

Guidelines for Measuring the Amount of Food Waste Generated and Food Waste Recycling Rate

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Food Industrial Policy Office, Biomass Policy Division, Food Industry Affairs
Bureau, the Ministry of Agriculture, Forestry and Fisheries
Office of Recycling Promotion, Policy Planning Division, Waste Management and
Recycling Department, the Ministry of the Environment

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1. Objectives of the Guidelines

Food-related business operators are required to accurately weigh and keep a record of the amounts of food waste generated from their business activities, how much of the food waste is recycled, and other realities related to the recycling of food waste. This must be done in accordance with Article 15, Paragraph 1 of the Ministerial Ordinance to Provide Food-related Business Operator with Criteria pertaining to the Promotion of Recycling Food Waste (2001, the Ordinance No. 4 of the Ministry of Finance, Ministry of Health, Labor and Welfare, Ministry of Agriculture, Forestry and Fisheries, Ministry of Economy, Trade and Industry, Ministry of Land, Infrastructure and Transport, and Ministry of the Environment; hereafter the “Ordinance on Criteria”) specified by the competent minister pursuant to Article 7 of the Act on the Promotion of Recycling and Related Activities for Treatment of Food Waste (Act No. 116 of 2000; hereafter the “Food Waste Recycling Act”).

Moreover, under Article 9 of the Food Waste Recycling Act, food-related business operators who generated at least 100 tons of food waste during the previous fiscal year (hereafter “Business Operators with Massive Food Waste”) are required to report to the competent minister each year the amounts of food waste generated from their business activities and how much of the food waste is recycled in accordance with the Ministerial Ordinance on Regular Reporting by Business Operators with Massive Food Waste (2007, the Ordinance No. 3 of the Ministry of Finance, Ministry of Health, Labor and Welfare, Ministry of Agriculture, Forestry and Fisheries, Ministry of Economy, Trade and Industry, Ministry of Land, Infrastructure and Transport, and Ministry of the Environment; hereafter the “Ordinance on Regular Reporting”).

Before choosing to have food waste converted into heat as a waste management option, food-related business operators are required to make sure that no facilities for the production of specific feed or fertilizer are unavailable near their own factories or the places of business, and that facilities offering to convert waste into heat are available in accordance with Article 9 of the Ordinance on Criteria. In addition, they need to keep track of the generated heat quantities once they turn to conversion of waste into heat.

The Basic Principles regarding the Promotion of Recycling Food Waste, which are based on Article 3, Paragraph 1 of the Food Waste Recycling Act (2015, Notification No. 1 of the Ministry of Finance, Ministry of Health, Labor and Welfare, Ministry of Agriculture, Forestry and Fisheries, Ministry of Economy, Trade and Industry, Ministry of Land, Infrastructure and Transport, and Ministry of the Environment; hereafter the “Basic Principles”), stipulate that Business Operators with Massive Food Waste must report the amounts of generated food waste and how much of the food waste has been recycled to the prefectural governments. Hence, the form for the report pursuant to the Ordinance on Regular Reporting has also been modified so that the Business Operators can address the report to the prefectural government.

The Guidelines illustrate how to weigh the amounts that must be reported, thereby facilitating the control of food waste generation, recycling of food waste, conversion of food waste into heat, and reduction of food waste by food-related business operators.

2. Measuring the amount of food waste generated

Article 2, Paragraph 1 of the Ordinance on Regular Reporting specifies how to calculate the amount of food waste generated. First, the following are calculated: (i) the amount recycled to be used as raw materials for specific feed or fertilizer, (ii) the amount of waste converted into

heat, (iii) the reduced amount of food waste, (iv) the amount other than (i), (ii), and (iii), e.g., the amount recycled to be used as raw materials for products other than specific feed or fertilizer. Then (i), (ii), (iii), and (iv) are aggregated, and (v) the amount of food waste disposed of as waste is added to the total.

As a rule, food-related business operators need to measure the annual amounts in these five categories in weight at all places of business, and to organize and save the measuring method.

As the means to measure these amounts, we envisage the use of weighing equipment each time food waste is carried into the storage site or the use of a truck scale to weigh the vehicle that collects and transport food waste. If it is unfeasible to weigh all recyclable food waste, the weight may be estimated on the basis of the capacities of trash bins or other containers used, the number of these bins or containers, and the weight of food waste per unit volume.

If it is unfeasible to measure the amounts of food waste generated at all places of business and/or to measure the annual amounts of food waste, the Business Operators may use the following approaches to estimate the generated amounts. Please note that using only part of actual records to estimate the whole weight calls for greater focus on the grounds for the calculation and the availability of accurate figures.

- (1) Using the amounts of food waste generated at sample places of business to estimate the total
If it is unfeasible to measure the annual amounts of food waste generated at all places of business across the country, follow the steps below to estimate the total amount of generated food waste from all places of business per prefecture:
 - Select sample places of business in the prefecture.
 - Based on the amount of generated food waste sorted by business type at these sample places, specify the amount of food waste generated at each place of business.
 - Multiply this amount by the total number of places of business in the prefecture. Note the following when this approach is taken to estimate the total:
 - (i) The more sample places of business are selected, the more accurate the figure is. Hence, it would be appropriate to designate all the places of business where the annual amount of generated food waste can be measured as samples in the prefecture.
 - (ii) If the places of business considerably vary in size and what they do, it would be appropriate to classify these places by size or what the business offers (e.g., large, medium, or small size; main products that the place makes and/or sells) and estimate the amount of generated food waste by classification.
 - (iii) It is also an option to follow the steps below to estimate the total amount of generated food waste from all places of business per prefecture:
 - Specify the basic unit of food waste generated at the sample places of business, instead of the amount of food waste generated at each place of business.
 - Multiply the original unit by the sum of sales, production volume, and other values closely related to the amount of food waste generated as a result of business activities at the places of business in the prefecture.
- (2) Using the amounts of food waste generated during sample periods to estimate the total
If it is unfeasible to measure the annual amount of generated food waste, follow the steps below to estimate the total amount of food waste generated during the year:

- Specify sample periods.
- Measure the amounts of food waste by business type generated at all places of business in the prefecture during these periods.

When this approach is adopted, it is appropriate to specify the periods during which a periodic change cycle related to the amount of generated food waste is completed (e.g., one week, one month, three months, six months), and which allow the Business Operator to calculate the annual values by multiplying them by integers.

Therefore, before setting the sample periods, the Business Operator should have a clear idea about how to measure generated food waste during the seasons when the amounts of the waste are irregular (e.g., periods of large-scale promotional activities such as sales; the midsummer when the shelf life of food is short).

(3) Combining (1) and (2) to estimate the total

Follow the steps below to combine (1) and (2) above to estimate the total amount of generated food waste from all places of business per prefecture:

- Designate sample places of business and periods in the prefecture.
- Based on the amounts of food waste generated at these places of business during the periods, specify the annual amount of generated food waste per place of business.
- Multiply this amount by the total number of places of business in the prefecture.

3. Measuring the controlled amount of food waste

Under Article 2, Item 4 of the Ordinance on Regular Reporting, the controlled amount of food waste is calculated by subtracting the basic unit of food waste generated during the fiscal year from the basic unit in 2007 and, then, multiplying the value by the sales, production volume, and other values closely related to the amount of food waste generated because of business activities for the fiscal year.

Therefore, Business Operators with Massive Food Waste need to not only measure the amount of generated food waste using any of the methods described in 2 above, but have accurate figures of the sales, production volume, and other values closely related to the amount of food waste generated because of business activities, which are used as the denominator to calculate the basic unit of the amount of generated food waste.

More precisely, sales, production volumes, production quantities, numbers of customers, and quantities of raw materials may be used as the indicators that quantify business activities.

Please refer to the “List of Values Closely Related to Food Waste Generated by Business Type” for candidate values closely related to food waste sorted by regularly reported business type.

When the Business Operators change the values closely related to the amount of food waste generated that are considered most appropriate for regular reporting, they should have clear reasons for the change.

Furthermore, food-related business operators who also run different businesses should use indicators related only to food-related businesses.

4. Measuring the amount of recycled food waste

Article 8, Paragraph 2 of the Ordinance on Criteria stipulates that, when food-related business operators outsource the recycling of food waste, they must keep track of the production of specific feed or fertilizer by the outsourcee.

(1) Measuring the recycled amount

The recycled amount means the quantity of recyclable food waste sent to any facilities for the production of specific feed or fertilizer using the waste. It is not the quantity of specific feed or fertilizer produced through recycling.

Therefore, the recycled amount can be measured by weighing it at the place of business run by the food-related business operators, that is, at the place of business that discards recyclable food waste. It can also be weighed when the food waste is carried into the facilities for the production of specific feed or fertilizer.

When the recycled waste is converted into methane so that all fermentation waste or other substance is used as a raw material for a fertilizer, the whole recycled amount is recorded as “recycled to make fertilizer” because the Ordinance on Criteria prioritizes recycling into fertilizer. When the recycled waste is converted into methane so that part of the fermentation waste or other substance is used as a raw material for a fertilizer and the remaining portion is disposed of (e.g., processed as effluent), the proportion of the fermentation waste used as a raw material for a fertilizer is multiplied by the recycled amount, and the calculated value is recorded as “recycled to make a fertilizer,” and the remaining portion as “converted into methane.”

It is possible that food-related business operators reduce recyclable food waste as

pretreatment before outsourcing the production of specific feed or fertilizer for recycling the waste. In this case, the reduced quantity due to this pretreatment is measured as a reduced amount, and the quantity of recyclable food waste sent to the facilities for the production of specific feed or fertilizer by the outsourcee after reduction is measured as a recycled amount.

The total recycled amount in the prefecture is measured by adding up the amounts recycled out of the food waste from all the places of business in the prefecture.

(2) Keeping track of the production of specific feed or fertilizer

To keep track of the production of specific feed or fertilizer by the outsourcee for recycling, Business Operators with Massive Food Waste may receive regular reports from the outsourcee on the status of the production, or look into the status themselves.

5. Employing the conversion of food waste into heat as a waste management option; Measuring the quantities of waste converted into heat and of heat or electricity generated by the conversion

(1) Basics regarding the conversion of food waste into heat

The Food Waste Recycling Act specifies that the conversion of food waste into heat at efficiency higher than a certain level may be selected if recycling food waste by regular means is an unfeasible option. Food-related business operators should turn to conversion of their food waste into heat only when recycling the waste by regular means is unfeasible. This means that they should first consider turning the waste into feed or fertilizer. The basic principles set forth when conversion into heat should be considered, and state the ideas about the conversion as a means of turning food waste into a usable form. To sum up the ideas, the use of heat produced by food waste incineration leads to reduction in the usage of fossil fuels along with CO₂ emissions, thereby helping stop global warming. With this in mind, the waste-to-energy process designed to use heat generated by food waste incineration or to convert such heat into electricity constitutes one of the means of recycling only when it meets certain statutory requirements (or when the generated energy can be used at a level of efficiency equal to or higher than methanation in the case of recyclable food waste that is difficult to recycle because of the location of the recycling facilities or issues that the facilities have in accepting the food waste).

Furthermore, Article 2 of the Food Waste Recycling Act and the Ministerial Ordinance to Provide Criteria for Article 2, Paragraph 6 of the Act on the Promotion of Recycling and Related Activities for Treatment of Food Waste (2007, the Ordinance No. 5 of the Ministry of Agriculture, Forestry and Fisheries and Ministry of the Environment; hereafter the “Ordinance on Conversion of Waste into Heat) set forth the details and extent of the conversion into heat defined as a means of recycling by the Food Waste Recycling Act.

Reference

Content of the Ordinance on Conversion of Waste into Heat

- The criteria for the use of food waste for conversion into heat shall fall under (i), (ii), and (iii) below.

(i) The criteria must correspond to a, b, or c below:

- a Conversion of food waste into heat may be selected if no facilities for the production of specific feed or fertilizer (hereafter “Specific Feed or Fertilizer Production Facilities”) are available within 75 kilometers of the factory or place of business run by the food-related business operator whose business activities generate food waste (hereafter the “Food-related

Business Operator's Factory and Workplace").

- b The recyclable food waste generated at the Food-related Business Operator's Factory and Workplace that corresponds to (1) or (2) below may be used for conversion into heat if it is highly unfeasible for any Specific Feed or Fertilizer Production Facilities within 75 kilometers of the Food-related Business Operator's Factory and Workplace (hereafter "Specific Feed or Fertilizer Production Facilities in the Area") to accept the recyclable food waste.
 - (1) The food waste is of a type unsuitable for recycling at any Specific Feed or Fertilizer Production Facilities in the Area.
 - (2) The food waste has inherent properties unsuitable for recycling at any Specific Feed or Fertilizer Production Facilities in the Area.
- c If the amount of recyclable food waste generated at the Food-related Business Operator's Factory and Workplace exceeds the total quantity of food waste recyclable at any Specific Feed or Fertilizer Production Facilities in the Area, the amount in excess may be converted into heat.
 - (ii) If the food waste is recyclable and waste edible oil or something similar (its heat value must be at least 35 megajoules per kilogram (MJ/kg)) is used, the value of heat generated per use of 1 ton must be at least 28,000 MJ and the generated heat must be used effectively.
 - (iii) If the food waste is recyclable and something other than the substance specified in the preceding paragraph is used, the value of heat generated per use of 1 ton or the quantity of electricity generated from the heat must be at least 160 MJ and the generated heat or electricity must be used effectively.
- The criterion for transfer of food waste used for conversion into heat is that the food waste shall be transferred to parties capable of meeting all of (i), (ii), and (iii) above.

(2) Factors to consider before opting for conversion of food waste into heat

As stipulated in the Ordinance on Conversion of Waste into Heat, food waste may be converted into heat at waste management facilities capable of such conversion at certain efficiency only when recycling the waste by regular means is unfeasible. Hence, before opting for conversion of food waste into heat, the food-related business operator needs to determine whether recycling the food waste by regular means is unfeasible and whether the waste-to-energy plants operate at the efficiency specified by the Ordinance on Conversion of Waste into Heat. Figure 1 shows the factors to consider before deciding on the conversion.

Description

- (i) Recycling facilities are located within 75 kilometers of registered recycling business operators in most regions across Japan, except for several areas in Hokkaido, Northern Tohoku, and Southern Kyushu. To measure the distances to these facilities using a map, food-related business operators can contact the prefectural or municipal waste management department for the recycling facilities' addresses in the vicinity of their places of business.
- (ii) However, none of the recycling facilities located within 75 kilometers can accept these business operators' food waste if the type or inherent properties of the waste is/are unsuitable for recycling at these facilities. For example, recycling facilities that produce cattle feed from recyclable food waste made of plant residues cannot recycle food waste made of animal residues.

Therefore, food-related business operators should be clear about the type and properties

of their recyclable food waste before they contact the manager of the recycling facilities to inquire whether they will accept the waste.

Note that rotten food waste that can no longer be recycled does not constitute unrecyclable waste. This is because, although recyclable food waste in general spoils, decomposition occurs because of inappropriate management and is not the food's inherent property.

- (iii) However, when the quantities of these business operators' food waste exceed the capacities of the recycling facilities located within 75 kilometers, these facilities cannot accept the amount in excess even if the type and properties of the food waste is/are suitable for recycling at these facilities. For example, if 10 recycling facilities are located within 75 kilometers and the sum of their annual capacities (available capacities) is 1,000 tons, and if 1,500 tons of recyclable food waste is generated during the year, then, these facilities cannot accept the extra 500 tons for recycling.
Therefore, food-related business operators should be clear about how much and when recyclable food waste is generated, before they contact the manager of the recycling facilities to inquire whether they will accept the waste.
- (iv) Recyclable food waste is classified into different types. When it is classified in light of conversion into heat, waste edible oil, soy sauce, and other substances from which large amounts of heat are produced may be directly used as fuels plants' boilers. Hence, recyclable food waste of this type is classified as "waste edible oil or other similar substances" separately from other recyclable food waste. More specifically, substances that produce lower heating values of 35 MJ/kg or more are classified into this type. Please refer to (4) for how to measure lower heating values.
- (v) Recyclable food waste other than waste edible oil or other similar substances (i.e., substances with lower heating values of less than 35 MJ/kg) may be combusted with other waste at waste-to-energy plants to use the heat as energy or to convert the heat into electrical energy. Hence, such waste is treated differently from the waste classified into the same category as waste edible oil.
- (vi) The most common machine capable of using waste edible oil as a fuel is probably a boiler. The efficiency at which waste edible oil is turned into biodiesel fuel is about 80 percent. From the standpoint of energy use at efficiency equal to or higher than that, let us postulate the boiler efficiency of 80 percent as the indication of a facility's capability of functioning as a waste-to-energy plant. Any facilities offering to convert waste into heat have the design and actual values of their boiler efficiency available to the public.
- (vii) Given the above factors, efficient conversion of waste into heat specified by the waste-to-energy standards is feasible when the measured lower heating value (MJ/kg) of waste edible oil is multiplied by the efficiency of the boiler for converting waste into heat and the calculated value is more than 28,000 MJ/t.

Example

The lower heating value of waste edible oil is 35 MJ/kg, and boiler efficiency is 80 percent

$$35 \times 1,000 \times 0.8 = 28,000 \text{ MJ/t}$$

In this case, to use energy at efficiency equal to or higher than that of turning the waste edible oil into biodiesel, the boiler's steam at 100 degrees Celsius or higher is

basically used as the thermal source for the production process at a food manufacturing plant.

The table below shows other cases in which generated heat is used effectively.

It is possible to use waste edible oil or something similar as is as the thermal source for a boiler to generate electricity using a steam turbine. However, in the light of energy efficiency, this approach is not expected to offer high waste-to-energy efficiency, and it is more efficient to turn edible oil into biodiesel as a fuel for a diesel engine used to generate electricity. Hence, power generation that uses waste edible oil as a boiler's thermal source, as well as a steam turbine, in general unlikely qualifies as conversion of waste into heat as a waste management option.

Table Effective Use of Generated Heat or Electricity

Use			Suitability
Heat Supply	A food-related business operator's own boiler	For boiler operation	×
		For the operation of production facilities and utilities at a food factory	○
		For utilities in an administration building at a food factory	○
		Heat supply to external facilities	○
		Boilers other than a food-related business operator's own, e.g., those for waste heat supply at waste disposers' or municipal waste management facilities	○
Electricity Generation	A food-related business operator's in-house electricity generation	For the operation of electricity generation facilities	×
		For the operation of production facilities and utilities at a food factory	○
		For utilities in an administration building at a food factory	○
		Electric power selling	○
	Electricity generation other than a food-related business operator's in-house electricity generation, e.g., that for energy-from-waste at waste disposers' or municipal waste management facilities	Electric power selling (excluding supply for the operation of waste incineration plants (including incineration facilities at electricity generation facilities and at other facilities) and for recreational facilities for local communities around the waste management facilities)	○

- (viii) When recyclable food waste other than waste edible oil is combusted at a waste-to-energy plant, the energy should be used at efficiency equal to or higher than that of turning recyclable food waste into methane. In this light, the general indication of a

facility's capability of functioning as a waste-to-energy plant is that the net power generation efficiency there is at least 10 percent.

The net power generation efficiency is calculated as follows:

- Subtract the quantity of electricity required to keep the plant in operation from the total electricity generated by combusting waste at a waste-to-energy plant (i.e., a waste incineration plant that supplies electricity to external entities (e.g., electric power selling)) to calculate the net electricity generated.
- Divide the net electricity by the lower heating value of the waste combusted at the waste-to-energy plant.
- Translate the calculated value into percentage. Waste-to-energy plants usually have the actual values of the power generation efficiency; therefore, the net value of it is publicly available. If it is difficult to acquire the accurate net power generation efficiency, the value can be calculated by a simple formula using the percentage of generated electricity used inside the waste-to-energy plant (house percentage) and the design power generation efficiency (generating end). (Formula: Power generation efficiency (generating end) $\times$ (1 - house percentage / 100))

Example

- When net electricity generated is available
The annual amount of waste incinerated at the waste-to-energy plant is 100,000 tons.
The annual quantity of electricity sold to electric power companies (net electricity generated) is 40 million kWh.
The average lower heating value of waste (wet basis) is 9 MJ/kg.
In this case, the power generation efficiency (net) is calculated as follows:
Note: 1kWh = 3.6 MJ, 9 MJ/kg = 9,000 MJ/t
$$40 \text{ million kWh} / (9 \text{ MJ/kg} \times 100,000 \text{ t}) = 40 \text{ million} \times 3.6 / 900 \text{ million} = 0.16 = 16\%$$
- When using the total electricity generated and house percentage for calculation
The annual amount of waste incinerated at the waste-to-energy plant is 100,000 tons.
The total electricity generated is 55 million and the house percentage is 40 percent annually.
The average lower heating value of waste (wet basis) is 9 MJ/kg.
In this case, the power generation efficiency (net) is calculated as follows:
Note: 1kWh = 3.6 MJ, 9 MJ/kg = 9,000 MJ/t
$$55 \text{ million kWh} / (9 \text{ MJ/kg} \times 100,000 \text{ t}) \times (1 - 40\% / 100) \text{ (house percentage)} = 55 \text{ million} \times 3.6 / 900 \text{ million} \times 0.6 = 0.132 = 13.2\%$$
- When using the house percentage and power generation efficiency of the generating end for calculation
When the power generation efficiency of the generating end is 20 percent and the house percentage is 40 percent at the waste-to-energy plant, the power generation efficiency (net) is estimated as follows:
$$20\% \times (1 - 40\% / 100) = 12\%$$

The flowchart in Figure 1 shows the flow for waste-to-energy, which includes the case where waste is converted into heat for supply and use. In addition, in the case of heat, the indication of the facility's capability of functioning as a waste-to-energy plant is whether the net efficiency of heat utilization is at least 10 percent, just as the power generation efficiency. The net efficiency of heat utilization is calculated as follows:

- Acquire the quantity of heat that is generated by incinerating waste at a waste heat supply facility (i.e., a waste incineration plant that supplies heat to external entities) and is supplied to external entities.
- Divide the quantity by the lower heating value of the waste combusted at the waste heat supply facility.
- Translate the calculated value into percentage. Any facilities have the value available to the public. At a waste heat supply facility like this, only the heat supplied to external entities qualifies as effective use. The heat for the use of the plant's equipment, hot-water supply, and the use of warm water within the facility is excluded. Furthermore, heat utilization at external recreational facilities for local communities^{*1} is not deemed as effective use of generated heat and, thus, it does not qualify as conversion of food waste into heat as a waste management option. Heat utilization is acknowledged as effective use only when the heat is supplied by a heat supply business, or when the heat is supplied for utilities at operational facilities, production at a plant, or a thermal source of energy used for utilities (see the Table).

*1: Some waste incineration plants (i.e., waste heat supply facilities) were built along with a swimming pool, ice skating rink, greenhouse, or other recreational facilities for local communities in the vicinity that use heat from the plants. Although these recreational facilities are considered necessary for waste management, they do not constitute extended effective use of heat generated from waste management to replace fossil fuels in areas outside waste management.

The effective use of energy for heating, air conditioning, and hot-water supply relies on the temperature of steam or water. This means that the effective use should be designed in terms of effective energy efficiency that takes account of the temperature of steam and water. However, the idea of effective energy efficiency is not common and, thus, the design of the use is based on simple energy efficiency. But then heat utilization should be as efficient as possible in the light of the effective use of energy. Hence, it is desirable to utilize heat at a temperature as high as possible^{*2} even when the efficiency exceeds the 10-percent heat utilization efficiency calculated as above.

*2: Heat utilization with effective energy efficiencies of 10 percent or more is equivalent to a power generation efficiency of 10 percent. The temperature of steam or water in that case is 120 degrees Celsius or higher.

- (ix) In addition to the specific examples above, efficient conversion of waste into heat specified by the waste-to-energy standards is feasible when the measured lower heating value (MJ/kg) of recyclable food waste (excluding waste edible oil) is multiplied by the net power generation efficiency at the waste-to-energy plant offering to convert waste into heat and the calculated value is more than 160 MJ/t.

Example

The annual amount of waste incinerated at the waste-to-energy plant is 100,000 tons.

The annual quantity of electricity sold to electric power companies (net electricity

generated) is 40 million kWh.

The average lower heating value of waste (wet basis) is 9 MJ/kg.

The average lower heating value of food waste (wet basis) is 1.4 MJ/kg.

In this case, the power generation efficiency (net) is calculated as follows:

Note: 1kWh = 3.6 MJ, 9 MJ/kg = 9,000 MJ/t

$$40 \text{ million kWh} / (9 \text{ MJ/kg} \times 100,000 \text{ t}) = 40 \text{ million} \times 3.6 / 900 \\ \text{million} = 0.16 = 16\%$$

The quantity of electricity generated from one ton of food waste is calculated as follows:

$$1.4 \text{ MJ/kg} \times 16\% = 1,400 \text{ MJ/t} \times 0.16 = 224 \text{ MJ/t}$$

In addition, in the case of heat supply, efficient conversion of waste into heat specified by the waste-to-energy standards is feasible when the measured lower heating value (MJ/kg) of recyclable food waste (excluding waste edible oil) is multiplied by the net efficiency of heat utilization at the waste heat supply facility offering to convert waste into heat and the calculated value is more than 160 MJ/t.

- (x) The website of the Ministry of the Environment (<http://www.env.go.jp/recycle/food>) shows the current situations of waste-to-energy facilities designed to convert waste into heat at a net power generation efficiency and heat utilization efficiency of 10 percent or more (or generating end efficiency of 17 percent or more). These facilities may be used for the conversion of waste into heat as a waste management option.

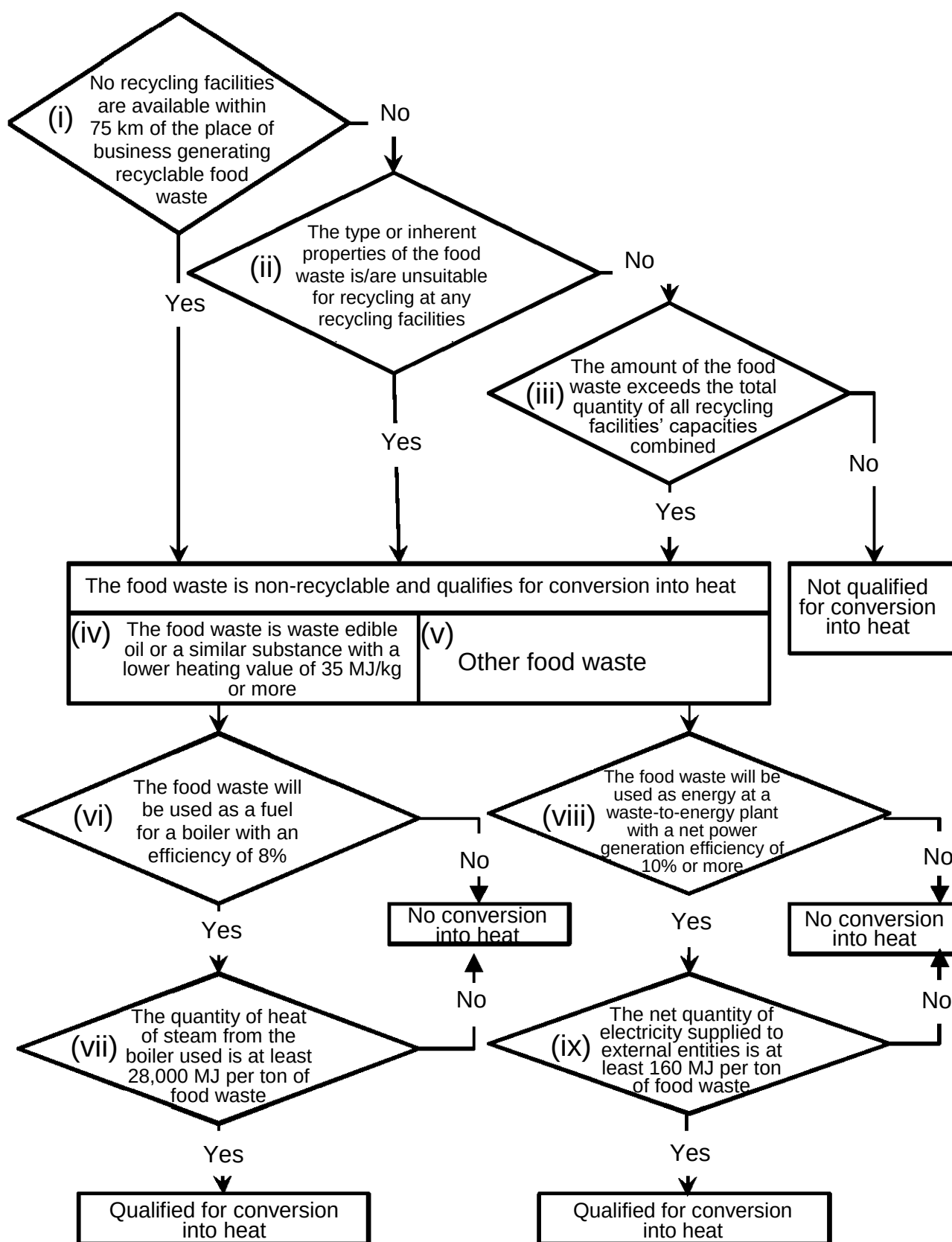


Figure 1 Factors to Consider before Opting for Conversion of Food Waste into Heat

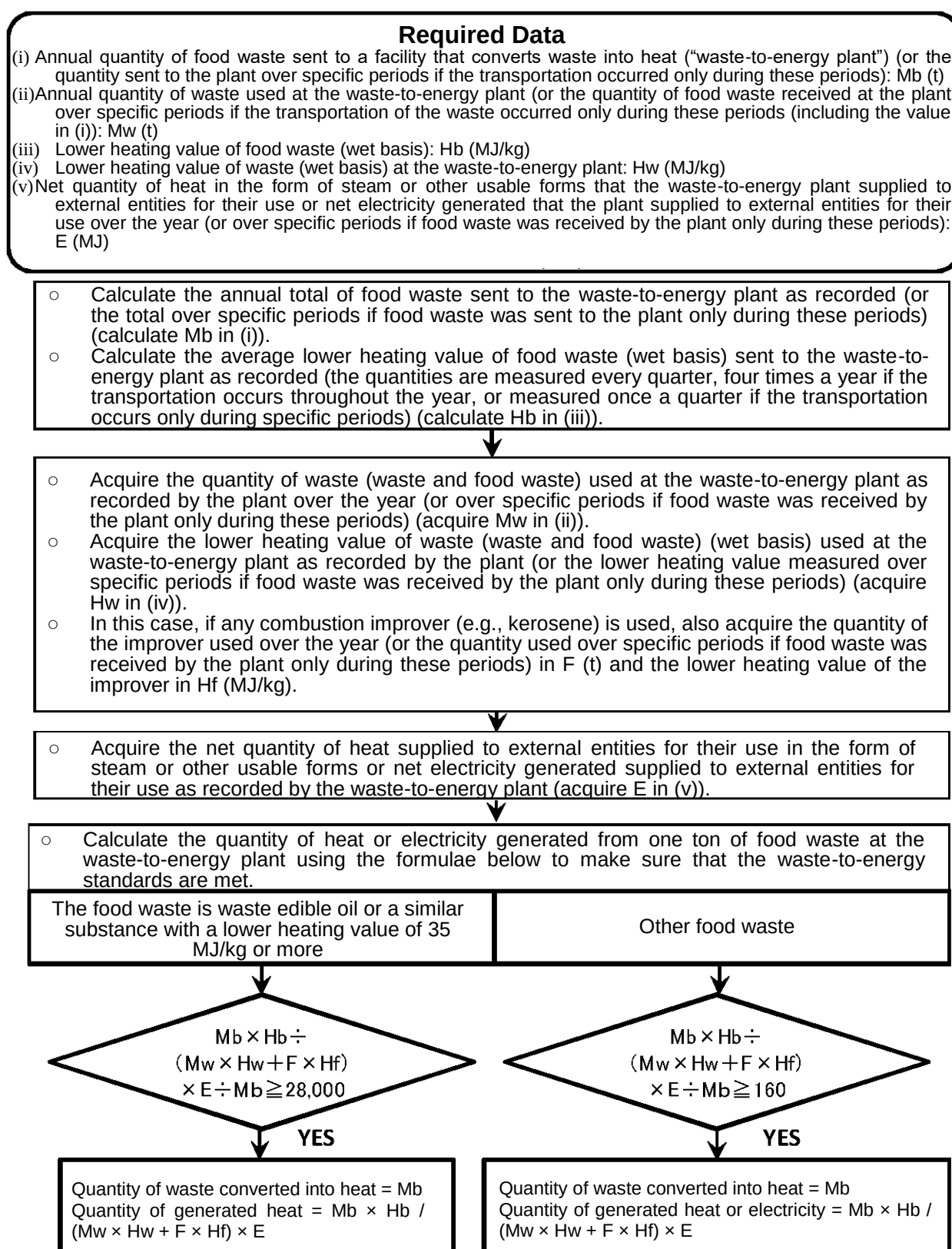


Figure 2 How to Calculate the Amount of Waste Converted into Heat and the Quantity of Heat/Electricity Generated from the Conversion

(3) How to Measure the Amount of Waste Converted into Heat and the Quantity of Heat or Electricity Generated from the Conversion

Article 9 of the Ordinance on Criteria stipulates that the amount of waste converted into heat and the quantity of heat or electricity must be measured and recorded to calculate the recycling and other relevant rates. It also requires that Business Operators with Massive Food Waste should include the measured amounts and rates in their regular reporting.

Figure 2 shows how to calculate the amount of waste converted into heat and the logic of it. When heat or electricity specified by the Ordinance on Conversion of Waste into Heat has been generated from food waste sent to the waste-to-energy plant or other facilities offering to convert waste into heat, and when it has been confirmed that the generated heat or electricity is effectively used, the quantity of the heat or electricity is determined as the amount converted into heat. More precisely, if food waste is sent to a waste-to-energy plant throughout a year, the quantity of the waste counts as the amount converted into heat when the annual quantity sent to the plant as well as the annual quantity of heat or electricity effectively used (i.e., the quantity of heat or generated electricity supplied to external entities for their use) are measured and it has been confirmed that the criteria specified by the Ordinance on Conversion of Waste into Heat has been met (i.e., at least 28,000 MJ per ton of waste edible oil or at least 160 MJ per ton of food waste other than waste edible oil). If food waste is sent to a waste-to-energy plant during specific periods only, the quantities of the waste count as the amount converted into heat when the quantities sent to the plant, as well as the quantities of heat or electricity effectively used over these periods, are measured and it has been confirmed that the criteria specified by the Ordinance on Conversion of Waste into Heat has been met.

In either case, it is also an option to measure the quantities of food waste sent to a waste-to-energy plant, as well as of heat or electricity effectively used by month or other unit, rather than the sum over the period(s), and total the amounts sent to the plant over the period(s) during which the criteria specified by the Ordinance on Conversion of Waste into Heat has been met (and this fact has been confirmed), so that the total is acknowledged as the quantity converted into heat.

(4) References for How to Measure the Lower Heating Value

To measure the lower heating value of food waste, generated food waste needs to be sampled to measure its heating value. Please refer to JIS K 0060: 1992 Sampling method of industrial waste and the quartering method described in I of Appendix 1 “Notes on Guidance for General Waste Management Businesses” (November 4, 1977, Waste Management 95, Notice from Head of the Waste Management Section, the Water Supply and Environmental Sanitation Department, the Ministry of Health and Welfare) for how to sample food waste, so that typical samples can be consistently obtained.

JIS Z 7302-2: Densified refuse derived fuel – Test method for gross calorific value serves as a useful reference for how to measure the lower heating value of sampled food waste.

(5) Keeping a Record in accordance with Article 9 of the Ordinance on Criteria

To have their food waste converted into heat as a means of recycling, food-related business operators must keep a record of the following in accordance with the Ordinance on Criteria:

- (i) Whether any Specific Feed or Fertilizer Production Facilities are available within 75 kilometers of their factories or places of business where their business activities generate food waste

- (2) Record whether any Specific Feed or Fertilizer Production Facilities are available within 75 kilometers of their factories or places of business where their business activities generate food waste after looking into (i).
- (ii) Situations in which it is highly unfeasible to have their food waste from the factories or places of business recycled at the Specific Feed or Fertilizer Production Facilities located within 75 kilometers of these factories or places of business where their business activities generate food waste

(2) Record the following:

- Date when the business operator contacted the manager of recycling facilities to inquire whether they will take the waste (the date the response from the manager was received)
 - Name and address of the manager of the facilities
 - Reason(s) that the manager gave for rejecting the waste at the recycling facilities
- (iii) Type, heating value, and other properties of the food waste to convert into heat
- For the type of the food waste, record how the waste is generated and whether it is animal or plant foodstuff.

For the heating value of the food waste, record the lower heating value of the food waste measured according to (4).

For other properties of the food waste, record the details of the properties (e.g., metallic and/or salinity content) if the waste has been rejected by the recycling facilities for its properties.

- (iv) Quantity of heat generated from conversion of the waste into heat (or the quantity of electricity if the heat has been converted into electricity)

Record regularly (e.g., monthly or annually) the amount of waste converted into heat measured according to (3) along with the quantity of heat or electricity generated from the conversion.

- (v) Name and address of the facility offering to convert food waste into heat

Record the name and address of the facility offering to convert food waste into heat.

If food waste is sent to more than one facility for conversion into heat, it may be desirable to sort the substances recorded for (iii) and (iv) by facility.

6. Measuring the reduced amount of food waste

The Food Waste Recycling Act defines reduction in this context as reducing the amount of food waste by dehydrating, drying, fermenting, or carbonizing it. A reduced amount is officially acknowledged when the food-related business operator does the reduction of food waste it has generated to decrease the quantity of waste discharged from the place of business. This means that, if the reduction is outsourced, the reduced amount is not acknowledged as reduction specified in the Act.

Moreover, the reduced amount refers to the reduced quantity of food waste due to reduction, rather than the amount of food waste managed by a facility or equipment for waste reduction.

Hence, the reduced amount is calculated by subtracting the amount of food waste after reduction from the amount of food waste sent to a facility for waste reduction. It may also be calculated by the formula below as necessary:

Amount of food waste sent to a facility for waste reduction × reduction efficiency (%) at the facility

7. Calculating the recycling rate

Calculate the recycling rate using the formula specified in Article 2 of the Ordinance on Criteria. To be more specific, use the values measured for 2 to 6 above to calculate the rate.

Formula using the values for the fiscal year:	
$\frac{\text{Controlled amount} + \text{Recycled amount} + \text{Amount converted into heat} \times 0.95 + \text{Reduced amount}}{\text{Controlled amount} + \text{Amount of generated food waste}}$	$\times 100$

8. Notes on Preparing a Regular Report in accordance with Article 1 of the Ordinance on Regular Reporting

When Business Operators with Massive Food Waste submit their regular reports to the competent minister in accordance with Article 9, Paragraph 1 of the Food Waste Recycling Act, they are required to complete and submit the form specified by the Ordinance on Regular Reporting. In addition to the notes included in the remarks column on the form, the following must be noted as Business Operators fill out the form.

- (1) The form for regular reporting is available in Excel (2003) for download on the website of the Ministry of Agriculture, Forestry and Fisheries (http://www.maff.go.jp/j/shokusan/recycle/syokuhin/s_houkoku/index.html).

When the report is created in Excel, save the file in an electronic medium (e.g., CD-R) to submit it with the report in paper form.

- (2) The names of business types that should be used to fill in the “Business Type” field are shown on the Detailed List of Business Types for Regular Reporting (same as “Appropriate Business Types” in (4)). Refer to the Japan Standard Industrial Classification (published by the Ministry of Internal Affairs and Communications) for details of the Business Types.
- (3) As for the field “Any of businesses listed in Article 9, paragraph 2 of the Act,” write “Yes” if the business has any clauses, agreement other than the clauses, environmental policy, code of conduct, or manual specified in the items under Article 3 of the Ordinance on Regular Reporting.
- (4) If more than one business type is entered in the Business Type field, fill out Tables 1 to 11 and 13 for each of the business type, and then provide the whole amount.

If the status of recycling by business type is unclear, it is possible to give an amount estimated from 2 (1) (iii) as an emergency measure, provided that an internal system to keep track of the status by business type will be established as soon as possible.
- (5) When “Yes” is entered in the field “Any of businesses listed in Article 9, paragraph 2 of the Act,” complete Tables 1 to 15 with information that includes data from members.
- (6) In the “Year on year rate (%)” field in Table 3, enter “Previous year’s result is zero” when the preceding year had no result.
- (7) When the amount of food waste generated is measured using the methods described in 2. (1) to (3) to complete the field “How to grasp quantity of generation” in Table 1, enter the number of places of business used as samples, when the waste was generated, and how they were used to estimate the amount.
- (8) To complete Table 2, use the name(s) and unit shown on the List of Values Closely Related to the Amount of Food Wastes Generated by Business Type wherever possible.
- (9) To complete the field “Standard basic unit of generation” in Table 3, enter the value of the standard basic unit of generation specified by the competent minister in accordance with Article 3, Paragraph 2 of the Ordinance on Criteria, if any.
- (10) To complete the field “Standard execution rate (%)” in Table 11, enter the value calculated by the following process in accordance with Article 2 of the Ordinance on Criteria.
 - (i) Calculate the standard execution rate for FY2007 using the formula below:

Formula using the values for FY2007:

$$\frac{\text{Recycled amount} + \text{Amount converted into heat} \times 0.95 + \text{Reduced amount}}{\text{Amount of generated food waste}} \times 100$$

- (ii) Calculate the standard execution rate for FY2008 by adding a specific value to the standard execution rate for FY2007 calculated in (i). The table below shows the values to add according to the rates for FY2007.

If the standard execution rate for FY2007 is less than 20 percent, the rate for that fiscal year should be considered 20 percent and entered in the field accordingly. Hence, enter 22 percent as the standard execution rate for FY2008.

Standard Execution Rate for FY2007	Value to Add
20% to less than 50%	2
50% to less than 80%	1
80% or more	0

- (iii) Calculate the standard execution rate for FY2009 by applying the rule for FY2007 shown in the table in (ii) to the standard execution rate calculated using the process in (ii) (i.e., consider “Standard Execution Rate for FY2007” as “Standard Execution Rate for FY2008”). Apply the same to the calculation of the rates for FY2010 and thereafter.
- (iv) The standard execution rate for each fiscal year is a target value that is automatically calculated as soon as the standard execution rate for FY2007 becomes clear. The actual recycling rates for FY2008 and thereafter are not related directly to the calculation of the standard execution rate.
- (11) To complete the field “Type of specific fertilizer or feed” in Table 12, enter fertilizer, feed, fuels and reducers manufactured through carbonization, oil and oil products, ethanol, or methane.
- (12) In the fields “Outsourcee or transferee vendor” in Tables 12 and 13, enter one outsourcee or transferee vendor in each field.
- (13) In the “Quantity of heat recovered or the quantity of electricity converted from the heat” in Table 13, enter the value calculated according to 5 (3).
- (14) The following are the instructions for completing Table 14:
- (i) In the field “Matters concerning priority of recycling of recyclable food waste” under “Principles of recycling of recyclable food waste,” enter “Compliant” when it can be concluded that food waste has been recycled or managed in any other proper ways in accordance with the principles specified in Article 1, Paragraph 2 of the Ordinance on Criteria; otherwise enter “Not compliant.”
- (ii) In some of the fields under “Control of food waste generation,” “N/A” is entered depending on the processes the business has, that is, the process of manufacturing and/or processing, selling, cooking, or serving food.
All food-related business operators must complete the fields “Periodically measure the quantity of food wastes by form of generation such as unsold to grasp the variation” and “Set segmented targets as necessary and work on systematic control of generation of food wastes.”
- (iii) The fields under “Standards for collection or transportation of food wastes” are

completed by food-related business operators who collect and/or transport food waste themselves.

- (iv) The fields under “Standards for outsourcing collection or transportation of food wastes” are completed by food-related business operators who outsource the collection and/or transportation of food waste to contractors.
- (v) The fields under “Standards for manufacturing of specific fertilizer or feed pertaining to recycling” are completed by food-related business operators who recycle their food waste themselves.
- (vi) The fields under “Standards for outsourcing manufacturing of specific fertilizer or feed and transfer of recyclable food waste pertaining to recycling” are completed by food-related business operators who outsource the recycling of their food waste to contractors.
- (vii) The fields under “Heat recovery of recyclable food waste” are completed by food-related business operators who convert their food waste into heat themselves or outsource the conversion to contractors.
- (viii) The fields under “Volume reduction of food waste, etc.” are completed by food-related business operators who work on the reduction of food waste.
- (ix) Business operators with more than one place of business enter “Compliant” in each field if at least half of these places can be rated “Compliant.”

Example

Of Places of Business A, B, and C, A and B can be rated “Compliant”: Enter “Compliant”

Only A can be rated “Compliant”: Enter “Not compliant”

- (15) In Table 15 “Advanced Approaches to Recycling of Recyclable Food Waste, etc.,” specify the business’s particularly notable efforts to comply with the Ordinance on Criteria and other initiatives to promote the recycling of food waste.
- (16) When “Agree” is entered in Table 16 “Agree or Disagree with National Publication,” the name of the business, basic unit(s) of generation in Table 3, the rate of recycling for the current fiscal year in Table 11, and the efforts specified in Table 15 will be published on the government’s website and other relevant places.

Appendix

Excerpt from Notes on Guidance for General Waste Management Businesses
(November 4, 1977, Waste Management 95, Notice from Head of the Waste Management Section,
the Water Supply and Environmental Sanitation Department, the Ministry of Health and Welfare)

I. How to analyze the characteristics of waste

The following methods shall be the standard procedures for analyzing the characteristics of waste. However, if the municipality has any other appropriate process in place, it may continue to follow the conventional process.

1. Sampling

(1) Sampling from collection vehicles

Sample at least 10 kg of waste from a randomly selected collection vehicle, 200 kg or more in total.

(2) Sampling from a refuse pit

Sample at least 200 kg of well-mixed waste in a refuse pit.

2. Preparing the sample for analysis

Mix the sample well with shovels or other tools on a dry floor (e.g., a concrete floor). If the sample is bagged, take it out of the bag. Break up particularly large refuse into appropriate sizes.

Then, while mixing the sample well, reduce the weight into smaller segments using the quartering method to sample 5 to 10 kg.

Note: It is desirable that particularly large waste (especially blankets, tires, wood and bamboo, oil tin, or any other materials that are hard to crush into pieces) is set aside in the process of reduction, and shred these materials to mix again with the sample at the end of the process. For example, if the sample is quartered four times according to the quartering method, set aside a blanket after the second quartering so that two more rounds reduce it to $1/2^2$, i.e., $1/4$. In other words, $1/4$ of the blanket's overall weight is eventually added to the sample.

3. Measuring and analyzing the sample

(1) Weight per unit volume

Put part of the sample collected after the process described in 2. into a container with a known capacity and drop the sample three times from about 30 centimeters above. Then, if the weight decreases, add more of the sample equivalent to the decrease.

Calculate the weight per unit volume (or apparent specific gravity) using Formula (1) below:

Weight per unit volume (kg/m^3) = Weight of the sample (kg)/Capacity of the Container (m^3) -- Formula (1)

(2) Moisture

Weigh the sample used in 3 (1), and then dry the sample at 105 degrees Celsius, give or take 5 degrees Celsius, with a dryer or any other proper tool until it reaches a constant weight. Weigh it again.

Calculate the moisture level using Formula (2) below:

Moisture (%) = ((Weight of the sample before drying (kg) - Weight after drying (kg) / Weight before drying (kg)) $\times$ 100 -- Formula (2)

(3) Analyzing the types and composition of waste

Spread all the sample used in 3 (2) over a plastic sheet or anything appropriate for the task. Sort the waste into the six basic groups below and weigh each group to calculate weight ratio in percentage.

- (i) Paper and cloth
- (ii) Plastic, synthetic resin, rubber, leather
- (iii) Wood, bamboo, straw
- (iv) Kitchen waste (including animal and plant residues, eggshells, clam shells)
- (v) Incombustible garbage
- (vi) Other (any refuse that passed through a sieve with 5-millimeter openings)

(4) Ash

Crush the waste sorted into the groups in 3 (3), except for incombustible refuse, into pieces smaller than 2 millimeters using a crusher. Put part of the crushed waste into crucibles to heat them at 105 degrees Celsius, give or take 5 degrees Celsius, for two hours.

Then weigh the waste, ignite it in an electric furnace at 800 degrees Celsius for two hours, and weigh it again.

Calculate the ash level using Formulas (3), (4), and (5) below:

Ash in the waste in each group (%) = (Weight of the waste after ignition (kg) / Weight before ignition (kg) × 100 -- Formula (3)

$$\text{Ash in dry waste (\%)} = \frac{\sum_{i=1}^6 (A_i \cdot B_i)}{\sum_{i=1}^6 A_i} \text{ -- Formula (4)}$$

A_i: Weight ratio (%) of the waste in each group “i” calculated in (3)

B_i: Ash (%) in each group “i” (100 for incombustible waste)

Ash in kitchen garbage (%) = Ash in dry waste (%) × ((100 - moisture (%)) / 100) -- Formula (5)

(5) Combustible portion

Calculate the combustible portion using Formula (6) below:

Combustible portion (%) = 100 - Moisture (%) - Ash in kitchen garbage -- Formula (6)

(6) Lower heating value

The lower heating value of kitchen waste can be estimated using Formula (7) below:

H₁ = 4,500 V - 600 W -- Formula (7)

H₁ = Lower heating value of kitchen waste (kcal/kg)

V: Combustible portion of kitchen waste (%)

W: Moisture level in kitchen waste (%)

4. Notes regarding the process of analyzing the characteristics of waste

- (1) Collect and reduce samples as quickly as possible.
- (2) If the sample is weighed before it is dried to measure the moisture level on any day after it is collected, store the sample in a tightly sealed container so that the moisture level will remain the same.
- (3) If the work is done beside a refuse pit, assign a safety supervisor to prevent any workers from falling into the pit and any other accidents.
- (4) Take precautions against injury during the process of reducing the sample and sorting waste, or of any other tasks that requires workers to directly touch kitchen garbage. In addition, prepare to give first aid (e.g., cleaning a cut with antiseptic) immediately to an injured worker.

II. How to measure the loss on ignition of waste incineration residues at a refuse incineration

plant

1. Sampling

Collect one to two kilograms of waste incineration residues four to five times a day, that is, five to ten kilograms in total, as a sample. The residues may be those after watering or water sealing.

2. Moisture

Weigh the sample and, then, dry it at 105 degrees Celsius, give or take 5 degrees Celsius, with a dryer or any other proper tool until it reaches a constant weight. Weigh it again. Calculate the moisture level using Formula (1) below:

Moisture (%) = ((Weight of the sample before drying (kg) - Weight after drying (kg) / Weight before drying (kg)) × 100 -- Formula (1)

3. Removing large-sized incombustible waste

Pour all the sample after it is dried through a sieve with 10-millimeter openings. Weigh incombustible waste in the sample remaining on the sieve. Calculate the percentage of large-sized incombustible waste in the sample using Formula (2) below:

A (%) = Weight of incombustible waste (kg) / Weight of the sample after drying (kg) × 100 -- Formula (2)

4. Measuring the loss on ignition

Crush combustible substances in the sample remaining on the sieve. Then mix them with the sample that passed through the sieve, and quarter the mix to reduce the weight to precisely 20 to 50 grams.

Place the reduced sample in an electric furnace to ignite it for three hours at 600 degrees Celsius, give or take 25 degrees Celsius, before cooling it in a desiccator. After it is cooled, precisely weigh the sample.

Calculate the loss on ignition after the removal of large-sized incombustible waste (I') using Formula (3) below.

I' (%) = ((Weight of the waste before ignition (g) - Weight of the waste after ignition (g) / Weight before ignition (g)) × 100 -- Formula (3)

Calculate the loss on ignition of waste incineration residues using Formula (4) below.

I (%) = I' × ((100 - A)/100) -- Formula (4)

III. How to measure the temperature at the outlet of the combustion chamber in a refuse incineration plant

The standard measurement of the temperature at the outlet of the combustion chamber shall use a chromel-alumel thermocouple. Tightly seal the opening to prevent the air outside from coming in during the measurement.