European Union

Interreg
CENTRAL EUROPE

BIOCOMPACK-CE

# "SUSTAINABLE PAPER-PLASTICS DESIGN"

## DEVELOPING AND STRENGTHENING CROSS-SECTORAL LINKAGES AMONG ACTORS IN SUSTAINABLE BIOCOMPOSITE PACKAGING INNOVATION SYSTEMS IN A CENTRAL EUROPEAN CIRCULAR ECONOMY

TAKING
**COOPERATION**
FORWARD

Biocompack-CE is a project funded by the Interreg Central Europe programme supported by the European Regional Development Fund.

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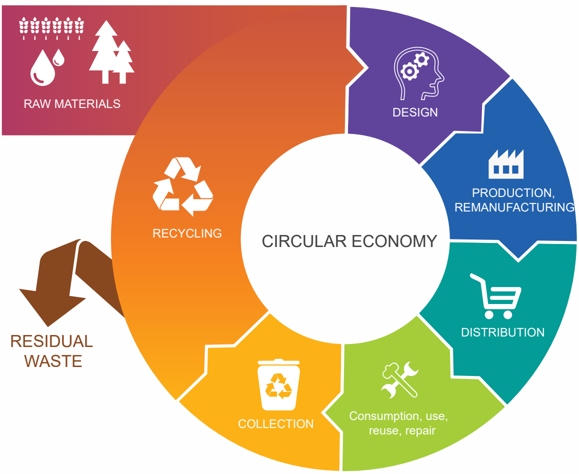
# CIRCULAR ECONOMY

## WHAT IS CIRCULAR ECONOMY?

- The value of products, materials and resources in the economy is maintained for as long as possible
- Waste generation is kept to a minimum and waste is treated as a resource

## WHY CIRCULAR ECONOMY?

- Protecting enterprises from resource scarcity and price volatility, increasing resource independence
- Energy savings
- Creating a sustainable, low-carbon, resource-efficient
- and a competitive economy
- Limiting irreversible damage to the environment caused by the use of non-renewable resources




source: *European Parliament*

# THE ROAD TO THE CIRCULAR ECONOMY

In 2016, sectors important for the implementation of circular economy in the EU employed **4 million people, 6% more** than in 2012.

In 2016, activities related to, among others, recycling, repair and restoration, generated **147 billion** euro in added value and generated **17.5 billion** euro in investment.

## 10%

**Municipal waste** accounts for approximately **7-10%** of all waste generated in the EU.

## 12%

**Recycling in the EU** is growing, while still meeting **only 12% of raw material** needs - the global economy has a potential of only 9%.

## 25%

In 1995, an average of **64%** of **municipal waste** was landfilled in the EU. In 2000, **55%** of them were landfilled, with the recycling rate at **25%**. In 2016, landfilling of municipal waste in the EU decreased to **24%** and the recycling rate increased to **40%**.

## 40%

The average level of **municipal waste recycling in the EU** is about **40%**, sometimes reaching **80%**. In Poland it is **27%**, and as much as **42%** of waste is still landfilled (2017).

**European Commission announcement of 2 December 2015: Closing the loop - An EU action plan for the circular economy**

Revision of six waste management directives

- Concerning waste **(2008/98/EC)**
- Concerning packaging and packaging wa-stewaste **(94/62/EC)**
- Concerning waste management **(1999/31/EC)**
- Concerning end-of-life of vehicles **(2000/53/WE)**
- Concerning batteries and accumulators and waste batteries and accumulators **(2006/66/EC)**
- Concerning on waste electrical and electronic equipment **(2012/19/EU)**

## RECYCLING AS A PILLAR OF CIRCULAR ECONOMY

Currently: preparing for the **re-use** and **recycling** of waste materials, such as at least **paper, metal, plastic** and **glass** from households - minimum **50% by 2020.**

After the changes: higher levels of preparation for re-use and recycling of municipal waste:

- minimum **55% by 2025**
- minimum **60% by 2030**
- minimum **65% by 2035**

The possibility of postponing the above-mentioned goals of 5 years by countries with more catching up to do in terms of recycling and landfilling reduction.

Materials that are used to generate energy, as fuels, burned, fill workings or stored will not be counted towards the achievement of the established goals.

## SEPARATE COLLECTION - THE KEY TO RECYCLING

- Until now: separate collection as a means of facilitating the preparation of waste for reuse and recycling with a limited scope of use
- After the changes: separate collection is practically the rule in waste management, and its scope is expanding
- By 1 January 2025, a separate system for the collection of textiles and hazardous waste from households must be established
- By 31 December 2023, bio-waste is to be either collected separately or recycled at source (e.g. composted at home)
- Separate targets are set for ferrous metals and aluminum
- The weight of recycled packaging waste is generally measured when the waste enters the recycling process
- Recognition of biodegradation as a form of recycling
- BUT oxo-degradable plastic packaging is not considered biodegradable packaging
- A Member State may postpone by a maximum of five years the deadline for meeting the recycling targets while respecting certain minimum levels

## GOALS FOR THE FUTURE

| Packaging type | 31.12.2025 | 31.12.2030 |
|---|---|---|
| All packaging | **65%** | **70%** |
| Cardboard and paper | **75%** | **85%** |
| Plastics | **50%** | **55%** |
| Ferrous metals | **70%** | **80%** |
| Aluminium | **50%** | **60%** |
| Glass | **70%** | **75%** |
| Wood | **25%** | **30%** |

# MATERIALS
## *PAPER*

**PAPER = CELLULOSE PULP + ADDITIVES**

CELLULOSE PULP is prepared from ligno-cellulose natural sources: mainly wood or annual plants
wood is composed by three main polymers:

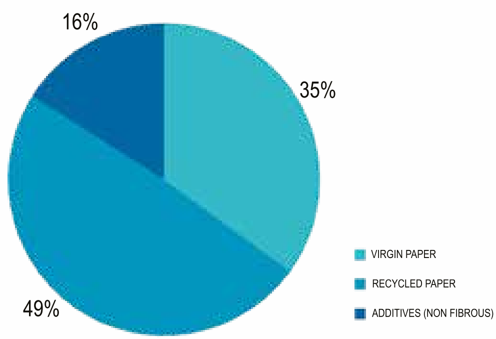
- Cellulose (homo-polysaccharide)
- Hemicelluloses (hetero-polysaccharides)
- Lignin (aromatic polymer- phenylpropane units)

Their content in paper vary as a function of the process used to obtain cellulose from wood.

**Paper is mainly composed by cellulose fibres: virgin,** obtained from wood or annual plants, **or recycled,** obtained from recovered used paper**.**

**Inorganic fillers represents a significant amount of material in several paper grades for surface coatings**.
*Fillers are mostly recycled back into the products in the paper recycling process.*

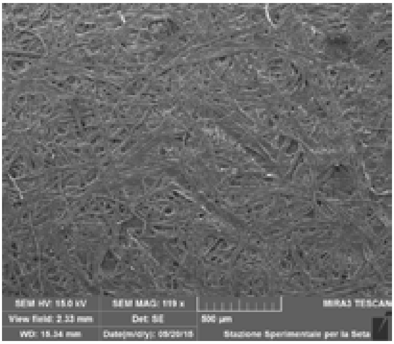
AVERAGE PAPER COMPOSITION



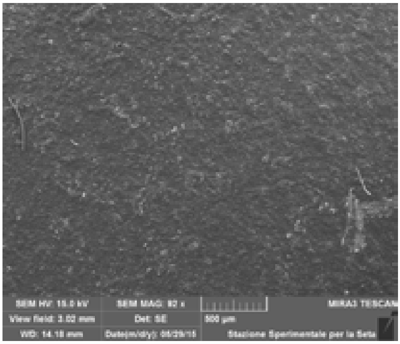

*source: ASSOCARTA*

## PAPER vs COATED PAPER

Coated paper can be made using several materials, such as kaolinite, calcium carbonate, bentonite and talc. Coating increases functionality reducing the size of the paper pores reducing liquid/gas diffusion.




NATURAL PAPER

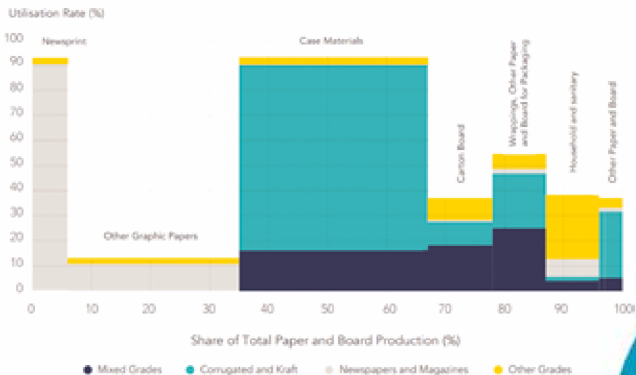



COATED PAPER

## PAPER FOR RECYCLING

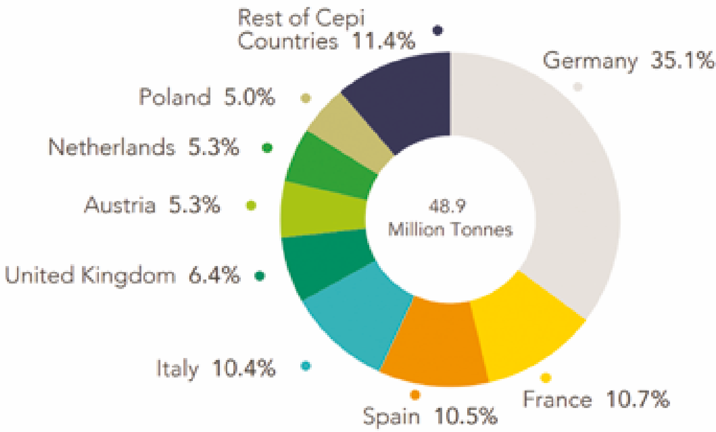
Paper for recycling represents globally the main raw material for the paper industry.

### UTILISATION OF PAPER FOR RECYCLING BY SECTOR IN 2019




*source: Cepi Key Statistics 2019*

In Europe, nearly 50 million tonnes of recycled paper are used every year. Two thirds of this is concentrated in 4 countries.

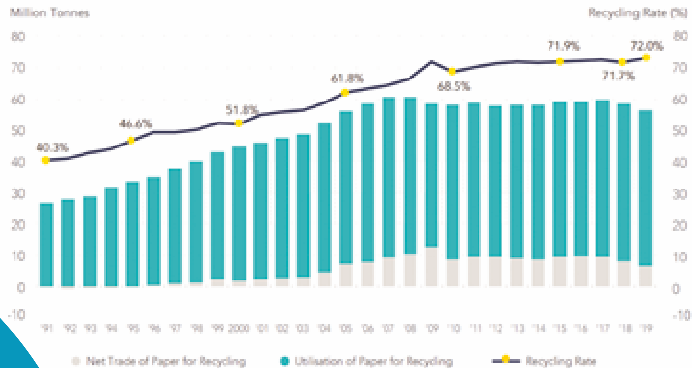



*source: Cepi Key Statistics 2019*

Paper for recycling represents globally the main raw material for the paper industry.

**Europe shows the highest recycling rate worldwide**

### UTILISATION, NET TRADE AND RECYCLING RATE[1] OF PAPER FOR RECYCLING IN EUROPE (EU-28 + NORWAY AND SWITZERLAND




The Recycling Rate is the utilisation of paper for recycling plus the net trade of paper for recycling, compared to paper and board consumption.

# MATERIALS

## *PLASTICS and BIOPLASTICS*

Plastics are polymer-based materials

This material is “formulated” by the addition of additives. Plastics are defined by their plasticity – a state of a viscous fluid at some point during processing**.**

We can classify polymers by: physicochemical properties, origin, origin of the raw material, susceptibility to microorganism enzymes activity.

**PHYSICOCHEMICAL PROPERTIES** →

- **Thermoplasts – they become soft when influenced by heat, become hard after a decrease of temperature.**
*(PE-polyethylene, PET-polyethylene terephthalate, PVC-polyvinyl chloride, PP-polypropylene, PS-polystyrene)*
- **Thermoset (duroplasts) – after formed they stay hard, they do not become soft when influenced by heat.**
*(EP-polyepoxide, PUR-polyurethane, PF-phenol formaldehyde resins,PTFE- polytetrafluoroethylene)*
- **Elastomers – materials, which we could stretch and squeeze, which follow deformations but they reshape back afterwards**
*Indian rubber/caoutchouc has been almost entirely replaced with elastomers. Also many new adaptions have been discovered.*

**ORIGIN** →

- **Synthetic polymers,** originate from **chemical synthesis**
*(polymerization , copolymerization , poly-condensation)*
- **Natural polymers,** produced by **organisms**
*(e.g. cellulose, protein, nucleic acids)*
- **Modified polymers,** those are **natural polymers, chemically changed** to receive new functional properties
*(e.g. cellulose acetate, modified protein, thermoplastic starch)*

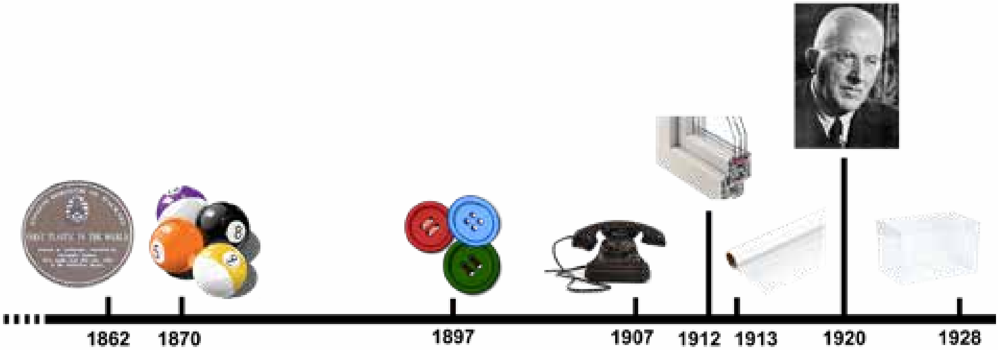
**ORIGIN OF RAW MATERIALS** →

- **Renewable resources** (plants and animals)
- **Non-renewable (fossil) resources** (petroleum, coal)

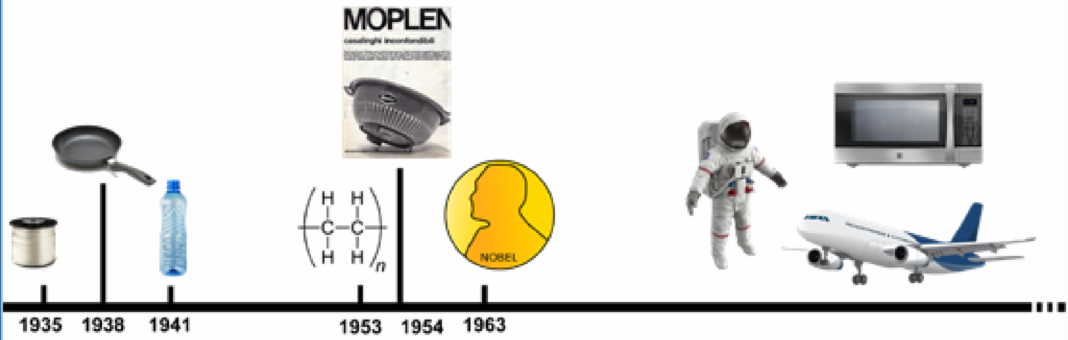
**SUSCEPTIBILITY TO MICROORGANISM ENZYMES ACTIVITY** →

- **Biodegradable** *(polylactide-PLA, regenerated cellulose, starch)*
- **Non-degradable** *(polyethylene – PE, polystyrene - PS)*

# THE HISTORY OF PLASTICS

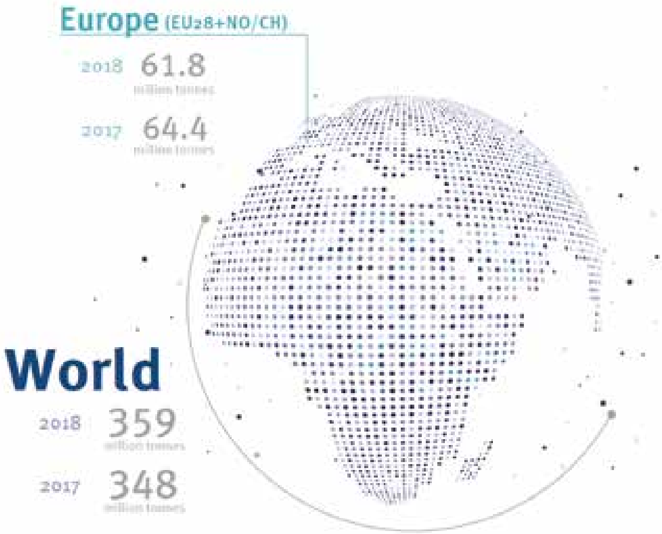



- 1862: the Englishman Alexander Parkes isolates and patents the first semi-synthetic plastic material, which he names Parkesina (better known later as Xylonite). It is a first type of celluloid, used for the production of handles and boxes, but also of flexible products such as cuffs and shirt collars.
- 1870: brothers John Wesley and Isaiah Hyatt patented the celluloid formula in the United States with the aim of replacing ivory in the production of billiard balls.
- 1897: Friedrich Adolph Spitteler and Wilhelm Krische invent galalith in Germany, produced from casein.
- 1907: Belgian-American chemist Leo Baekeland synthesizes Bakelite.
- 1912: in Germany Fritz Klatte discovers the production process of PVC.
- 1913: the Swiss Jacques Edwin Brandenberger invents a cellulosic-based material produced in very thin and flexible sheets, Cellophane.
- 1920: Hermann Staudinger, in Freiburg (Germany), starts in 1920 the studies on the structure and properties of natural and synthetic polymers.



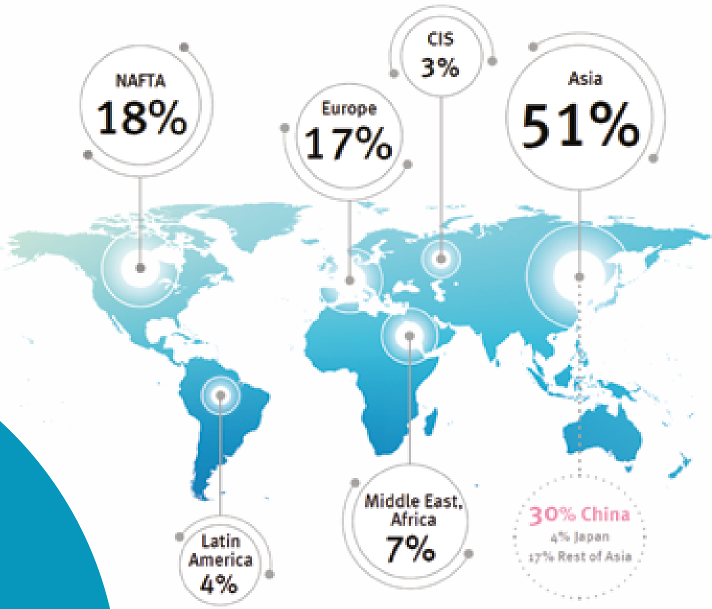

- 1928: Polymethylmethacrylate (PMMA), better known under the trade name of Plexiglas, is developed in the laboratory
- 1935: Walter Carothers synthesizes nylon
- 1938: Roy J. Plunkett accidentally discovers polytetrafluoroethylene (PTFE), also known as Teflon
- 1941: resuming Carothers' research, John Rex Whinfield and James Tennant Dickson invent polyethylene terephthalate (PET)
- 1953: Karl Ziegler isolates polyethylene (PE)
- 1954: Giulio Natta discovers isotactic polypropylene (PP), then marketed as Moplen
- 1963: Ziegler and Natta win the Nobel Prize for chemistry
- Since the 1970s: definitive consecration of plastic in all fields.

## WORLD AND EU PLASTICS PRODUCTION DATA




*source: Plastics Europe 2019*

## DISTRIBUTION OF GLOBAL PLASTICS PRODUCTION




*source: Plastics Europe 2019*

**The “big five” plastics with largest market share:**

- Polyethylene (PE)
- Polypropylene (PP)
- Polyvinyl chloride (PVC)
- Polystyrene (solid – PS and foamed – EPS)
- Polyethylene terephthalate (PET)

## PLASTICS DEMAND IN EUROPE DISTRIBUTION BY SEGMENTS AND POLYMER TYPES 2018


**51,2 M t**
**is the total European plastics converters demand**

*source: Plastics Europe 2019*

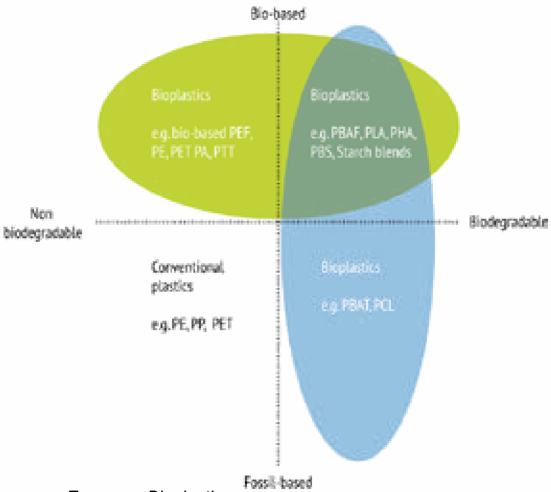
**Packaging**, **constructions** and **automotive** represent **70%** of the plastics end-use market in EU countries. It means **35,6 million tonnes** of plastics demanded by converters in 2018.

Bioplastics are a large family of different materials

Bioplastics are not just one single material. They comprise of a whole family of materials with different properties and applications. According to European Bioplastics, a plastic material is defined as a bioplastic if it is either biobased, biodegradable, or features both properties.

**Bioplastics are biobased, biodegradable, or both.**

*European Bioplastics*




*source: European Bioplastics*

**Biobased** means that the material or product is (partly) derived from biomass (plants). Biomass used for bioplastics stems from e.g. corn, sugarcane, or cellulose.

**Biodegradable plastics from renewable resources:**

Thermoplastic starch (TPS)

Polyhydroxyalkanoates PHAs (made by microorganisms) PHB, PHV

Polylactide (PLA)

Cellulose based plastics

**Biodegradable plastics from fossil resources:**

Synthetic aliphatic polyesters – polycaprolactone (PCL);

Synthetic and half-synthetic aliphatic copolymers (AC) and polyesters (AP);

Synthetic aliphatic-aromatic copolymers (ACC);

Polymers soluble in water – poly(vinyl alcohol) (PVOH)

**BIODEGRADABLE PLASTICS ARE NOT DESIGNED TO BE DISPOSED IN THE NATURE!!!**

Biodegradability is not function of origin of the raw material but is only related to structure!

## BIODEGRADABILITY VS COMPOSTABILITY

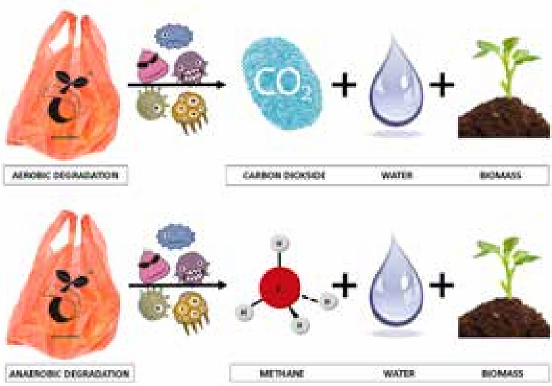
**Biodegradable ≠ Compostable**

**Compostable = Biodegradable**

**Biodegradability** is the ability of organic substances and materials to be broken down into simpler substances through the action of enzymes from microorganisms. If this process is complete, the initial organic substances are **entirely converted into simple inorganic molecules** such as water, carbon dioxide and methane. Biodegradation is part of the earth's natural life cycle, which is based on carbon.

**Compostability** is a characteristic of a product, packaging or associated component that allows it to biodegrade under specific conditions (e.g. a certain temperature, timeframe, etc) and to be transformed into **compost** through the composting process. Compost is therefore the result of disintegration and **aerobic biodegradation** (occurring in the presence of oxygen): mature compost is similar to fertile soil and its high proportion of organic substances means it can be used as a fertiliser.

These specific conditions are described in standards, such as the European standard on industrial composting **EN 13432** (for packaging) or **EN 14995** (for plastic materials in general). Materials and products complying with this standard can be certified and labelled accordingly.



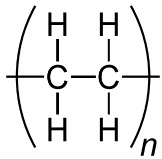
### ‘Oxo-degradable’ plastics

Plastics that are advertised as being ‘oxo-degradable‘ or ‘oxo-biodegradable’ are made from conventional plastics and mixed with additives in order to mimic biodegradation. However, the main effect of oxidation is a mere fragmentation of the material or product into small particles that remain in the environment. These products to not comply with the standards for compostability and are not considered bioplastics.

**NOT biodegradable**
**NOT compostable**

### BIO POLYETHYLENE (Green PE)

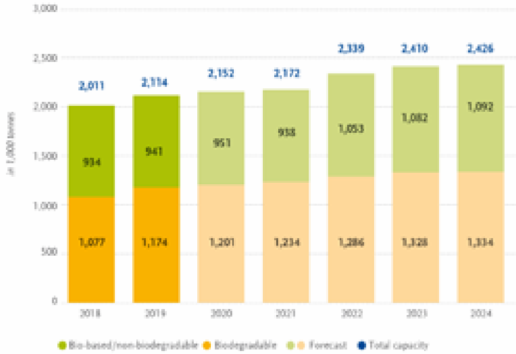
Plastics, made from ethanol which is produced from sugarcane. Equivalent to traditional PE with the same chemical formula. The properties are identical to those of conventional polyethylene, physical properties for conversion into plastics products and also its recycling properties. It is extremely versatile in terms of applications and is recyclable in the same chain established for conventional PE




**BIO POLYETHYLENE is biobased but not biodegradable**

Sugarcane
↓ fermentation, distillation
Ethanol
↓ dehydration
Ethylene
↓ polymerization
PE

## GLOBAL PRODUCTION CAPACITIES OF BIOPLASTICS AND ESTIMATION (2018-2024)



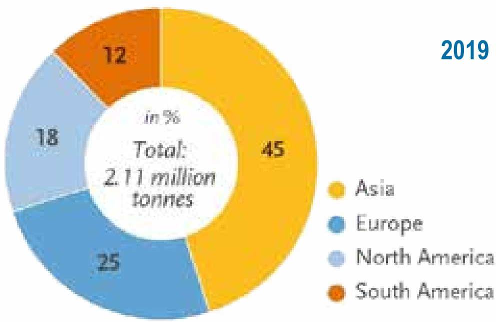

*source: European Bioplastics (2019), Nova Institute (2019)*

New and innovative biopolymers, (bio-based PP and PHAs) show the highest relative growth rates. In 2019, **bio-based PP** entered the market on a commercial scale with a strong growth potential . The production capacities are predicted to almost sextuple by 2024. **PHAs** are an important polymer family, whose production capacities are estimated to more than triple in the next five years.

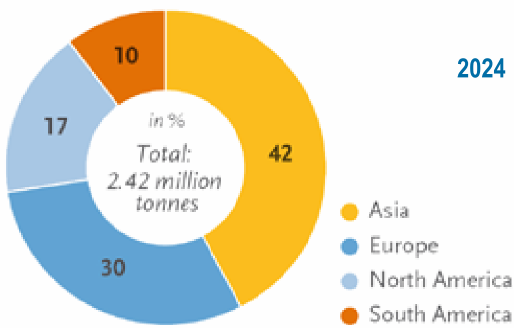
## GLOBAL PRODUCTION CAPACITIES OF BIOPLASTICS BY REGION IN 2019 AND IN 2024

Asia is the major hub for the production of bioplastics, however Europe ranks highest in the field of research and development and it is the industry's largest market worldwide.

By now, **one fourth** of the global bioplastics production capacity is located in Europe.



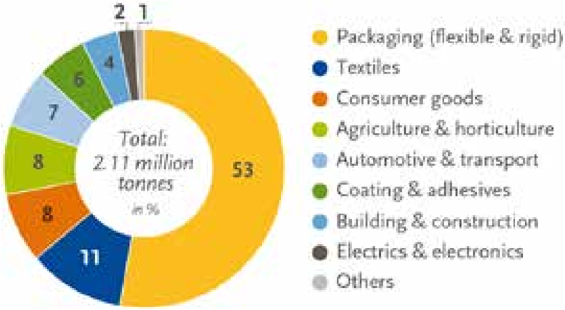

*source: European Bioplastics (2019), Nova Institute (2019)*




*source: European Bioplastics (2019), Nova Institute (2019)*

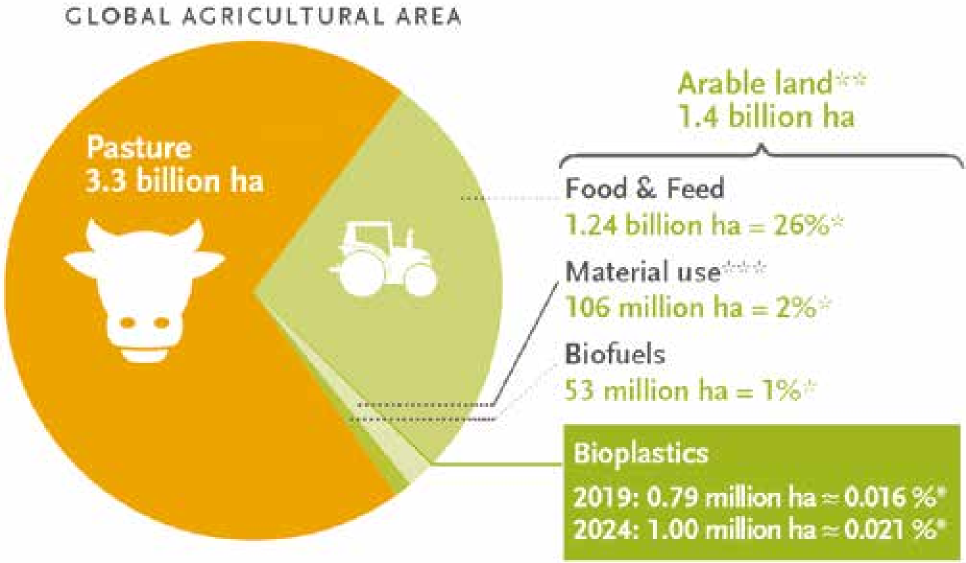
### GLOBAL PRODUCTION CAPACITIES OF BIOPLASTICS BY MARKET SEGMENT IN 2019

There is a high demand for packaging made from bioplastics. In 2019, global production capacities of bioplastics amounted to about 2.11 million tonnes with almost **53% (1.14 million tonnes)** of the volume destined for the packaging market – the biggest market segment within the bioplastics industry.




*source: European Bioplastics (2019), Nova Institute (2019)*

### LAND USE ESTIMATION FOR BIOPLASTICS 2019 AND 2024




*source: European Bioplastics (2019), FAO stats (2017), Nova Institute (2019), Institute for Bioplastics and Biocomposites (2019).*

*in relation to global agricultural area
**including approx 1% fallow land
***land use for bioplastics is part of the 2% material use

The land used to grow the renewable feedstock for the production of bioplastics amounted to approximately **0.79 million hectares** in 2019, which accounted for less than **0.02%** of the global agricultural area of 4.8 billion hectares.

# MATERIALS - BIOCOMPOSITES

## Lamination

### PROCESS

The process through which two flexible packaging webs are joined together by using a bonding agent.
The substrates making up the webs consist of film and paper.
In general terms an adhesive is applied to the less absorbent substrate web, after which the second web is pressed against it to produce a duplex-layer.

### APPLICATIONS

Web laminating is used to improve the appearance and barrier properties of substrates.
The choice of the most suitable web laminating process is mainly dictated by the end-use of the product.

### ADVANTAGES

- Easy to operate
- Short set up
- Less waste
- Small MOQ
- Less operators (1 person)
- Can be use as a slittering machine

### DISADVANTAGES

- Extra cost to produce the roll of the bioplastic (blown extrusion)
- Extra cost of adhesives/glue
- The adhesive/glue also has to be un-solvent and biodegradable!
- Risk of a wrong adhesion (the paper can take away the glue)
    - finishing time is long (have to dry up)
    - higher thickness for the equal quality

## Extrusion

### PROCESS

The converting processes that allow the substrates to be combined to obtain a single compound structure. The materials can be bioplastics, paper, carton board, or aluminum films.

### APPLICATIONS

Extrusion coating and laminating lines are usually custom-built and can be configured for a variety of applications including flexible packaging, industrial wraps.
Extrusion coater laminators deliver a combined substrate, the component elements of which would be very difficult to separate. The combined substrate inherits highly enhanced physical properties and barrier protection performance from its component elements.

### ADVANTAGES

- Big capacity
- Cost effective
- Constant adhesion
- No finishing time
- No glue needed
- Don't need to extrude the coating material
- Constant and low thickness

### DISADVANTAGES

- Extra HR (at least 2 people)
- Long setup
- Special drying system required
- Special screw design required
- Big MOQ

# CERTIFICATION
## *PRINCIPLES*

**Certification** is the formal attestation or confirmation of certain characteristics of:
- object,
- person,
- or organization.

This confirmation is often, but not always, provided by some form of external review, education, assessment, or audit.

Common type of certification in modern society is product certification.

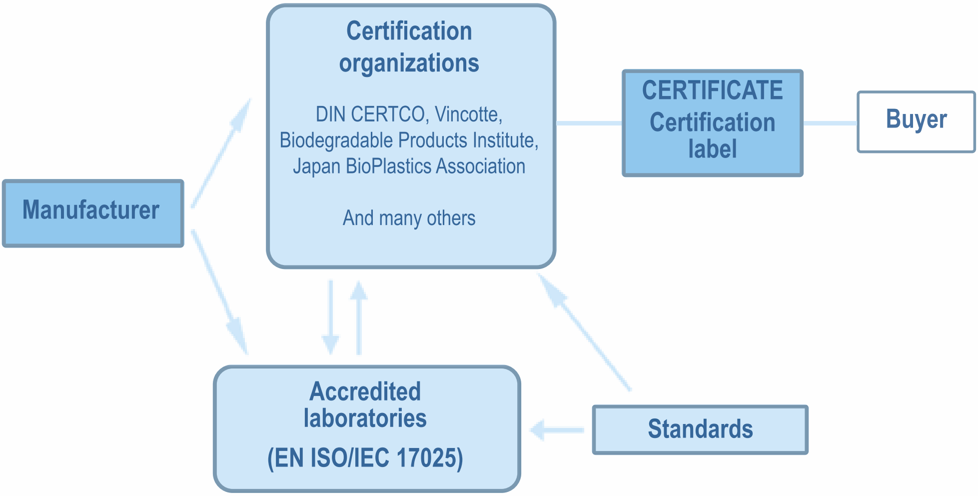
This refers to processes intended to determine if a product meets minimum **standards**, similar to quality assurance.

| STANDARD | CERTIFICATE |
|---|---|
| ▪ Set of requirements that a product/service shall conform to<br><br>▪ Two types:<br>▪ Specification (e.g. EN 13432)<br>▪ Test method (e.g. ISO 14855)<br><br>▪ Basis for certification systems | ▪ Independent confirmation that material/product conforms to specific requirements<br><br>▪ Product/material verifications are based on standard test methods |

**CLEAR, TRUSTED, BACKED BY SCIENCE**

- **proof** issued by an **independent** authority
- based on a **certification process**, which often follows standard specification/test method
- voluntary, commercial
- a **document** and a **logo**, on-line record -> public recognition

# CERTIFICATION PROCESS




**Valid** certificate contains a name of the certification organization and the certification number
Other claims, although also called certificates, are **not valid**.

# STANDARDISATION OF BIOPLASTICS

There are several reasons why standardization of bioplastics is important:

- Very **difficult to distinguish** bioplastics from “conventional” plastics
- Overcome difference in opinion
- To prevent **false advertising / greenwashing**
- Basis for
    - a guarantee for **consumers**
    - a tool for **producers**

# CERTIFICATION
## *PAPER PRODUCTS*

### FOREST CERTIFICATION
It is mainly connected to sustainable forest management, however, recently also paper for recycling has been included
It requires the certification of an indipendent body

**FSC 100%**
Product coming only from certified FSC forest.

**FSC Mix**
Product containing a mix of certified materials.

**FSC Ricycled**
Product containing only recycled material.

### ENVIRONMENTAL LABELS TYPE I
Voluntary Environmental labels based on ISO 14024 with external indipendent certification. Several paper products may be included in these certification scheme. The most common in Europe are Ecolabel, Der Blaue Engel and Nordic Swan.

### ENVIRONMENTAL LABELS TYPE III
- Based on life cycle analysis (LCA);
- Wide range of environmental parameters are taken into account;
- They are subjected to external indipendent certification

# CERTIFICATION
## *BIOPLASTICS*

### CERTIFICATION FOR COMPOSTABILITY

The harmonised European **standard EN 13432** “Requirements for packaging recoverable through composting and biodegradation” requires at least **90% disintegration** after twelve weeks, **90% biodegradation** ($CO_2$ evolvement) in six months, and includes tests on ecotoxicity and heavy metal content.
It is the standard for biodegradable packaging designed for treatment in industrial composting facilities and anaerobic digestion.

**Standard EN 14995** describes the same requirements and tests as EN 13432, while applying not only to packaging but plastics in general.

OK compost TÜV AUSTRIA INDUSTRIAL

compostable

INDUSTRIAL COMPOSTABLE DIN Geprüft

- First certification scheme Vinçotte, 1995
- Products **certification**
- Intermediates/additives **registration**
- Chemically unmodified materials and components of natural origin
- Organic components > 50 %
- Printing dyes - compostable
- Blends and laminates – all compostable, ½ thickness
- Certification of products made of registred materials (IR, thickness)

**Chemical Composition**
No substance that are harmful to the environment. Level of heavy metal contents and other hazardous elements within standardized limits.

**Biodegradability**
More than 90 % conversion of organic carbon into $CO_2$, in maximum of 180 days.

**Disintegration during composting**
Quick disintegration of the material (12 weeks, sieve fraction)

**Eco toxicity**
Positive results from testing of the compost quality (germination rate, biomass mass)

**Labelling**
Labelling according to certification scheme, allows the inhabitants to identify and collect the waste in organic waste bins

## ADDITIVES

According to EN 13432, EN 14995, ISO 18606, ASTMD 6400 and ISO 17088, organic additives whose biodegradability has not been separately determined can be used on the following conditions:

▪ Less than 1 % of mass per organic additive.
▪ Less than 5 % of mass in total of organic additives whose biodegradability has not been proven.
▪ Additives are harmless for the composting process.

## OXO-DEGRADABLE

Oxo-degradable plastics are made of conventional plastics (e.g. PE or PP) supplemented with additives in order to mimic biodegradation. **They cannot be considered as bioplastics and have failed to prove proper biodegradability in any environment.**

| | EN 13432, EN 14995, ISO 18606 and ISO 17088 | ASTMD 6400 | AS 4736 ind. | AS 5810 Home |
|---|---|---|---|---|
| **Disint.** | > 90% within 12 weeks (2mm sieve fraction) | > 90% within 12 weeks (2mm sieve fraction) | > 90% within 12 weeks (2mm sieve fraction) | **Time x2 longer** than EN 13432 |
| **Heavy metals** | EN 13432, Annex A | **~ 10 x** EN 13432 USA **~ 3 x** EN 134232 Canada | As EN 13432 | As EN 13432 |
| **Biodeg.** | > 90% within 180 days or relative to + control | > 90% within 180 days or relative to + control | > 90% within 180 days or relative to + control | **Time x2 longer** than EN 13432 (**at 25°C**) |
| **Negative effect and plant toxicity** | > 90% germination rate and biomass of two plants | > 90% germination rate and biomass of two plants | > 90% germination rate and biomass of two plants + **warm test (ASTM E 1676)** | > 90% germination rate and biomass of two plants + **warm test (ASTM E 1676)** |

## BIOBASED CONTENT

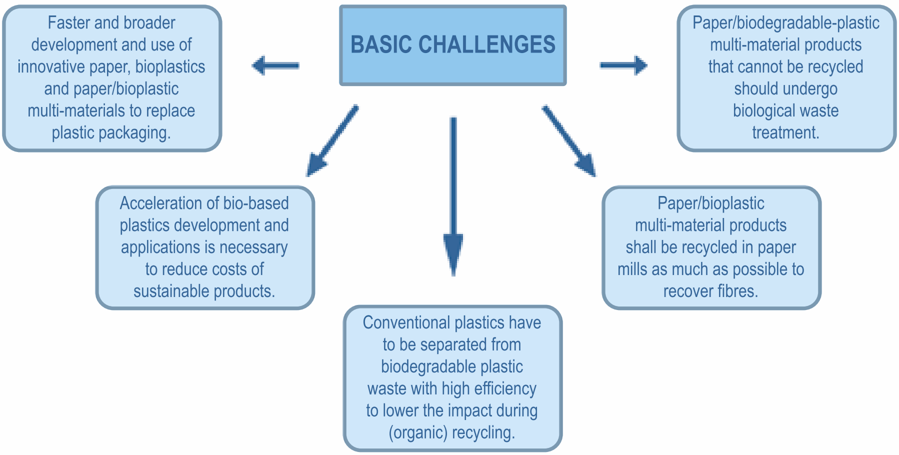
There are different standards for the measurement of the renewable content of bio-based materials, including bioplastics:

- **EN 16640** *"Bio-based products – Determination of the bio-based carbon content of products using the radiocarbon method"*, describes how to measure the carbon isotope 14C (radiocarbon method).
- **EN 16785-1** *"Bio-based products – Bio-based content – Part 1: Determination of the bio-based content using the radiocarbon analysis and elemental analysis"* accounts for other bio-based elements in a polymer through elemental analysis.
- **EN 16785-2** *"Bio-based products – Bio-based content – Part 2: Determination of the bio-based content using the material balance method"*, describes a material balance method to determine the renewable content of a bio-based product.

Requirements:

- min. 50 % of organic compounds
- min. 20 % of carbon from renewable resources
- non-toxic

# BIOCOMPACK-CE STRATEGY




## CURRENT CRITICAL ISSUES IN THE VALUE CHAIN

**Costs/market**

• Generally still much higher than conventional plastics

• Present small niche market does not allow sufficient returns

• The use of bioplastics in combination with paper to achieve greater functionalities (barrier, transparency) leads to increased costs in comparison to mono-materials

• Needed focus on user demand

**Performances/properties/functionalities of materials**

• Properties of biodegradable bioplastic and biopolymers are not yet fully comparable to oil-based material

• Bioplastics not commoditized /information less available

• mechanical and/or functional properties of the bio-based packaging products shall be further developed.

**Availability of raw material and conversion processes technology**

• Available at higher costs than equivalent fossil-based plastics

• Few biodegradable biopolymers are available at a commercial scale (TPS, PLA, PHA)

• Still not many companies with a know how and practice of processing paper and bioplastics in composites.

**Waste collection systems and products end of life**

• Not optimised for multi-material packaging

• Composting infrastructures are not yet widely spread

• Organic waste is still highly contaminated with plastics

• Presence of specialised paper recycling mills is scattered or not present at all

• Compostable packaging is not easily distinguishable

• Fast development of integrated anaerobic and aerobic digestion industrial plants

• Promote material recycling of paper/bioplastic products

• Develop suitable locally based collection systems

• Develop low cost composting infrastructures

• Avoid dragging effect through clear labelling and consumers' education poses additional constrains to the acceptance.

**Innovation system**

• Improve production processes of raw materials and additives

• Innovation in transformation-converting technologies

• Supporting innovation in SMEs intended to create new services and products

• Set-up of co-innovation partnerships alongside existing and new value chains

**Policy, regulation, market**

- Integrating approaches
- Perform scenario analysis at regional level
- Create a new cross-sectorial interconnection
- Public procurement regulation, developing tools, increased awareness and incentives
- Promote current applications of paper/bioplastics products
- Open new markets for new applications
- Support creation of knowledge centres
- Support new companies accompanying converters to develop and integrate bioplastics/biomaterials

**Value chain and communication**

- Spread awareness about sustainable production of bio-based products
- Enhance the clarity, accessibility and harmonization of sustainability certifications and standards
- Expanding the adoption of life-cycle methodologies (LCA, LCC, S-LCA)
- Improve mechanisms to identify and promote case studies and best practice exchange

## OUR VISION

1. **Packaging contributes to food safety** providing a barrier to external physical agents and microbial contamination. Very importantly, it increases the shelf life of packaged foods thus reducing food waste. Nonetheless, due to its large use and often very short life cycle it brings a significant environmental burden.

2. **Material combinations (like paper and plastics)** in packaging add value, functionality and improve critical properties (e.g. barrier properties). On the other hand, it may provide a substantial barrier to optimal recovery options like reuse and recycling.

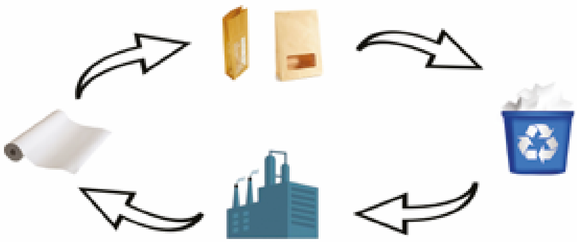
3. **Acceptable material combinations must be**
   - easy to separate
   - recyclable by existing and available technology intended for a common material stream.

4. **Sustainability of combined materials** use strongly depends on real, not potential, waste management practices and available infrastructure. However, recycling infrastructures shall develop in order to meet the complexity of new packaging multi-materials.

5. **The best ecological solution** in paper/plastics composites is offered by materials produced from renewable raw materials (bio-based). Following this principle that should reduce the carbon footprint in the production stage. Since bio-based plastics can be either biodegradable or non-biodegradable the end-of-life impact is addressable through two options:
   - paper/biodegradable plastics combinations that are fully biodegradable and compostable
   - paper/not-biodegradable bioplastic may be recycled separately or in specialised paper recycling mills.

6 Multi-material recycling is the preferred waste treatment option, before organic recycling (aerobic treatment - industrial composting or aneorobic treatment - biogasification) due to material preservation. In principle, the following general approach may be suggested to ensure a limited impact on recycling operations

- **Non-food packaging and dry food packaging shall be recycled**, preferentially in the paper stream if not separate streams



- **Wet food packaging in contact with wet or greasy food shall be organically recycled** – composted in aerobic or anaerobic conditions

7 Combined materials and products thereof have a real potential to be an integral part of both circular resource use and the bioeconomy providing that

- Systemic policy measures will greatly support a widespread application of sustainable combined materials
- Ecodesign and considerations of real end-of-life options are taken as a prerequisite for efficient combined materials products
- Effective technical standard for ecodesign and multi-material recycling as well as the development of advanced recycling infrastructures in CE will be encouraged and implemented

# DESIRED FUTURE OUTCOMES

## GENERAL GOALS

- Economic activity
- Jobs creation
- Strengthening regional innovation
- Exports
- Higher added value products
- Regional value chains
- Recognition of region
- Contribution to global sustainable development goals
- Improved utilization of local renewable resources
- Contribution to circular and bio economy

## SPECIFIC MID-TERM GOALS ACTIONS AND SUPPORTING MEASURES

- Greater integration and cooperation between paper and bioplastic
- Improved technical communication among stakeholders of paper-bioplastics value chain
- Increased the level of education and communication with final consumers
- Create new market opportunities based on social responsibility
- Ambitious regulative measures with promoting
- Develop local infrastructure

## SPECIFIC LONG-TERM GOALS

- Industrial leadership in biocomposite products
- New generation of biocomposite packaging materials
- Innovative production technologies
- Full range of materials with different end-of life options,
- Greater alliance of entire bio-based industry supply chain,
- Separated waste collection, material sorting,
- Increase of capacity and technologies of paper recycling mills
- Development of bio-additives and bio-coatings
- Policy development and implementation
- Greater environmental awareness, social costs and
- Corporate Social Responsibility, green public procurement
- Incorporation of information technologies in collection sorting and waste management.

# IMPLEMENTATION SCENARIOS

The goals can be achieved through a number of measures. In principle, two main scenarios can be distinguished:

**Scenario 1** in which development is supported through **strong official innovation** and **sustainability policy.**

**Scenario 2** that relies on “soft” **non policy measures.**

## SCENARIO 1

*Relies on policymakers at local, national, regional and European levels to continue and deepen in very specific ways the current support for innovation, circular economy, bioeconomy and sustainable development goals.*

There are several regulatory approaches that could be taken:

1. Prohibiting combined packaging (vs. monomaterial packaging) on the basis that it limits recycling taking into account available recycling technology.
2. Mandating that paper/plastic composites are designed to standards that support:

• **easy** paper (and plastic) **recycling**

or

• **composting** (alternatively aerobic biogasification).

In order to reach regulatory change:

1. **Public pressure** and support for change
2. **Awareness** of the issue
3. Sufficient **information** that supports the need for change
4. Existing **solutions** that can realistically be applied

These conditions are most reliable on media, NGOs, science/research, industry (offering workable solutions).

## SCENARIO 2

*Relies on a voluntary change in packaging design.*

The change can be initiated by different stakeholders in the value chain:

- packaging **waste management companies**
- **retailers**, especially large with significant market shares
- **local government** that regulates public systems such as municipal markets or publicly owned businesses
- **companies**, selling to the public as well as NGOs and similar
- **producers** of packaging

### Specific measures to reach packaging change

1. Providing **accurate and objective arguments** for stakeholders
2. Setting proper **alliances** to make change possible
3. **Solving** technical issues
4. **Certification**
5. **Communication** with stakeholders including policy-makers

# PAPERBIOPACK.EU
## *TRANSNATIONAL BIOCOMPOSITE PACKAGING CENTER*

**PAPERBIOPACK** is the name that partners chose for the **Transnational Biocomposite Packaging Centre (TBPC).** TBPC is a virtual network platform of technology and business innovation service providers in the area of sustainable paper-plastics packaging solutions.

The platform provides **scientific, technical, technology as well as economic feasibility assessment**, promotion and other supporting types of expertise to offer well rounded, one-stop support service.

## WHY THE MARKET NEEDS PAPERBIOPACK?

The packaging market is very dynamic and the demand across the world reached US $917,1 billions in 2019. However, companies are not always able to face the continuous challenges that arise above all with regard to sustainable packaging.

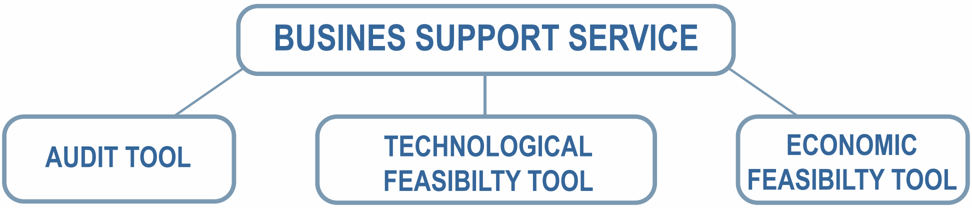
### FOUR REASONS TO CHOOSE PAPERBIOPACK

1. to deliver **support** to companies
2. to **exchange** information, knowledge and resources
3. to **develop** R&D business ecosystems
4. to **help** in implementation new market oriented projects

# THE BUSINESS SUPPORT SERVICE

The project offers, through the platform PaperBioPack, a set of tools developed to consult and support companies in the packaging industry in order to raise cross sectorial linkages between the actors of the segment.

The aim of the Business Support Sevice is to provide tailor-made innovative paper-bioplastic packaging solutions in the framework of personal meetings between companies and the experts from the TBPC.




**THE AUDIT TOOL** is an assessment of framework conditions.
• It can be sent in advance (Google form)
• It serves to give a general picture on the company and the framework conditions
• It is ideal for screening the possible fields of innovation within the contacted company

**THE TECHNOLOGICAL FEASIBILITY TOOL** is an assessment of the company's technological readiness level.
• It gives insight into technical parameters of the company
• It allows to measure the technological readiness level of the consulted company
• It is required to serve as a starting point for the possible innovative solutions

**THE ECONOMIC FEASIBILITY TOOL** is an economical assessment of the provided innovatovative solution.
• It gives a general comparison for the company regarding the main financial parameters of the suggested innovative solution and the currently used technologies/materials
• It can only be a starting point for detailed financial analysis on the return of potential investment in the innovative solution

# CASE STUDIES

Pilot actions have been carried out with companies in all participating countries and used to test the business support service and the integrated approach of the innovation support group of cross-sectoral competences in paper and plastics, gain experience in decentralized project implementation and produce tangible examples of joint cooperation.

The first pilot action covered the testing of the business support service among 3 companies of the consortium. Feedback has been taken into account before the support service was tested in the second pilot action among 3 companies in each of the six countries (18 companies total) selected through a public call for proposals. The third pilot action concerned the testing of an integrated technology transfer approach including the cross-sectoral knowledge capacities of the project partners in a group of 6 companies selected among the companies of the 2 previous pilots.

The 6 companies chosen for the 3rd round of the pilot actions are:

**Bioplan** (Croatia)

**Lic Packaging** (Italy)

**Panara** (Slovakia)

**Pol-Zdob Drukarnia** (Poland)

**Turizem Bled** (Slovenia)

**Ugrinpack** (Hungary)

## BIOPLAN (CROATIA)

**FOUNDATION:** 2007
**SIZE:** small-sized
**KEY PRODUCTS/ SERVICES:**

- production and distribution of agricultural products (fruits and vegetables)
- consulting in agriculture
- greenhouse construction
- agriculture watering development

**THE COMPANY**

Bioplan is a small-sized company covers wide range of agricultural business, but this case study is oriented on the development of sustainable packaging for fruits and vegetables (strawberries and similar fruits, particularly). Currently, these products are packed in polyspropylene (PP) transparent boxes.

According to its environmental sustainable agricultural production, Bioplan try to make the packing of its products also **more environmentally friendly**. First attempt has been to prepare packaging for strawberries made of paper and biodegradable plastic as a „window". In this case the box is closed and the product is safe of contamination, but the content is visible.

**TESTING OF MATERIALS ADEQUACY**

Use of biodegradable bags made by EcoCortec (EcoWorks) is successfully demonstrated in some cases, such as open packaging, where content is visible.

**3. CONCLUSION AND RECCOMENDATION**

EcoWorks film is opaque and **not suitable** for the closed packaging when the selling goods must be visible. Furthermore, EcoCortec is not able to make perforations on film, now.
Biodegradable plastic for "window" on paper box for strawberries and similar fruits should be thicker and transparent. It is obvious that the processing conditions (especially cooling rate) during plastic's production should be modified to obtain transparency. If it is impossible, another material needs to be used.
Final conclusion is that the packaging or it's part made of EcoWorks is not suitable when buyer wants to see fruits or vegetables packed in close box.

## LIC PACKAGING (ITALY)

**FOUNDATION:** 1952
**EMPLOYEES:** Large size company
**KEY PRODUCTS/ SERVICES:**
- Corrugated boxboards
- Display containers
- Food packaging (paper based trays)

**KEY MATERIALS:**
- Recycled and virgin paper
- Bioplastic

### THE COMPANY

Lic Packaging is a large Italian packaging producer (paperboard packaging) developing innovative paper based products for food contact with the aim to replace conventional plastic products in the market.

### THE MAIN ASSUMPTIONS FOR THE STUDY WERE THE FOLLOWING:

- All assessed packaging is intended for packing of 300g of fresh meat (functional unit)
- The shelf life of the different packaging solution was declared by the company in cooperation with their client (11 days for paper and PS packaging; 13 days for PET)
- The products are constituted by a tray plus a cover film, additionally only in the case of PET tray an internal pad is present.
- The mass of the different layers of materials was received from the company based on average production data.
- Recycling was included for paper/PLA and PET tray, but not for PS trays. As a matter of fact, even though recycling of PS is technically possible it does not take place in industrial practice (due to low economic benefit of PS recycling) The study was performed using a SimaPro software and EcoInvent data base. The system boundary was from cradle to cradle including the impact/credit of material recycling.

## CONCLUSIONS

The single score results, which summarize the impact of all categories, show that the environmental impact of PS packaging is the lowest among the analyzed packaging solutions, the main reason being the lower mass of the product. However, there is not a great difference between Paper/PLA and PS trays when the benefit of actual paper recycling in taken into account. In contrast, PET tray has a significant higher impact even though a slightly longer shelf life of the packed meat was taken into account as well as actual recycling was foreseen.

It is also relevant to mention that **the paper based solution with PLA show the lowest impact in all mid-point categories** except for agricultural land occupation, in this context FSC certification of the paper material play an important role to ensure the environmental sustainability of the land.

In the general context, the slightly lower environmental impact of PS packaging in comparison to paper/PLA tray does not counter balance the advantage to use a new paper based packaging solution made from renewable resources. As a matter of fact, PS is currently subjected to many criticism, strongly under scrutiny and will soon be banned for several single use plastic applications. It is produced from fossil resources and it does not match the criteria of the circular economy due to the fact that it is not recycled in practice. Besides, while PS has been widely used for this application for long time the new developed paper/PLA solution may offer the opportunity to reduce the environmental impact through further innovation in the field of bioplastic production.

## SHORT TERM SOLUTIONS/FURTHER ACTIONS

The paper based bioplastic packaging seems well positioned for this specific application, however there might be some potential improvement to be investigated:

1. **potential reduction of the total weight of the product**
2. since the major impact of the paper based packaging solution is due to the use of agricultural land for the production of virgin paper, one strategy might be to reduce the impact on this category through the **use of recycled paper** or an alternative paper based material in place of a part of the virgin paper.

## PANARA (SLOVAKIA)

...panara

**FOUNDATION:** 2006
**EMPLOYEES:** small size company
**KEY PRODUCTS/ SERVICES:**

- production of biodegradable plastic blends
- NONOILEN 1st and 2nd generation biodegradable plastics testing
- development of new materials based on NONOILEN
- orientation on innovative materials for packaging

**KEY MATERIALS:**
Basic biodegradable blends based
on natural resources
two generations of NONOILEN products

### THE COMPANY

Since 2006 the PANARA company started with R&D in bioplastics area with the goal to develop biodegradable and bio-based blends for different types of plastic processing. Strong partnership with the Slovak University of Technology escalated into common excellent and the unique Center called CEPOMA (Center for Applied Research of Environmentally Friendly Polymeric Materials) which is technological and technical base for research and development activities connected with new biodegradable and bio-based plastic materials.

### TESTING OF THE PREPARATION TECHNOLOGY OF MULTI-LAYER FILMS BASED ON NONOILEN

NONOILEN is produced by a unique technology that uses the most advanced knowledge of ecology and plastics processing. Properties of NONOILEN mixtures are similar to conventional plastics such as PE or PP, but especially polyesters. NONOILEN is a biodegradable plastic that is degradable into harmless and non-toxic products, that do not contribute to global warming. The appropriate combination of NONOILEN components can be produced as new bioplastic with:

- flexibility that will be maintain for several years
- better shape stability at elevated temperatures up to 100 °C
- stable properties during its storage and use
- excellent printing and coloring

## TECHNOLOGICAL PARAMETERS – MECHANICAL PROPERTIES

The study of the effect of technological parameters of granulate processing on mechanical properties of single-layer film which ensure sufficient mechanical properties of the final multi-layer film.

## TECHNOLOGICAL PARAMETERS – BARRIER PROPERTIES

The study of the effect of technological parameters of granulate processing on barrier properties of monolayer film which ensure sufficient barrier properties of the final multi-layer film.

Oxygen permeability is at the level of LDPE or Ecoflex, which is also a biodegradable and compostable polymer but not from renewable sources. Water vapour permeability is at the level of LDPE.

## CONCLUSION/SOLUTION

The solution of the present project is based on the natural resource base of the material NONOILEN, which has a potential to combine several recipes to eliminate unwanted parameters listed. PANARA in a close cooperation with the STU **has developed bio-plastic materials based on renewable resources** (100%) under the name of NONOILEN, namely NONOILEN 1st and 2nd generation, with distinct times and conditions of bio-decomposition. NONOILEN 1st generation is decomposable in conditions of **industrial composting** and NONOILEN 2nd generation in conditions of **domestic compost**. Noted solutions of the material NONOILEN are the subject of the two applications of the invention.

The result of the Pilot Action Project is the optimization of the material track and technological parameters of production of at least two-layered film with chill-roll technology. This was realized on knowledge of the testing of the correlation between the rheological and mechanical properties of the films prepared in the previous development materials and the resulting processing and mechanical properties of the final mono- and multi-layer films.

Testing was carried out under the conditions of low-capacity operation with the idea to achieve the best economic and environmental parameters of the final product.

The ecological benefits of these packaging materials consist not only in their origins from the renewable sources of raw materials but also in biodegradability, allowing them to be broken down by means of microorganisms for biomass, carbon dioxide and water.

## POL-ZDOB DRUKARNIA (POLAND)

**FOUNDATION:** 1990
**SIZE:** Medium
**KEY PRODUCTS/ SERVICES**
- flexographic overprints on paper-based and foil surfaces
- overprints in HIGH DEFINITION FLEXO technology
- FLEXO technology printing with low-migration UV inks and solvent inks.

**THE COMPANY**

The participating company is medium Polish packaging printing company established in Kraków in southern Poland. The nature of their products is semi-finished products with the end use for food (dry, wet and liquid) as well as primary and secondary packaging. The base materials are virgin paper, coated paper, and plastics, including biobased and biodegradable. The company is producing food packaging for both dry and wet food with the storage time of over 6 months. The base materials of their products are virgin and coated paper, and plastics, including biodegradable and biobased plastics.

**TESTING OF MATERIAL ADEQUACY**

Testing focused on the following properties:
- Water resistance
- Seal ability
- Recyclability with paper
- Compostability

**Testing of material** adequacy was dedicated to new materials for paper coating and tea envelopes. The company was seeking for a bioplastic material for tea envelopes that could be printed and would be biodegradable.

Potential material alternatives were considered: Ecovio, dispersion barrier, or a new Biotec material which is certified for home compost. There were other materials that were taken into consideration due to their properities, such as PLA or cellulose, and materials produced by Futamura, e.g. Naturflex. During the further testings, the SunStar DFC Coating was chosen as the most suitable. The SunStar DFC Coating is an aqueous coating intended for application to paper, carton

board and natural fibre packaging. The coating improves moisture barrier and grease resistance properties. It is a more **ecologically friendly alternative** to polyethelene extruded boards. It i salso suitable for food packaging, for both indirect and direct food contact.
The first tests were performed manually in order to ensure the adequacy of the different types of materials. In order to carry out the procedure a so called „stick" was applied by a flexo printing technology. Although this type of testing allows to achieve representative end results in a relative costeffective way. Further testing focused on the following properties:

- Water resistance
- Grease resistance
- Seal ability
- Recyclability with paper
- Composability

The sample of new packaging was tested for the compostability in accordance to **EN 14806:2005** - Packaging.

## TESTING OF INDUSTRIAL TECHNOLOGIES

POL-ZDOB is equipped with a modern machine park that enables them to perform flexographic overprints in up to 10 colours, both on paper-based and foil surfaces. They perform overprints in high definition flexo technology and flexo technology printing with low-migration UV inks and solvent inks. The testing of new materials has taken into consideration the available machines and incorporated the most sufficient methods of coating and printing to a satisfactory results.

## CONCLUSION/SOLUTION

The nature of their products is semi-finished products with the end use for food (dry, wet and liquid) as well as primary and secondary packaging. The base materials are virgin paper, coated paper, and plastics, including biobased and biodegradable. The testing of material adequacy and industrial technologies. The obtained results proved that **the change of coating was beneficial** from the ecological point of view without the loss of the usability parameters.

# BLED LOCAL SELECTION BRAND (SLOVENIA)

Four companies that participated in our project are completely different from each other in terms of activity, but we detected a connection between them, which strives for the same goal. Main story is city Bled, the largest tourist destination in Slovenia. Bled is striving to transform into an environmentally friendly green destination. Part of this effort is the use of sustainable packaging for specific local products represented under the common brand Bled Local Selection. The development of packaging is at the heart of establishing a value chain and a wider regional impact.

Included companies:

- Turizem Bled, creator of a common brand Bled Local Selection which joins local producers of consumer products,
- startup company Dodopack, which develops and innovates packaging
- Termopol d.o.o., which produces plastic packaging and aims to replace it with biocomposite laminated paper,
- Infrastruktura Bled d.o.o., waste management service in Bled.

Case study made for Bled Local Selection brand will in the future have an opportunity to be extended to other emerging local brands in the Julian Alps, whose

## IDENTIFYING SPECIFIC GROUPS OF PACKAGING PRODUCTS

Bled Local Selection brand is created according to the guidelines of already existing local brand Bohinjsko from Bohinj.

All products and their packaging were classified according to the type of product (food products, gastronomic offer, arts and crafts, gift packagings and packaging that is used in a gift shop). We divided food products into products that need dry storage and those who need to be refrigerated. For each product, we defined the packaging material, label and printing.

All identified replacement materials can be either recycled or reused.

## OVERALL RECOMMENDATIONS:

- Composite materials are recommended where they contribute to the sustainability and functionality of the packaging. Where possible, is best to use recyclable mono materials.

• use biodegradable ink
• packaging is mostly digitally printed, that means that the amount of colors has no special effect
• smaller printed surface is better,
• avoid unnecessary use of glue (appropriate structural design).

**OVERAL PACKAGING CONCEPT**

The Bled Local Selection brand already has developed corporate identity, a story and visual guidelines. Proposals from our side was to design all the packaging in a way that it can be recognized from the shape itself. A specific shape that will represent all common local brands in the area of Julian Alps.

**GRADUAL PROTOTYPING FOR A SPECIFIC PURPOSE TYPE OF PACKAGING**

**Gift bag**

Existing gift bag is made of laminated paper and nylon string. We made a new paper gift bag in non-standard shape with a minimal printed surface.

**Cream cake packaging**

Existing packaging is a plastic container that is recyclable. We made a packaging made from paper laminated with biodegradable plastic and small biodegradable plastic window, which can be recycled with industrial composting.

**GRADUAL PRODUCTION AND IMPLEMENTATION**

In consideration that Bled Local Selection is relatively new brand and a project that is just beginning to establish guidelines, recommendations such as which materials or their combinations should be replaced and used for packaging local products, can make a significant change into becoming aspect of their story from the beginning to the end.

A very important part is to properly label and add all the certificates that correctly guide the user what to do with the packaging after service. This has to be adapted to each packaging individually. The certification scheme depends on the final packaging, combination of material, lamination and printing.

## UGRINPACK (HUNGARY)

**FOUNDATION:** 1991
**EMPLOYEES:** small size company
**KEY PRODUCTS/ SERVICES:**

- production of flexible
- packaging materials
- packaging of promotional products
- production of POS products
- packaging of blister products

**KEY MATERIALS:**

- flexible packaging
- materials
- rigid packaging materials
- blister
- POS

### THE COMPANY

The participating Hungarian small packaging company is producing paper products and different materials (e.g. paperboard, linerboard, laminated or extruded material, plastic film). Considering the financial position and strategy of the company and taking into account the Hungarian market and demands the best solution would be replace Pe (polyethylene) to Ecovio.

### TESTING OF MATERIAL ADEQUACY

The first tests have been done manually in order **to ensure the adequacy** of the different types of materials. In order to carry out the procedure a so called „stick" has been applied by flexo printing technology.

Although this type of testing allows to achieve representative end results in a relative cost effective way, the thickness of the coating layer could not be precisely measured, which has been a great disadvantage.

Testing focused on the following properties:

- Water resistance
- Grease resistance
- Seal ability
- Recyclability with paper
- Compostability

From each supplier 2-4 materials have been tested on different types of papers. These were the following:

- Thinner, lower grammage paper used for coldcuts, sandwiches, hamburgers
- Thicker grammage paper used for dry food packaging (e.g. sugar stick)
- Cardboard material for food containers and paper cups

Some of the samples proved to be sufficient after the manual testing.

## TESTING OF INDUSTRIAL TECHNOLOGIES

**In the first test** rotogravure technology has been used to spread the coating layer with a Comexi type machine.

With the rotogravure roller the surface of the paper has soaked up too much coating and the instant drying out of the material could not be guaranteed.

**As a second option** a Varga laminating machine has been used, where the coating has been done with a rubber roller. In this case the coating layer is submitted from the rubber roller to a spreading roller, which thereby enables the precise setting of the thickness of the coating by the compression of the two rollers.

**In the third testing** a W&H Flexo printing line has been used. Here an anilox (ceramic) roller has been used which submitted the coating material to a rubber roller, which applied it to the carrier surface, the paper in this case. The viscosity in this case is similar to the inks applied in this type of technology.

The coating has been applied with one printing werk, but this proved to be insufficient. The thickness of the layer failed the tests, it proved neither to be liquid proof, nor tightly sealed.

With the usage of thinner paper as base material, the sealing test proved to be satisfactory, as well as greaseproofness. Nevertheless, pinholes could be observed on the surface, which caused the leaking of high viscosity liquids, such as water. **When using thicker cardboard, the result turned out to be better.**

## CONCLUSION/SOLUTION

**The adaptation of the flexo technology seems to be the best practice**. It is clear and understated, that the viscosity of the coating material has to be higher. The adequate grammage of the coating layer should be minimum 6 gramm/squaremeter.

Besides this, in order to implement the innovative solution Ugrinpack has to purchase new anilox rollers.

# PARTNERS AND CONTACTS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