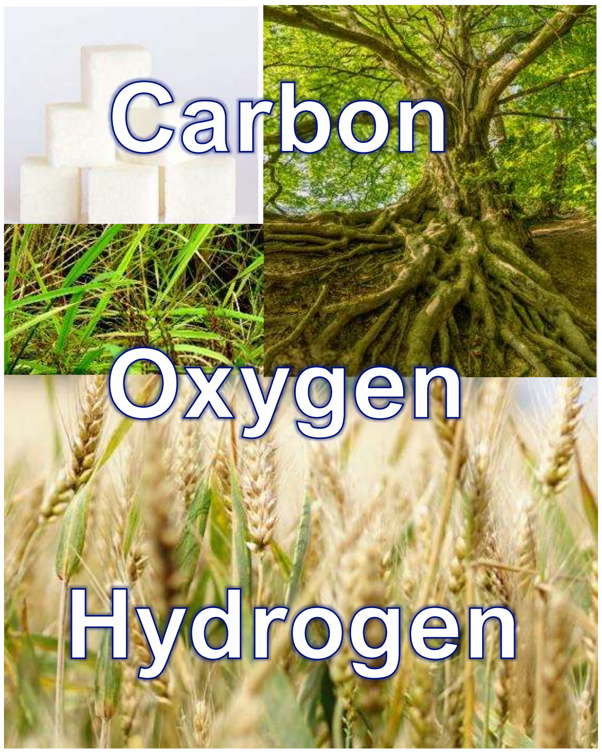
Designing the bio-polyesters of tomorrow through ring-opening polymerization

Patrick Farquet I Sulzer Chemtech Ltd

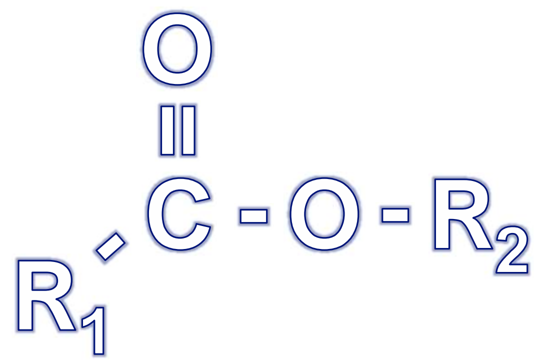
10th edition of our Circular Biobased Products Symposium

Bio-polyesters

High carbon and oxygen yields from first and second generations feedstocks



Polyester: The ester linkage



Bio-polyesters are excellent carbon and oxygen storage materials from biomass feestocks

PLA – ”Shining star” of bio-based polyesters

PLA has the best yield from raw materials to polymers compared to other bio-plastics

1st Generation: Sugar Cane / Beet / Wheat / Corn / Tapioca

11 / 8 ton*
Sugar Cane / Beet
→

3.7 / 2.6* ton
Wheat / Corn
→

*dry basis

Sugar Platform

1.5 – 1.8 ton
Sucrose

1.5 – 1.8 ton
Glucose

→ **1.3 ton Lactic acid** → **1 ton PLA**

Yield from “sugars” 1.5 – 3x better than any other bio-polymers

Advantages

- Renewable raw material
- Potential of localization of supply chain for raw material
- The only viable and scalable bio-based alternative to fossil plastics
- Reduced GHG emission compared to fossil-based plastics

Global bio-polymer demand is surging

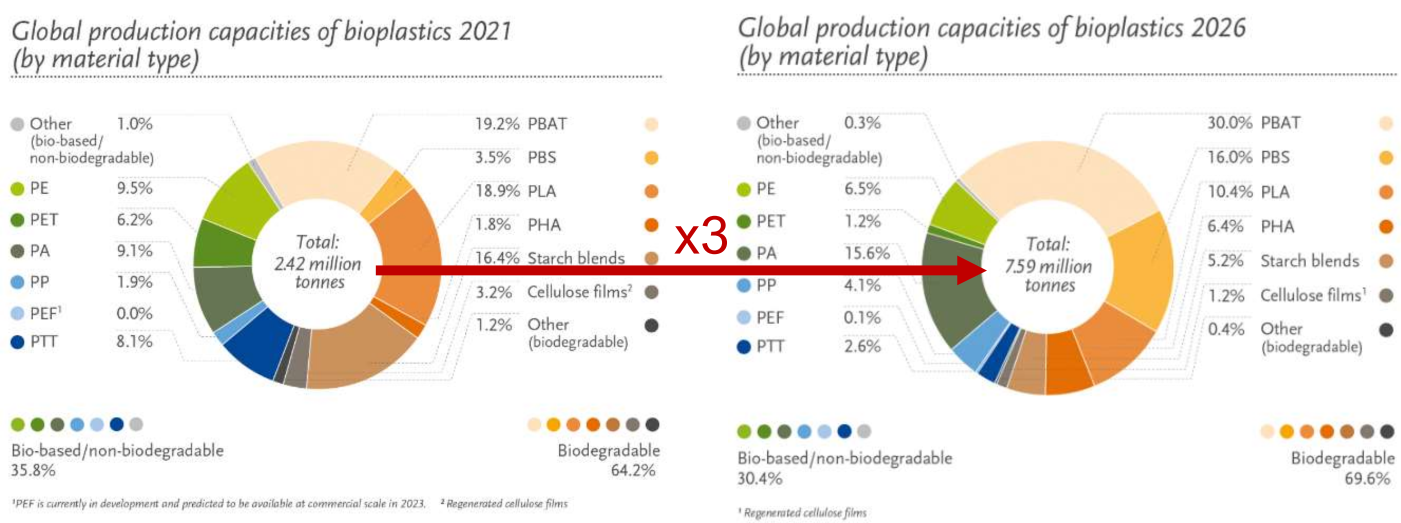
Growth mainly driven by bio-polyesters

Why Bio-polyesters

Compared to other bio-polymers, biopolymers:

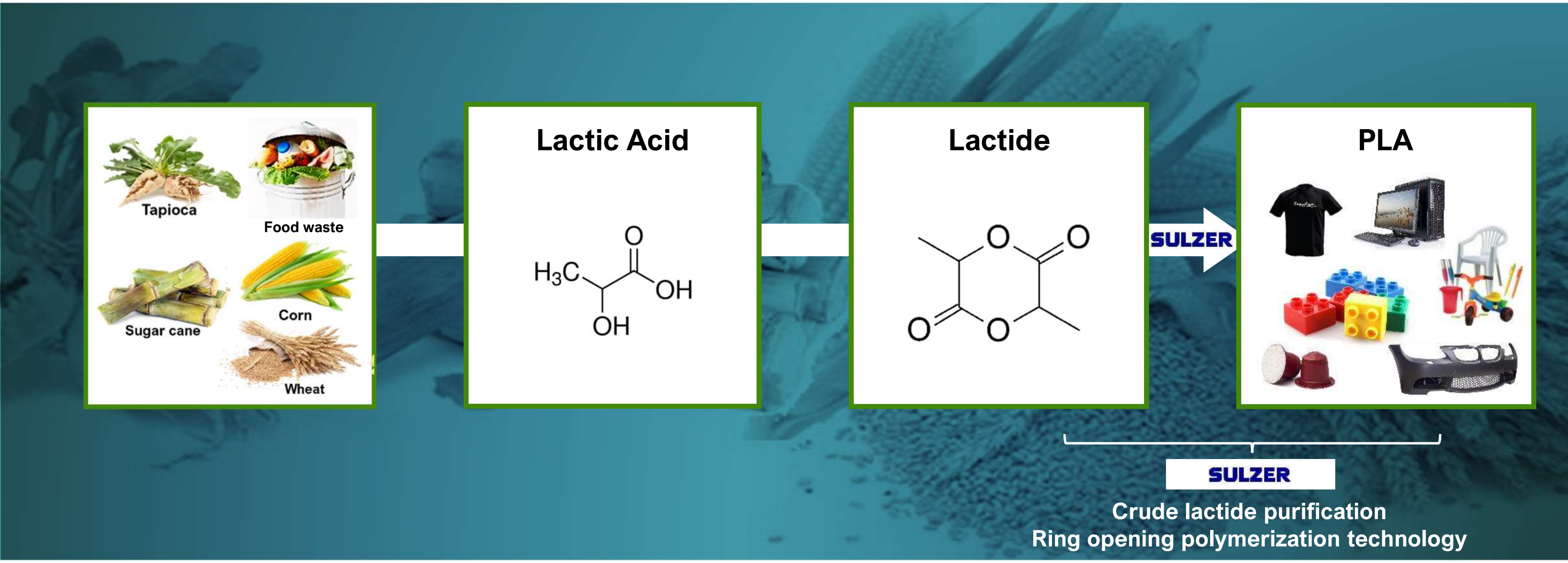
1. Often a better CO_2 footprint due to their ability to keep carbon and oxygen in the polymer backbone
2. Can have various end-of-life options (i.e. composability, biodegradability), recycling or incineration.

Biopolymer Production Capacities



PLA : Sulzer’main involvement in bio-polyesters

Market leader for technology licensing from lactide to PLA



Sulzer PLA (Poly lactic acid) technology deployment

Our long-standing renewable carbon success story

1991
First feasibility test for L-lactide (monomer)

1995
First installation of a full automated pilot plant for lactide monomer in Asia

2002
First full-scale demonstration plant for lactide production
1 kta,
(Japan)

2007
First pilot plant in Switzerland

0.2 kta, Sulzer (Switzerland)

2011
5 kta, Synbra (NL)

2012
1 kta, Sulzer (Switzerland)

2015
10 kta, Jiangsu Supla (Asia)

2018
75 kta, Total Corbion PLA (Asia)

2020
30 kta, B&F (China)

Under execution

75 kta Natureworks (Thailand)

30 kta Yangzhou Huitong Biological New Material (China)

75 kta Jindan New Biomaterials (China)

Sulzer Chemtech – Division of the Sulzer group

We are committed to sustainable innovation

Sulzer Chemtech

Our technologies

- Mass transfer
- Thermal separation
- Mixing and reaction
- Polymerization and foaming
- Hydrotreating

Sustainable Innovation

Our development areas

- Recycling
- CO_2 capture and utilization
- Biofuels / bio-chemicals
- Bio-polymers and bio-monomers

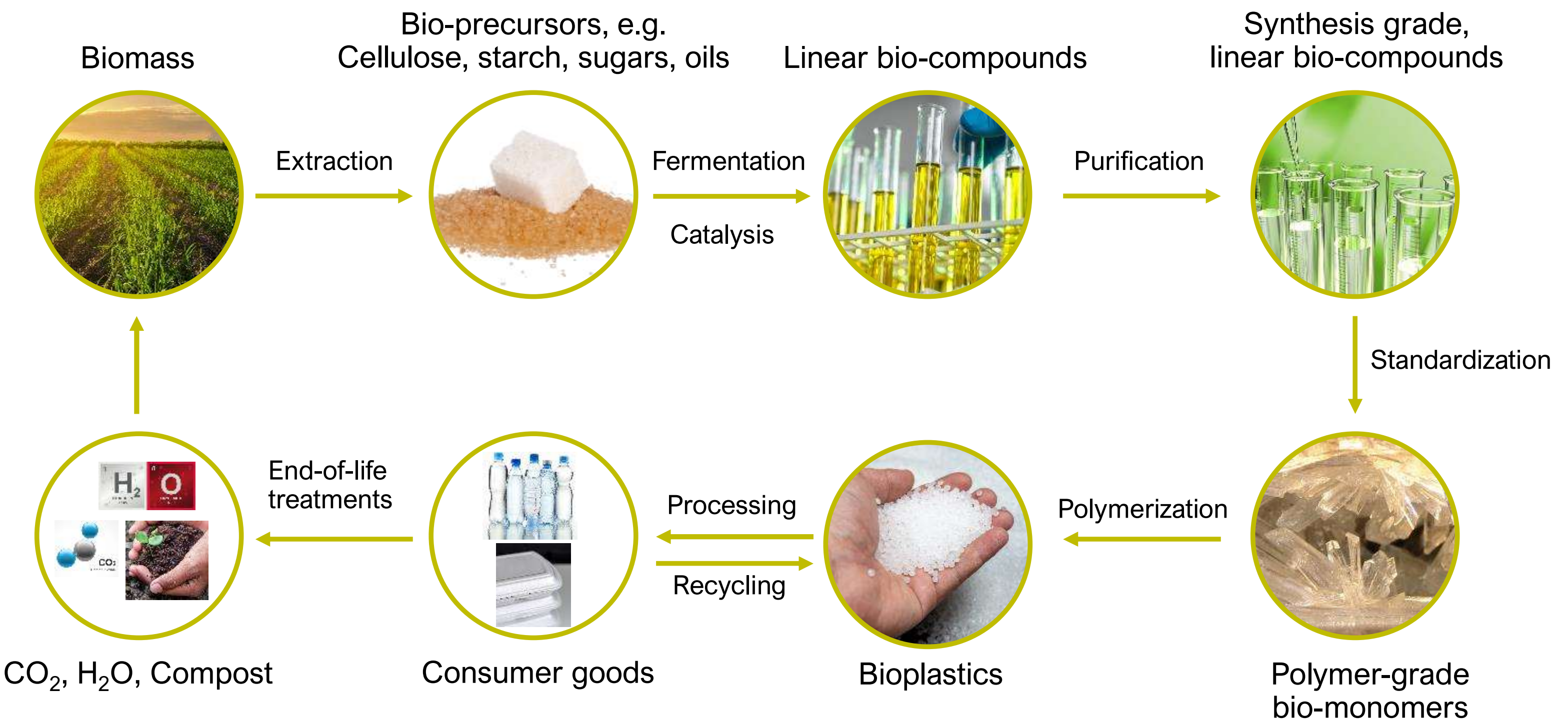
Bio-polymers/monomers

Focused on bio-polyesters

- Novel technologies for sustainable biopolyester production
- Bioplastic applications development
- Bio-foaming technology

Sulzer's role in bio-polyesters

Where we contribute to a sustainable plastics economy



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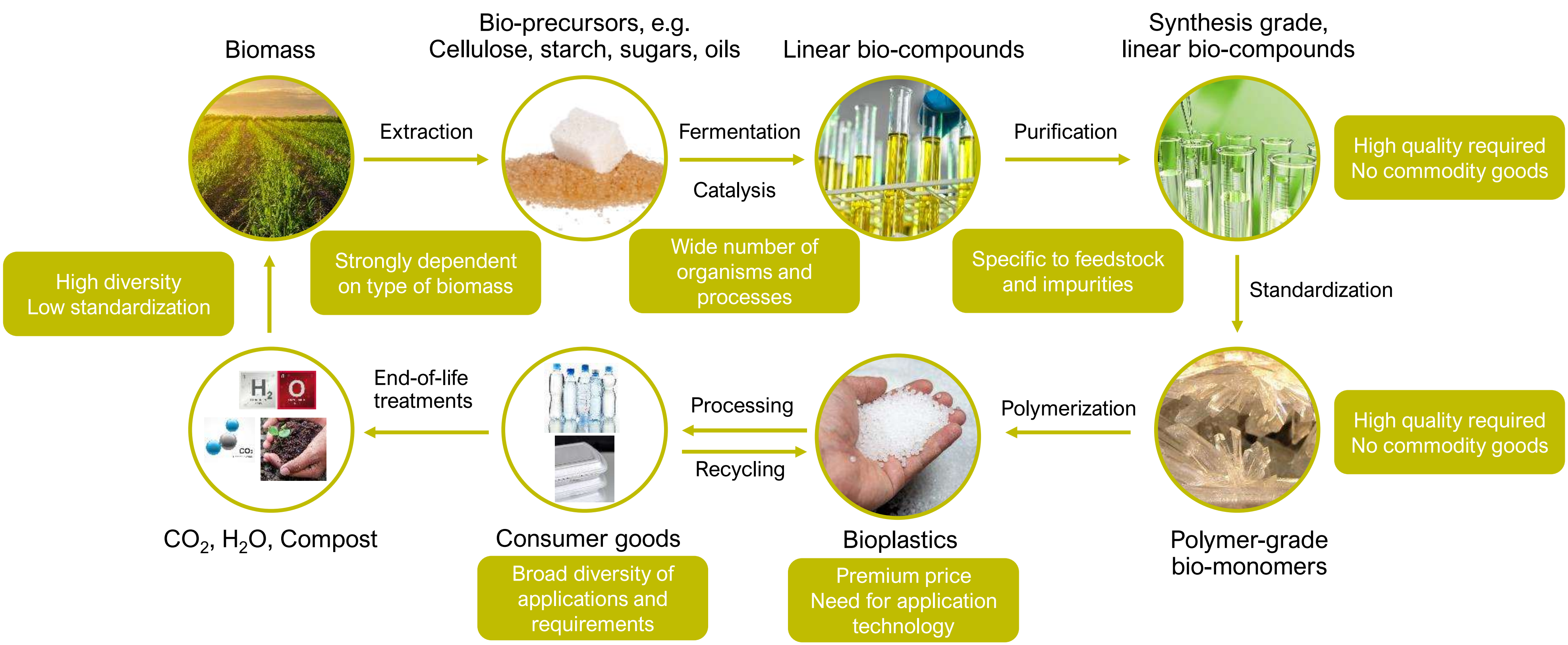

Sulzer's role in bio-polyesters

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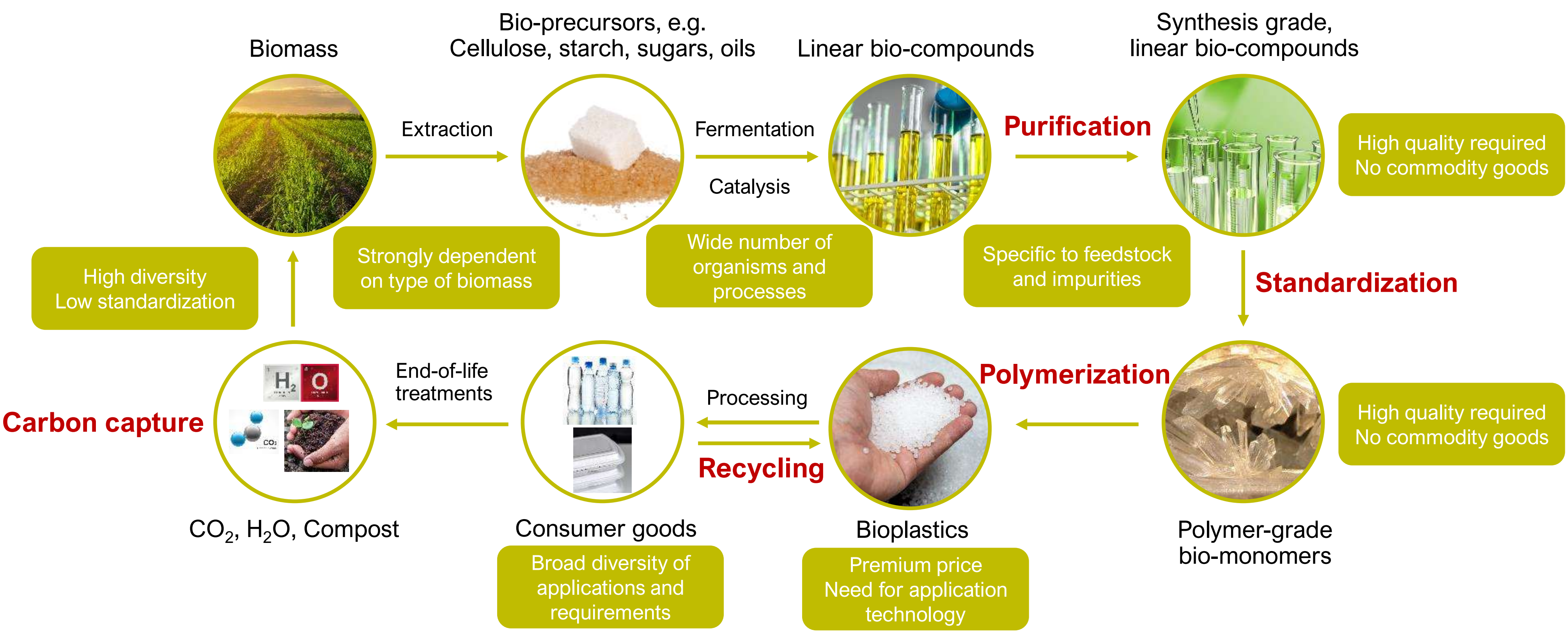
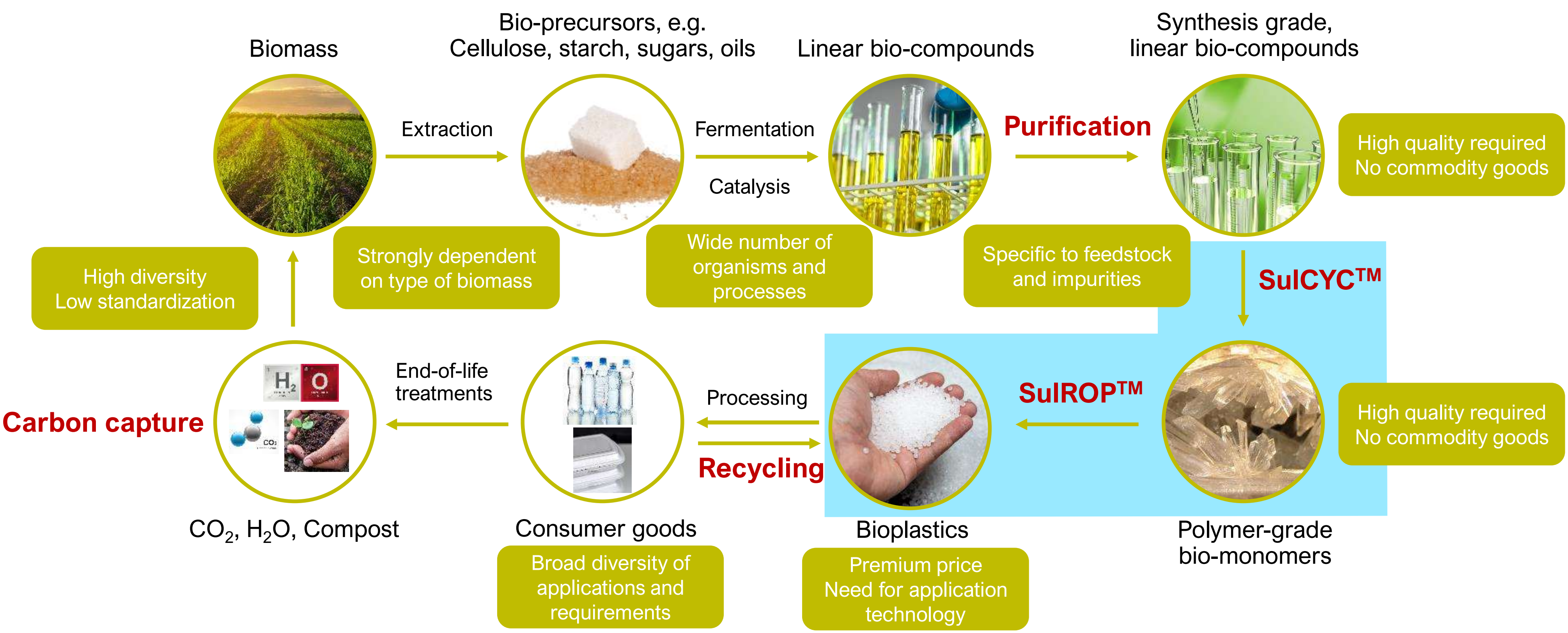


Sulzer's role in bio-polyesters

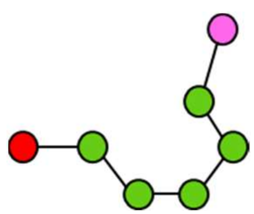
Where we contribute to a sustainable plastics economy



What's next after PLA ?

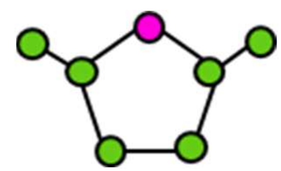
Developing a portfolio of novel bio-polyesters using our technology platforms

Bio-based linear species

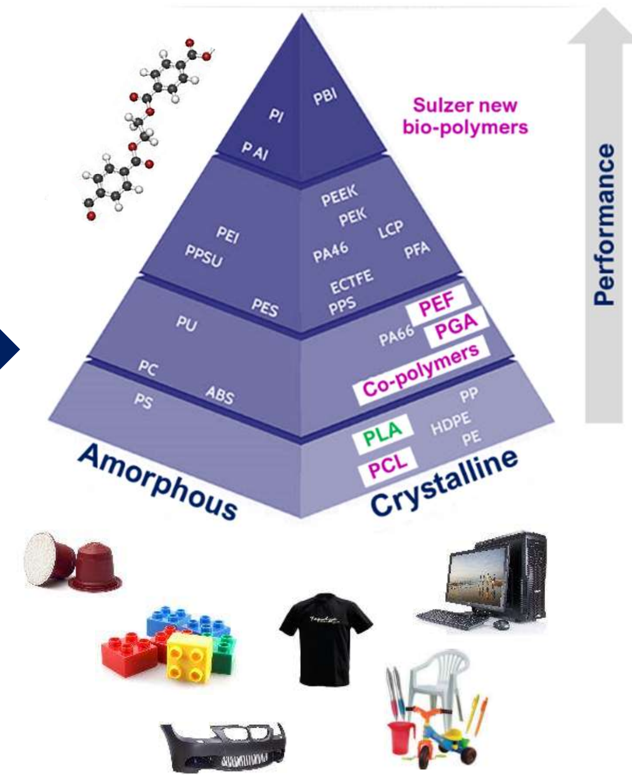


SulCYC™ →

Cyclic compounds



SulROP™ →



Swift scale-up of novel bio-polyesters

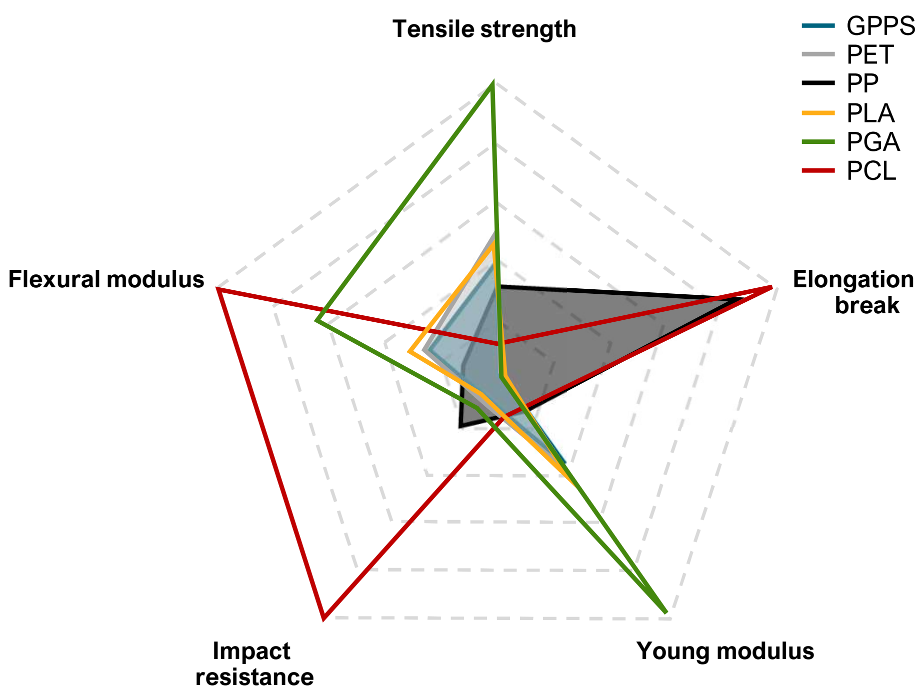
We bring technologies from lab scale to industrialization

Lab research	Analytical characterization	Piloting and scale-up	Technology licensing
			

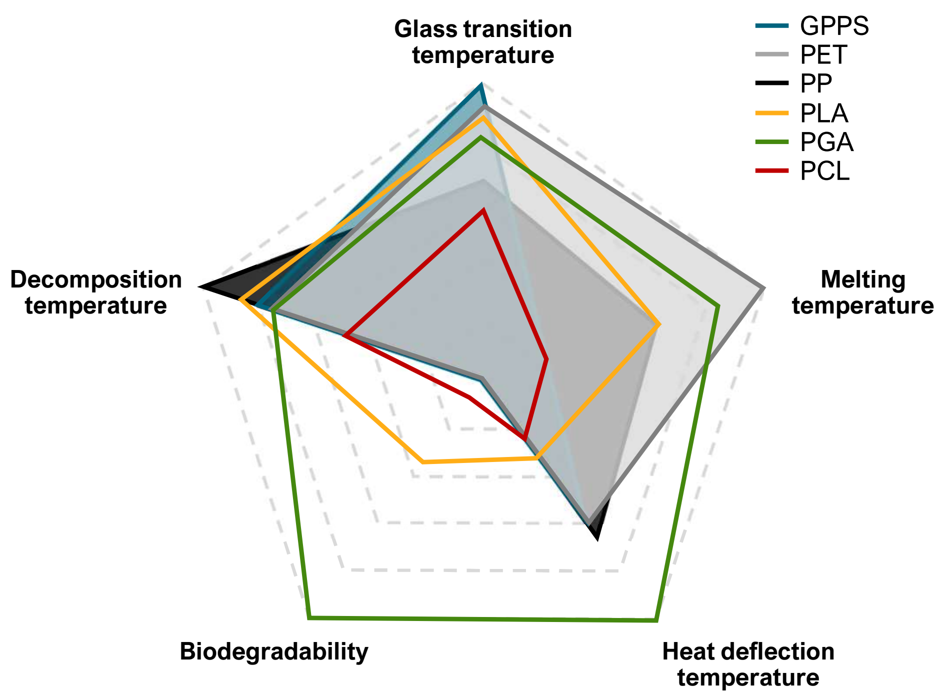
Capabilities from lab research to pilot engineering and commercial plant design in Switzerland

Overall summary of bio-(co)polymers properties

MECHANICAL PROPERTIES*



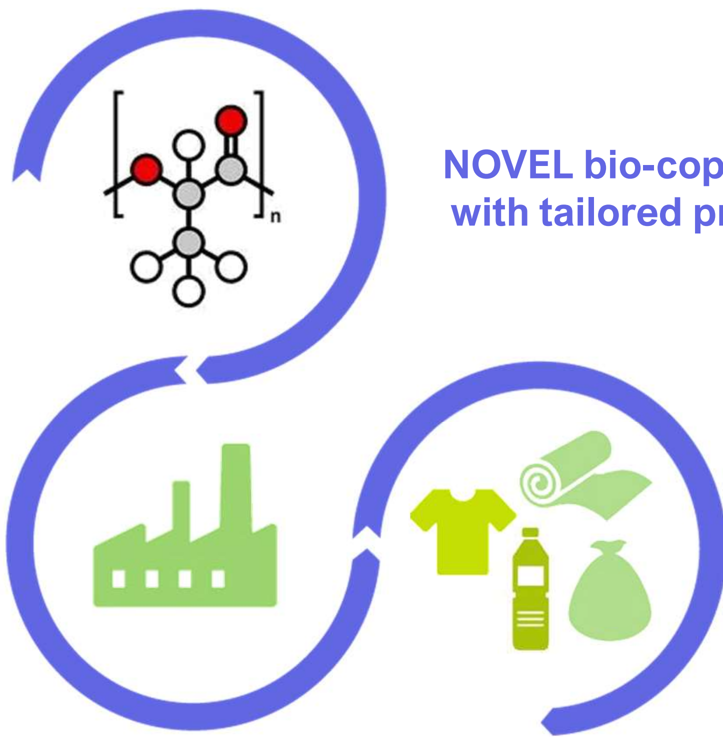
THERMAL PROPERTIES*



*All values were normalized based on their actual data to a maximum score of 10

Conclusions and Outlook

Following the strong PLA market growth, we will continue to offer tailored and licensing solutions:



NOVEL bio-copolyesters with tailored properties

NEXT generation processes for bio-copolyesters

NEW applications and formulations

Thank you!

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