



# Novel packaging films and textiles with tailored end of life and performance based on bio-based copolymers and coatings

H2020-BBI-JTI-2018  
GA 837761



1<sup>st</sup> CONFERENCE ON  
GREEN CHEMISTRY &  
SUSTAINABLE COATINGS

ecofunco FINAL EVENT

17-18

JUNE  
2022

PISA, ITALY & ONLINE



*This project has received funding from the Bio-based Industries Joint Undertaking (JU) under the European Union's Horizon 2020 research and innovation programme under grant agreement No 837761. The JU receives support from the European Union's Horizon 2020 research and innovation programme and the Bio-based Industries Consortium.*







Multilayer packaging are extremely challenging to recycle  
PLA's biodegradability is not granted in every environment

31% plastic  
currently recycled

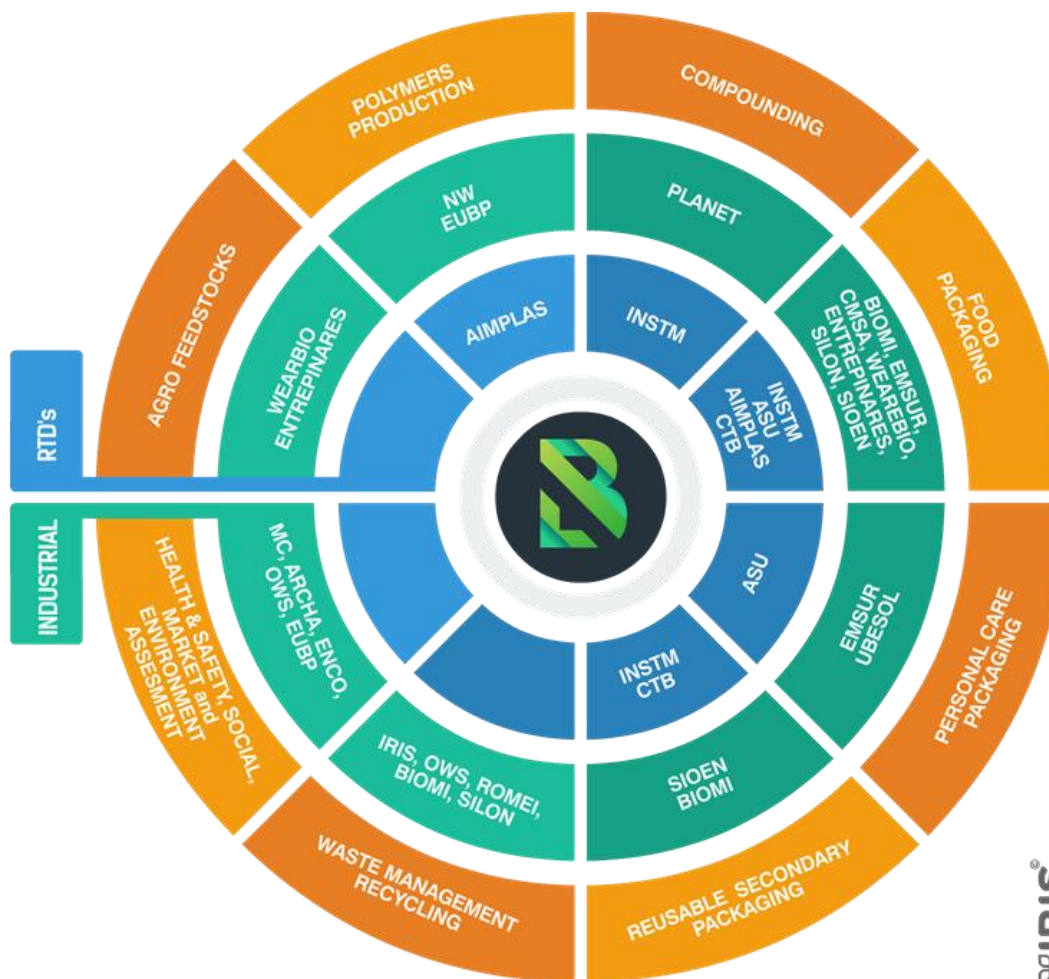
8 million/day  
plastic items reaching  
oceans

41% plastic  
currently incinerated





- Call topic: BBI.2018.SO3.R10 - *Develop bio-based packaging products that are biodegradable/ compostable and/or recyclable*
- RIA (Start TRL 3-4, Target TRL 5-6)
- 4 years (1/06/2019 – 31/05/2023 )
- Budget 5,4M€ (BBI-JU contribution 4,2M€)
- 21 partners (4 RTOs, 9 SMEs, 6 Large & a pan EU industry association)
  - 7 BIC members
  - +Advisory board
- 8 countries



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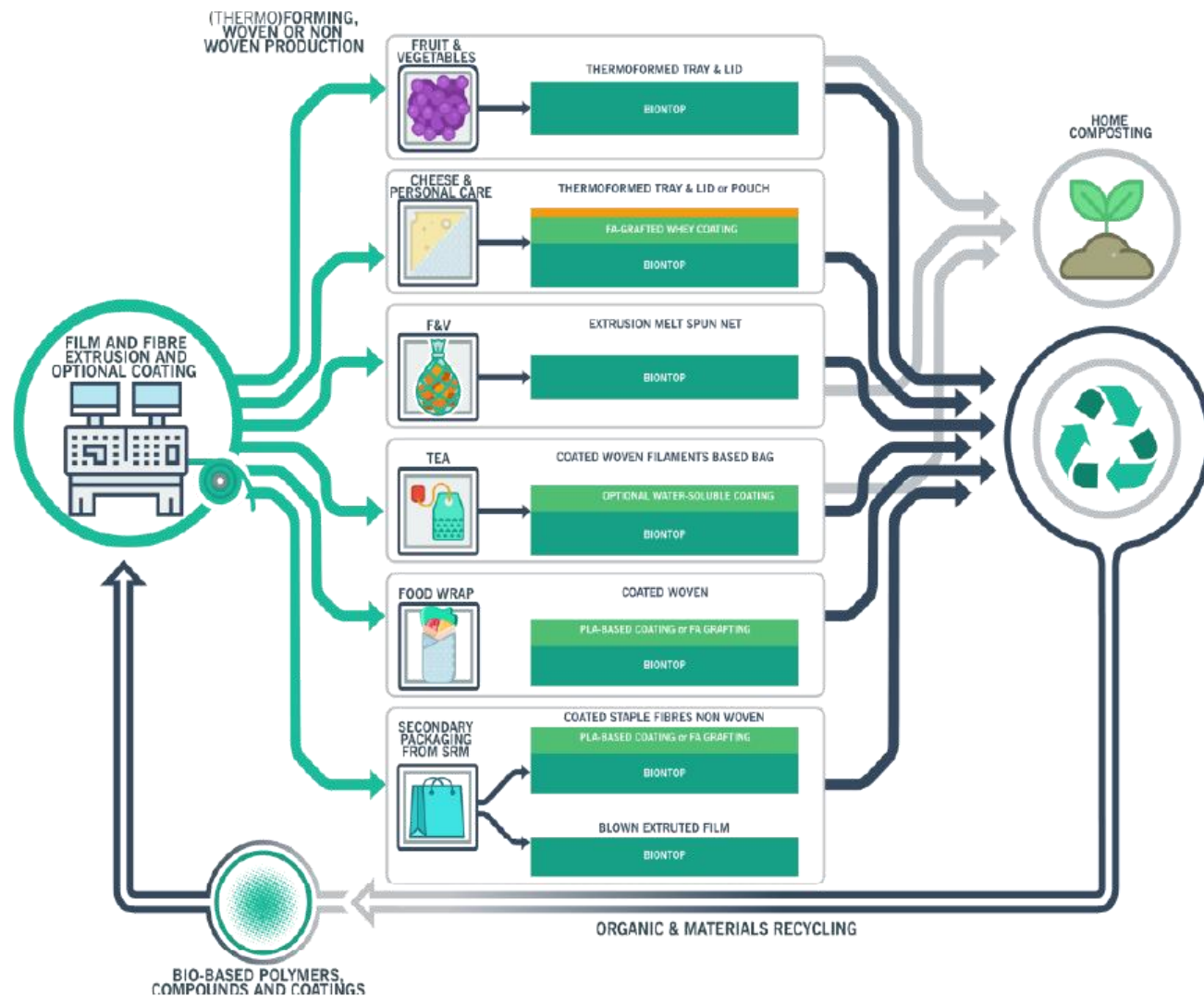
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IRIS

### SUSTAINABLE BY DESIGN PACKAGING



The 4 SO in the BBI SIRA 2017

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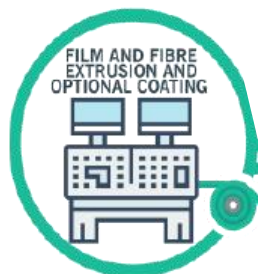
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- **Formulation:** sustainably sourced comonomers, additives, agricultural fillers to speed up disintegration



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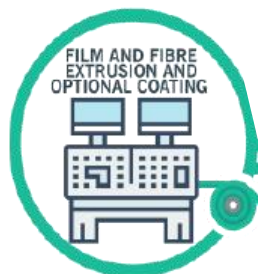
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A stylized green leaf with a blue drop.  
**Bio-based Industries**  
Consortium



- **Formulation:** sustainably sourced comonomers, additives, agricultural fillers to speed up disintegration
- **Synthesis:** direct polycondensation and batch synthesis followed by **reactive extrusion** or batch copolymerization



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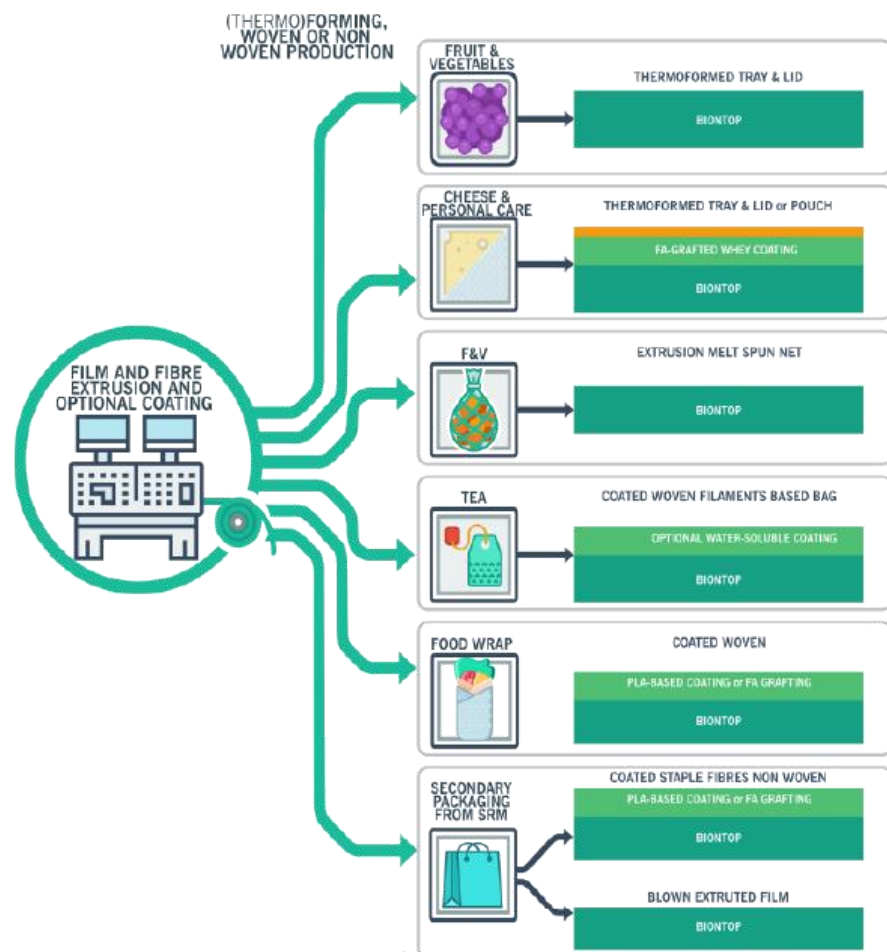


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- **Formulation:** sustainably sourced comonomers, additives, agricultural fillers to speed up disintegration
- **Synthesis:** direct polycondensation and batch synthesis followed by **reactive extrusion** or batch copolymerization
- **Conversion:** Extrusion, lamination, thermoforming, melt spinning (nets, textiles and nonwovens), blown extrusion of recycled and virgin copolymers.

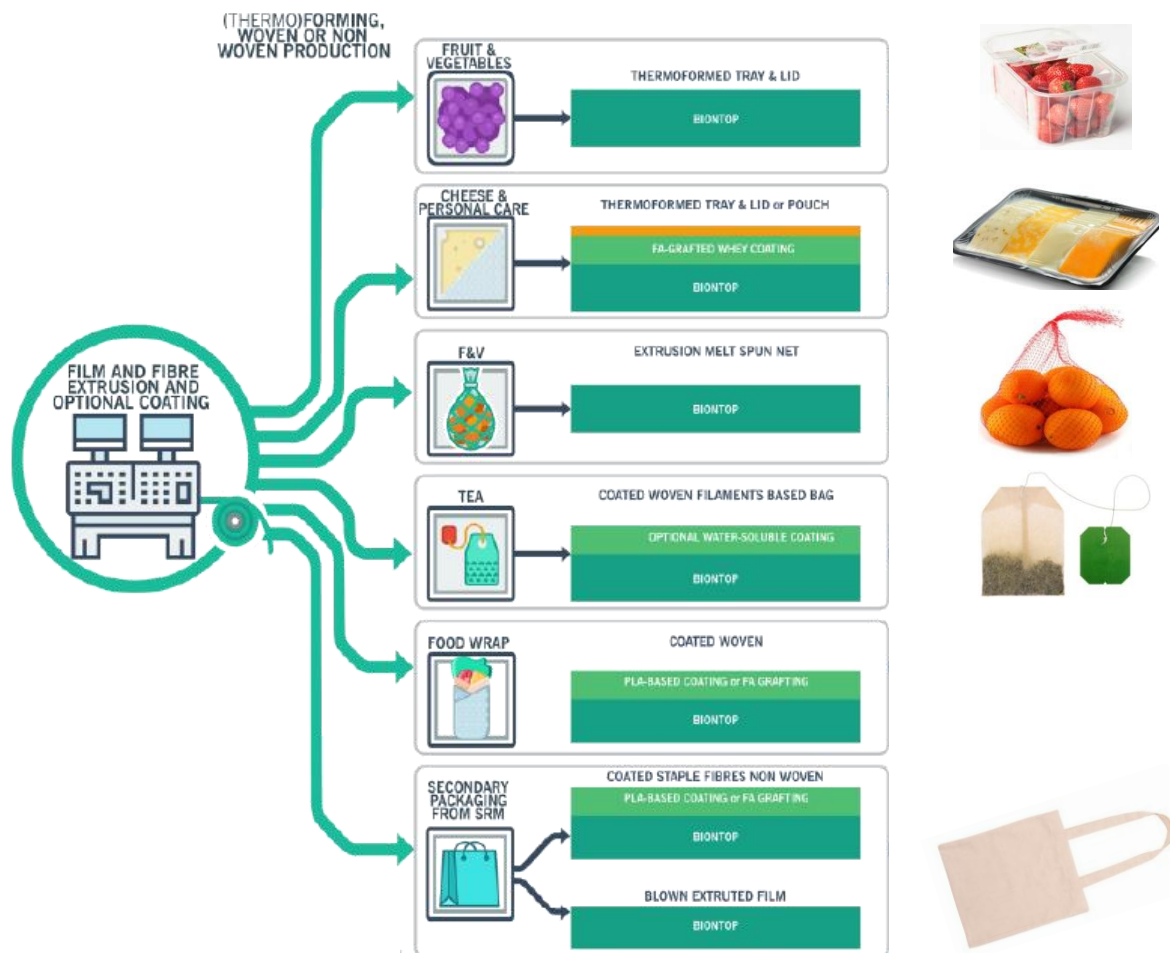
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- ▶ **Recyclable** (material & organically) home-compostable monomaterial **trays & films** for F&V
- ▶ **Recyclable** (mat. & org.) **multilayer trays & films** compatible with MAP e.g. for **dairy & personal care**.
- ▶ Home compostable and org. recyclable **nets** for F&V.
- ▶ Home compostable and org. recyclable **coated textiles**, e.g. monofilament woven fabric tea bags.
- ▶ **Recyclable** (mat. & org.) reusable **coated woven fabrics** e.g. food wraps.
- ▶ Recyclable (mat. & org.) reusable **secondary packaging** from secondary raw materials: extruded blown bags & non-woven bags.

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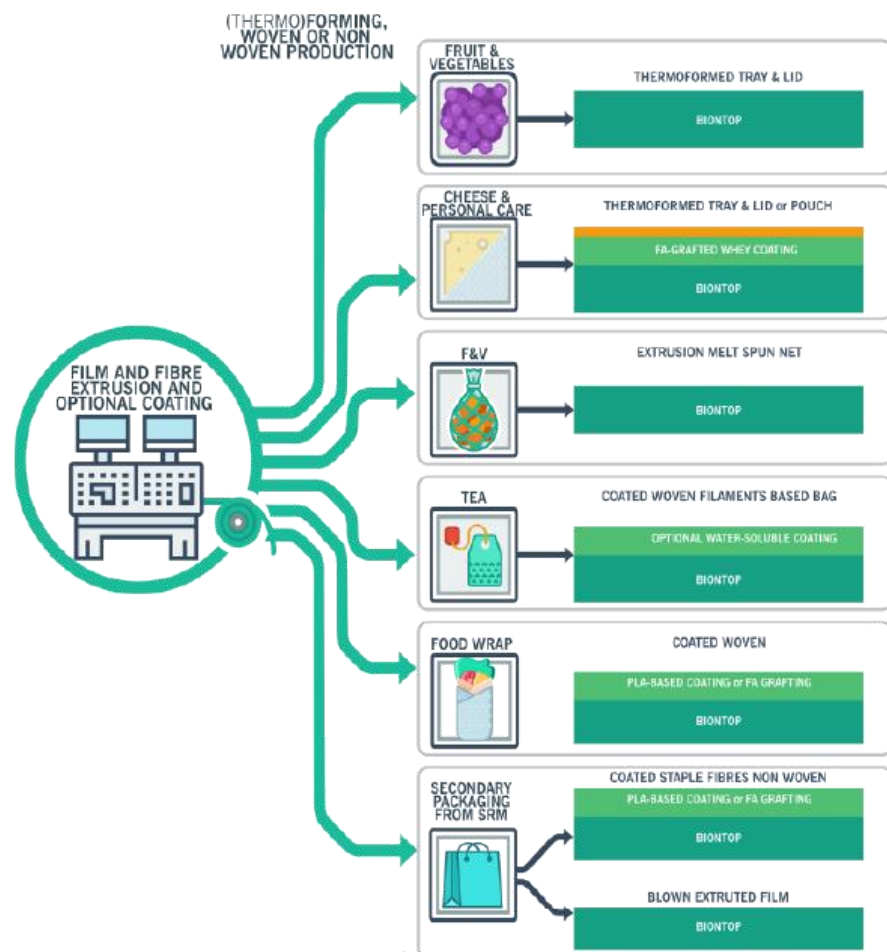


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- **Tailor barrier and surface properties** (e.g. for easy emptying): solvent-free grafting of whey protein-based barrier coating on PLA films and textiles.
- **Coating processes:** direct, transfer, hotmelt coatings and direct fatty acid grafting

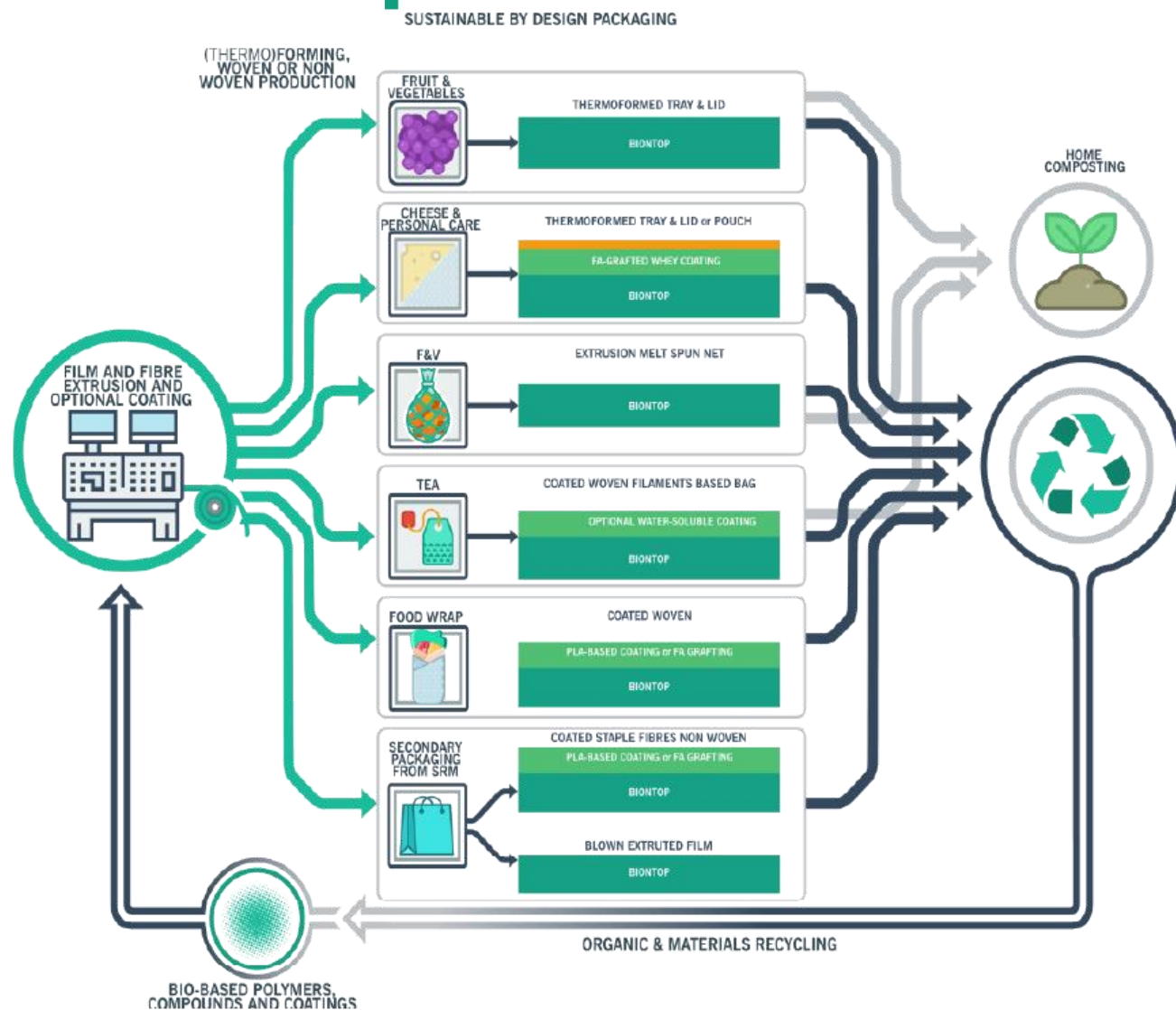
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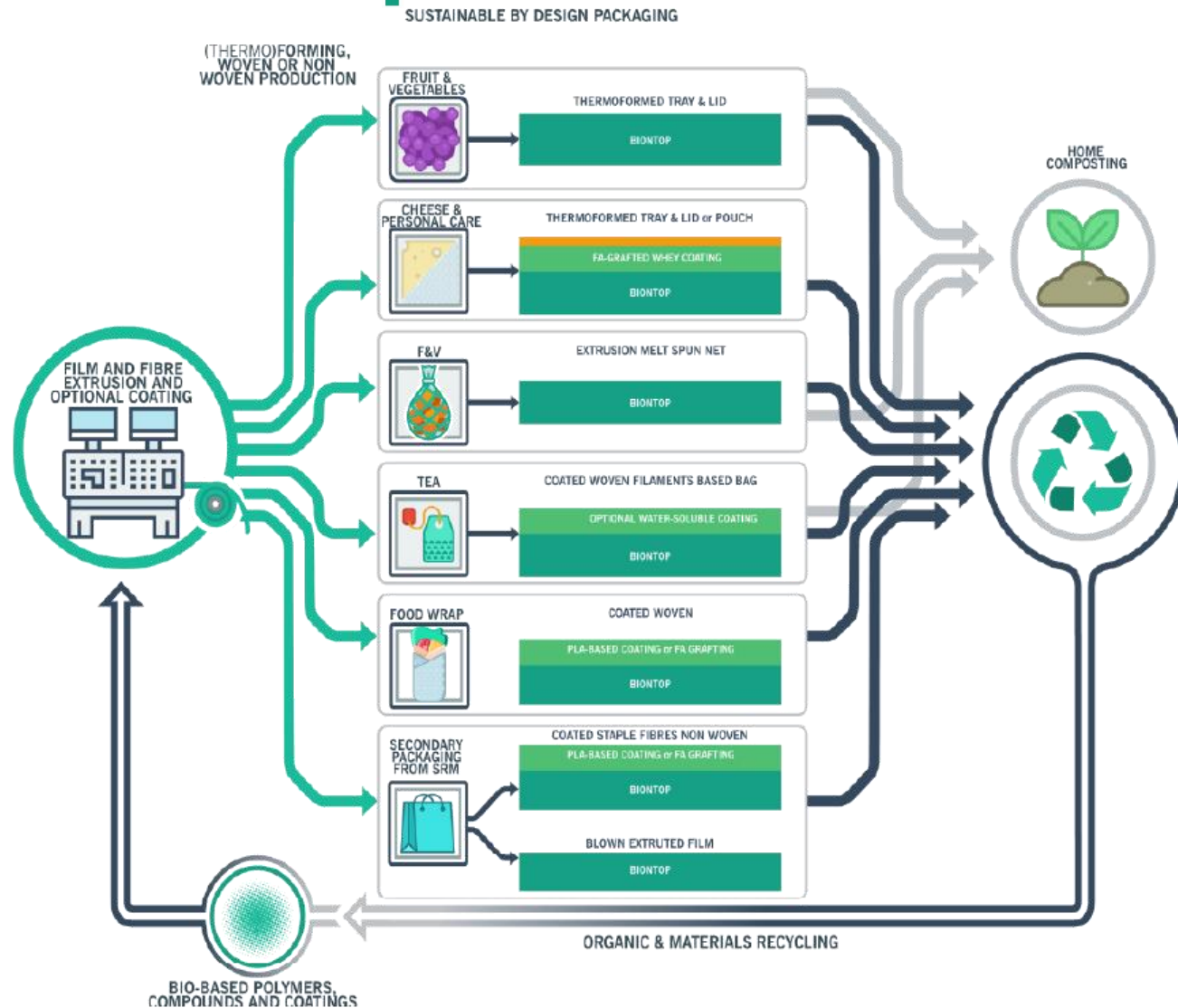
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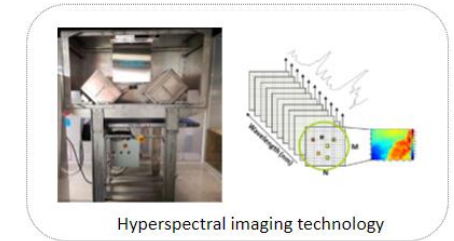
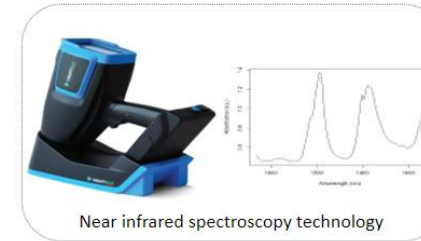


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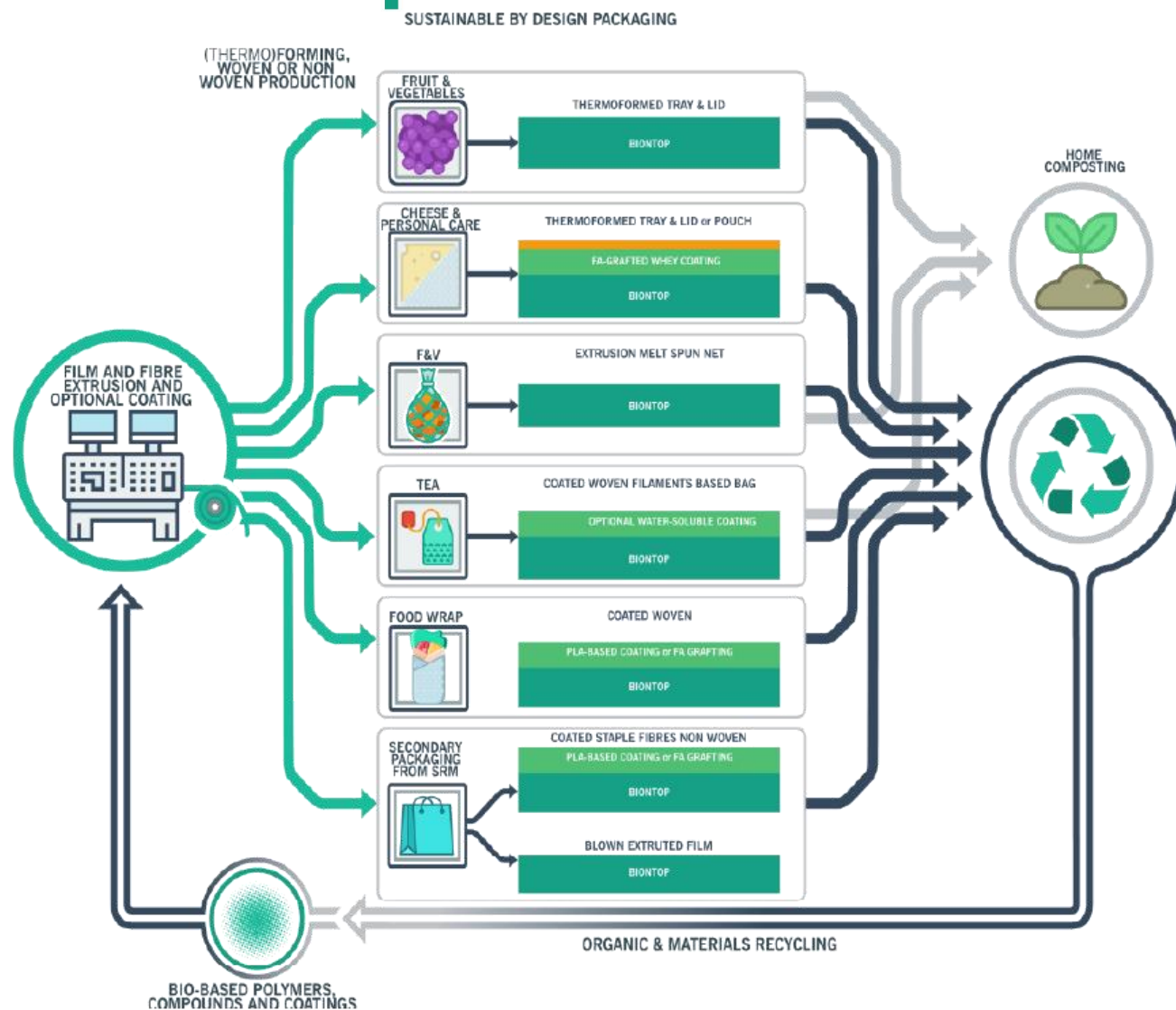
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## ➤ Material sorting: PLA determination.



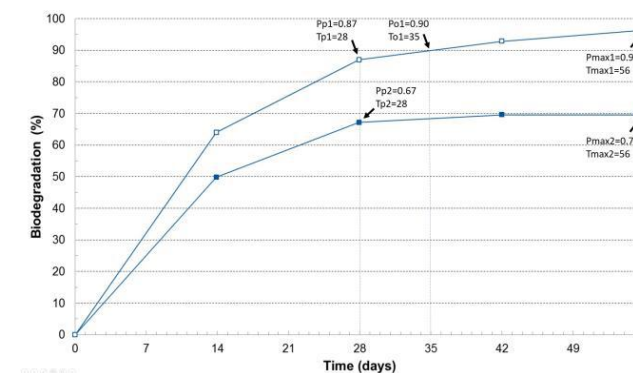
- **Multilayer recycling:** effect of proteins
- **Material reprocessing:** mechanical properties, (re)processability of blends, films and trays
- **PLA degradation in mild conditions:** biodegradation under home composting (28°C).
- **Biodegradation in soil (25°C) and in home composting**





## ➤ Predictive biodegradation modeling as support for eco-design of the new materials applications.

- Setup and data pre-processing, pre-analysis
- Data modeling and calibration.
  - Biodegradation
  - Disintegration
- Case-Based Reasoning model



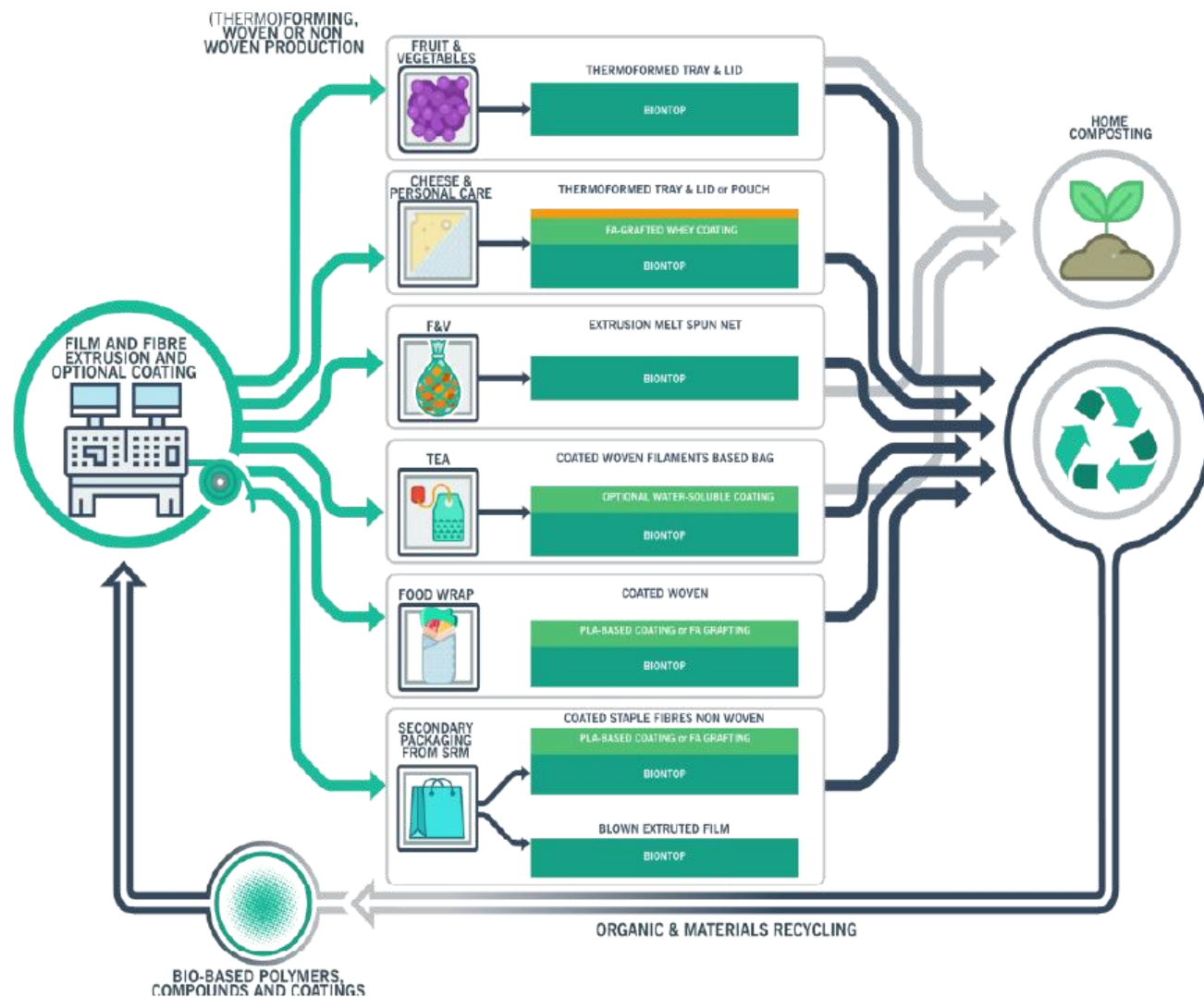
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- Previously developed protein-based coatings.
- Novel fatty acid grafting
  - Removable
  - Hydrophobic
- Applicable to fibers



- **Tailor barrier and surface properties** (e.g. for easy emptying): solvent-free grafting of whey protein-based barrier coating on PLA films and textiles.
- **Coating processes:** direct, transfer, hotmelt coatings and direct fatty acid grafting



## Development of multifunctional coating solutions with tailored properties

- \* Barrier to oxygen & UV (whey)
  - \* Barrier to aroma (e.g., alginates)
  - \* Barrier to water & vapour: hydrophobic grafting
  - \* Barrier to grease & liquids
- (FA for repellence or plastic or PLA coating for textiles).

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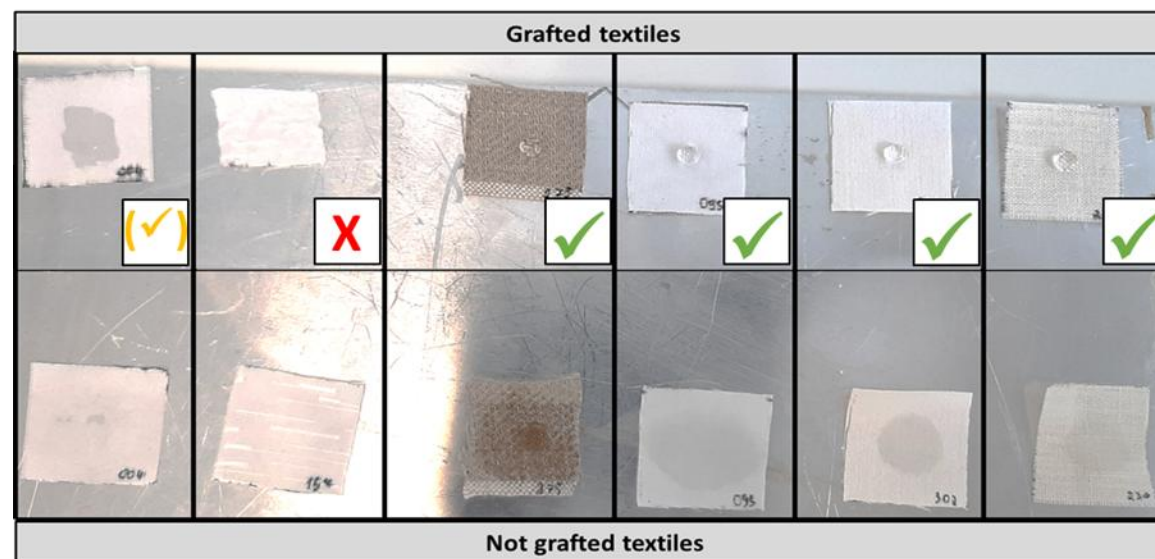
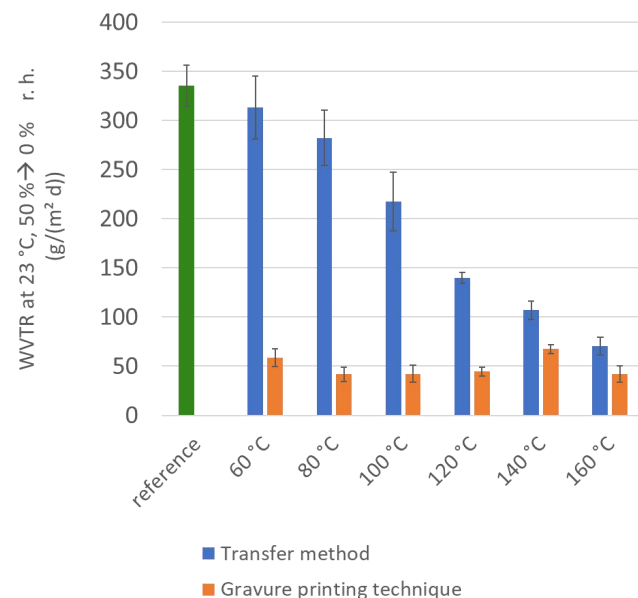


The logo for the Bio-based Industries Consortium, featuring a stylized green leaf and a blue water drop.  
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## Development of multifunctional coating solutions with tailored properties

- Development, processing and testing of a new water barrier and repellence coating



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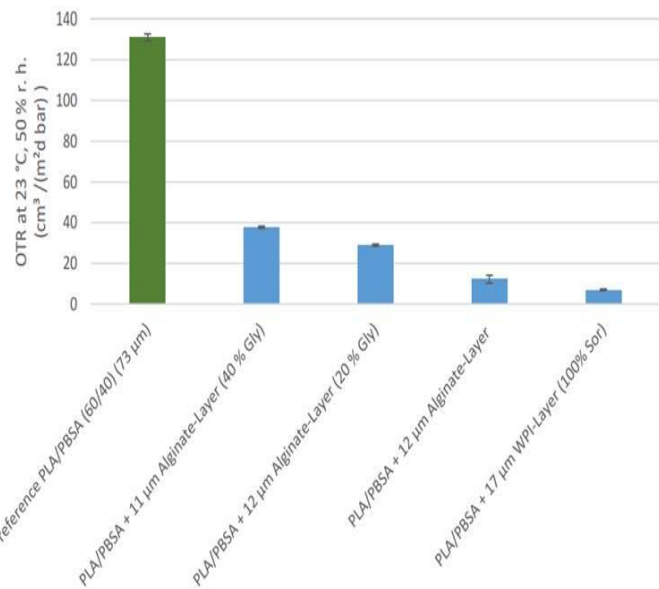


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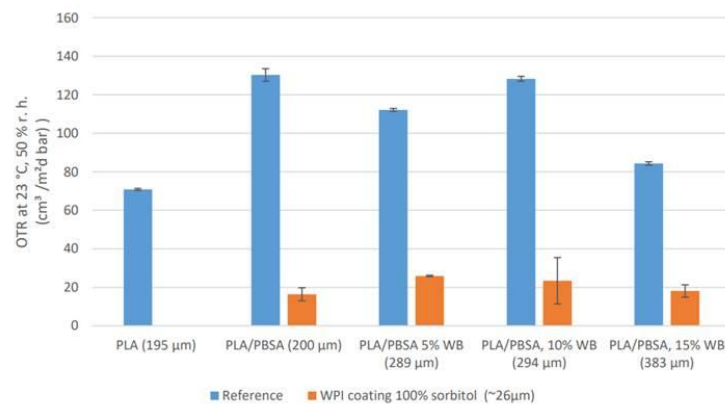
## Development of multifunctional coating solutions with tailored properties

- Development, processing and testing of a new water barrier and repellance coating
- Processing and testing of the barrier and repellance coatings for films & trays

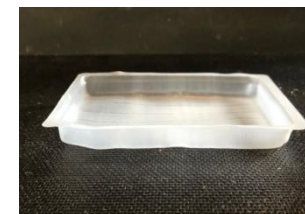
Thinner films and an alginate and WPI coating for lid film application:



OTR of the WPI coated films



- The films coated with WPI and grafted with fatty acid chloride are thermoformable for small trays
- FA grafting generates a repellent effect to different food simulants (water, oil, ethanol)
- Whey protein coating and FA grafting on small PLA/PBSA trays achieve a **BIF** (Barrier improvement factor) of ~ 90 (OTR)



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## Development of multifunctional coating solutions with tailored properties

- Development, processing and testing of a new water barrier and repellance coating
- Processing and testing of the barrier and repellance coatings for films & trays
- Production and characterisation of PLA and FA coatings for textiles

### Transfer coating (food wrap):

- Lamination of PLA film on PLA substrate
- Use of low Tg PLA adhesive coating

### Direct coating (shopping bag)

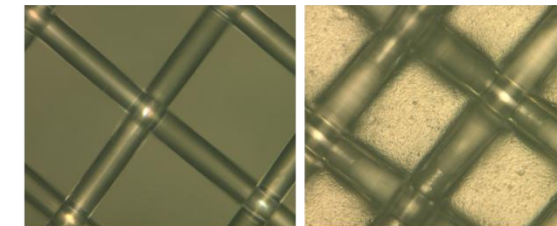
- Use of PLA plastisol coating
- Use of crosslinkers to improve durability

### Hotmelt coating (textile food wrap)

- PLA in molten state is coated on substrate

## Alginate coatings for tea bags

Micrograph: Digital microscope VHX.100, Keyence (300x)



Reference PLA Textile

PLA Textile + 1x Alginate coating (16%)

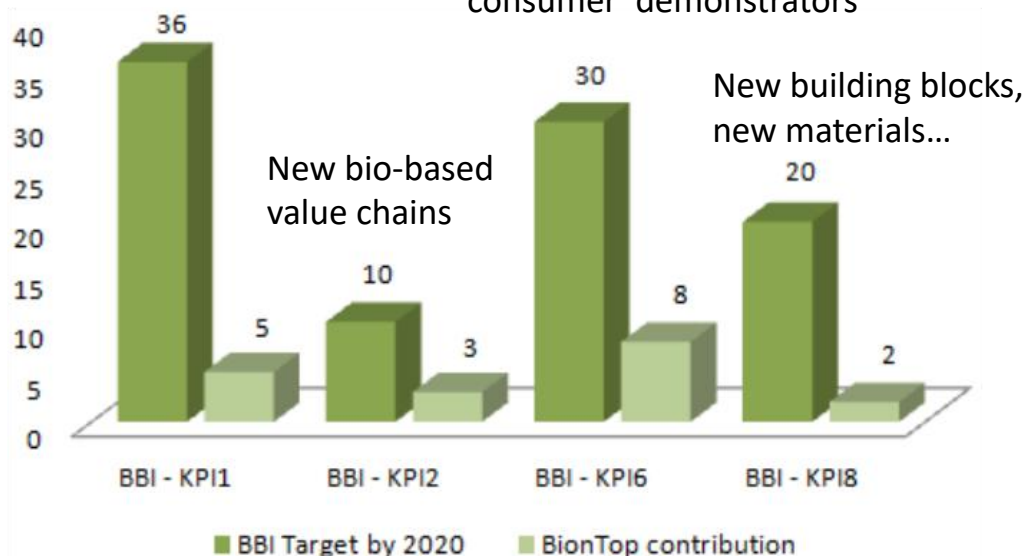




### BIONTOP CONTRIBUTIONS TO BBI JU KPI's

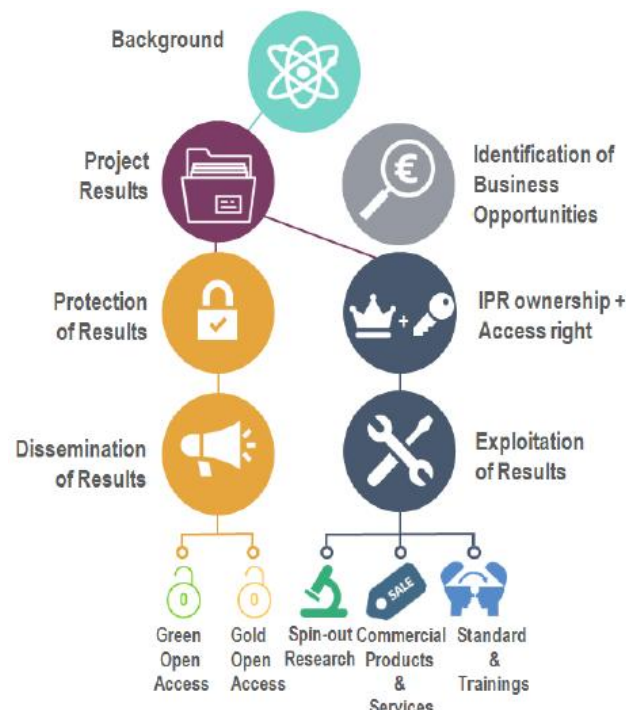
New cross-sector  
interconnections

New bio-based  
'consumer' demonstrators



New bio-based  
value chains

New building blocks,  
new materials...



- \* Bio-based value chains.
- \* Business models
- \* Market opportunities
- \* Consumer perception
- \* Maximise the innovation impacts
- \* Uptake of the project results for growth and jobs
- \* Protecting BIONTOP knowledge and results (IPR)
- \* Robust plan for the C&D and exploitation
- \* Dialogue w/public and policy makers to lobby for the set up of standards and, policy recommendations

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**Thank you for your attention**

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