PWMI Newsletter

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Plastic Waste Management Institute
JAPAN

Plastic Products, Plastic Waste and Resource Recovery [2004]

Background information and notes on the publication of the Flowchart of Plastic Products, Plastic Waste and Resource Recovery (2004)

The Plastics Waste Management Institute (PWMI) takes annual surveys about the amount of waste plastic recycling, the amount of discharge, industrial waste, and local government policies. The results of these surveys are compiled and published as a flowchart of plastic products, waste, and recycling. This flowchart provides a quantitative macro perspective on processing and disposal by showing how much plastic is produced, what products are made, and whether the waste plastic is recycled into useable material.

To obtain each quantity shown in the flowchart, PWMI used statistical processing of the numeric data and the survey results.

The year 2000 is accepted to be the first year of the recycling-oriented society in Japan. Six recycling-related laws centered about the Basic Law for Promoting the Creation of a Recycling-oriented Society have come to be enacted, and with these laws, a recycling mechanism for the new century has begun to take hold.

In 2004, plastic recycling continued to expand on the basis of these recycling laws, and the Container and Packaging Recycling Law, now in its 10th year of operation, began to be reexamined and revised in the Industrial Structure Council and Central Environment Council. And at the same, policies governing the processing of plastic waste have gone through major changes in the Tokyo Metropolitan Government and the Ministry of the Environment. In particular, plastic waste, which is difficult to recycle, is to be incinerated for energy recovery as a general rule instead of being used in landfills. The background to these changes include extensive technical innovation in incineration facilities in conformance with the Law Concerning Special Measures against Dioxins and revisions of the Waste Management Law, promotion of new energy sources including incineration with power generation, and ratification of the Kyoto Protocol for the prevention of global warming. The idea here was that plastic waste, which has the same heat capacity as fossil fuels, should be used as a precious resource for energy recovery instead of being disposed in landfills that place a big load on the environment. The demand for refuse paper and plastic fuel (RPF) has increased dramatically in industry especially in paper and cement manufacturing.

2004 Highlights

1) Plastic utilization rate increased steadily reaching 60% of total plastic waste discharge.

2) Mechanical recycling increased to 1,810 thousand tons (+170 thousand tons) and thermal recycling

(energy recovery) to 3,990 thousand tons (+220 thousand tons).

3) The mechanical recycling of domestic plastic waste and the conversion of industrial plastic waste to RPF increased significantly.

Plastic production in 2004 increased by 490 thousand tons from the previous year to 14,460 thousand tons signaling an economic recovery. Plastic consumption in Japan was 11,360 thousand tons in 2004 (an increase of 360 thousand tons from the previous year). Total plastic waste discharge increased to 10,130 thousand tons (+120 thousand tons) with 5,190 thousand tons of this attributed to domestic plastic waste (+60 thousand tons) and 4,940 thousand tons to industrial plastic waste (+60 thousand tons).

At 6,110 thousand tons, utilized plastic waste increased by 360 thousand tons from the previous year reaching a plastic utilization rate of 60%.

The mechanical recycling of domestic plastic waste came to 460 thousand tons (+130 thousand tons). The expansion of sorted collection in accordance with the Container and Packaging Recycling Law and the expansion of PET-bottle collection via dedicated routes contributed to this figure. The mechanical recycling of post-use products increased by 120 thousand tons from the previous year to 900 thousand tons. Here, PET bottles accounted for 387 thousand tons (+120 thousand tons), agricultural plastics for 75 thousand tons (+13 thousand tons), containers and packaging for 54 thousand tons (+5 thousand tons), and pipes and joints for 20 thousand tons (+2 thousand tons) indicating that the recycling system is functioning.

The increase in thermal recycling (energy recovery) to 3,990 thousand tons (+220 thousand tons) includes the remarkable increase in densified-refuse derived fuel from industrial plastic waste, which increased by 130 thousand tons from the previous year to 490 thousand tons. Increased use of RPF was observed in incineration with power generation and paper and cement manufacturing.

At the same time, 850 thousand tons of plastic waste was exported as scrap plastic, an increase of 170 thousand tons. Though the Chinese government put a halt to the import of scrap plastic from Japan in May 2004, trade statistics showed an increase in total exports to Hong Kong and China. The maintenance of a domestic recycling system in conjunction with the internationalization of recycling is an issue to be addressed.

Together with the promotion of a recycling-oriented society, various types of recycling techniques for plastic waste are expanding steadily. We expect further progress to be made taking environmental, economical, and social factors into account.

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

・This figure is determined by an estimation system developed by PWMI based on usage quantities by demand-generating fields and by resin type (usage quantities have been calculated annually for the last 15 years) and on product lifetimes by demand-generating fields (using a PWMI discharge model for the last 15 years).

・Considering that the export/import of new and used automobiles affects the amount of domestic plastic waste, corrections have been made to amounts of reclaimed products and discharge in the transportation field. Beginning in 2004, corrections based on the import/export quantities of four types of home appliances (televisions, refrigerators, air conditions, and washing machines) are made to the amount of reclaimed plastic products in Japan.

・Discharge ratios for domestic waste and industrial waste have been estimated using a PWMI discharge model for demand-generating fields.

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

This figure refers to incineration processing by an incinerator equipped with power-generation facilities in waste processing conducted by local governments. The ratio shown is determined on the basis of PWMI surveys.

・Incineration with heat utilization facility

This figure refers to incineration processing by an incinerator that, while not equipped with power-generation facilities, has external facilities for utilizing heat. The ratio shown is determined on the basis of PWMI surveys.

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 is based on the results of PWMI surveys.

・The ratios for energy recovery such as power generation in incineration handled by industrial waste management contractors are based on the results of PWMI surveys.

・Incineration with heat utilization facility

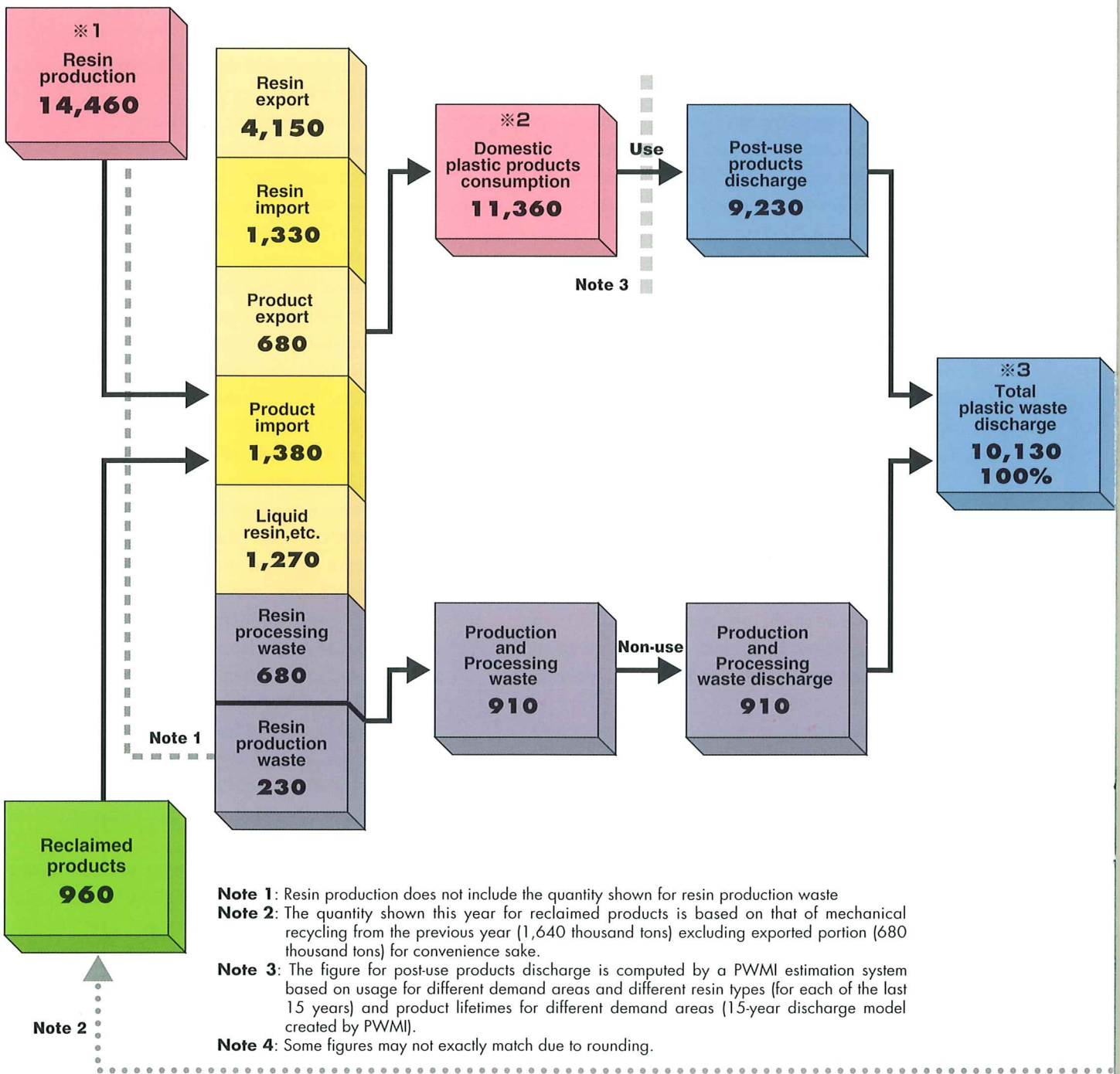
Ratios for heat utilization in industrial-waste incineration processing by local governments and industrial waste management contractors are based on the results of PWMI surveys.

Flowchart of plastic products, plastic waste and resource recovery

2004

[Unit; thousand tons]

Resin production, resin processing, and marketing of products | **Discharge**



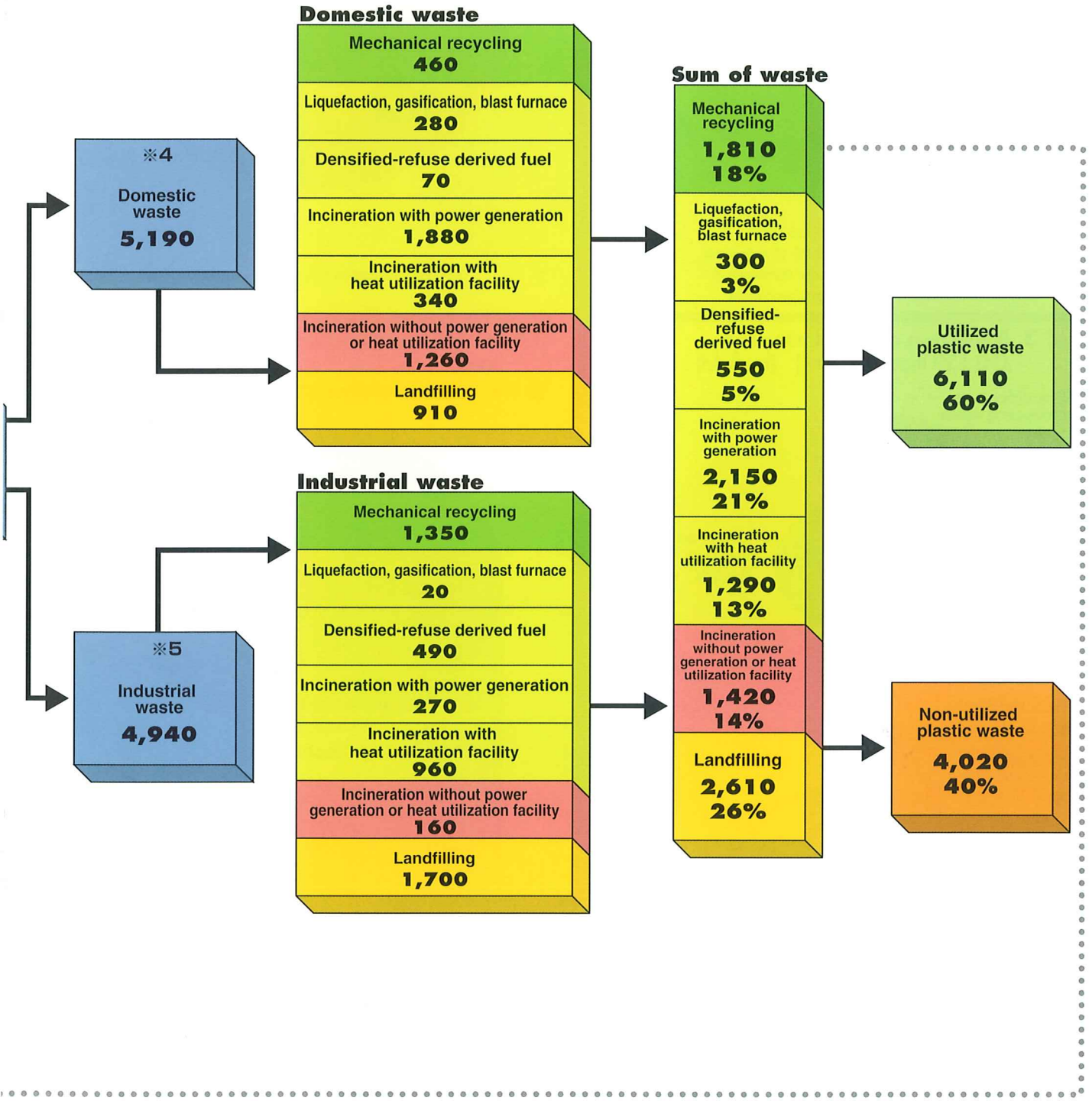
Note 1: Resin production does not include the quantity shown for resin production waste

Note 2: The quantity shown this year for reclaimed products is based on that of mechanical recycling from the previous year (1,640 thousand tons) excluding exported portion (680 thousand tons) for convenience sake.

Note 3: The figure for post-use products discharge is computed by a PWMI estimation system based on usage for different demand areas and different resin types (for each of the last 15 years) and product lifetimes for different demand areas (15-year discharge model created by PWMI).

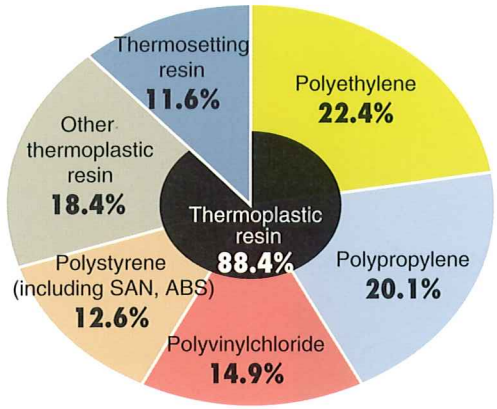
Note 4: Some figures may not exactly match due to rounding.

Disposal and recovery



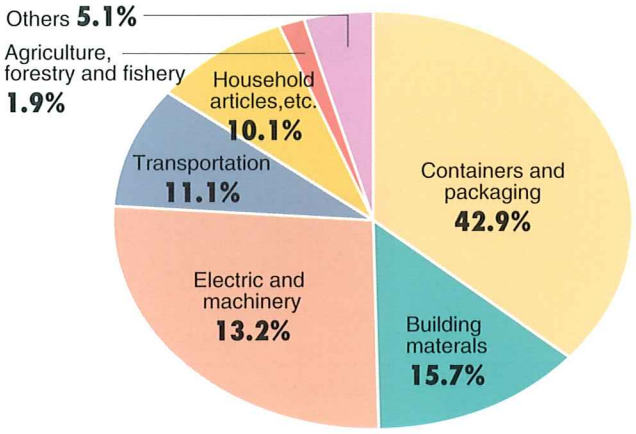
Details of flowchart elements

※1 Breakdown of resin production (14,460 thousand tons) by resin type



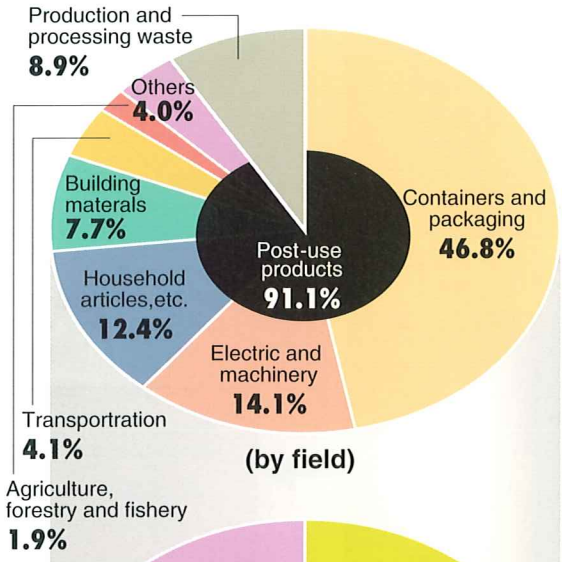
(Source: METI chemical-industry statistics)
For convenience sake, the other 1.4% of resins not categorized as thermosetting resin or thermoplastic resin are included in "other thermoplastic resin."

※2 Breakdown of resin products by field (11,360 thousand tons)

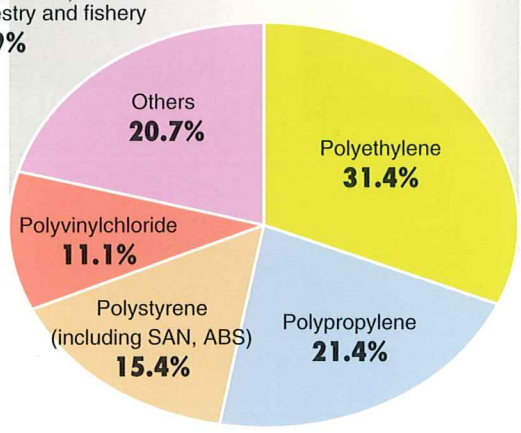


(Source: estimates from related organizations)

※3 Breakdown of total plastic waste (10,130 thousand tons) (by field)



(by field)

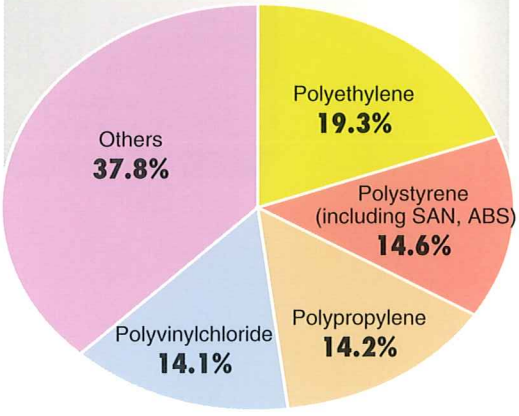


(by resin type)

※6 Breakdown of mechanical recycling (1,810 thousand tons)

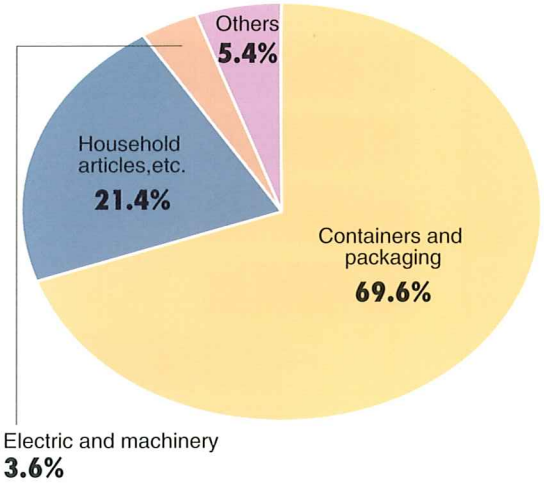
● Breakdown of mechanical recycling resources

(by discharge type)

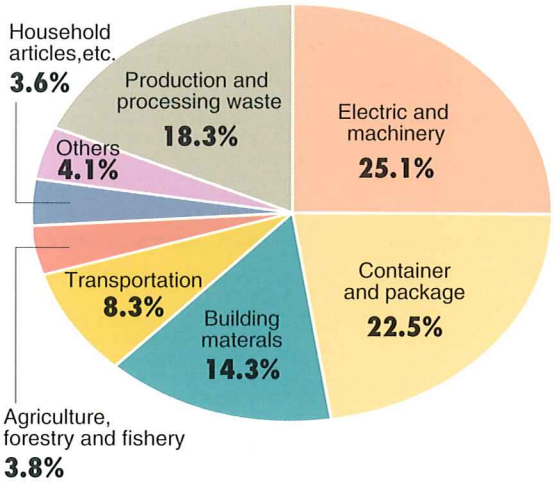


(by resin type)

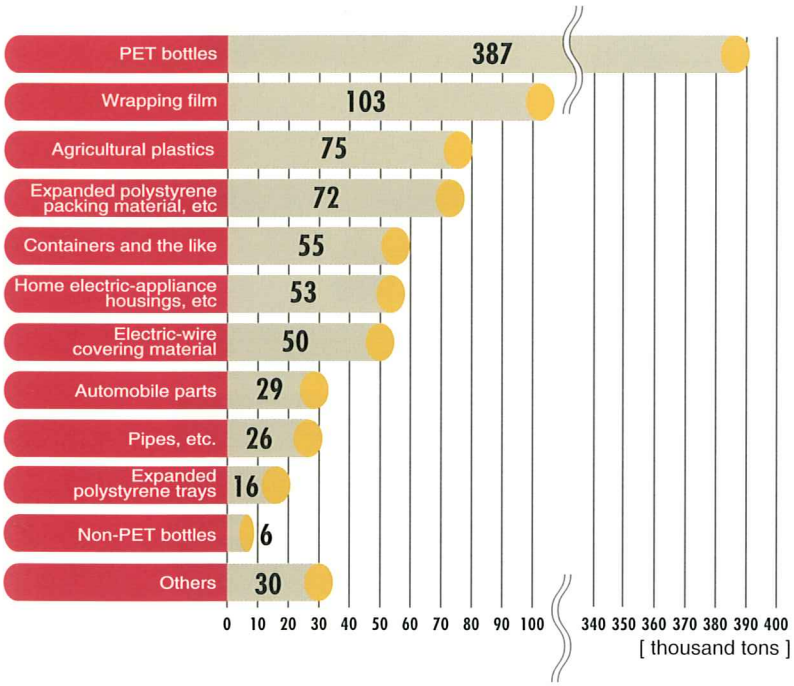
※4 Breakdown of domestic waste by field (5,190 thousand tons)

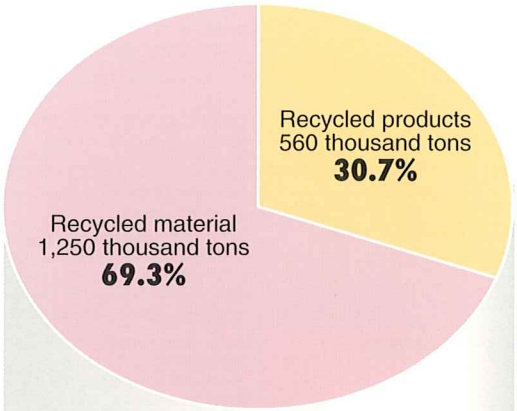


※5 Breakdown of industrial waste by field (4,940 thousand tons)

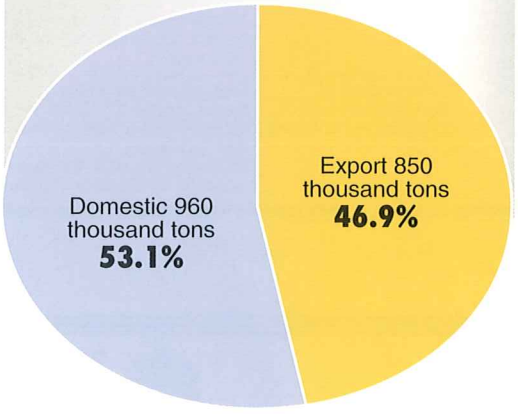


○ Breakdown of post-use products for mechanical recycling (780 thousand tons)





(by type of reclaimed products)



(by destination of recycling use)

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
1986	9,370	7,300	4,530	2,500	55	2,030	45
1987	10,030	7,920	4,650	2,600	56	2,050	44
1988	11,020	8,610	4,880	2,760	57	2,120	43
1989	11,910	9,570	5,060	2,910	58	2,150	42
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	1,0980	9,970	5,080	51	4,890	49
2001	13,880	1,0960	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

* 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
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
Utilization rate(%)	26	25	39	42	44	46	50	53	55	58	60

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

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. PWMI has also implemented a loan guarantee system to promote the growth of the plastic-waste recycling business. The main activities at PWMI are presented below in the section titled "Operations (1971-2003)." 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 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.

Members

The current members consist of the following 18 corporations, 3 organizations and 5 supporting members (as of April 2005).

●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

●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
Japan Urethane Industries Institute
Vinylidene Chloride Health Conference

Operations(1971-2004)

	Target Field	Recent Projects
Technology development	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)
Surveys	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.).
Public relations	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 disseminatere 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

Plastic Waste Management Institute
Sumitomorokko Bldg., 1-4-1 Shinkawa Chuo-ku, Tokyo 104-0033 Japan
Tel: 81-3-3297-7511, Fax: 81-3-3297-7501
Web site: http://www.pwmi.or.jp