



# PEF: a recyclable bio-based alternative for the future

## Greater Region Plastic Conference

Thijs Meijssen

# Synvina – In a nutshell

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## Naming origins

- SYN= Synergies between parent companies / Nature & chemistry
- VI = Vitality
- NA = Nature

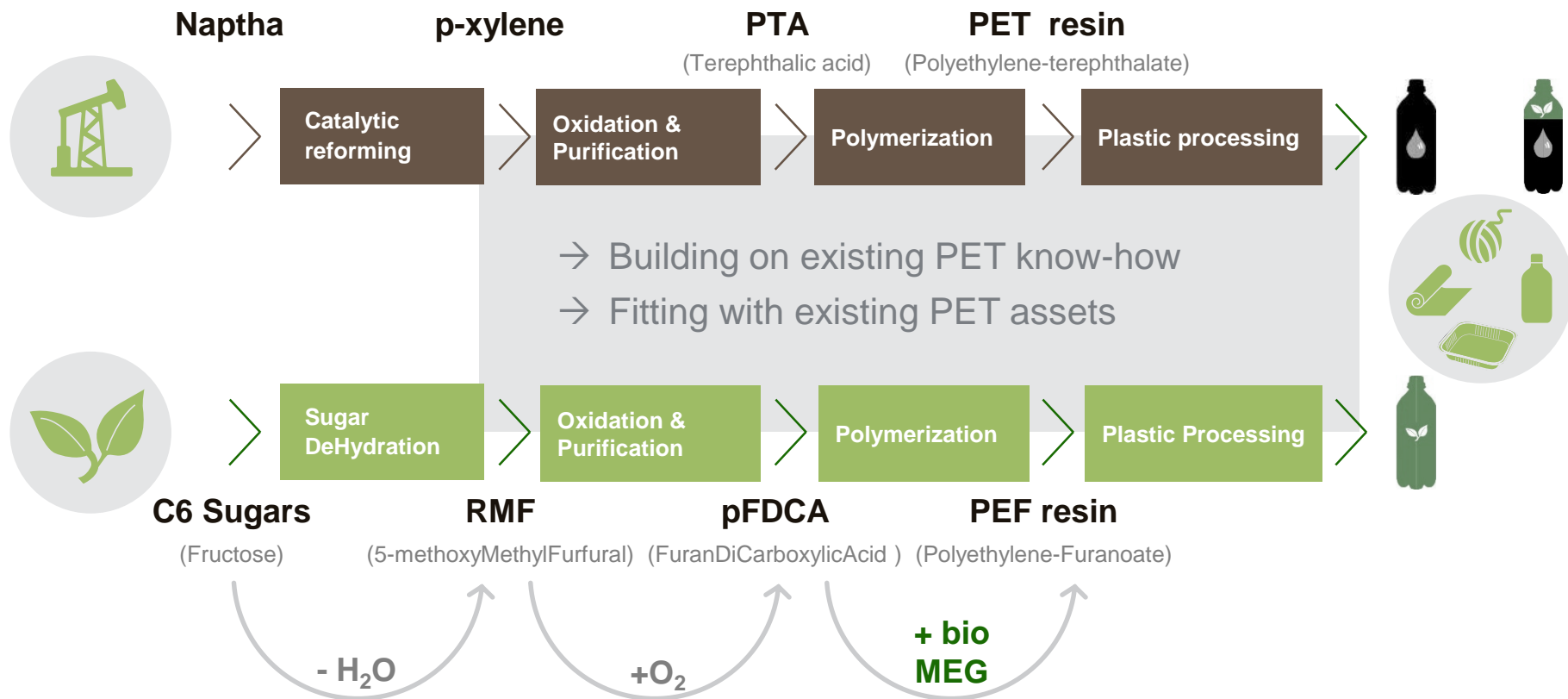
**~70 Employees**

## Global Company with Locations in:

- HQ in Amsterdam
- Pilot plant: Geleen, Netherlands
- Commercial Plant Site: Antwerp, Belgium
- Satellites: Canada, Japan, USA

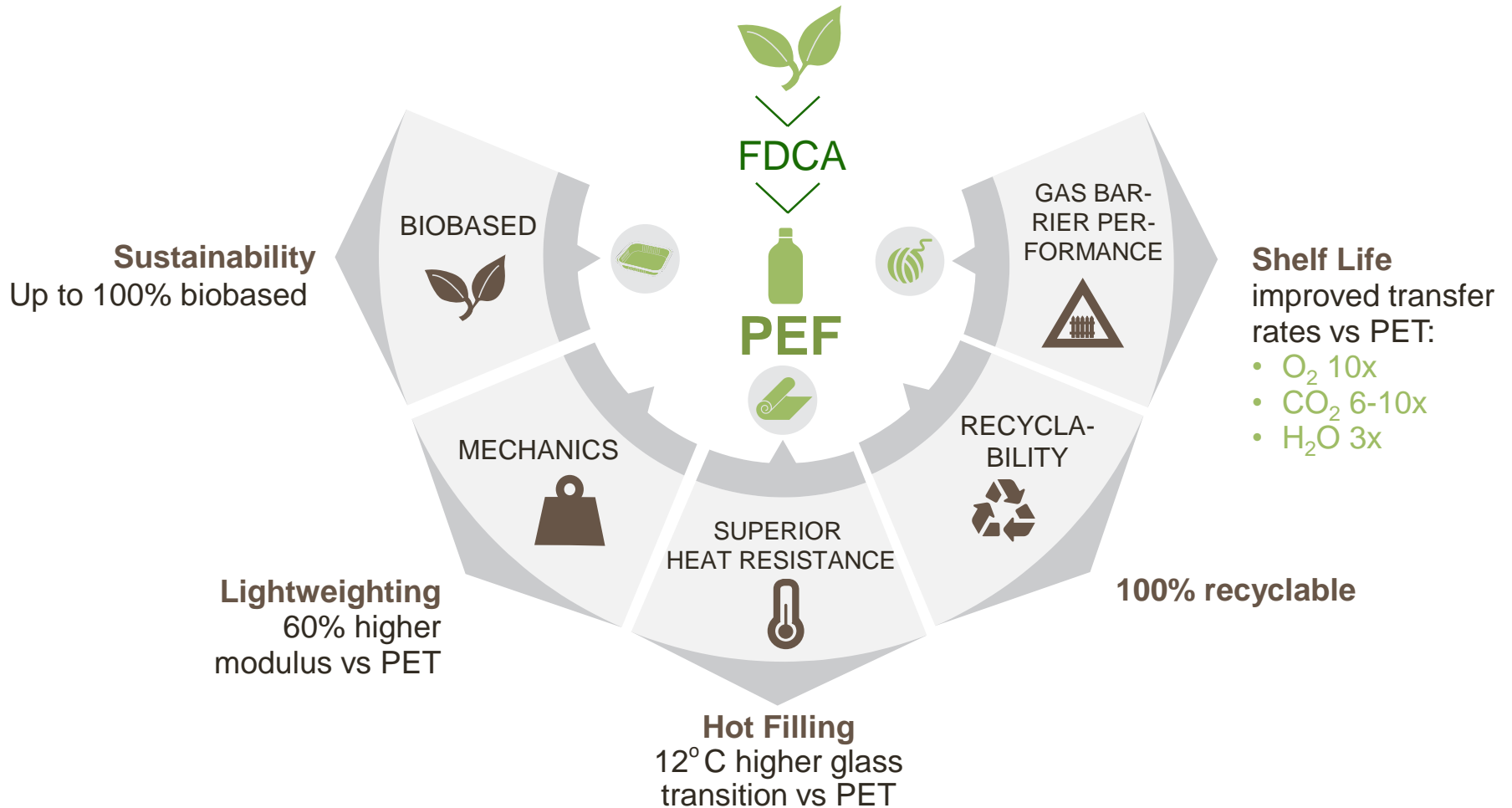


# A New Value Chain: From Sugars to PEF



Catalytic processes, developed with high throughput screening technology

# Synvina: What can PEF do?



# Application Example

## Bio- based Bottle

### 1- Shelf Life extension & Waste reduction vs PET

- 6x higher CO<sub>2</sub> Barrier for Carbonated Beverages
- 10x higher O<sub>2</sub> Barrier

### 2 – Same Safety & Design Freedom as PET

- Equal pressure & break resistance
- Full transparency & shape freedom
- No additional equipment required  
-> Standard investments in preform and blow molds

### 3- Bio-Based

- Sustainable & Renewable Feedstock
- Fully recyclable



	PET		PEF	
Volume (mL) / preform weight	237 /9g	237 /13g	237 /10g	237 /14g
4.2 Vol. CO <sub>2</sub> Shelf life to -17.5% (wks)	4	6	12	20
Oxygen ingress - time to 5 ppm (wks)	3 (est.)		26 (est.)	

\* based on 100 % yield assumption

# Application Example

## Flexible Film Packaging - BOPEF

### 1 - High-barrier substrate film

- 11x higher O<sub>2</sub> & 3x higher moisture barrier than BOPET  
→ Avoids need for barrier layers such as PVDC and EVOH
- Barrier does not vary significantly with humidity  
→ Consistent & reliable barrier



### 2 - Processability

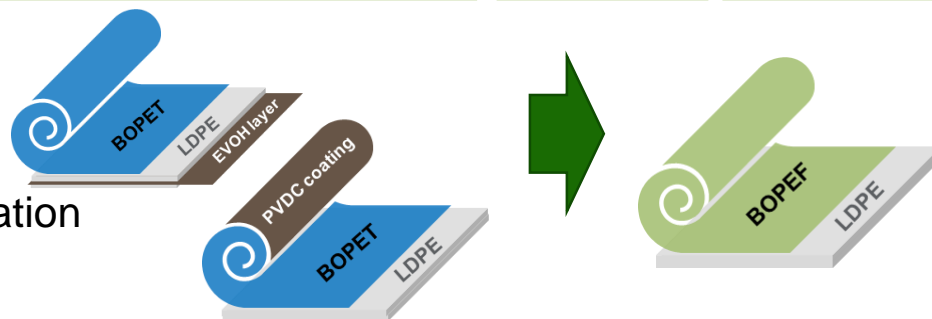
- No new equipment required
- Equal thermo-mechanical & surface properties to BOPET  
→ Conventional coating, printing and lamination

#### 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

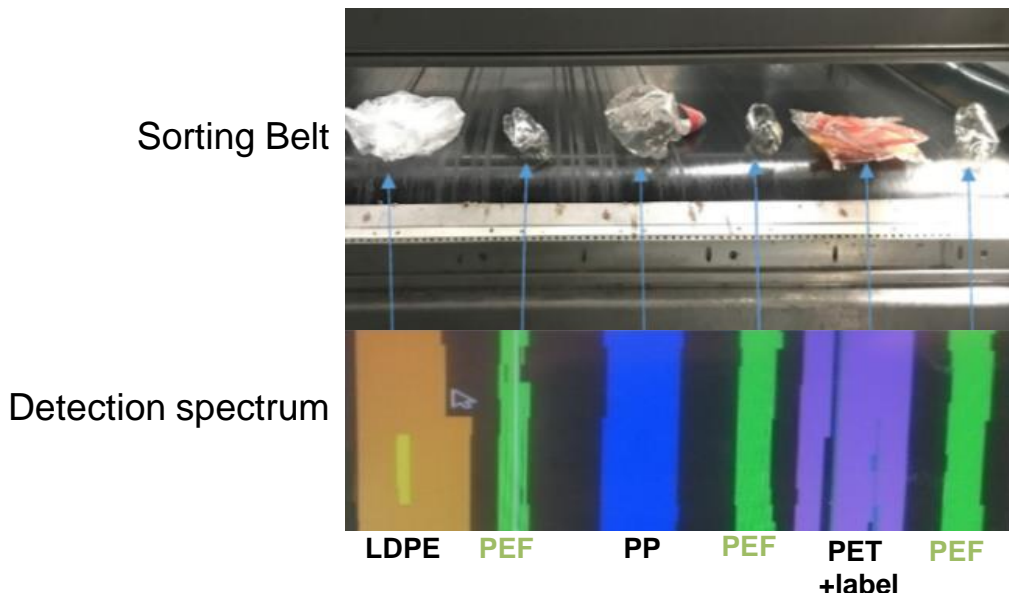
### 3 - Opportunities:

- Up to **100% Bio-based layer**
- Reduce structure complexity
- Reduced GHG emissions upon incineration
- **PEF is recyclable**
- Chlorine Free



# PEF Recycling: Collection & Sorting

- PEF is detectable and sortable in existing Near Infrared systems (both TOMRA & Pellec tested)
- In Deposit Schemes the bottle label could be modified for PEF to be collected
- Machines can be programmed for PEF to be sorted into rPET stream or in a separate rPEF stream



# PEF Recycling: PEF into rPET

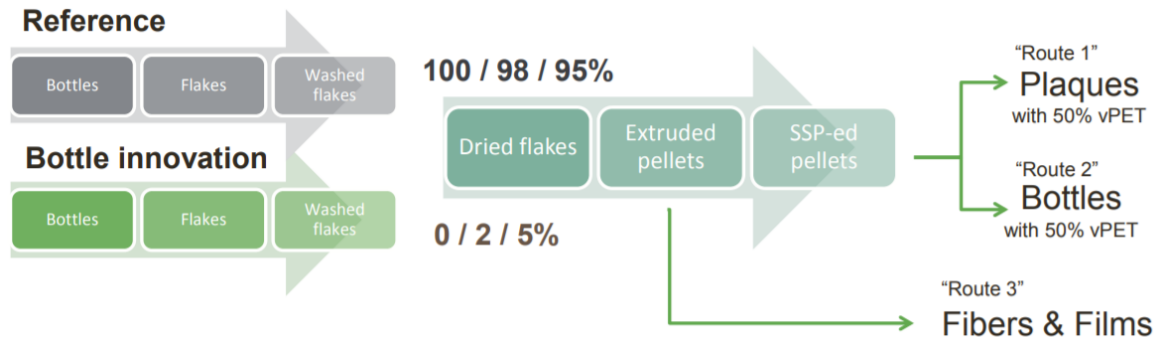
- 1 | PEF can be recycled using the similar steps & equipment as PET
- 2 | PEF can be recycled with PET up to certain % without difficulties, such as haze, in resulting recycled bottles
- 3 | PEF has significantly less impact on rPET than Nylon or PLA





# PEF Recycling: PEF into rPET (2)

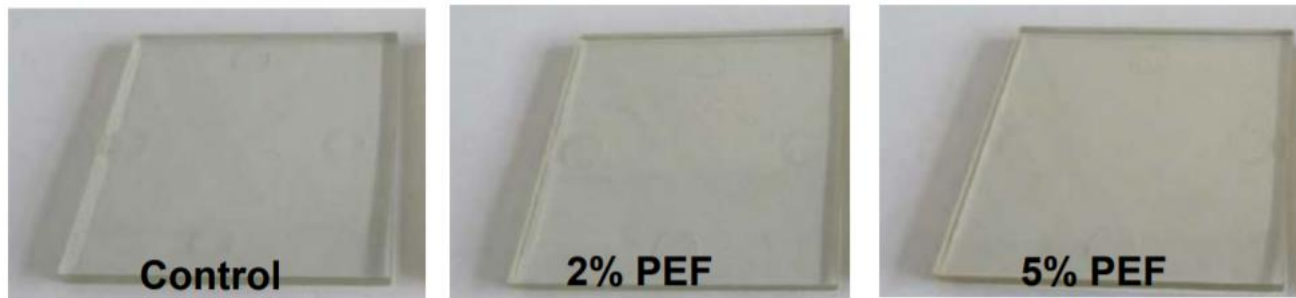
## 1 | Testing according to EPBP protocol (adapted schematic below)



Trials were conducted as follows:

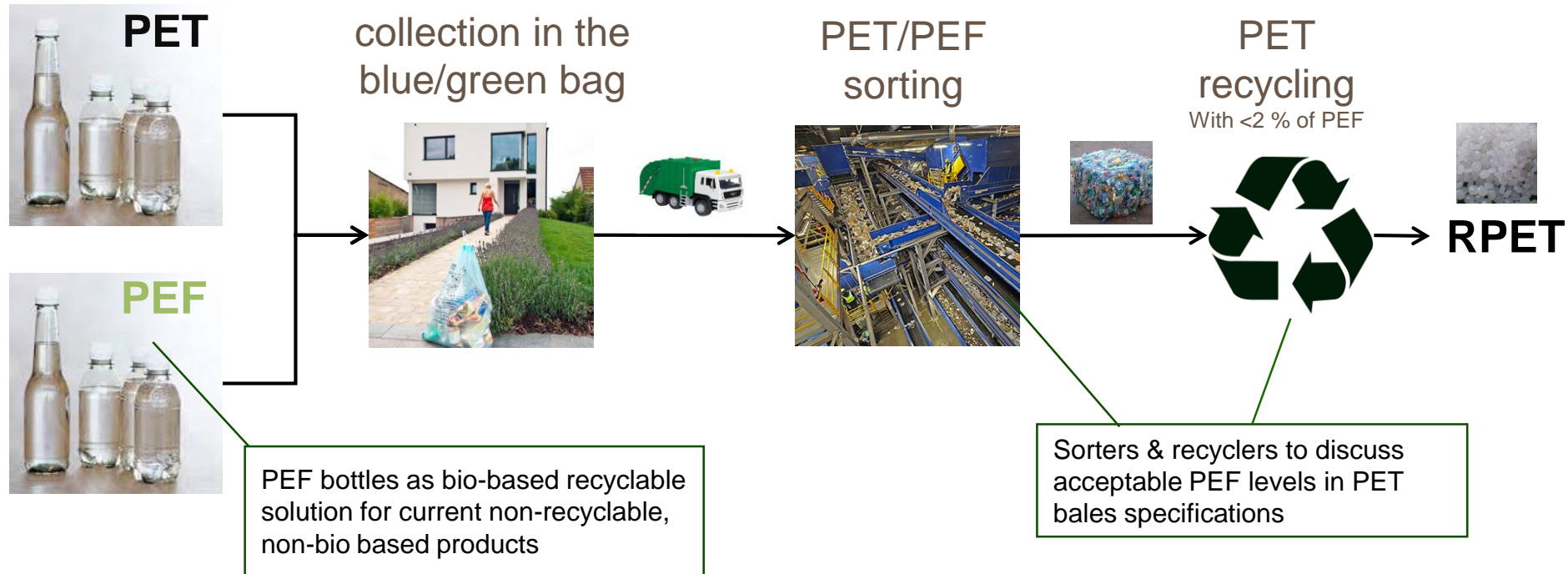
- Bottle to Plaque according to 'EPBP Route 1' at PTI Europe
- Bottle to Bottle according to 'EPBP Route 2' at PTI Europe (without flake washing)
- Fiber trials using virgin IV 0.6 dL/g resins of up to 20% PEF in PET at Centexbel

## 2 | Resulting products are completely haze free up to 2% and nearly at 5%



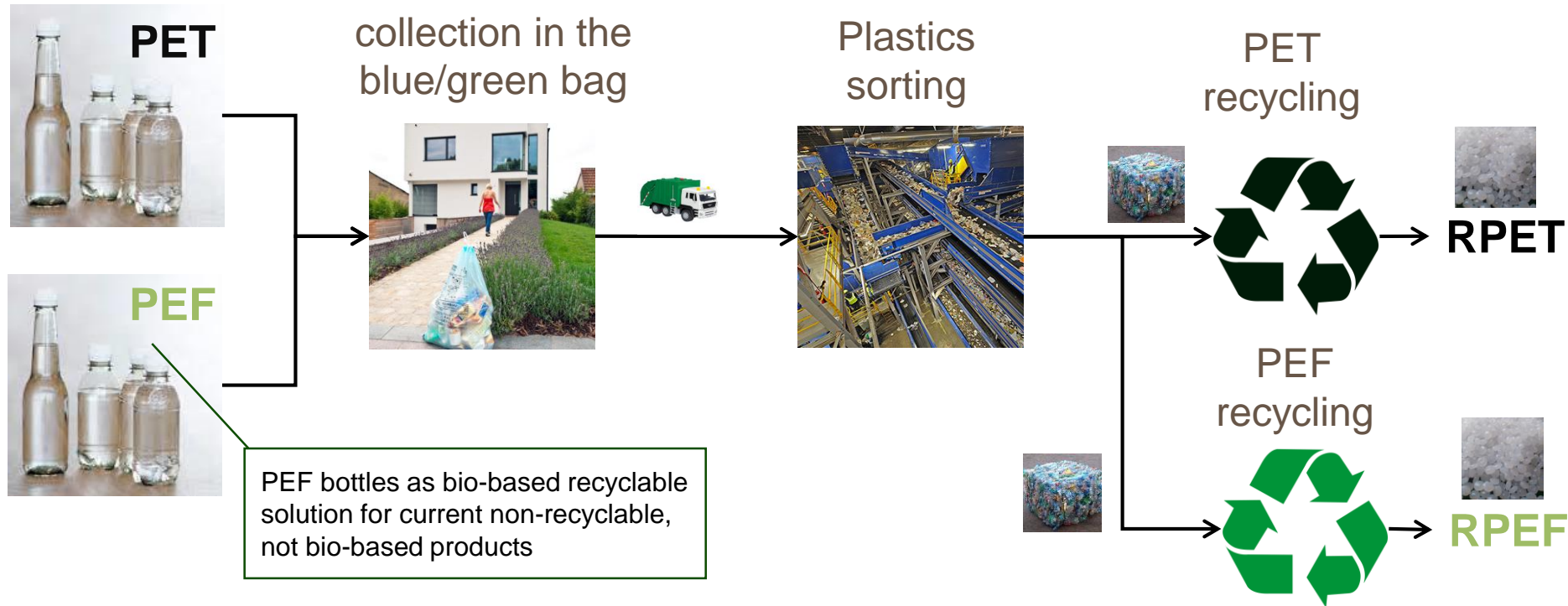
→ EPBP has awarded interim approval to Synvina's PEF Polyester resin in a test market (max 2%)

# PEF Recycling: PEF into rPET (3)



- 1 | PEF could be collected with the waste stream in the green/blue bag
- 2 | PEF could be sorted together with PET in PET bales up to a certain %
- 3 | PEF could be recycled together with PET in rPET

# PEF Recycling: PEF into rPEF



- 1 | PEF could be collected with the waste stream in the green/blue bag
- 2 | PEF could be sorted separately into PEF bottle bales
- 3 | PEF could be recycled separately from into rPEF

# Synvina vision: PEF Recycling

- 1 | Initially recycle PEF into rPET Stream  
→ But this is a value loss therefore...
- 2 | Long term view is to create a separate PEF to rPEF recycling stream, when enough volume is available

## Outlook:

- Perform recycling trials on industrially relevant equipment
- Demonstrate commercially viable rPEF products



**Example of RPEF product:  
T-shirt (first test)**





# SYNVINA

functional. sustainable. bioplastics.

**Thijs Meijssen, [Thijs.meijssen@synvina.com](mailto:Thijs.meijssen@synvina.com)**