Bioplastics - a new threat or industrial synthesis?

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What do we know about bioplastics?

Few points helping to understand the topic:

1

The bioplastics can be made from either fossil (petrochemical) or biological (vegetable) resources,

2

The degradation of biodegradable plastics over a time differs, they should not be freely released into the environment in an uncontrolled manner. Not all biodegradable plastics are compostable,

3

A problem with biodegradable and compostable plastics is the lack of clarity about the standards for their biodegradability,

4

Bio-based plastics are plastic that are wholly or partly renewable. Bio-based plastics are not always biodegradable!

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Bioplastics

bio-based – is (at least partly) derived from biomass (e.g. from corn, sugarcane, trees, algae etc.)

biodegradable – implies that microorganisms that are present in the environment can convert the material into natural substances (i.e. water, carbon dioxide or compost) without polluting the environment

European Bioplastics Association

Types of polymers in terms of biodegradation and the sources of their origin

Biodegradable polymers made of **renewable resources** (so-called "double green"): PLA, PHA, TPS, starch blends	**Non-biodegradable** polymers produced from **renewable resources**: Bio-PE, Bio-PP, Bio-PET
Biodegradable and **petrochemical** polymers: PBAT, PCL, PBS	**Non-biodegradable** and **petrochemical** polymers: (PE, PP, PET, PS, PVC)

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Global production capacities of bioplastics

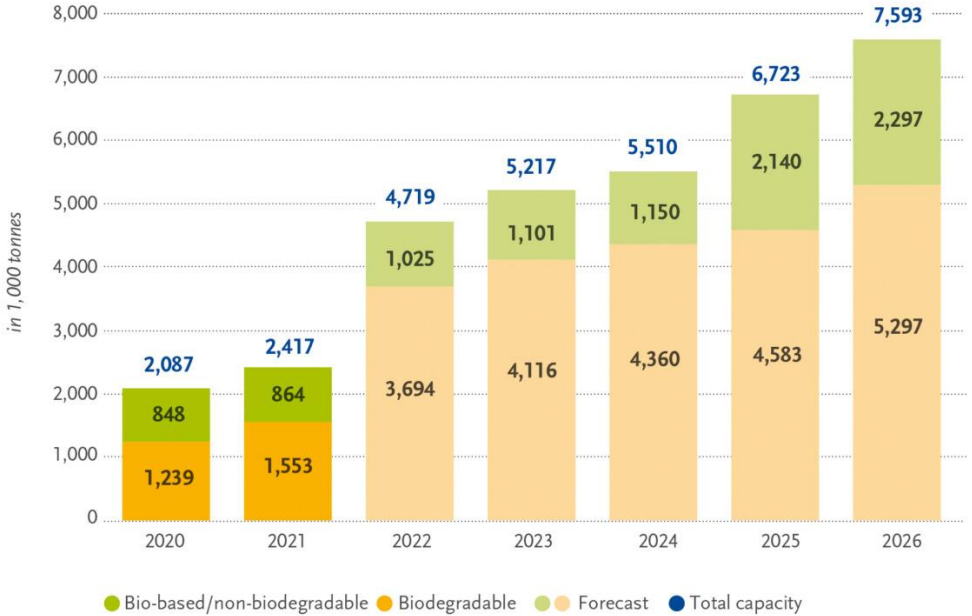
376 million tonnes plastics

…produced anually.

Poland alone it is 650 thousand tones, while in Norway it is 540 thousand tones (Mepex estimates).

1% bio-plastics

Global production capacity will increase from around 2.42 million tonnes in 2021 to around 7.59 million tonnes in 2026



Source: European Bioplastics, nova-Institute (2021)
More information: ***www.european-bioplastics.org/market*** *and* ***www.bio-based.eu/markets***

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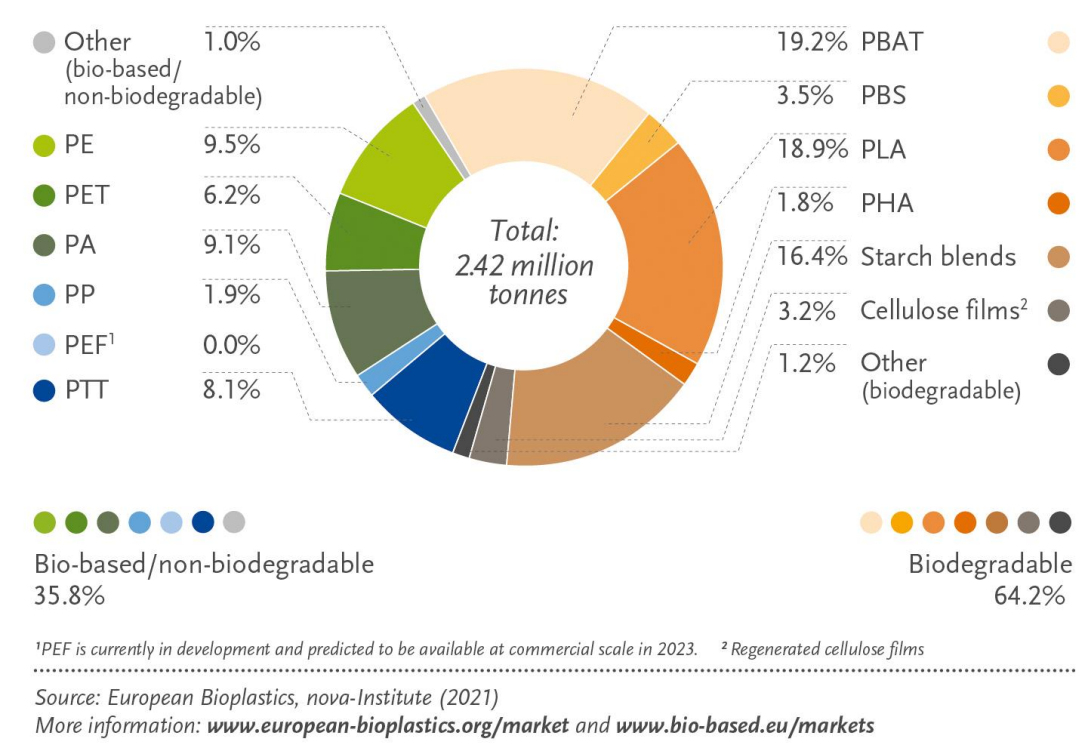
Global production capacities of bioplastics



2021 – by material type

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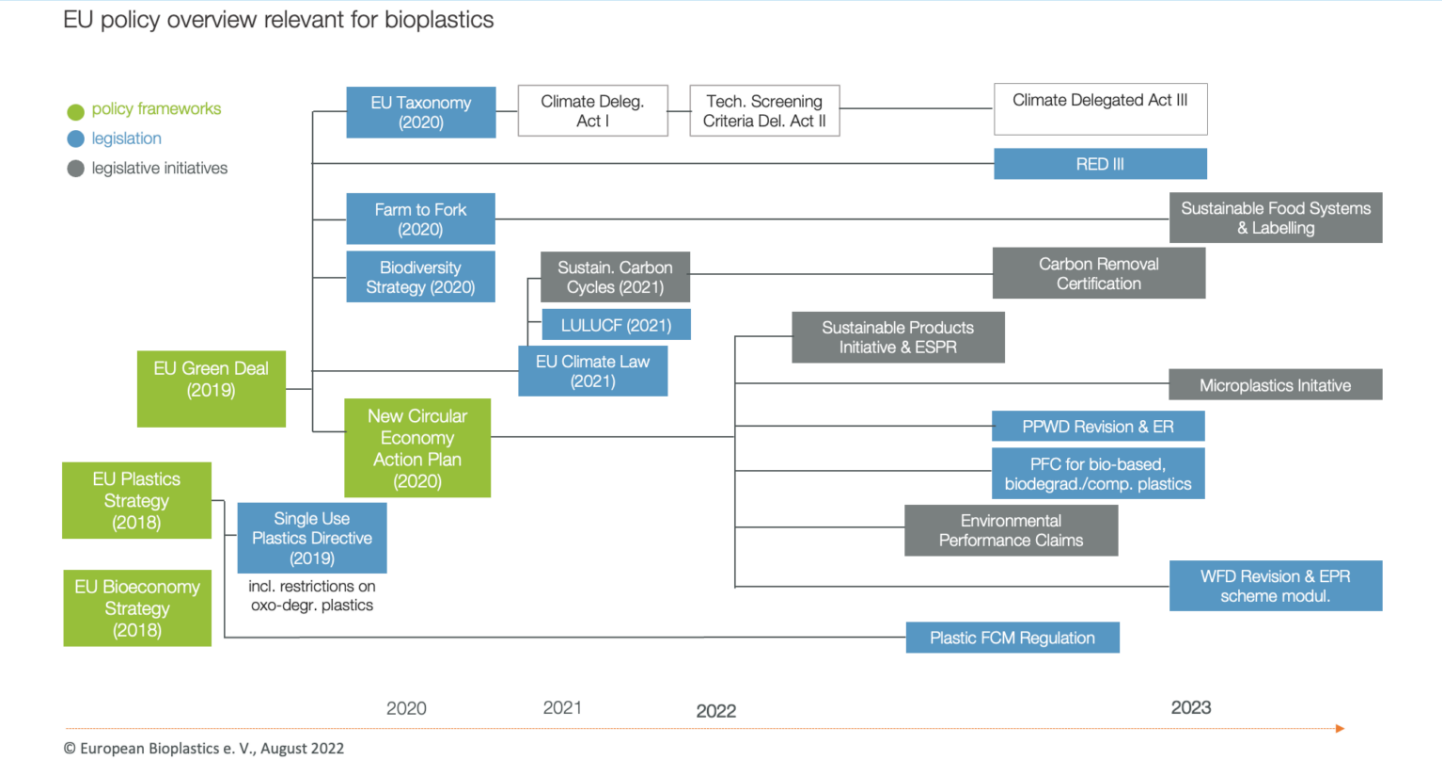
EU policy for bioplastics



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DIGEST PLAST - project in cooperation between Poland and Norway under EEA and Norway Grants

Pre- treatment methods of biodegradable plastics prior anaerobic digestion

Biogas potential of anaerobic digestion with biodegradable plastics – AMPTS test

Impact of basic process parameters on conversion of biodegradable plastics to microplastics – field study at utilisation plant Szadółki Poland

Digestate quality properties and microplastics presence evaluation

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Analysed bioplastics

PLA	Polylactic acid
PHA	Polyhydroxyalkanoates
Cellulose	Polysaccharide
Bran	Hard outer layers of cereal grain
Bioplast 120	Bio-plastic of bacterial origin
PHBV	Poly(3-hydroxybutyrate-co-3-hydroxyvalerate)
PHBH-HF	Poly(3-Hydroxyhexanoate with 3-Hydroxybutyrate) - hemp fibre

Pre-treatment methods of biodegradable plastics prior anaerobic digestion

2 methods were tested to verify if increase in the biogas production rate of the organic fraction of municipal waste (OFMW) with bioplastics is possible.

Thermal pre-treatment – 55ºC and 90ºC (3h, and 24h) (4 different time/temperature conditions).

Mechanical pre-treatment – 0.5 cm and 2.0 cm cut

AMPTS – Automatic Methane Potential Test System

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Pre-treatment methods

of biodegradable plastics prior anaerobic digestion

bran BP 120 cellulose PLA

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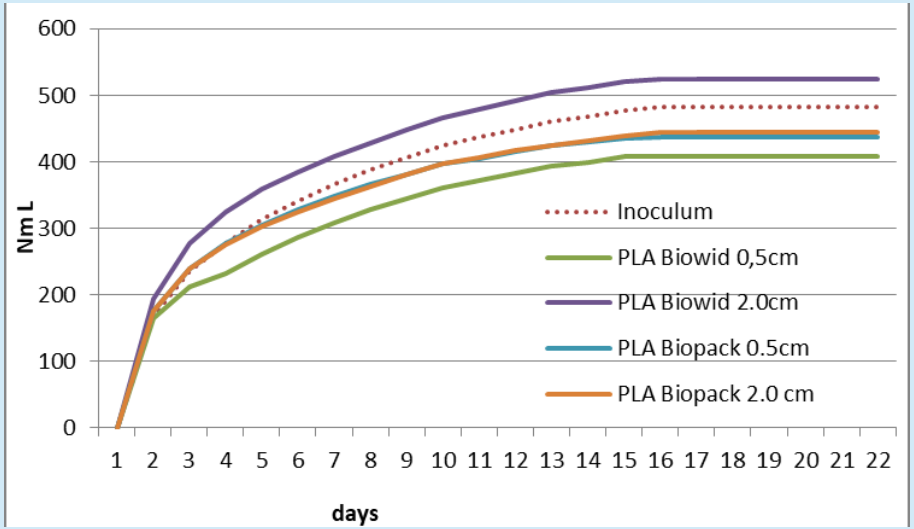
Anaerobic digestion of PLA

Mechanically pre-treated prior anaerobic digestion.



PLA cups (biowid, biopack) – size of 2cm and 0.5 cm

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PLA after anaerobic digestion

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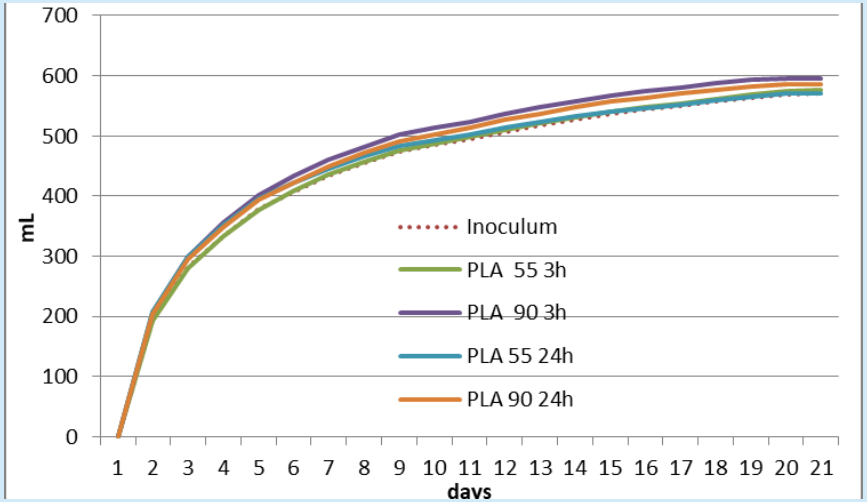
Anaerobic digestion of PLA

Thermal pre-treated prior anaerobic digestion.



	SMP
PLA 55 3h	2.2
PLA 90 3h	8.1
PLA 55 24h	0.4
PLA 90 24h	5.3

mL/gVS

Specific Methane Potential

- PLA Biowid cups, 55^{o}C (3 h, 24h), 90^{o}C (3h, 24h)

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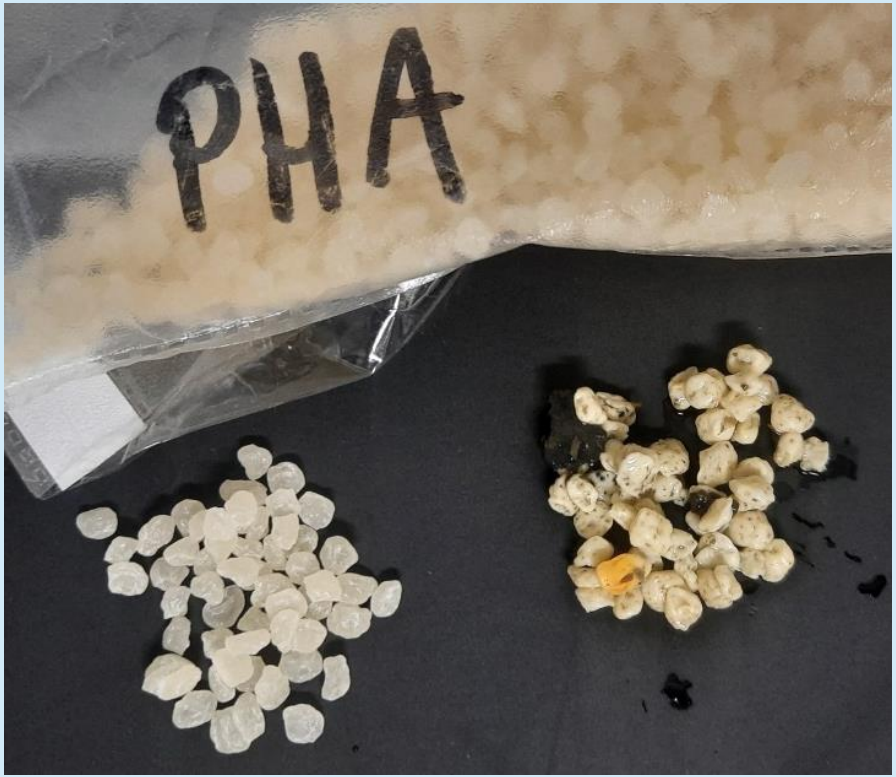
PHA (polyhydroxyalkanoates)

After 26 days of anaerobic digestion



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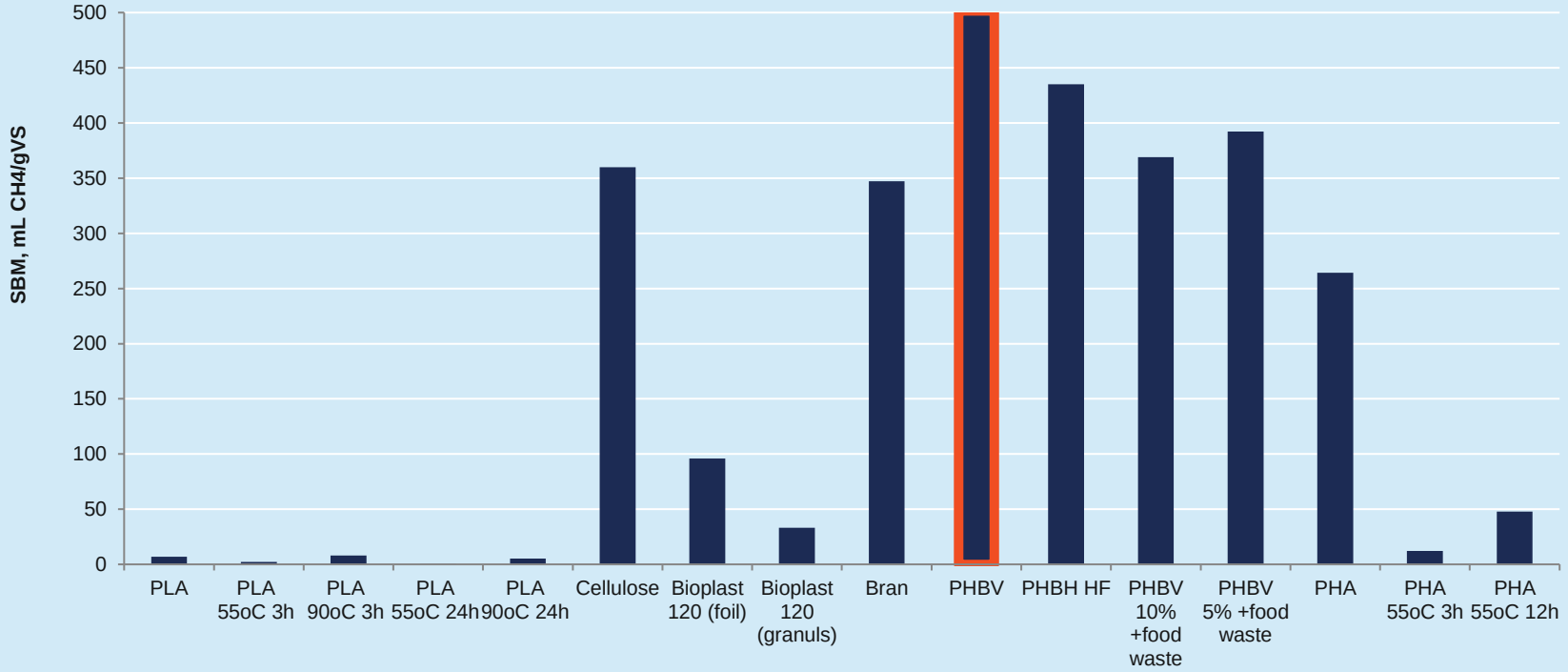
SBP (Specific Methane Potential) of bioplastics



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Conclusions

- PLA (polylactic acid) and PHA (polyhydroxyalkanoates) are the main drivers of this growth in the field of biodegradable plastics.
- Bioplastics may have the same properties as ordinary plastic.
- There is a strong discrepancy between regulations at the national and EU level.
- There is lack and no clarity in policy related to bioplastics.

Main problems:

- lack of clarity about the standards for biodegradability of bioplastics
- lack of common terminologies and regulations

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Thank you for your attention

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