Biorizon

The way to aromatics

A way to more sustainable & profitable functionalized aromatics

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Powered by:

TNO innovation for life

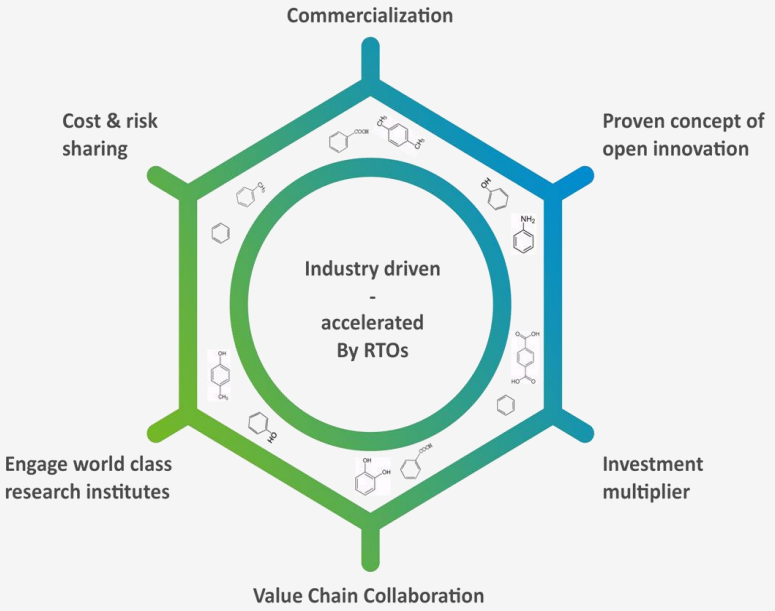
vito vision on technology

GREEN CHEMISTRY CAMPUS

Agenda

- Biorizon – who are we
- Bio-Aromatics 101
- Bio-aromatics – Shared Research
- The Horizons
- Biorizon going forward
- Summary

Shared Research Center



Biorizon

The way to aromatics

Biorizon is a Shared Research Center with an initial focus on technology development for the production of biobased aromatics for performance materials, chemicals & coatings. Biorizon is anticipating the expected growing shortage of aromatics from the petrochemical industry and the widely shared ambition to green the chemical industry.

Our goal is to be a leading European Center for biobased aromatics within 3 years and to be in the global top 3 within 5 years. This way the participating companies will get the best results possible!

Initiators

As an independent and customer-orientated research organization, VITO provides innovatory technological solutions and makes scientifically-based recommendations and provides support to stimulate sustainable development and reinforce the economic and social fabric of Flanders.

TNO is an independent research organization that, on the basis of its expertise and innovations, makes an important contribution to the competitive strength of businesses and organizations, the economy and the quality of society in its entirety. TNO occupies a unique position thanks to its versatility and its capacity to integrate this knowledge.

The Green Chemistry Campus, located on the SABIC Innovative Plastics site is an incubator where businesses accelerate their bio-based innovations on the cutting edge of agro and chemistry. The campus is an initiative of the Province of North Brabant, the Municipality of Bergen op Zoom and NV REWIN West-Brabant.

Why are (bio)Aromatics important

Market size

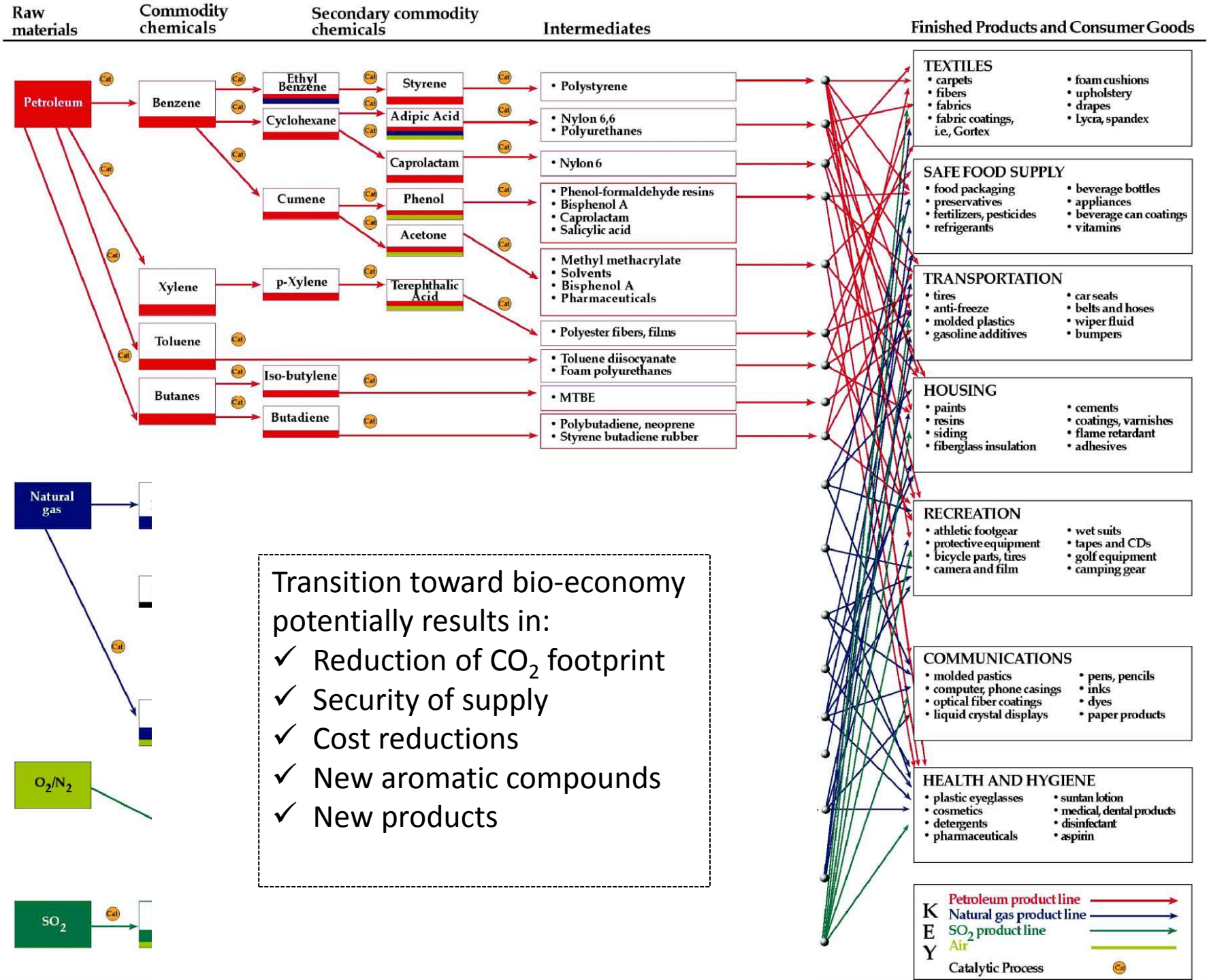
- 40 % of bulk chemicals are aromatics
- Benzene, toluene, and xylenes ("BTX") a $120 billion global market

Employment in Europe

- 20.000 – 70.000 – 1.000.000
- socio-economic impact , contribution to everyday's life

Increasing Demand/Security of Supply

- Brandowners , producer consumer (Coca Cola)
- Shale gas – crude oil price volatility



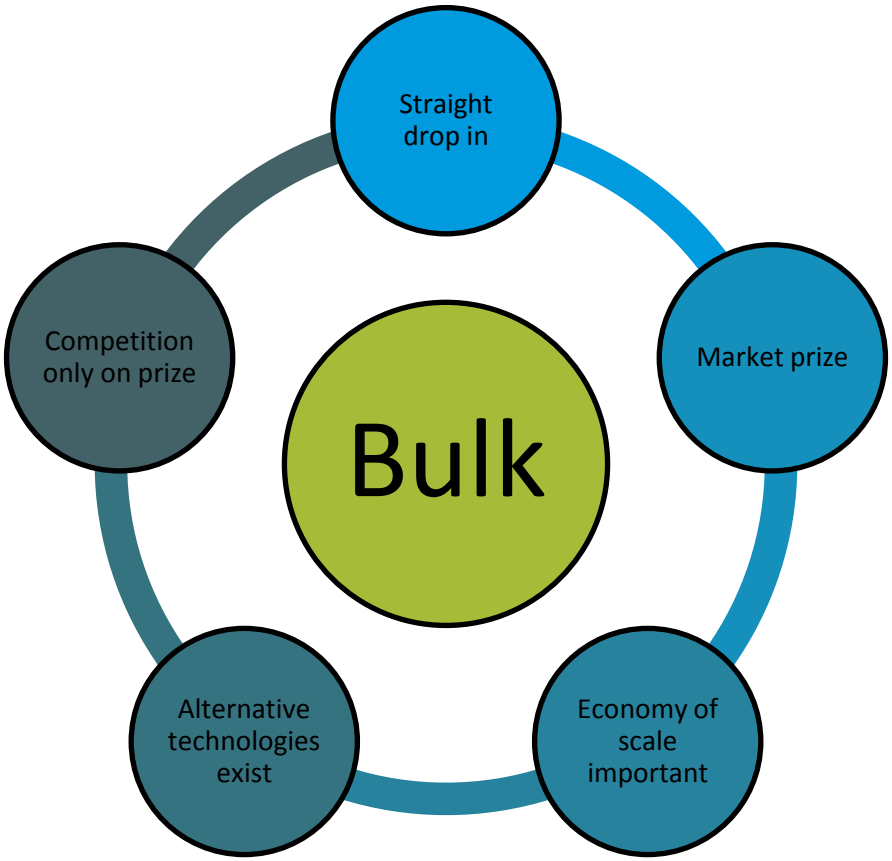
Transition toward bio-economy potentially results in:

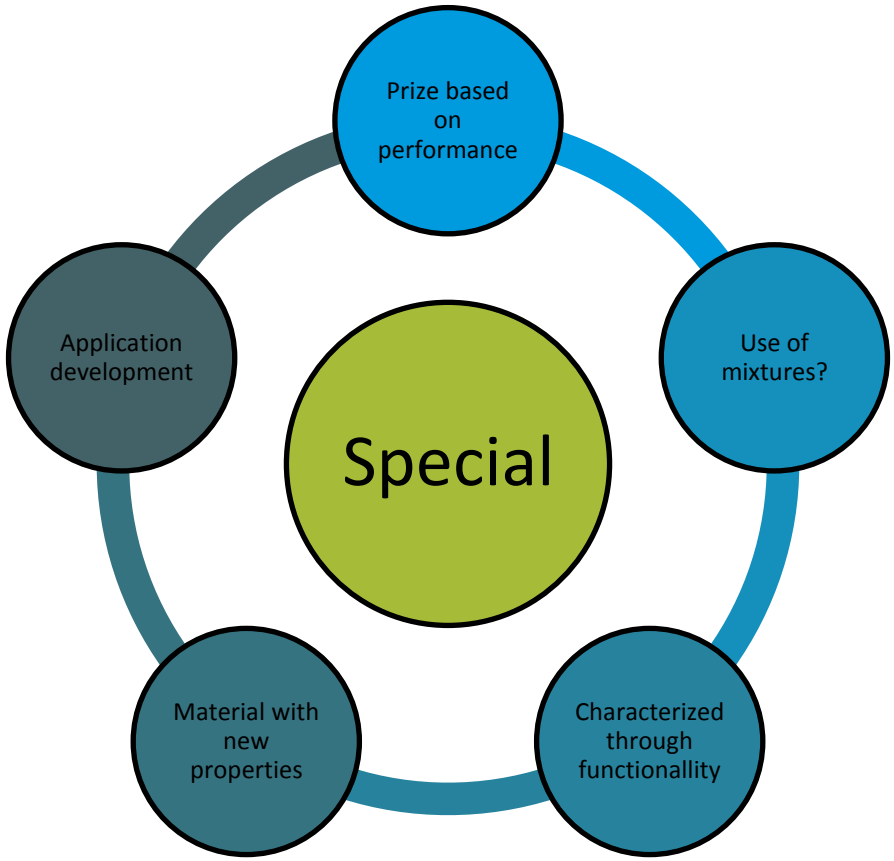
- ✓ Reduction of CO_2 footprint
- ✓ Security of supply
- ✓ Cost reductions
- ✓ New aromatic compounds
- ✓ New products

OPPORTUNITY

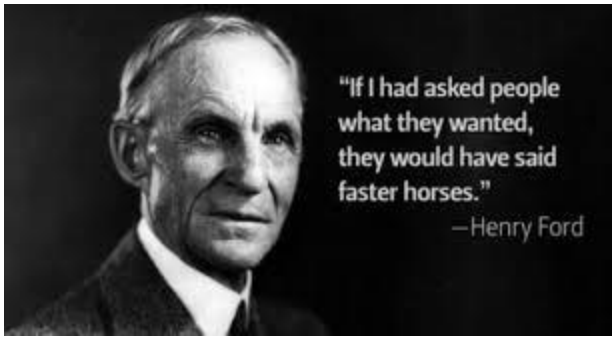
- New Functionalities
- New Structures
- New “tools” for polymer and material chemists
- Challanges of the 21st century require new materials

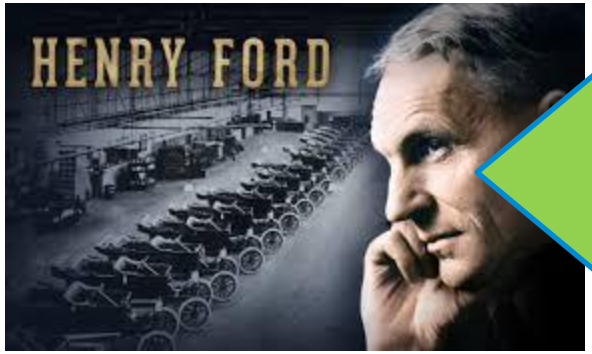
Bulk vs Speciality aromatics





Market Research





Speciality Bioaromatics

Bulk Bioaromatics

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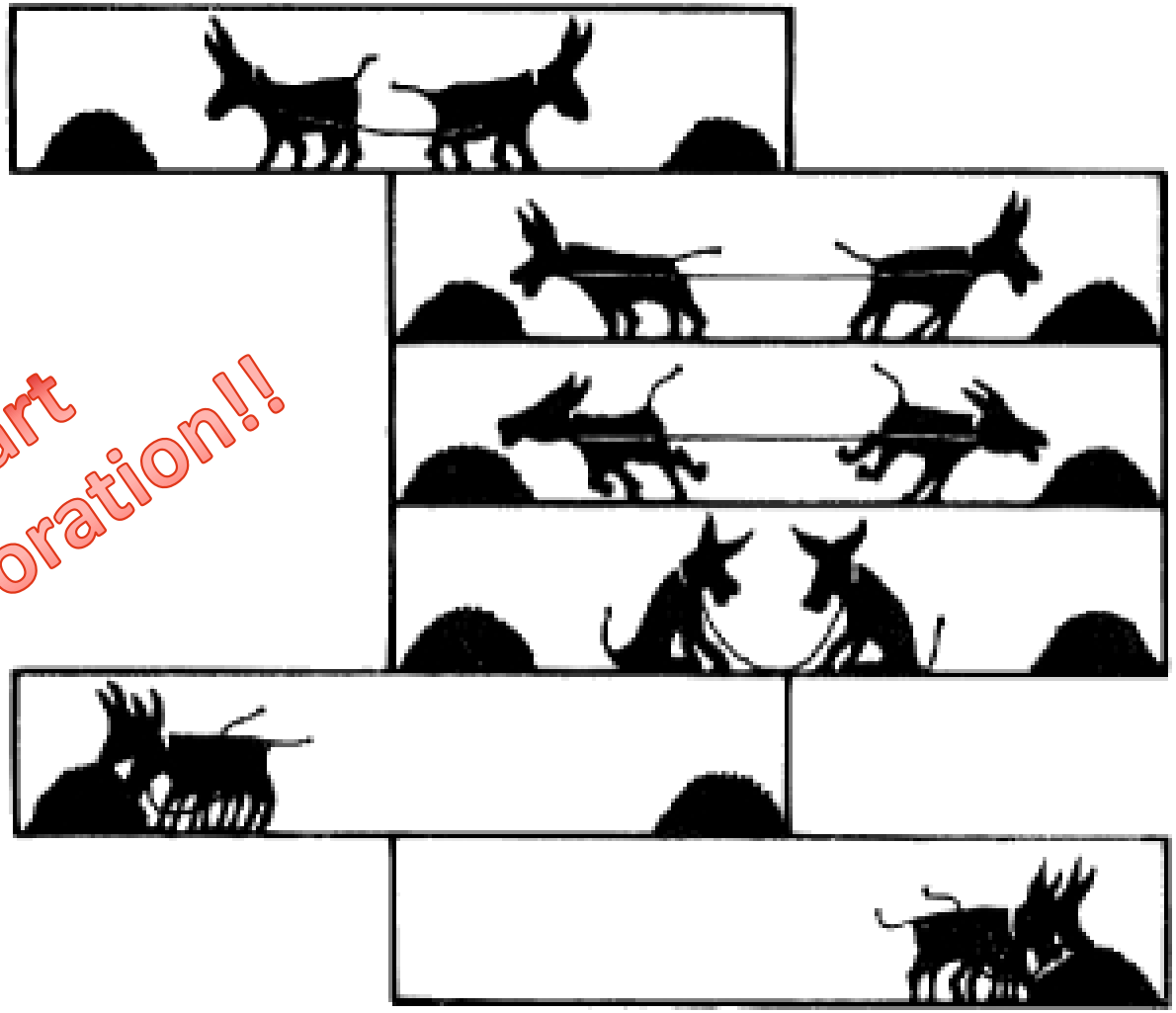
What is shared research?



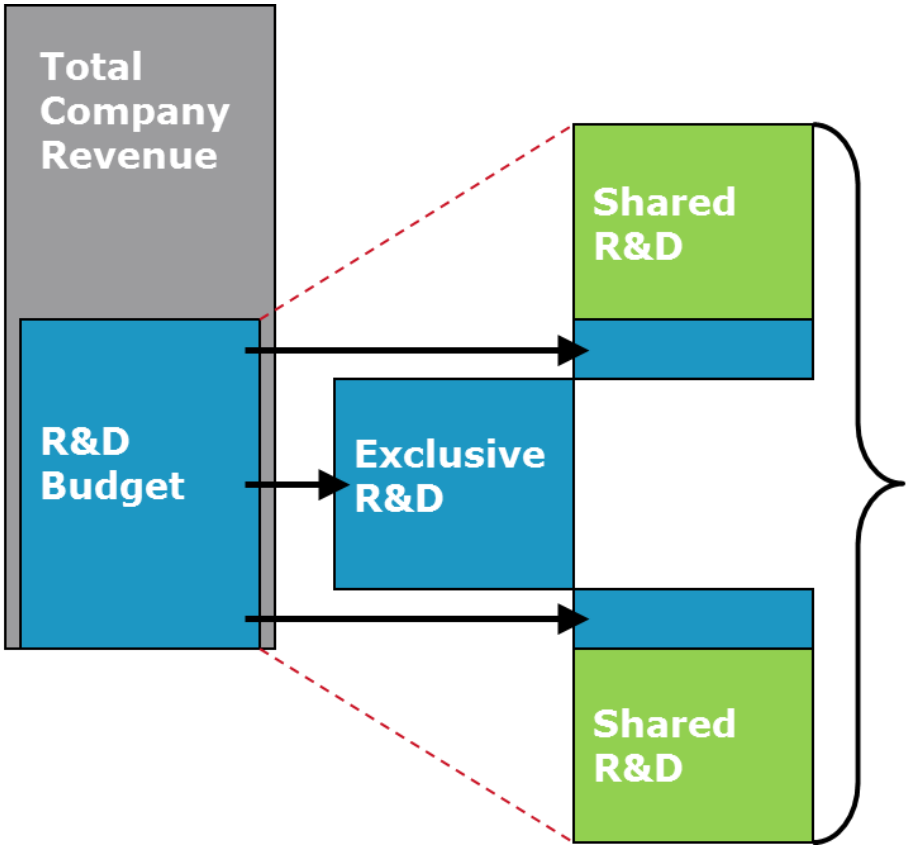
What is shared research?

A Business Perspective

Innovation becoming more complex:

we can't stop innovating…

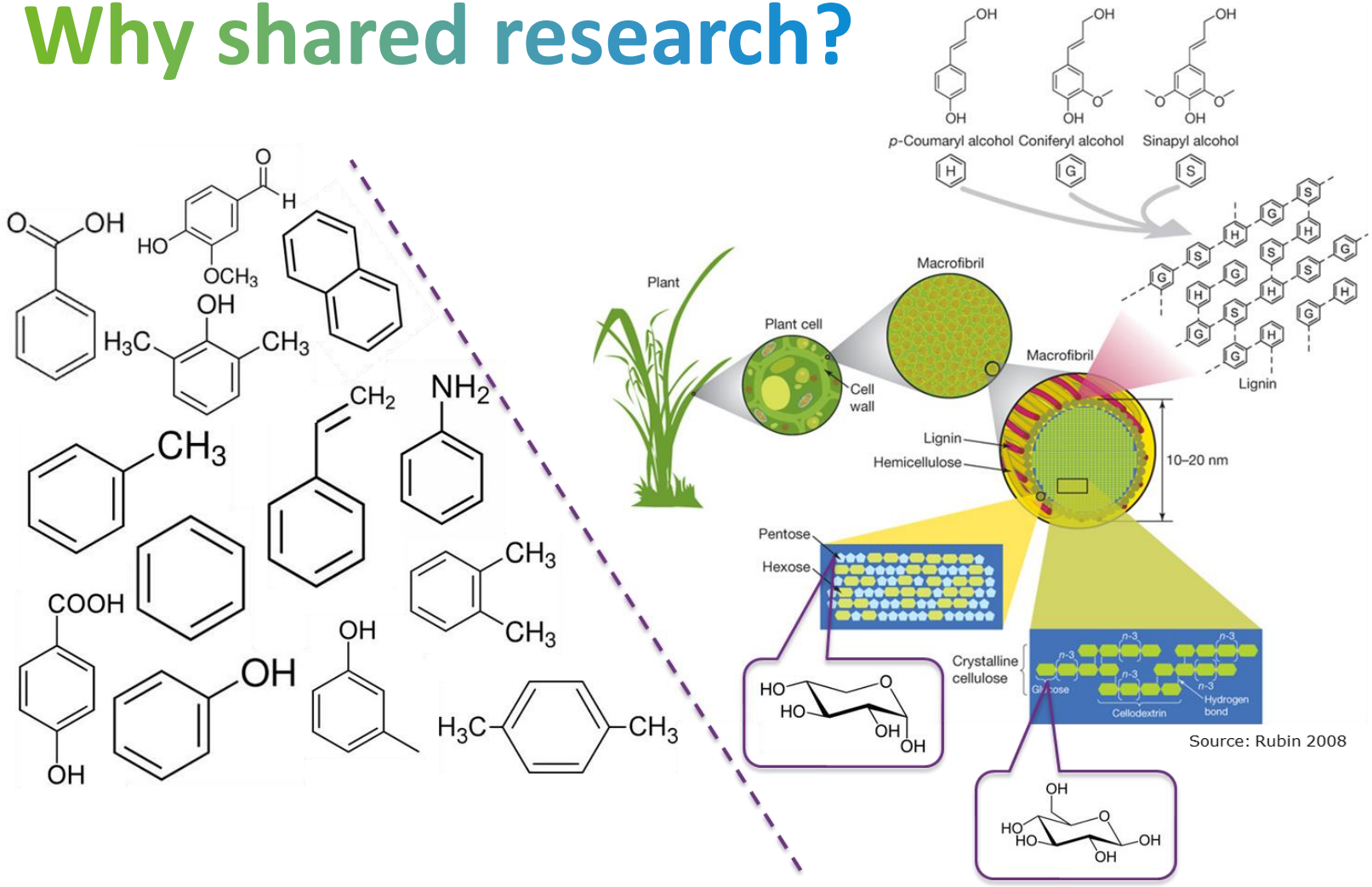
…but we can't bear the costs and risks anymore



Leverage:

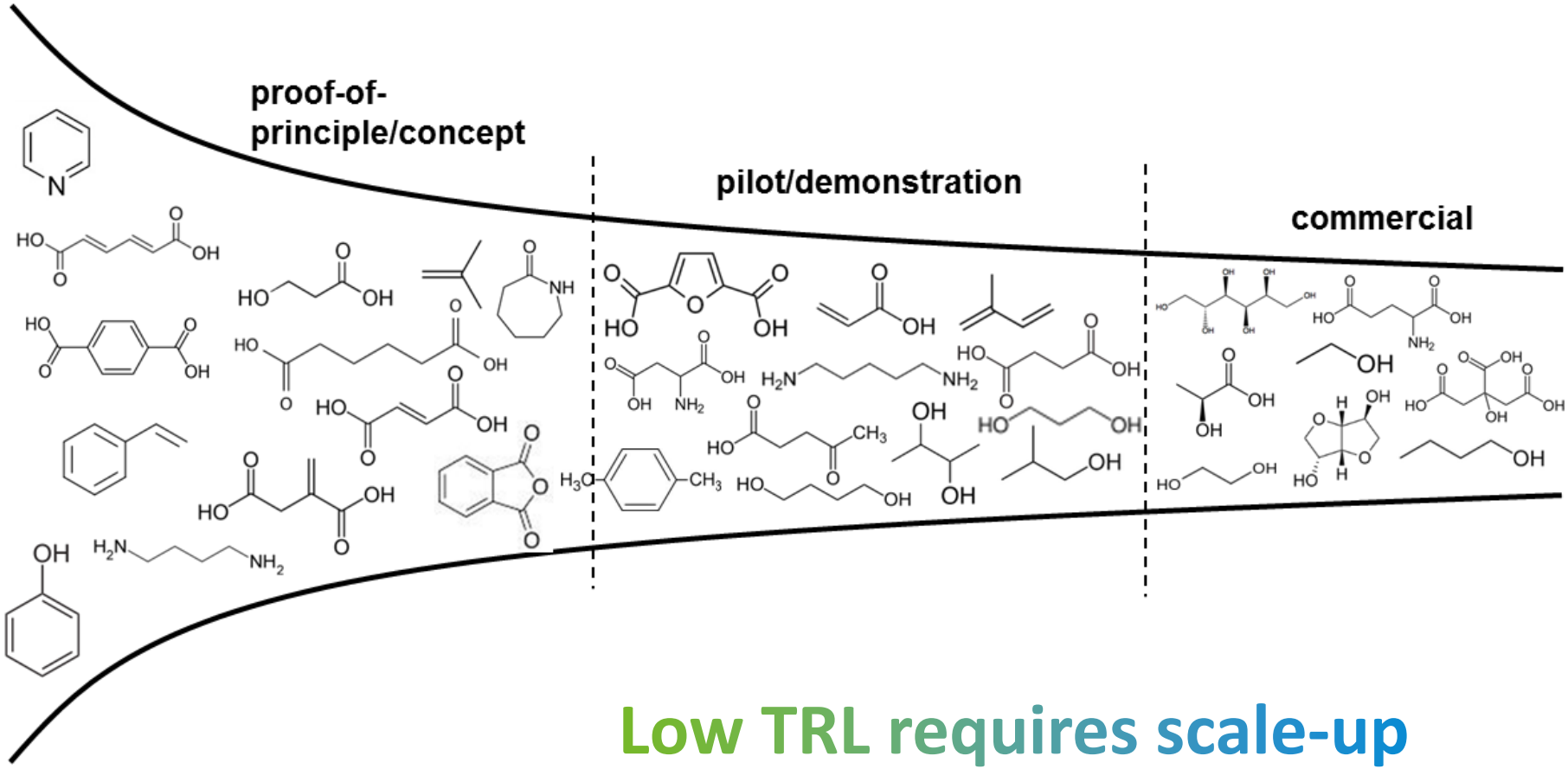
1. **Innovating by combining ideas**
2. **Sharing of facilities and competencies**
3. **Reducing time to market**
4. **Sharing of R&D costs and risks**

Why shared research?



Complex innovations required

Why shared research?



Low TRL requires scale-up

Renewable aromatics, how?

Biorizon approach to accelerate European progress

Industry-inspired roadmap

Time-to-market analysis

Detailed technology review

IP-scan

Workshop with >15 industrial participants

Guesstimate analysis of economic potential

Bilateral discussions & group sessions

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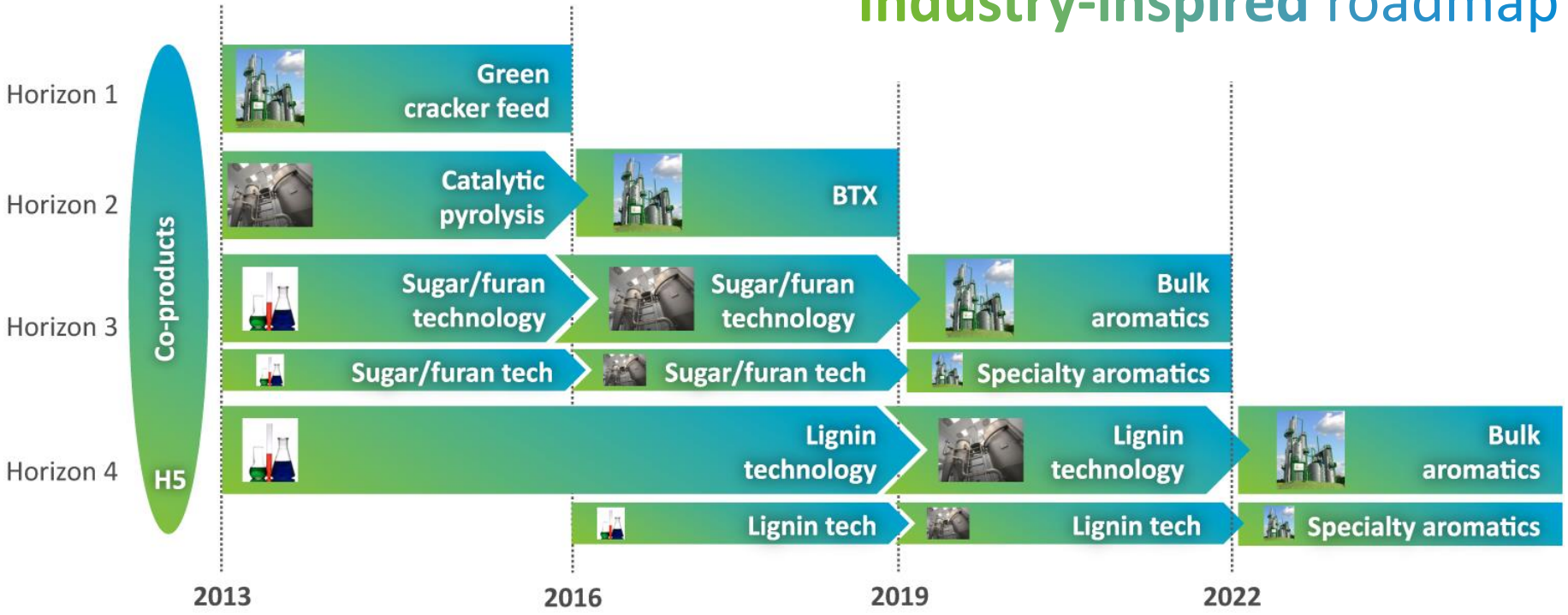
Renewable aromatics, how?

Industry-inspired roadmap



Activities: SRP lines | horizon | co-products

Scale of activities: Lab | Pilot | Demo

Horizon 1

- A deployment activity, focused on the **short-term realization of a demonstration plant** for the production of **green cracker feed**.

  Catalytic pyrolysis technology will be applied to de-oxygenate lignocellulosic biomass into a mixture of hydrocarbons, as feedstock for conventional cracking.

Horizon 1

- A deployment activity, focused on the **short-term realization of a demonstration plant** for the production of **green cracker feed**.

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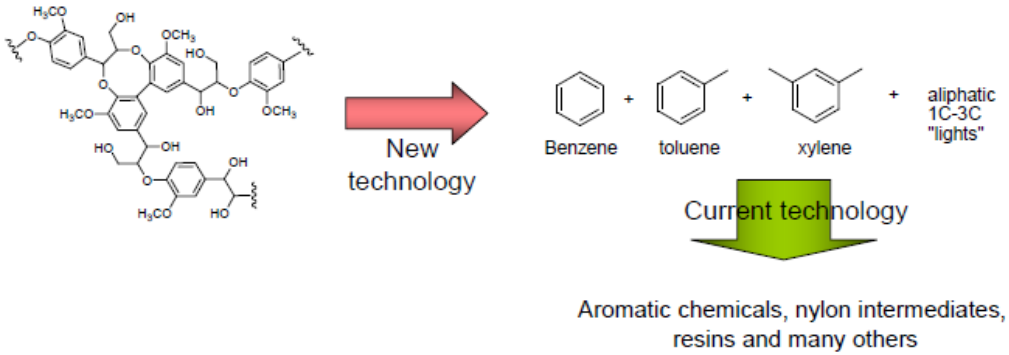
Horizon 2

- Focus on the accelerated scale-up of **catalytic pyrolysis technologies for BTX** production from low-cost & low-quality biorefinery co-products (stand-alone unit).

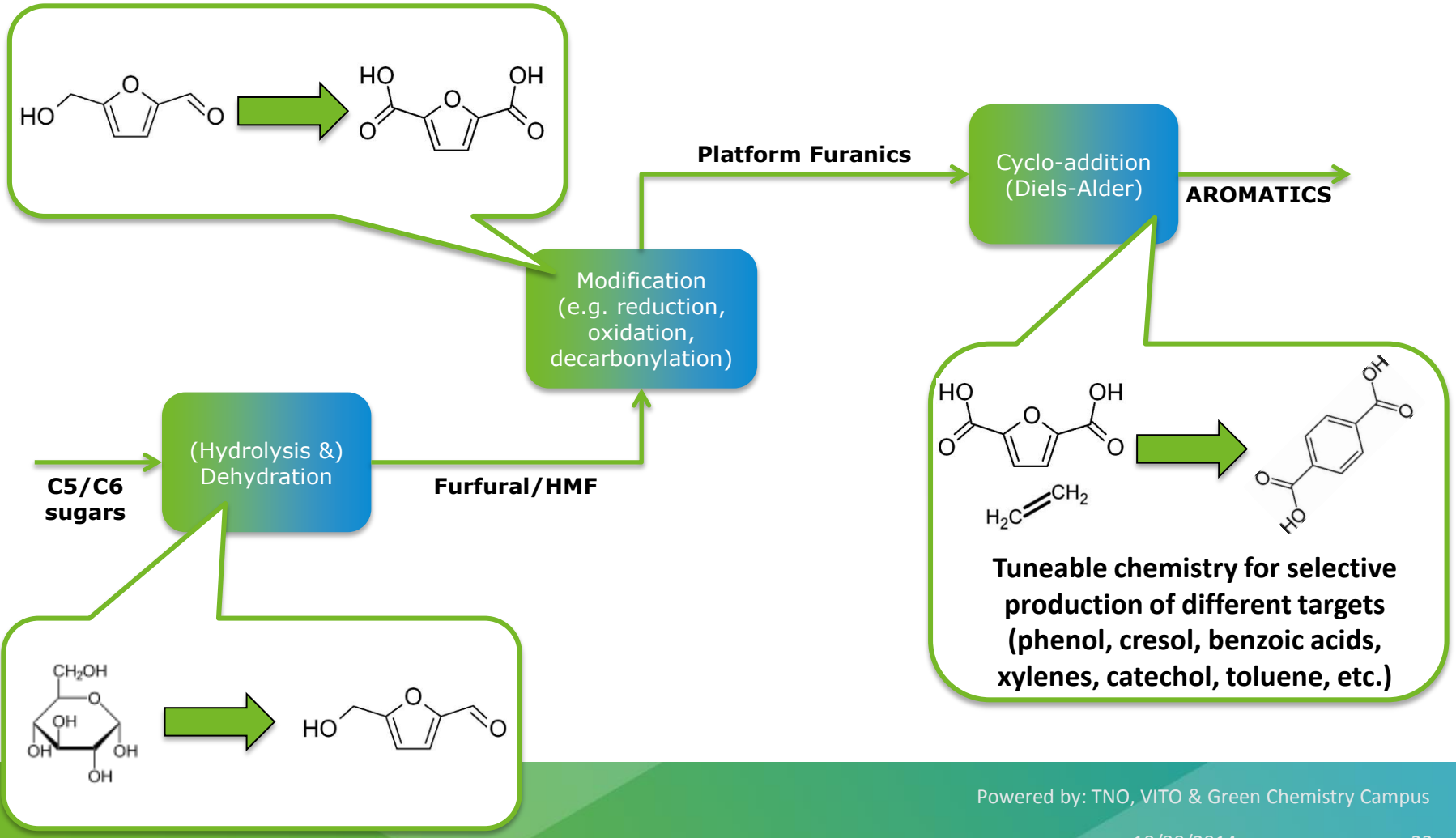


Horizon 3

- Focus on (bio-)chemical technologies toward **functionalized bulk & specialty compounds from sugar**, preferably with higher O, N or halogen content.

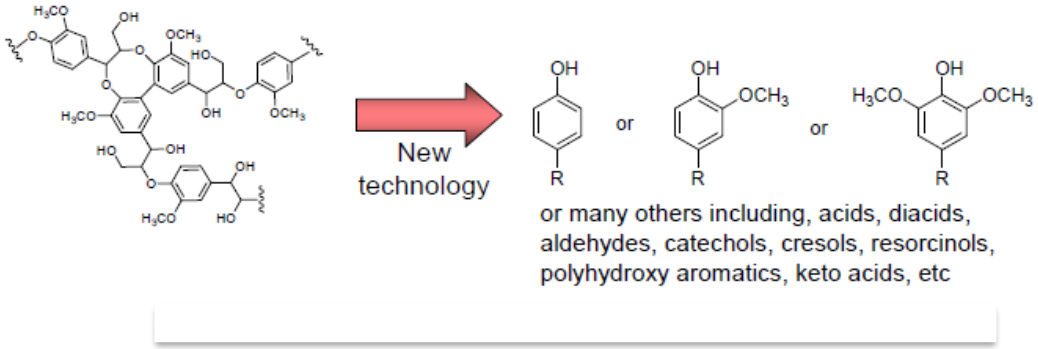
Technology: furan-centered chemistry

Highly selective & tuneable conversions



Horizon 4

- Focus on (bio-)chemical technologies toward **functionalized bulk & specialty compounds from lignin**, preferably with higher O, N or halogen content.
- Lignin conversion to innovative molecules & materials



Lignin – the VITO line in Biorizon

Facts

- Major aromatic resource of the bio-based economy
- 55 million tons/year of lignin as side product of pulping processes

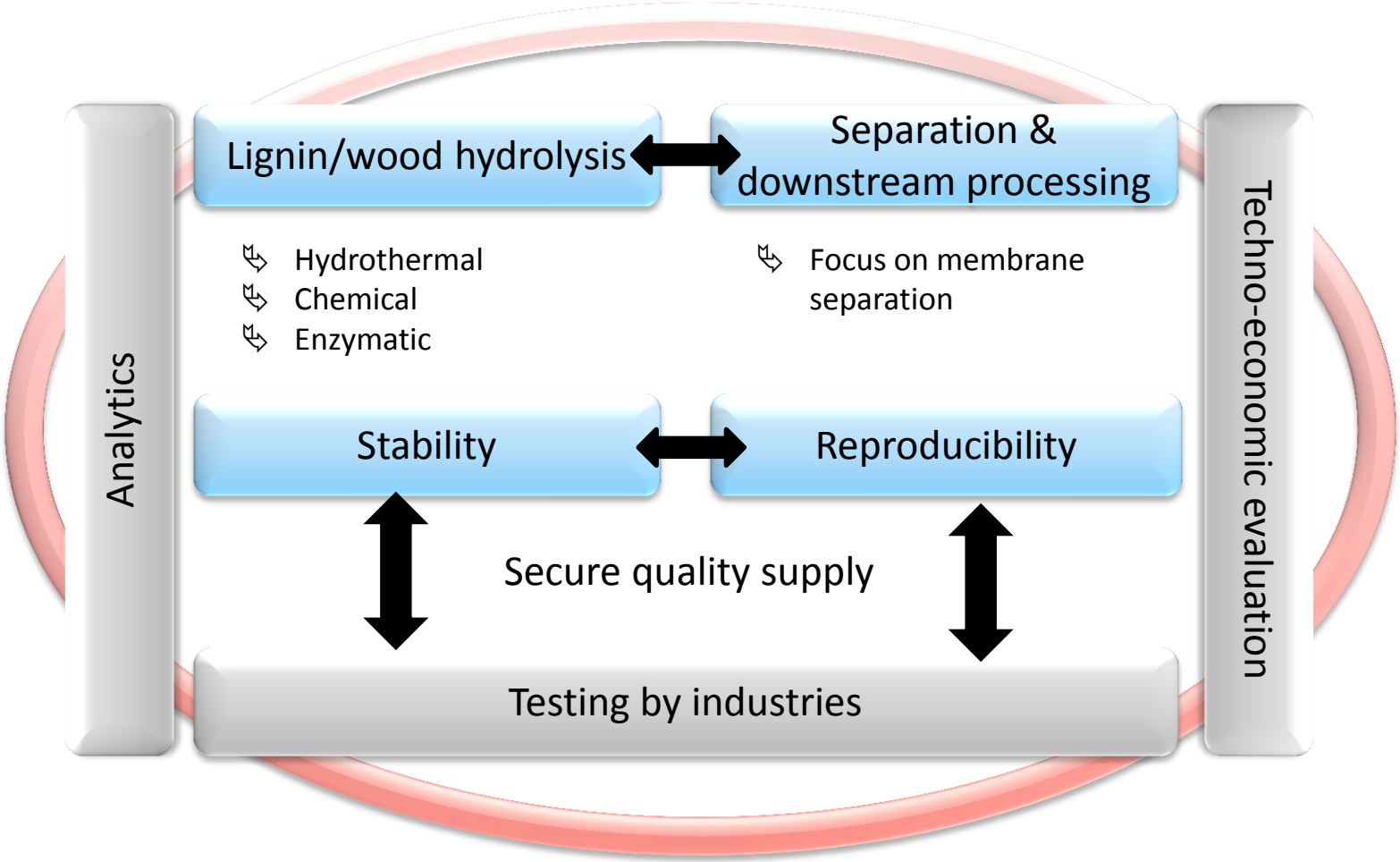
Challenges

- Non uniform structure
- Unique chemical reactivities
- Organic & inorganic impurities
- Up to 25 different types of bonds
- Most studies on lignin model compounds
- Price competitive processes

Expectations

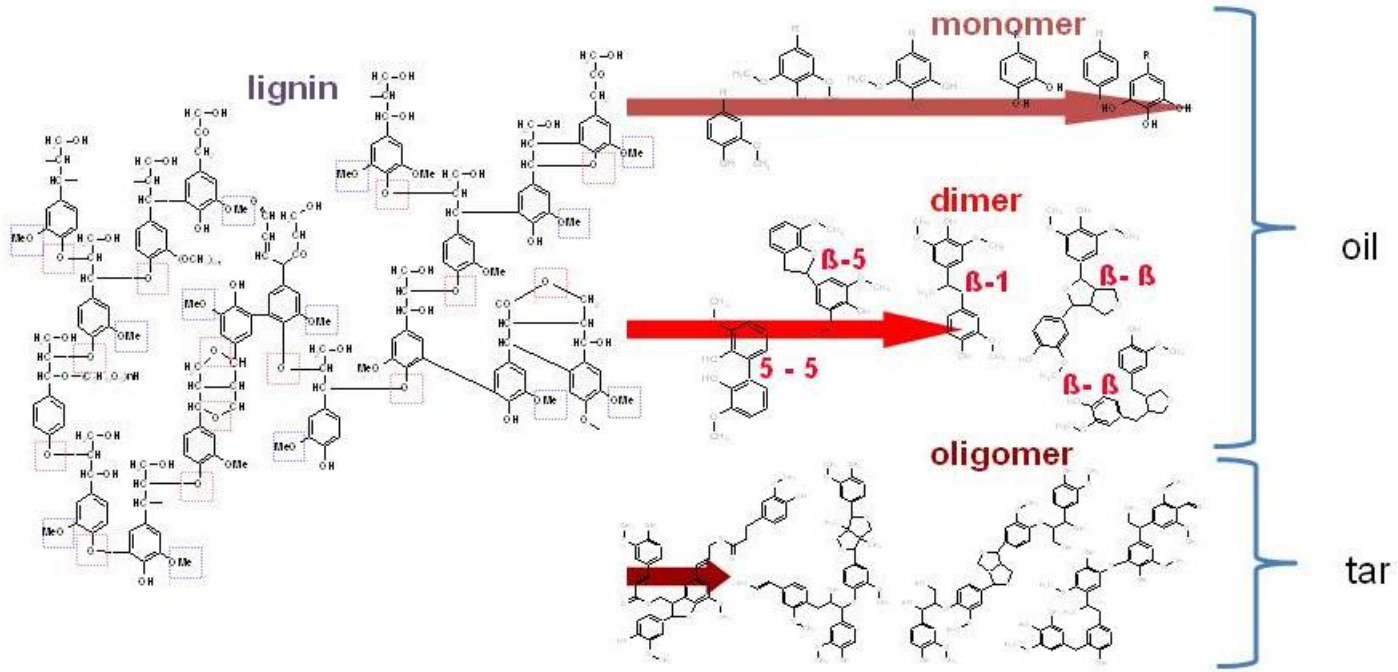
- Large volume
- High purity
- Constant quality
- Low price
- Defined structure
- High added value chemicals – specialty chemicals

Biorizon approach for lignin



Biorizon approach for lignin

- Only depolymerization steps are needed to produce aromatics
- Novel di-, tri-, oligo and polymers
- Maintain functionality as designed by nature
- Add/change/remove functionality is possible
- Possibility to maintain heteroatoms (O) in products



Horizon 5

- **Application development of co-products** from horizons 1-4, focused on resource efficiency and generating added value for the value chains developed in horizons 1-4. SME focus.

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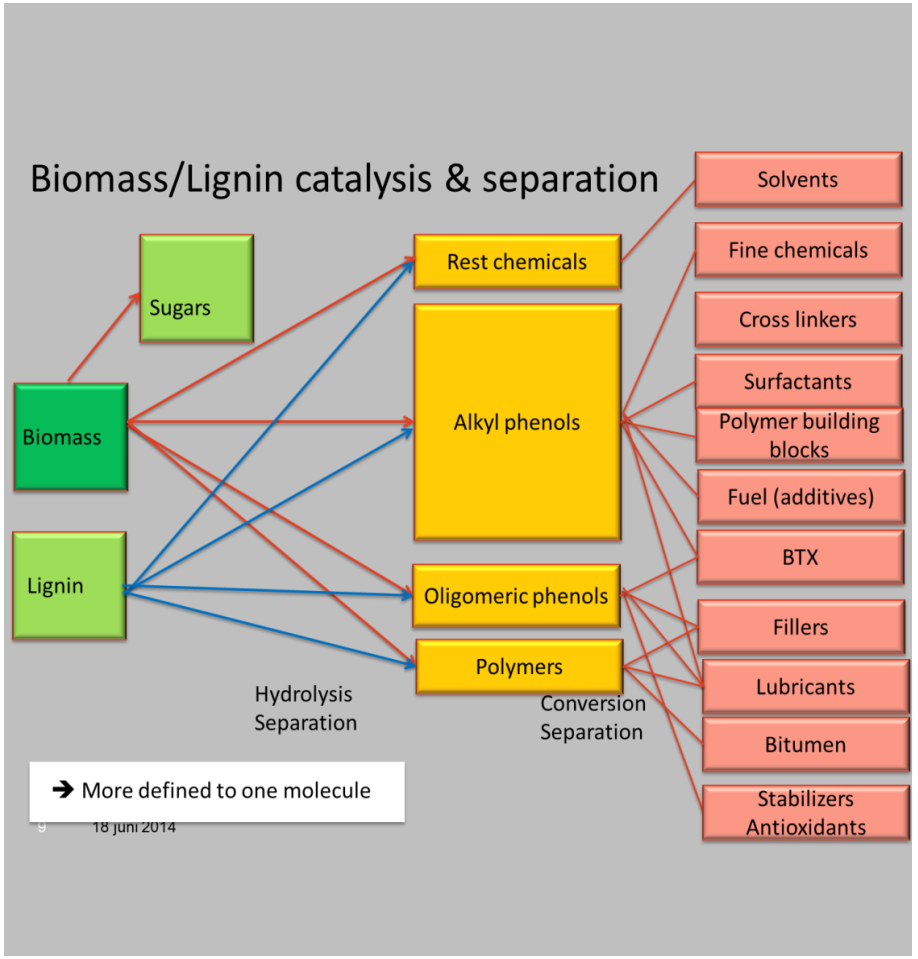
New initatives

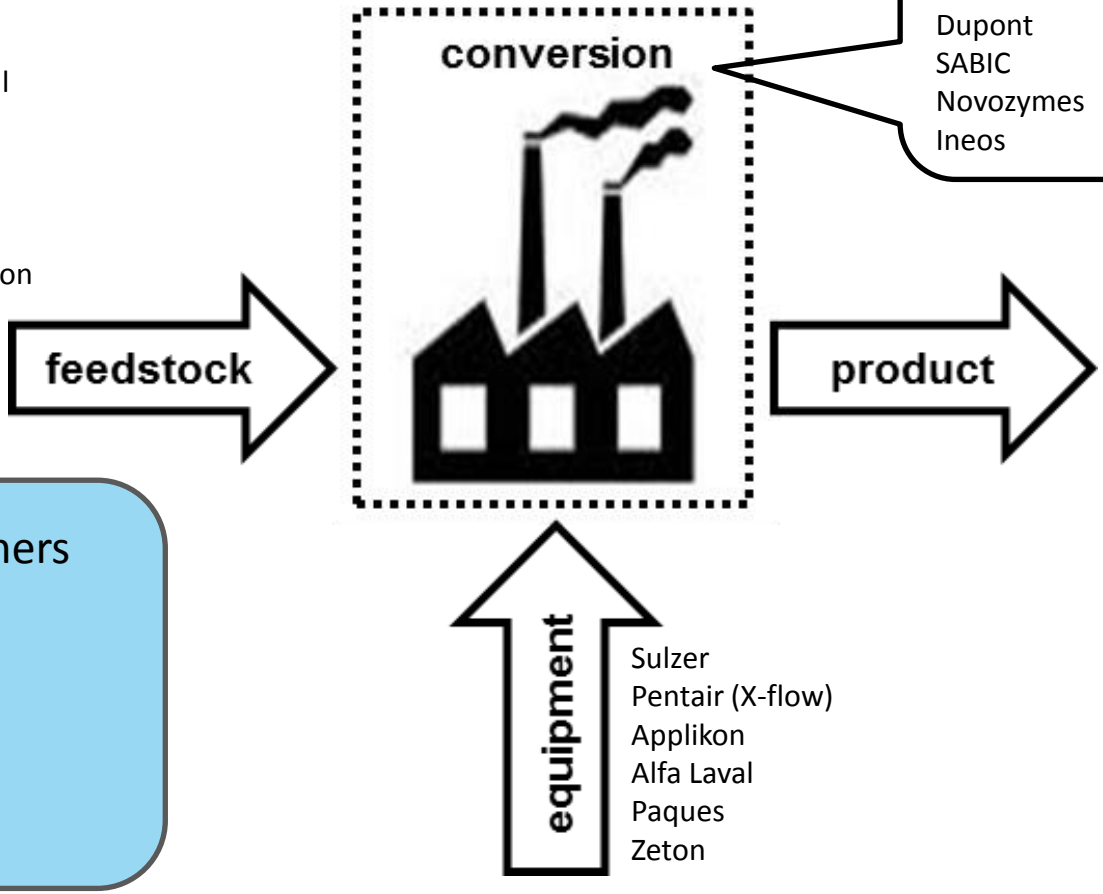
- FISCH-BIOAROMAT: full chain (small amounts)
- BBI-HELIVA: full chain at pilot scale
- SBO: Integrated chain starting from poplar
- Cross Border project for demoplants
- Extension towards other research groups
- Commitment o many large and small companies (high enthusiasm at the end-users side)



Total value chain approach

Examples of potential partners

Roquette
COSUN-SU
Tereos Syral
Cargill
Tate & Lyle
CIMV
SAPPI
Lamb Weston
UPM
ADM



Conversion:

Virent	Ajinomoto
DSM	BTG
Dupont	BASF
SABIC	Annelotech
Novozymes	Avantium
Ineos	Total

SABIC
DOW
BASF
Solvay
Bayer
PPG
ICL
JBF
Evonik
Lanxess
AKZO
Reichhold

Sulzer
Pentair (X-flow)
Applikon
Alfa Laval
Paques
Zeton

Brand Owners
(launching customers)

Philips
Nike
Heinz
…

Summary-Questions

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