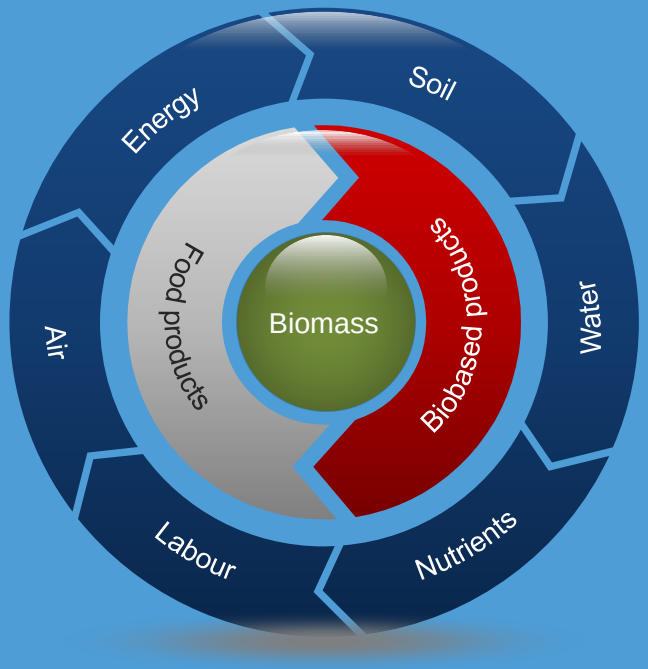
Renewable materials in a circular carbon economy

Christiaan Bolck – Wageningen Food & Biobased Research

M2i Meeting Materials 2018 - Noordwijkerhout



WAGENINGEN UR
For quality of life

Biobased Products Innovation Plant

FOOD & BIOBASED RESEARCH
WAGENINGEN UR

Developed products

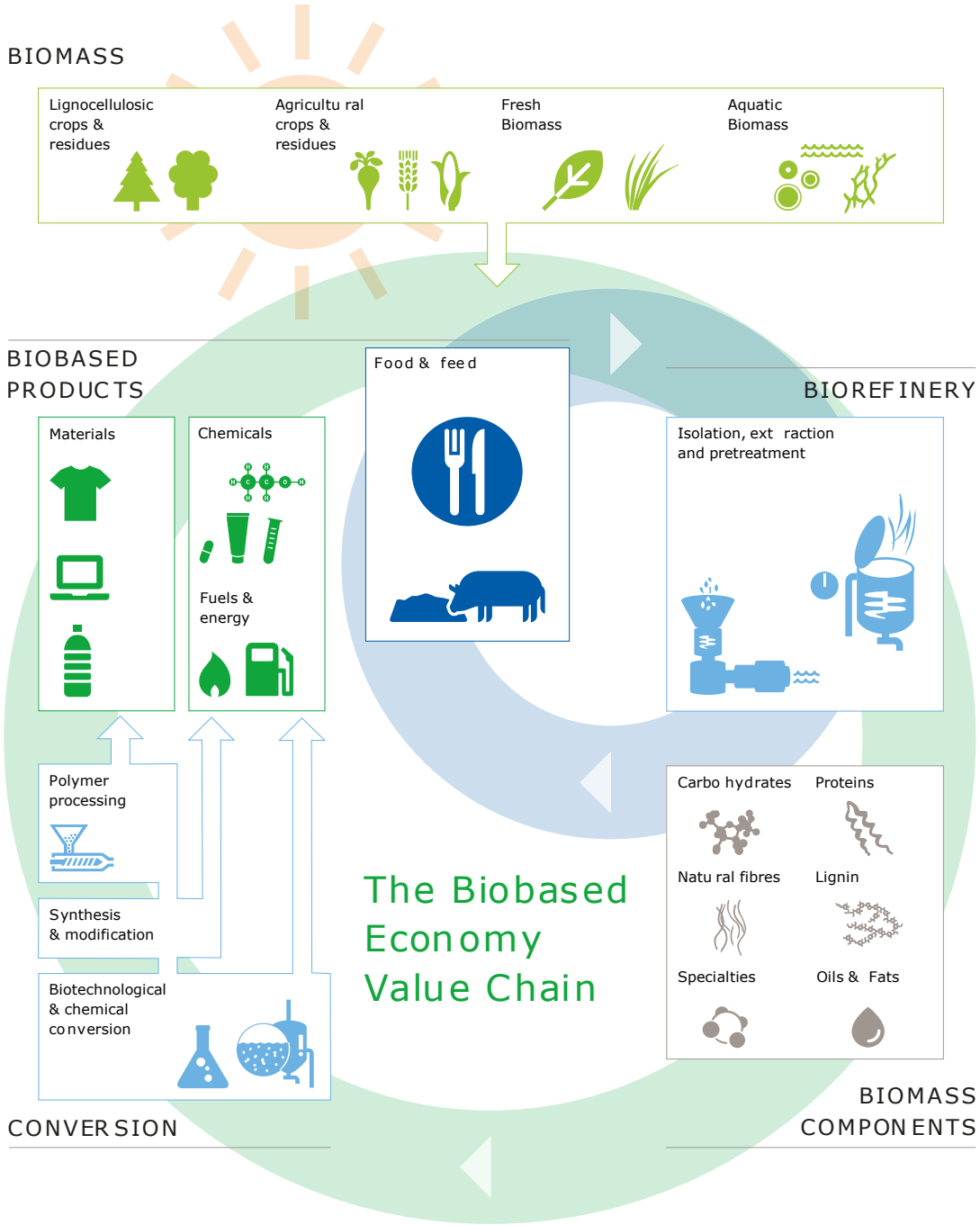
WAGENINGEN UR
For quality of life

WR Vision

Total use via (bio)refinery

Strategic themes :

- Circular & Biobased Economy
- Resource Use Efficiency



WAGENINGEN UR
For quality of life

Current societal drivers

- Scientific
  - > functionality from nature
- Environmental
  - > Climate / no fossil carbon
  - > Circular
- Social
  - > Economy
  - > Jobs

Plasticdeskundigen uit hele wereld komen twee dagen bijeen om antwoord te vinden op groeiend probleem

Hans Verbraeken
Amsterdam

De wereld raakt overspoeld met plastic. Sinds medio jaren zestig is de productie van plastic vertwintigvoudigd en tot 2050 wordt nog eens een ruime verdrievoudiging van het plasticgebruik voorzien. Er is dan 1,1 miljard ton plastic op aarde. Alarmerender uitgedrukt: 1.100.000.000.000 kilo plastic. Van koffiebekertjes voor de consument tot hit-

kunst-

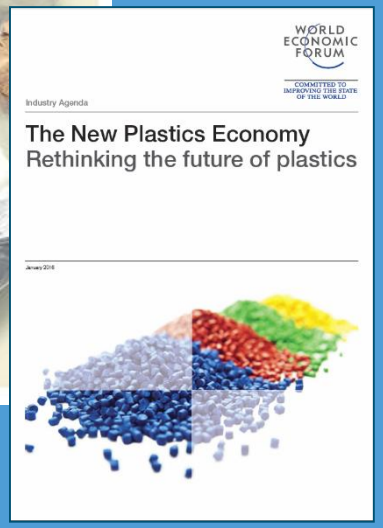
eu. Het
ieren
keten.
landen
Westen,
elijker
et

wordt gewoon verbrand, waardoor fossiele CO_2 de lucht ingaat.

Donderdag en vrijdag komen plastic-experts uit bedrijfsleven, overheden en onderzoeksinstituten bijeen in Rotterdam om te praten over dit wereldwijde probleem. De organisatoren van de 'European Conference on Plastic' hopen dat er na twee dagen ideeën en initiatieven op tafel liggen om het probleem aan te pakken.

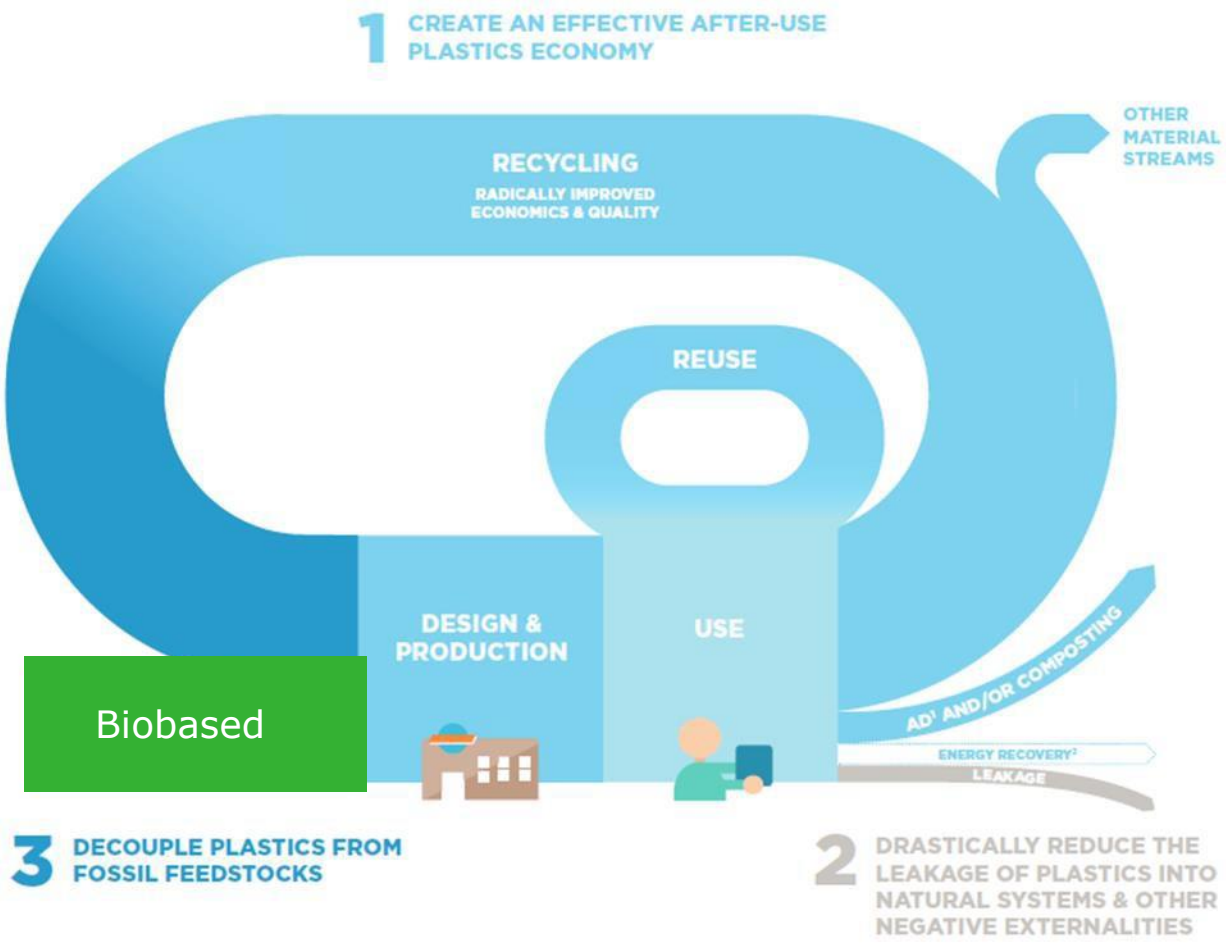
'Hoe kunnen we meer circulair omgaan met ons plastic? Hoe kunnen we plastic weer als grondstof gebruiken, hoe zorgen we ervoor dat geen plastic meer in de oceanen terechtkomt?', zegt Christiaan Bolck, expert duurzame materialen aan Wageningen University & Research. Hij formuleert een aantal dwingende vragen waarop het het antwoord gevonden moet worden. 'Wat is de goede, duurzame grondstof voor plastic in plaats van fossiele grondstoffen?'

De bijeenkomst moet volgens Bolck 'handen en voeten geven aan het EU-beleid'. De resultaten van twee dagen Rotterdam moeten een toevoeging vormen voor de 'EU Strategy on Plastics', een aanvalsplan voor het plasticprobleem.



WAGENINGEN UR
For quality of life

Ambitions of the New Plastics Economy



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

Current market drivers

- New unique functional properties: Tg, Tm, gas barrier, UV-stability, water sensitivity, targeted biodegradability, strength, impact
- Non toxic additives and functional ingredients such as plasticizers, fire retardants, anti-fouling, water binders
- Recycling of thermosets, post consumer plastics, textiles, diapers, packaging and foodwaste
- Added value for industrial organic waste like leaves for packaging and sewer sludge for plastics or foodwaste
- Regulation support at NL and EU level: normalization, standardization, certification

Research tracks renewable materials in a circular carbon economy

1. Sustainable packaging
2. New Biobased Polymers
3. Cellulose from underutilized biomass
4. Closing the loop of consumer waste
5. Plastics in the environment

biobased performance materials

Bekijk hoe de tomatendoos wordt gemaakt

fd. Home Mijn nieuws Laatste nieuws Krant Beurs Meer

Hans Verbraeken • Ondernemen

Kunststofindustrie roept op tot recyclingrevolutie

Het recyclingsysteem van kunststoffen in Nederland functioneert onvoldoende. Dat stelt de Federatie Nederlandse Rubber- en Kunststofindustrie (NRK) in het Masterplan Kunststof Kringloop, dat deze week gepubliceerd wordt. De gerecyclede kunststof- recyclaat - komt terecht in slechts een beperkt aantal producten. Vooral omdat de kwaliteit van de gerecyclede grondstoffen te gering is of de hoeveelheden te klein. Daardoor worden grondstoffen nu vooral hergebruikt in laagwaardige toepassingen als pallets, drainagebuizen, tuinmeubelen, kratten en haspels. Dat is doodzonde. Het recyclaat kan en moet ook worden verwerkt in hoogwaardiger producten, zoals in verpakkingen, goed voor 40% van alle geproduceerde kunststoffen, zo meldt het Masterplan Kunststof Kringloop.

Het plan is mede ondertekend door onder meer onderzoekers van

WAGENINGEN UNIVERSITY & RESEARCH

1. Sustainable Packaging

Example project :
Alternatives for multilayer gas and watervapour barrier materials

Recycling & Reuse

- Traditional biobased materials
  - Wood; pallets often reused
  - Paper & board; recycled
  - New development: beverage cartons

- Plastics mono-materials
  - PET flessen (deposit systeem)
  - Industrial plastic waste and distribution waste
  - PLA collection during festivals (Loopla proces)
- Recycling van post-use/consumer plastics
  - At the source ; Plastic Heroes
  - From combined waste;

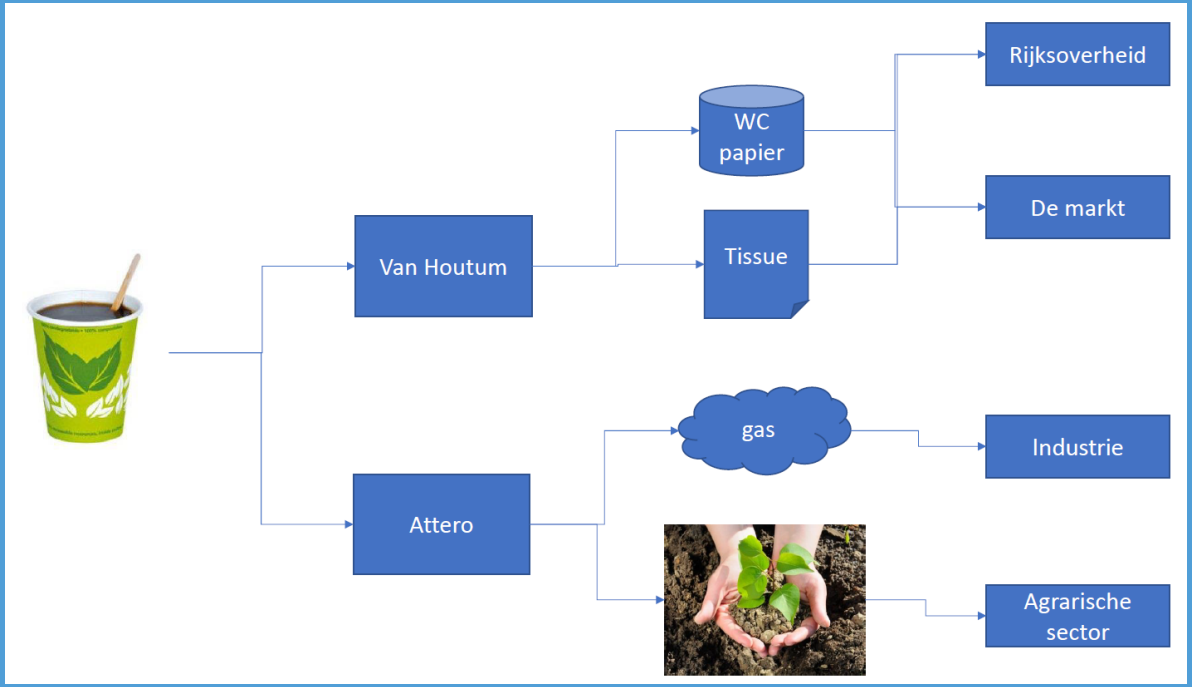
When biodegradable products?

- Functional advantage (bags for green waste)
- Biodegradation is imposed by law
- Recycling is not possible (multilayer) or expensive (agriculture)
- Price/performance

- Litter solution?

PLA coated paper cups : LCA study

- Organic recycling: best for climate
- Paper recycling: best total score
- Incineration: worst case



Advise:

- Buy PLA cups,
- End of life paper recycling
- Communicate to users to reuse cups separate cups from moist and dirt

Disposables

- Fibre based : Board & Roots
- Biobased plastic PLA and Starch blends

- Feature biodegradability
  - Controlled environment: compostability and/or digestibility
  - Uncontrolled : better safe then sorry
- Sometimes challenge: temperature and water resistance

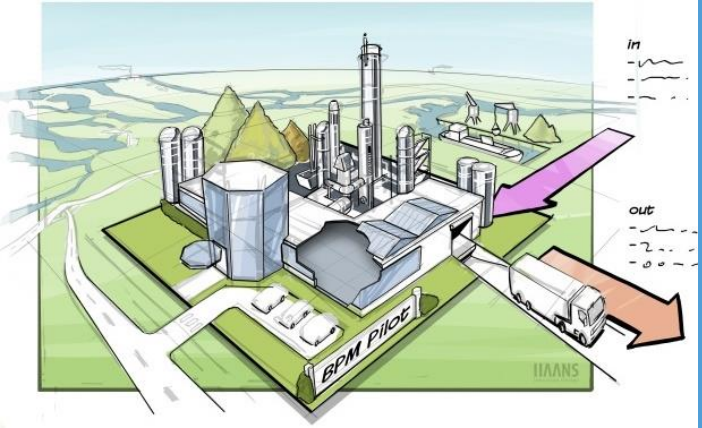
WAGENINGEN
UNIVERSITY & RESEARCH

2. New Biobased Polymers

- Using biobased building blocs for new non polluting and circular materials
- Taking polymers 2 market : Polymerisation pilot plant initiatives

Example projects :

- Recyclable thermosets en resins
- Biobased Elastomers



BPM programme

- PPP coordinating R&D activities in the Netherlands on (Circular) Biobased Performance Materials
- Initiated by Wageningen Food and Biobased Research
- Fills an important gap in research that catalyzes the biobased economy
- Is unique in its construction: industrial partners participate actively from all parts of the value chain
- Sponsored by the Dutch Government
- Start in 2010 & 2nd tranche 2015,
- New 3rd tranche 2019 (!)

Projects 2nd tranche

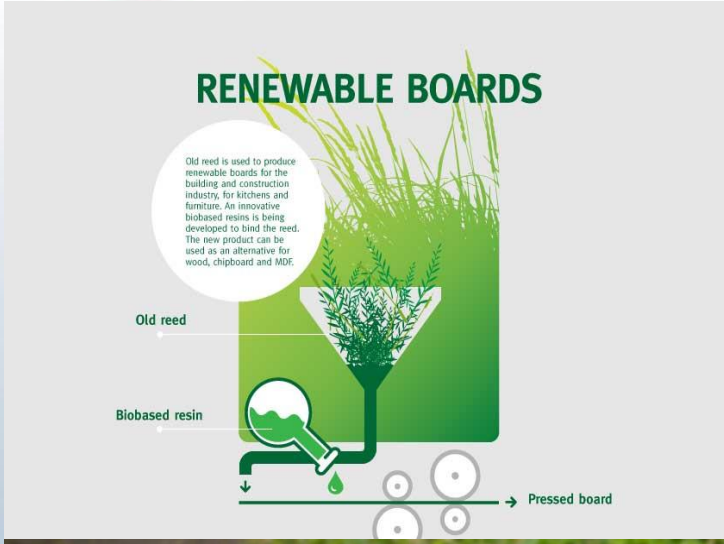
biobased performance materials

- MAGIC : Rail fastening systems : Edilon Sedra, Croda
- HIPPIE : High performance polymers from isoidide : ADM, DuPont, HCA
- SPECIFIC : Starch PE films with Improved barrier : AVEBE, Sabic
- DISCOVER : Covering materials for Roofing : Icopal, Stichting DAKlabel

Projects 2nd tranche

biobased performance materials

- Glue Reed : Renewable boards
  DSM, Natuurmonumenten, Compakboard, CS process eng.
- MethaForm : Biobased itaconic acid and methacrylic acid
  ADM, EOC, Van Wijhe Verf
- APPS : Applications for PBS
  Reverdia, Promens, Teamplast
- FOAMEX : Extrusion foaming
  Synbra Technology, Nomacorc, Sulzer Chemtech



3. Materials from under utilized biomass

- Fuelled by the circular economy
- Refinery and materials sciences

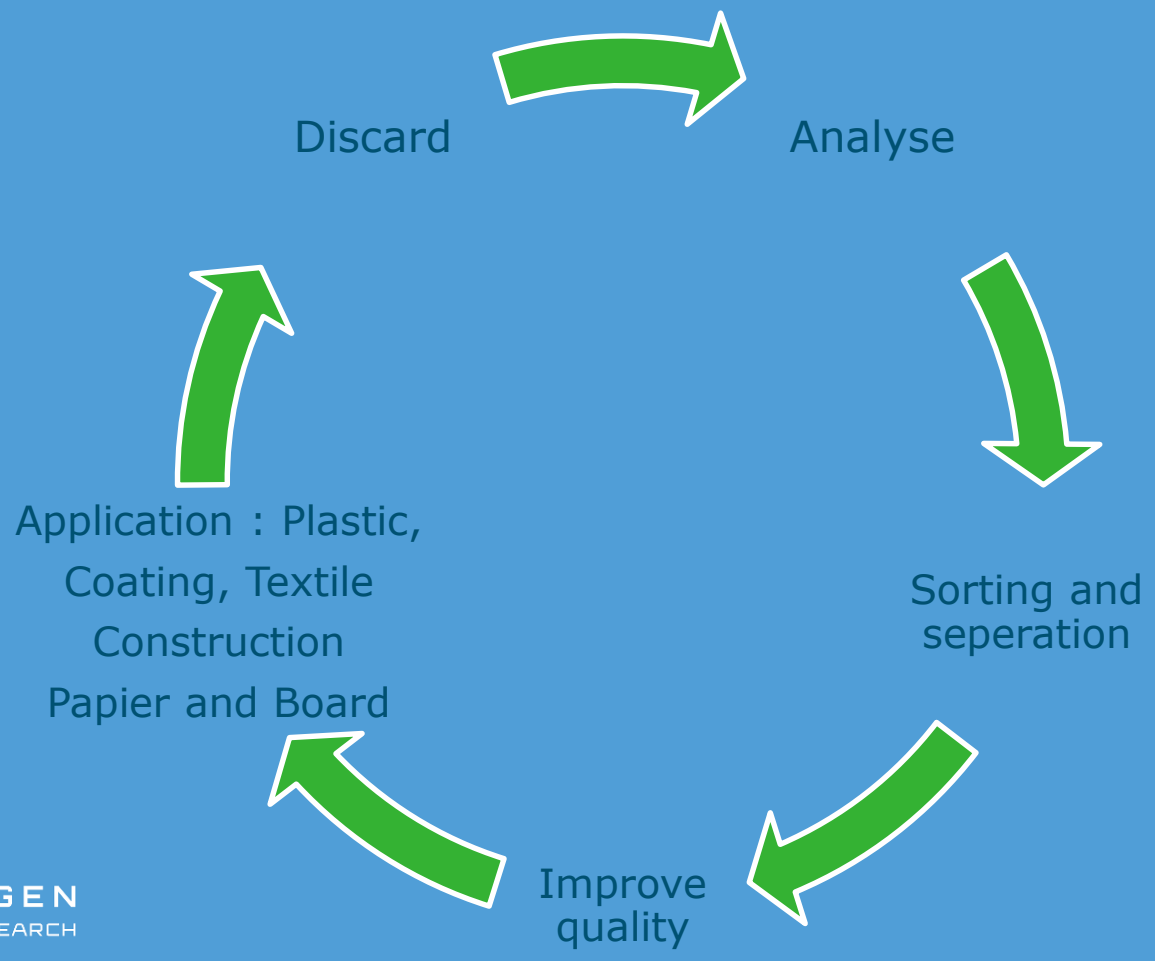
Example projects :

- Thermoplastic lignocellulose : thermoplastic materials from naturally abundant biopolymers and its derivatives
- Sea2plastics : production of plastics materials based on seaweed and chitin
- Fibrewaste4paper&construction : valorising waste fibres like tomato leaves and reed

4. Closing the loop of consumer waste

Example project

Sustainable chains for supplying sustainable plastic packaging & textiles

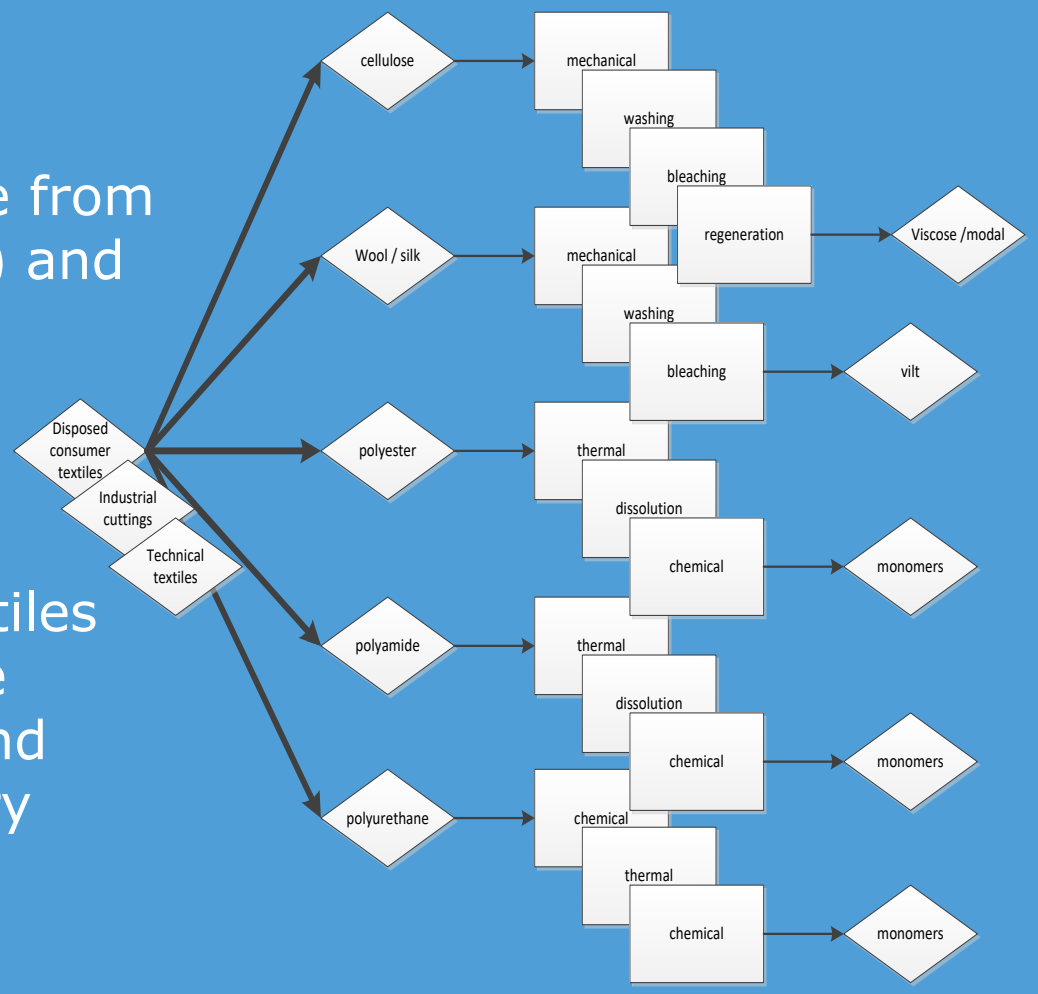


Plastic recycling

- Improving the properties and value of post-consumer recycled plastics
- Which contaminations have the largest detrimental effect on plastic recyclates
  - Sorting errors
  - Packaging design
  - Packaging content
- Blueprint recycled plastics
  - Standards post use recycled plastics
  - Scope : all applications including packaging
  - Focus large volumes: PP, PE, PET, PS, PVC

Wastexcel : recycling mixed textile

- 6 million tons/y discarded in EU
- Recovery of mixed textile from natural (cellulose/cotton) and synthetic (polyester and elastan) raw materials
- Reuse of the cellulosic fractions from mixed textiles would make the EU more resource independent, and makes the textile industry overall more sustainable

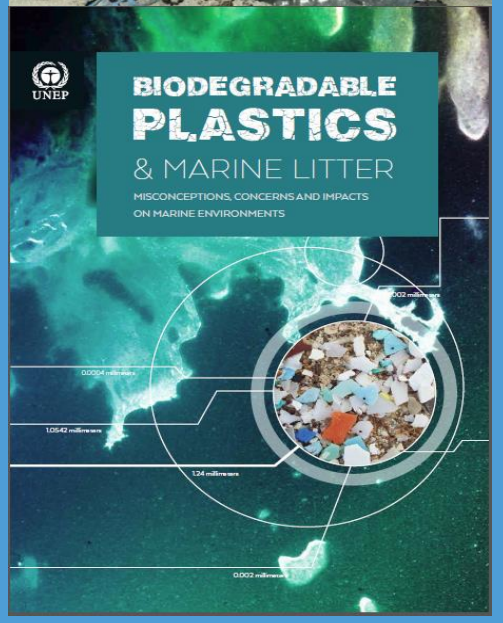


WAGENINGEN
UNIVERSITY & RESEARCH

5. Plastics in the environment

- CSI Plastics
  - Where are plastics found in the marine environment?
  - How to prevent ...
  - Are biodegradable plastics THE solution?

- Closing the biocycle : triggered biodegradation in soil and sea



WAGENINGEN UR
For quality of life

Thank you for your attention

christiaan.bolck@wur.nl

+31 317 480229

www.wageningenur.nl/en/fbr

www.biobasedperformancematerials.nl/uk

WAGENINGEN
UNIVERSITY & RESEARCH