



# World Congress on Industrial Biotechnology

July 23 – 26, 2017  
Montréal, Canada



#BIOWC17





# PEF Packaging Opportunities

A New Value Chain from Development to Commercialization

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# Synvina company profile

## Joint Venture between Avantium and BASF

- Established September 23rd 2016

## Naming origin

- SYN = Synergies, VI(a) = The Road, NA = Nature

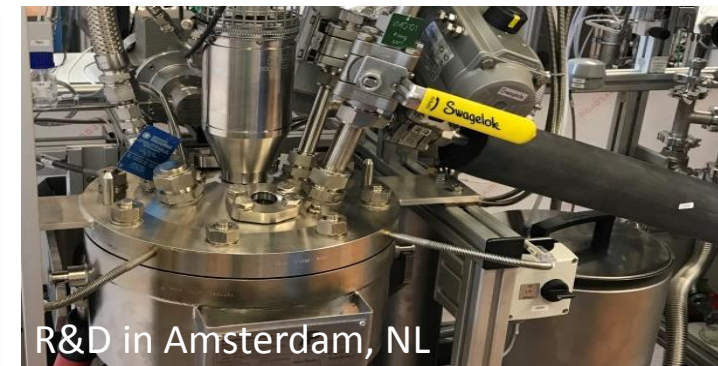
## 64 Employees

- Process Development, Operation & Engineering
- Product, Application & Business Development
- Management, IP / Legal & Support

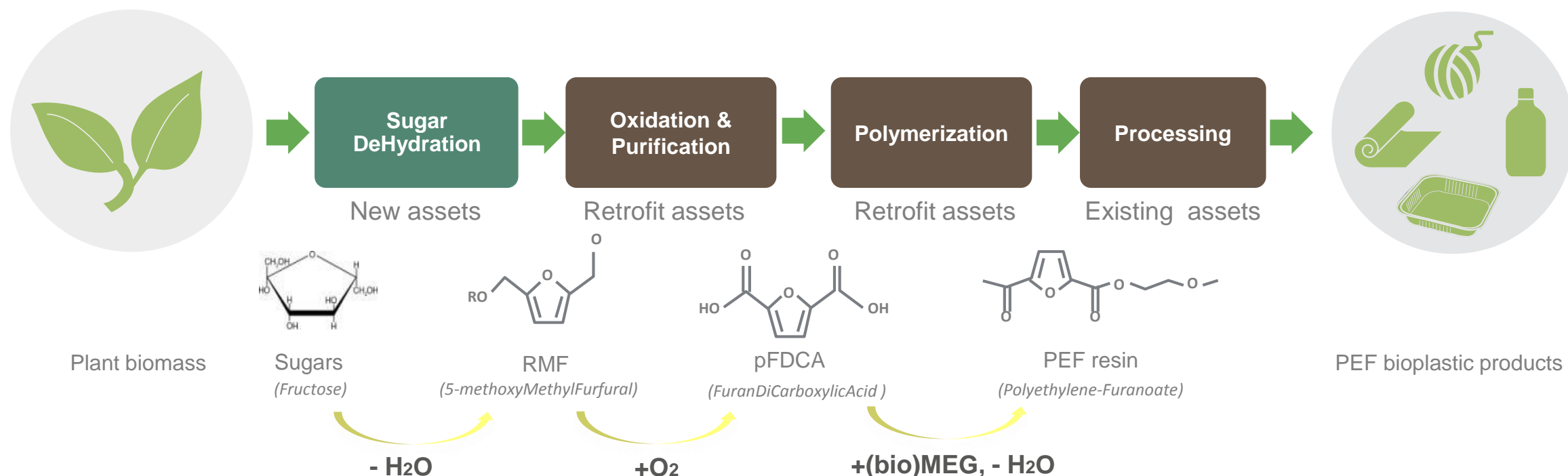
## Global Company with Locations in:

- HQ and R&D: Amsterdam, Netherlands
- Pilot plant: Geleen, Netherlands
- Commercial Plant Site: Antwerp, Belgium
- Satellites: Canada, Hong Kong, Japan, USA

**Mission: Market leadership in FDCA and PEF**



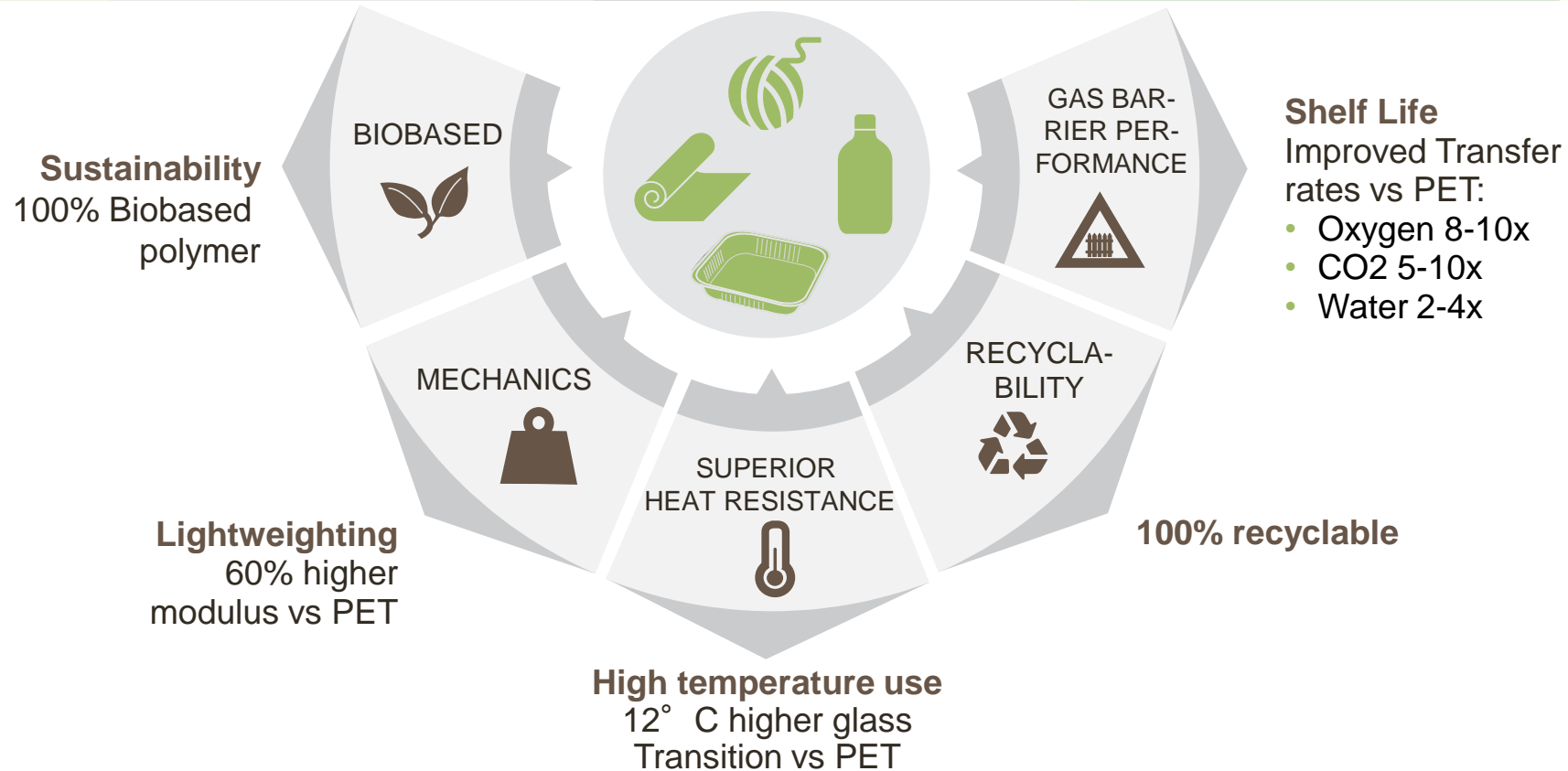
# A New Value Chain: From Sugars to PEF



- Catalytic processes, developed via high throughput screening at Avantium (who continues to work a.o. on 2<sup>nd</sup> generation sugars)
- Chemistry of RMF to PEF is comparable to paraxylene to PET – retrofitting possibilities for existing assets



# Why PEF?



- PEF provides the most favorable thermo-mechanical features of the (conventional) FDCA-based polyesters, for rigid applications
- Chemically similar to PET, providing good compatibility with PET manufacturing, recycling and quality control procedures

# Opportunities in rigid packaging

## Culminating the trend to small size bottles

Bottle	PET		PEF	
Volume (oz / mL)	8 / 237	12 / 355	8 / 237	12 / 355
Weight (g)	9	13	10	14
Drop test @ 1.8m	Pass	Pass	Pass	Pass
3.0 Vol. CO <sub>2</sub> Shelf life to -17.5% (wks)	4	8	20	27
4.2 Vol. CO <sub>2</sub> Shelf life to -17.5% (wks)	4	6	12	20



### Compared to same bottle in PET:

- Equal pressure and breaking resistance
  - Up to 6x CO<sub>2</sub> shelf life and 2x top load
- Conventional safety of plastic vs glass  
→ Enables existing supply chains and sales channels for small CSD bottles

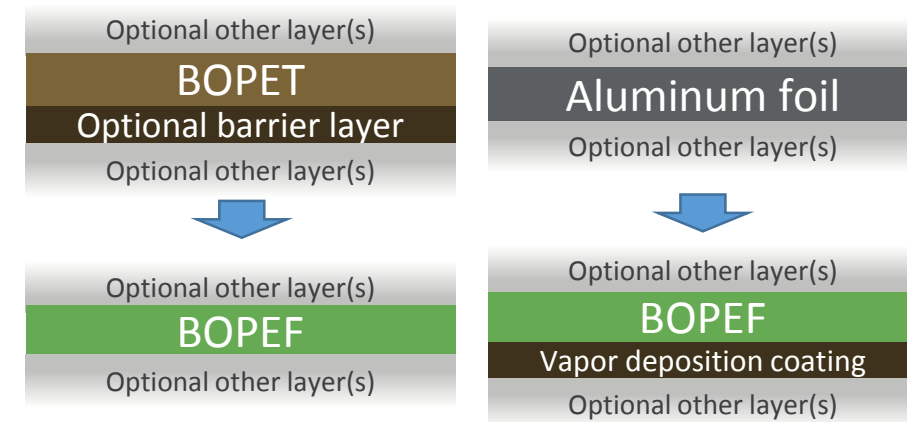
### Opportunities:

- Brand differentiation in Carbonated Soft Drinks: 100% Bio-based, full transparency and shape freedom
- Also highly suitable for oxygen sensitive products, e.g. juices/nectars, teas/coffees and sauces
- Minor to no additional equipment investment and recyclable

# Opportunities in flexible packaging

## A new high-barrier substrate film

Biaxially Oriented film	BOPET		BOPEF	
Gauge (µm)	12	16	12	16
Strength (MPa)	230		260	
Break elongation (%)	100		47	
Oxygen transmission (cc/m <sup>2</sup> .day.atm)	120	90	11	9
Moisture transmission (g/m <sup>2</sup> .day)	50	38	15	11



## Compared to BOPET-based packaging

- Equal thermo-mechanical & surface properties → Conventional coating, printing and lamination into various structures
- 11x higher O<sub>2</sub> and 3x higher moisture barrier → Avoids need for barrier layers such as PVDC and EVOH

## Opportunities:

- Brand differentiation through increased bio-based content, while reducing complexity
- SiO<sub>x</sub>/AlO<sub>x</sub> coated or metalized BOPEF can offer superior barrier to conventional substrate films
- Recyclable with suitable other layers or compatible with clean energy recovery at reduced GHG emissions

# Circular Economy

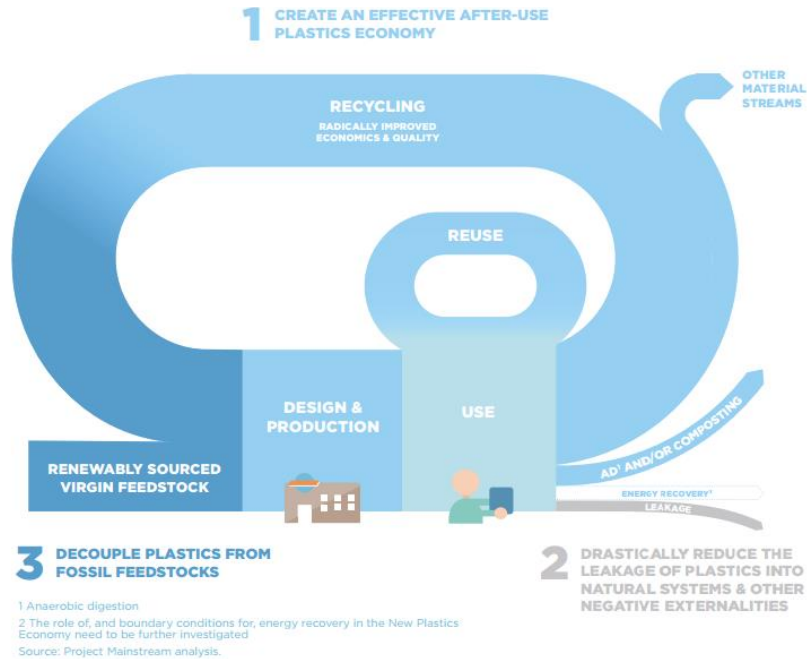
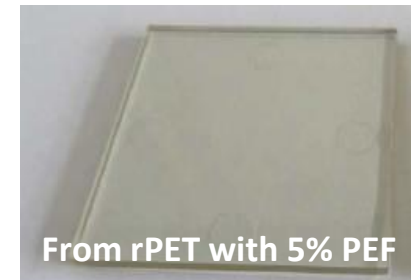
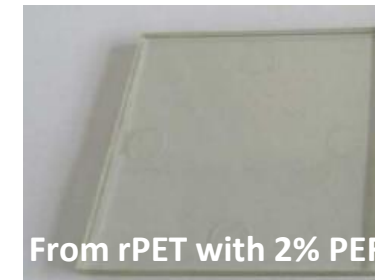
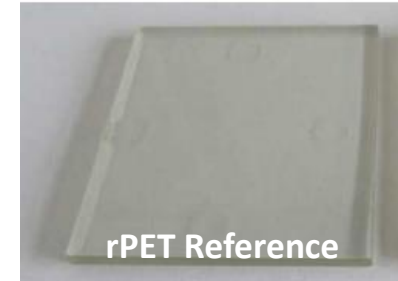
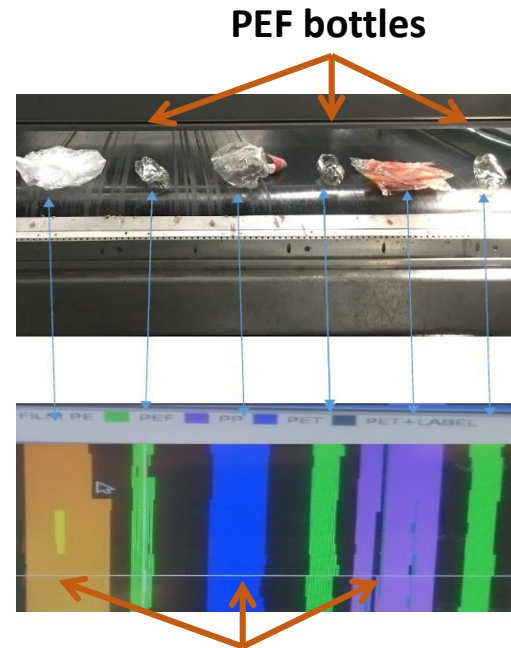


Image from “The New Plastics Economy”  
Ellen MacArthur Foundation (2016)



Plaques according to EPBP route 1 (with 50% vPET)

- PEF can be sorted from other plastics, and recycled to ‘rPEF’ using the same steps as PET
- Synvina obtained EPBP interim approval for 50 kta launch in EU, allowing to build towards separate PEF recycling
- PEF reduces the need for multi-material functionality in packaging, one of the challenges for the circular economy



# Summary

## Take away messages

- Synvina aims to be market leader in FDCA and PEF, through strengths of both our parent companies and partners in the value chain
- Synvina's bio-based PEF value chain is set-up for easy adoption by the existing industry
  - Fitting with existing production, manufacturing, recycling and quality & safety procedures
- PEF offers unique opportunities in packaging
  - Enabling for safe and recyclable small-size rigid packaging
  - Providing simplicity and renewability to flexible packaging
- PEF and other FDCA-based polymers are the next step towards a circular economy in packaging



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