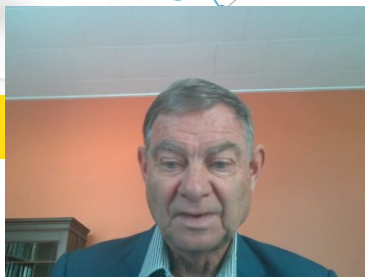
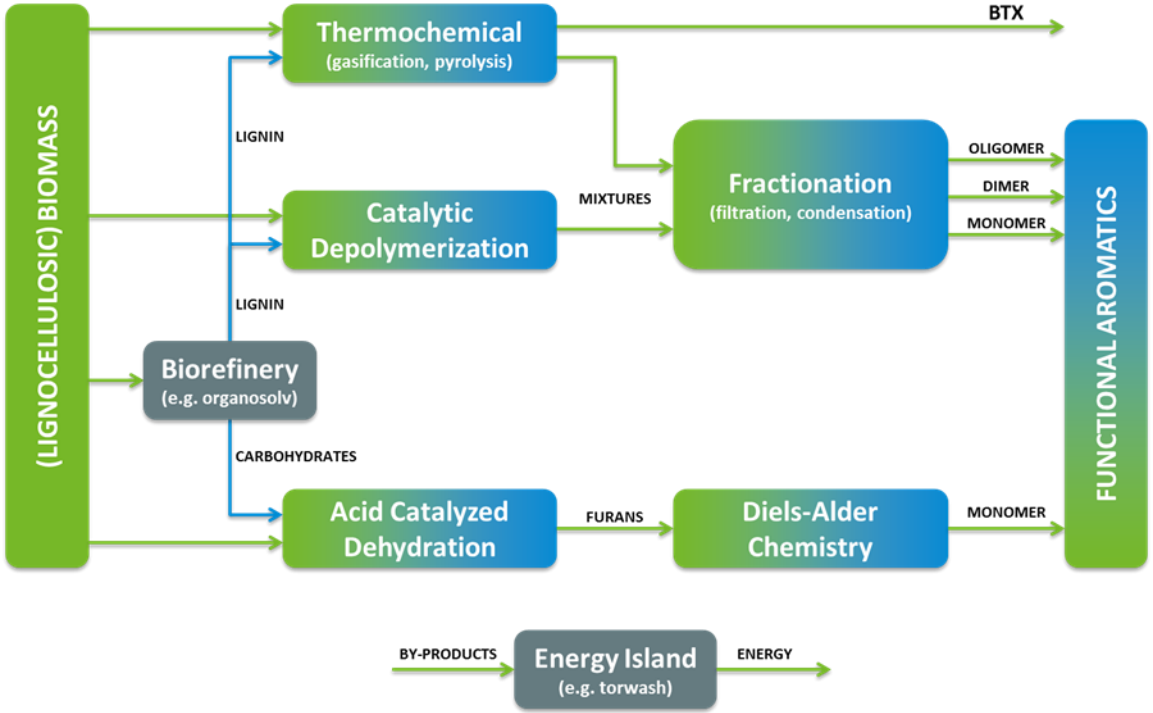
Vanguard Case Bio-aromatics

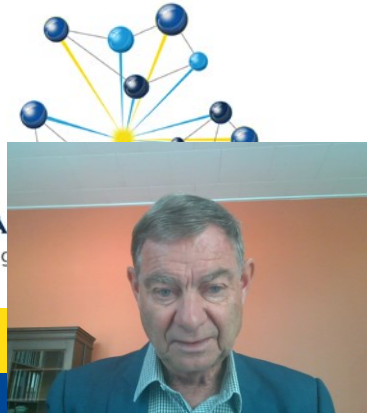
Leader: Flanders (Ludo Diels)
Co-leaders: South Netherlands, NRW

Shaping bio-based value chains through cross-regional cooperation, 30 September 2021



The lignocellulose Biorefinery



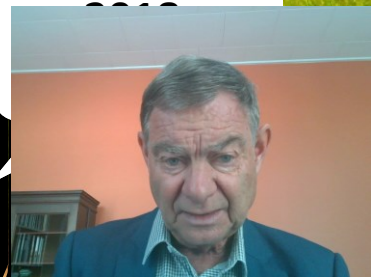


Bio-aromatics case on its way to pilots and demo's

Array of commercial bio-aromatic production facilities

2025: 1st Commercial bio-aromatic production

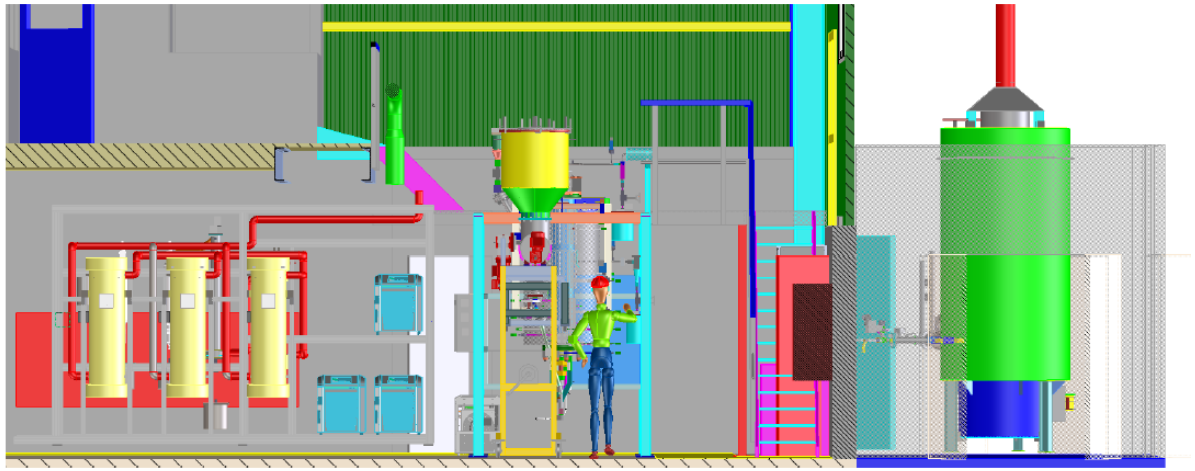
2022: 1st Demo plant (50 ton/year)



Business Model Development

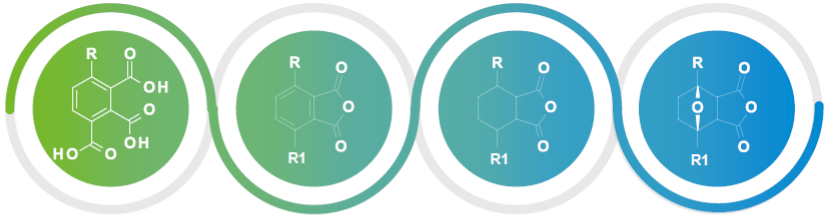
- Primary business model is based on the Shared Research Center Biorizon
- From R&D to Pilot actions and Demo installed
- Several actions on pyrolysis
- Several actions on Sugar to aromatics (spin off Relement)
- Lignovalue Pilot plant operational January 2022,

Pyrolysis-based lignin valorization
Piloting at the Green Chemistry Campus BoZ

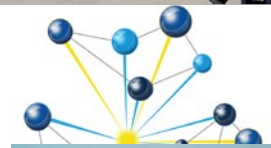


- 5 kg/h PYRENA/PYPO piloting facility: 5 kg/h PYRENA fast pyrolysis unit + directly coupled staged condensation unit (PYPO - Pyrolysis Product Obtention unit
- From Q3 2020, 4-5 day experimental campaigns, yielding typically 5-10 kg scale sample batches for application development
- Application development with a range of industry partners

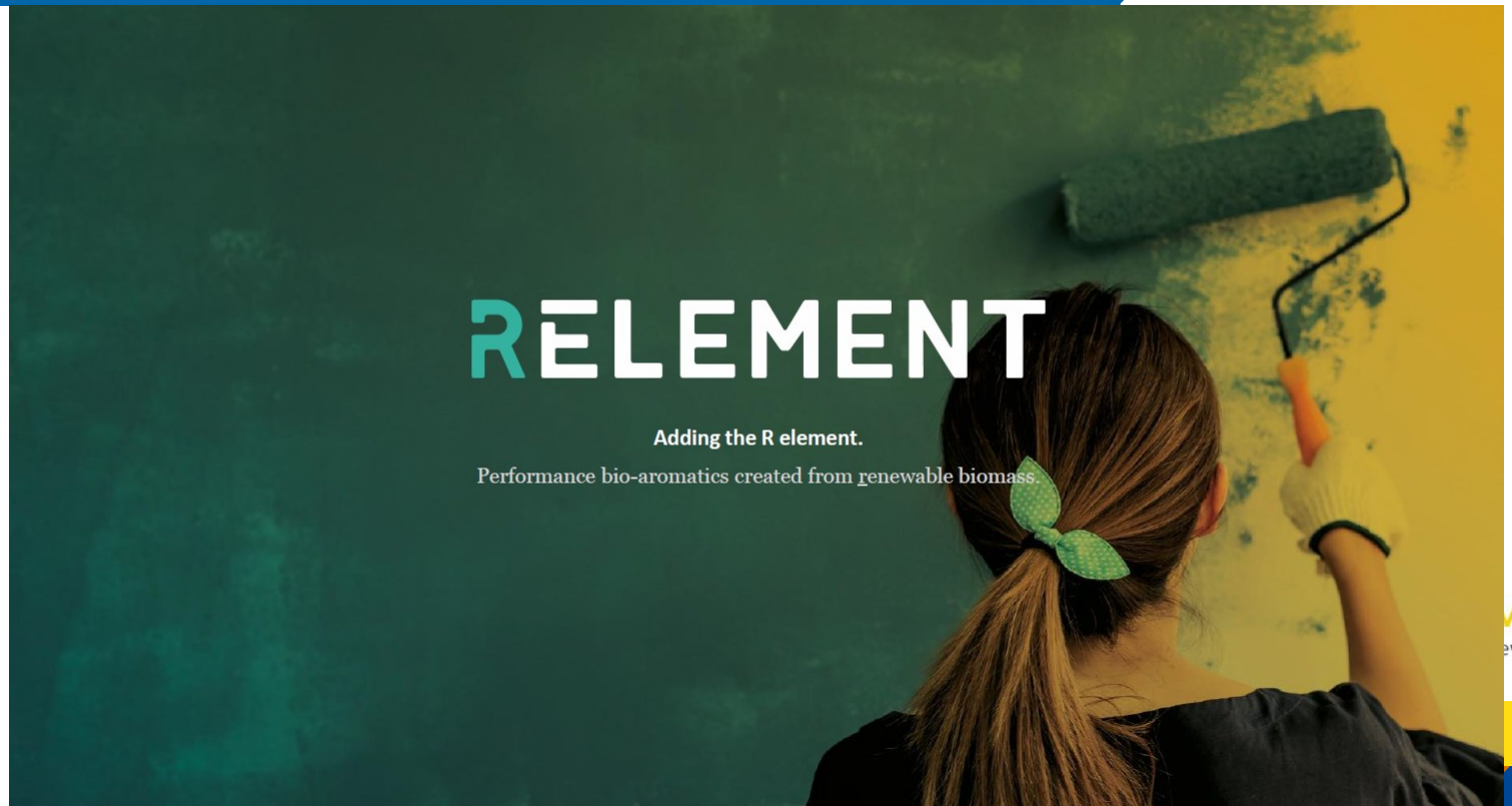
Ability to offer a bioaromatics platform



	Hemimellitic Acid	Phthalic Anhydrides	Hexahydro Phthalic Anhydrides	Epoxy-Hexahydro Phthalic Anhydrides
Targeted Markets	Polyurethanes Specialty lubricants Plasticizers	UV resistant coatings Monomer	UV resistant coatings Plasticizers Epoxy Curing agent	Novel coatings Other innovative applications
Volume Possible	10's of kgs	10's of kgs	10's of kgs	10's of kgs
Performance	Dimensional stability High Temperature Stability	Higher UV resistance	Super UV resistance Electrical insulator	To be explored
Derivatives Available	1	2	3	3



Spin off for furans-based chemistry

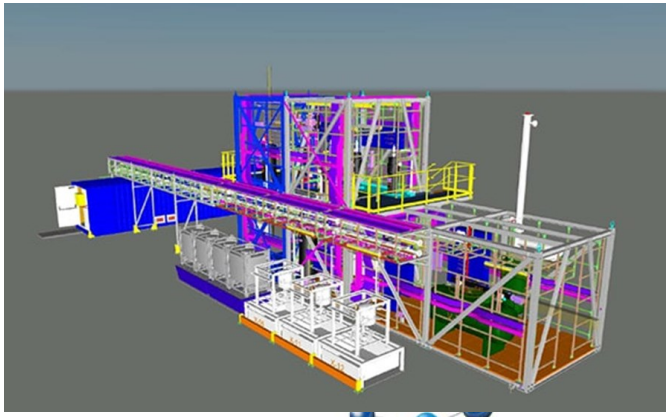


Lignovalue Pilot plant

€4.3 Mio budget

Design and construction of a pilot plant for the depolymerization of lignin/wood into innovative biobased aromatics

- ❑ Starting date: 30/05/2018
- ❑ Design of LignoValue Pilot plant
  - Continuous
  - Mobile
  - As flexible as possible
  - Treatment of lignin and wood
- ❑ Operational mid 2021



Technology choice

Metal-catalyzed conversion of lignin/wood in **solvent medium**

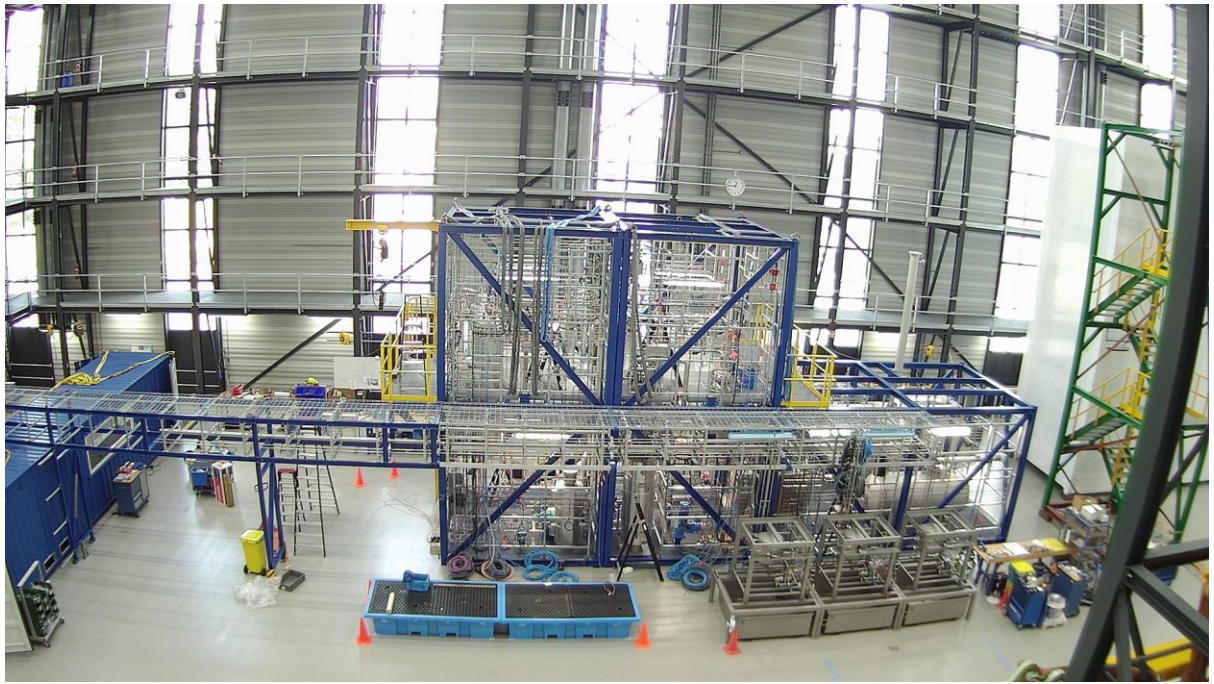
Feedstock

Solvents (Methanol, ethanol,...)

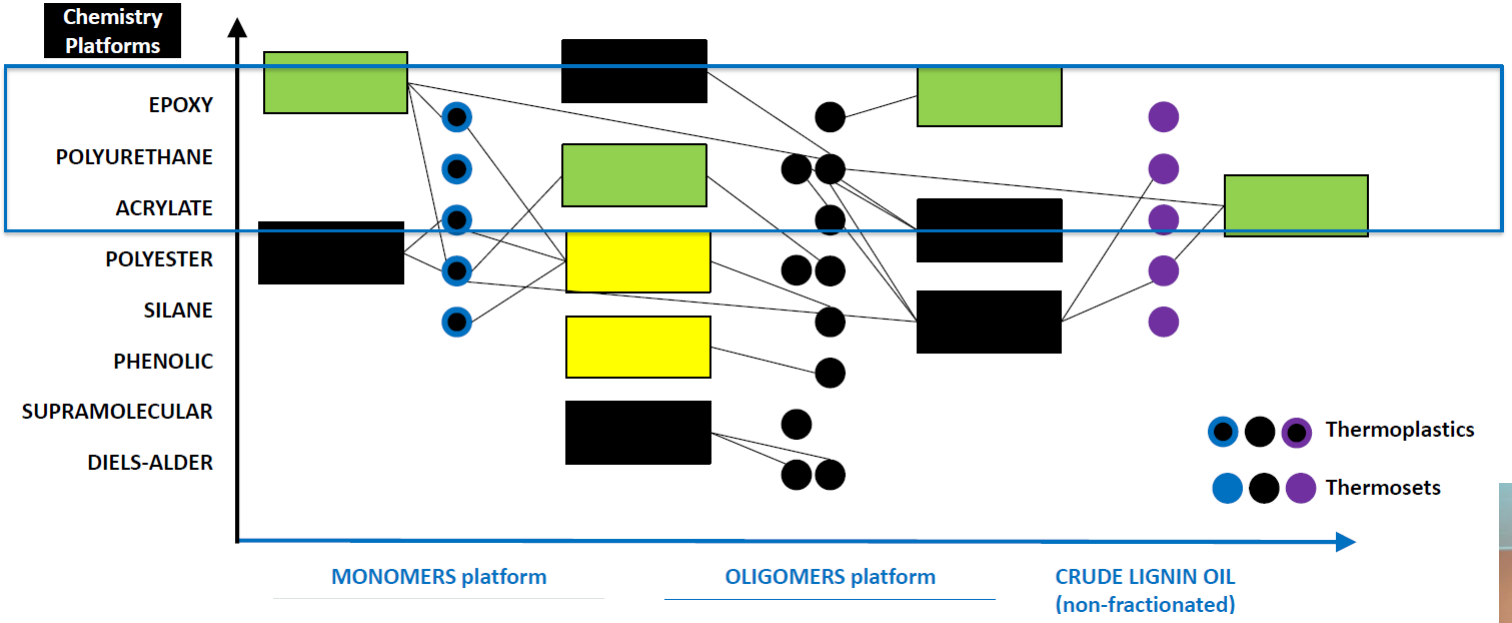
Inert atmosphere (N_2) or H_2

100 - ≥ 300 °C (medium to high)

Lignovalue Pilot plant



Linking the lignin fractions with chemistry



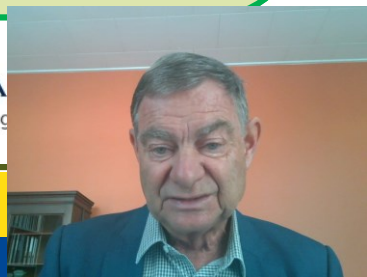
Biorizon

Bio-aromatic on the agenda of BIG-C (NL-FL-NRW)

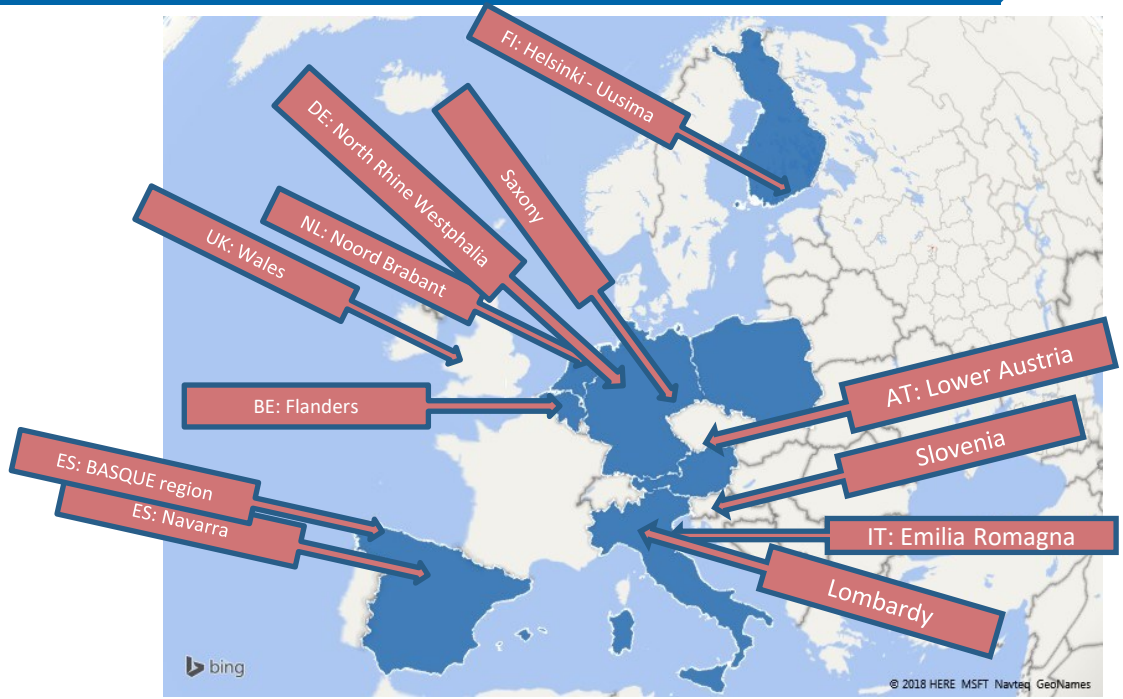
Bio-aromatics on the agenda of Vanguard Biobased (EU)

time

Thanks to Triple Helix bio-aromatics is nog very well on the regional, but also international agenda. It starts from the strong chemical region Antwerp-Amsterdam-Rhein-ruhr Region
Ideal starting point

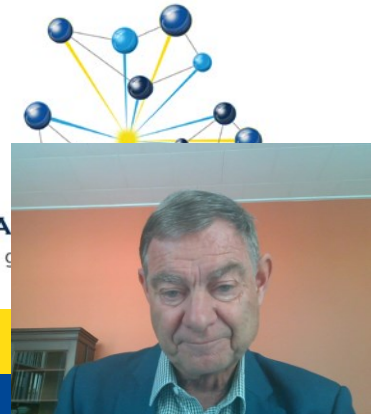


Partnerships that are still moving

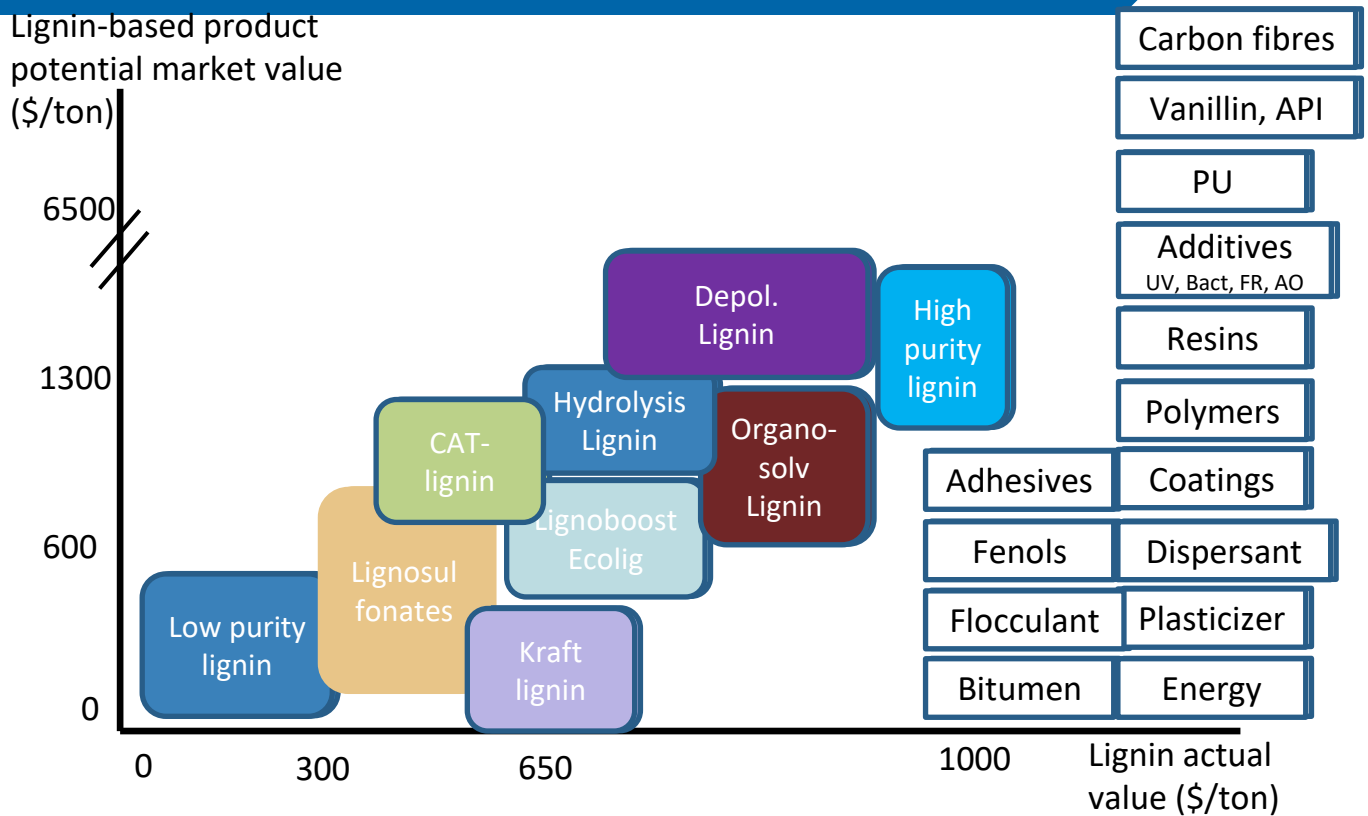


Collaboration over the value chain

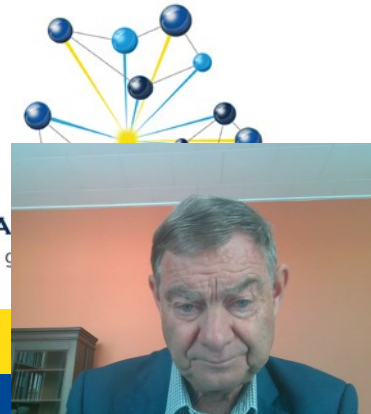
- 8 application companies
- 7 clusters/ecosystems (Vanguard)
- 1 enduser
- 13 feedstock suppliers (Vanguard)
- 3 investors
- 11 process stakeholders (Vanguard



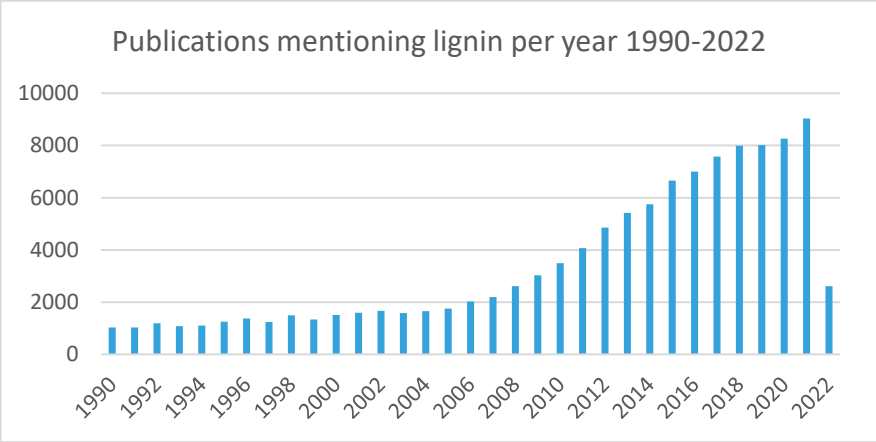
Lignin value vs lignin-based product value

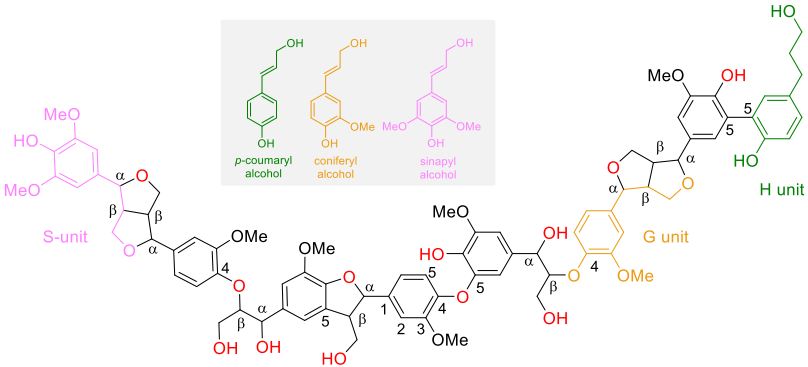


- Polyurethanes
- Polyacrylamides



LIGNIN MATERIALS, CLOSE TO MARKET?





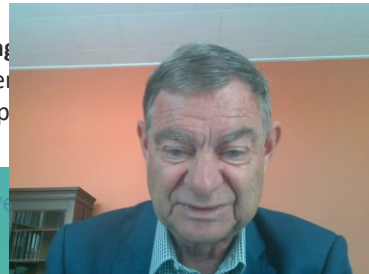
Avantium and Roelofs construct the world's first test road with lignin produced in the Netherlands

Bio-bitumen: Stora Enso + Poab→ Road in Sweden

Photo credit: Peab

Latvijas Finieris→ Industrial production of biobased glue in plywood

"Lignin as a coating material is **actually very promising** compared to the synthetic and bio-based coatings curren anti-corrosion, anti-bacterial, anti-icing, and UV-shielding p

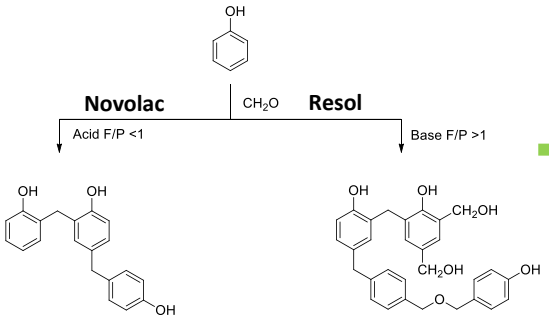


Biorizon
The way to aromatics

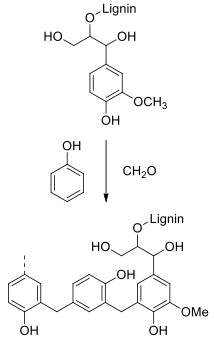
BIORESAL PROJECT

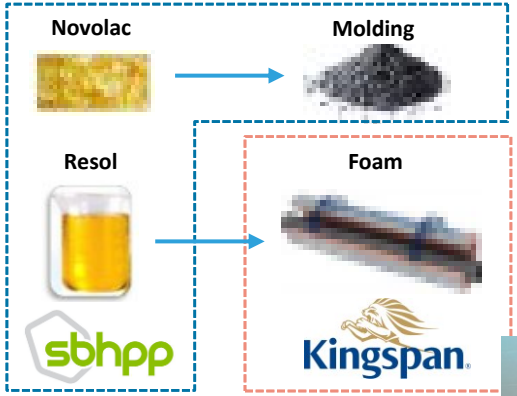
BIORESAL (BIObased RESins from Aldehydes and Lignin) Project aims to valorize technical lignins and depolymerized lignins to produce Lignin based phenolic resins for foam and molding applications→ **Replacement of phenol by lignin.**

PF resins



(L)PF resins





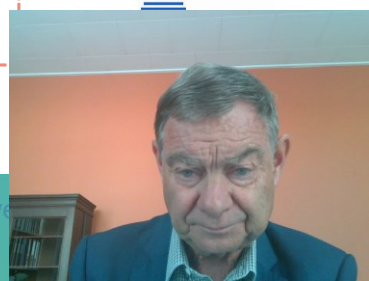
Chem. Modification
Tailoring lignin fractions

vito

TEA
Process design

INEOS
THE WORD FOR CHEMICALS

Chem. Modification
HCOH replacement



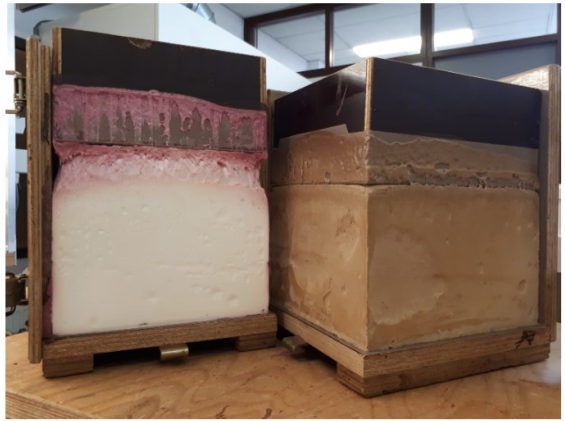
Biorizon
The way to aromatics

BIORESAL PROJECT

- **LPF Foam evaluation with technical, purified and modified lignins**

The thermal conductivity
Friability
The compressive strength
} on target ✓

Specifications of LPF improved after adapting the resin procedure and after formulation development of the foam at lab scale.



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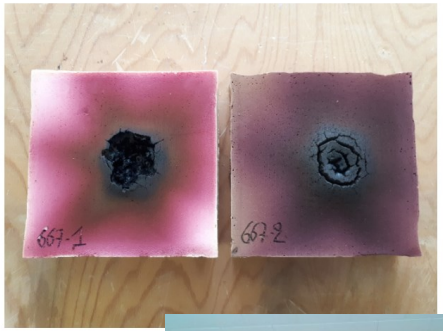
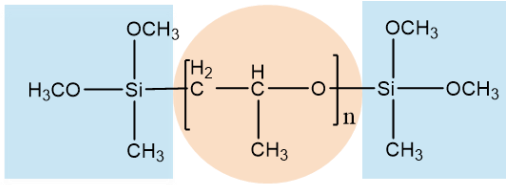
NOK

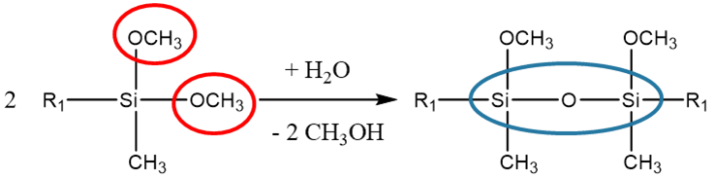


CAMBIUM PROJECT

O&O KANEKA-VITO

- Liquid Polymers (MS Polymer)
  - Sealants, adhesives and coatings
  - Construction, transportation and industry

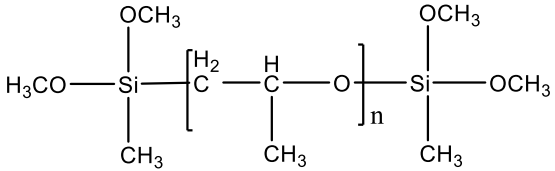


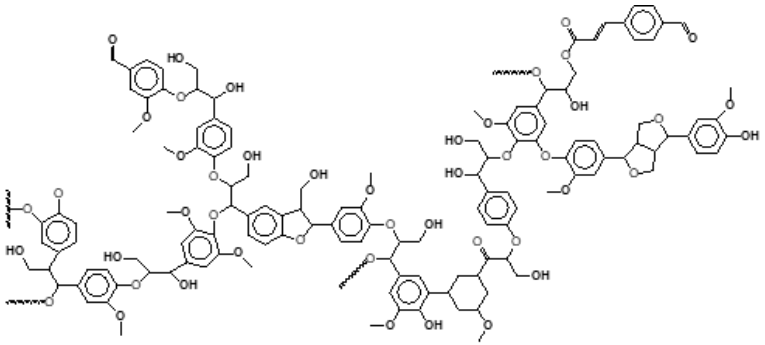


Biorizon
The way to aromatics

CAMBIUM PROJECT

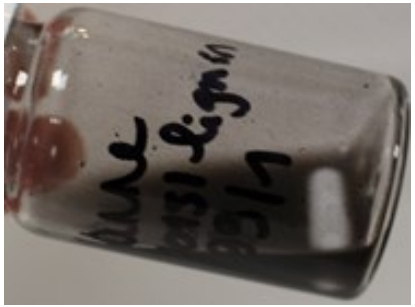
Lignin: complex and polar
MS polymer : well-defined and apolar



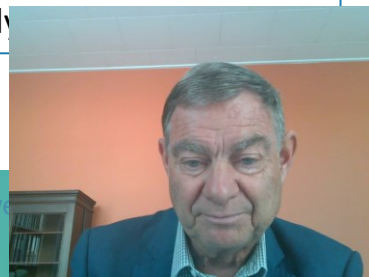


If you blend the two (1wt% KL)

+



Challenge: make lignin miscible with MS poly



CAMBIUM PROJECT

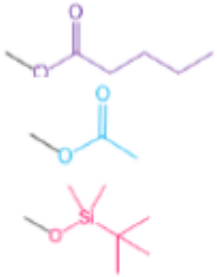
Non-reactive silylation proved to have best compatibility

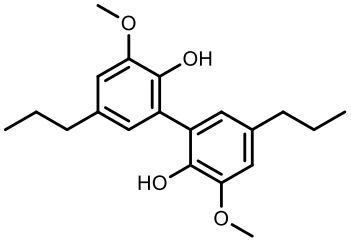
Lignin fragment	*Kraft lignin*	*Fractionated Lignin*	*PG dimer*	*PG monomer*
Mw (g/mol)	5200	1000-2300	330	166
Non-modified	NOK	NOK	NOK	NOK
Modified	NOK	OK (silylation)	OK (silylation)	OK (silylation)

Butylation

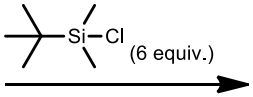
Acetylation

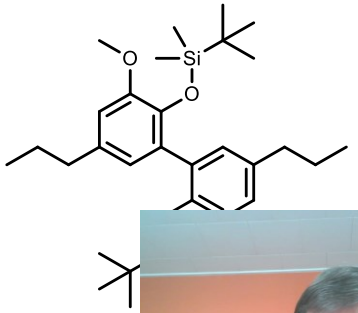
Silylation





Propyl Guaiacol Dimer





Silylated Pro

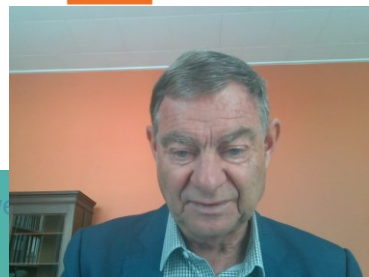
PROJECTS ON EARLY STAGE→ COMING SUCCESSFUL STORIES?

Sustainable COATings based on LIGNIn resins and bio-additives with improved fire, corrosion and biological resistance

LIGNICOAT project proposes the development of eco-innovative materials from lignocellulosic biomass in order to obtain bio-based sustainable coatings considering the availability and carbon footprint of resources.
The LIGNICOAT project aims to increase the bio-based content of the coatings while ensuring performance and providing anti-corrosive, fireproof, and antimicrobial features. The ambitious goal of the project is to assist in the transition of the Paints and Coatings industry from fossil-based to bio-based products.

Project Partners

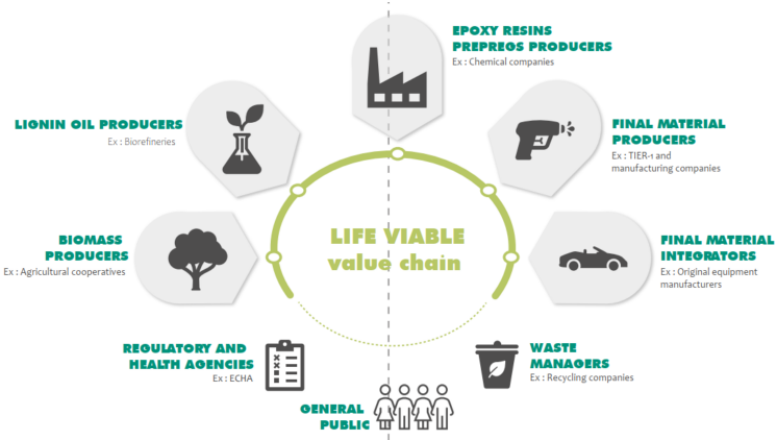
tecnalia
AEP polymers
ARDITEC
AXIA INNOVATION
Barpimo
ecoat
FORESA TECHNOLOGIES
HEXION Responsible Chemistry
iris COATINGS
Junta de Castilla y León
NORCE
VencoreX
vito
VTT



Biorizon
The way to aromatics

PROJECTS ON EARLY STAGE→ COMING SUCCESSFUL STORIES?

VIABLE



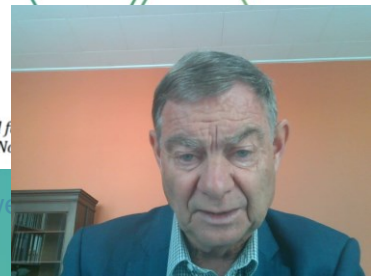
Valorization of lignin biomass into competitive components grAdually replacing BPA in the formuLation of Epoxy resins

CONTEXT OF THE PROJECT

BPA Bisphenol A (BPA) is a commodity chemical produced world-wide in a large volume every year. It is used in the production of epoxy resins and polycarbonates. However, its endocrine disrupting properties and its fossil-based composition raise concerns about its environmental impact and health toxicity as well as its sustainability.

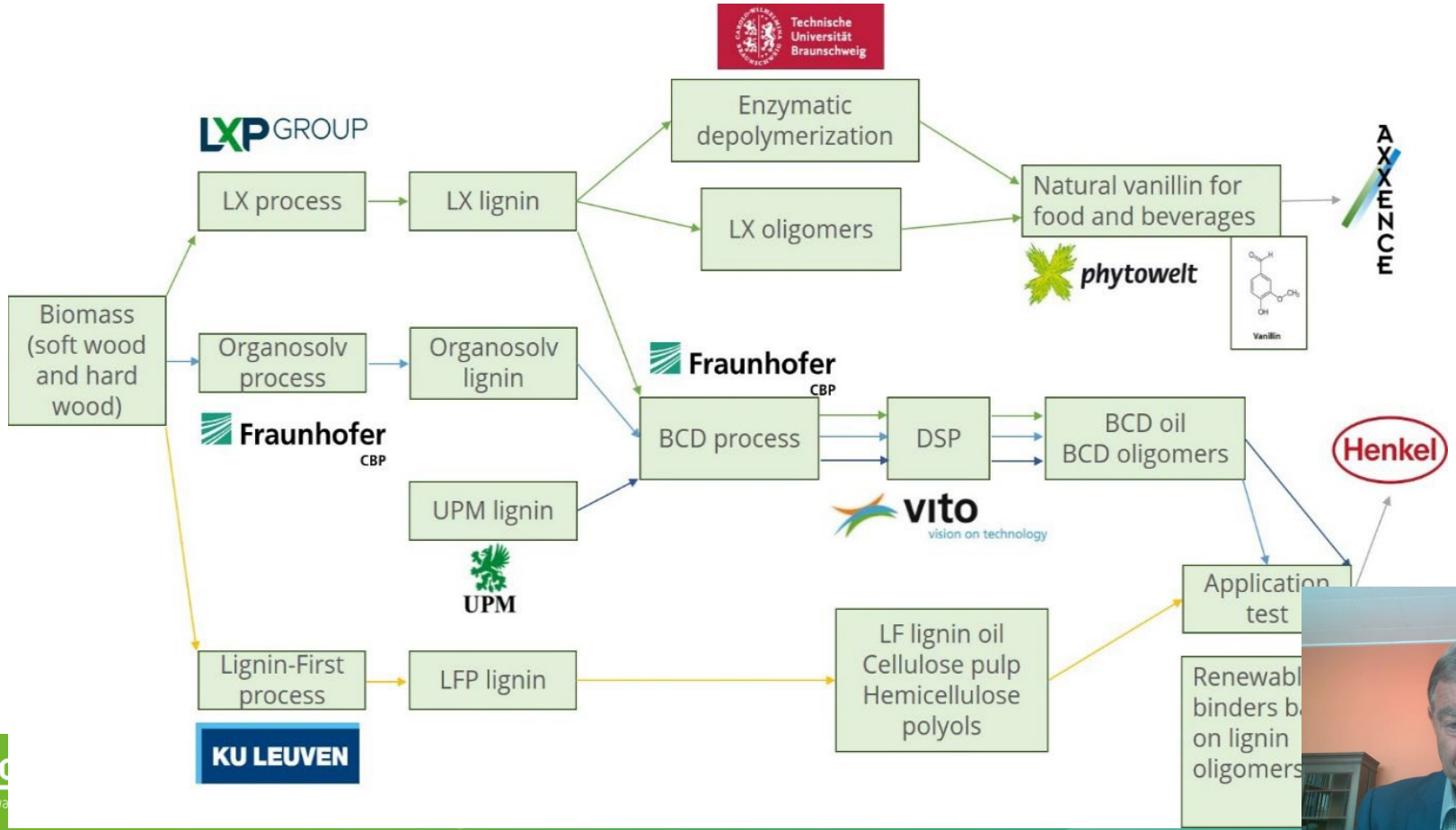
The VIABLE project therefore aims to improve the sustainability and the environmental impact of epoxy resins manufacture by lowering the BPA content in the formulation of epoxy resins by 20 to 50%.

This project has received f
under grant agreement N



Biorizon
The way to aromatics

ALIGN, BMBF PROJECT IN COLLABORATION WITH FLANDERS



CA17128 - Establishment of a Pan-European Network on the Sustainable Valorisation of Lignin

Downloads

LIGNICOST

Albania, Austria, Belgium, Bosnia&Herzegowina, Bulgaria, Croatia, Cyprus, Czech Republic, Denmark, Estonia, Finland, France, Germany, Greece, Hungary, Iceland, Ireland, Italy, Latvia, Lithuania, Luxembourg, Netherlands, North Macedonia, Norway, Poland, Portugal, Romania, Serbia, Slo
Slovenia, Spain, Sweden, Switzerland, Turkey, UK

Need for concrete suggestions by other regions

- Lignovalue opening (6 October 2022)
- Vanguard meeting (5 October 2022)
- New projects are coming
- Suggestions by regions?

THANKS!

Any questions?

You can find me at

Ludo.diels@vito.be