Biorefineries of the future: what are the options

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Wageningen
University &
Research
Who
What
Why
How

Campus ecosystem

University
- Students / scientists
- Education
- International
- Known worldwide
- Fundamental research
- High quality / high rankings

Research institutes
- Research employees
- Translation research from fundamental to applied
- Shared research facilities
- Pre-competitive & confidential projects

Startups
- StartLife
- Support & coaching starters
- Incubator
- Interaction & learning
- (Seed) capital

(Inter)national companies
- R&D departments
- Researchers
- Own & shared facilities
- Looking for interaction *and* confidential surrounding

Beyondte
Cleanlight
ClearDetections
Dyadic Nederland
Foodcase Imagination Lab
Food Solution Center

GreenFood50
GWFabs
Innosieve Diagnostics

Micreos
NGN
Nuplex Resins
Pectcof
SoilCares Research

Wageningen UR focus

Main global challenges

- Climate change
- Overpopulation urban centres
- Malnutrition
- Overconsumption nature & natural resources

Needed transitions

Circular agri-food systems

Eating proteins from more divers sources

A circular biobased economy

Technological disruptions & digital connectivity

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WHY?
According to WUR

Renewable Materials: this is why

Fossil Free

Security of supply

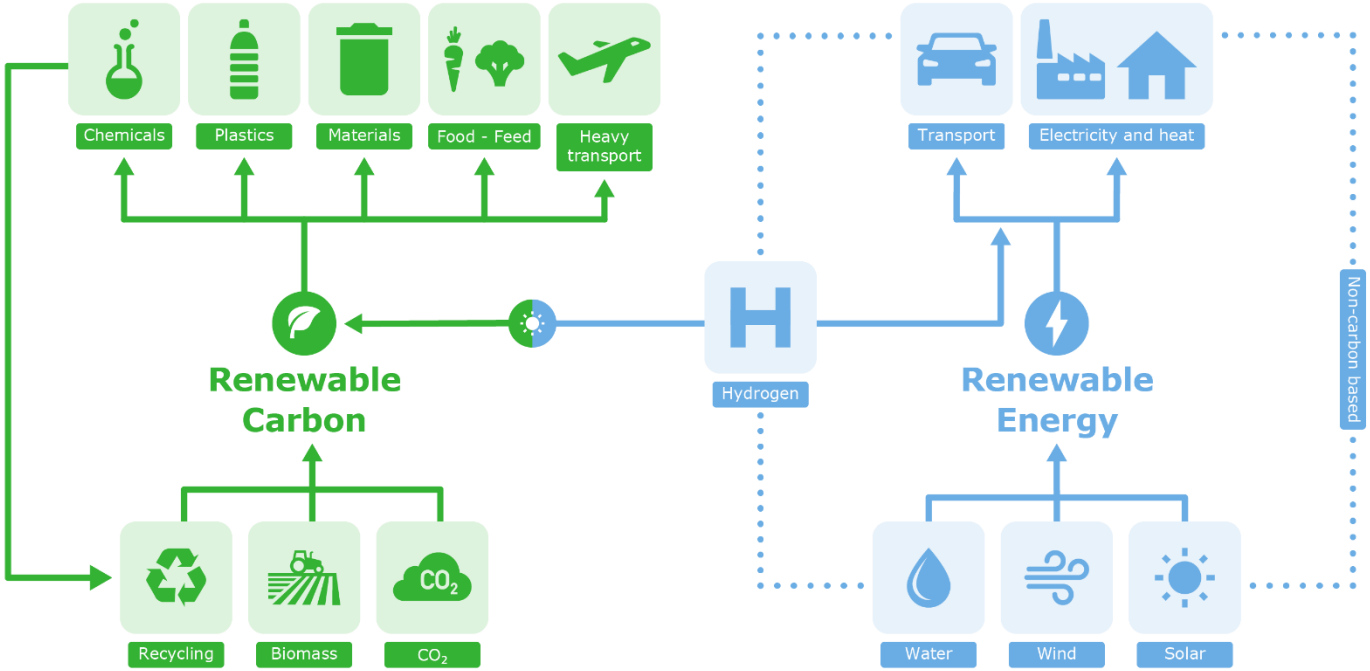
Climate

CO_2

Safe Environment

Microplastics

Renewable Carbon for a Fossil Free society



WUR transition pathways

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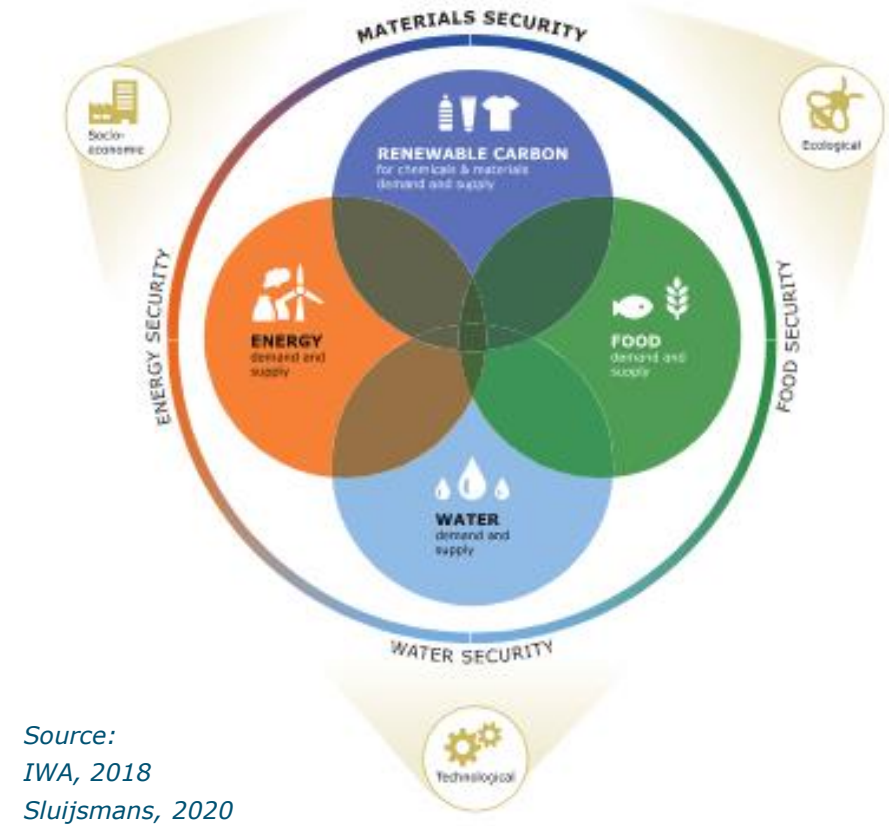
Source: NOVA Institute

Materials transition: part of greater challenge

Additional entry point
to the water-food-energy nexus

From linear fossil-based to
circular fossil-free materials



Source:
IWA, 2018
Sluijsmans, 2020

Growth in global demand biobased products

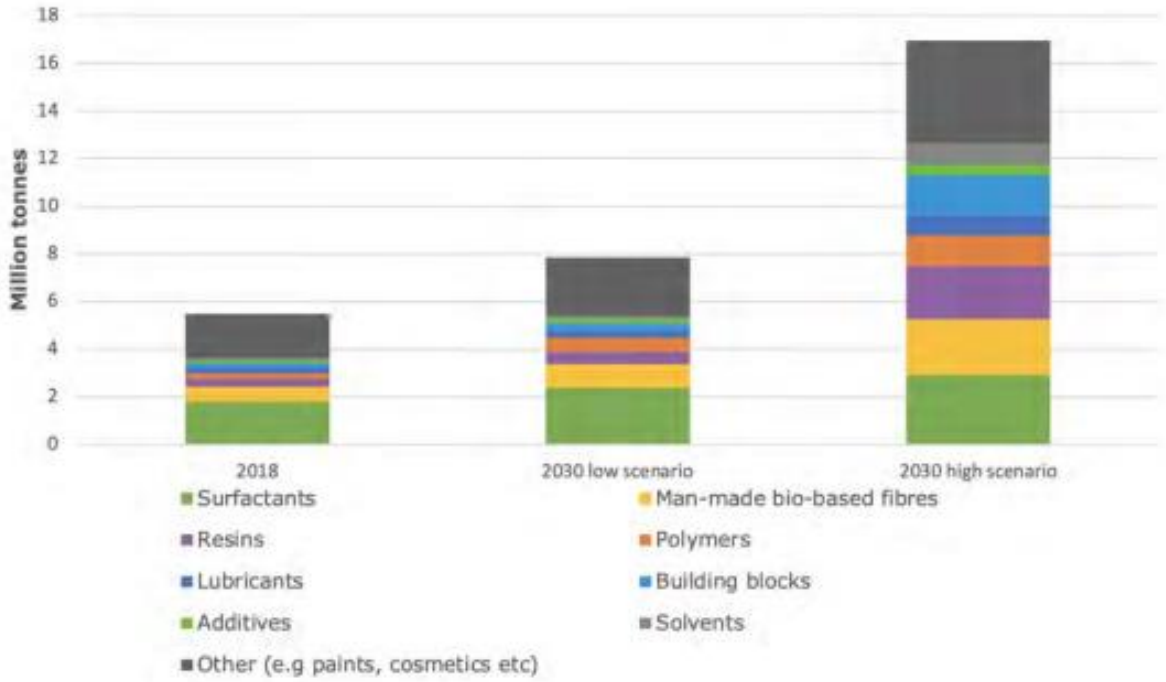


Figure 2. Demand for bio-based products 2019, and 2030 low- and high scenario[14]

Source: EU Biorefinery Outlook, Final Report 2021

Materials transition for a Fossil Free Society

Complex of technical and non-technical actions by multiple stakeholders

Diverse combination of solutions

Biorefineries of the future

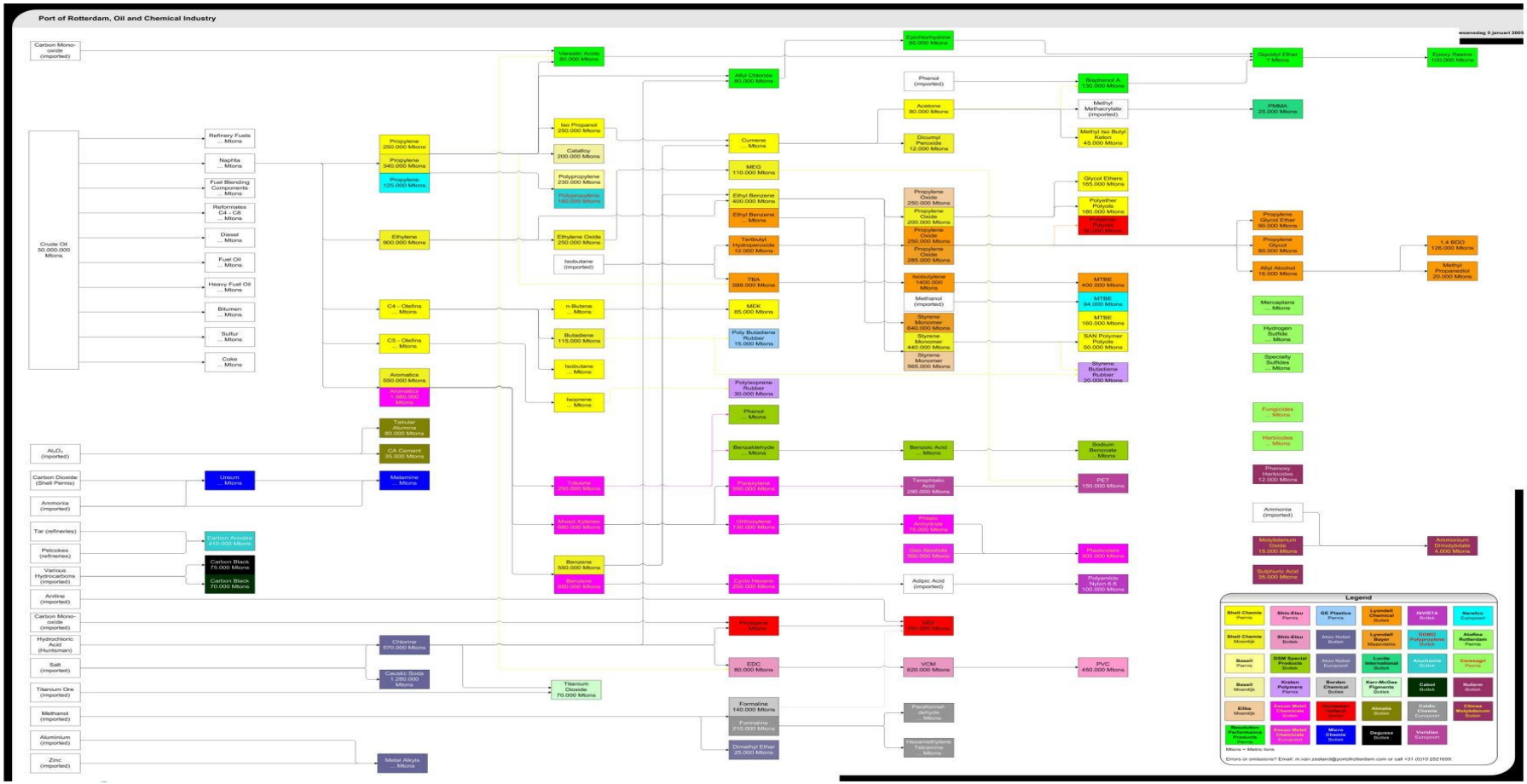
Drop-in via bionaphtha refinery

- Basis: existing petrochemical infrastructure

Mild biorefinery

- Basis: biomass composition

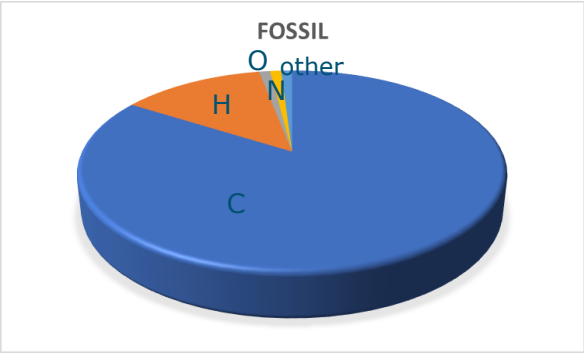
The Chemical Products of the Port of Rotterdam

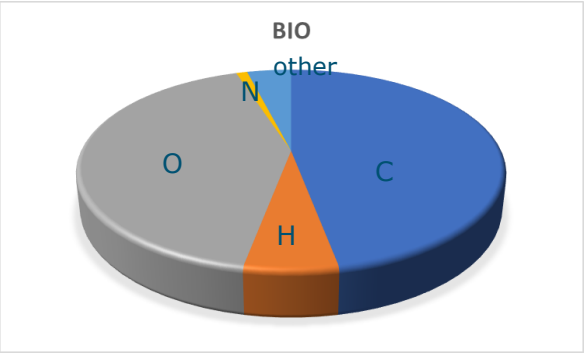


Fossil vs. Biomass composition

Ultimate composition:

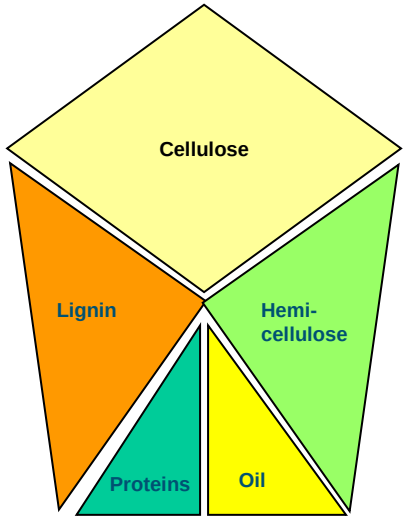
C
H
O
N
Other





Different types of feedstock require different type of processing leading to different type of processes, products and properties.

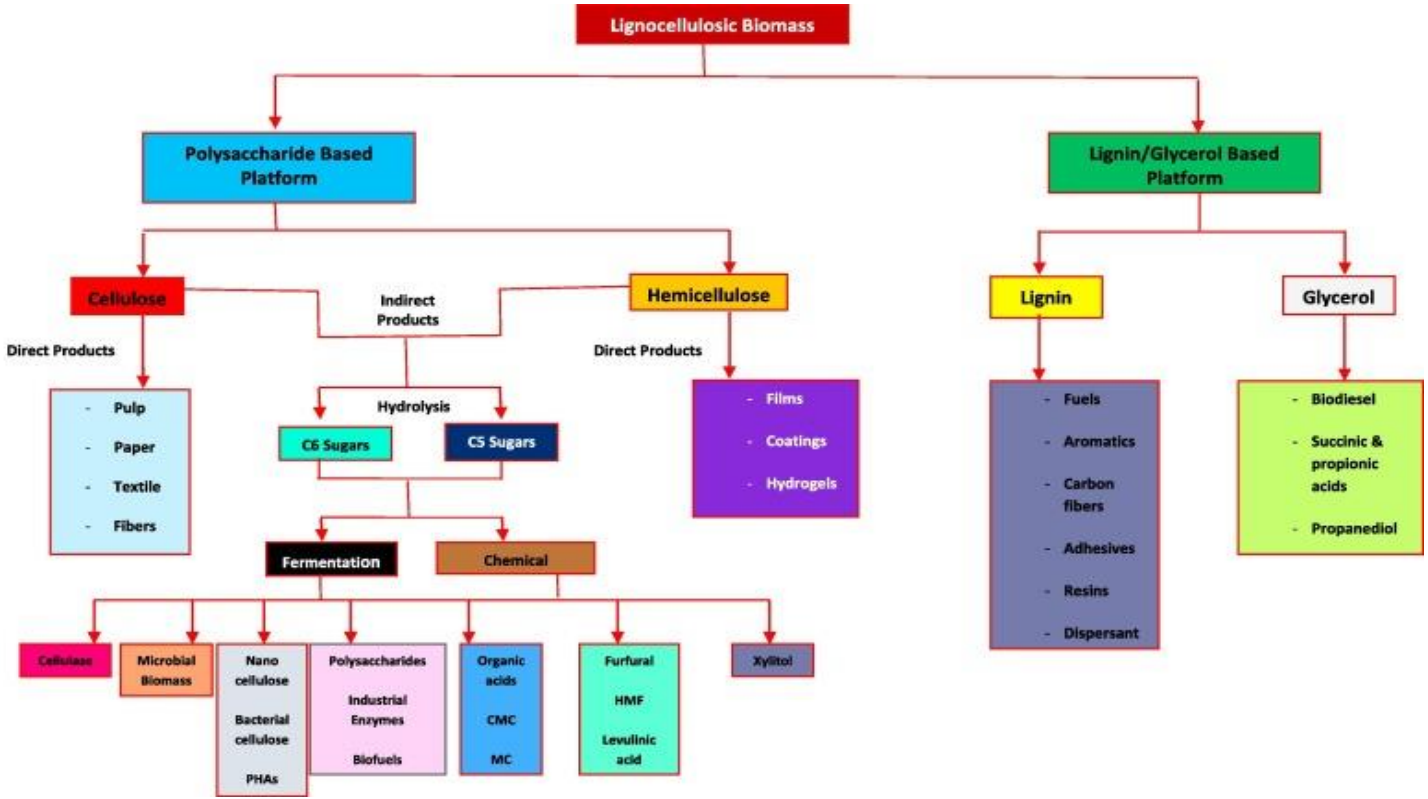
General composition of biomass



Cellulose (40-50%)
Hemi-cellulose (20-25%)
Lignin (20-25%)
Proteins (up to 10%):
Oil (up to 10%):
(Tr)ash (sand, metals, plastics, ...)

Mild biorefining uses 'non-destructive' processes so that maximum value can be derived from plant-based resources following principles of cascading and total-biomass use

Mild biorefinery example setup



Mild biorefinery vs. bionaphta refinery

Because

- Uses inherent functionality and composition of the plant
- Less energy usage
- Biodegradable
- New properties
- Chance to include circular design

But

- Requires new infrastructures and markets
- Requires different mild processing approach

Biorefinery of sugar beet leaf: multiple products

Sugar Beet

Cellulose

Sucrose

Molasses

Pulp

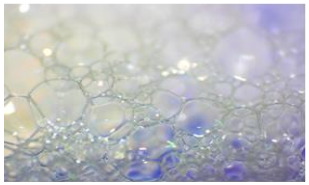
Pectin

Arabinose

Betaine

Galacturonic acid

Galactaric acid



- Cationic surfactants
- Anti-microbials
- Anti-statics

- Anionic surfactants
- Chelates
- Sequestering agents
- Bleach activators

Biorefinery of sugar beet leaf: more products

Leafs
40 ton/ha

Sugar beets
80 ton/ha

Protein (Rubisco)

Protein (feed)

Biopolymers

Biogas

Paper

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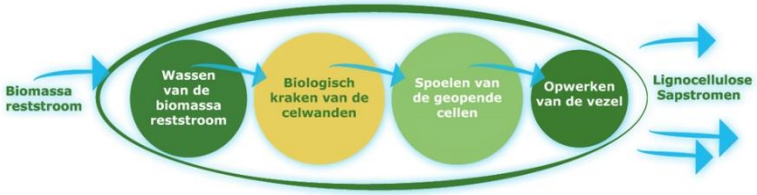
Grass refining

Mild refining of lignocellulose biomass: grass, agri-food residues towards

- Products based on inert fibers
- Juice containing minerals, salts and sugars



Advantages

- ✓ Turns costly residue into multiple valuable products
- ✓ Year round production
- ✓ Small scale (10.000 tons/year DM)
- ✓ Simple robust production process without chemicals and low water and energy footprint

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Thank you for your attention

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