

# Bonjour toute le monde!



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d'emballage



## AUTOMOTIVE PACKAGING SYSTEMS

# Sustainability and performance. Drivers, challenges and solutions.

Groupement pour l'Amélioration des Liaisons dans l'Industrie Automobile (GALIA)

Groupe Utilisateurs Emballages

02/07/2020



**ITENE** RESEARCH  
CENTER

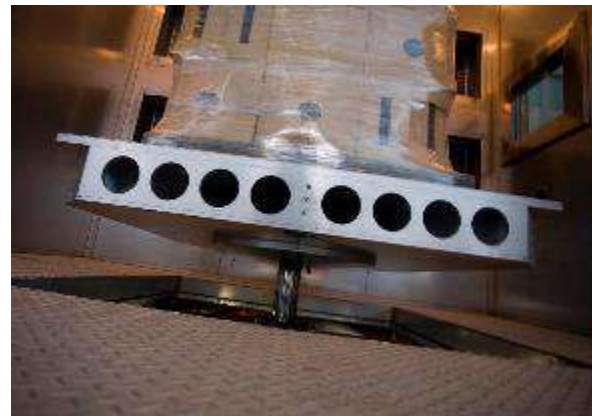
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- 1 / Who we are
- 2 / What we do
- 3 / What we do in France
- 4 / Packaging sustainability and performance.  
Drivers, challenges and solutions.
- 5 / Business case.  
Development of new reusable industrial plastic packaging



1/

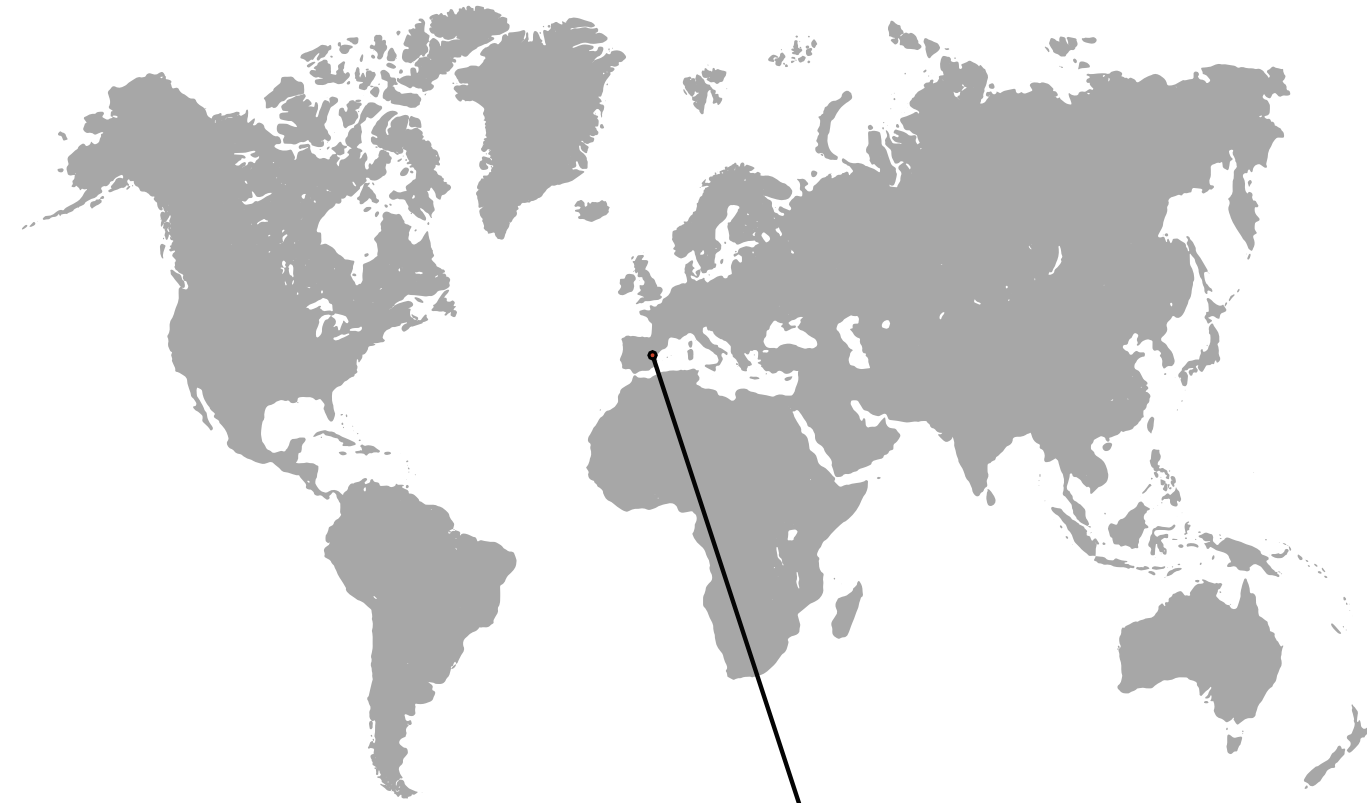
Who we are



**ITENE is the reference research centre in packaging, transport and logistics.**

25 years creating technological solutions through R&D

# 1/ Who we are LOCATION

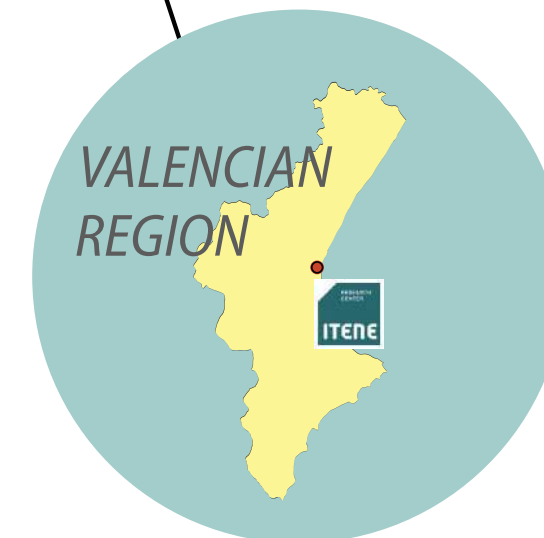


## Contact

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## Location

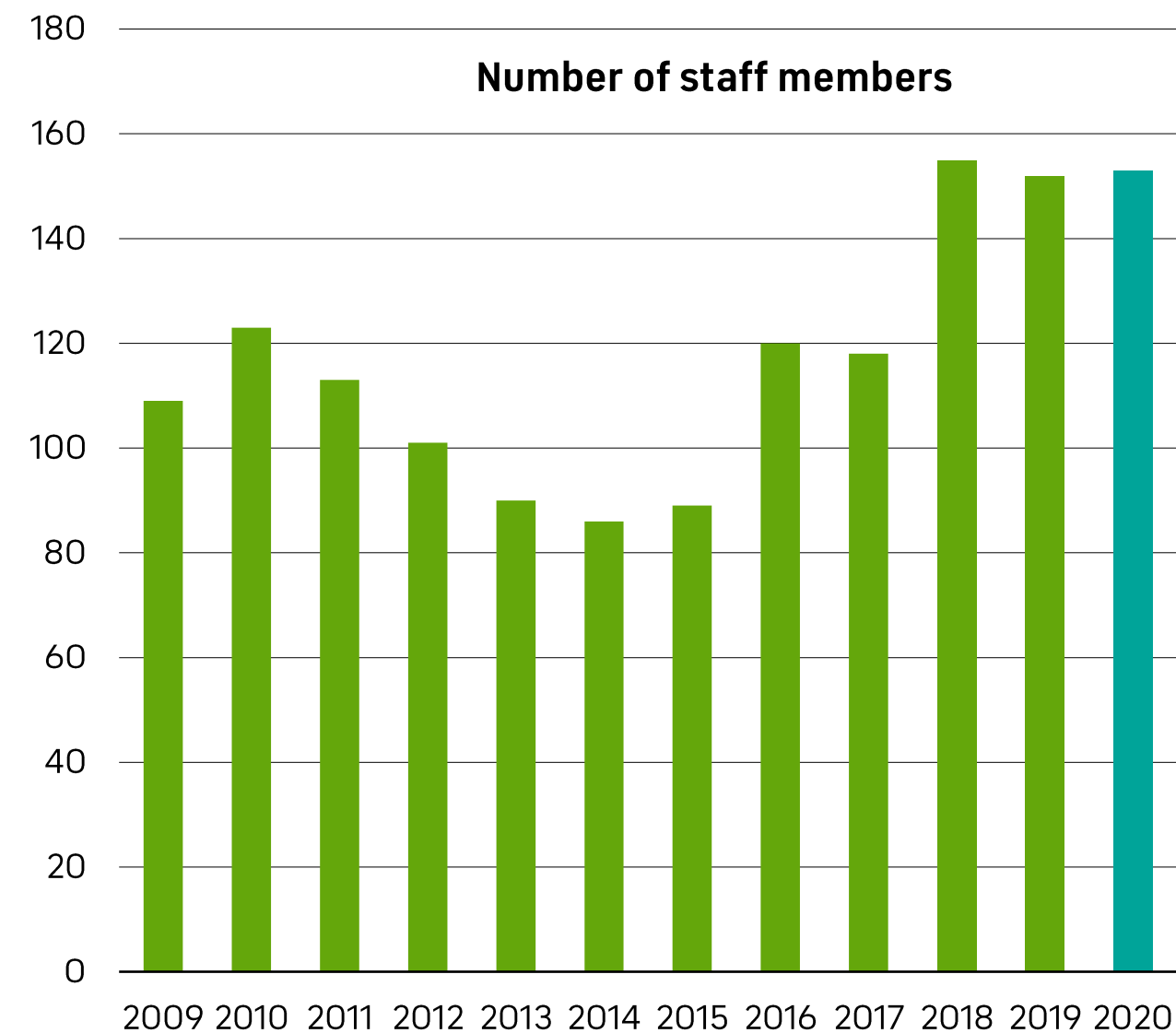
Parque Tecnológico  
C/ Albert Einstein, 1  
46980 Valencia, Spain

# 1 / Who we are

## OPERATIONS | Team staff

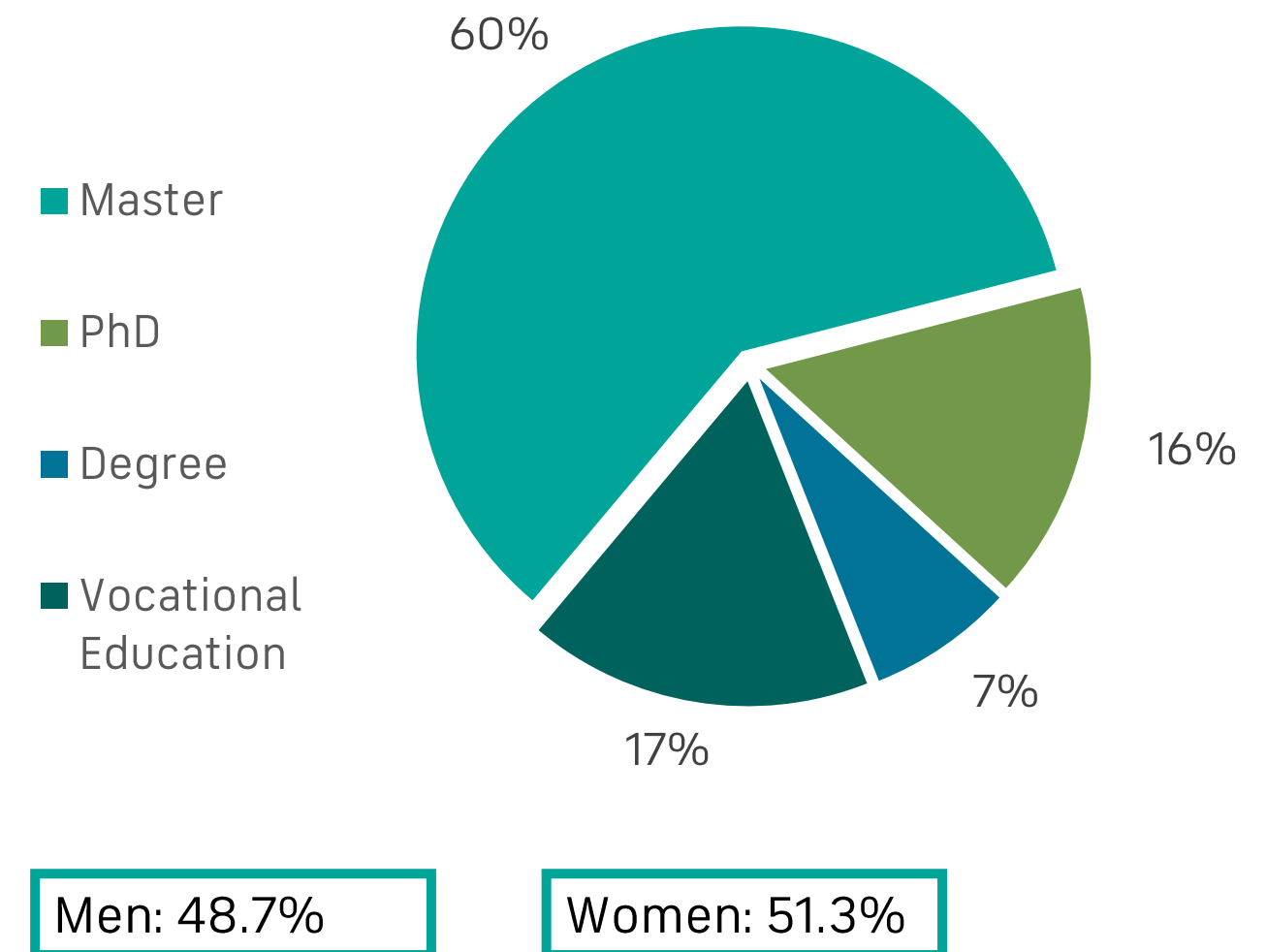
### GROWTH

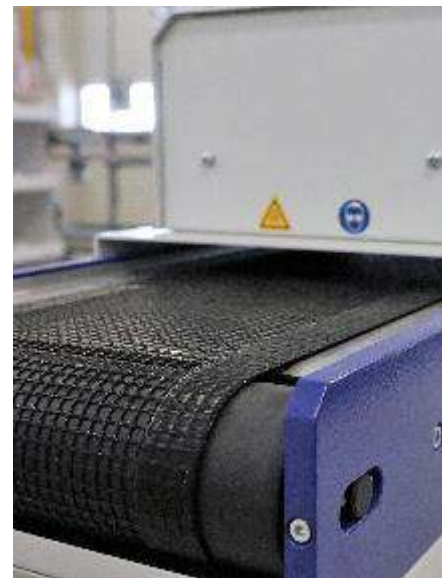
Our team has grown solidly and steadily in recent years.



### EXCELLENCE

Three quarters of our professionals have a master's or doctorate degree in their field.





# 1/ Who we are

## FACILITIES | Laboratories and pilot plants

ITENE's headquarters are located in a **7,250 m<sup>2</sup> building owned by ITENE**

These facilities include **3,000 m<sup>2</sup>** of laboratories and pilot plants.

### LABORATORIES

- Chemical characterisation of materials
- Physical-mechanical characterisation of materials
- Microbiological analysis
- Nanosafety
- Packaging assessment
- Approval of dangerous goods packaging

### PILOT PLANTS

- Packaging
- New materials and processing
- Packaging production
- Modification and synthesis of additives
- Compostability  
Assessment of packaging materials

### CENTRES

- Transportation simulation

# 1 / Who we are

## NETWORKING | Entities of which we are members

### International scale



#### ISTA

International Safe Transit Association (ISTA)

- President of the Board of Directors (Europe)



#### IAPRI

International Association of Packaging Research Institutes.



#### EPIC

European Packaging Institutes Consortium.



#### EARTO

European Association of Research and Technology Organisations.



#### ETP-ALICE –

Alliance for Logistics Innovation through Collaboration in Europe

- Executive Group,
- Urban Logistics working group.



#### SPIRE

European association SPIRE, Sustainable Process Industry Through Resource and Energy Efficiency.



#### HISPACK

International Packaging Exhibition Barcelona.

- Organizing Committee



#### GALIA

French Automotive Industry Cluster



2/

What we do



## 2/ What we do **TECHNOLOGIES**



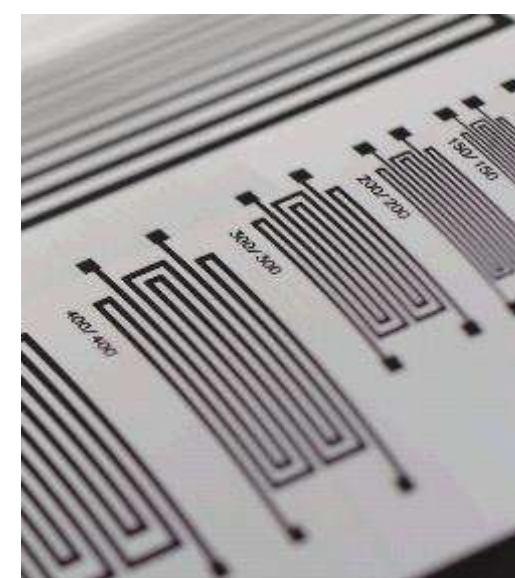
**New advanced materials**



**Functional additives & Nano-materials**



**Packaging and packaging systems**



**Functional coatings & electronic printing**



**Circular economy & sustainability**



**Packaging for distribution**



**Logistics, transport and distribution**



**Urban mobility and intermodality**



**Security of goods and people**

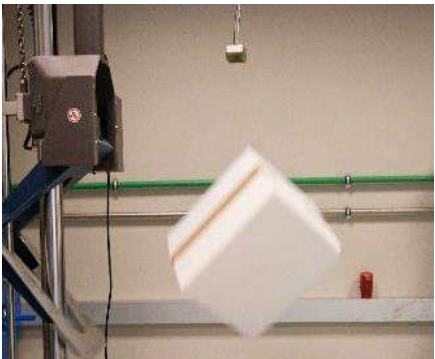
We work with all the **state-of-the-art technologies.**



Material characterisation



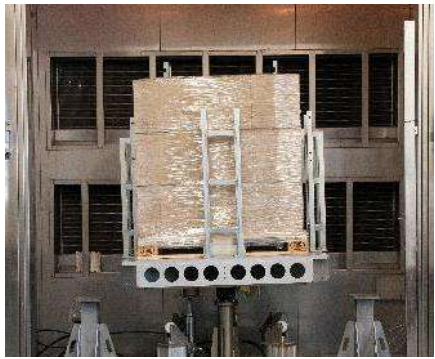
Packaging safety and ergonomics



Packaging assessment



Approval of packaging and containers for dangerous goods transport



Transportation simulation



Safety for packaging in contact with foodstuffs



Compostability



Safety in working environments

## 2 / What we do

### FACTS & FIGURES | Testing services

**+500** Specialised packaging tests

**116** Accredited tests

### Certified laboratories



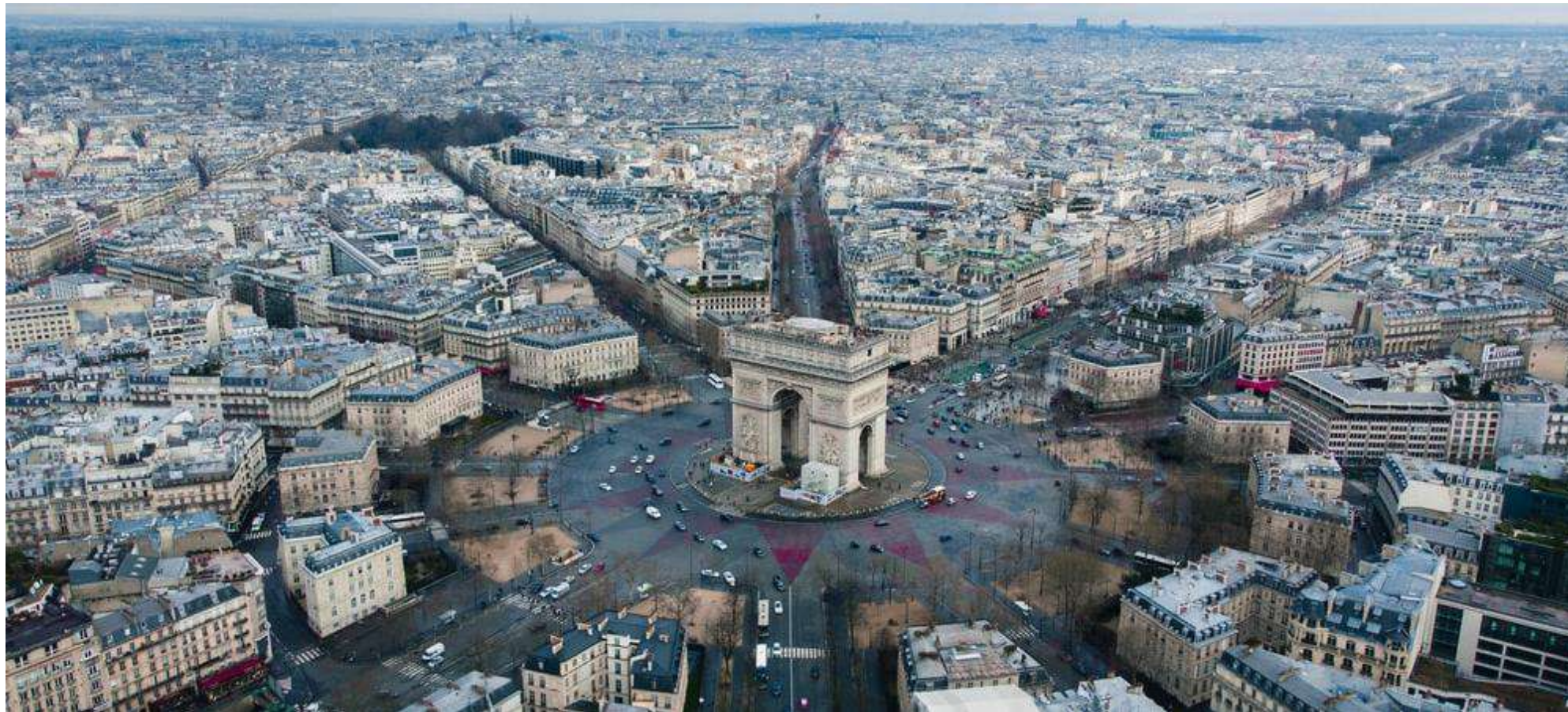
### Accreditations



### Approvals

ITENE is the first laboratory appointed by **Amazon** as an **APASS member** (Amazon Packaging Support and Supplier Network).





### 3 / What we do in France

### 3 / What we do in FRANCE

ACTIVITIES IN FRANCE | EU funded projects | French partners



#### Other research centers



### 3 / What we do in FRANCE

ACTIVITIES IN FRANCE | EU funded projects | French partners



#### Chemicals & Materials



**SOLVAY**

**Honeywell**



#### Plastic additives



#### BioPlastic material industries



**NaturePlast**  
L'expert en Bioplastiques



**AHLSTROM  
MUNKSJÖ**

#### Paper packaging materials

#### Plastic packaging industries



*Ets*

**Bugnon**



#### Packers



#### Retailers

**Carrefour**



#### Consulting/ Engineering



**VERTECH  
GROUP**



#### Waste Management systems and equipment industries



### 3 / What we do in France

#### ACTIVITIES IN FRANCE | Portfolio of clients and services

##### SECTOR PORTFOLIO

###### FOOD & BEVERAGE

- Food ingredients
- Dietetic and Nutrition
- Water

###### PACKAGING

- Biobased plastic materials
- Plastic packaging
- Plastic films
- Paper and cardboard boxes
- Pallets
- Tape/ Seals
- Machinery



##### SERVICES PORTFOLIO

###### PACKAGING TESTING

- Transport simulation protocols
- Transport monitoring
- Validation (e.g. Compression testing)

###### FUNCTIONALITY and PERFORMANCE

- Barrier properties (Oxygen, Watervapor)

###### FOOD SAFETY

- Compliance
- BPA
- Migration

###### SUSTAINABILITY

- Biodegradation & compostability testing



**Packaging  
sustainability and  
performance.**

**4 / Drivers, challenges  
and solutions.**

## 4 / Packaging sustainability and performance. Drivers, challenges and solutions.

# B2B Packaging R & D drivers



### **POLICIES/ LEGISLATION**

- GOVERNMENTS
- GLOBAL INITIATIVES



### **TECHNOLOGY**

- PACK. SUPPLIERS
- MANUFACTURERS
- RECYCLERS



### **CUSTOMERS**

- INDUSTRY
- TRADE
- CONSUMERS

## 4 / Packaging sustainability and performance. Drivers, challenges and solutions.

### PACKAGING SUSTAINABILITY REGULATIONS



## 4 / Packaging sustainability and performance. Drivers, challenges and solutions.

### EU ACTION PLAN FOR THE CIRCULAR ECONOMY

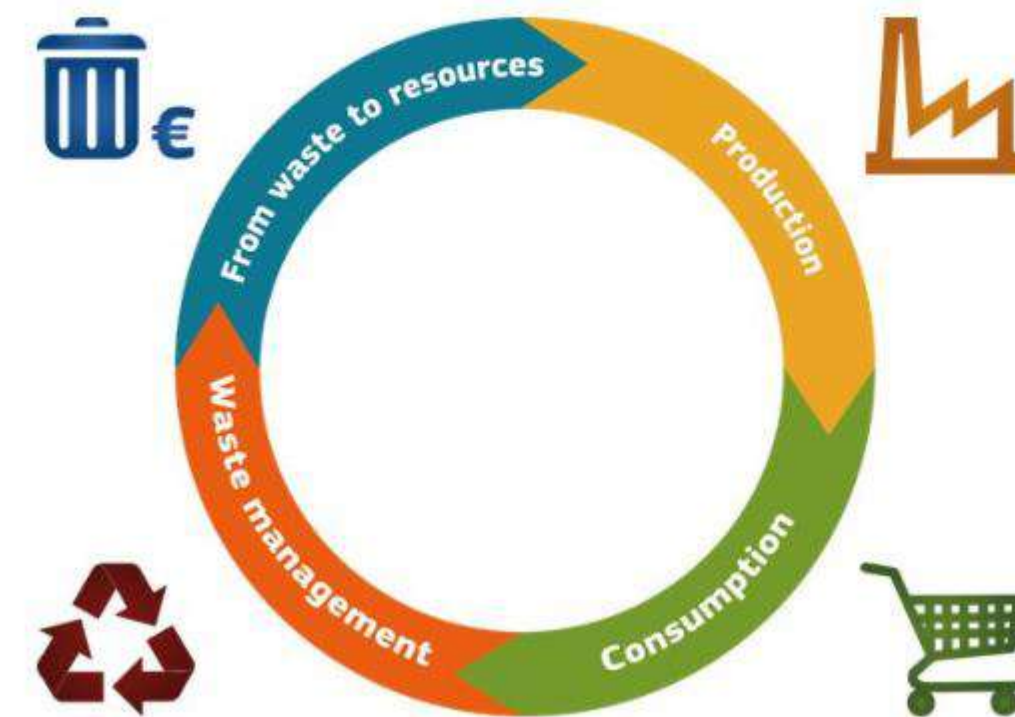
#### The EU Action Plan – Closing the loop

It establishes a concrete and ambitious programme of action, with measures covering the whole cycle: from production and consumption to waste management and the market for secondary raw materials.

#### From a Linear Economy...



#### ... to a Circular Economy



## 4/ Packaging sustainability and performance. Drivers, challenges and solutions.

### WASTE MANAGEMENT HIERARCHY (FROM DIRECTIVE 2008/98/EC ON WASTE)

#### Key components

- Sets the basic concepts and definitions related to **waste management**, such as definitions of **waste**, **recycling**, **recovery**.
- It establishes the **waste management hierarchy**
- The waste hierarchy favors **prevention**, then **re-use**, then **recycling**.



## 4 / Packaging & Sustainability

### EUROPEAN STRATEGY FOR PLASTICS IN A CIRCULAR ECONOMY

#### European Strategy for plastics

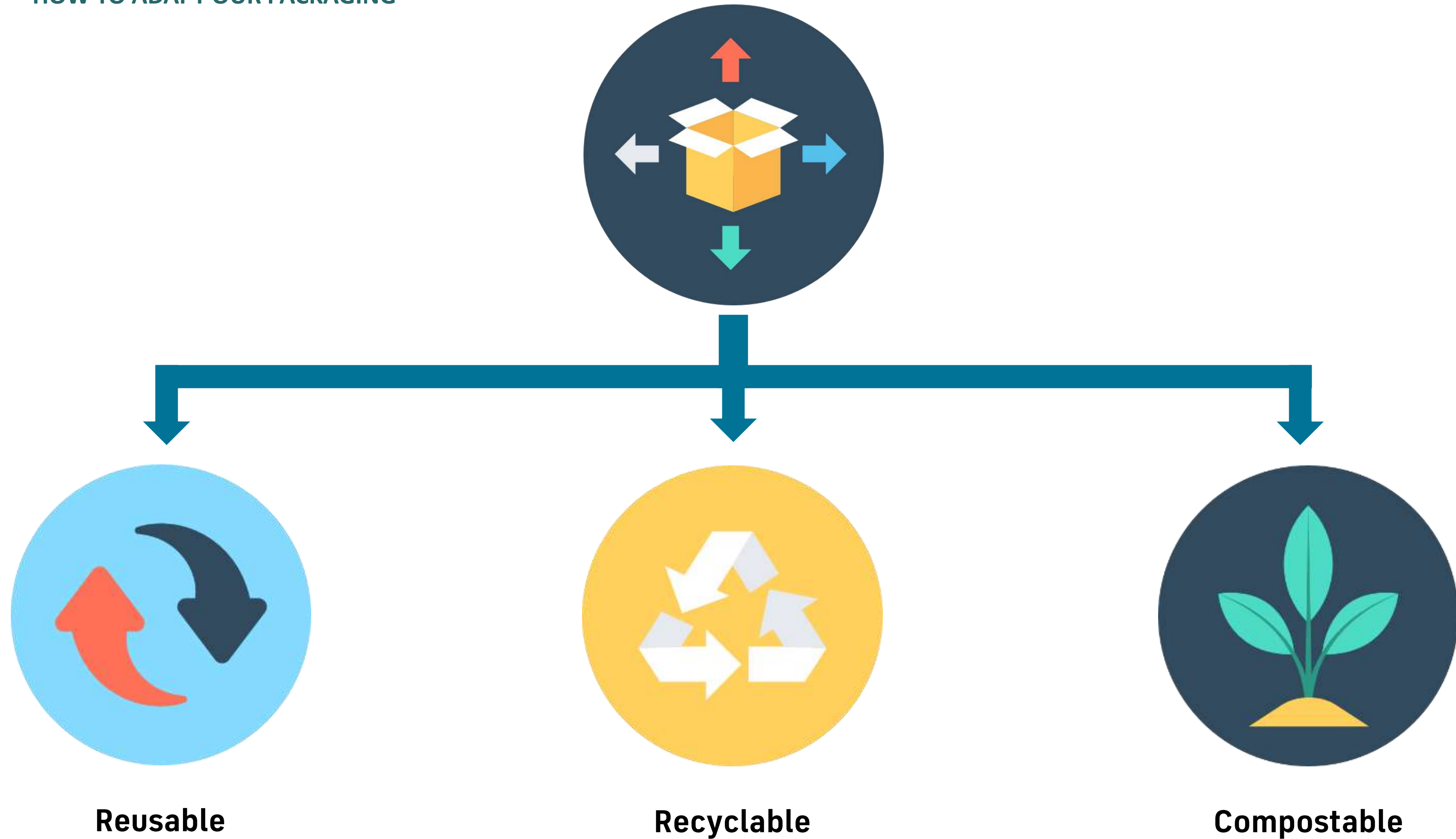
Series of actions to achieve the necessary change in the plastics industry to reduce the **generation of waste, increase the recycling rate and its reuse.**

#### Objectives



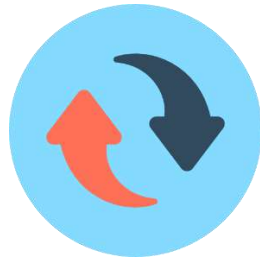
## 4 / Packaging sustainability and performance. Drivers, challenges and solutions.

### HOW TO ADAPT OUR PACKAGING



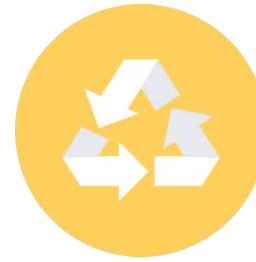
## 4 / Packaging sustainability and performance. Drivers, challenges and solutions.

### UNDERSTANDING CONCEPTS (FROM DIRECTIVE 94/62/EC)



#### REUSE

Any operation by which packaging, which has been conceived and designed to accomplish within its life cycle a minimum number of trips or rotations, is refilled or used **for the same purpose for which it was conceived**



#### RECYCLING

Reprocessing in a production process of the waste materials **for the original purpose or for other purposes** including organic recycling but excluding energy recovery

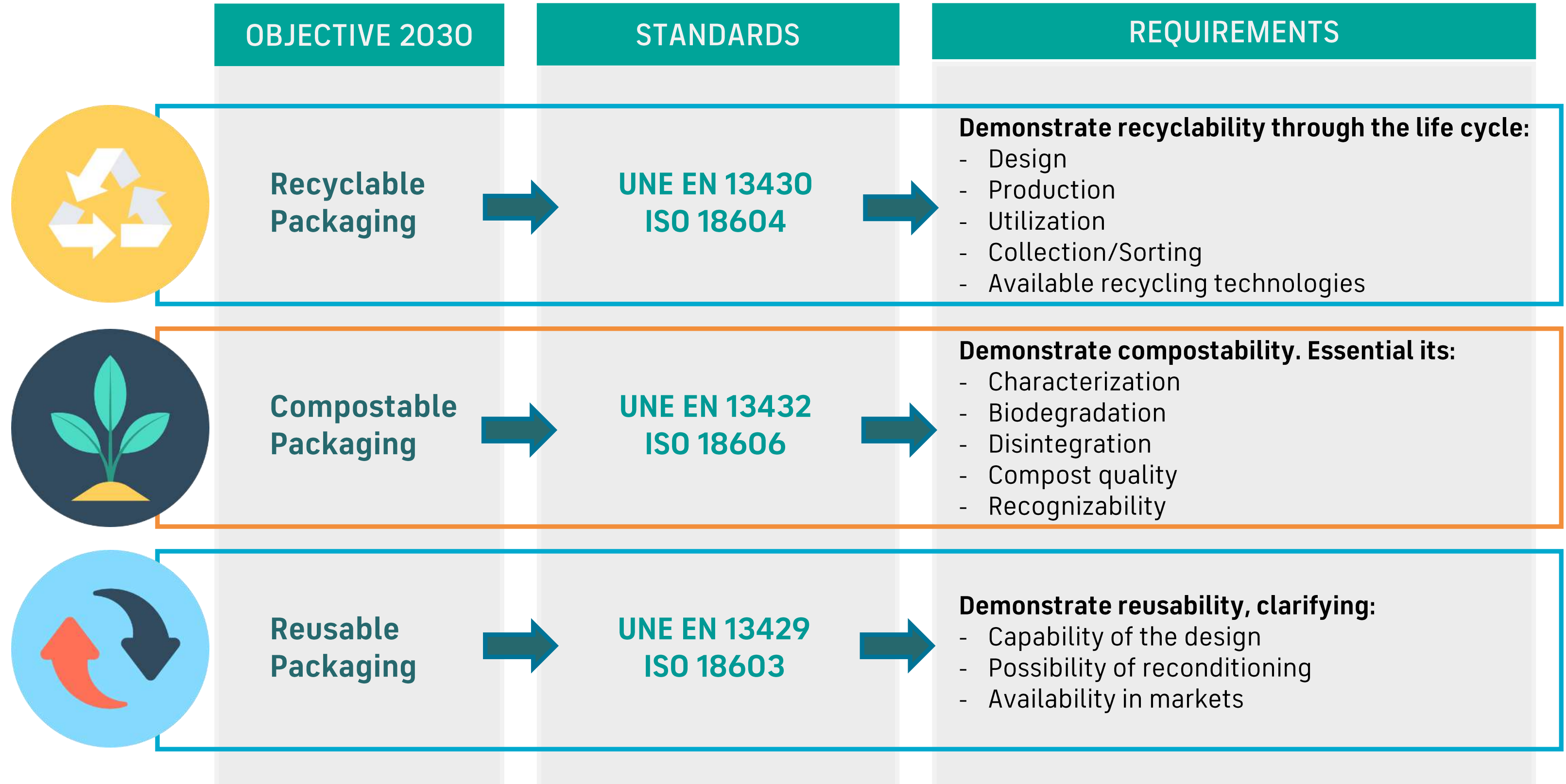


#### ORGANIC RECYCLING

The aerobic (composting) or anaerobic (biomethanization) treatment, **under controlled conditions and using micro-organisms**, of the biodegradable parts of packaging waste, which produces stabilized organic residues or methane. Landfill shall not be considered a form of organic recycling

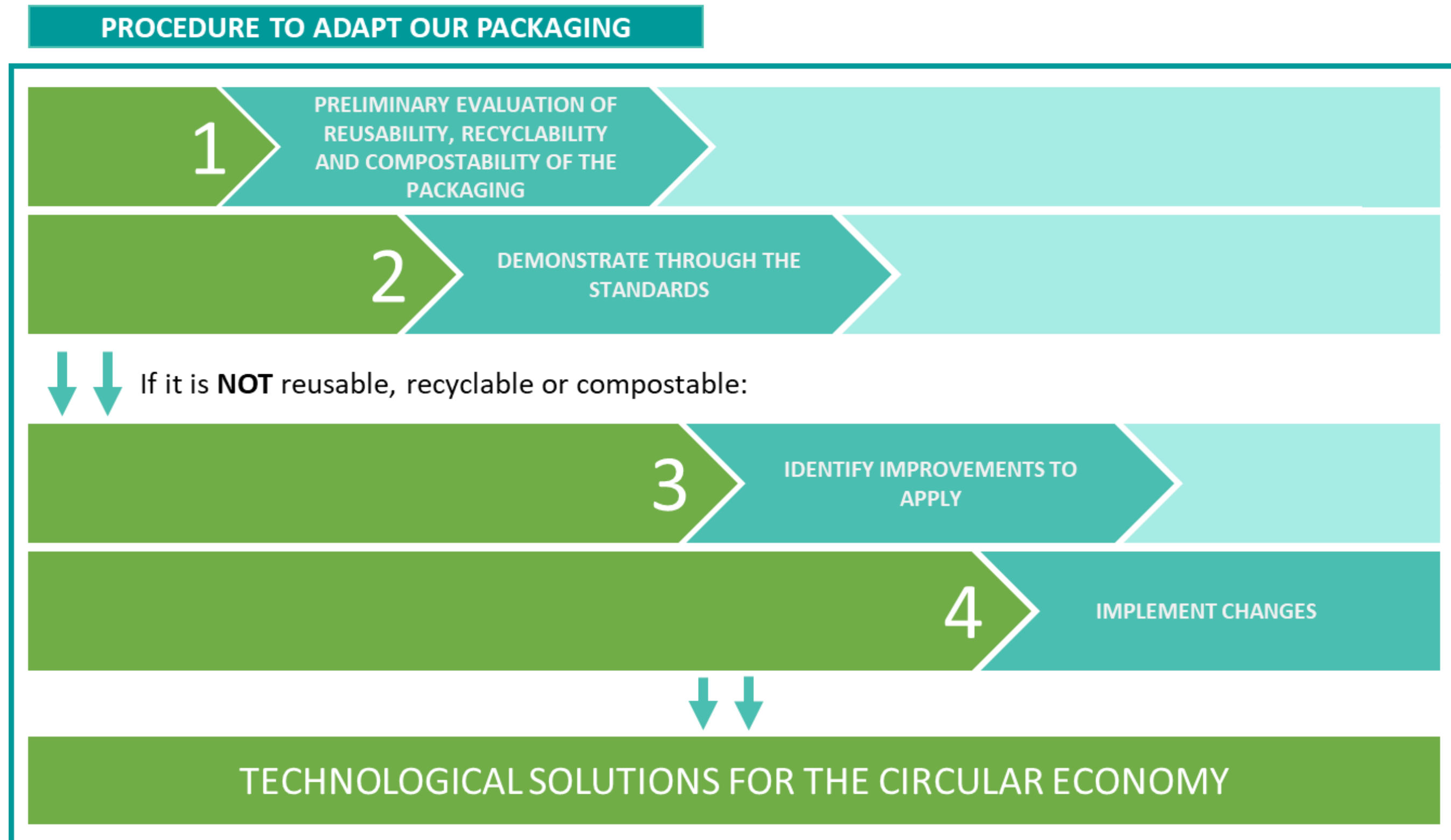
## 4 / Packaging sustainability and performance. Drivers, challenges and solutions.

### STANDARDS



# 4 / Packaging sustainability and performance. Drivers, challenges and solutions.

## PROCEDURE TO ADAPT OUR PACKAGING



## 4 / Packaging sustainability and performance. Drivers, challenges and solutions.

### ECO-DESIGN AND LIFE CYCLE ANALYSIS | Capabilities

#### Eco-design

Product eco-design takes into account the entire life cycle, from manufacturing processes and material use to waste reduction.



#### European Green Deal (Dec. 2019)

It aims to bring together under a common narrative and a single umbrella the multiplicity of Directives and other European initiatives aimed at reducing the impact on the environment with one main objective:

- GHG reduction to **50-55% by 2030 compared to 1990**
- **Climate neutral by 2050**

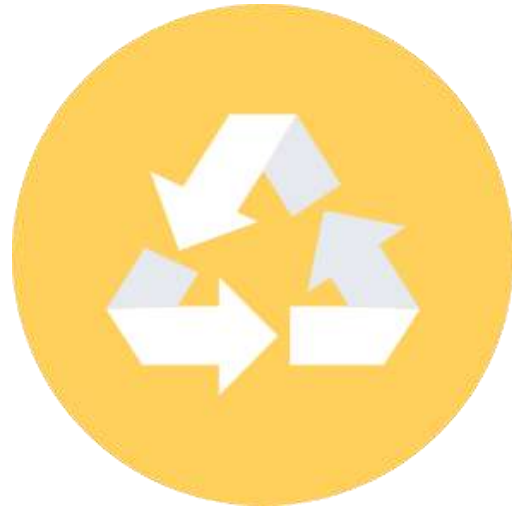
#### Carbon footprint analysis (LCA)

The packaging, transport and logistics sector is a key player in the European Green Deal.

- Environmental indicator that quantifies the amount of direct and indirect Greenhouse Gas (GHG) emissions from an individual, product, event or organization. It is measured in terms of mass of CO2 equivalent (CO2-eq).
- It can be applied to the **eco-design process**

## 4/ Packaging sustainability and performance. Drivers, challenges and solutions.

### RECYCLABILITY ASSESSMENT | Capabilities



**Recyclable**

Packaging  
Recyclability  
Assessment  
according to EN  
13430/ISO 18604



Evaluation of the 5 requirements according to the standard



Recyclability rate



Report on recyclability



Self-declaration



Logo on packaging (Recyclable 18604)

4 / Packaging sustainability and performance. Drivers, challenges and solutions.

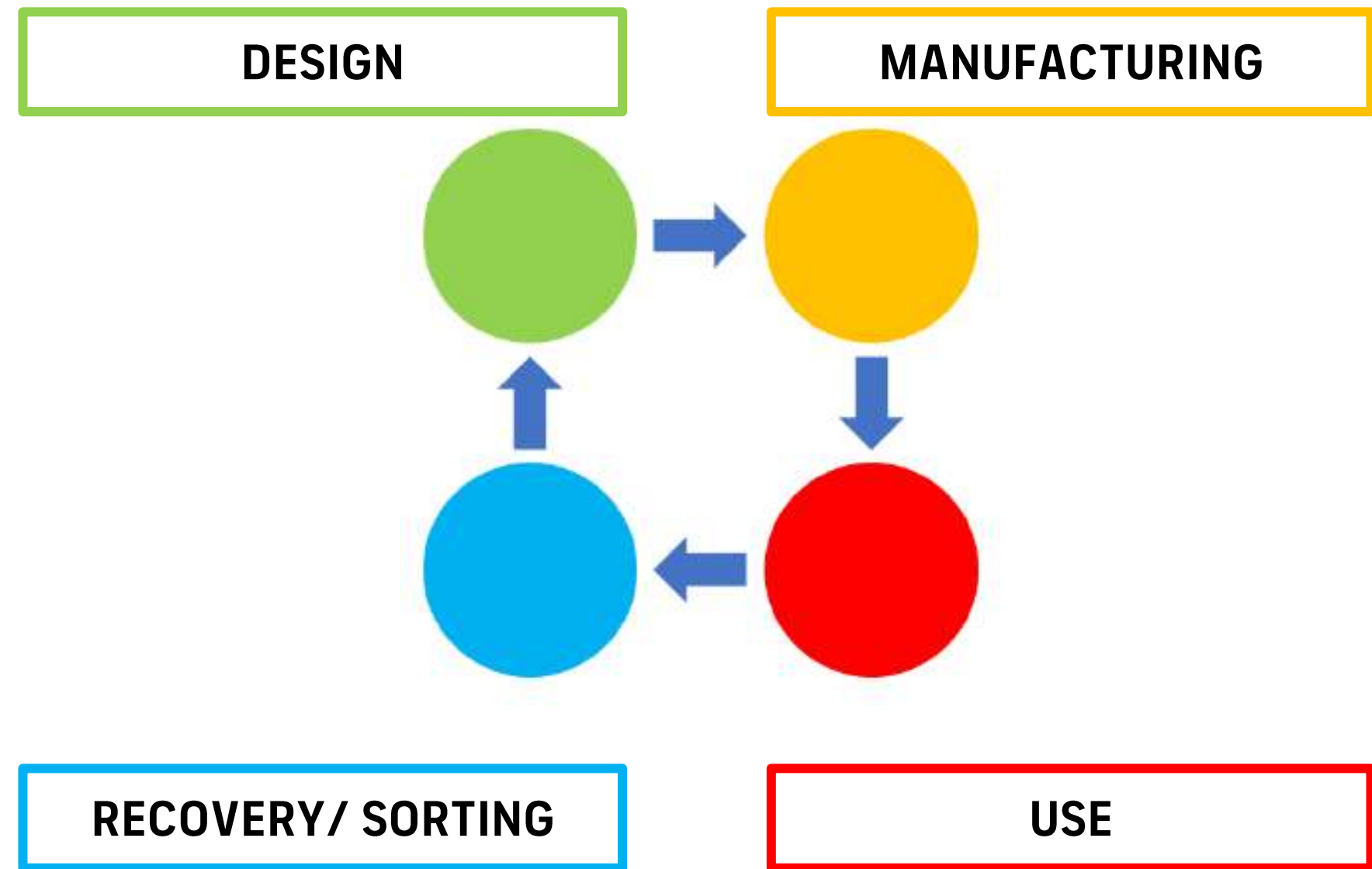
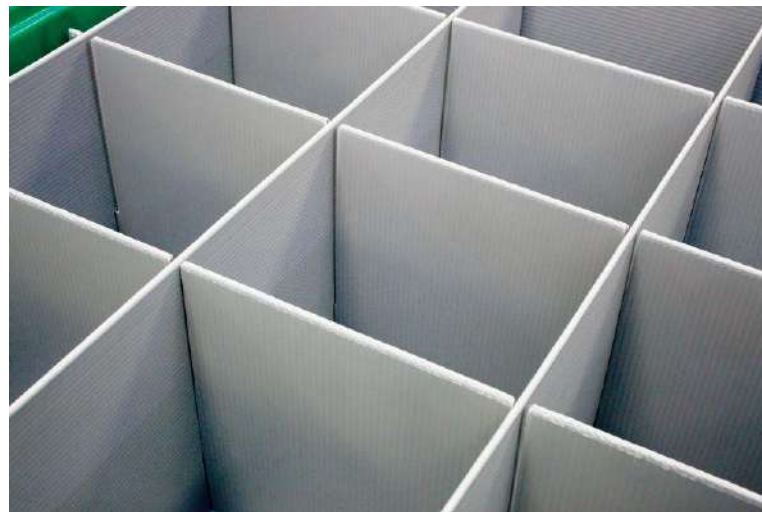
RECYCLABILITY ASSESSMENT | 1.- Packaging description



Componentes	Material	Peso (Kg)	Dimensiones (mm)
Pallet			
Celdillero			
Faja			
Protección metálica			
Frontal			
Etiquetero			
Frontal flexible			
Cantoneras			
Tapa			
Tornillos, arandelas, etc			
Velcros			
Tubo posicionador			
Barra posicionador			
Cinta tapa			
PESO TOTAL			kg

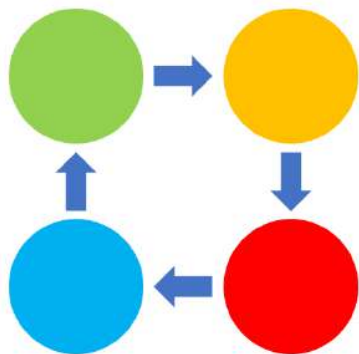
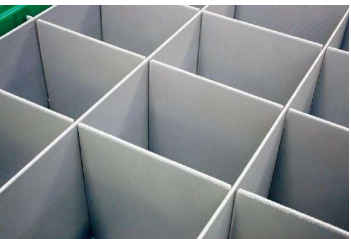
#### 4/ Packaging sustainability and performance. Drivers, challenges and solutions.

### RECYCLABILITY ASSESSMENT | 2.- Criteria for the analysis of recyclability



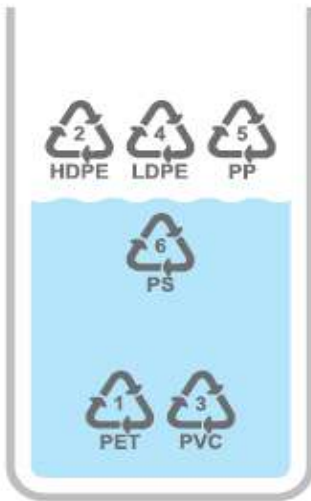
4 / Packaging sustainability and performance. Drivers, challenges and solutions.

RECYCLABILITY ASSESSMENT | 2.- Criteria for the analysis of recyclability



DESIGN

- Compatibility with recycling systems
- Emissions to the environment from packaging recycling
- Component separability
- Compatibility of the composition or combination of materials
- Tolerances not supported elements

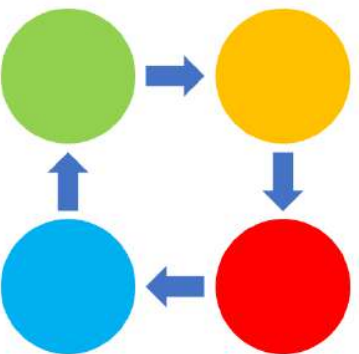


Main component	Secondary component								
	HDPE	LDPE	PP	PVC	PS	PET	Paper/ cardboard	Steel	Aluminium
HDPE									
LDPE									
PP									
PVC									
PS									
PET									
Paper/ cardboard									
Aluminium									

		Criteria for recyclable packaging	
		Suitability of available recycling technology	Emissions to the environment from the recycling of containers and packaging
Design criteria	Separability of components	~	✓
	Compatibility of constituent material or combination of materials in the recycling process	✓	✓
	Acceptable tolerances for non-compatible elements or substances in the recycling process	✓	✓

4 / Packaging sustainability and performance. Drivers, challenges and solutions.

RECYCLABILITY ASSESSMENT | 2.- Criteria for the analysis of recyclability



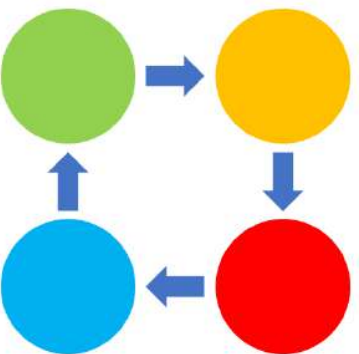
MANUFACTURING

- Control of the construction / composition and treatment of packaging
- Emissions to the environment from packaging recycling
- Raw materials and material composition in production, conversion and filling
- Control and changes during processing

		Control de la construcción/composición y tratamiento de los envases y embalajes	Emisiones al medio ambiente procedentes del reciclaje de envases y embalajes
Criterios de producción	Materias primas y composición de materiales en la producción, conversión y llenado	✓	✓
	Control y cambios durante el procesado	✓	✓

4 / Packaging sustainability and performance. Drivers, challenges and solutions.

RECYCLABILITY ASSESSMENT | 2.- Criteria for the analysis of recyclability



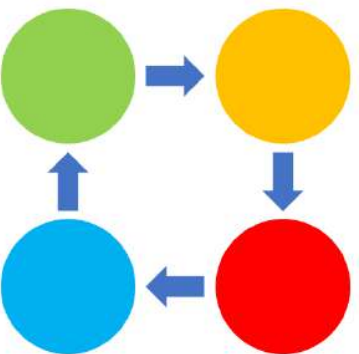
USE

- Control of the construction / composition and treatment of packaging
- Emissions to the environment from packaging recycling
- Compliance with other essential safety and hygiene requirements for the user
- Emptying of the product by end user, does not interfere the remains in the recycling
- Classification and identification of the of waste by end user (collection, classification and recycling)

		Control de la construcción/composición y tratamiento de los envases y embalajes	Emisiones al medio ambiente procedentes del reciclaje de envases y embalajes
Criterios de utilización	Imparcialidad para los requisitos esenciales	✓	✓
	Vaciado por el usuario final	✓	✓
	Clasificación por el usuario final	✓	✓

4 / Packaging sustainability and performance. Drivers, challenges and solutions.

RECYCLABILITY ASSESSMENT | 2.- Criteria for the analysis of recyclability



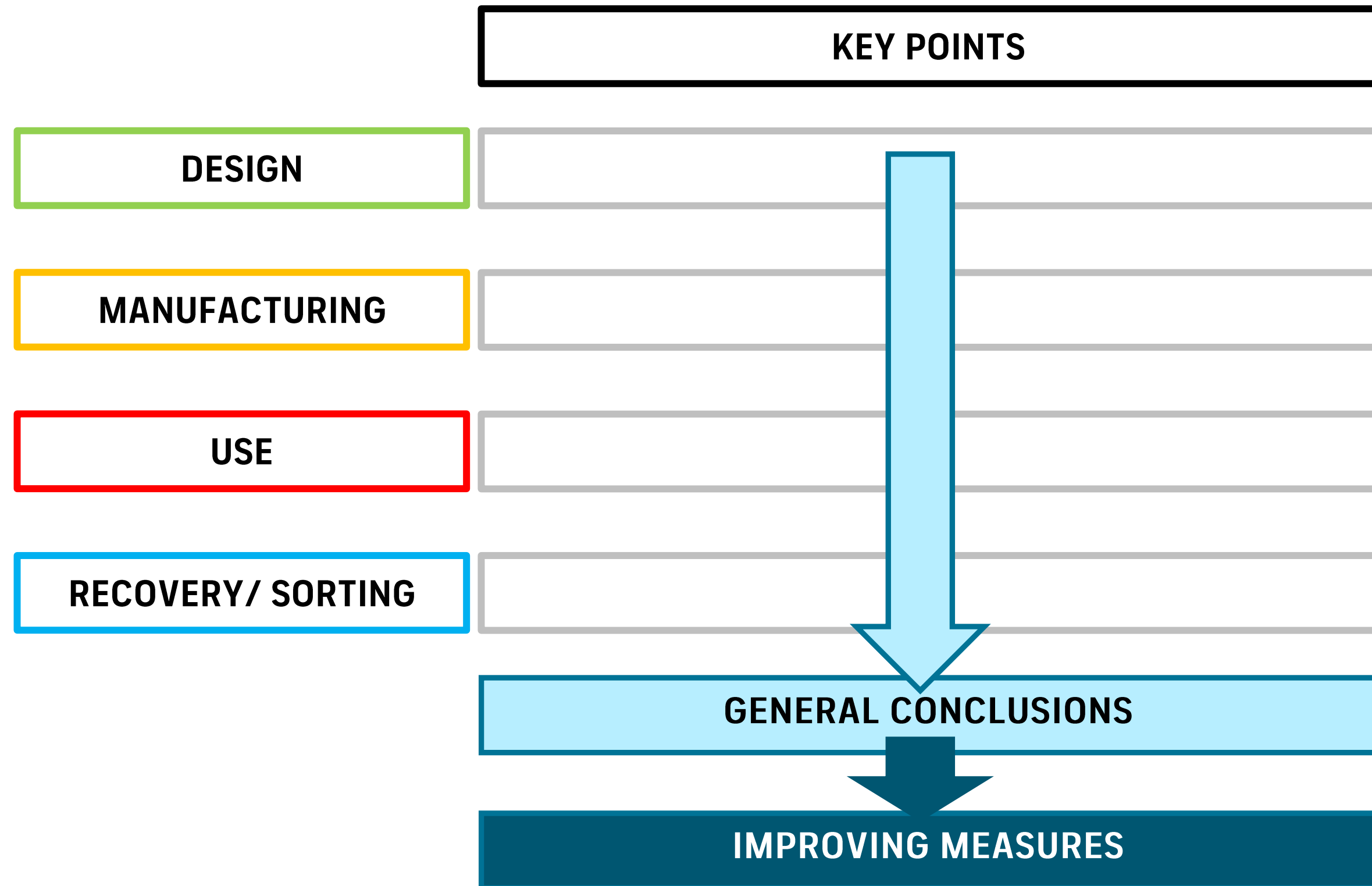
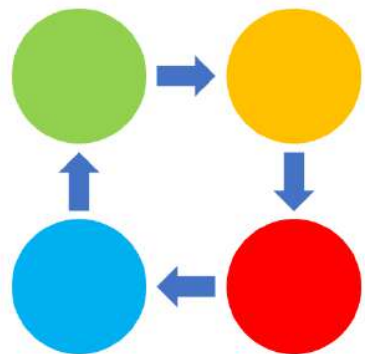
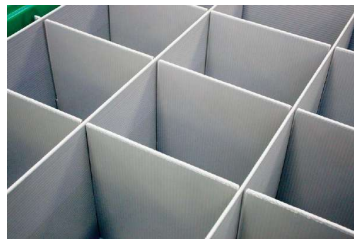
RECOVERY/ SORTING

- Control of the construction / composition and treatment of packaging
- Suitability of available recycling technology
- Emissions to the environment from recycling
- Collection and sorting systems available

		Control de la construcción/composición y tratamiento de los envases y embalajes	Idoneidad de la tecnología de reciclaje disponible	Emisiones al medio ambiente procedentes del reciclaje de envases y embalajes
Criterios de recogida - Clasificación	Sistemas de recogida y clasificación disponibles	~	✓	✓

#### 4 / Packaging sustainability and performance. Drivers, challenges and solutions.

### RECYCLABILITY ASSESSMENT | 3.- Impediments to recycling

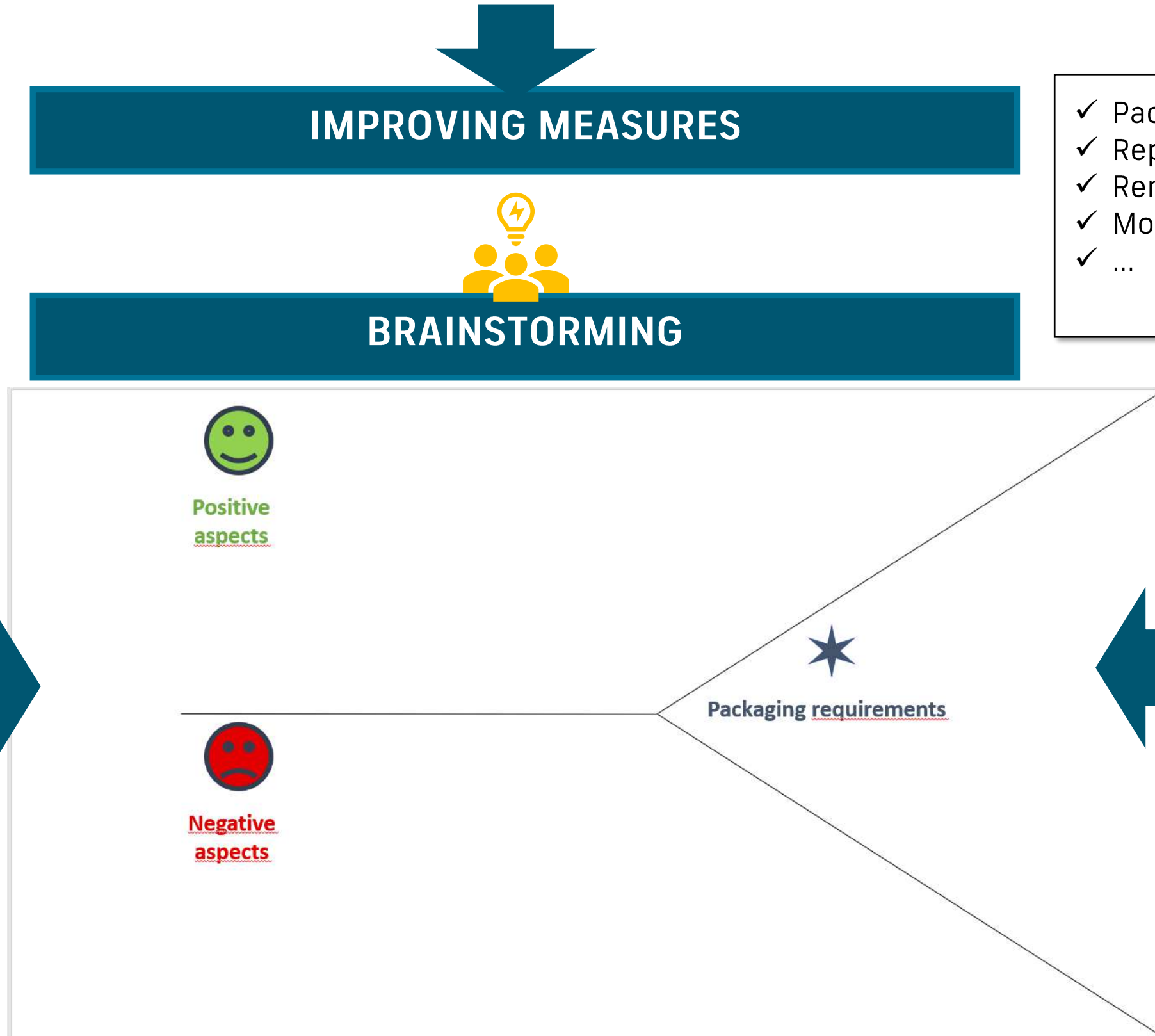


#### 4/ Packaging sustainability and performance. Drivers, challenges and solutions.

### RECYCLABILITY ASSESSMENT | 3.- Impediments to recycling



COMPANY



- ✓ Packaging redesign
- ✓ Replace material
- ✓ Remove material
- ✓ Mono-material
- ✓ ...



4 / Packaging sustainability and performance. Drivers, challenges and solutions.

RECYCLABILITY ASSESSMENT | 4.- Percentage of recyclability



1	Unidad Funcional de Envase o Embalaje						
	Componentes	Componente 1	Componente 2	Componente 3	Componente 4	Componente 5	Componente 6
2	Descripción						
3	Peso del componente como % de la unidad funcional total						
4	Si el componente es aceptado en su totalidad para el reciclado en base a normas o especificaciones nacionales, europeas, internacionales o comerciales, se proporciona una referencia detallada						
5	Si el componente cumple con tal(es) norma(s)/especificaciones se rellena la línea 6 – y entonces se va a la línea 11 y se anota que el 100% está disponible para el reciclado. Si no es así, se continúa en la línea 6.						
6	Flujo de material deseado	Metal	Plástico	Plástico	Metal	Plástico	-
7	Se recomienda una alternativa tal como la recuperación cuando se identifiquen constituyentes dentro del componente que puedan causar problemas en el reciclado global. Referencia el Informe CR 13688						
8	Constituyentes propensos a causar problemas en la recogida y clasificación						
9	Constituyentes propensos a causar problemas en el reciclado						
10	Constituyentes propensos a causar una influencia negativa en el reciclado final						
11	Porcentaje en peso del componente disponible para el reciclado						
12	Porcentaje en peso de la unidad funcional disponible para el reciclado (Línea 11*Línea 3/100)						
13	Porcentaje total disponible para el reciclado (suma la línea 12)	Fecha y firma					

## 4/ Packaging sustainability and performance. Drivers, challenges and solutions.

### REUSABILITY ASSESSMENT | Capabilities



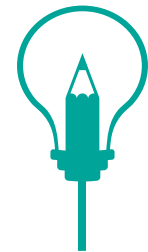
#### Reusable

Packaging Reusability Assessment according to:

- UNE EN 13429/ISO 18603 "Packaging – Reuse "
- UNE-CEN / TR 14520 IN: 2008 "Containers and packaging. Reuse. Methods for evaluating the fitness for use of the reuse system "
- Guides on reuse and recyclability of official European organizations



Evaluation of the 5 requirements according to the standard



Suitability of the container or packaging for reuse



Reuse system (open, closed or hybrid)



Reconditioning system



Conformity declaration

## 4/ Packaging sustainability and performance. Drivers, challenges and solutions.

### REUSABILITY ASSESSMENT | 2.- Criteria for the analysis of reusability



#### PACKAGING APTITUD FOR REUSE

- Deliberate objective
- Design suitable for multiple circuits or rotations
- Empty / Unloaded
- Refilled / Reloaded
- End of life

#### REUSE SYSTEM (OPEN, CLOSED OR HYBRID)

- Manufacturer / Asset Manager / Supplier / Customer
- Cleaning / Repairing / Reconditioning
- Reload process

#### RECONDITIONING SYSTEM

#### 4 / Packaging sustainability and performance. Drivers, challenges and solutions.

### REUSABILITY ASSESSMENT | 2.- Criteria for the analysis of reusability



#### RECONDITIONING SYSTEM

- Packaging conditions evaluation
- Disposal of damaged or non-reusable parts
- Product removal
- Cleaning and washing as required
- Repair (if applicable)
- Inspection and evaluation according to requirements
- Re-entry into the Reuse System

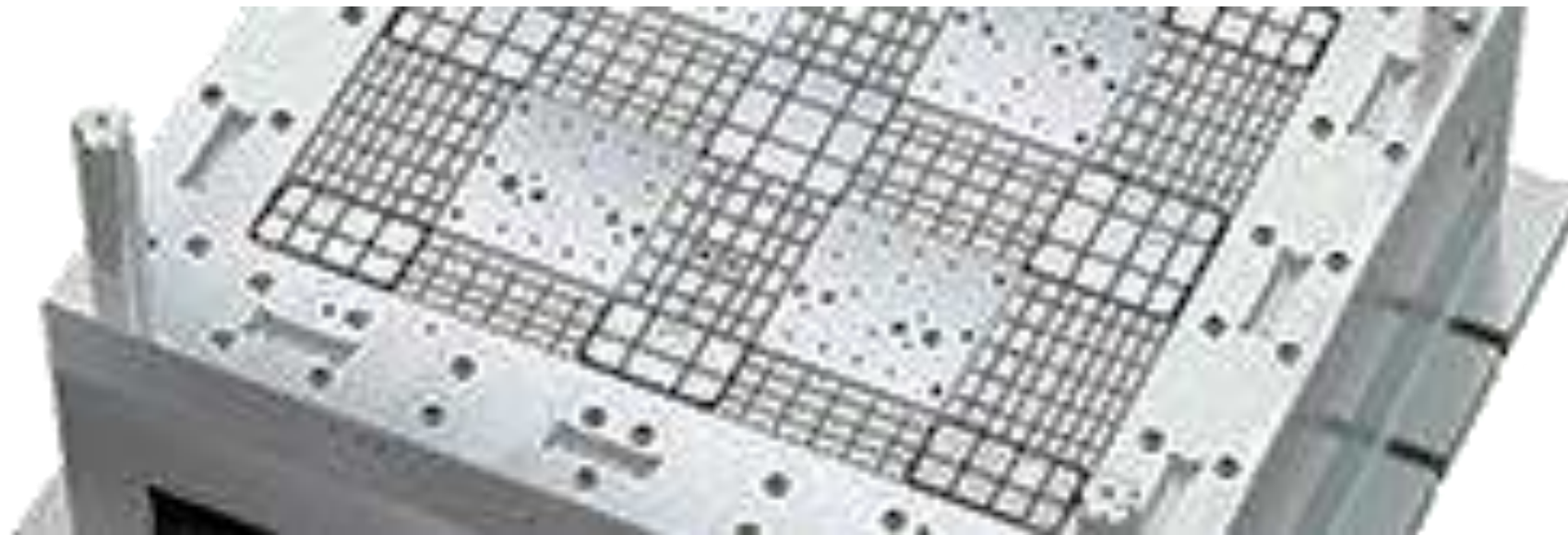
4 / Packaging sustainability and performance. Drivers, challenges and solutions.

REUSABILITY ASSESSMENT | 3.- Declaration of conformity



DECLARACIÓN DE CONFORMIDAD		
A continuación, se presentan los criterios de capacitación de la familia de envase objeto de estudio, así como las referencias y las fuentes donde se pueden consultar, que permiten la demostración de conformidad de dicho envase o familias de envase con la norma ISO 18603 referente a la reutilización de envases.		
Tabla 2. Demostración de conformidad con la ISO 18603		
Identificación del envase o embalaje		
Embalaje Dimensiones: 1214 x 1014 x 1200 mm		
Criterios de capacitación	Si/No	Referencias y fuentes
Teniendo en cuenta las circunstancias/localizaciones particulares de uso, la intención es que el envase o embalaje sea reutilizado		Documento técnico 18603/2019/2, p.7
El diseño del envase permite que los componentes principales lleven a cabo un número de circuitos o rotaciones en las condiciones normales de uso predecibles		Planos de especificaciones de las partes
El envase o embalaje puede ser vaciado/descargado sin daños significativos, además de poder ser reparado de manera viable		Procedimiento de reacondicionamiento (p. 9-10)
El envase o embalaje puede ser reacondicionado conforme con el anexo B (limpiado, lavado, reparado) por cualquier método y para cualquier nivel puede especificarse, mientras que se mantenga su capacidad para cumplir su función deseada		Procedimiento de reacondicionamiento (p. 9-10)
Cualquier proceso de reacondicionamiento dentro del control del envasador/llenador se gestiona de modo que se tenga en cuenta su impacto medioambiental		Procedimiento de reacondicionamiento (p. 9-10)
Está disponible un proceso de reacondicionamiento y es aplicable a los envases o embalajes reutilizables, incorporando todos los elementos esenciales		Procedimiento de reacondicionamiento (p. 9-10)
El envase o embalaje puede ser rellenado/recargado sin riesgos para la integridad del producto o para la salud y seguridad de aquellos responsables de llevarlo a cabo		Procedimiento de reacondicionamiento (p. 9-10)
En las circunstancias y localizaciones del uso deseado, las disposiciones (organizativas, técnicas, financieras) están establecidas y están disponibles para hacer posible la reutilización		Disponibilidad de un sistema de reutilización (p. 8-9)
Se identifica al sistema de reutilización como apropiado, en las actuales circunstancias de uso		Sistema de reutilización cerrado (p. 8-9)
A la luz de las respuestas registradas arriba, este envase o embalaje se considera que es reutilizable dentro de los términos de la Norma ISO 18603:2013.		
Fecha:		
Firma		





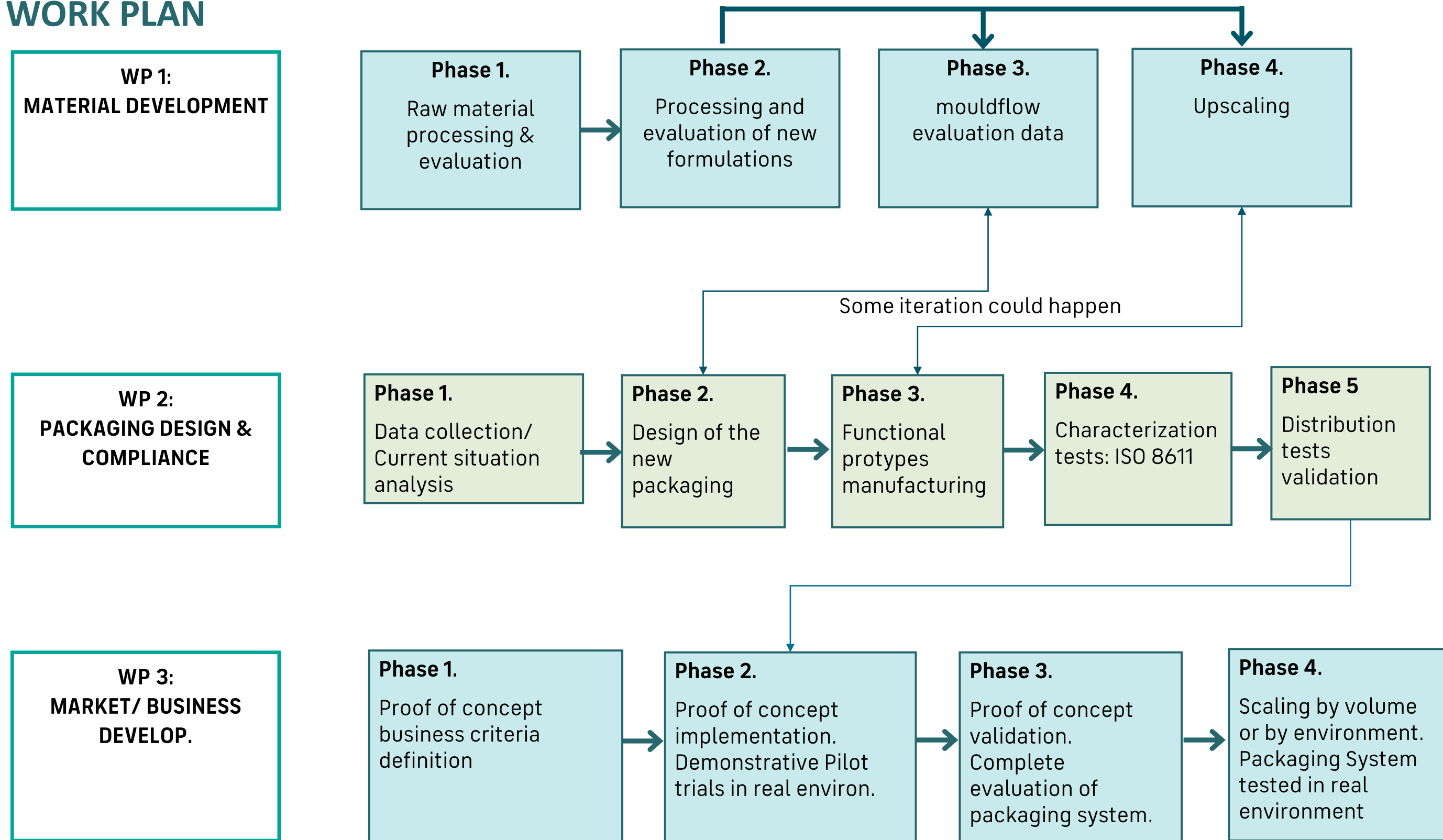
5/

**BUSINESS CASE**  
Development of new  
reusable industrial  
plastic packaging

Development of  
engineered resin  
blends and end-user  
driven design

# 5 / Development of new reusable industrial plastic packaging

## WORK PLAN



## 5 / ITENE's Circular economy technologies VALUE CHAIN TECHNOLOGIES | Capabilities



**New packaging materials and material development**



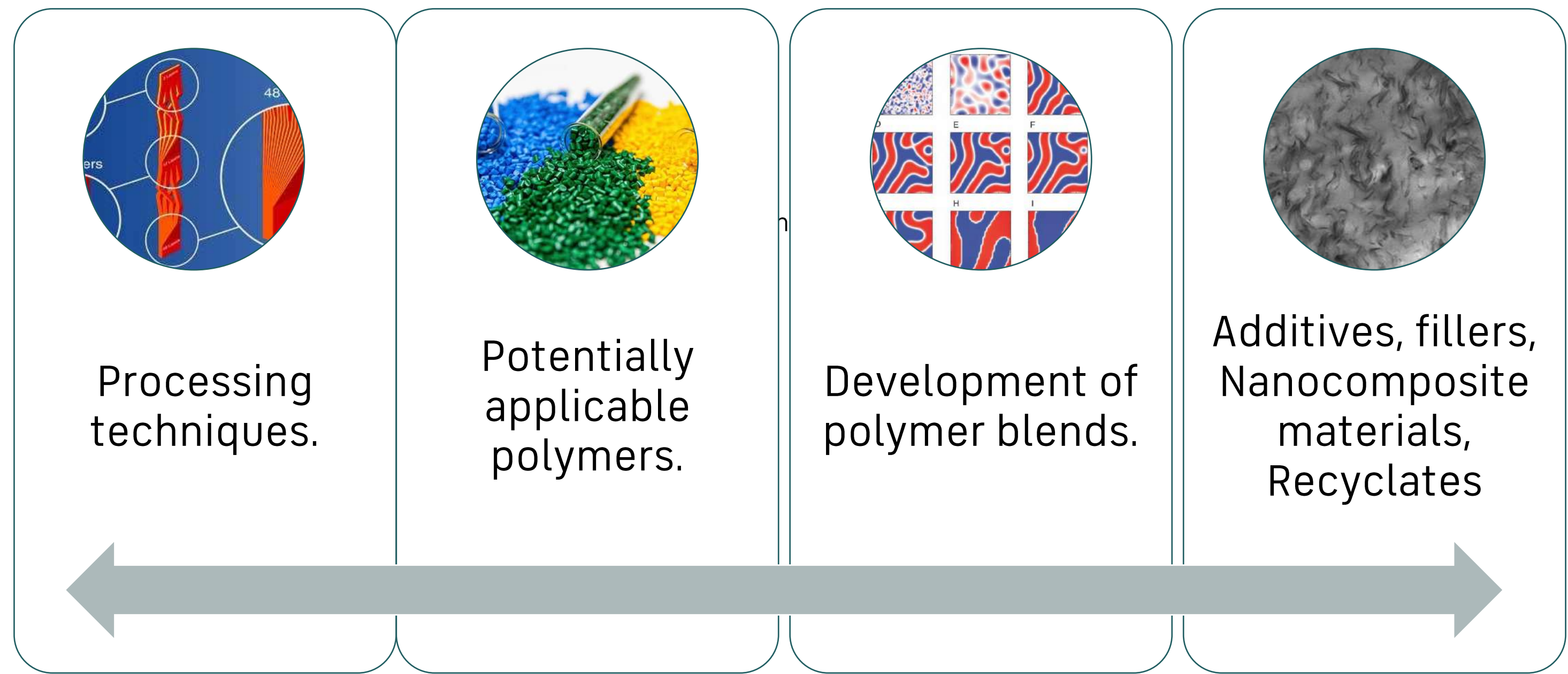
**Ecodesign and Life Cycle Analysis**



**Recyclability & Reusability assessment**

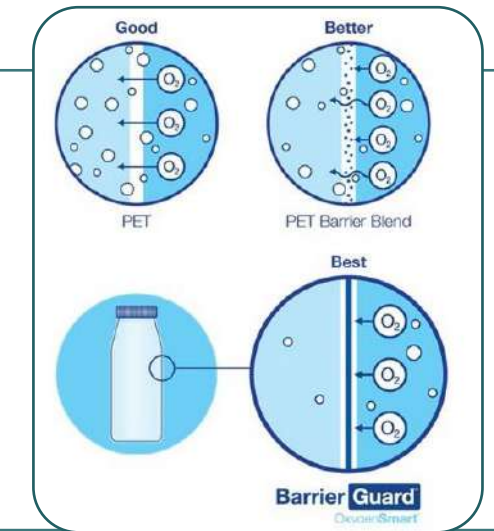
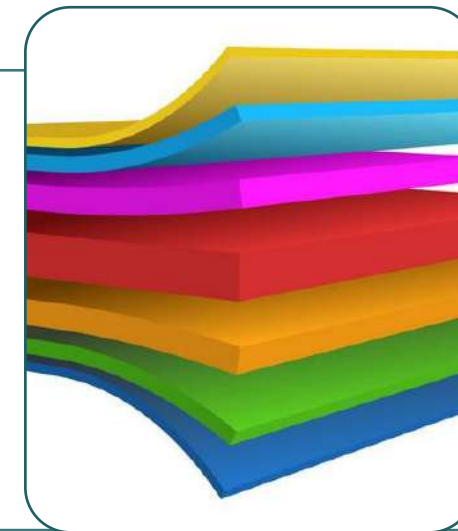
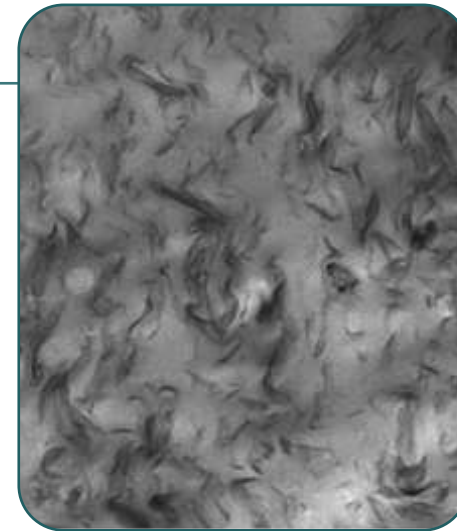
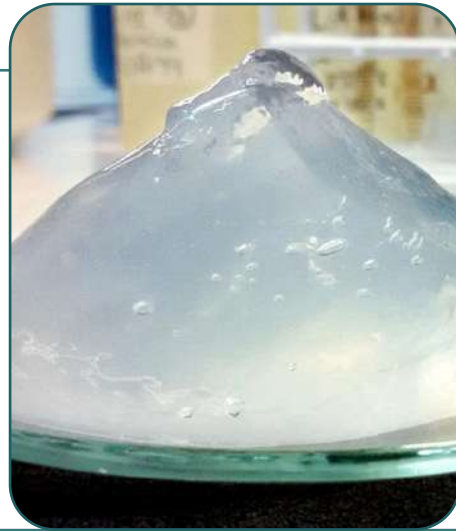
# 5 / ITENE's Circular economy technologies

## POTENTIAL ROUTES FOR MATERIAL DEVELOPMENT.



## 5 / ITENE's Circular economy technologies

### POTENTIAL ROUTES FOR MATERIAL DEVELOPMENT. ROUTES AT ITENE



#### Development of tailored reinforcements

- Inorganic: clay based
- Organic: MFC, chitin based..

#### Development of blends and copolymers.

- Development of blends with different polymers.
- Development of copolymers, such as copolyesters.
- Rheological and physical properties of components.
- Type and intensity of blending (extruder type, processing parameters, screw design...).

#### Compounding

- Screw design.
- Evaluation of alternative feeding or dispersion routes.
- Masterbatch development, active or conventional materials.

#### Processing

- Injection molding.
- ISBM.
- Cast film and sheet coextrusion.
- Extrusion coating and lamination.
- Thermoforming
- Coating and lamination.

#### Characterization and evaluation of materials

- Thermal properties (DSC, TGA, DMA, HDT).
- Mechanical properties (Tensile, tear, impact, sealing, penetration)..
- Barrier (OTR, WVTR, CO2TR, Grease).
- Food contact evaluation (migration, NIAS).
- Biodegradability/composability.



## 5/ ITENE's Packaging system technologies **DESIGN & OPTIMIZATION | VALIDATION**

**ITENE works to define, validate and optimise packaging systems to standardise and improve packaging solutions:**

- 1. Standardisation of packaging references for all product families and distribution channels.**
- 2. Reduction of packaging incidents during goods handling and transport.**
  - Stability issues with palletised loads.
  - Over or under packing.
  - Resistance to adverse weather conditions.
- 3. Preventing product damage costs and minimizing environmental impact.**
- 4. Ensuring compliance with current legislation.**

## 5 / ITENE's Packaging system technologies

### DESIGN & OPTIMIZATION | Capabilities



#### Diagnosis of company's packaging system

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We identify improvement solutions that reduce costs and environmental impacts, and increase customer satisfaction, therefore, enhancing company's market positioning.



#### Standardisation of packaging references

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We help to standardise dimensions and technical specifications for all product families and distribution channels.



#### Design and development of packaging solutions

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We work on solutions for new products and to improve existing packaging system in terms of over or under packing. As an example, we can help to improve shrink wrapping applications for palletised loads by optimising parameters. To this end, we have an industrial automatic shrink wrapper that reproduces the different configurations and compares them with the current shrink wrapping operations.

## 5 / ITENE's Packaging system technologies

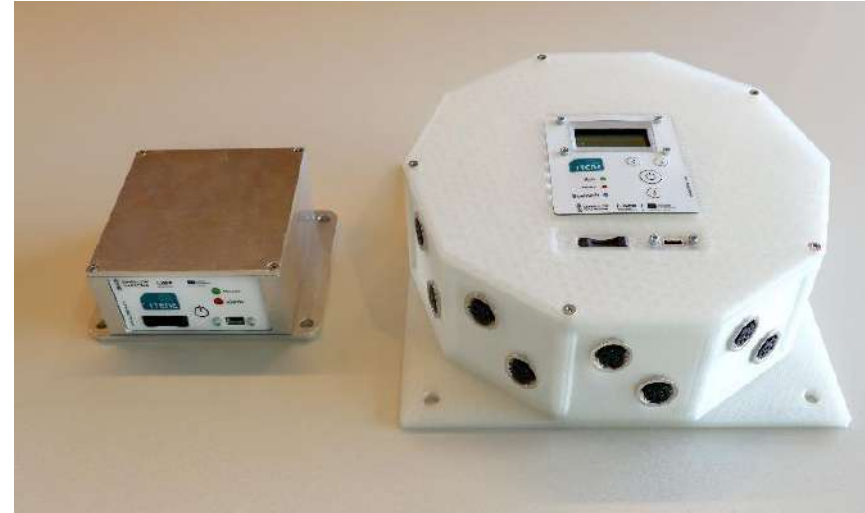
### VALIDATION OF PACKAGING SYSTEMS | Transport risk simulation capabilities



#### Development of test protocols that simulate the distribution route

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We adhere to standards such as the ASTM and ISTA protocols or adapt the test severity level to the company's routes, previously defined by a data recorder device, in order to validate the optimised packaging systems.



#### Definition of the company's distribution routes

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For this we use proprietary data recorder devices that quantify mechanical risks such as vibration, jolts and impacts, and atmospheric risks such as temperature and relative humidity.



#### Increased stability and safety of palletised loads

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We assess the company's degree of compliance with transport regulations and the related **UNE 12.195-1:2010** and **EUMOS 40509:2012** standards on the packaging, stowage and securing of cargo in both road and sea transport. Our consultancy service is divided into four stages: diagnosis, definition of protocols to be updated, load stability assessment and employee training.

## 5 / ITENE's Packaging system technologies

### VALIDATION OF PACKAGING SYSTEMS | Transport risk simulation capabilities

**ITENE's simulation laboratory equipment is tailored to realistically replicate distribution risks.**

This factor, together with the use of data recorders to identify and assess route risks, makes this laboratory a specialist centre in reproducing a company's distribution risks and, therefore, successfully optimising its packaging systems.

*\*Equipment placed inside a climate chamber that applies mechanical risks as well as temperature and relative humidity parameters previously defined during the target distribution route.*



**Multi-axial Simulation Table\***

This table simulates characteristic vertical and angular vibrations that occur during transport.



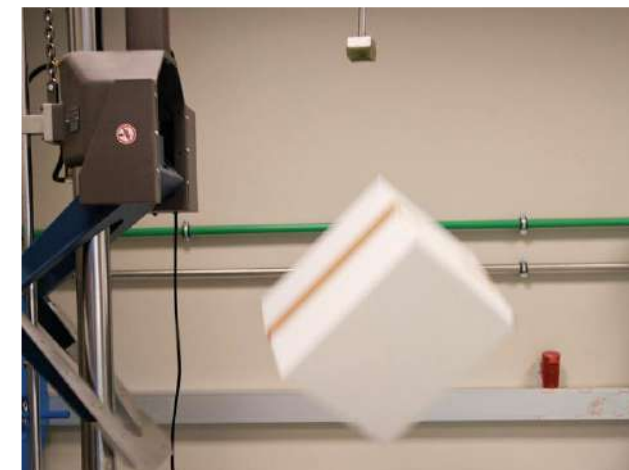
**Compression tester**

This machine simulates the force sustained during the palletisation and stacking of loads in storage and transport.



**Acceleration machine**

This maps out the rigidity of the loads when they are subjected to the typical accelerations involved in handling and transport.



**Drop test machine**

This simulates packaging and palletised load impacts and knocks occurring during handling and transport.



**Horizontal impact and stability machine**

This device simulates braking operations, train wagon coupling, start-ups, etc.



**Data recorder**

Measuring axial and angular accelerations, during journeys, with very high frequency data collection, providing comprehensive information on a specific route.

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