PWMI Newsletter

NO 34 2007.5

Plastic Waste Management Institute
JAPAN

Plastic Products, Plastic Waste and Resource Recovery [2005]

Background information and notes on the publication of the Flowchart of Plastic Products, Plastic Waste and Resource Recovery (2005)

Six recycling-related laws centered about the Basic Law for Promoting the Creation of a Recycling-oriented Society have come to be enacted, and the last of these, the Automobile Recycling Law, went into effect in 2005. Plastic recycling has been expanding steadily based on the Container and Packaging Recycling Law and Home Appliance Recycling Law. But in this initial year of the Automobile Recycling Law, the number of used cars targeted for scrapping came out to only 3,050,000 vehicles falling quite short of the initially projected 4,000,000. This was attributed to an increase in the number of exported used cars, an increase in used-car inventory within Japan, and a jump in the scrapping of used cars just before the Automobile Recycling Law went into effect.

Work on revising the Container and Packaging Recycling Law has been moving forward since the summer of 2004 at the Industrial Structure Council and Central Environment Council. Main issues to be dealt with were finally established at the end of 2005.

In the last several fiscal years, incineration facilities have been the target of much technical innovation, and the establishment of trash incineration facilities in conjunction with power generation has progressed. In 2004, major policy changes were made at the Tokyo Metropolitan Government and the Ministry of the Environment in relation to the processing of plastic waste (in particular, plastic waste was declared a precious resource unsuitable for disposal in landfills, and plastic waste that was difficult to reuse would be employed for energy recovery while ensuring an energy-recovery rate at or greater than a certain value). In short, as plastic waste has the same heat capacity as fossil fuels, using it for energy recovery instead of being disposed in environmentally harmful landfills means that a clear direction in the effective reuse of plastic waste has been established. In concert with these policy changes, the demand for RPF (Refuse Paper and Plastic Fuel) has been increasing steadily in industry especially in paper and cement manufacturing.

2005 Highlights

1) Plastic utilization rate increased steadily reaching 62% of total plastic waste discharge.
2) Mechanical recycling increased to 1,850 thousand tons (+40 thousand tons) and thermal recycling (energy recovery) to 4,140 thousand tons (+150 thousand tons).
3) The export of plastic waste especially to Hong Kong and China increased by 210 thousand tons over the previous year surpassing 1,000 thousand tons (to 1,060 thousand tons). This amount of exported plastic waste came to more than half that of mechanical recycling, or 57.3% (+10.4%).

Although plastic production had been on the decrease since its peak in 2000, it began to increase again in 2004 reflecting an economic recovery and continued to increase, if only slightly, in 2005 reaching 14, 510 thousand tons (+50 thousand tons). Plastic consumption in Japan was 11,590 thousand tons in 2004 (an increase of 230 thousand tons from the previous year), and total plastic waste discharge came to 10,060 thousand tons (-70 thousand tons). Of this, 5,200 thousand tons could be attributed to domestic plastic waste (+10 thousand tons) and 4,860 thousand tons to industrial plastic waste (-80 thousand tons). Thus, despite the increase in plastic consumption, discharge decreased, which can be attributed to the decrease in the number of scrapped cars (resulting in -100 thousand tons) due to the enactment of the Automobile Recycling Law.

At 6,280 thousand tons, utilized plastic waste increased by 170 thousand tons from the previous year reaching a plastic utilization rate of 62%. The mechanical recycling of post-use products increased by 30 thousand tons from the previous year to 930 thousand tons. Contributing to this amount was an increment of 27 thousand tons in recycling generated by the Container and Packaging Recycling Law and an increment of 18 thousand tons in recycling generated by the Home Appliance Recycling Law indicating that these recycling laws are functioning well. Here, the increment related to the Container and Packaging Recycling Law consisted mainly of plastic containers and packages; the actual volume of collected PET bottles (estimated by the Council for PET Bottle Recycling to be more than 381 thousand tons) remained at about the same level as the previous year.

Energy recovery of plastic waste came to 4,140 thousand tons (+150 thousand tons) including a remarkable increase in incineration with power generation to 2,310 thousand tons (+160 thousand tons). Although densified-refuse derived fuel (most being RPF) increased to 620 thousand tons (+60 thousand tons), growth has slowed somewhat due to competition among various fields for industrial plastic waste.

At the same time, exports of plastic waste especially to China and Hong Kong increased by 210 thousand tons over the previous year topping 1,000 thousand tons (to 1,060 thousand tons). As a result, the amount of exported plastic waste came to more than half that of mechanical recycling (57.3%). While efforts to form a recycling-oriented society are making progress, a situation has arisen that could result in a breakdown of Japan's recycling system especially in regard to PET bottles. The maintenance of recycling systems including those in other countries is becoming an issue of concern. In Japan, a variety of recycling techniques are coming to be developed, and the mechanical recycling field is experiencing dramatic growth at sites that use plastic waste in the form of containers and packages. There is consequently the fear that a recycling system that includes other techniques may become unbalanced. The hope is that further progress can be made in a well balanced manner 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 and of the four types of home appliances (televisions, refrigerators, air conditions, and washing machines) affects the amount of plastic waste in Japan, corrections are made to the amounts of reclaimed plastic products and plastic waste discharge.

· 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 / 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 (previous reports used actual values from two years before).

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.

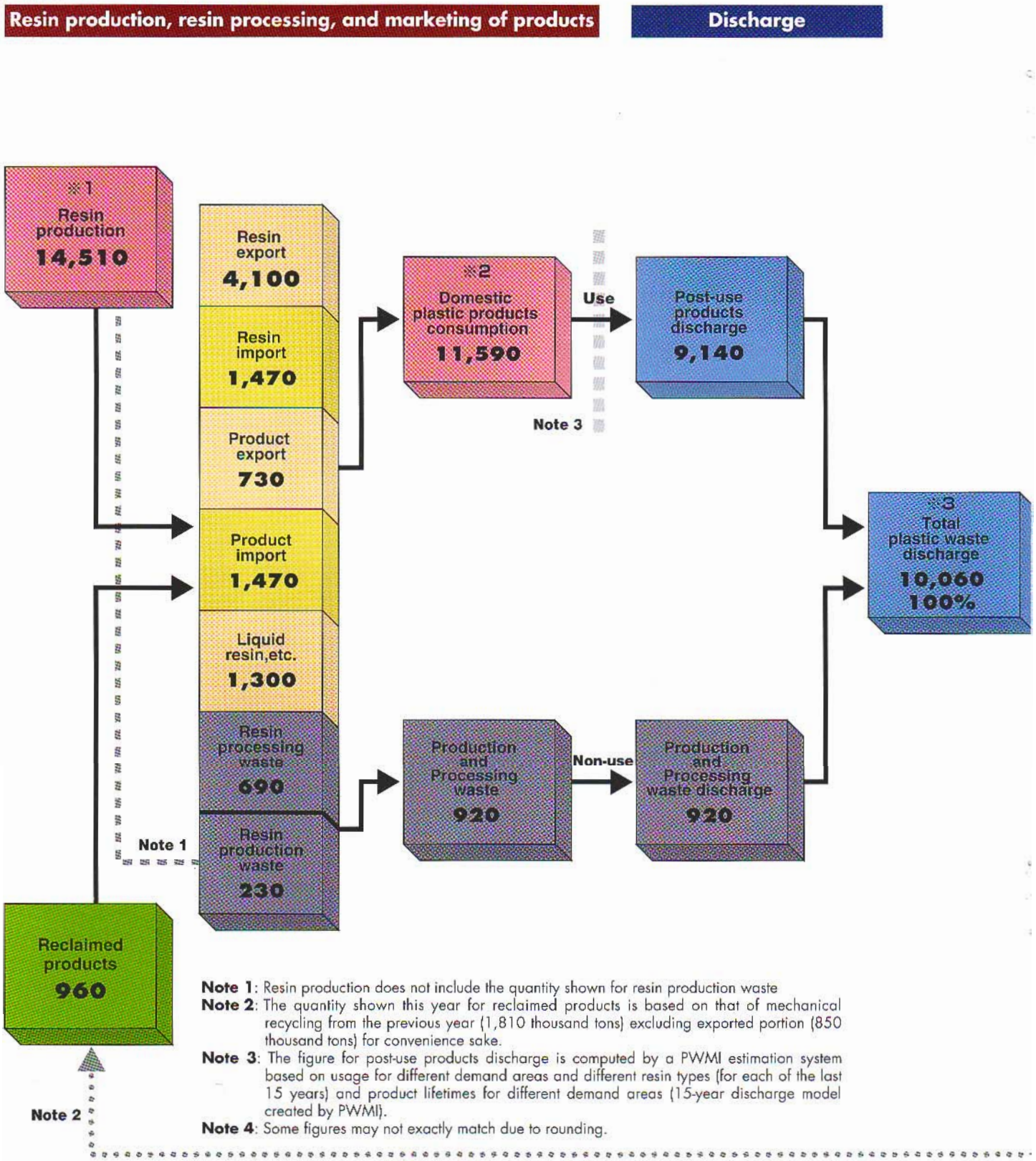
· Incineration with heat utilization facility

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

2005

[Unit; thousand tons]



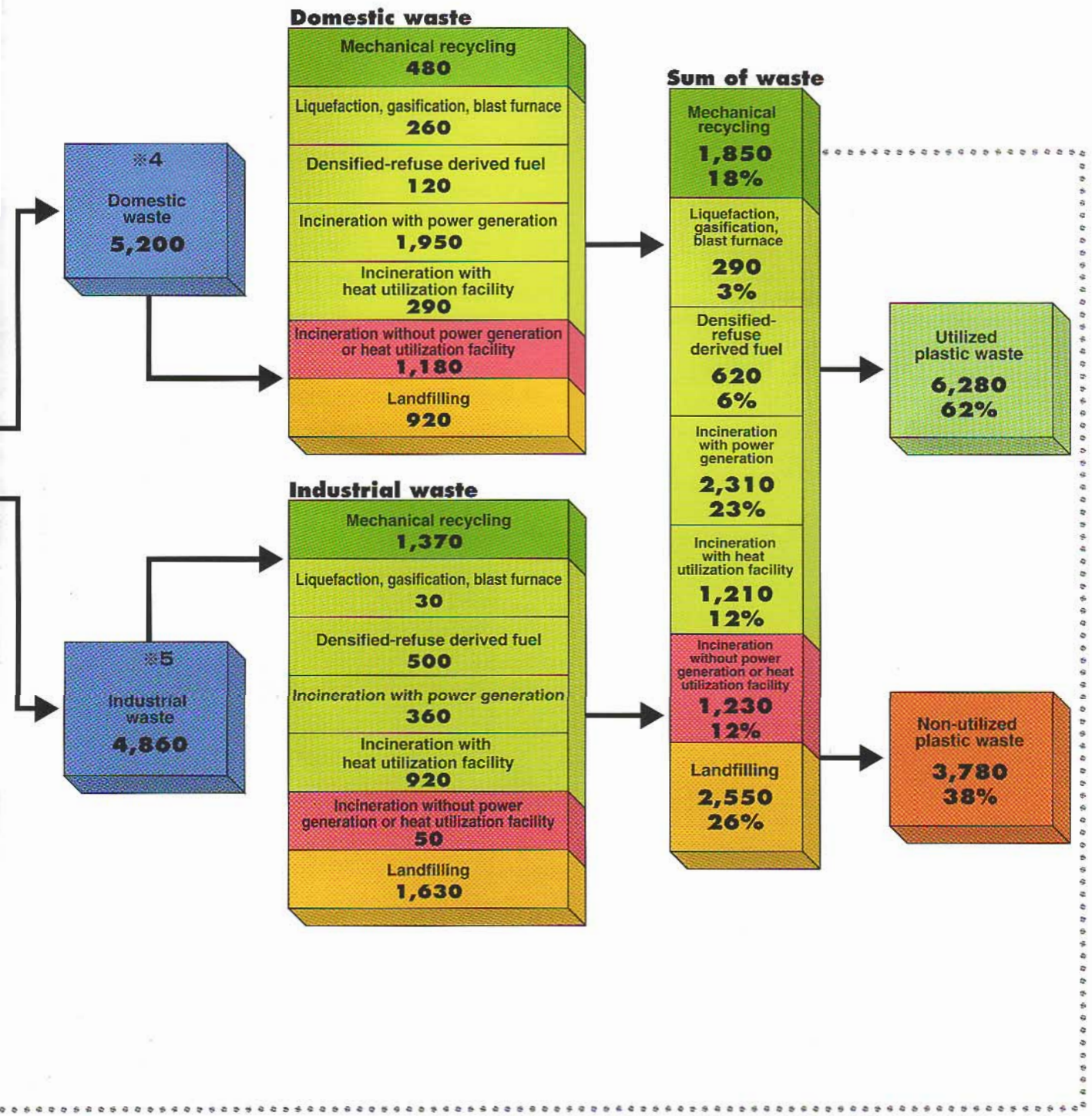
Note 1: Resin production does not include the quantity shown for resin production waste

Note 2: The quantity shown this year for reclaimed products is based on that of mechanical recycling from the previous year (1,810 thousand tons) excluding exported portion (850 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).

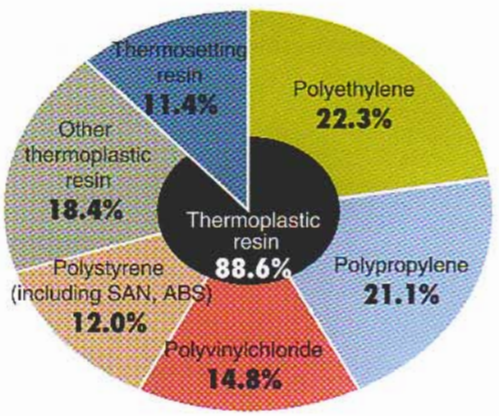
Note 4: Some figures may not exactly match due to rounding.

Disposal and recovery



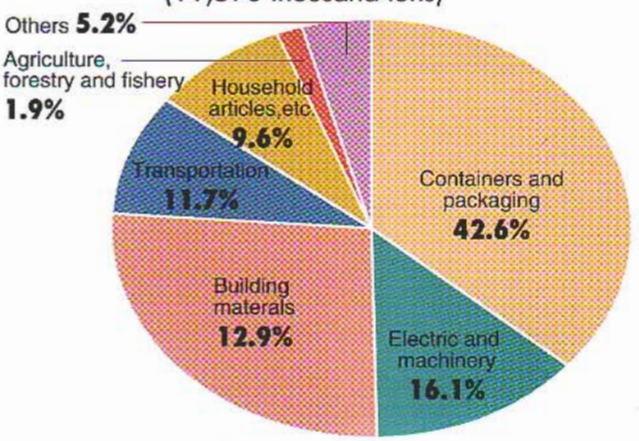
Details of flowchart elements

※1 Breakdown of resin production (14,510 thousand tons) by resin type



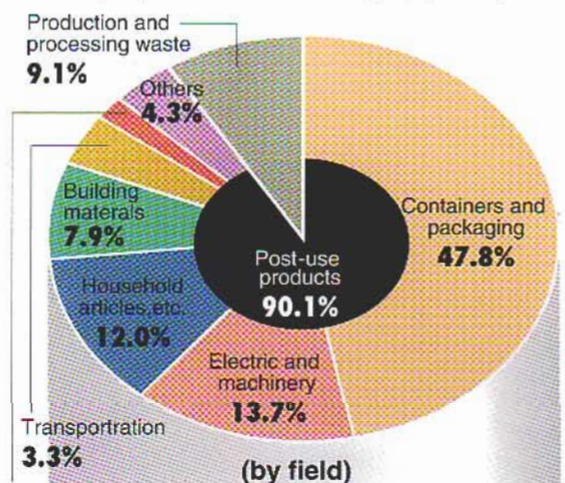
(Source: METI chemical-industry statistics)
For convenience sake, the other 1.4% of resins not categorized as thermosetting resin or thermoplastic resin are included in "other thermoplastic resin."

※2 Breakdown of resin products by field (11,590 thousand tons)

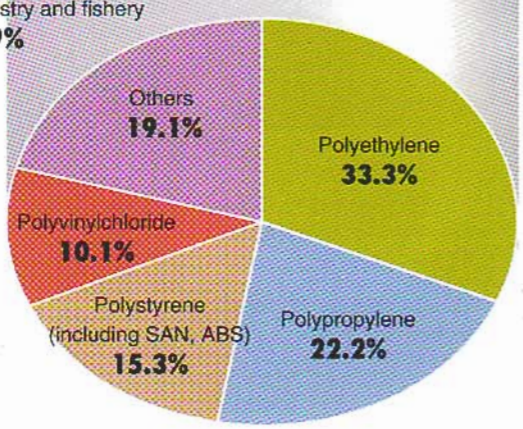


(Source: estimates from related organizations)

※3 Breakdown of total plastic waste (10,060 thousand tons) (by field)



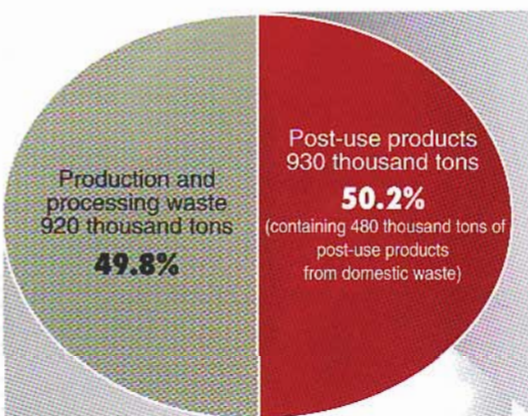
(by field)



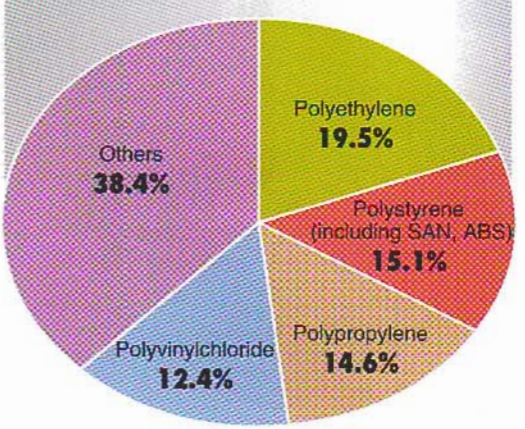
(by resin type)

※6 Breakdown of mechanical recycling (1,850 thousand tons)

● Breakdown of mechanical recycling resources

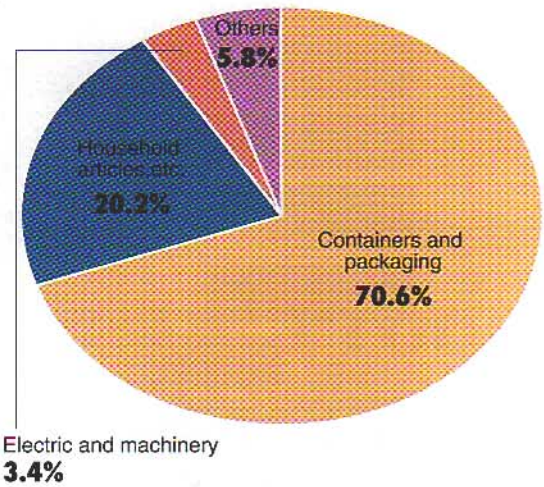


(by discharge type)

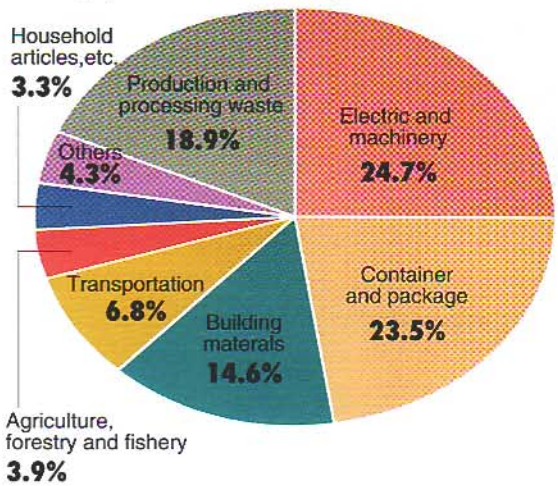


(by resin type)

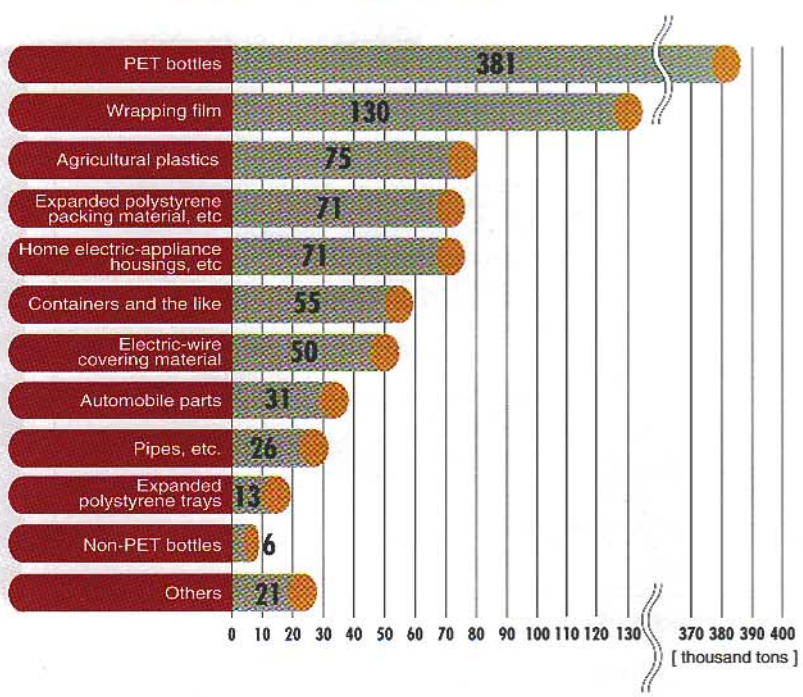
※4 Breakdown of domestic waste by field (5,200 thousand tons)

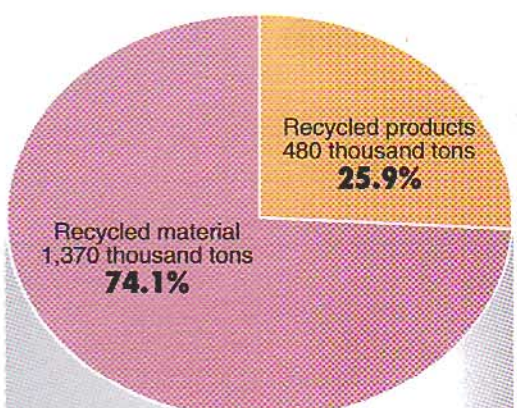


※5 Breakdown of industrial waste by field (4,860 thousand tons)

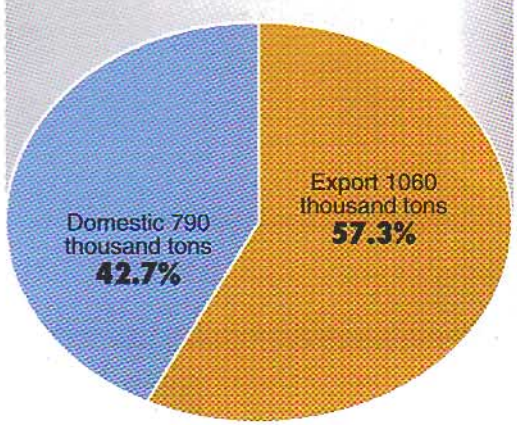


○ Breakdown of post-use products for mechanical recycling (930 thousand tons)





(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
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
2005	14,510	11,590	10,060	5,200	52	4,860	48

* 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
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
Utilization rate(%)	26	25	39	42	44	46	50	53	55	58	60	62

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

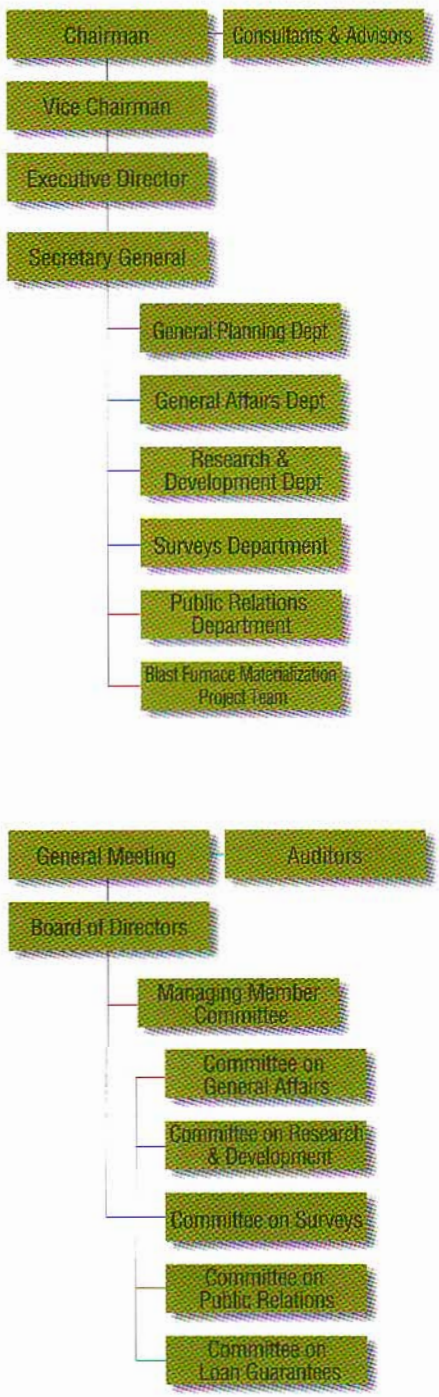
Supporting Members

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

Operations(1971-2005)

	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



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