



# ISSUES AND DEVELOPMENT STRATEGIES FOR BIODEGRADABLE PLASTICS

**Revelop  
Moon Sang Gwon**

# FOUR KEY ISSUES RELATED TO THE BIODEGRADABLE PLASTICS INDUSTRY

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- RAW MATERIALS

ARE THE RAW MATERIALS SUSTAINABLE, AND DO THEY AVOID ADVERSE IMPACTS ON ECOSYSTEMS, BIODIVERSITY, AND FOOD RESOURCES?

- WASTE MANAGEMENT

IS THERE AN ESTABLISHED SYSTEM FOR COLLECTING AND MANAGING WASTE?

- COST

CAN IT ACHIEVE PRICE COMPETITIVENESS COMPARABLE TO CONVENTIONAL (NON-BIODEGRADABLE) PLASTICS?

- APPLICABILITY BEYOND SINGLE-USE PRODUCTS

CAN ITS APPLICATIONS BE EXPANDED BEYOND SINGLE-USE PRODUCTS?

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# FOUR KEY ISSUES RELATED TO THE BIODEGRADABLE PLASTICS INDUSTRY (RAW MATERIALS)

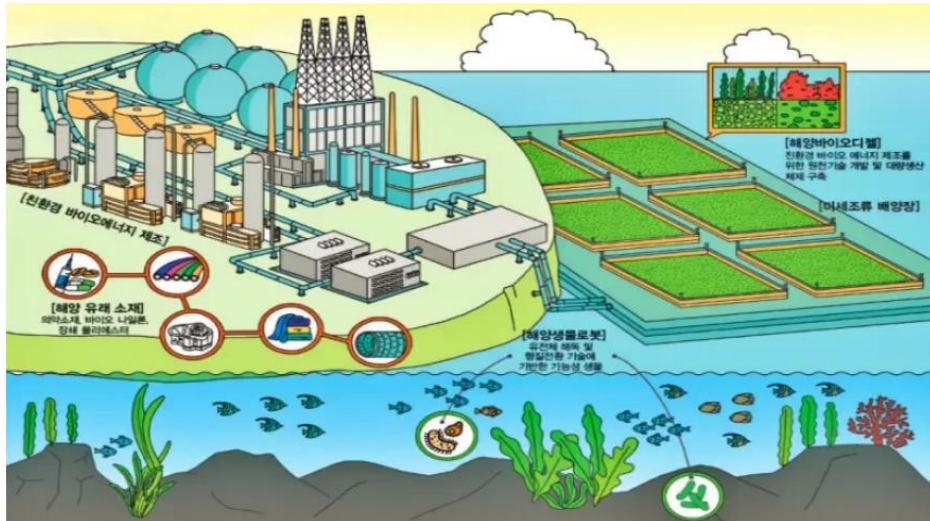
## RAW MATERIALS

ARE THE RAW MATERIALS SUSTAINABLE, AND DO THEY AVOID ADVERSE IMPACTS ON ECOSYSTEMS, BIODIVERSITY, AND FOOD RESOURCES?

IS IT POSSIBLE TO ASSESS THE POTENTIAL IMPACTS ON BIODIVERSITY ASSOCIATED WITH THE INCREASED UTILIZATION OF MARINE-DERIVED RAW MATERIALS??

IS IT POSSIBLE TO MANAGE ISSUES SUCH AS DEFORESTATION AND THE CONVERSION OF TROPICAL RAINFORESTS FOR RAW MATERIAL CULTIVATION ASSOCIATED WITH THE GROWING PRODUCTION OF BIOPOLYMERS?

IS IT POSSIBLE TO ADDRESS THE ETHICAL CONCERNS ASSOCIATED WITH UTILIZING FOOD RESOURCES FOR BIOPOLYMER PRODUCTION?"



Marine and Fisheries Biotechnology Development and Utilization (Source: Korea Institute of Marine Science & Technology Promotion)



Illegal Deforestation of the Amazon Rainforest in Brazil (Source: AFP, Yonhap News)






The World of Eco-friendly Chemistry – Bioplastics (Source: LG Chemtopia)

# FOUR KEY ISSUES RELATED TO THE BIODEGRADABLE PLASTICS INDUSTRY (RAW MATERIALS)

## Biodegradable Polymers in Various Environments According to Established Standards & Certification Schemes

Update  
2024

### NOTES

-  proven biodegradability
-  proven biodegradability for certain grades
-  biodegradability not proven

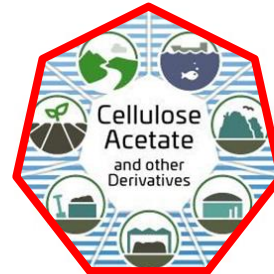
The biodegradability of plastics derived from these biodegradable polymers can only be guaranteed if all additives and (organic) fillers are biodegradable, too. Dying and finishing of cellulosic fibres, for example, may prevent their biodegradation in the environment.

Biodegradation depends on the complex biogeochemical conditions at each testing site (e.g. temperature, available nutrients and oxygen, microbial activity, etc.). Therefore, these generalised claims about biodegradability can only serve as approximations and need to be confirmed by standardised testing under lab conditions. In-situ behaviour can vary, depending on the mentioned conditions, size of the plastic, grade of the polymer and other factors. For instance, biodegradation testing is often performed after milling, showing the inherent nature of the material to biodegrade. In reality, the same level of biodegradation will be obtained, be it possibly within a different timeframe.

### SLOWER BIODEGRADING POLYMERS

The polymers shown in the poster are rapidly biodegraded in the labelled environments, within the time frame of the corresponding standards or certificates. Some biopolymers, such as PBS or PLA in soil and also lignin/wood for virtually all environments, also biodegrade, but (much) more slowly. Full biodegradation can take several years to decades to be achieved. In addition, for some applications with a use phase in a certain environment (e.g. geotextiles), too rapid biodegradation is not desired, as their function should first be given for a few years. However, for these cases no standards exist so far.

- 1 incl. P3HB, P4HB, P3HB4HB, P3HB3HV, P3HB3HV4HV, P3HB3HX, P3HB3HO, P3HB3HD
- 2 PLA is likely to be biodegradable in thermophilic anaerobic digestion at temperatures of 52°C within the time frame mentioned in standards. This does not apply to mesophilic digestion.



— in thermophilic digestion\*

### ENVIRONMENTS

#### IMPORTANT TEST CONDITIONS, CERTIFICATION SCHEMES AND STANDARDS

For more details, refer to the original documents.



**MARINE ENVIRONMENT**  
Temperature 30°C, 90 % biodegradation within a maximum of 6 months. Certification: TÜV AUSTRIA OK biodegradable MARINE and DIN CERTCO DINplus biodegradable in marine environment, the latter is based on ISO 22403, the standard giving requirements for marine biodegradability.



**FRESH WATER**  
Temperature 21°C, 90 % biodegradation within a maximum of 56 days. Certification: TÜV AUSTRIA OK biodegradable WATER. Research on standards (especially on requirements) is on-going.



**SOIL**  
Temperature 25°C, 90 % biodegradation within a maximum of 2 years. Certification: TÜV AUSTRIA OK biodegradable SOIL and DIN CERTCO DIN-Geprüft Biodegradable in Soil. DIN-Geprüft Biodegradable in Soil is based on the European standard EN 17033 dedicated to mulch films but can be used for other products as well.



**HOME COMPOSTING**  
Temperature 28°C, 90 % biodegradation within a maximum of 12 months. Certification: TÜV AUSTRIA OK compost HOME and DIN CERTCO DIN-Geprüft Home Compostable.



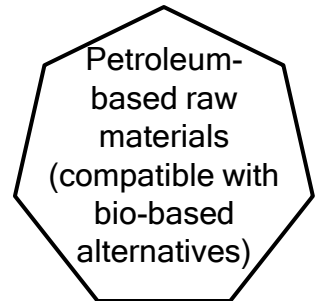
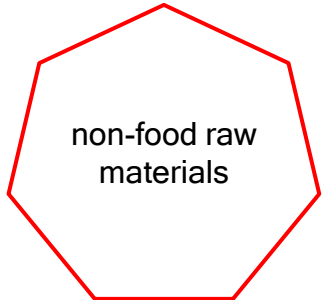
**LANDFILL**  
No European standard specifications or certification scheme available since this is not a preferred end-of-life option for biodegradable waste.



**ANAEROBIC DIGESTION**  
Thermophilic 52°C / Mesophilic 37°C  
A specific European standard or certification scheme for anaerobic digestion is not yet available. Anaerobic digestion in a biogas plant is mentioned in EN 13432 and EN 14995: 50 % biodegradation within two months, usually followed by aerobic digestion.



**INDUSTRIAL COMPOSTING**  
Temperature 58°C, 90 % biodegradation within a maximum of 6 months. Certification: TÜV AUSTRIA OK compost INDUSTRIAL, DIN CERTCO DIN-Geprüft Industrial Compostable and both "Seedling". EN 13432 and EN 14995 are the European reference standards and the basis of these certification schemes.



# FOUR KEY ISSUES RELATED TO THE BIODEGRADABLE PLASTICS INDUSTRY (WASTE MANAGEMENT)

## WASTE MANAGEMENT

IS IT POSSIBLE TO ESTABLISH AND OPERATE A WASTE COLLECTION SYSTEM (COVERING REUSE, RECYCLING, AND COMPOSTING)?

: PROFITABILITY IS THE CENTRAL ISSUE IN WASTE MANAGEMENT, SERVING AS THE KEY DRIVER FOR INVESTMENT ATTRACTION, COMPETITION STIMULATION, AND THE DEVELOPMENT OF WASTE MANAGEMENT SOLUTIONS

추진 과제 ③

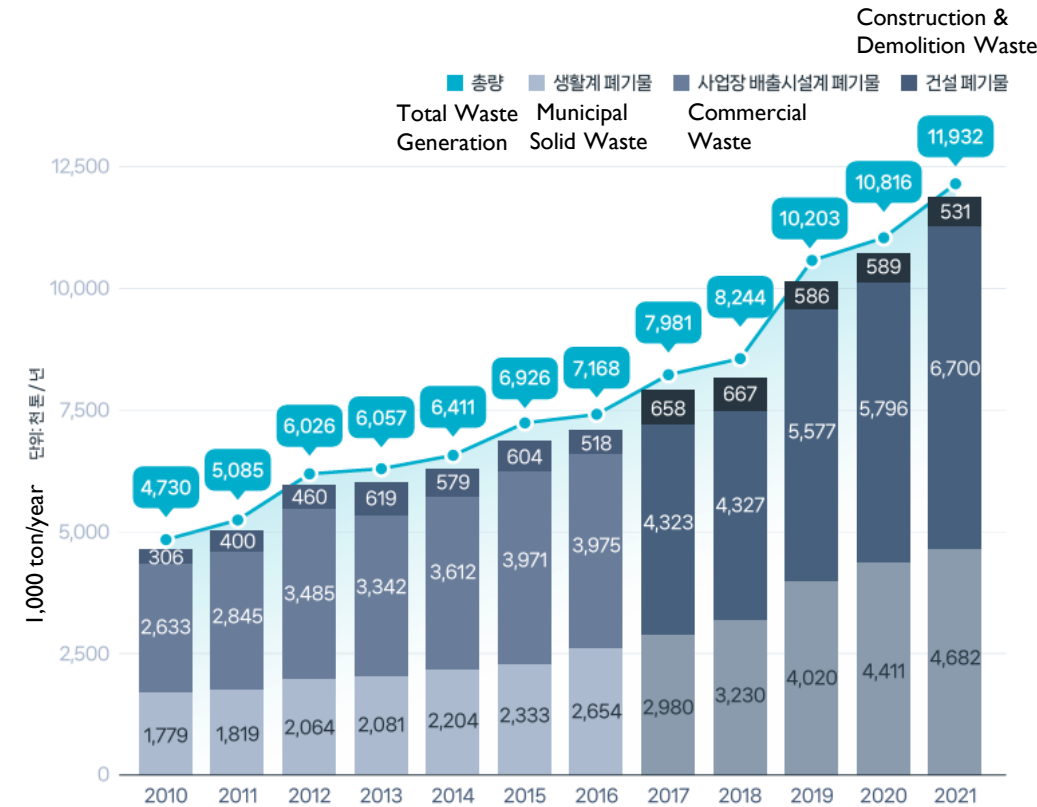
### 재생원료 대체재 산업 및 시장 육성

Fostering industries and markets for recycled materials and substitutes



규제 유연화로 신기술·신사업 촉진 제1차 규제혁신 전략회의 과제로 추진중

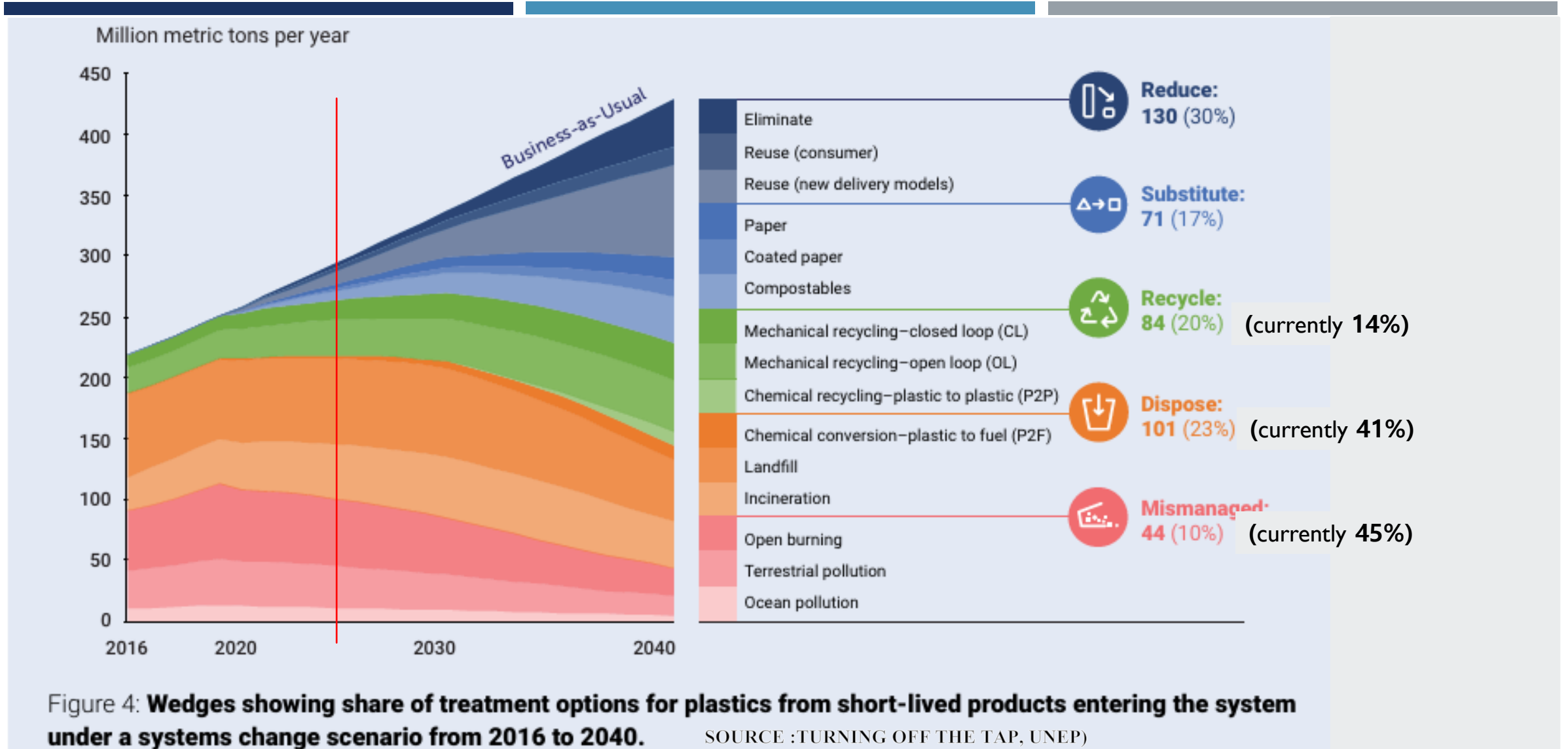
- Establishment of a Circular Economy Regulatory Sandbox to support the demonstration and commercialization of innovative technologies and services for plastic phase-out
- Simplification of certification criteria and procedures for recognizing recyclable resources exempted from regulations on organic waste, and reduction of regulatory burdens on recycling businesses



Source: Achieving a circular economy and carbon neutrality through plastic phase-out policy (MOE)

Plastic waste generation of Korea (2023 plastic Korea 2.0 GreenPeace)

# FOUR KEY ISSUES RELATED TO THE BIODEGRADABLE PLASTICS INDUSTRY (WASTE MANAGEMENT)



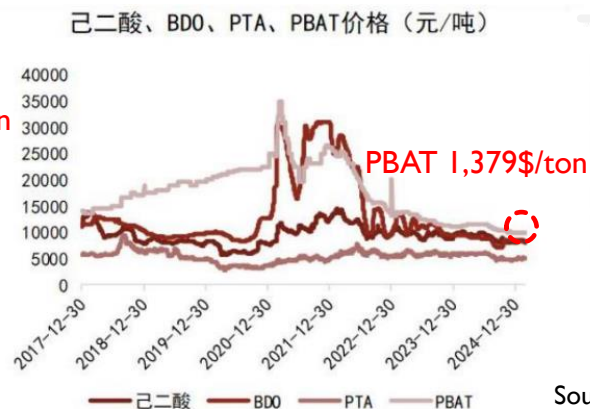
# FOUR KEY ISSUES RELATED TO THE BIODEGRADABLE PLASTICS INDUSTRY (COST)

## ■ COST

CAN IT ACHIEVE PRICE COMPETITIVENESS COMPARABLE TO CONVENTIONAL (NON-BIODEGRADABLE) PLASTICS?

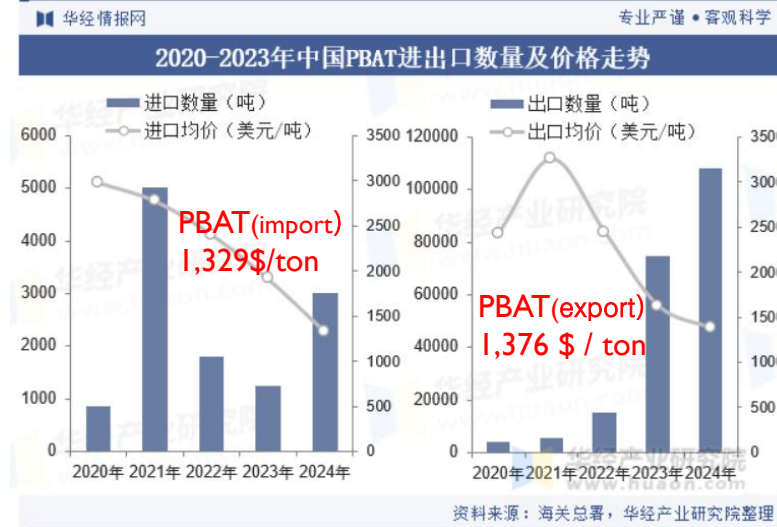
Category	Conventional Plastic	Bio-based Plastic	Biodegradable Plastic
Natural Decomposition	Not possible	Not possible	Possible
Carbon Reduction Effect in Manufacturing Process	None	Yes	Yes
Endocrine-disrupting Chemicals (Environmental Hormones)	Contains some	None	None
<b>Production Cost (per kg)</b>	<b>USD 1.7-2.0</b>	<b>USD 2.0-2.5</b>	<b>USD 4.0-5.0</b>
Durability (Suitability for Outer Packaging)	Yes	Yes	Partially
Feedstock	Petroleum	Biomass (+Petroleum)	Crops, Microorganisms

Are bio-based plastics environmentally friendly even if they are not biodegradable? (Source: Shindonga, 2020-11-15)



PE 1,214 \$/ton

聚乙烯 (PE)	2025-02-28	元/吨	8793
EVA	2025-02-28	元/吨	12000
苯乙烯 (一级品)	2025-02-20	元/吨	8597
聚丙烯 (拉丝) PP	2025-02-28	元/吨	7350



Source: China SHANXI Securities Industry Weekly Report

SOURCE: 华经情报网 HUAON.COM

# FOUR KEY ISSUES RELATED TO THE BIODEGRADABLE PLASTICS INDUSTRY (APPLICABILITY)

- APPLICABILITY BEYOND SINGLE-USE PRODUCTS

CAN ITS APPLICATIONS BE EXPANDED BEYOND SINGLE-USE PRODUCTS?

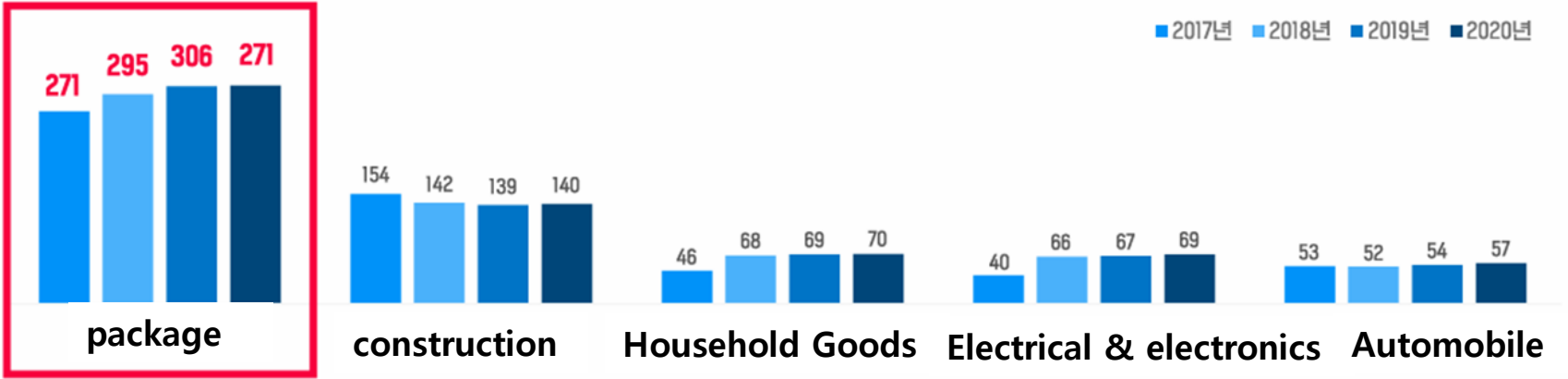
### Average lifespan per use case

(in years)



CLIMATE IMPACTS OF PLASTICS (출처:GRID ARENDAL,2024)

### 분야별 플라스틱 사용량 추이



Source: Achieving a circular economy and carbon neutrality through plastic phase-out policy (MOE)

# FOUR KEY ISSUES RELATED TO THE BIODEGRADABLE PLASTICS INDUSTRY (APPLICABILITY)

	Korea	EU	Canada	Germany
Plastic Carrier Bags	●	●	●	●
Plastic Package	●	●	●	●
Plastic Cup (Single Use)	●	●	●	●
Plastic Cup Lid	●	●	●	●
Plastic Container(Single use)	●	●	●	●
EPS(Expanded polystyrene) container	●	●	●	●
Plastic Cutlery(SingleUse)	●	●	●	●
Plastic Straw	●	●	●	●
Plastic Hygiene (+wet tissue)	●	●	●	●

**Level of Regulation**

- **Strict** : Policies beyond production and use bans
- **Standard** : Partial restriction on use & Consumption reduction
- **Minimal** : ban on free distribution ,labelling, campaigns
- **No regulation**
- **Suspension** : Regulation adopted with a grace period for enforcement

Comparison of Regulatory Stringency on Single-use Plastics by Country (Source: *Plastic Korea 2.0*, Greenpeace, 2023)

# FOUR KEY ISSUES RELATED TO THE BIODEGRADABLE PLASTICS INDUSTRY (APPLICABILITY)

- APPLICABILITY BEYOND SINGLE-USE PRODUCTS

IF THE PRODUCTION OF SINGLE-USE PRODUCTS IS UNAVOIDABLE...

	Single-use items in common use	Culturally driven single-use products	Industry-specific single-use products
EU		Cotton buds, balloon stick	EPS container/cup
korea	Plastic carrier bag, straw (stirrer), cutlery, dish Amenity (tooth brush, tooth paste, shampoo, conditioner, razor)	Tooth picks, wooden chop sticks, Cheering goods, plastic tablecloths, promotional materials(paper), umbrella sleeves	Plastic food container(single use), paper cup