
Development of functional barriers for the use of recycled materials in multi-layer food packaging

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Technology Centre with more than 25 years of experience **helping companies in the plastic sector**

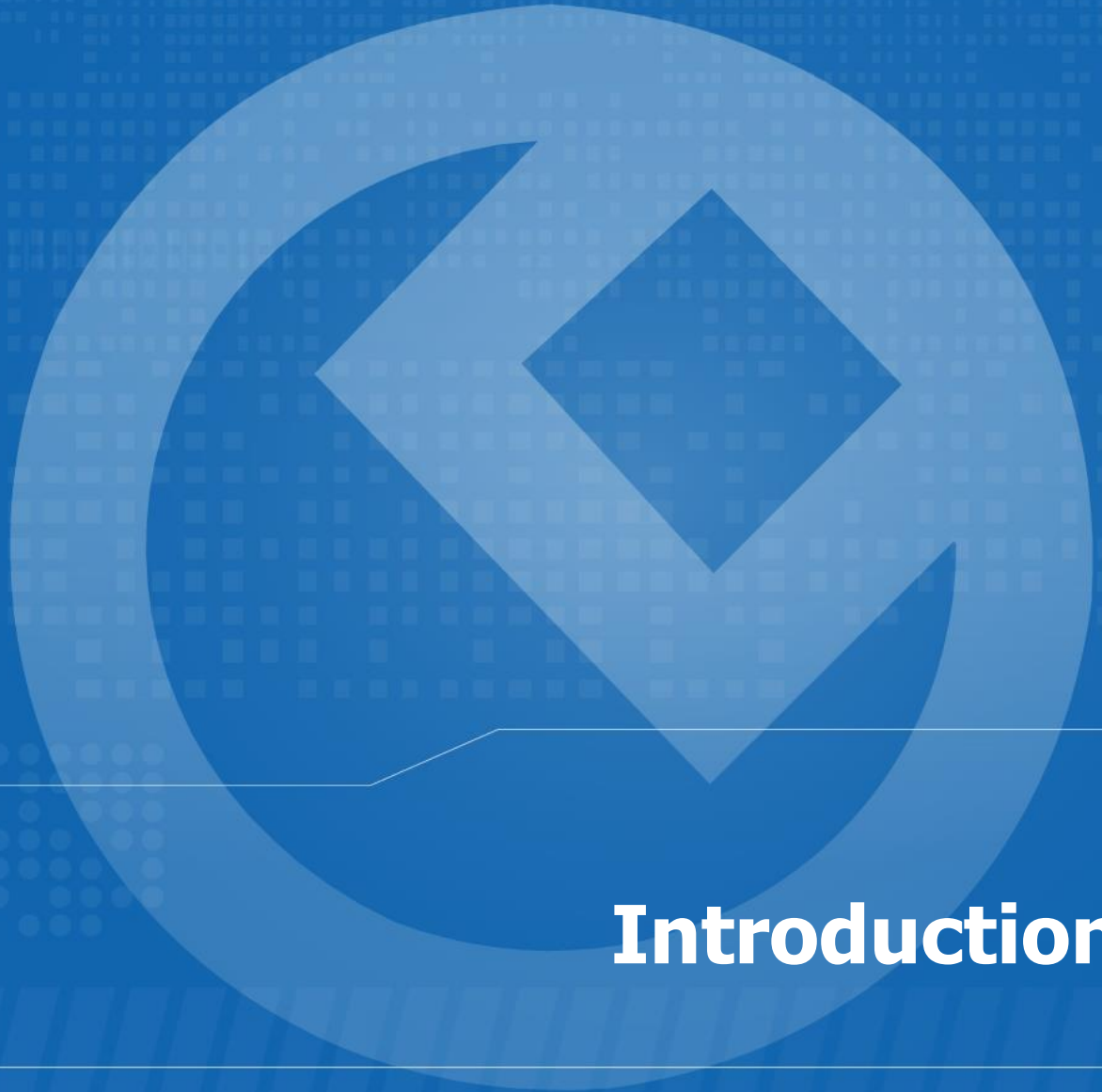
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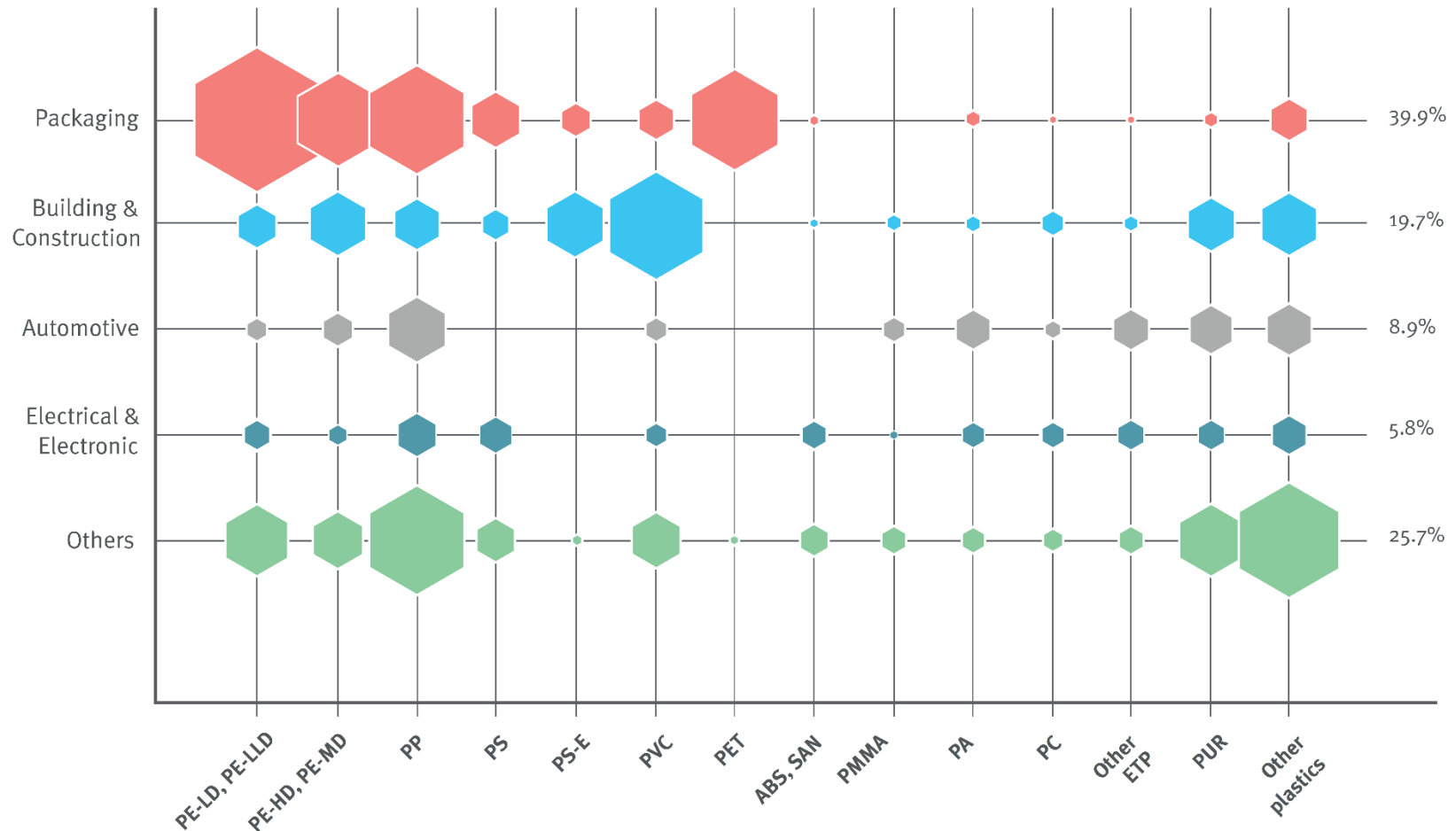
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Introduction

Introduction

European plastics demand: **40% of plastic materials are used in packaging sector** (PlasticsEurope, 2015)



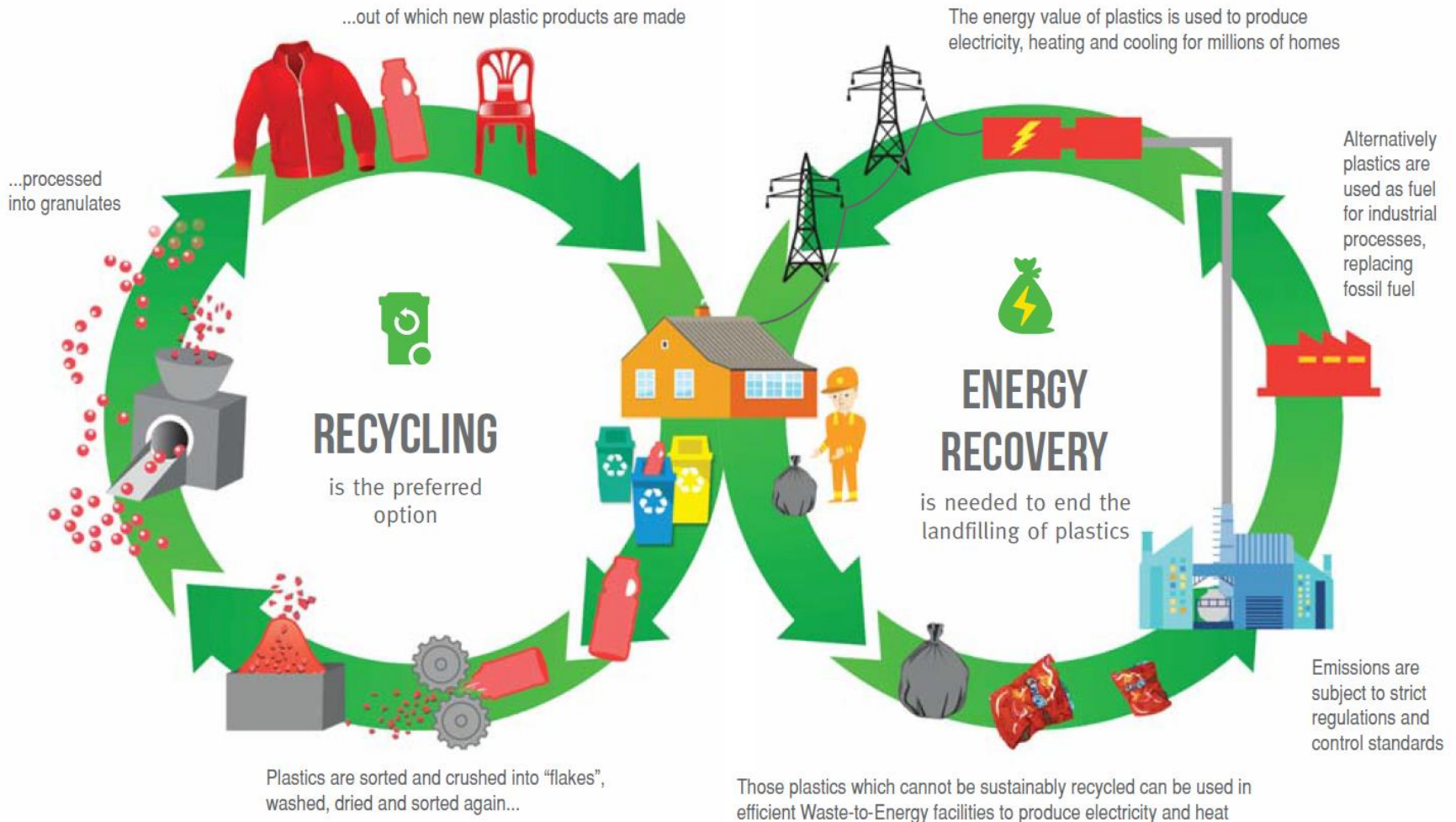
Introduction

Treatment for **post-consumer plastics waste** in Europe
(PlasticsEurope, 2014)



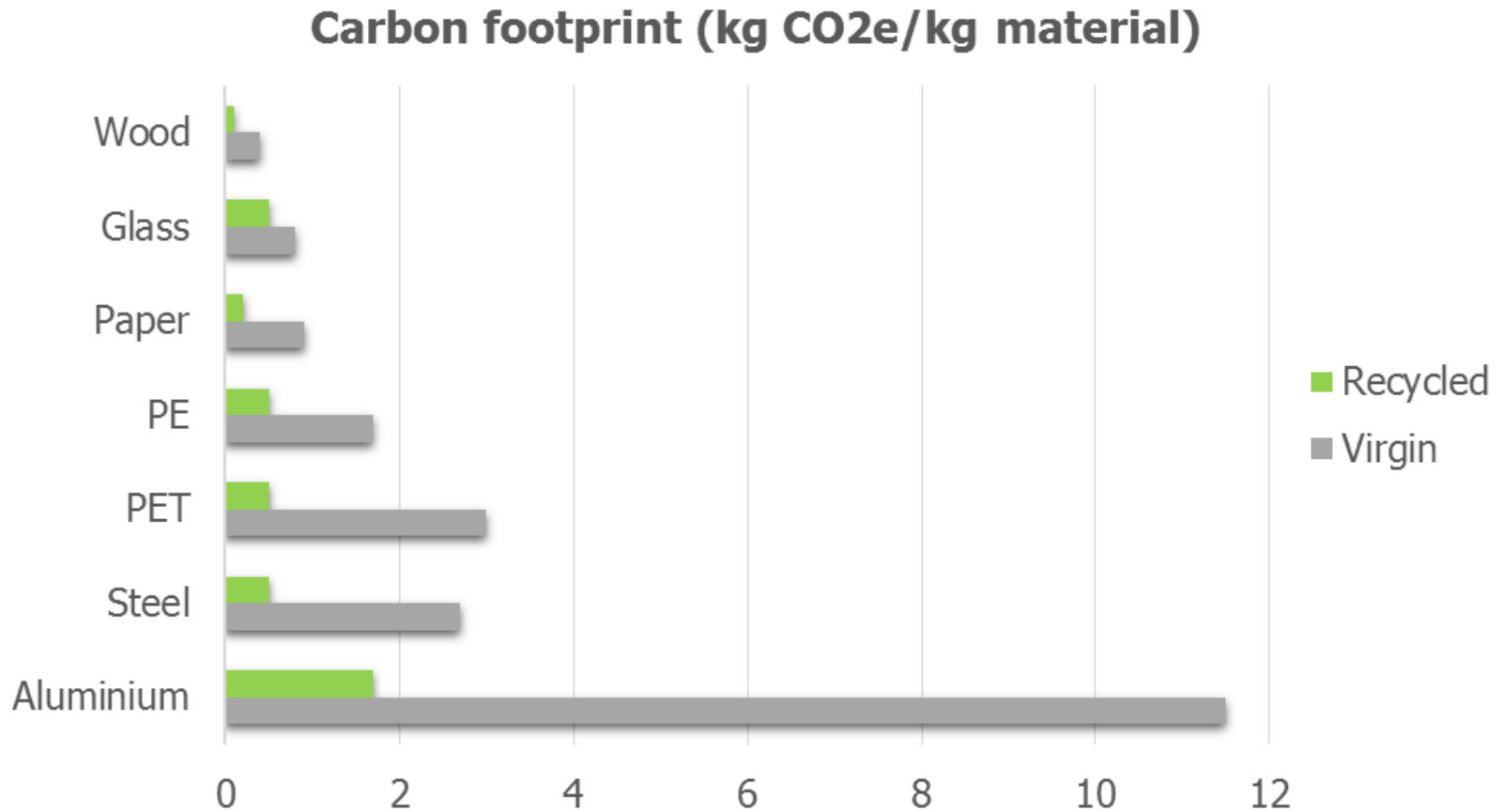
Introduction

Why recycling? Waste is a valuable resource (circular economy)



Introduction

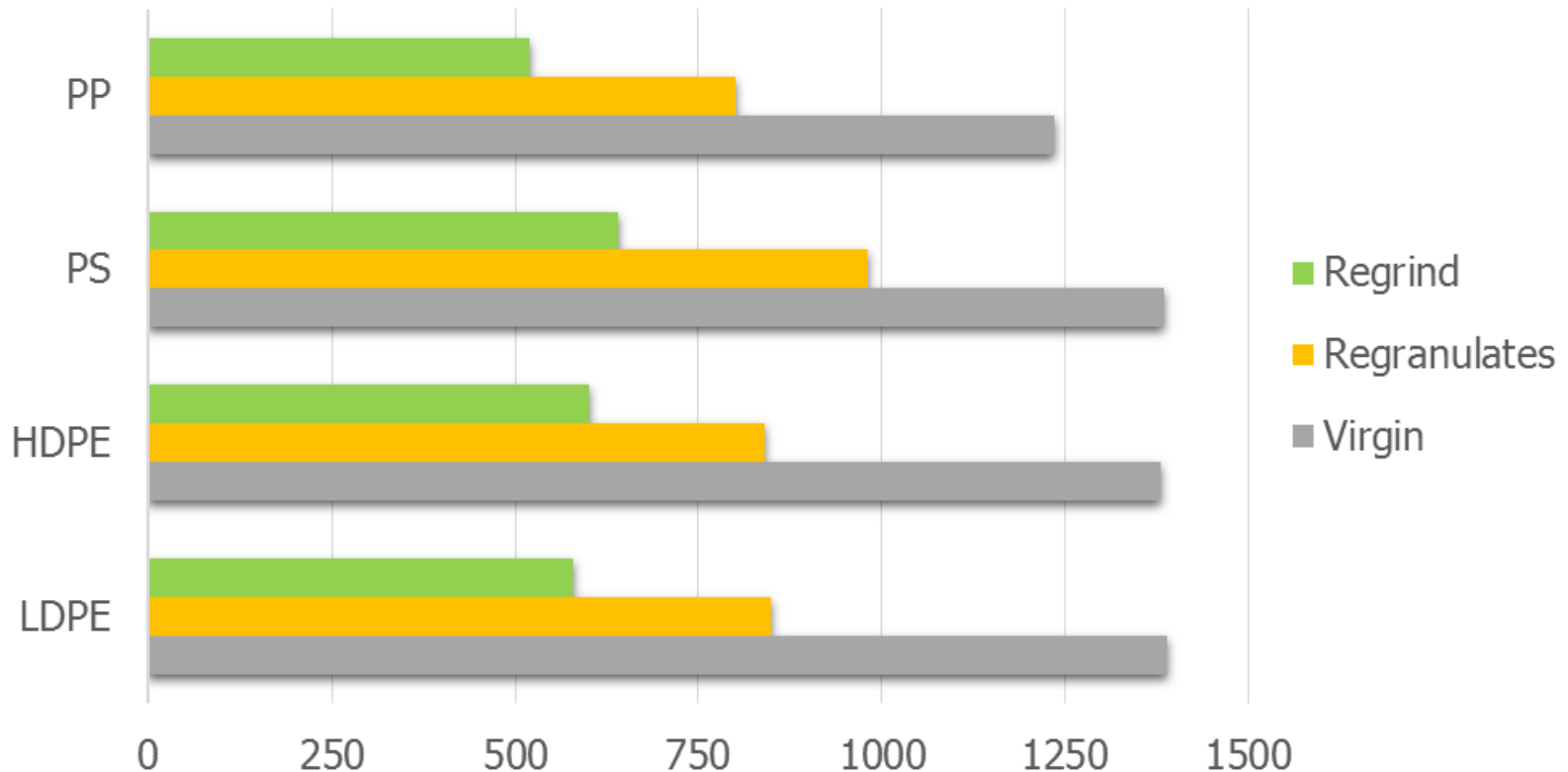
Why recycling? For many materials the difference in carbon intensity between virgin and recycled sources can be enormous



Introduction

Why recycling? Recycled materials typically have a lower price than equivalent virgin materials

Average market price, Sept. 2016 (€/t)



Introduction

How to boost recycling?

Improving the quality of recycling...

...e.g., **decontamination of critical substances** in plastic packaging waste **to close the loop**



Finding new applications for recycled plastic materials...

...e.g., manufacture of **food packaging with recycled plastics**



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Recycled plastics in contact with food

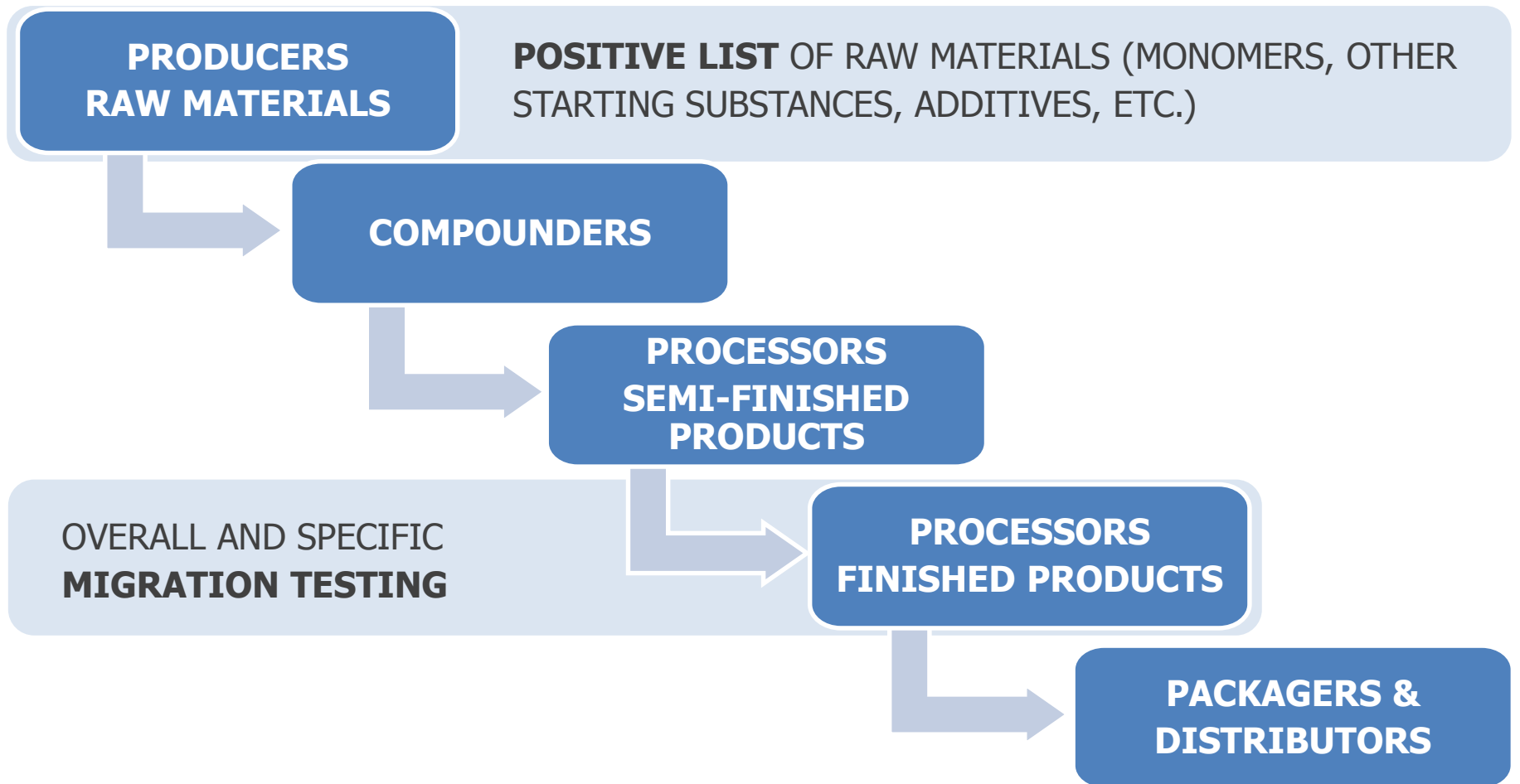
Recycled plastics in contact with food

EU legislative overview on food contact materials

General regulations on FOOD CONTACT MATERIALS (FCM)	
EC 1935/2004	General basis covering all FCM for securing protection of human health: food safety, labelling, declaration of compliance, traceability
EC 2023/2006	Rules on good manufacturing practice for FCM : quality assurance and control systems, detailed rules for the application of printing inks
Specific regulations for PLASTIC MATERIALS	
EU 10/2011 & amendments: EU 321/2011 EU 1282/2011 EU 1183/2012	Authorised substances : positive list of raw materials Basic rules on (overall and specific) migration testing for final product Rules for plastic (& multi-material) multi-layer materials Restriction of use of certain substances (Ba, Li, etc.) Definition of functional barrier concept and application Requirements for declaration of compliance
EC 1895/2005	Restriction of use of certain epoxy derivatives
Specific regulation for RECYCLED PLASTIC MATERIALS	
EC 282/2008	Requirement of individual authorization by EFSA for recycling process

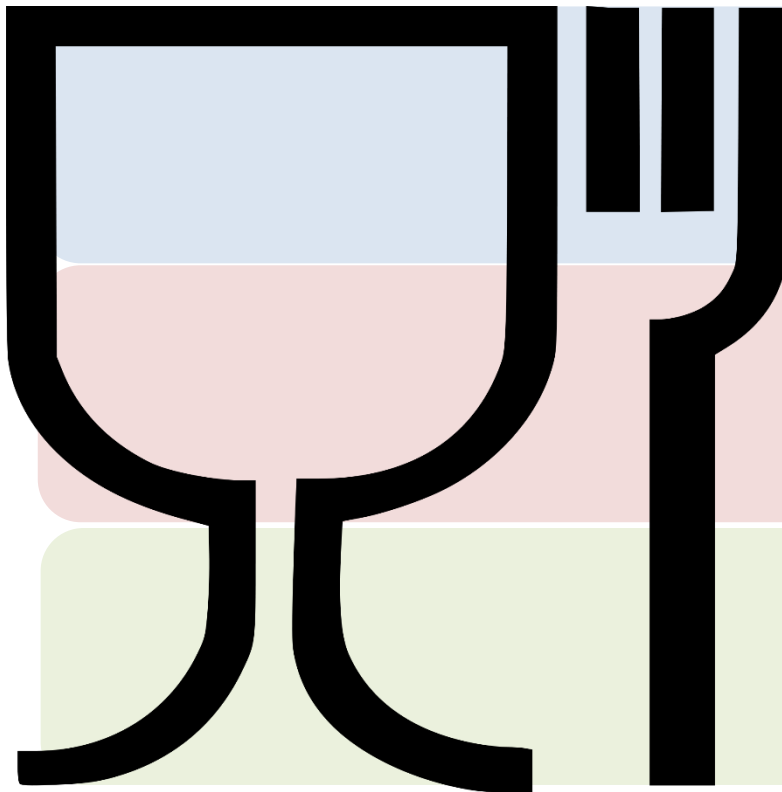
Recycled plastics in contact with food

Regulation EU 10/2011 (on plastic materials in contact with food)



Recycled plastics in contact with food

3 possibilities to use recycled plastic materials in contact with food



1. Offcuts and scraps from the production of plastic FCM
(Regulation EC 2023/2006)

2. Recycled plastics from processes **authorised by EFSA**
(Regulation EC 282/2008)

3. Recycled plastics used **behind a functional barrier**
(Regulation EU 10/2011)



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Functional barriers

Functional barriers

What is a functional barrier?

It is a layer (or multi-layer) within food contact materials and articles which prevents the migration of substances from behind that barrier into the food (including set-off during storage of stackable packaging)

*Scheme of a bi-layer system:
recycled plastic behind a functional barrier*



Functional barriers

Behind a functional barrier, **non-authorised substances can be used**, provided they fulfil certain criteria and their migration remains below a given detection limit: 0.01 mg/kg in foodstuff (10 ppb)

Substances not covered by the functional barrier concept:

- Mutagenic
- Carcinogenic
- Toxic to reproduction
- Nanoparticles



Functional barriers

The **effectiveness of the functional barrier** depends on:

- Concentration and diffusion coefficient of contaminants in the recycled layer
- Chemical nature and thickness of the barrier layer
- Conditions of use:
 - Type of food
 - Temperature and time of use



Functional barriers

Types of functional barriers

Absolute barriers

Glass and some metals may ensure complete blockage of migration

Glass

Aluminium foil $\geq 8 \mu\text{m}$ thickness

Partial barriers

Plastics may reduce the migration of substances below specific migration limits or detection limits

If recycled PET/virgin PET at room temperature and below:
Virgin PET $\geq 25 \mu\text{m}$ thickness

If recycled PET/virgin PET at higher temperatures:
Virgin PET $\geq 50 \mu\text{m}$ thickness



Functional barriers

The **effectiveness as a functional barrier** of a given thickness of a virgin polymer **must be demonstrated**

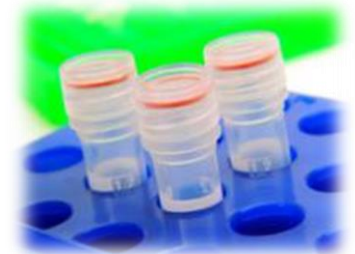
Intentional contamination of polymer with a known concentration of surrogate substances (challenge test)



Incorporation of contaminated polymer into an inner layer of the finished article, using virgin polymer as the barrier layer



Migration testing with food-simulating solvents under worst foreseeable conditions of use



Functional barriers

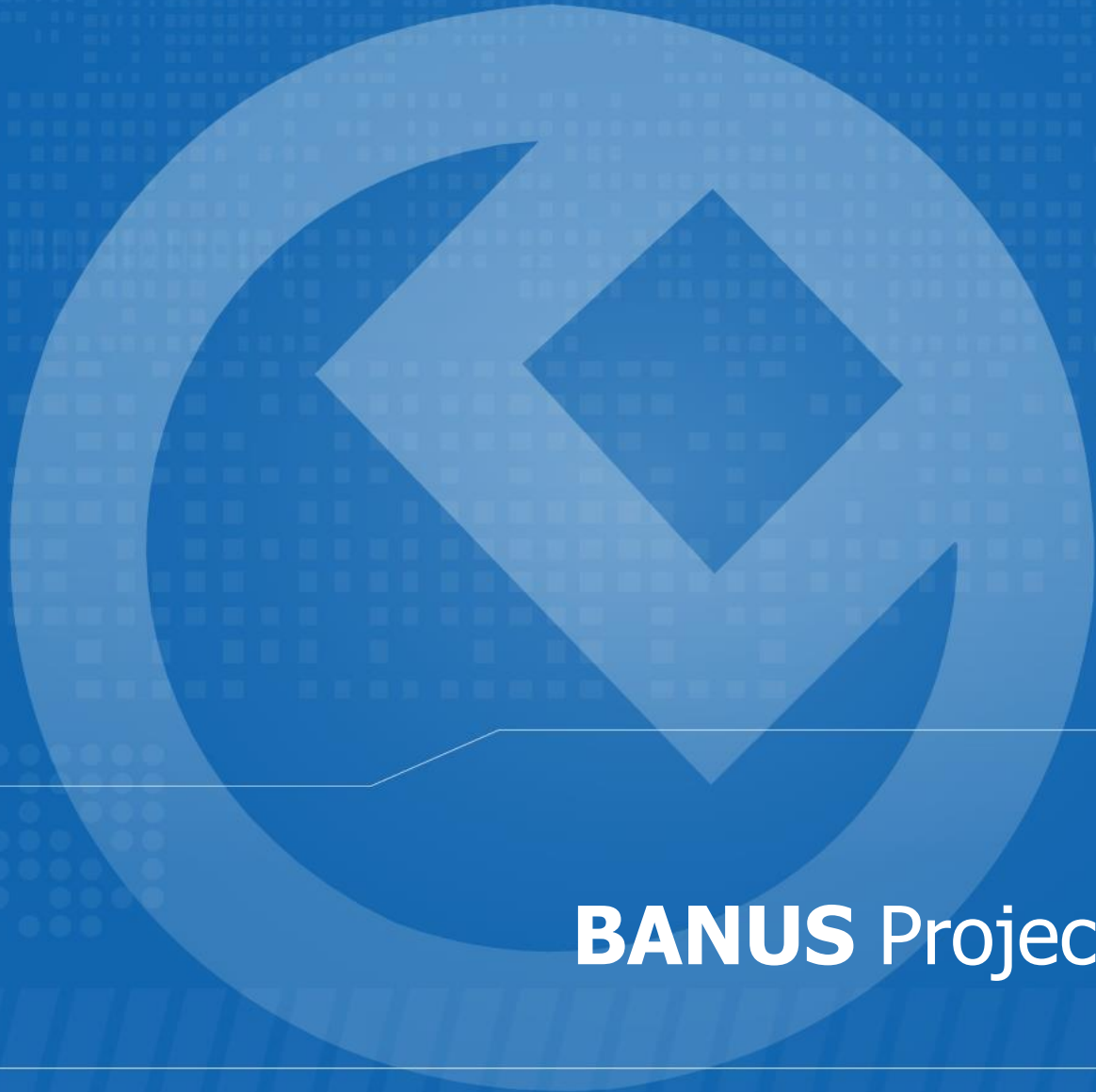
Functional barrier films at contact conditions of 10 day @ 60°C

Film structure	Base polymer	Barrier material
36 µm O-PET corona treated	PET	PET
12 µm PET metallised	PET	metallisation
12 µm PET-SiOx 80 nm	PET	SiOx
12 µm PET/AlOx/adhesive/30 µm PP	PP	PET-AlOx
6 µm aluminium/PE	PE	Aluminium
15 µm OPA	PA	PA
12 µm PET	PET	PET
12 µm PVDC coated transparent polyester film	PET	PVDC
PE/EVOH 3 µm/PE total 30 µm	PE	EVOH

Source: **JRC draft for consultation** - "Technical guidelines for compliance testing in the framework of Regulation (EU) No 10/2011 on plastic food contact materials"



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BANUS Project

BANUS project

BANUS Project:

Definition and development of **functional barriers** for the use of **recycled materials in multi-layer food packaging**

<http://www.banus-project.eu>

BANUS

Funded by




Associated beneficiaries




BANUS project

Functional barriers for the use of **recycled materials** in **multi-layer food packaging** → **3 different case studies**

	Case study 1: Semi-rigid multi-layer plastic packaging
Current structure	Ext PP/EVOH/PP Int
Processing technology	Co-extrusion
BANUS structure	Ext PP/Recycled PP/EVOH/PP Int
End-users application	


BANUS project

Functional barriers for the use of **recycled materials** in **multi-layer food packaging** → **3 different case studies**

	Case study 2: Flexible multi-layer multi-material packaging
Current structure	Ext Paper/PET metallised/PE Int
Processing technology	Lamination
BANUS structure	Ext Paper/Recycled Paper/PET met/PE Int
End-users application	

BANUS project

Functional barriers for the use of **recycled materials** in **multi-layer food packaging** → **3 different case studies**

	Case study 3: Coated paperboard packaging
Current structure	Ext Paperboard/Coating Int
Processing technology	Coating
BANUS structure	Ext Paperboard/Recycled PB/Coating Int
End-users application	



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Conclusions

Conclusions

- 3 options to use recycled plastics in food contact applications
- Functional barriers allow to use post-consumer recycled plastics from non-food contact origin
- The effectiveness of the functional barrier must be demonstrated case by case
- Diffusion effects may appear during co-extrusion → these effects must be carefully analysed and minimized
- The conditions of use related to the functional barrier must be clearly established in the declaration of compliance





Thank you

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