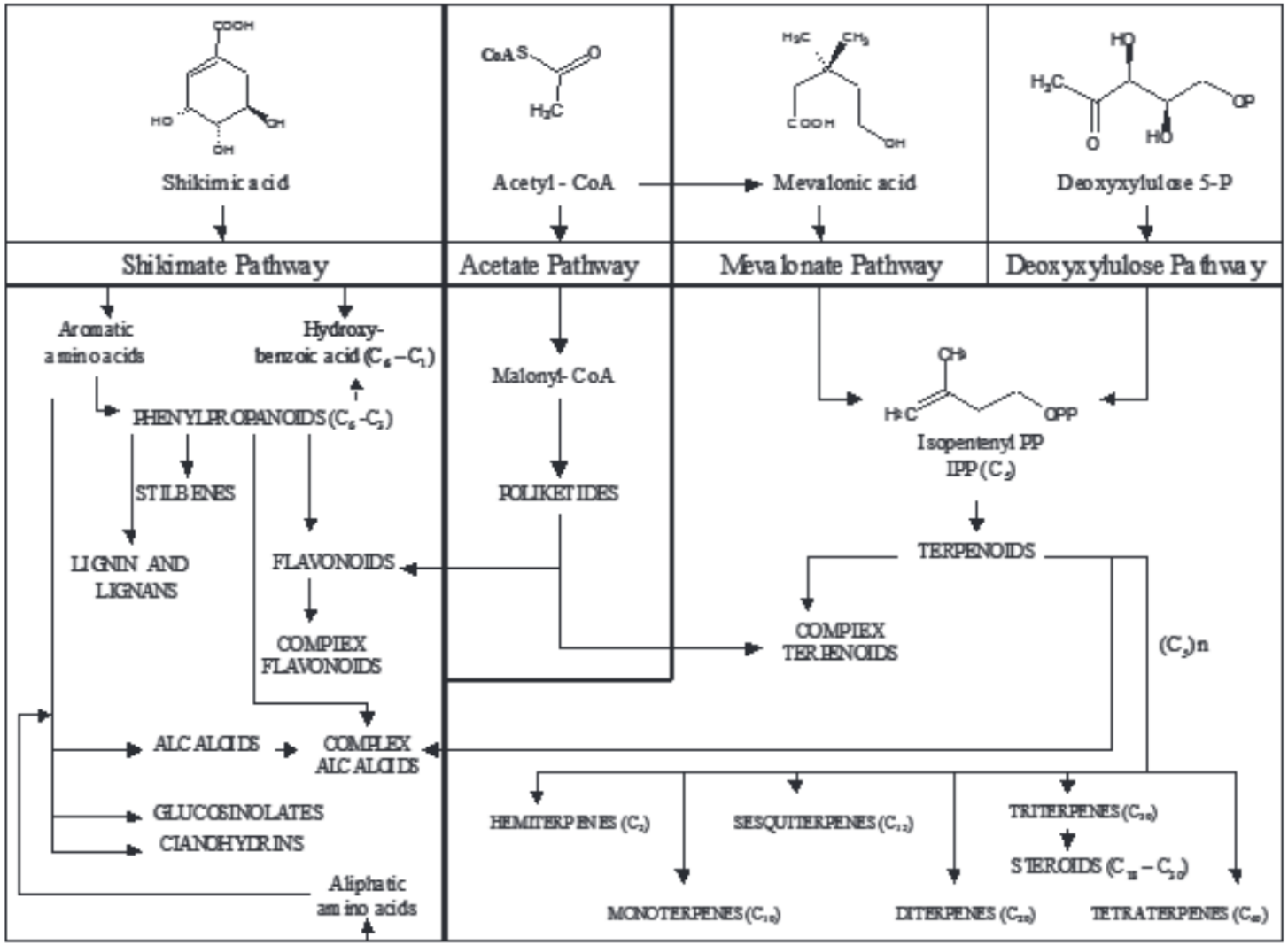
Hanzehogeschool Groningen
University of Applied Sciences

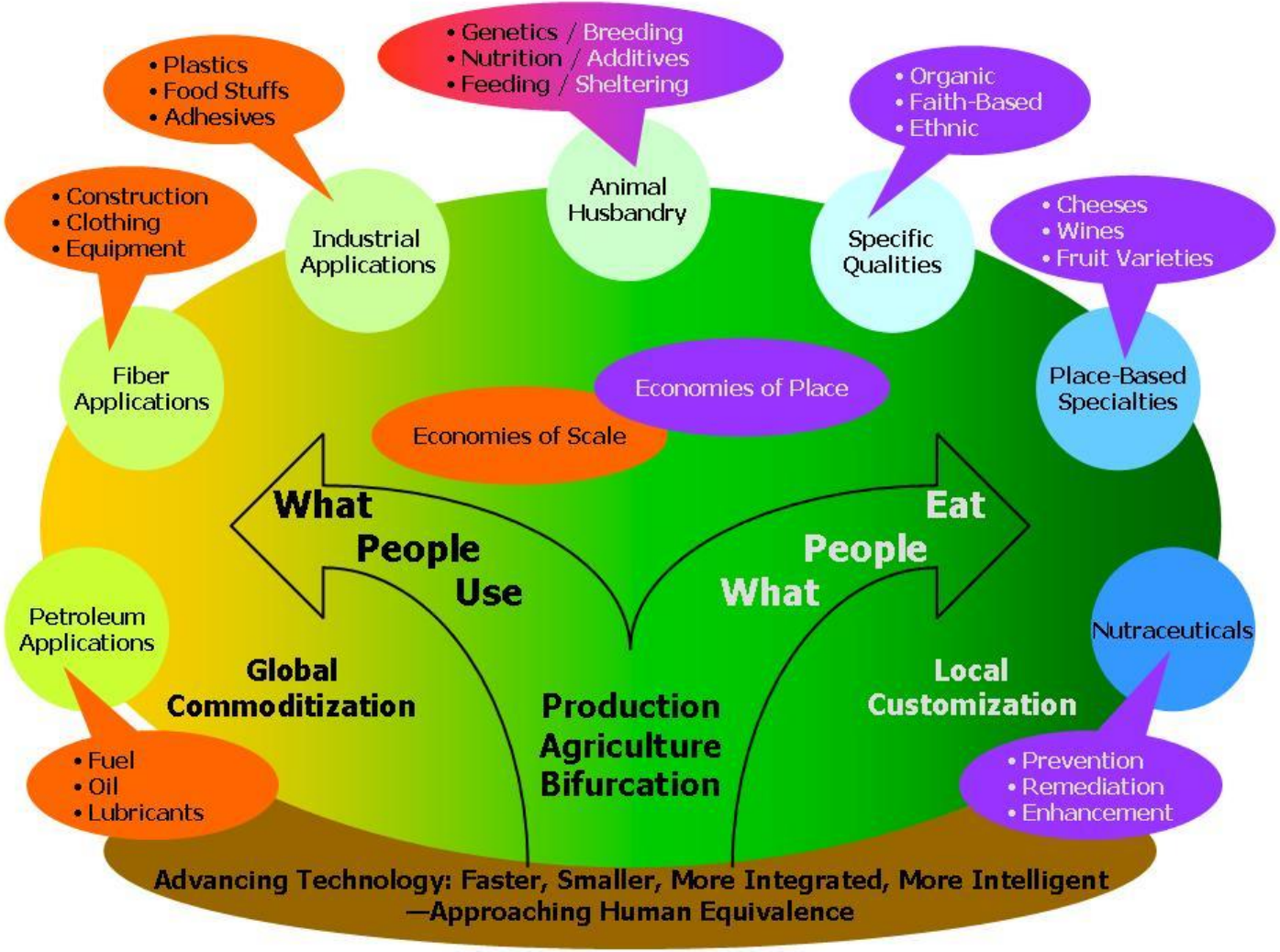
Transition Bioeconomy

share your talent.
move the world.

Sun Based Inspiration


Shikimic acid
Acetyl - CoA
Mevalonic acid
Deoxyxylulose 5-P
Shikimate Pathway
Acetate Pathway
Mevalonate Pathway
Deoxyxylulose Pathway
Aromatic amino acids
Hydroxy-benzoic acid (C_6-C_1)
PHENYLPROPANOIDS (C_6-C_3)
STILBENES
LIGNIN AND LIGNANS
FLAVONOIDS
COMPLEX FLAVONOIDS
ALCALOIDS
COMPLEX ALCALOIDS
GLUCOSINOLATES
CIANOHYDRINS
Aliphatic amino acids
Malonyl-CoA
POLIKETIDES
Isopentenyl PP IPP (C_5)
TERPENOIDS
COMPLEX TERPENOIDS
$(C_5)n$
HEMITERPENES (C_5)
SESQUITERPENES (C_{15})
TRITERPENES (C_{30})
STEROIDS ($C_{27}-C_{29}$)
MONOTERPENES (C_{10})
DITERPENES (C_{20})
TETRATERPENES (C_{40})

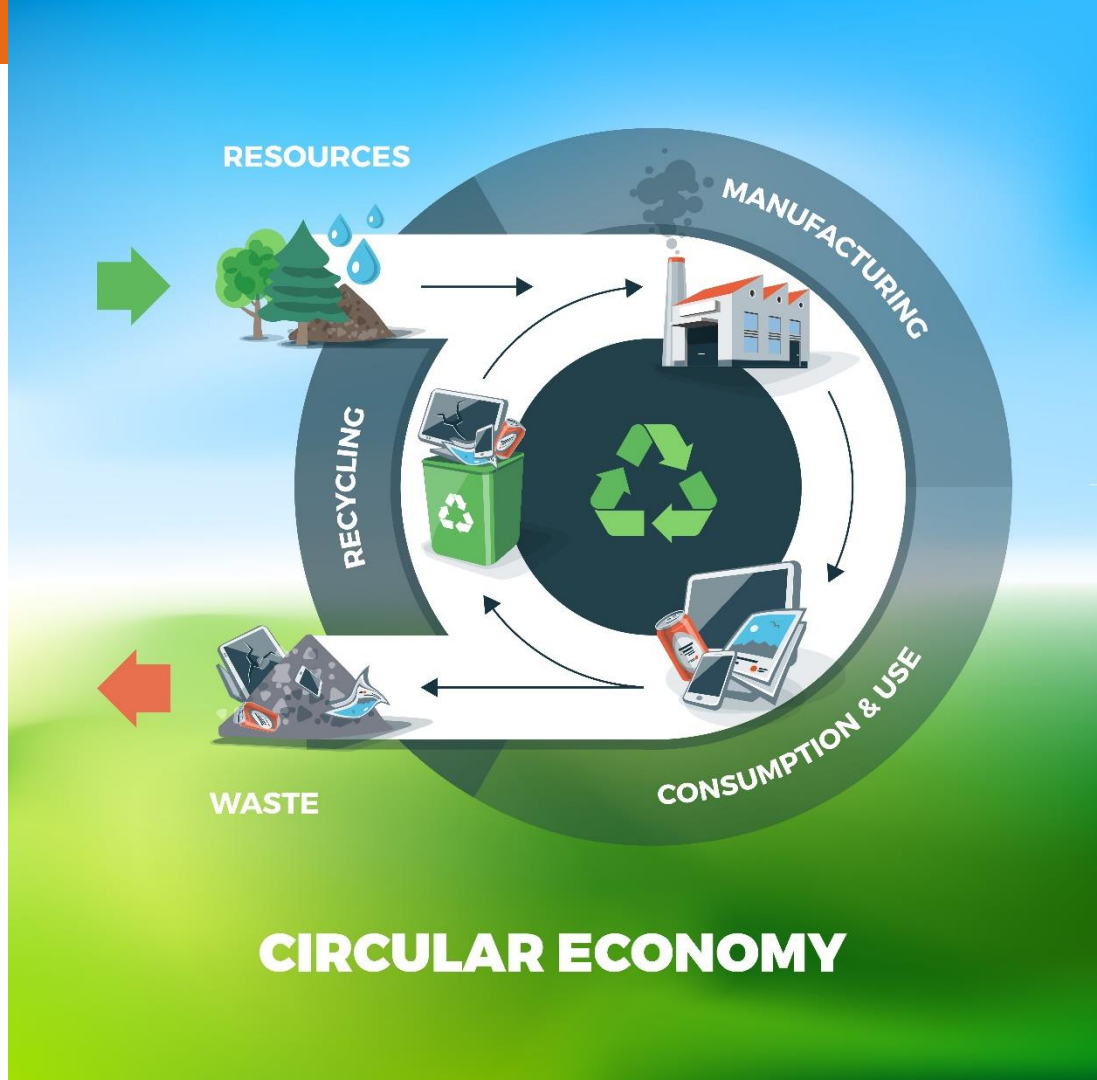
Sun based Inspiration & Innovation


• Genetics / Breeding
• Nutrition / Additives
• Feeding / Sheltering
• Plastics
• Food Stuffs
• Adhesives
• Organic
• Faith-Based
• Ethnic
Animal Husbandry
Industrial Applications
Specific Qualities
• Cheeses
• Wines
• Fruit Varieties
• Construction
• Clothing
• Equipment
Fiber Applications
Economies of Place
Economies of Scale
Place-Based Specialties
What People Use
What People Eat
Petroleum Applications
Nutraceuticals
Global Commoditization
Production Agriculture Bifurcation
Local Customization
• Fuel
• Oil
• Lubricants
• Prevention
• Remediation
• Enhancement
Advancing Technology: Faster, Smaller, More Integrated, More Intelligent
—Approaching Human Equivalence

The most c
to American ind
work has been a
Henry Ford, who
producing one b
form of distrib
buttons, coil p
Mr. Ford uses

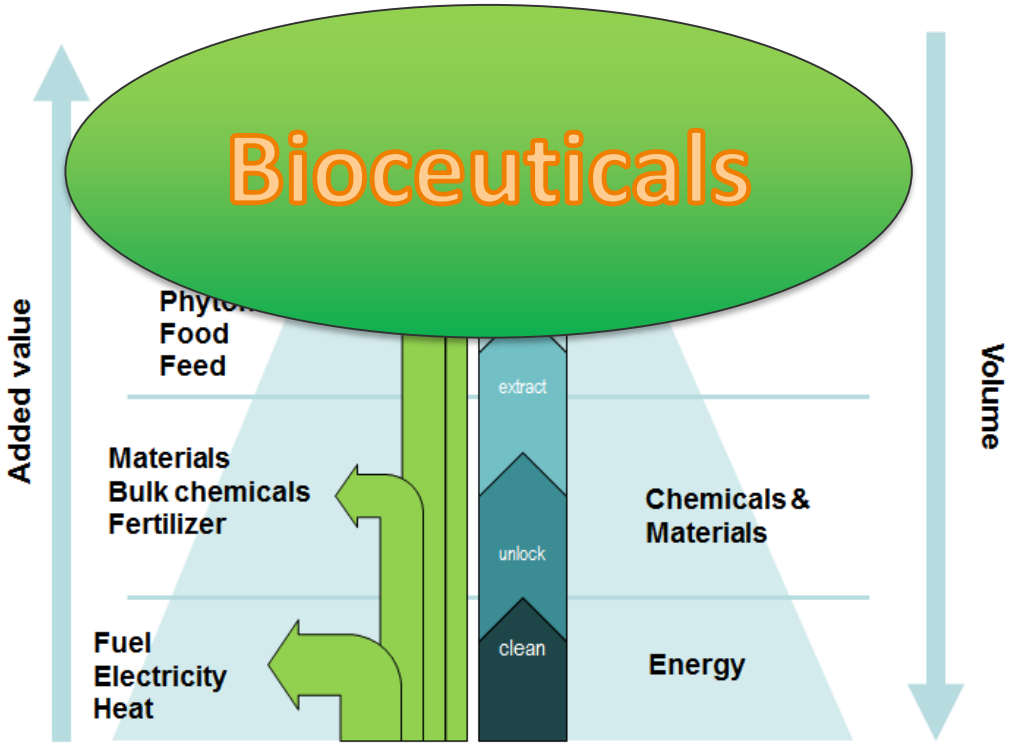
Biobased Economy

- Using renewable materials and ingredients
- Re-using non-renewable materials and ingredients



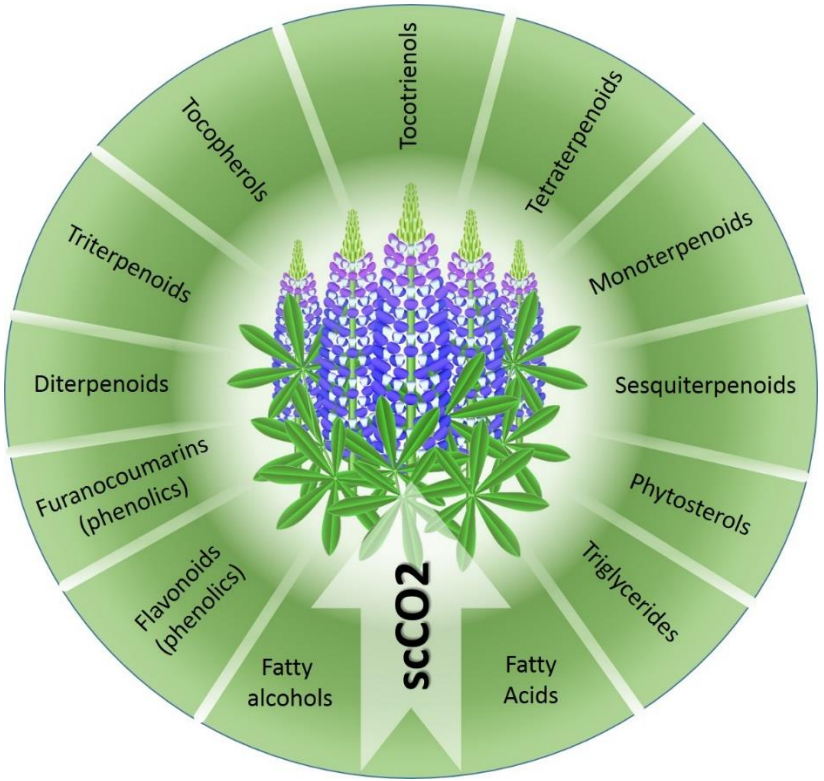
Biomass value pyramid: biocascading

- Using all the components from biomass for value creation
- Implementation of cost effective energy efficient green biorefinery processes
- Industrial symbiosis for complete biomass valorisation



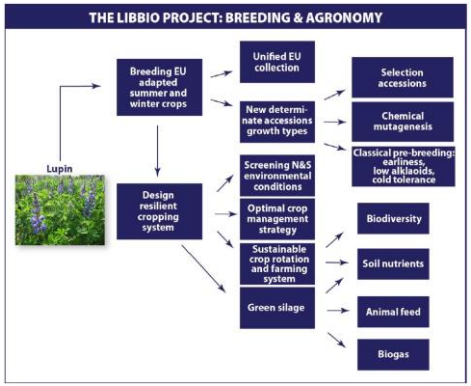
Greenextraction Bioceuticals

- Greenextraction are extraction processes which reduces energy consumption, makes use of renewable solvents, and ensure a safe high quality product. (Chemat et al 2015)
- Natural ingredients (secondary plant metabolites) sourced from botanicals, existing crops/marines or side streams of biomass processing.



Semi-industrial scale in H2020 project LIBBIO

- H2020 project, 14 partners 8 countries
- Hanze is techno-scientific coordinator
- Hanze develops integrated scCO2 biorefinery



European Commission

Horizon 2020
European Union funding
for Research & Innovation

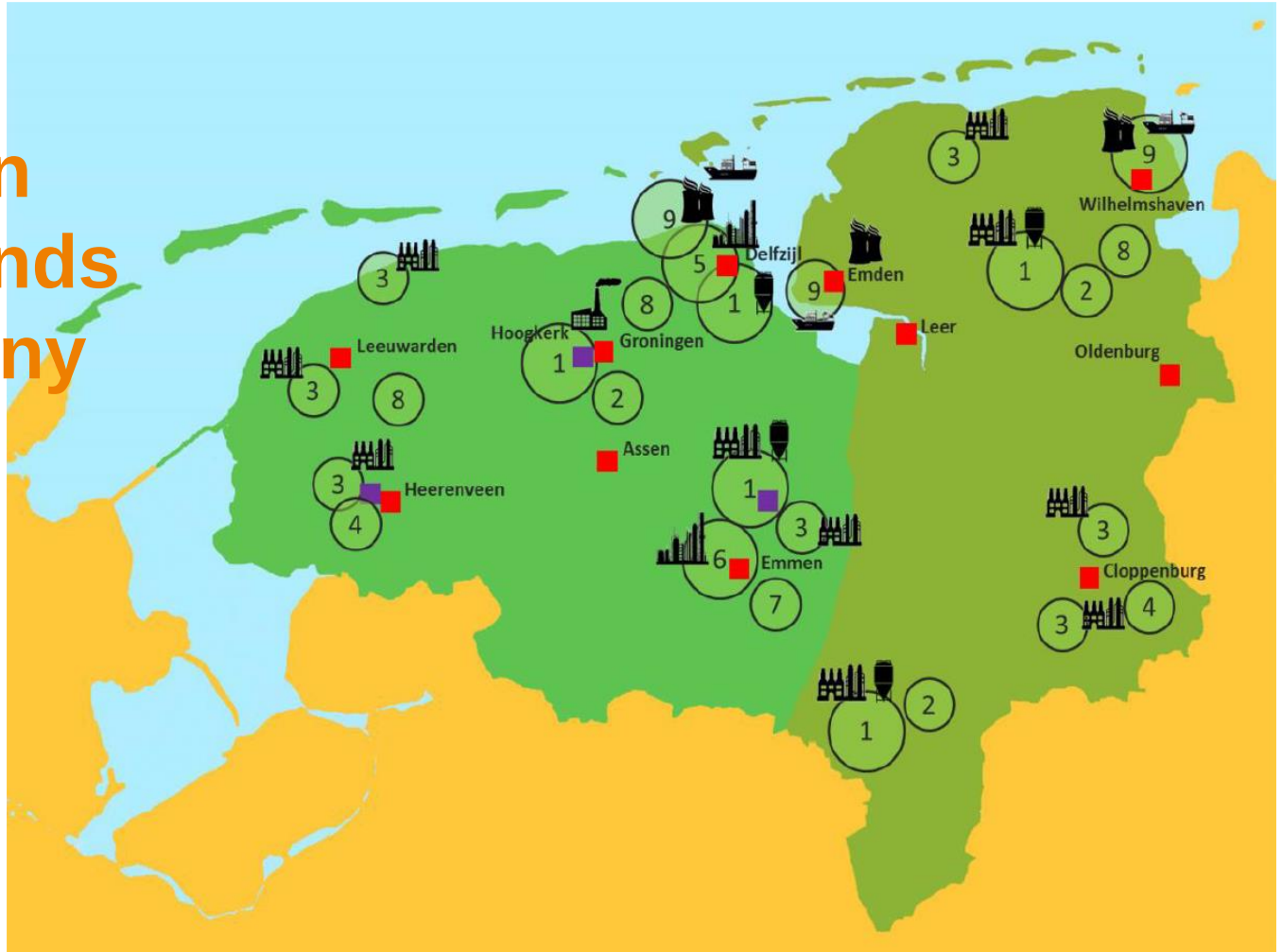
Phytosana/Greenextraction

- Cooperation with many SME's
  - SynCom
  - DonkerGroen
  - AVEBE
  - Ofichem
  - HLB
  - Feyecon
  - Chemconnection
- Initiation of Phytosana in cooperation with RUG and Uni Oldenburg

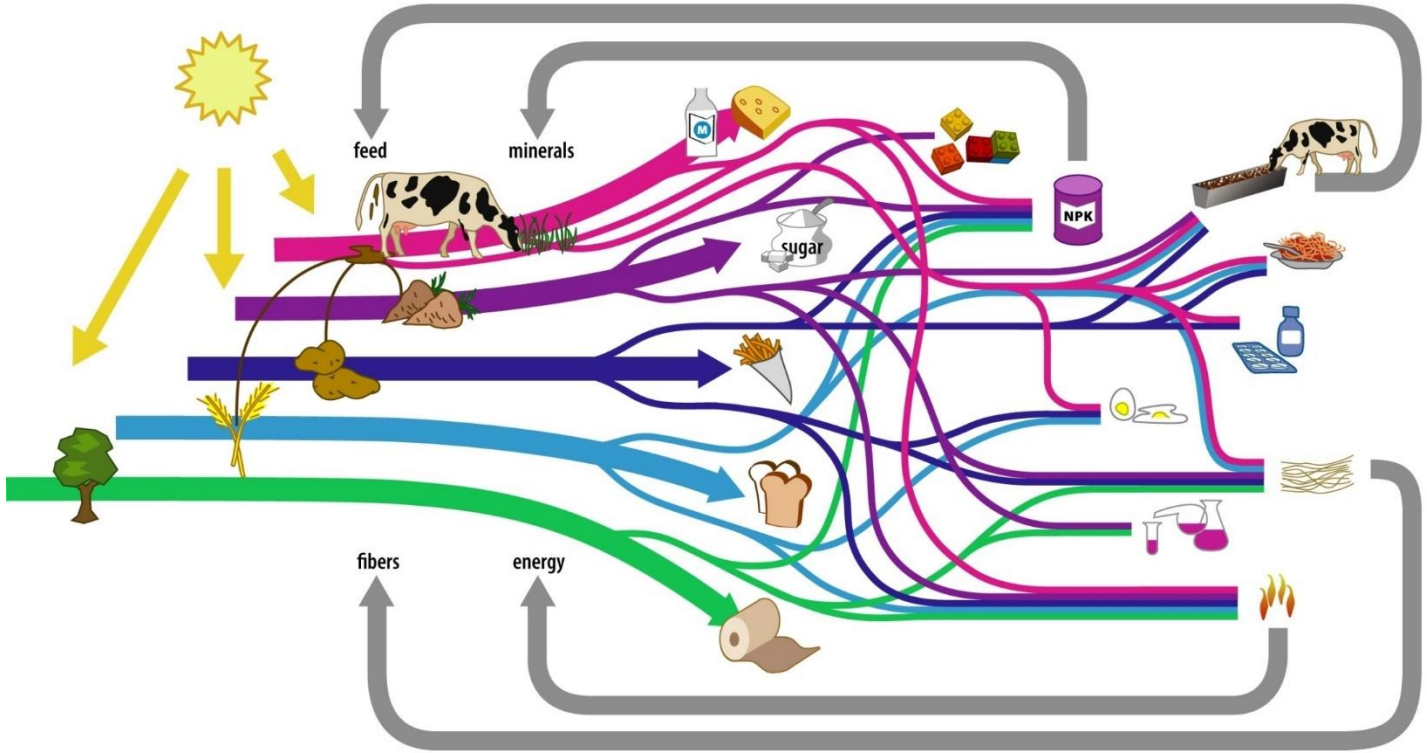
INTERREG - Grenzregionen gestalten Europa
Europäischer Fonds für Regionale Entwicklung der Europäischen Union
INTERREG - Grensregio's bouwen aan Europa
Europees Fonds voor Regionale Ontwikkeling van de Europese Unie

EDR PhytoSana

Biobased Economy in N-Netherlands and Germany

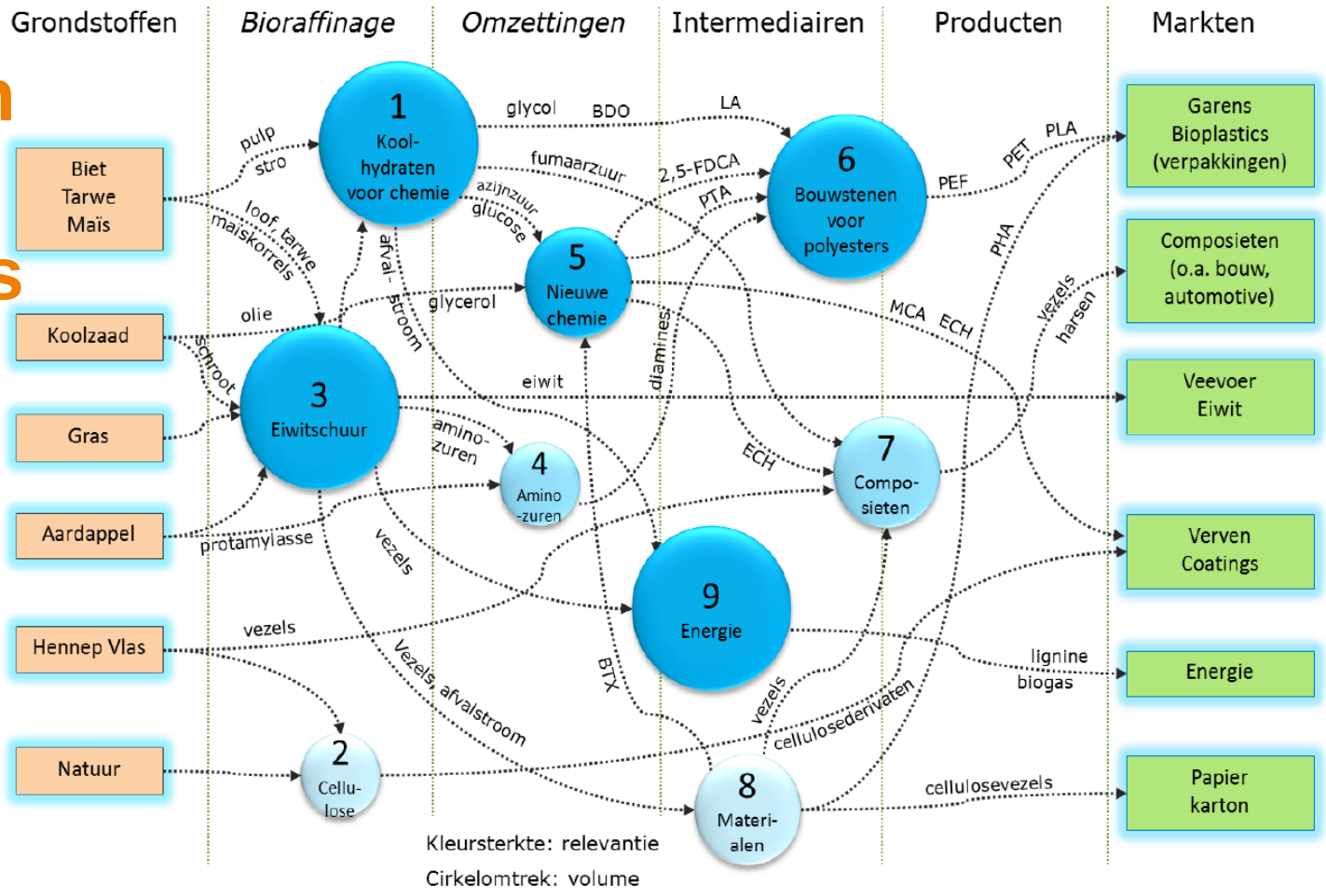


Industrial biobased symbiosis: *Dutch Biorefinery Cluster*



vorld.

Biobased Economy in North-Netherlands and Germany



Quadruple helix

- Cooperation between:
  - Government
  - Education
  - Industries & SMES
  - Knowledge institutes

chemelot

The chemical innovation community

BERNN

Bio Economy Region Northern Netherlands

Hogeschool VHL
University of Applied Sciences

Hanzehogeschool Groningen
University of Applied Sciences

rijksuniversiteit groningen

NHL HOGESCHOOL

Stenden hogeschool

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Zernike Advanced processing

- Semi-industrial scale Greenextraction
- Cooperation between education, research, companies and government
- https://www.youtube.com/watch?v=uaQPH1ti7dc

ZAP GRONINGEN

Hanzehogeschool Groningen
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rijksuniversiteit groningen

Noorderpoort

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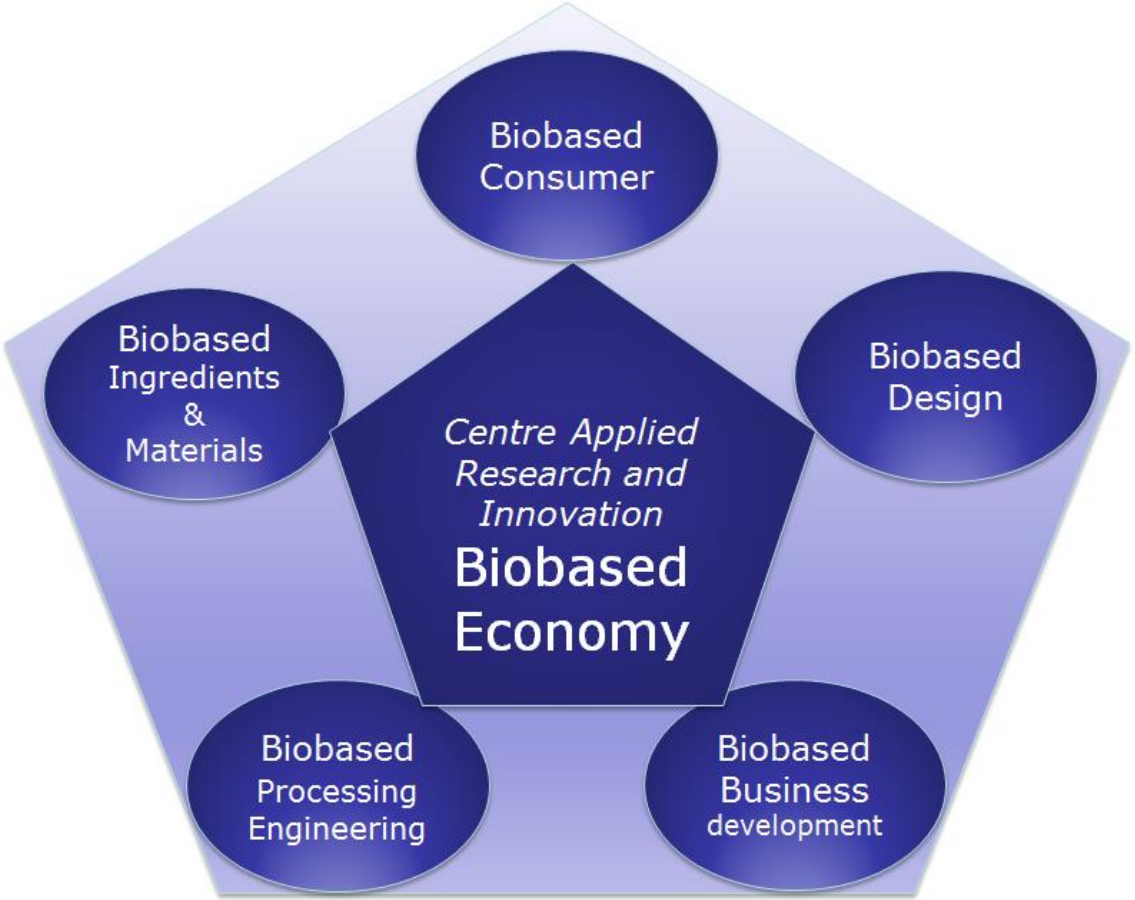
Knowledge Centre BioBased Economy



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Stimulating cooperation

- Be proud on region and achievements
- Act in trust
- Adjudge each other (gunnen)

- Strong leadership
- Supportive networks
- Unconditional support SME

Bio inspired
is the future