Topic 1.　Waste Management Facts and Plans

Contents

1 Present Status of Waste Management in Japan

In Japan, various data pertaining to waste management are continuously collected in accordance with the law in an effort to develop an understanding of the circumstances of waste management throughout the country. This continuous accumulation and analysis of data enables a quantitative understanding of trends over time, and is used as basic data for formulating strategies and plans for waste management.

This section uses numerical data to introduce the state of waste management in Japan and presents information obtained from the basic data that can be verified using numerical values. The information presented demonstrates the importance of understanding the circumstances of waste management relying upon basic data and setting numerical targets in waste management plans.

1.1 Definition and Categorization of Waste

Waste is generated from many different sources; therefore, it is essential to have a clear definition of waste when considering anything related to waste management. In Japan the waste is classified into two broad categories by the law: municipal waste and industrial waste.

*This text discusses the municipal solid waste component of municipal waste.

The *Waste Management and Public Cleansing Law* (*Waste Management Act*) of Japan defines waste as follows.

Chapter I General Provisions
(Definitions)
Article 2

1 In this Law, “waste” refers to refuse, bulky refuse, ashes, sludge, excreta, waste oil, waste acid and alkali, carcasses and other filthy and unnecessary matter, which are in solid or liquid state (excluding radioactive waste and waste polluted by radioactivity).

2 In this Law, “municipal solid waste” refers to waste other than industrial waste.

3 In this Law, “specially controlled municipal solid waste” refers to those municipal solid waste specified by a Cabinet Order as wastes which are explosive, toxic, infectious or of a nature otherwise harmful to human health or the living environment.

4 In this Law, “industrial waste” refer to the waste categories defined below:

1) Ashes, sludge, waste oil, waste acid, waste alkali, waste plastics and others specified by a Cabinet Order among all the wastes remaining as a result of business activity.
2) Imported waste (excluding the kinds of waste defined in the preceding Item, those wastes attributable to navigation of a ship or aircraft (confined to the items specified by a Cabinet Order), which are defined as “navigational waste” in Paragraph1 of Article 15-4-2, and waste personally carried into Japan by persons entering the country (confined to the items specified by a Cabinet Order), which are defined as “carried-in waste” also in Paragraph 1 of Article 15-4-2).

5 In this Law, “specially controlled industrial waste” refer to those industrial wastes specified by a Cabinet Order as wastes which are explosive, toxic, infectious or of a nature otherwise harmful to human health and the living environment.

Source: “Waste Management and Public Cleansing Law” (Law No. 137 of 1970)

Accordingly, waste is unwanted matter in a solid or liquid state (excluding gases), and earth and sand are outside the scope of the *Waste Management Act*.

Figure 1-1 shows how waste is categorized in Japan, as well as the characteristics of the waste categorization.

- Wood scraps, metal scraps, and 20 other types of waste from among the waste generated in connection with business activities are defined as industrial waste (Table 1-1 shows categories and examples of waste items).
- Industrial waste that is potentially explosive, toxic, or infectious is defined as specially controlled industrial waste (Table 1-2 provides summaries of the categories).
- Waste, other than industrial waste is classified as municipal waste, which is further categorized into municipal waste, sewage, and specially controlled municipal waste (Table 1-3 provides summaries of the categories). Additionally, municipal waste is categorized into household waste and business waste generated by offices and the like.

(FY[1] 2019 figures: Municipal waste amount generated: 42.74 million tons/year, Industrial waste amount generated: 379.75 million tons/year)

It should be noted that in many countries, construction waste is categorized as municipal waste; however, in Japan, construction waste - generated during the demolition of private dwelling houses - is categorized as industrial waste.

Note that this text generally deals with municipal waste. Additionally, the term “waste” is used to mean municipal waste unless otherwise specified. However, the term may include industrial waste when policies, laws, hazardous waste, dioxin-related problems, and the like are discussed in the relevant text.

[1] In Japan, Fiscal Year (FY) starts from April and ends in March. For example, FY 2019 means from April 2019 to March 2020.

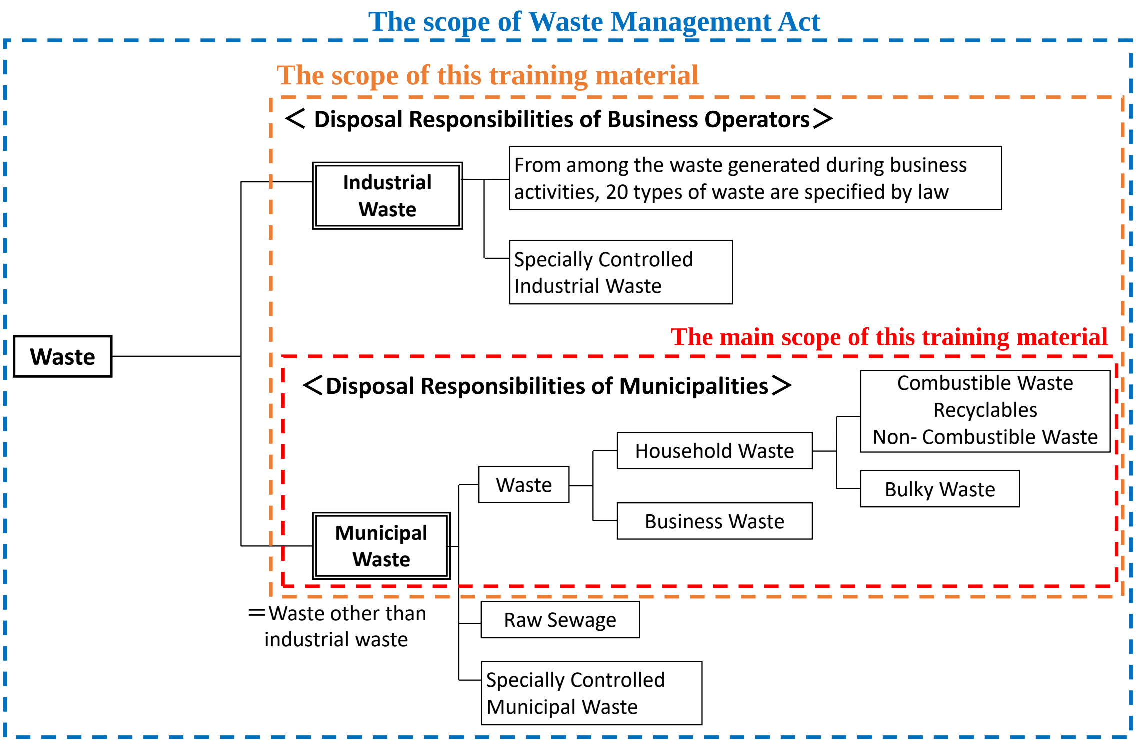


Figure 1-1 Categories of Waste in Japan

Table 1-1 Types of Industrial Waste and Examples of Waste Items

Category	Examples of Waste items
1. Cinders, Ashes	Coal dust, incinerator ash, particles from furnace cleaning, and other incineration residues
2. Sludge	Organic sludge: Paper sludge, sewage sludge, activated sludge, glue dregs, *urushi* lacquer dregs, etc. Inorganic sludge: Coagulated sedimentation sludge, plating sludge, bentonite mud, crushed stone sludge, etc.
3. Waste oil	Waste oils (e.g., lubricating oil, insulating oil, cleaning oil, cutting oil), waste solvents, tar pitch, and all other waste oil from mineral oils and animal and vegetable fats and oils
4. Waste acid	Waste sulfuric acid, waste hydrochloric acid, waste photo developing solution, and all other acidic waste liquids
5. Waste alkali	Waste metallic cleaning liquid, waste photo developing solution, and all other alkaline waste liquids
6. Waste plastics	All waste plastics from solid and liquid synthetic polymeric compounds (e.g., synthetic resin waste, synthetic fiber waste, synthetic rubber scraps)
7. Waste paper	Waste paper from the construction industry (generated by the construction, remodeling, or demolition of structures) and the paper manufacturing, pulp/paper products manufacturing, newspaper, publishing, bookbinding, and printed material processing industries
8. Wood scraps	Wood scraps from the construction industry (generated by the construction, remodeling, or demolition of structures), the lumber industry, wood products manufacturing, pulp, imported lumber wholesaling, and goods

Category	Examples of Waste items
	leasing industries, and wood scraps from pallets used for distributing goods
9. Waste fibers	Items containing waste natural fibers from the construction industry (generated by the construction, remodeling, or demolition of structures) and the textile industry (excluding the clothing/other textile product manufacturing industry)
10. Animal and vegetable residues	Animal and vegetable residues used as raw materials in the food products manufacturing, medicinal product manufacturing, and fragrance manufacturing industries
11. Solid animal waste	Solid unwanted materials generated in the process of slaughtering animals at slaughterhouses and poultry processing plants
12. Rubber scraps	Natural rubber scraps (synthetic rubber scraps are categorized as waste plastics)
13. Metal scraps	Scraps generated by grinding or cutting steel and nonferrous metals
14. Glass shards, concrete rubble (excluding that generated by the construction, remodeling, or demolition of structures), and ceramic waste	Glass, concrete rubble generated in the product manufacturing process, ceramic waste, waste plasterboard, etc.
15. Slag	Residue (slag) from blast furnaces, open-hearth furnaces, and the like, cupola slag, slag, bad ore, bad coal, coal dust, waste sand from castings, etc.
16. Rubble	Concrete fragments and similar unwanted materials generated by the construction, remodeling, or demolition of structures
17. Animal manure	Manure from cattle, horses, pigs, sheep, goats, and other livestock generated by livestock farming
18. Animal carcasses	Carcasses of cattle, horses, pigs, sheep, goats, and other livestock generated by livestock farming
19. Soot	Soot generated by, and collected in the dust collection systems of facilities that generate soot and smoke
20. Items treated for the disposal of the types of waste listed above	Items treated for the disposal of the types of industrial waste listed in 1-19, that do not fall under any of categories 1-19 (e.g., concrete-solidified sludge)

Source: Waste Disposal and Public Cleansing Act (Act No. 137 of 1970)
Enforcement Order of the Waste Disposal and Public Cleansing Act (Cabinet Order No. 300 of 1971)

Table 1-2 Summary of the Categories of Specially Controlled Industrial Waste

Classification	Main category		Summary
Specially controlled industrial waste	Waste oil		Gasoline, kerosene, diesel oil (excluding flame-resistant pitch and the like)
	Waste acid		Extremely corrosive waste acid of pH 2.0 or lower
	Waste alkali		Extremely corrosive waste alkali of pH 12.5 or higher
	Infectious industrial waste*1		Industrial waste generated by medical facilities and the like that may contain infectious pathogens or have infectious pathogens attached to them
	Specified hazardous industrial waste	Waste PCBs	Waste PCBs and waste oil containing PCBs
		PCB-contaminated materials	PCB-soaked sludge, PCB-coated or -soaked waste paper, PCB-soaked wood scraps or waste fibers, plastics or metal scraps that encapsulate PCBs or have PCBs attached, ceramic waste or rubble with PCBs attached
		PCB treatment materials	Items treated for the disposal of waste PCBs or PCB-contaminated materials, that contain PCBs*2
		Waste mercury and mercury compounds	(1) Waste mercury and mercury compounds generated at specified facilities*1 (2) Industrial waste containing mercury or mercury compounds, or waste mercury recovered from mercury-containing products that have become industrial waste
		Designated sewage sludge	Sludge designated under Article 13-4 of the *Enforcement Order of the Sewerage Act**2
		Slag	Items containing heavy metals in excess of certain concentrations*2
		Waste asbestos	Items associated with asbestos material removal work or items generated by workplaces with dust-generating facilities specified under the *Air Pollution Control Act*, susceptible to scattering
		Cinders	Items containing heavy metals or dioxins in excess of certain concentrations*2
		Soot	Items containing heavy metals, 1,4-Dioxane, or dioxins in excess of certain concentrations*2
		Waste oil	Items containing organochlorine compounds or 1,4-Dioxane*2
		Sludge, waste acid, or waste alkali	Items containing heavy metals, PCBs, organochlorine compounds, pesticides, 1,4-Dioxane, or dioxins in excess of certain concentrations*2

*1: Applies only to facilities from which they are discharged
*2: See the criteria set out in Enforcement Regulations of the Waste Management Act and the Ministerial Order for Criteria for Determining Industrial Waste Containing Metals (Ministerial Order for Determination Criteria)
*3: PCBs: Polychlorinated biphenyls
Source: Overview of Regulations for Specially Controlled Waste, Ministry of the Environment Website
http://www.env.go.jp/recycle/waste/sp_contr/ (accessed December 11, 2021)

Table 1-3 Summary of the Categories of Specially Controlled Municipal Waste

Classification	Main category	Summary
Specially controlled municipal waste	Parts containing PCB	Parts containing PCB in waste air conditioners, waste TVs, and waste microwave ovens
	Waste Mercury	Waste mercury recovered from products containing mercury that have become municipal waste
	Soot	Soot generated in the dust collection systems of waste treatment plants
	Soot, cinders, sludge	Items from waste incinerators - specified facilities under the *Act on Special Measures against Dioxins* - with dioxins content in excess of 3 ng/g
	Infectious municipal waste*	Municipal waste generated by medical facilities and the like that may contain infectious pathogens or have infectious pathogens attached to them

*: Applies only to facilities from which they are discharged

Source: Overview of Regulations for Specially Controlled Waste, Ministry of the Environment Website
http://www.env.go.jp/recycle/waste/sp_contr/ （accessed December 11, 2021）

Column: Background of Waste Classification in Japan

As explained previously, the *Waste Management Act* - Japan's basic law on waste management - sets out two classifications of waste: municipal waste and industrial waste. The classification is based on waste generated in connection with business activities and who is responsible for treatment, which is rather uncommon when compared with other countries. The following is the background behind this classification.

As people's lives became more affluent during Japan's period of high economic growth (1960s and 1970s), pollution became a serious problem due to factors such as increasing urban population density and the expansion of the heavy and chemical industries. At the time, the *Public Cleansing Act* (1954 - 1970) clearly stipulated that the government was responsible for waste management services, however the actual services provided mainly focused on the collection and disposal of waste discharged from households in urban areas. It was not clear who was responsible for waste associated with industrial activities; and therefore, a lot of waste was not properly collected or disposed of. Consequently, waste associated with industrial activity became an important factor caused various types of pollution of the environment.

Photo 1-1 Waste Vehicles Traffic at Landfill (Tokyo in the 1970s)
Source: Tokyo Metropolitan Government Bureau of Environment

Photo 1-2 Landfill (Tokyo in the 1970s)
Source: Tokyo Metropolitan Government Bureau of Environment

Under these circumstances, a committee comprising central government ministries, municipalities, and academics was established in 1967 to engage in discussions with the aim of modernizing waste management. The committee recognized that the increasing amount of waste and changes in the composition of waste associated with economic growth were major problems. The committee further identified the increase in plastics, bulky waste, and waste associated with industrial activities in the waste stream as major concerns for the future. In particular, waste associated with industrial activities was completely unregulated, despite clear indications that this waste category would continue to increase as the economy grew. The committee's reports highlighted the extreme importance of establishing systems and methods for treating and disposing of waste associated with industrial activities in pursuit of pollution prevention.

Based on reports from the committee and others, the Ministry of Health and Welfare (Ministry of Health, Labour and Welfare) made the following proposal: “Given the present state of waste, and based on the ‘polluter pays’ principle, we should establish standards for the treatment of waste associated with industrial activities as the responsibility of business operators, and consider waste generated in daily life as the responsibility of municipalities, expanding areas in which municipalities should treat the waste beyond urban areas.”

As a result, the *Waste Management Act* enacted in 1970 set out two categories of waste: municipal waste, which is waste generated by household and businesses activities, and industrial waste, which is waste generated by industrial activities.

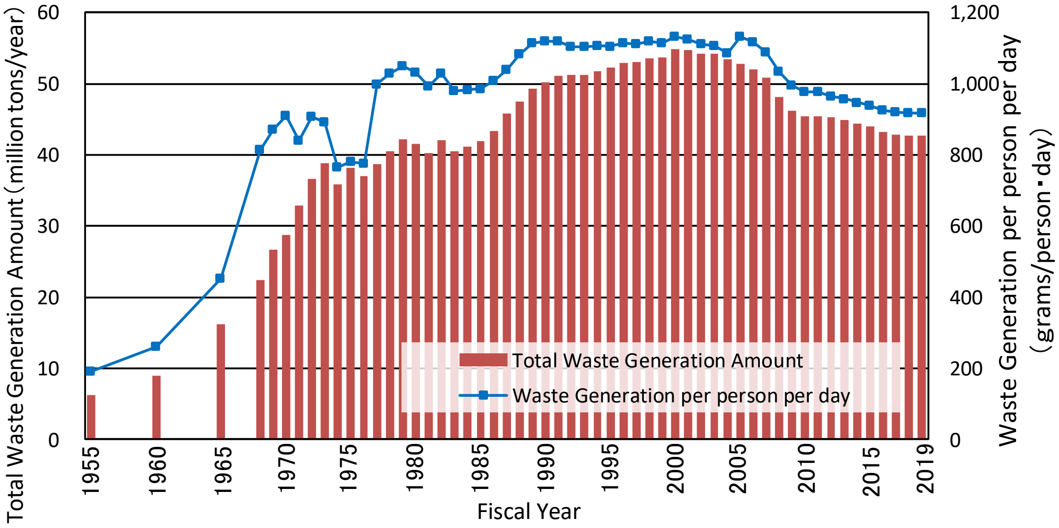
1.2 Waste Management Conditions

(1) Waste Generation Amount

Although the waste generation amount in Japan increased as the economy grew, it has begun to decline since the formation and promotion of a sound material-cycle society based on the 3Rs. The amount of waste generated is greatly affected by demographic changes, however social and economic factors also have an impact.

During Japan's period of high economic growth (1960s and 1970s), factors such as rising incomes and changes in consumer behavior drove the development of an economic structure based on mass production and mass consumption, causing both municipal and industrial waste to rapidly increase and diversify. Later, during the bubble era[2] (late 1980s and early 1990s), the amount of waste increased swiftly as consumption and production activities expanded further. However, the total amount of waste generated and the unit generation rate per person per day have trended downward since 2000, in part due to the efforts to develop a sound material-cycle society. Accordingly, the total amount of waste generated is also changing in response to social and economic changes. Figure 1-2 shows trends in the total amount of waste (municipal waste) generated in Japan and the amount generated per person per day.

[2]The bubble era refers to the economic boom in Japan, especially in the late 1980s and very early 1990s, when asset prices soared. The name is derived from the way asset prices expanded like a bubble and burst under certain circumstances.



*1: Disaster waste amounts generated by natural disasters such as earthquakes and floods are not included.
*2: Total Waste Generation Amount＝Planned Collection Amount＋Group Collection Amount + Direct Transported Waste Amount to Treatment Facilities (refer to the following Figure 1-3). However, from 1971 to 1984, Group Collection Amount was recorded as Domestic Self Disposal Amount, and there is no data for Domestic Self Disposal Amount before 1970.
*3: Waste Generation per person per day＝Total Annual Waste Generation Amount / (Total Population x Number of days in one year)
Source: Ministry of Health and Welfare (1972-1997) and Ministry of the Environment (1998-2019) "Waste Management in Japan" (1972-2019)
Ministry of the Environment "History and Current State of Waste Management in Japan" (2014)

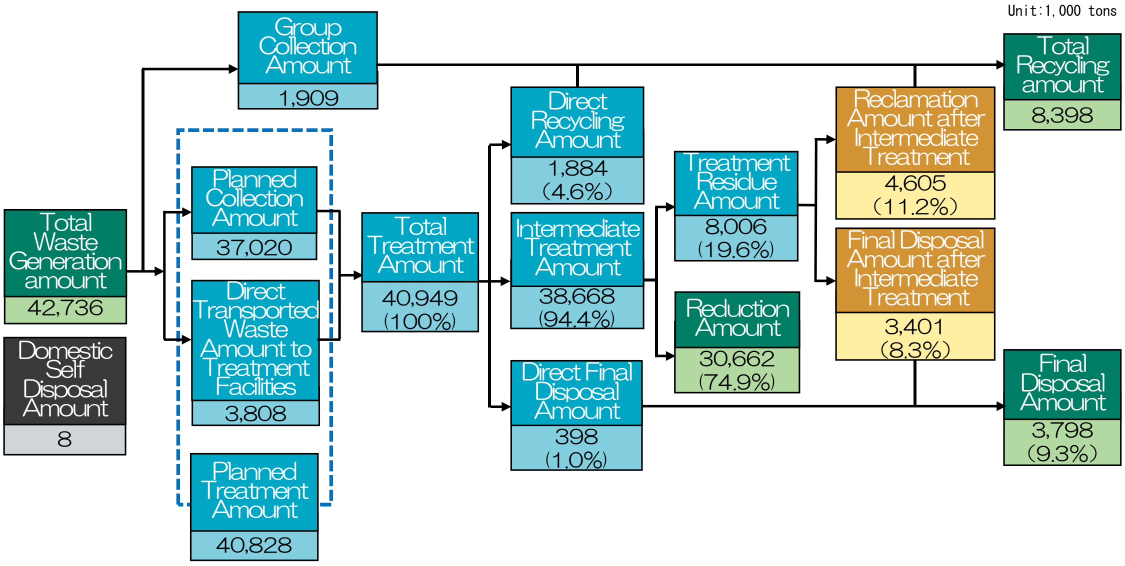
Figure 1-2 Waste Generation Amount and Waste Generation per Person per Day

(2) Waste Management Flow

The waste management flow clarifies how the waste is transferred from collection to the discharge to final disposal sites. Additionally, using numerical values to visualize the relationships between amounts of waste at the different flow stages of generation, treatment, recycling, and disposal can make it easier to identify issues, verify the effectiveness of measures and develop waste management plans.

The Ministry of the Environment and municipalities regularly prepare waste management flows that visualize the path waste travels from discharge to recycling and final disposal. This waste management flow makes it possible to develop an appropriate understanding of the relationships between amounts of waste at the different stages of treatment, recycling, and disposal, which is useful for understanding the status of waste and formulating plans.

Figure 1-3 shows the waste management flow in Japan in FY2019. According to the flow chart, all discharged waste is treated, except for the waste collected through Group Collection (recyclables collection activities organized by residents groups) which is recycled. Of all discharged waste that does not undergo intermediate treatment, 4.6% is directly recycled and 1.0% is sent directly to final disposal without intermediate treatment; 94.4% of discharged waste undergoes intermediate treatment. Overall, assuming the total processed waste amount is 100%, then the amount of waste reduced is 74.9%, the amount of waste recycled is 15.8%, and the amount of waste for final disposal is 9.3%.



*: Because of Planning errors, "Planned Treatment Amount" and "Total Treatment Amount" (Total Treatment Amount ＝Intermediate Treatment Amount + Direct Final Disposal Amount + Direct Recycling Amount) are not equal.

Source : Ministry of the Environment "Annual Report on the Environment, the Sound Material-Cycle Society and Biodiversity in Japan 2021" (2021)

Figure 1-3　Waste Management Flow in Japan (FY 2019)

Table 1-4　Definitions of the Main Terms Used in the Waste Management Flow

Term	Definition
Total waste generation amount	The sum of the amount of waste collected by municipalities for proper treatment and recycling (planned collection amount), the amount of waste directly received from waste generators at municipality treatment plants (direct receiving amount), and the amount of waste collected by local communities for recycling purposes (group collection amount).
Planned treatment amount	The amount of waste to be treated, calculated for future plans and set after listing present circumstances and setting reduction targets and forecast populations, and estimating future generation amounts of waste.
Total processed waste amount	The sum of the amount of waste that undergoes intermediate treatment such as incineration, shredding, sorting, etc. (intermediate treatment amount), the amount of waste sent directly to final disposal without intermediate treatment (direct final disposal amount), and the amount directly received by recycling operators (direct recycling amount).
Direct recycling amount	The amount of waste collected by municipalities (or contractors) as recyclables and delivered directly to recycling operators. This item was newly established in Japan in 1998.
Group collection amount	The amount of waste collected through recycling activities in which local residents' groups (e.g., town assemblies, neighborhood associations, children's associations, parent-teacher associations (PTAs), condominium associations) collect used paper, aluminum cans, and other recyclables from private residences for recycling, and deliver them to contracted collection operators.

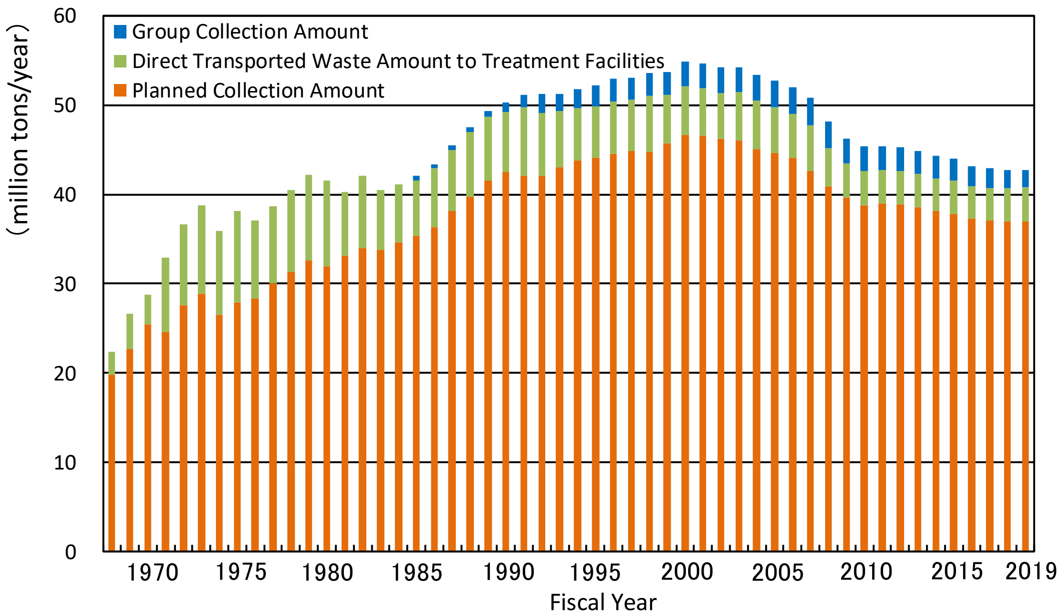
Source: Ministry of the Environment "Waste Management in Japan (FY2019)" (2021)

(3) Waste Collection and Transport

To deal with the increasing volume of waste, efforts are being made to streamline waste collection and transport in Japan by transitioning away from the model in which municipalities directly manage collection and transport, and toward a model in which the work is outsourced and licensed to private operators.

1) Planned collection amount

The planned collection amount is the amount of waste collected by municipalities for proper treatment and recycling. Direct transported waste amount refers to the amount of waste brought directly to waste treatment facilities by waste generators. Group collection is an activity of local residents' groups to collect used paper, aluminum cans, and other recyclables from each household for recycling, and deliver them to contracted collection operators. In Figure 1-4, the planned collection amount, direct transported waste amount to treatment facilities and group collection amount in Japan are shown. The planned collection amount can be calculated properly because surveys pertaining to amounts of waste have been conducted every year, and annual figures for amounts of waste are known.



*: Group collection amounts prior to 1984 are unknown; the sum of planned collection amount, direct transported waste amount to treatment facilities, and group collection amount after 1984 is consistent with the definition of total waste generation amount.

Source: Ministry of Health and Welfare (1972-1997) and Ministry of the Environment (1998-2019) "Waste Management in Japan" (1972-2019)

Figure 1-4 Planned Collection Amount

2) Status of Machinery and Equipment for Waste Collection and Transport

Discharged waste is collected using collection vehicles, which transport the waste to treatment plants or transfer facilities. Collection vehicles are commonly referred to as “packers” in Japan. The waste collected by the collection vehicles is transferred to transport vehicles, often referred to as secondary transport for onward transport to treatment plants; and the majority of the transport vehicles are trucks (for more details on waste collection and transport machinery and equipment, refer to Topic 4-1.3: Features of Vehicles and Equipment for Waste Collection and Transport).

Table 1-5 provides descriptions of the three operation forms of waste collection and transport: directly managed, outsourced, and licensed.

Table 1-5 Forms of Waste Collection and Transport

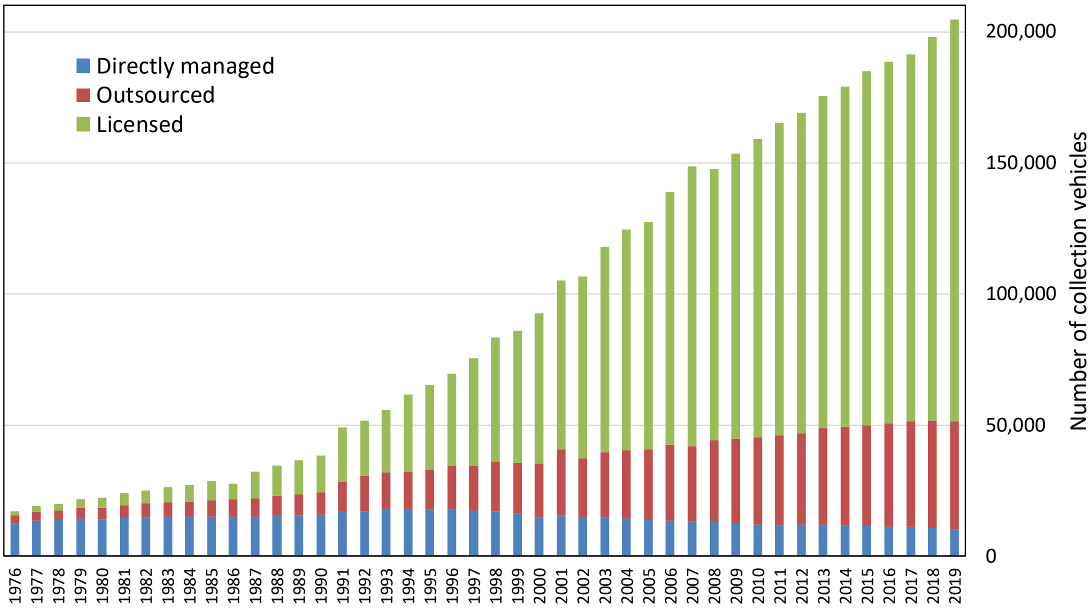
Form	Description
Directly managed	When a local government (e.g., municipality) or association*1 implements waste collection and transport.
Outsourced	When a private operator implements waste collection and transport, outsourced as part of municipal public services.
Licensed	When a private operator in business for profit implements waste collection and transport.*2 These operators collect and transport business waste.

*1: Association refers to a group established under an agreement for multiple parties to fund and jointly operate a business; in the area of waste management, an association is an organization that is jointly engaged in the construction, operation, and maintenance of facilities, as well as waste collection and transport and other aspects of the business.

*2: Operators licensed to handle the municipal waste components included in business waste (e.g., kitchen waste, waste paper, wood scraps, waste fibers, vegetable scraps, sorted sludge).

Japan is in the process of transitioning away from waste collection and transport directly managed by municipalities in order to deal with increasing amounts of waste, through outsourcing and licensing of increasing shares of waste collection. Accordingly, the number of waste collection and transport vehicles under the directly managed form of waste collection and transport is decreasing. In particular, small and medium-sized municipalities have more difficulty in securing funds and human resources compared to large municipalities, and thus are using contractors and licensed operators in an attempt to streamline waste collection and transport operations. Figure 1-5 shows trends in the number of vehicles for waste collection and transport under the three operation forms.

Notably, the trends are the same when comparing vehicle capacity for the three forms rather than number of vehicles.



*1: Prior to 1990, some vehicles owned by associations were included, and from 1991, only vehicles owned by municipalities were included, excluding vehicles owned by some associations.

*2: Vehicles before 1990 were classified as special vehicles and transport trucks, and although the definition of vehicles is different, special vehicles are counted as collection vehicles.

Source: Ministry of Health and Welfare (1972-1997) and Ministry of the Environment (1998-2019) "Waste Management in Japan " (1972-2019)

Figure 1-5 Number of Collection Vehicles

(4) Intermediate Treatment of Waste

1) Waste Treatment Amounts

Measures of waste treatment have been promoted in Japan in line with the basic policy to incinerate waste as a method of intermediate treatment in pursuit of sanitary treatment. As a result, incineration treatment now accounts for roughly 80% of overall intermediate treatment, while the amount of waste disposed directly into landfills has decreased. In the meantime, recycling-related legislation has been established in an effort to promote material recycling. Consequently, the amount of directly recycled waste increased and the amount of waste disposed directly into landfills decreased, although both trends have since leveled out.

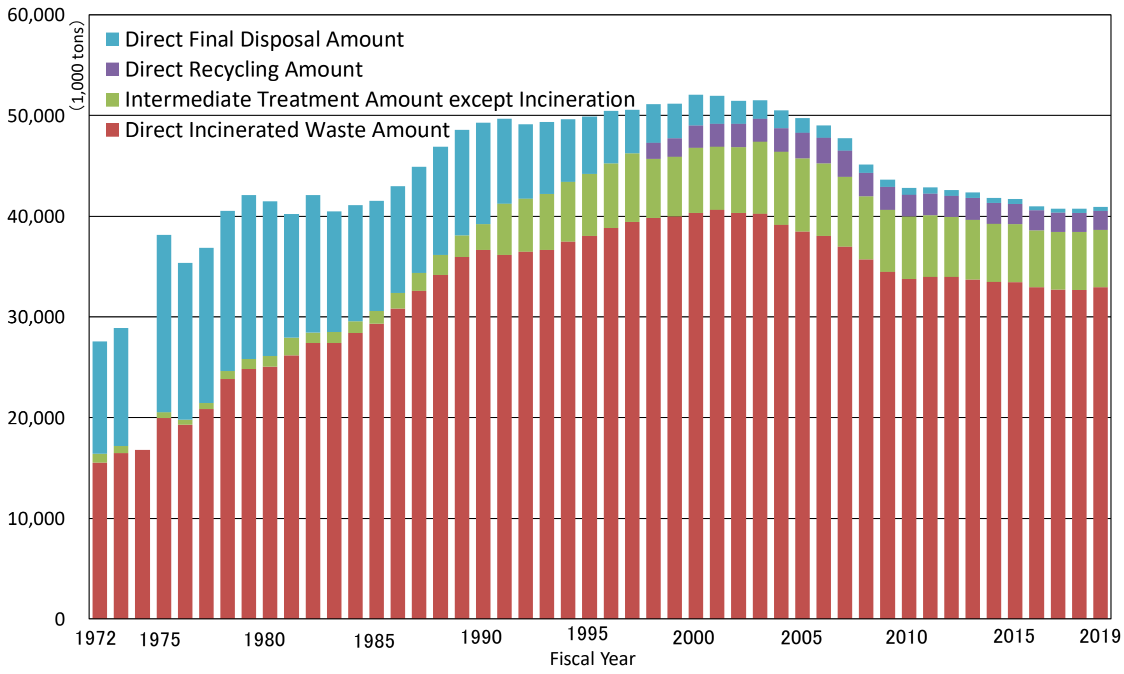
Collected waste is transported to intermediate treatment plants for treatment. In Japan, intermediate treatment has long been used to mitigate the difficulty of securing landfill sites and in pursuit of the sanitary treatment of waste, and various intermediate treatment technologies are being used to promote recycling and further reduce the waste amount for final disposal. There are many types of intermediate treatment plants for different wastes; examples include incineration plants, bulky waste treatment plants, and composting plants (for more details on intermediate treatment, refer to Topic 4-2: Intermediate Treatment).

In FY 2019, the total treated waste amount[3] was 40.95 million tons, of which 32.94 million tons, or roughly 80%, underwent incineration treatment (direct incineration amount). A total of 5.72 million tons of waste underwent intermediate treatment other than incineration (intermediate treatment amount excluding incineration), and 1.88 million tons was directly received by recycling operators (direct recycling amount).

The direct incineration amount increased until around 2000 amid the ongoing upgrade of intermediate treatment plants at the time to process growing amounts of waste. Additionally, the direct final disposal amount has trended downward since the 1980s and decreased to 400,000 tons in 2019 as a result of the increase in the direct incineration amount.

The intermediate treatment amount from recycling and the like started to increase in the 1990s with the launch of efforts to establish a sound material-cycle society and the enactment of laws on recycling, but leveled off in 2007 and has remained flat since.

[3] Total treatment amount = Intermediate treatment amount + Direct final disposal amount + Direct recycling amount



*1: Excluding disaster waste generated by natural disasters such as earthquakes and floods.
*2: Intermediate treatment facilities other than incineration include bulky waste treatment facilities, facilities for recycling, waste composting facilities, methanization facilities, waste fuel conversion facilities, etc.
*3: "Direct Recycling Amount" is a new item used since 1998. Until 1997, the "Direct Recycling Amount" was probably recorded in the "Intermediate Treatment Amount excluding Incineration".
Source: Ministry of Health and Welfare (1972-1997) and Ministry of the Environment (1998-2019) "Waste Management in Japan" (1972-2019)

Figure 1-6 Waste Treatment Conditions in Japan

2) Recycling Amount

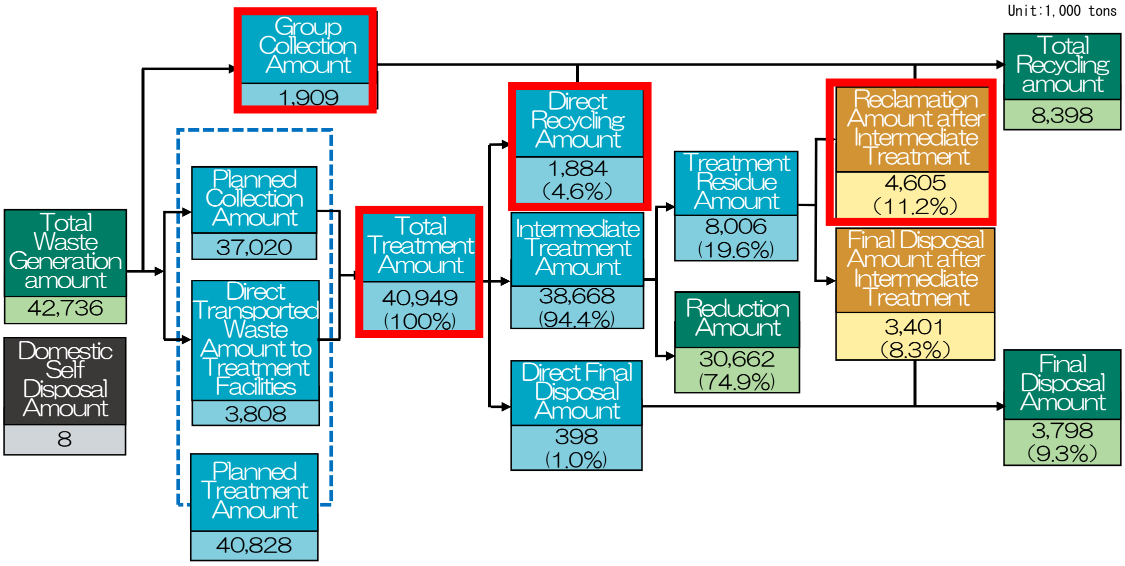
In Japan, the recycling rate can be used as an indicator to examine the results of efforts to improve recycling, including thorough sorting and separate collection (direct recycling amount), efficient intermediate treatment (recycling amount after intermediate treatment), and the promotion of recycling activities by residents (group collection amount).

Recycling is the recapture and reuse of resources that have been discarded (here, recycling means material recycling, in which materials are reused as raw materials, and does not include thermal recycling[4], in which thermal energy is recovered and utilized). In Japan, the recycling rate is defined as the percentage the total recycled waste amount (Direct recycling amount + Group collection amount[5] + Recovery amount after intermediate treatment) of the total treated waste amount (Total treatment amount + Group collection amount).

[4] In the EU, the concept of energy recovery is used to distinguish it from thermal recycling, and recovery of thermal energy is not included in recycling.

[5] All the Group collection waste is considered to be thoroughly sorted at source and composed only of recyclables.

$$\text{Recycling Rate (\%)} = \frac{\text{Direct Recycling Amount} + \text{Group Collection Amount} + \text{Recovery Amount after Intermediate Treatment}}{\text{Total Treatment Amount} + \text{Group Collection Amount}} \times 100$$

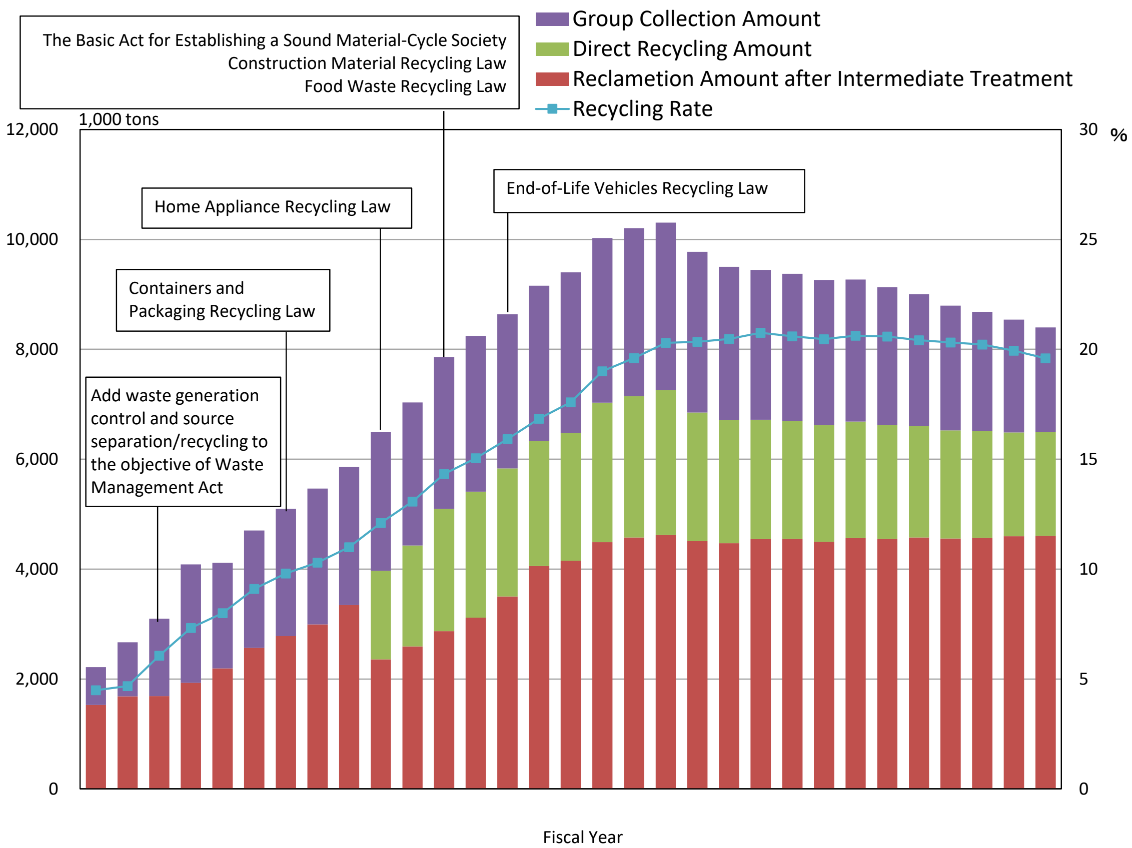


*1：Because of planning errors, "Planned Treatment Amount" and "Total Treatment Amount"
(＝Intermediate Treatment Amount + Direct Final Disposal Amount + Direct Recycling Amount) are not equal.
*2: "Direct recycling" is defined as the direct delivery to a recycler without passing through a recycling facility.
*3: Red boxes are items related to the calculation of the recycling rate.
Source : Ministry of Environment "Annual Report on the Environment, the Sound Material-Cycle Society and Biodiversity in Japan 2021" (2021)

Figure 1-7 Waste Management Flow in Japan (FY 2019) (Reproduced)

Since the 1990s, Japan has promoted the recycling of waste and strived to increase the direct recycling amount by amending the *Waste Management Act* and establishing the *Act on Establishing a Sound Material-Cycle Society* and other laws on recycling. Additionally, the increase in awareness on recyclables among residents and business operators and the technological innovations in intermediate treatment have improved recycling (for more details on laws and regulations, refer to Topic 2-2.2: Legal Structure Pertaining to Waste Management).

As shown in Figure 1-8, the enactment of recycling laws have significantly contributed to the increase in recycling amount (the sum of the direct recycling amount, the recovery amount after intermediate treatment, and the group collection amount) and the trend in recycling rate increased through 2007 due to the promotion of sorting and recycling of containers and packaging, home appliances, and more under these laws.



*1: Excluding disaster waste generated by natural disasters such as earthquakes and floods.

*2: "Direct Recycling Amount" is a new item since 1998. Until 1997, the "Direct Recycling Amount" was probably recorded in the "Intermediate Treatment Amount except Incineration".

Source: Ministry of Health and Welfare (1972-1997) and Ministry of the Environment (1998-2019) "Waste Management in Japan" (1972-2019)

Figure 1-8 Recycling Amount and Recycling Rate

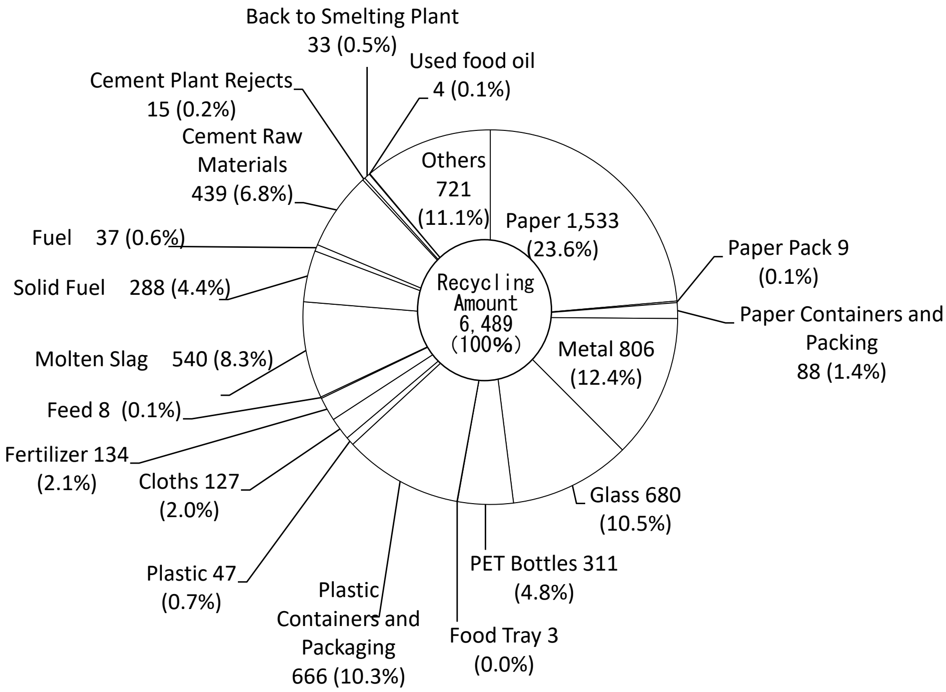
An item's suitability for recycling depends on how easy it is to recycle it (how willing residents and business operators are to cooperate) as well as local characteristics and customs. Paper has been recycled in Japan for a long time; it was the most recycled resource in FY2019. Paper comprises more than 20% of separate waste collected by municipalities, and more than 90% of recyclables collected through resident-driven group collection.

Figure 1-9 provides a breakdown of the amount of resources recycled and group collection amounts by item in FY2019. The total amount of resources recycled through separate collection by municipalities (direct recycling amount) and resources recycled after intermediate treatment (recovery amount after intermediate treatment) was 6.49 million tons (amount of resources recycled), and the amount of resources recycled through group collection by residents' groups (the group collection amount) was 1.91 million tons.

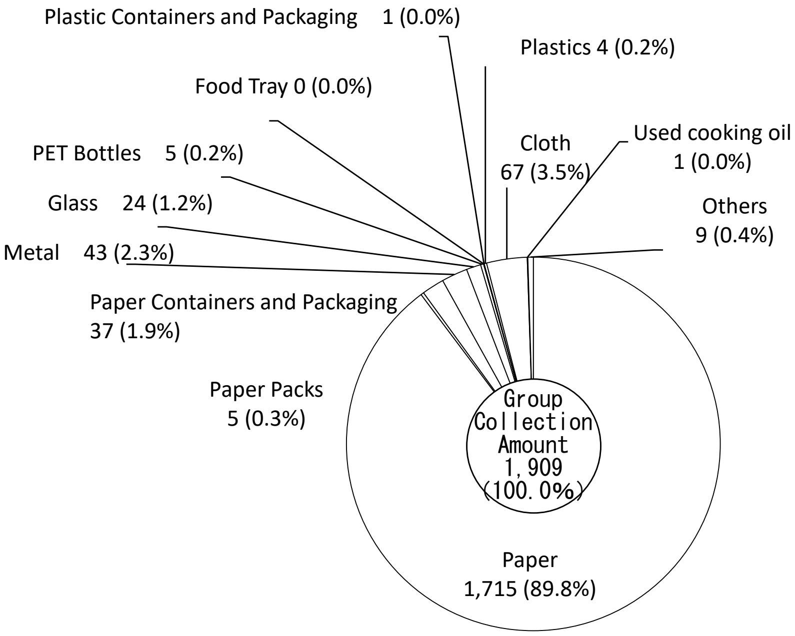
The most commonly recycled item was paper (23.6%), followed by metals (12.4%), glass (10.5%), plastic containers and packaging (10.3%), and molten slag (8.3%). Additionally, the most common item in group collection was paper (89.8%), followed by textiles (3.5%), metals (2.3%), paper containers and packaging (1.9%), and glass (1.2%). Newspapers, magazines, cardboard, and other paper comprised nearly 90% of group collection (for more details on recycling technologies, refer to Topic 4-2.5: Recycling Technology).

Unit: 1,000 tons

Recycling Amount



Group Collection Amount



Source: Ministry of the Environment Website "Results of the survey on municipal waste management (FY2019)" (2021) https://www.env.go.jp/press/files/jp/115966.pdf（accessed January 24, 2022）

Figure 1-9 Breakdown of Recycling Amount and Group Collection Amount (FY2019)

3) Present State of Intermediate Treatment Plants

In Japan, various intermediate treatment technologies, such as incineration plants, are being implemented based on the characteristics of the municipalities. In densely populated urban areas, incineration technology is favored for its effectiveness in reducing the high amounts of waste generated in those areas. In sparsely populated rural areas - specifically in areas with close-knit local communities - recycling technologies and treatment methods other than incineration tend to be used because it is easier to get residents there to cooperate with waste sorting. Regarding incineration plants, technological innovations are being made not only to properly treat waste but also to facilitate effective measures, including inter-municipal waste treatment, dealing with dioxin-related problems, and promoting residual thermal utilization.

Examples of intermediate treatment plants include waste incineration plants, bulky waste treatment plants, organic waste recycling plants (e.g., composting plants, livestock feed processing plants, methane gasification plants), recycling plants, and fuel processing plants (for statistical data in Japan, waste incineration plants are classified into incineration, gasification melting/reforming, carbonization, and others).

Table 1-6 shows the number and treatment capacity of waste incineration plants by type in FY2019. As of 2019, there are a total of 1,067 incineration plants in Japan with a total treatment capacity of roughly 177,000 tons per day.

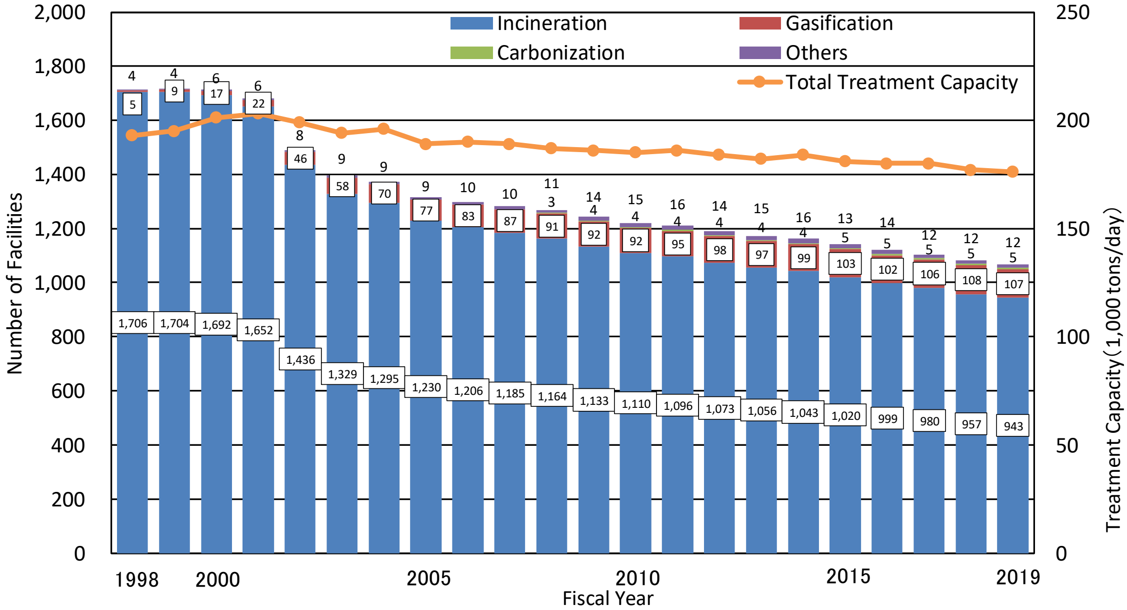
Figure 1-10 shows trends in the number and treatment capacity of waste incineration plants by type. Although both the number and treatment capacity of these plants are trending downward, the latter is only decreasing slightly. The treatment capacity is decreasing less than the number of plants because of expansion of inter-municipal waste treatment and measures to promote the consolidation of waste incineration plants into those with treatment capacity of at least 100 tons per day, even though the amount of waste generated is decreasing due to factors such as the promotion of the 3Rs. Consequently, efforts are being made to maintain proper waste treatment capacity while promoting dioxins countermeasures (for more details on waste incineration plants, refer to Topic 4-2.2: Incineration Technology, and for more details on dioxins countermeasures, refer to Topic 5-3: Dioxins Problem).

Table 1-6 Number of Facilities and treatment Capacity by Type of Incineration (FY2019)

Type of Facilities	Incineration	Gasification	Carbonization	Others	Total
Number of Facilities	943	107	5	12	1,067
Treatment Capacity (ton/day)	153,978	21,196	206	1,328	176,707

*: Facilities established by municipalities and clean associations, including those for which construction began in the year in question and those for which construction was suspended, excluding disused facilities and those owned by private companies.

Source: Ministry of the Environment “Waste Management in Japan (FY2019)” (2021)



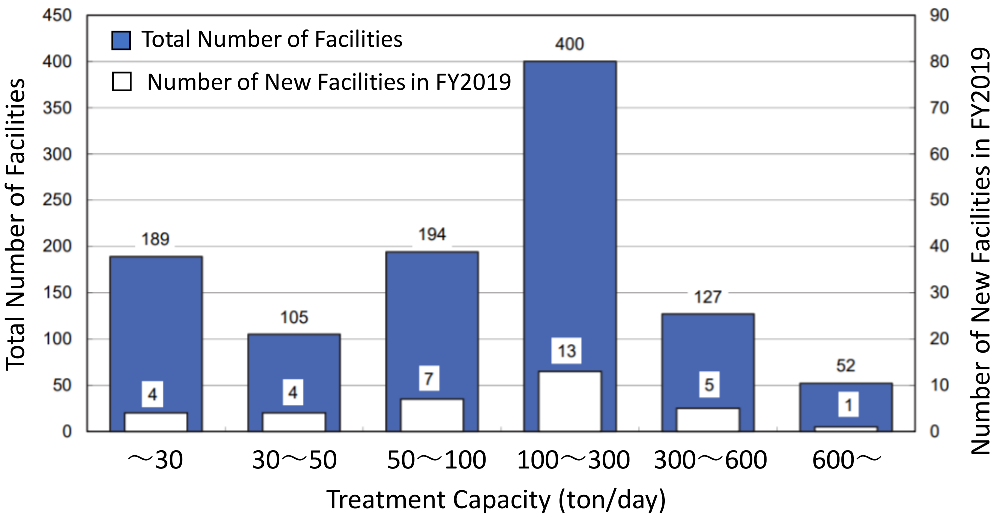
*1: Facilities established by municipalities and clean association, including those for which construction began in the year in question and those for which construction was suspended, excluding disused facilities and those owned by private companies.

*2: Until 2004, carbonization was included in incineration.

Source: Ministry of the Environment “Waste Management in Japan” (2000-2021)

Figure 1-10 Number of Waste Incineration Facilities by Type of Incineration

Figure 1-11 shows the number of waste incineration plants by capacity in FY2019. As a result of the promotion of inter-municipal waste treatment and waste incineration power generation, there are more waste incineration plants with treatment capacity of 100 to 300 tons per day (400 plants) than any other capacity range. The plants being developed in Japan are smaller than those in major cities in foreign countries, which are capable of treating at least 1,000 tons per day.



Source: Ministry of the Environment “Waste Management in Japan (FY2019)” (2021)

Figure 1-11 Number of Waste Incineration Facilities by Treatment Capacity (FY2019)

4) Residual Thermal Utilization at Waste Incineration Plants

Innovations in incineration power generation technology and measures and legislation to promote the use of renewable energy have driven the introduction of thermal power generation at incineration plants. The residual heat generated by incineration treatment is used not only inside plants but also at facilities outside plants for giving back to residents.

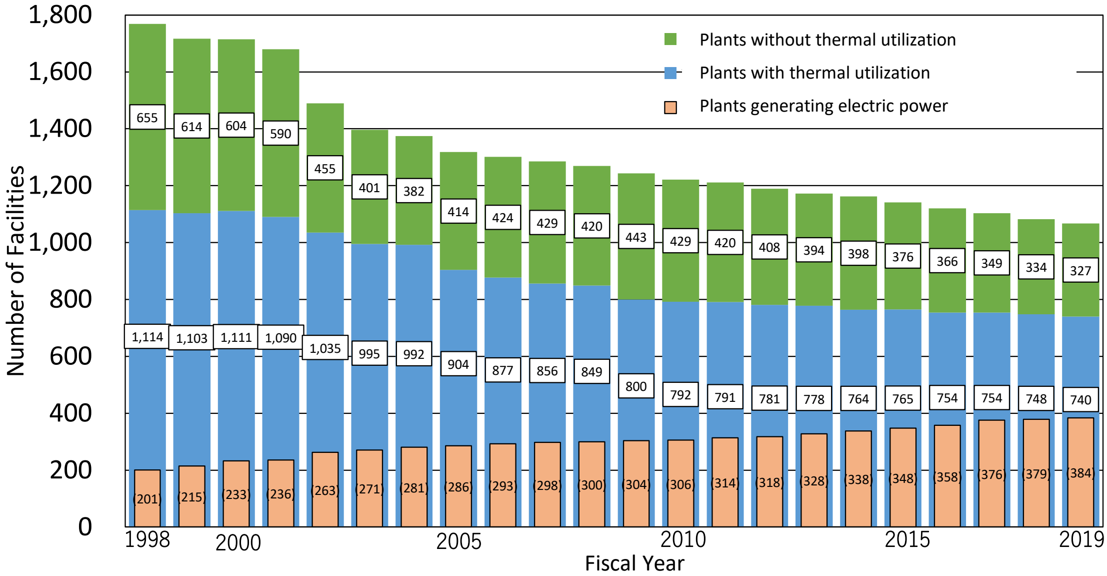
Table 1-7 shows the state of residual thermal utilization at waste incineration plants in FY2019. Residual heat is utilized at 740 plants, or 69.4% of the total plants. Methods of residual thermal utilization include hot water, steam, and power generation; for purposes such as supplying electricity and heating air and water within plants, as well as for heating swimming pools and at other local facilities outside plants.

Table 1-7 Residual Thermal Utilization at Waste Incineration Plants (FY2019)

Thermal Utilization	With Thermal Utilization								Without Thermal Utilization
		Hot Water		Steam		Power Generation		Others	
		Inside Plant	Outside Plant	Inside Plant	Outside Plant	Inside Plant	Outside Plant		
Number of Facilities	740	618	206	236	90	381	267	40	327

*1: Due to duplicated responses, the total number of facilities does not match the total number of respondents.
Source: Ministry of the Environment "Waste Management in Japan (FY2019)" (2021)

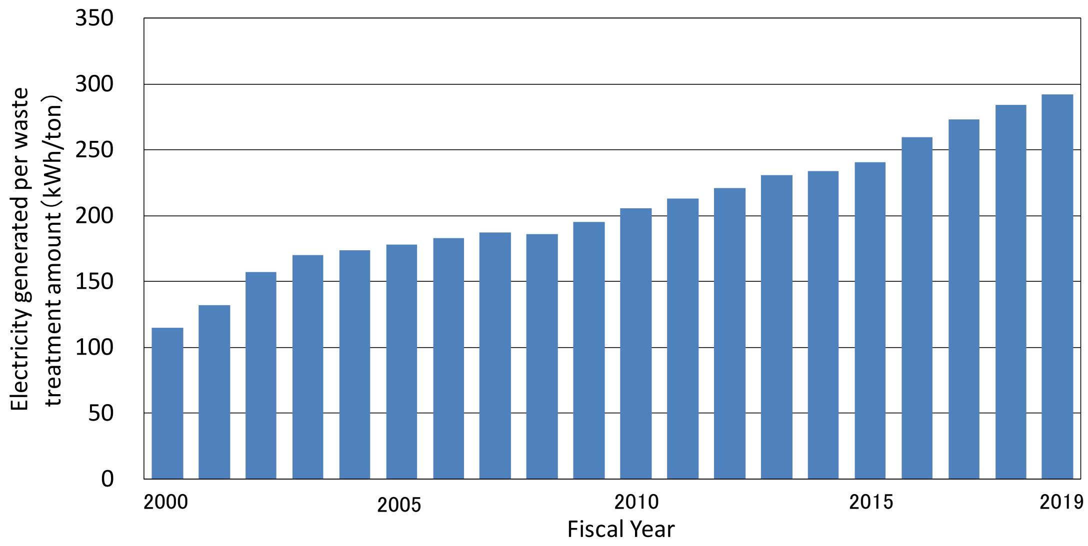
Figure 1-12 shows trends in the number of waste incineration plants where residual thermal utilization is implemented. Although the number of waste incineration plants has been decreasing, the number of plants where residual thermal utilization is not implemented is also decreasing, falling to 327 in 2019. Conversely, the number of plants where waste incineration power generation is implemented has been increasing, rising to 384 in 2019. In Japan, waste power generation is being proactively introduced in an effort to establish a sound material-cycle society. Legislation for the introduction of waste power generation has been developed; for example, the *Act on Special Measures Concerning Procurement of Electricity from Renewable Energy Sources by Electricity Utilities*, which requires electricity utilities to use new energy sources, was enacted in 2003, and the feed-in tariff (FIT) system for renewable energy was put into operation in 2012.



Source: Ministry of the Environment "Waste Management in Japan" (2000-2021)

Figure 1-12 Number of Waste Incineration Plants with Residual Thermal Utilization

Figure 1-13 shows the annual increasing trend in electricity generated per ton of treated waste. Although the low efficiency of waste incineration power generation was an issue when it was first introduced at waste treatment plants, efficiency has improved thanks in part to increasing heating (calorific) values of the waste incinerated partly due to the increase in waste plastics, and technological innovations in power generation facilities, thereby helping to promote the introduction of waste incineration power generation. Of all waste incineration plants with power generation facilities, 285 (74% of the total) had power generation efficiency of at least 10% in FY2019. Additionally, 45 plants had a power generation efficiency of at least 20% (for more details on the systems, refer to Topic 2-3.2: Thermal Recovery).

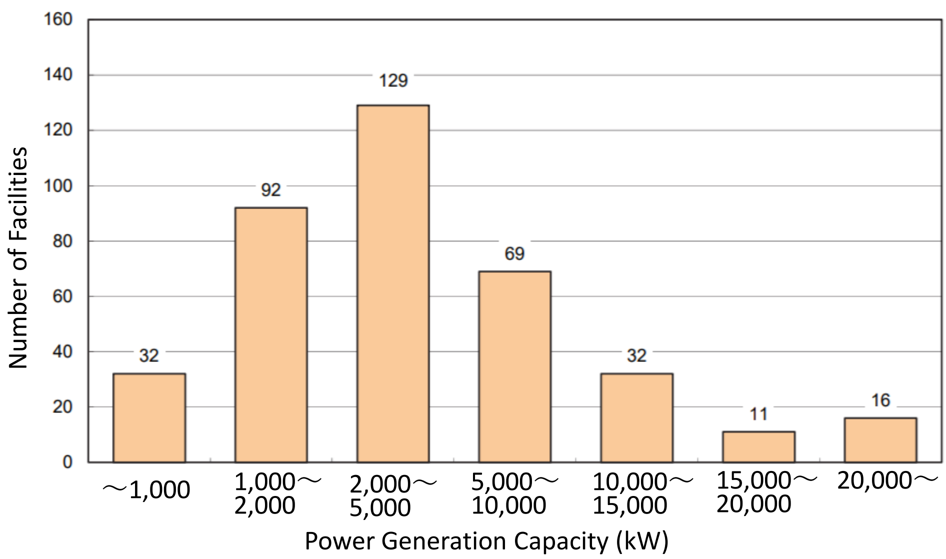


*: Available electric energy per ton of waste treated (kWh/ton) = $\dfrac{\text{Total annual electricity generated in facilities (kWh)}}{\text{Annual waste treatment amount in facilities (tons)}}$

Source: Ministry of the Environment "Waste Management in Japan" (2000-2021)

Figure 1-13　Electricity Generated per Ton of Waste Treated

Figure 1-14 shows the number of waste incineration plants by electric power generation capacity in FY2019. There are more plants with power generation capacity of 2,000 kW to 5,000 kW (129 plants, 34% of the total) than any other capacity range. A total of 59 plants - 15% of the total - have a power generation capacity of more than 10 MW.



*: Of the 384 facilities with power generation equipment, 381 facilities with valid responses were included in the survey.
Source: Ministry of the Environment "Waste Management in Japan (FY2019)" (2021)

Figure 1-14　Number of Waste Incineration Plants by Electric Power Generation Capacity (FY2019)

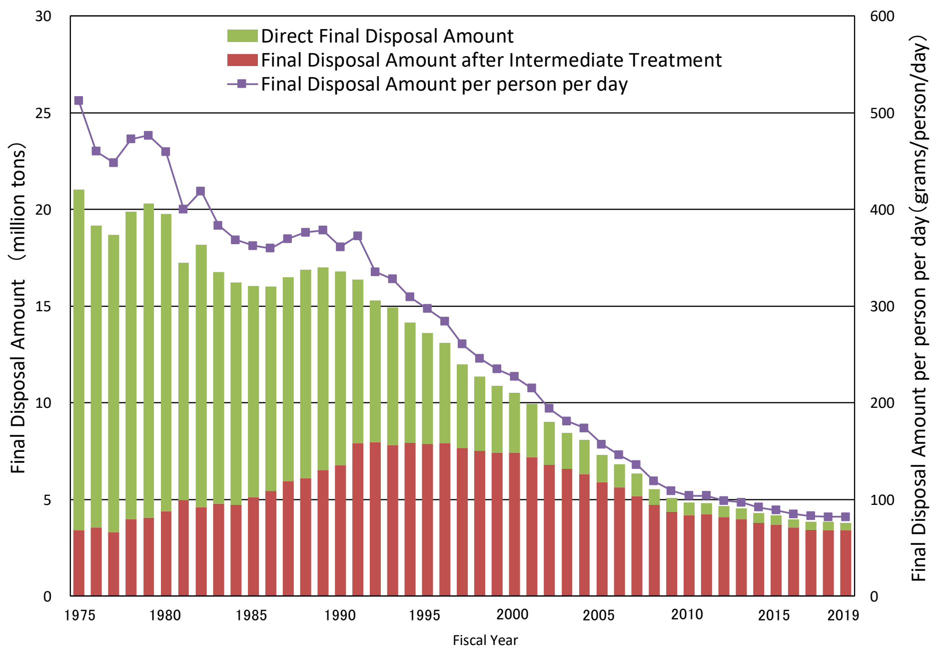
(5) Final Disposal of Waste

1) Final Disposal Amount

The final disposal amount in Japan has decreased as a result of the proactive introduction of intermediate treatment technologies, i.e. the usage of incineration plants and the promotion of recycling.

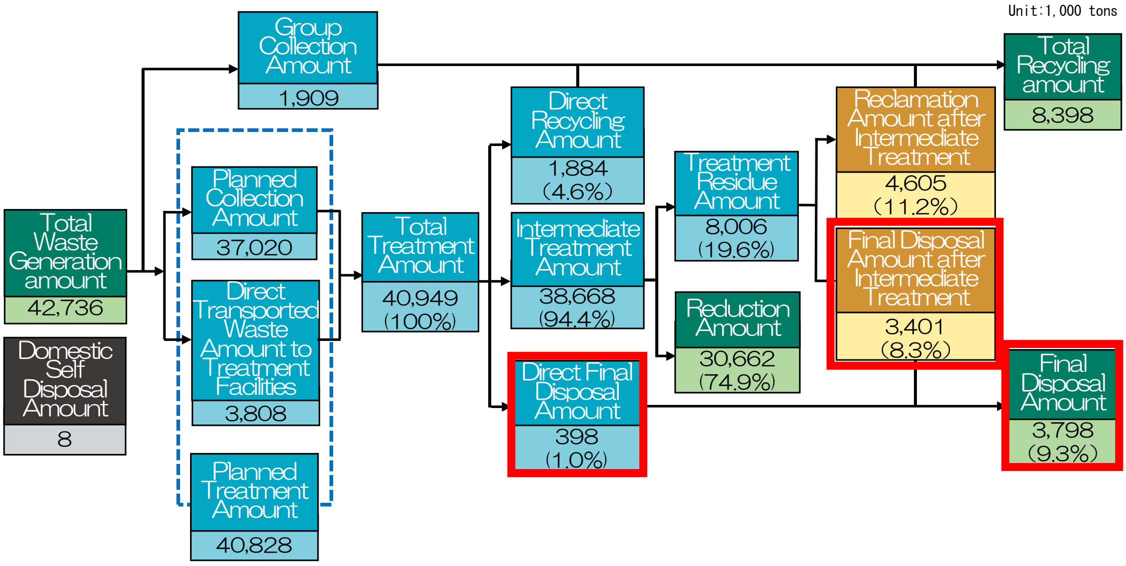
"Final disposal" means that waste is ultimately disposed into landfill sites at the last stage of the waste management flow. The final disposal amount is the sum of the amount of waste sent directly to final disposal without intermediate treatment (direct final disposal amount) and the amount of waste sent to final disposal after intermediate treatment (final disposal amount after intermediate treatment).

Figure 1-15 shows the annual trends in the final disposal amount. The direct final disposal amount has decreased substantially due to incineration and other forms of intermediate treatment and promotion of the 3Rs; the figure fell to 400,000 tons in FY2019. The final disposal amount after intermediate treatment has also remained low (3.4 million tons in FY2019) due in part to advances in incineration technology that have improved the rate of reduction through incineration. The total final disposal amount has generally continued trending downward due to the effects of measures for waste minimization and recycling, among other things; in FY2019, the total final disposal amount was 3.8 million tons, or 9.4% of the total treatment waste amount (for more details on final disposal, refer to Topic 4-3: Final Disposal).



Source: Ministry of Health and Welfare (1975-1997) and Ministry of the Environment (1998-2019) "Waste Management in Japan" (1975-2019)

Figure 1-15 Final Disposal Amount in Japan



*1: Because of Planning errors、"Planned Treatment Amount" and "Total Treatment Amount" (＝Intermediate Treatment Amount + Direct Final Disposal Amount + Direct Recycling Amount) are not equal.

*2: "Direct recycling" is defined as the direct delivery to a recycler without passing through a recycling facility.

*3: Red boxes are items related to the final disposal.

Source : Ministry of the Environment "Annual Report on the Environment, the Sound Material-Cycle Society and Biodiversity in Japan 2021" (2021)

Figure 1-16 Waste Management Flow in Japan (FY 2019) (Reproduced)

2) Remaining Life and Capacity at Landfill Sites

All though the service life of landfill sites in Japan is increasing due to the reduction of final disposal amount, the capacity of the landfill continues to decrease over time. Therefore it is crucial to reduce the final disposal amount as well as to develop new landfills. Since the shortage of landfill sites is an important issue, and because it takes time to develop landfill sites, statistical data over a period of time is used to calculate and verify the number of years sites can remain in service, which are then used in plans for future landfill site development.

When looking into constructing new landfill sites, it is essential to have a firm understanding of the remaining life and capacity of existing landfill sites. Table 1-8 shows the number and remaining life of landfill sites for municipal waste in FY2019, and Figure 1-17 shows how those figures have trended. As of the end of FY2019, there are 1,620 municipal waste landfill sites in Japan, with a remaining capacity of about 100 million m^3 and a remaining life of approximately 21 years.

The downward trend of remaining landfill capacity has slowed due to the establishment of legislation to minimize waste, promote recycling, and reduce the final disposal amount in response to the priority issue - the shortage of landfill sites – and because of measures including the promotion of reduction through intermediate treatment and recycling technologies. Although the remaining life of landfill sites has held steady at above 20 years in the last 10 years, necessary measures continue to be implemented in light of the severity of the situation.

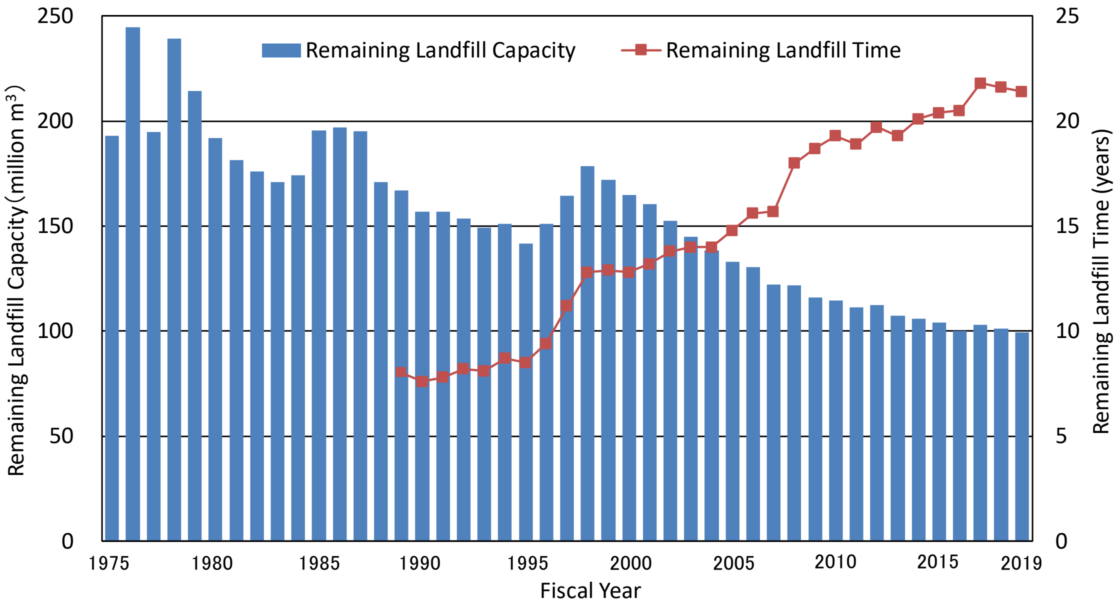
Notably, the remaining life of landfill sites is the period (number of years) during which disposal at existing landfill sites is possible if the final disposal amount in a given fiscal year is maintained without developing new landfill sites. Remaining life is calculated using the following formula.

$$\text{Remaining Time (Year)} = \frac{\text{Remaining capacity at the end of the year}}{\text{Final Disposal Amount of year / volume-to-mass ratio of the waste (bulk density of the waste can be 0.8163)}}$$[6]

Table 1-8 Number and Capacity of Municipal Waste Landfill Site（FY 2019）

Number of Landfill Sites by terrain					Total Area	Total Capacity	Remaining Capacity	Remaining Time
Mountains	Sea	Water surface	Flat Land	Total	(1,000m²)	(1,000m³)	(1,000m³)	(Year)
1,165	25	10	420	1,620	42,762	470,762	99,507	21.4

Source: Ministry of the Environment “Waste Management in Japan (FY2019)” (2021)



Source: Ministry of Health and Welfare (1972-1997) and Ministry of the Environment (1998-2019) “Waste Management in Japan” (1972-2019)

Figure 1-17 Number and Capacity of Municipal Waste Landfill Sites

[6]The relative bulk density of landfill waste is the volume-to-mass ratio of the waste at the time it was dumped. In Japan, it is generally considered to be roughly 0.3 when waste is discharged and 0.8 when it is dumped into landfills.

(6) Composition of Waste

In order to understand the types, characteristics, and other attributes of waste generated in each area, it is essential to survey the composition of waste and its three components of moisture content, combustibles content, and ash content. Ongoing surveys are required because the quality of waste changes in response to factors such as changes in social circumstances and the diversification of lifestyles. Survey results can be used as basic data not only for design conditions when developing facilities such as incineration plants and landfill sites, but also for considering suitable measures to reduce waste and promote recycling based on the waste quality.

Paper, textiles, and plastics comprise roughly 70% of waste in Japan, and data from surveys shows that this waste contains high-calorie combustibles and relatively little moisture content; this data is the basis for efforts to utilize incineration technologies and promote the recycling of plastics.

Waste composition is the categorization of waste into items and material classifications; waste composition surveys categorize waste into paper, textiles, kitchen waste, and the like, and show the relative weights of each as percentages. The three components of waste – moisture content, combustibles content, and ash content - are indicators of the properties of waste. In Japan, municipalities conduct surveys at incineration plants and other facilities four times a year in accordance with the *Waste Management Act* in order to develop an understanding of the types, characteristics, and other attributes of waste generated in each area.

The results of waste composition surveys can be used to verify the composition of the waste being generated, which is useful for examining the state of the generation of plastics and other recyclable items and measures suitable for those items as well as considering the possibility of introducing waste incineration plants and plant specifications. The results of surveys of the three components are important indicators for verifying the properties and combustibility of waste, and are essential data for planning the development of waste incineration plants. Additionally, because most ash content is incombustible waste, the three-component data is important for considering landfill capacity and other matters when formulating plans for developing landfill sites.

The results of waste composition and three-component surveys are compiled by municipalities and reported to the Ministry of the Environment, where the data is accumulated and used to identify nationwide trends. Table 1-9 and Figure 1-18 show the results of waste composition analysis (dry weight base) at waste incineration plants throughout Japan in FY2019; although lifestyle changes prompted an increase in plastics, kitchen waste decreased as a result of advancements in recycling and minimization of organic waste.

Table 1-9 Result of Composition of Waste (Dry Weight base)

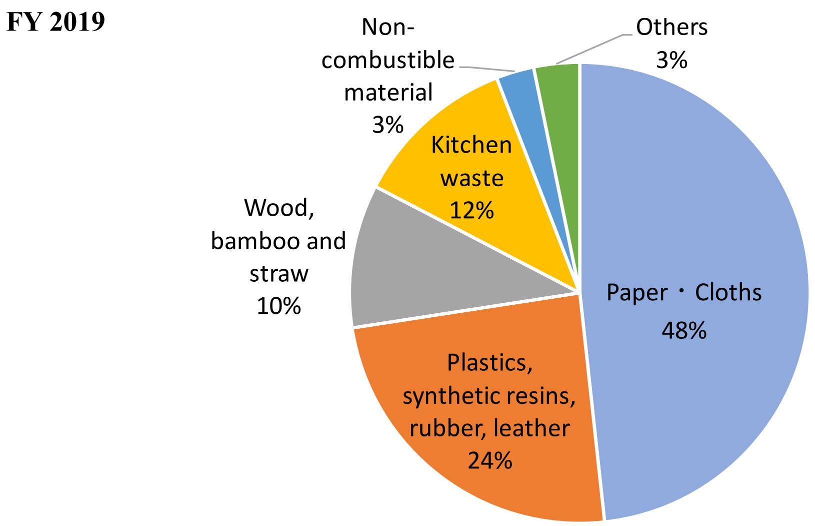
Survey year	Paper, Cloth	Plastic synthetic resins, rubber, leather	Wood, bamboo and straw	Kitchen waste	Non-combustible waste	Others	Total
2019	48%	24%	10%	12%	3%	3%	100%

*1: The composition of municipal waste delivered mainly to incineration facilities is surveyed, so recyclables sorted before collection are not included.

*2: The composition ratio is by dry-base weight excluding water.

*3: The values are obtained by dividing the survey results for each treatment facility in Japan proportionally by the amount of waste treatment at each facility.

Source: Ministry of the Environment Website "Results of the survey on municipal waste management (FY2019)" https://www.env.go.jp/recycle/waste_tech/ippan/ （accessed January 25, 2022）



*: The values are obtained by dividing the survey results for each treatment facility in Japan proportionally by the amount of waste treatment at each facility.

Source: Ministry of the Environment Website "Results of the survey on municipal waste management (FY2019)" https://www.env.go.jp/recycle/waste_tech/ippan/ （accessed January 25, 2022）

Figure 1-18 Result of Composition of Waste (Dry Weight Base)

Waste composition surveys also measure bulk density (weight of waste per m^3 of waste). The unit volume weight is important data for designing the remaining life of landfill sites, waste pits at waste incineration plants, and storage facilities at other plants. Lower calorific values represent available rather than measurable thermal energy, and are extremely important data for designing waste incineration plants.

Table 1-9 shows the composition of waste (dry weight base) in FY2019. Paper and cloth account for about half of the total weight, and plastics, rubber, and leather for a quarter. Table 1-10 shows the bulk density, the three components, and the lower calorific values (measured values) in FY2019. It should be noted that these values are based on dry weight base, which does not take moisture content into account, and thus differ in composition from wet weight base, which take moisture content into account.

The highest and lowest values for the three components and lower calorific values indicate the extreme variations in the waste data. Reasons for these large variations may be attributed to differences in types of waste and the lack of uniformity in waste samples used in the surveys. Accordingly, the coning and quartering technique is used to ensure the uniformity of samples to the extent possible in waste composition surveys (for more details on the coning and quartering technique, refer to Column: Surveys on Municipal Waste Composition in Developing Countries).

Table 1-10 Weight per Volume, Three Components and Lower Calorific Value of Waste

Survey year	Value	Weight per Volume (kg/m^3)	Three Components (%)			Lower Calorific Value* (Measured value kJ/kg)
			Moisture content	Combustible content	Ash content	
2019	Weighted average	153	43	45	12	9,796
	Maximum	596	72	91	74	22,241
	Minimum	15	4	2	2	1,393

*: Lower Calorific Value＝Higher Calorific Value－Latent heat of condensation of water vapor×Amount of water vapor

Source: Ministry of the Environment Website "Results of the survey on municipal waste management (FY2019)" https://www.env.go.jp/recycle/waste_tech/ippan/ (accessed January 25, 2022)

Column: Surveys on Municipal Waste Composition in Developing Countries

Knowing the composition of waste is essential for formulating plans for recycling and the stable operation of intermediate treatment plants. In developing countries in particular, there are conspicuous seasonal variations in waste composition, especially during the rainy season, when the moisture of the waste is higher and heating values are lower, making incineration more difficult. Additionally, waste often contains large amounts of concrete rubble, earth, and sand, increasing the burden on the machinery and equipment at intermediate treatment plants (for details on the significance of surveys, refer to Topic 1-2.1: Management of Waste-Related Data). It is also necessary to distinguish between surveys of waste composition at the generation sources and at landfill sites and other receiving facilities, depending on the intended use of the composition data. The following points are worthy of particular attention when conducting waste composition surveys in developing countries.

Important Points to Remember

(1) Timing of Surveys

In areas with clearly defined rainy and dry seasons, conduct surveys in both seasons. The amount of moisture content and bulk density of waste differs widely between the seasons because the waste contains a lot of moisture during the rainy season.

Additionally, avoid conducting surveys during Christmas, New Year's, and other holidays specific to the country because the quantity and quality of waste generated differ from normal times.

(2) Safety of Work

Organize and prepare the gear needed to work safely (e.g., gloves, boots, safety clothing, and masks).

Also, pay sufficient attention to countermeasures against mosquito-borne infections and hazardous waste such as injection needles, and sort the waste in covered areas.

Table 1-11 Examples of Equipment Needed for Waste Composition Surveys

Equipment to wear	Equipment
Vest	Hanging scale
Helmet	Container box (large ~ small）, Bucket
Boots	Plastic sheeting
Medical Mask	Zip Lock, Plastic bag
Gloves	Tongs, Shovels, Scoops
Goggles	Measure tape, Duct tape

(3) Accuracy of Sorting and Measurement

Clarify among the survey team in advance the standards for sorting, the methods of measurement, and the minimum unit of measurement weight (conduct practical exercises in the field in advance). Pay particular attention to what kind of waste is categorized as "other." Additionally, check whether the waste to be surveyed is missing any recyclables that were collected from the generation sources (private residences or business operators), transfer stations, or the like prior to taking the survey samples.

In the waste composition surveys, the coning and quartering technique is usually used to obtain representative samples and minimize the effects of waste non-uniformity and imbalance. The following figure illustrates the coning and quartering technique.

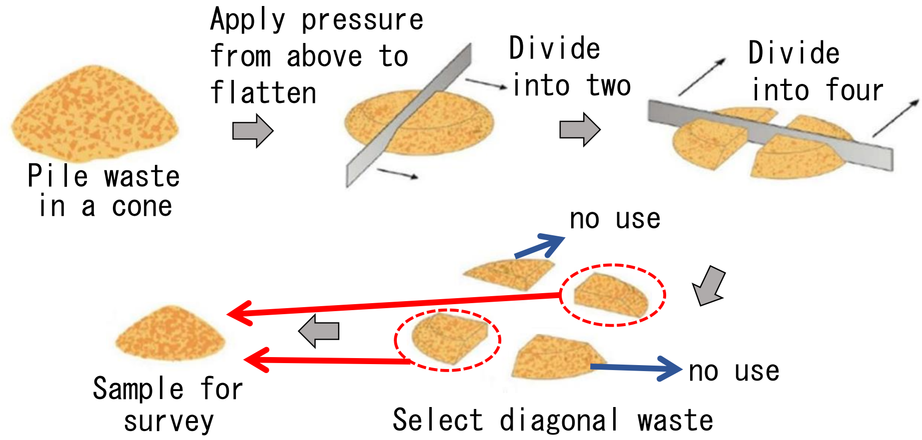


Figure 1-19 Overview of Conical Quartering Technique

Photo 1-3 Piling up

Photo 1-4 Dividing into four

Photo 1-5 Separating

Photo 1-6 Plastics

Photo 1-7 Glass

Photo 1-8 Cloth

Source: Yachiyo Engineering Co., Ltd.

Surveys on Municipal Waste Composition in Indonesia

Photo 1-9 Separating

Photo 1-10 Separating

Source: Yachiyo Engineering Co., Ltd.

Surveys on Municipal Waste Composition in Senegal

Column: The Three Components of Waste

The values of the three components are important for understanding the combustibility of waste and the amount of incinerator ash generated when developing the specifications of incineration plants. The composition of moist waste can be broadly classified into three categories: moisture, ash, the inorganic matter that remains after combustion, and combustibles which are burned off. Moisture content, ash content, and combustibles content are known as the three components of waste. Table 1-12 shows the characteristics of each.

Table 1-12 Main Elements in the Three Components

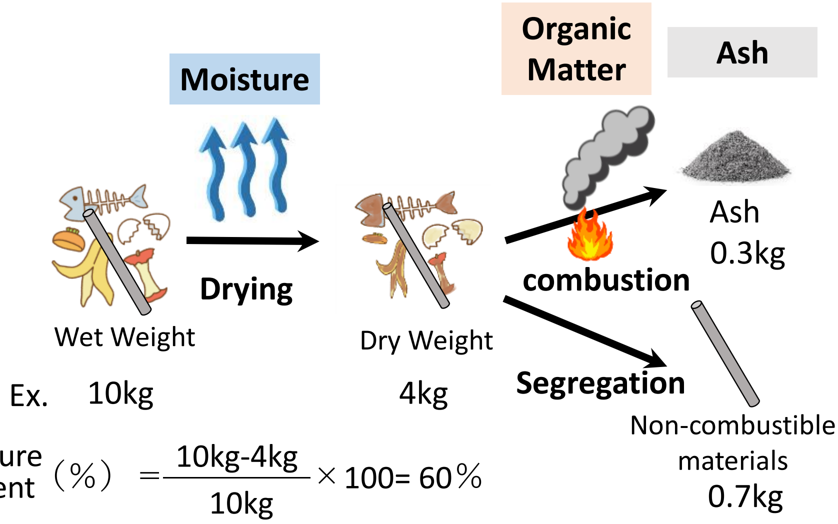
Three Components	Properties and constituent elements
Moisture content	Water（H_2O）
Ash content	The inorganic substance that remains after the complete combustion of a substance. Main elements are potassium (K), calcium（Ca）and magnesium (Mg) .And include small amounts of metallic elements such as iron (Fe), aluminum (Al), zinc (Zn), sodium (Na), copper (Cu), etc.
Combustible content	Organic matter that turns to gas when burned and disappears. It is composed of elements such as carbon (C), oxygen (O), hydrogen (H), nitrogen (N) and phosphorus (P). When heated at high temperatures and with sufficient oxygen supply, it becomes a gas such as carbon dioxide.

Processes such as drying and burning are necessary for determining the actual proportions of the three components of waste. The table below shows the methods of calculating the proportions.

Table 1-13 Calculation Method of the Three Components

Three Components	Calculation method
Moisture content	$\text{Moisture (\%)} = \dfrac{\text{Wet Weight} - \text{Dry Weight}}{\text{Wet Weight}} \times 100$ Calculated by the difference in weight before drying and after drying at 105°C.
Ash content	$\text{Ash (\%)} = \dfrac{\text{Weight of "combustible" residue after drying} + \text{Weight of "non-combustibles"}}{\text{Wet Weight}} \times 100$ Calculated as the sum of the weight of incombustibles and ash remaining after combustion *: All incombustible materials (e.g., iron, stone, etc.) are considered to be non-combustible
Combustible content	$\text{Combustible (\%)} = \dfrac{\text{Wet Weight} - \text{Moisture Weight} - \text{Ash Weight}}{\text{Wet Weight}} \times 100$ Calculated from the difference between the wet weight and the weight of the moisture and ash content

For example, suppose the wet weight of waste is 10 kg, the dry weight is 4 kg, and the ash and non-combustibles after combustion weigh 0.3 kg and 0.7 kg, respectively. In this case, the ratio of the three components to the wet weight can be calculated as shown on the next page. Also, using the Turner triangle shown on the next page it is possible to use the values of the three components to approximate what can be burned without auxiliary fuel when the heating value cannot be measured.

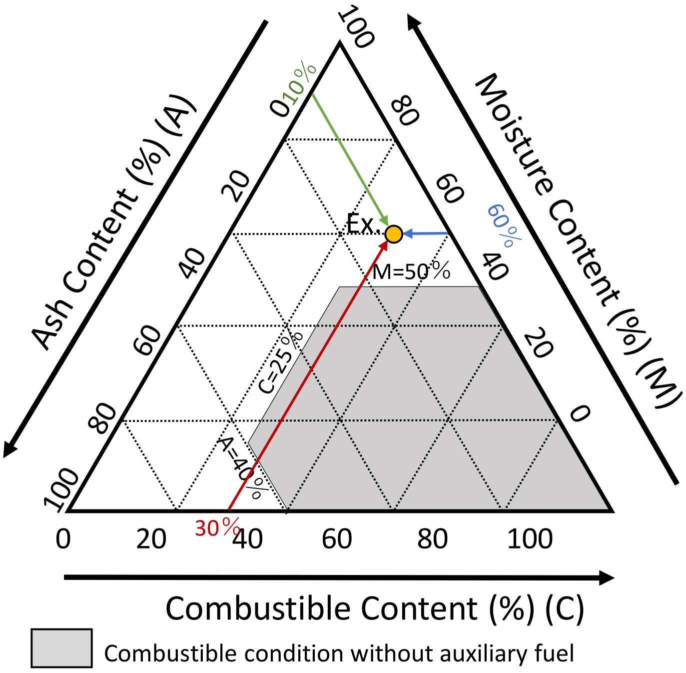


$$\text{Moisture Content (\%)} = \frac{10\text{kg}-4\text{kg}}{10\text{kg}} \times 100 = 60\%$$

$$\text{Ash Content (\%)} = \frac{0.3\text{kg}+0.7\text{kg}}{10\text{kg}} \times 100 = 10\%$$

$$\text{Combustible Content (\%)} = \frac{4\text{kg} - (0.3\text{kg}+0.7\text{kg})}{10\text{kg}} \times 100 = 30\%$$

Figure 1-20 Example of the Calculation of Three Components



Source: World Bank Technical Paper No.462 "Municipal Solid Waste Incineration" (T. Rand, J. Haukohl, U. Marxen 2000)

Figure 1-21 Triangle for Assessment of Combustibility of Waste

2 Waste Management Plans

The Ministry of the Environment uses quantitative figures as basic information when considering the formulation of policies and plans related to waste management, which makes it possible to set numerical targets for policies and the like and to indicate specific plans for developing facilities.

Municipalities use data collected and analyzed in the course of carrying out municipal waste management in areas under their jurisdiction to formulate and implement plans for collection, sorting, facility maintenance, and more. Each of these plans contains basic policies and specific measures for efficient and effective waste generation reduction, waste collection and transport, intermediate treatment, and final disposal, and serves as the basis for carrying out waste management administration.

This section introduces the frameworks and approaches for formulating various plans for waste management at national and local levels, which are based on quantitative data.

2.1 Management of Waste-Related Data

(1) Data Management for the Entire Country

In Japan, the central government collects data from municipalities to create a shared database. The database enables the Ministry of the Environment to understand the circumstances of waste management across the country and municipalities to share information with each other. This allows the Ministry of the Environment to formulate measures and strategies that are in line with the actual circumstance and to promote cooperation between the Ministry and municipalities.

In Japan, the Ministry of the Environment publishes the results of an annual survey on the state of municipal waste management. Since the 1970s the Ministry of the Environment has been conducting a survey in the form of a questionnaire to municipalities and associations for the purpose of obtaining basic data on municipal waste administration. The central government then collects and accumulates the data from municipalities to build a nationwide database, which is characteristic of data management in Japan.

Table 1-14 shows the survey items, which are broadly divided between the conditions of facility operation and the conditions of treatment. The data obtained is aggregated by municipalities in each prefecture, and the statistical tables are available to the public. This data fulfills an important role in examining and setting specific priority targets, achievement indicators, and other criteria when formulating plans for waste management.

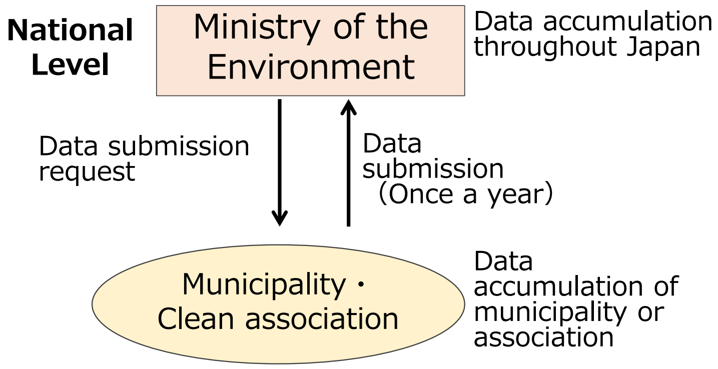


Figure 1-22 Waste Data Collecting System in Japan

Table 1-14 Survey iItems Covered in the Ministry of the Environment Survey on Municipal Waste

Items		Main survey contents
Facility	Incineration plant	Annual treatment amount, Type of waste, Type of facilities and plants, Waste composition, etc.
	Bulky waste treatment facility	Annual treatment amount, Collected resources amount, Type of waste, Type of treatment
	Recycling facility	Annual treatment amount Collected resources amount, Output amount, Type of facilities, etc.
	Fuel conversion facility	Annual treatment amount, Type of waste, Type of facilities, Capacity of facilities, etc.
	Other facilities	Annual treatment amount, Type of waste, Treatment method, Capacity of facilities, etc.
	Storage facility	Annual storage amount, Type of waste, Type of facilities, number of categories, etc.
	Landfill	Capacity, Disposal amount, Remaining landfill capacity, Type of waste, etc.
	Sewage treatment facility	Annual treatment amount, Recycling amount, Type of treatment, Capacity of facilities, etc.
	Small-scale sewage treatment equipment	Sewage treatment amount, Type of treatment, Planned maximum sewage amount, etc.
	Reuse and repair facilities	Annual treatment amount, Area, Targeted items, etc.
Treatment	Waste management status	Total population, Waste generation amount, Waste treatment amount, Disposal amount, etc.
	Waste management system	Collection and transport (Household and Business waste), Number of sorted items, Service fee, etc.
	Treatment of raw sewage	Total population, Service fee, etc.
	Expense	Specific revenue sources (central government disbursements, local government disbursements, etc.), general revenue sources, etc.
	Personnel, machinery, etc.	Number of staff, Number of collection vehicles, Number of outsourced contracts, Number of treatment companies, etc.
	Disaster waste treatment	Treatment amount, Reduction processing rate, Recovered Amount after Intermediate Treatment, etc.
	Expense for disaster waste treatment	Specific revenue sources (central government disbursements, prefectural government disbursements, etc.), general revenue sources, etc.
	Personnel, machinery, etc. for disaster waste treatment	Number of staff (General and technical staff)

Source: Ministry of the Environment Website "Results of the survey on municipal waste management"
https://www.env.go.jp/recycle/waste_tech/ippan/ (accessed January 26, 2022)

(2) Formulation of Various Plans Based on Data

Data collected through surveys on waste can be used not only to set basic policies on waste management, but also as the basis for various plans and policies, including waste collection and transport plans, development plans and life extension plans for facilities, and policies for promoting waste minimization and recycling.

In the course of carrying out waste management, municipalities continuously collect a variety of data and use it to formulate policies and plans for the future.

Waste incineration plants and other intermediate treatment plants and landfill sites in Japan are equipped with scales that automatically weigh and collect data of incoming waste, recyclables (e.g., cans, glass bottles, paper), and disposal waste such as incinerator ash. The amount of waste generated can be ascertained from the amount of incoming waste weighed at waste incineration plants and other intermediate treatment plants or at landfill sites when said treatment plants are not available. Ascertaining the amount of waste generated makes it possible to verify that plants are operating according to plans and staying within their treatment capacities. Additionally, combining the amount of waste generated with other data such as demographic trends makes it possible to project amounts of waste generated in the future. This ability to project amounts of waste generated makes it possible to examine the number of collection vehicles, the treatment capacity of incineration and other forms of intermediate treatment, and the remaining disposal capacity (remaining service life) of landfill sites, which enables the review of waste collection and transport plans and the formulation of plans for developing intermediate treatment plants and landfill sites.

The results of waste composition surveys can be used to develop an understanding of the types and amount of waste, making it possible to verify whether the quality of the waste meets the design conditions for intermediate treatment plants or whether it causes problems with the plants' functions. Additionally, identifying recyclable items makes it possible to formulate policies and plans for recycling and resource circulation.

Regarding surveys of the three components and heating values of waste, the results for combustibles demonstrate the combustibility of the waste, while the results for ash content make it possible to estimate incineration residue; therefore, survey results make it possible to estimate waste combustion efficiency and final disposal amounts.

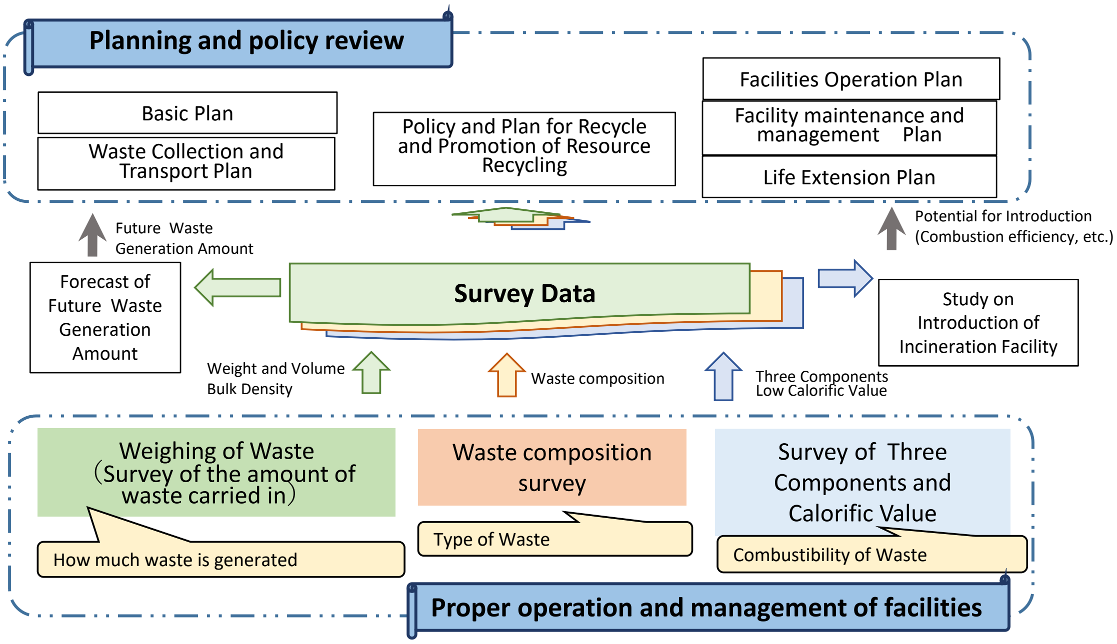


Figure 1-23 Examples of Utilization of Waste Survey Data

2.2 National-Level Waste Management Plans

Plans formulated by the central government clearly set out specific numerical targets and implementation items for the target fiscal year. The data collected by the central government from municipalities is used in the plans, which set out policy for waste management at the national level.

(1) Fundamental Plan for Establishing a Sound Material-Cycle Society

The Fundamental Plan for Establishing a Sound Material-Cycle Society goes beyond the framework of waste to outline the sound material-cycle society Japan should aim to become, and includes matters such as ensuring material circulation in society, curtailing natural resource consumption, and reducing environmental impact. Because the plan presents the basic policy of the central government, municipalities have a clear idea of the vision for each area and how they should go about achieving it.

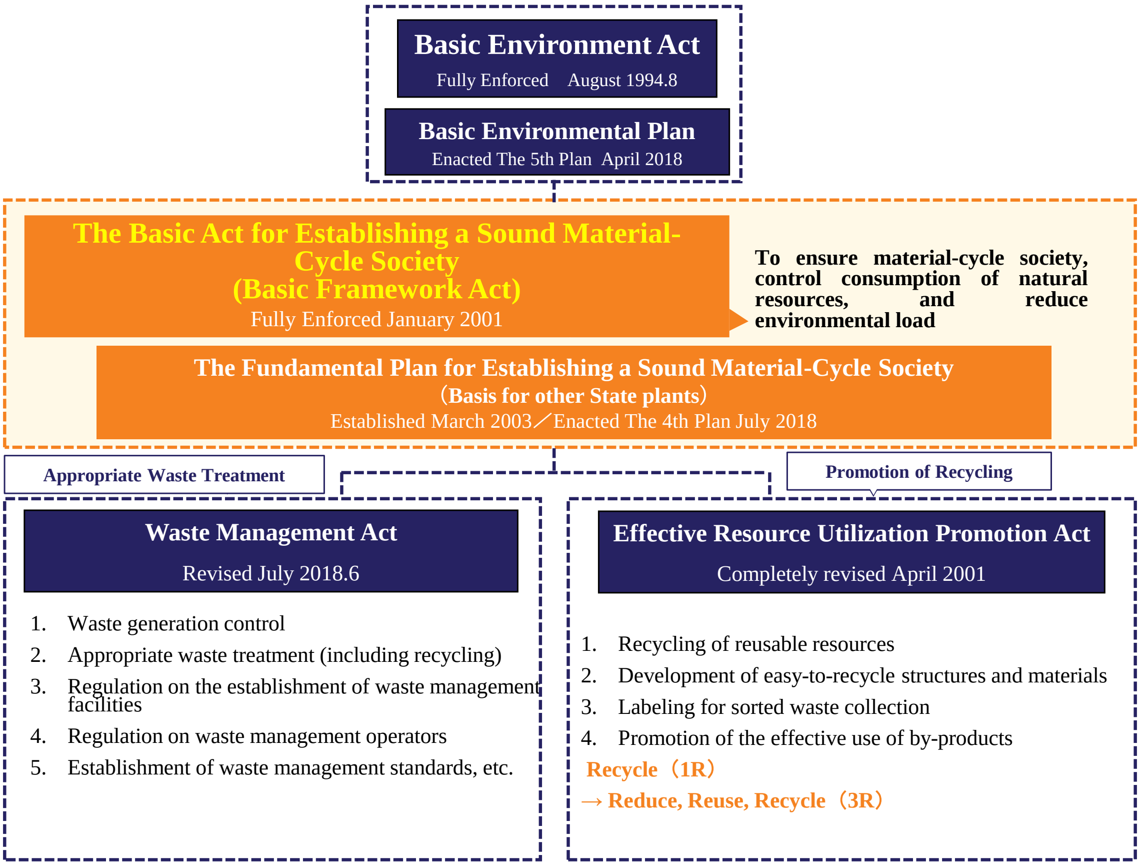
The plan lists priority targets for resource productivity, that include among others the ratio of recycled resources to natural resources used, the final disposal amount, and sets out specific future targets in the form of numerical values.

Figure 1-24 shows the positioning of the Fundamental Plan for Establishing a Sound Material-Cycle Society, which was developed to comprehensively and systematically promote measures for forming a sound material-cycle society founded on the *Basic Act on Establishing a Sound Material-Cycle Society* (for more details on the *Basic Act on Establishing a Sound Material-Cycle Society*, refer to Topic 2-2 (2): Basic Act for Establishing a Sound Material-Cycle Society).

The Fundamental Plan for Establishing a Sound Material-Cycle Society is updated every five years, and the Fourth Fundamental Plan for Establishing a Sound Material-Cycle Society was formulated in 2018. This fourth iteration of the plan sets out visions, initiatives, and indicators for each of seven pillars (e.g., integrated efforts to create a sustainable society, regional revitalization through the formation of a Regional Circular and Ecological Sphere) with the aim of resolving the issues in the area of recycling listed below. Table 1-15 is an overview of the Fourth Fundamental Plan for Establishing a Sound Material-Cycle Society.

Issues in the Area of Recycling in Japan

- Restoration and recovery from environmental contamination caused by radioactive materials released from nuclear power plant accident
- Frequent occurrence of major disasters, and delayed countermeasures
- Changes in people’s focus (from material wealth to spiritual wealth)
- Securing the leaders of resource circulation and proper treatment



Source: Ministry of the Environment "Fourth Fundamental Plan for Establishing a Sound Material-Cycle Society" (2018)

Figure 1-24 Position of the Fundamental Plan for Establishing a Sound Material-Cycle Society

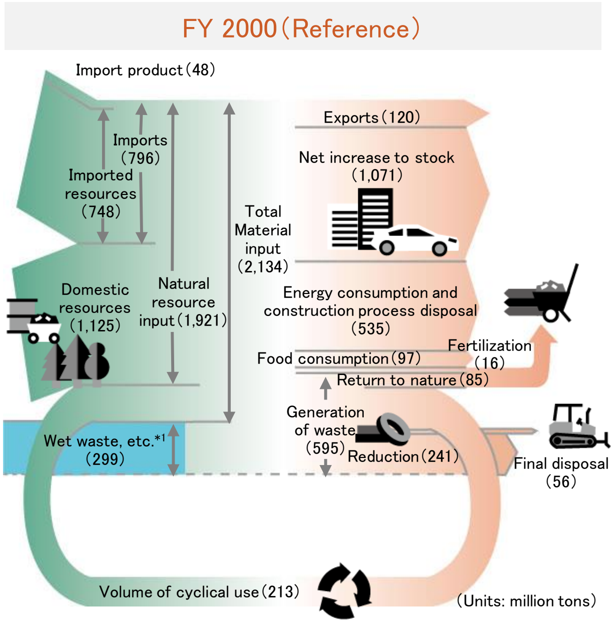
Table 1-15 Overview of the Fourth Fundamental Plan for Establishing a Sound Material-Cycle Society

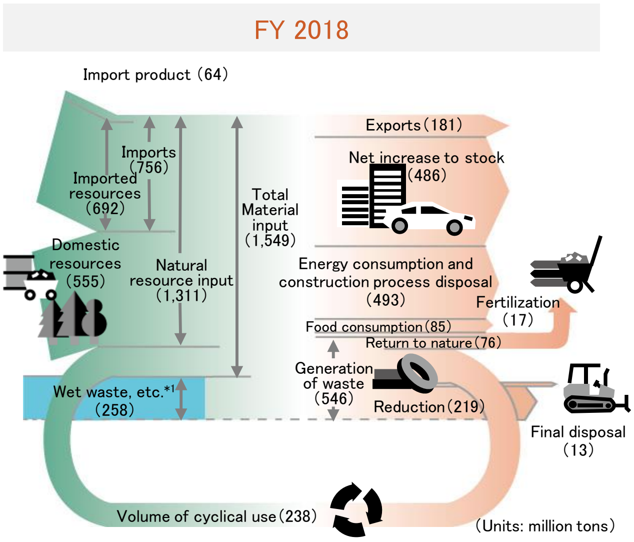
Item	Description
Overview	The plan was established to comprehensively and systematically promote measures for forming a sound material-cycle society based on the *Basic Act on Establishing a Sound Material-Cycle Society*.
Formulation date	June 2018 (updated every five years (previously updated in 2003, 2008, and 2013))
Plan duration	Five years from FY2018 to FY2022
Implementation items	1. Integrated efforts to create a sustainable society 2. Regional revitalization through the formation of a Regional Circular and Ecological Sphere 3. Thorough resource circulation throughout product lifecycle 4. Promotion of proper treatment, and environmental restoration 5. Establishment of a disaster waste treatment system 6. Establishment of a proper international resource circulation system, and overseas expansion of the recycling industry 7. Infrastructure development in the area of recycling
Priority targets (FY2015 to FY2025)	・Resource productivity*1: From JPY 380,000/ton to JPY 490,000/ton ・Inflow ratio of recycled resources to natural resources used*2: 16% to 18% ・Outflow ratio of recycled resources to natural resources used**3: 44% to 47% ・Final disposal amount: 14 million tons to 13 million tons (3 million tons of municipal waste, 10 million tons of industrial waste) ・Expansion of sound material-cycle society business markets: Roughly double the FY2000 level (JPY 40 trillion) by FY2025 ・Reduction of household food loss: Half of the FY2000 level (4.33 million tons) by FY2025 ・Amount of waste generated per person per day: From 925 g/person/day (FY2016) to 850 g/person/day ・Amount of household waste generated per person per day: From 507 g/person/day (FY2016) to 440 g/person/day ・Remaining life of landfill sites: Municipal waste: Maintain above 20 years in FY2022 Industrial waste: Roughly 10 years by FY2020 ・Rate of formulation of disaster waste treatment plans: Prefectures: From 43% to 100% Municipalities: From 21% to 60% ・Electronic manifest diffusion rate: From 53% (2017) to 70% (2022) ・Rate of implementation of specific 3R actions: Increase 20% by FY2025 from the level in the FY2012 public opinion survey

*1: Resource productivity = GDP / Natural resource input
*2: Inflow ratio of recycled resources to natural resources = Amount of recycled resources used / (Input of natural resources + Amount of recycled resources used)
*3: Outflow ratio of recycled resources to natural resources = Amount of recycled resources used / Amount of waste generated
Source: Ministry of the Environment "Fourth Fundamental Plan for Establishing a Sound Material-Cycle Society" (2018)

Column: Material Flow in Japan

The first step in establishing a sound material-cycle society is knowing the amount of resources being extracted, consumed, and disposed of. Material Flow Analysis (MFA) is the basis for the overall vision of material flow in Japan's economy and society (FY2000 and FY2018) and the target values for material flow indicators set in the Fourth Fundamental Plan for Establishing a Sound Material-Cycle Society.





*Wet waste, etc.: Input of water included in waste and the like (sludge, livestock waste, night soil, waste acid, waste alkali) and sediments dumped in the process of economic activities (sludge in mining, construction and in waterworks as well as slag)

Source : Ministry of the Environment Website "Annual Report on the Environment, the Sound Material-Cycle Society and Biodiversity in Japan 2021" (2021)

Figure 1-25 Material Flow Analysis in Japan

Resource Productivity

Resource productivity is indicated by GDP (the total value added of goods and services produced within a defined period of time) in terms of the amount of natural resource input. The aim is to provide more goods and services with less resource input.

Inflow Ratio of Recycled Resources to Natural Resources Used

While materials become waste on the outflow side, they are material input on the inflow side. In other words, the inflow ratio of recycled resources to natural resources used is the ratio of the amount of recycled resources in terms of the total amount of material input.

Outflow Ratio of Recycled Resources to Natural Resources Used

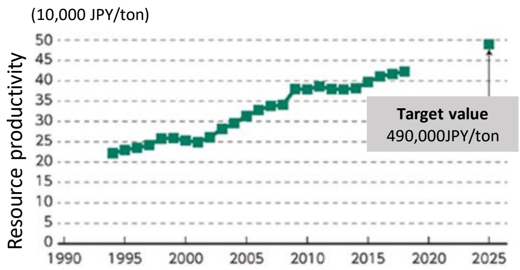
This is the ratio of the amount of recycled resources in terms of the total amount of waste generated.

Final Disposal Amount

This is the amount of waste disposed of in landfill sites or otherwise dumped.

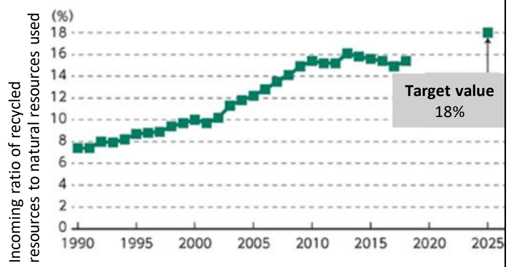
Resource Productivity

(= GDP*1/ Natural resources ,etc. input)



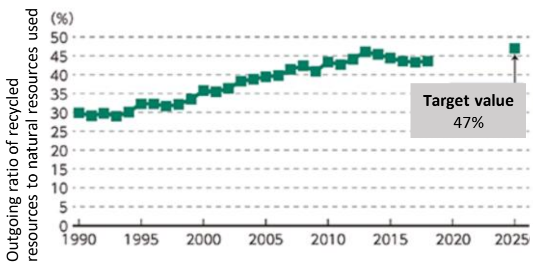
Inflow Ratio of Recycled Resources to Natural Resources Used

(= Cyclical amount used/(Natural resources, etc. input + cyclical amount used))



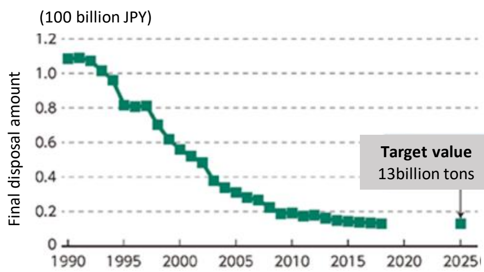
Outflow Ratio of Recycled Resources to Natural Resources Used

(= Cyclical amount used/ Waste generation Amount)



Final Disposal Amount

(= Waste disposal amount)



*1: GDP: Gross Domestic Product

*2: Due to a revision of the method for estimating inflow and outflow ratios of recycled resources, the figures for FY2016 and later were estimated differently than those for and before FY2015.

Source : Ministry of the Environment Website "Annual Report on the Environment, the Sound Material-Cycle Society and Biodiversity in Japan 2021" (2021)

Figure 1-26 Resource Productivity, Inflow and Outflow Ratios and Final Disposal Amount

(2) Waste Management Facility Development Plan

The Waste Management Facility Development Plan is a plan for the development of facilities for the treatment and disposal of waste. However, recently various functions have been demanded of these facilities in addition to proper waste treatment. The plans includes interaction with the local community, response to social structural changes, and disaster countermeasures. For this reason, the plan provides specific figures for the recycling rate, remaining life of the disposal facility, average incineration power generation efficiency, and the percentage of waste derived energy supplied externally as priority targets.

The Waste Management Facility Development Plan defines the targets and outline of the waste management facility development project for the planning period, based on the *Waste Management Act*. The Waste Management Facility Development Plan is updated every five years, and the plan formulated in 2018 emphasizes the development of waste management facilities that create new value for the region, in addition to the promotion of the 3Rs and proper treatment, climate change countermeasures, and strengthening of disaster countermeasures, which have been addressed in the past. Furthermore, in light of changes in the social structure surrounding waste treatment, such as a declining population, the plan also describes the soft measures necessary for the proper operation of waste treatment facilities. The outline of the waste treatment facility development plan (formulated in 2018) is shown in Table 1-16.

Table 1-16 Outline of the Waste Management Facility Development Plan (Formulated in 2018)

Item	Contents
Outline	The plan defines the targets and outline of the waste management facility development project for the planning period, based on the *Waste Management Act*.
Date of formulation	June 2018 (formulated every five years – introduced in 2003, and revised in 2008, and 2013)
Plan period	Five-year period from FY 2018 to FY 2022
Basic philosophy	1. Promote the 3Rs based on basic principles 2. Ensure a municipal waste treatment system that is resilient and safe against climate change and disasters 3. Develop municipal waste treatment facilities that take advantage of local autonomy and ingenuity
Implementation items	1. Promotion of 3Rs through municipal waste treatment systems for municipalities 2. Stable and efficient development and operation of facilities to ensure sustainable and appropriate treatment 3. Promotion of climate change measures in waste treatment systems 4. Promotion of the utilization of waste biomass 5. Strengthening disaster countermeasures 6. Development of waste treatment facilities that create new value for the region 7. Securing the understanding and cooperation of local residents, etc. 8. Ensuring proper bidding and contracting for construction work related to waste treatment facility development
Priority targets (FY2018↓ FY2022)	Waste recycling rate: 21%→27% ・Remaining life of landfill sites for municipal waste: Maintain the level of FY2017 (20 years) ・Average power generation efficiency of waste incineration facilities constructed during the period: 19% → 21% ・Percentage of facilities supplying energy from waste to external sources: 40% → 46% ・Population penetration rate of septic tanks in septic tank improvement areas: 53% → 70%. ・Percentage of combined treatment septic tanks: 62% → 76% ・Greenhouse gas reduction due to the introduction of energy-saving septic tanks: 50,000 t-CO_2 → 120,000 t-CO_2

Source: Ministry of the Environment "Waste Management Facility Development Plan" (2018)

2.3 Plan for Waste Management at the Municipality Level

Municipalities, which are responsible for the practical management of waste, formulate their own plans according to the plans and policies formulated by the central government. Because each municipality is responsible for the realization of the plan (for example, implementation of collection work, construction of facilities, etc.), it is necessary to formulate a plan that is feasible according to the actual situation. Accumulated data and data from other municipalities are being utilized for this purpose.

Based on the numerical data, measures to be taken and their effectiveness (emission control, reduction, and public awareness) will be considered, and necessary facilities will be planned.

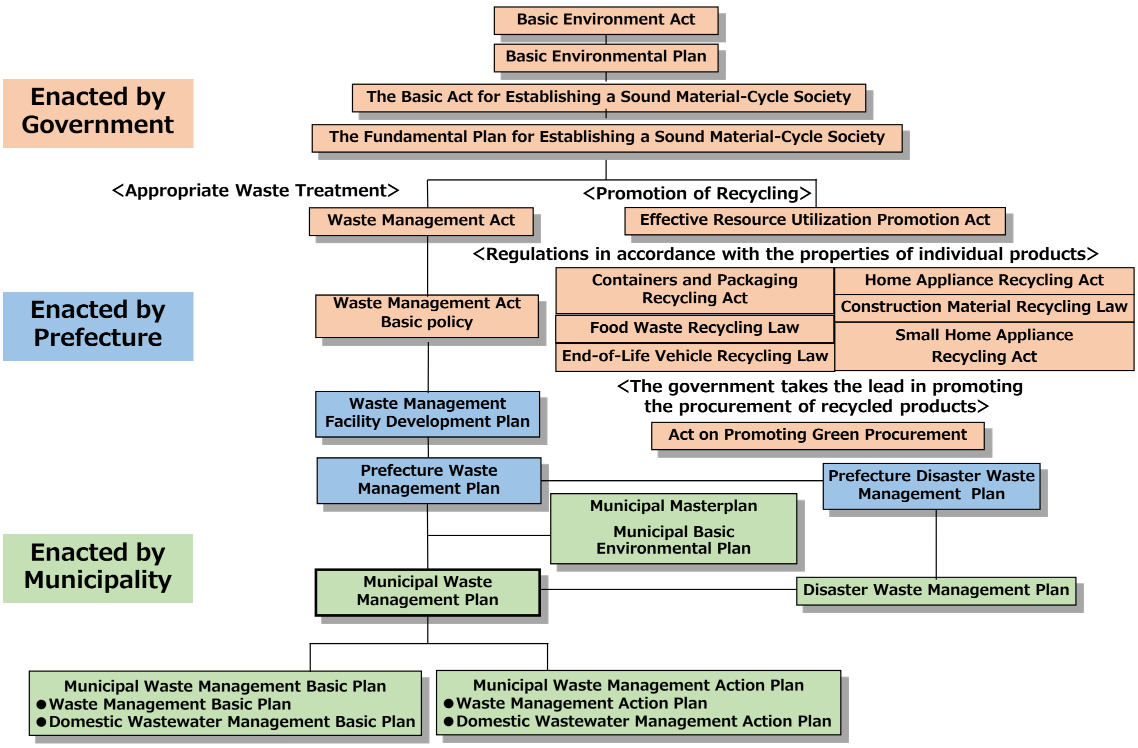
Based on the various laws and plans at the national level, plans for waste management at the municipality level are formulated (as of 2020, 1,741 municipalities: 23 special wards, 792 cities, 743 towns, and 183 villages). The central government prepares guidelines and manuals for each municipality to formulate their plans. Each plan has a set period of time, and a new plan is developed for every set period of time (5 years, 10 years, etc.).

Municipalities develop not only plans required by law, but also action plans such as implementation plans, which are designed to promote activities through cooperation between the administration and local residents. Municipalities that formulate a variety of plans disclose information on draft plans on their websites, and collect public comments on the plans in order to enhance the practicability of the plans. Medium and long-term plans are periodically reviewed to maintain highly feasible plans in line with social conditions, and that the plans are being reliably implemented.

Main items to be analyzed and calculated in the plan based on basic data related to waste (waste amount and composition) are shown below.

- Projected future waste amount
- Amount of waste to be collected, treated, and disposed of in the future
- Number of collection vehicles required for collection in the target area
- Amount of waste that can be recycled in the target area
- Treatment capacity of intermediate treatment (incineration facilities, etc.)
- Landfill disposal capacity of landfill sites

The relationship between the various laws and the plans is shown below in Figure 1-27.



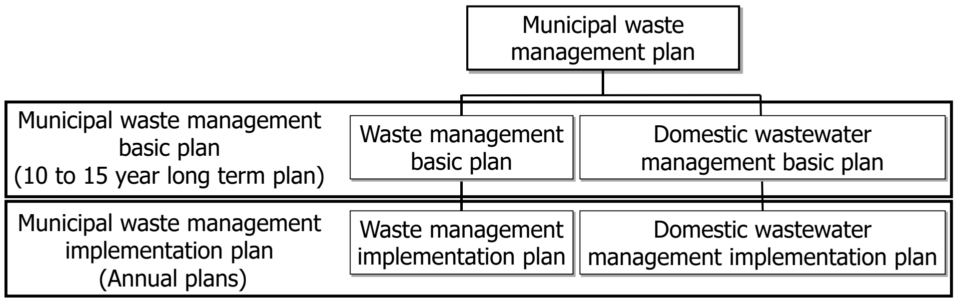
Source: Ministry of the Environment "Waste Management Basic Plan Formulation Guidelines" (2016)

Figure 1-27 Relationship between Various Laws and Plans

(1) Municipal Waste Management Plan

The municipal waste management plan shown in Figure 1-27 is based on the *Waste Management Act*, and is set by the municipality regarding the municipal waste management plan in the area of the municipality. The outline of the municipal waste management plan is shown in Table 1-17. There is a basic long-term plan for 10 to 15 years and an implementation plan that is set for each fiscal year. The long-term plan will be reviewed every five years based on the status of achievement of the plan.

Table 1-17 Outline of the Municipal Waste Management plan

Item	Contents
Outline	Based on the *Waste Management Act*, the municipality establishes a plan for municipal waste disposal in the area of the municipality in order to properly dispose of general waste while preserving the living environment and improving public health, which are the objectives of the Act.
Scope of application	All areas within the municipality
Target	All municipal waste generated in the municipality (including municipal waste to be disposed of under the instructions of the municipality, by large waste generators and by parties other than the municipality)
Plan structure	
Contents of each plan	**[Municipal waste management basic plan]** Clarifies the basic policy from a long-term perspective, the future social and economic conditions surrounding waste treatment, the expected generation of municipal waste, local development plans, and the demands of local residents. In addition to the above, the development of municipal waste treatment facilities and systems, and the securing of financial resources are fully considered. Then, realistic and concrete measures to realize them are comprehensively examined. [Items specified in the waste management basic plan] 1. Estimated amount of waste generated and treated → Refer to column on next page 2. Matters related to measures to reduce waste discharge 3. Types and categories of waste collected separately 4. Basic matters concerning the proper treatment of waste and the persons who carry out such treatment 5. Matters concerning the development of waste treatment facilities 6. Other necessary matters concerning waste treatment **[Municipal waste management implementation plan]** The plan must be formulated annually based on the municipal waste management basic plan, and clarify the status of general waste discharge, treatment entities, collection plan, intermediate treatment plan, and final disposal plan. Municipalities must conduct collection, transportation, and disposal based on this plan.

Source: Ministry of the Environment "Waste Management Basic Plan Formulation Guidelines" (2016)

Column: Projecting the Future Amounts of Waste Generated and Treated

According to the Ministry of the Environment's Waste Management Basic Plan Formulation Guidelines (2016), the methods for future projections of waste generation and treatment are as follows.

(1) Future Projections of Population and Business Activities, etc.

A. Future Projections of Population

It is appropriate to use the trend method*[1] or the cohort factor method*[2] to project the future population. It is also possible to use the projected future population as indicated in the basic concept of the municipality.

B. Future Projections of Business Activities, etc.

Concerning business waste, it is desirable to make the forecast considering the relevant conditions, such as changes in the number of employees and business establishments and shifts in economic conditions.

(2) Future Projections of Waste Generation Amount

First, make an estimate of how the amount of waste generated will change in the future if the control of waste discharge and recycling is not promoted, and improvements toward the formation of a sound material-cycle society are not made.

As a projection method, the amount generated per person per day (g/person/day) can be calculated based on past results, and the actual results can be estimated in the future using methods such as the trend method*[1], and then multiplied by the projected future population to forecast the amount generated.

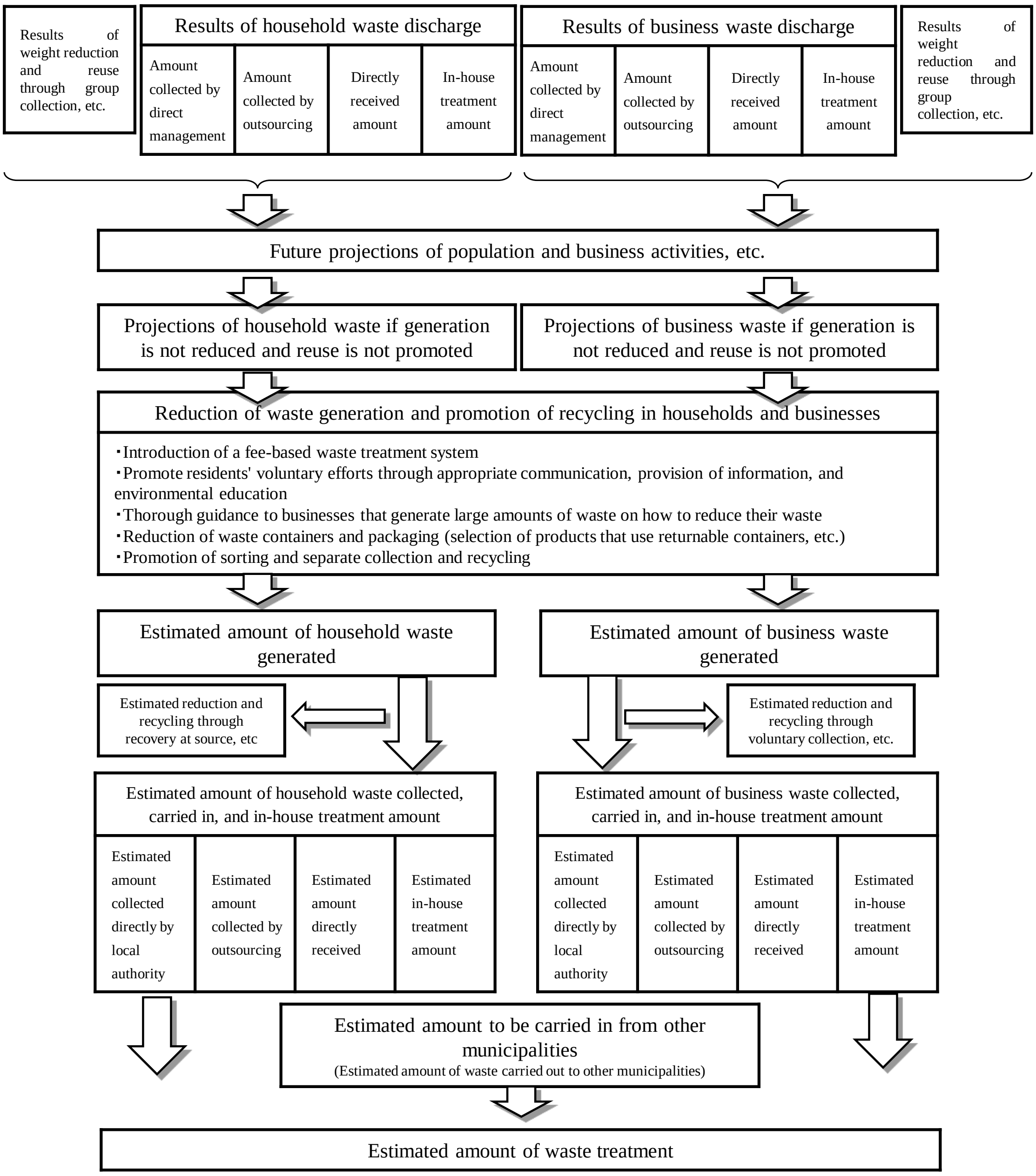
Next, it is necessary to set targets based on the policies to be implemented to reduce waste generation and promote recycling in households and business establishments. Specifically, targets for the amount of waste produced are set based on the effects of generation control through the introduction of fee-based waste treatment and the implementation of public awareness programs. The target values for recycling must be set based on changes in the classification of waste sorting and separate collection.

Based on the above, the amount of waste generated by type of waste (for example, combustible waste, non-combustible waste, recyclables, bulky waste, specially-controlled general waste, etc.) after achieving the set target, is projected after considering the effects of measures for each type of waste, such as collection (directly or outsourced), directly received at the recycling facility, and group collection.

In order to clarify the treatment systems and quantities to achieve the target values, it is desirable to prepare a flow diagram showing the quantities from discharge to recycling and final disposal in the target year or intermediate target year.

Preparation of a time-series graph to compare the forecast values in the case where the current situation is maintained without the previously considered improvements toward the formation of a sound material-cycle society, and the target values to be achieved through various measures, will make it easier to explain to residents.

*1: The trend method is a type of chart analysis that focuses on the chronological changes, such as rising, falling, and leveling off, to forecast the amount generated in the future.
*2: The cohort factor method is a method for calculating the future population by calculating the annual changes in the population by age for each demographic factor (death, birth, and population movement).



*: With regard to waste collection, it is desirable to classify recyclables into paper, metal, glass, and plastic containers and packaging in order to set targets for resource recycling and reuse, as well as to estimate the amount of waste discharged by type (combustible, noncombustible, recyclables, etc.), corresponding to separate collection.
Source: Ministry of the Environment "Waste Management Basic Plan Formulation Guidelines" (2016)

Figure 1-28 Examples of Methods for Projecting the Future Amount of Waste Generated and Treated

(2) Municipal Separate Collection Plan

The municipal separate collection plan is set by municipalities for implementing separate collection of waste containers and packaging based on the *Containers and Packaging Recycling Act*. The plan is formulated every three years for a five-year term, and has been formulated nine times since 1997.

An outline of the 9th Municipal Separate Collection Plan is shown in Table 1-18. The total number of municipalities is 1,741 (including special cities) and all of them have formulated their respective 9th Municipal Separate Collection Plan, and it is expected that all municipalities will carry out some kind of waste containers and packaging separate collection during the five years from FY2020 to FY2024.

Table 1-18 Outline of the 9th Municipal Separate Collection Plan

Item	Contents
Outline	Set by municipalities for implementing separate collection of waste containers and packaging based on the *Containers and Packaging Recycling Act* and the *Plastic Resource Recycling Promotion Act*.
Plan period	Five-year period from FY 2020 to FY 2024
Scope of application	All municipalities can formulate municipal separate collection plans at their own discretion. (Disposal of municipal waste is an autonomous task of municipalities, and separate collection is not mandatory, but instead introduced and implemented based on local conditions.)
Target of separate collection	Article 2 of the Ministerial Ordinance on the Separate Collection of Containers and Packaging Waste (Ordinance of the Ministry of Health and Welfare No. 61 of 1995) stipulates the following categories for sorting in consideration of the promotion of recycling: steel containers, aluminum containers, glass containers (sorted into three colors: colorless, brown, and other), paper beverage containers, cardboard containers, paper containers and packaging, PET bottles, plastic containers and packaging (only white styrofoam food trays can be sorted and collected).
Matters to be formulated	・Projected amounts of waste containers and packaging to be discharged in each fiscal year ・Matters related to measures to promote reduction of waste containers and packaging discharged ・Type of waste containers and packaging that are to be sorted and collected and the classification of sorting pertaining to collection of the waste containers and packaging ・The amount of waste containers and packaging that conform to the specified sorting standards obtained in each fiscal year and the expected amounts of waste containers and packaging specified by the ordinance of the competent ministry prescribed in Article 2, paragraph 6 of the *Containers and Packaging Recycling Act* (steel containers, aluminum containers, glass containers (colorless, brown, etc.), cardboard, paper containers for beverages, paper

Item	Contents
	containers and packaging, PET bottles, plastic containers and packaging) ・Basic matters concerning the party that implements separate collection ・Matters related to the development of facilities used for separate collection ・Other important matters concerning implementation of separate collection of waste containers and packaging
Projected implementation of separate collection	Pet bottles FY2020: 1,724 municipalities (99.0%) → FY2024: 1,724 municipalities (99.0%) Estimated amount of separate collection: 312,000 tons → Estimated amount of separate collection: 317,000 tons Plastic containers FY2020: 1,390 municipalities (79.8%) → FY2024: 1,398 municipalities (80.3%) Estimated amount of separate collection: 726,000 tons → Estimated amount of separate collection: 726,000 tons Paper containers and packaging* FY2020: 863 municipalities (49.6%) → FY2024: 865 municipalities (49.7%) Estimated amount of separate collection: 101,000 tons → Estimated amount of separate collection: 103,000 tons

*: In addition to the above-mentioned 865 municipalities (FY2024) that have positioned paper containers and packaging in their separate collection plans, there are many municipalities that collect paper containers and packaging as miscellaneous waste, etc., together with paper other than containers and packaging for recycling.

Source: Ministry of the Environment, "Guide to Formulating Municipality Separate Collection Plans (Ninth Revised Edition)" (2019).
Ministry of the Environment Website, "Results of the Estimated Amount of Separate Collection From 2020 Based on the Containers and Packaging Recycling Act" https://www.env.go.jp/press/107515.html (accessed January 30, 2022) https://www.env.go.jp/press/107515.html (accessed January 30, 2022)

(3)　Inter-Municipal Waste Treatment Plan

Inter-municipal waste treatment refers to the practice when several municipalities jointly implement the treatment and disposal of waste, thereby reducing the environmental burden and costs.

Since the issuance of the plan titled "Regarding the Inter-municipal Waste Treatment Plan" (Ministry of Health and Welfare, May 28, 1997), all prefectures have formulated plans for inter-municipal waste treatment, and prefectures and municipalities have been making efforts for inter-municipal waste treatment and the consolidation of waste treatment facilities.

As a result, a total of 438 blocks for inter-municipal waste treatment were established nationwide (as of 2020). As of 2013, the number of waste incineration facilities in 245 of these blocks had decreased compared to the time when the plan was formulated, and a certain degree of success has been achieved in terms of inter-municipal waste treatment and consolidation. On the other hand, there have been cases where inter-municipal waste treatment and consolidation have not advanced due to factors such as the belief that there is little merit in doing so and the difficulty in coordinating among municipalities and with residents.

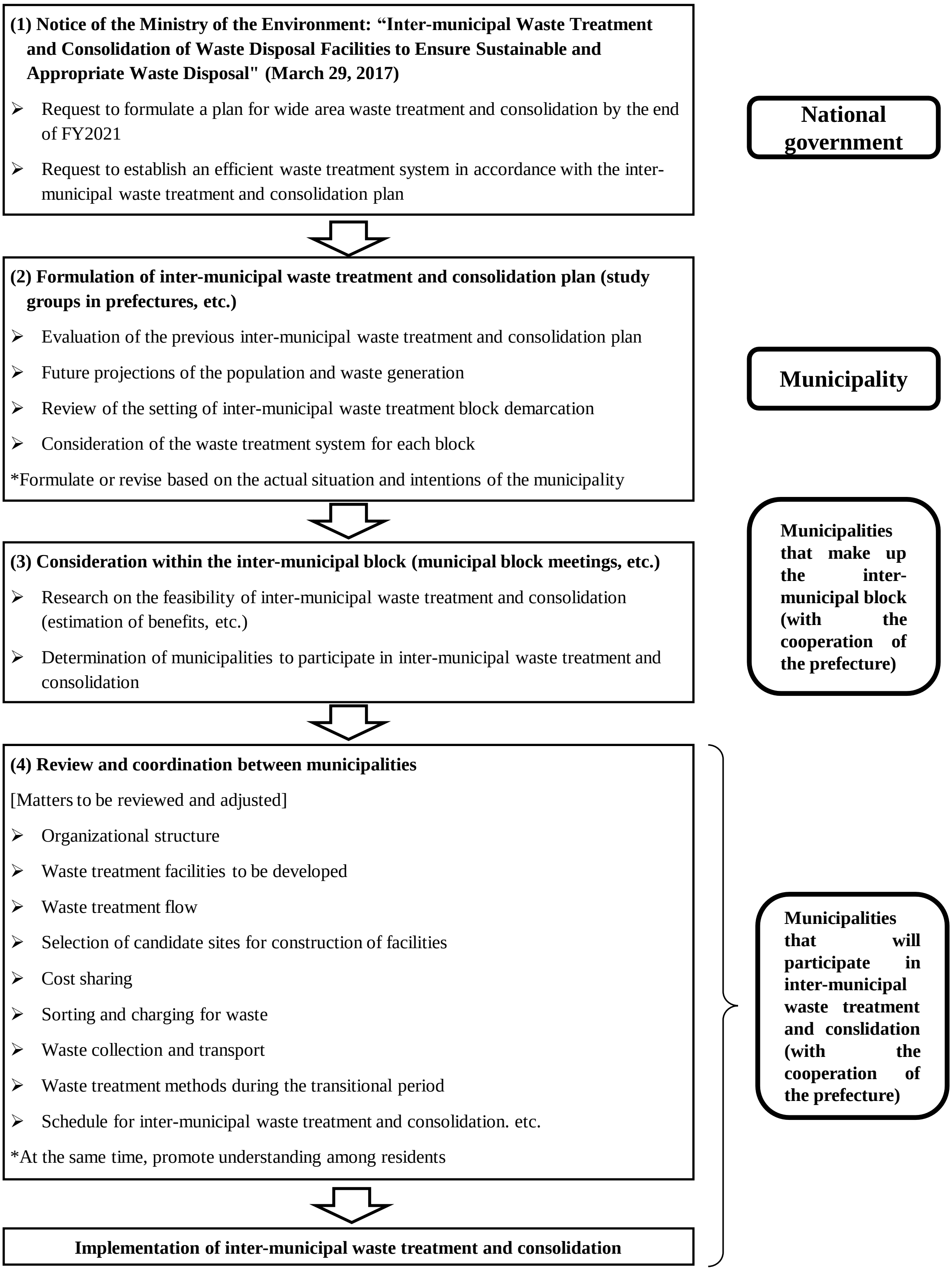
Japan's population is currently in a declining stage, and it is expected that the financial position of the national and municipalities will become more difficult and that there will be a shortage of manpower for waste treatment. In addition, the total amount of waste generated is also on a downward trend, making it extremely difficult to continue with the conventional waste treatment system. The inter-municipal waste treatment plan has been formulated based on the fact that it will be necessary to consider a stable and efficient waste treatment system from a medium to long-term perspective. An outline of the inter-municipal waste treatment plan is shown in "Guidance on Inter-municipal Waste Treatment and Consolidation", prepared by Ministry of the Environment, in 2020.

Table 1-19 provides an outline of the inter-municipal waste treatment system, and Figure 1-29 shows the flow of efforts needed to develop inter-municipal waste treatment and consolidation and the implementing bodies for these efforts (for more details on inter-municipal waste treatment, refer to "Topic 2-3.4: Inter-Municipal Waste Disposal").

Table 1-19 System of Inter-Municipal Waste Treatment Plan

Item	Contents
Outline	The prefecture and the municipalities in its jurisdiction collaborate to formulate an inter-municipal waste treatment and consolidation plan.
Plan period	In principle 10 years
Necessity of the inter-municipal waste treatment	(1) Ensure sustainable and appropriate treatment ・Establishment of a stable and efficient waste treatment system ・Renewal of aging waste treatment facilities ・Improving the cost efficiency of waste treatment ・Securing human resources and transfer of technology through cooperation among prefectures and municipalities (2) Promotion of climate change measures ・Energy conservation at waste treatment facilities ・Recovery and utilization of waste energy (3) Promotion of waste recycling and biomass utilization ・Utilization of waste biomass (4) Strengthening disaster countermeasures ・Ensuring the continuity of waste treatment operations in the event of a disaster ・Focusing investment on strengthening facilities and systems (5) Creation of new value for the region
Inter-municipal Waste Treatment Plan Contents	(1) Plan period (2) Creation of an inter-municipal waste treatment block demarcation (3) Waste treatment system in each block (4) Estimation of current and future emissions of dioxins (5) Waste treatment methods during the transitional period until the completion of inter-municipal waste treatment (6) Where to use RDF when it is produced (7) Other matters (transportation method, amount recycled, amount of waste generated, sorting method, etc.) (8) How to follow up on the inter-municipal waste treatment plan
Points to consider when formulating the plan	・The body that formulates the plan ・Evaluation of the previous inter-municipal waste treatment plan ・Future projections of the population and waste generation ・Review of the setting of inter-municipal waste treatment block demarcation ・Consideration of the waste treatment system for each block

Source: Ministry of the Environment "Guidance on Inter-municipal Waste Treatment and Consolidation" (2020)



Source: Ministry of the Environment "Guidance on Inter-municipal Waste Treatment and Consolidation" (2020)

Figure 1-29 Action Flow and Actors for Inter-Municipal Waste Treatment and Consolidation

2.4 Plan for the Development of Waste-related Facilities

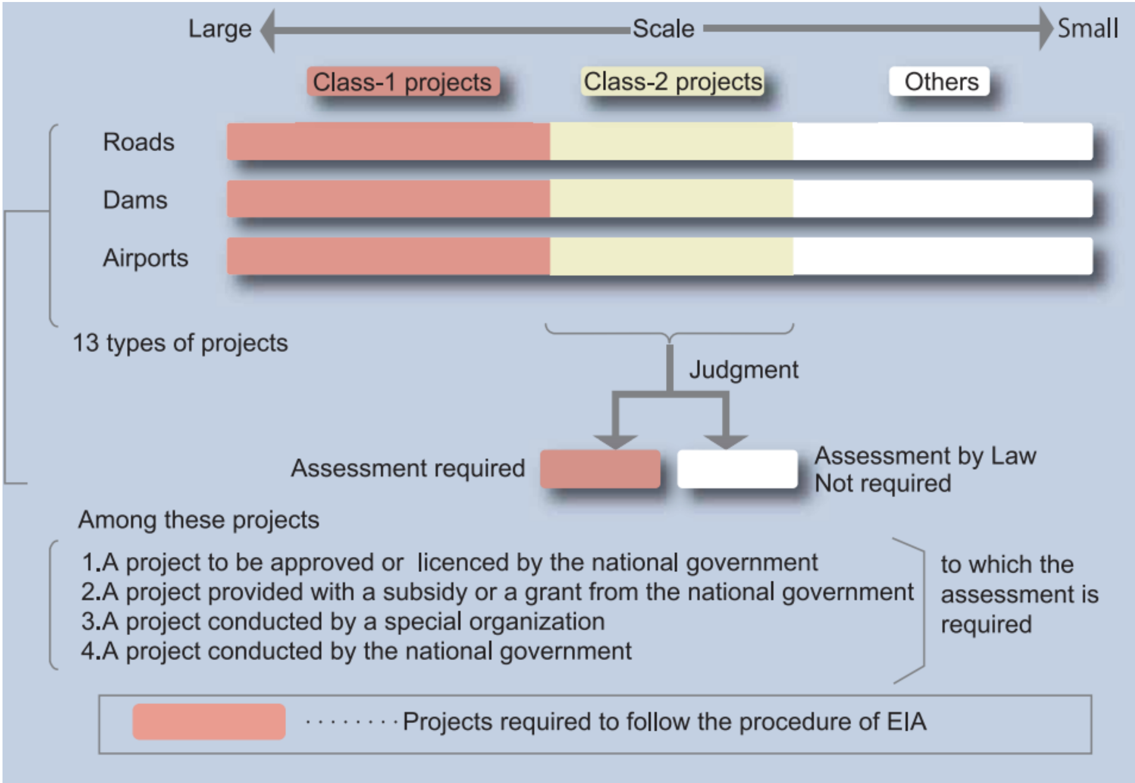
(1) Technical Guidelines for Environmental Impact Assessment

Environmental assessments in Japan are broadly classified into four types of assessments, including legal assessments, and the content of the assessment differs depending on the type and scale of the project. The information necessary for implementation of an assessment, such as the flow of assessment and items to be surveyed, is provided in detail in the guidelines. As for the field surveys conducted for the assessment, detailed measurement methods are defined.

When developing a facility such as a waste incineration plant or a landfill site, an environmental assessment is often conducted to investigate, predict, and evaluate the environmental impact on the surrounding area. The implementation of environmental assessment also plays an important role in building consensus with the surrounding residents. In Japan, as shown in the table below, there are four types of assessment: 1) assessment based on the *Environmental Impact Assessment Act*, 2) assessment based on local government ordinances, 3) assessment based on the *Waste Management Act*, and 4) voluntary assessment.

1) Assessment based on the Environmental Impact Assessment Act

Thirteen (13) types of projects are identified in the *Environmental Impact Assessment Act* as targets of this assessment. Depending on the scale of the target facility, there are two main types of projects: Class 1 projects are those for which environmental assessment is mandatory, and Class 2 projects are those for which the need for environmental assessment is judged individually, as shown in the following figure. A landfill site is classified as a Class 1 project for an area of 30 ha or more, and a Class 2 projects for an area of 25-30 ha. On the other hand, intermediate treatment facilities (incineration plants, etc.) are not subject to assessment under the *Environmental Impact Assessment Act*.



Source: Ministry of the Environment "Environmental Impact Assessment in Japan" (2020)

Figure 1-30　Projects Subject to the Environmental Impact Assessment Act

2) Assessment Based on Local Government Regulations

For projects that are not required to be assessed under the *Environmental Impact Assessment Act*, an environmental assessment must be conducted if the project is subject to the assessment ordinance of the municipality. Each municipality has its own environmental assessment ordinance that defines the scale of projects that require environmental assessment, and also establishes technical guidelines for environmental impact assessment to ensure that environmental impact assessment and post-implementation studies of waste treatment facilities are properly conducted based on scientific knowledge.

3) Assessment Based on the Waste Management Act

Table 1-20 shows an outline of the Guidelines for Living Environment Impact Studies for Waste Treatment Facilities, which show how to conduct assessments based on the *Waste Management Act*. These guidelines cover items related to people's lives, such as air quality, noise, and odor, as the living environment.

Table 1-20 Outline of the Guidelines for Living Environment Impact Studies for Waste Treatment Facilities

Item	Contents
Outline	Technical guidelines for environmental impact assessment to ensure that environmental impact assessment and post-implementation studies of waste treatment facilities are properly conducted based on scientific knowledge.
Date of formulation	1998 (revised in 2006)
Applicable facilities	Incineration facilities, landfill sites, other facilities (crushing and sorting facilities, manure treatment facilities, sludge dewatering facilities, etc.)
Plan to assessment	Environmental impact assessment items, actions subject to environmental impact assessment, timing of environmental impact assessment, regions where environmental impact assessment is to be conducted, surveys, forecasts, evaluations, environmental conservation measures, follow-up assessment, etc. Organization of survey items → Setting of the area to be surveyed → **Survey** Understanding of current status → **Projection** → **Assessment** Impact analysis → Preparation of living environment impact survey form Flow of environmental impact assessment
Examples of environmental impact assessment items	Examples of survey items stated in the Guidelines for Living Environment Impact Studies of Waste Treatment Facilities <u>Incineration Facilities</u> Air quality, noise, vibration, odor, water quality <u>Landfill</u> Air quality, noise, vibration, odor, water quality, groundwater

Source: Ministry of the Environment, "Guidelines for Living Environment Impact Studies of Waste Treatment Facilities" (2006)

4) Voluntary Environmental Assessment

For projects which are not subject to environmental assessment under municipal ordinances or the *Waste Management Act*, the business operator may voluntarily conduct an assessment, also known as a voluntary assessment or mini-assessment. In particular, for waste treatment facilities and landfill sites projects, it should not be considered that an assessment is not necessary because these projects are not targeted in the relevant laws and regulations, and it is customary to conduct voluntary environmental assessments for these projects.

The following pictures show examples of actual surveys in an environmental assessment.

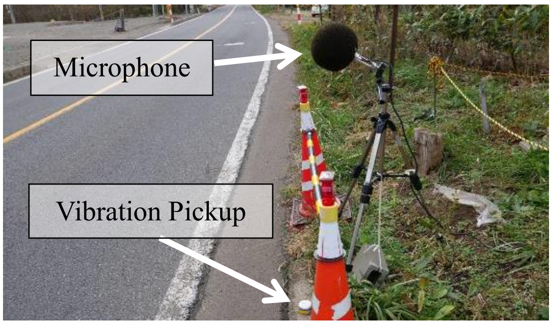


Photo 1-11 Roadside Noise and Vibration Surveys

Photo 1-12 Installed Sound Level Meter and Vibrometer

Photo 1-13 Balloon Release for Upper-level Meteorological Survey*

Photo 1-14 Odor survey

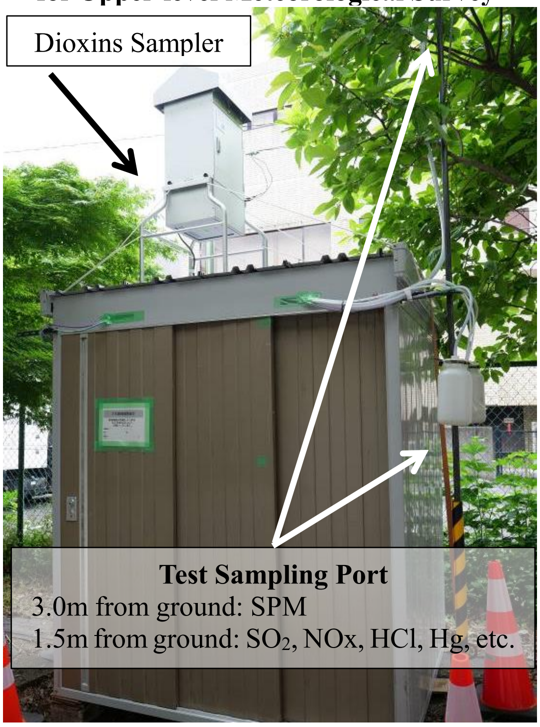


Photo 1-16 Simple installation Shed for Measuring Air Quality

Photo 1-15 Collecting river Water for Water Quality Survey

Photo 1-17 Road Traffic Volume survey

*: The upper-level meteorological survey is carried out to predict the dispersion of exhaust gases from incineration facility chimneys. A small GPS-equipped device is attached to a balloon to measure air temperature and wind speed at different altitudes (the equipment is not recovered).

Source: Yachiyo Engineering Co., Ltd.

Activities Related to Environmental Assessment

Column: Environmental and Social Considerations in Developing Countries

In Japan, impact assessments are mainly conducted from the environmental perspective, but in projects for developing countries, social factors such as resettlement, indigenous peoples, living and livelihoods are of greater importance. For example, waste pickers who make a living by sorting and selling recyclables at disposal sites, will lose their jobs if open dumping sites are closed, and they will need support. In some cases where necessary land acquisition results in resettlement of residents, it may be required to pay them compensations.

JICA has released the Guidelines for Environmental and Social Considerations, which describes the process of environmental and social considerations, as well as a checklist of items by category and items to be monitored in each category. Examples of check items are shown in the table below. There is a need to investigate environmental and social considerations that match the nature of the project, the policies of the country, and the characteristics of the site.

Table 1-21 Categories and Items in Checklists

Category	Item
1. Permits approval and consultations	Environmental assessment and environmental permits, Explanations to, and consultations with the local stakeholders
2. Pollution control measures	Air quality (including greenhouse gas), Water quality and water use, Waste, Soil contamination, Noise and vibration, Subsidence, Odor, Sediment
3. Natural environment, protected areas	Protected area, Ecosystem and biodiversity, Hydrology, Topography and geology, Management of abandoned sites
4. Social environment	Resettlement, Living and livelihood, Heritage, Landscape, Ethnic minorities and indigenous peoples, Working conditions (including occupational safety)
5. Others, impacts during construction	Accident prevention measures, Monitoring

*: When using the checklist, appropriate items are selected and checked depending on the sector and nature of the project.

Source: JICA "Guidelines for Environmental and Social Considerations" (2022)

Table 1-22 Monitoring Items

Category	Item
1. Permits and approvals, consultations	Response to conditions set by authorities
2. Pollution prevention measures	Air quality, Water quality and water use, Waste, Noise and vibration, Odor
3. Natural environment protected areas	Ecosystem and biodiversity
4. Social environment	Resettlement, Living and livelihood
5. Others, Grievances	Number and contents of complaints

*1: Monitoring items are selected according to the sector and nature of the project.

*2: For air quality, water quality, noise and vibration, specify whether emission levels or environmental levels. It also should be noted that the monitoring items in the construction phase are different from those in the operation phase of the project.

Source: JICA "Guidelines for Environmental and Social Considerations" (2022)

(English) https://www.jica.go.jp/environment/guideline/ei8tc50000005dzu-att/guideline_202201_e.pdf

(2) Comprehensive Plan for Extending the Service Life of Waste Treatment Facilities (Waste Incineration Facilities)

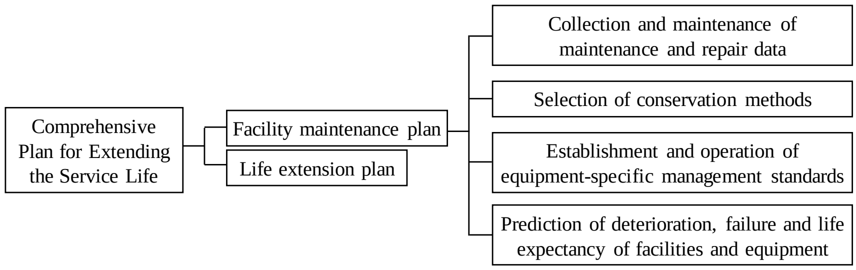
Waste treatment facilities are projects that place a high burden on the public administration due to the high cost of construction and the need for obtaining the residents' acceptance of the facility. Therefore, this plan has been formulated with the aim of ensuring that the facilities that have been developed will be in operation for as long as possible. In the Comprehensive Plan for Extending the Service Life of Waste Treatment Facilities, it is required to extend the service life of waste treatment facilities by sustaining all the functions of the facilities over the long term through appropriate operation management, periodic maintenance, and functional diagnosis noting the unique role of the waste treatment facilities in the management of the waste.

Waste treatment facilities often operate under conditions where the facilities, equipment, and components that make up the facilities are exposed to high temperatures, high humidity, and corrosive gases, and are prone to wear and tear due to mechanical movement. Therefore, the performance of waste treatment facilities deteriorates and wears out more rapidly than other urban facilities, and the service life of the facilities as a whole is considered to be shorter than that of other urban facilities. Although the service life of concrete buildings is about 50 years, some waste treatment facilities have been decommissioned entirely after about 20 years, including buildings that can still be used, because of deterioration in plant performance. On the other hand, waste incineration plants have a possibility of operating for more than 30 years, by implementation of proper daily operation and suitable periodic maintenance, appropriate annual periodic inspections and maintenance, and periodic updating of core facilities.

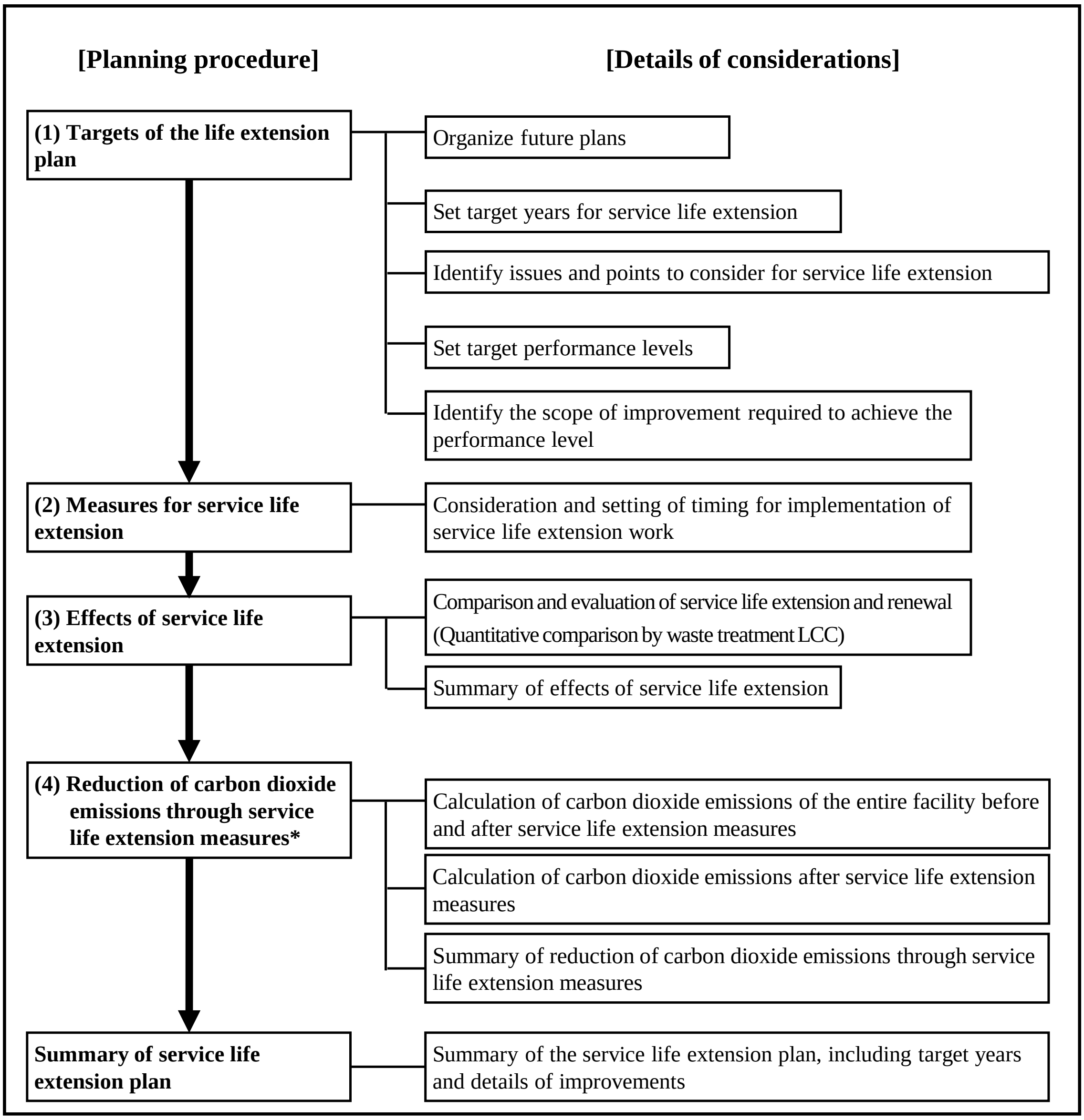
An outline of the Guidance on Creation of Comprehensive Plan for Extending the Service Life of Waste Treatment Facilities (waste incineration facilities) issued by Ministry of the Environment is shown in Table 1-23. The plan is designed to preserve and extend the service life of such facilities through systematic inspections, investigations, repairs, and improvements based on foresight into the condition of facilities, including aging, from a long-term perspective. Municipalities formulate a facility maintenance plan to evaluate and improve the overall operational condition of the facility based on periodic maintenance records and functional diagnosis data of facilities and equipment. Based on the data accumulated through the operation of the facility maintenance plan, a life extension plan is developed, and facilities should be renewed at appropriate time intervals. Furthermore, as for main facilities and equipment, a detailed maintenance plan is developed with reference to the current condition of the facilities, track records of past repair and maintenance, and patterns of degradation and malfunction. A Comprehensive Plan for Extending the Service Life is developed with detailed plans for facility maintenance and life extension, which can in turn be used to prepare long-term budget plans and plans for applying for subsidy from the Ministry of the Environment. As shown in Figure

1-31, in order to apply for life extension work as a project eligible for a subsidy from the Ministry of the Environment, it is also required to calculate the effect of carbon dioxide emission reduction by renewal of facilities and equipment from the point of view of global warming countermeasures.

Table 1-23 Outline of Comprehensive Plan for Extending the Service Life of Waste Treatment Facilities (Waste Incineration Facilities)

Item	Contents
Outline	The purpose of this plan is to extend the service life of waste treatment facilities by introducing the concept of stock management, proper daily operation and management, appropriate annual inspections and maintenance, and plan for periodic renewal of major facilities and equipment.
Applicable facilities	Waste treatment facilities in general
Plan structure	
Details to be considered for service life extension	1. Organize future plans 2. Set target years for service life extension 3. Identify issues and points to consider for service life extension 4. Set target performance levels 5. Identify the scope of improvement required to achieve the performance level 6. Comprehensive coordination of regional units

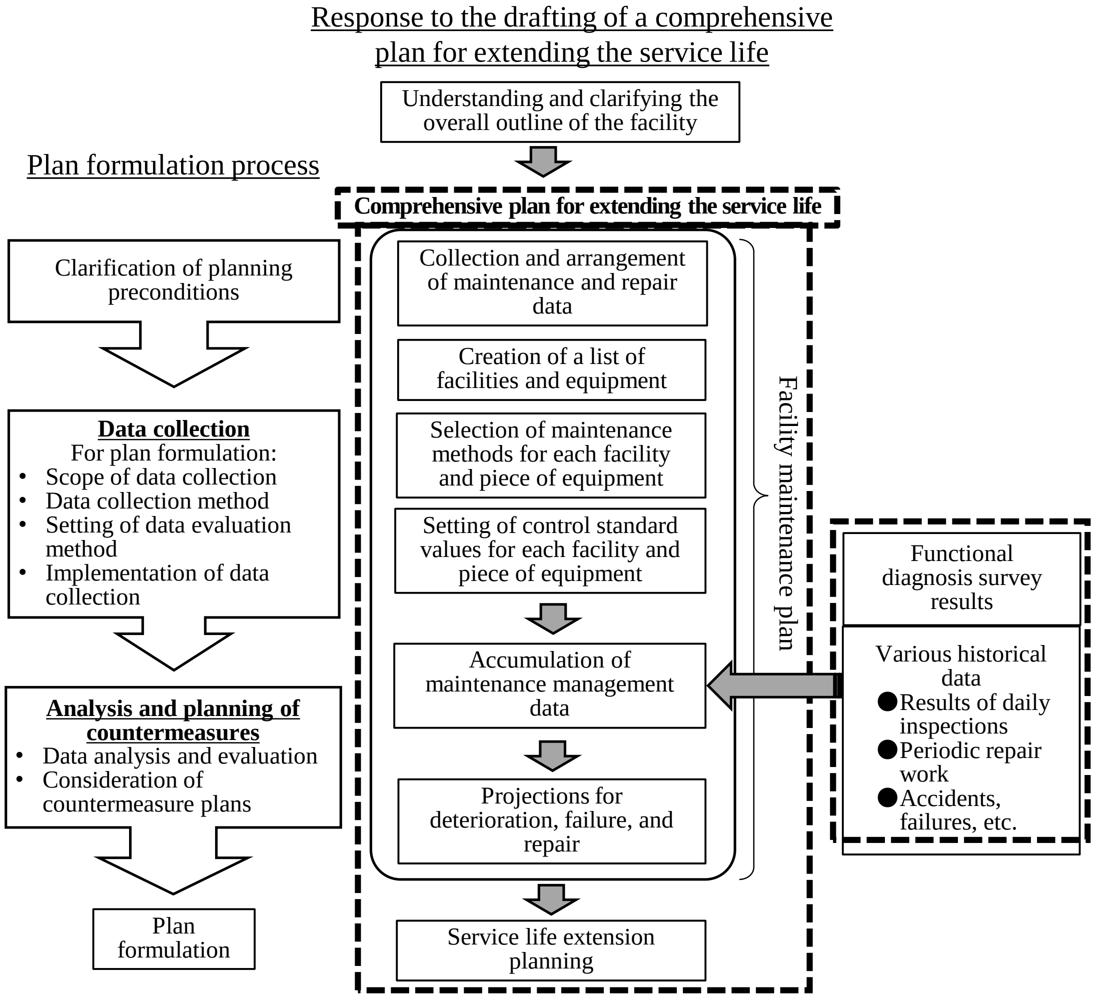
Source: Ministry of the Environment, "Guidance on Creation of Comprehensive Plan for Extending the Service Life of Waste Treatment Facilities (Waste Incineration Facilities Applications)" (2021)



*: This is mandatory if the core facility improvement project is to be implemented with a grant.

Source: Ministry of the Environment, "Guidance on Creation of Comprehensive Plan for Extending the Service Life of Waste Treatment Facilities (Waste Incineration Facilities Applications)" (2021)

Figure 1-31 Flow of Service Life Extension Planning (Waste Incineration Facilities)

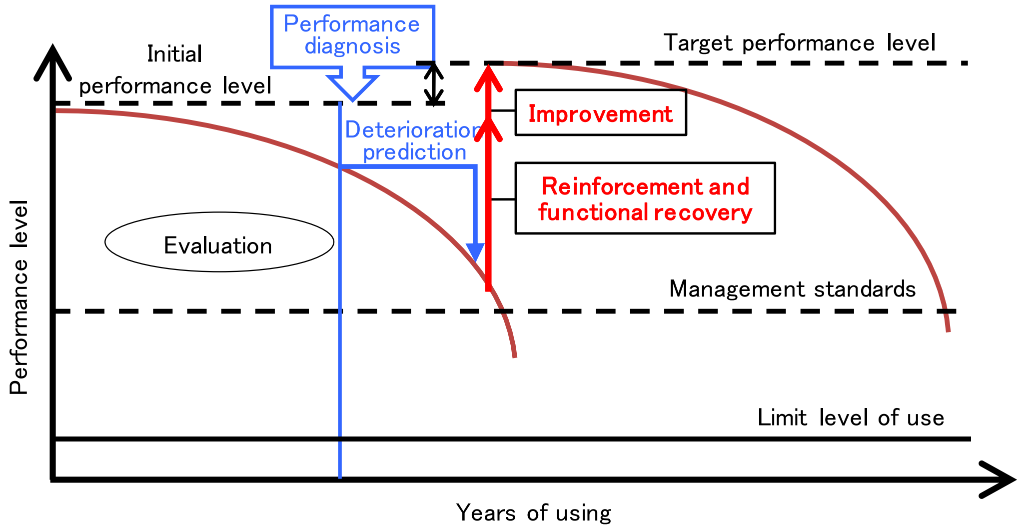


Source: Ministry of the Environment, "Guidance on Creation of a Comprehensive Plan for Extending the Service Life of Waste Treatment Facilities (Waste Incineration Facilities Applications)" (2021)

Figure 1-32 Framework of Comprehensive Plan for Extending the Service Life

Column: What is Stock Management?

In stock management, in order to extend the service life of facilities, at the time of performing routine maintenance, functional diagnosis is conducted before the required performance level of a facility's plant and equipment declines below the management level. Based on the results of the functional diagnosis, functional maintenance measures and life extension measures are implemented to effectively utilize and extend the service life of existing facilities, and at the same time, reduce life cycle costs. This kind of technical system and management method is called stock management. Stock management can be expected to have a variety of benefits, such as reducing the burden on municipalities by extending the service life of facilities, reducing lifecycle costs, improving safety, enhancing functions, and securing the trust of residents in the facilities.



Source: Ministry of the Environment, "Guidance on Creation of Comprehensive Plan for Extending the Service Life of Waste Treatment Facilities (Waste Incineration Facilities Applications)" (2021)

Figure 1-33 Performance Degradation Curves and Control Levels