

Circular and renewable bioaromatic building blocks for more sustainable plastics

The Bioeconomy Pilot of the Vanguard Initiative

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The Bioeconomy partnership at a glance

Long term Goals



Support the creation of new integral bio-based value chains and connections between chemistry, agro-food, bioenergy, biofuels sectors



Promote new business opportunities through interregional cooperation and exchange of ideas*



Encourage projects at the demonstration stage towards their upgrading and business exploitation (beyond TRL 5)

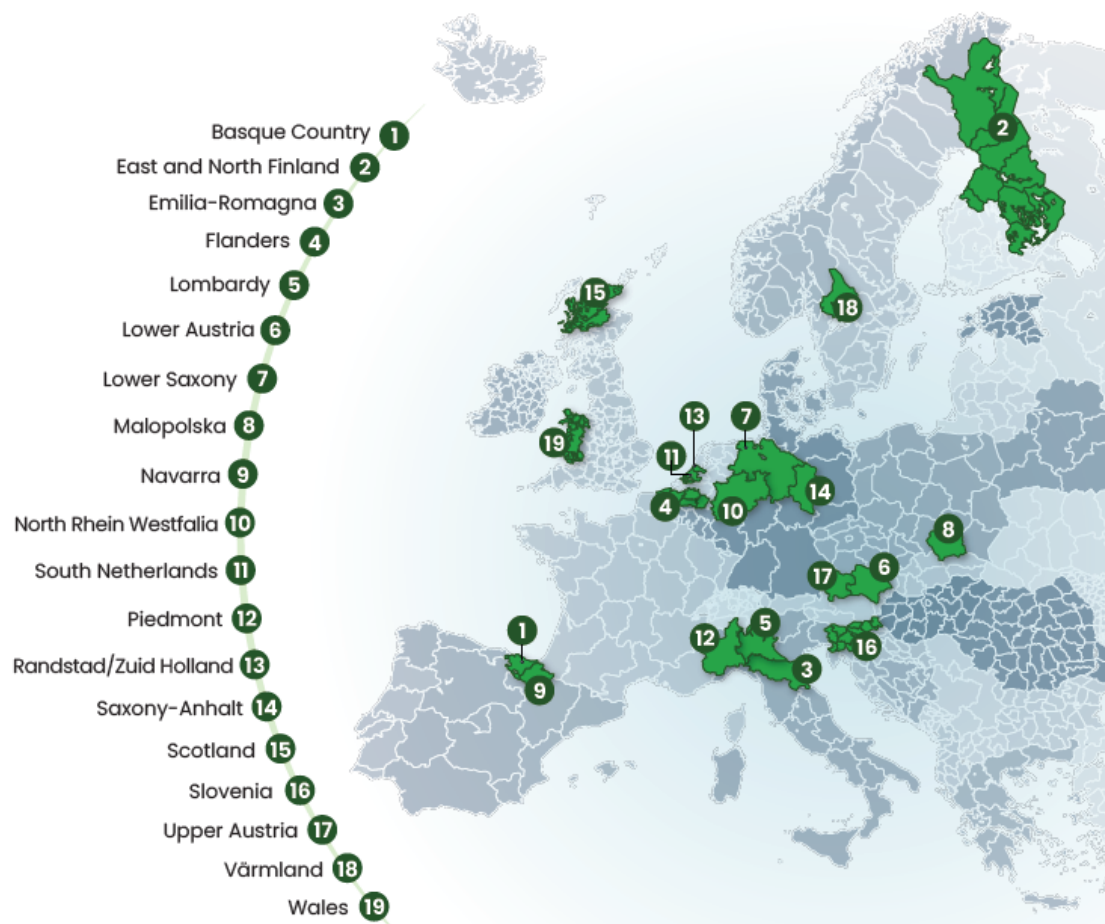


Support the establishment of investment pipelines based on industry-driven business cases coherent with the smart specialisation strategies of the participating regions



Promote the political engagement to position the Smart specialisation agenda at the centre of the EU's drive for a sustainable economy

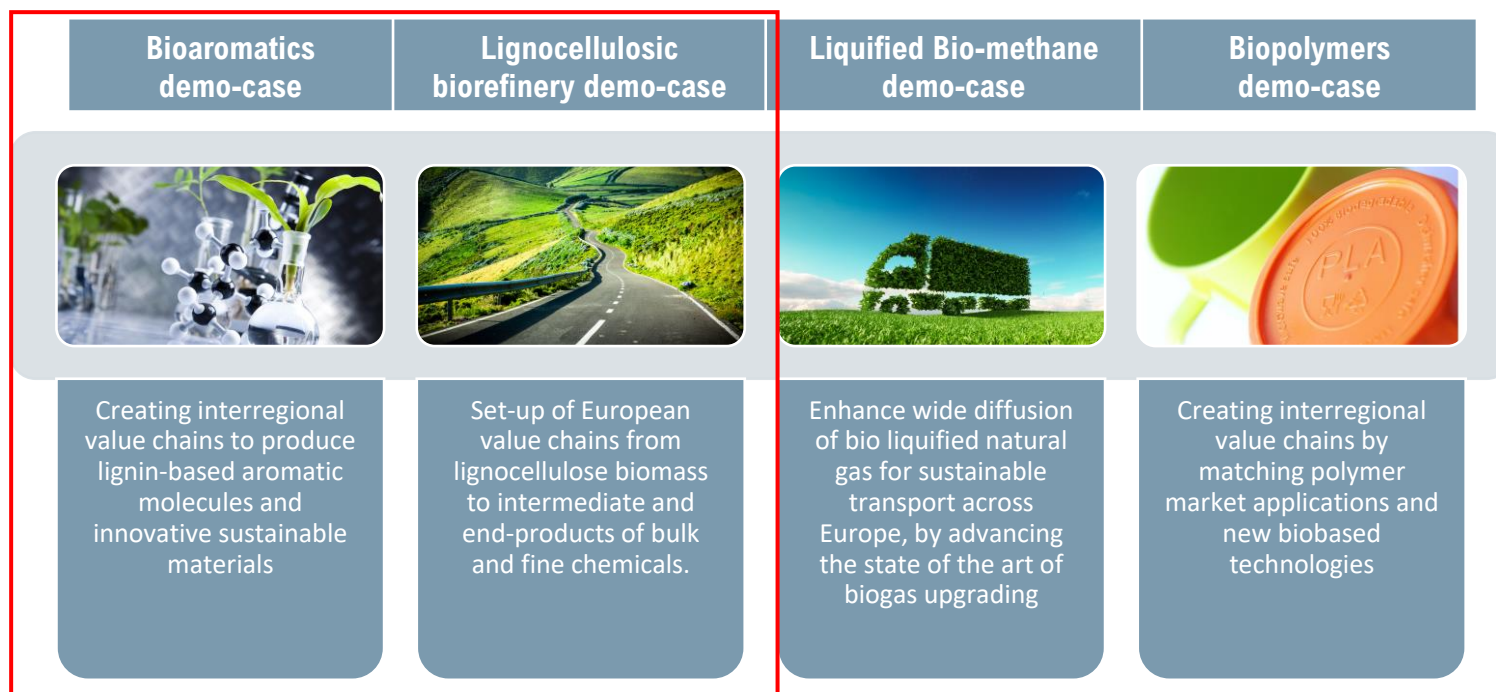
The Vanguard initiative regions participating in the Bioeconomy Pilot



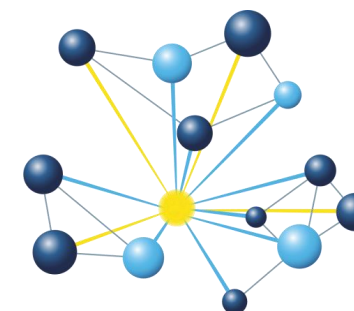
OUR COMMITMENT

- Co-led by **Lombardy** (IT) and **Randstad** (NL) Regions
- Technical coordination led by the **Lombardy Green Chemistry Cluster** (IT)
- **19 VI regions** involved
- Works for getting **better engaged** VI regions and increasing the number of **new members**
- **monthly matchmaking and investing forums, 1to1 meetings and new partnerships.**

The Bioeconomy Pilot demo-cases



Today's focus



VANGUARD INITIATIVE

New growth through smart specialisation

RESULTS OBTAINED UNTIL NOW

- Mapping **over 50 PROMISING CIRCULAR BIOECONOMY BUSINESS MODELS** ACROSS EU
- Designing and implement **BUSINESS PLANS** Suitable for private and public funds
- **Open access** to EU companies to the best portfolio for biobased materials
- Commissioning of **10 pilot plants**
- Enhancing **12 USE-CASES** gathering over 50 public-private entities across EU
- Promoting over **20** matchmaking events annually involving **1.000+ people**

VANGUARD INITIATIVE

Biorefinery

- Biorefinery, being the sustainable processing of biomass into a spectrum of marketable products (food, feed, materials, chemicals) and energy (fuels, power, heat)
- Biomass feedstock can be: vegetable oils, carbohydrates, wood, grass, lignin





Fossil oil value chain via oil refineries and crackers, naphtha, chemicals and plastics



Biobased value chain via biorefineries, intermediates, chemicals and bioplastics

Biorefineries according to EC report 2018

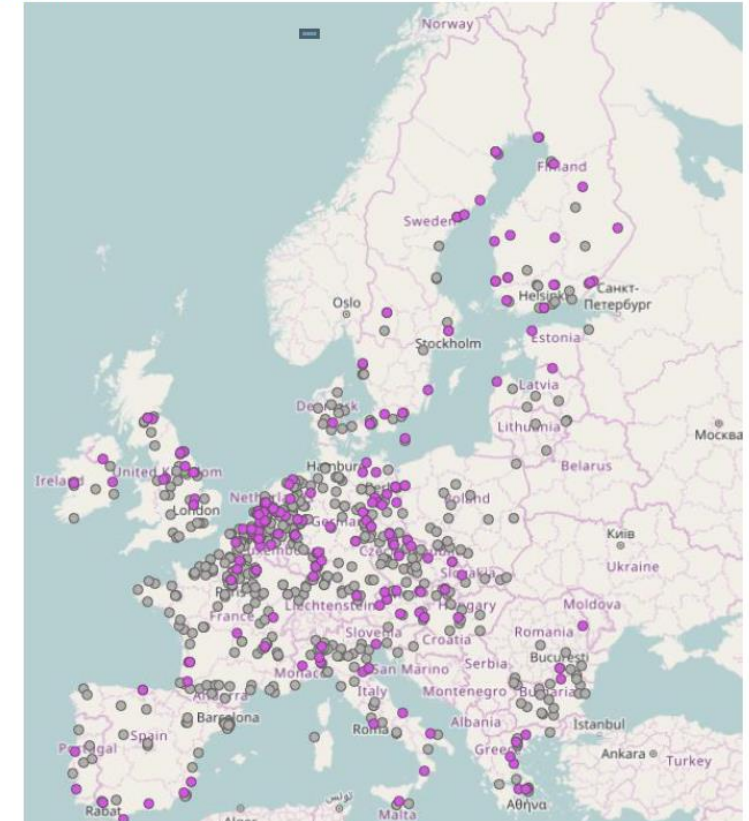


Biorefineries distribution in the EU Research Brief

HIGHLIGHTS

- 803 biorefineries have been identified in the EU, of which 507 produce bio-based chemicals, 363 liquid biofuels and 141 bio-based composites and fibres (multi-product facilities are counted more than once).
- Of those facilities, 177 are reported as *integrated biorefineries* that combine the production of bio-based products and energy.
- The location of most biorefineries shows correspondence with chemical clusters and ports.
- Generally, the highest concentration of biorefineries is located in the central part of the EU, particularly in Belgium and the Netherlands.
- Agricultural resources are the feedstock source used by most biorefineries in all EU countries with the exception of Finland, Sweden and Portugal.
- Marine and waste resources are relevant in some countries but not yet highly exploited in biorefineries.

Map of biorefineries producing bio-based chemicals, liquid biofuels and composites and fibres in the EU

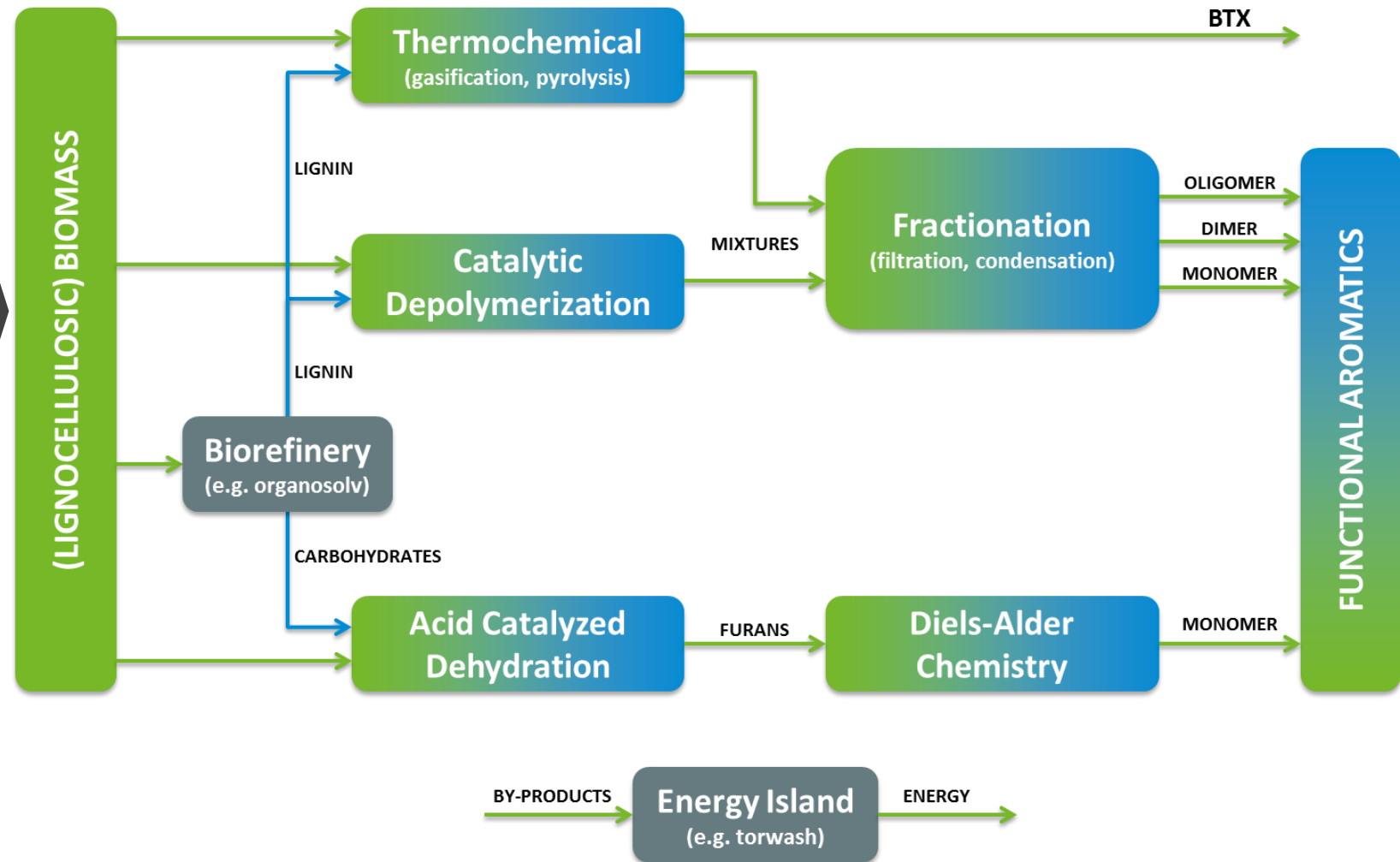


How to cite: Parisi, C. (2018). "Research Brief: Biorefineries distribution in the EU". European Commission - Joint Research Centre.
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Key Challenges for lignocellulosic biorefinery

- Lignocellulosic biomass is recalcitrant
- Total valorization of all streams is challenging
- By-products impact the business case
- Only smart, integrated approaches will do!
- Scale-up to pilot and demo takes \$\$ and time
- Scale is a very important factor (small or large)
- Close to feedstock or close to market ?

The lignocellulose biorefinery



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.

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



Lignovalue Pilot plant



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



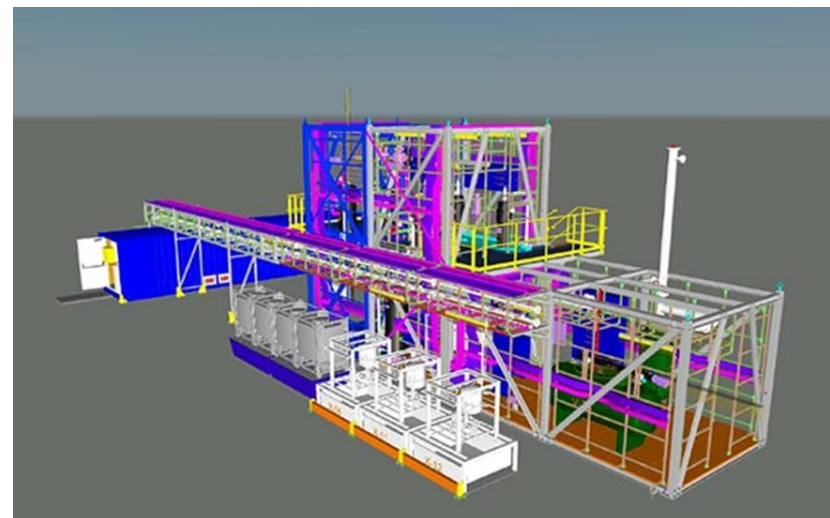
Solvents
(Methanol,
ethanol,...)



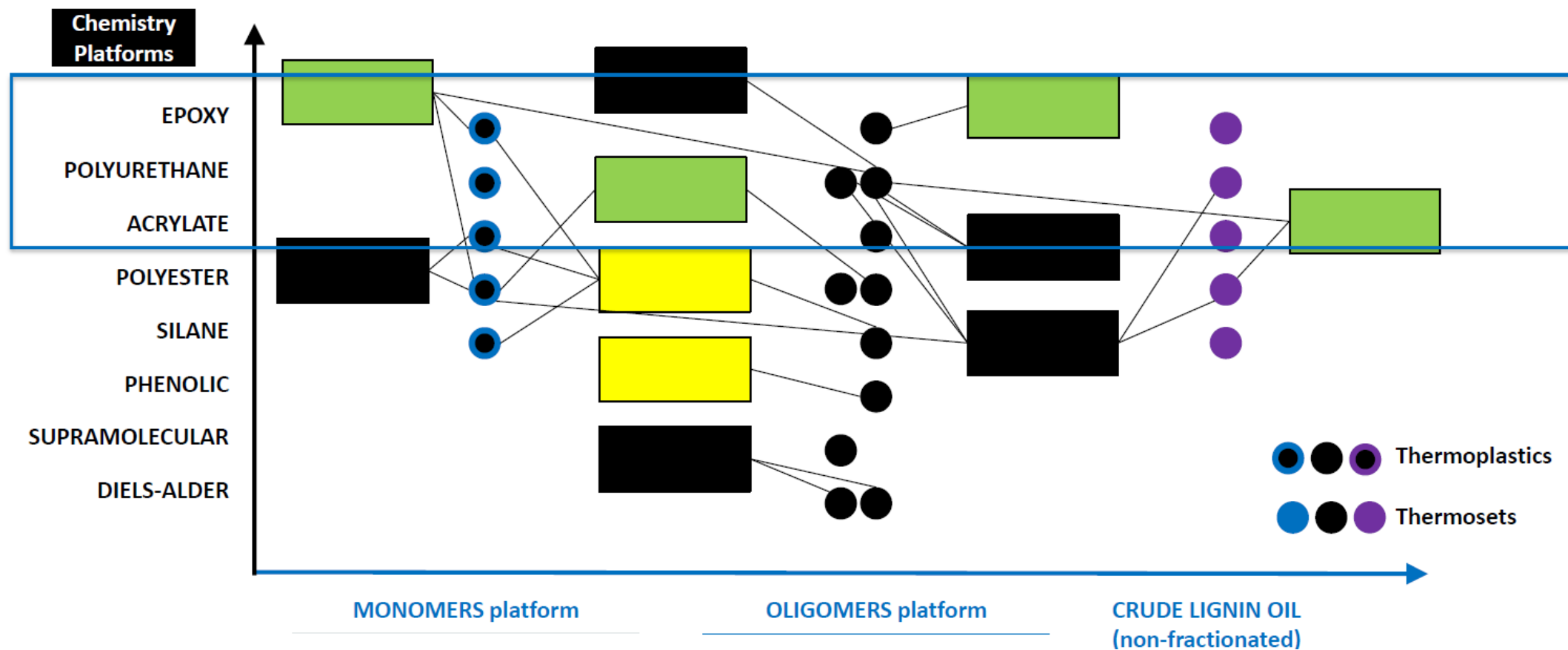
Inert
atmosphere
(N₂) or H₂



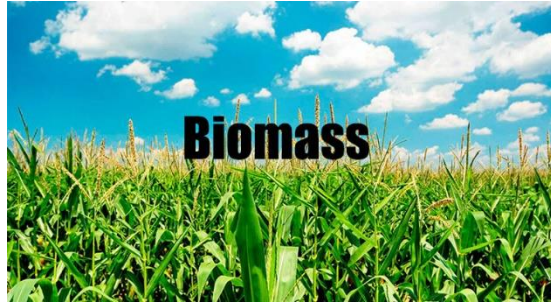
100 - ≥ 300 °C
(medium to
high)



Linking the lignin fractions with chemistry



Next to Biomass....Municipal Solid Waste and RDF feedstock for chemicals



- Lignocellulosics to bio-aromatics BTX
- Carbohydrates to functional bio-aromatics
- Lignine to (mixed) bio-aromatics
- Biomass waste has positive value



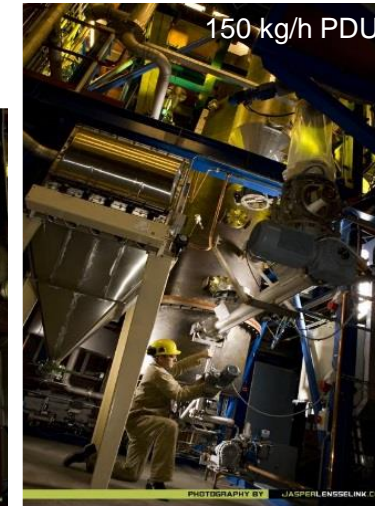
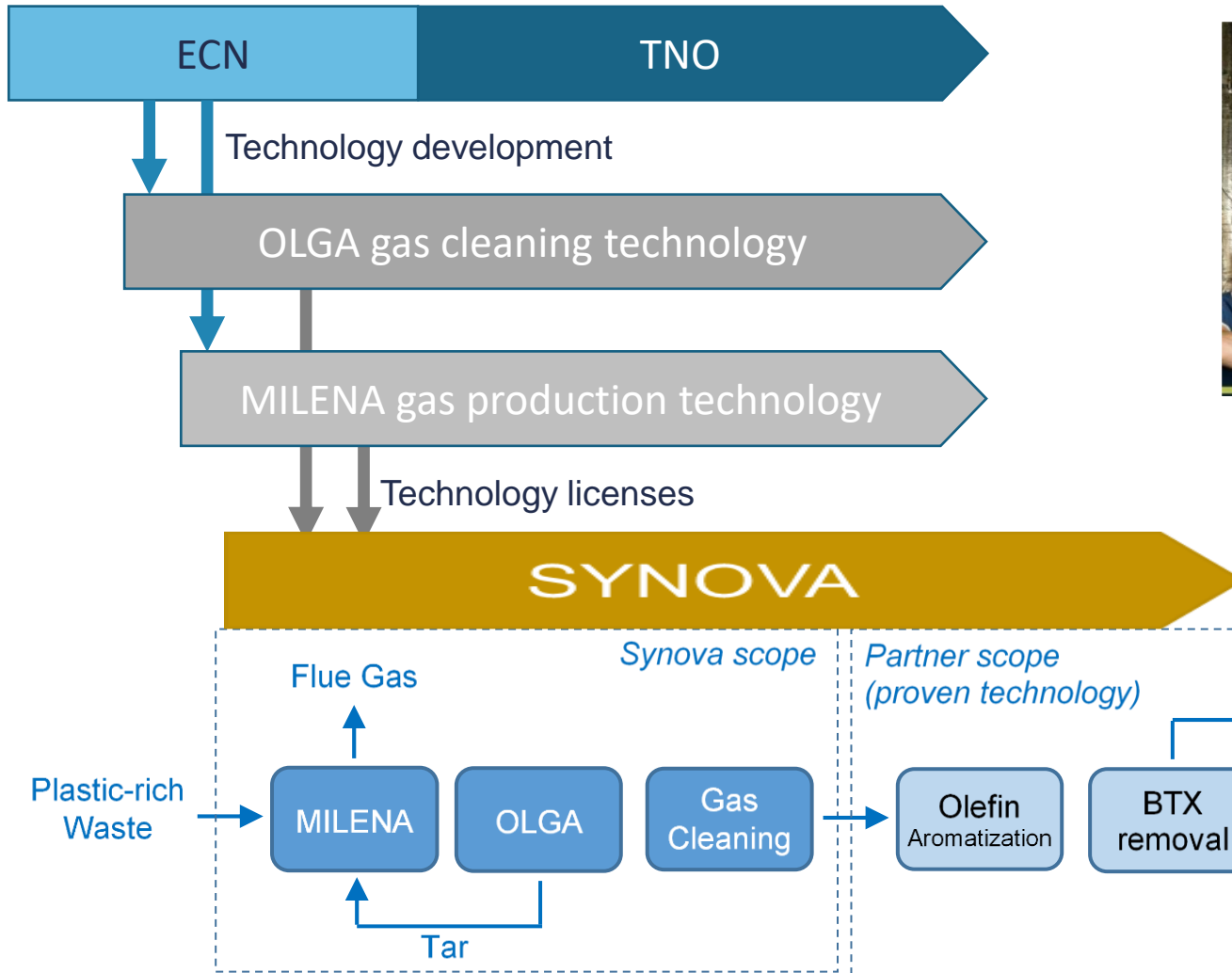
- **Biomass-rich RDF** fraction from MSW has negative value
- Typical 18% plastic, 30% water, 10% ash, 42% biomass
- Too heterogenous for most pyrolysis processes
- Mild gasification/cracking possible to RNG (TRL 7)
- Gasification to syngas is state-of-the-art (TRL 9)



- **Plastic-rich RDF** fraction from MSW has negative value
- Typical 59% plastics, 1% water, 11% ash, 29 % biomass
- Too heterogenous for most pyrolysis processes
- Mild gasification/cracking possible to High Value Chemicals, incl. BTX
- Gas cleaning is essential step

SYNOVA is scaling up technology from TNO

Plastic-rich RDF to BTX



Value chain benzene: nylon 6, PS, PC, Phenolics
 Value chain toluene: PUR soft and flexible foam
 Value chain xylene: PET packaging and textiles

BTX liquid



Gas to RNG/LNG,
 engine, methanol, ...



Existing separation
 units in e.g. refineries

All major multi billion \$\$ end-markets



Next steps

- Biorizon event (2 December 2021)
- A new Vanguard meeting
- Inauguration of Lignovalue in June 2022
- New projects are coming



Cooperation
opportunities on
bioeconomy consistent
with **Interregional
Innovation Investment I3**

interregional alliances
for sustainable
development



Interregional cooperation plays a crucial role in achieving the green transition in obtaining Environmentally Friendly Materials

FOCUS ON APPLICATION

1. **Biopolymers for medical applications.** PLA, PHA and others for medical and industrial applications from postconsumer feedstock and bio-based substrates
2. **Biopolymers for fashion.** Polyester and polyurethane-based synthetic leather from agricultural waste

FOCUS ON RAW MATERIAL SUPPLY

1. **PLA from food waste.** Demonstration plant project to produce Poly-Lactic Acid (PLA) biopolymer from waste products of bakery industry
2. **Lignin-derived biopolymers.** Goldilocks – Lignin-based platform for fuels, chemicals and materials



Is your region having plans to support the development of biopolymers?

Can you give some examples or are you interested in learning more?

BIOPOLYMERS DEMO-CASE
NEW AND SUSTAINABLE BIOPOLYMERS

🎯 PHA/PHB/PLA polyurethanes and polyesters from agriculture waste

🎯 **Application owners**
Biopolymers for medical applications
Biopolymers for fashion

🎯 **Raw material supply**
PLA from food waste
Lignin-derived polyurethanes

FOCUS:
creating interregional value chains by matching market applications and new technologies

Biopolymers and biocomposites



Many thanks for your attention!

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