Food Waste Segregation and Treatment

GUIDEBOOK

National Environment Agency

Safeguard · Nurture · Cherish

Disclaimer
This guide serves as a reference for premises owners and operators to get a basic understanding of food waste segregation and treatment. All reference and sources of the information appearing in this guide have been cited and credited to the best of our knowledge.

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ACKNOWLEDGEMENTS

This Food Waste Segregation and Treatment guidebook is developed by NEA, with the input from various stakeholders. This guidebook outlines steps that different stakeholders can take in embarking on their food waste segregation and treatment journey.

NEA would like to thank all the organisations which have contributed insights aiding the development of this guidebook.

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CHAPTER I: INTRODUCTION

AIM

This guidebook aims to guide premises owners and operators who generate food waste to (i) implement proper food waste segregation and (ii) adopt food waste recycling/ treatment methods.

OVERVIEW OF FOOD WASTE MANAGEMENT

In 2019, the Ministry of the Environment and Water Resources (MEWR) launched the inaugural Zero Waste Masterplan which lays out Singapore's strategies in becoming a Zero Waste Nation by adopting a circular economy approach. In particular, the Masterplan highlights the government's plans to close the loop for three key waste streams, namely packaging waste (including plastics), electrical and electronic waste (e-waste), and food waste.

Food waste is one of the major waste streams identified under the Sustainable Singapore Blueprint (SSB) with a high generation tonnage but low recycling rate. The amount of food waste generated in Singapore is expected to increase in tandem with population and economic growth. Singapore generates about 750,000 tonnes of food waste yearly of which only less than 20 per cent are recycled. Food waste that are not recycled are disposed of at Singapore's Waste-to-Energy (WtE) plants for incineration.

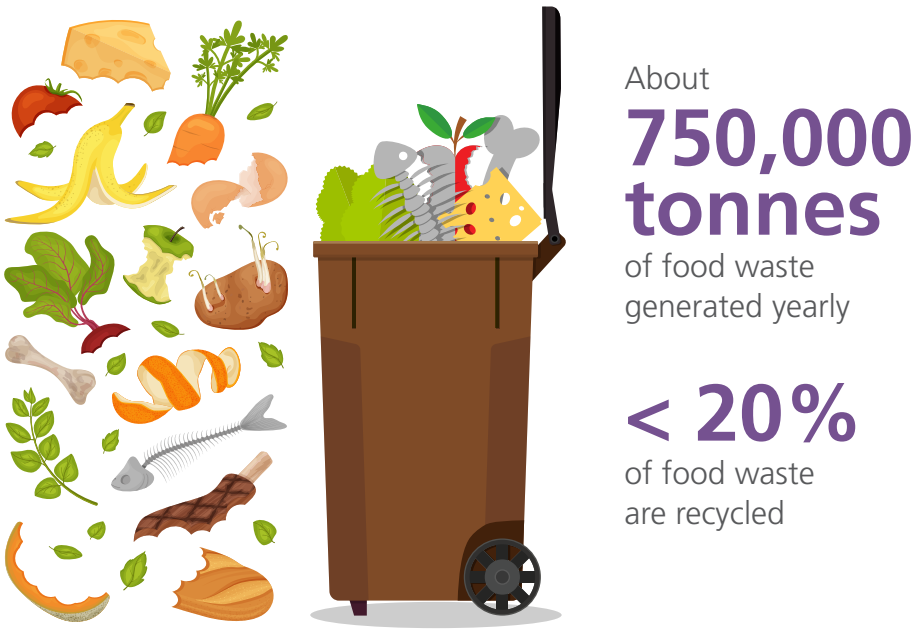

Figure 1: Food waste statistics

Therefore, there is a need to manage food waste holistically. Reducing food wastage, redistributing unsold or excess food, and recycling/treating food waste are the key approaches in Singapore's food waste management strategy, with the preferred approach being reduction at source. The food waste management hierarchy is shown in the diagram below.

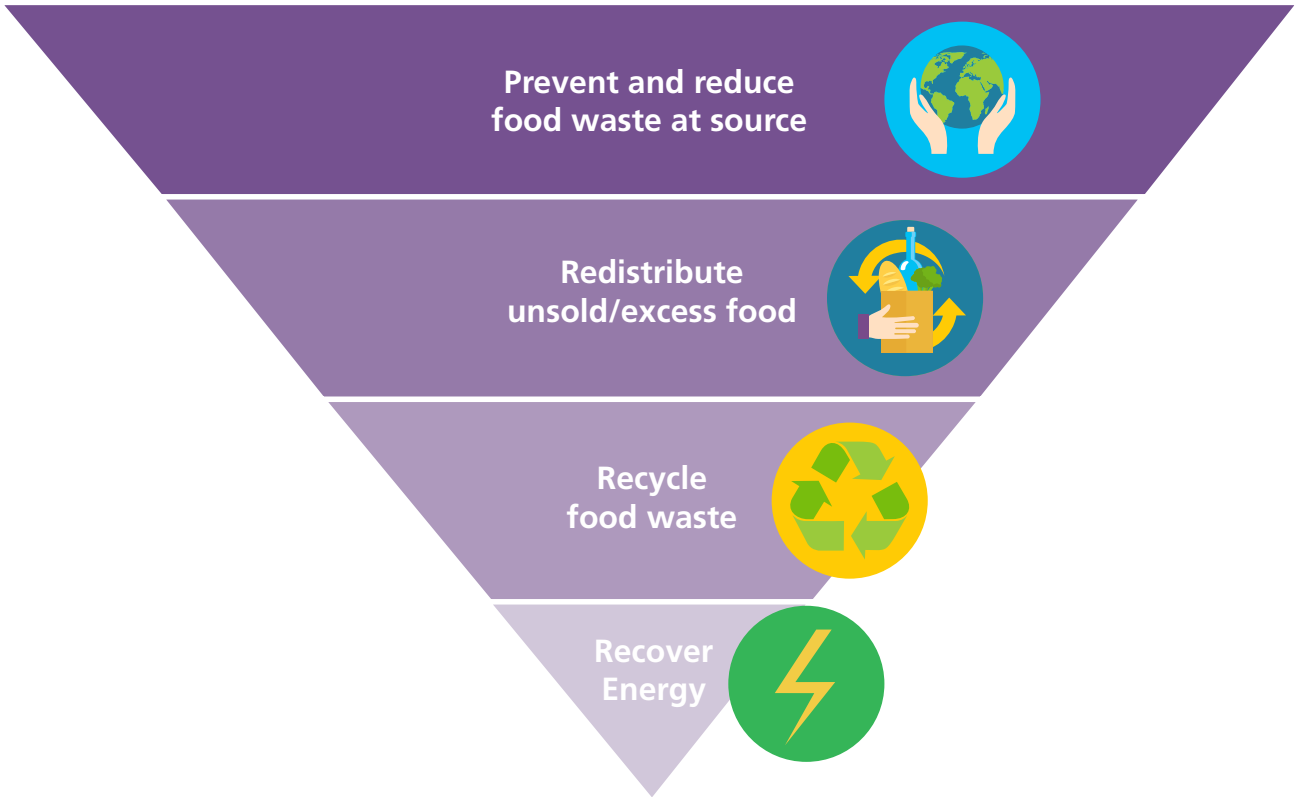

Figure 2: Food Waste Management Hierarchy

The landmark Resource Sustainability Act (RSA)[1] was gazetted in October 2019 to give legislative effect to new measures to address our key waste streams. The following legislations relating to food waste are:

- From 2021: Developers of new large commercial and industrial premises will have to allocate and set aside space for on-site food waste treatment systems in their design plans.
- From 2024: Large commercial and industrial food waste generators will have to segregate their food waste for treatment.

[1] *For more information on the Resource Sustainability Act (Part 5 Food Waste), please refer to (https://sso.agc.gov.sg/Acts-Supp/29-2019/Published/20191004?DocDate=20191004)*

IMPORTANCE OF FOOD WASTE SEGREGATION AND RECYCLING

While the preferred approach is to prevent the generation of food waste at source, not all food waste is avoidable (e.g. bones, shells/husks). Food waste that cannot be avoided should be recycled where possible.

Food waste can be recycled into useful resources or products such as animal feed, compost/ fertiliser, non-potable water or biogas for energy generation, instead of being incinerated at the WtE plants. There is potential for homogeneous food waste such as spent grains, okara waste, bread waste, and fruit and vegetable waste to be converted into products with higher value, for instance animal feed, cleaning agent etc.

In addition, segregating food waste for treatment provides other benefits such as reducing odour and pest nuisances at the premises and contamination of recyclables, which allows greater resource recovery.

To ensure the successful implementation of food waste recycling/treatment, it is crucial for food waste to be properly segregated from non-food waste items.

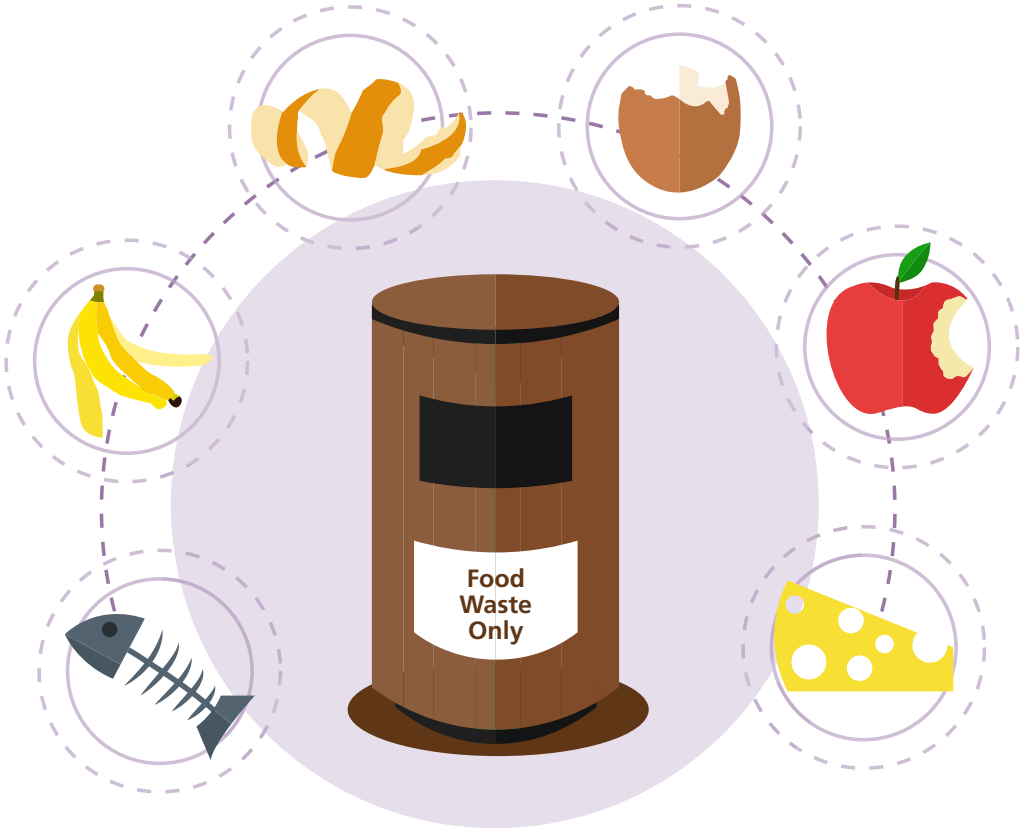

Figure 3: Dedicated food waste bin for segregated food waste

CHAPTER II: IMPLEMENTATION OF FOOD WASTE SEGREGATION

This chapter provides a step-by-step guide on implementing proper food waste segregation.

Step 1: Identify the locations within your premises where food waste is generated

- Common locations include kitchens (where food preparation waste such as vegetable trimmings are generated) and dishwashing or tray-return areas (where post-consumer food waste is collected).

Step 2: Decide the location(s) to segregate food waste

- Food waste segregation point(s) can be located independently or co-located with existing waste collection points within the premises, such as bin centres or tray-return areas.

Step 3: Set up a segregation process at identified locations(s)

- Designate sufficient space for food waste segregation and collection.
- Employ resources to support food waste segregation and collection.

Figure 4: Food waste segregation and collection at the tray-return area of the Environment Building canteen

RESOURCES TO SUPPORT FOOD WASTE SEGREGATION

1. DEDICATED FOOD WASTE SEGREGATION AND COLLECTION RECEPTACLES

Dedicated food waste receptacles such as coloured SS EN 840 certified Mobile Garbage Bins (MGBs) and plastic receptacles can be used by stakeholders to facilitate the segregation and collection of food waste.

Food retail tenants and stallholders who face space constraints can segregate their food waste using smaller plastic containers within their shop spaces. The bigger MGBs can be deployed at centralised collection points (e.g. tray return areas or bin centres) for stakeholders to dispose of their segregated food waste prior to on-site treatment or collection for off-site treatment.

It is also important to have clearly labelled food waste receptacles to allow stakeholders to easily identify the correct point for the disposal of segregated food waste. The labels should be on the lid and side(s) of the bins so that they are clearly visible. This helps to prevent stakeholders from mistaking the food waste bins as general waste bins. The dedicated food waste receptacles can also be colour-coded to distinguish them from general waste bins.

Figure 5: Clear labels on the food waste containers and bins (Images: Participating premises under NEA's food waste-used water sludge co-digestion project)

A general waste bin should be placed beside the food waste bin with clear labels for both bins. This reduces the contamination of food waste with non-food waste.

Figure 6: Placement of general waste bin beside food waste bin
(Image: Participating premises under NEA's food waste-used water sludge co-digestion project)

Case Study - Minimising Contamination of Segregated Food Waste

Figure 7: Metal "insert" placed at the opening of a food waste bin

Some premises has also implemented food waste segregation for a pilot where segregated food waste is collected and sent to a demonstration facility at the Ulu Pandan Water Reclamation Plant for co-digestion with used water sludge[2].

To minimise contamination of food waste by non-food waste, one of the participating premises for the co-digestion project has designed a metal "insert" placed at the top of the food waste bin to restrict the types of items that can be disposed of into the food waste bin. The insert was designed such that non-food waste such as disposable cups bigger than the opening will not fall through. The metal "insert" has helped to improve the purity of the food waste collected.

[2] *For more information on the co-digestion with used water sludge demonstration project, please refer to (https://www.nea.gov.sg/media/news/news/index/co-digestion-of-food-waste-and-used-water-sludge-enhances-biogas-production-for-greater-energy-generation)*

Case Study - InterContinental Singapore Robertson Quay

RB Corp, owner of InterContinental Singapore Robertson Quay, has implemented a seamless "throw-to-treat" food waste segregation and transportation process to manage the food waste generated from its premises.

Grinder throwpoints have been installed at dishwashing and food preparation areas where most of the food waste is generated. Kitchen staff will directly deposit the food waste into these throwpoints which will grind the food waste. Thereafter, a pressurised pump will transport the grinded food waste to a centralised collection tank, which regulates the amount of food waste sent to the on-site digester to avoid overloading the system.

Figure 8: In-feed grinder station

Case Study - Jurong Pioneer Junior College (JPJC)

JPJC has adopted an on-site food waste treatment system which converts food waste into compost. To facilitate food waste segregation, JPJC placed a basket on top of the collection pail. The basket acts as a sieve to drain gravy or water from the food waste before it is transferred to the on-site composter for further treatment.

Figure 9: Basket placed on top of collection pail to drain away gravy and liquids

2. EDUCATIONAL MATERIALS WITH CLEAR INSTRUCTIONS

The provision of educational materials with clear instructions can improve stakeholders' awareness of the food waste treatment project and ensure proper food waste segregation. Educational materials such as posters can be displayed at the food waste segregation and collection points (e.g. tray return area) where food waste is being segregated.

Educational materials should preferably comprise the following:

1. Clear instructions on the types of food waste that can and cannot be deposited into the food waste bins.

   Depending on the type of treatment solutions adopted (e.g. on-site vs off-site, aerobic vs anaerobic), or the different types of treatment systems, the types of food waste that can be recycled may differ. Owners of premises who are planning to install or have adopted on-site food waste treatment should check with their system suppliers on the types of food waste that can be accepted by the system.

2. Photographs and pictures to show the expected quality of food waste to be collected in the food waste bins.

   The use of visual aid and prompts such as photographs of the segregated food waste can enhance stakeholders' level of understanding and help to reinforce the importance of proper segregation of food waste.

3. Clear process flow diagram to provide stakeholders with information on the purpose of food waste segregation.

4. Educational materials can be translated into different languages to cater to a wider range of stakeholders.

An example of a poster consisting these components is shown below:

Photograph/ picture to show the expected quality of food waste to be collected in the food waste bins

1 Clear instructions on the types of acceptable and unacceptable food waste

2 Educational materials in different languages to cater to targeted stakeholders

3 Clear process flow diagrams/ information to provide stakeholders with the knowledge on the purpose of food waste segregation for treatment

Figure 10: Food waste segregation outreach poster under NEA's food waste-used water sludge co-digestion project

3. CLEAR SIGNAGE AT FOOD WASTE COLLECTION POINTS

Setting up prominent food waste collection points with clear signage such as banners and posters helps the proper disposal of segregated food waste into dedicated food waste collection bins.

For example, NEA conducted a food waste segregation pilot at Tampines West, where segregated food waste was collected from nearby coffee shops and food retail establishments. The food waste collection point is co-located with the existing bin centre and a banner was displayed to clearly indicate the food waste recycling corner where the food waste collection bins are placed.

Figure 11: Food waste recycling corner at bin centre

Owners of some premises with food waste segregation also co-located their food waste collection points with existing recycling corners where other recyclables are segregated for collection.

Figure 12: Clear signage to direct stakeholders to dispose segregated waste into dedicated bins for collection, e.g. food, general trash, plastic and cans (Image: Participating premises under NEA's food waste-used water sludge co-digestion project)

Case Study - Pasir Panjang Wholesale Centre (PPWC)

PPWC is one of the participating premises under NEA's co-digestion pilot where segregated food waste is collected from various premises and sent to the demonstration facility at Ulu Pandan Water Reclamation Plant (UPWRP) for co-digestion with used water sludge[3].

To demarcate an area for food waste collection point, PPWC constructed a cage to barricade food waste bins at the food waste collection point. Prior to the installation of the cage, the food waste bins were easily accessible by members of the public which resulted in the bins being contaminated with non-food waste items.

Figure 13: Barricaded food waste collection point at PPWC

[3] *For more information on the co-digestion with used water sludge demonstration project, please refer to (https://www.nea.gov.sg/media/news/news/index/co-digestion-of-food-waste-and-used-water-sludge-enhances-biogas-production-for-greater-energy-generation)*

4. OUTREACH PROGRAMMES FOR STAKEHOLDERS

Engagement

Apart from having the hardware to facilitate food waste segregation, it is also important to conduct engagement and training programmes to engage stakeholders' participation and support for the project.

Examples of how to engage stakeholders for a successful food waste segregation and treatment project are listed below.

Stakeholders involved	Possible engagement
Tenants (e.g. food retail tenants)	• Incorporate clauses in the tenancy agreement, specifying the participation of tenants in the food waste segregation and treatment project • Conduct periodic briefing sessions to tenants (e.g. share on the types of food that can/cannot be deposited into the system, updates on the project)
Staff	• Train staff on the proper segregation of food waste, e.g. removal of any non-food waste items (e.g. disposable plates, cups and cutlery, tissue) • List the roles and responsibilities of staff for the segregation, collection and transportation of food waste in the Standard Operating Procedure (SOP) or work manual
Contractors (e.g. cleaning contractors, waste contractors)	• Provide dedicated food waste bins for segregation • Provide training to operate the on-site food waste treatment system

Case Study - Jurong Town Corporation (JTC)

Figure 14: Publicity material circulated on JTC staff intranet

An on-site food waste treatment machine has been installed at the cafeteria of JTC Summit to treat segregated food waste. To engage the stakeholders, JTC disseminated information about the on-site digester on their employee portal. This helped to raise awareness of the on-site treatment machine and encourage proper food waste segregation by the patrons.

Incentives and recognition

There could be potential cost savings reaped from the segregation of food waste for treatment, particularly if owners and operators adopt a variable waste collection contract, where waste disposal cost is dependent on the amount of waste disposed of. Premises can also reap savings from reduced haulage fees when food waste is treated on-site. The savings from food waste segregation and treatment could be passed on to stakeholders (e.g. tenants, staff, contractors) to encourage and sustain their participation in food waste segregation.

Owners and operators can also recognise stakeholders' participation in food waste segregation. For instance, where compost is generated from food waste treatment, owners and operators can share the compost with stakeholders who could use it for gardening. Owners and operators of premises could also develop a recognition scheme to show appreciation for stakeholders' participation in segregating their food waste.

Figure 15: Decal put up at a food stall to recognise the stallholder's efforts in segregating food waste for treatment (Image: Participating stall under NEA's on-site food waste treatment system pilot at Block 628 Ang Mo Kio Ave 4 Market & Food Centre)

CHAPTER III: FOOD WASTE TREATMENT OPTIONS

This chapter provides an overview of food waste treatment options and considerations for each treatment option. The type of option can be classified into two categories: on-site and off-site.

On-site treatment refers to the installation of treatment system within the building premises to treat segregated food waste, while off-site treatment refers to the sending of segregated food waste to be treated at a licensed waste disposal facility not within the premises where the food waste was generated.

ON-SITE FOOD WASTE TREATMENT

Owners and operators of premises who wish to implement on-site food waste treatment can consider adhering to the steps in the flowchart below.

Figure 16: Workflow for implementing on-site food waste treatment

Step	Description
1. Determine the capacity of food waste treatment system	Prior to selecting the food waste treatment system, we recommend premises owners or operators to conduct a food waste audit to determine the amount of food waste generated. This provides an indication of the capacity that is needed for the food waste treatment system. To conduct a food waste audit, you can refer to the NEA Food Waste Management webpage for the Food Waste Minimisation Guidebook[4] which provides a simple food waste audit template. Alternatively, owners or operators of premises who wish to conduct an in-depth audit can refer to SS 633 - Singapore Standards on Food Waste Management for Food Manufacturing/Processing Establishments[5] and SS 640 - Singapore Standards on Food Waste Management for Food Retail, Wholesale and Distribution Establishments[6]. Owners and operators of premises can also work with suppliers of on-site treatment systems (listed in the Appendix) to estimate the amount of food waste generated and the recommended capacity of the system.
2. Consider the type of food waste treatment system	When selecting the type of food waste treatment system, consider the following: 1. Type of food waste that can be treated Consider the types of food waste that the system can and cannot treat. Some systems require a grinder to crush big or hard bones before they can be treated. Generally, hard shells (e.g. lobster/oyster shells, coconut/durian husks) or fibrous items like sugarcane bagasse cannot be deposited into the treatment system. 2. Types and uses of end-products Consider the uses of the end-product(s) (e.g. non-potable water, compost, fertiliser and liquid nutrient) generated from the food waste treatment system. In general, there are 2 types of end-products. a. Non-potable water: This may be used to backwash the treatment system (e.g. cleaning of the system by reversing the flow of liquid back into the system) or washing of floors. Please ensure that the effluent discharge complies with PUB's trade effluent discharge requirements[7], and is discharged via a grease trap into the sewer. b. Compost/fertiliser/liquid nutrient: This may be used for landscaping purposes. Please refer to the SS 628 – Singapore Standards on Specifications for Compost[8] for the use of compost in agriculture and horticulture.

[4] *Refer to NEA Food Waste Management webpage for the Food Waste Minimisation Guidebook (https://www.nea.gov.sg/our-services/waste-management/3r-programmes-and-resources/food-waste-management/food-waste-management-strategies)*

[5] *Refer to SS 633 - Singapore Standards on Food Waste Management for Food Manufacturing / Processing Establishments (https://www.singaporestandardseshop.sg/Product/SSPdtDetail/023d4d48-f3fa-4d70-9c96-0dfe1333ac1b)*

[6] *Refer to SS 640 - Singapore Standards on Food Waste Management for Food Retail, Wholesale and Distribution Establishments (https://www.singaporestandardseshop.sg/Product/SSPdtDetail/01b00b90-9fc4-4fb1-abd5-07b97e0a88b4)*

[7] *Refer to PUB website for trade effluent discharge requirements (https://www.pub.gov.sg/usedwater/legislation)*

[8] *Refer to SS 628 – Singapore Standards on Specifications for Compost (https://www.singaporestandardseshop.sg/Product/SSPdtDetail/6521d403-f66c-45f3-8db6-e41731b888b3)*

Step	Description
3. Location of food waste treatment system	Premises owners should cater space to house the food waste treatment system. In general, the space required for a 1-tonne food waste treatment system is approximately the size of 2 car parking lots (25 square metres). For new developments, this space could be set aside at the planning stage. For existing developments, the space could be allocated during the Addition & Alteration (A&A) works. It is also recommended to check with suppliers on the exact space requirements for the specific systems. For hygiene purposes, the food waste treatment system should be sited away from the food preparation area. Some possible areas for siting of the food waste treatment system include the bin centre or dishwashing area. Please ensure that proper refuse, odour and pest management are in place with the installation of the food waste treatment system. There should also be a power supply available for the treatment system.

OFF-SITE FOOD WASTE TREATMENT

For owners and operators of premises that are not able to adopt on-site treatment due to limitations such as space constraints, they may opt to send their food waste for offsite treatment.

To do so, they are required to engage an NEA-licensed General Waste Collector (GWC) with Class B licence for the transportation of segregated food waste to a licensed waste disposal facility for treatment. An example of a licensed waste disposal facility for the treatment of segregated food waste will be the upcoming food waste treatment facility in Tuas Nexus (expected to be operational in 2024).

For premises generating homogeneous food waste (e.g. okara waste, spent grains, bread waste), they can contact local food waste recycling companies to process the food waste into animal feed or other value added products.

A link to the list of licensed GWCs and local food waste recycling companies is included in the Appendix.

CHAPTER IV: REVIEWING THE FOOD WASTE SEGREGATION PROCESS

This chapter discusses the need for a review of the food waste segregation process and how food waste segregation can be improved.

Following the implementation of food waste segregation, owners and operators of premises should continue to engage stakeholders on proper food waste segregation and monitor the success of the food waste segregation and treatment project. Proposed monitoring parameters are:

1. Tonnage of food waste recycled
2. Percentage of contamination of food waste bin
3. Types of food waste thrown

A sample workflow to review the food waste segregation process is provided below.

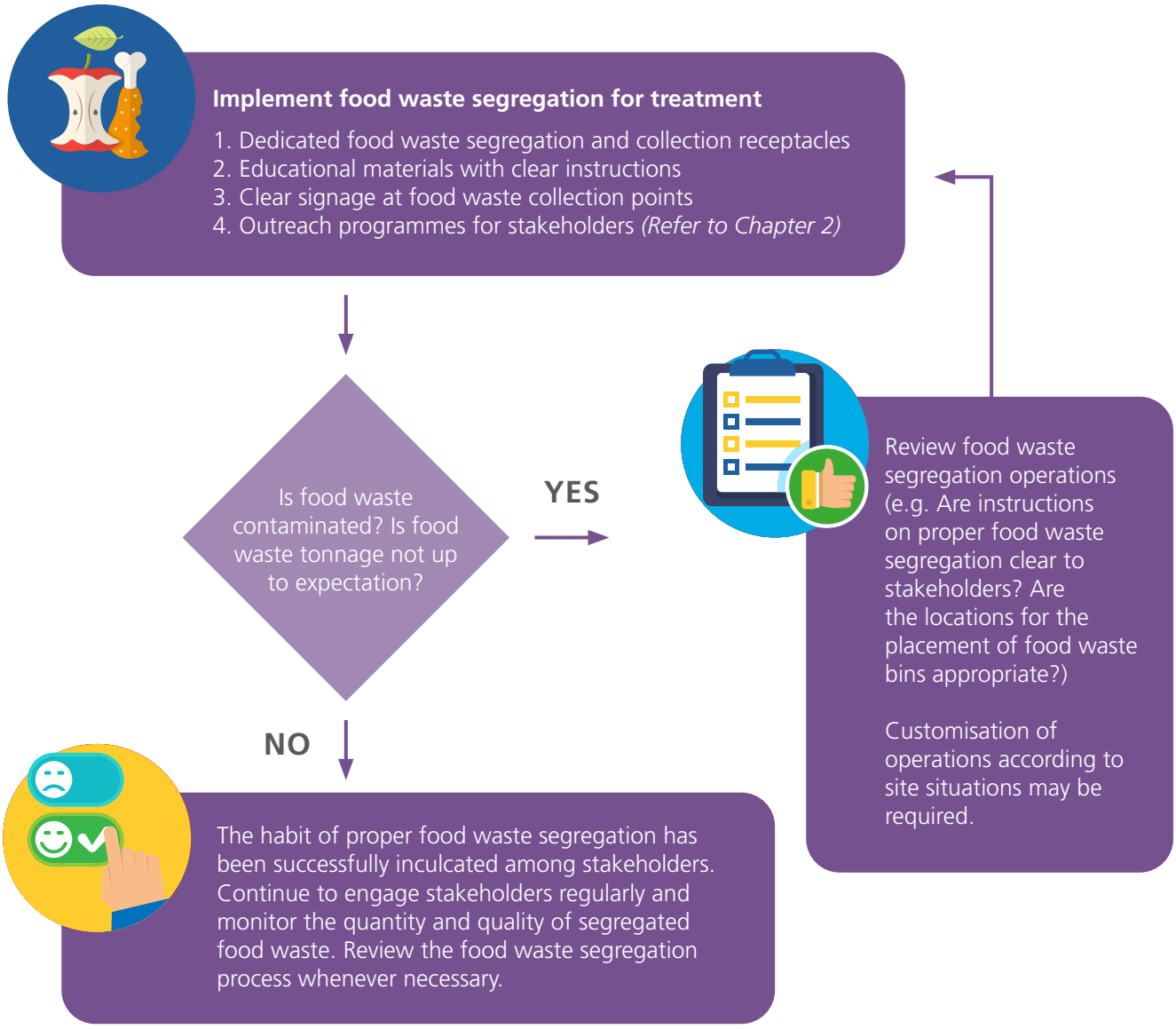

Figure 17: Workflow to review the food waste segregation process

CONCLUSION

This guidebook was developed to support premises owners and operators on implementing proper food waste segregation and treatment. With the implementation of food waste segregation and treatment, food waste can be diverted for treatment / recycling instead of being disposed of at WtE plants for incineration. This would reduce the amount of ash generated from incineration which are sent to Singapore's only landfill, Semakau Landfill and it is projected to run out of space by 2035.

Furthermore, segregating food waste for treatment brings about other benefits such as reduced odour and pest nuisances at the premises, and reduced contamination rate of recyclables. Food waste can also potentially be converted into useful resources or higher-value products which will allow for greater resource recovery.

These food waste segregation and treatment efforts will help contribute towards Singapore's target of 70 per cent recycling rate by 2030 and is an important step towards our vision of becoming a Zero Waste Nation.

CHECKLIST

A.	**Segregation and collection of food waste *(Refer to Chapter 2)***	
1.	Have you identified the sources of food waste generation within your premises?	☐
2.	Have you designated the location and space to segregate food waste?	☐
3.	Do you have the relevant resources to support food waste segregation?	
	– Dedicated food waste segregation and collection receptacles	☐
	– Educational materials with clear instructions	☐
	– Clear signage at food waste collection points	☐
	– Outreach and training programmes	☐
B.	**Food waste treatment options *(Refer to Chapter 3)***	
1.	Have you decided if on-site or off-site food waste treatment should be adopted?	☐
i.	**On-site treatment**	
	a. Have you determined the capacity of food waste treatment system?	☐
	b. Have you determined type of on-site treatment system that can accept the type of food waste generated at your premises?	☐
	c. Is space allocated for the food waste treatment system?	☐
ii.	**Off-site treatment**	
	Have you engaged a licensed General Waste Collector with Class B licence?	☐

APPENDIX

Please refer to NEA website.

1. List of licensed general waste collectors (GWCs)
2. List of on-site treatment system suppliers and local food waste recycling companies