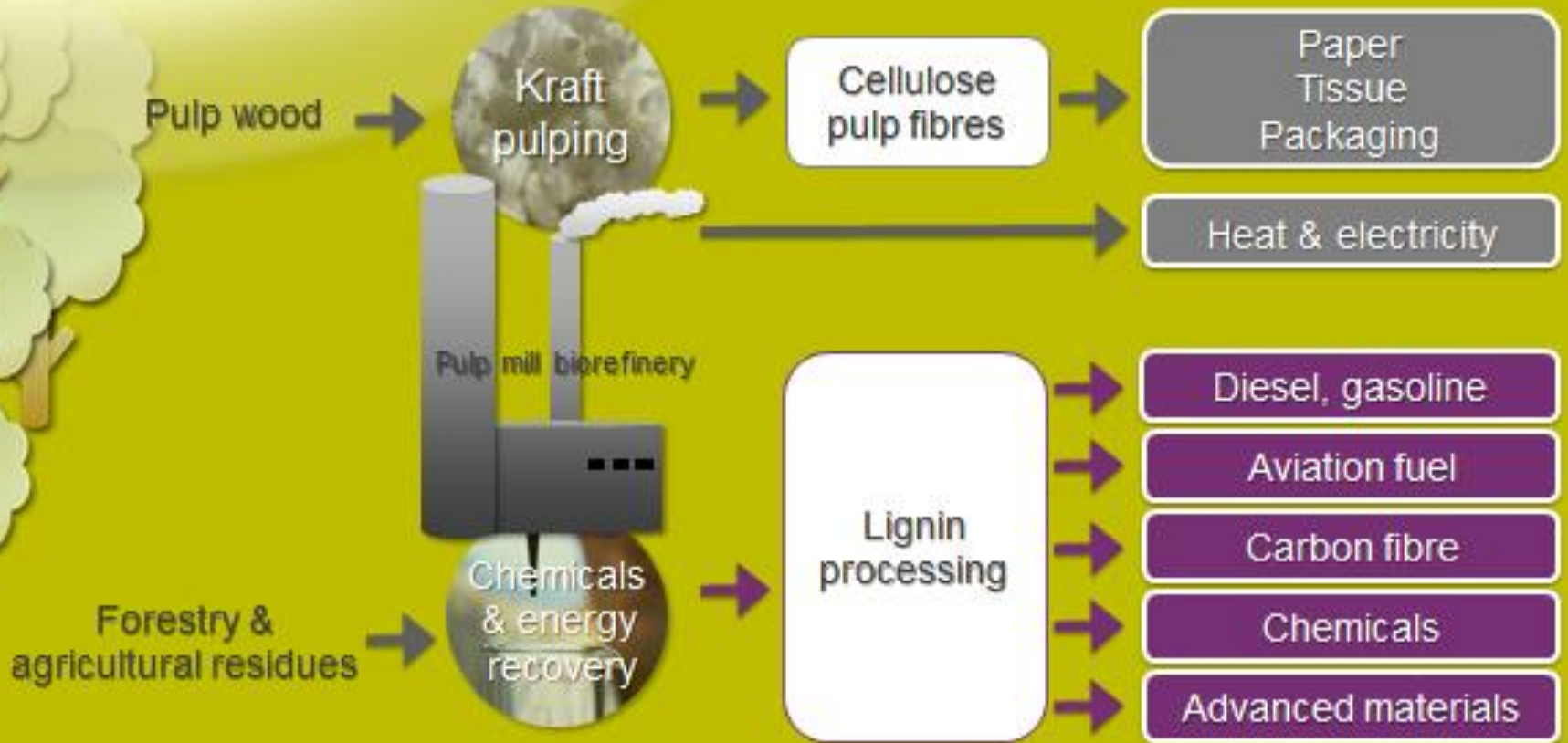


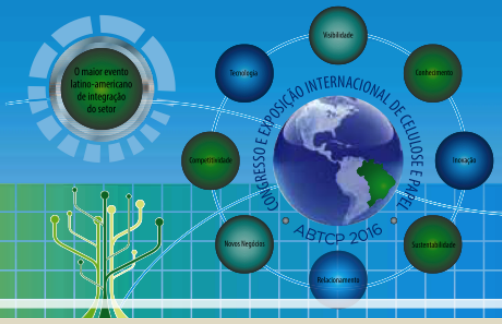


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Lignin value chains

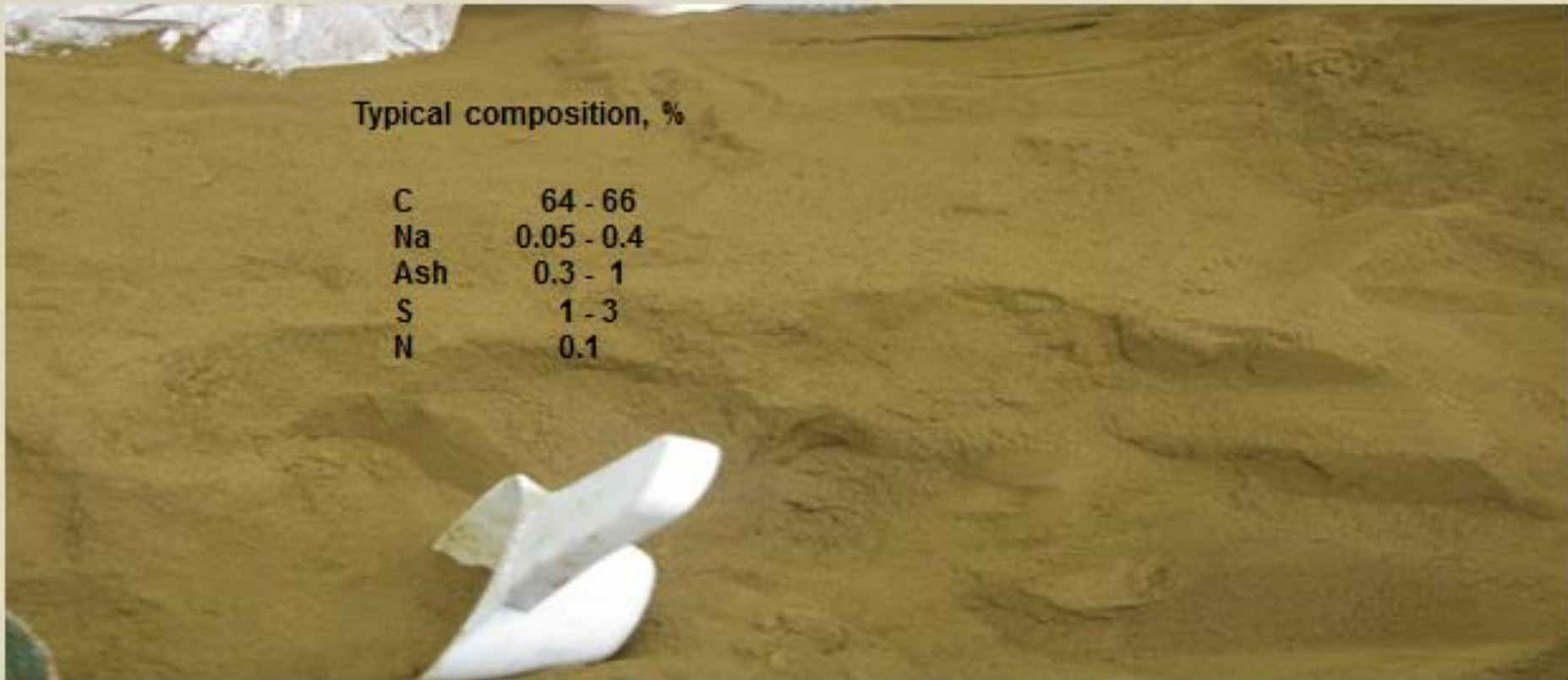




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Lignin is a new kraft pulp mill product





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Lignin of tomorrow

Utilising a greater part of wood and producing marketable products other than pulp has become a focus recently for the pulp and paper industry. Lignin is one of the non-traditional products produced today from wood biomass on a commercially-viable scale.

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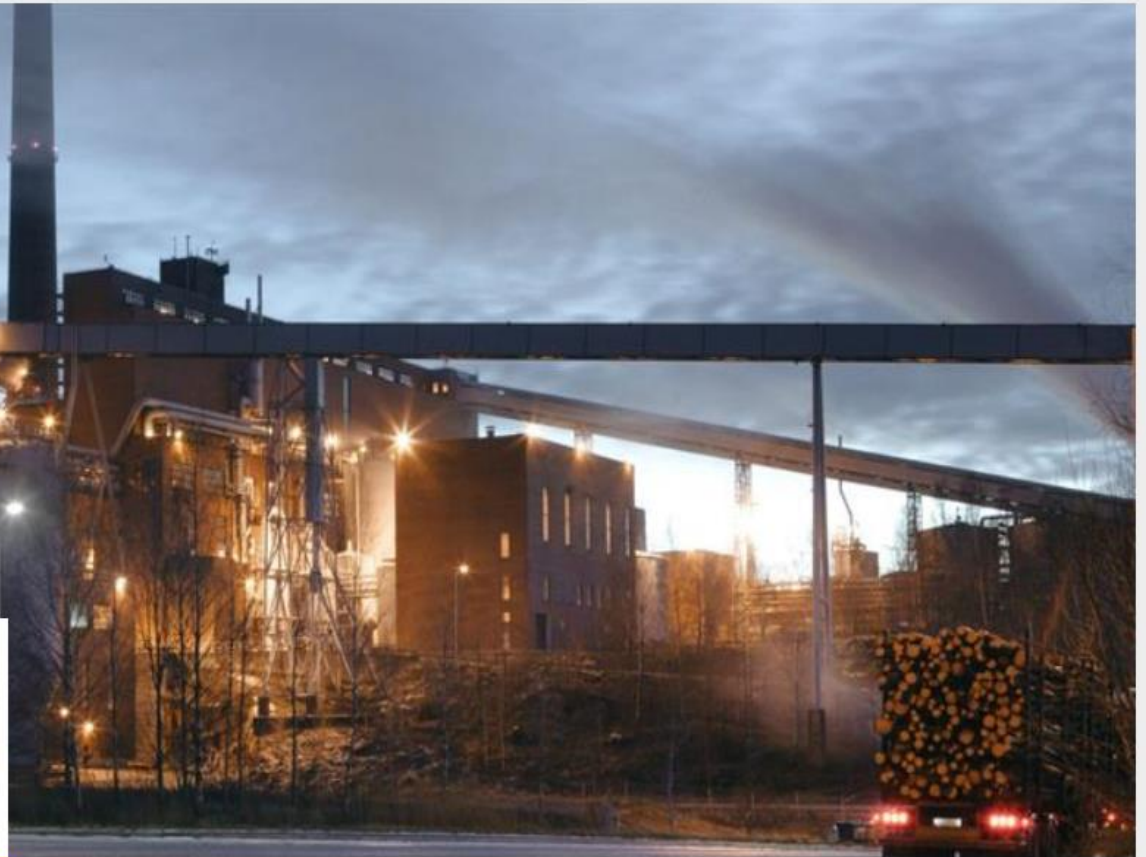
There are many potential markets for lignin. Refined lignin can be used for replacement of phenols that are used in resins for adhesives in, for example, plywood and veneer applications. Stora Enso's Sunila Mill in Finland is the world's first integrated lignin extraction plant to produce dry kraft lignin and

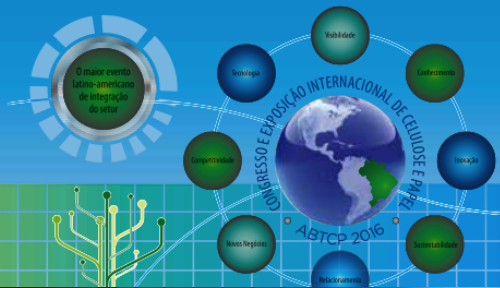
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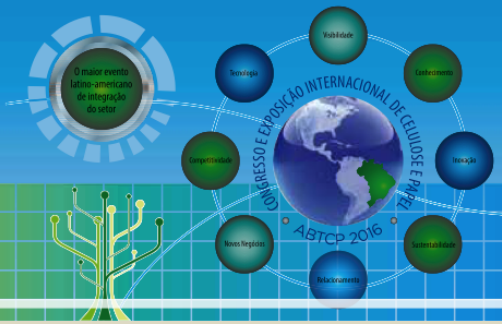


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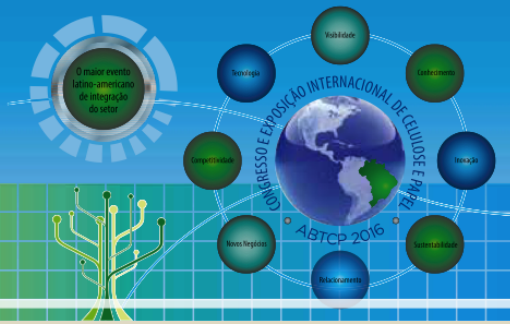


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Targeted LignoBoost lignin properties

		Standard LignoBoost	Modified process
Ash	%	0.4 - 1.0	≤ 0.02
Na	%	0.2 - 0.4	≤ 0.01
Carbohydrates	%	1 - 2	≤ 0.4
Sulfur	%	1 - 3	0.3 – 0.7 (soda = 0.1)
Mw	Dalton	3000	1600 – 7000
Tg	°C	140 - 150	110 - 170

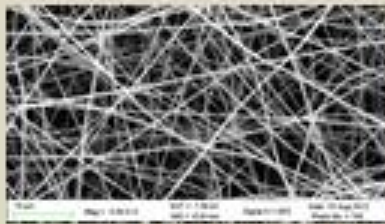


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Dispersants



Carbon nanofibre (CNF)



Carbon fibre (CF)



Activated CF & CNF



Hydrofobic surfaces

€ € \$ \$
Higher value opportunities!!
 € € \$ \$



**Resins
 Binders**



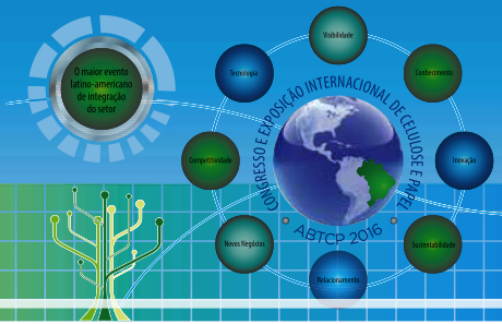
Asphalt



Biooil and chemicals



Biocarbons



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Thermally induced lignin foaming

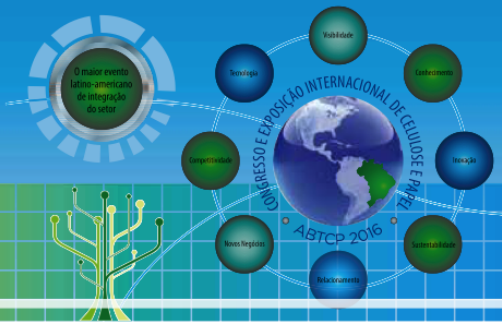
Volume expansion for SW lignin



-0,5

3

4



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- Melt spinning of 100 % SW and HW lignin
- First lignin-based CF composites demonstrated

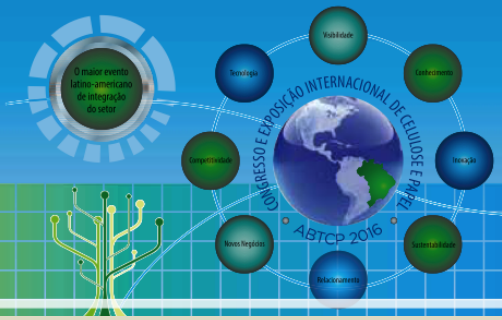


Toy car roof

Innventia, Swerea,
 Blatraden & KTH



Balsa wood
 laminate



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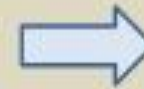
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Water soluble modified kraft lignin

Kraft lignin

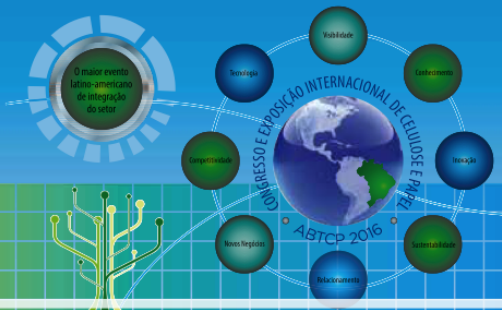


Modified lignin



Fully water soluble lignin





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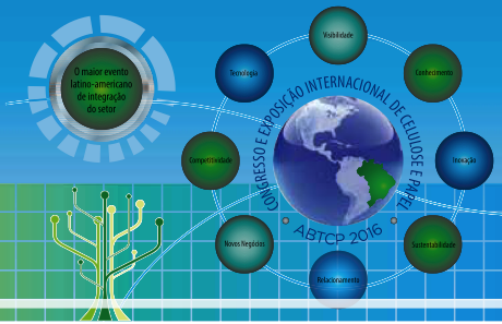
Gasoline and diesel from lignin

SCA has developed technology that converts black liquor into renewable gasoline and diesel.

SCA's pilot plant in Obbola outside of Umeå will start up early 2017. The plant will have initial capacity to produce about one liter of gasoline and diesel per hour.

The goal is to produce biofuels at one or more of our plants in Östrand, Obbola and Munksund.

But first we will build and get running the pilot plant, then evaluate the project before we come so far that we make decisions on the continuation.



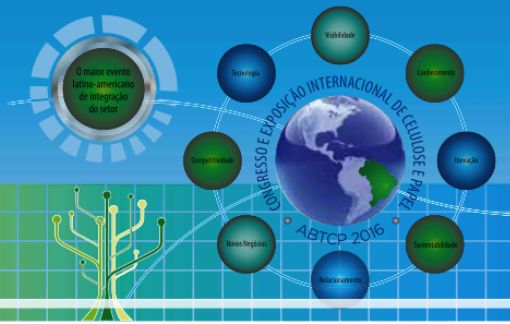
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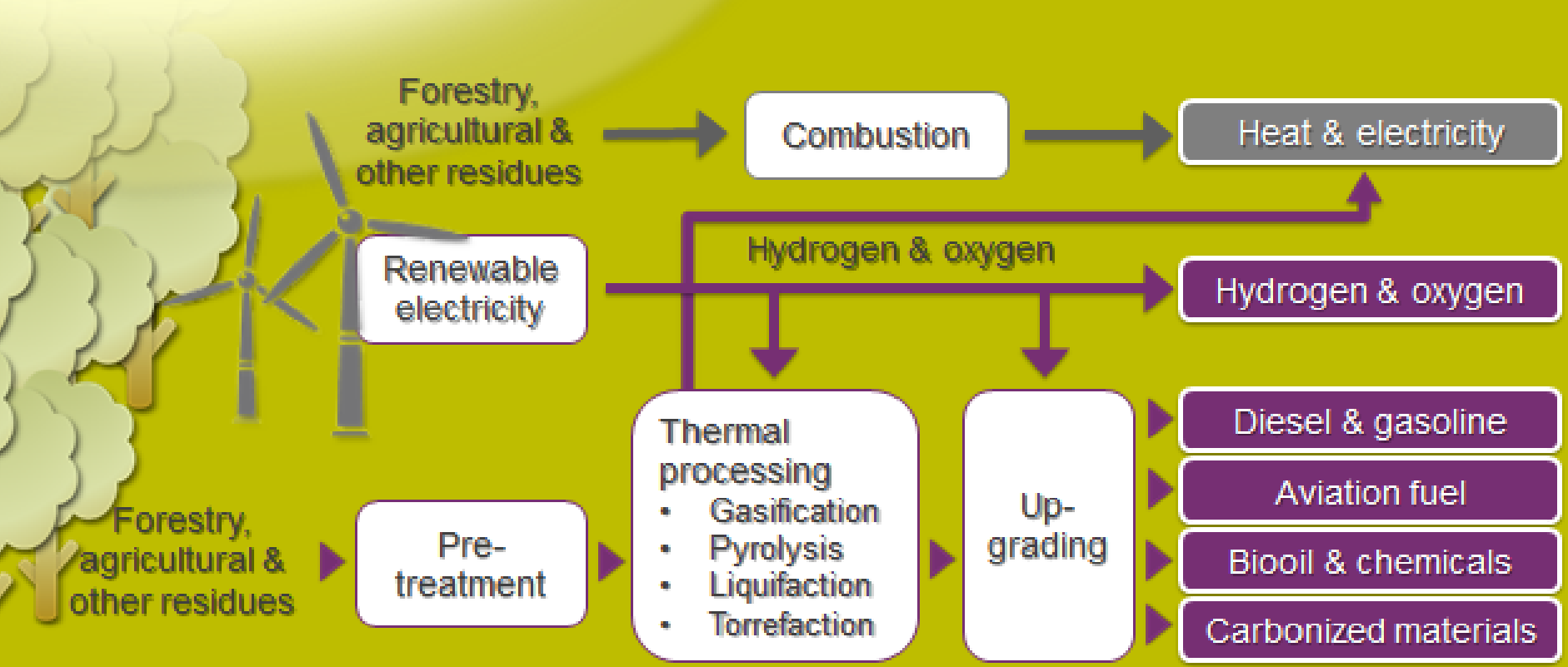
PREEM "Future gasoline and diesel from the forest"

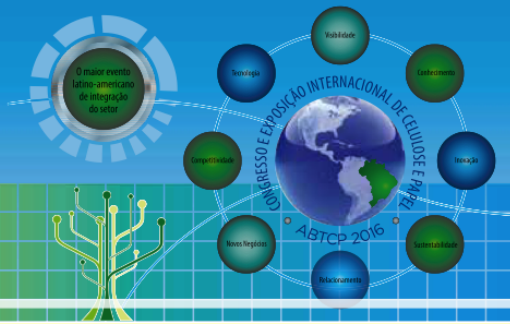
1. Lignin from pulp mill black liquors
2. Lignin depolymerised to liquid
3. Conventional gasoline produced in Preem's oil refinery in Lysekil
4. Evolution gasoline
 - conventional gasoline
 - reduces emissions of CO₂
 - works in all gasoline engines



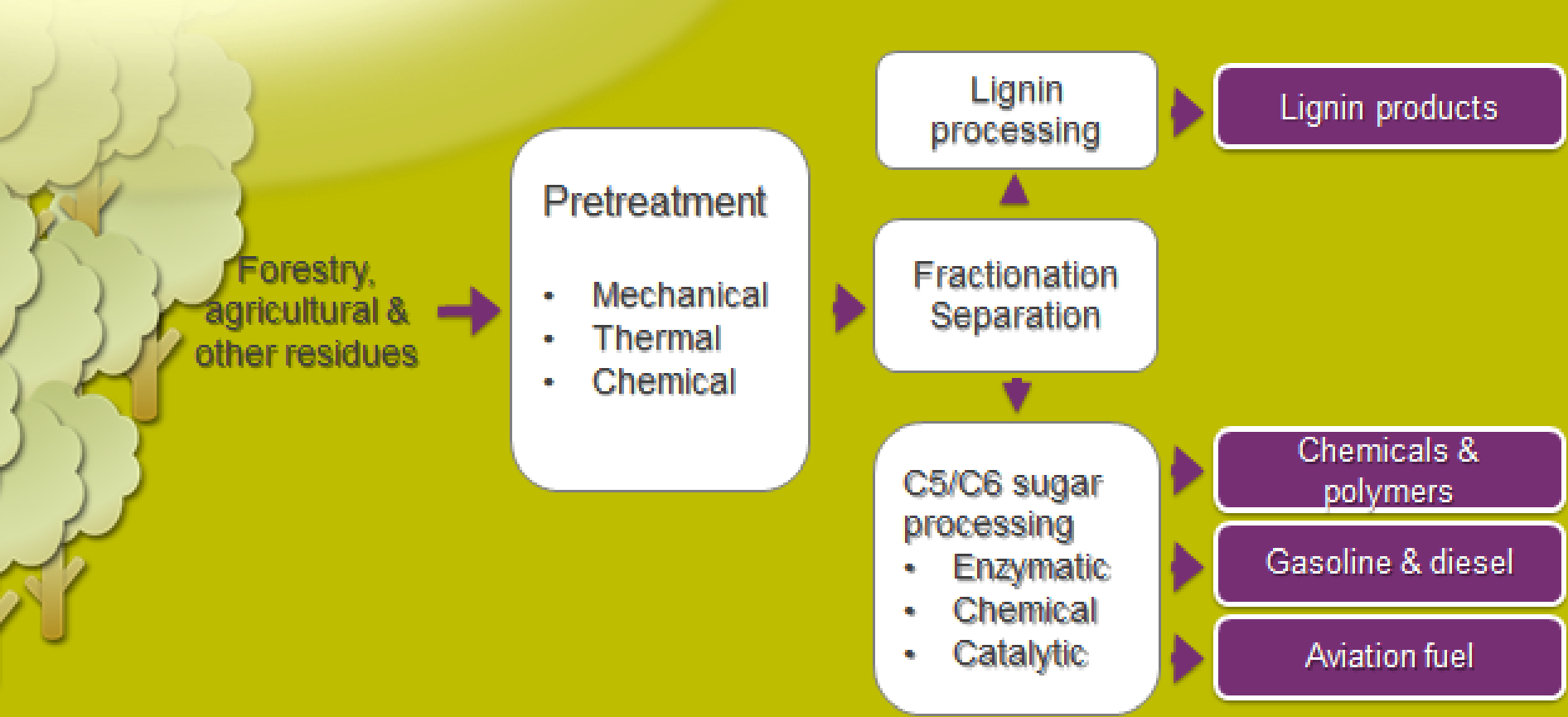


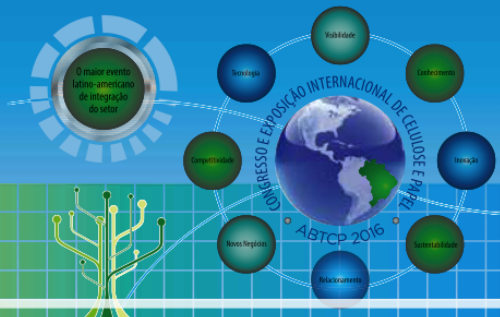
Thermal value chains





Sugar value chains

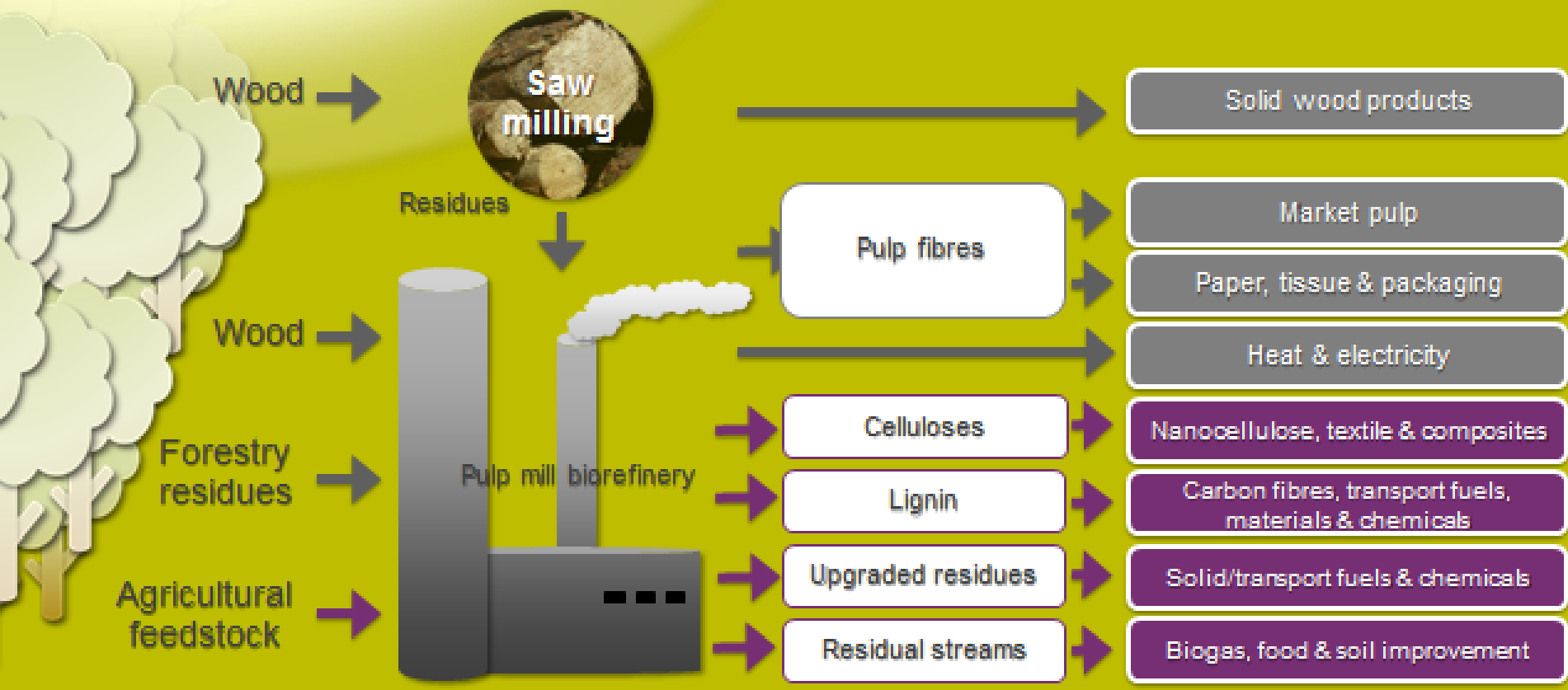




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Future pulp mill based biorefinery





Conclusions

- Pulp mills are well positioned to be nodes for new value chains
- Countries with large forest assets and pulp mills will benefit
- Several biorefining processes under development
- Momentum for a forest-based economy
- Value added products