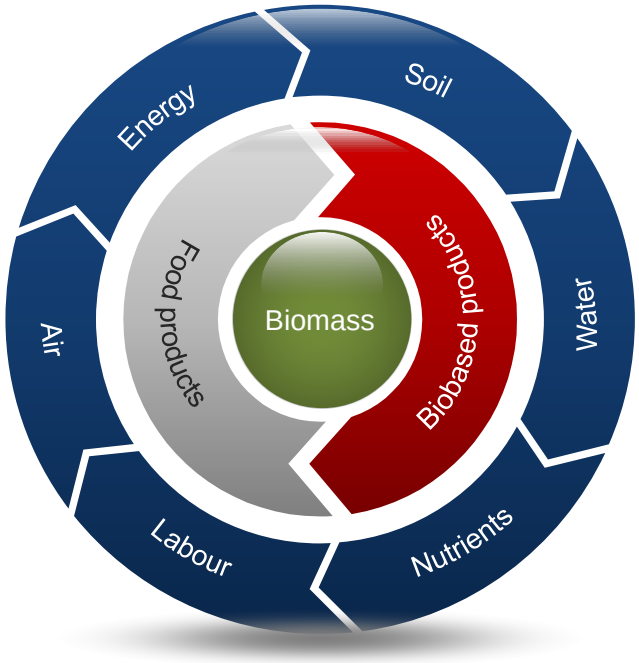
De circulaire kas : composteerbare hulpmiddelen en benutting vezels

Christiaan Bolck – program manager renewable materials

NVTL Jaarcongres 2020 – 11 februari - Wageningen



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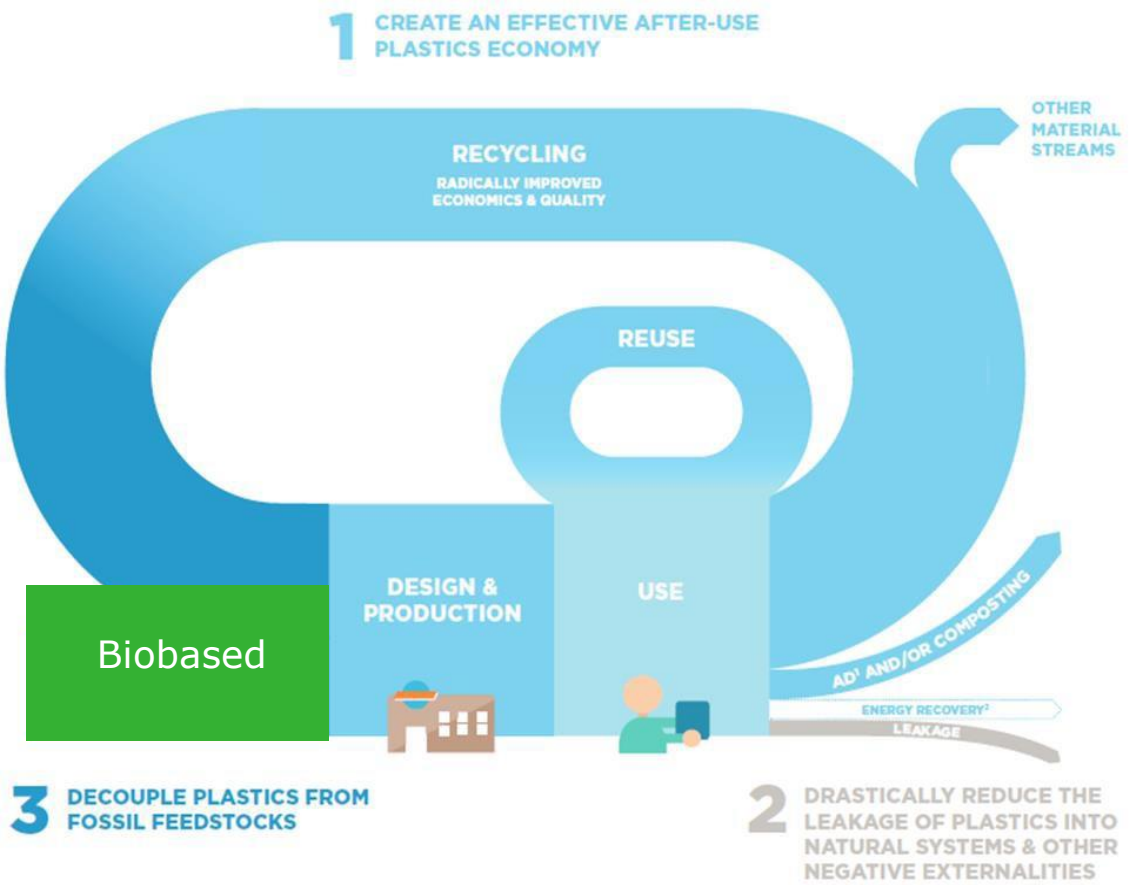
Onderwerpen die aan bod komen

1. Introductie
2. Wat is verteerbaar en composteerbaar
3. Beschikbare materialen en producten
4. Hergebruik vezels uit de kas voor papier en karton

Current societal drivers

- Climate / no fossil carbon
- Circular / plastic soup



1 Closed-loop recycling: Recycling of plastics into the same or similar-quality application

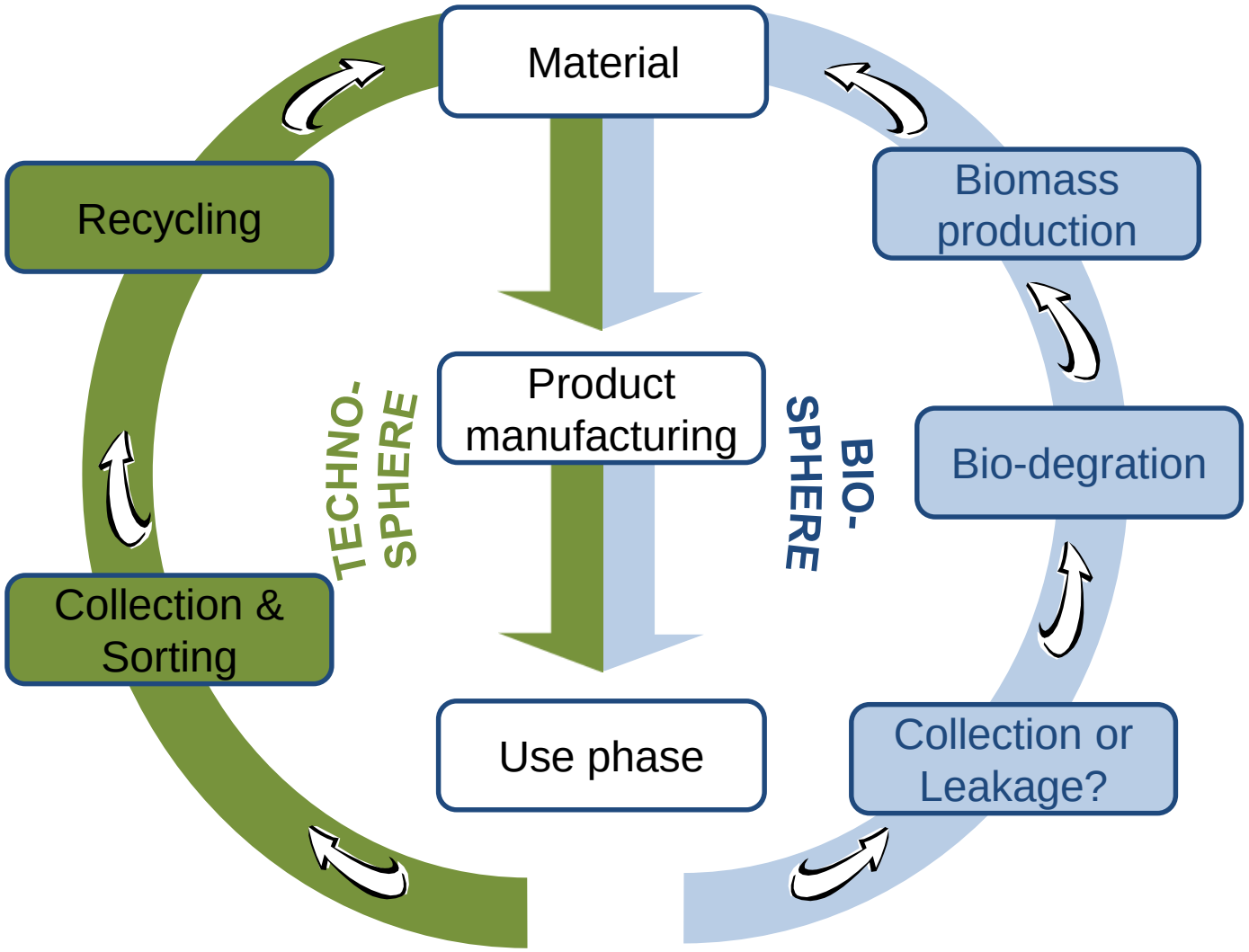
2 Cascaded recycling: Recycling of plastics into other, lower-value applications

Source: Project Mainstream analysis – for details please refer to the extended version of the report available on the website of the Ellen MacArthur Foundation: www.ellenmacarthurfoundation.org

Ambitions renewable materials :

- Recyclable, compostable and biodegradable on land and sea
- Out perform fossil counterpart on functionality and environmental impact
- Direct use of functionality provided by nature
- Maximize recycling (>95%) and virgin needed for growth and loss should be biobased
- Use and reuse of biobased fibres

Circular options for renewable materials



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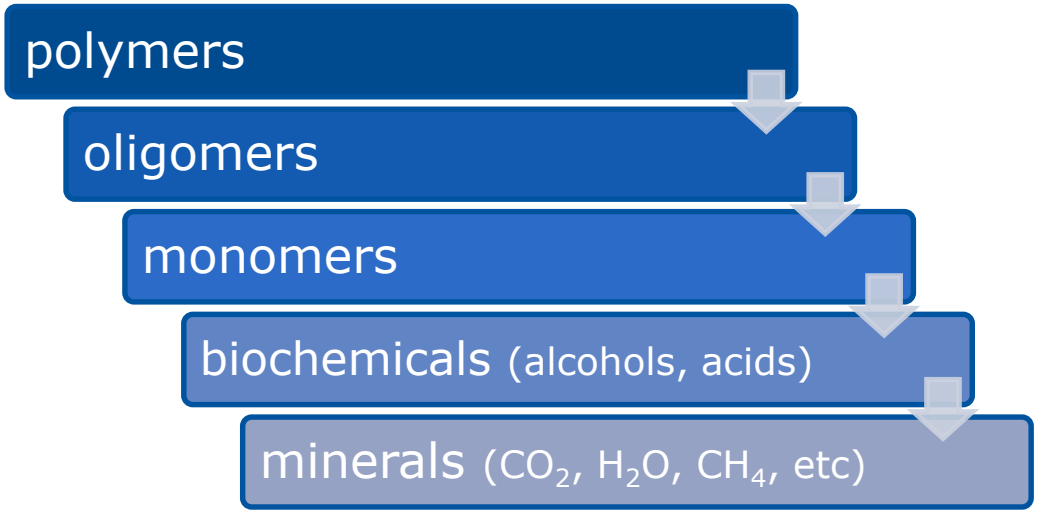
Defining: “Biodegradable”

(= biodegradeerbaar = biologisch afbreekbaar)

Biodegradation = mineralisation



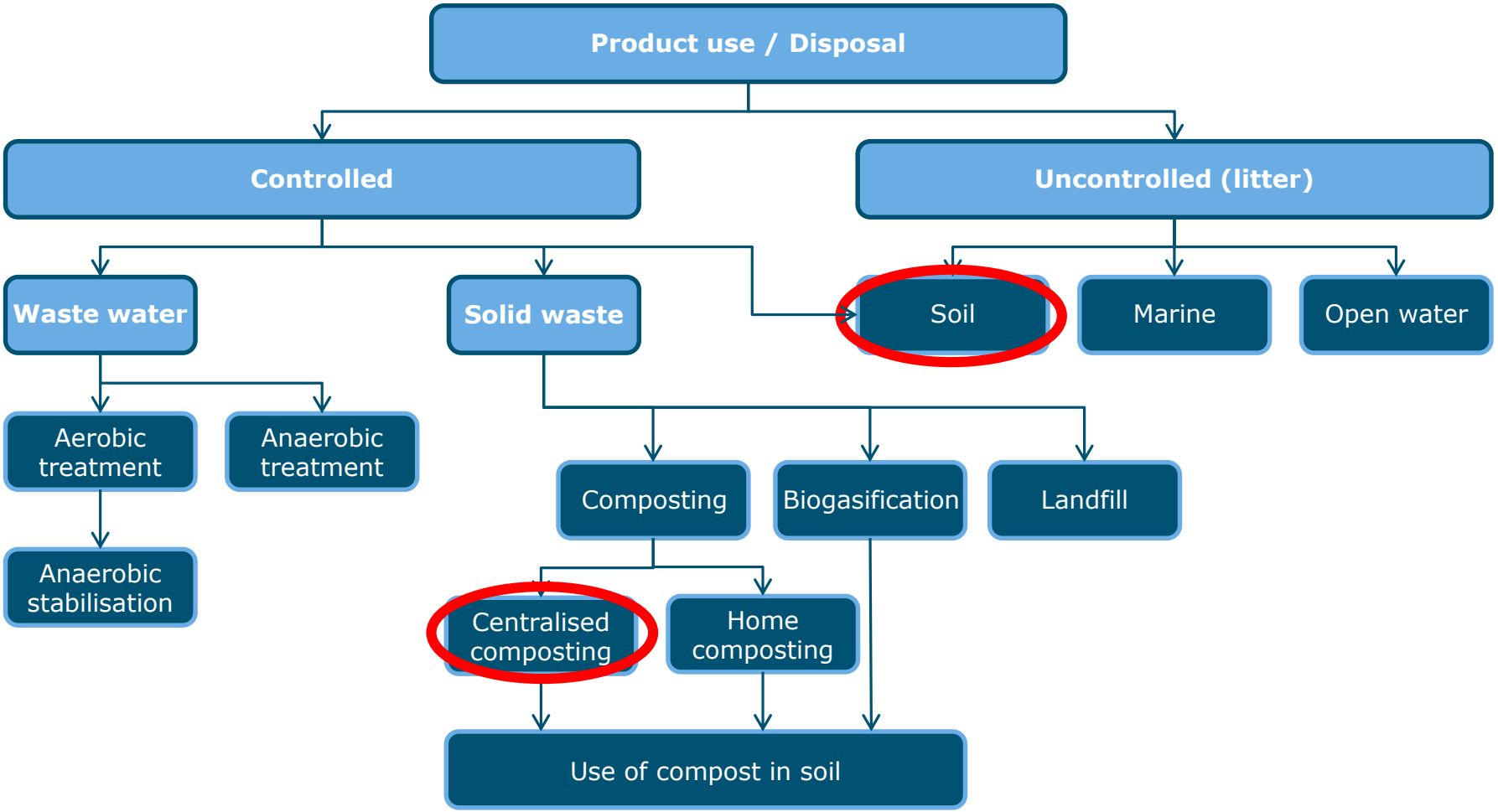
Aerobic: $C_{POLYMER} + O_2 \rightarrow CO_2 + H_2O + C_{RESIDUE} + C_{BIOMASS}$

Anaerobic: $C_{POLYMER} \rightarrow CO_2 + CH_4 + H_2O + C_{RESIDUE} + C_{BIOMASS}$

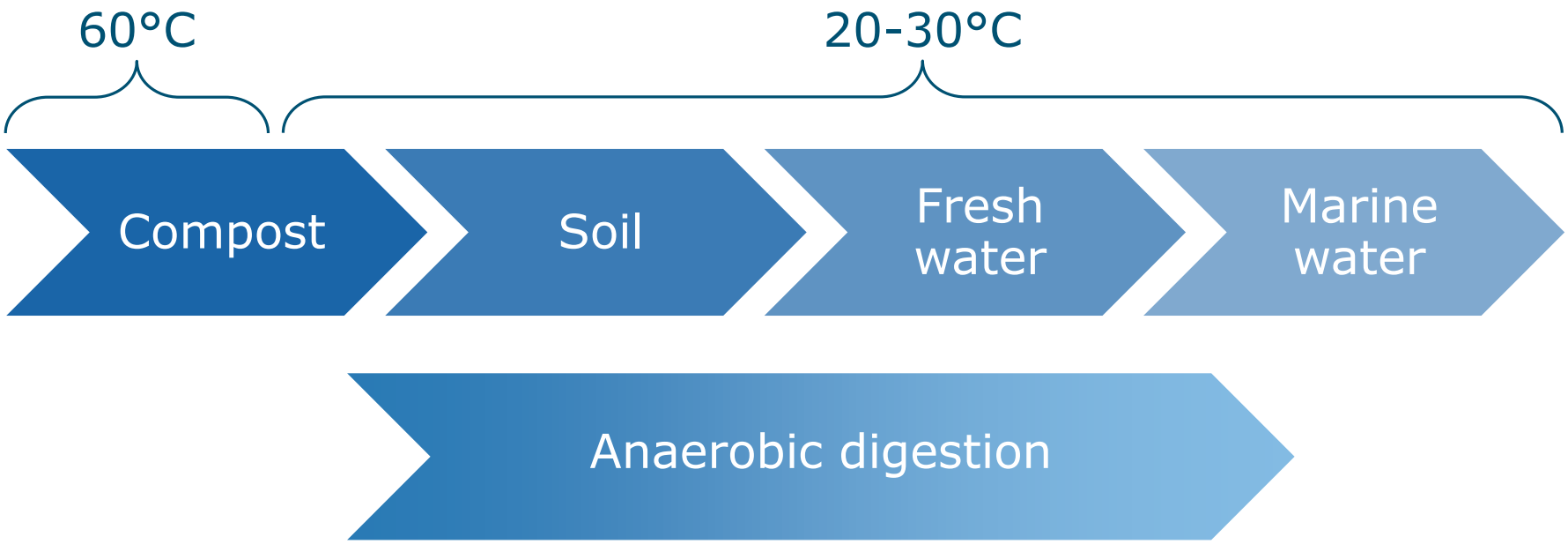
Biodegradation depends on:

- Chemistry of the polymer/product
- Activity of biological systems
  - the presence of micro-organisms
  - the availability of oxygen
  - the amount of available water
  - the temperature
  - the chemical environment (pH, electrolytes, etc.)

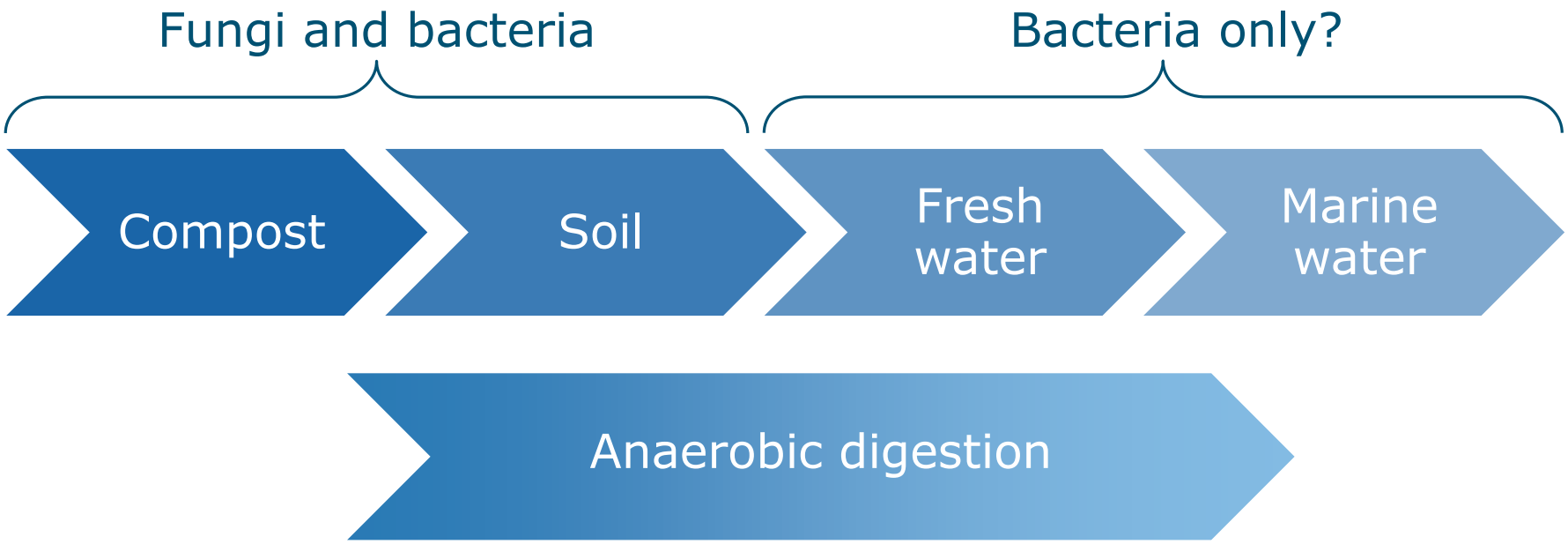
End of life: environmental niches



Aggressiveness of environment



Aggressiveness of environment



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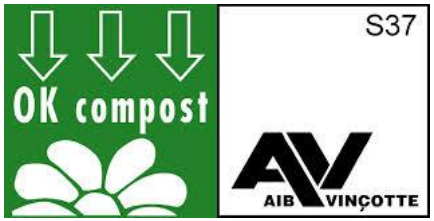
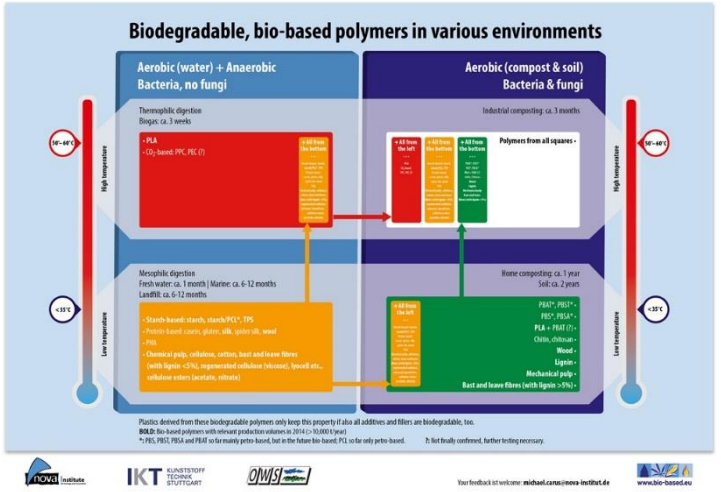
Biodegradable plastics



- Plastic that are degraded by micro-organisms
- Biodegradation largely depends on the environment
  - Soil
  - Water, marine
  - Anaerobic (digestion),
  - Composting (industrial or home)
- Standards and certificates important!



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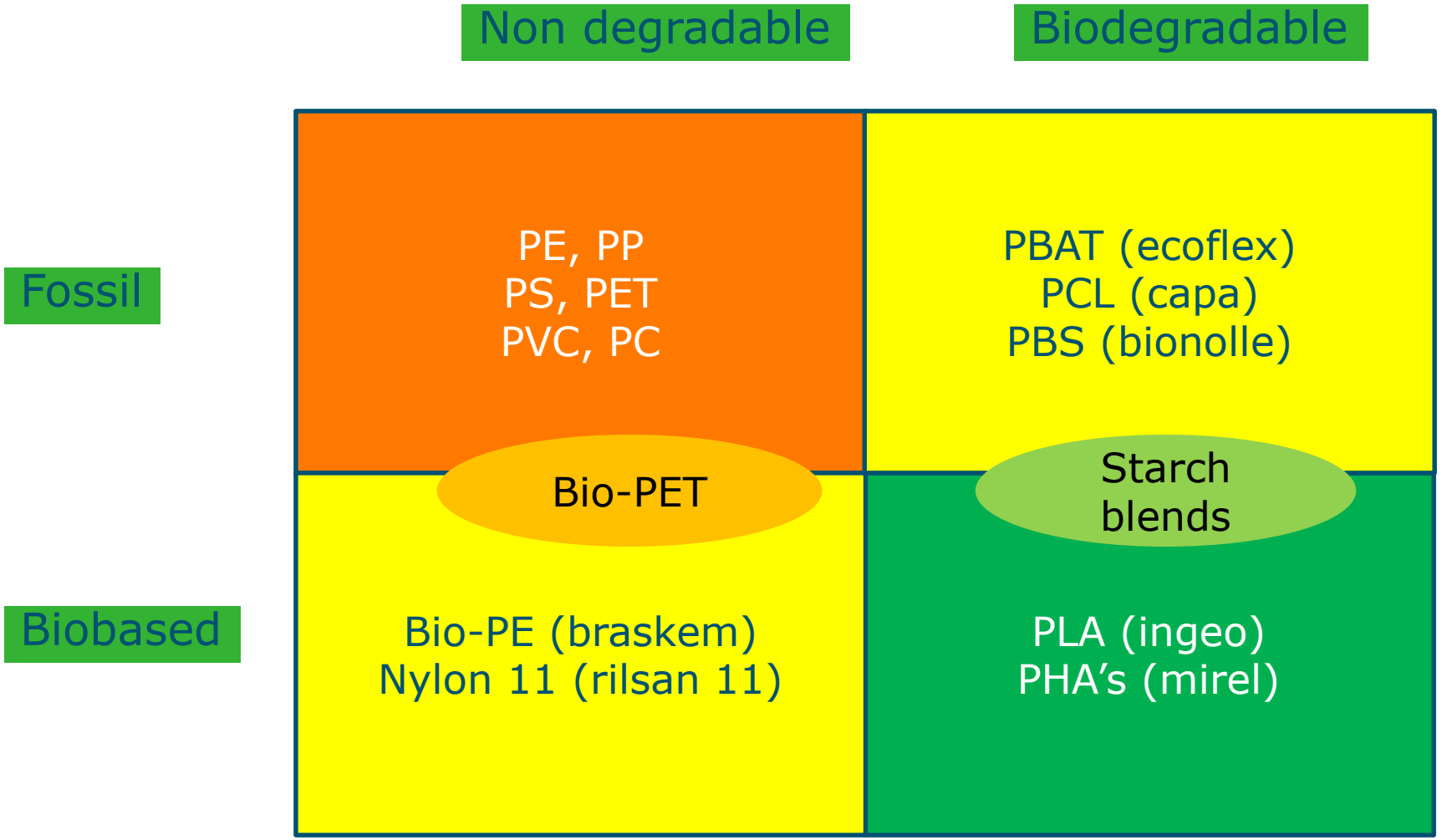
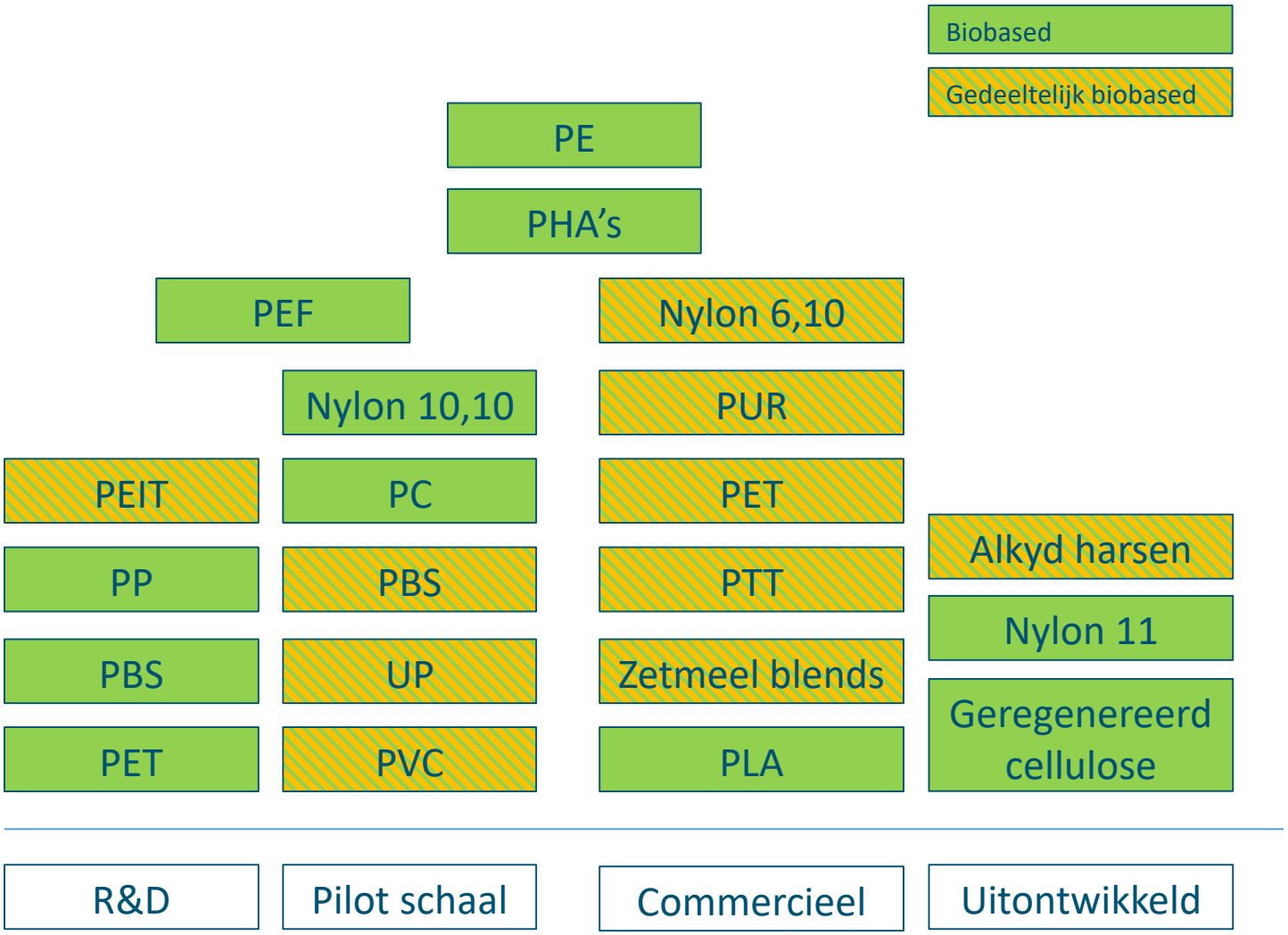
Available materials



Ontwikkelingsstadia van biobased plastics



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Binding material

General issues :

- UV/thermal stability
- tailor made degradability

Binding tapes :

- stiffness (400 - 600 MPa)

Binding tubes :

- stiffness (< 30 MPa), so plasticizers have to be used

Biologisch afbreekbare plantenpot

Spuitgieten vs. Thermovormen

Van Intratuin naar Desch Plantpak

Van prototype naar degrade merknaam

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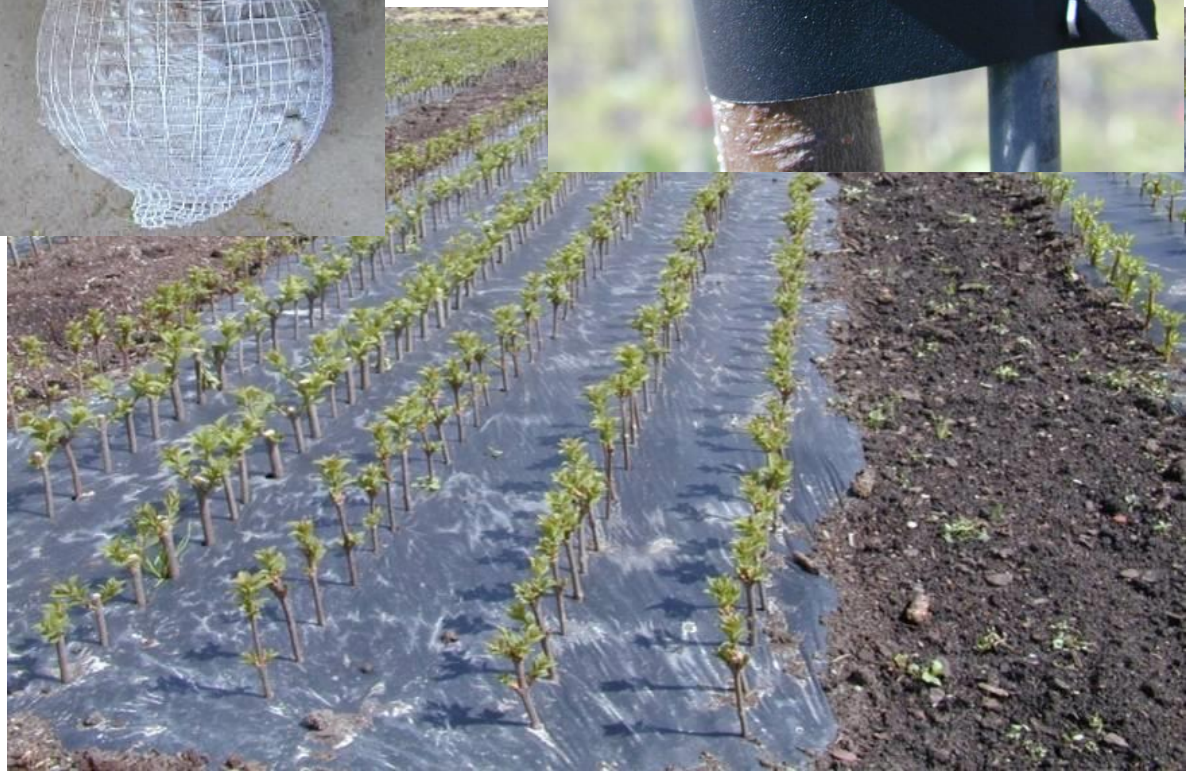
Other examples of agricultural applications



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Tomato leaves and stems for pulp & paper

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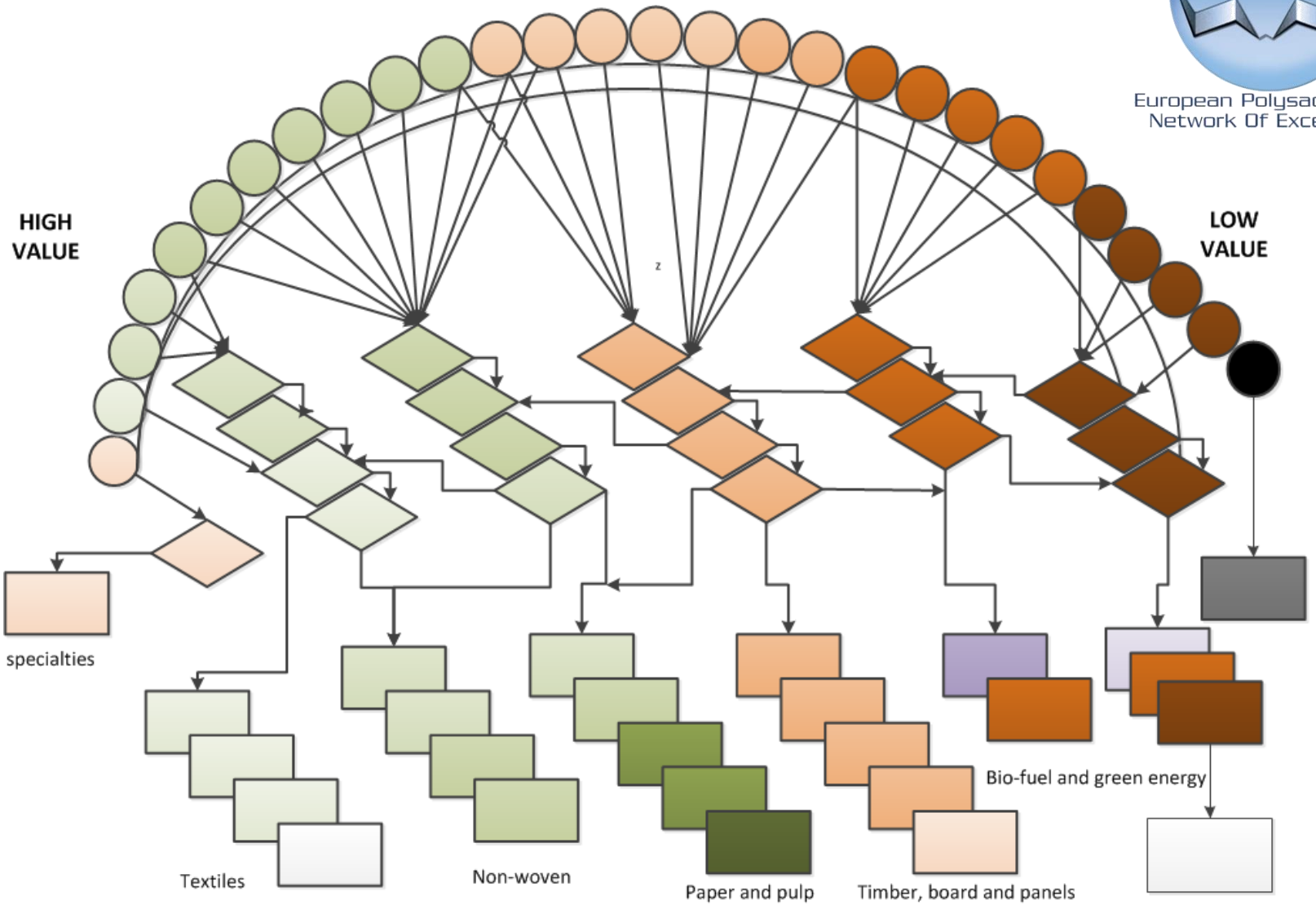
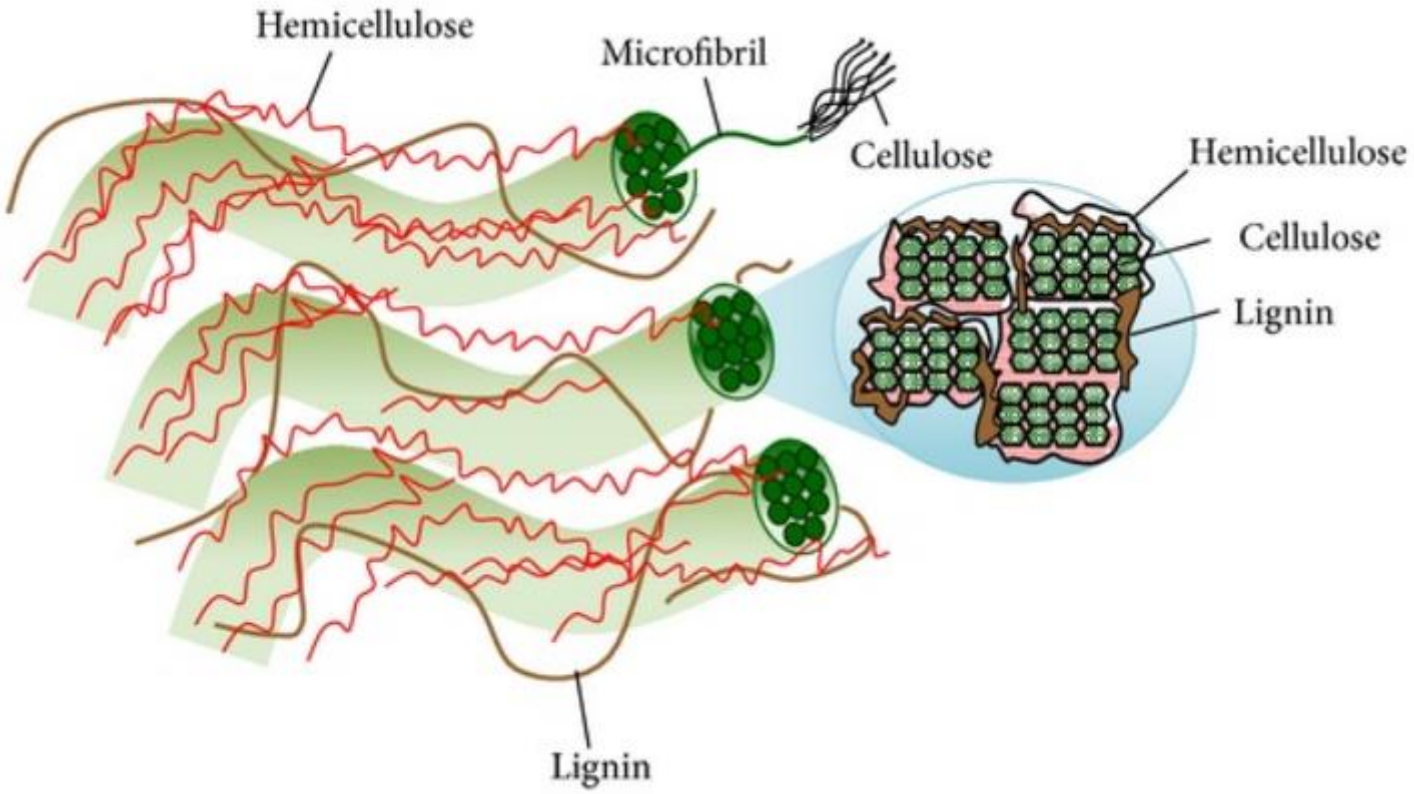
Cellulose resource matrix

epnoe
European Polysaccharide Network Of Excellence



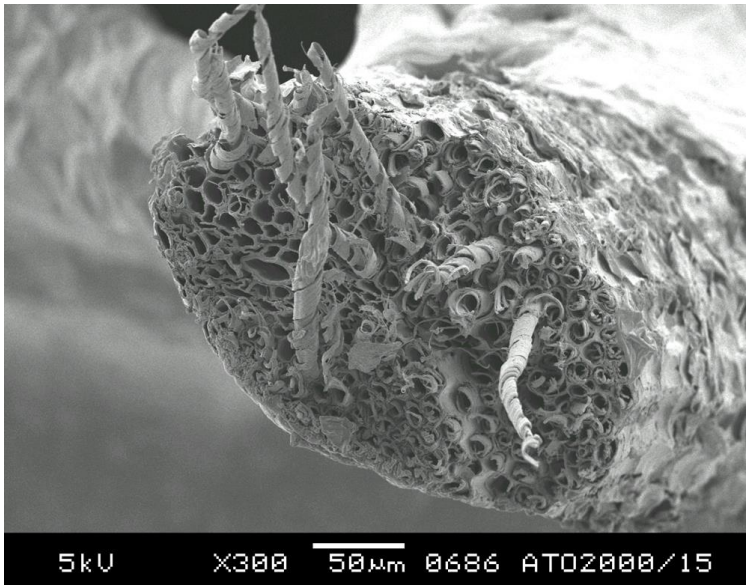
Chemical structure



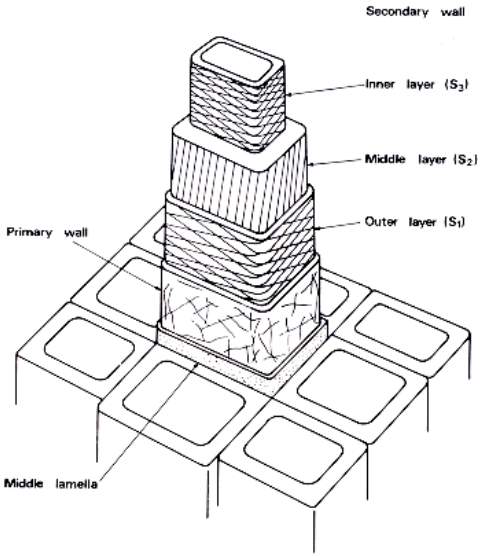
Review Article
Conversion of Lignocellulosic Biomass to Nanocellulose: Structure and Chemical Process

Chemical and physical properties

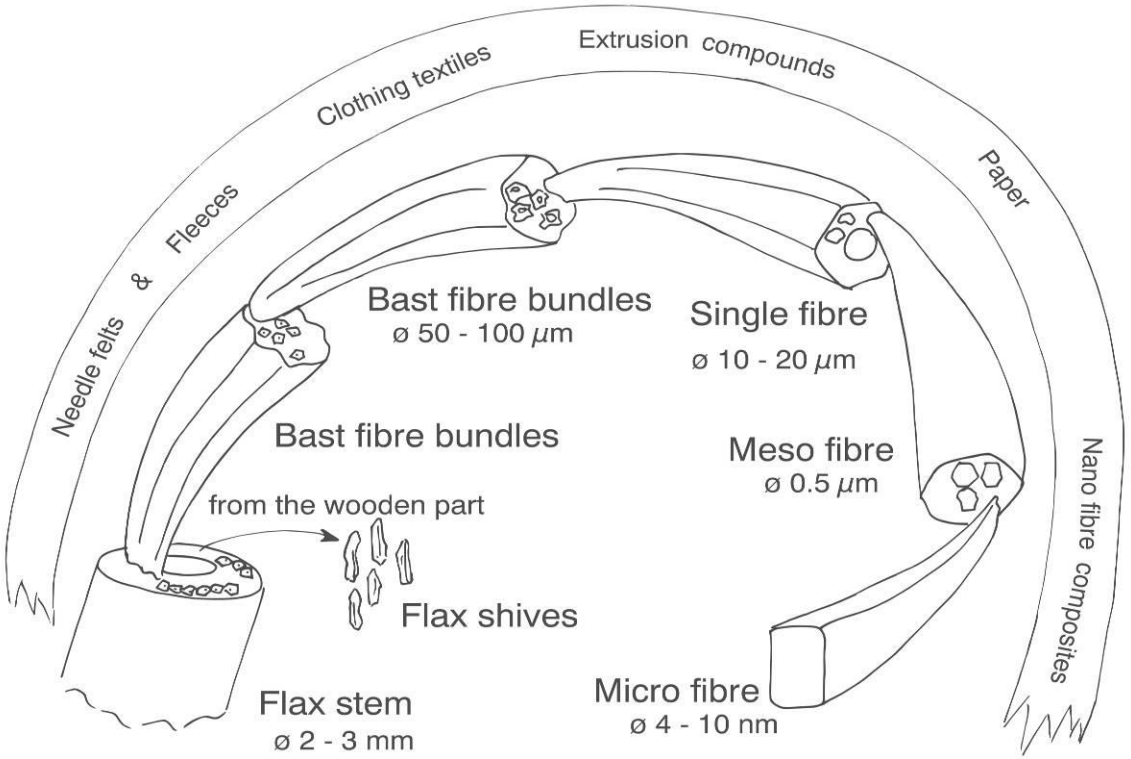
- Fibre dimensions
  - Fibre length
  - Diameter
  - Lumen
  - Cell wall thickness
- Cellulose properties
  - cellulose fibre strength properties
  - microfibril orientation
  - density
  - polymerisation degree / Molecular mass distribution
  - swelling
  - solubility in alkali / ionic liquids
- Cellulose quality parameters
  - purity
  - DP
  - crystallinity / amorphous phase



Cellulose resources



Wood



Flax

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Thank you for your attention

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www.biobasedperformancematerials.nl/uk

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Biobased Products Innovation Plant

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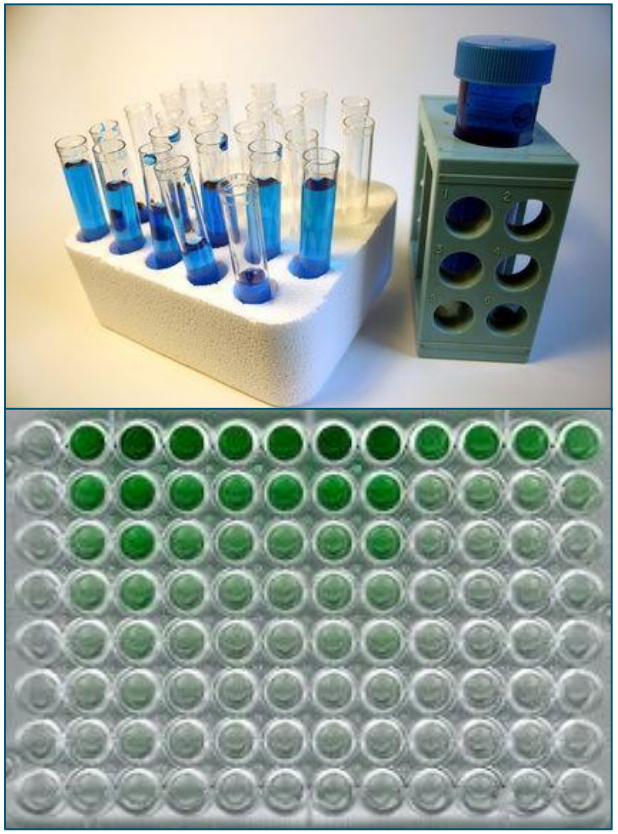
Measuring biodegradability

- Enzyme assays



Measuring biodegradability

- Enzyme assays
- Plate tests

Measuring biodegradability

- Enzyme assays
- Plate tests
- Respiration tests

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Measuring biodegradability

- Enzyme assays
- Plate tests
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- Gas (CO2 or CH4) evolution tests

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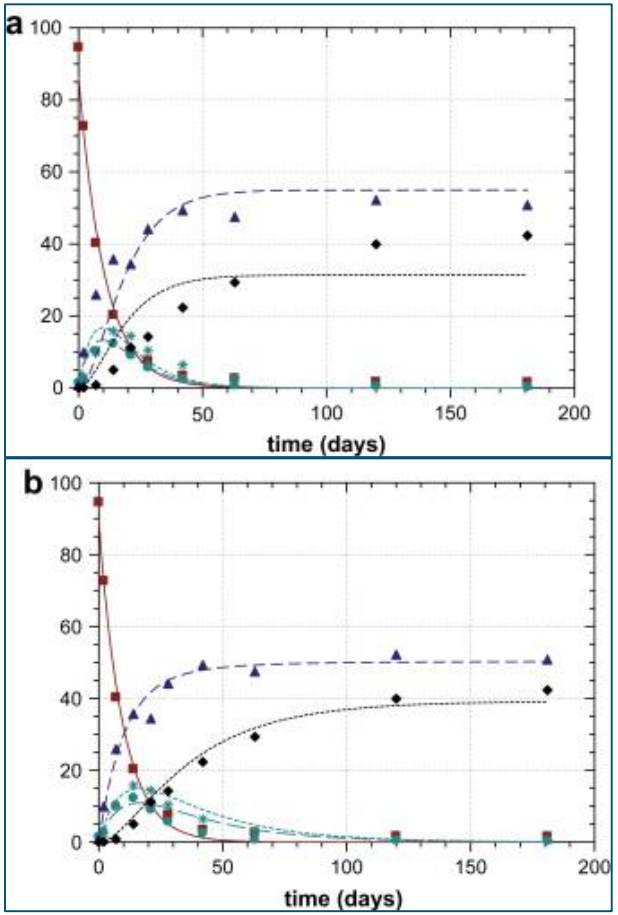
Measuring biodegradability

- Enzyme assays
- Plate tests
- Respiration tests
- Gas (CO2 or CH4) evolution tests
- Radioactively labelled polymers



Measuring biodegradability

- Enzyme assays
- Plate tests
- Respiration tests
- Gas (CO2 or CH4) evolution tests
- Radioactively labelled polymers
- Laboratory-scale simulated accelerating environments

Measuring biodegradability

- Enzyme assays
- Plate tests
- Respiration tests
- Gas (CO2 or CH4) evolution tests
- Radioactively labelled polymers
- Laboratory-scale simulated accelerating environments
- Natural environments, field tests

Standard testing methods (ISO)

- ISO 7827:1996 Water quality - Evaluation in an aqueous medium of the "ultimate" aerobic biodegradability of organic compounds - Method by analysis of dissolved organic carbon (DOC)
- ISO 9408:1999 Water quality - Evaluation of ultimate aerobic biodegradability of organic compounds in aqueous medium by
- ISO 13975:2012 Plastics - Determination of the ultimate anaerobic biodegradation of plastic materials in controlled slurry digestion systems - Method by measurement of biogas production
- ISO 14592-1:2003 Water quality - Evaluation of the aerobic biodegradability of organic compounds at low concentrations - Part 1: Shake-flask batch test with surface water or

Standard testing methods (ASTM)

- ASTM D2020-92(2003) Standard Test Methods for Mildew (Fungus) Resistance of Paper and Paperboard
- ASTM D5209-92 Standard Test Method for Determining the Aerobic Biodegradation of Plastic Materials in the Presence of Municipal Sewage Sludge (withdrawn in 2004).
- ASTM D5210-92(2007) Standard Test Method for
- ASTM D6139-00(2005) Standard Test Method for Determining the Aerobic Aquatic Biodegradation of Lubricants or Their Components Using the Gledhill Shake Flask
- ASTM D6340-98(2007) Standard Test Methods for Determining Aerobic Biodegradation of Radiolabeled Plastic Materials in an Aqueous or Compost Environment
- ASTM D6400-04 Standard

Standard testing methods (EN, OECD)

- EN 12224:2000 Geotextiles and geotextile-related products - Determination of the resistance to weathering
- EN 12225:2000 Geotextiles and geotextile-related products - Method for determining the microbiological resistance by a soil burial test
- EN 12280-1:1997 Rubber- or plastic- coated

- OECD 301 A: DOC Die-Away
- OECD 301 B: CO2 Evolution (Modified Sturm Test)
- OECD 301 C: MITI (I) (Ministry of International Trade and Industry, Japan)
- OECD 301 D: Closed Bottle
- OECD 301 E: Modified OECD Screening