Singapore Standards Council

SS 633 : 2017
(ICS 67.020; 13.020.20; 13.030.99)

SINGAPORE STANDARD

Code of practice for food waste management for food processing/manufacturing establishments

Published by

Enterprise Singapore

SS 633 : 2017
(ICS 67.020; 13.020.20; 13.030.99)

SINGAPORE STANDARD

Code of practice for food waste management for food processing/manufacturing establishments

---

ISBN 978-981-47-8468-9

This Singapore Standard was approved by the Food Standards Committee on behalf of the Singapore Standards Council on 7 December 2017.

First published, 2018

The Food Standards Committee, appointed by the Standards Council, consists of the following members:

		Name	Capacity
Chairman	:	Dr Allan Lim	*Individual Capacity*
1st Deputy Chairman	:	Dr Yap Him Hoo	*Agri-Food & Veterinary Authority of Singapore*
2nd Deputy Chairman		Mr Lim Kay Kong	*Individual Capacity*
Advisors	:	Prof Chua Sin Bin	*Individual Capacity*
		Mr Tan Khieng Sin	*Individual Capacity*
Secretary	:	Mr Lee Huan Tiat	*Singapore Manufacturing Federation – Standards Development Organisation*
Members	:	Mr Andrew Chan	*The Restaurant Association of Singapore*
		Dr Diana Chan	*Temasek Polytechnic*
		Ms Chong Nyet Chin	*NTUC Fairprice Co-operative Ltd*
		A/Prof Ralph E Graichen	*Agency for Science, Technology and Research*
		Mr Richard Khaw	*Singapore Institute of Food Science and Technology*
		Mr Sunny Koh Lai Hong	*Singapore Manufacturing Federation*
		Ms Adeline Leong	*National Environment Agency*
		Mr Lim Chee Kang	*Workforce Singapore*
		Mr Munir Hussain	*Majlis Ugama Islam Singapore*
		Mrs Ngan-Loong Mann Na	*Food Innovation Resource Centre*
		Dr Ong Mei Horng	*Fraser and Neave, Limited*
		Dr Eunice Pang	*Health Promotion Board*
		Mr Rashid Hassan	*Commonwealth Capital*
		Mr Siew Kwok Siong	*Consumers Association of Singapore*
		Ms Bernice Tay	*SPRING Singapore*
		Mr Wong Mong Hong	*Singapore Food Manufacturers' Association*
		Ms Lianey Yeap	*SATS Catering Pte Ltd*
		Prof Zhou Weibiao	*National University of Singapore*

The Working Group on Food Waste Management for Food Processing/Manufacturing Establishments, appointed by the Food Standards Committee to assist in the preparation of this standard, comprises the following experts who contribute in their *individual capacity*:

		Name
Convenor	:	Dr Chen Wei Long
Secretary	:	Ms Esther Chia

Members : Prof William Chen Wei Ning
Mr Michael Lee Kok Wei
Dr Lee Mun Wai
Mr Allan Lim Yee Chian
Ms Jeneve Lim
A/P Liu Shao Quan
Dr Jonathan S C Low
Mr Mohd Noor Bin Hashim
Dr Ng Cher Siang
Mr Nicholas Ng
Dr Puah Chum Mok
Mr Roshith Rajan
Ms Claire Ariela Shen
Mr Teng Meng Hua, Simon
Mr Constant Van Aerschot
Ms Laudine Witteveen
Ms Wong Hou Jih
Mr Wong Mong Hong
Ms Wong Suat Li
Ms April Yang

The organisations in which the experts of the Working Group are involved are:

Agri-Food & Veterinary Authority of Singapore
Alpha Biofuels (S) Pte Ltd
Asia Pacific Breweries (Singapore) Pte Ltd
Biomax Green Pte Ltd
Business Council for Sustainable Development Singapore
Cooking Art Industries
Eco-Wiz Group Pte Ltd
Food from the Heart
Nanyang Technological University
National Environment Agency
National University of Singapore
NTUC Foodfare Co-operative Ltd
Singapore Food Manufacturers' Association
Singapore Institute of Manufacturing Technology
Singapore Manufacturing Federation
Singapore Polytechnic
Sodexo Services Asia Pte Ltd
The Food Bank Singapore Ltd
Waste Management and Recycling Association of Singapore

(blank page)

Contents

Foreword

This Singapore Standard was prepared by the Working Group on Food Waste Management for Food Processing/Manufacturing Establishments under the direction of the Food Standards Committee.

This standard is developed to help reduce food waste. The more food waste is being produced, the more there is to dispose of by recycling and re-using, burial (landfill) or burning (incineration). For land scarce Singapore, this poses a challenge to find land for landfills and incineration plants. Therefore, there is a need to manage food waste holistically.

This standard is intended to improve food manufacturing practices and competitiveness through a more efficient use of food resources in production/planning processes. This includes food waste reduction management that takes into consideration overproduction, expiration, spoilage, overcooked items, contaminated items, etc.

With food waste reduction management in place, it increases Singapore's resistance to price fluctuations in imported raw agricultural materials and reinforces the concept of sustainable production. Reduction in waste also helps food processing/manufacturing establishments to save money on commodities, labour, energy and disposal costs.

In preparing this standard, reference was made to the following publications:

1. Food Loss and Waste Accounting and Reporting Standard Version 1.0, Food Loss + Waste Protocol, http://www.wbcsd.org/contentwbc/download/1003/12937

2. Global food losses and food waste – Extent, causes and prevention (2011), Rome, Food and Agriculture Organization of the United Nations (FAO), http://www.fao.org/docrep/014/mb060e/mb060e.pdf

3. SAVE FOOD: Global Initiative on Food Loss and Waste Reduction, Definitional framework of food loss(27 February 2014), Rome, Food and Agriculture Organization of the United Nations (FAO), http://www.fao.org/3/a-at144e.pdf

4. Sustainable Management of Food: Food Recovery Hierarchy, United States Environmental Protection Agency, https://www.epa.gov/sustainable-management-food/food-recovery-hierarchy

5. Technical Paper on Post-Harvest Losses and Strategies to Reduce Them (January 2014), Action Contre la Faim (ACF), ACF International, https://www.actioncontrelafaim.org/wp-content/uploads/2018/01/technical_paper_phl__.pdf

Acknowledgement is made for the use of information from the above publications.

This standard is expected to be used by food processing/manufacturing establishments, which include slaughter houses, food processing, central kitchen, storage providers and business-to-business (B2B) service providers.

Attention is drawn to the possibility that some of the elements of this Singapore Standard may be the subject of patent rights. Enterprise Singapore shall not be held responsible for identifying any or all of such patent rights.

NOTE

1. *Singapore Standards (SSs) and Technical References (TRs) are reviewed periodically to keep abreast of technical changes, technological developments and industry practices. The changes are documented through the issue of either amendments or revisions.*

2. *An SS or TR is voluntary in nature except when it is made mandatory by a regulatory authority. It can also be cited in contracts making its application a business necessity. Users are advised to assess and determine whether the SS or TR is suitable for their intended use or purpose. If required, they should refer to the relevant professionals or experts for advice on the use of the document. Enterprise Singapore shall not be liable for any damages whether directly or indirectly suffered by anyone or any organisation as a result of the use of any SS or TR.*

3. *Compliance with a SS or TR does not exempt users from any legal obligations.*

Code of practice for food waste management for food processing/manufacturing establishments

1 Scope and objective

1.1 Scope

This Singapore Standard specifies the recommended best practices for food processing/manufacturing establishments in developing their food waste management plans. It sets out recommendations and guidelines for proper food waste management at various stages in the food value chain, from receiving raw materials, to processing, storage, packaging, transportation, distribution, and returned foods. It does not include incoming raw material and recalled products (see Figure 1).

The deletion of stages or processes is only permitted if it does not significantly change the overall conclusions of the study. Any decision to omit stages or processes should be clearly stated, and the reasons and implications for their omission should be explained.

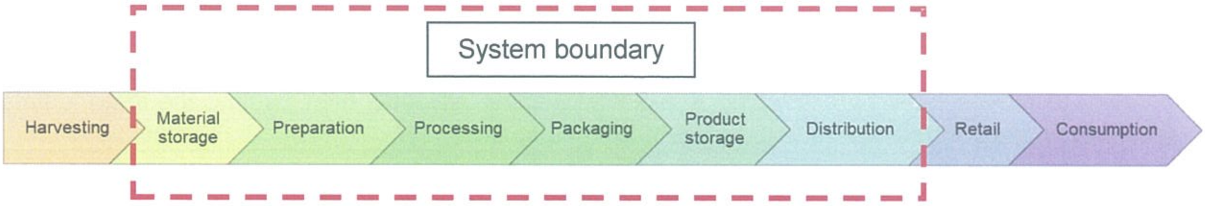


Figure 1 – Food value chain

1.2 Objective

The objective of this Singapore Standard is to help food processing/manufacturing establishments develop a food waste management plan with the goal of minimising food waste generated and a move towards a zero-waste nation, as set out in the Sustainable Singapore Blueprint 2015.

2 Normative references

There are no normative references cited in this Singapore Standard.

3 Terms and definitions

For the purpose of this Singapore Standard, the following terms and definitions apply.

3.1 Animal feed

Reduces food loss and waste (FLW) by substituting part of the food for livestock with processed FLW.

3.2 Avoidable FLW

FLW that can be prevented. Typical causes include process inefficiency, poor stock management, overproduction, loss or human neglect. It can be managed with current technologies and/or changes in operations (i.e. within human control).

3.3 Composting/aerobic digestion

A process to reduce FLW by decomposing it into compost/greywater.

3.4 Distribution

The movement of goods from a source to the customer or business user. Typical causes of food waste at this stage are inappropriate handling and transportation, which results in spoilage and loss.

3.5 Edible and avoidable FLW

Food or drinks that are meant for human consumption, including materials involved in the production of food, as well as food that has passed its sell-by date and has become unsafe to consume. The following substances are not included: tobacco, pharmaceutical products, food supply chain agents (e.g. water used for cleaning/cooking purposes).

3.6 Edible and unavoidable FLW

FLW caused by technical, design, raw material quality or process constraints (e.g. purged soy sauce from pipe after every production run).

3.7 Energy extraction

A process to reduce FLW by converting it into intermediate products then burning the intermediate products to produce energy:

- Anaerobic digestion: generation of biofuels/biogas
- Transesterification: converting used cooking oil into biodiesel.

3.8 Equipment/process design change

The possibility of customising, upgrading, developing or innovating tools, equipment, machines, technologies and/or modifying production processes such that waste generated from production is reduced.

3.9 Food loss

The decrease in quantity or quality of food. It usually happens in the postharvest and food processing stages in the food value chain.

3.10 Food waste

Food meant for human consumption, including food that is damaged or expired. Typical causes include sudden changes in demand, poor inventory management or substandard practices during the food production stage in the food value chain.

3.11 Food loss and waste (FLW)

Encompasses both food loss and food waste. Food packaging and water are not considered in this Standard.

3.12 Food redistribution

The reduction of FLW by giving away excess food that is ready for sale and mainly caused by overproduction.

3.13 Incineration

The reduction of FLW by burning it in waste-to-energy (WTE) plants. It is the least preferred option because food quality is retained the least here.

3.14 Industrial application

The reduction of FLW by converting it into materials for other industrial processes (e.g. shredding into construction filler materials, converting into bioplastics/biopolymers, rendering fat/oil into soaps or cosmetics, etc.).

3.15 Inedible and unavoidable FLW

FLW generated as a by-product of the main materials (ingredients) being consumed in a process (e.g. eggs shells from the eggs used to bake cakes). Food in this category of FLW is never intended for human consumption.

3.16 Manufacturing process improvement

The reduction of FLW by improving manufacturing process/production efficiency, stock management, loss or human neglect.

3.17 Packaging

Materials used to wrap or protect goods, and includes weighing, labelling, sealing. Typical causes of food waste at this stage are spoilt packaging resulting in tainting, drainage or pests invasion.

3.18 Preparation

The act of preparing food for consumption, and includes cleaning, grouping, dehulling, pummelling, mashing, packing, soaking, dehydrating, straining and milling. Typical causes of food waste at this stage are losses during the processing of food and tainting resulting in reduction in quality of food.

3.19 Processing

The act of processing food for consumption, and includes blending, cooking, frying, shaping, trimming, chopping, extrusion. Typical causes of food waste at this stage are losses during the processing of food and tainting resulting in reduction in quality of food.

3.20 Storage

The act of keeping goods in a place when not in use. Typical causes of food waste at this stage are the intrusion of pests, leakages, tainting and natural dehydration of food.

3.21 Unavoidable FLW

Parts of food products in a food production chain that are unfit for human consumption and is not within human control.

4 Collection of FLW data

4.1 Process and FLW generation mapping

For each stage of the food manufacturing value chain, it is helpful to visualise the processes and their inter-relationships using a process flow diagram (Figure 2). Each of the processes should be initially described to define:

- where the unit process begins, in terms of the receipt of raw materials or waste generation;
- the nature of the transformations and operations that occur as part of the unit process; and
- where the unit process ends, in terms of the destination of the intermediate or final products.

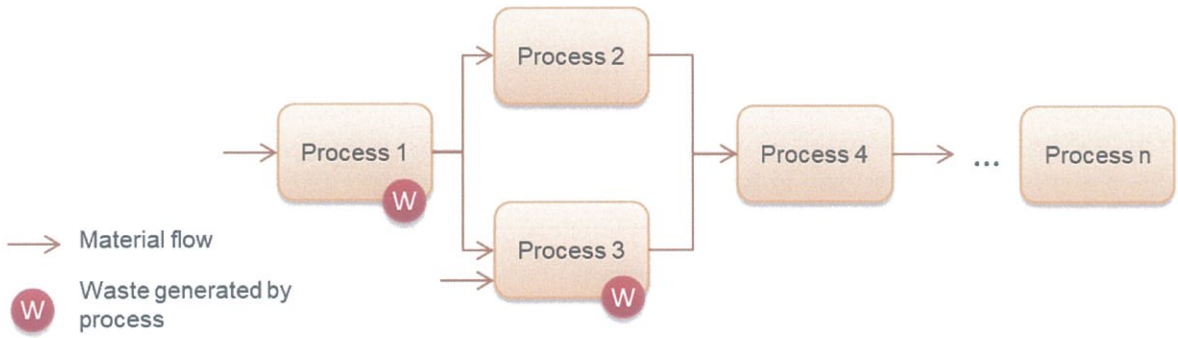


Figure 2 – Example of a process flow diagram

4.2 Data collection

For production lines with high production mix, a cut-off rule (e.g. 80/20 rule or from experience) may be applied to select the most significant FLW to be targeted for data collection, and subsequently for analysis and improvement. The significant FLW to be targeted is selected based on generated quantity.

A cut-off rule is optional and may be applied based on the cost of disposal and/or cost of food loss. It is carried out once at the start of one-year cycle of data collection.

As food waste may lead to increase in material cost, companies may choose to correlate the food waste generated to the unit cost of material loss and/or unit cost of end product. Companies may choose to use which ever unit cost they see fit to calculate their cost due to food waste.

Data collection shall be done based on the overall FLW generated at the production site. One of these methods shall be used for waste data collection:

- Direct weighing (most preferred) – Using a measuring device to determine the weight of food waste.
- Mass balance calculation – Do a simple mass balance calculation from the recipe to determine the weight of the food waste.
- Counting – Assessing the number of items that make up the food waste and using the result to determine the weight.
- Assessing volume – Assessing the physical space occupied by food waste and using the approximate density to determine the weight.

Data collection shall take into account the product mix (e.g. in high-mix, low-volume environments). Data collected shall be consistent and representative of FLW generation pattern and/or fluctuation in the production over the reporting period.

The time horizon for each data collection period shall be one calendar year (i.e. for a duration of 12 months).

Data collection shall be conducted at least once a month.

Since data collection may span several reporting locations, measures should be taken to ensure consistency in the data collected. These measures should include the following:

- Draw process flow diagrams that outline all the processes for each stage covered in the scope;
- Describe briefly each process with respect to factors influencing the waste;
- Specify the units of measurement used;
- Indicate the method(s) used to collect the data;
- Record the date (and time) data is collected;
- Document clearly any special cases, irregularities or other items associated with the data provided; and
- Specify if data was collected for pre-compacted FLW or compacted FLW and make sure subsequent data collections are consistent to this.

Repeat data collection for every month throughout the reporting period. When data collection is completed, the next step is to identify the hotspots of waste generation. See Annex A for examples.

5 Hotspot analysis of FLW

5.1 FLW quantification

FLW quantification shall be done to aggregate the quantities of FLW generated across all processes within the system boundary for the reporting period (Figure 1). The quantity of FLW should be expressed as mass or volume, and the unit used should be consistent throughout the entire data collection process.

Regardless of the level of granularity, the quantity of FLW generated at each process should be aggregated according to the type of FLW produced (Figure 3).

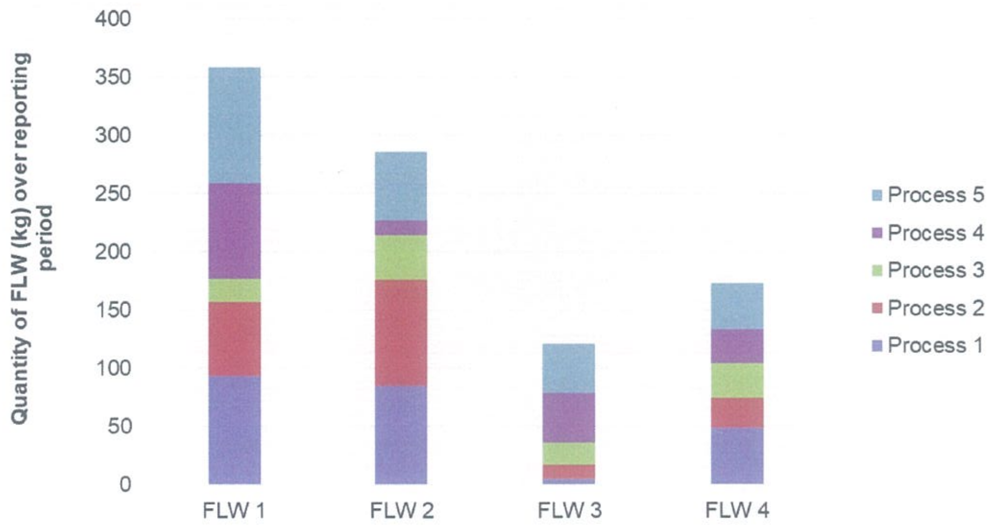


Figure 3 – Example of data quantification

5.2 FLW hotspots identification

The identification of FLW hotspots should be conducted to determine the processes where the largest quantities of FLW are generated. The goal is to focus FLW reduction efforts on the processes that are generating the most significant quantities of FLW.

FLW hotspots may be identified for different types of FLW using methods such as the 80/20 rule (Figure 4) to identify the processes that contribute to 80% of the total quantity generated for each type of FLW. See Annex B for examples.

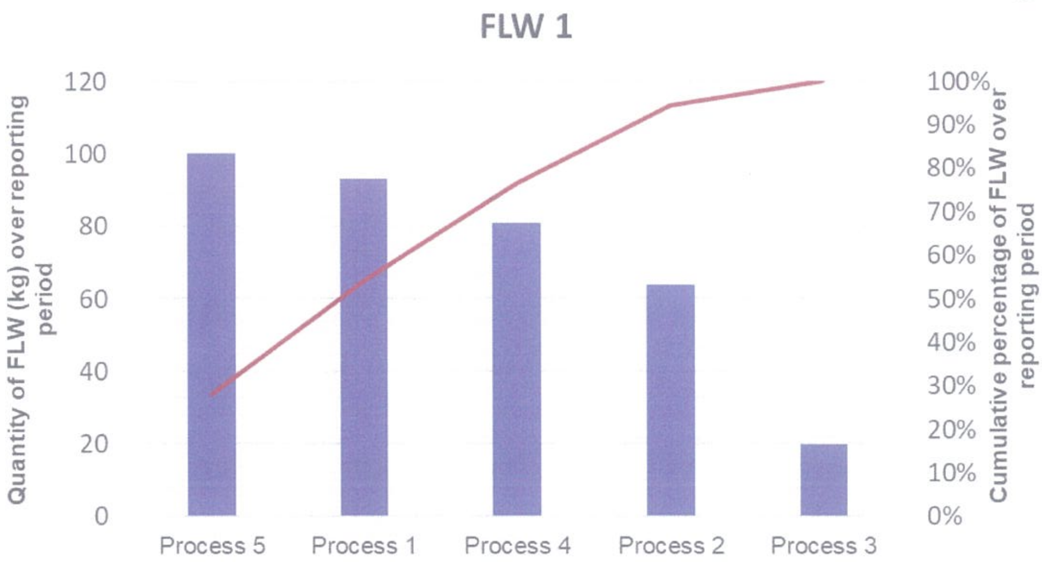


Figure 4 – Example of hotspot identification using the 80/20 rule

6 Planning of FLW reduction

6.1 FLW classification

The FLW generated with the highest quantity shall be classified with respect to their causes (Figure 5):

- edible and avoidable;
- edible and unavoidable; or
- inedible and unavoidable.

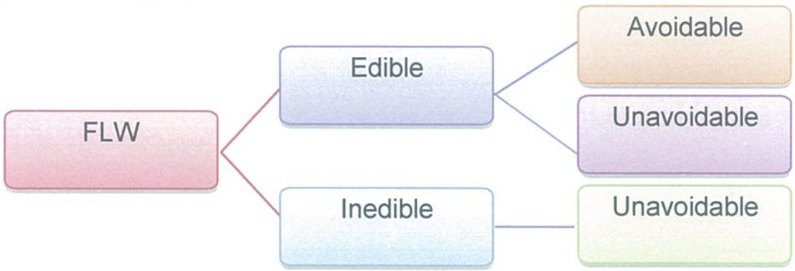


Figure 5 – Classification of FLW

6.2 FLW reduction guide

The FLW reduction hierarchy (Figure 6) follows the retention of value in terms of food quality. This means the higher the rank of the hierarchy, the better the retention of food quality. For instance, human consumption has a higher value compared to animal consumption, which in turn has a higher value than non-food application. Therefore, a higher rank in the hierarchy is more preferable as a means of reducing FLW that goes into incineration.

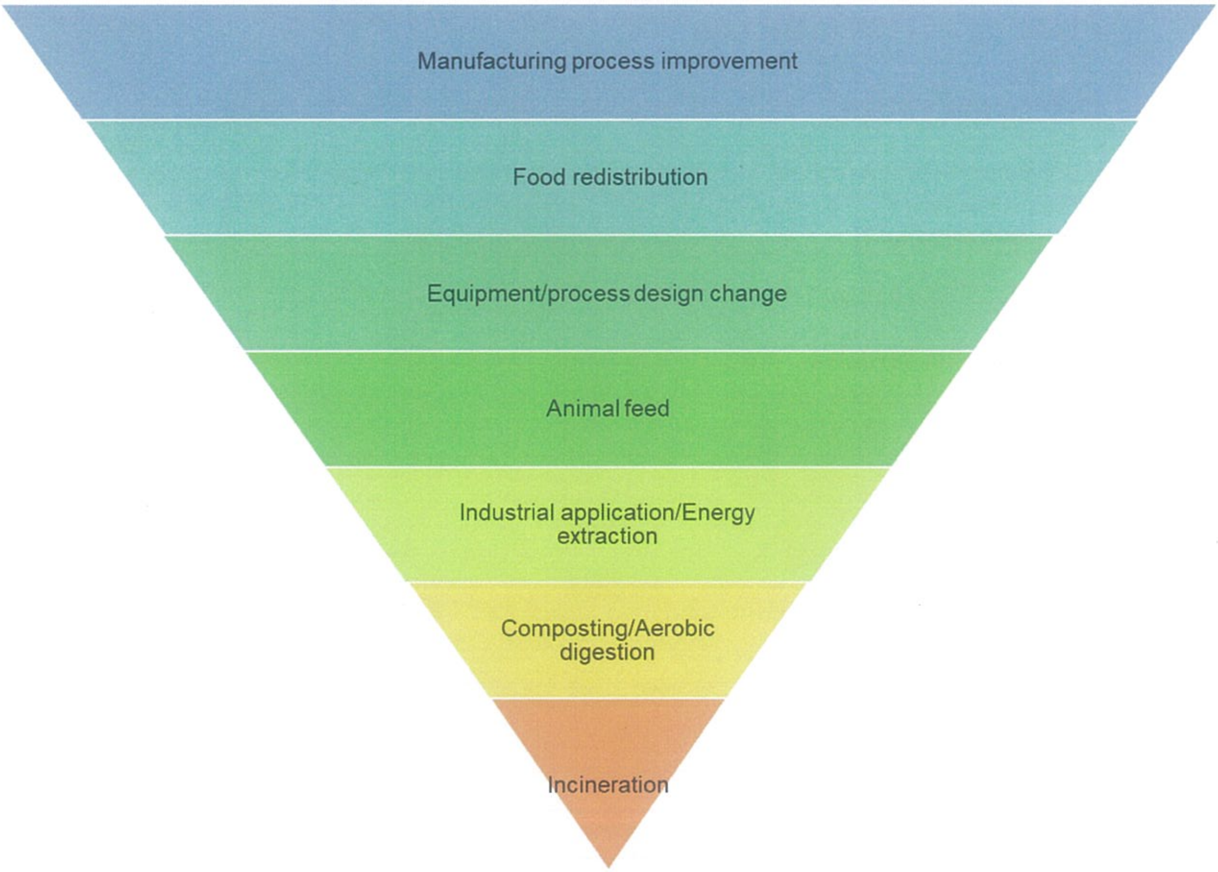


Figure 6 – FLW reduction hierarchy

Examples of FLW reduction initiatives are summarised in Table 1. Refer to Annex C for more examples.

Table 1 – FLW reduction initiatives

Levels in FLW reduction hierarchy	Examples of FLW reduction initiatives
Manufacturing process improvement	Change standard operating procedures (SOP) Design new training programme for workers
Food redistribution	Donate food to food distribution charities
Equipment/process design change	Invest in new moulds Upgrade machines Redirect food waste back into production line
Animal feed	Recycle FLW to use as animal feed
Energy extraction/ Industrial application	Process into filler construction materials Send FLW for anaerobic digestion Convert waste cooking oil to bioethanol
Composting/Aerobic digestion	Convert FLW into fertiliser
Incineration	Burn FLW straight up to obtain energy

Edible-avoidable FLW is identified as the FLW with the highest value, where the foremost recommended means of reduction begins with reduction at source and descends accordingly down the hierarchy.

This is followed by edible-unavoidable FLW, where the foremost recommended means of reduction begins with equipment/process design change and descends accordingly down the hierarchy.

Inedible-unavoidable FLW follows next, in which the foremost recommended means of reduction begins with animal feed and descends accordingly down the hierarchy.

Figure 7 shows the link between the classification of FLW and the FLW reduction hierarchy.

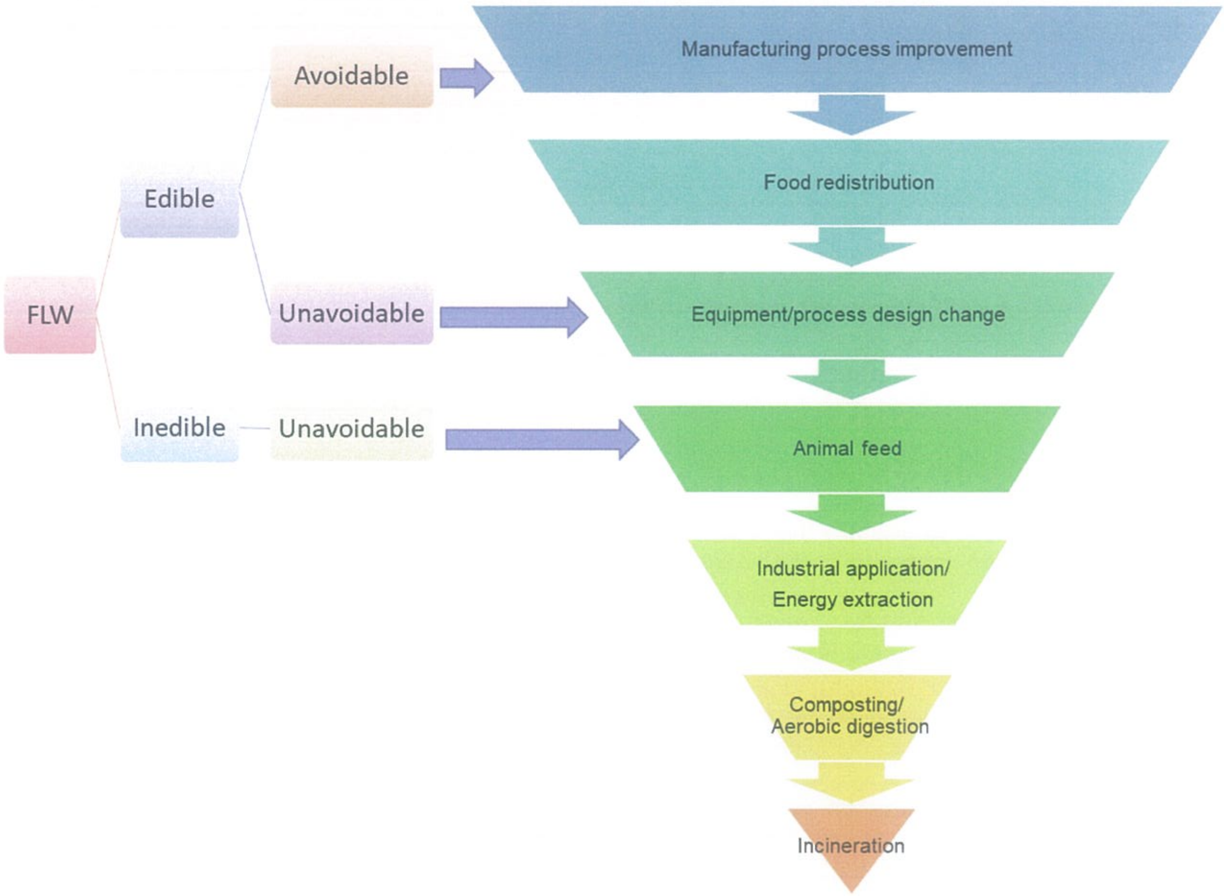


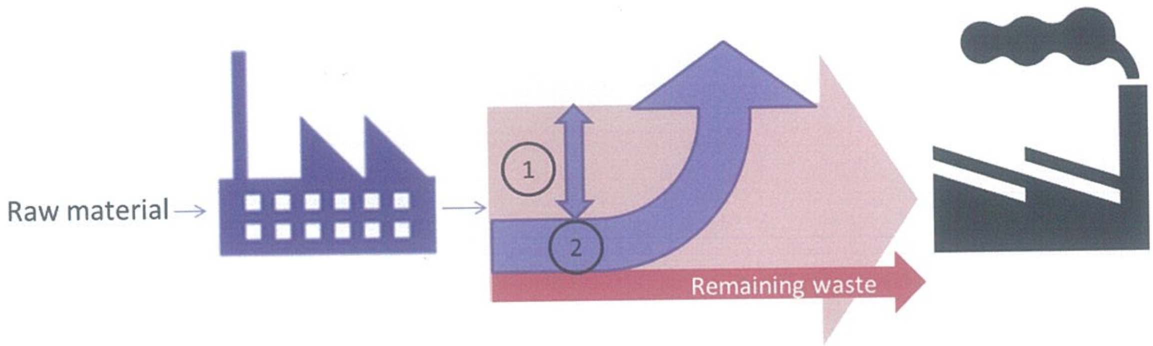
Figure 7 – FLW reduction guide

7 Quantification of FLW reduction efforts

7.1 General

The first aim is to reduce the absolute amount of FLW produced. This can be done through manufacturing process improvement or equipment/process design change.

The second aim is to divert FLW away from incineration. This can be done through the redistribution of edible FLW, recycling FLW into animal feed, putting FLW through industrial application/energy extraction and composting/aerobic digestion (see Figure 8). See Annex D for examples.



(1) Reduction of FLW is measured by looking at the absolute reduction of waste that was generated at source.

(2) Reduction of FLW is measured by looking at the diversion of FLW away from incineration.

Figure 8 – Concept diagram for quantification of FLW reduction efforts

7.2 FLW reduction at source

The purpose of (1) is to quantify the results of FLW reduction efforts taken in manufacturing process improvement and equipment/process design change.

Normalisation is mandatory to provide a comparable measurement of reduction efforts. When doing normalisation, the following measures shall be taken to ensure accuracy of results:

- Normalisation unit shall be consistent throughout the years (e.g. if kg/output unit is used, make sure it is used consistently every year).
- Choice of normalisation units is entirely up to the companies as long as they are able to accurately quantify the reduction of FLW (e.g. companies may choose to normalise according to total production output or raw material input).

Normalisation is done by taking the quantity of the waste generated from each process and dividing it by the unit the user has chosen to normalise with, i.e.

$$\text{Normalised waste output} = \frac{\text{waste output from a specific process for that specific year}}{\text{unit of normalisation}}$$

7.3 FLW diversion from incineration

The purpose of (2) is to quantify the results of efforts taken to divert generated FLW away from incineration according to the rank in the FLW reduction hierarchy. It is optional but highly encouraged as it provides a way for companies to track their diversion. A sample template for FLW diversion tracking is found in Table 2.

$$\text{Diversion factor} = \frac{\text{FLW diverted away from incineration}}{\text{FLW produced for the year}} \times 100\%$$

If there has been an increase in the diversion factor over the years, it indicates that there has been an improvement in terms of diversion of waste away from incineration and up the hierarchy.

Table 2 – Sample template for FLW diversion tracking

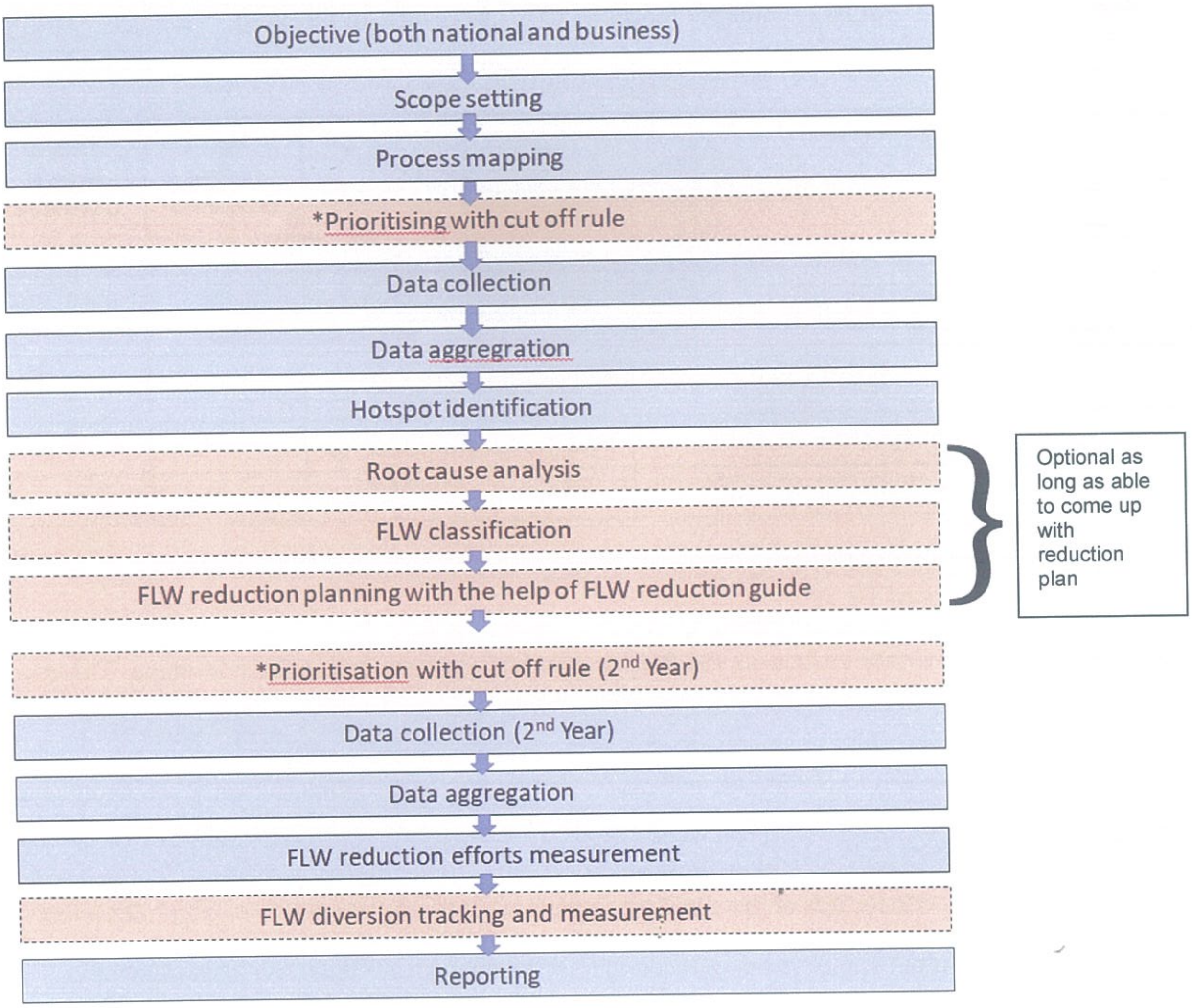
Total quantity in year [unit]						
S/N	Food value chain	Process	Brief description	FLW name	Year 1 (waste diverted)/ kg	Year 2 (waste diverted)/ kg
Total waste diverted/ kg						
Total waste produced/ kg						
Diversion factor (total waste diverted/total waste produced), %						

8 Reporting of FLW

The report shall minimally include all the filled in data sheets from data collection steps. The report should include:

- Clear explanation of any assumptions;
- Clear justification for any optional steps.

Figure 9 depicts a summary flowchart of the entire standard. Blue boxes are mandatory steps while orange boxes are optional steps of this FLW management standard.



*Prioritisation is only an option when users of the standard have no means to collect data for all types of FLW

Figure 9 – Summary flowchart for FLW management standard

Annex A
(informative)

Example of collection of FLW data

A.1 Information on Company A

Company A is a tofu manufacturer in Singapore and their products are packed tofu, tau kwa and soy milk. The company wishes to reduce their production waste and decided to adopt the Singapore Standard on food waste management for food processing/manufacturing establishments. The scope starts from material storage to distribution (see Figure A.1).

Figure A.1 – Food value chain of Company A

A.2 Process flow diagram for Company A

The process map of Company A is represented by Figure A.2.

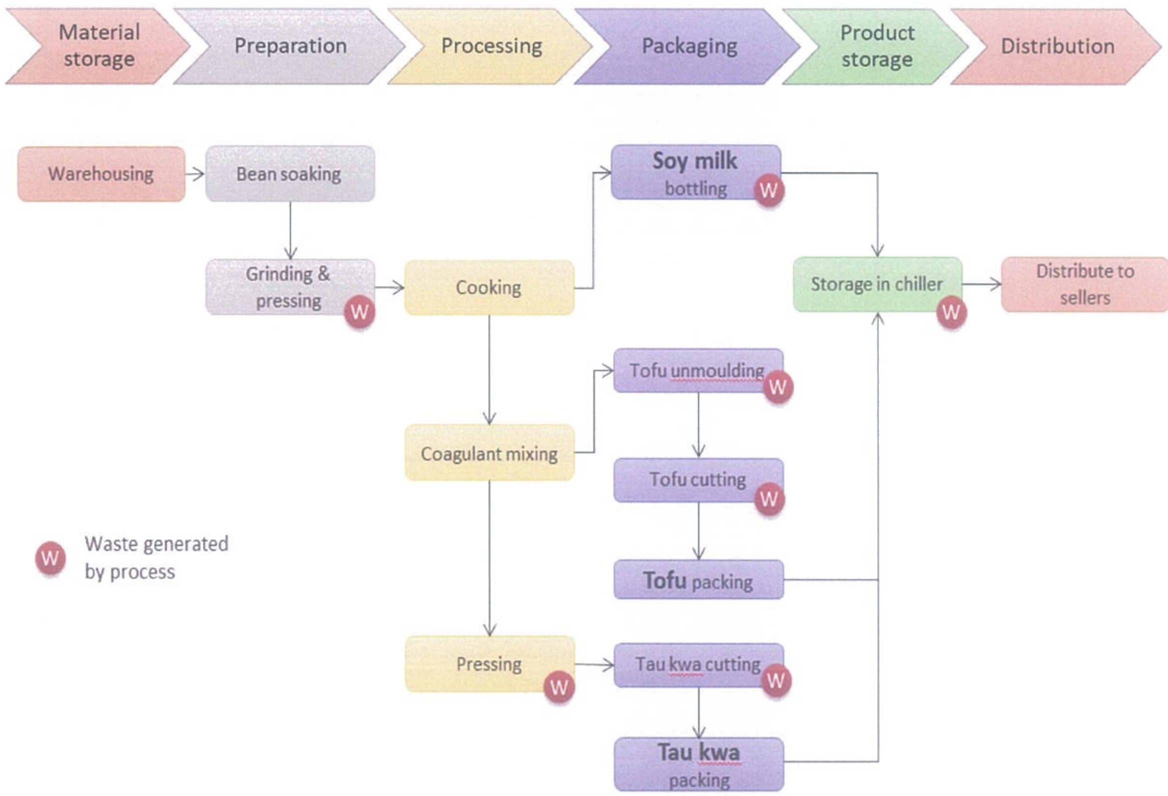


Figure A.2 – Process map of Company A

A.3 Example using 80/20 prioritisation

The example of prioritisation using 80/20 rule for Company A is represented by Figure A.3.

– Look into final waste bin before disposal time.

– Decide on the percentage, either by weighing or visual inspection.

– Focus on waste that makes 80% of total quantity.

Observation date	Total (kg/day)	Tofu scrap	Okara	Expired packaged soy products	Tau kwa scrap	Others
10 January 2016	50	20 (40%)	14 (28%)	8(16%)	4(8%)	4(8%)

Figure A.3 – Example of best practice of prioritisation using 80/20 rule

– From the results, prioritise on tofu scrap, expired packaged soy products and okara (total 84%).

A.4 Sample template for data collection

The example of data collection sheets for Company A are represented by Figure A.4.

# of days production line was active for the month: 20
Reporting month: January
Reporting year: 2017

Food chain	Process	Brief description	Name of FLW	Quantity for the day	Quantity for the month	Unit	Approximate density	Data collection method	Comment/ assumption made	Observer and date	Final destination
Preparation	Grinding & pressing	Soy milk production	Okara	14	280	kg	-	Calculate from mass balance	Okara = bean – soy milk		Incineration
Packaging	Tofu unmoulding	Tofu removed from mould	Tofu scrap	5	100	kg	-	Direct weighing	Extrapolated from per day		Incineration
	Tofu cutting	Cut away uneven tofu sides/edges	Tofu scrap	12	240	kg	-	Direct weighing	Extrapolated from per day		Incineration
	Tofu packing	Tofu packed to individual containers	Tofu scrap	4	80	kg	-	Direct weighing	Extrapolated from per day		Incineration
Product storage	Storage in chiller	Storage of packaged and ready-to-sell products	Expired packaged soy products	-	160	kg	-	Counting	Weight of tofu = value indicated on the packaging		Incineration

(a) Sheet 1 of Company A

Product name	Production volume	Unit	Production period	Comments/assumption made	Observer and date
Tofu	1000	kg	01/01/2017 - 31/01/2017	Extrapolated due to constant daily production	
Tau kwa	800	kg	01/01/2017 - 31/01/2017	Extrapolated due to constant daily production	
Soy milk	300	kg	01/01/2017 - 31/01/2017	Recorded daily	

(b) Sheet 2 of Company A

Figure A.4 – Example of data collection sheets of Company A

Annex B
(informative)

Example of hotspot analysis of FLW

B.1 Example of FLW quantification and hotspots identification

The quantification is as follows:

– Compile the completed data collection for every process and waste type (see table below).

– Create a chart based on this compilation. This shows the waste quantity.

The examples on data aggregation and data quantification for Company A are represented by Figures B.1 and B.2.

Compile all data

Year	Process	Tofu scrap (kg/year)	Okara (kg/year)
2016	…	…	…
2016	Grinding	-	3360
2016	Tofu cutting	2880	-
2016	Tofu packing	960	…
2016	…	…	…

Figure B.1 – Example of data aggregation of Company A

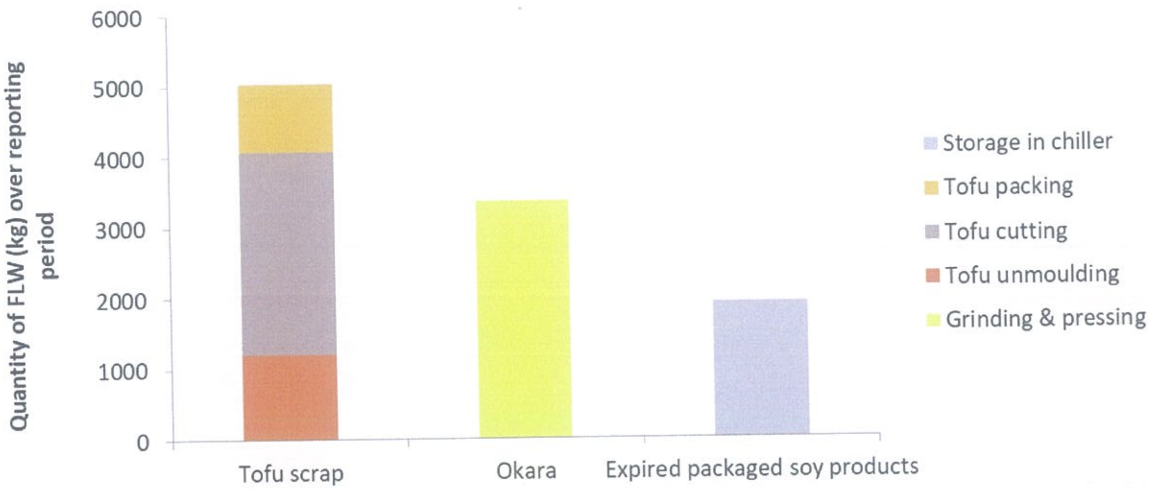


Figure B.2 – Example of data quantification of Company A

B.2 Example of hotspots identification for Company A

The example of hotspots identification for Company A is represented by Figures B.3. The example of hotspot identification using 80/20 rule for tofu scrap, okara and expired packaged soy products are represented by Figures B.4, B.5 and B.6.

Waste	Warehousing	Bean soaking	Grinding & pressing	Coagulant mix	Cooking	Soy milk bottling	Tofu unmoulding	Cutting	Tofu pack	Storage in chiller
Okara	0	0	3360	0	0	0	0	0	0	0
Tofu scrap	0	0	0	0	0	0	1200	2880	960	0
Expired packaged soy products	0	0	0	0	0	0	0	0	0	1920

Figure B.3 – Example of hotspots identification for Company A

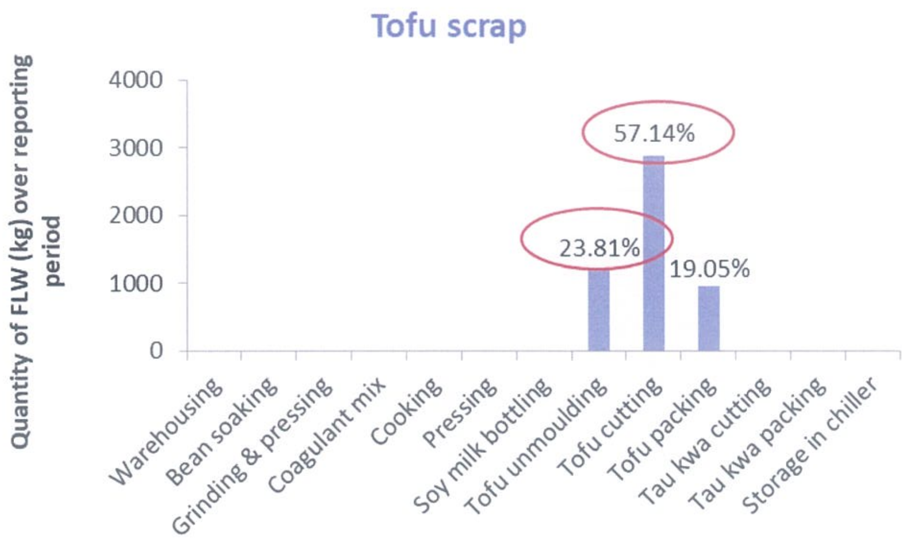


Figure B.4 – Example of hotspot identification using 80/20 rule for Company A (tofu scrap)

From Figure B.4, tofu scrap is mostly generated in unmoulding and cutting process (total 80.95%). Therefore, the aim is to reduce tofu scrap generated in unmoulding and cutting process.

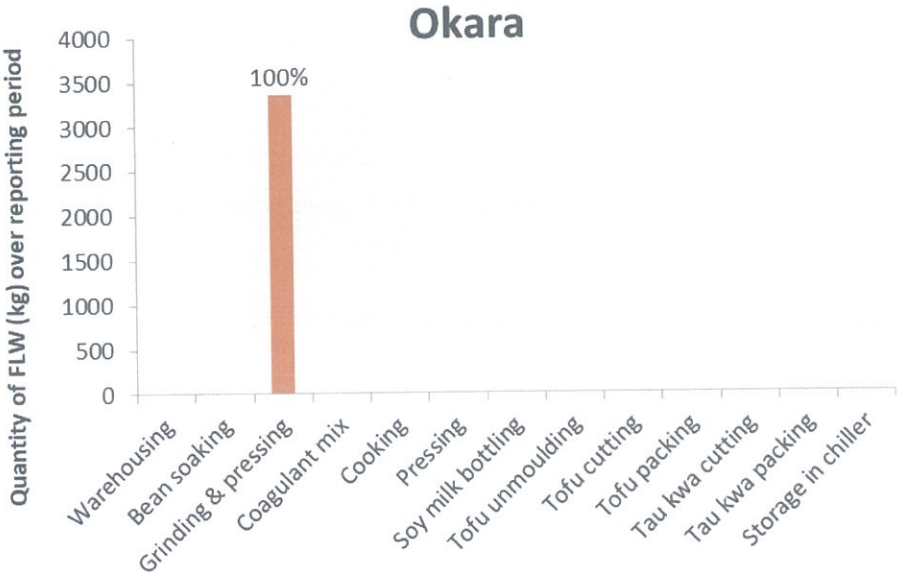


Figure B.5 – Example of hotspot identification using 80/20 rule for Company A (okara)

Okara is generated during the grinding and pressing process as shown in Figure B.5. Hence, Company A should focus its FLW reduction efforts on the identified process in order to reduce the amount of okara generated.

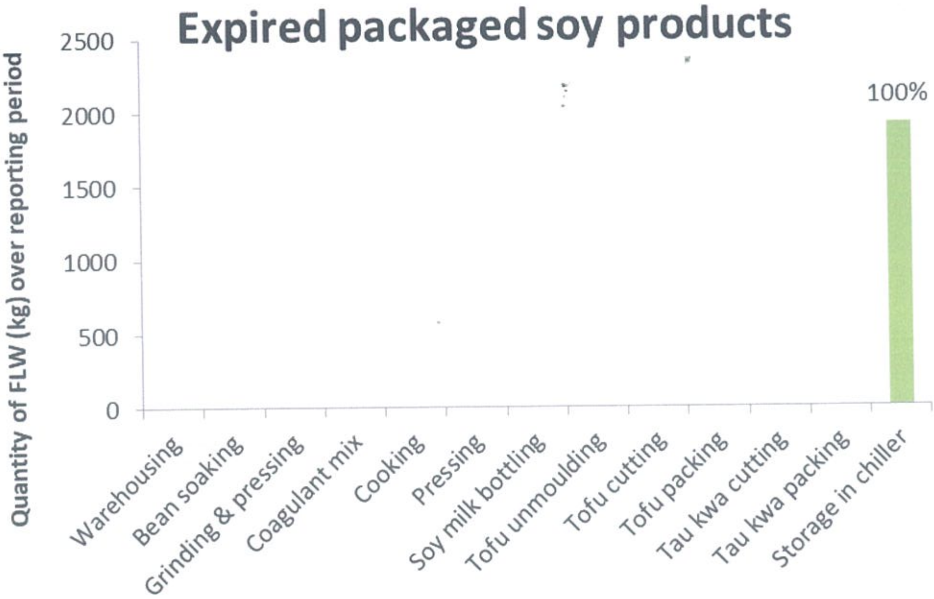


Figure B.6 – Example of hotspot identification using 80/20 rule for Company A (expired packaged soy products)

Similarly, for the case of expired packaged soy products, it is generated during the storage process. Company A should focus its FLW reduction efforts on the identified process as shown in Figure B.6.

Annex C
(informative)

Example of planning of FLW reduction

C.1 Fish bone diagram for Company A

The fish bone diagram example for Company A is represented by Figure C.1.

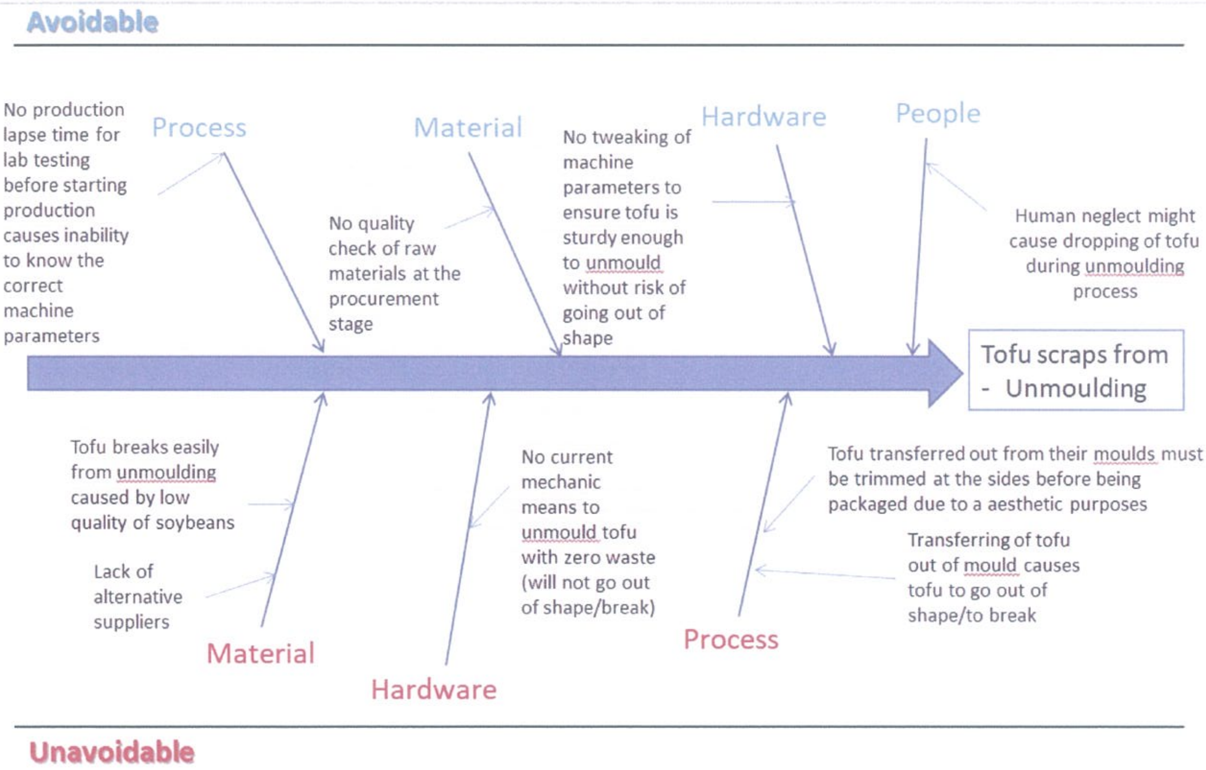


Figure C.1 – Example of fish bone diagram for Company A

- Continuing with the data collection sheet introduced in Clause 4, list down the initiatives done to reduce the FLW generated at each process.
- Not all reduction measures need to be filled. Aim for at least one measure per process, starting from the highest priority.

C.2 FLW reduction plan for Company A

The FLW reduction plan for Company A is seen in Figure C.2.

- Company A has decided to focus on tofu scraps generated from the unmoulding process.
- A brainstorming session was done with management and production staff to identify reduction measures based on the reduction hierarchy.

Waste	Processes	Categories of causes	Manufacturing process improvement	Food redistribution	Equipment/ process design change	Animal feed	Industrial application/ Energy extraction	Composting/ Aerobic digestion	Incineration
Tofu scraps	Unmoulding	A	Create a new training program		Invest in a machine that is able to automatically tweak the parameters according to the lab test results	Sell to local farm	Feed into evaporating dryer and process into filler materials /AD	Send to fertiliser manufacturer	
			Create an additional QC step in SOP during raw material procurement stage		Invest in R&D technologies to ensure faster lab test results				
	Unmoulding	U-E			Design a new mould	Sell to local farm	Feed into evaporating dryer and process into filler materials /AD	Send to fertiliser manufacturer	
					Automating the unmoulding process				

Figure C.2 – Example of FLW reduction plan for Company A

Annex D
(informative)

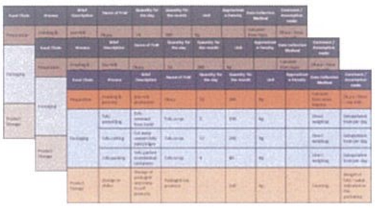
Example of quantification of FLW reduction efforts

D.1 Example of normalisation for Company A

The compilation of waste generation and product output data for Company A is seen in Figure D.1. The data extracted from aggregation of data collected every month for Company A is summarised in Figure D.2.

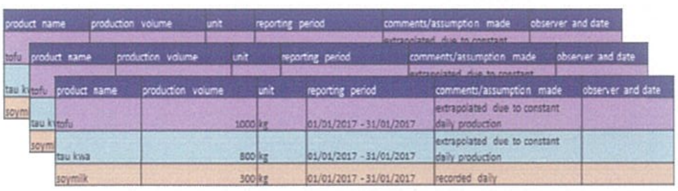
- Company A has chosen to normalise according to their total production output volume for the year.
- Normalisation is the division of the waste generated from a process for the year over the total production output.
- Normalised waste output = $\frac{\text{total waste output from a specific process for that specific year}}{\text{total production output for the year}}$

Waste generation data compiled previously:



Total quantity in year [kg]						
S/N	Food value chain	Process	Brief description	FLW name	2016	2017
1	Preparation	Grinding and pressing	Soy milk production	Okara	3360	3000
2a	Packaging	Unmoulding	Tofu removed from mould	Tofu scrap	600	400
2b	Packaging	Unmoulding	Tofu removed from mould	Tofu scrap	600	400
3	Packaging	Cutting	Cut away uneven tofu sides/edges	Tofu scrap	2880	2000
4	Packaging	Packing	Tofu packed to individual containers	Tofu scrap	960	500
5	Product storage	Storage in chiller	Storage of packaged and ready-to-sell products	Expired packaged soy products	1920	500
					10320	6800

Product output data compiled:



product name	production volume	unit	reporting period	comments/assumption made	observer and date
tofu	1000	kg	01/01/2017 - 31/01/2017	extrapolated due to constant daily production	
tau kwa	800	kg	01/01/2017 - 31/01/2017	extrapolated due to constant daily production	
soymilk	300	kg	01/01/2017 - 31/01/2017	recorded daily	

Year	Total production output	Unit
2016	23400	kg
2017	25200	kg

Figure D.1 – Waste generation and product output data compiled for Company A

Normalization: $\frac{3360}{23400} = 0.14$

Total quantity in year							
S/N	Food value chain	Process	Brief description	FLW Name	2016 (waste generation/ production output)	2017 (waste generation/ production output)	Increase/decrease in FLW generated at source
1	Preparation	Grinding & pressing	Soy milk production	Okara	0.14	0.12	-17%
2a	Packaging	Unmoulding	Tofu removed from mould	Tofu scrap	0.03	0.02	-38%
2b	Packaging	Unmoulding	Tofu removed from mould	Tofu scrap	0.03	0.02	-38%
3	Packaging	Cutting	Cut away uneven tofu sides/edges	Tofu scrap	0.12	0.08	-36%
4	Packaging	Packing	Tofu packed to individual containers	Tofu scrap	0.04	0.02	-52%
5	Product storage	Storage in chiller	Storage of packaged and ready-to-sell products	Expired packaged soy products	0.08	0.02	-76%
					0.44	0.27	-39%

Figure D.2 – Data extracted from aggregation of data collected every month for Company A

- Decrease in the absolute amount of waste produced for all types of FLW generated from 2016 to 2017.
- Reduction is highly apparent for expired packaged soy products and this is due to Company A creating a new inventory check SOP.
- Top most level of hierarchy fulfilled as seen in Figure D.3.

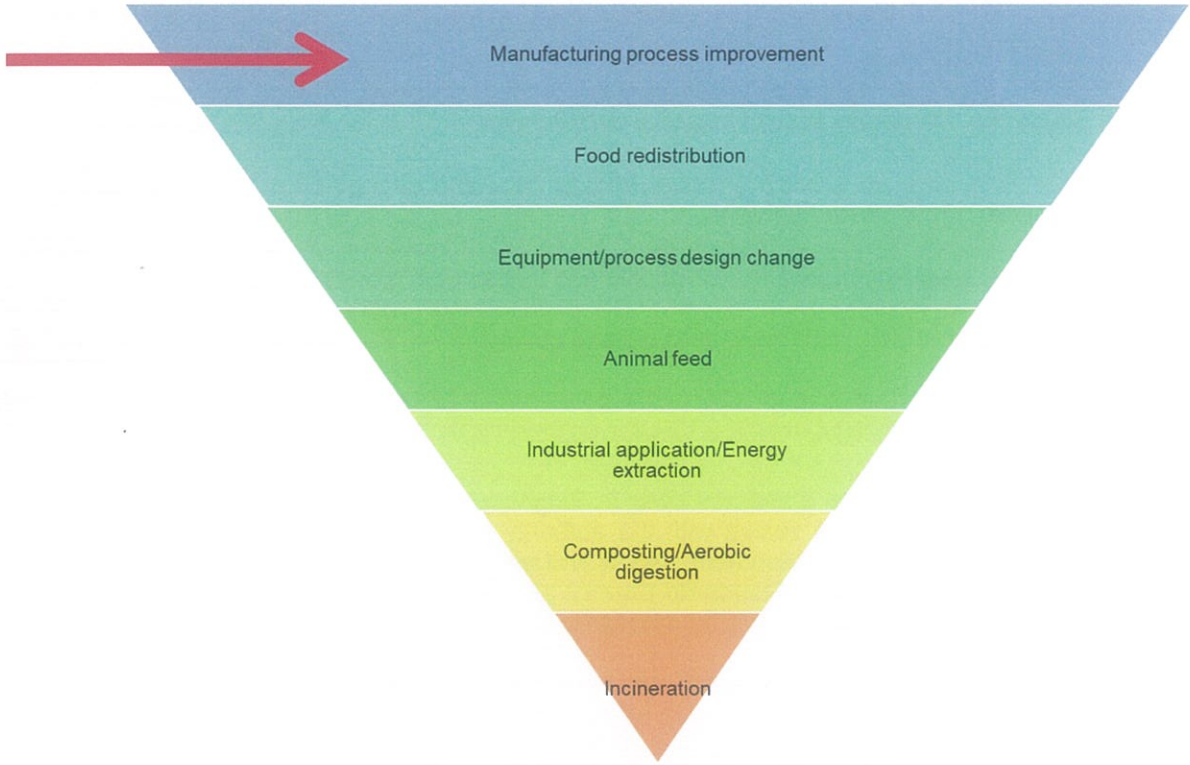


Figure D.3 – FLW reduction hierarchy

D.2 Example for FLW diversion from incineration

The FLW diversion tracking for Company A is represented in Figure D.4.

Total quantity in year						
S/N	Food value chain	Process	Brief description	FLW name	2016 (waste not incinerated)/kg	2017 (waste not incinerated)/kg
1	Preparation	Grinding & pressing	Soy milk production	Okara	150	170
2a	Packaging	Unmoulding	Tofu removed from mould	Tofu scrap	320	350
2b	Packaging	Unmoulding	Tofu removed from mould	Tofu scrap	290	300
3	Packaging	Cutting	Cut away uneven tofu sides/edges	Tofu scrap	50	60
4	Packaging	Packing	Tofu packed to individual containers	Tofu scrap	95	125
5	Product storage	Storage in chiller	Storage of packaged and ready-to-sell products	Expired packaged soy products	45	50
			Total waste not incinerated/ kg		950	1055
			Total waste produced/ kg		1200	1200
			Diversion factor (total waste not incinerated/ total waste produced) %		79%	88%

Improvement!

Figure D.4 – FLW diversion tracking for Company A

ABOUT ENTERPRISE SINGAPORE

Enterprise Singapore grows stronger enterprises by transforming industries, building new capabilities, and providing Singapore companies access to global opportunities.

We also establish Singapore as a leading global trading hub, and strengthen quality and trust in Singapore's enterprises, products and services.

Through this, we aim to create good jobs for our people and sustainable growth for our economy.

For more information, please visit: http://www.enterprisesg.gov.sg.

ABOUT THE SINGAPORE STANDARDISATION PROGRAMME

Enterprise Singapore is the national standards body in Singapore and we administer the Singapore Standardisation Programme. We are vested with the authority to appoint an industry-led Singapore Standards Council to approve the establishment, review and withdrawal of Singapore Standards (SSs) and Technical References (TRs). The Standards Council also advises Enterprise Singapore on the policies, strategies, initiatives and procedures for standards development and promotion.

Enterprise Singapore and the Standards Council collaborate with key stakeholders from industry and government agencies to identify and develop new standards as well as review existing standards to enhance the competitiveness of enterprises and support social, safety, health and environment initiatives in Singapore.

SSs and TRs are in the form of specifications for materials, products, services and systems, codes of practice, requirements for interoperability, methods of test, management systems, guidelines, nomenclatures, etc.

TRs are pre-SSs developed to address urgent industry demand and are issued for industry trials for a period of time. Comments received during this trial period are considered when a TR is reviewed. TRs can become SS after the trial period, continue as TRs for further industry trials or be withdrawn.

To ensure adequate viewpoints are considered in the development and review of SSs and TRs, committees and working groups set up by the Standards Council consist of representatives from various key stakeholders which include industry associations, professional bodies, academia, government agencies and companies. SSs are also put up for public comment before publication.

In the international and regional fora, Enterprise Singapore represents Singapore in the International Organization for Standardization (ISO), the Asia-Pacific Economic Co-operation (APEC) Sub-committee for Standards and Conformance (SCSC), the Pacific Area Standards Congress (PASC) and in the ASEAN Consultative Committee on Standards and Quality (ACCSQ). The Singapore National Committee of the International Electrotechnical Commission (IEC), which is supported by Enterprise Singapore, represents Singapore in the IEC.