

# PWMI Newsletter

NO 38 2009.5



Plastic Waste Management Institute  
JAPAN

## Plastic Products, Plastic Waste and Resource Recovery<sup>[2007]</sup>

### Background information and notes on the publication of the Flowchart of Plastic Products, Plastic Waste and Resource Recovery (2007)

In Japan, the Containers and Packaging Recycling Law, which went into full effect in 2000, has been achieving steady results in the recycling of containers and packaging. According to materials released by the Ministry of the Environment, the sorted collection of plastic containers and packaging and the amount of recycled products in municipalities has been increasing annually with results for FY2007 showing a 6% increase over the previous fiscal year. At the same time, our survey for 2007 revealed that exports as a destination of recycling use for all plastic waste including containers and packaging have been increasing over these last several years. This suggests that high prices for resources continue to persist. At the same time, both the export and import of resin and resin products have been increasing reflecting the ongoing progress of globalization.

Examining changes in each of the three effective usage techniques of plastic waste, that is, mechanical recycling, chemical recycling, and energy recovery, we see that mechanical recycling continued to show

robust growth while chemical recycling was essentially unchanged. Meanwhile, the figures for energy recovery, which had been increasing up until last year, actually decreased though only by a small amount. However, the 2006 revisions to the Containers and Packaging Recycling Law acknowledged for the first time the potential of “thermal recovery” to recover energy from “plastic containers and packaging,” although such a process had to be accompanied by emergency-evacuation and supplementary conditions. Thus, coupled with the development and enhancement of incineration facilities, we can expect energy recovery to continue to have a place as a recycling technique of plastic waste including that of business activities.

The Plastic Waste Management Institute would like to extend its deep appreciation to the Ministry of Economy, Trade and Industry (METI), Ministry of the Environment (MOE), various local governments, and related organizations for providing valuable data and helpful advice during the course of this survey.

# 2007 Highlights

1. Thanks to the robust increase in mechanical recycling, the effective plastic utilization rate climbed by 1% to 73%.
2. In destinations of recycling use, exports showed an increase of 17% over the previous year bringing it to 71%.

Plastic production for 2007 came to 14,650 thousand tons (+200 thousand tons relative to the previous year) while plastic consumption in Japan decreased to 11,030 thousand tons (-170 thousand tons). This can be attributed to an export surplus in the export/import of resin and resin products of 2,290 thousand tons (+270 thousand tons) and to a decrease in reclaimed products to 650 thousand tons (-70 thousand tons).

In addition, domestic (general) plastic waste came to 5,020 thousand tons (-60 thousand tons) and industrial plastic waste to 4,920 thousand tons (-60 thousand tons) making for a total plastic waste discharge of 9,940 thousand tons (-110 thousand tons). Though the amount of discharge of industrial plastic waste has been decreasing overall, it actually showed an increase of 20 thousand tons in the transport sector as the number of scrapped cars, which had previously dropped due to the enactment of the Automobile Recycling Law, has begun to

stabilize. As for methods of disposal and recovery, mechanical recycling increased to 2,130 thousand tons (+90 thousand tons) while incineration without power generation or heat utilization facility decreased to 1,470 thousand tons (-100 thousand tons). Exports as a destination of mechanical recycling use increased significantly to 1,520 thousand tons (+220 thousand tons) reaching 71% (+7%) of all recycling use. Furthermore, in the breakdown of mechanical recycling by type of resin, we note that PET resin has previously been included in "Others," but a portion of it is now given its own category of "PET resin used in designated PET bottles" to clearly indicate the amount of such resin that has been recycled. As a result of creating this new category, the ratios for each type of resin in this chart have changed significantly.

The results of this year's survey showed that the effective utilization rate of plastic waste climbed 1% from last year to 73%.

## Explanation of flowchart items

### (1) Resin production, resin processing, and marketing of products

#### 1-1 Resin production

This figure was determined on the basis of chemical-industry statistics from the Ministry of Economy, Trade and Industry (METI).

#### 1-2 Reclaimed products

For convenience sake, the figure used here as input is that of mechanical recycling from the previous year taking figures for export and import of plastic waste into account (Ministry of Finance, trade statistics).

#### 1-3 Domestic plastic products consumption

• (Domestic plastic products consumption) = (Resin production) - (Resin export) + (Resin import) - (Liquid resin, etc.) - (Resin processing

waste) + (Reclaimed products) - (Product export) + (Product import)

- Resin export and import figures are based on trade statistics from the Ministry of Finance.
- Figures for liquid resin, synthetic fiber, etc. that fall outside plastic waste discharge are based on chemical-industry statistics from the Ministry of Economy, Trade and Industry.
- Figures for plastic product export and import are based on trade statistics from the Ministry of Finance.
- Figure for processing waste considers discharged waste from the processing step that is not turned into products.

### (2) Discharge

#### 2-1 Industrial waste and domestic waste

- Industrial waste is waste generated by business

activities as defined by the Waste Disposal and Public Cleansing Law, and includes ashes, sludge, waste oil, waste acid, waste alkali, and waste plastic. Its disposal is generally the responsibility of the party that generates the waste. Domestic waste is waste other than industrial waste and its disposal is mainly handled by local governments.

#### 2-2 Post-use products discharge

Considering that the export/import of new and used automobiles affects the amount of plastic waste in Japan, corrections are made to the amounts of reclaimed plastic products and plastic waste discharge related to the transport industry. From 2004, corrections have also been made to the amount of reclaimed plastic products in Japan based on export/import amounts of four types of home appliances (televisions, refrigerators, air conditioners, and washing machines).

#### 2-3 Production and processing waste discharge

• Amount of production waste is not included in amount of resin production, and amount of processing waste is extrapolated from the results of questionnaires.

#### 2-4 Total plastic waste discharge

• This figure is the sum total of post-use products discharge and production and processing waste discharge.

#### 2-5 Breakdown of total plastic waste discharge by resin type

• These breakdown figures were estimated from amounts for post-use products discharge, production and processing waste discharge, breakdown of resin production, etc.

### (3) Disposal and recovery

#### 3-1 Mechanical recycling

• All mechanical recycling figures and breakdowns are extrapolated from the results of questionnaires sent to recycling companies.

- "Recycled material" indicates pellets, flakes, fluff, blocks, and ingots, while "recycled products" refer to film sheets, stakes, pipes, etc.
- The export figure under "destination of recycling use" for mechanical recycling is based on "scrap plastic" statistics from Ministry of Finance trade figures.

#### 3-2 Densified-refuse derived fuel, liquefaction, gasification, blast furnace raw material

• Figures for liquefaction, gasification, blast furnace raw materials, and coke-oven chemical materials approved as product recycling procedures by the Containers and Packaging Recycling Law have been determined on the basis of bids announced by the Japan Containers and Packaging Recycling Association and results of questionnaires.

- The figure for densified-refuse derived fuel includes energy recovery as cement kiln fuel and power-generation.

#### 3-3 Disposal and recovery of domestic waste

- Incineration/landfilling ratio

This ratio is determined on the basis of past surveys conducted by PWMI.

- Incineration with power generation / incineration with heat utilization

"Incineration with power generation" means incineration processing by an incinerator equipped with power-generation facilities and "incineration with heat utilization" means incineration processing by an incinerator that, while not equipped with power-generation facilities, has facilities for utilizing heat externally. The ratios shown are determined by PWMI surveys based on values published by the Ministry of the Environment. The announcement of these values, by the way, is now made at an earlier date by the ministry, and this report therefore uses actual values from the previous fiscal year.

#### 3-4 Disposal and recovery of industrial waste

- Disposal and recovery of industrial waste is partially commissioned to local governments as business-related waste. The ratio of such processing by business to that commissioned to local governments is determined on the basis of PWMI surveys. The percentage breakdown of commissioned processing into incineration with power generation, incineration with heat utilization facility, incineration without power generation or heat utilization facility, and landfilling is based on figures for domestic waste processing.

The incineration/landfilling ratio in the processing of industrial waste and the energy recovery rate in incineration with power generation are based on the latest surveys conducted by PWMI in fiscal years 2004/2006.

# Flowchart of plastic products, plastic waste and resource recovery

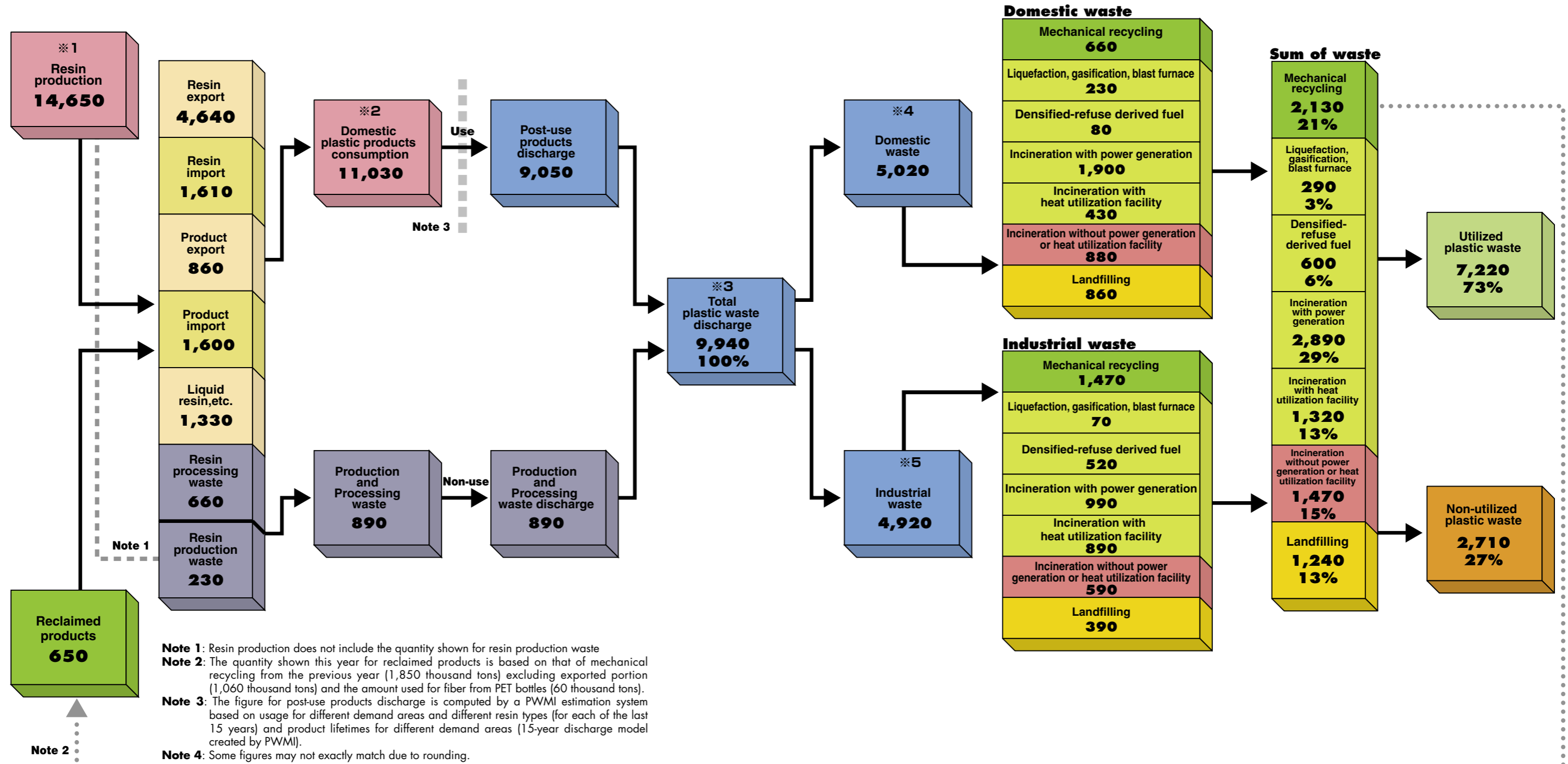
2007

[ Unit; thousand tons ]

Resin production, resin processing, and marketing of products

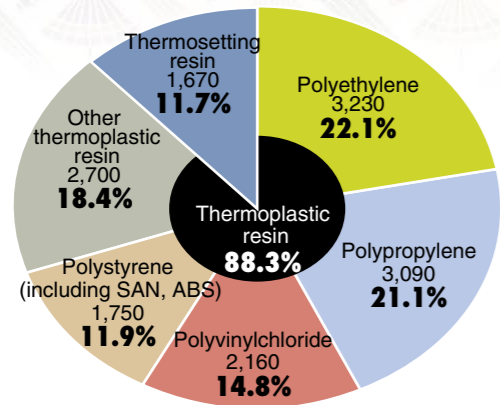
Discharge

Disposal and recovery



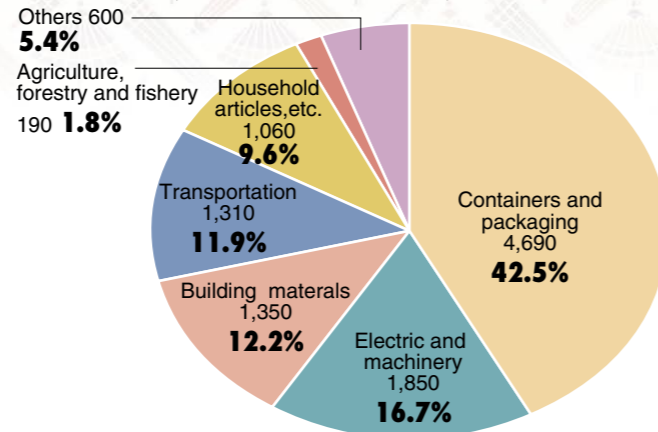
# Details of flowchart elements

※ 1 Breakdown of resin production (14,650 thousand tons) by resin type



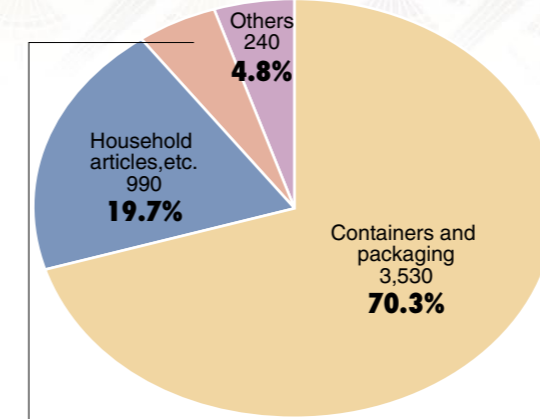
(Source: METI chemical-industry statistics)  
For convenience sake, the other 1.4% of resins not categorized as thermosetting resin or thermoplastic resin are included in "other thermoplastic resin."

※ 2 Breakdown of resin products by field (11,030 thousand tons)

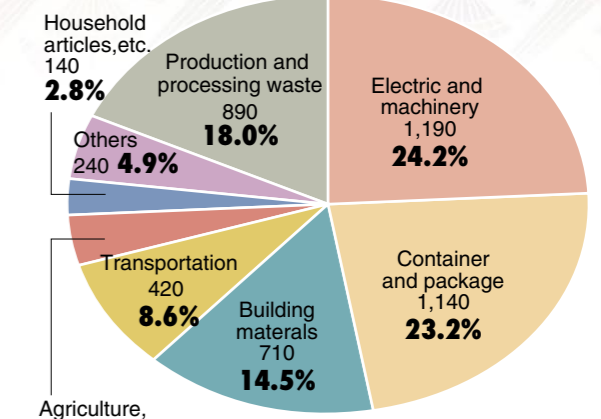


(Source: estimates from related organizations)

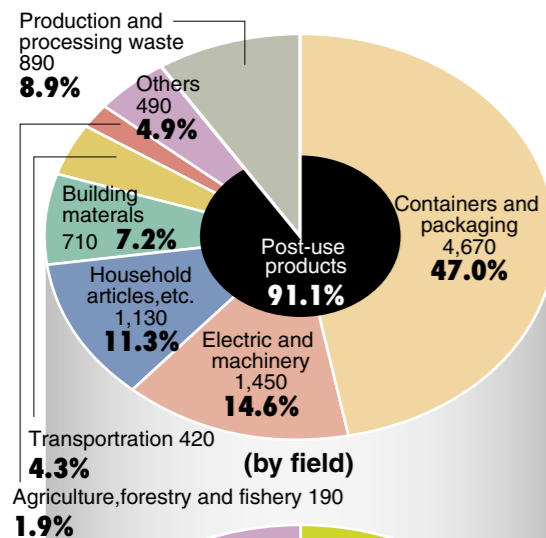
※ 4 Breakdown of domestic waste by field (5,020 thousand tons)



※ 5 Breakdown of industrial waste by field (4,920 thousand tons)

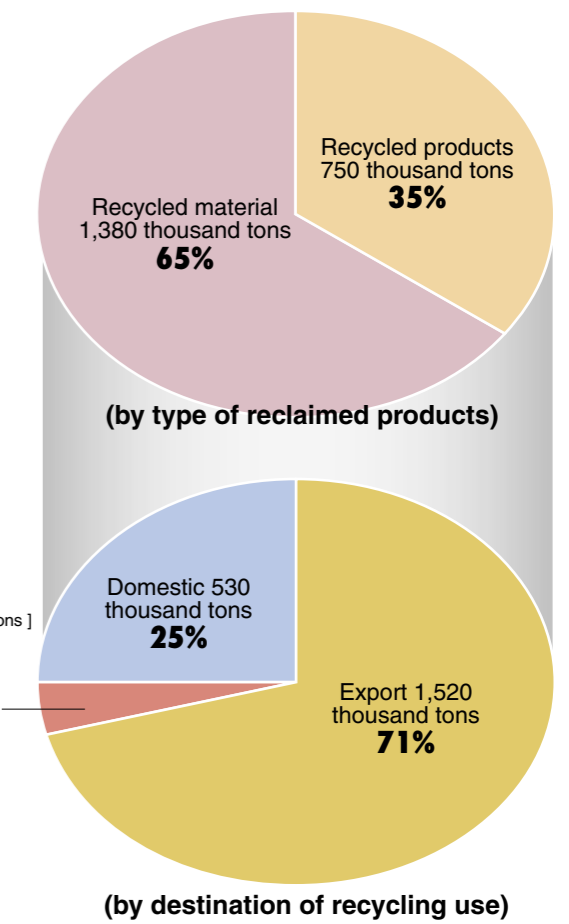
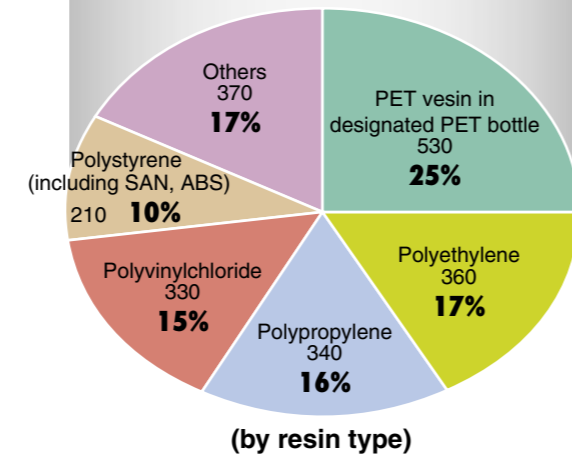
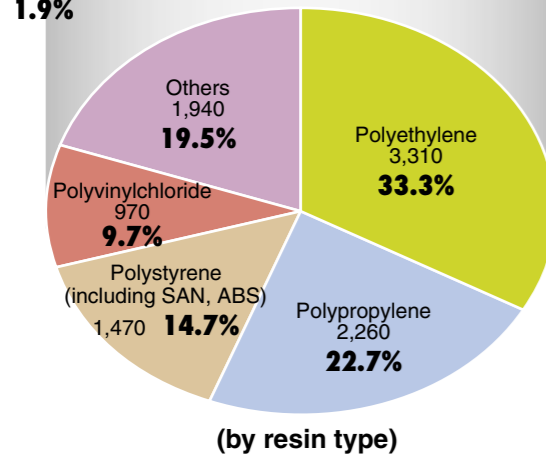
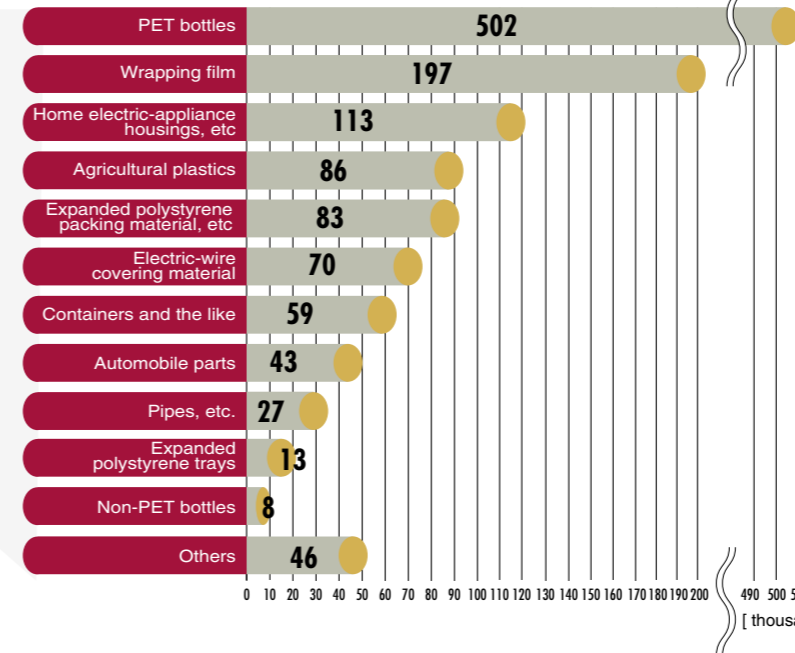
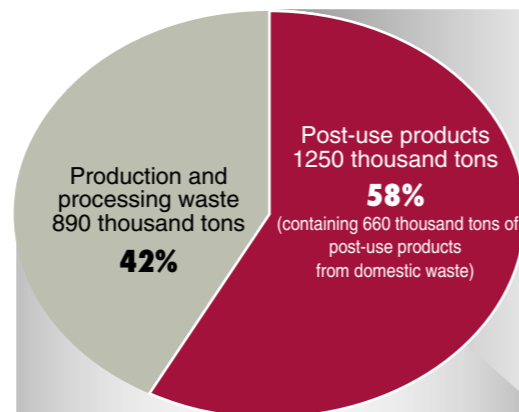


※ 3 Breakdown of total plastic waste (9,940 thousand tons) (by field)



※ 6 Breakdown of mechanical recycling (2,130 thousand tons)

○ Breakdown of post-use products for mechanical recycling (1,250 thousand tons)  
● Breakdown of mechanical recycling resources



(Footnote for \*6 "by Resin Type" pie chart)  
Among PET resin previously included in "Others," a new category has been established named "PET resin used in designated PET bottles" to clearly indicate the recycled amount of this type of resin stipulated by the Containers and Packaging Recycling Law.

# Introduction To PWMI

## Goals and Tasks

The Plastic Waste Management Institute (PWMI) was originally founded as the Plastic Management Research Association in November 1971, and received its current name in July 1972 as a result of expanded operations.

The goals of PWMI are to research and develop systems for optimal processing of plastic waste and effective use of processed waste as a resource, and to promote the use of these systems.

To accomplish these goals, PWMI performs a wide variety of tasks. These include researching and developing technologies for using plastic waste effectively, performing model experiments, disseminating technologies, conducting research surveys, publicizing the work of PWMI, and providing loan guarantees to recycling ventures.

## Activities

### Ongoing R&D, Surveys, and Public Relations

Since its founding, PWMI has been engaged in various activities related to plastic waste. These range from the development of processing and recycling technologies to the surveying of discharge amounts and waste-processing conditions and publicity work to raise the level of consciousness regarding the processing and recycling of plastic waste. The main activities at PWMI are presented below in the section titled "Operations (1971-2008)." For the future, PWMI plans to continue its work on plastic waste through activities of this nature.

### Responding to New Challenges

In the last few years, under the keyword of the 3Rs (reduce, reuse, and recycle), Japan has enacted a number of laws related to recycling, including The Basic Law for Establishing a Recycling-based

Society. In January 2005, the End-of-Life Vehicle Recycling Law (Automobile Recycling Law) became effective and other full-scale activities were launched toward achieving the goal of sustainable development. These efforts are helping to gradually decrease the quantity of final waste disposal and to ease the pressure on final disposal sites. For the past several years, the PWMI has made great efforts toward the enforcement of and the smooth operations of the Containers and Packaging Recycling Law. Efforts include recycle technology related to liquefaction, gasification, and reducing agent in blast furnaces. At the same time, PWMI provides relevant information about law provisions and enforcement.

Recently PWMI has been advancing activities to help comply with recycling laws for home appliance and automobile. We are concentrating efforts to develop feedstock recycle technology that effectively uses shredder dust, which is a main component of plastic. We are also concentrating efforts to develop recycle technology for individual plastic products

## Members

### Regular members

Asahikasei Chemicals Corporation.  
Chisso Corporation  
DuPont-Mitsui Polychemicals Co., Ltd  
Japan Polyethylene Corporation  
Japan Polypropylene Corporation  
Kaneka Corporation  
Maruzen Petrochemical Co., Ltd.  
Nippon Unicar Co., Ltd.  
Prime Polymer Co., Ltd.  
Shin Dai-Ichi Vinyl Corporation  
Shin-Etsu Chemical Co., Ltd.  
Sumitomo Chemical Co., Ltd.  
SunAllomer Ltd.  
Taiyo Vinyl Corporation  
Tosoh Corp.  
Tokuyama Sekisui Co., Ltd.  
Ube-Maruzen Polyethylene Co., Ltd.  
V-Tech Corporation

like the material used to make a CD-ROM, which is an area of recycling expected to expand rapidly in the future.

Since 1991, PWMI has energetically used life cycle inventory and the life cycle assessment methods to examine plastic recycling. Making use of the results of these studies accumulated over the years, PWMI is also developing a new assessment tool to determine the best recycling method based on how the plastic waste is generated. The eco-efficiency analysis tool integrates resource preservation, environmental burden, and economic (social) cost factors.

A frequent request from educational institutions is access to learning material related to plastic waste and recycling for environmental studies. In response, PWMI has placed high priority on developing its website as a means to publicize activities. In addition, as people grow increasingly concerned about matters related to health and safety, PWMI will distribute information about the high safety of materials that have been recycled from plastic waste.

The current members consist of the following 18 corporations, 3 organizations and 4 supporting members (as of May 2009).

### Trade Organizations

Japan Petrochemical Industry Association  
Japan Plastics Industry Federation  
Vinyl Environmental Council

### Supporting Members

Japan PET Bottle Association  
Japan Expanded Polystyrene Recycling Association  
Japan PVC Environmental Affairs Council  
Vinylidene Chloride Health Conference

# Plastics production and waste discharge

Year	Resin production	Domestic plastic products consumption	Total plastic waste discharge	Domestic waste		Industrial waste	
	1,000 t/year	1,000 t/year	1,000 t/year	1,000 t/year	%	1,000 t/year	%
1975	5,170	3,150	2,610	1,470	56	1,140	44
1980	7,520	5,520	3,250	1,780	55	1,470	45
1985	9,230	6,990	4,190	2,320	55	1,870	45
1990	12,630	9,990	5,570	3,130	56	2,440	44
1991	12,800	10,070	6,220	3,450	55	2,770	45
1992	12,580	9,280	6,920	3,910	56	3,010	44
1993	12,250	9,020	7,560	4,190	55	3,370	45
1994	13,040	9,660	8,460	4,230	50	* 4,230	50
1995	14,030	9,790	8,840	4,430	50	4,410	50
1996	14,660	10,810	9,090	4,550	50	4,540	50
1997	15,210	11,360	9,490	4,780	50	4,710	50
1998	13,910	10,200	9,840	4,990	51	4,850	49
1999	14,570	10,810	9,760	4,860	50	4,900	50
2000	14,740	10,980	9,970	5,080	51	4,890	49
2001	13,880	10,960	10,160	5,280	52	4,890	48
2002	13,850	10,570	9,900	5,080	51	4,820	49
2003	13,980	11,010	10,010	5,130	51	4,880	49
2004	14,460	11,360	10,130	5,190	51	4,940	49
2005	14,510	11,590	10,060	5,200	52	4,860	48
2006	14,450	11,200	10,050	5,080	51	4,980	49
2007	14,650	11,030	9,940	5,020	51	4,920	49

\* The method for making estimations was changed in 1994 so that non-use resin production and processing waste would be added to the figure for industrial waste.

# Change in Utilized Plastic Waste by Amount and Rate Over Time

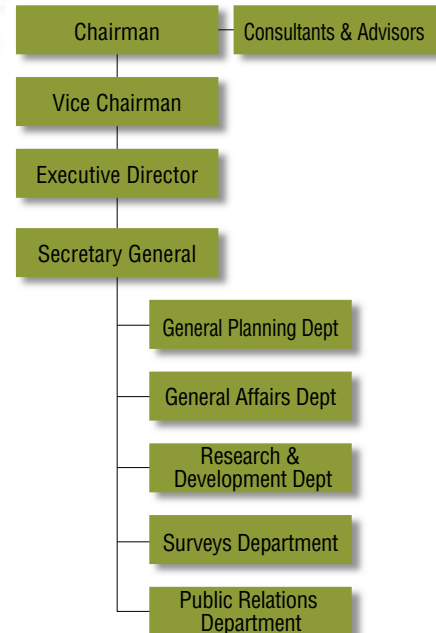
Year	1990	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007
Utilization amount (thousand tons)	1,440	2,210	3,580	3,990	4,350	4,520	4,940	5,350	5,420	5,750	6,110	6,280	7,210	7,220
Utilization rate(%)	26	25	39	42	44	46	50	53	55	58	60	62	72	73

Please see the PWMI Web site for detailed data on the production, discharge, reuse, and disposal of plastic products.

## Operations(1971-2009)

	Target Field	Recent Projects
<b>Technology development</b>	Sorting, volume reduction	Research of PET-bottle recovery system. Development of automatic sorting/separation technology using near-infrared radiation (spectroscopic analysis). Development of volume-reduction technology for raising waste-transport efficiency. Develop automatic sorting/separation technology and systems using near-infrared radiation (for shredder dust), static electricity, and buoyancy.
	Recycling promotion	Research and develop mechanical-recycling system for plastic waste. Survey current state of mechanical recycling/processing industry
	Feedstock recycling	Develop technologies for using plastic waste as raw material for liquefaction and gasification through thermal breakdown techniques. Develop technology for using plastic waste as a blast-furnace reducing agent in steel production.
	Incineration, energy recovery	Investigate conditions for suppressing generation of toxic substances and technologies for removing them when incinerating plastic waste. Develop energy-recovery technologies through densified-refuse derived fuel.
	Technology development support	Make extensive calls for new technology-development themes in relation to recycling technologies, reclaimed products, and combustion techniques, and fund R&D expenses. Survey and develop techniques for evaluating environmental effects and environmental load-economy of recycling. (LCI, LCA, eco-efficiency analysis)
<b>Surveys</b>	Domestic waste systems	Survey local-government activities to determine amount of plastic waste occupied by domestic waste. Survey progress in constructing PET-bottle recycling systems. Obtain basic data for performing life cycle analyses (LCA).
	Industrial waste systems	Survey discharge, processing, and reuse of industrial plastic waste. Perform a basic survey on the reuse of plastic waste generated in construction.
	Production to processing/disposal flow	Survey current state of plastic production, discharge, reuse, and processing/disposal in Japan, quantify its macro flow, and publish an annual report.
	Overseas surveys	Survey overseas trends in plastic recycling and processing. Participate in international conferences and exchange information in conjunction with European and U.S. organizations (Plastics Europe/APC) and Far East Asian countries (Korea, Taiwan, etc.).
<b>Public relations</b>	Exhibits, etc	Hold "Recycled Products Exhibition" as a cosponsor with the Ministry of Economy, Trade and Industry (METI) and the Japan Plastics Effective Utilization Union. Support recycling exhibits held by local governments and recycling organizations.
	Dissemination of information through print media	Gather materials at recycling sites and local governments and disseminate cycling-related information through periodical publications. Announce and publicize results of PWMI activities and current state of plastic recycling in newspapers, mass media, etc.
	Dissemination of information through digital and audio/visual media	Disseminate explanatory material on PWMI activities and plastic recycling to local governments, general public, and students through pamphlets, movies, videos, CD-ROMs, and Web sites. Prepare a Web site for recycling and environmental studies targeting elementary and junior high schools

## Organization



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