PWMI Newsletter

NO 48 2019.2

Plastic Waste Management Institute
JAPAN

Plastic Products, Plastic Waste and Resource Recovery [2017]

Background information and notes on the publication of the Flowchart of Plastic Products, Plastic Waste and Resource Recovery (2017)

The following improvements and assessments were performed to improve the accuracy of the Flowchart of Plastic Products, Plastic Waste and Resource Recovery.

(1) Revision of the incineration/landfilling ratio of domestic (general) plastic waste

At PWMI, we have been calculating the incineration/landfilling ratio of domestic waste and using it in the preparation of the Flowchart of Plastic Products, Plastic Waste and Resource Recovery. We have done this by determining the amount of plastic waste in domestic waste discharged from households (household garbage) and domestic waste discharged from offices (office garbage) based on the "Nation Survey on the State of Discharge and Treatment of Municipal Solid Waste" released annually by the Ministry of the Environment summarizing the results of surveys on the treatment of domestic waste. The amount of plastic in this garbage, for example, the amount of plastic in sorted combustible garbage, can be obtained by multiplying the amount of combustible garbage (= statistical data) by the ratio of plastic included within such garbage. Some municipalities have been measuring the ratio of plastic in each type of sorted garbage, so we have been using those publically released values to apply the ratio of plastic in each type of sorted garbage to each plastic-waste collection pattern (= method of garbage sorting) of each municipality thereby determining the amount of plastic in each type of sorted garbage. The statistical data of the Ministry of the Environment includes the collection pattern of each municipality, but a questionnaire submitted by the ministry to municipalities revealed some data that did not agree with actual conditions, so we went to the websites of all municipalities to directly check their collection patterns.

On the other hand, some "domestic waste" undergoes incineration by private facilities other than municipalities, but only the number of such facilities is included in "Waste Treatment in Japan" that sums up the results of the surveys mentioned above. In addition, data on the amount of treated waste is not publically released by individual facilities, so as a result, private figures on waste treatment have not been counted. This time, we conducted a separate survey and determined the amount of plastic incinerated by private facilities as far as we could tell and added in that amount.

Based on the above study, we were able to improve the accuracy of the incineration/landfilling ratio of domestic waste, but found that, in the end, the survey results did not have a major effect on this ratio.

(2) Revision of method for estimating domestic-waste densified-refuse derived fuel (RPF & RDF)

Some municipalities independently take on the treatment of recovered plastic waste as resource garbage for the manufacture of Refuse derived Paper and Plastics densified Fuel (RPF). In the past, we determined the amount of plastic waste used for this purpose by submitting a questionnaire to RPF manufacturers and using the results obtained. However, not all processors could be covered by this questionnaire and its return rate was not high, so the possibility exists that the amount of plastic waste used for RPF has been under-estimated by this method.

We therefore established a new method for calculating the amount of plastic waste used for RPF. This new estimation method uses the average plastic content in RPF obtained from RPF production figures released by the Japan RPF Association and the results of the questionnaire-based survey as well as the ratio of plastic waste used for RPF originating from independent municipal processing.

With this new estimation method, we found that the amount of domestic-waste densified-refuse derived fuel increased by about 10%.

2017 Highlights

(1) Resin production in 2017 increased by 270 kt (+2.5%) from the previous year to 11,020 kt and domestic plastics products consumption likewise increased by 320 kt (+3.3%) to 10,120 kt.

(2) Total plastic waste discharge increased by 40 kt (+0.5%) from the previous year to 9,030 kt.

(3) Effectively used plastic waste increased by 160 kt (+2.2%) from the previous year to 7,750 kt while non-utilized plastic waste decreased by 120 kt (-8.7%). As a result, the effective plastic utilization rate improved by two points from the previous year to 86%.

Resin production for 2017 increased from the previous year to 11,020 kt (+270 kt relative to 2016; +2.5%). However, the fact that the amount of liquid resin, etc., which is not counted as resin in the PWMI flowchart, increased by about 160 kt had the effect of preventing a substantial increase in resin production. In addition, resin export, resin import, product export, and product import increased to 4,060 kt (+100 kt; +2.5%), 2920 kt (+260 kt; +9.7%), 830 kt (+60 kt; +7.2%), and 2,000 kt (+50 kt; +2.3%), respectively. This increase in resin import was much greater than the increase in resin export as a result of the two-year straight decrease in the domestic distribution of mechanical recycling products (reclaimed products) produced in the previous year. As a result, domestic plastics products consumption increased to 10,120 kt (+320 kt; +3.3%).

Total plastic waste discharge increased only slightly to 9,030 kt (+40 kt; +0.5%). We have been using a new product discharge model to calculate this value since the 2016 PWMI flowchart, but the effect of switching to this new model (differences in the coefficients used in the first year of applying the new model) still remain, so in 2017, this model change had a negative effect on the figure for total plastic waste discharge. We consider that this effect will gradually decrease over time.

This figure for total plastic waste discharge can be broken down into domestic plastic waste, which increased to 4,180 kt (+110 kt; +2.6%), and industrial waste, which decreased to 4,850 kt (-60 kt; -1.3%).

Turning to disposal and recovery methods, mechanical recycling increased to 2,110 kt (+50 kt; +2.5%), feedstock recycling*1 increased to 400 kt (+40 kt; +11.3%), and energy recovery*2 in total increased to 5,240 kt (+70 kt; +1.4%). The effective plastic utilization increased to 7,750 kt (+160 kt; +2.2%) from the previous year. The non-utilized plastic waste by incineration without power generation or heat utilization facility or by landfilling decreased to 1,280 kt (-120 kt; -8.7%).

The percentage contributions to the effective plastic utilization rate by mechanical recycling, feedstock recycling, and energy recovery were 23%, 4%, and 58%, respectively, resulting in a 2-point improvement from the previous year to 86%.

This increase in the effective plastic utilization rate is attributed to a large increase in energy recovery made up by an increase in the incineration rate of domestic waste, particularly an increase in the incineration with power generation rate, and an increase in the use of densified-refuse derived fuel and cement material/fuel in industrial waste.

The export of plastic waste that makes up a large percentage of mechanical recycling (= reclaimed products) continued to decrease falling to 1,290 kt (-90 kt; -6.2%).

*1:feedstock recycling = blast/coke furnaces + gasification + liquefaction

*2:energy recovery = densified-refuse derived fuel and cement material/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 estimated on the basis of chemical-industry statistics from the Ministry of Economy, Trade and Industry (METI). Note that (synthetic) resin does not include synthetic rubber or synthetic fiber.

1-2 Reclaimed products

・For convenience sake, this figure was estimated assuming that the previous year's recycled products (domestically used portion) are used in the current year while taking figures for export and import of plastic waste into account.

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/import figures are based on trade statistics from the Ministry of Finance.

・Figures for liquid resin, etc. such as additives and paints that fall outside the scope of plastic waste at the time of discharge are based on chemical-industry statistics from METI.

・Figures for plastic product export and import are based on trade statistics from the Ministry of Finance.

・Resin processing waste refers to 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 were determined from an automobile database (Japan Automobile Manufacturers Association (JAMA)); home appliance figures were based on "Current Production Statistics" from METI.

(2) Discharge

2-1 Post-use products discharge

- This figure is calculated by a PWMI estimation system based on domestic plastic input by demand-generating fields and by resin type (usage quantities have been calculated annually from 1976) and on a new product discharge model by demand-generating fields ("100-year discharge model" formulated by PWMI in 2017).
- Since the export of used automobiles affects post-use products discharge in Japan, corrections were made to plastic waste discharge in the transport industry. Here, the number of exported used automobiles is based on data released by Japan Automobile Dealers Association.
- Discharge ratios for domestic waste and industrial waste were estimated using a new product discharge model by demand-generating fields (formulated by PWMI in 2017).

2-2 Production and processing waste discharge

- Amount of resin production waste (resin discharged as waste in the resin-production stage) is not included in the amount of resin production. The amount of resin production waste and amount of resin processing waste were each estimated using a prescribed waste ratio.

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 of post-use products discharge, production and processing waste discharge, resin production, etc.

(3) Disposal and recovery

3-1 Mechanical recycling

- Figures for the mechanical recycling of domestic plastic waste are based on the weight of collected PET bottles (The Council for PET Bottle Recycling) and weight 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. Residual amounts after the mechanical recycling of other plastic containers and packaging were allocated to densified-refuse derived fuel using figures released by The Japan Containers And Packaging Recycling Association as coefficients.
- Figures for the mechanical recycling of industrial plastic waste were determined by deducting the amount of mechanical recycling of domestic plastic waste from the total amount of mechanical recycling using statistics from industry associations and the results of questionnaires sent to recycling companies. All production waste and processing waste are assumed to be mechanically recycled.
- "Recycled material" indicates pellets, flakes, fluff, blocks, and ingots, while "recycled products" refer to film sheets, stakes, pipes, etc. other than the above.
- The export figure for recycled material and recycled products (export figure for plastic waste) was calculated after correcting for the "scrap plastic" export figure based on trade statistics from the Ministry of Finance. The import figure for recycled material and recycled products is small enough to be ignored.

3-2 Densified-refuse derived fuel and cement material/fuel, blast/coke furnaces, gasification, and liquefaction

- Figures for densified-refuse derived fuel includes plastic waste for power generation; figures for densified-refuse derived fuel and cement material/fuel are based on the results of surveys covering respective industry associations.
- Figures for blast furnace raw materials, coke-oven chemical materials, gasification, and liquefaction approved as product recycling methods by the Containers and Packaging Recycling Law are based on data released by The Japan Containers And Packaging Recycling Association. Associated figures for industrial waste were based mainly on the results of questionnaires.

3-3 Incineration/landfilling of domestic waste

- Incineration/landfilling ratio
  This figure was estimated using the results of PWMI surveys based on figures in the "FY2016 Nation Survey on the State of Discharge and Treatment of Municipal Solid Waste" released by the Ministry of the Environment.
- Incineration with power generation, incineration with heat utilization, and simple incineration of domestic waste
  "Incineration with power generation" means incineration processing by an incinerator equipped with power-generation facilities, "incineration with heat utilization" means incineration processing by an incinerator that, while not equipped with power-generation facilities, has facilities for utilizing heat externally, and simple incineration means incineration processing by an incinerator other than that above. The ratios shown were estimated using the results of PWMI surveys based on values released by the Ministry of the Environment.

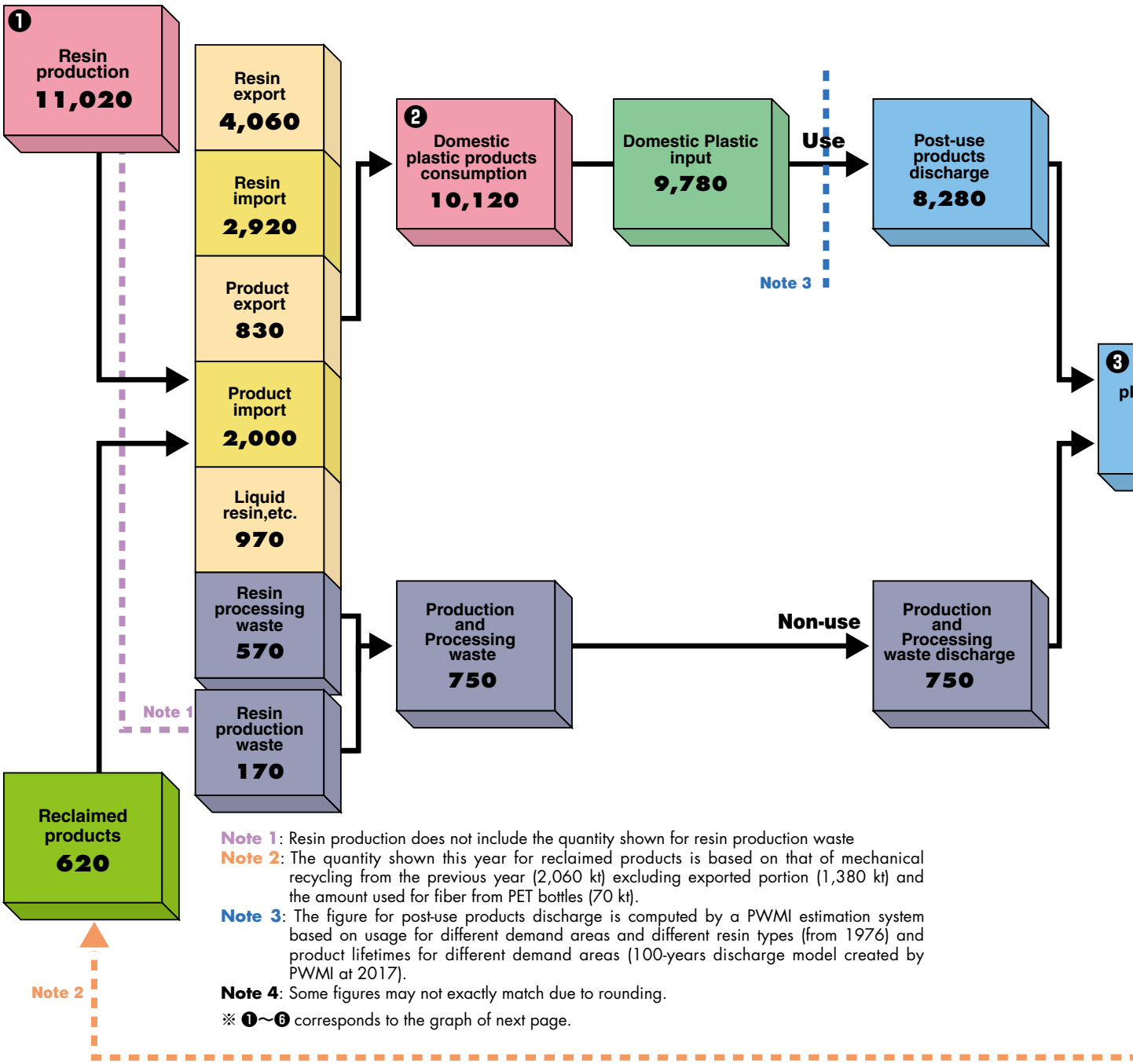
3-4 Incineration/landfilling of industrial waste

- Incineration and landfilling of industrial waste is partially commissioned to local governments as business-related waste. The ratio of such processing by business operators to that commissioned to local governments was determined on the basis of PWMI surveys. The percentage breakdown of commissioned processing into incineration with power generation, incineration with heat utilization facility, simple incineration, and landfilling was based on figures for domestic waste processing.
- The incineration/landfilling ratio in the processing of industrial waste was based on the latest survey conducted by PWMI in fiscal year 2013. In addition, the percentage breakdown of incineration processing into incineration with power generation, incineration with heat utilization facility, and simple incineration were based on the results of previous surveys conducted by PWMI in fiscal years 2006 and 2008.
- Figures for incineration with power generation includes plastic waste traded for a price.

Flowchart of plastic products, plastic waste and resource recovery 2017

[Unit; kt （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

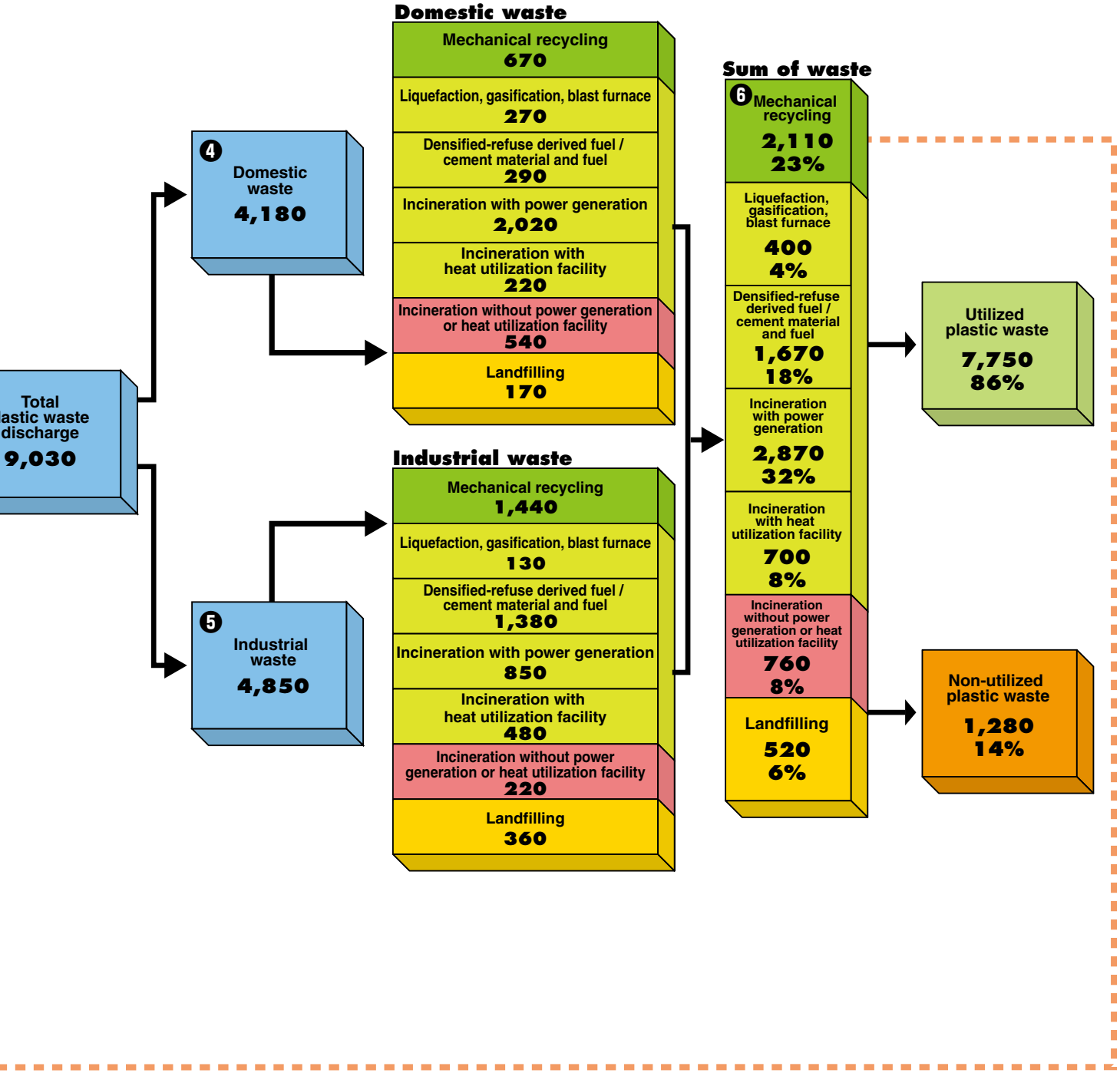
Note 2: The quantity shown this year for reclaimed products is based on that of mechanical recycling from the previous year (2,060 kt) excluding exported portion (1,380 kt) and the amount used for fiber from PET bottles (70 kt).

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 (100-years discharge model created by PWMI at 2017).

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

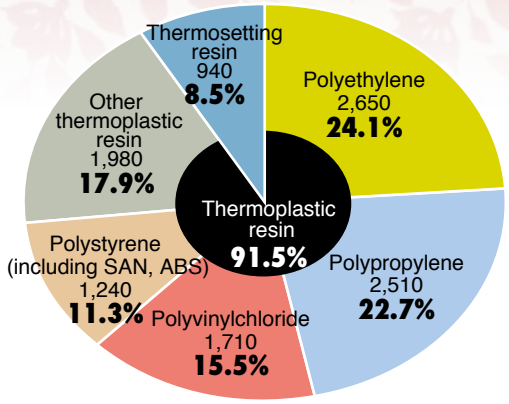
※ ❶~❻ corresponds to the graph of next page.

Disposal and recovery

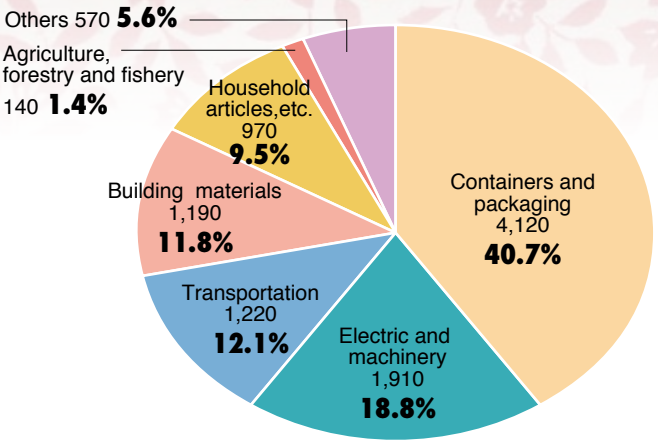


Details of flowchart elements (unit : kt (thousand tons))

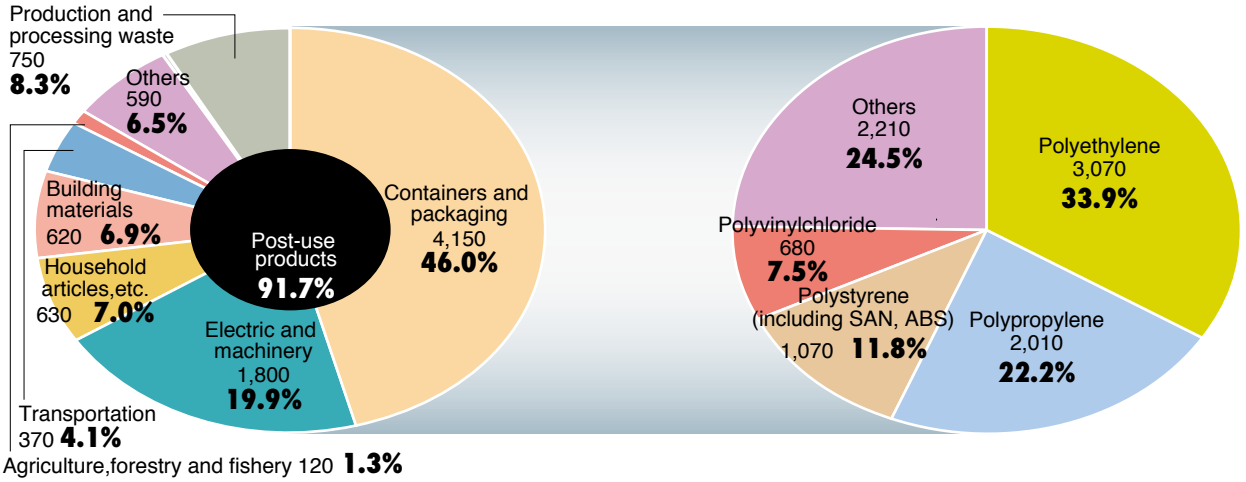
❶ Breakdown of resin production (11,020kt) by resin type



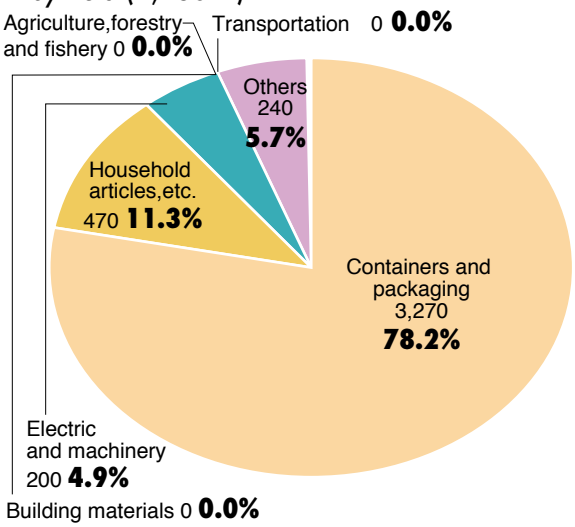
❷ Breakdown of resin products by field (10,120kt)



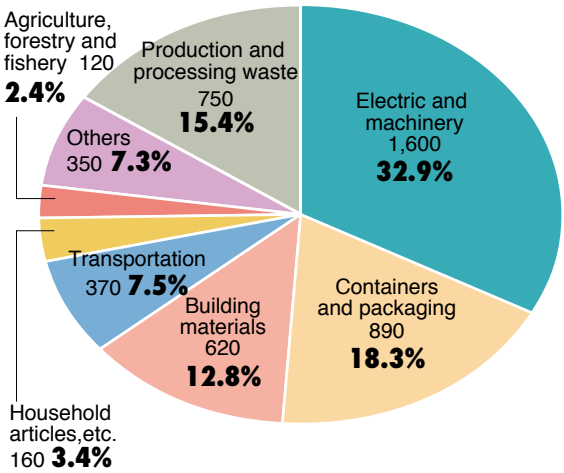
❸ Breakdown of total plastic waste by field and resin type (9,030 kt)



❹ Breakdown of domestic(general) waste by field (4,180 kt)

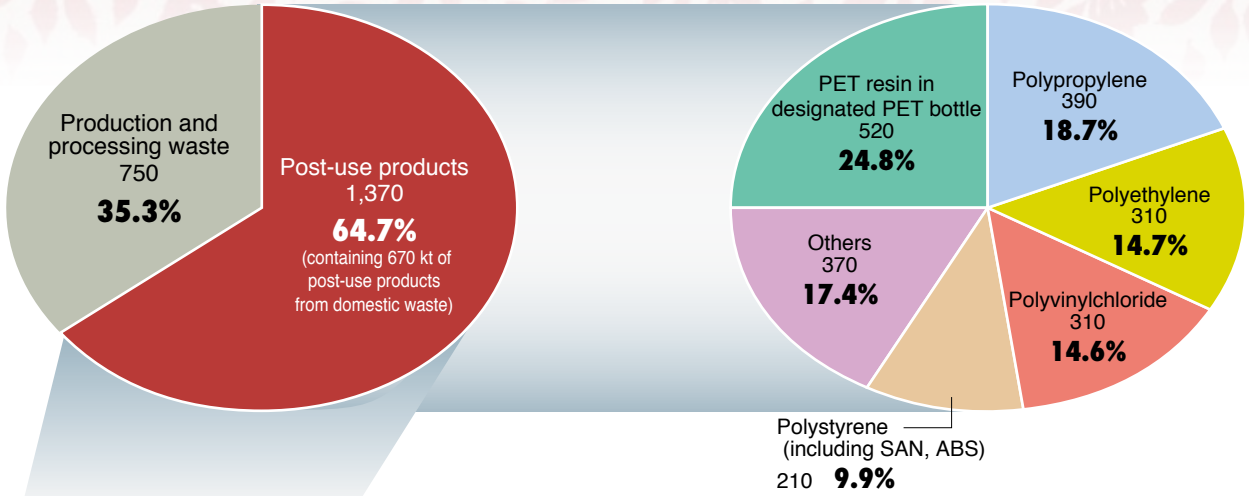


❺ Breakdown of industrial waste by field (4,850 kt)

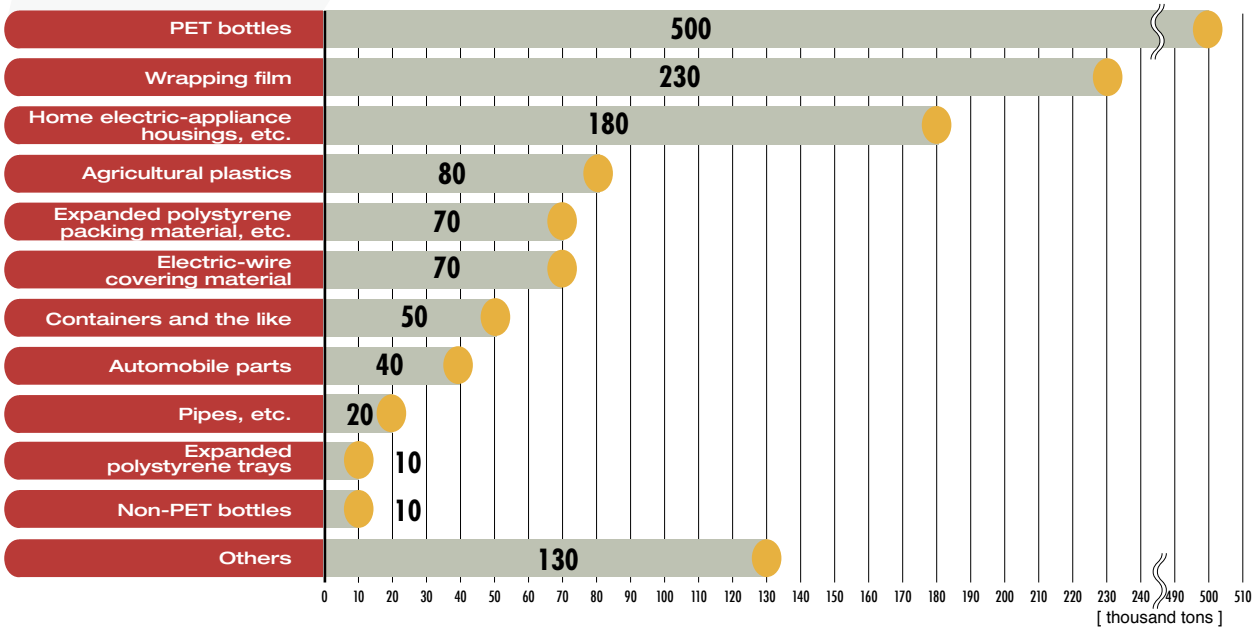


❻ Breakdown of mechanical recycling (2,110 kt)

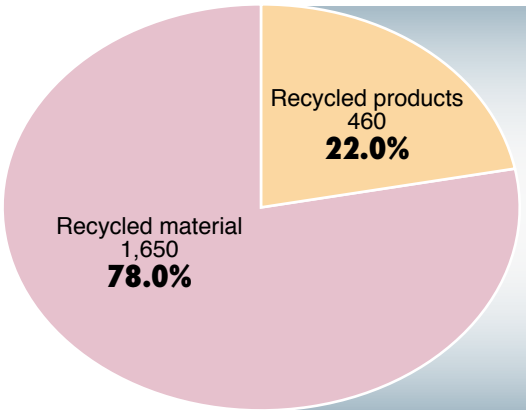
○ Breakdown of mechanical recycling resources and resin type



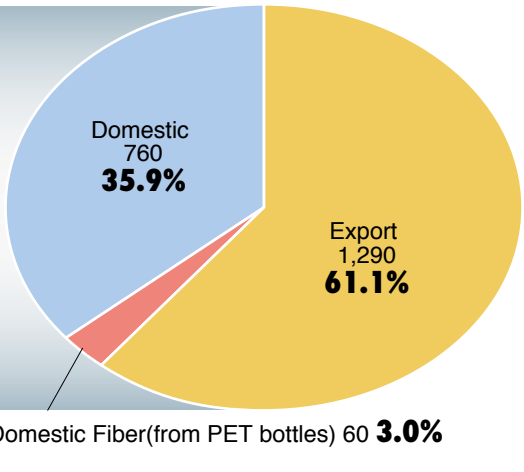
○ Breakdown of post-use products for mechanical recycling (1,370 kt)



(by type of reclaimed products)



(by destination of recycling use)

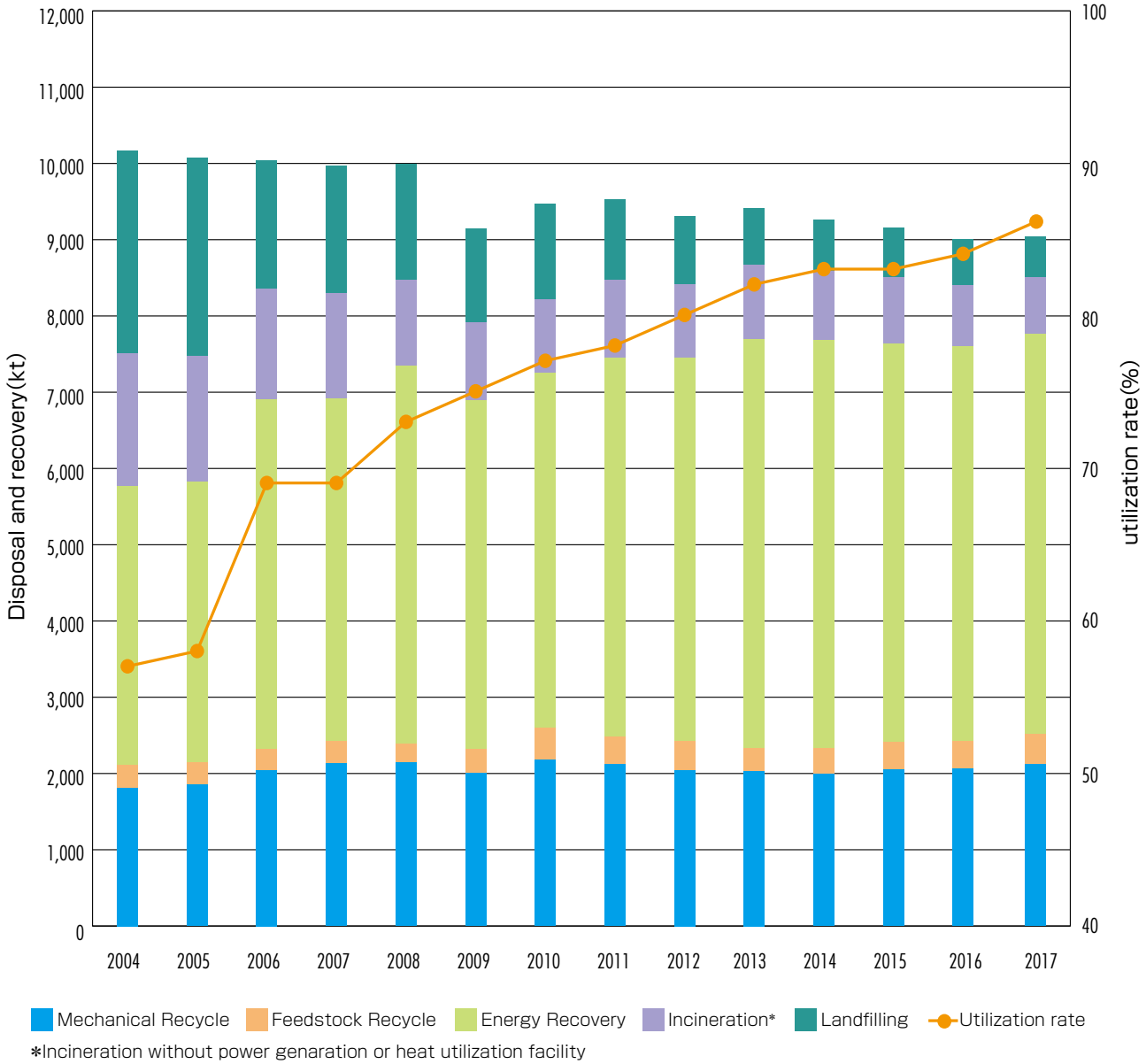


Plastics production and waste discharge

Year	Resin production	Domestic plastic products consumption	Total plastic waste discharge	Domestic waste		Industrial waste	
	kt	kt	kt	kt	%	kt	%
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	50
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
2012	10,540	9,600	9,290	4,460	48	4,820	52
2013	10,600	9,660	9,400	4,540	48	4,860	52
2014	10,610	9,770	9,260	4,420	48	4,830	52
2015	10,860	9,640	9,150	4,350	48	4,800	52
2016	10,750	9,800	8,990	4,070	45	4,920	55
2017	11,020	10,120	9,030	4,180	46	4,850	54

Change in Utilized Plastic Waste by Amount and Rate Over Time

Year	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017
Total Plastic waste discharge (kt)	10,130	10,060	10,050	9,940	9,980	9,120	9,450	9,520	9,290	9,400	9,260	9,150	8,990	9,030
Utilization amount (kt)	5,750	5,820	6,880	6,920	7,330	6,890	7,230	7,440	7,440	7,670	7,680	7,630	7,590	7,750
Utilization rate(%)	57	58	69	69	73	75	77	78	80	82	83	83	84	86



*Incineration without power genaration or heat utilization facility

Business Overview

History

Originally founded in December 1971 as the Plastic Management Research Association, the Plastic Waste Management Institute (PWMI) received its current name in July of the following year as operations expanded. For the last 40 years or so, PWMI has endeavored to research and develop technology for the optimal processing and effective use of plastic waste and to publicize its findings. In addition, PWMI has changed into a general incorporated association as a result of Laws Related to the Reform of the Public-Interest Corporations System (enacted in December 2008). As a result of this change, PWMI's objectives were newly established in April 2013 as "surveying and researching the recycling of plastic waste and contributing to a reduction in environmental load by the total recycling of plastic, and helping plastic-related industries to expand their business soundly and contributing to the creation of a society capable of sustainable growth."

Business Content

(1)Survey and research the generation, recycling, and disposal of plastic waste and promote the appropriate use of plastic waste through various means including techniques for evaluating environmental load
(2)Support the education and study of the recycling of plastic and plastic waste and engage in related public relations activities
(3)Interface and collaborate with domestic and foreign institutions in the plastic and plastic-waste industries

Activities

The three core activities of PWMI are summarized below.
(1) Provision of life cycle assessment (LCA) base data and LCA evaluation of recycling & recovery (R&R) technologies

PWMI provides scientific and high-reliability data for widespread use by related industries and general citizens for application to carbon footprint systems, etc. It also works to solve technical issues so that the effective use of plastic waste can be evaluated by LCA.
(2) Preparation of the Flowchart of Plastic Products, Plastic Waste and Resource Recovery and ongoing improvements to its accuracy

PWMI strives to obtain a clear understanding of the entire lifecycle of plastic from its production stage to its disposal and R&R and to prepare and provide a highly accurate flowchart of this process.
(3) Support of environmental education

PWMI continues to hold instructor training courses and on-site classes and works to raise the level of consciousness in society regarding the usefulness of plastic. In addition to holding on-site classes on plastic R&R at primary and middle schools especially in Japan's Kanto region, PWMI will honor as much as possible requests for instructor training courses in line with new teaching guidelines and for lectures at universities specializing in environmental science.

Members (as of January 2019)

Regular members: 17 corporations and 3 organizations
Supporting members: 3 organizations

Regular members

Asahi Kasei Corp.
DuPont-Mitsui Polychemicals Co. Ltd.
Japan Polyethylene Corporation
Japan Polypropylene Corporation
JNC Corporation
Kaneka Corporation
Maruzen Petrochemical Co., Ltd.
NUC Corporation
Prime Polymer Co., Ltd.
Shin Dai-Ichi Vinyl Corporation
Shin-Etsu Chemical Co., Ltd.
Sumitomo Chemical Co., Ltd.
SunAllomer Ltd.
Taiyo Vinyl Corporation
Tokuyama Sekisui Co., Ltd.
Tosoh Corp.
Ube-Maruzen Polyethylene Co., Ltd.

(Trade organizations)

Japan Petrochemical Industry Association
The Japan Plastics Industry Federation
Vinyl Environmental Council

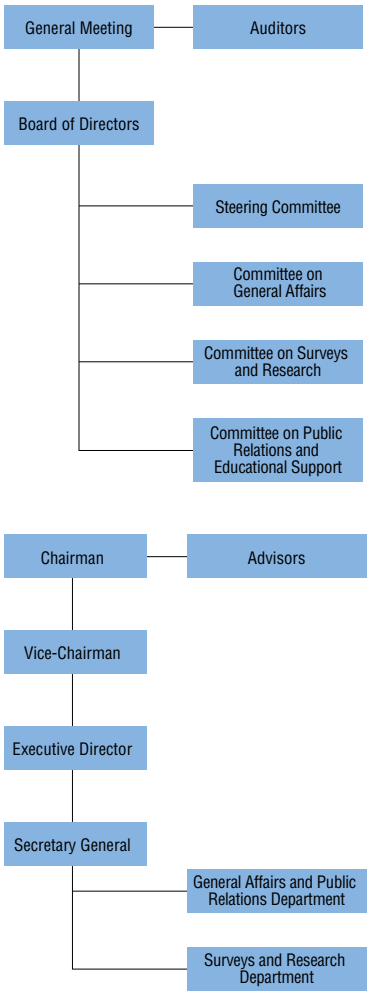
Supporting members

Japan PET Bottle Association
Japan Expanded Polystyrene Association
Japan PVC Environmental Affairs Council

Directors

Chairman: Kohei Morikawa
Vice-Chairman: Hiroshi Yokota
Executive Director: Hisao Ida
Directors: 10
Auditors: 2

Organization



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