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# FACTSHEET

## Plastic Waste Recycling in Germany and Japan

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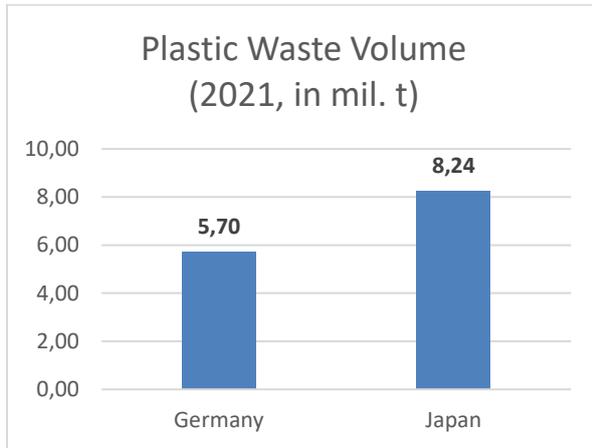
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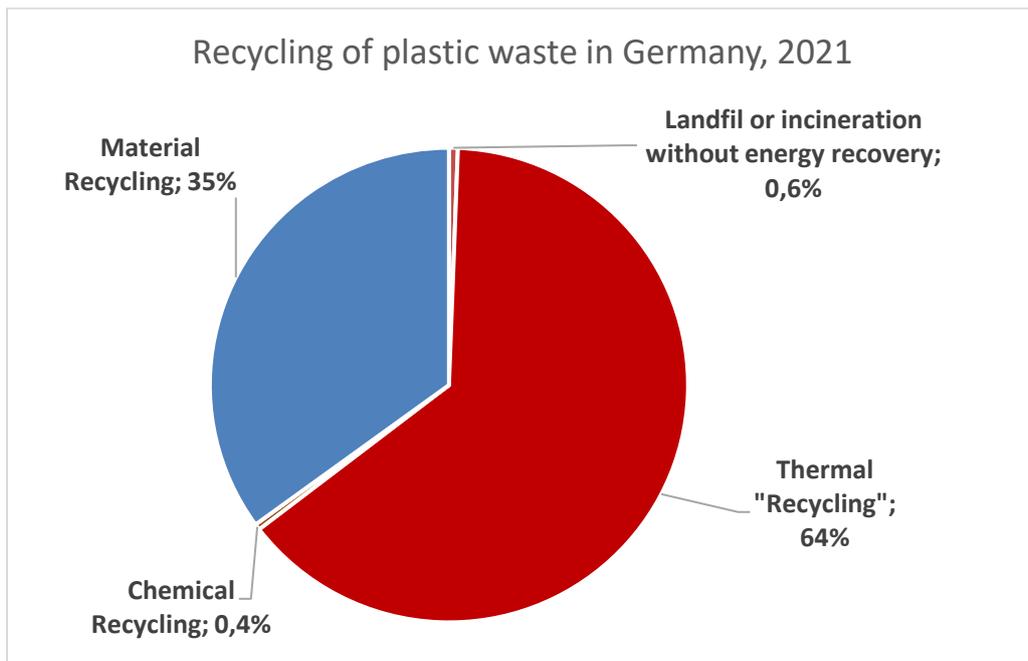
## List of Abbreviations

BMUV	Bundesministerium für Umwelt, Naturschutz, nukleare Sicherheit und Verbraucherschutz (Federal Ministry for the Environment, Nature Conservation, Nuclear Safety and Consumer Protection)
GHG	Greenhouse Gas
GWh	Gigawatt hours
JCPRA	Japan Containers and Packaging Recycling Association
kt	1000 t
METI	Ministry of Economy, Trade and Industry
MoEJ	Ministry of Environment Japan
PET	Polyethylenterephthalate
RDF	Refuse Derived Fuel
RPF	Refuse Paper & Plastic Fuel
SDGs	Sustainable Development Goals
UBA	Umweltbundesamt (German Environment Agency)
µm	micrometre

## 1 Main facts at a glance

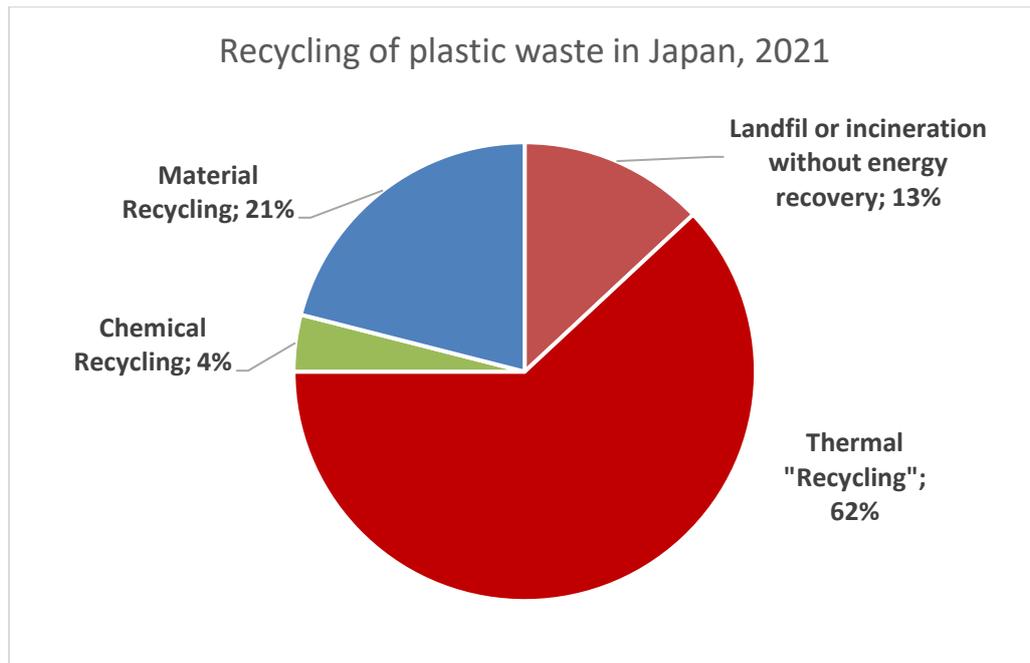


Sources: [Umweltbundesamt, 2021](#), [Plastic Waste Management Institute, 2022](#)

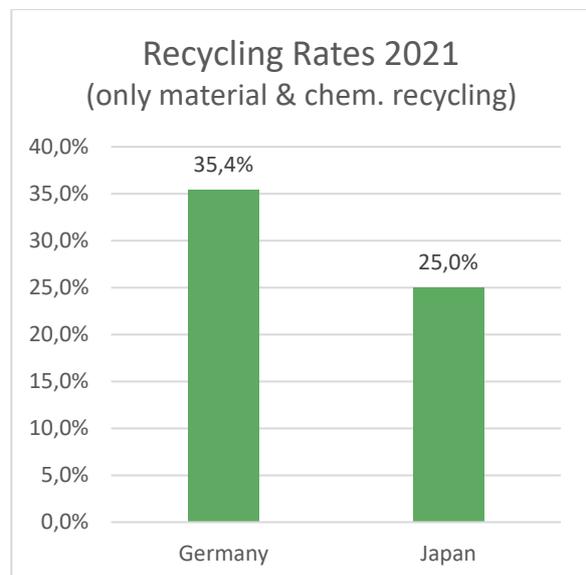
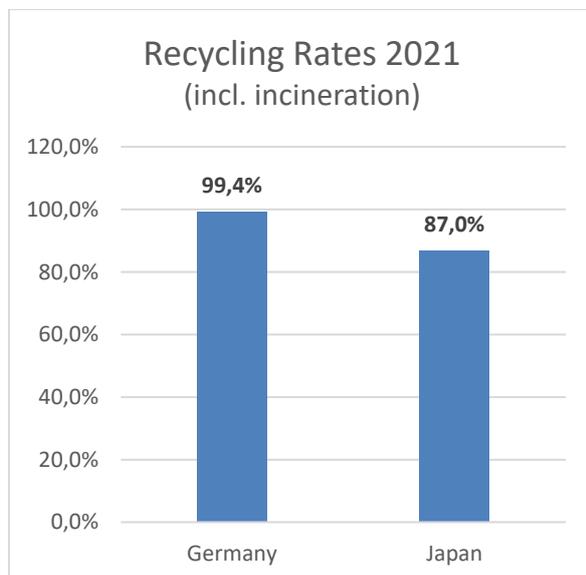


Source: [Conversio Market and Strategy, 2022 \[24\]](#)

## Plastic Waste Recycling in Germany and Japan



Source: [Plastic Waste Management Institute, 2022](#)



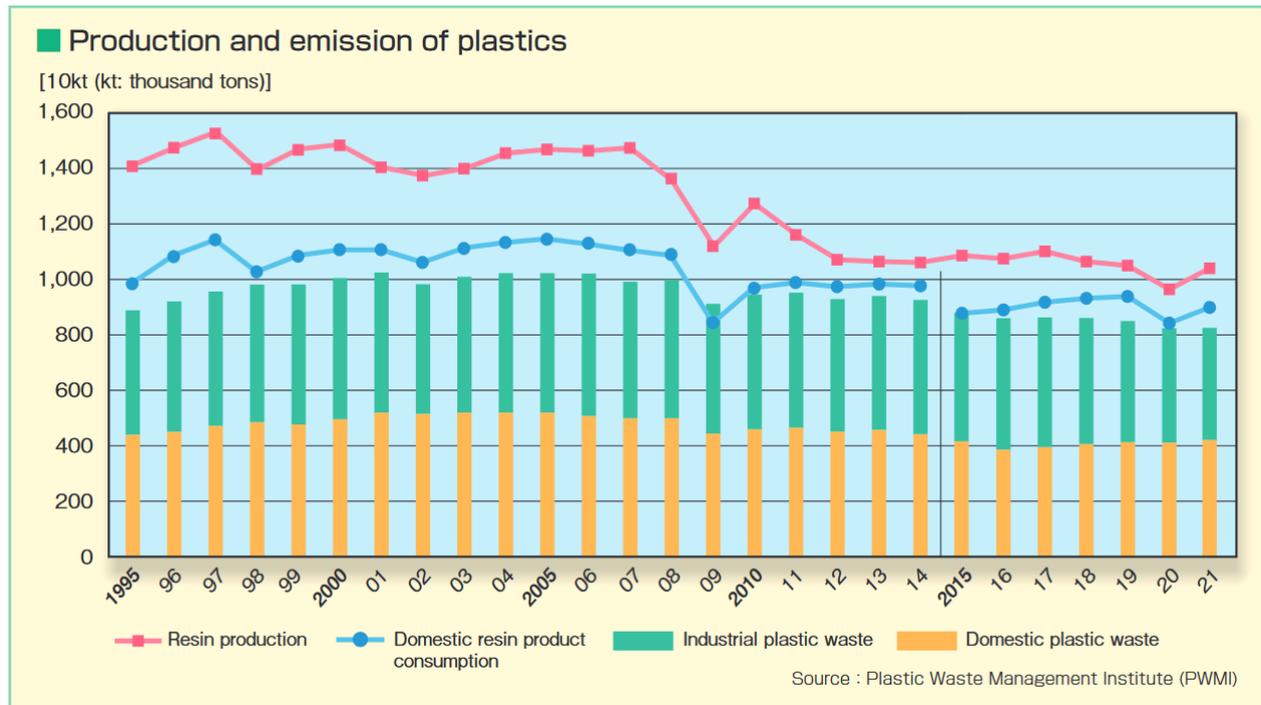
Sources: [Umweltbundesamt, 2021](#), [Plastic Waste Management Institute, 2022](#)

## 2 Plastic Waste: Volume, Emissions, Recycling Rates

### 2.1 Japan

Japan is the second-largest consumer of single-use plastic packaging in the world after the USA. Plastic waste accounted for 1.9 % of industrial waste and of 14.7 % of general waste in Japan in 2022. [07]

The **amount of plastic waste from industry and households** only slightly decreased and somewhat stagnated in the past years as shown in the graph below.

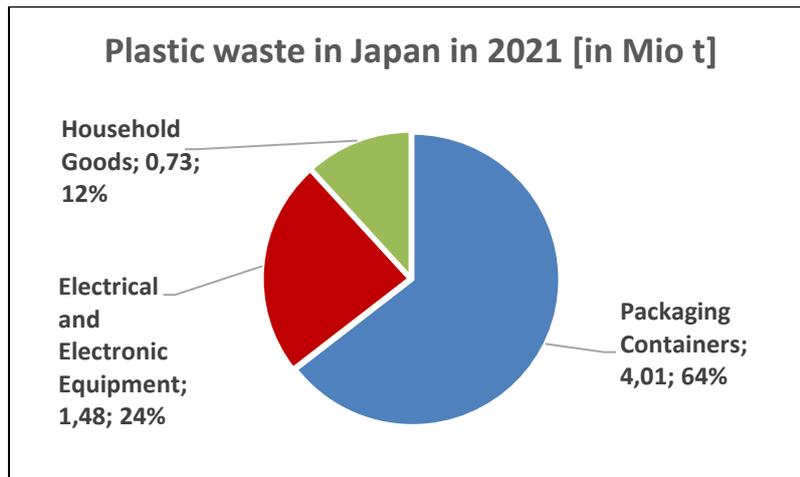


Source: Plastic Waste Management Institute, 2022 [11]

Polyethylene accounted for 33.8% of the total amount of waste plastic discharged at 2.79 mil. t, polypropylene 24.4% at 2.01 mil. t, polystyrene 12.2% at 1.01 mil. t, and polyvinyl chloride 8.5% at 700,000 tons in 2021 [09].

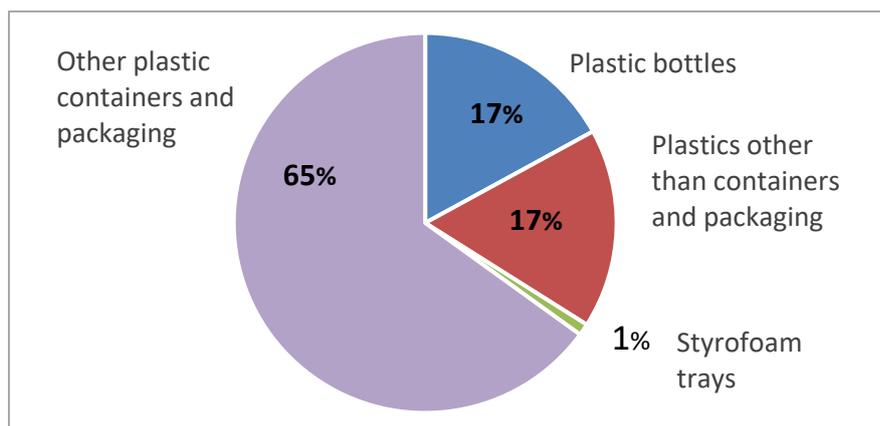
The **amount of waste plastic** in 2021 was 8.24 million tons. The breakdown by sector is 4.01 mil. t, or 48.7%, for packaging, containers, etc., 1.48 mil. t, or 17.9%, for electrical and electronic equipment, wires and cables, machinery, etc., and 730,000 tons, or 8.9%, for household goods, clothing and footwear, furniture, toys, etc. [13].

## Plastic Waste Recycling in Germany and Japan



Source: Association for the Circulation and Re-Use of Plastics, 2022 [13]

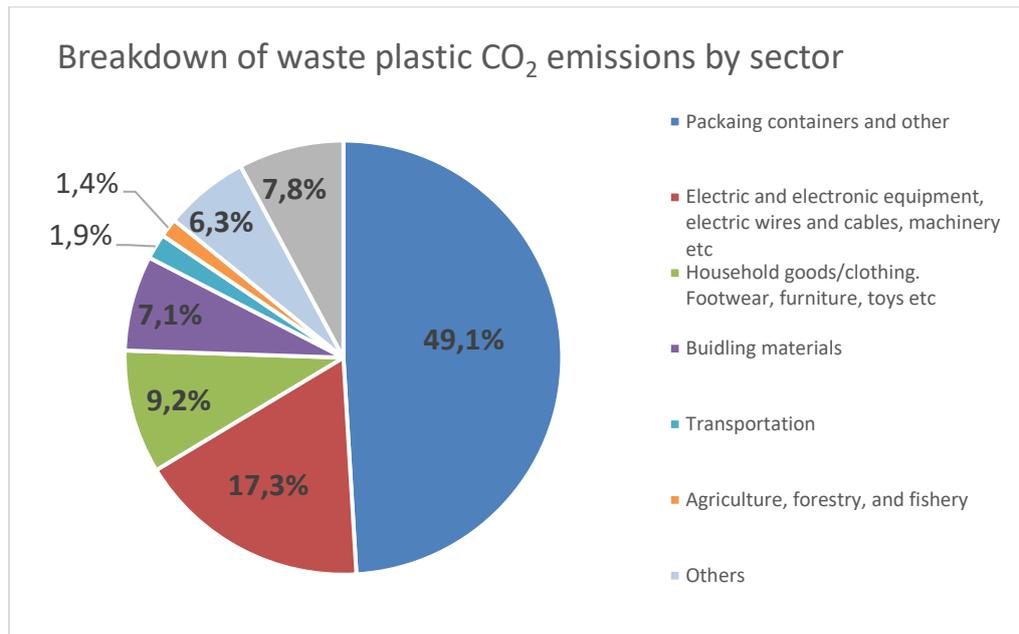
**Plastic waste is mainly composed by** plastic containers and packaging (65%), by PET plastic bottles and other plastics (17% each) as shown in the graph below.



Source: Plastic Waste Management Institute, 2022 [11]

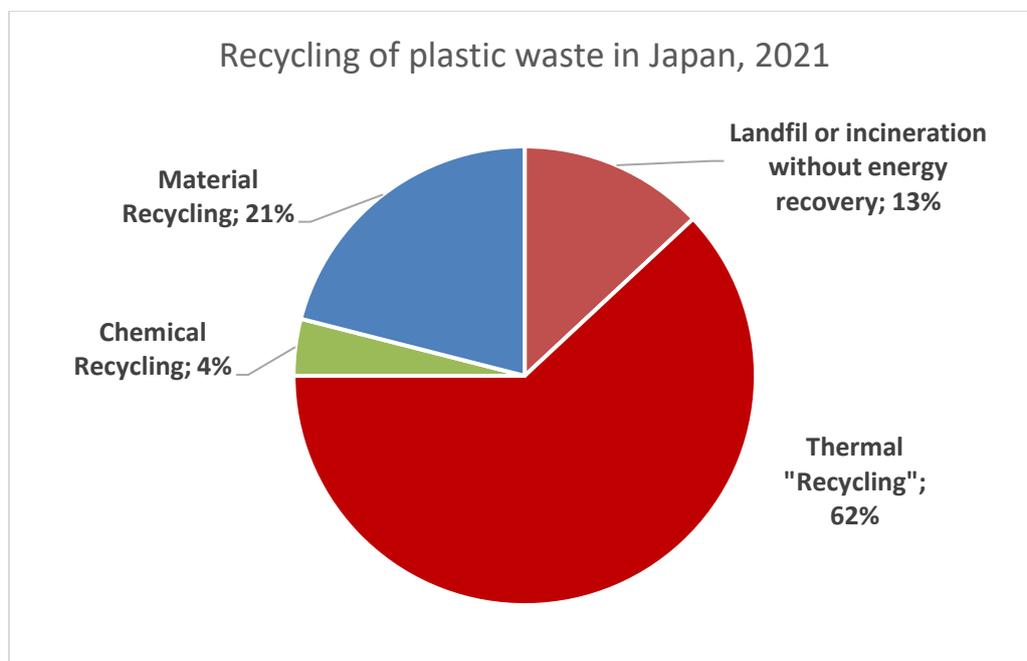
According to the Plastic Waste Management Institute, the **CO<sub>2</sub> emissions by waste plastics** in Japan accounted to 823 mil. t in 2021. The breakdown can be seen in the graph below. [18]

## Plastic Waste Recycling in Germany and Japan



Source: *Plastic Waste Management Institute, 2022 [18]*

In 2021, Japan's official **recycling rate for plastics** was 87% (compared to 58% in 2005). In terms of disposal and recovery methods, mechanical recycling increased to 1,770 kt (+40 kt; +2%), chemical recycling increased to 290 kt (+20 kt; +7%), and energy recovery (thermal recycling) increased in total to 5,110 kt (+20 kt; ± 0%). However, 62% of the plastics were still processed by thermal “recycling”, that means incineration with energy recovery [11]. Instead of a "recycling powerhouse", Japan can be rather seen as an "incineration powerhouse" [12].



Source: [Plastic Waste Management Institute, 2022 \[11\]](#)

The **recycling methods, shares, and total amounts of plastics** processed are listed in detail below. [14]

## Plastic Waste Recycling in Germany and Japan

Category	Way of recycling	Share
Material recycling	Recycled plastic - Converted to plastic raw materials - Converted to plastic products	21%
Chemical recycling	Raw material/Monomerization Blast furnace reductant Coke oven chemical feedstock Gasification/Oilification (Chemical feedstock)	4%
Thermal recycling (Energy recovery)	Gasification, Oilification (Fuel)	2%
	Cement raw materials/fuel	24%
	Refuse power generation	31%
	RPF (Refuse derived paper and plastics densified Fuel)	4%
	RDF (Refuse Derived Fuel)	

Source: Plastic Waste Management Institute, 2023 [14]

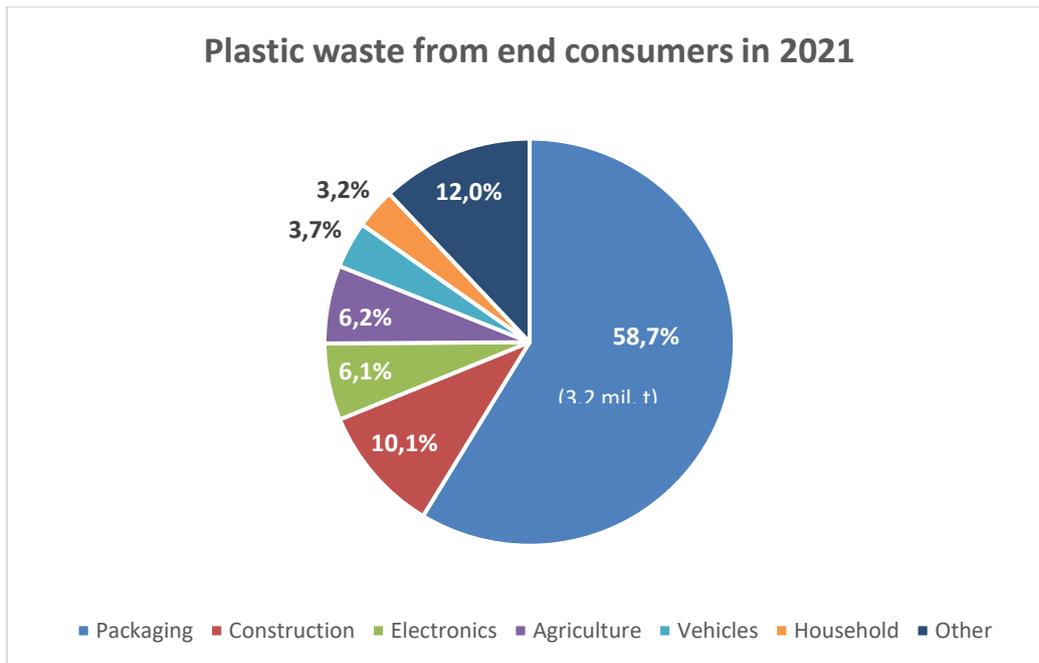
The energy generation from waste incineration is steadily increasing in Japan. Approximately 70% of all waste incineration plants in Japan (1,028 sites) use some form of surplus heat used for heating, bathing, and hot water pools. As of 2021, there were 396 waste incineration plants with power generation facilities, accounting for 39% of all waste incineration plants, with a total power generation capacity of 2,149 MW. The total amount of electricity generated was 10,452 GWh (+299 GWh compared to the previous year), which was enough to power approximately 2.50 million households. [14]

## 2.2 Germany

In 2021, the total volume of produced plastic in Germany amounted to 14,038 kt, representing a decrease of around 1.4% compared to 2019 levels. Despite a 4-5% increase from 2020, it could not fully offset the 5-6% decline experienced in 2020. The volume for recycle and by-product reuse totaled 2,287 t, constituting 16.3% of the total processing volume in 2021. Plastics derived from fossil raw materials accounted for 83.7% of the total in 2021, a decrease of 4.4% from 2019 levels. The volume of plastic packaging waste increased by a total of 1.1% compared to 2019. In the agricultural sector, the volume of plastic construction products (e.g., films, plastic products from private end consumers) continued to increase. [24]

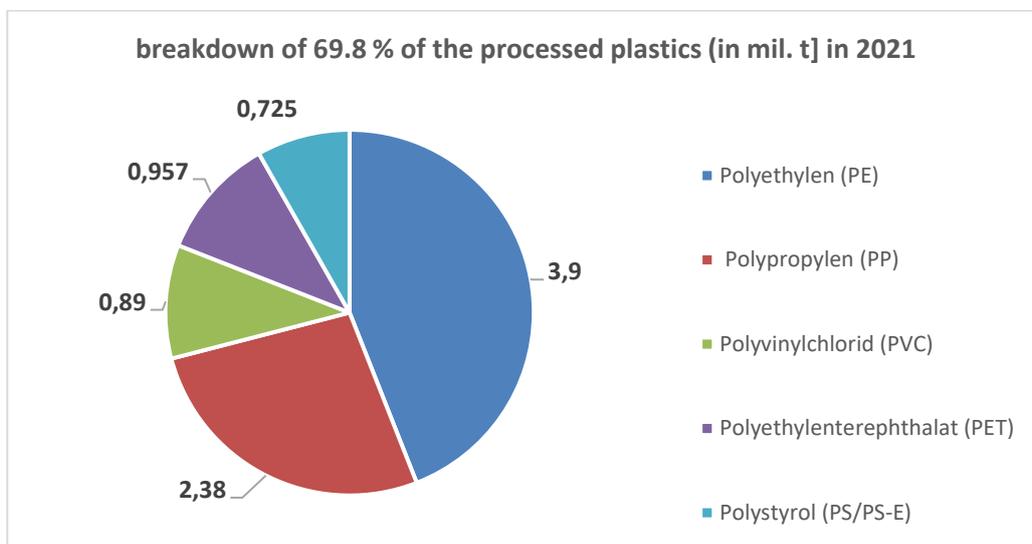
In 2021, plastic waste from end consumers consisted of 58.7 % packaging (3.2 million tons), 10.1 % construction, 6.1 % electronics, 6.2 % agriculture, 3.7 % vehicles, 3.2 % household, 12.0 % other [24].

## Plastic Waste Recycling in Germany and Japan



Source: *Conversio Market & Strategy 2021* [24]

Almost 70% of processed plastic in Germany in 2021 was thermoplastics. Around two thirds of these were polyethylene (PE) or polypropylene (PP) as shown in the graph below. [21]



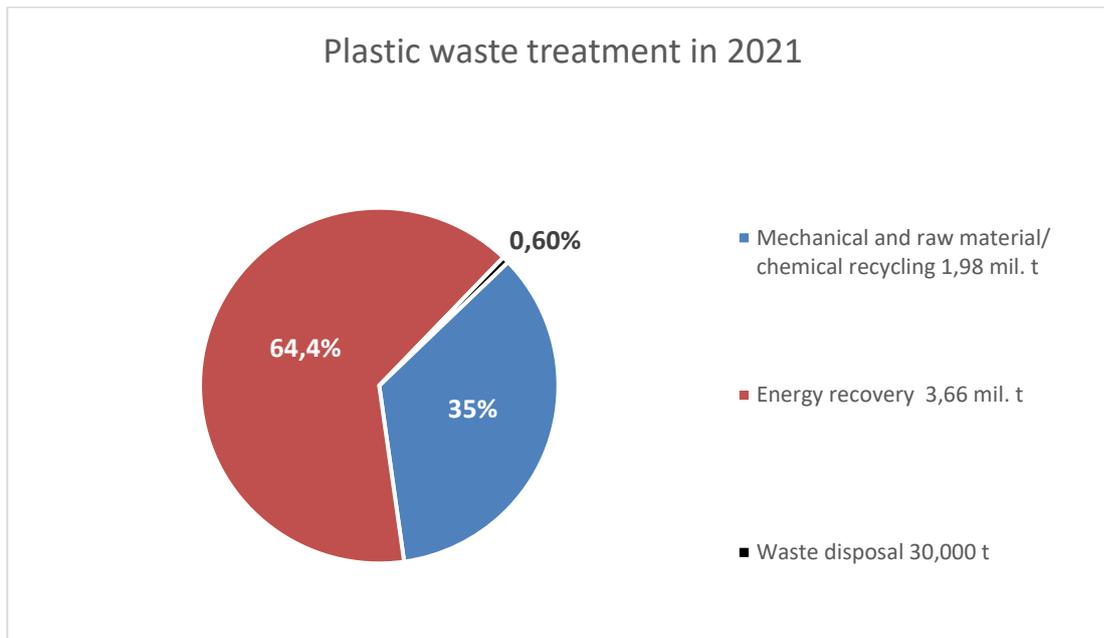
Source: [Umweltbundesamt, 2023](#) [21]

The production of one ton of plastic generates almost **two tons of CO<sub>2</sub>**, and the incineration of the waste adds another 2.7 tons of CO<sub>2</sub>. The manufacture of plastic products used in Germany recently released 30 mil. t of CO<sub>2</sub> every year. With recycled plastic, emissions are only half as high on average, and can be up to 80 % lower for individual products. [22]

## Plastic Waste Recycling in Germany and Japan

**In 2021, the total amount of plastic waste in Germany was 5.67 mil. t.** 0.9 mil. t accounted for industrial waste, 5.4 mil. t for private and commercial end consumers. [23, 24] 99.4% of plastic waste was recycled or used to generate energy. Compared to 2019, this corresponds to a decrease of 1.4%. [21]

35% of the plastic waste processed in 2021 were recycled mechanically or chemically, 64.4% were used for energy generation, 0.6% were disposed of, sent to landfill or incinerated in plants without energy generation. [23]

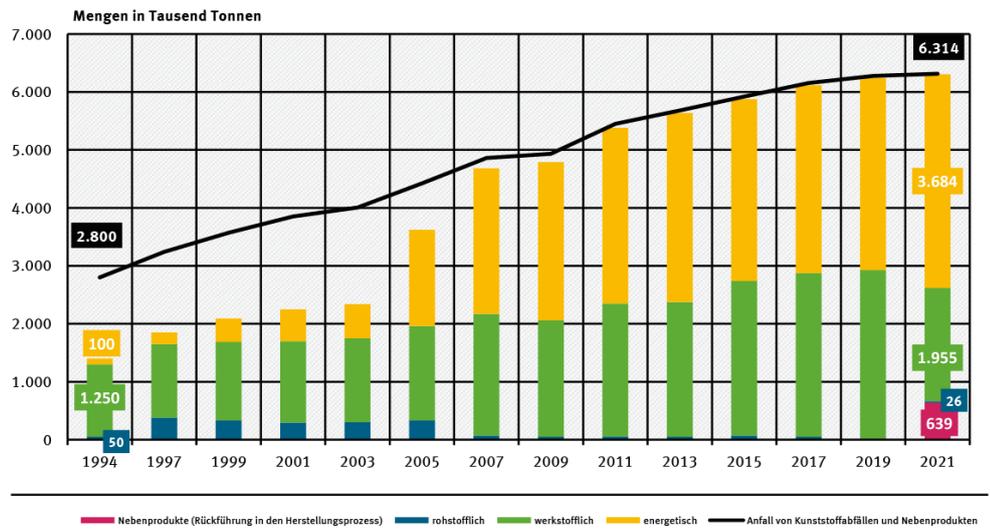


Source: [Umweltbundesamt, 2023](#) [23]

Since 1994, the total amount of mechanical recovery and by-product reuse has increased by 3,6% in average. Following a relatively stagnant period between 2009 and 2013, recycling efforts have picked up pace in recent years. Feedstock recovery, which experienced significant growth early in the decade before stabilizing around 300 kt for an extended period, dropped to approximately 26 kt in 2021, falling below previous levels. Energy recovery quantities also decreased by around 320 kt in 2021. Approximately 23% of plastic waste overall and 20% of post-consumer waste were utilized as substitute fuel in 2021. [24]

## Plastic Waste Recycling in Germany and Japan

### Entwicklung der Verwertung der Kunststoffabfälle (inkl. Nebenprodukte)



Ab 2021 werden Nebenprodukte (kein Abfallstatus, Wiedereinsatz ist kein Recycling) getrennt von den Kunststoffabfällen ausgewiesen und es änderte sich der Bezugspunkt zur Ermittlung der Recyclingmengen; siehe Erläuterungen im Text.

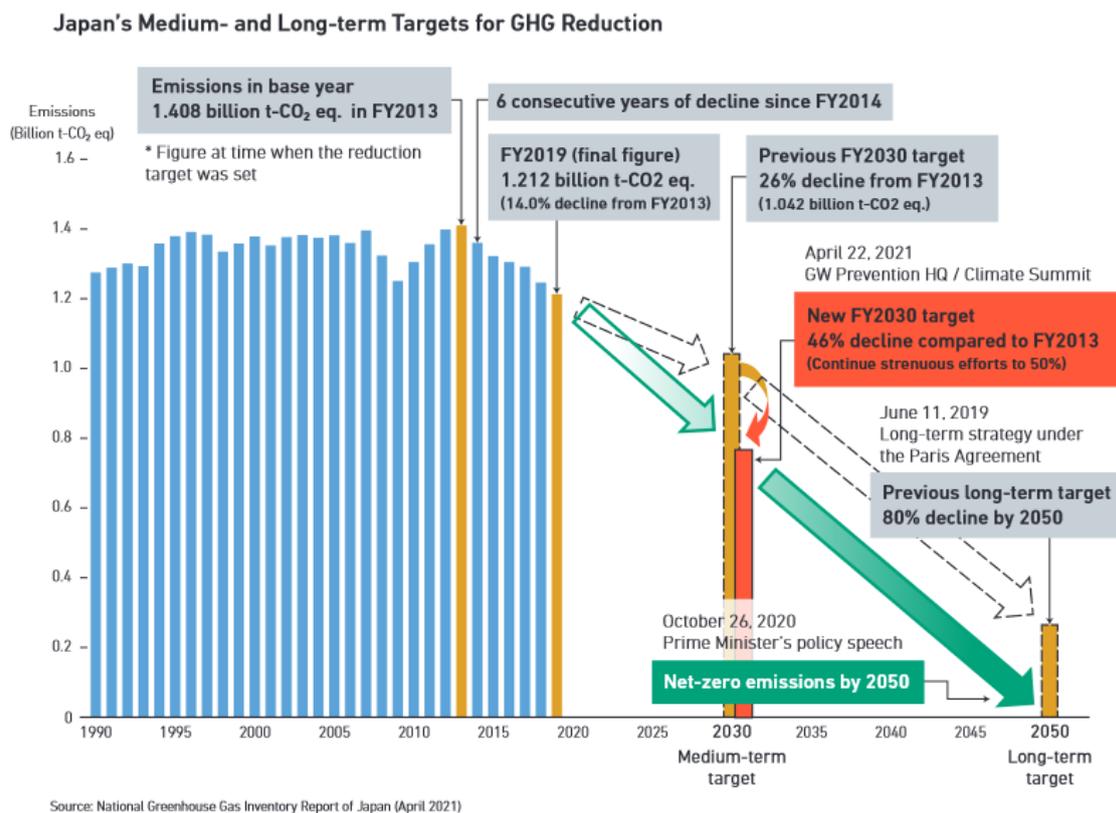
Quelle: Umweltbundesamt 2023, eigene Zusammenstellung mit Daten der CONVERSIO Markt & Strategy GmbH - Stoffstrombild Kunststoffe in Deutschland 2021

Source: [Umweltbundesamt](https://www.umweltbundesamt.de), 2023 [21]

### 3 Political strategies and regulations to reduce plastic waste

#### 3.1 Japan

Japan aims to reach **net zero emissions** by 2050 and to reduce Japan's greenhouse gas emissions by 46 % below 2013 levels by fiscal year 2030. [01], [02]



**Improving carbon and material recycling** is one of the measures adopted by the Japanese government to reach net zero. Carbon-free synthetic fuels are to be made commercially available by 2040. Furthermore, manufacturing costs of plastics are to be reduced. [01]

Japan faces the second **highest amount of plastic container and packaging waste per capita**. At the same time, China and other Asian countries ceased imports of plastic waste from Japan.

In order to increase the low rate of plastic waste recycling and to decrease environmental pollution from marine plastics, a **new strategy for plastic recycling** was adopted by METI in 2021 as part of the **Green Growth Strategy Through Achieving Carbon Neutrality** in 2050 [03]. It addresses the whole lifecycle of plastics and involves all stakeholders. The strategy named “**3R and Renewables**” sets specific milestones:

- Reduce: Cumulative suppression of 25% of single-use plastics by 2030
- Reuse, recycle: Reusable/recyclable design by 2025
- Reuse/recycle 60% of containers and packaging by 2030
- Effective use of 100% of used plastics by reuse and recycling etc. by 2035
- Recycling and bio-based plastics: Double the use of recycled content by 2030 / introducing about 2 million tons of bio-based plastics by 2030

## Plastic Waste Recycling in Germany and Japan

The **Plastic Resource Circulation Act** in 2022 [04], including new policy measures for transition to a circular economy through advancing circulation of resources, ranges three phases:

- Design manufacturing, sales
- Provision
- Discharge – collection – recycling.

The key factors for success of this act are [05]:

- Develop guidelines for Design for the Environment for manufacturers.
- Set criteria for retailers and service providers to reduce single-use plastics.
- Manufacturers and retailers develop a plan to collect and recycle their used products.

In addition to the 3 phases, the government formulated five specific **requests to businesses and local governments**:

- Design Guideline and Certification System for Products Using Plastics
- Voluntary collection and recycling by manufacturers and distributors
- Rationalization of the use of certain plastic products
- Emission control, recycling, etc. by emitting companies
- Separate collection and recycling of plastic-used product waste by municipalities.

The **main regulations and laws in Japan** related to plastic recycling are:

### ➤ **Containers and Packaging Recycling Law (1995)**

Target: reduce the volume of containers and packaging waste, which accounts for about 20 to 30% of the weight and 60% of the volume of household waste. The regulation places the responsibility for waste reduction and recycling on the shoulders of consumers, municipalities, and businesses, respectively. [08]

### ➤ **Act for Establishing a Recycling-Oriented Society (2000)**

Target: a society in which the consumption of natural resources is reduced and the burden on the environment is minimized as much as possible through the control of waste generation and its proper recycling and disposal.

With the above law as a basic framework, the Law for Promotion of Effective Utilization of Resources, Waste Disposal and Public Cleansing Law, and individual recycling laws have been enacted. Individual recycling laws consist of 6 categories, Containers and Packaging Recycling Law, Home Appliance Recycling Law, Food Recycling Law, Construction Recycling Law, Automobile Recycling Law, Small Home Appliance Recycling Law. [09]

### ➤ **Law for Promotion of Resource Recycling of Plastics (2022)**

Target: promotion of resource recycling of plastics and stipulate necessary measures at each stage of plastic-using products from design and manufacture, sale and supply, to discharge, collection, and recycling. Designers and manufacturers are required to design in accordance with the "Guidelines for the Design of Plastic-Used Products" established by the government. They include reducing the amount of plastic used, reusing parts, designing products that are easy to recycle, substituting materials other than plastic, and using recycled plastic and bioplastics. [10]

## 3.2 Germany

The policy in Germany is to a great extent driven by European guidelines such as the **European plastics strategy**. The EU Commission's new strategy for the circular economy is primarily concerned with the design, labeling and recycling of plastic products: The comprehensive strategy requests that all plastic packaging should be designed to be recyclable or reusable by 2030. It proposes specifications for packaging that should lead to less waste and better recycling. Furthermore, a political framework for "bioplastics" is to be created. The Commission also wants to counteract environmental pollution caused by microplastics. Finally, claims about the sustainability of products are to be more strictly regulated, thus preventing greenwashing. [06]

The EU rules stipulate that at least 55 % of municipal waste in the EU must be recycled by 2025. This EU-wide target will be increased to 60 % by 2030 and 65 % by 2035. The EU recycling target for packaging waste is 65 % (by 2025) and 70 % (by 2030), with specific targets set for certain materials. [27].

From 2025, single-use PET drinks bottles must contain at least 25% recycled plastic (recyclate). From 2030, this quota will be increased to at least 30% for all single-use plastic drinks bottles. Reusable PET bottles already contained an average of 26% recycled material in 2015 [25].

The German government has tightened the target in the Circular Economy Act in 2020: The recycling rates for municipal waste should be gradually increased to 55 % from 2025, 60 % from 2030 and 65 % from 2035. In 2021 already the recycling rate for municipal waste increased to 68%. [28] [33]. There has been a clear increase in recycling rates since 2002. The recycling rate for municipal waste exceeded to 65% for the first time in 2012 and, following a decline in 2013, has exceeded this figure again since 2014. [30]

There is no singular law in Germany for the collection and recycling of plastics. Instead, there are a number of relevant laws and regulations. Two of the most important are:

### ➤ **Circular Economy Act**

The Circular Economy Act [19] came into force on June 1, 2012.

Target: to promote the circular economy, to conserve natural resources and to ensure the protection of people and the environment in the generation and management of waste.

Product responsibility has been extended to include the duty of care, which requires products to be kept fit for use and only allowed to be disposed of as a last resort. The duty of care also ensures a duty of transparency. Reports on the handling of surplus goods, returns or measures to maintain the usability of products can be required. In order to improve the recycling of waste, the separate collection obligation for waste is to be strengthened in particular.

### ➤ **Packaging Act**

The German Packaging Act (VerpackG) of 2017 [20] transposes the European Packaging Directive 94/62/EC into German law. The target is to regulate the placing of packaging on the market as well as the take-back and high-quality recycling of packaging waste.

In order to prevent plastic waste, the German Federal Ministry for the Environment, Nature Conservation, Nuclear Safety and Consumer Protection (BMUV) has adopted several measures [31]:

- In 2020, the Federal Cabinet decided to ban disposable plastic products (e.g., drinking straws, disposable crockery). It came into force EU-wide in July 2021.

## Plastic Waste Recycling in Germany and Japan

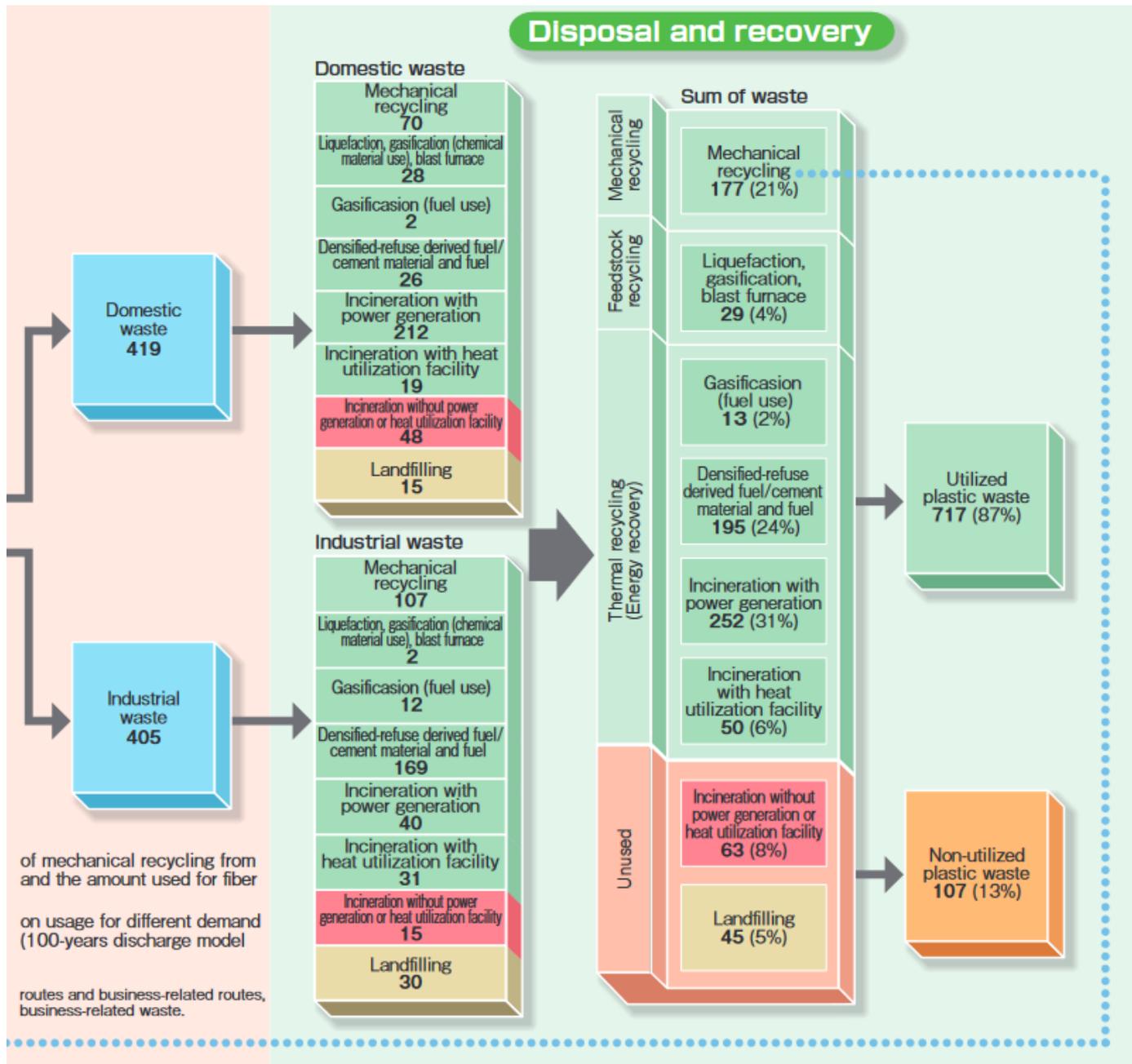
- Since 2021 stricter regulations for the export of plastic waste (cleaned, well-sorted and recyclable) are in force. The export of poorly recyclable waste from the EU to Asia and other parts of the world will be banned.
- BMUV has committed to an international commitment against marine litter ("End Plastic Pollution – Towards a Legally Binding Agreement" in March 2022.
- Since January 2022, the Federal government also banned plastic bags. Lightweight plastic bags (thickness of 15 to 50 µm) can no longer be brought into circulation.
- Since 2022, an extension of the deposit obligation to all cans and plastic bottles is in force.
- From 2022, the binding recycling rate for plastic waste was increased to 63 percent.
- Reusable alternatives for to-go products are to be offered mandatory since January 2023.
- Phasing out the use of microplastics in cosmetic products is discussed since 2023. The aim is a voluntary renunciation.

## **4 Plastic waste collection system**

### ***4.1 Japan***

The plastic waste collection system in Japan differs depending on the source of plastic waste (household/domestic waste and industrial waste) as outlined in the flowchart of plastic waste recycling 2022 below. [15]

Plastic Waste Recycling in Germany and Japan



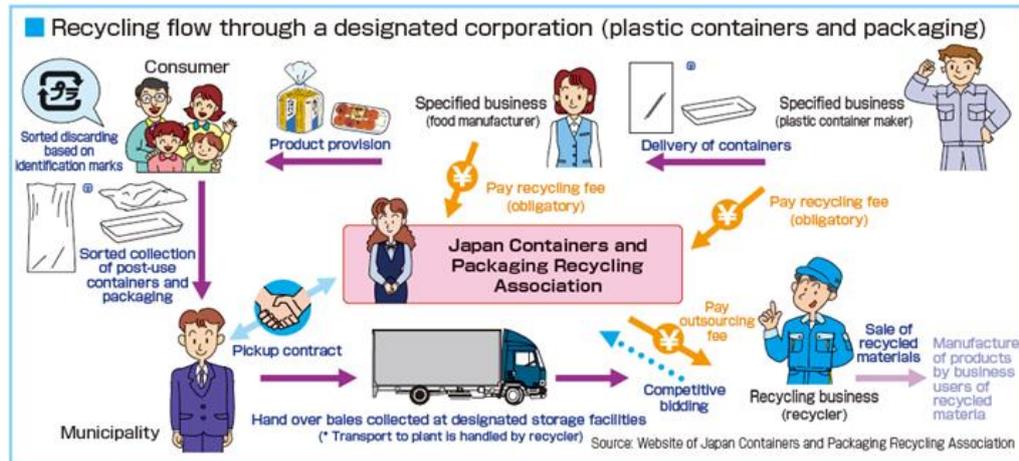
Source : Plastic Waste Management Institute (PWMI)

Source: Plastic Waste Management Institute [15]

## Plastic Waste Recycling in Germany and Japan

### ➤ Household Waste

Municipalities are responsible for the separate collection, sorting and cleaning of packaging waste in compliance with legal requirements. 90% of all municipalities handed over their waste to the Japan Containers and Packaging Recycling Association (JCPRA). [16] Plastic containers and packaging collected at designated storage facilities are handed over to the municipalities. Transportation to the factory is performed by a recycling company.



Source: Japan Containers and Packaging Recycling Association, 2023 [16]

### ➤ Industrial Waste

The collection and recycling system for industrial waste is functioning as follows:

Company ➡ JCPRA ➡ Recycler

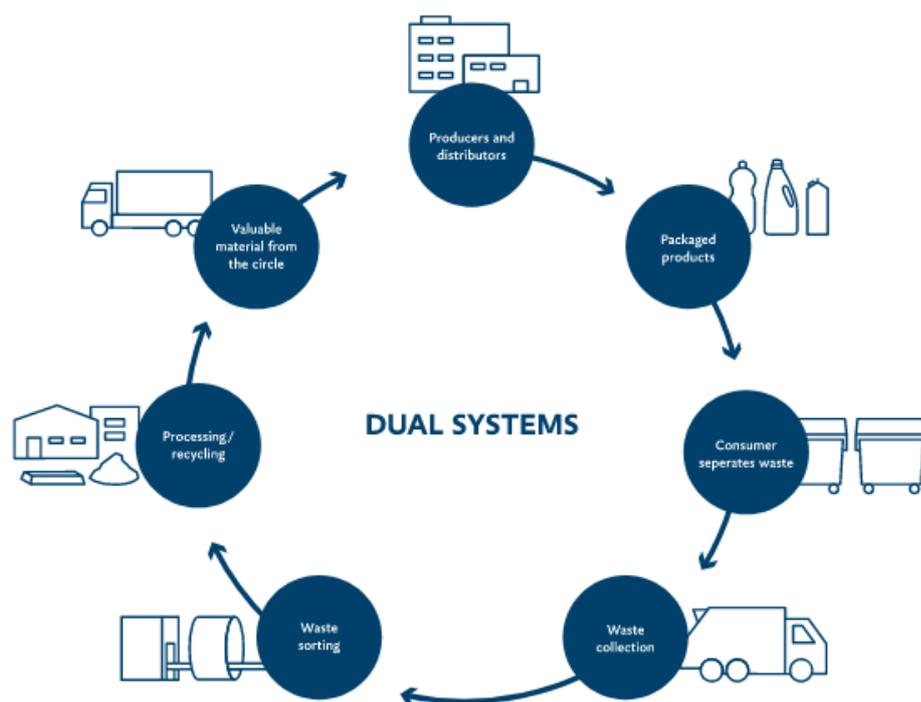
The JCPRA acts as a liaison between companies and recycling companies. The JCPRA outsources recycling to external companies, which it selects through competitive bidding. The outsourcing costs, in turn, are transferred to the companies via a quantity-dependent fee.

As of 2020, the number of operators in the channel of collection and transportation of waste plastics is 535. And the number of businesses for intermediate treatment and recycling is 284 nationwide. [17]

## 4.2 Germany

The ten German dual systems (e.g., DSD Duales System Deutschland) organize the collection, sorting and recycling of used sales packaging for industry and trade throughout Germany. They are responsible for ensuring that the recycling rates prescribed by law under the Packaging Act are achieved.

## Plastic Waste Recycling in Germany and Japan



Source: Reclay Group [32]

All manufacturers and retailers (online and stationary) as well as importers and foreign exporters who place packaged goods on the market in Germany must participate in a dual system and pay so-called participation fees to the dual system. These fees are generally included in the product price. The dual systems commission private or municipal waste disposal companies to collect sales packaging. In principle, consumers have access to collection containers such as yellow garbage cans and yellow sacks for packaging made of plastics, composite materials, tinplate and aluminum.

## 5 Technology trends and market developments

### 5.1 Japan

The urge to reduce plastic waste and increase the recycling rate, and the related political measures as described in the previous chapters, already had and are expected to have a significant impact on the market in Japan.

As of 2021, the domestic market for recycled plastics and materials was around €1.2 billion, of which recycled plastics account for €1 billion. In 2035, the domestic market for recycled plastics and materials is projected to be 504 billion yen<sup>1</sup>, and the market for recycled plastics is projected to be 355.3 billion yen<sup>2</sup>. Both are expected to more than double in size compared to today. The forecast is that an increasing

<sup>1</sup> 504 billion Yen = 3,12 billion Euro (by currency rate of Jan 22, 2024: 1 Euro = 161.46 Yen)

<sup>2</sup> 355.3 billion yen = 2,2 billion Euro (by currency rate of Jan 22, 2024)

## Plastic Waste Recycling in Germany and Japan

number of companies are adopting the product from an environmental perspective, and the expansion will be driven by material recycling plastics. [07]

Major trends of the plastic recycling market in Japan are as follows:

### ➤ **Increasing Recycling Rates**

The country has set ambitious targets to reduce plastic waste and promote recycling. Efforts are focused on enhancing collection systems, improving sorting technologies, and expanding the range of recyclable materials.

### ➤ **Chemical Recycling Technologies**

Chemical recycling is a prominent trend in Japan's plastic recycling. Japan has made investments in developing advanced chemical recycling technologies to address the challenges posed by complex and contaminated plastics. Techniques enables the production of high-quality recycled materials. however, this method has not been penetrated yet.

### ➤ **Circular Economy Approaches**

The concept of the circular economy is a driving force in Japan's plastic recycling trends. Japan recognizes the need to shift from a linear "take-make-dispose" model to a circular system that promotes resource conservation and minimizes waste generation. Japan is investing in research and development to enhance recycling technologies, promote eco-design principles, and encourage product stewardship. These trends highlight Japan's commitment to sustainable waste management, technological innovation, and resource conservation.

## **5.2 Germany**

According to estimates by the Plastics Recyclers Europe association, around €1.75 billion was invested in the expansion of plastics recycling capacities in Europe in 2021. According to the association, recycling capacities increased by 17% from 9.6 million to 11.3 mil. t of input per year. "The positive growth we are seeing today will shape and further strengthen the market for recycled plastics in order to achieve the EU targets," said the association president. [29]

Plastics recycling is currently developing very rapidly from a niche to a trend. This is being driven by the legal targets for plastics recycling set by the European Union and many countries around the world, as well as by the European Green Deal, which aims to make Europe the first climate-neutral continent and in which the circular economy plays a significant role. Recycling rates and the quality of recyclates are increasing as a result of stricter EU regulations and new recycling technologies.

### ➤ **Focus is on new recycling technologies**

There are currently no satisfactory solutions in terms of the circular economy, such as black plastics and heavily contaminated and mixed plastic waste. The plastics industry is also researching innovative technologies for the chemical recycling of plastic waste in various projects.

### ➤ **Investing in circular raw materials and new material cycles**

Innovations across the plastics value chain are presented almost daily. This allows more plastic waste to be recycled and alternative raw materials to be used in plastics production.

### ➤ **Sustainable product design, improved waste sorting technologies and diversified raw material sources**

Today's waste sorting processes cannot yet reliably distinguish between recyclable and non-recyclable packaging. This is why R-Cycle documents packaging properties during production and makes this data available to improve the sorting process at the end of the life cycle.

### ➤ **Change recyclability and functions of plastic packaging**

The industry is working intensively on using innovations to make previously non-recyclable packaging increasingly recyclable or to achieve the same protective function with other plastic solutions, for example mono-material instead of composite.

## **6 Potentials for cooperation**

Both Germany and Japan still face similar problems: the amount of plastic waste has only slightly decreased or stagnated over the past years. The impact of China's 2018 ban on plastic waste imports, the commitment to global GHG emission reduction, and concerns about global marine pollution has put the issue on the top of the political agenda in both countries.

On the other hand, Germany and Japan have accumulated extensive experience and knowledge in political measures to reduce plastic waste, in plastic waste collection systems, recycling methods, and alternative materials. Advanced technologies and mechanisms will be required. The business and technological cooperation potential for plastic recycling is significant. Especially advanced sorting technologies for industrial and household wastes (e.g., identification and sorting technologies for the mechanical recycling of black plastics) are needed.

By sharing experiences, best practices, industry insights, technical expertise, and R&D innovations, can accelerate the reduction of plastic waste, the increase of recycling rates, and thus the reduction of GHG emissions.

## 7 References

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