Topic 6. Efforts of the Municipalities in Japan

Contents

1 Overview of Municipalities

Each municipality in Japan has developed its own distinctive approach to waste management based on the national policy. In Topic 6, one municipality is selected from each of large-, medium-, and small- scale municipalities of Japan, and the important points related to waste management in each of the selected three municipalities are highlighted by detailing the experience and knowledge of waste management of that municipality.

This topic introduces the waste management practices of the following three municipalities, selected based on their size and characteristics: the 23 special cities of Tokyo representing a large municipality, Fujisawa City a medium-sized municipality, and Shibushi City a small municipality.

The 23 special cities of Tokyo (hereinafter refer to as Tokyo 23 Cities), the capital of Japan, located at the center of Tokyo, have experienced the challenges of waste management while Tokyo was developing into the large-scale metropolitan capital city of today, and have finally established their current waste management system. Tokyo 23 Cities have also led Japan's waste management program and assisted other municipalities. Local governments in developing countries, especially in capitals and large cities with similar conditions as that of Tokyo, can benefit from the lessons learnt from Tokyo 23 Cities and their experiences.

Fujisawa City is a medium-scale municipality with a population of 430,000. Medium-scale municipalities are suitable for helping to understand the comprehensive system adopted by Japan's municipalities to manage waste. Fujisawa City has from early on actively engaged the private sector in waste recycling and facilities improvement activities. Thus, Fujisawa City is selected as a representative of medium-scale municipalities. Furthermore, Fujisawa City has maintained records of their waste management efforts for many years, and there are many lessons to be learned from the city's experiences for municipalities in developing countries aiming to build a comprehensive waste management system including intermediate treatment in the future.

The third municipality selected here, Shibushi City does not have incineration plants and is known for its high recycling rate. Although it has a short history of waste treatment, the city has reduced the amount of waste disposal at landfill by implementing multi-item sorted waste discharge and separate collection to support recycling, and thereby the life of landfill sites has been successfully extended. The case in Shibushi City may be thought-provoking for municipalities of developing countries that are either planning to promote, or are already engaged in recycling. The Shibushi case study demonstrates how the city reached an agreement with its residents and obtained their cooperation during the development process of their multi-item waste recycling system as well as overcoming other issues.

Note that the history of waste management and recycling from the past to the present in the Tokyo 23 Cities and Fujisawa City is summarized in a chronological table at the end of their respective sections in this topic.

Figure 6-1 Position Map of the Selected Three Municipalities

Table 6-1 Basic Information and the Characteristic of the Selected Three Municipalities

No.	Item	Tokyo 23 Cities	Fujisawa City	Shibushi City
1	Population (person)	9,561,576	434,568	31,160
2	Area (km^2)	627.53	69.56	290.28
3	Collection method (Direct/Contract out)	Direct/Contract out	Contract out (60%)	Contract out
4	Number of Incineration Plants	21	2	0
5	Number of Recycling Plants	3	1	2
6	Number of landfill Sites	2 (adjacent)	1	1
7	Amount of Waste Generated (ton/year)	3,264,286	137,371	9,644
8	Recycling Rate (%)	16.2	29.4	75.1
9	Landfill Amount (ton/year)	298,667	361	2,479
10	Distinctive points, events and initiatives	・War on waste ・Tokyo Model	・Resource Recovery by Fujisawa Method ・WtE Construction by DBO	・Recycling (Shibushi Model) ・Qualified Compost

*: Data is of 2019 and the area is as of October 1, 2021.

Source: Based on Ministry of the Environment Website “2018 Actual Situation Survey Result of General Waste” (2021) https://www.env.go.jp/recycle/waste_tech/ippan/r1/index.html (accessed January 1, 2022)
Ministry of Land, Infrastructure, Transport and Tourism “2021 Area survey by prefecture, city, town, and village nationwide (As of October 1, 2021)” (2021)

2 Waste Management Efforts Made by the 23 Special Cities of Tokyo

From 1900 to the present, the 23 special cities of Tokyo have overcome various waste management problems in changing historical backgrounds. The waste management measures taken in each time period are introduced in this section.

Having an area of approximately 2,194 km^2 (as of 2017), Tokyo is the capital of Japan which is Japan's political, administrative, and economic center. Tokyo, consisting of 23 special cities, 26 cities, 5 towns, and 8 villages, has a population of 14,000,000 (as of 2017) of which the population of the 23 special cities is 9,500,000. The Tokyo Metropolitan Government (hereinafter referred to as TMG) has published "One Hundred Years of Waste Management in Tokyo" on the occasion of the 100th anniversary (2000) of the enactment of the *Waste Cleaning Act* in 1900 and the transfer of the administration of waste management from TMG to Tokyo 23 Cities due to the expansion of self-government. This section summarizes the struggles of Tokyo to improve the unsanitary living environment during the hardships of the Great Kanto earthquake (1923) and World War II, the efforts of people involved in waste management, and the history of Tokyo 23 Cities that have overcome municipal waste problems.

With reference to "One Hundred Years of Waste Management in Tokyo" and information from the "Clean Authority of TOKYO", this section describes the history of waste management in Tokyo 23 Cities, the war on waste, current waste management efforts, and international contributions.

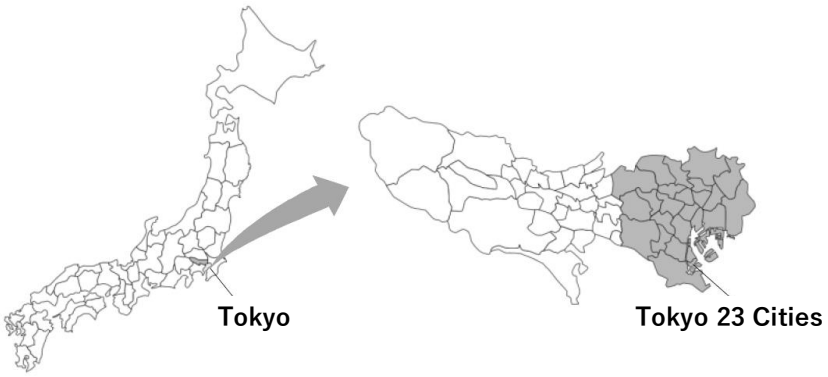


Figure 6-2 Location of Tokyo and Tokyo 23 Cities

2.1 History of Waste Management in Tokyo

(1) Dawn of the Waste Problem, 1900 - 1955

In the latter half of the 19th century, cholera and plague pandemics were spreading globally and taking measures to protect public health became an issue in Japan as well. The TMG had identified unsanitary conditions as one of the causes of the spread of these infectious diseases, and recognized that prompt and proper disposal of waste and human waste was essential to improve the situation. In 1900 the government of Japan enacted the *Waste Cleaning Act* and municipalities assumed responsibility for waste management. In response, Tokyo introduced a waste collection system and started to contract out collection services to business operators. However, in 1908 problems of unreliable waste collection by business operators arose and TMG reversed its decision of contracting out collection and returned to directly-managing waste collection. Furthermore, to cope with the rapidly increasing amount of waste associated with urbanization, Tokyo constructed the first waste incineration plant in Osaki in 1924 and a municipal waste treatment plant in Fukagawa in 1929.

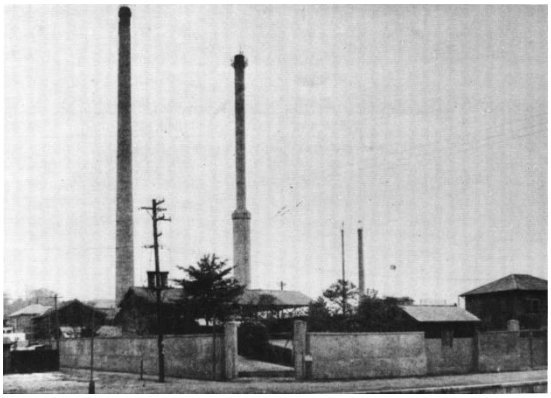


Photo 6-1 Osaki Incineration Plant (Completed in 1924)

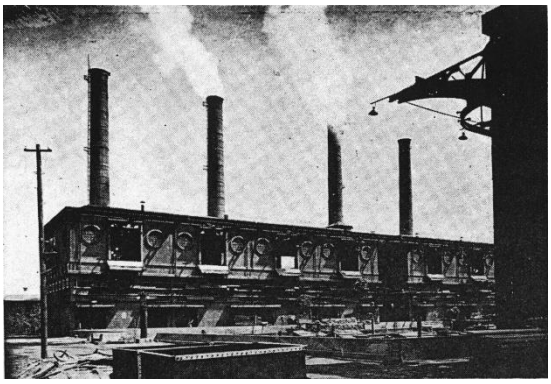


Photo 6-2 Fukagawa No 2 and No 3 Incineration Plant (Completed in 1933)

Source: TMG Archives

(2) Period of High Economic Growth - Escalation of the Waste Problem, 1955 - 1973

During the war years, Tokyo's population declined sharply to about 2.5 million. Because of the extreme scarcity of food and other daily commodities, waste generation significantly decreased and around 1945 waste collection was discontinued and residents disposed of their waste by themselves. After the war, however, Tokyo's population grew due to the return of evacuees and military personnel, and sanitary conditions worsened, underlining the urgent need to implement drastic waste management countermeasures.

In 1954, the central government enacted the *Public Cleansing Act*. The act stipulated; (1) the central government sets administrative standards and each municipality is responsible to implement these standards, (2) the concept of simply disposing of waste is replaced by an obligation to manage

the waste in a sanitary method from the standpoint of prevention and environmental sanitation, (3) the responsibilities of the central and prefectural governments and the obligations of municipalities are clarified, and residents are also obliged to cooperate. In response, Tokyo improved the related ordinances and organization. During this period, the mechanization of waste collection progressed. The previous waste collection operation using handcarts was gradually becoming unable to cope with the rapid increase in waste generation. In addition, it was becoming difficult to secure sufficient manpower due to more attractive jobs created by the economic growth. The use of handcarts became less desirable because of the associated poor environmental hygiene and low efficiency, and handcarts were replaced by direct collection and transport by vehicles.

Furthermore, in 1963, a subsidy system was introduced to support the development of the increasingly required larger waste treatment facilities. The *Waste Management Act* was enacted in 1970, and Tokyo revised the waste ordinances to clearly specify the responsibility of business operators who generate business waste and the importance of obtaining the understanding of residents on the waste management system. During this period, mass consumption and increased waste disposal emphasized the need for more efficient waste collection and transport. In 1963, Tokyo abolished the separate collection of kitchen waste, which was introduced in 1931, and returned to mixed waste collection. Mixed waste collection caused many incinerators to shut down because the organic acids corroded the incineration equipment. Therefore, the construction of many new incinerators began. At that time, the amount of waste discharged was increasing and the waste composition was changing due to the increase in plastic waste, making it impossible to treat the waste properly. Under these circumstances, in 1971, the Governor of Tokyo declared a “war on waste” at the Tokyo Metropolitan Assembly and promoted the development of incineration technology and treatment.

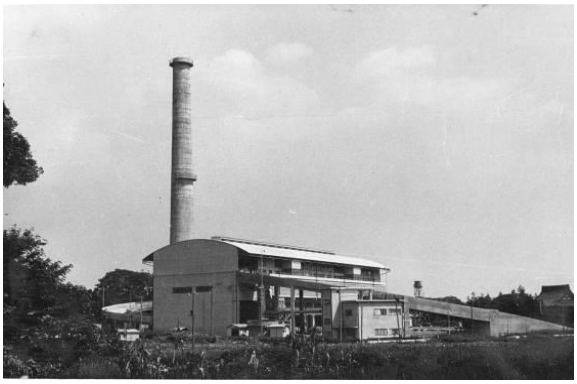


Photo 6-3 Kamisyakujii Fifth Incineration Plant (Completed in 1957)

Photo 6-4 Itabashi Incineration Plant (Completed in 1961)

Source: TMG Bureau of Environment

(3) Period of Stable Economic Growth - Addressing the Environmental Problem, 1973 - 1985

Following the enactment of the *Waste Management Act* by the central government in 1970, Tokyo revised the ordinance to clearly specify the responsibility of business operators who generated business waste. As the necessity for reuse and recycling of waste increased, recycling activities and group waste collection were promoted, and thorough discussions were conducted with local residents through explanatory and consultative meetings. In 1985, incineration plants were in operation at only 13 locations and in order to ensure that the combined incineration capacity was sufficient, source separation and separate collection of combustible and incombustible waste were started.

Photo 6-5 Separate Discharge of Recyclables in Omorideragou Town (1977)

Photo 6-6 Separated Recyclables at the Collection Station in Omorideragou Town (1977)

Source: TMG Bureau of Environment

(4) Significant Increase of the Amount of Waste, 1985 - 1990

Rapid economic growth led to redevelopment in Tokyo and a rush to construct new buildings and condominiums. People's lifestyles also changed resulting in generation and disposal of large amounts of waste and increased variation in waste compositions. TMG reacted by calling for waste reduction and recycling.

(5) Introduction of a Sound Material-Cycle Society, 1990 - Present day

With the revision of the *Waste Management Act* in 1991, promotion of waste reduction and recycling heightened. After the central government enacted the *Act on the Promotion of Effective Utilization of Resources* in 1991, Tokyo started to fully charge for bulky waste collection in the same year and for business waste collection in 1996. Tokyo also established a new ordinance that strictly promoted the reduction of waste generation and reuse of waste in 1992. In 1997, TMG started resource recovery and collection of PET bottles from stores.

More efforts were needed to achieve waste reduction and coming closer to developing a sound material-cycle society, and these included the expansion of waste treatment plants. In the 1990s,

dioxins generated from incineration plants by the incomplete combustion of waste became a major social problem in Japan. Tokyo was under pressure to respond to the dioxins problem. Incineration plants were reconstructed, upgraded or altered and new technologies were introduced. During the period from 2002 to 2008 gasification fusion furnaces and ash melting facilities were improved, by 2009 all waste plastics that were not recycled were fully incinerated accompanied by heat recovery, and by 2015 all the ash produced in the incineration plants were reformed into raw material for use in the cement production industry.

2.2 Noteworthy Experience: War on Waste

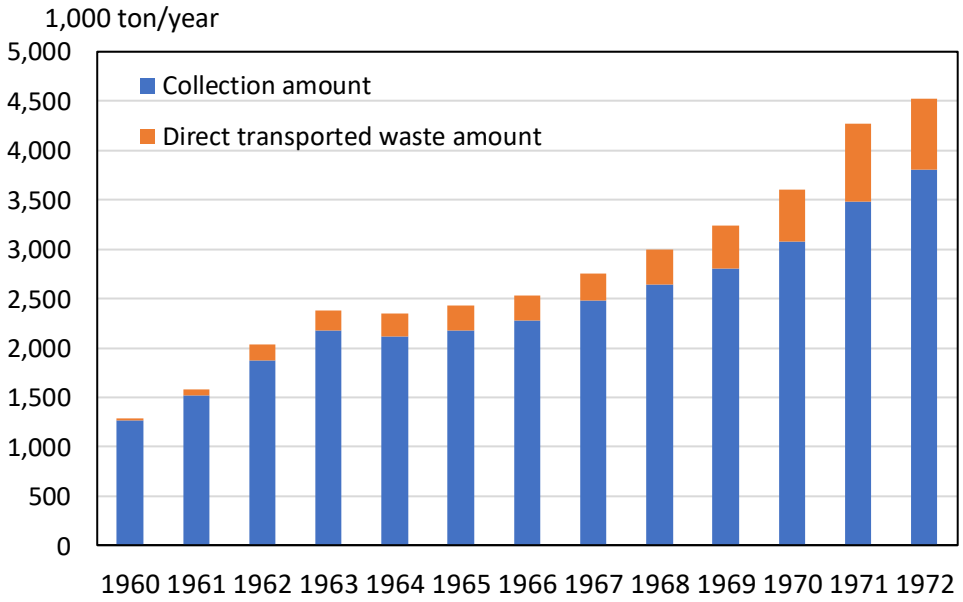
"War on Waste" refers to disputes over the treatment and disposal of waste in the Tokyo 23 Cities, particularly those between Koto City and Suginami City from the late 1950s through the 1970s, which erupted into protests and court battles involving local residents over the construction of an incineration plant. In response to the rapid increase in waste amount, TMG continued to landfill waste in the bay area, and attempted to promote the construction of an incineration plant without the full understanding of local residents. In this background, this was an opportunity to reaffirm the importance of dialogue and cooperation between the local governments and residents regarding the operation of waste management, a common practice today, and the "Principle of waste treatment within the administrative boundary where the waste was generated".

(1) Rapidly Increasing Amount of Waste Generation and Waste Management Dependent on Landfill During the Period of High Economic Growth

The period of high economic growth ushered in changes in the lifestyle of the people towards mass production of products and goods, their increased consumption and early disposal. As a consequence, the waste generated by the citizens of Tokyo increased as shown in Figure 6-3. In addition, the composition of the generated waste became much more diverse. The increase in waste plastics, bulky waste, and hazardous industrial waste was making the waste management significantly difficult.

Tokyo was not capable of sufficiently managing such waste and mostly depended on waste disposal in land reclamation in the sea in Koto City. Confronted with the problems of flies from the disposal site, traffic jams caused by approximately 5,000 vehicles a day transporting waste, increased accidents and traffic jams, and scattering of waste and the presence of polluted water on the access road to the landfill, Koto City made repeated requests to TMG to take appropriate countermeasures. In response to those requests, TMG decided to establish a waste incineration system capable of treating the entire amount of combustible waste by 1970, and attempted to move forward with a plan to construct a waste incineration plant. However the plan did not go ahead due to opposition from local residents in various areas. The strongest opposition occurred in Suginami City, where the opposition group campaigned for a blanket withdrawal of the construction plan, which had been unilaterally announced without prior explanation. The opposition group filed a lawsuit with the court, and TMG initiated legal proceedings based on the *Land Expropriation Act*. Meanwhile, waste management conditions in Tokyo significantly worsened, the incineration plant construction project was greatly delayed, and the amount of incinerated waste, designated in the ten-year plan of Tokyo, reached less than a half of the target value of 8,000 tons per year. Under such circumstances, Koto City took a tougher line, and in September 1971, the Koto City assembly announced its opposition to accepting waste from outside Koto City. In response, on September 28, 1971, the governor of Tokyo declared the "War on Waste" at the metropolitan assembly stating that: "A looming crisis of waste is now threatening the lives of the residents in Tokyo. Taking measures to address this issue is

most urgent. Delay of even one day now will lead to an irreversible consequence in the future. I declare the War on Waste and commit to introducing appropriate waste management".



Source: Akio Ishii "Journal of the Japan Society of Material Cycles and Waste Management (Vol.17, No.6)" (2006)

Figure 6-3 Changes of Collection and Direct Transport waste Amounts in the Tokyo 23 Cities

(2) Opposition Movement against Construction and Principle of In-city Treatment

The principle of waste treatment within the administrative boundary where the waste was generated was born during the "War on Waste". This principle remains a basic policy of waste management in Tokyo 23 Cities even at present. In some instances a treatment facility in one special city accepts waste from a neighboring special cities. In such instances adjustments are made to distribute the burden of nuisance impartially amongst the 23 cities.

On September 27, 1971, the Koto City Assembly decided to send an open letter of inquiry to TMG and the other 22 special cities, demanding the observance of "the principle of in-city treatment of waste" and "fair distribution of burden of nuisance". The concept of principle of waste disposal within the administrative boundary was a natural concept under the laws and regulations that set municipalities as responsible for disposal. Since TMG was responsible for the wide-area waste management within the 23 cities of Tokyo at that time, it was necessary for all concerned to reconfirm the basic matters so that the burden would not be concentrated in some districts. In July 1972, the Tokyo 23 Cities advisory board was established consisting of representatives of Suginami City and experts, and held meetings several times in that year to discuss a site for constructing an incineration plant.

However, local residents of the areas selected as candidate sites immediately opposed the construction of the plant in their areas. Reasons for the opposition were the method of selecting the site, road conditions, and traffic pollution expected to be caused by collection vehicles. As Koto City became aware of the slow progress of selecting a site in Suginami City, Koto City began to stop receiving waste from Suginami City. As the result, the advisory board rushed to select a site for the incineration plant and determined it to be the Takaido district in Suginami City. In August, 1973, after the site for Suginami plant had been determined, TMG met for the first time with the opposition group. However, the opposition group maintained their strong opposition and eventually sued TMG in the Tokyo District Court.

Source: TMG Bureau of Environment

Photo 6-7 Planned site of Suginami Incineration Plant

(3) Path toward Reconciliation and the Terms of Settlement

The Suginami Incineration Plant construction problem was resolved after a long process spanning eight years since the Takaido district was first announced as the planned site in November 1966. The basic determining factors of the settlement were the acknowledgement of the need for reliable pollution control and the importance of residents' participation from the planning phase. Since then, when facilities are to be developed, resident participation is ensured from the planning phase.

In February 1974, the Tokyo District Court provided recommendations for reconciliation concerning the lawsuit filed by the opposition group to cancel the land expropriation proceedings, and opinions of both sides were to be confirmed by April 30. On April 30, after confirming that both parties intended to reconcile, the Tokyo District Court started to mediate a reconciliation settlement.

The Tokyo District Court heard the opinions of both sides and established the council for organizing the reconciliation conditions concerning the Suginami Incineration Plant construction, and thus launched discussions for specific reconciliation conditions.

Reconciliation discussions proceeded based on the "principle of residents' requests" presented by the plaintiff and the verbal note shown to the residents by TMG in June 1973. The verbal note, indicating TMG's basic policies, stated that: [1] the scale of the plant will be changed from 900 tons to 600 tons, [2] resident participation is basically ensured during both the construction and operation phases of the plant, [3] access roads used by waste trucks are to be located underground. Focal points of discussion were [1] pollution control, [2] beneficial facilities and countermeasures for neighboring areas, [3] a resident participation system, and [4] the scale of the incineration plant. Local residents were most concerned about point [1] and it dominated the discussions. After continuing the reconciliation discussions for six months, both sides came to a settlement in November, 1974. The terms of reconciliation acknowledged the thoroughgoing pollution control and the local residents' participation from the planning phase. Thus, as the result of reconciliation, construction of the Suginami Incineration Plant started.

Photo 6-8 Suginami Incineration Plant

Photo 6-9 Underpass of Suginami Incineration Plant (1982)

Source: TMG Bureau of Environment

(4) Lessons Learned - Changes in Tokyo Residents' Awareness of Waste Treatment

The Governor of Tokyo's declaration of the "War on Waste" drastically changed the awareness of the people of Tokyo regarding the waste problem. It created an awareness that waste treatment was not only a municipal matter for the TMG, but also a problem that residents should tackle together with the government.

The background of the movements against the construction of incineration plants that took place in various regions during the era of the "War on Waste", was local residents' concerns about pollution and that the importance and seriousness of municipal waste management were not fully shared with the local residents. Since the declaration of the "War on Waste", the awareness of Tokyo residents regarding the waste problem changed dramatically through the blocking of waste coming into Koto City and the problem of constructing Suginami Incineration Plant. Although waste management is one of the most fundamental urban issues, along with urban planning and water and sewerage systems, the people of Tokyo did not necessarily have such awareness. Rather, they were more conscious of avoiding waste. The declaration of the "War on Waste" greatly changed such conception and raised awareness that waste is a very serious problem. It also led to the realization that it is important for project implementers to repeatedly communicate the necessity and safety of the facility and promote the understanding of local residents. Since the "War on Waste", the construction of waste treatment facilities has been conducted with the participation of local residents, including careful explanation and incorporation of their requests from the planning stage. In addition, agreements were signed with representatives of residents' groups to operate the facility in compliance with laws and regulations and self-imposed limits, disclose various data on the facility's operations and provide tours of the facilities.

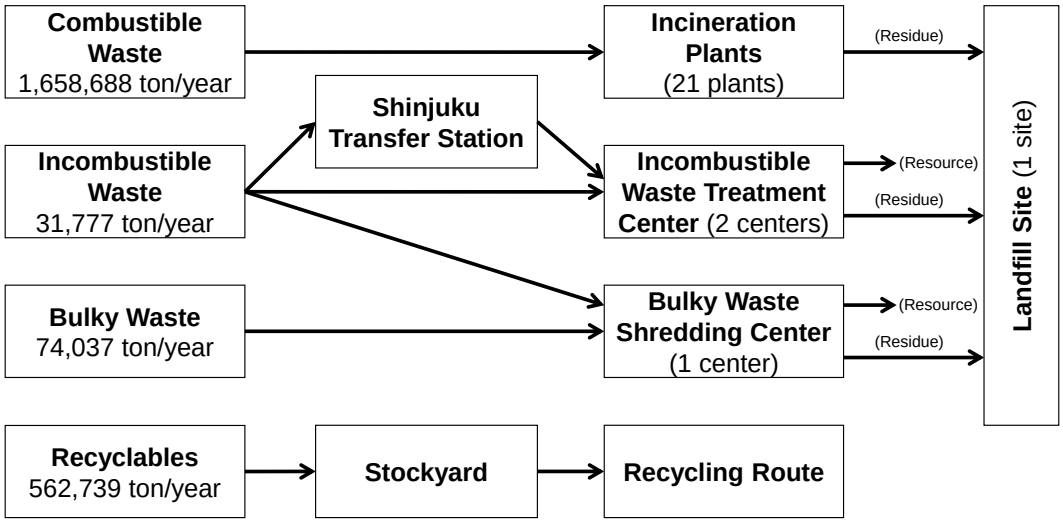
2.3 Current Waste Management in the Tokyo 23 Cities

In the previous section, the history of waste management in the Tokyo 23 Cities and the noteworthy experience garnered from the "War on Waste" was described. This section will provide a description of the waste management flow formed on the basis of that experience.

(1) Waste Management Flow in the Tokyo 23 Cities

The municipal waste management flow in Tokyo is shown in Figure 6-4 for each of the four waste categories of combustible waste, recyclables, incombustible waste, and bulky waste. Combustible waste is incinerated in the incineration plant of each of the 23 special cities. Incombustible waste and recyclables are transported to the incombustible waste treatment centers located in two places within the Tokyo 23 Cities. As the special cities of Shibuya, Shinjuku, Nakano, Suginami, Toshima, and Nerima are far away from either of the incombustible waste treatment centers, incombustible waste and recyclables generated from those cities are transported to the Shinjuku transfer and recycling center where the waste is then transferred into larger trucks for further transport to the incombustible waste treatment centers. At the incombustible waste treatment center, resources are collected and residue is transported to the landfill site for disposal. Bulky waste is transported to the bulky waste shredding center, located in one place within the 23 cities. At the center the bulky waste is shredded, and after the resources are collected, the residue is transported to the landfill site for disposal.

In addition to the municipal waste, private businesses that are licensed by the 23 cities directly transport their business-related combustible waste to the incineration plants.



Source: Clean Authority of TOKYO, "Outline of Projects" (2022)

Figure 6-4 Waste Management Flow in Tokyo 23 Cities

(2) Operating Bodies for Waste Management and their Responsibilities

In the Tokyo 23 Cities, each city mayor is responsible for the municipal waste management in the city. Each city is responsible for the waste collection and transport, but due to the limited number of intermediate treatment facilities, the 23 cities have established the Clean Authority of TOKYO to jointly manage intermediate treatment. A clean authority is an organization established by several local governments or special cities for the purpose of jointly providing a portion of administrative services.

The final disposal site is established and managed by TMG. The Clean Authority of TOKYO uses the final disposal site under a contract with TMG. Because multiple responsible entities are involved and the responsibilities are complex, it is important for all the entities to work together to ensure proper waste management.

Table 6-2 Operating Bodies in the 23 Cities of Tokyo Responsible for Waste Management and their Individual Responsibilities

Category of waste management	Responsible operating body	Responsibility
Waste treatment planning	Each of the 23 cities of Tokyo	Development of waste treatment plans for each city
Sorting and separate discharge Cooperation for waste reduction	Residents, business operators	・ Waste discharge by properly separating waste according to instructions of each city ・ Maintaining financial resources of each city by paying city taxes
Collection, transport, and recycling	Each of the 23 cities of Tokyo	・ Waste collection by direct management of each city and transport of the waste to intermediate treatment facilities according to categories of waste ・ Payment of assessed share (tax) according to the amount of waste treated etc.
Incineration (Thermal recycle)	Clean Authority of TOKYO	・ Improvement and operation of 21 incineration plants, 2 incombustible waste treatment centers, and one bulky waste shredding center to extend the final landfill sites lifetime by reducing the amount of waste to be landfilled. ・ Paying landfill tipping fees
Final disposal	Each of the 23 cities of Tokyo	・ Final disposal using a final disposal site established and managed by TMG (under contract out).

Source: Clean Authority of TOKYO, “Tokyo Model (general version)” (2018)

(3) Main Measures for Separated Waste Discharge

Tokyo 23 Cities have taken major measures from 1989 to 2000 to promote and strengthen waste reduction and recycling based on the 3Rs principle, as shown in Table 6-3. Until 1999, TMG was responsible for deciding on the policy of sorting classification and separate discharge. However , this responsibility has shifted to each city since 2000.

Table 6-3 Main Measures Based on the 3Rs Principle

Year	Description
1989	Start of the TOKYO SLIM campaign • Promotion of waste reduction and recycling through mass media • Start of the "Tokyo waste conference" with the participation of citizens of Tokyo, business operators, and the municipal administration • On-the-spot guidance by waste inspectors at premises of business operators to promote waste reduction and recycling The Tokyo Waste Conference annually held from 1991 to 1998 was attended by tens of thousands of participants each time, attracting attention to waste management.
1991	Charge for bulky waste collection • Bulky waste weighing less than 200 kg was charged in 1991.
1996	Charge for business waste • For approximately 560,000 business operators, business waste weighing less than 10 kg a day was charged. The Tokyo Rules prescribing the roles and responsibility sharing were proposed. • Tokyo rule I - Setup of weekly municipal resource recovery • Tokyo rule II - Promotion of collection of containers etc. by manufacturers etc. • Tokyo rule III - Collection of widely used PET bottles from stores after use Business operators discharged waste with a sticker indicating the paid waste fee affixed on it.
2000	Resource recovery operators dealing in used paper, bottles, and cans • Combustible waste collection was reduced from three times to twice a week, and collection of resources - used paper, bottles, and cans - was newly scheduled once a week.

Source: Clean Authority of TOKYO, "Tokyo Model (outline)" (2018)

(4) Public Awareness and Environment Education Intended for Separated Waste Discharge

The Tokyo 23 Cities have been providing environment education for a long-period of time and have endeavored to enhance awareness and foster habits to support recycling, through thorough face-to-face communication and education of the next generation of waste generators.

Regarding waste discharge practices, ongoing promotional activities are conducted through public relations newsletters on a daily basis to ensure that the rules for sorting and discharging of waste are followed. If the rules are not followed, guidance is stepped up through door-to-door visits. When existing rules are changed, or new rules are established, sufficient time is spent on carefully informing residents of the changes or new rules to ensure a smooth transition. Specifically, face-to-face communication is emphasized and a variety of awareness-raising and educational tools, such as the distribution of multilingual leaflets are utilized so that foreign residents can understand the information.

In addition, facility tours are actively arranged. Visitors facilities have been enhanced, and social study tours for elementary schools, group tours and private tours are implemented. Facilities are open to public during environmental events held in each city. Altogether 60,000 people participate in tours annually. As facility tours allow residents, pupils and students to see the facilities with their own eyes, tours are very effective to enhance awareness on waste management.

(5) Group Collection

In the Tokyo 23 Cities, residents are proactively conducting the following activities to recyclables by means of group collection.

- Voluntary resident groups, each consisting of more than 10 families, collect resources generated from homes and hand them over to resource recovery operators. The model project of TMG's "Waste Reduction and Recycling Movement", launched in 1955, was the prototype for this movement.
- Municipal administrations support these activities by providing financial incentives according to the collected recyclables amounts, providing information about resource recovery operators, and supplying or lending work tools and equipment.

The amount of resource recovery by group collection amounts to approximately 35% of the entire amount of resource recovery in the 23 cities. It also amounts to approximately 8% of the entire amount of waste and resources generated from households (2016).

(6) Waste Collection and Transport

As shown in Table 6-4, various measures have been taken to ensure 100% waste collection in the Tokyo 23 Cities. FUREAI collection is a waste collection support initiated by the municipalities to help elderly people and others who have difficulty in taking out waste by themselves. This service is expected to increase from now on.

Table 6-4 Various Measures to Ensure Waste Collection

Planning	Efficient Waste Collection	FUREAI Collection
Creation of plans for waste collection and transport • Based on the estimated waste amount, waste discharge rules, population density and other data, and on-site conditions, plans for distribution of personnel and vehicles and plans for transportation routes, etc. are integrated into the general work plan.	**Waste compactor trucks** • More than 1,500 waste trucks collect waste from approximately 440,000 stations. • About 70% of waste trucks are small compactor vehicles that can turn in a small radius and achieve high waste compaction rates. • Affixing stickers on unseparated waste and uncollectible waste to promote observance of correct waste separation and discharge.	**FUREAI collection** • Visiting elderly people and impaired people who have difficulty in taking out waste by themselves, to collect their household waste.

Source: Clean Authority of TOKYO "Tokyo Model (outline)" (2018)

Photo 6-10 Waste Collection

Photo 6-11 Waste Collection Crew Directly Collecting Waste from Elderly People

Source: Yachiyo Engineering Co., Ltd.
Clean Authority of TOKYO "Tokyo Model (outline)" (2018)

(7) Recycling

Table 6-5 summarizes the transport destination of recyclables, incombustible waste, bulky waste, and combustible waste collected through municipal collection and the methods for recycling of each waste category.

Table 6-5 Optimal Waste Recycling Suitable for Waste Categories and Treatment Levels

Separation Category	Transport Destination	Recycling Method
Recyclables	Incombustible waste treatment center	Recycling and merchandising by private collection operators
Incombustible waste	Incombustible waste treatment center	Collection and reuse of iron, aluminum, etc.
Bulky waste	Bulky waste shredding center	Same as above
Combustible waste	Incineration plant	Effective use of thermal energy Forming incineration ash into raw material for cement production

Source: Clean Authority of TOKYO "Tokyo Model (outline)" (2018)

Photo 6-12 Overview of Incombustible Waste Treatment Facility and Bulky Waste Treatment Facility

Source: Yachiyo Engineering Co., Ltd.

Photo 6-13 Aluminum Collected at Incombustible Waste Treatment Facility and Bulky Waste Treatment Facility

(8) Incineration and Thermal Recovery

The Clean Authority of TOKYO incinerates municipal waste generated from the Tokyo 23 Cities at 21 incineration plants owned by those cities. In case of shutdown of all furnaces in one city, incineration plants in a neighboring city receive and treat that city's waste. In times of emergencies such as the occurrence of the Great East Japan Earthquake in 2011, Clean Authority of TOKYO accepted to treat disaster waste generated from outside the Tokyo 23 Cities. This was made possible by the understanding of the local management council with which the clean authority had an agreement for the operation of the facility. Plastics, which were once excluded from incineration before the total incineration system for combustible waste was established, were later made eligible for incineration (except for plastics that can be recycled) in order to extend the life of final disposal sites and make effectively utilize resources. The energy recovered from incineration is used within the facility, sold to electric utilities and heat suppliers, and returned to local communities such as through use in schools and homes. Furthermore, selling electric power to electricity producers is conducted according to the feed-in tariff (FIT) system. As of the end of FY2000, eleven (11) plants were selling electricity under the FIT system (eight (8) plants were not eligible, total operating plants at the time were 19 plants). In addition, electricity is supplied to nearby public facilities, such as botanical gardens and swimming pools, either free of charge or for a fee. Some of the plants are operated directly and others are outsourced to private operators.

(9) Final Disposal

In Tokyo, from 1927 to the present, 100,000,000 tons of waste were disposed of in seven (7) landfill sites. In addition to intermediate treatment residue, industrial waste generated by small to medium-sized business operators in Tokyo is also sent to landfill sites. As of around 2006, the service life of the new maritime landfill site currently being utilized was expected to be available for about 30 more years. However, the subsequent implementation of thermal recycling of plastic waste and the slag formation from the incineration ash have increased the service life of the landfill to more than 50 years from the present.

After the completion of disposal in a landfill, the site is utilized in a variety of ways as shown in Table 6-6 and Figure 6-5.

Table 6-6 Land Use after Closing of Landfill Sites in Tokyo

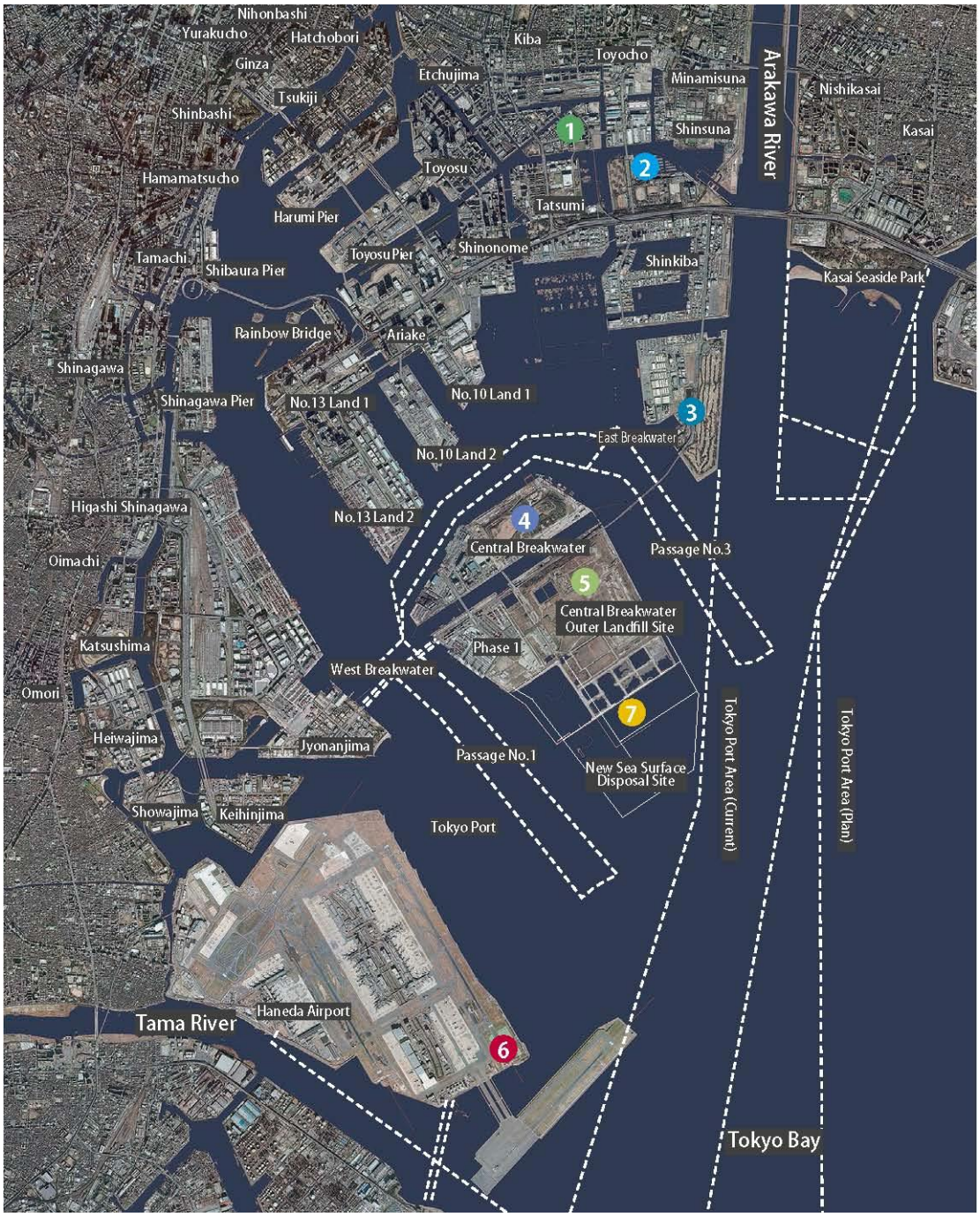
Name of landfill site	Service period (year)	Area (ha)	Use of the land
① No. 8 Site	1927 - 1962	36.4	Park, residential area, railway station
② No. 14 Site	1957 - 1966	45.0	Park, tropical plant garden, baseball stadium, incineration plant
③ No. 15 Site	1965 - 1974	71.2	Industrial area, park, camp site
④ Central Breakwater Inner Landfill Site	1973 - 1986	78.0	Park
⑤ Central Breakwater Outer Landfill Site	1977 - present	199.0	In service
⑥ Haneda Offshore Landfill Site	1984 - 1991	12.4	Airport
⑦ New Sea Surfacre Disposal Site	1998 - present	319.0	In service

Source: Clean Authority of TOKYO “Tokyo Model (outline)” (2018)

Photo 6-14 Landfill (⑤ Central Breakwater Outer Landfill Site)

Photo 6-15 Landfill of Incinerated Ash (⑤ Central Breakwater Outer Landfill Site)

Source: Yachiyo Engineering Co., Ltd.



*: Dotted lines indicate port area boundaries and shipping channels.

Source: TMG Bureau of Environment “Tokyo Metropolitan Government Waste Landfill Site” (2020)
https://www.kankyo.metro.tokyo.lg.jp/data/publications/resource/pamphlet_list.files/english_pamphlet2021.pdf

Figure 6-5 Final Disposal Sites in Tokyo

2.4 International Cooperation

In overcoming a large number of waste problems, Tokyo has accumulated rich and diverse knowledge and experience on waste management. Tokyo has been engaging in international cooperation activities concerning waste management and recycling in order to share the city's experience and knowledge with developing countries that are facing serious waste problems, and to develop overseas the waste technologies that can contribute to the reduction of the global environmental load. Table 6-7 shows specific international cooperation projects in which Tokyo has been involved.

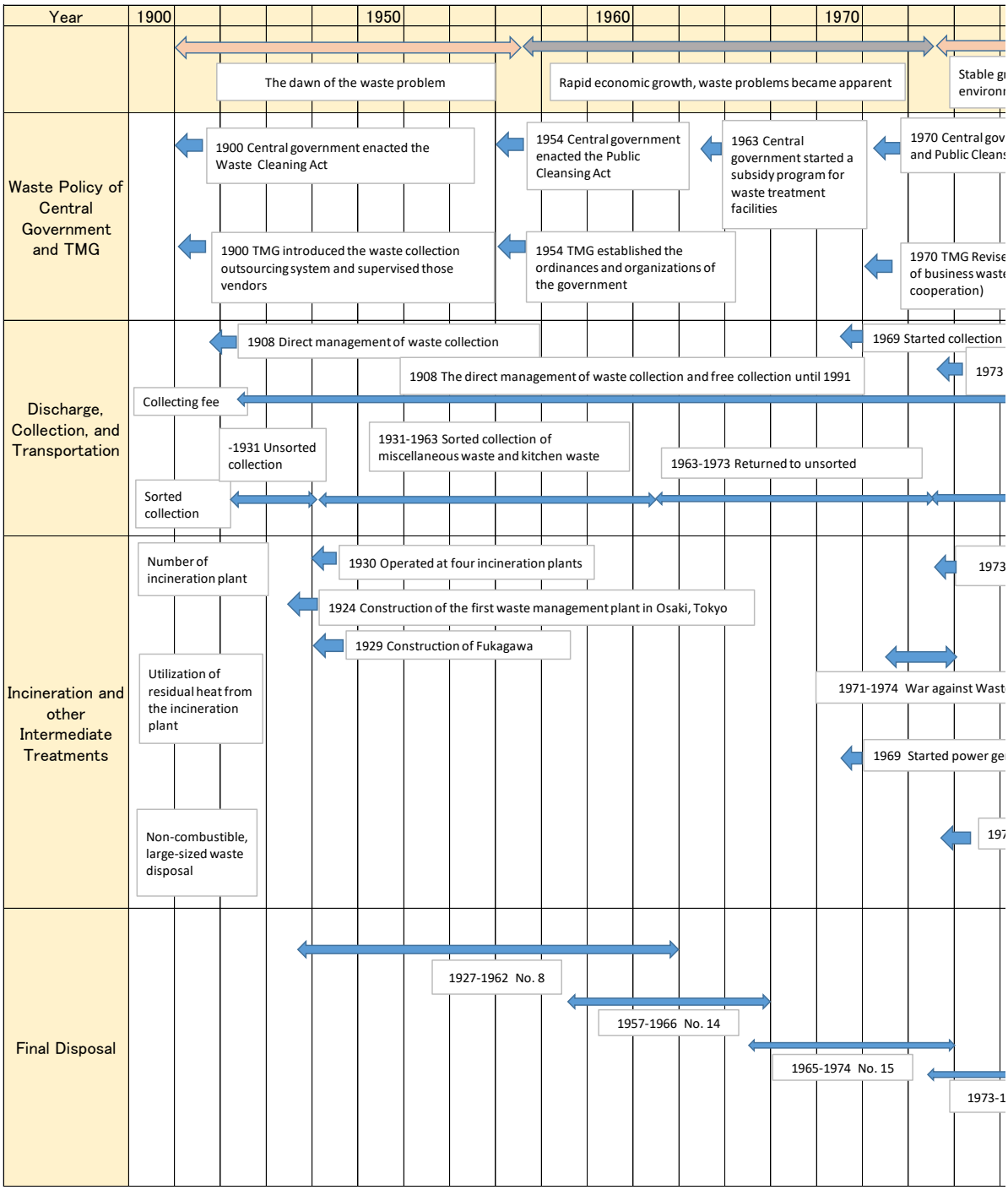
Table 6-7 Examples of Tokyo's International Cooperation Projects

FY	Results of Initiatives
2018	**＜Technical Advice to Foreign Cities＞** ・ **Ministry of the Environment "Overseas CO_2 Reduction Support Project through Strategic International Development of Japan's Recycling Industry"** Dispatched staff to the state of Telangana, India, to provide technical advice on the contents of a feasibility study on the project. ・ **Asian Development Bank (ADB) "Capacity Building Program for Urban Waste Management in the Maldives"** In cooperation with the Ministry of the Environment, TMG, Katsushika City, and other related organizations, ADB conducted site visits and lectures in Japan for administrative officials and others in the Maldives. In addition, staff members were dispatched to the Maldives to provide technical advice on local issues. ・ **Ministry of the Environment: "Survey on Bilateral Cooperation for 3Rs and Appropriate Treatment in the Asian Region"** Staff members were dispatched to Jakarta, Indonesia and Doha, Qatar to give lectures at workshops and other events on the theme of the experiences of the 23 cities of Tokyo regarding waste treatment.
	＜Support for the Education and Training of Foreign Personnel＞ ・ **JICA "Technical Capacity Building on Waste Management for Introduction of Waste Power Generation"** Accepted Vietnamese government officials and others as trainees, and in cooperation with Suginami City, conducted observation tours and lectures on waste separation and collection, recycling, intermediate treatment, etc. at collection sites and the Suginami Intermediate Treatment Plant.
2019	**＜Technical Advice to Foreign Cities＞** ・ **Ministry of the Environment "Overseas CO_2 Reduction Support Project through Strategic International Development of Japan's Recycling Industry"** Dispatched staff to Hanoi, Vietnam, to provide technical advice on the contents of the project feasibility study. ・ **Ministry of the Environment "Survey on Bilateral Cooperation for 3Rs and Appropriate Treatment in Asia"** Dispatched a staff member to Hanoi, Vietnam to give a lecture at the Japan-Vietnam Joint Committee and workshop on the experience of waste disposal in the Tokyo 23 Cities. ・ **Ministry of the Environment "Commissioned work for identifying projects for the Climate Technology Center Network (CTCN), etc."** Dispatched a staff member to Hanoi, Vietnam to assist in the preparation of request forms for CTCN projects in Vietnam, and provided technical advice on the contents of the forms.

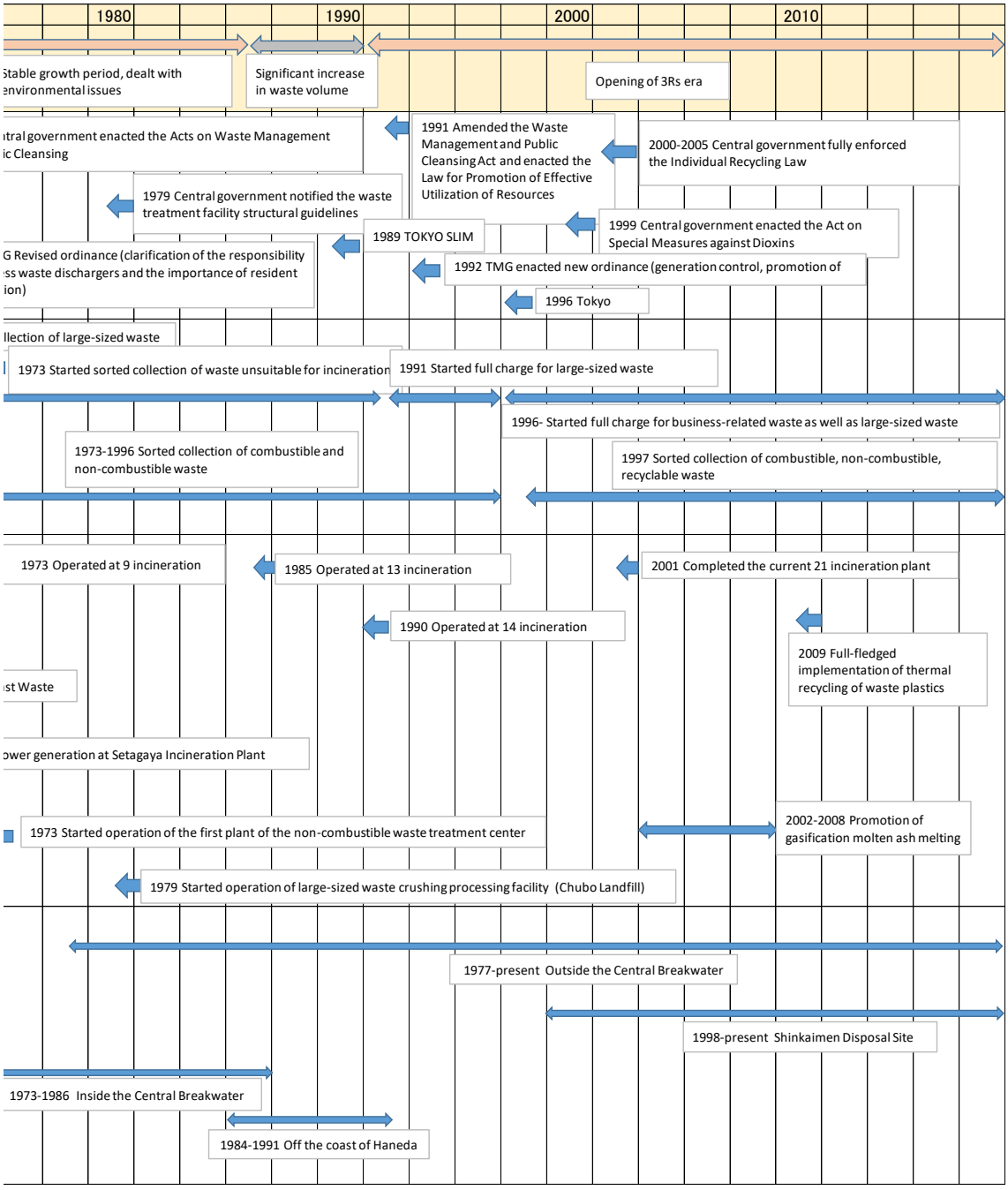
FY	Results of Initiatives
	＜Support for the Education and Training of Foreign Personnel＞ ・ **JICA "Project for Promotion of Waste Management Improvement in Kolkata Metropolitan Area, India"** Received local government officials and others from the Kolkata metropolitan area in India as trainees, and conducted observation tours and lectures on waste separation and collection, recycling, intermediate treatment, etc. at the Arakawa Recycling Center and Adachi Waste Disposal Plant in cooperation with Arakawa City.
2020	**＜Technical Advice to Foreign Cities＞** ・ **"The 10th Asia-Pacific 3R and Circular Economy Promotion Forum" Co-hosted by the Ministry of the Environment and the United Nations Center for Regional Development** Attended the forum, which was held in online format, and shared information on 3Rs and circular economy promotion with a wide range of stakeholders, including governments, international organizations, and research institutes.
	＜Support for the Education and Training of Foreign Personnel＞ ・ **Ministry of the Environment "Training Program to Promote Overseas Development of Japan's Recycling Industry"** Accepted trainees from six countries in an online format. In collaboration with Minato City, lectures and question-and-answer sessions were held for administrative officials from Mozambique on waste separation and collection, recycling, and other topics. In addition, the system of a waste treatment plant was introduced and a question-and-answer session was held for five other countries, including Indonesia. ・ **JICA "Technical Capacity Building on Waste Management for the Introduction of Waste Power Generation"** JICA provided materials and a question-and-answer session to assist in the implementation of on-demand training for multinational government officials and others.

Source: Clean Authority of TOKYO "Business Overview FY2021" (2021)

Attachment 1 History of Solid Waste Management of Tokyo 23 Cities



Source: Japan Environmental Sanitation Center


1980
1990
2000
2010
table growth period, dealt with environmental issues
Significant increase in waste volume
Opening of 3Rs era
tral government enacted the Acts on Waste Management ic Cleansing
1991 Amended the Waste Management and Public Cleansing Act and enacted the Law for Promotion of Effective Utilization of Resources
2000-2005 Central government fully enforced the Individual Recycling Law
1979 Central government notified the waste treatment facility structural guidelines
1999 Central government enacted the Act on Special Measures against Dioxins
1989 TOKYO SLIM
G Revised ordinance (clarification of the responsibility ss waste dischargers and the importance of resident ion)
1992 TMG enacted new ordinance (generation control, promotion of
1996 Tokyo
llection of large-sized waste
1973 Started sorted collection of waste unsuitable for incineration
1991 Started full charge for large-sized waste
1996- Started full charge for business-related waste as well as large-sized waste
1973-1996 Sorted collection of combustible and non-combustible waste
1997 Sorted collection of combustible, non-combustible, recyclable waste
1973 Operated at 9 incineration
1985 Operated at 13 incineration
2001 Completed the current 21 incineration plant
1990 Operated at 14 incineration
2009 Full-fledged implementation of thermal recycling of waste plastics
st Waste
ower generation at Setagaya Incineration Plant
1973 Started operation of the first plant of the non-combustible waste treatment center
2002-2008 Promotion of gasification molten ash melting
1979 Started operation of large-sized waste crushing processing facility (Chubo Landfill)
1977-present Outside the Central Breakwater
1998-present Shinkaimen Disposal Site
1973-1986 Inside the Central Breakwater
1984-1991 Off the coast of Haneda

3 Waste Management Efforts Made by Fujisawa City

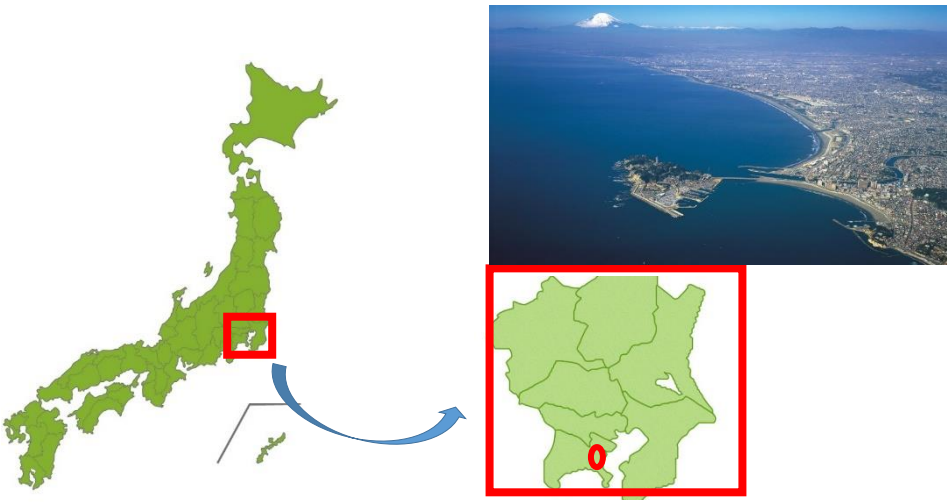
This section describes how Fujisawa City, an average medium-size Japanese city, has solved waste management issues in various periods from the 1940s up to the present date. Specifically, the focus is on the city's experience in managing recyclables starting from the early 1970s. Based on the experiences, the sound material-cycle waste management system was established.

Established as a city in 1940, Fujisawa City has been incorporating neighboring towns and villages and is still developing as a major urban city in the Shonan region, and presently has an area of 69.56 km^2 and a population of 430,000. From 1955 to the late 1960s, during the period of high economic growth, many large companies developed factories in the city almost turning it into an industrial city. However, the early half of the 1970s commercial facilities were developed in the city and Fujisawa City became the commercial heart of the Shonan region. In recent years, Fujisawa City has become a city with a wide variety of characteristics, including that of an educational city.

The waste treatment system is based on a recycling system known as the Fujisawa Model, which is supported by one facility for pulverization and recycling, two incineration facilities, and one final disposal facility that promotes recycling, utilizes incineration energy, and reduces the load on the final disposal facility.

Fujisawa City has summarized the present waste management situation in a document titled the "Outline of Waste Management". In this document, the activities for waste management from the 1940s to the present day are outlined to describe the history of the city's waste management.

This section will overview Fujisawa City's efforts in waste treatment with reference to the "Outline of Waste Management (2019: Fujisawa City)".



Source (Photo): Fujisawa City "Overview of Waste management in Fujisawa City (JICA Training Text)" (2019)

Figure 6-6 Location of Fujisawa City

3.1 History of Waste Management in Fujisawa City

Fujisawa City has developed its waste management along with the times, from the improvement of waste collection to the full-scale introduction of 3Rs, and the period from the 1945s to the present is divided into four periods.

(1) Period of Seeking a Better Waste Collection Method, 1945 - 1964

The history of waste management in Fujisawa City began in this period. Waste collection carried out by private sector operators started in 1947 and three years later, the collection operation was changed to direct management by the city. Late in this period, the amount of generated waste significantly increased due to the expansion of the urban district, increase in population, and enhanced standards of living. Accordingly, door-to-door collection was changed to station collection, and use of mechanized collection vehicles was promoted.

Table 6-8 Waste Management Related Events from the 1945 to 1964 Period

Storage and discharge	From 1950, plastic containers were used for discharging municipal waste.
Collection and transport	From 1947, waste collection was carried out by private operators using two-wheeled carts, general carts, etc. From October, 1950, waste collection was conducted for a fee by tricycles and carts under the direct management of the city mainly in the urban area which was a special cleaning district designated by the former *Waste Cleaning Act* of 1900. Around 1961, the collection system was enhanced and mechanical power was actively introduced. In 1964, conventional door-to-door collection was changed to collection at stations and the system of "discharge of waste using containers at stations on fixed dates" was adopted. Also, to increase waste collection and transport efficiency, special vehicles - waste trucks - were introduced into operation.
Recycling	No records
Intermediate treatment	Collected waste was incinerated at the Ishinazaka incineration plant (fixed batch furnace, 15t/8h, 2 units) built in 1955.
Final disposal	Collected waste was previously buried in agricultural land, dry riverbeds, etc. After the waste incineration plant was built, incineration residue (ash) and some kitchen waste were disposed. As a result, the amount of waste disposed decreased.

Source: Fujisawa City "Outline of Waste Management FY2019" (2021)

(2) Period of Seeking Proper Waste Treatment for Bulky Waste, 1965 - 1974

Accompanied by the high economic growth, consumption styles diversified and discharging of bottles, cans, and home appliances in the waste increased. Both the quantity and quality of waste significantly changed. In addition, the central government thoroughly revised its former *Public Cleansing Act* and enacted the *Waste Management Act* with the aim to secure and preserve

appropriate living environment, and regulate waste management from a broad perspective, thereby fundamentally addressing waste management issues throughout the entire municipality.

Table 6-9 Waste Management Related Events from the 1965 to 1974 Period

Storage and discharge	No records
Collection and transport	In this period, bulky waste increased in both quantity and size. It became difficult to incinerate such waste, and separate collection of bulky waste was introduced in 1970, through contract out. From 1970 to 1979, bulky waste was directly disposed of at the Ishinazaka landfill site. From 1973, municipal waste was collected twice a week on designated days of the week throughout the entire city.
Recycling	No records
Intermediate treatment	Separate collection of bulky waste began in 1970, and from then on only municipal waste was incinerated in the incineration plants. However, with the increase of the municipal waste amount and changes in the waste quality, the capacity of incineration facilities was enhanced. The Ishinazaka incineration plant was expanded; 2 units of 40t/8h in 1965, + 1 unit of 40t/8h in 1968. To address further anticipated increase of waste in the near future, the North Waste Management Center (incineration plant) was constructed with a mechanical furnace of 150t/24h installed in 1970, and a second furnace of 150t/24h installed in 1973.
Final disposal	With the increase of incineration residue (ash), it became necessary to secure a long-term final disposal site. In cooperation with a land owner, a landfill site was constructed in Chogo Kamiyadai in 1972.

Source: Fujisawa City "Outline of Waste Management FY2019" (2021)

(3) Dawn of 3Rs and Period for Development of Intermediate Treatment Facilities, 1975 - 1994

During this period, the amount of waste continued to increase and the contents of waste were diversified as well. Consequently, it became difficult to conduct proper treatment and disposal of waste collected based on only two categories: municipal waste and bulky waste. To find an effective means for waste reduction, the "Fujisawa City Waste Reduction Promotion Office" was established in April, 1977, and waste reduction and recycling measures were regularly discussed. Fujisawa City invited citizens to participate in the discussions at the early design phase of the waste management system instead of asking citizens for their cooperation after the system had been designed. As a result, a waste separation system was successfully established. It was favorably accepted by the citizens. In October 1990, Fujisawa City established the "Fujisawa City Waste Control Conference" with the participation of four parties: citizens, business operators, academic experts, and municipal administration officials. The Conference proposed measures to reduce the amount of waste by 20% by the year 2000, to the mayor of Fujisawa City in October 1991.

Table 6-10 Waste Management Related Events from the 1975 to 1994 Period

Storage and discharge	In 1978, along with the recycling of municipal waste, paper bags designed for municipal waste discharge were allowed in addition to the conventional plastic containers. Thus, two methods for discharging waste became permissible.
Collection and transport	No records
Recycling	Fujisawa City started to implement a waste reduction and recycling policy. The "Fujisawa City Waste Reduction Promotion Office" was established and waste reduction and recycling measures were regularly discussed. As a result, in February, 1978, collection of recyclables - bottles, cans, metals, fabric, paper – was initiated jointly by three parties; the city, citizens, and the Shonan Branch of the "Kanagawa Resource Recovery Merchant Cooperative Association" (the name was changed to the "Fujisawa City Resource Recovery Cooperative Association" on April 1, 1989). Thus, waste was collected according to three categories: municipal waste, bulky waste, and recyclables. History of the recyclables collection (Fujisawa method) will be described in section 3.2, hereafter "Noteworthy experience: Recycling of recyclables - Fujisawa method".
Intermediate treatment	Construction of the bulky waste shredding facility (50t/5h) was launched in 1978 to improve direct landfill of bulky waste. Reconstruction of the aging Ishinazaka incineration plant started in 1979 and was completed after three years, and operation commenced from 1981. The Ishinazaka waste management center (currently Ishinazaka Environment Center, an incineration plant) was constructed in 1983 (fluidized-bed system 130t/24h x 3 units) and started operation in 1984. For this facility, strict environmental quality standards, such as double-structured side walls of the plant building, etc., were required because urbanization of neighboring areas progressed and residential areas expanded while the former furnaces were in operation. Furthermore, renovation of the incineration facility (furnace No. 1, 150t/24h x one unit) of the North Waste Management Center and construction of the bulky waste shredding facility (30t/5h) were launched in 1984. Those facilities were completed and started operating in October, 1986. In addition, renovation of the shredding facility of the Kirihara Waste Management Center was launched in 1986 and the facility was completed in March, 1989. Renovation work for the waste incineration facilities in the North Waste Management Center was launched in 1987 and completed in March, 1989.
Final disposal	The Chogo Chubun first landfill site was constructed in 1973, and the Yane landfill site and Kuzuhara landfill site were constructed in 1979. The Ishinazaka landfill site (city-owned land) that had been used since 1970 was transformed into a lush green park and opened to the public in 1981. The Yane landfill site which had fulfilled its role in 1986 was transformed into a multipurpose ground in April, 1988. The Chogo Chubun second landfill site had also fulfilled its role in 1986. To replace the Kuzuhara landfill site, which had been used along with the Yane and Chogo Chubun landfill sites and would soon reach its disposal capacity, construction of the Kuzuhara second landfill site started in 1987 and was completed in 1989.

Source: Fujisawa City "Outline of Waste Management FY2019" (2021)

(4) Period of Full-Scale 3Rs Introduction, after 1995

The amount of generated waste nationwide began to increase in the 1980s. Municipalities hastened to improve landfill sites, and started to seriously engage in waste management based on the 3Rs policies, and increased source separation and separate collection activities for some recyclables. In 1999, the collection of PET bottles was initiated citywide, followed by source separation and separate collection of miscellaneous waste paper resources in 2001. In the same year, with the implementation of the *Small Home Appliance Recycling Act*, four home appliance items were excluded from the general collection, and the separate collection of plastic containers and packaging was introduced in 2002.

In 2014, the Recycle Plaza Fujisawa was completed. The Recycle Plaza incorporated a recycling facility and a public educational facility, thereby greatly contributing to public awareness of waste management. This type of recycle plaza has been constructed nationwide since 1990.

Table 6-11 Waste Treatment Related Events after 1995

Storage and discharge	No records
Collection and transport	In 1998 the South Waste Management Center construction started and was completed in February, 1999. Since 1999 waste has been collected and transported to two centers: one in the north and the other in the south.
Recycling	Intermediate treatment of resources was conducted in recycling facilities. However, the adjacent shredding facility of the Kirihara Environment Center deteriorated with age, and from 2010 the facility was renovated into a material recycle facility as a four-year project. At the time of construction the tentative name of this facility was the Fujisawa City Recycle Center. The waste treatment building equipped with a shredding facility was built in March, 2013, and the environmental education building was built in January, 2014, to enhance public awareness of environmental problems. In February, 2014, it was decided to name those facilities the Recycle Plaza Fujisawa.
Intermediate treatment	Regarding waste treatment facilities, the North Environment Center was improved to ensure that its functions are properly maintained, and the exhaust gas advanced treatment (dioxin reduction) facility of Ishinazaka Environment Center was also improved as a three-year project from 1997 to 1999. Furthermore, at the North Environment Center, furnace No. 2 was modified in 2002 and 2003, and furnace No. 1 was upgraded as a three-month project in 2004. This construction was done by the DBO (develop-build-operate) system.
Final disposal	The Kuzuhara second landfill site that had been used since 1989 was expected to become full in 2003. Accordingly, construction of the Onnazaka landfill site started in 1994 as a three-year project to be used as the next landfill site. It was completed in March, 1997.

Source: Fujisawa City “Outline of Waste Management FY2019” (2021)

3.2 Noteworthy Experience: Recycling of Recyclables - Fujisawa Method

The "Fujisawa method" has two features: [1] it was the nation's first project of this kind, and [2] it was a project in which citizens, municipal administration, and collection operators were jointly engaged. The citizens followed the sorting and separate discharge instructions provided by the municipal administration together with the waste collection operators, and as a result it became possible to obtain recyclables of the quality required by the recycled goods market.

In the 1970s Japan's major municipalities became involved in separated waste collection. At the time the objective behind separate waste collection was to support the proper treatment of waste, and was not for the promotion of recycling. In those days, incineration was the main method of waste treatment and therefore, incombustible waste and bulky waste that could interfere with the incineration process were separately collected and not taken to incinerators. Many municipalities started to separate recyclables for the purpose of recycling in the 1990s. However, Fujisawa City was engaged in recycling of recyclables earlier, in the 1970s through the joint activities of citizens, municipal administration, and collection operators. This method was referred to as the "Fujisawa method" which attracted countrywide attention.

Column: Waste Reduction and Background of the Movement to Recycle Waste

(1) Rapid Increase of Bulky Waste

Sorted collection of bulky waste started in 1970 and continued as usual for a while at the time of the oil shock in 1973. To promote resource saving, during that time, Fujisawa City was striving to provide leadership training for local children's associations, residents' associations, and women's associations to initiate voluntary group collection of recyclables for recycling. However, the amount of bulky waste began to significantly increase from around 1975 by 10 to 20% a year and the cost of collection increased accordingly.

(2) Saturation of Landfill Sites

Since the start of waste separation in 1970, collected bulky waste was directly disposed of in city-owned land (area of 37,000 m^2) located in the center of the city. However, around 1977 the landfill capacity was filling up as a result of urbanization in neighboring areas. As it was difficult to secure alternative landfill sites, proper treatment of bulky waste became necessary considering environmental conservation and effective utilization of landfills.

(3) Composition of Bulky Waste

Fujisawa City conducted field investigation of its landfill sites and at stations where the bulky waste was delivered. Results of the investigation revealed that approximately 60% of bulky waste - such as large furniture units, large electric home appliances, bottles, cans, metals, cardboard, etc. - could be recycled or reused, and separating bulky waste would help reduce such bulky waste, extend the service life of the city's landfills, conserve the environment, and benefit recycling of waste.

(4) Establishment of the Waste Reduction Promotion Office

In April 1977 Fujisawa City established the "Waste Reduction Promotion Office" to address the urgent needs, specifically; to cope with the increase in bulky waste amount and filling up of landfills, reducing waste, promoting waste recycling, and implementing proper treatment. The

investigation research group, which was a subordinate organization of the Office, researched and discussed specific measures. The investigation results showed that large quantities of bottles, cans, metals, paper, and fabric were contained in conventional municipal waste and bulky waste. Since separation of such waste would be an easy process to implement, an outline of the measures was roughly developed as follows. The city, working jointly with residents and waste collection operators would implement a waste collection system. In that system, routes for collecting recyclables would be newly established, and local residents would sort out their waste before discharge and bring the separated waste on designated dates and to designated containers placed at designated locations. Waste collection operators would then collect the separated waste. Such a collaboration system was considered to be appropriate.

(5) Trial Collection in Model Districts and Expansion throughout the Entire City Area

Based on discussions by the investigation research group, three model districts were selected; a housing complex, an independent housing district, and a mixed district having both residences and shops. Separate waste collection trials were performed in the three districts for three months from September, 1977. The results of the trial collection were favorable.

The results confirmed that considerable advantages could be expected from this waste collection method. It was also confirmed that the waste collection could be satisfactorily introduced if sufficient efforts were made to promote the understanding of residents and public awareness about the implementation method, and give proper instructions. Accordingly, the "Operating procedure for Fujisawa City waste reduction and recycling activities" was created, and while proceeding with the improvement of the city's advisory system and promoting public awareness of the new system in public relations publications, Fujisawa City launched the step-by-step implementation of the waste collection project. The first phase commenced implementation in February, 1978, the second phase started in August, 1978, and the third phase in February, 1979. Upon the expansion of the model districts, city staff were mobilized under administration-wide coordination to instruct citizens on source separation and separated waste discharge. The citizens eagerly cooperated. Thus, it took only one year to expand the collection system throughout the entire city area from the time the collection was first implemented in the first district.

This method, referred to as the "Fujisawa method", where citizens, municipal administration, and collection operators worked together, attracted countrywide attention.

Source: Fujisawa City "Outline of Waste Management FY2019" (2021)

3.3 Experience of Construction and Renovation of Incineration Facilities

Construction of waste incineration facilities requires the understanding and agreement of local neighborhood residents through having a dialogue with them. When the new plant, Ishinazaka Environment Center was constructed at the site of the old Ishinazaka incineration plant in Fujisawa City, the neighboring areas were crowded residential areas and strict environmental measures were required. Furthermore, as the service life of incineration facilities is long, ranging from 30 to 35 years, it was necessary to respond to changes both in waste quality, as well as in laws and regulations during the long operation period. Fujisawa City also took countermeasures against high-calorie heat generation and dioxins.

Construction and improvement of waste incineration facilities presented significant challenges for all municipalities in Japan. During the period of high economic growth, waste quality dramatically changed, and facilities failed to properly manage such waste, causing unexpected problems. Also, during renovation of old facilities, strict environmental measures were required due to the urbanization of neighboring areas and spread of crowded residential areas around the facilities since they were first constructed. Landfill sites were confronting similar conditions. Developed urban areas were expanding to a level where there was no longer any surplus land in the city, and it was becoming difficult to find sites for constructing new landfill sites. These are usual challenges in many countries.

In 1981, a new Ishinazaka Incineration Plant (capacity of 390 ton/day) was constructed as a facility of the Ishinazaka Environment Center in Fujisawa City on the site of the old waste treatment facility. The areas around the site had been developed into residential areas. Thus, the site of the incineration plant was located in what had become a residential area, and accordingly strict environmental measures had to be taken. When a new waste incineration facility is constructed at a site where there used to be a facility, it is necessary to give due consideration to residents in neighborhoods adjacent to the new plant even if those affected neighborhoods developed after the old incineration facility had been built and was in operation.

From 1986 to 1990, renovation works were carried out at the North Waste Management Center to deal with the high-calorie heat generation.

Subsequently, the North Waste Management Center and Ishinazaka Environment Center have undergone dioxins reduction modification works.

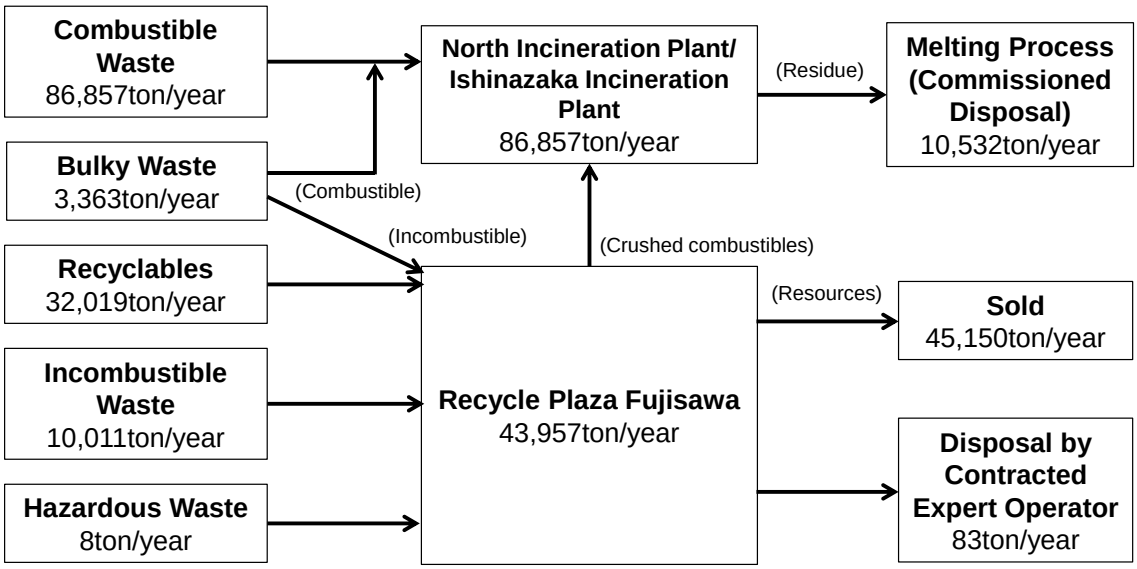
When the No. 1 furnace at the North Waste Management Center was renewed between 2004 and 2007, various privatization methods were considered to meet the needs for cost reduction and leveling due to the financial difficulties at the time. As a result, DBO (Design-Build-Operate) method was adopted for the construction work.

3.4 Current Waste Management in Fujisawa City

In Fujisawa City, based on efforts in recycling of recyclables, and construction and improvement of incineration facilities, the consumption of natural resources has been reduced, and a resource-recycling waste treatment system was established with the aim of realizing a society in which the burden on the environment is minimized as much as possible.

(1) Waste Management Flow in Fujisawa City

As shown in Figure 6-7, the waste management flow in Fujisawa City starts with waste being collected according to the following categories: combustible waste, bulky (large-sized) waste, incombustible waste, recyclables, and hazardous waste. After collection, combustible waste and combustible bulky waste are incinerated at the North Incineration Plant and the Ishinazaka Incineration Plant, and incineration residue is treated by melting. Incombustible bulky waste, incombustible waste, and recyclables are shredded and sorted at the Recycle Plaza Fujisawa, and resources are then sold and shredded combustibles are incinerated. Incineration residue is disposed of in a landfill. Hazardous waste is temporarily kept at the Recycle Plaza Fujisawa and then disposed of by the contracted expert operators.



Source: Fujisawa City "Outline of Waste Management FY2019" (2021)

Figure 6-7 Waste Management Flow in Fujisawa City (FY2020)

(2) Source Separation and Separate Waste Discharge, Collection, and Transport

In 2007, Fujisawa City changed the waste collection system from station collection to door-to-door collection. The reasons for changing from the highly-efficient station collection to the door-to-door collection were to eliminate waste stations that may detract from the local scenery and to clarify the responsibility of waste generators who discharge waste. Door-to-door collection while lower in terms of collection efficiency, is expected to achieve the major goal of reducing the amount of combustible waste by encouraging individuals to thoroughly sort out their own waste.

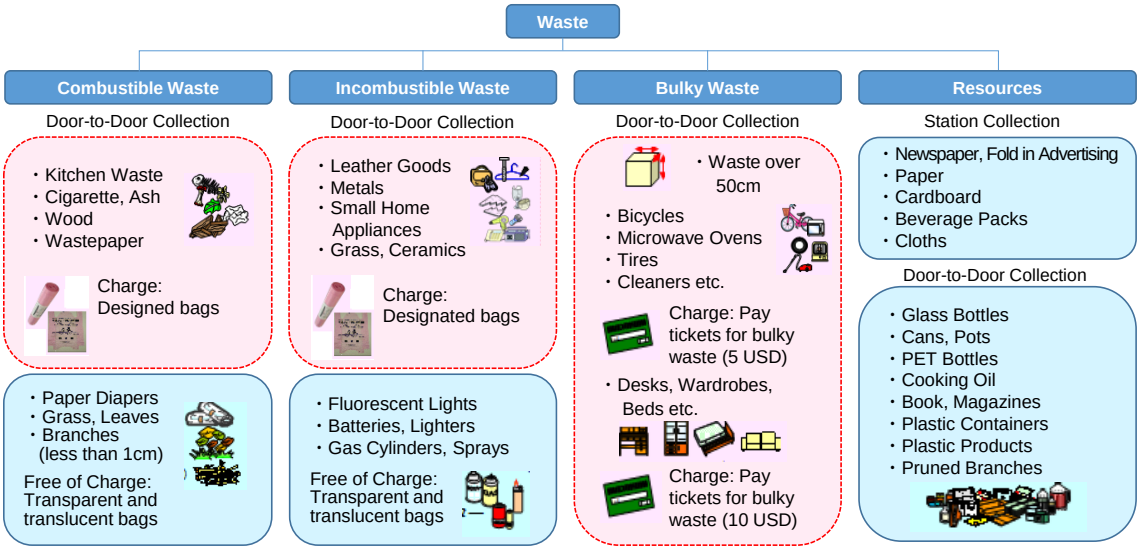
Since 1992, Fujisawa City had been collecting the four waste categories of combustible waste, incombustible waste, bulky waste, and recyclables by station collection method. However, with the objective to further reduce the waste amount, in April, 2007, the station collection system was changed to the door-to-door collection system throughout the entire city; and waste was sorted according to the items shown in Figure 6-8, with the exception of some recyclables. In contrast to station collection, which does not clearly identify the waste generators, door-to-door collection, in which waste is collected in front of the home, clearly identifies the waste generators. Therefore, it was expected that door-to-door collection would lead to greater responsibility felt by waste generators and motivate them to better sort their waste at source, which in turn would lead to waste reduction (for more details on station collection and door-to-door collection, refer to “Topic 4-1.2 Collection Methods”). In addition, in October of the same year, the city started to charge for the collection of combustible and incombustible wastes by requiring residents to purchase and use designated waste bags so as to further promote waste reduction (for more details on charging fees, refer to “Topic 3-3.4 (4) Charging Fees on Waste Management”).

Combustible waste discharged in designated bags from each household is collected twice a week by small compactor vehicles of two-ton capacity and lightweight trucks belonging to the North Environment Center and the South Environment Center. Since April, 2012, contracted collection operators have been collecting combustible waste in about 60% of the city area.

Collection of bulky waste is done by contracted collection operators. Bulky waste discharged in front of each house is collected by compactor vehicles and dump trucks every other day in each area and transported to the Recycle Plaza Fujisawa (shredding facility). Furthermore, to respond to an aging society, a waste collection support was started from April, 2015, by helping elderly people and others who have difficulty in discharging waste from their homes.

Incombustible waste is discharged in designated bags from each household two or three times a month on designated days. Collection of incombustible waste discharged from about 40% of the city area is directly managed by the city, and incombustible waste discharged from the remaining 60% of the city area is collected by contracted collection operators. All of the collected incombustible waste is transported to the Recycle Plaza Fujisawa.

Recyclables are discharged at stations once every other week in cooperation with local residents' associations etc. and is collected by the Fujisawa Resource Circulation Cooperative Association.



Source: Fujisawa City "Solid waste management in Fujisawa City (JICA training text)" (2019)

Figure 6-8 Waste Sorting Items

Table 6-12 Prices of Designated Waste Bags

Type	Types of bags		Price	
	Object	Size	10 bags in 1pack	5 bags in 1pack
Household Waste	Bags for combustible and incombustible wastes (Pink color)	Mini (5 L)	100 JPY	-
		Small (10 L)	200 JPY	-
		Medium (20 L)	400 JPY	-
		Large (40 L)	-	400 JPY
	Bags for combustible waste only (Yellow color)	Mini (5 L)	100 JPY	-
		Small (10 L)	200 JPY	-
		Medium (20 L)	400 JPY	-
		Large (40 L)	800 JPY	-
Business Waste	Bags for combustible and incombustible waste (Blue color)	Medium (20 L)	1,500 JPY	-
		Large (40 L)	3,000 JPY	-

Source: Fujisawa City Website "Types of Designated Collection Bags and Handling Stores" https://www.city.fujisawa.kanagawa.jp/kankyo-j/kurashi/gomi/wakekata/shushubukuro.html (accessed February 9, 2022)

(3) Recycling

The Recycle Plaza Fujisawa was built in 2014 by combining a shredding and recycling treatment building with an environmental education building aiming of promoting public awareness through the display of environmental systems and provision of experiential activities. Recycle Plaza Fujisawa receives and recycles the entire quantity of bottles, cans, and PET bottles and some part of plastic containers and packaging. Recyclables that is not received at the Recycle Plaza Fujisawa is recycled by the Fujisawa Resource Circulation Cooperative Association and private business operators. Thus, under the management of the city, private business operators utilize their own recycle routes to increase the recycling rate.

Source: Fujisawa Eco Website "Recycling Plaza Fujisawa"
https://fj4.city.fujisawa.kanagawa.jp/recycleplazafujisawa/ (accessed January 24, 2022)

Photo 6-16 Recycling Plaza Fujisawa

(4) Intermediate Treatment by Incineration

Combustible waste is received at the Ishinazaka Environment Center and the North Environment Center and then incinerated.

The Ishinazaka Environment Center is equipped with continuous-firing type fluidized-bed system incineration furnaces (130t/24h x 3 furnaces). As the amount of collected waste was reduced due to the benefits of using the paid-for designated bag system, since 2008 operation of furnace No. 1 has been discontinued, while furnace No. 2 and furnace No. 3 are in operation.

The North Environment Center is equipped with firing type stoker furnaces (150t/24h x 2 furnaces). Furnace No. 1 was demolished because of deterioration due to age, but furnace No. 2 was upgraded using the DBO method and is currently in operation.

Photo 6-17 North Incineration Plant (150t/24h×1 unit)

Photo 6-18 Ishinazaka Incineration Plant (130t/24h×3 unit)

Source: Fujisawa City "Outline of Waste Management FY2020" (2022)

(5) Environmental Education and Public Services

Fujisawa City provides an experiential learning program for the fourth grade elementary school pupils and kindergarten children by visiting their schools and kindergartens. For the purpose of promoting waste reduction and recycling so as to extend the service life of its landfill sites, children can begin to acquire knowledge about waste management and become aware of the present circumstances from childhood. Furthermore, the "quick call FUREAI collection" is being implemented. This service is intended for households with aged or disabled residents who are not able to take out their household waste (except for bulky waste) and recyclables to the stations. A city staff member announces their offer to help at the entrance of the house and helps the residents who need assistance to discharge their own waste.

Photo 6-19 School Visit Program

Photo 6-20 FUREAI Collection Vehicle

Source: Fujisawa City "Solid waste management in Fujisawa City (JICA training text)" (2019)

(6) Final Disposal

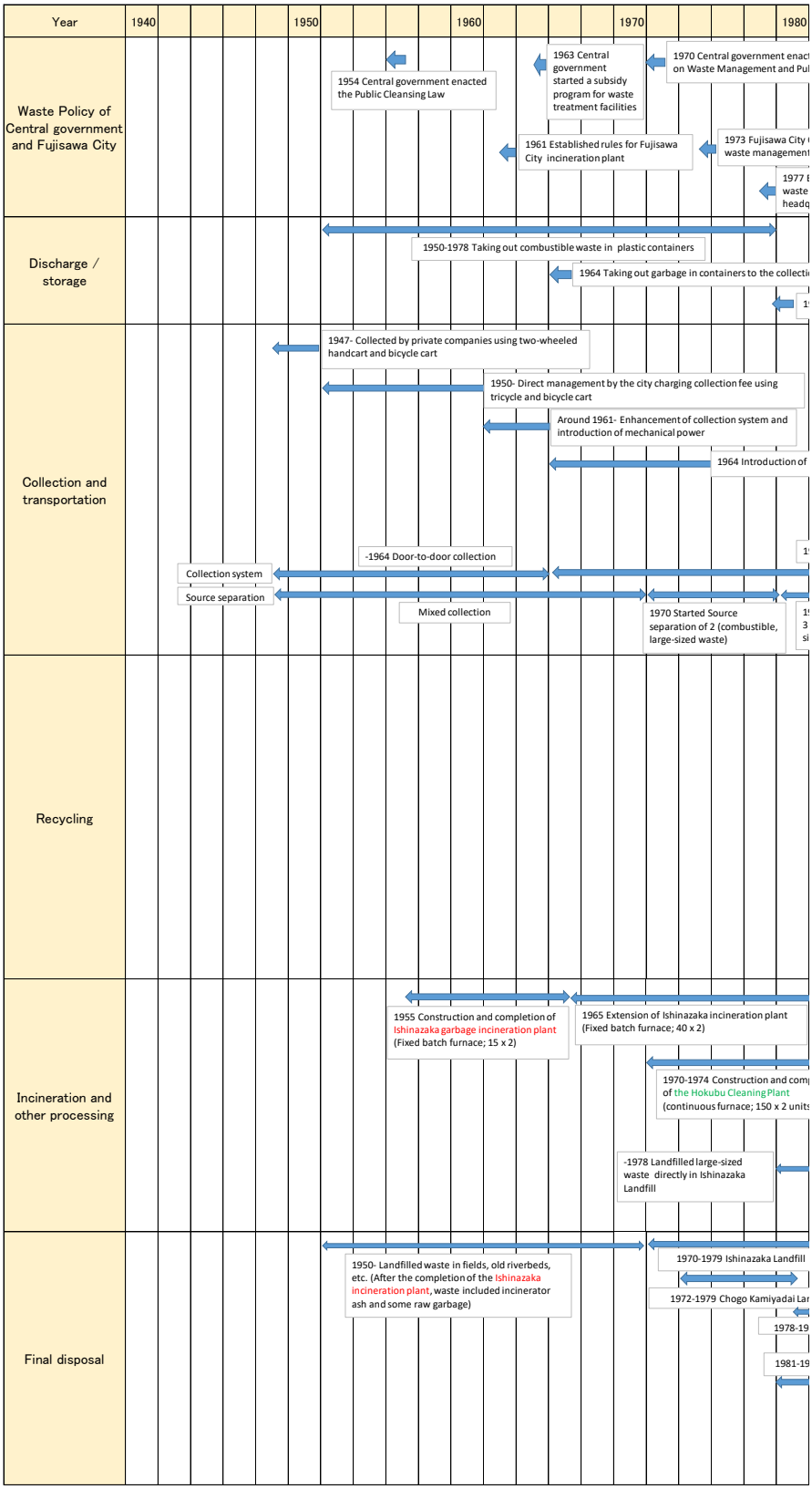
The Onnazaka landfill site, constructed in 1997, is currently Fujisawa City's only landfill site. Initially, the landfill operation was scheduled to end in 2008, but as a result of construction of expansion works, the landfill operation period was extended to 2036.

As it is extremely difficult to secure a site to construct a new landfill in the city, further waste reduction is required. The city is striving to effectively utilize the waste items intended for landfill so as to reduce the amount of waste entering the landfill and thereby extend the life of the landfill site.

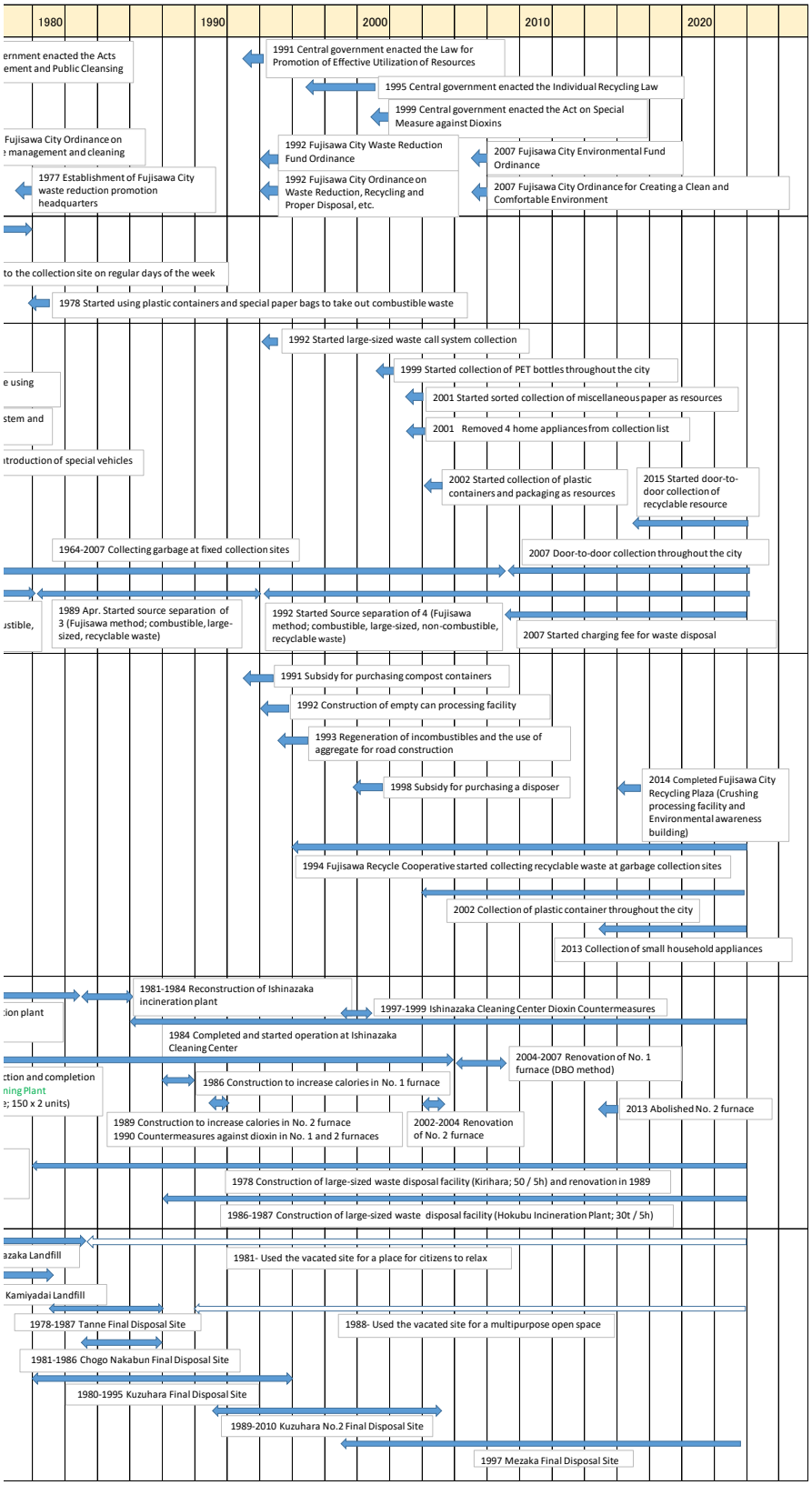
Source Fujisawa City "Solid waste management in Fujisawa City (JICA training text)"（2019）

Photo 6-21 Onnazaka Landfill Site

Attachment 2 History of Solid Waste Management of Fujisawa City



Source: Japan Environmental Sanitation Center


1980
1990
2000
2010
2020
ernment enacted the Acts
ement and Public Cleansing
1991 Central government enacted the Law for Promotion of Effective Utilization of Resources
1995 Central government enacted the Individual Recycling Law
1999 Central government enacted the Act on Special Measure against Dioxins
Fujisawa City Ordinance on
management and cleaning
1992 Fujisawa City Waste Reduction Fund Ordinance
2007 Fujisawa City Environmental Fund Ordinance
1977 Establishment of Fujisawa City waste reduction promotion headquarters
1992 Fujisawa City Ordinance on Waste Reduction, Recycling and Proper Disposal, etc.
2007 Fujisawa City Ordinance for Creating a Clean and Comfortable Environment
to the collection site on regular days of the week
1978 Started using plastic containers and special paper bags to take out combustible waste
1992 Started large-sized waste call system collection
1999 Started collection of PET bottles throughout the city
e using
2001 Started sorted collection of miscellaneous paper as resources
stem and
2001 Removed 4 home appliances from collection list
troduction of special vehicles
2002 Started collection of plastic containers and packaging as resources
2015 Started door-to-door collection of recyclable resource
1964-2007 Collecting garbage at fixed collection sites
2007 Door-to-door collection throughout the city
ustible,
1989 Apr. Started source separation of 3 (Fujisawa method; combustible, large-sized, recyclable waste)
1992 Started Source separation of 4 (Fujisawa method; combustible, large-sized, non-combustible, recyclable waste)
2007 Started charging fee for waste disposal
1991 Subsidy for purchasing compost containers
1992 Construction of empty can processing facility
1993 Regeneration of incombustibles and the use of aggregate for road construction
1998 Subsidy for purchasing a disposer
2014 Completed Fujisawa City Recycling Plaza (Crushing processing facility and Environmental awareness building)
1994 Fujisawa Recycle Cooperative started collecting recyclable waste at garbage collection sites
2002 Collection of plastic container throughout the city
2013 Collection of small household appliances
ion plant
1981-1984 Reconstruction of Ishinazaka incineration plant
1997-1999 Ishinazaka Cleaning Center Dioxin Countermeasures
1984 Completed and started operation at Ishinazaka Cleaning Center
2004-2007 Renovation of No. 1 furnace (DBO method)
ction and completion
ning Plant
; 150 x 2 units)
1986 Construction to increase calories in No. 1 furnace
2013 Abolished No. 2 furnace
1989 Construction to increase calories in No. 2 furnace
1990 Countermeasures against dioxin in No. 1 and 2 furnaces
2002-2004 Renovation of No. 2 furnace
1978 Construction of large-sized waste disposal facility (Kirihara; 50 / 5h) and renovation in 1989
1986-1987 Construction of large-sized waste disposal facility (Hokubu Incineration Plant; 30t / 5h)
azaka Landfill
1981- Used the vacated site for a place for citizens to relax
Kamiyadai Landfill
1978-1987 Tanne Final Disposal Site
1988- Used the vacated site for a multipurpose open space
1981-1986 Chogo Nakabun Final Disposal Site
1980-1995 Kuzuhara Final Disposal Site
1989-2010 Kuzuhara No.2 Final Disposal Site
1997 Mezaka Final Disposal Site

4 Waste Management Efforts made by Shibushi City

Shibushi City is a municipality that does not have a waste incineration facility, which is rare in Japan, and has worked to reduce and recyclables through thoroughgoing separation of household waste. In complete contrast to previously implemented mixed waste collection, the introduction of source separation and separated waste collection of multiple waste items successfully achieved a large reduction in final waste disposal to one-eighth. The experience of Shibushi City provides an understanding of needed design of the waste management system and how to obtain residents' cooperation in order to make recycling successful.

Shibushi City was established in January 2006 through the merger of former Shibushi town, former Ariake town, and former Matsuyama town. The city has a fan-shaped area measuring approximately 23 km from east to west and 18 km from north to south and has a total area of 290.28 km^2 which is approximately 3.2% of the total area of Kagoshima Prefecture. Table 6-13 shows the population and the number of households according to the national population census of 2020.

Taking advantage of a vast expanse of farmland and genial climate and utilizing large-scale dry field irrigation, the city has developed into one of the prefecture's most productive and specialized agricultural areas for growing tea and vegetables.

Source: Shibushi City Website "Why don't you start agriculture in Shibushi City"
https://www.city.shibushi.lg.jp/soshiki/10/2170.html (accessed January 24, 2022)

Table 6-13 Population and Number of Households in Shibushi City (2020)

Item	Matsuyama District	Shibushi District	Ariake District	Total Shibushi City
Number of households (household)	1,580	7,293	4,368	13,241
Population (male)	1,721	7,480	4,797	13,998
Population (female)	1,886	8,233	5,212	15,331
Population (total)	3,607	15,713	10,009	29,329
Population per household (person)	2.28	2.15	2.29	2.22

Source: Bureau of Statistics, Ministry of Internal Affairs and Communications "Results of 2020 national population census" (2021)

Source (Photo): Yachiyo Engineering Co., Ltd.

Figure 6-9 Location of Shibushi City

4.1 History of Waste Management - Waste Recycling Project around the Time Shibushi City Was Established

Shibushi City, which does not have an incineration facility, began its own waste recycling efforts in response to the growing need to reduce the amount of waste disposed at landfill. These efforts were completely new for both the municipality and residents.

The former towns of Shibushi, Ariake, and Matsuyama did not have any incineration plants and the collected waste was discarded in a landfill located in a depressed area surrounded by mountains. However, with the rising concern for environmental problems, it became impossible to continue discarding waste in this location. Accordingly, in 1990, the South Soo Welfare Association, consisting of the former towns of Shibushi, Ariake, and Osaki, constructed a controlled-type landfill site with a landfill capacity of 720,000 m^3 to directly receive waste generated from those three towns without separating waste items. Since waste was simply dumped in the landfill site, the site became a breeding ground for flies, mosquitos, rats, and crows, causing an offensive odor, and as a consequence a large number of complaints from neighboring residents were lodged with the South Soo Welfare Association. Furthermore, estimates showed that the landfill site would become full in 1998 if direct landfill continued without separating waste items. Thus, waste reduction became an urgent issue. From that time, Shibushi City started to actively work on the recycling. Table 6-14 shows Shibushi City's efforts in waste management from the inauguration of the city to the present date.

Table 6-14 Shibushi City's Efforts in Waste Management from the Inauguration of the City to the Present Date

Start year	Event and project
1990	The former towns of Shibushi, Ariake, and Osaki (South Soo Welfare Association) constructed a controlled-type landfill site with a landfill capacity of 720,000 m^3.
1998	Source separation of cans, bottles, and PET bottles started using designated bags.
1999	Started the sorting process of the above at the Soo Recycle Center, which was completed in 1999.
1999	Collection of 19 items of resources was started at 500 stations in the city.
2003	Started the source separation of 24 items.
2004	The source separation of kitchen waste started three times a week at 600 stations in the former town of Shibushi and Ariake. Composting started in the Soo Recycle Center.
2006	Shibushi City was established through the merger of 3 towns. The source separation of kitchen waste started at the former town of Matsuyama.
2007	The door-to-door collection of bulky waste started.
2011	JICA Partnership program (Grass-roots technical cooperation) project (Fiji)
2013	Collection of small home appliances started. The number of items to be separated became 27.
2018	The source separation of disposable diapers started in model districts.
2019	The model districts for the sorted collection of disposable diapers were expanded.

Source: by interview to Shibushi City

4.2 Noteworthy Experience: History of Separation of 27 Waste Items - Shibushi Model

The city drastically changed its stance on the waste collection method from “It is OK to put anything in a black bag.” to “Write your name on the waste bag and discharge it responsibly”. The tireless efforts of city staff in charge led to the success of recycling. The staff provided opportunities for all residents to express their opinions which were carefully listened to, and thoroughly explained the new system. This attitude encouraged the residents to cooperate.

The three former towns of Shibushi, Ariake, and Osaki constructed a full-scale final disposal facility in 1990. However, as the amount of waste brought in increased year by year, it was estimated that the facility would become full by 2004, even with the introduction of separate collection of cans, bottles, and PET bottles. Although construction of full-scale incineration facilities was discussed, there was concern that costs for construction, maintenance, and management of incineration facilities would become a huge burden on the city in the future. As a result, Shibushi City decided to carry out a thoroughgoing recycling for the purpose of waste reduction so as to extend the life of the landfill site.

This decision was one in which the municipality top officials were heavily involved. At the time, a wide-area waste treatment plan was underway to process waste from neighboring cities and towns in one large incinerator, and the three towns had the option of participating in this plan. However, in

light of the environmental and health impacts of incineration and the social trend toward a sound material-cycle society, the leaders and officials at that time decided to promote recycling by separation of waste. It was a decision made by the administrative leaders who considered the impact of incineration on the health of citizens and the risk of environmental pollution at that time.

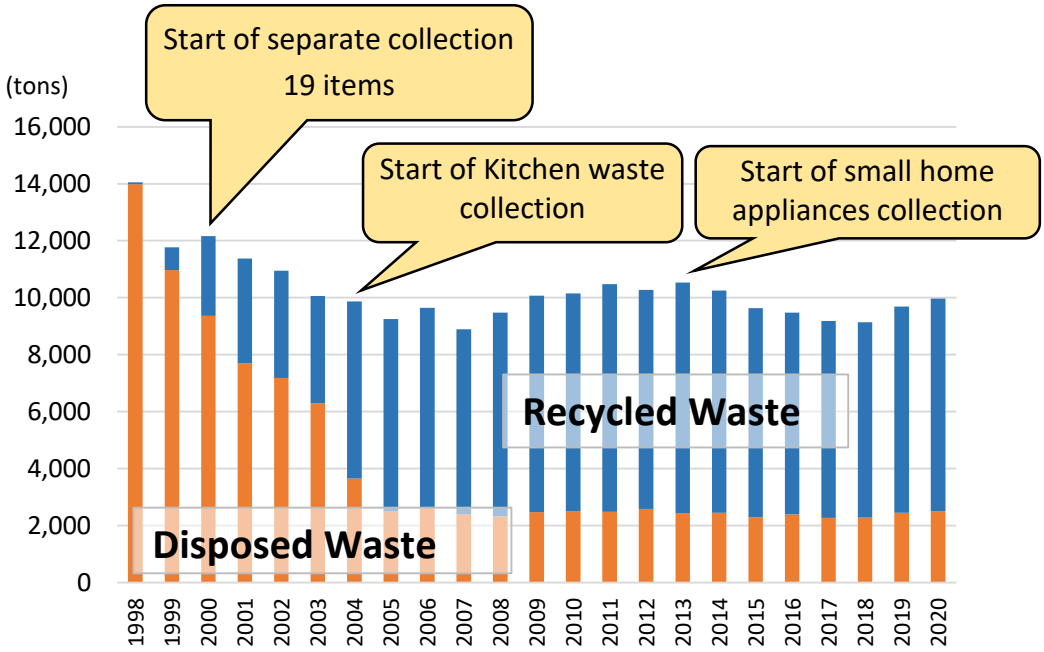
In order to promote effective recycling, separation of multiple waste items is effective; therefore, the number of separated items was increased to 27 items by 2013. No other Japanese municipality had ever experienced the sorted collection of as many as 27 items. However, through thorough and painstaking dialog between the administration and citizens, sorted collection of 27 waste items is now a part of life in Shibushi City as shown in photos 6-22 to 6-25.

In contrast to the previous stance of “It is OK to put anything in a black bag”, municipal personnel in charge visited neighborhoods to explain to residents to “Write your name on the waste bag and discharge it responsibly”. The black plastic bags with no names on them were not designed to raise awareness that the person putting out the waste should be responsible for separating it properly, as long as it was impossible to tell who put out what and what was put out.

The city actively promoted public awareness activities. Briefing sessions with residents were frequently held to provide an opportunity for each resident to express an opinion. In briefing sessions, the current conditions of the landfill site and the necessity of recycling were explained in detail. Some residents objected on the grounds that it was troublesome to separate waste, but administrators visited them and respectfully explained the reasons for change. In addition, environmental education programs were implemented 76 times in 2016 and altogether 1,868 people participated in the programs.

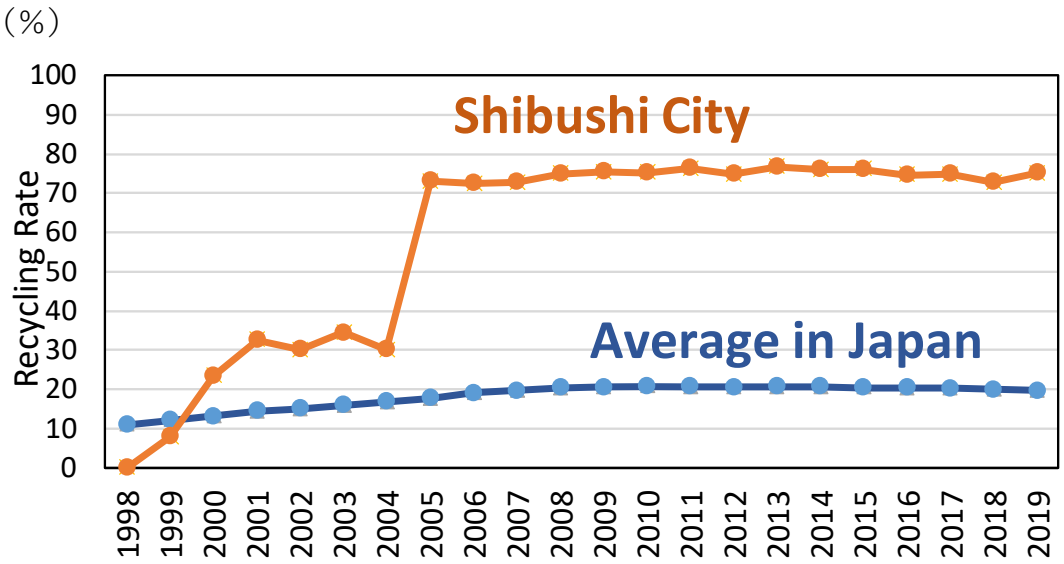
The city’s painstaking efforts changed residents’ consciousness about waste management. It seemed that the attitude of sorting waste being “troublesome” changed into an attitude of “gratitude”. This was because residents do not need to store the kitchen waste at home.

As shown in Figure 6-10 and Figure 6-11, the city successfully reduced waste to be disposed of in the landfill by 80% in 2008 and the recycling rate remained very high in comparison with the national average. The landfill site significantly changed because kitchen waste was not being landfilled there anymore. The offensive odor, flies, crows, and rats disappeared. The reduction of the amount of waste being deposited into the landfill made it possible to extend the life of the landfill site.



Source: Shibushi City Website "Please cooperate in the separate collection of waste" https://www.city.shibushi.lg.jp/soshiki/6/1826.html (accessed January 20, 2022)

Figure 6-10 Waste Treatment and Disposal Amount Trends in Shibushi City



Source: Ministry of the Environment Website "Results of the survey on municipal waste management (FY1998 to 2019)" http://www.env.go.jp/recycle/waste_tech/ippan/index.html (accessed January 24, 2022)

Figure 6-11 Annual Trend of Recycling Rate in Shibushi City

Photo 6-22 Collected Recyclables at Collection Area (1)

Photo 6-23 Collected Recyclables at Collection Area (2)

Photo 6-24 Waste Discharge by Resident

Photo 6-25 Resource Collection by Businesses

Source: Yachiyo Engineering Co., Ltd.

4.3 Current Waste Management in Shibushi City

(1) Waste Management Flow in Shibushi City

Figure 6-12 shows the waste management flow in Shibushi City. Waste is collected according to four categories: kitchen waste, recyclables, bulky waste, and municipal waste. The separate collection of 27 sorted items is based on these four categories. Kitchen waste and recyclables are brought by each family to the waste station, then the waste collection and transport operators transport the waste to the compost center and the recycling center, where composting is implemented and recyclable resources are separated and sold. Bulky waste is collected door-to-door and transported to the recycle center. At the recycling center, the waste is separated into resources and residue; resources are sold, and residue is disposed of in the landfill. Municipal waste is brought by each household to the waste station, directly transported to the landfill site and disposed of in the landfill.

With this system, which does not have incineration facilities, the annual waste management cost per capita in Shibushi City is around JPY 11,000 (in FY 2019), which is about JPY 5,000 lower than the national average of about JPY 16,000. In addition, part of the profit from the sale of recyclables is returned to citizens through subsidies for the cost of holding environmental study sessions by citizens and managing the waste stations.

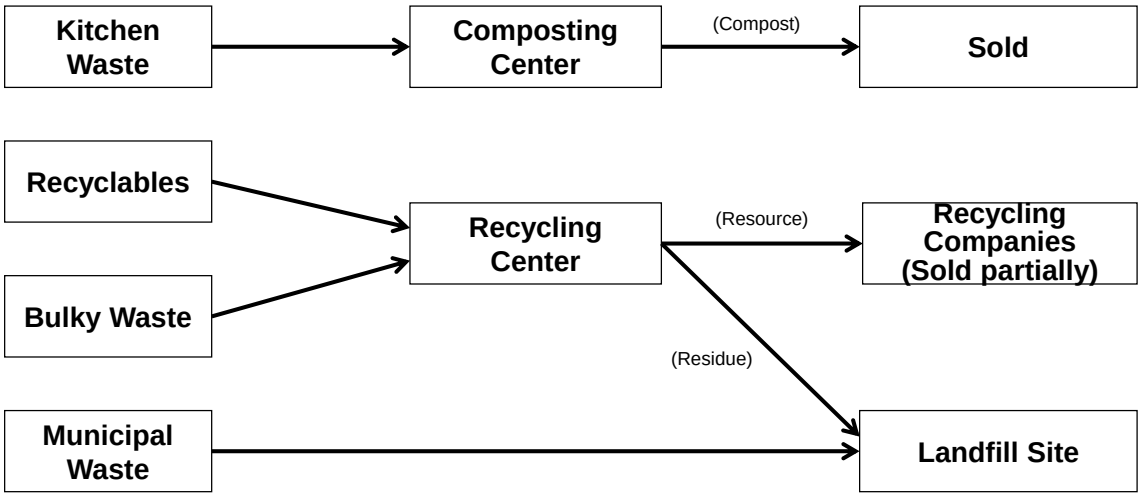


Figure 6-12 Waste Management Flow of Shibushi City

(2) Composting

Since Shibushi City has no incineration facility, the most feasible waste reduction method is composting. Successful composting is a matter of greatest importance. To produce good compost without generating odor from the facility, the proper handling of kitchen waste is essential throughout the process from the time it was discharged from each household to the time it arrives at the facility. Although making good compost is not a final goal, good compost is highly marketable and the production process functions as a waste treatment process.

In Shibushi City, kitchen waste separately collected from each household is transported to the compost center (Matsuyama organic plant of the Soo Recycle Center), established in 1999, so as to be converted into compost. An overview of the process is described below.

1) Collection, Transport to the Facility, and Shredding

Kitchen waste is discharged into a covered 50-liter container placed at the dedicated kitchen-waste station (Photo 6-26). Woodchips are laid at the bottom of the container. The woodchips are generated by shredding tree branches (Photo 6-27) purchased from a timber mill. The utilization of woodchips also reduces the generation of odors caused by composting.

Kitchen waste is collected three times a week, but citizens are allowed to discard kitchen waste at any time into this container; therefore, they do not need to store the kitchen waste in their homes. The collected kitchen waste is manually put into a hopper (Photo 6-28). The emptied container is cleaned by woodchips without washing with water (Photo 6-29), woodchips are then laid at the bottom of the container (Photo 6-30) and the container is returned to the station. Kitchen waste loaded into the hopper is mixed with woodchips at a ratio of 1:1, and then loaded into a shredding machine.

The amount of kitchen waste converted into compost at this facility is approximately one ton (50 containers worth) a day. The cooperation of the residents is essential in order to collect good, raw compost material.

2) Production of Compost

Kitchen waste is mixed with shredded woodchips at a ratio of 1:1 and stored in a concrete yard for six months. One lot of the concrete yard has the capacity to generate one-month worth of compost (Photo 6-31). During the six-month storage period, the waste mixture is agitated once a week (Photo 6-32). The agitation frequency depends on when the temperature of the waste pile becomes less than 30°C. Typically, agitation is performed once a week.

3) Completion and Packaging

After six-month of maturing (Photo 6-33), the mature waste mixture is strained through a sieve twice. It is first strained through a 30-mm vibrating sieve (Photo 6-34) and then put through a 10-mm rotating sieve. Oversized particles captured in the 30-mm sieve are returned upstream (shredded kitchen waste). Particles that have passed through the 10-mm rotating sieve are then packed in bags. There are two types of bags, 15 kg (300 JPY≒3 USD) and 5 kg (100 JPY≒1 USD). The compost packed in these bags is finally sold (Photo 6-35).

The above description is the compost treatment process in this facility. The kitchen waste is handled effectively, and no foul odor is emitted from any process, thereby generating ideal compost. About 80% of the compost produced is sold over-the-counter, and 20% is distributed free of charge twice a year at community centers and other locations to give back to local residents. Shibushi City has a thriving agricultural industry, which provides a stable source of sales for the compost produced, making the compost business possible.

Photo 6-26 Containers for Organic Waste Placed at Stations

Photo 6-27 Branches before Shredding

Photo 6-28 Waste Carried into the Plant

Photo 6-29 Cleaning of Containers

Source: Yachiyo Engineering Co., Ltd. , Japan Environmental Sanitation Center

Photo 6-30 Container with Woodchips (Sawdust) Laid at the Bottom

Photo 6-31 Concrete Composting Yard

Photo 6-32 Mixing of Compost by Heavy Equipment

Photo 6-33 Matured Compost

Photo 6-34 Final Processing Process after Maturing

Photo 6-35 Packaged Compost

Source: Yachiyo Engineering Co., Ltd. , Japan Environmental Sanitation Center

(3) Sorting Waste for Recycling

Recyclables which have been collected through separate collection are split and sorted again at the recycling center, thereby making it possible to sell waste items that would normally be disposed of. A stable system has been established in which waste collection operators accept all of the 27 items of sorted waste.

As described earlier, Shibushi City asks residents to separate 27 items of waste, and the separated recyclables are transported to the Soo Recycle Center (Photo 6-36).

As shown below, at the Soo Recycle Center, waste is separated according to item with resorting as required, compressed, solidified, carefully selected, and stored until shipment. In Shibushi City, waste that cannot be recycled is classified as “municipal waste” and is disposed of in the landfill.

For a year when the sorted collection system was being introduced, municipal administrators and instructors visited waste stations once a month on a designated day to instruct local residents to separate waste. Before the change to sorted collection, measures were taken to mainly reduce the amount of waste. At the start of the significantly changed way of collecting sorted waste, local residents were confused about the new procedure. However, municipal administrators regularly visited the stations and carefully explained the process to residents, which encouraged the residents to participate in the new waste collection system.

1) Recycling of Spray Cans and Cassette-type Gas Cylinders

Spray cans and cassette-type gas cylinders are collected as they are (Photo 6-37). Such waste is compressed in the Soo Recycle Center and then shipped (Photo 6-38).

2) Metal Lids, Pots, Kettles, etc.

The degree of impurity removal and waste quality vary, and recycle value is low. However, such waste is successfully shipped from this facility (Photo 6-39).

3) Bottles

Bottles are collected and stored according to color (Photo 6-40).

4) Ceramics

When ceramics only are pulverized, they become a valuable material. Ceramics are pulverized by a dedicated pulverizer (Photo 6-41).

5) PET Bottles

PET bottles are commonly collected and recycled nationwide. Caps and labels are removed. The compressed PET bottles are evaluated as high-value product (Photo 6-42, 43).

6) Plastics

In addition to “other plastics” as specified in the *Containers and Packaging Recycling Law*, all kinds of waste plastics are collected in this facility. This is different from other municipalities. In

many other municipalities, plastic product waste, with the exception of PET bottles, is considered as combustible waste. Impurities are removed in this facility and then transported to a steelworks company to be used as a reducing agent for blast furnaces (Photo 6-44, 45).

7) Waste Oil

Two hundred liters of waste oil are collected daily and recycled oil is generated in the reproduction equipment. The operating capacity of this equipment is 200 liters a day, and 150 liters of recycled oil is refined from 200 liters of waste oil by means of one batch operation per day. Recycled oil is used as a fuel for vehicles in the recycle center (Photo 6-46).

8) Disposable Diapers

The sorted collection of disposable diapers started in 2018 in the model districts which were expanded in 2019.

9) Other Items

Volume reduction of polystyrene foam and the separation of fluorescent lamps and small home appliances are also implemented (Photo 6-47, 48, 49).

The Soo Recycle Center engages 40 workers and 10 seniors to perform the above work. Waste management is conducted based on two policies: to separate waste that can be sold as the result of separation, and to adequately treat waste that cannot be sold so as to reduce disposal cost.

As for recycling items, business operators who will accept the resources are first determined and then resource items to be separated are determined. As a result, there is no problem with collected resources remaining untreated. In FY2021, Shibushi City earned approximately JPY 13 million from the sale of separated resources to private companies. A portion of the income was then returned to the public by using it to manage waste collection points and to hold environmental study sessions.

Photo 6-36 Overview of Soo Recycle Center

Photo 6-37 Spray Cans and Cassette Cylinders

Source: Yachiyo Engineering Co., Ltd.

Photo 6-38 Compressed Cans

Photo 6-39 Metal Lids, Pans and Kettles

Photo 6-40 Bottles

Photo 6-41 Ceramics

Photo 6-42 Compressed PET Bottles (Grade A)

Photo 6-43 Compressed PET Bottles (Grade B)

Photo 6-44 Sorting Process of Containers and Packaging Plastics

Photo 6-45 Compressed Containers and Packaging Plastics

Source: Yachiyo Engineering Co., Ltd.

Photo 6-46 Waste Oil

Photo 6-47 Volume Reduced Styrofoam

Photo 6-48 Fluorescent Lamps

Photo 6-49 Small Size Home Appliances

Source: Yachiyo Engineering Co., Ltd.

4.4 International Cooperation

Shibushi City has been accepting trainees from overseas since 2009, and from 2011, a JICA Partnership program (grass-roots technical cooperation) project (regional proposal type) titled "Promotion of Shibushi Model (Waste Minimization without incineration) from Fiji to Pacific Island Countries" was implemented (Photo 6-50). The Shibushi Model to implement thoroughgoing waste recycling without having an incineration plant is expected to become a most suitable model for countries that do not have incineration facilities.

Source：Shibushi City

Photo 6-50 Compost Making Practice in a JICA Project Conducted in Shibushi City

5 Suggestions Based on the Waste Management Efforts of the Three Municipalities

As described in the previous sections, administrators in charge of waste management of three municipalities that represent large-, medium-, and small-scale municipalities in Japan were confronted with hardships but eventually overcame the problems. In this section, the kinds of problems municipal administrators were confronted with and how they addressed the problems will be described; section 5.1will highlight the efforts of each municipality, and section 5.2 will address the identification of future issues.

5.1 Waste Management Efforts Made by Each Municipality

(1) Tokyo 23 Cities

Formulation of TMG Ordinances and Measures in Conjunction with Enactment of National Legislation

- Following the enactment of the *Waste Cleaning Act* by the central government in 1900, Tokyo introduced a contract out waste collection system and in the same year started to enter into contracts with business operators.
- Following the enactment of the *Public Cleansing Act* by the central government in 1954, Tokyo improved the waste management ordinances and the organization.
- The *Waste Management Act* was enacted in 1970, and Tokyo revised the ordinance by clearly specifying the responsibilities of business operators who generated business waste and the importance of gaining the cooperation of local residents.
- In conformity with the revised *Waste Management Act* in 1991 and the establishment of the *Effective Resources Utilization Promotion Act* in 1991 by the central government, Tokyo established a new ordinance that strictly promoted the reduction of waste generation and reuse of waste in 1992.

Citizen's Participation and Consensus-building among Residents

- With the experience of the “War on Waste”, citizens’ awareness about the waste problem significantly changed in Tokyo. They became aware that waste problem is not only the administration’s problem but is an issue for both residents and administration to mutually resolve.
- In order to gain the understanding of residents, Tokyo also focuses on public relations. In particular, Tokyo accepts about 60,000 facility tours annually and takes advantage of the facility tours to repeatedly explain the necessity and safety of the facilities.

Intermediate Treatment

- Since the first incineration facility was built in Tokyo in 1924, incineration has been the main intermediate treatment method, but during those early years of incineration treatment, there were technical issues such as incomplete combustion due to excessive moisture. For this reason, for a while kitchen waste was separated from the waste treated at the incineration plants.
- Presently, there are two types of management methods for waste incineration plants: direct management and outsourcing to the private sector.
- Currently, the DBO (Design-Build-Operate) method is not used for the incineration plants. This is because centralized management of the operating 21 plants provides economies of scale and facilitates uniform improvement in technology.

- When a new incineration plant was planned and built, a trilateral treaty was concluded among the residents, city administration where the facility is located, and Clean Authority of TOKYO. Although contents of the treaty vary by city depending on discussions with residents, the basic points are the voluntary criteria for pollution control, the amount of waste to be received, the number of service vehicles accessing the area, access route, etc. In addition, operation council meetings are periodically held to receive and discuss reports on operating conditions of furnaces, pollution control data, furnace operation planning, etc.
- In principle the new incinerator plants are constructed, or re-built on the same sites as existing plants. This is because it is difficult to secure sites for construction of new plants in a large city like Tokyo.

Principle of Waste Disposal within the Administrative Boundary and Inter-municipal Waste Disposal

- In principle, each of the 23 cities of Tokyo treats waste within its own city area at a waste treatment plant owned by the city. Currently, in response to the decrease in the amount of waste, each city, regardless of whether it has a plant or not, mutually cooperates and collaborates with each other cities to ensure a stable intermediate waste treatment system within the 23 cities under the responsibility of the 23 cities as a whole.
- In case of shutdown of all furnaces of a certain incineration plant, etc., waste is sometimes brought to an incineration plant located outside the city where the waste is treated. This cooperation between the Tokyo 23 Cities is made possible owing to the understanding of local residents and the local operating council for joint waste treatment.
- Concerning wide-area (as well as inter-municipal) treatment of waste in the event of a disaster, Tokyo received disaster waste from districts outside Tokyo at the time of the Great East Japan Earthquake. This was done because the local operating council understood the difficult of the situation. Thus, in the Tokyo 23 Cities, while the principle of disposal within each area is observed, flexible waste treatment management has been conducted as necessary.

(2) Fujisawa City

Waste Collection

- Fujisawa City changed the waste collection system in 2007 from station collection to door-to-door collection. Reasons for abandoning the highly-efficient station collection in favor of door-to-door collection were to improve the local scenery and to clarify the responsibility of people who discharge waste. However, there was concern that the clarification of each resident's responsibility could lead to an increase in illegal dumping. Patrols in the city were enhanced; however, there was no particular increase of illegal disposal associated with the door-to-door collection.
- The city charged for the waste collection when the door-to-door collection was introduced, and the revenue was applied to part of the collection cost that increased as the result of implementing the door-to-door collection.
- Fujisawa City determined that the implementation of door-to-door collection was successful because: (1) the local scenery was improved, (2) responsibility of each resident was clarified and the recycling rate increased, and (3) many other municipalities started to introduce the door-to-door collection after Fujisawa City first implemented the system.

Recycling

- In the 1970s, Fujisawa City became the first city in Japan to undertake the collection of recyclables through the joint activities of citizens, municipal administration, and collection operators. This was due to (1) a rapid increase in bulky waste, (2) a shortage of final disposal facilities, and (3) a survey of bulky waste composition that revealed the presence of many recyclable resources.

Intermediate Treatment

- Through the DBO (Design-Build-Operate) system, a new incineration plant was constructed from 2004 to 2007. At the time of construction of the new incineration plant, cost reduction and leveling were required due to financial difficulties at that time and various privatization methods were discussed. As a result, it was decided that the project for the construction of a new incineration plant was to be implemented by the DBO method. Since the start of facility operation, the municipality has been monitoring the private sector operator's performance in operating and maintaining the plant. Specifically, the municipality confirms the operating conditions of the facility and also inspects the facility from the aspect of business operation.
- The North Waste Management Center was reconstructed from 1986 to 1990 to handle high-calorie heat generation. This countermeasure modification work was carried out because the calorific value of waste had increased significantly compared to the time of construction.
- Subsequently, the North Waste Management Center and Ishinazaka Environment Center have undergone dioxin reduction modification work.

Consensus-building with Residents

- At the time of rebuilding Ishinazaka Environment Center (incineration plant), the neighboring areas had more developed into crowded residential areas than when the former facility was constructed years before. The construction planning was shared with local residents at an early phase of planning, and the rebuilt facility was planned and constructed to provide social benefits to the society in addition to its waste treatment function.

(3) Shibushi City

Sorted Collection of Kitchen Waste

- When separate collection of kitchen waste was introduced in 2004, the municipality conducted verification testing in model districts before expanding the system in the city. The implementation result indicated that the sorted collection of kitchen waste was well received by residents because they did not have to keep kitchen waste at home for many days.
- When separation of kitchen waste was started, eight administrators in charge explained the waste management system to the residents for a three-month period. Municipal administrators and instructors visited each of the waste stations once a month on a designated day to instruct local residents on separating waste.

Recycling

- In 1998, the three towns decided to change from mixed collection to separate collection. Under the leadership of the mayors of the three towns, consideration of the incineration option was stopped and the recycling process was initiated.
- In 1999, the three towns started collecting 19 recyclable items at 500 stations in the city.
- In 2013, the city started collecting small home appliances, bringing the total number of sorted items to 27.
- In 2018, the city started sorted collection of disposable diapers.

Consensus-building with Residents

- The city is aware that to obtain the understanding and cooperation of citizens, it is important for administrators in charge to have direct conversations with each local resident. In those days, it was possible for representatives of the community to explain the circumstances to local residents. However, instead of doing so, the city frequently held briefing sessions joined not only representatives but also by residents to provide opportunities for each resident to express their opinion. Some residents objected on the grounds it was troublesome to separate waste, but administrators visited them and respectfully explained the reasons for change, which encouraged the residents to cooperate.

5.2 Summary Based on the Experience of the Three Municipalities for Major Waste Management Issues

Compliance with the Law

In many developing countries, compliance with the law is an issue even when the law is well developed. One of the reasons for the lack of compliance with the law may be that the law does not take into account the culture of the country and the behavior of its citizens. In other cases, the rules and standards necessary for the realization of the law are not established. It is essential for the law to be effective, that; (1) the law must take into account the culture of the country and the behavior of its citizens, and (2) the necessary rules and standards must be established to realize the law. In the case of Tokyo 23 Cities, local governments have formulated ordinances and taken measures based on national laws in conjunction with the enactment or revision of waste management-related laws.

Collection Improvement

Holding waste generators accountable is important for improving waste collection. Some municipalities have changed the collection system from station collection to door-to-door collection, as in the case of Fujisawa City. This is because it is expected that clarifying the responsibility of residents as waste generators will result in thorough source separation of waste and promotion of waste reduction. While door-to-door collection is acceptable for small and medium-sized municipalities, it is difficult for large municipalities. As developing countries will be required to improve waste collection, including separate collection, it is necessary to clarify the responsibility of waste generators according to the size of the municipality.

Recycling

In order to initiate recycling, a strong commitment from the administrative head is necessary, as in the case of Shibushi City. It is also important that all stakeholders share the policy and plan. To do so, it is effective to start with a small area on a trial basis first. It is desirable to carefully select the area on trial ahead of the others and to expand the implementation areas in stages. This introduction method is recommended even for smaller municipalities. In this process, it is important to check the waste flow from waste to recyclables. Especially in developing countries, recycling is often based solely on economics. In addition, there are cases where non-recyclable waste (recycling residues) is disposed of inappropriately. Attention should be paid to the proper disposal of recycling residues.

Consensus-building with Residents (Resident Cooperation)

When introducing a source separation and separate collection system, it is desirable to provide detailed explanations to each person as much as possible, as in the case of Shibushi City. In Japan, even in large cities, leaflets explaining the separation method are distributed through regular meetings of neighborhood associations, for example, so that each person can be informed of the separation method. It is important to collect and analyze data on waste (waste amount, waste composition, etc.) that can clearly indicate the need for source separation, and to share the results with residents.

In general, people may have an excessive aversion to facilities they are not familiar with. It is an effective way to provide people with an opportunity to actually experience a facility tour in order to dispel the aversion to the facility and to change attitudes.

After construction, it is necessary to create a mechanism for daily dialogue with residents, including facility tours, as in the case of Tokyo 23 Cities. In the tours, sharing information on facility operation, including operational data, environmental data, and the status of accidents at the facility, is important for developing a relationship of trust with residents.

Development of Treatment Facilities

In the construction plan of treatment facilities, it is important to involve residents from the early stages of the planning. In Japan, the construction plan is devised together with local residents and incorporates their requests from the early stages of the planning. This approach is based on the experience in dealing with past opposition movements against the construction of facilities.

In planning waste incineration facilities, waste quality changes should be noted. In Japan, most of the waste incineration facilities constructed during the high-growth period were later renovated with high-calorie countermeasures to cope with the subsequent increase in the calorific value of waste. In developing countries where waste incineration facilities are planned, it should be noted that waste quality will change with future economic growth.

Understanding waste quality is also important when planning compost or methane fermentation facilities. It is necessary to collect a lot of waste data on a daily basis. Even though composting and methane fermentation are excellent recycling methods, they have less effect on waste reduction than incineration, so if they do not work well, they will not be evaluated from the viewpoint of waste treatment. Especially in composting, if the quality of compost is not good, its market value will be low and it may have to be disposed of.

Although there are still few full-fledged waste treatment facilities (intermediate treatment facilities) in developing countries, it is important to develop treatment facility plans based on the predicted data of waste in the future.

Treatment Privatization

When outsourcing to the private sector, if the administration does not properly manage the contractor, the service will deteriorate, leading to a loss of trust from residents. Even in the case of private finance initiative (PFI) for waste management, it is important to clarify the division of responsibility for long-term risks with the private company and not to leave everything to the private company. In developing countries, lack of ownership may be observed in the introduction of privatization, so this point should be noted. Japan's track record (experience) shows that the DBO (Design-Build-Operate) method, rather than PFI, has been adopted. In the DBO method, basic conditions for which the municipality is fundamentally responsible are clarified, including the quantity and quality of waste, treatment and disposal of incinerated ash, compliance with stricter laws and regulations, and negotiations with residents.

Inter-municipal Waste Management

In many countries, municipal solid waste is managed within the local district in principle, but as in the case of Tokyo 23 Cities, inter-municipal waste management is adopted if necessary. This is because inter-municipal waste management is expected to ensure a stable and efficient waste management system and reduce waste management costs. Even in developing countries, there are many cases where it is desirable to implement inter-municipal waste management, such as the construction of landfill sites and waste-to-energy facilities. In Japan, the central government has established guidelines for inter-municipal waste management, and is also promoting inter-municipal waste management in emergency responses to disasters etc.