PWMI Newsletter

NO 42 2013.4

Plastic Waste Management Institute
JAPAN

Plastic Products, Plastic Waste and Resource Recovery [2011]

Background information and notes on the publication of the Flowchart of Plastic Products, Plastic Waste and Resource Recovery (2011)

It is estimated that the Great East Japan Earthquake of March 11, 2011 generated a total of 18,020 kt of disaster-related waste (debris) in Iwate, Miyagi, and Fukushima prefectures (source: Reconstruction Agency, Current Status and Path Toward Reconstruction, September 14, 2012). The amount of plastic in this debris has been roughly estimated to be about 1,000 kt based on the composition of that debris described in a Ministry of the Environment (MOE) report titled "Promotion of Wide-area Processing of Disaster-related Waste" (January 11, 2012, etc.). Furthermore, disaster-related waste outside these three prefectures and that deposited by the subsequent tsunami has been estimated to be about 3,000 kt and 5,000 kt, respectively, so if these figures are included, the total amount of plastic discharged in the wake of the earthquake can be estimated to be in the range of 1,000 – 1,500 kt.

The flow of plastic material presented here by Plastic Waste Management Institute (PWMI) uses the estimation scheme shown on pages 8 – 9. This scheme is not oriented to estimating plastic waste generated by disasters, and as a result, the amounts and types of plastic waste generated by the Great East Japan Earthquake are not taken into account in the Flowchart of Plastic Products, Plastic Waste and Resource Recovery (2011) published here.

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

2011 Highlights

(1) This year, resin production decreased by 1,110 kt (-8.7%) relative to 2010. At the same time, the export of resin or resin products decreased while their import increased relative to 2010. These trends are thought to be due to the effects of the Great East Japan Earthquake, the strong yen, and other factors. As a result, domestic plastic products consumption increased by 160 kt (+1.7%).

(2) Total plastic waste discharge increased slightly by 70 kt to 9,520 kt (+0.7%) over 2010.

(3) The amount and percentage of mechanical recycling decreased somewhat as Japan's eco-point system and eco-car subsidy program came to an end (end of December 2010 and end of September 2010, respectively), but since the amount and percentage of incineration with power generation increased, the effective plastic utilization rate increased by one point over 2010 to 78%.

Resin production in 2011 suffered a large drop to 11,590 kt (-1,110 kt relative to 2010; -8.7%), and resin export and product export both decreased to 3,910 kt (-540 kt; -12.1%) and 870 kt (-70 kt; -7.3%), respectively. Resin import and product import, meanwhile, increased to 2,270 kt (+280 kt; +13.7%) and 1,850 kt (+150 kt; +8.9%), respectively. As a result, domestic plastic products consumption increased slightly to 9,870 kt (+160 kt; +1.7%).

Total plastic waste discharge showed a slight increase to 9,520 kt (+70 kt; +0.7%). The reason for this is that domestic plastic products consumption increased by a small amount despite the decrease in resin production relative to 2010.

The breakdown for the destinations of plastic waste in 2010 was 4,650 kt (+70 kt; +1.4%) for domestic (general) plastic waste and 4,860 kt (±0 kt; 0.1%) for industrial plastic waste.

With regards to methods of disposal and recovery, the portion of total plastic waste discharge (which increased by 70 kt from 9,450 kt to 9,520 kt) applied to mechanical recycling and feedstock recycling*1 decreased to 2,120 kt (-50 kt; -2.0%) and 370 kt (-50 kt; -12.5%), respectively. Within the energy recovery*2 category, incineration with power generation increased to 3,260 kt (+240 kt; +7.8%) pushing up total energy recovery to 4,960 kt (+310 kt; +6.6%).

The percentage contributions to the effective utilization rate of plastic waste by mechanical recycling, feedstock recycling, and energy recovery were 22%, 4%, and 52%, respectively, each of which either increased or decreased relative to 2010. Overall, however, the effective utilization rate of plastic waste went up one point to 78%.

Exports of plastic waste for mechanical recycling were about the same as 2010 at 1,630 kt (-10 kt; -0.1%).

*1 feedstock recycling = blast/coke furnaces + gasification + liquefaction
*2 energy recovery = densified-refuse derived fuel + incineration with power generation + incineration with heat utilization facility

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.

1-4 Domestic plastic input

・(domestic plastic input) = (domestic plastic products consumption) – {(exported plastic parts from assembled products) – (imported plastic parts from assembled products)}

・Assembled products: automobiles, home appliances (televisions, refrigerators, freezers, air conditioners, washing machines and dryers)

・Number of exported/imported assembled products: Automobile figures are based on Monthly Motor Vehicle Statistics of Japan from Japan Automobile Manufacturers Association (JAMA); home appliance figures are based on "Current Production Statistics" from Ministry of Economy, Trade and Industry (METI).

(2) Discharge

2-1 Post-use products discharge

・This figure is determind 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 from 1976) and on product lifetimes by demand-generating fields (using a PWMI discharge model for the last 60 years)

・Since the export of used automobiles affects the amount of plastic waste in Japan, corrections are made to plastic waste discharge in the transport industry. Here, the number of used automobiles is based on "number of post-use automobiles" issued by JAMA and the number of exported used automobiles is based on data released by Japan Automobile Dealers Association (JADA).

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

2-2 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 re-sults of questionnaires.

2-3 Total plastic waste discharge

・(total plastic waste discharge) = (post-use products discharge) + (resin production waste) + (resin processing waste)

2-4 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

・Figures for the mechanical recycling of domestic plastic waste are based on the volume of collected PET bottles (The Council for PET Bottle Recycling) and volume of collected white trays (Japan Plastic Food Container Industry Association), and figures for the mechanical recycling of other plastic containers and packaging are based on data released by The Japan Containers And Packaging Recycling Association. From this year on, residual amounts after the mechanical recycling of other plastic containers and packaging will be allocated to densified-refuse derived fuel and other items using figures released by The Japan Containers and Packaging Recycling Association as coefficients. (In previous years, residual amounts were all allocated to landfilling.)

・Total figures and breakdowns for the mechanical recycling of industrial waste are extrapolated from the results of questionnaires sent to recycling companies.

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 question-naires.

・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 proce-ssing 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 .

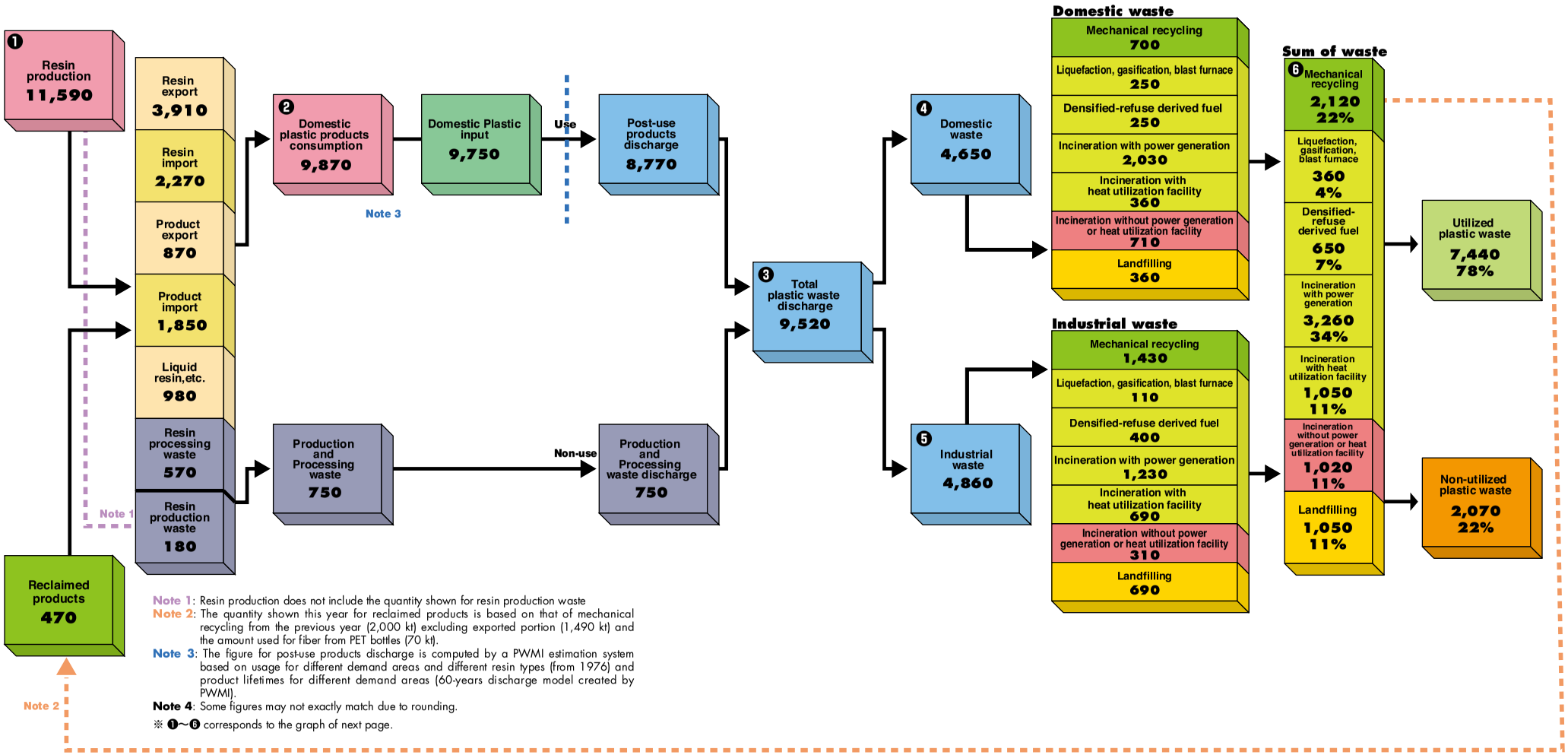
3-4 Disposal and recovery of industrial waste

・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 2006/2008.

Flowchart of plastic products, plastic waste and resource recovery 2011

[Unit; kt （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 (2,000 kt) excluding exported portion (1,490 kt) and the amount used for fiber from PET bottles (70 kt).

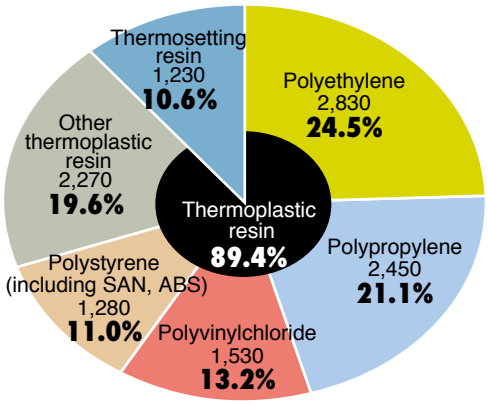
Note 3: The figure for post-use products discharge is computed by a PWMI estimation system based on usage for different demand areas and different resin types (from 1976) and product lifetimes for different demand areas (60-years discharge model created by PWMI).

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

※ ❶~❻ corresponds to the graph of next page.

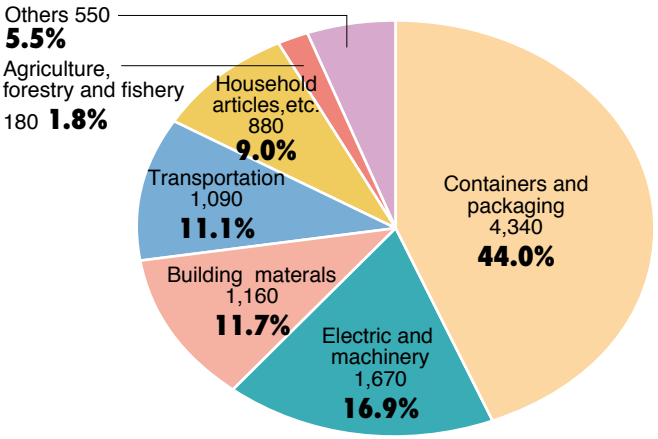
Details of flowchart elements

❶ Breakdown of resin production (11,590kt) by resin type



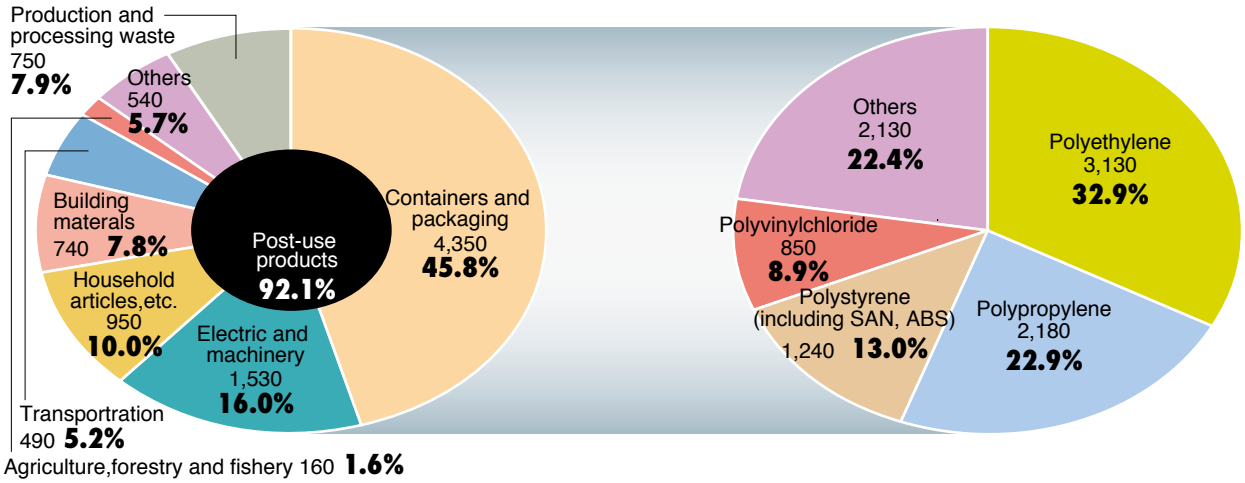
(Source: METI chemical-industry statistics)

❷ Breakdown of resin products by field (9,870kt)



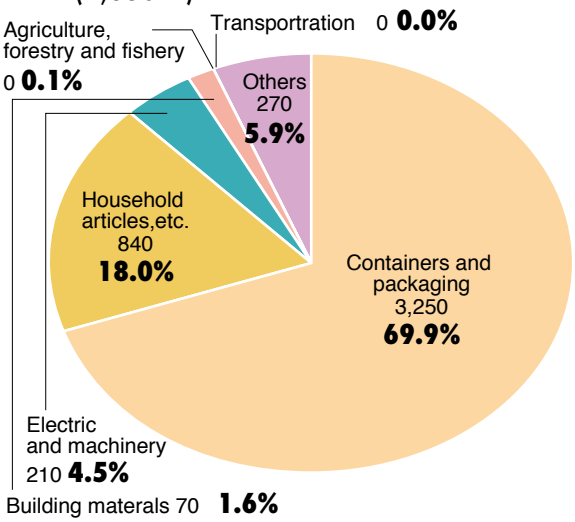
(Source: estimates from related organizations)

❸ Breakdown of total plastic waste (9,520 kt) (by field)



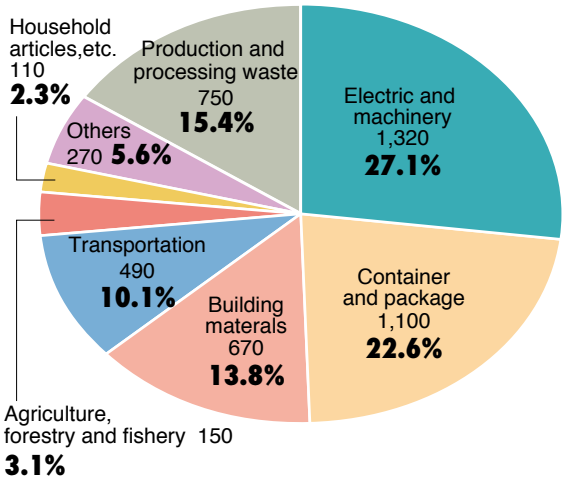
(by field) **(by discharge type)**

❹ Breakdown of domestic waste by field (4,650 kt)



(by resin type)

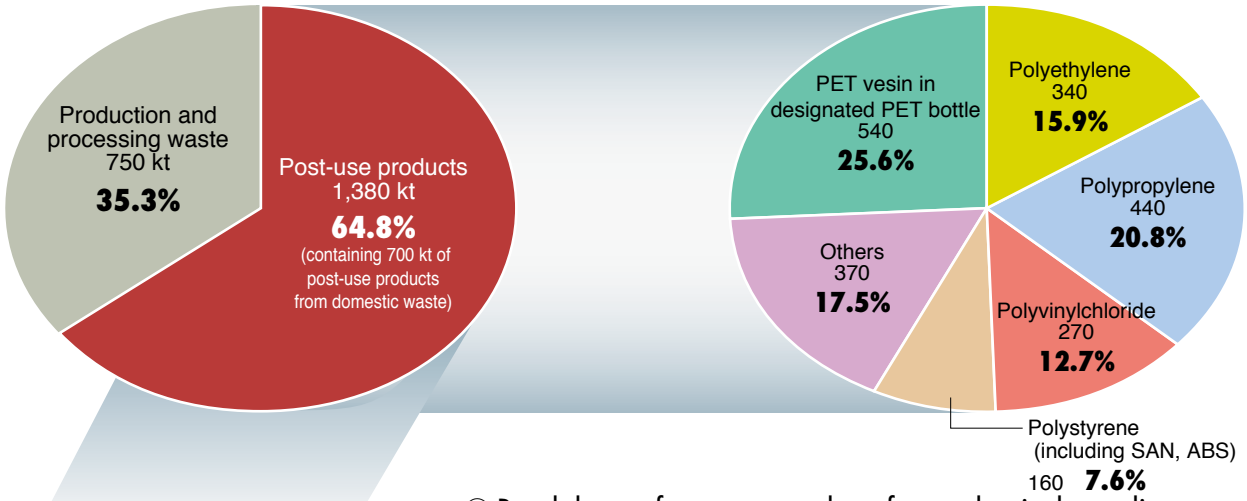
❺ Breakdown of industrial waste by field (4,860 kt)



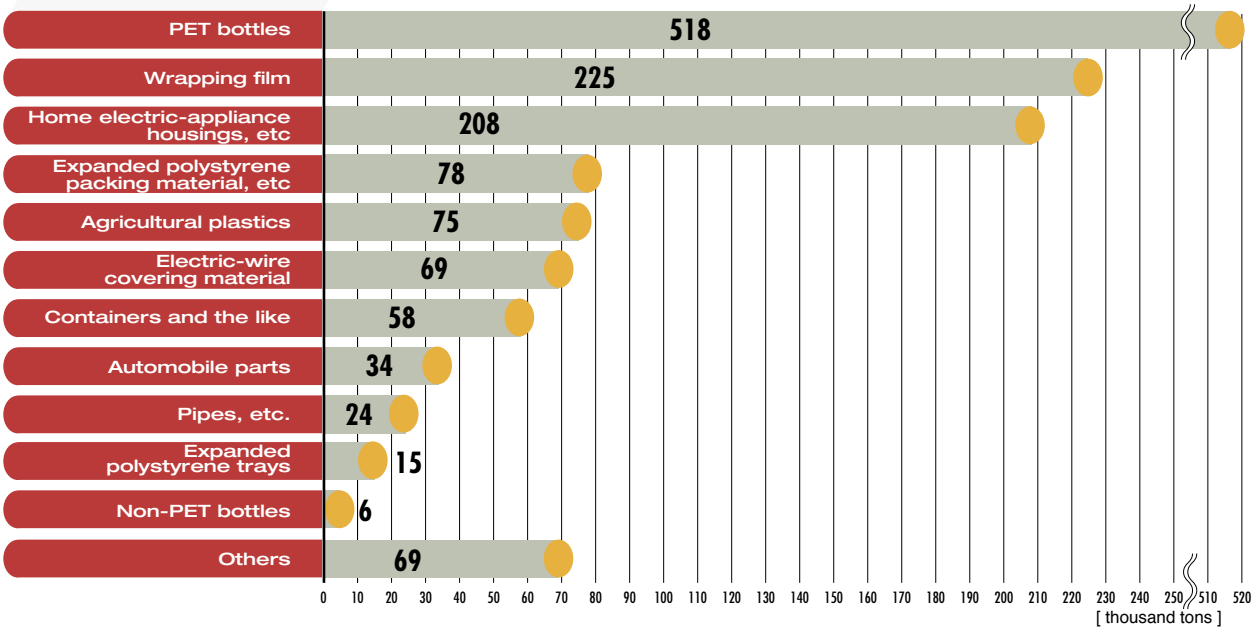
(by resin type)

❻ Breakdown of mechanical recycling (2,120 kt)

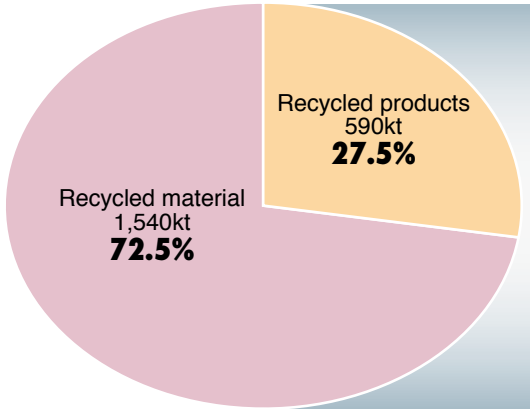
○ Breakdown of mechanical recycling resources



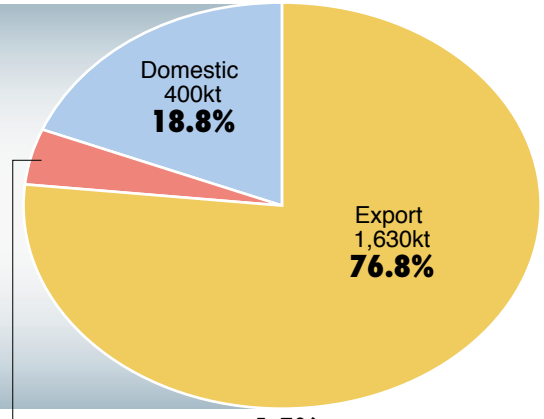
○ Breakdown of post-use products for mechanical recycling (1,380 kt)



(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	
	kt/year	kt/year	kt/year	kt/year	%	kt/year	%
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
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
2008	13,450	10,890	9,980	5,020	50	4,960	50
2009	11,210	8,430	9,120	4,440	49	4,680	51
2010	12,700	9,700	9,450	4,590	49	4,860	51
2011	11,590	9,870	9,520	4,650	49	4,860	51

Change in Utilized Plastic Waste by Amount and Rate Over Time

Year	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011
Total Plastic waste discharge (kt)	9,970	10,160	9,900	10,010	10,130	10,060	10,050	9,940	9,980	9,120	9,450	9,520
Utilization amount (kt)	4,610	5,130	5,160	5,410	5,750	5,820	6,880	6,920	7,330	6,890	7,230	7,440
Utilization rate(%)	46	50	52	54	57	58	69	69	73	75	77	78

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

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.

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 (1971-2011)." 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, 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 17 corporations, 3 organizations and 4 supporting members (as of May 2013).

● Regular members

Asahikasei Chemicals Corporation.
DuPont-Mitsui Polychemicals Co., Ltd
Japan Polyethylene Corporation
Japan Polypropylene Corporation
JNC 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.

● Trade Organizations

Japan Petrochemical Industry Association
Japan Plastics Industry Federation
Vinyl Environmental Council

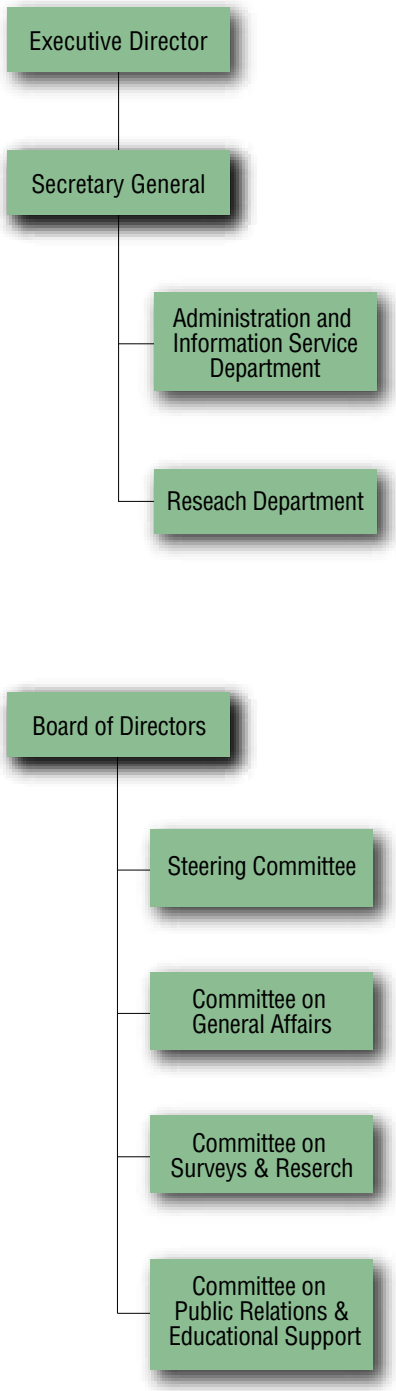
● Supporting Members

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

Operations(1971-2012)

	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, and Web sites. Prepare a Web site for recycling and environmental studies targeting elementary and junior high schools

Organization



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