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Biodegradable and compostable packaging

an alternative to plastics

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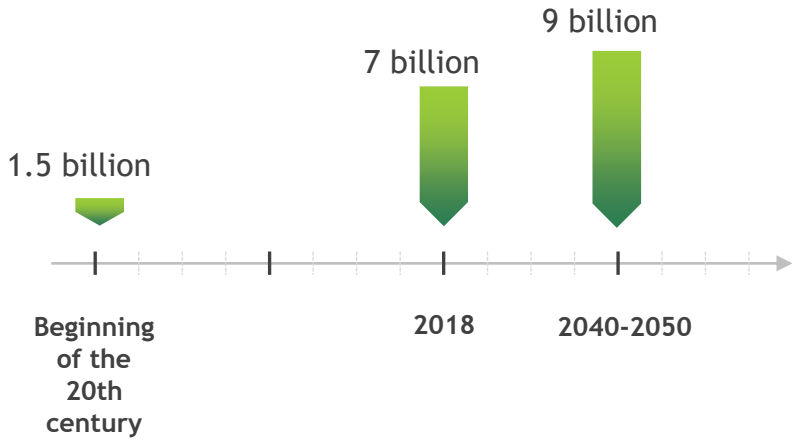
MORE NEEDS

Main causes of emerging waste problems

LESS CAPACITIES

increasing world's population



consumer lifestyle

limited water and clean air resources

limited sources of natural resources and fuels

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Legal measures and recommendations in Europe:

The new **Circular Economy** package, adopted by the European Commission on 2 December 2015, forces a new approach in the planning and operation of municipal waste systems. The package sets different target, such as the 65% municipal waste recycling and re-use target by 2030, common to all members of the European Union (EU)

EU - banned sale, as of 2021, of plastic products that can be produced using an alternative raw material, such as:

- plastic cups
- tea and coffee stirring sticks
- ear buds
- plastic cutlery and dishes
- drinking straws
- balloon clips
- cotton buds

Zero waste program - zero waste to landfills by 2030s.
The only way to manage /recycle waste - recycling or biodegradation

2015

2021

Around 2030

2015 2018 2021 2025 Around 2030

2018

2025

On 1 January 2018 Poland enacted regulations that introduce a **recycling fee for disposable plastic bags issued at the checkout**. The special regulation sets the fee at PLN 0.20 per plastic bag, but - according to the law - this amount may be increased in the future to even as high as PLN 1

EU - the recovery rate for plastic bottles will be 90%, as foreseen in the proposed Article 9. Originally the year set for achieving this target was 2025, but following some negotiations it was postponed and split into two stages: 77 per cent by 2025 r. and 90 per cent by 2029. 2030 is the target year for recovery and recycling of at least 30 per cent of all plastic bottles.

A closed loop economy - or Circular Economy:

What is Circular Economy?

This new model of economy replaces the "Linear Model" and is based on the idea that the value of products, materials and resources is to be maintained in the economy for as long as possible, so that as the result waste generation is kept to a minimum. According to this concept, raw materials and are recirculated many times, often moving from one industry to another.

In other words, it is about closing a product's life cycle and moving from a linear model of economy (acquisition of resources - production - use - disposal of waste) to a circular model (production - use - utilising waste as a resource in the next production cycle).

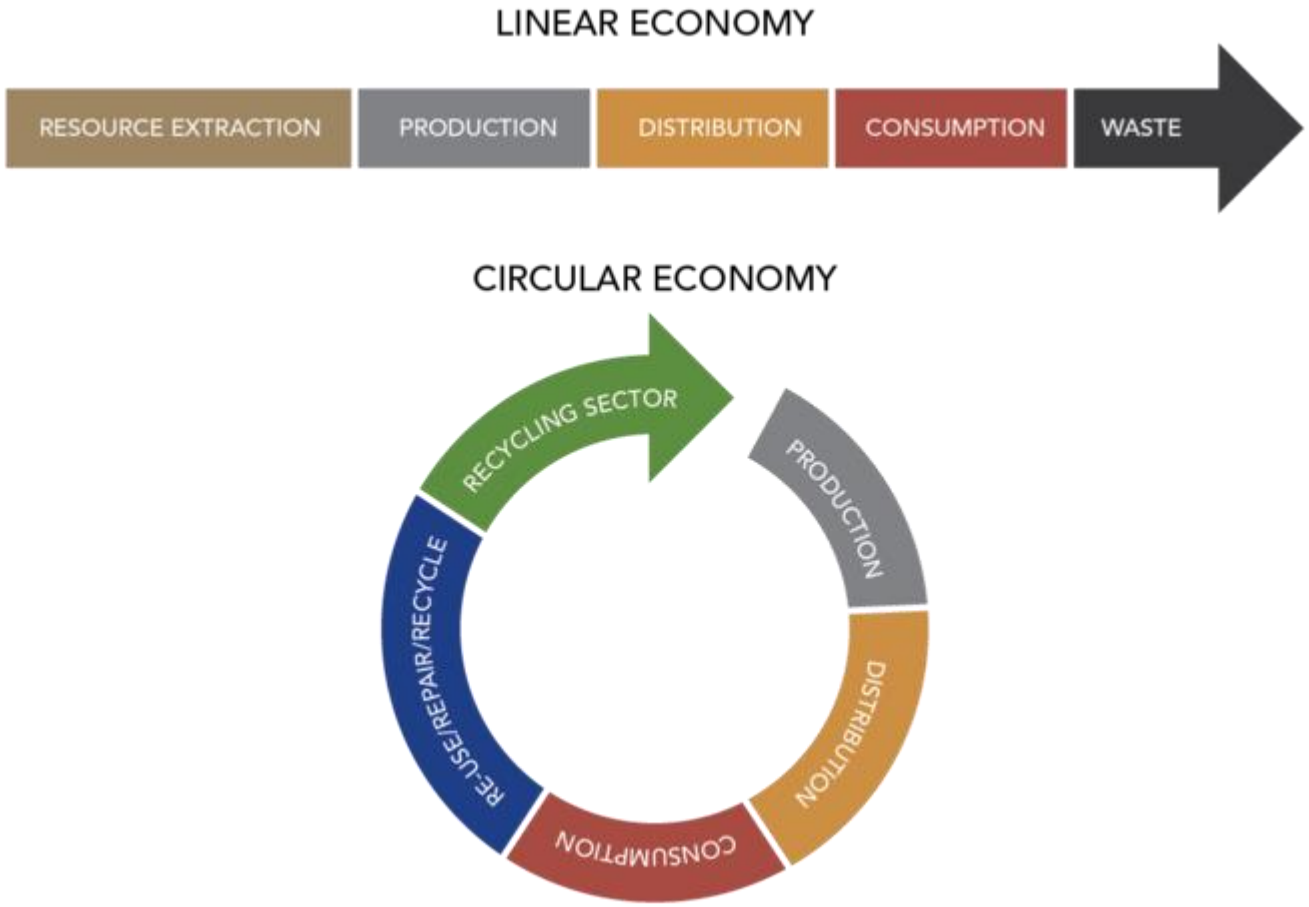


Image: World Economic Forum

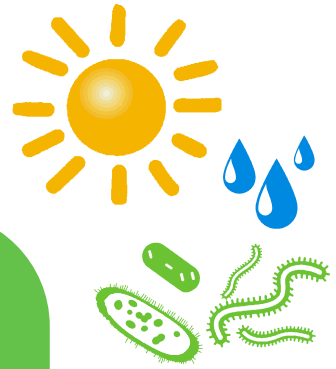
Measures to deal with the problem:

- rational use of resources - water and energy
- moving towards a more efficient and cost effective method of production
- conscious consumption - saving and reusing
- no food waste
- waste segregation and recycling

and for packaging:

- reducing the size and area of packaging to a minimum
- reduced packaging thickness
- standardisation of raw materials used for packaging
- recyclable packaging
- replacing oil-based raw materials with renewable materials

Biodegradable and compostable packaging



There are plants, for example, corn, which yield starch. This starch is used to produce packaging that is **biodegradable and also compostable**. Under atmospheric conditions and in presence of bacteria, the material decomposes to its original form and returns to the soil, from which plants grow. This is a closed cycle.

Biodegradable and compostable plastics:

Biodegradable plastics - plastics that fully decompose under the influence of microorganisms to carbon dioxide or methane and water, biomass and inorganic components in aerobic or anaerobic conditions.

Plastics that are only certified as biodegradable (whether in soil or water) are not intended for composting because, due to their composition or degradation mechanism, they can seriously disrupt the process.

Compostable plastics - plastics that are biodegradable under composting conditions where the degradation rate is comparable to the duration of the composting cycle and follows the applicable standards.

Composting is organic recycling, which is the aerobic treatment of waste from biodegradable packaging and yields organic matter and compost. It is based on biochemical processes taking place in artificially created industrial conditions, ensuring an optimal reaction environment and the possibility to control the process intensity.

It is assumed that **compostable plastics are always biodegradable** while **biodegradable** plastics **are not necessarily compostable** (as biodegradation may take longer than required for composting). Therefore, compostable plastics belong to a subgroup of biodegradable plastics.

Types of biodegradable and compostable plastics:

Today, more and more manufacturers offer commercially produced biodegradable plastics on the market.
The most common materials can be classified into the following groups:

- **Cellulose-based plastics, such as**
  Cellophane
  NatureFlex

- **PLA based plastics** - polylactide, poly lactic acid, (which can be made from maize or sugar cane)

- **Potato starch based plastics - MaterBi**

- **PHA-based plastics (PHB, PHBV, etc.)**

- **Plastics based on aliphatic-aromatic polyesters**

- **Lignin-based plastics**

Properties of biodegradable and compostable films:

Different biodegradable and compostable films exhibit properties consistent with their petroleum-based equivalents, including :

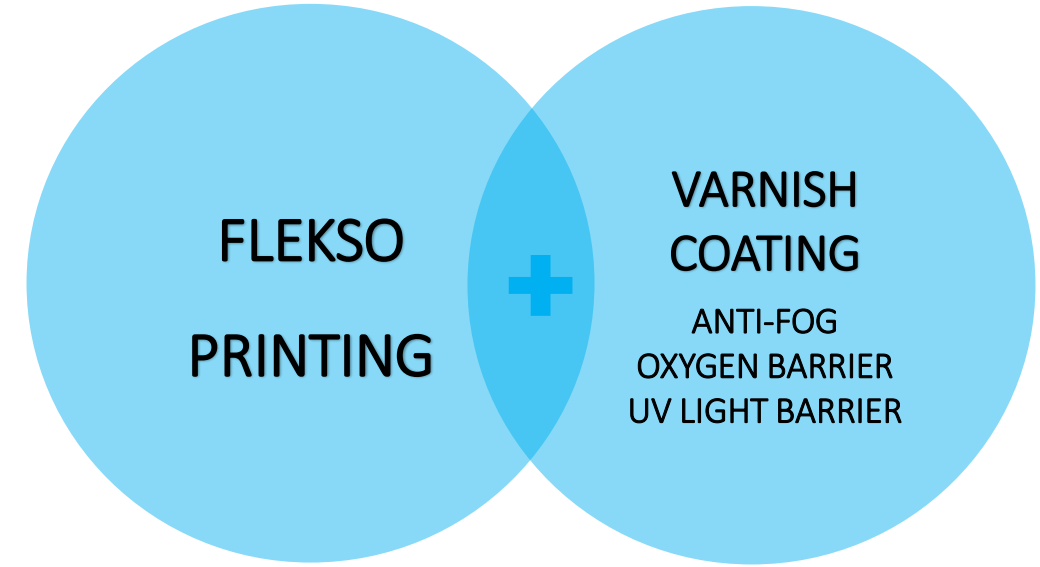
- High gloss, translucency and transparency
- good weldability
- Metallised and white films are available
- Excellent barrier properties against penetration of gases and mineral oils
- Adjustable moisture permeability
- Natural good bend and torsion properties
- High heat resistance
- Natural antistatic properties facilitate printing and lamination
- Excellent chemical resistance
- Resistance to greases, oils and fats
- Facilitated printing and processing on machines

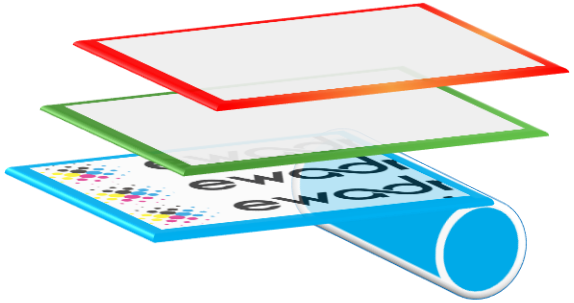
Comparison of properties of standard films with biodegradable and compostable films

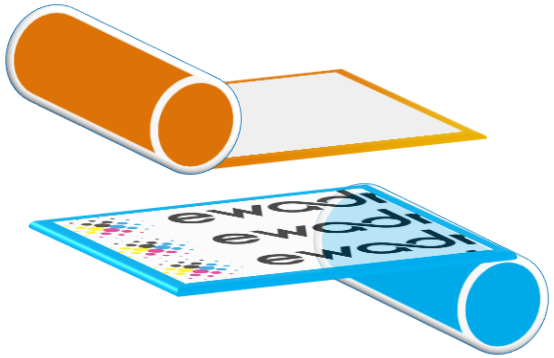
Type of film		Permeability/penetrability		Temperature range of weld
		O_2 oxygen	H_2O water vapour	
		(cc/m².24h) 23°C, 0%RH	(g/m².24h) 38°C, 90%RH	°C
plastic film	BOPP standard	1.800	6	115 - 145
	BOPP coated on two sides with acrylic lacquer	850	5.5	85 - 145
	PP CAST	4.200	12	115 - 150
	PE-LD	4.000	20	
	BO PET	80	40	144 - 170
cellulose films	cellophane XS	5.0	20	100 - 160
	cellophane WS	5.0	350	105 - 160
	lMS cellophane	5.0	600	90 - 160
	NatureFlex NK	5.0	20	115 - 170
	NatureFlex NE	5.0	75	80 - 200
	NatureFlex NVR	5.0	120	80 - 200
	NatureFlex NVS	5.0	600	90 - 200
	NatureFlex metallized NM	0	10	90 - 200

Source: Futamura, Data for clear films,25 microns thick (or nearest equivalent), indicative.

Biodegradable and compostable films can be printed, laminated and covered with varnish:







Oxygen, water vapor and carbon dioxide permeability values for different petroleum-based polymers and biopolymers:

Material designation	Thickness:	Oxygen permeability [1] [cm^2/m^2 in 24h]	Water vapour permeability [2] [g^2/m^2 in 24h]	Carbon dioxide permeability [1] [cm^3/m^2 in 24h]
LD-PE	25	7 880	-	42 000
HD-PE	25	2 890	-	9 190
PA (NYLON)	12	45	350	8 400
OPP	25	2 500	-	8 400
OPS	25	5 520	-	13 900
PET	12	140	20	-
PVC	25	121	-	499
PC	25	4 730	-	17 100
EVOH/EVAL	20	0.25	-	0.6
PLA	25	675	375	2 850

Source: Monika Kaczmarczyk, Alicja Kaszuba, Jacek Frydrych "Packaging materials of controlled barrier properties: the SelectPerm project "Food packaging materials with selective oxygen and carbon dioxide (O2/CO2) permeability"", Packaging No. 4/2015, p. 86

Examples of the use of biodegradable and compostable films:

Image: Futamura

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The benefits of using biodegradable and compostable films:

- Elimination of the use of limited fossil fuel resources

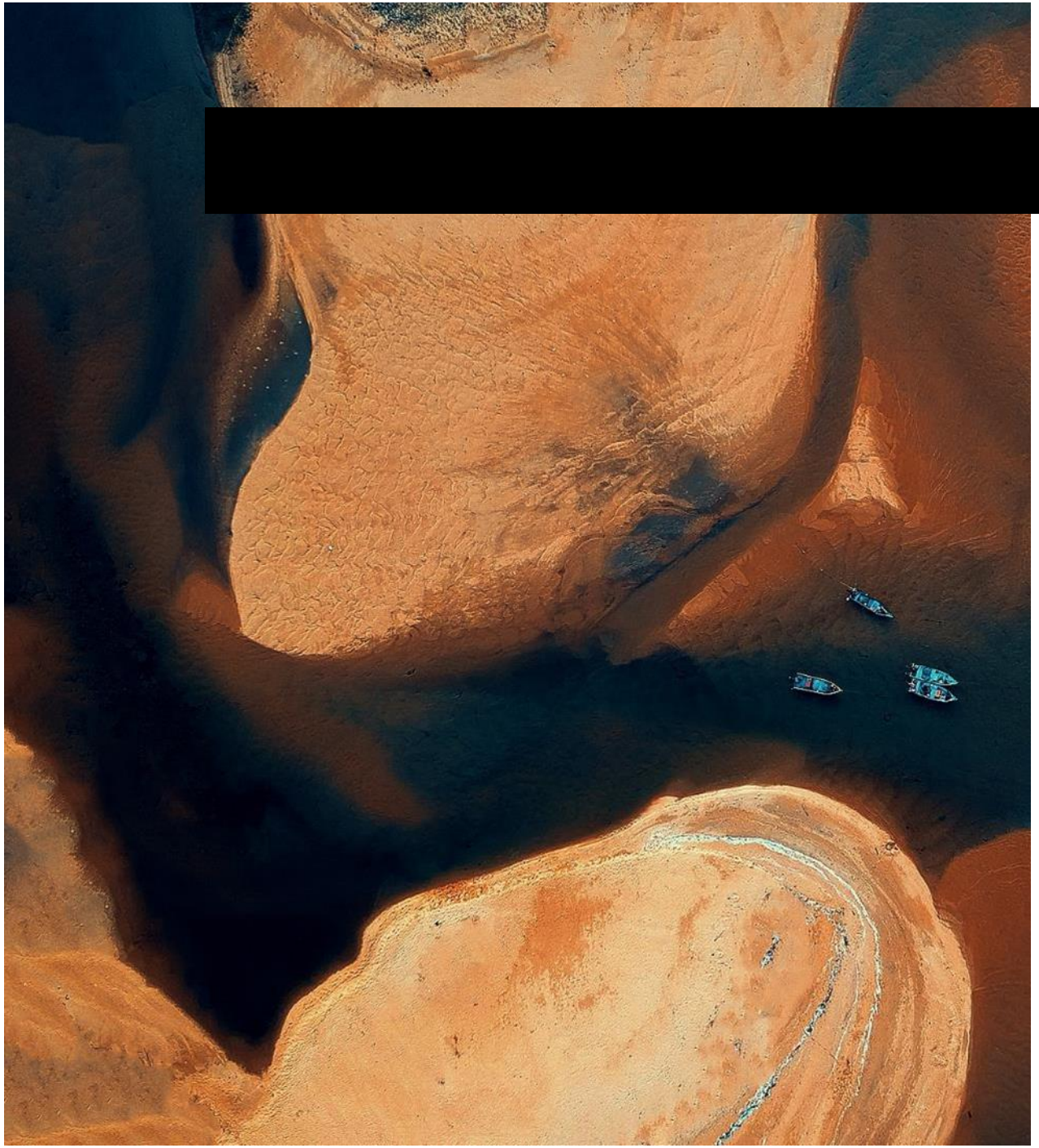
- Use of renewable raw materials for packaging
- Reduced harmful waste in the environment

- Reduced costs associated with segregation, storage and disposal of waste

DISADVANTAGES ???

So far , only one - higher cost

However, even this may soon change given the tax policies of the EU and its member states



THANK YOU

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