PWMI Newsletter

NO 28 2004.6

Plastic Waste Management Institute
JAPAN

Plastic Products, Plastic Waste and Resource Recovery [2002]

Background information and notes on the publication of the Flowchart of Plastic Products, Plastic Waste and Resource Recovery (2002)

The Plastic Waste Management Institute conducts annual surveys on matters related to plastic waste. These include a questionnaire-based survey on amount of recycling, a survey on the amount of plastic waste discharge, a survey directed toward local governments on domestic waste management, and a survey on industrial waste management. The results of these surveys are combined and published as the Flowchart of Plastic Products, Plastic Waste and Resource Recovery. This flowchart is published annually and provides quantitative information on the macro flow of plastic production in Japan, its manufacture into products, and its use and disposal, as well as resource recovery and disposal processing of plastic waste.

Please note that the quantities shown in the flowchart are the result of statistical processing performed by the Plastic Waste Management Institute based on statistical data and replies to questionnaires.

Plastic is a relatively new material that has been used in the development of over 100 diverse product groups. Its multifunctionality, processability, moldability, and lightness make it ideal for a wide variety of applications that cannot be achieved by traditional materials like metal, wood, and glass. Plastic has played an important role in the creation and growth of new industries. Resin production in 2002 came to about 190,000 thousand tons worldwide and 14,000 thousand tons in Japan.

At the same time, there is serious concern that unrestrained expansion of economic activities could destroy natural cycles on a global scale. In response to this problem, plans for achieving sustainable development in modern society were presented at the United Nations Johannesburg Summit 2002.

While plastic excels in weather resistance, corrosion resistance, durability, and lightness, these features are actually a major cause of dwindling landfill space when discharging plastic directly. In addition, the generation of dioxins when incinerating plastics, a problem that is now practically solved from a technical standpoint, was treated as a major environmental issue in the past causing much social anxiety.

The year 2000 saw the drafting and enacting of various laws toward the formation of a recycling-oriented society, and these laws have begun to function as a mechanism for the new century. The year 2002 likewise saw the enactment of the Construction Materials Recycling Law as well as discussion in the Diet toward the proclamation of an Automobile Recycling Law. Furthermore, in December 2002, complete enforcement of the Air Pollution Law in relation to dioxins went into effect. In response to stricter standards for discharging dioxins into the atmosphere, local governments approved the upgrading of incinerators and the improvement of performance in power-generation facilities. That year saw the commencement of full-scale operations by power-generation facilities using plastic waste based on new technologies like gasification-and-melting furnaces.

A variety of plastic recycling techniques have come to be developed and expanded in the areas of mechanical recycling, feedstock recycling, and energy recovery. There has also been much activity toward the 3R's (reduce, reuse, recycle) at the design stage of plastic products including the streamlining of plastic grades, reduction in weight, and labeling of material type.

The use of plastic can make products smaller and lighter. The pliability of plastic can also reduce energy consumption when

manufacturing products and the long life of plastic products can help preserve resources. There are many cases in which the use of plastic materials in itself has given rise to highly efficient products using less resources and less energy. Recognizing that plastic can be a vital material in the quest for sustainable development, it should make even more contributions to society in the future.

2002 Highlights

(1) Plastic utilization rate expanded steadily reaching 55% of total plastic waste discharge (an increase of 2.1% over the previous year).

(2) In more detail, mechanical recycling and feedstock recycling combined was responsible for a plastic utilization rate of 18% (an increase of 1.4% over the previous year) while energy recovery was responsible for a plastic utilization rate of 37% (an increase of 0.7% over the previous year).

(3) The export of scrap plastic expanded especially to China.

At 13,850 thousand tons, resin production in Japan in 2002 was about the same as the previous year, but because of the expansion of resin exports, domestic plastic consumption at 10,570 thousand tons actually decreased from the previous year by 390 thousand tons. Total plastic waste discharge at 9,900 thousand tons also decreased from the previous year by 260 thousand tons. Here, domestic waste at 5,080 thousand tons, which decreased from the previous year by 200 thousand tons, made up most of this decrease. Mechanical recycling from domestic waste was 260 thousand tons (+ 60 thousand tons) and use of domestic waste in liquefaction, gasification, and blast furnaces was 190 thousand tons (+ 50 thousand tons). This 110-thousand-ton increase in resource recovery reflects the gradual expansion of recycling related to the Containers and Packaging Recycling Law.

Utilized plastic waste increased by 60 thousand tons from the previous year to 5,420 thousand tons despite the decrease in total plastic waste discharge. Achieving a plastic utilization rate of 55% in 2002, utilized plastic waste continues to increase steadily. In mechanical recycling, post-use products accounted for 690 thousand tons, an increase of 90 thousand tons from the previous year. Specifically, PET bottles accounted for 220 thousand tons (+ 42 thousand tons), expanded polystyrene (including trays) for 85 thousand tons (+ 6 thousand tons), and pipes and joints for 17 thousand tons (+ 1 thousand tons) indicating that the recycling systems in each of these business areas was operating smoothly. The amount of plastic waste from home electric-appliance housings at 62 thousand tons also increased significantly (+ 28 thousand tons) indicating that the Home Appliances Recycling Law is beginning to have an effect. At the same time, the export of scrap plastic jumped dramatically by 160 thousand tons to 550 thousand tons with much of this centered on China. This trend is not unique to Japan and can also be seen in Europe and North America. It is no doubt related to China's current economic growth.

A variety of systems for recycling plastic waste are growing steadily in the form of mechanical recycling, feedstock recycling (e.g. liquefaction, gasification, blast furnace raw materials, coke-oven chemical materials), and energy recovery (e.g. cement kiln fuel, refuse derived fuel, incineration with power generation). To improve the plastic utilization rate in the future, energy recovery will become even more important.

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.

・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.

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

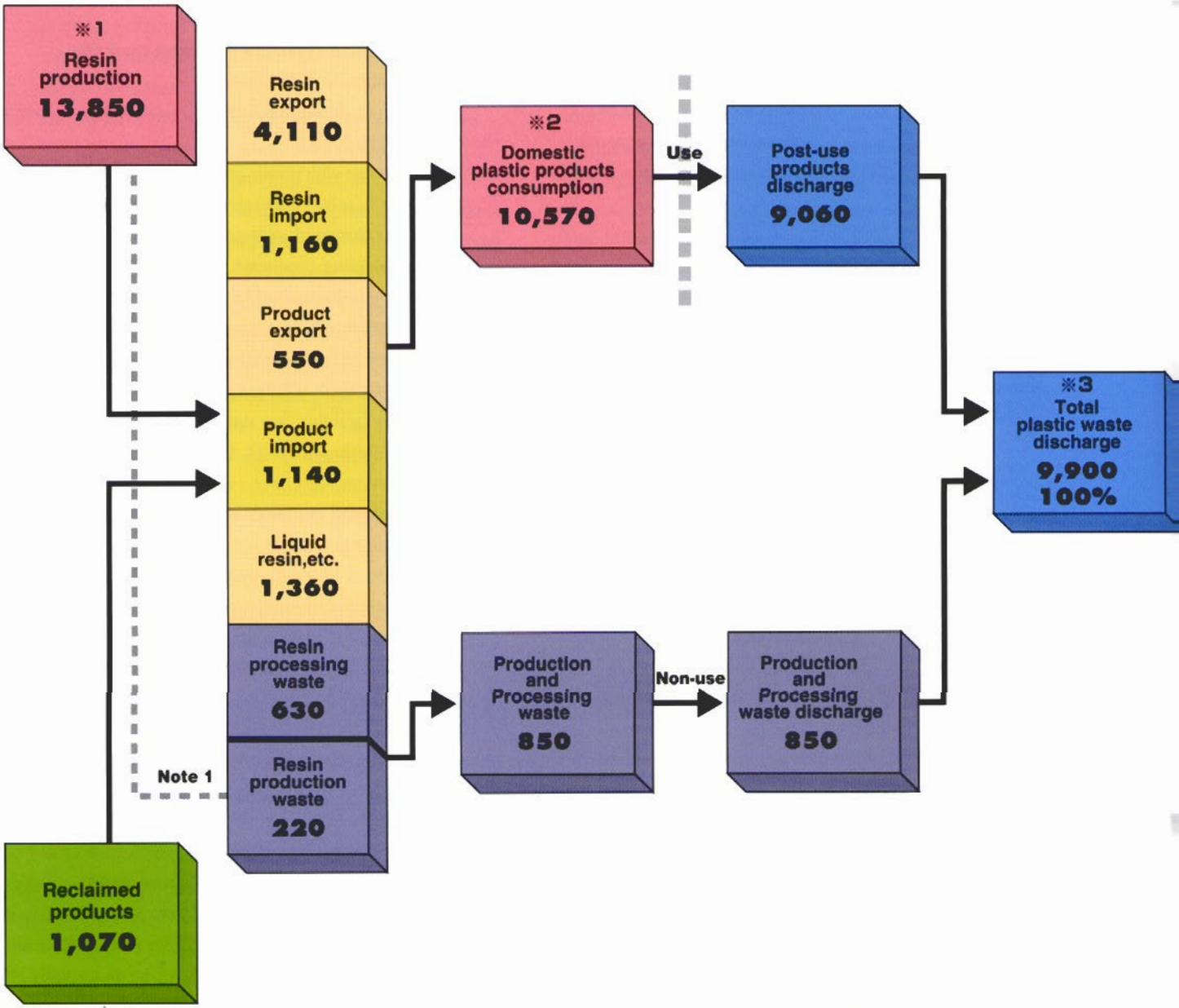
Ratios for heat utilization in industrial-waste incineration processing by local governments and industrial waste management contractors are based on the results of PWMI surveys.

Flowchart of plastic products, plastic waste and resource recovery

2002

[Unit; thousand tons]

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

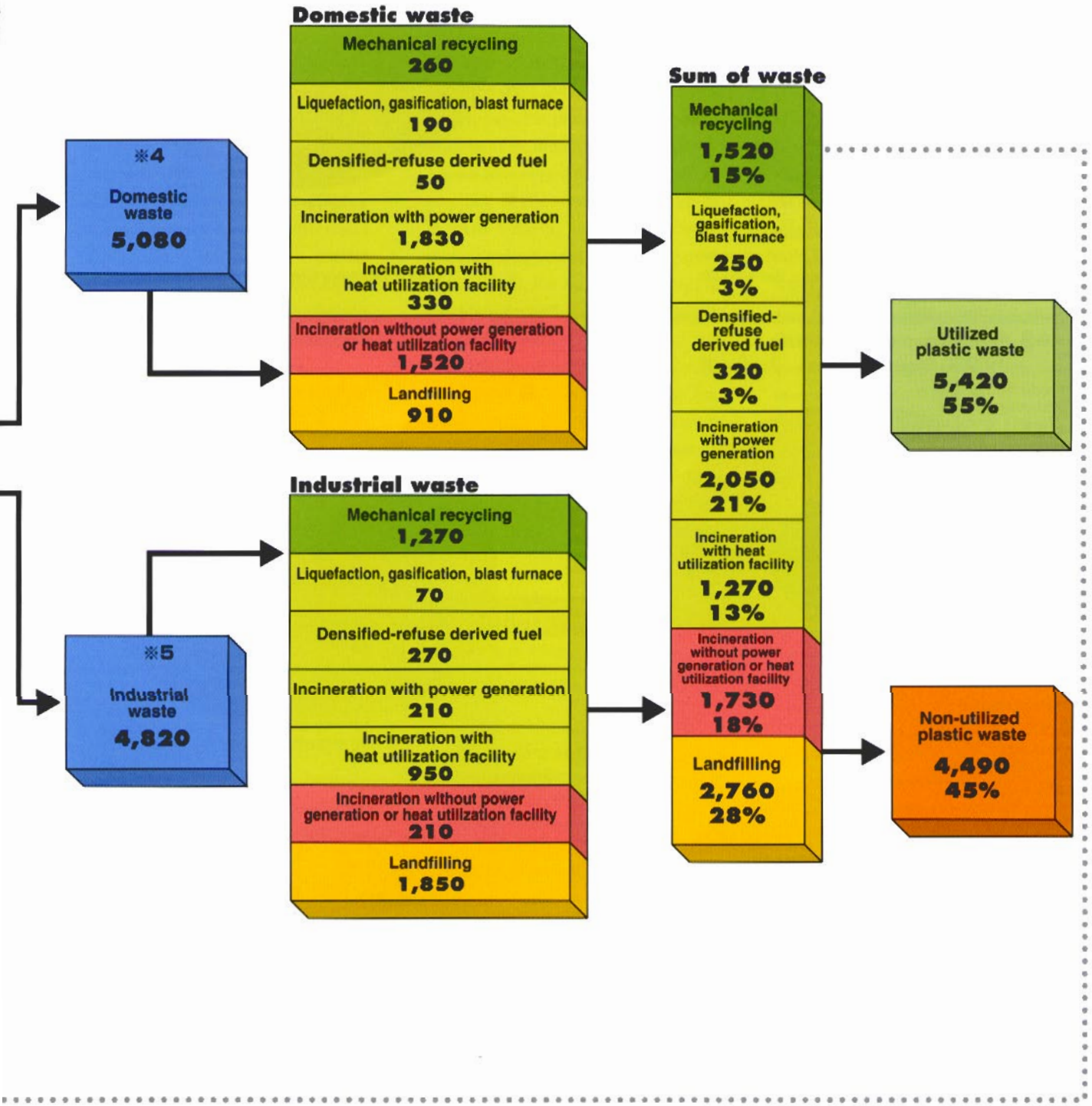


Note 1: Resin production does not include the quantity shown for resin production waste

Note 2: The quantity shown this year for reclaimed products is based on that of mechanical recycling from the previous year (1,470 thousand tons) excluding exported portion (390 thousand tons) for convenience sake.

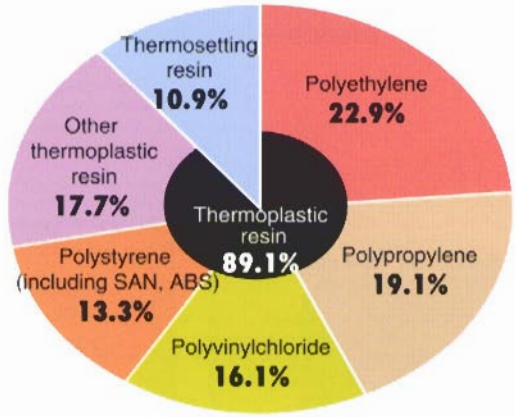
Note 3: Some figures may not exactly match due to rounding.

Disposal and recovery



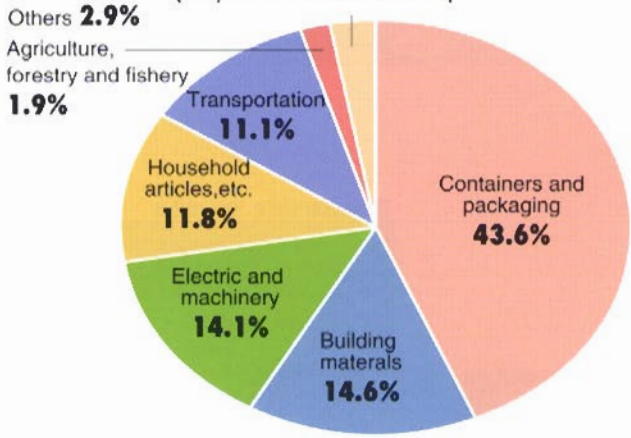
Details of flowchart elements

※1 Breakdown of resin production (13,850 thousand tons) by resin type



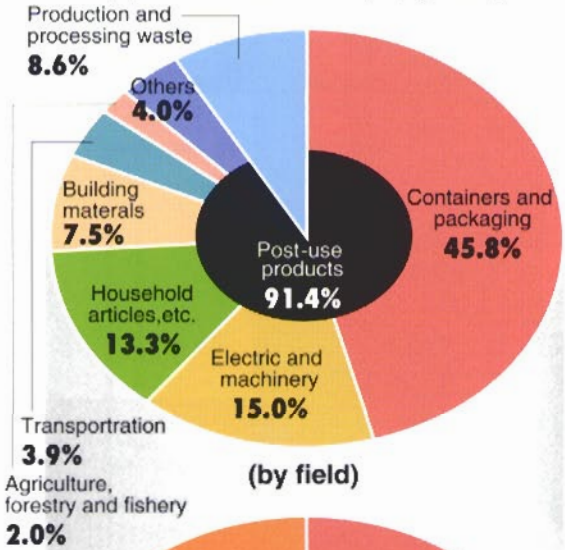
(Source: METI chemical-industry statistics)
For convenience sake, the other 1.4% of resins not categorized as thermosetting resin or thermoplastic resin are included in "other thermoplastic resin."

※2 Breakdown of resin products by field (10,570 thousand tons)

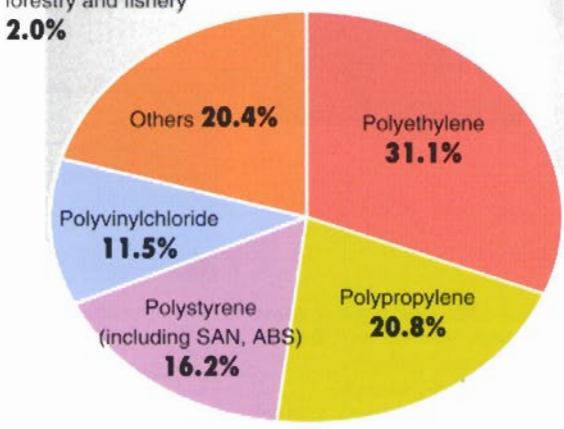


(Source: estimates from related organizations)

※3 Breakdown of total plastic waste (9,900 thousand tons) (by field)



(by field)

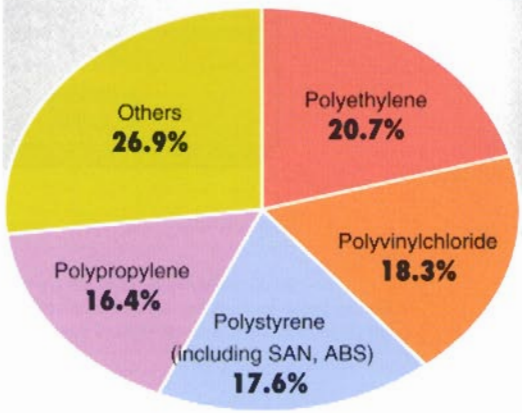


(by resin type)

※6 Breakdown of mechanical recycling (1,520 thousand tons)

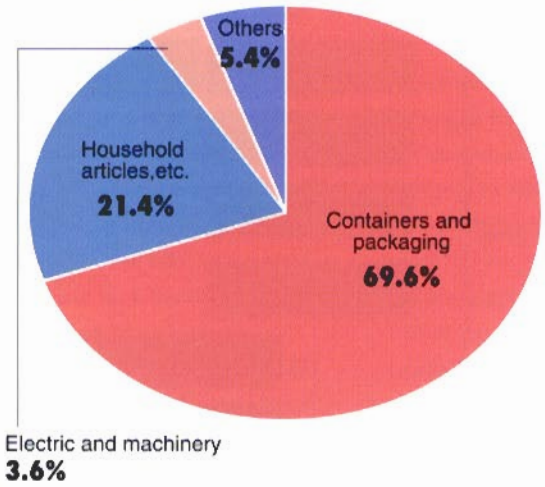
● Breakdown of mechanical recycling resources

(by discharge type)

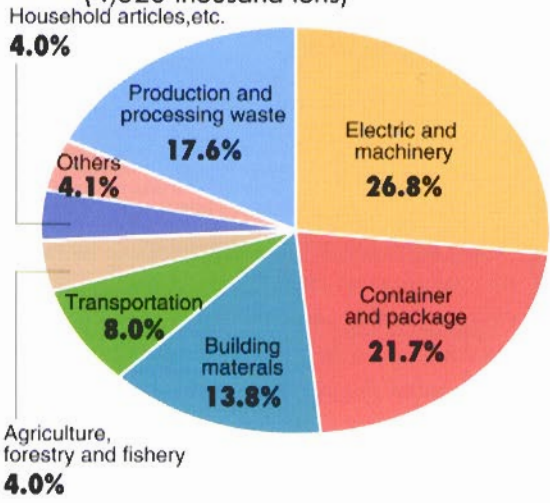


(by resin type)

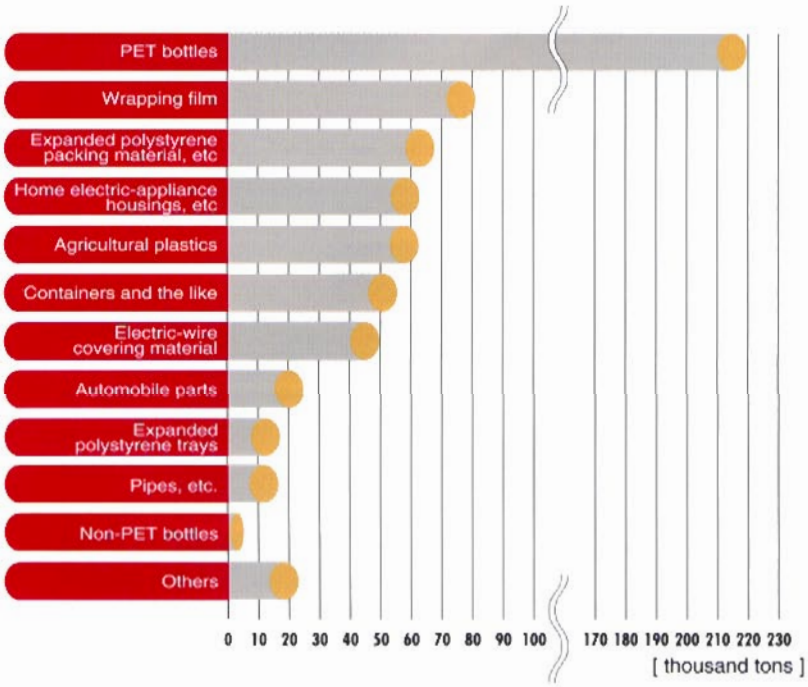
※4 Breakdown of domestic waste by field (5,080 thousand tons)

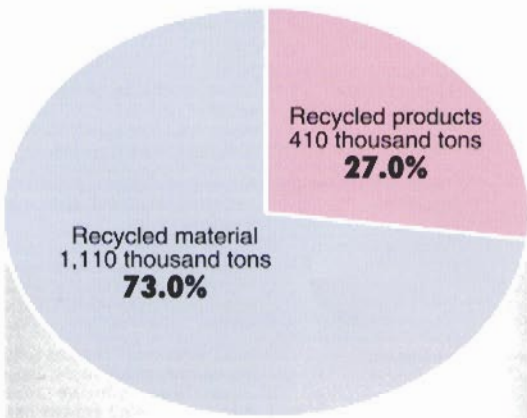


※5 Breakdown of industrial waste by field (4,820 thousand tons)

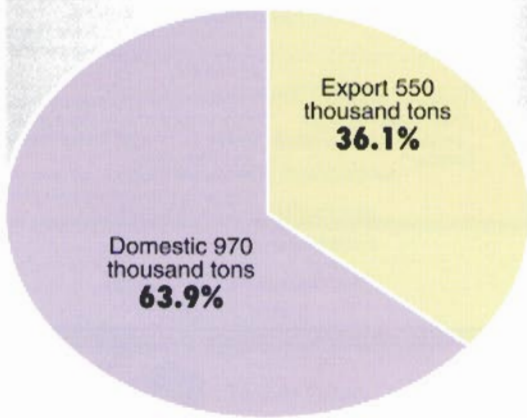


○ Breakdown of post-use products for mechanical recycling (690 thousand tons)





(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

* 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
Utilization amount (thousand tons)	1,440	2,210	3,580	3,990	4,350	4,520	4,940	5,350	5,420
Utilization rate(%)	26	25	39	42	44	46	50	53	55

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 these last few years, waste problems have become increasingly severe and social concern for dealing with these problems through recycling has been growing. Against this background, PWMI has placed much importance on the smooth enactment and implementation of the Containers and Packaging Recycling Law in Japan, and has undertaken the development of recycling technologies indispensable to this end. These include the use of plastic waste as raw material for liquefaction and gasification and as blast furnace fuel. PWMI has also provided information essential to the drafting and enactment of various laws related to plastic waste and recycling. Social conditions with regard to waste handling have, in fact, been changing dramatically in recent years. For example, the movement toward a recycling-oriented society characterized by the 3R's (reduce, reuse, recycle) has been gaining momentum especially with enactment of the Basic Law for Establishing the Recycling-based Society as well as the Home Appliances Recycling Law, Construction Materials Recycling Law, and Automobile Recycling Law.

Against this background, PWMI is promoting activities that will help plastic contribute to the formation of a recycling-oriented society. For example, PWMI is developing tests based on life cycle assessment (LCA) to determine just how plastic is contributing to a sustainable society. It is also promoting eco-efficiency analysis from the viewpoints of "resource preservation," and "environmental load-economy (cost to society" as a new evaluation tool for selecting optimal recycling techniques based on the manner in which plastic waste is generated.

At the same time, PWMI is placing much importance on public relations especially in the form of environmental education materials dealing with plastic and recycling. The need for such materials has been expressed by many educational sites, and their provision will be centered about a Web site.

Finally, in response to rapidly growing concern for people's health and safety, PWMI will continue to inform the general public that plastic is a highly safe material even during waste processing.

Members

The current members consist of the following 19 corporations, 3 organizations and 5 supporting members (as of June 2004).

●Regular members

Asahikasei Chemicals Corporation.
Chisso Corporation
DuPont-Mitsui Polychemicals Co., Ltd
Idemitsu Petrochemical Co., Ltd.
Japan Polyethylene Corporation
Japan Polypropylene Corporation
Kaneka Corporation
Maruzen Polymer Co., Ltd.
Mitsui Chemicals Inc.
Nippon Unicar 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 Industries, Ltd.
V-Tech Corporation

●Trade Organizations

Japan Petrochemical Industry Association
Japan Plastics Industry Federation
Vinyl Environmental Council

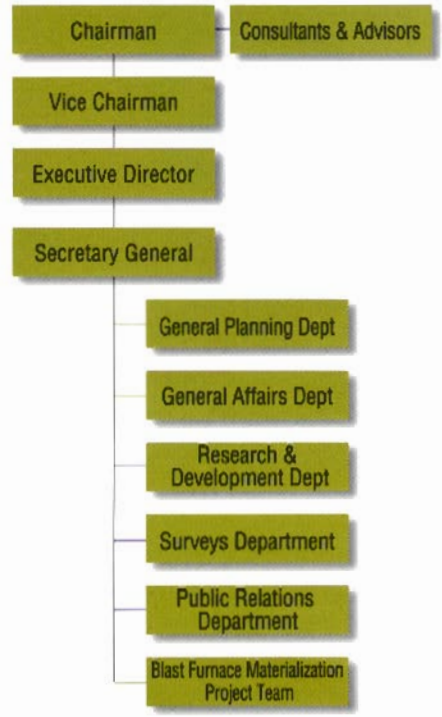
●Supporting Members

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

Operations(1971-2003)

	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 (APME/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