

Lignocellulosic Biorefinery Democase

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Willem Sederel

10 years university



9 years biobased economy



36 years in industry



6 years retired



Process development – Scale-up
Product development – Global impact
Application development
Marketing – Automotive, B&C

Democase leader Lignocellulosic
Biorefinery within the Bioeconomy
Pilot of VI (2018)



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Why is Lignocellulosic biomass relevant ?

- Lignocellulosic is the most abundant biomass feedstock on earth
- All regions have various varieties present
- Wood, straw, grass, stover, reed, miscanthus
- Residue/waste streams under utilised
- Not used for food, no direct competition (2G)



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Why are Biorefineries relevant ?

- Biorefining is conversion of biomass into valuable products with low/no waste
- Products can be intermediate chemicals, materials, heat, electricity, energy carriers
- Examples are cellulose, sugars, lignin, rosins, tall oil, pyrolysis oil, gasses, biochar, tar, water
- There are over 200 biorefineries in Europe (2017)
- There are over 803 biorefineries In EU (EC 2018)



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Biorefineries in Europe 2017



Biorefinery is a container term:
a plant converting biomass
into a spectrum of valuable
products

1G biorefineries (food & non-food)

Carbohydrates (sugars & starches)
Proteins (wheat, dairy)
Vegetable oils

2G biorefineries

Biofuels
Biochemicals
Biomaterials

Pulp and paper mills

cellulose fiber

Pyrolysis plants

pyrolysis oil

Gasification plants

biogas (CH₄,CO,CO₂,H₂)



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Biorefineries according to EC report 2018

How to cite: Parisi, C. (2018). "Research Brief: Biorefineries distribution in the EU". European Commission - Joint Research Centre. **AUTHOR:** **CONTACT:**

PARISI Claudia



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



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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 ?



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Scaling up for new product/market combinations



New Model change

Every 0,5-1 year
(medium cost)



Every 4-5 year
(high cost)




Every 20-30 years
(very high cost)



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The 2G journey – 17 years of continuous development and one of our largest R&D investments



novozymes 

What is currently being done ?

Core team created early 2018 with Wales, Scotland, Flanders and South Holland/Randstad
Please join us when you have a (potential) business case in your region

1. Redefinery Project

Large scale biorefinery

- Randstad region (VI)
- South Netherlands (VI)
- Flanders (VI)
- Vasternorrlands

Consortium by Biobased Delta

Hard wood chips/pellets

Swedish technology

C6 to lactic acid

C5/C6 to bioethanol (2G)

Lignin to bitumen (asphalt)



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Redefinery Update May 2019

- RWE is facilitating the operations, but will not act as operator
- Link with sub-regional plans and scenario's
- RED II subsidies on bio-ethanol have major effect on business case
- New concept of flexible design being considered



What is currently being done ?

2. Scottish Project (draft)

Wood based biorefinery

- *Commercial scale (TRL8)*
- Fermentable sugars & Lignin to products
- *Demo scale (TRL4-6)*
- Integrated with CHP

3. Slovenia Project

Small/medium wood biorefinery

Slovenian concept

Workshop will follow



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Example Manufacturing Models

“Nordic”

- Close to biomass
- Pulp mill biorefinery
- Centralized
- Integrated operations
- Product transport
- Capital efficiency
- Operational cost
- Cost & CO2

“Rotterdam”

- Close to market
- Biorefinery in cluster
- Centralized
- Integrated operations
- Feedstock transport
- Capital efficiency
- Operational cost
- Cost & CO2

Regional

- Local4local
- Small scale
- Decentral
- Spoke-in-wheel
- Local transport ++
- Capital efficiency
- Operational cost
- Cost & CO2



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Example Manufacturing Models

“Nordic”

- Soft wood
- Pulp mill biorefinery
- 100 -150 KT
- Integrated operations
- mixed C5/C6, lignin
- UPM/IBIOIC
- C5/C6 Bioethanol
- Lignin to panels

“Rotterdam”

- Hard wood
- Biorefinery in cluster
- 500-600 KT
- Integrated operations
- C6, C5/C6, lignin
- SEKAB -tech
- C6 to chem C5/C6
- Lignin to bitumen

Regional-Slovenia

- Forestry, Agro, MSW
- Small scale
- Typical 30-50 KT
- Spoke-in-wheel
- Cellulose, sugars, Lignin
- Various
- Fibers, chem
- L to syngas



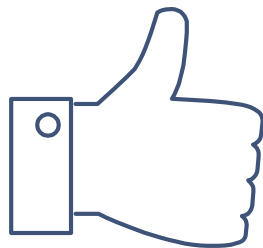
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What do we expect today?

- Provide useful support for the Slovenian business case
- Review options for different value chains as function of pretreatment technology
- Sharing knowledge and network to increase efficiency and reduce T-2-M
- Linking with other cases, eg Bioaromatics/Biorizon
- Help in developing projects, link to tools, instruments and centers of know how
- Help raising interest for Local4Local Lignocellulosic Biorefinery in other regions
- Help in creating piloting and demonstration options for derisking the business case



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THANKS!

Any questions?
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