BioBased Circular

WAGENINGEN UNIVERSITY & RESEARCH

BioBased Circular

Innovatie en opschaling van biopolyester ketens

Future Festival
25 november 2025
Edwin Hamoen
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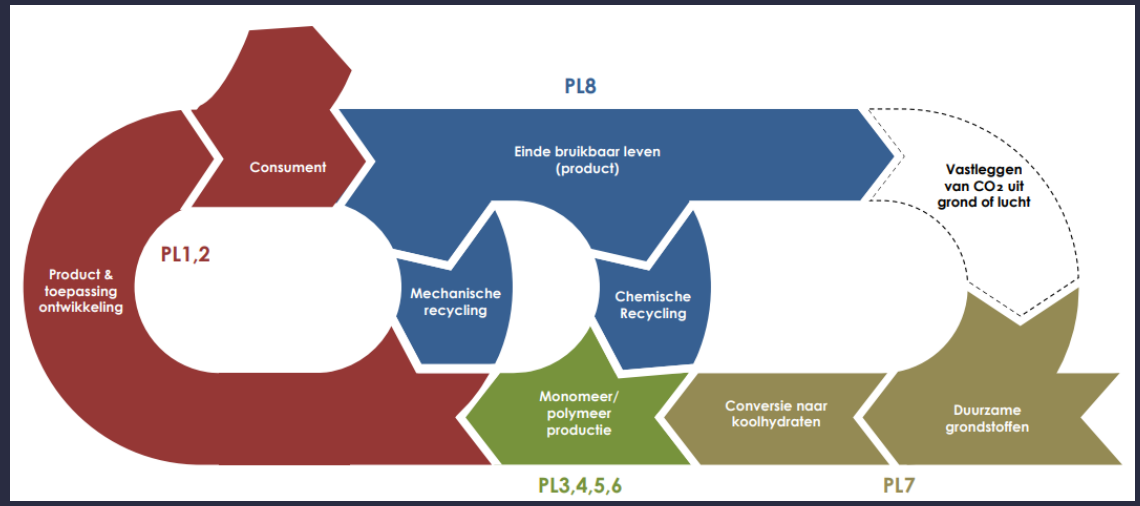
- BBC scope en status
- Moonshot: ambitie 2050
- Biogrondstoffen beschikbaarheid: Arjen van Kampen, Wageningen FBR

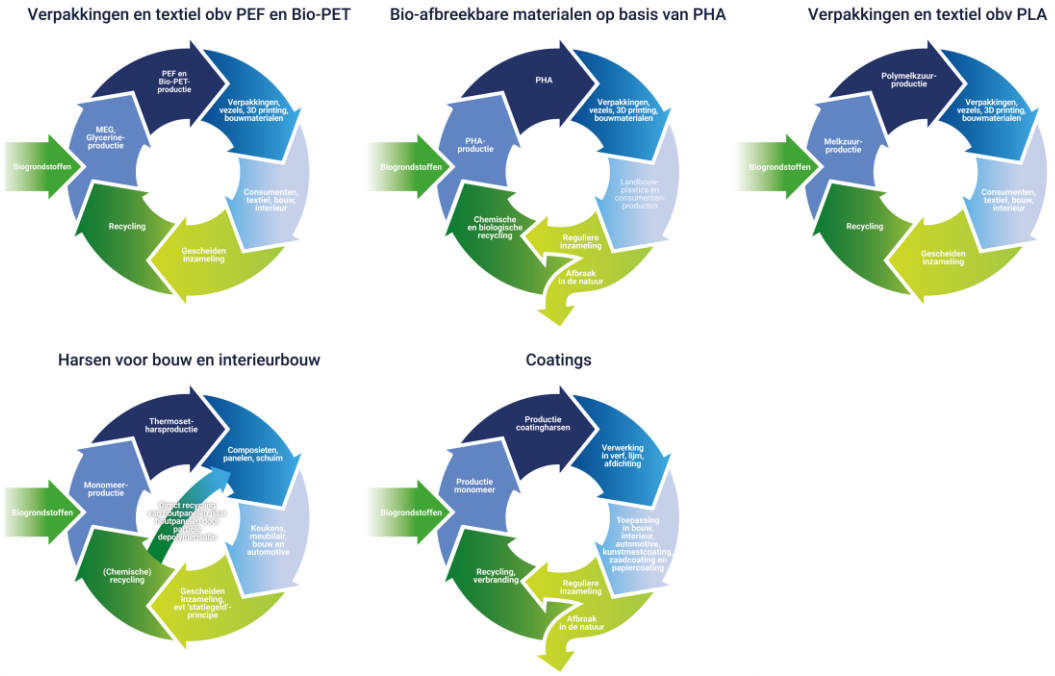


BBC van fase 1 naar fase 2

Fase 1: 2024-2026 – €102m
Fase 2: 2027-2032 – €236m reservering

- Externe evaluatie Technopolis: positief, ga zo door
- Voorstel fase 2 update indiening 1 december

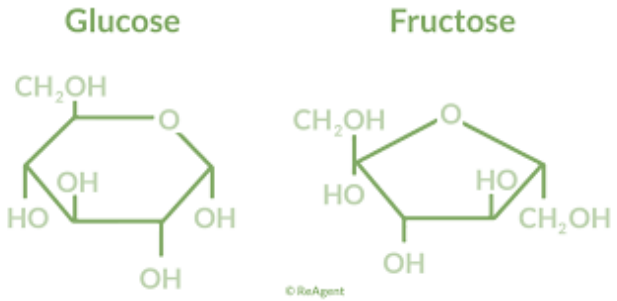
Bezoek NGF commissie aan BBC in Emmen, 19 nov

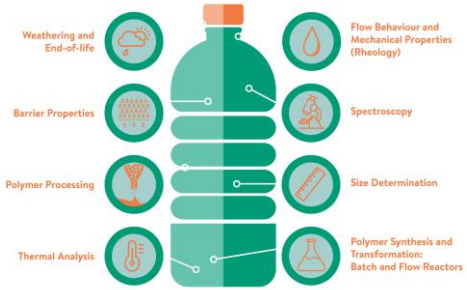


Waarom polyesters?

Maximize yield of biomass feedstocks

- Composition
- Weight per acre



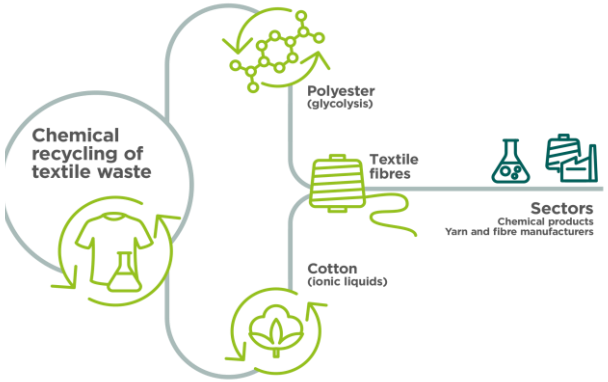


Different properties

- Strengths
- Barriers

Circular by design & versatile end-of-life options

- Easy to re-use
- Higher chemical recycling efficiency

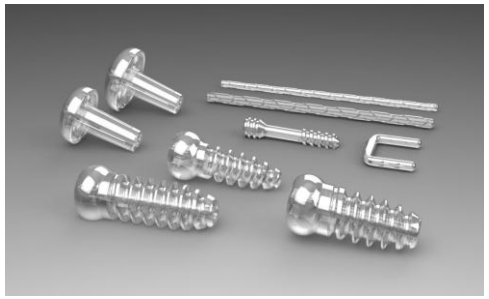


Biodegradable in shorter and longer scenarios

- Easier degradable then PE, PP
- Avoiding accumulation of persistent microplastics

Concrete voorbeelden

Toegevoegde waarde in functionaliteit



BBC instrumenten

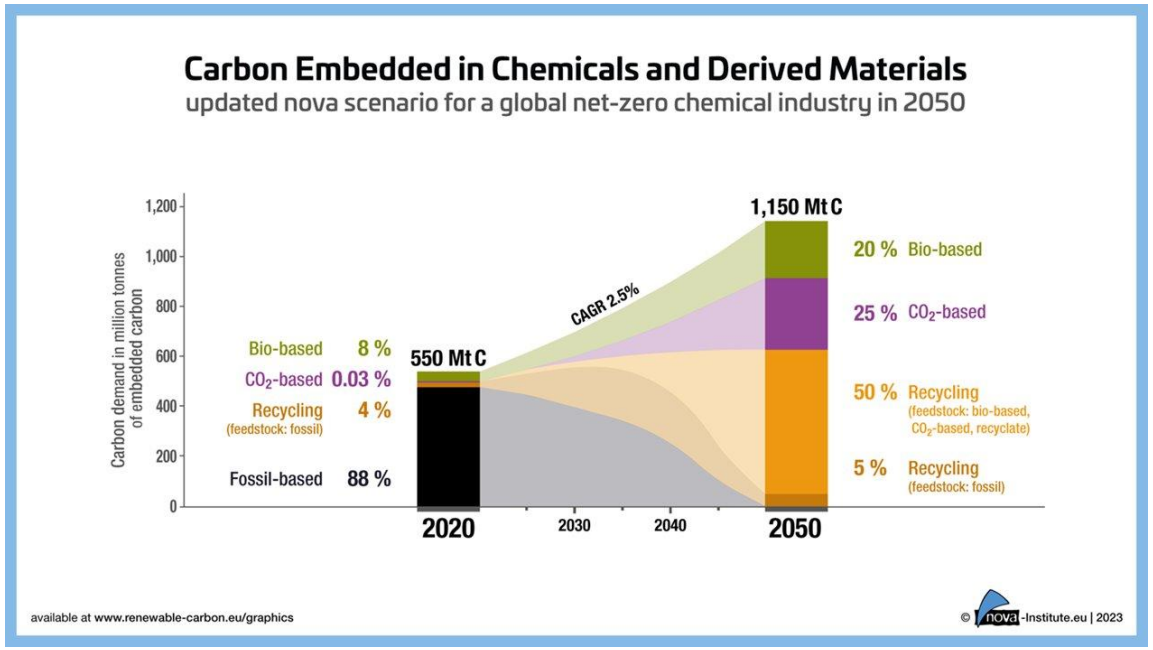
		2024 & 2025	2026
MOOI	< 4 m€	20 m€	-
EKOO	< 500 k€	5 m€	6 m€
STCB – test	< 25 k€	1 m€	4 m€
Innovation Impact Challenge: Drainagebuizen en geotextielen *		880 k€	nnb
DEI+	< 10 m€	-	22 m€

**: samen met Building Balance*

123 bedrijven ontvangen subsidie vanuit BBC instrumenten

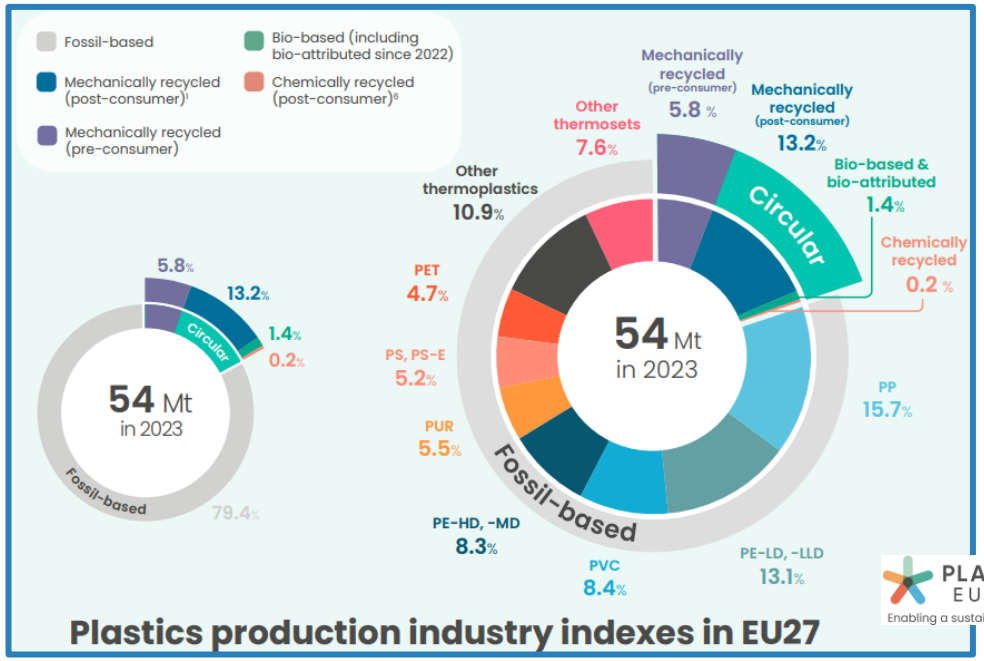
Plastics transitie naar 2050

Global carbon chemical industry

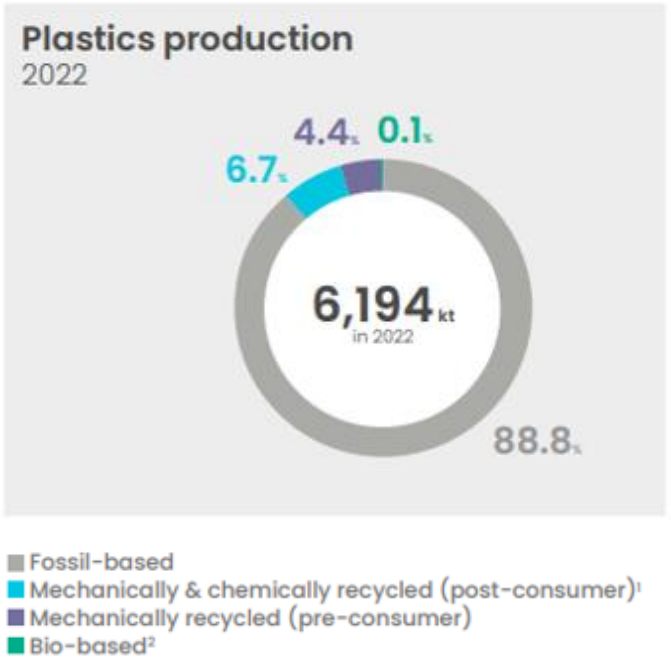


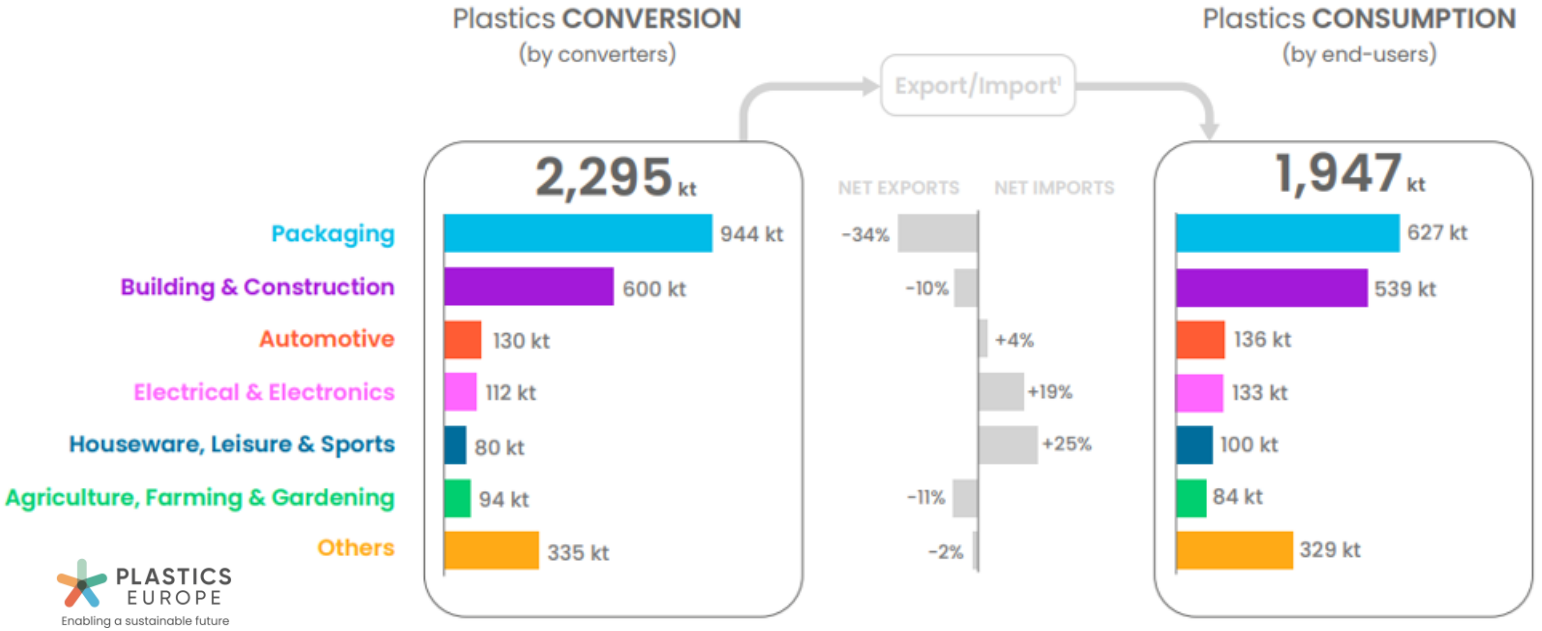
European plastics

2022: 59 Mt/yr
2023: 54 Mt/yr
2050: 65 Mt/yr ?



Plastics in Nederland





Nederlandse plastic productie ontwikkeling

2022	6,2 Mt	217% overcapaciteit
2050	3,3 MT	60% overcapaciteit

BBC ambitie fossielvrij

Hernieuwbare grondstof verdeling

Recycling	45%	1,5 Mt
Biomassa	**45%**	**1,5 Mt**
CO_2	10%	0,3 Mt

BBC doel

En nu de praktijk in 2050

1,5 Mt/jaar biopolymeren in Nederland
- ‘Novel’ biopolyesters
- Drop-in biopolymeren

Essentiele tussenstap 2032:
Realisatie demonstrators en flagships

Hypothetische invulling

Biopolyester fabrieken	Drop-in biopolymeer fabrieken
2 PLA fabrieken van 200 kta	1 PE fabriek van 250 kta
2 PEF fabrieken van 100 kta	1 polyamide fabriek van 100 kta
10 PHA fabrieken van 25 kta	
4 thermosets fabrieken van 25 kta	
1 PET fabriek van 150 kta	
50 kta overig	

Plus 1,5 Mt plastics obv gerecycled plastic: PET, PE, PP

FDCA Avantium, Delfzijl

Biogrondstoffen beschikbaarheid

Biogrondstoffen en land zijn schaars. Nodig voor:

- Polyesters
- Chemicaliën en derivaten
- Bouwmaterialen
- Brandstoffen; wegverkeer, scheepvaart, luchtvaart?
- Energie???

Maar natuurlijk ook voor voedsel, en diervoeder

En dat allemaal binnen de planetaire grenzen, bijdrage aan gezonde bodem en natuur

Samenwerking gestart: afstemming hoe en voor welke keten wanneer biogrondstoffen beschikbaar maken

ChemistryNL

TKI ENERGIE EN INDUSTRIE
Topsector Energie

VNCI

Platform Hernieuwbare Brandstoffen.

PLATFORM BIO ECONOMIE

BioBased Circular

Rijksdienst voor Ondernemend Nederland

Scoping Study Bioresources

Results Bioresources (WP1) en State-of-the-art study (WP2)

25 November 2025

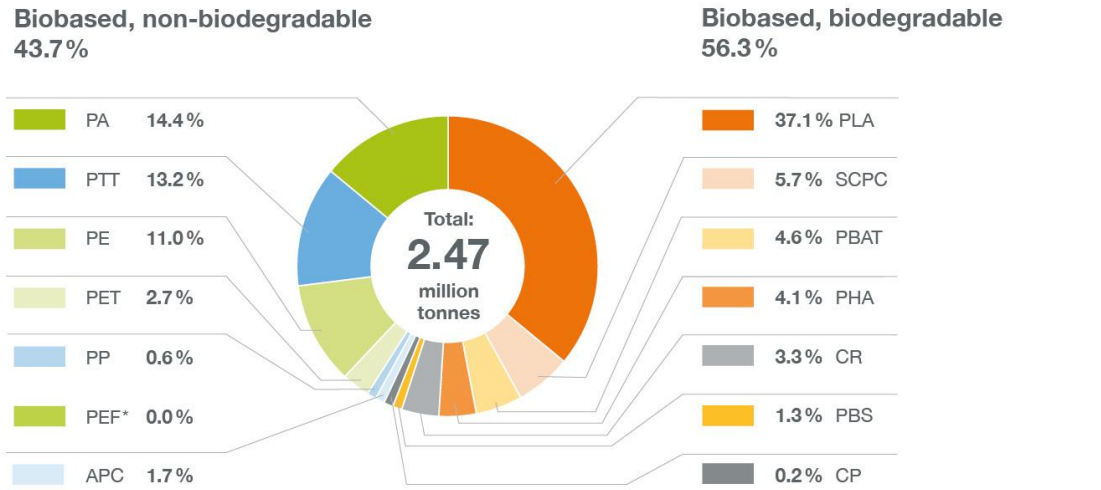
Arjen van Kampen

Objectives scoping study

- Making an inventory of available and suitable biomass (both NL and EU) for the Dutch biobased chemical industry and formulating a strategy to make this biomass actually available.
- The expected results:
  - Report on biomass availability now (WP1) and in the future (scenario's => WP3)
  - Report on technologies to set up value circles from biomass to polyesters in 2032 and 2050
  - Positioning document which includes rationale, assessment framework and strategy for making biobased raw materials available for the biobased chemical industry
- Execution: Wageningen Research (WFBR, WEnR, WPR)

Bioplastics landscape

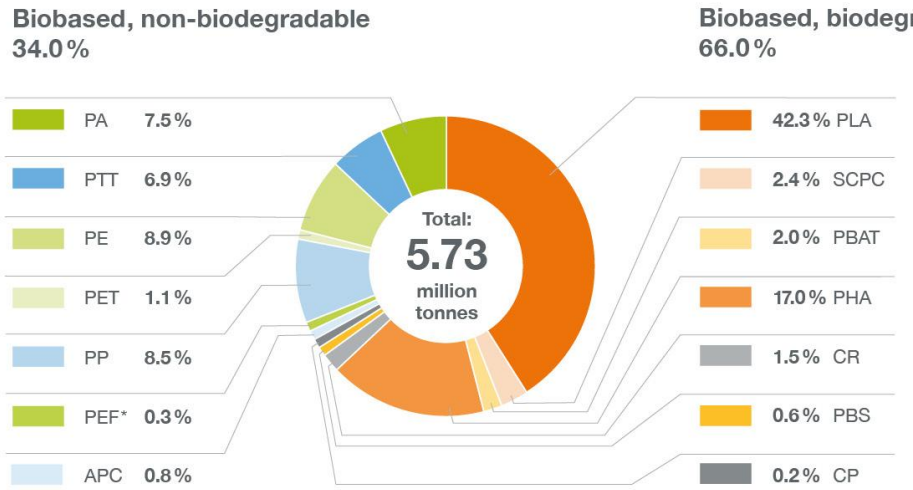
Global production capacities of bioplastics 2024



APC Aliphatic Polycarbonates
CP Casein Polymers
CR Cellulose Regenerates
PA Polyamides
PBAT Poly(Butylene Adipate-co-Terephthalate)
PBS Polybutylene Succinate and Copolymers
PE Polyethylene
PEF Polyethylene Furanoate
PET Polyethylene Terephthalate
PHA Polyhydroxyalkanoates
PLA Polylactic Acid
PP Polypropylene
PTT Polytrimethylene Terephthalate
SCPC Starch Containing Polymer Compounds

* PEF ava
Source: E

Global production capacities of bioplastics 2029



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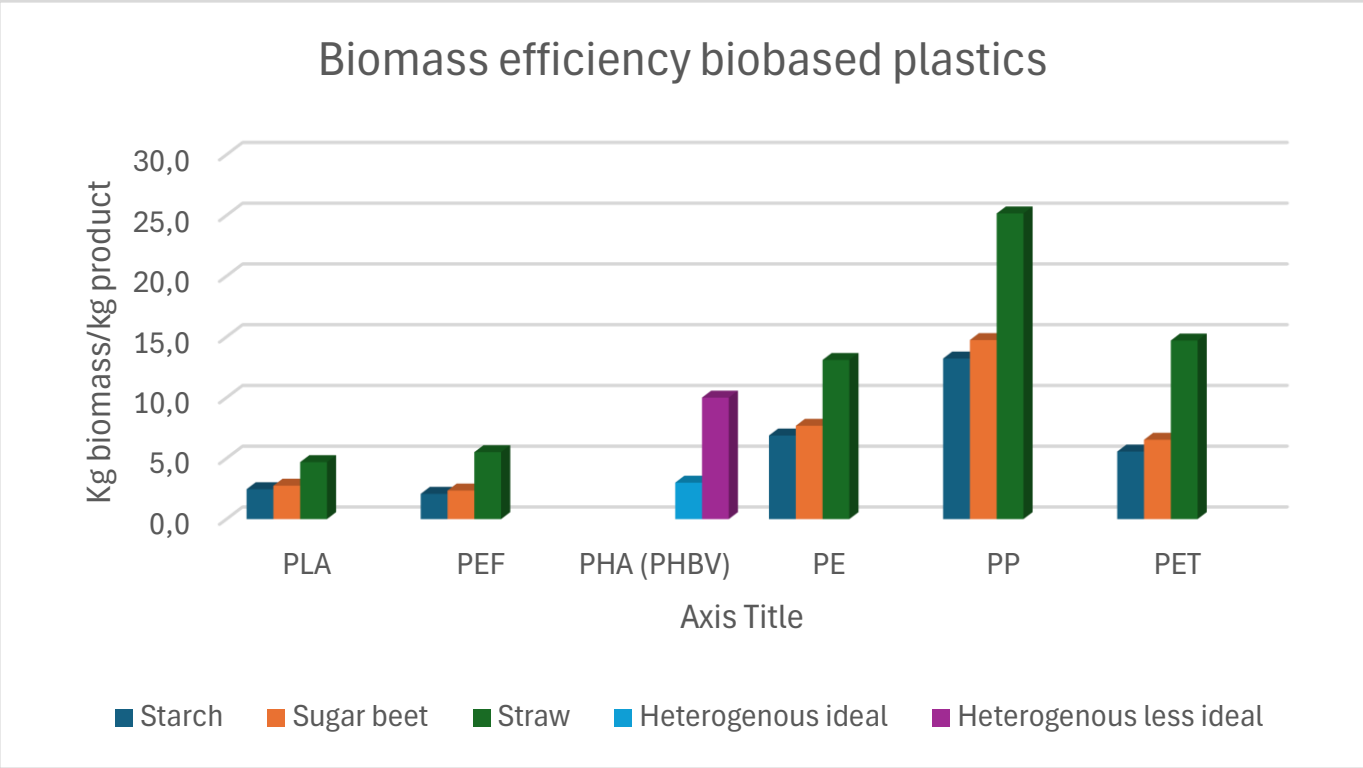
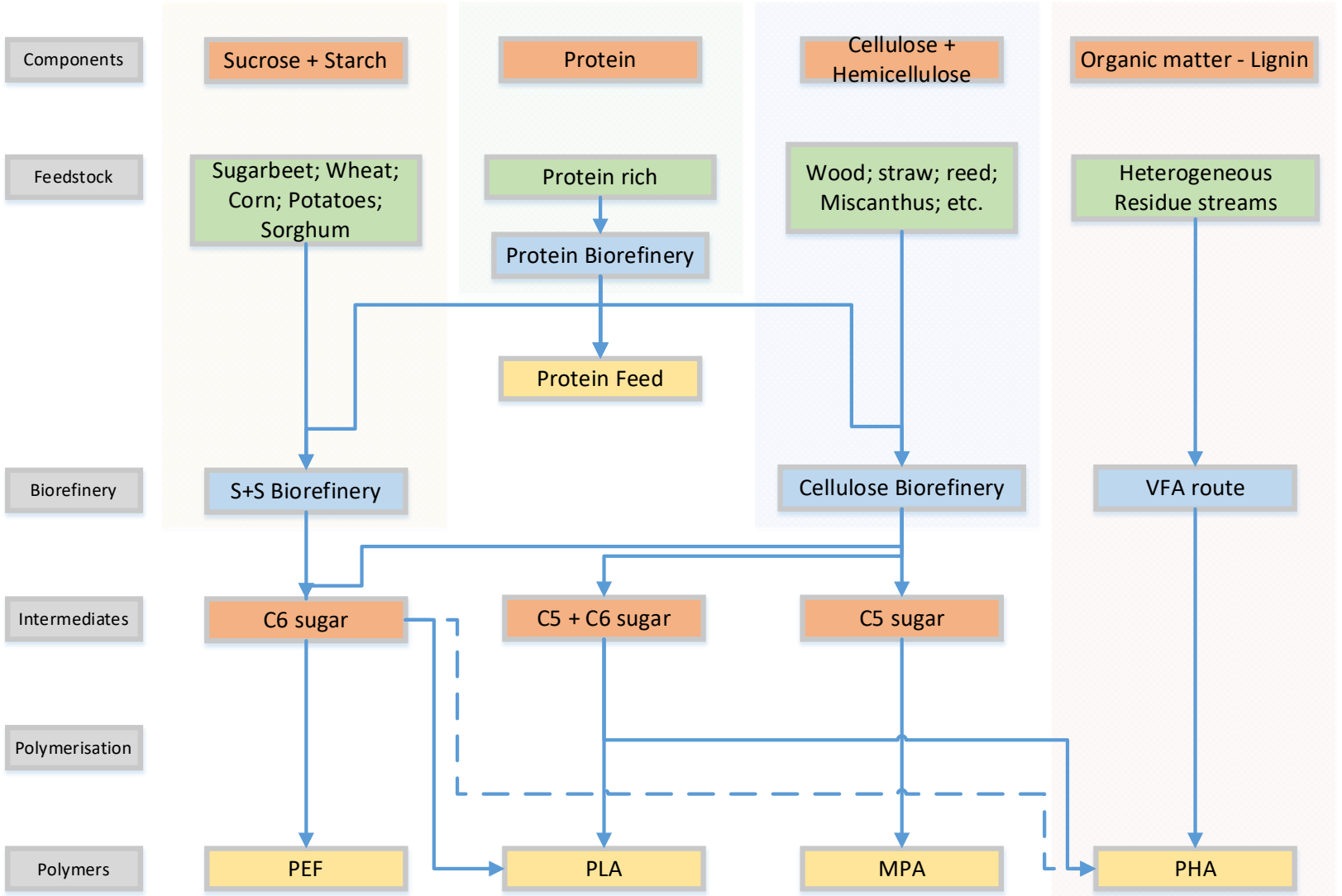
* PEF available at comm
Source: European Biopla

Polyesters and polyolefins

- Property-wise, biobased PE/PP are expected to have a role in the future biobased plastic mix where biobased polyesters cannot provide these properties (e.g. some packaging applications).
- From a biomass efficiency perspective, the differences are significant.



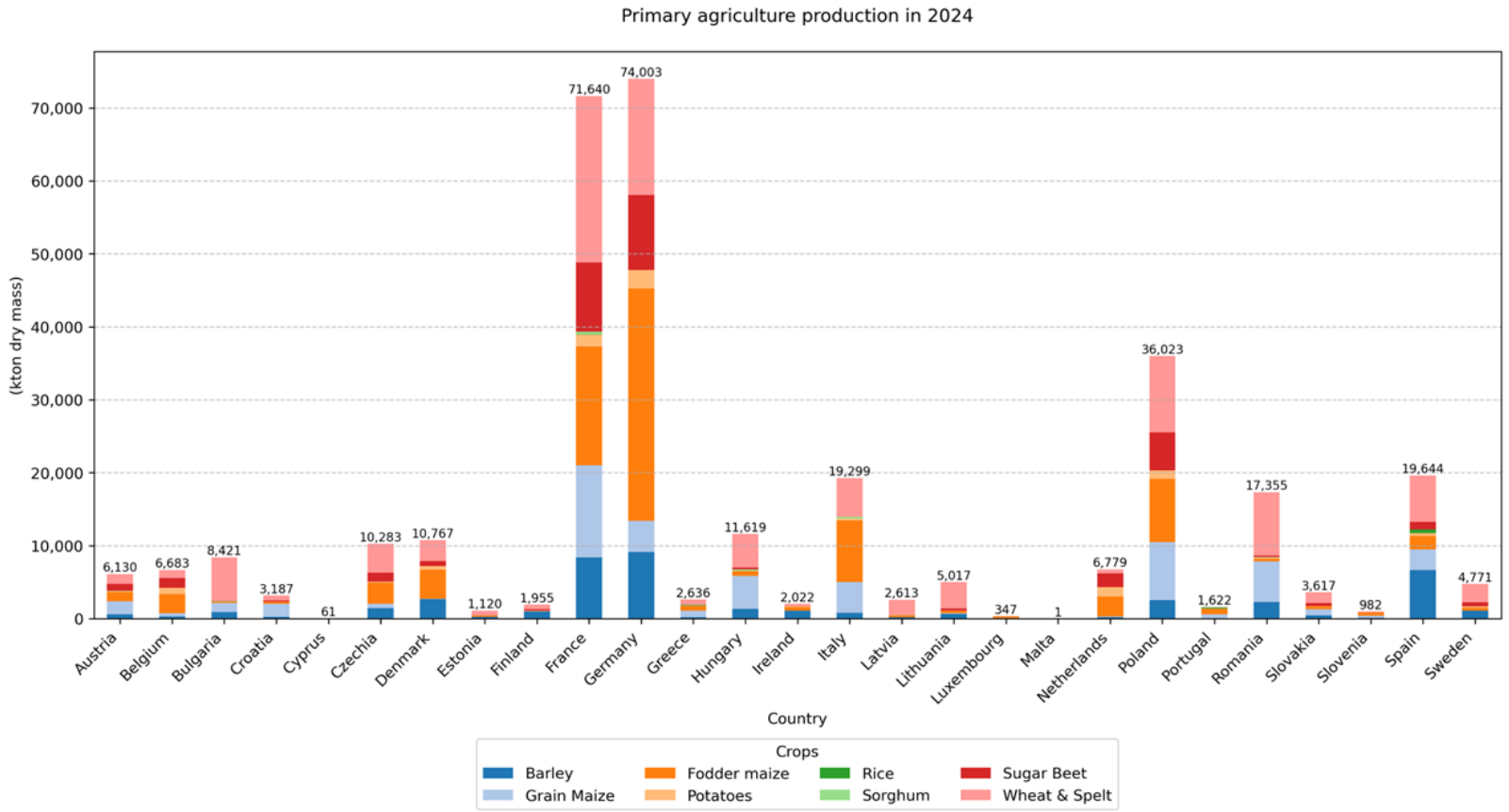
Routes towards Polyesters



Short and longer term feedstock options

		Starch and sucrose(C6)	Lignocelluosic (C5+C6) Sugars for ethanol or ethanol-derived building blocks	Lignocellulosic (C5+C6) Sugars other polyester building blocks	Protein biorefinery	VFA
SotA 2032	**Potential feedstocks for polyesters in 2032**	Grain maize Barley Rough rice Wheat Sugar beet	Stem wood; Straw; reed; Corn stover;		DDGS Brewer's spent grain Sugar beet leaves Meadow grass Food rejects industry	Specific food rejects industry Industrial waste water Potato pulp
SotA 2050	**Potential feedstocks for polyesters in 2050**	Potato pulp Wheat bran; Soy bean hulls; Rice hulls Food Rejects industry	Grass (hay, meadow grass) Fibre crops (miscanthus or shives) Fibre crops (fibres) Grass (public space) Sugar beet leaves DDGS from maize Deinking sludge Confectionary waste Textiles Sieve fraction primary sludge Paper unrecyclable fibre	Grass (hay, meadow grass) Stem wood; Fibre crops (miscanthus or shives) Fibre crops (fibres) Grass (public space) Sugar beet leaves Straw; reed; Corn stover; DDGS from maize Deinking sludge Confectionary waste Textiles Sieve fraction primary sludge Paper unrecyclable fibre	Peanut meal Rapeseed meal DDGS from wheat Sunflower meal DDGS from maize Liquid whey permeate Broad bean (= horsebean, Fava bean) Peas	Sieve fraction primary sludge waste water Food waste (restaurants, catering, etc.) Source separated kitchen waste (GFE) Source separated organics (GFT)

EU-potential agriculture



Moonshot would require: 1,25% of wheat AND 2% of maize AND 4% sugar beet AND 0,5% straw would be sufficient to attain moonshot.

In addition, use Dutch biomass where possible!

NL potential

Biorefinery	Biomass stream	Bioplastic potential (kton/a)	Mobilization percentage	BBC bioplastic production
Starch / Sugar	Starch and sugar crops	1,803	25%	451
(Hemi)Cellulose	Straws (wheat, barley, maize)	435	35%	152
(Hemi)Cellulose	Lignocellulosic crops (e.g. meadow grass)	1,302	40%	521
(Hemi)Cellulose	Primary woody residues (grass from nature and landscape)	81	50%	41
C5 / C6 Polymers	Secondary food residues (DDGS, BSG, bran, pulp)	275	50%	138
(Hemi)Cellulose	Secondary and tertiary residues containing cellulose & hemicellulose	127	50%	64
VFA route	Heterogeneous streams (e.g. kitchen, slaughter, water treatment) to PHA	173	75%	130
	Total	4,196		1,497

Conclusions

- Maximum use of Dutch primary carbohydrate crop potential (sugar beet, cereal processing) is key to obtaining feedstock security.
- Potential new crops: sorghum, miscanthus, protein crops for which the primary (straw) and secondary (protein biorefinery) streams could be used by BBC.
- Integration with other industries:
  - Paper (Eska/Paques)
  - Textiles (Avantium)
  - Food processing (Chaincraft, Triple W), e.g. dairy, breweries, protein crops
  - Organic waste, waste water, sludge (Paques, Triple W, Recell,).
- Particularly using VFA or robust fermentation processes, BBC can be an effective up-cycler of side-streams.
- European opportunities particularly in biobased commodities (sucrose, starch, straw and wood chips. Enough availability for transition, but availability in case of a mature sector on a European level is uncertain. Availability of commodity sugars can only be determined by using scenario's

Thank you!

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Stellingen

Ja / Nee

Stelling 1

Leeft de voedsel/materialen tegenstelling nog in de maatschappij?

Stelling 2

Is het verstandig biomassa in te zetten voor vloeibare brandstoffen: auto's, scheepvaart, luchtvaart?

Stelling 3

De grootste belemmering voor opschaling van biogrondstoffen teelt voor polymeren en chemie is financiering

Stelling 4

Algen en wieren zijn niet meegenomen als potentiele biogrondstoffen voor biopolyesters. Terecht of onterecht?

Stelling 5

In Nederland moeten we toewerken naar 1, 2 of 3 grote bioraffinage faciliteiten die feedstock leveren aan chemie, materialen en brandstoffen

Open vraag

Welke biogrondstoffen en kansen zien we met z'n allen over het hoofd?