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# Circular Value Chains of Electrical and Electronic Equipment in ASEAN

**Edited by**

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# Executive Summary

This study is a response to a request from the Association of Southeast Asian Nations (ASEAN) and Japan for the ASEAN–Japan Circular Economy Initiative. The focus is on addressing urgent issues related to electrical and electronic equipment (EEE) waste, which is one of the fastest-growing waste streams, and presenting policy recommendations for future collaboration on this matter between ASEAN Member States (AMS) and Japan. The study highlights the importance of establishing circular value chains for EEE in ASEAN to maximise resource efficiency and to minimise negative environmental impact.

EEE refers to equipment that is dependent on electric currents or electromagnetic fields to work properly as well as equipment for generation, transfer, and measurement. EEE contains valuable precious metals and raw materials such as gold, silver, palladium, and copper, with a value of approximately $57 billion in 2019. However, despite its value, e-waste is not effectively managed.

The United Nations Institute for Training and Research (UNITAR) predicted that e-waste generation will increase from 53.6 million tonnes in 2019 to 74.7 million tonnes in 2030, with 47.0% generated in Asia. However, only 11.7% is collected and properly recycled. ASEAN faces challenges in treating uncontrolled used EEE and e-waste generated locally as well as those imported from East Asia due to regulatory and sector-specific obstacles.

In ASEAN, the informal sector – such as waste pickers and recyclers who have no licenses to treat waste – plays a significant role in waste management. Since EEE includes hazardous materials, the improper treatment of used EEE causes environmental pollution and health damage. In many cases, environmental considerations are lacking in ASEAN, even in small recycling companies. Moreover, the informal sector does not usually have the technologies and knowledge for environmentally sound treatment due to a lack of opportunity.

Japan has extensive experience in environmentally sound e-waste management infrastructure and treatment capacity. This experience can be a valuable reference for ASEAN in establishing circular value chains of EEE.

The global momentum towards a circular economy is driven by concerns over resource and energy constraints, climate change, and waste issues. A circular economy promotes the efficient and cyclical use of resources while maximising added value and is linked to the idea of creating sustainable systems. Investment in environmental goods and services supports circular economy businesses throughout the value chain, including sourcing and production stages. Given the growing urgency for achieving carbon neutrality and uncertain supply of natural resources and energy, there is a need to accelerate circular economy initiatives through resource, environmental, and industrial policies.

ASEAN and Japan are both pursuing circular economy policies, with ASEAN adopting the *Framework for Circular Economy for the ASEAN Economic Community* in 2021 and publishing the *ASEAN Sustainable Consumption and Production Framework* in 2022. Japan, likewise, has a comprehensive policy package for a growth-oriented, resource-autonomous economic strategy. The ASEAN–Japan Circular Economy Initiative is also expected to enhance mutually beneficial economic relations.

In the transition towards a circular economy, international trade and trade facilitation for second-hand goods play crucial roles in closing the loop on cross-border activities. The use of raw materials in a cascading manner and incorporation of secondary resources in the production process are integral to achieving a circular economy, prolonging product life, and enabling cleaner product cycles. However, existing regulatory regimes and arrangements focus on ensuring the safety of new EEE and do not adequately extend to second-hand, refurbished, or remanufactured equipment.

Three key recommendations are proposed. First, Japan should exchange specific experiences and capacity building in establishing and enforcing legal systems, focussing on the progress made by each AMS. For example, Viet Nam and Singapore have enacted laws for used EEE and e-waste management, including extended producer responsibility (EPR) and recycling fee systems. However, the enforcement of these laws appears to be inadequate. By exchanging experiences, Japan can share its expertise in establishing and enforcing laws, such as its Home Appliance Recycling Law. Workshops can also facilitate the exchange of experiences and promote cooperation in human resources development amongst government officials.

Second, business collaborations between AMS and Japan should be fostered. This collaboration can take various forms, such as technical cooperation, joint ventures, and international resource circulation involving the trade of used EEE, remanufactured goods, and scraps. Promoting business-matching opportunities and establishing joint ventures in AMS can encourage business collaborations. Creating conducive circumstances for the global trade of used EEE, reused goods, remanufactured goods, and scraps will further facilitate international resource circulation. Notable examples of successful business cases, such as Reuse Mobile Japan, Dowa Holdings, JX Metals, Mitsubishi Materials, Jaring Metal, FUJIFILM Business Innovation, Wongpanit, and EcoBatt-Energy Cambodia, demonstrate how collaboration could address specific challenges outlined in this study.

Lastly, closer alignment with international rules and standards and advancement of trade openness between AMS and Japan are recommended. To ensure the enforcement of e-waste trade regulations and smooth trade of used EEE, closer alignment with international rules and standards to distinguish between used EEE and e-waste is important. As for promoting remanufacturing, standardisation of the definitions of remanufactured EEE and origin of remanufactured goods and harmonised standards for quality and safety assurance for remanufactured goods amongst AMS and Japan would be helpful.

# Chapter 1

# Circular Value Chains of Electrical and Electronic Equipment in ASEAN

## 1. Introduction

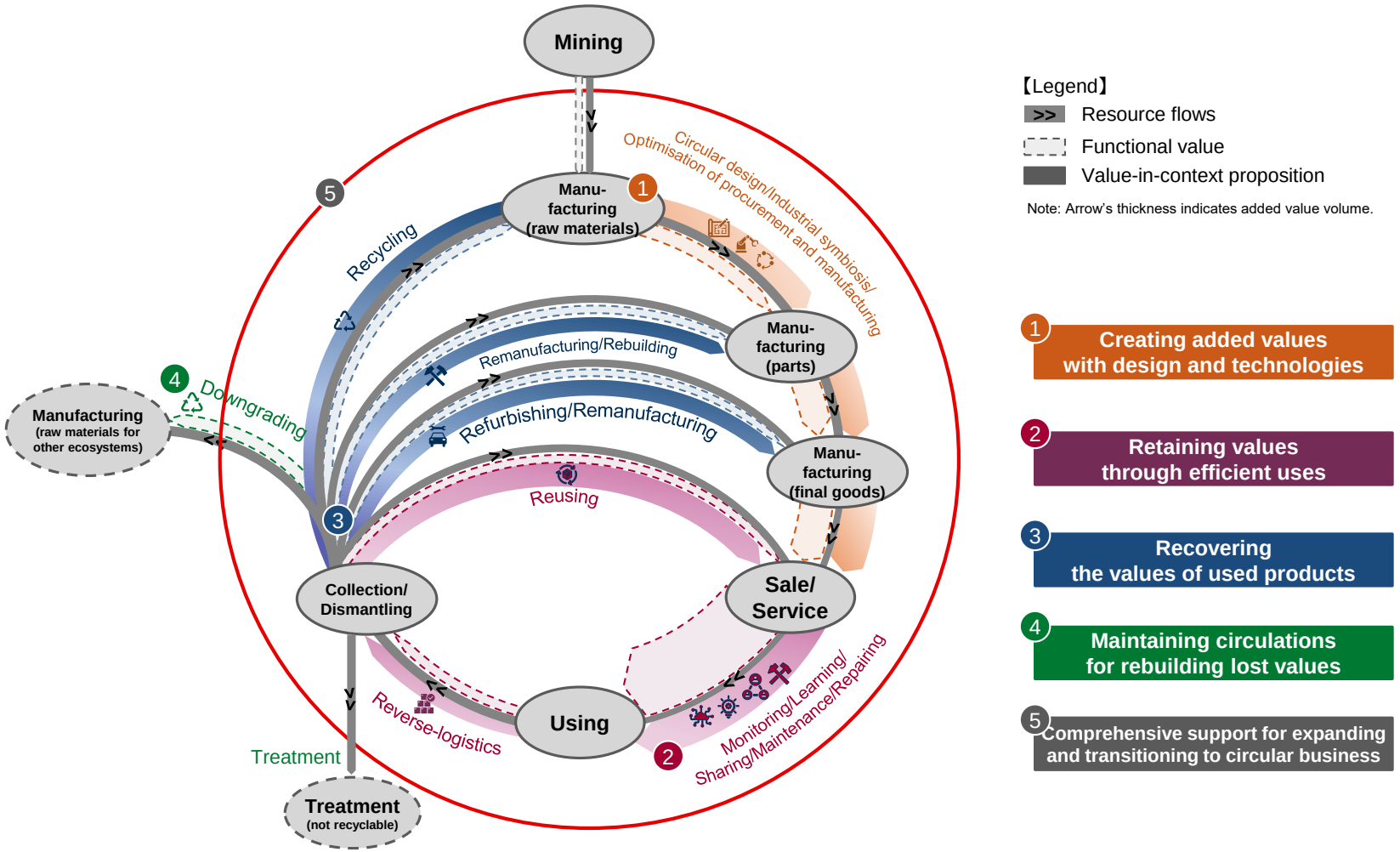
This study is a response to a request from the Association of Southeast Asian Nations (ASEAN) and Japan for the ASEAN–Japan Circular Economy Initiative. The focus is on addressing urgent issues related to electrical and electronic equipment (EEE) waste, which is one of the fastest-growing waste streams, and presenting policy recommendations for future collaboration on this matter between ASEAN Member States (AMS) and Japan.

This chapter provides overall information on the circular value chains of electrical and electronic equipment (EEE) in AMS and Japan. It investigates the current situation of EEE circular value chains in AMS through a literature review, analyses gaps in the value chains between AMS and Japan, and identifies challenges for AMS in improving their circular value chains for EEE.

In a circular economy, organisations maintain a circular flow of resources and recover, retain, and add value to these resources (Murakami, 2022). For that, it is necessary to recover, retain, and add to as much value per resource as possible; thus, it is important to consider not only functional value that consumers perceive by utilising the function of products but also the environmental value – a kind of value in context[1] – which consumers perceive by feel. For example, environmental value is observed when a consumer who wants to contribute to the circular economy uses a product made from recycled materials. Value in exchange must thus be considered, which comes from the concept of traditional economics, including functional value as well as value in context. Five categories for circular value chain activities are illustrated below, depending on the difference of value (Figure 1.1).

[1] Value in context is value that is perceived by consumers, depending on the dynamic context of producers and consumers.

**Figure 1.1. Circular Value Chains – A Model**




Note: The sizes of arrows of value in context and functional value show the relative amount of value as a reference. For example, the value of washing machines – which denotes the willingness to pay for washing machines – is higher than that for motors. Consumers see more environmental value of reused products than recycled products because the loss of resources in reuse activities is less than that of recycling activities.
Source: Circular Economy Association, https://www.ce-association.org/en/resource/column/.

The first category of circular value chain activities – starting from the upstream –focusses on adding value through design and technology. It encompasses various manufacturing processes, such as raw materials, parts, and final goods production as well as sales and services activities. Businesses that produce refrigerators made from recycled materials is an example. The function to cool foods is added to refrigerators as value, and an environmental value is also proposed to consumers who want to contribute to achieving a sustainable society by utilising recycled materials.

The second category of circular value chain activities aims to retain value through efficient utilisation of products. This begins with sales and services activities, extends to consumers, and then returns the retained value of the products back to sales and services activities. Businesses that reuse and resell used refrigerators made from recycled materials is an example. In this case, the function of refrigerators – cooling foods – is repeatedly used by more than one consumer. An environmental value is also proposed to more than one consumer who wishes to contribute to achieving a sustainable society by reusing materials for their intended purpose.

The third category focusses on recovering the value of used products. It involves maximising the value of products through refurbishing, remanufacturing, and recycling. Businesses for the horizontal recycling of e-waste – in which e-waste is recycled into the same category products as originally intended for use – are examples. Metal scraps, such as copper, are collected from the e-waste and put into the manufacturing process of the same category of products, so the function as metal is recovered. This leads to a perceived environmental value to a consumer who wants to contribute to a sustainable society by utilising recycled materials without disposing of the materials.

The fourth category emphasises maintaining circulation to rebuild lost values, also referred to as 'cascade recycling' that minimises the loss of recycled materials. Businesses for cascade recycling recycle e-waste into lower-value products before it is discarded. As an example, plastics are collected from e-waste and are put into the manufacturing process of building materials; the function as plastics is not lost. However, cascade recycling is not necessarily recommended in a circular economy, as the proposed environmental value to a consumer is not high.

The fifth category of circular value chain activities provides comprehensive support for the expansion and transition to circular businesses. The activities of this category promote the above four categories of circular value chain activities and are conducted by businesses and other organisations. For example, industrial organisations can develop quality standards for recycled materials, information platform businesses can construct databases of information on the quality of various parts for reuse, and governments can establish legal systems to ensure the collection of used EEE and e-waste.

Promoting and strengthening circular value chain activities in the five categories above are crucial for developing circular value chains for EEE in ASEAN. This research specifically focusses on the activities from the collection of used EEE and e-waste to the input of raw materials to manufacturers, as the difference in these processes between AMS and other countries is significant. In this chapter, Japan is considered a model case for circular value chains of EEE. The circular value chain activities emphasised in this research include collection, dismantling and classification, reuse, repair, refurbishment, remanufacturing, recycling and downgrading (i.e. cascade recycling), and treatment (i.e. disposal and energy recovery).

For the purposes of this report:

(i) **Reuse.** According to the Basel Convention, reuse refers to the using again of a product, object, or

substance that is not waste, for the same purpose for which it was conceived, without the necessity of repair or refurbishment.[2]

(ii) **Repair.** This refers to the fixing of a specified fault in an object or replacement of defective components to make the waste or product a fully functional product to be used for its originally intended purpose.[3]

(iii) **Refurbishment**. Refurbishment refers to the modification of an object to increase or to restore performance and/or functionality or to meet applicable technical standards or regulatory requirements with the result of making a fully functional product to be used for a purpose that was originally intended.[4]

(iv) **Remanufacturing.** This refers to a standardised industrial process that takes place within industrial or factory settings in which a core product or module – that has been sold, worn, or is no longer functional – is restored to same-as-new or better condition and performance.[5]

(v) **Recycling.** Recycling refers to relevant operations that prevent waste disposal and allows material to re-enter the loop.[6] In this research, allowing material to re-enter the other ecosystem loop – known as downgrading – is also included in recycling.

The choice of Japan as a model is based on its status as an exemplary case in establishing and enforcing legal systems, such as the Act on Recycling of Specified Kinds of Home Appliances and Act on Promotion of Recycling of Small Waste Electrical and Electronic Equipment.

In this research, the following definitions are used:

(i) **EEE.** This refers to equipment that is dependent on electric currents or electromagnetic fields to work properly as well as equipment for its generation, transfer, and measurement. Televisions, refrigerators, washing machines, air conditioners, personal computers, mobile phones, and multifunction printers are the focus, because their circular value chains are well-established in Japan.

(ii) **E-waste.** EEE becomes e-waste once it has been discarded by its owner as waste without the intent of reuse (STeP Initiative, 2014).

(iii) **Used EEE.** This refers to used equipment for the purpose of reuse.

(iv) **Second-hand goods.** These are goods that are reused, repaired, or refurbished.

(v) **Second-hand shops.** These are shops that sell second-hand goods.

EEE contains copper, aluminium, and other precious metals, but it also includes hazardous materials. For example, printed circuit board contains lead; refrigerators and air conditioners contain fluorocarbons; and televisions contain brominated flame retardants (Hosoda, 2003). Improper treatment of lead causes health damage due to direct exposure or indirect exposure through water or soil pollution. Improper treatment of fluorocarbons causes destruction of the ozone layer. Heating plastics containing brominated flame retardants emits dioxin. Therefore, establishing proper EEE

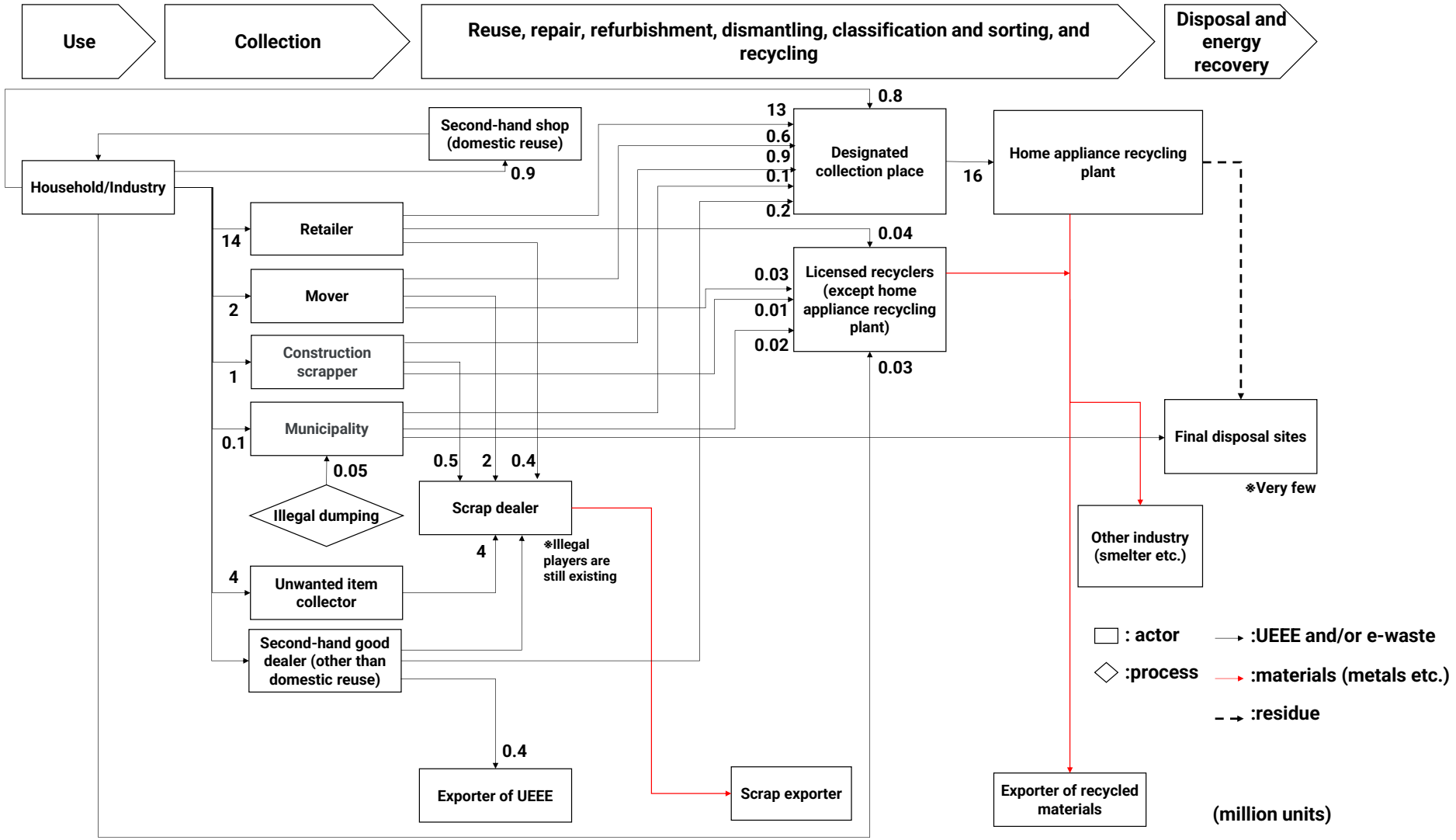
[2] UNEP, Reuse, *UNEP Circularity Platform*, https://buildingcircularity.org/reuse/
[3] UNEP, Repair, *UNEP Circularity Platform*, https://buildingcircularity.org/repair/
[4] UNEP, Refurbish, *UNEP Circularity Platform*, https://buildingcircularity.org/refurbish/
[5] UNEP, Remanufacture, *UNEP Circularity Platform*, https://buildingcircularity.org/remanufacture/
[6] UNEP, Recycle, *UNEP Circularity Platform*, https://buildingcircularicty.org/recycle/

circular value chains is an important health and environmental issue as well.

## 2. Japan's EEE Value Chain

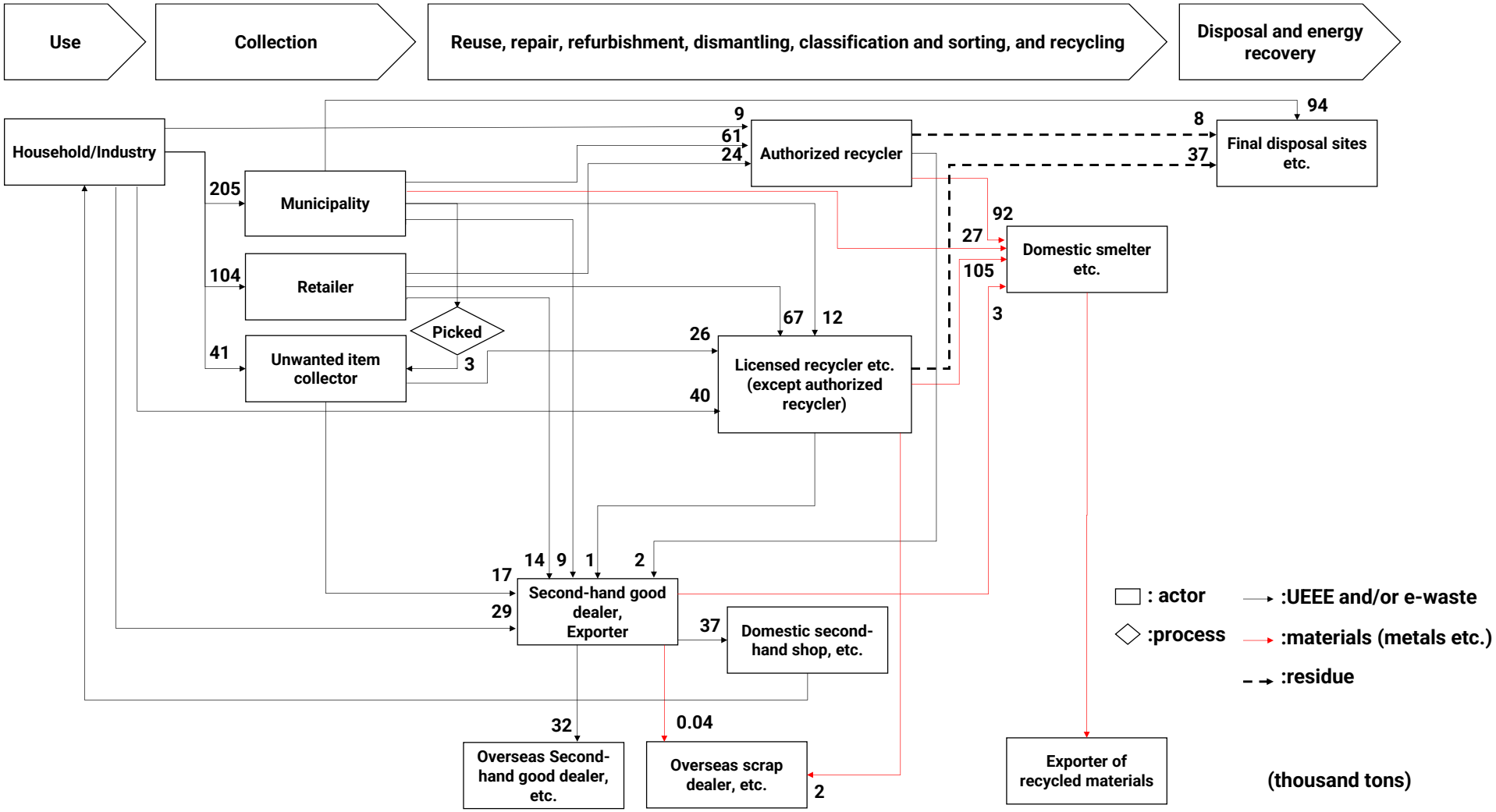
In Japan, the structure of the circular value chain varies, depending on the product category of EEE. Devices such as televisions, refrigerators, washing machines, and air conditioners – which fall under the Home Appliance Recycling Act – are collected and treated according to that law (Figure 1.2). Smaller appliances, including computers and mobile phones, are collected and recycled under the Small Waste Electrical and Electronic Equipment Recycling Act (Figure 1.3). As a unique case, multifunction printers are collected, remanufactured, and recycled based on the voluntary contribution of companies, which conduct these efforts as a part of their business operations (Figure 1.4).

**Figure 1.2. Circular Value Chain of Televisions, Refrigerators, Washing Machines, and Air Conditioners in Japan, 2020**



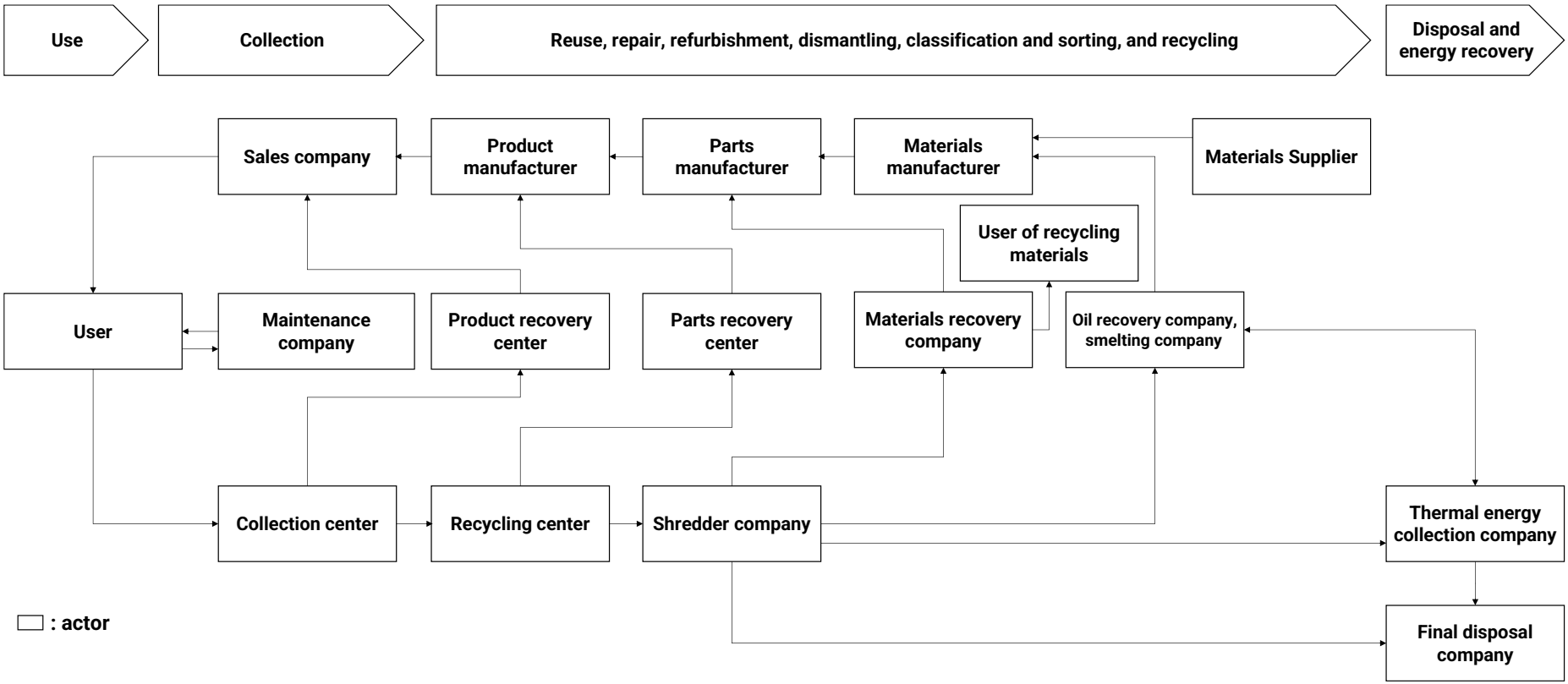

UEEE = used electrical and electronic equipment.
Source: METI (2023).

**Figure 1.3. Circular Value Chain of Small Home Appliances in Japan, 2020**




UEEE = used electrical and electronic equipment.
Source: METI (2023).

**Figure 1.4. Circular Value Chain of Multifunction Printers in Japan**




Note: The example above is for the company Ricoh, which has the functions of a sales company, maintenance company, collection centre, product manufacturer, product recovery centre, recycling centre, and parts recovery centre.
Source: RICOH, Comet Circle [in Japanese], https://jp.ricoh.com/sustainability/environment/management/policy/comet

In Japan, the EEE circular value chain from collection to final disposal is relatively well established. EEE and e-waste are collected appropriately in accordance with the related laws. Its reuse is also well managed thanks to the activities of industrial associations. Most collected e-waste is delivered to licensed recyclers, who dismantle, classify, and sort e-waste and deliver metal scraps to domestic smelters. Domestic smelters recycle steel, copper, aluminium, and various precious metals. This capacity to treat copper and precious metals, however, can be improved.

## 2.1. Collection

### 2.1.1. Four Home Appliances

During the collection process, four home appliances – televisions, refrigerators, washing machines/dryers, and air conditioners – are collected from households by various entities, such as manufacturers, retailers, movers, construction scrappers, unwanted item collectors, second-hand shops, second-hand good dealers, municipalities, and scrappers.[7] They are eventually delivered to home appliance recycling plants, which are managed by manufacturers or licensed recyclers (METI, 2023).

As manufacturers are obligated to recycle these used home appliances under the Home Appliance Recycling Act, designated collection places have been set up to ensure recycling. In 2020, about 55% of these used home appliances were collected by retailers, and they delivered about 97% of them to the designated collection places (METI, 2023).

Additionally, movers – who have licenses to treat waste based on the Act on Waste Management and Public Cleansing – are permitted to collect the four used home appliances when individuals are moving residences.[8] When the appliances are left in buildings to be demolished, construction scrappers collect them also in compliance with the Act on Waste Management and Public Cleansing. In 2020, about 9% of the four used home appliances were collected by movers and about 6% were collected by construction scrappers, who then delivered them to designated collection places, licensed recyclers, or scrappers (METI, 2023).

Unwanted item collectors collect used EEE and e-waste from users other than manufacturers, retailers, movers, construction scrappers, scrappers, municipalities, second-hand shops, and second-hand good dealers, on trucks or at collection points prepared by the unwanted item collectors. Some unwanted item collectors may be illegal because they do not have licenses to treat waste based on the Act on Waste Management and Public Cleansing (METI, 2023). In 2020, about 16% of the four used home appliances were collected by unwanted item collectors and delivered to scrappers or exporters of second-hand goods.

Some of the four used home appliances are delivered from users to domestic second-hand shops and collected by second-hand good dealers who export the used EEE to other countries. In 2020, about 4% of used appliances were collected by domestic second-hand shops, and less than 2% of the appliances were collected by second-hand good dealers.

Municipalities collect the four used home appliances that retailers are not obligated to collect under

[7] Before the Home Appliance Recycling Act in 2001, there was a trade-in custom regarding these home appliances (METI, 2022a).

[8] Government of Japan METI, Appropriate Treatment of the Used Four Home Appliances by Movers [in Japanese], https://www.meti.go.jp/policy/it_policy/kaden_recycle/shiryousyu/KadenRecycleInfoSession_Doc3.pdf

the Home Appliance Recycling Act. For example, when users cannot identify where they bought a used appliance, they can ask the municipality to collect it. Municipalities also collect dumped appliances (METI, 2023). Municipalities deliver the collected appliances to designated collection places, licensed waste disposers, or disposal sites (METI, 2023). In 2020, less than 1% of the four used home appliances were collected by municipalities (METI, 2023).

Some e-waste is collected by scrappers via various entities such as retailers, movers, construction scrappers, unwanted item collectors, and second-hand good dealers. Scrappers are actors who treat e-waste as scraps.[9] Some scrappers shred the e-waste, some collect metal scraps and sell them, and others store the e-waste in their yards. Scrappers deliver e-waste or metal scraps to domestic or foreign companies. In 2020, about 26% of the used four home appliances were collected by scrappers via other actors such as retailers, movers, construction scrappers, unwanted item collectors, and second-hand good dealers (METI, 2023).

### 2.1.2. Small Home Appliances

Used small home appliances covered by the Recycling of Small Waste Electrical and Electronic Equipment Act are collected by various entities such as municipalities, retailers, unwanted item collectors, second-hand good dealers, exporters, scrappers, and authorised recyclers (METI, 2023). The collected volume of used small home appliances by municipalities and authorised recyclers has increased, from 21,000 tonnes in 2012 to 100,000 tonnes in 2020 (METI, 2022b).

Municipalities are obligated to collect used small home appliances separately, and almost all municipalities try to do that.[10] They collect the appliances at public facilities and retail shops with specific boxes, at various public events, or with other municipal waste. In 2020, about 43% of used small home appliances were collected by municipalities (METI, 2023).

Retailers are obligated to ensure the appropriate collection of used small home appliances as well. Some retailers receive used appliances at their shops or when they deliver their new products. In 2020, about 21% of used small home appliances were collected by retailers (METI, 2023).

Unwanted item collectors collect small home appliances from users on trucks or at collection points organised by the unwanted item collectors. There are also a few cases in which they picked the used appliances from municipality collection points. In 2020, about 9% of used small home appliances were collected by unwanted item collectors (METI, 2023). Some unwanted item collectors are doing so illegally because they have no licenses to treat waste based on the Act on Waste Management and Public Cleansing (METI, 2023).

Some used small home appliances are also delivered to second-hand goods dealers and exporters through municipalities, retailers, unwanted item collectors, authorised recyclers, or other licensed recyclers. In 2020, about 15% of the used appliances were collected by second-hand good dealers and exporters. Second-hand good dealers and exporters deliver the collected appliances to second-hand shops in Japan or other countries. Few collected small appliances are delivered as scrap for recycling to scrappers in other countries.

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[9] Government of Japan, METI, Flow of Used Home Appliances [in Japanese], https://www.env.go.jp/council/former2013/03haiki/y0311-20/mat08.pdf

[10] SWEEE, Collection Method [in Japanese], Collection Methods, https://www.sweee.jp/recovery.html

Authorised recyclers are licensed by the Ministry of Economy, Trade and Industry (METI) and Ministry of the Environment (MOE). Authorised recyclers meet the standards of environmentally sound treatment and capacity for valuable resource recovery. Some set up collection places, and some collect used appliances at users' houses. In 2020, less than 2% of used appliances were collected by authorised recyclers directly.

#### 2.1.3. Multifunction Printers

Manufacturers generally collect used printers from users.

### 2.2. Reuse and Repair

While the ratios of reuse for the four home appliances and small appliances are not particularly high, industry associations – such as the Japan Reuse Affairs Association, Japan Reuse Organization, and Japan Containers and Packaging Recycling Association – have developed systems to promote appropriate reuse (METI, 2023).

Appropriate second-hand shops comply with regulations and ensure quality management. Such shops do not deliver the used EEE to illegal recycling places; they confirm the quality of a reused good before selling it and guarantee the quality during a certain period. The Japan Reuse Affairs Association and Japan Containers and Packaging Recycling Association have certified second-hand shops that comply with regulations and ensure quality management, while the Japan Reuse Organization has established a digital manifest system for tracking information on suppliers and buyers of reused products, covering the four home appliances (MOE, 2016). The system prevents a second-hand shop from buying and selling illegally obtained, used EEE – such as a stolen good – as well as delivering used EEE to illegal recycling places. These activities enable consumers to buy good-quality second-hand goods, which leads to promotion of reuse businesses.

### 2.3. Dismantling, Classification, Sorting, and Material Recycling

E-waste and used EEE are dismantled, classified, sorted, and recycled by licensed recyclers, which aim to achieve environmentally sound treatment and recovery of many valuable resources. Although there may be instances of illegal treatment of e-waste for the four home appliances and small appliances, those volumes are relatively small (METI, 2023).

For multifunction printers, non-reusable parts are crushed, sorted, and recycled into new multifunction printers.[11]

As for the four home appliances covered by the Home Appliance Recycling Act, most are recycled by the home appliance recycling plants managed by the manufacturers or licensed recyclers. The plants dismantle, classify, and sort e-waste and recover metal scraps (i.e. copper, aluminium, and steel) and plastics as recyclable resources (METI, 2022a). About 92% of air conditioners, 72% of cathode-ray tube (CRT) televisions, 85% of liquid crystal display (LCD) televisions and plasma televisions, and 92% of refrigerators collected at designated collection places were recycled in 2022 (METI, 2022b). In 2022, about 100,000 tonnes of metal scraps were recycled (METI, 2022b). Residues are utilised for energy recovery or disposed of properly (METI, 2023). In addition, licensed recyclers treat fluorocarbons as required in the Home Appliance Recycling Act (METI, 2022b).

[11] RICOH, Collection, Reuse and Recycling of Used Products [in Japanese], https://jp.ricoh.com/sustainability/environment/product/recycle/collect

During the process of recycling the small home appliances covered by the Recycling of Small Waste Electrical and Electronic Equipment Act, authorised recyclers dismantle, classify, and sort e-waste; deliver metal scraps such as steel, aluminium, copper, brass, silver, gold, and palladium as recyclable materials to domestic smelters; and recover plastics for recycling or energy recovery (METI, 2022b). Reusable EEE is delivered as reused goods to second-hand good dealers. About 90% of e-waste collected by authorised recyclers is reused, recycled, or utilised as fuel. In 2021, authorised recyclers treated about 100,000 tonnes of used small home appliances, and about 52,000 tonnes of metal scraps were delivered to domestic smelters and recycled. Authorised recyclers also manage hazardous parts such as batteries, fluorescent lamps, and fluorocarbons properly as well.[12]

However, the recycling rate of municipalities is lower than that of authorised recyclers. In 2018, the municipalities treated about 150,000 tonnes of used small home appliances, and about 37,000 tonnes of metal scraps were delivered to domestic smelters and recycled.

### 2.4. Remanufacturing and Refurbishment

Used multifunction printers from business sectors are remanufactured in Japan. Manufacturers collect used printers, dismantle them, and separate reusable parts for the remanufacturing processes. To promote remanufacturing, the manufacturers of multifunction printers have developed their own take-back system, unique technology for remanufacturing, standards for distinguishing parts that can be used for remanufacturing, and standards for quality and safety assurance. Some used multifunction printers are refurbished according to in-house quality standards and sold as refurbished products.[13]

### 2.5. Disposal and Energy Recovery

The collection rates of the four home appliances and collection volume of small home appliances have increased since enforcement of the associated acts. Home appliance recycling plants and authorised recyclers have achieved high recycling rates of used EEE and use of residues as fuel. However, about 30% of used small appliances still ended up in landfills with municipal waste in 2020 (METI, 2023). During such a process of disposal, e-waste is landfilled directly, landfilled after incineration, landfilled after crashing, or landfilled after melting (METI, 2023).

For multifunction printers, non-recyclable residue is utilised as fuel or disposed in final disposal sites.[14]

## 3. ASEAN Electrical and Electronic Equipment Value Chain

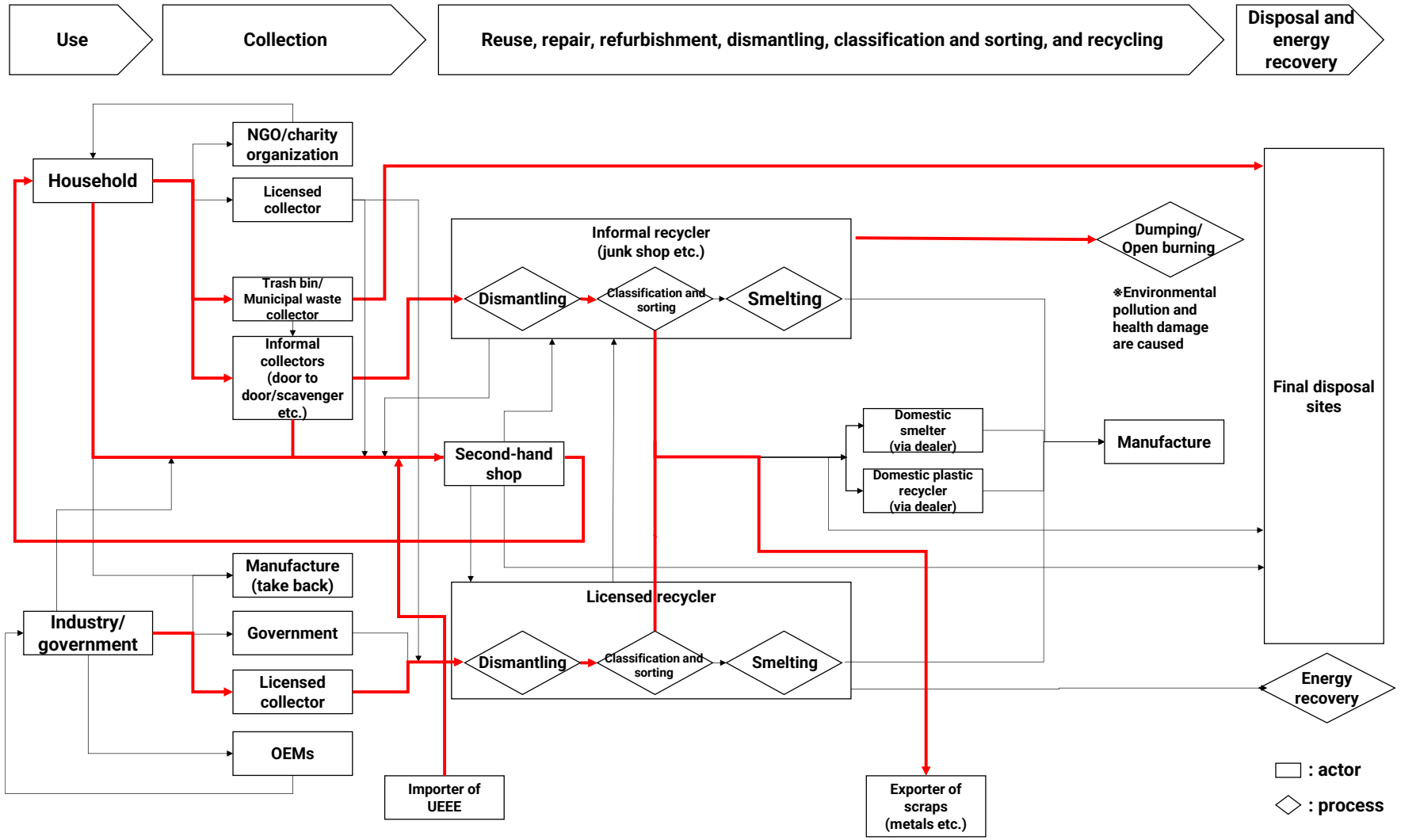
In AMS, used EEE and e-waste generated from households or industries are collected, reused, repaired, refurbished, recycled, or disposed of by various actors. Actors are classified into licensed actors and informal actors. Licensed actors are collectors or recyclers permitted to collect or to treat e-waste by each country's laws related to hazardous waste. Meanwhile, informal actors collect EEE and e-waste without licenses to treat hazardous waste (Figure 1.5). In AMS, EEE and e-waste are not collected nor treated separately by product category as in Japan, and low-value EEE that does not contain valuable materials is disposed of without recycling.

[12] Government of Japan, MOE, Capacity of Domestic Smelters of Non-Ferrous Metals [in Japanese], https://www.env.go.jp/recycle/yugai/conf/conf27-03/H280107_08.pdf)

[13] RICOH, Regeneration Machine [in Japanese], https://www.ricoh.co.jp/mfp/rc/

[14] RICOH, Comet Circle [in Japanese], https://jp.ricoh.com/sustainability/environment/management/policy/comet

**Figure 1.5. Circular Value Chain of Electrical and Electronic Equipment in ASEAN**




EEE = electrical and electronic equipment, NGO = non-governmental organisation, OEM = original equipment manufacturer.
Note: The flows that are applicable to five or more countries are shown in red. The flows that are applicable to at least one country are shown in black. Industry includes the office of private companies and public organisations and the factories of EEE.
Source: Authors.

### 3.1. Collection

In AMS, a lot of EEE and e-waste are collected by informal collectors (UNODC, 2022). Informal collectors deliver it to informal recyclers. In many cases, environmental considerations are lacking, even for some small recycling companies.

In at least five AMS, informal collectors – including waste pickers, scavengers, door-to-door collectors, and junk shops – collect e-waste from households and deliver it to informal recyclers. For example, in Cambodia, waste pickers collect e-waste from public trash bins (ASEAN-Korea Economic Cooperation Fund, 2020). In Indonesia, scavengers pick up e-waste from municipal waste collection points and deliver it to informal recyclers (METI, 2020). In Malaysia, door-to-door collectors visit households and collect EEE and e-waste, and then bring it to informal recyclers such as junk shops (METI, 2019). In the Philippines, junk shops collect e-waste from households directly and treat it themselves or deliver it to other junk shops (METI, 2019). In Thailand, door-to-door collectors buy e-waste from households, or scavengers pick up discarded e-waste (METI, 2020). In Viet Nam, door-to-door collectors visit households and buy e-waste from them, then deliver it to recycling villages (METI, 2019).

Used EEE is collected by second-hand shops directly or through other collectors such as door-to-door collectors in at least five AMS.[15] In Cambodia, about 80% of collected used EEE and e-waste are delivered to second-hand shops or repair and recycle shops; these are resold to households after repair (ASEAN-Korea Economic Cooperation Fund, 2020). About 50% of used EEE is reused in Thailand (Jiaranaikhajorn, 2013).

In at least five AMS, e-waste is collected by municipal waste collectors, which is mixed with municipal waste. It is disposed with municipal waste at final disposal sites. However, in Indonesia, scavengers do pick e-waste from municipal waste collection points (Utomo, 2021).

In Malaysia, Singapore, and Viet Nam, e-waste is collected from households and industries by licensed collectors. In Singapore, Alba E-Waste has collection points where e-waste is collected; it then delivers it to licensed recyclers based on Singapore's Resource Sustainability Act. In Malaysia, Ministry of Environment and Water-registered collection centres collect e-waste and deliver it to recyclers that have SW110 licenses. In Viet Nam, companies collect e-waste and deliver to licensed recyclers based on Prime Minister Decision No. 16/2015/QD-TTg, stipulating the take-back and recycling of discarded products to reduce the volume of e-waste discharged into the environment.

Some manufacturers have established their own take-back systems as well. HP, Dell, and Toshiba have take-back systems for computers, and Nokia has one for mobile phones in Indonesia; HP, Dell, Apple, and Toshiba have take-back systems for computers, and Nokia has one for mobile phones in Malaysia; and Nokia and TES-AMM have take-back systems for mobile phones, and Toshiba Lighting and Phillips have take-back systems for lighting equipment in Thailand (ASEAN-Korea Economic Cooperation Fund, 2020).

In addition, non-governmental organizations (NGOs) and charity organisations collect EEE for donation in Malaysia and Singapore. For example, the National Volunteer and Philanthropy Centre in Singapore maintains an online list of charity organisations that accept such donations. Brunei Darussalam's Department of Environment, Parks and Recreation also collects e-waste from government offices.

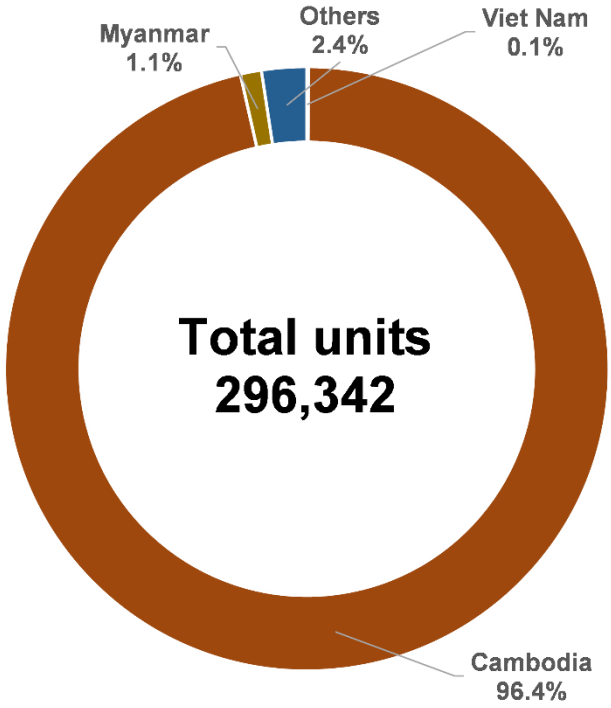
[15] Information on the second-hand shops was not found for Brunei Darussalam, Lao People's Democratic Republic (Lao PDR), and Singapore.

### 3.2. Reuse and Repair

Used EEE is generally reused via second-hand shops in Cambodia, Indonesia, Malaysia, Myanmar, Philippines, Thailand, and Viet Nam. Second-hand shops resell used EEE directly or after repair. Second-hand shops receive used EEE directly from households or from importers; they also import e-waste as used EEE (Kojima, 2014). Indeed, Europe, East Asia, and North America are primary exporters of uncontrolled used EEE and e-waste, but South-East Asia has no capacity for treating it (Baldé et al., 2022). Second-hand and new EEE are not distinguished by six-digit Harmonized System (HS) codes, and only a few countries distinguish between used and new EEE (Terazono and Yoshida, 2012).

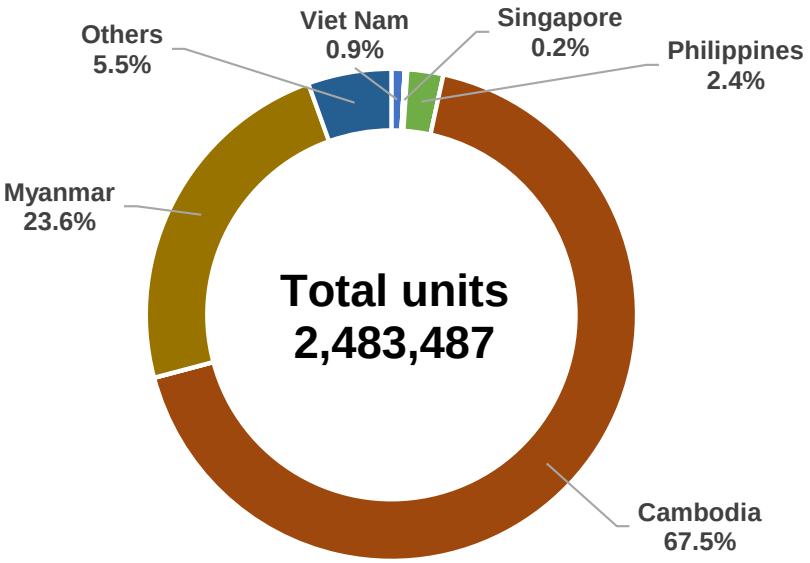
Trade statistics of Japan divide second-hand goods from new goods. In 2022, Japan exported second-hand air conditioners to Cambodia, Myanmar, and Viet Nam (Figure 1.6); second-hand refrigerators to Cambodia, Myanmar, and the Philippines (Figure 1.7); second-hand CRT monitors to the Philippines, Thailand, and Viet Nam (Figure 1.8); and second-hand LCD televisions to Malaysia, Myanmar, and Thailand (Figure 1.9).

**Figure 1.6. Exports of Second-Hand Air Conditioners from Japan to ASEAN, 2022**



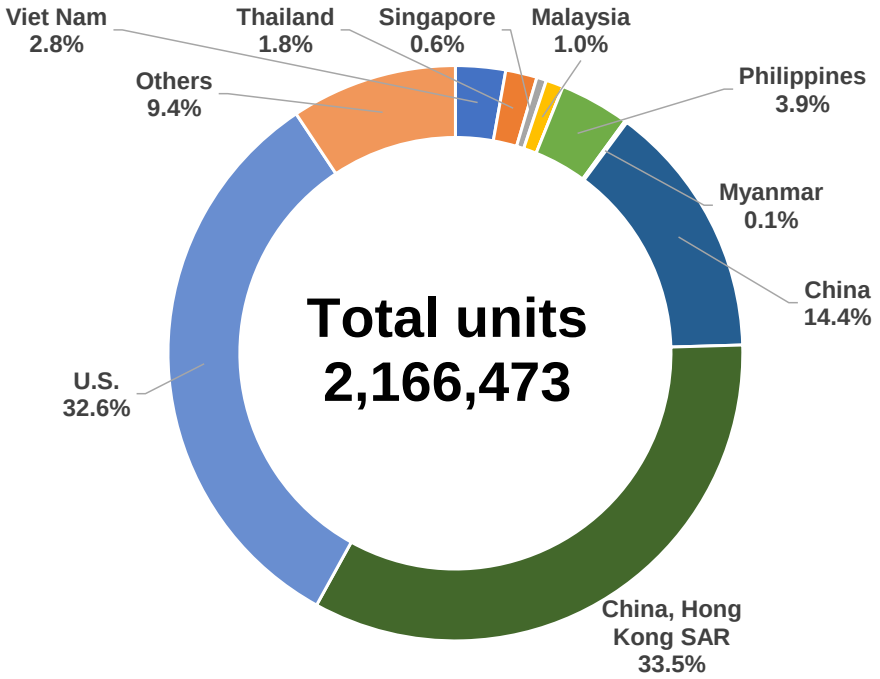

Note: Some units were exported to Indonesia, Lao People's Democratic Republic, Malaysia, Philippines, Singapore, and Thailand as well.
Source: Authors.

**Figure 1.7. Exports of Second-Hand Refrigerators from Japan to ASEAN, 2022**



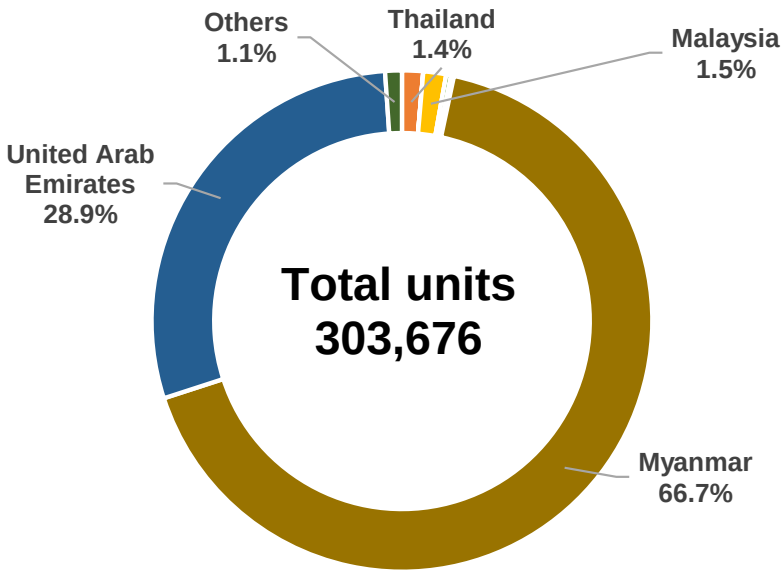

Note: Some units were exported to Thailand as well.
Source: Authors.

**Figure 1.8. Exports of Second-Hand CRT Monitors from Japan to ASEAN, 2022**




Note: Some units were exported to Brunei Darussalam, Cambodia, China, Hong Kong, and Indonesia as well.
Source: Authors.

**Figure 1.9. Exports of Second-Hand LCD Televisions from Japan to ASEAN, 2022**




Note: Some units were exported to China, Indonesia, Singapore, and Viet Nam.
Source: Authors.

Although some used EEE was imported into AMS for reuse, it was instead improperly recycled (Kojima, 2014). Second-hand shops also sell non-reusable products (i.e. e-waste) imported as used EEE (Terazono, 2015). Junk shops sometimes burn cables to collect copper and dump the residues in their backyards.

### 3.3. Dismantling, Classification, Sorting, and Material Recycling

In at least five AMS, e-waste is dismantled, classified, and recycled by informal recyclers such as junk shops or licensed recyclers. They generally dismantle e-waste and classify it into valuable parts, metal scraps, and plastic scraps, and then sell these to foreign or domestic recyclers or smelters. Sometimes e-waste or metal scraps are crushed and sorted to collect precious metals.

In Malaysia, informal recyclers dismantle e-waste manually and classify it into printed circuit board, plastic scraps, and metal scraps (i.e. copper, aluminium, steel, cable, and copper coil), and such valuable resources are then sold to domestic or foreign scrap dealers or smelters (METI, 2019). In Myanmar, informal recyclers dismantle EEE manually and classify it into various parts (i.e. metal frames, power supplies, printed circuit board, and plastics) (ASEAN-Korea Economic Cooperation Fund, 2020). Some informal recyclers there have introduced shredder machines for crushing and sorting e-waste (ASEAN-Korea Economic Cooperation Fund, 2020). In Viet Nam, recycling villages dismantle EEE manually, and classify printed circuit board, metal scraps, plastic scraps, and some valuable parts. Metal scraps are sold to domestic or foreign smelters, other recycling villages, or exporters (METI, 2019). Some recycling villages melt and cast metals from e-waste (Honda, Khetriwal, Kuehr, 2016). No masks or safety gear are used in these recycling villages (Honda, Khetriwal, Kuehr, 2016).

EEE contains valuable metals, but it also includes hazardous materials. Printed circuit board contain lead, refrigerators and air conditioners contain fluorocarbons, and televisions contain brominated flame retardants (Hosoda, 2003). The informal sector does not usually have technologies and

knowledge for environmentally sound treatment, causing environmental pollution and health damage (Table 1.1).

**Table 1.1. Examples of Environmental Pollution and Health Damage due to Improper Recycling in ASEAN**

| Country | Example |
|---|---|
| Cambodia | There is no mandate on wearing safety gear during dismantling processes, which has led to several accidents. Free discharge of toxic gases into the atmosphere from equipment results in health and environmental hazards. Residues are burned in dumpsites or disposed of in public places, causing extreme ground, water, and air pollution. |
| Indonesia | Environmental contamination happened in Pesarean Village, Adiwerna District, and Tegal Regency. [Pesarean Village] has a few metal businesses that smelter aluminium, lead, copper, zinc, and batteries, causing heaps of metal waste. In 2011, the consequences of a provincial example test showed that more than 46 individuals had high lead levels. |
| Thailand | Most informal e-waste recyclers do not use personal protective equipment when dealing with lead, cadmium, mercury, and other dangerous toxins. Insomnia, muscle atrophy, weakness, and headaches are often reported. 72.46% of people in the community where e-waste recycling occurred were concerned about their health, and the health of 31.02% of people in those communities was adversely affected. |
| Viet Nam | Most e-waste is manually recycled in 90 villages, which use manual techniques to sort, pre-process, melt, and cast metals from e-waste. Masks or safety gear while treating e-waste with chemicals are not used. |

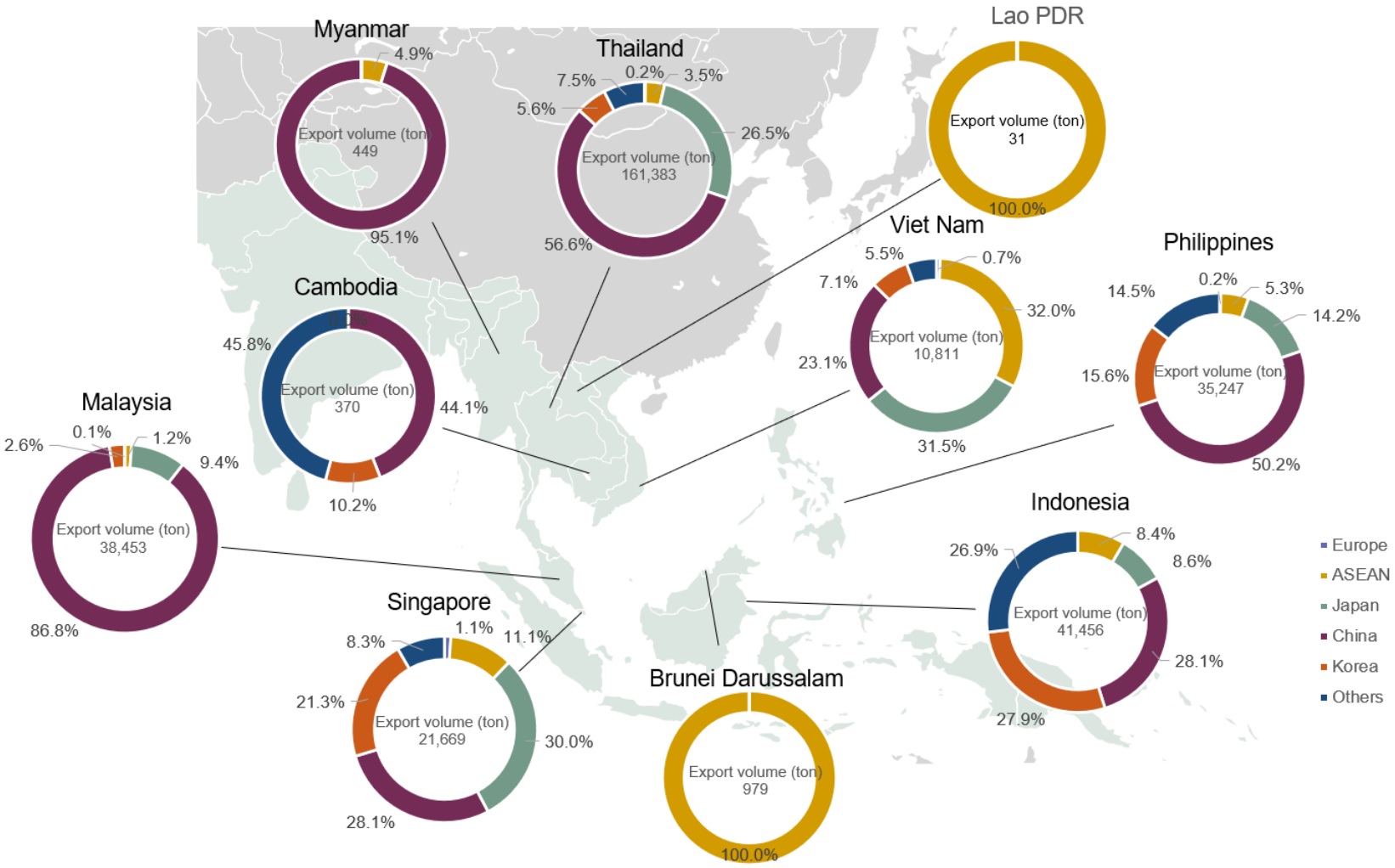
Sources: Honda, Khetriwal, Kuehr (2016); Decharata, Kiddee (2020); Shad, Ling, Karim (2020).

In at least five AMS, some e-waste – at least e-waste from industries – is dismantled, classified, and recycled by licensed recyclers. In Thailand, 81,220 tonnes of e-waste were treated by formal recyclers and 235,715 by informal recyclers in 2018 (ASEAN-Korea Economic Cooperation Fund, 2020). In Brunei Darussalam, Indonesia, the Philippines, and Thailand, licensed facilities dismantle e-waste and classify it into valuable parts, metal scraps, and plastic scraps, and sell them to foreign or domestic recyclers or smelters. In Malaysia, Viet Nam, and Singapore, licensed facilities smelt precious metals. For example, in Malaysia, licensed recyclers are categorised into full-recovery facilities and partial-recovery facilities based on regulations. Partial-recovery facilities dismantle e-waste; classify it into printed circuit board, metal scraps, and plastic scraps; and dispose of residues in the proper manner (METI, 2019). Some crush printed circuit board and sort metals and plastics (METI, 2019). Full-recovery facilities smelt precious metals such as gold, silver, and platinum with wet or dry smelting methods as well (METI, 2019).

The Ministry of Industry and Commerce and Ministry of Natural Resources and Environment inspect and ensure that pollution standards are met at recycling facilities in the Lao People's Democratic Republic (Lao PDR). As a result, only three factories have proper pollution treatment systems, with eight only partially meeting the criteria (ASEAN-Korea Economic Cooperation Fund, 2020).

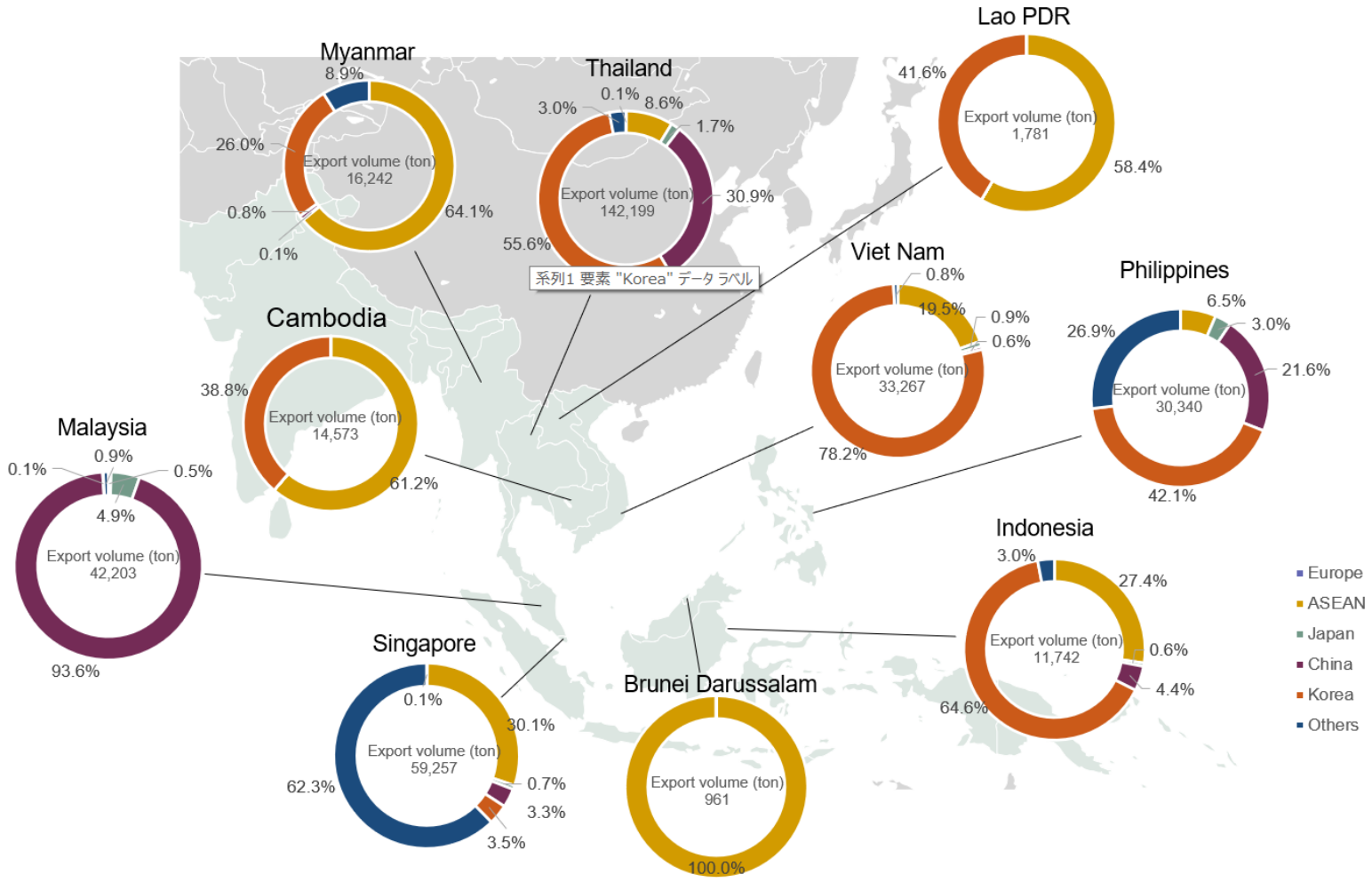
AMS export copper scraps to China, Japan, and Korea (Figure 1.10; aluminium scraps to China and Korea (Figure 1.11); and precious metal scraps to Japan and Korea (Figure 1.12). Additionally, some AMS export e-waste to Europe, Japan, and Korea based on the Basel Convention (Figure 1.13).

**Figure 1.10. Exports of Copper Scraps from ASEAN, 2021**



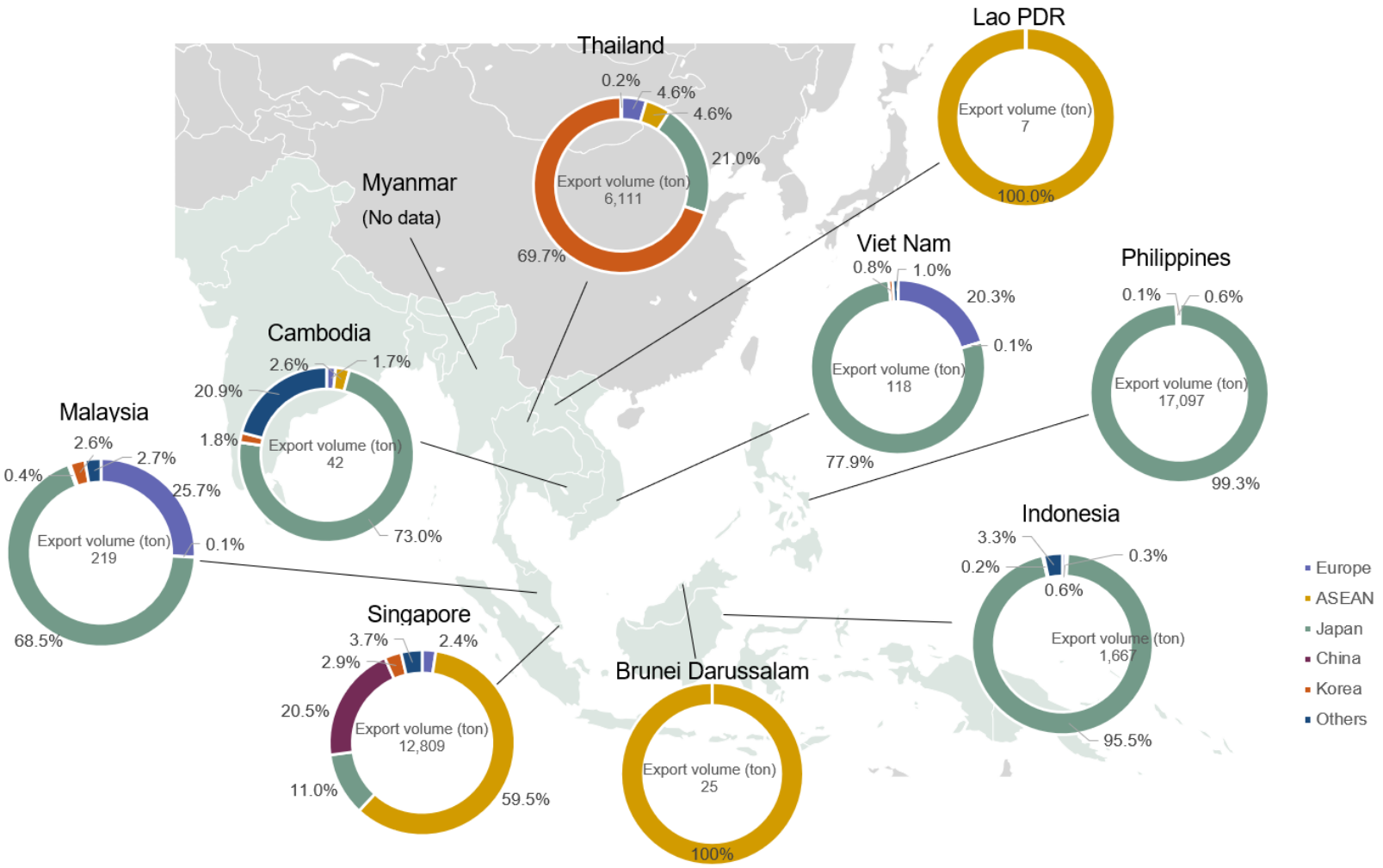

ASEAN = Association of Southeast Asian Nations, HS = Harmonized System, Lao PDR = Lao People's Democratic Republic.
Note: This figure is based on the data applicable to HS code 7404 (copper; waste and scrap), so it includes the volume of the scraps that are not from used electrical and electronic equipment/e-waste.
Source: UN, UN Comtrade Database, https://comtradeplus.un.org/ (accessed 30 June 2023).

**Figure 1.11. Exports of Aluminium Scraps from ASEAN, 2021**



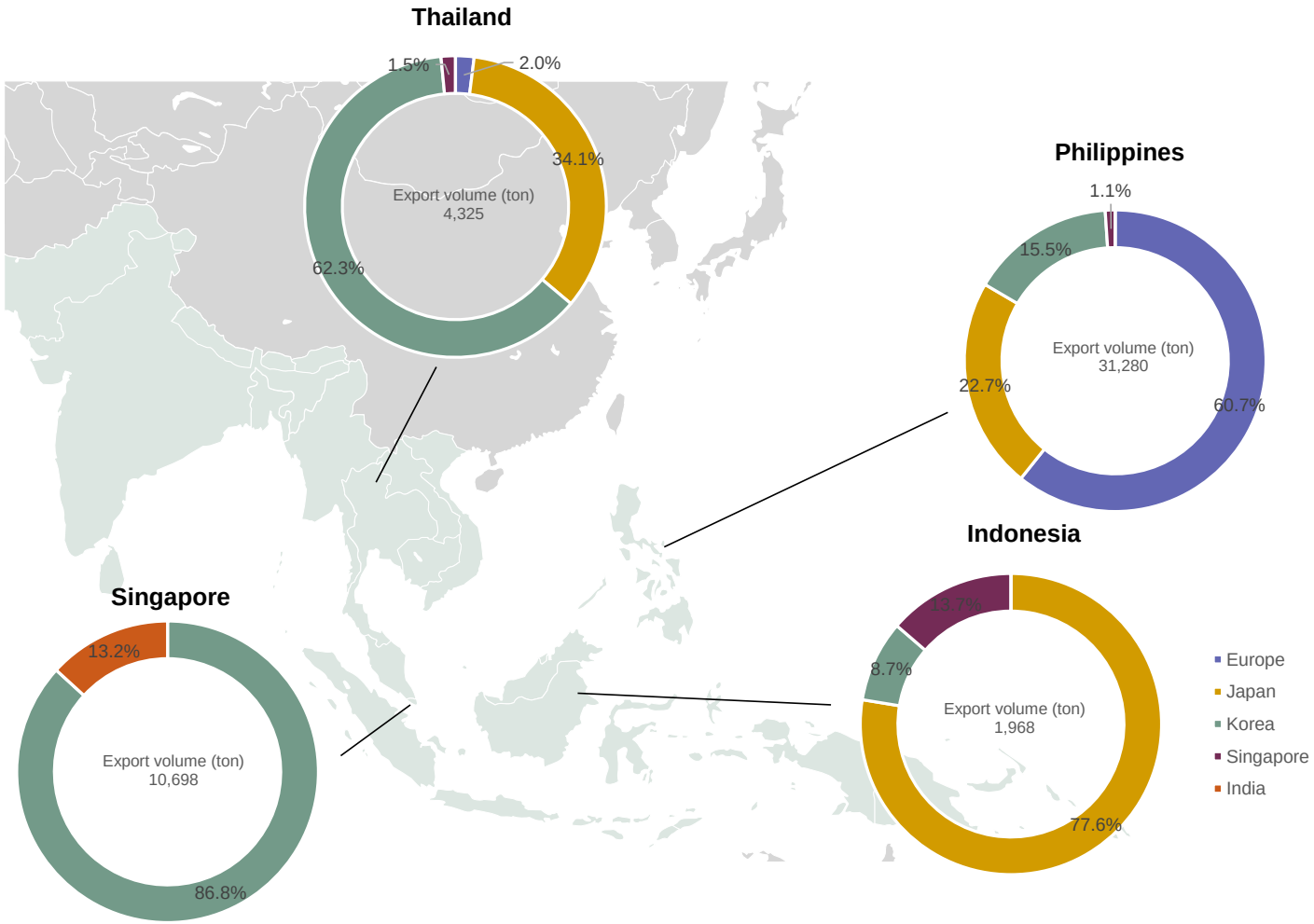

ASEAN = Association of Southeast Asian Nations, HS = Harmonized System, Lao PDR = Lao People's Democratic Republic.
Note: This figure is based on the data applicable to HS code 7602 (i.e. aluminium, waste, and scrap), so it includes the volume of the scraps that are not from used electrical and electronic equipment/e-waste.
Source: UN, UN Comtrade Database, https://comtradeplus.un.org/ (accessed 30 June 2023).

**Figure 1.12. Exports of Precious Metal Scraps from ASEAN, 2021**




ASEAN = Association of Southeast Asian Nations, HS = Harmonized System, Lao PDR = Lao People's Democratic Republic.
Note: This figure is based on the data applicable to HS code 7112 (i.e. waste and scrap of precious metal or of metal clad with precious metal; other waste and scrap containing precious metal compounds, of a kind used principally for the recovery of precious metal), so it includes the volume of the scraps that are not from used electrical and electronic equipment/e-waste.
Source: UN, UN Comtrade Database, https://comtradeplus.un.org/ (accessed 30 June 2023).

**Figure 1.13. Export of E-Waste from ASEAN, Based on the Basel Convention, 2021**




Note: E-waste includes batteries and printed circuit board in this figure. Other ASEAN Member States did not report exports of e-waste in 2021.

Source: Basel Convention, Basel Convention National Reports – Year 2021, https://www.basel.int/Countries/NationalReporting/NationalReports/BC2021Reports/tabid/9379/Default.aspx

The capacity of smelting non-ferrous metal is poor in AMS. Indeed, secondary production of highly recyclable metals, such as aluminium and copper, accounts for only 2.5% and less than 1.0% of total refined consumption in the ASEAN region, respectively, significantly below global rates (IISD, 2023). In contrast, Japan has good capacity for treatment of secondary raw materials, such as precious metal scraps and e-waste like printed circuit board; this figure measured 375,000 tonnes with a surplus capacity of 51,000 tonnes in 2014.[16]

### 3.4. Remanufacturing and Refurbishment

Remanufacturing of used EEE is rarely found in Indonesia, Malaysia, and Singapore. Remanufactured products are rarely sold in Singapore and Indonesia (Kamigaki, Matsumoto, Yun, 2017). Most used products cannot be collected in developing countries, an obstacle to remanufacturing activities (Kamigaki, Matsumoto, Yun, 2017). However, the refurbishment of multifunction printers by manufacturers does occur in Singapore and Indonesia, and the refurbishment of information and communications technology equipment is found in Malaysia (Centre for Remanufacturing and Reuse, 2015).

### 3.5. Disposal and Energy Recovery

In Brunei Darussalam, Cambodia, Lao PDR, Malaysia, Myanmar, Philippines, Singapore, and Thailand, e-waste from households is disposed of in final disposal sites mixed with municipal waste.[17] In Brunei Darussalam, e-waste is collected as ordinary municipal waste by local garbage collectors and delivered to final disposal sites such as Sungai Paku Landfill. In Malaysia, waste separation at the source is not common, so all types of municipal waste are collected in a single bin, and then this mixed waste is disposed of at landfill sites (Chow, 2017). In Myanmar, a lot of hazardous waste is sent to landfills due to lack of proper systems and methods to separate such waste (Thien et al., 2020). These circumstances are overwhelming the capacity of final disposal sites, and valuable resources such as such as copper, aluminium, and precious metals are lost. In Indonesia, scavengers pick e-waste from municipal waste collection points, so e-waste rarely flows into final disposal sites (Utomo, 2021).

In Cambodia, Indonesia, Myanmar, Philippines, Thailand, and Viet Nam, residues from e-waste are dumped or burned by informal recyclers. For example, in the Philippines, junk shops burn cables to collect copper and dump residues in their backyards. In Thailand, formal recyclers sometimes sell residues of e-waste to cement companies as fuel.

[16] Government of Japan, MOE, Capacity of Domestic Smelters of Non-Ferrous Metals [in Japanese], https://www.env.go.jp/recycle/yugai/conf/conf27-03/H280107_08.pdf

[17] Related information in Viet Nam is not found in this research.

**Table 1.2. Processes and Actors of the Electrical and Electronic Equipment Circular Value Chain in ASEAN**

| Country | Processes | Actors and Activities |
|---|---|---|
| Brunei Darussalam | Collection | • E-waste from households is collected by formal recycling companies (permitted by Ministry of Health) or formal municipal waste collectors. In addition, some NGOs have take-back initiatives.<br>• E-waste from government offices is collected by Department of Environment, Parks and Recreation. |
| | Reuse and repair | • Reuse, repair, and refurbishment were not found in the reviewed documents. |
| | Dismantling, classification, sorting, and material recycling | • E-waste collected by formal recycling companies is dismantled, crushed, and sorted. Valuable resources are exported according to the Basel Convention. Much e-waste may be disposed of at landfills, such as Sungai Paku Landfill. |
| | Remanufacturing and refurbishment | • Remanufacturing was not found in the reviewed documents. |
| | Disposal and energy recovery | • Many households disregard e-waste and treat it as ordinary domestic waste. It is collected by local garbage collectors and sent to Sungai Paku Landfill. |
| Cambodia | Collection | • Used EEE and e-waste from households are collected with municipal waste and can be picked up by informal collectors, such as waste pickers, from public trash bins. Informal recyclers have their own systems for the collection and transport of e-waste.<br>• A few formal companies, such as EcoBatt-Energy Cambodia, have started to collect used EEE and e-waste, including batteries from households and industries.<br>• About 85% of collected used EEE and e-waste are from households. These also come from offices, repair and dismantle shops, or importers. |
| | Reuse and repair | • 80% of collected used EEE and e-waste are delivered to second-hand shops or repair and recycle shops. These are resold to households after repair.<br>• Residues generated are landfilled with municipal waste or burned. |
| | Dismantling, classification, sorting, and material recycling | • E-waste is treated by informal recyclers. Informal recyclers dismantle e-waste and recover and sell the recyclable parts to scrap dealers. The recyclable parts are exported to China, Thailand, and Viet Nam. Residues are disposed of at municipal dumps or burned. |

| Country | Processes | Actors and Activities |
|---|---|---|
| | Remanufacturing and refurbishment | • Remanufacturing was not found in the reviewed documents. |
| | Disposal and energy recovery | • Valuable waste components are collected and exported, often from open dump sites, whereas non-valuable waste is disposed of in landfills. |
| Indonesia | Collection | • Used EEE and e-waste from households are stored at home, given to family or friends, or collected by formal or informal collectors.<br>• E-waste is collected at formal collection points or waste banks (i.e. municipality-registered collection centres where people exchange valuable waste and money) and then delivered to B3-licensed facilities. Alternatively, some used EEE is collected by second-hand shops or repair or refurbish shops and then resold. Some e-waste is also collected with municipal waste at collection points for municipal waste. Some global companies have take-back initiatives as well.<br>• E-waste is collected by junk shops, which treat used EEE as waste, without licenses. E-waste stored at collection points for municipal waste is picked up by scavengers.<br>• E-waste from industries is collected by formal collectors and delivered to licensed facilities. |
| | Reuse and repair | • Used EEE and e-waste delivered from households to second-hand shops are resold to households or delivered to junk shops that recycle them. Before resale, used EEE is repaired or refurbished if necessary. |
| | Dismantling, classification, sorting, and material recycling | • E-waste is recycled by formal and informal recyclers.<br>• E-waste collected from industries and at collection points and waste banks are treated by formal recyclers, which are licensed facilities. Formal recyclers dismantle, crush, and sort the e-waste. They recover and sell metal scraps to domestic or foreign smelters. They also recover plastic scraps and deliver them to domestic or foreign organisations.<br>• Informal recyclers, such as junk shops or organisations entrusted by junk shops, recover precious metals and plastics. Unusable parts are dumped. |
| | Remanufacturing and refurbishment | • Remanufactured products are rarely provided in Singapore and Indonesia. |
| | Disposal and energy recovery | • The Ministry of Environment and Forestry admits that Indonesia still does not have an e-waste final disposal site. Most may be picked by informal collectors from municipal waste. |
| Lao PDR | Collection | • Informal workers collect recyclable materials. |

| Country | Processes | Actors and Activities |
|---|---|---|
| | | • E-waste from industries may be collected by formal collectors. |
| | Reuse and repair | • Reuse, repair, and refurbishment were not found in the reviewed documents. |
| | Dismantling, classification, sorting, and material recycling | • E-waste is treated by formal and informal recyclers.<br>• Formal recyclers dismantle e-waste manually and classify and recover metal scraps and plastic scraps. Some formal recyclers melt printed circuit board.<br>• Treatment by informal recyclers is not clear. |
| | Remanufacturing and refurbishment | • Remanufacturing was not found in the reviewed documents. |
| | Disposal and energy recovery | • Mixed waste is disposed of in open-loop landfills. |
| Malaysia | Collection | • Used EEE and e-waste from households are collected by formal and informal collectors.<br>• E-waste is collected at collection centres of e-waste listed by the Department of Environment and delivered to licensed facilities. Alternatively, some is collected by second-hand shops or repair or refurbishment shops and then resold. Some e-waste is collected with municipal waste and delivered to disposal sites. NGOs and charity organisations also collect used EEE and donate it.<br>• E-waste is collected by informal collectors, such as door-to-door collectors and junk shops, which dismantle e-waste.<br>• E-waste from industries is collected by formal collectors and delivered to licensed facilities. |
| | Reuse and repair | • Much used EEE is collected by door-to-door collectors, street collectors, and municipal waste collectors and delivered to repair, retail, or second-hand shops. It is resold to households as second-hand or repaired goods. |
| | Dismantling, classification, sorting, and material recycling | • E-waste is treated by formal and informal recyclers. Formal recyclers are classified into full-recovery facilities and partial-recovery facilities.<br>• Partial-recovery facilities dismantle e-waste and classify and recover printed circuit board, metal scraps, and plastic scraps. Some facilities crush printed circuit board and sort metals and plastics. Residue is disposed of in the proper manner.<br>• Full-recovery facilities dismantle e-waste and classify and recover printed circuit board, metal scraps, and plastic scraps. Some facilities crush printed circuit board and sort metals and plastics. These also smelt precious metals with wet or dry smelting methods. Residues are disposed of in the proper |

| Country | Processes | Actors and Activities |
|---|---|---|
| | | manner.<br>• Informal recyclers, such as junk shops, dismantle e-waste manually and recover printed circuit board, plastic scraps, and metal scraps. Such valuable resources are for domestic or foreign scrap dealers or smelters. |
| | Remanufacturing and refurbishment | • Refurbishment of ICT equipment by original equipment manufacturers occurs. |
| | Disposal and energy recovery | • Waste separation at the source is not a common practice, which leads to the collection of all types of municipal solid waste in a single bin, then disposed of at landfills. Some e-waste also seems to be disposed of at landfills. |
| Myanmar | Collection | • There is an active informal sector with an established network for the collection of used EEE and e-waste and recycling, repair, refurbishment, and parts harvesting.<br>• Some e-waste from industries is collected by formal collectors such as Dowa Eco-System. |
| | Reuse and repair | • There is an active informal sector with an established network for collection of used EEE and e-waste and their recycling, repair, refurbishment, and parts harvesting. |
| | Dismantling, classification, sorting, and material recycling | • E-waste is treated by informal recyclers, which dismantle e-waste manually and recover various parts (metal frames, power supplies, printed circuit board, and plastics). Some informal recyclers have introduced shredder machines. Open burning of cables is conducted to recover copper. After recovering reusable components and recyclable materials, residues are disposed of with solid waste, burned by owners, or discarded in dumpsites or landfills. |
| | Remanufacturing and refurbishment | • Remanufacturing was not found in the reviewed documents. |
| | Disposal and energy recovery | • Almost all townships lack proper systems and methods to deal with such waste separately, with much of it ultimately sent to landfills or openly burned. |
| Philippines | Collection | • Used EEE and e-waste from households is delivered to junk shops. Some is collected by second-hand shops and then resold.<br>• E-waste from industries is generally collected by formal collectors and delivered to licensed facilities. |
| | Reuse and repair | • At households, schools, and small companies, second-hand goods are re-used.<br>• Used EEE and e-waste collected from households are delivered to second-hand shops or junk shops that recycle e-waste. Used EEE delivered to second-hand shops are resold to households. |

| Country | Processes | Actors and Activities |
|---|---|---|
| | Dismantling, classification, sorting, and material recycling | • E-waste is treated by formal and informal recyclers.<br>• Formal recyclers (licensed as TSD facilities) dismantle e-waste and classify and recover metal scraps, printed circuit board, and plastic scraps. They are sold in or out of the country. Printed circuit board is sometimes crushed and sorted. Residues are delivered to final disposal sites.<br>• Informal recyclers, such as mid- or large junk shops, dismantle e-waste and classify it into valuable materials and non-valuable materials. Valuable materials are sold to other formal recyclers or exporters. Non-valuable materials are disposed of. Junk shops burn cables to collect copper and dump residues in their yards. |
| | Remanufacturing and refurbishment | • Remanufacturing was not found in the reviewed documents. |
| | Disposal and energy recovery | • After being stored for a maximum of 3 years, 80% of e-waste is assumed to be landfilled since e-waste recycling is new, and facilities that handle e-waste are limited. |
| Singapore | Collection | • Used EEE and e-waste are collected at some collection points and delivered to licensed collectors (e.g. Alba E-Waste Smart Recycling) or *karang guni*, a kind of informal sector. |
| | Reuse and repair | • Reuse, repair, and refurbishment were not found in the reviewed documents. |
| | Dismantling, classification, sorting, and material recycling | • E-waste collected by Alba E-Waste Smart Recycling is classified and delivered to licensed recyclers for material recycling.<br>• Intermediate technologies can extract other precious metals besides gold and copper from e-waste. |
| | Remanufacturing and refurbishment | • Remanufactured products are rarely sold. |
| | Disposal and energy recovery | • E-waste that is thrown away, including all precious metals that it contains, are incinerated and landfilled at Semakau Landfill. |
| Thailand | Collection | • Used EEE and e-waste from households are stored at home, passed on to family or friends, or collected by both formal and informal collectors.<br>• Used EEE and e-waste are collected by formal collection companies such as Wongpanit and delivered to licensed facilities. Alternatively, some is collected by second-hand shops or repair or refurbishment shops and then resold. Some e-waste is collected with municipal waste.<br>• E-waste is collected by door-to-door collectors or junk shops that treat used EEE as waste without licenses.<br>• E-waste from industries is collected by formal collectors and subsequently delivered to licensed facilities. |

| Country | Processes | Actors and Activities |
|---|---|---|
| | Reuse and repair | • 50% of used EEE is sold to second-hand shops or recycling facilities. In the shops, it may be repaired. Used EEE that cannot be repaired is sold to formal or informal recyclers. |
| | Dismantling, classification, sorting, and material recycling | • E-waste is treated by formal and informal recyclers.<br>• Formal recyclers (licensed under the Factory Act) dismantle e-waste and classify and recover printed circuit board, metal scraps, and plastic scraps. Such valuable resources are sold in or out of the country. Residues are sometimes sold to cement companies as fuel.<br>• Informal recyclers, such as junk shops, dismantle e-waste manually and recover metal scraps, printed circuit board, plastic scraps, and other parts (e.g. cables and motors). Residues are landfilled or burned. |
| | Remanufacturing and refurbishment | • Remanufacturing was not found in the reviewed documents. |
| | Disposal and energy recovery | • Some hazardous waste is disposed of at managed landfills. |
| Viet Nam | Collection | • E-waste from households is collected by both formal and informal collectors.<br>• E-waste is collected by formal municipal collection companies with municipal waste. Some e-waste is collected by second-hand shops and then resold.<br>• E-waste is collected by door-to-door collectors.<br>• E-waste from industries is collected by formal collectors and delivered to licensed facilities. |
| | Reuse and repair | • Some used EEE and e-waste collected from households are delivered to recycling villages or repair shops. Used EEE delivered to repair shops is resold to the second-hand market. |
| | Dismantling, classification, sorting, and material recycling | • E-waste is treated by formal and informal recyclers.<br>• E-waste collected from industries is delivered to licensed recyclers, which dismantle it and classify and recover printed circuit board, metal scraps, and plastic scraps. Some recyclers crush printed circuit board and sort metals and plastics, while others recover precious metals through chemical methods.<br>• E-waste collected from households is delivered to recycling villages. Some dismantle e-waste manually and recover printed circuit board, metal scraps, plastic scraps, and some valuable parts. Metal scraps are sold to domestic or foreign smelters, other recycling villages, or exporters. Plastic scraps are sold to domestic or foreign recyclers. Residues are sometimes burned in the recycling villages. |

| Country | Processes | Actors and Activities |
|---|---|---|
| | Remanufacturing and refurbishment | • Remanufacturing was not found in the reviewed documents. |
| | Disposal and energy recovery | • Residues are sometimes burned in the recycling villages. |

EEE = electrical and electronic equipment, ICT = information and communications technology, NGO = non-governmental organisation.
Sources: Idris, Shams, and Yusof (2023); ASEAN-Korea Economic Cooperation Fund (2020); JICA (2019); METI (2019, 2020); Kamigaki, Matsumoto, and Yun (2017); Utomo (2021); Global Green Growth Institute (2018); Noudeng, Nguyen, Tran (2022); Centre for Remanufacturing and Reuse (2015); Chow (2017); OECD (2020); Ronald et al. (2018); Jiaranaikhajorn (2013); Alba E-Waste Singapore, https://alba-ewaste.sg/

## 4. Gaps in the EEE Circular Value Chains between Japan and ASEAN

In this section, gaps in the EEE circular value chains between Japan and ASEAN are described. Based on the results of the gap analysis, challenges for ASEAN in improving its EEE circular value chain are identified.

### 4.1. Gap 1: Poorly Managed Reuse Activities

In Japan, reuse activities are well managed by industry associations; in contrast, such activities are not found in AMS. Moreover, used EEE is imported into AMS as reused goods but is often improperly recycled instead. Second-hand shops sell non-reusable products and remove parts for junk shops, which then treat them in an improper manner. It is thus crucial to prevent the improper import of e-waste into AMS; importers and administrative agencies should also invoke the standards provided under the Basel Convention for distinguishing used EEE and e-waste. Additionally, second-hand shops must comply with regulations on the treatment of hazardous waste so that environmental pollution and health damage due to improper treatment of e-waste is avoided. Other challenges for well-managed reuse activities include:

(i) establishment of certification system of excellent second-hand shops that comply with regulations and ensure quality management of reused goods; and

(ii) establishment of a traceability system of reused products, which prevents a second-hand shop from buying and selling illegally obtained used EEE such as stolen goods and from delivering it to illegal recyclers.

### 4.2. Gap 2: Few Formal Collectors and Recyclers

In Japan, most e-waste – especially televisions, refrigerators, washing machines/dryers, air conditioners, and multifunction printers – are collected and recycled by licensed, well-managed collectors or recyclers. There, licensed recyclers have been able to receive more e-waste and achieve environmentally sound treatment and recovery of many valuable resources. In the ASEAN region, however, few licensed collectors and recyclers are active. For example, in Indonesia, Malaysia, the Philippines, Thailand, and Viet Nam, licensed collectors or recyclers only manage e-waste from industries and a limited amount of e-waste from households.

Governments in ASEAN struggle to regulate unlicensed collectors and recyclers and thus cannot make them comply with environmental and safety standards, leading to risks of environmental pollution and health damage. It is imperative to promote the participation of licensed collectors and recyclers and to formalise informal collectors and recyclers. Several barriers impede the participation of licensed collectors and recyclers, including

(i) difficulty in collecting e-waste from households due to the lack of collection systems,

(ii) lack of technologies and equipment for e-waste processing, and

(iii) high costs associated with environmentally sound e-waste collection and treatment.

### 4.3. Gap 3: Mixed Waste

In Japan, televisions, refrigerators, washing machines/dryers, and air conditioners are not mixed with municipal waste. About 70% is collected and delivered to designated collection places set up by manufacturers. In AMS, however, e-waste from households is collected along with municipal waste and disposed of in the same final disposal sites. Sometimes, scavengers pick e-waste from municipal waste collection points. The same occurs for valuable EEE, while less valuable EEE may also end up in final disposal sites. Problems in AMS thus include

(i) a lack of dedicated entities and infrastructure (i.e. collection points) for collecting e-waste from households,

(ii) lack of incentives for consumers to deliver e-waste to collection points, and

(iii) lack of consumer awareness and knowledge about the correct disposal of e-waste.

### 4.4. Gap 4: Low Capacity of Metal Scrap Recyclers

Japan has the capacity to recycle metal scraps, especially scraps containing copper and precious metals. In contrast, AMS have limited capacities. Metal scraps recovered from e-waste through dismantling, classification, and sorting are exported to other countries, particularly China, Japan, and Korea, where they are smelted.

From the viewpoint of the stable treatment of e-waste and stable supply of recycled resources, domestic recycling of metal scraps should be increased in all AMS. As global e-waste generation is predicted to increase (Baldé et al., 2017), AMS must expand their e-waste recycling capacities by ensuring the export of metal scraps for recycling while concurrently enhancing domestic capacities. This requires international cooperation and/or collaboration with countries capable of smelting these metals, involving both the public and private sectors.

### 4.5. Gap 5: Lack of Remanufacturing Activities

Remanufacturing of used multifunction printers is a well-established practice in Japan, yet remanufacturing of used EEE is uncommon in AMS. In general, remanufacturing is preferred over recycling and disposal, because remanufacturing generates more added value and fewer residues than recycling and disposal (OECD, 2020). In AMS, e-waste tends to be recycled, even when remanufacturing is possible. Hence, promoting the remanufacturing of used EEE should be prioritised before the recycling process. Potential barriers to remanufacturing in AMS include

(i) lack of efficient collection and take-back systems linked to manufacturers;

(ii) lack of access to technologies, know-how, and information needed to distinguish parts suitable for remanufacturing;

(iii) lack of standards for quality and safety assurance; and

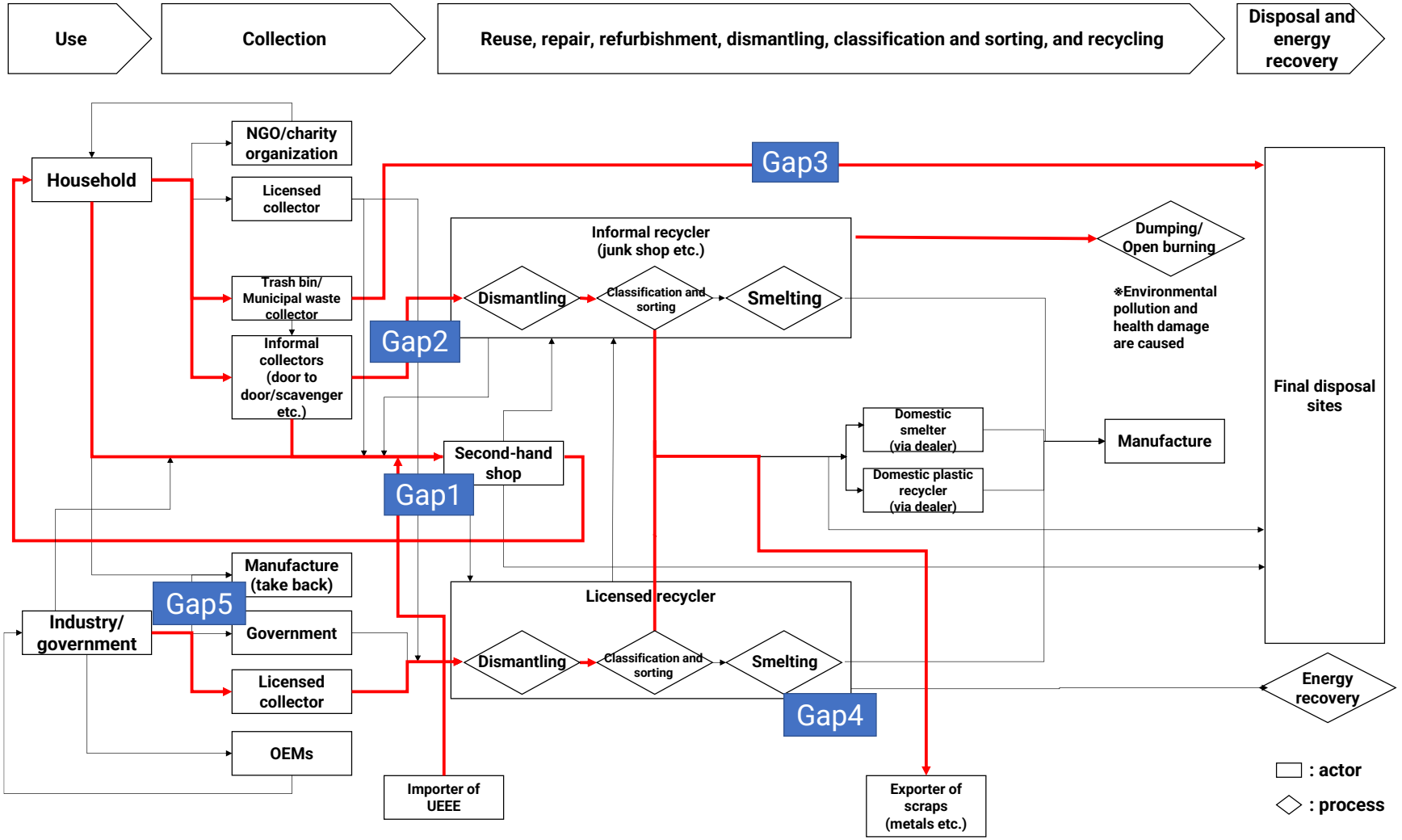
(iv) lack of necessary infrastructure (e.g. production lines) in factories.

Considering policies and legal systems to address these barriers should be prioritised, taking into account good practices in advanced countries. Legal systems for ensuring collection linked to manufacturers should be established; national laws and standards of quality and safety assurance for remanufactured goods should be drafted in alignment with international rules and standards; and national strategies and roadmaps, including research and development, for promoting remanufacturing should be developed. Each EEE manufacturer should promote their own take-back systems, research and development for remanufacturing, in-house standards for quality and safety assurance, and investment in necessary infrastructure.

## 5. Conclusion

In this chapter, the gaps between AMS and Japan's EEE circular value chains were explored. Five gaps in ASEAN are identified: (i) poorly managed reuse activities, (ii) low presence of formal collectors and recyclers, (iii) mixed waste, (iv) low capacity of metal scrap recycling, and (v) lack of remanufacturing activities (Figure 1.14).

**Figure 1.14. Gaps in the ASEAN Electric and Electronic Equipment Circular Value Chain**




NGO = non-governmental organisation, OEM = original equipment manufacturer, UEEE = used electrical and electronic equipment.
Note: The flows that are applicable to five or more countries are shown in red. The flows that are applicable to at least one country are shown in black. Industry includes private companies, public organisations, and factories.
Source: Authors.

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# Chapter 2

# Legal Systems and Standards for Improving the Electric and Electronic Equipment Circular Value Chains of ASEAN and Beyond

## 1. Introduction

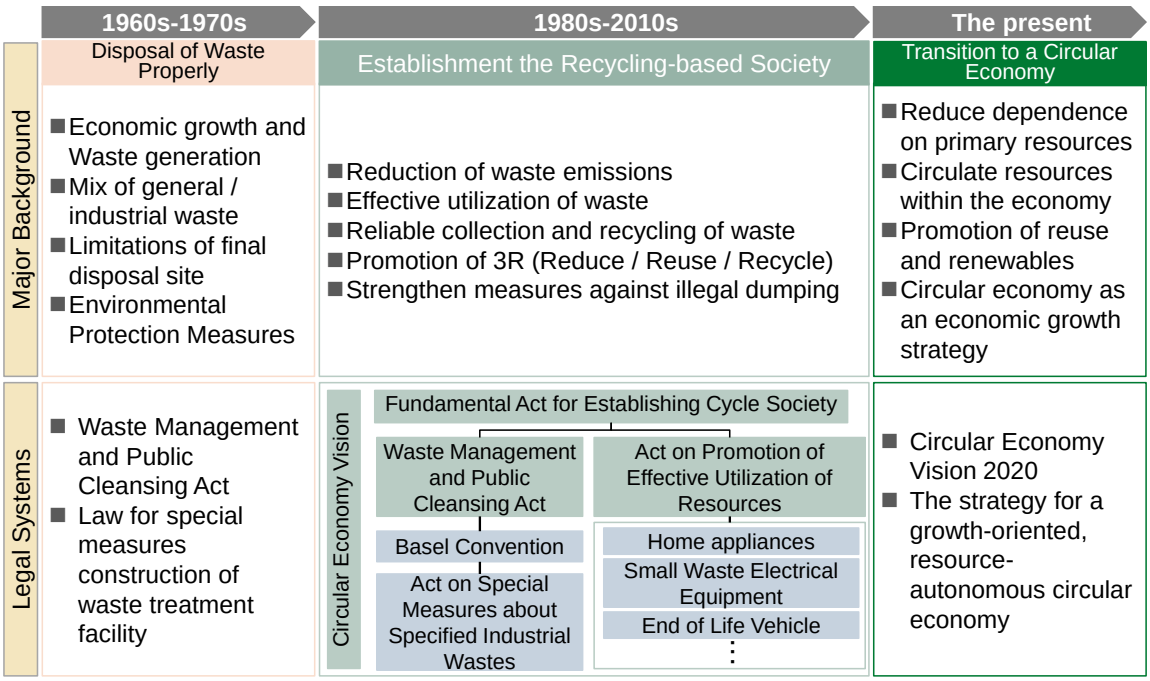
Waste issues are evolving with the global expansion of industrial and economic activities and the improvement of living standards over time. Developed countries have established various laws, regulations, and systems to address these changing characteristics at different stages. This chapter presents an overview of waste management in Japan and the European Union (EU), particularly from the perspective of the development of their associated legal systems. By linking these legal systems to the social background of each place, this section aims to provide guidance for developing legal systems that help address the current waste problems confronting Association of Southeast Asian Nation (ASEAN) Member States (AMS).

## 2. Waste-Related Legal System in Japan

### 2.1. Overview

In Japan, waste-related legal systems have changed in accordance with the shifting social background of the country, from proper waste disposal, to the establishment of a recycling-based society, and finally to the transition to a circular economy (Figure 2.1).

**Figure 2.1. Overview of the Waste-Related Legal System in Japan**




Source: Authors.

From the 1960s, in accordance with economic growth, industrial and other types of waste – including e-waste – increased in Japan. Environmental pollution and health hazards, due to improper waste disposal, became apparent. Therefore, in 1971, Japan enacted the Waste Management and Public Cleansing Act, which established the foundation for Japan's waste disposal system, focussing on proper disposal. The act classified waste into general and industrial, imposing responsibility for industrial waste disposal from business activities. It also secured a waste treatment system through outsourcing, introduced a permit system in which local governments grant and supervise licensed private operators to conduct general and industrial waste collection, and a created a manifest system to confirm that the waste is properly managed until its final disposal.

This act requires, in principle, that waste generators dispose of their waste (i.e. producer responsibility). However, it is impractical for citizens to dispose of general waste themselves; similarly, it is rare for industrial waste generators to have the capacity to properly dispose of industrial waste on their own. The act thus allows outsourcing of the collection and treatment of industrial waste to private operators. These private operators are licensed and supervised by local governments to ensure proper disposal.

The manifest system requires waste generators to confirm – through documents – that industrial waste has been properly disposed of in accordance with contracts when the disposal is outsourced. The purpose is to prevent improper disposal, such as illegal dumping, and to ensure the responsibility of the waste generators. In addition, to ensure the smooth operation of the waste treatment system, the act sets various standards for proper waste treatment, clarifies responsibilities of waste generators and processors, and strengthens regulations through mandatory measures and penalties.

However, emitters still lacked a sense of responsibility for industrial waste treatment costs, so industrial waste often flowed to dischargers that did not properly dispose of the waste and to unauthorised companies, resulting in rampant illegal dumping and improper disposal. Thus, by the 1980s, the mechanisms focussing on large-volume industrial waste disposal reached their limits. It became necessary to address waste generation through emissions control, recycling, and other ways. In 1991, the act thus added the reduction of waste generation to its objectives, and a new law for promotion of effective utilisation of resources was enacted to clarify policies aimed at reducing waste generation. It also set targets for the reduction of industrial waste and monitored the results.

In response to demands of society and the market, companies begun to promote product design and manufacturing that facilitates recycling and reuse and contributes to the reduction of waste generation, which also brought about changes in the industrial structure. In addition, operators that generated a large amount of industrial waste were obligated to formulate treatment plans, implement measures to control emissions, and report to local governments on their associated plans and measures.

At the turn of this century, the government began to establish a preliminary system centred on recycling. The Act on Promotion of Utilisation of Resources and various recycling laws (e.g. Home Appliance Recycling Act, Construction Recycling Law, Food Recycling Law, End-of-Life Vehicle Recycling Law, and Small Home Appliance Recycling Act) were developed in the 2010s, maintaining an emphasis on proper waste disposal. In particular, they enforced emitter responsibility and extended producer responsibility (EPR), introduced stricter penalties for improper disposal, secured appropriate treatment facilities, and developed special measures for industrial waste disposal (METI, 2006).

In the 2020s, Japan is restructuring its policy towards a circular economy, focussing on resource reuse and recycling, resource generation, resource sharing, and long-term use of resources. It aims to establish a growth-oriented, resource-autonomous circular economy. By making the domestic resource circular system self-sustaining and resilient, Japan intends to address the risks of resource and energy constraints, climate-change issues, and waste generation problems, ultimately achieving sustainable and steady economic growth (METI, 2006).

**Table 2.1. Established Waste-Related Acts in Japan**

| Established Act | Contents |
|---|---|
| Waste Management and Public Cleaning Act (1971) | Preserves the environment, and improves public health through the restriction of waste discharge, appropriate sorting, storage, collection, transport, recycling, and disposal. |
| | • Clarifies waste disposal responsibilities and disposal standards.<br>• Establishes the Discharger Responsibility Principle.<br>• Creates a permit system for industrial waste collectors and transporters.<br>• Creates standards for collection, transport, and disposal.<br>• Creates a manifest system for collection, transport, and disposal.<br>• Excepts licenses under the Recycler Designation System.<br>• Allows the installation of industrial waste treatment facilities.<br>• Establishes penalties to prevent illegal dumping and other improper disposal. |
| Act on Promotion of Effective Utilisation of Resources (1991) | Ensures effective use of resources, and promotes effective use of recycled resources and recycled parts even when a significant portion of the recycled resources and parts are disposed of without being utilised.<br>Takes necessary measures to promote effective use of resources, reduces the generation of used products and by-products, and promotes the use of recycled resources and parts, thereby contributing to waste reduction, environmental preservation, and economic development. |
| | • Regulates environmental considerations at the design and manufacturing stages of products.<br>• Establishes voluntary collection and recycling systems by operators. |
| Act on Recycling of Specified Kinds of Home Appliances (1998) | Realises sound waste treatment and efficient use of resources through the reduction of waste and full utilisation of recyclable resources for a sound material cycle, and introduces a new framework of recycling whose principle is to place an obligation on manufacturers and retailers of home appliances. |
| | • Recycles parts and materials by having manufacturers take back used products that are returned by consumers to dealers.<br>• Specifies four post-consumer home appliances: air conditioners, televisions, refrigerators and freezers, and washing machines/dryers. |

| Established Act | Contents |
|---|---|
| | • Mandates recycling by manufacturers.<br>• Requires a consumer to pay a collection and transport fee and a recycling fee when disposing of a product. |
| Act on Recycling of Specified Kinds of Small Waste Electrical Equipment (2015) | Promotes the recycling of small waste electrical and electronic equipment, thereby ensuring proper disposal of waste and effective use of resources and contributing to the preservation of the environment and economic development. |
| | • Targets electronic devices used by ordinary consumers in their daily lives, such as computers, cell phones, digital cameras, watches, and hair dryers.<br>• Requires citizens to separate and dispose of appliances according to the collection method designated by the municipality in which they reside.<br>• Requires proper recycling through delivery to proper operators. |

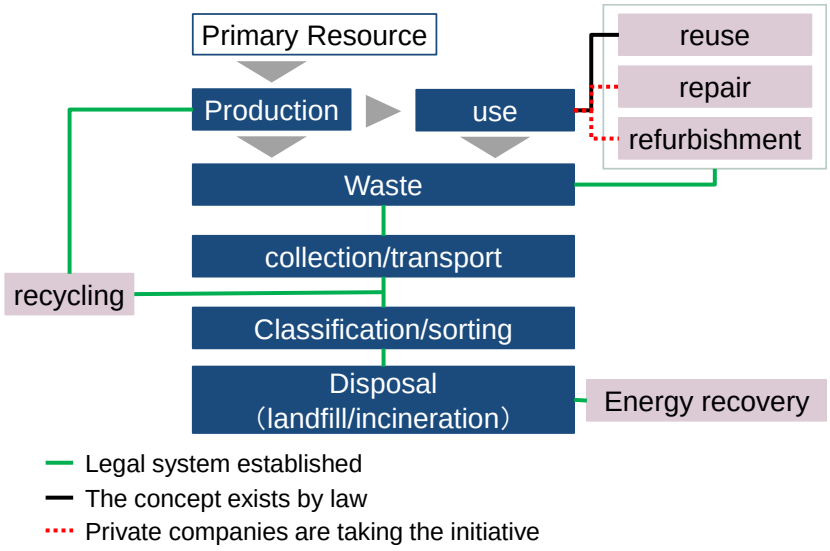
Source: Authors.

## 2.2. Lessons Learned

Japan has developed a waste management system that encompasses both response measures to properly dispose of the large amount of waste generated by its economic growth as well as preventive measures to control waste generation itself (Table 2.1). An important feature is the clarification of responsibilities, established through standards that must be adhered to by waste generators and processors at all stages of waste collection and treatment. The system also includes mechanisms for monitoring improper disposal and penalties, with the aim of enhancing awareness and competence amongst parties involved in waste management. Furthermore, to maintain the waste management infrastructure, the government provides grants for the development of waste treatment facilities and treatment technologies, fosters cooperation between the central government and local governments, and offers related financial and technical support to the private sector.

The legal system is based on concepts that contribute to reducing waste generation, including the realisation of a circular economy, the 3R principles (i.e. reduce, reuse, recycle), and EPR (Figure 2.2). Under the Basic Law on Resource Recycling, the government set forth goals and developed recycling laws for each product category. The private sector, in accordance with EPR, is thus obligated to collect and to recycle e-waste and end-of-life vehicles. Through the government's proactive enforcement, the private sector has become integral to Japan's domestic waste treatment infrastructure, encompassing activities of waste collection, transport, recycling, and final disposal. In addition, the central and local governments conduct waste management awareness programmes for citizens and businesses, as well as eco-town projects, which are believed to have led to the establishment of a nationwide culture and implementation system for waste management.

**Figure 2.2. Value Chain in Japan's Waste-Related Legal System**




Source: Authors.

## 3. Waste-Related Legal System in the European Union

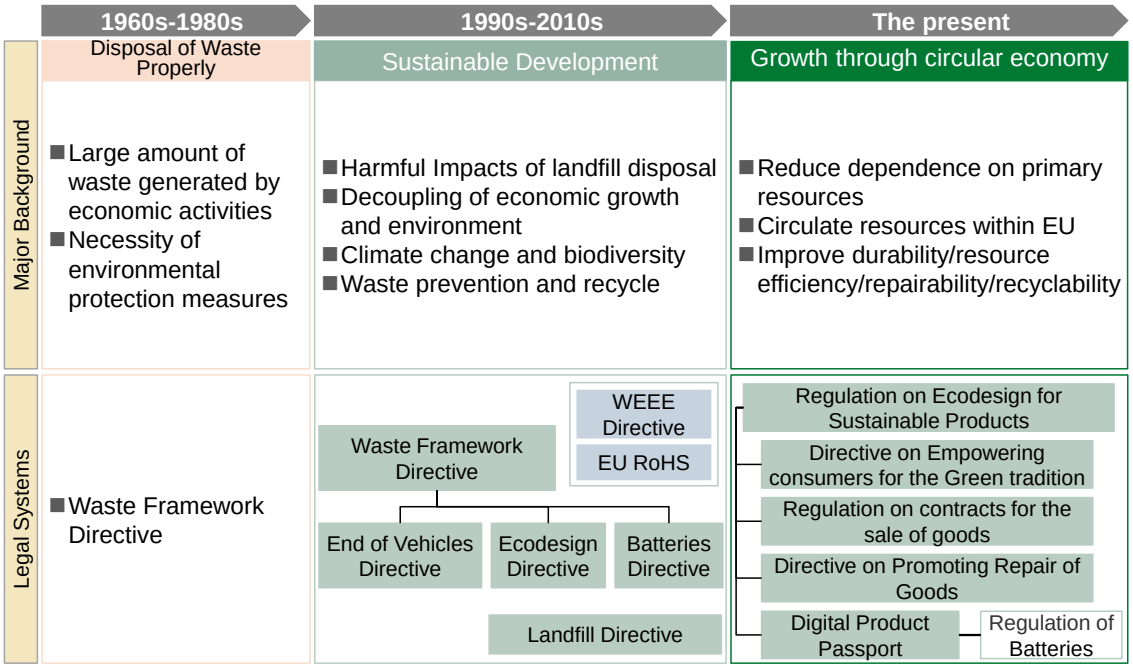
### 3.1. Overview

As in Japan, the development of the waste-related EU legal system can be divided into two phases: one addressing the proper disposal of large volumes of waste generated alongside economic growth, and the other aimed at reducing waste generation through realisation of a recycling-centric society (Figure 2.3).[18] The EU is further building a legal system to promote reuse, repair, and refurbishment based on the Waste Hierarchy.[19]

[18] Note that this section refers to EU directives and regulations, not to individual national laws of EU countries.

[19] Indicates a priority of a priority order in waste prevention and management legislation and policy. These are the cornerstone of EU waste policies and legislation. The methods of waste prevention and management are arranged in an inverted pyramid, starting with the most preferred means (i.e. prevention, preparing for reuse recycling, other recovery, and disposal).

**Figure 2.3. Overview of the European Union's Waste-Related Legal System**




EU = European Union, RoHS = Restriction of Hazardous Substances Directive, WEEE = waste from electrical and electronic equipment.
Source: Authors.

In the 1970s, environmental pollution and health hazards caused by waste became apparent across Europe, necessitating a unified waste management policy at the European Community level. The Waste Framework Directive, the basic law for waste management in the EU, was thus established. It defines waste and by-products, establishes a waste hierarchy, sets numerical targets for waste reduction, and defines recycling and treatment standards.[20]

As sustainable development became more important in the 1990s, the EU developed a legal framework to reduce the use of natural resources and amount of waste generated and to promote recycling. In particular, environmental pollution and health hazards caused by the landfilling of e-waste from households were becoming apparent, as proper disposal was not being carried out. Accordingly, the Waste Electrical and Electronic Equipment (EEE) Directive was established, which stipulates classification and design requirements for EEE as well as promotion of reuse and recycling. In addition, the Restriction of Hazardous Substances Directive was developed to limit the use of hazardous heavy metals and to promote the recycling of used EEE. The Battery Directive, which includes regulations for the entire life cycle of batteries that contain many hazardous substances, and the proposed Ecodesign Directive, which requires home appliances to be designed with a low environmental impact, were also promulgated. These directives and regulations have helped create a value chain that anticipates the reuse and recycling of products from their production stage.[21]

[20] European Commission, Waste and Recycling, Environment, https://environment.ec.europa.eu/topics/waste-and-recycling_en

[21] Municipal Waste Europe, Summary of the Current EU Waste Legislation, https://www.municipalwasteeurope.eu/summary-current-eu-waste-legislation

In recent years, the EU has launched an economic growth strategy leveraging the circular economy. It aims to establish a circular economy to keep resources circulating longer by improving legislation and strengthening the value chain, including long-life products, reuse, recycling, and remanufacturing. The proposed Ecodesign for Sustainable Products Regulation will specify requirements for the durability, reusability, and retrofitting/repairability of each product, including EEE. It also requires that a digital product passport be attached to a product or its packaging to disclose such product information to consumers. Furthermore, a draft directive on common rules promoting the repair of goods defines the consumer's right to repair as a new legal concept and imposes repair obligations on manufacturers of products under certain conditions.

**Table 2.2. Established Waste-Related Acts in the European Union**

| Established Act | Contents |
|---|---|
| Waste Framework Directive (2008) | Establishes basic concepts and definitions related to waste management, including definitions of waste, recycling, and recovery, to address the generation of large volumes of waste and associated environmental pollution. |
| | • Clarifies waste definition and waste treatment priorities.<br>• Sets numerical targets for waste reduction by the target year.<br>• Defines by-products, and sets recycling criteria. |
| Regulation on Ecodesign for Sustainable Products (proposal) | Reduces the negative life-cycle environmental impacts of products, and improves the functioning of the internal market.<br><br>Contributes to the objectives of EU industrial policy to boost the supply of and demand for sustainable goods, delivers on sustainable production, and ensures a level playing field for products sold on the internal market. |
| | • Targets about 30 products, including air conditioners, refrigerators, and other energy-consuming appliances.<br>• Defines basic requirements for product specifications and a framework for evaluating their conformity.<br>• Establishes various basic requirements commonly required of target products, such as durability, reusability, repairability, and energy efficiency.<br>• Requires disclosure of product information to consumers. |
| Directive on Promoting Repair of Goods<br><br>(proposal) | Promotes more sustainable consumption by increasing product repair and reuse, both within and outside of legal warranties. |
| | • Obligates the repair goods to which reparability requirements under EU legal acts apply.<br>• Informs consumers about producers' repair obligations.<br>• Creates an online national repair platform.<br>• Configures a voluntary EU quality standard for repair services. |
| WEEE Directive (2003) | Contributes to sustainable production and consumption through creation of waste EEE as a first priority, efficient use of resources and retrieval of secondary raw materials, and improvement of the environmental performance of everyone involved in the life cycle of EEE. |

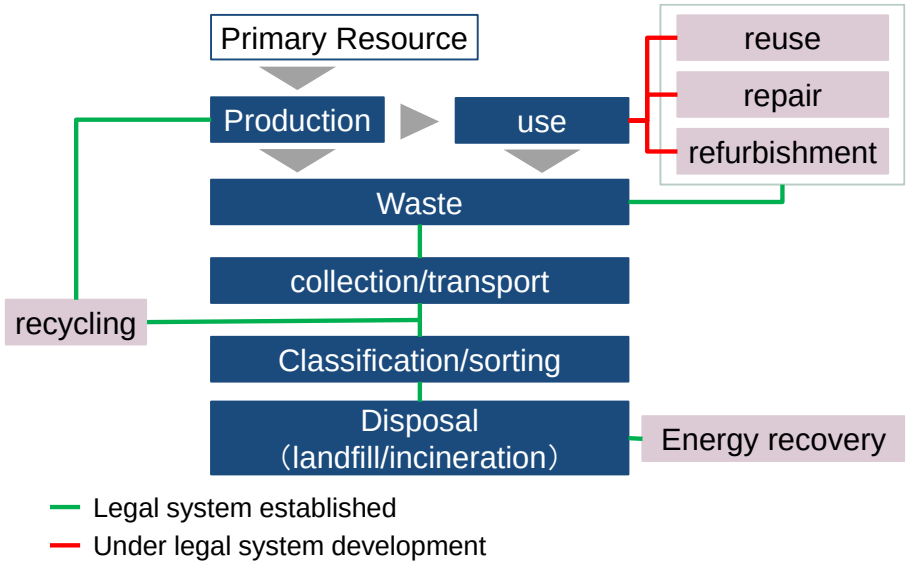
| Established Act | Contents |
|---|---|
| | • Designates the classification of electronic equipment.<br>• Provides for the promotion of recycling through design improvements.<br>• Leaves each country to create specifics of the directive. |

EEE = electrical and electronic equipment, EU = European Union.
Source: Authors.

### 3.2. Lessons Learned

The EU has built a legal system with binding force to realise waste management and the establishment of a circular economy, while taking into account the regional characteristics of member countries (Table 2.2). Waste reduction and the realisation of a circular economy are overall goals; legal systems for waste management generally take the form of directives and are left to the national laws of each country. However, much of the legislation that contributes to the realisation of a circular economy takes the form of regulations that are binding on member countries. It imposes strong obligations on the private sector at each stage of the value chain, from product design and manufacture to reuse, repair, refurbishment, and recycling. The European Commission's top-down legal systems for resource circulation and the solid implementation by businesses support the EU's circular value chain (Figure 2.4).

**Figure 2.4. Value Chain in the European Union's Waste-Related Legal System**




Source: Authors.

## 4. Waste-Related Legal System in ASEAN

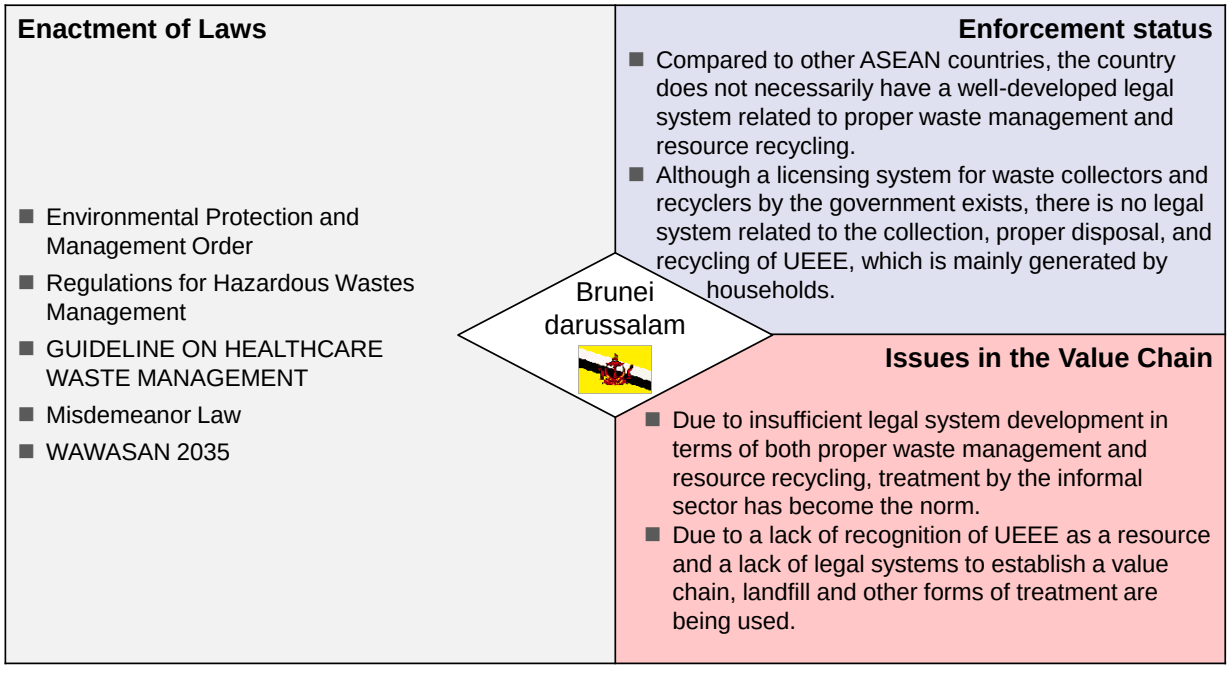
This section provides an overview of the waste-related legal systems or plans in force in AMS, status of their implementation, and challenges in the value chain surrounding EEE. While some AMS have developed legal systems and plans for resource circulation, including e-waste, others are still in the process. The implementation of these legal systems varies, and challenges exist within the circular value chains surrounding e-waste. In AMS where regulations exist for proper waste management, the informal sector still often plays a significant role. Additionally, in some AMS, the actual situation is difficult to grasp.

### 4.1. Brunei Darussalam

Brunei Darussalam has a basic framework for waste management and legislation on waste management, including hazardous substances. Yet there are no laws regarding the utilisation of used EEE or recycling of e-waste. Only two facilities collect e-waste, and no facilities treat it. Overall, the public is not aware of the proper management of waste and its effects on health.

Effective operation of the waste-related legal system has not been achieved; therefore, it is necessary to establish a system for the proper management of waste, including e-waste. Brunei Darussalam developed *Wawasan 2035* in 2007 as its economic strategy, where it mentions the proper management of waste and enhancement of recycling and reuse. Based on this strategy, the development of related laws and regulations may be underway (Figure 2.5).

**Figure 2.5. Waste-Related Legal System in Brunei Darussalam**

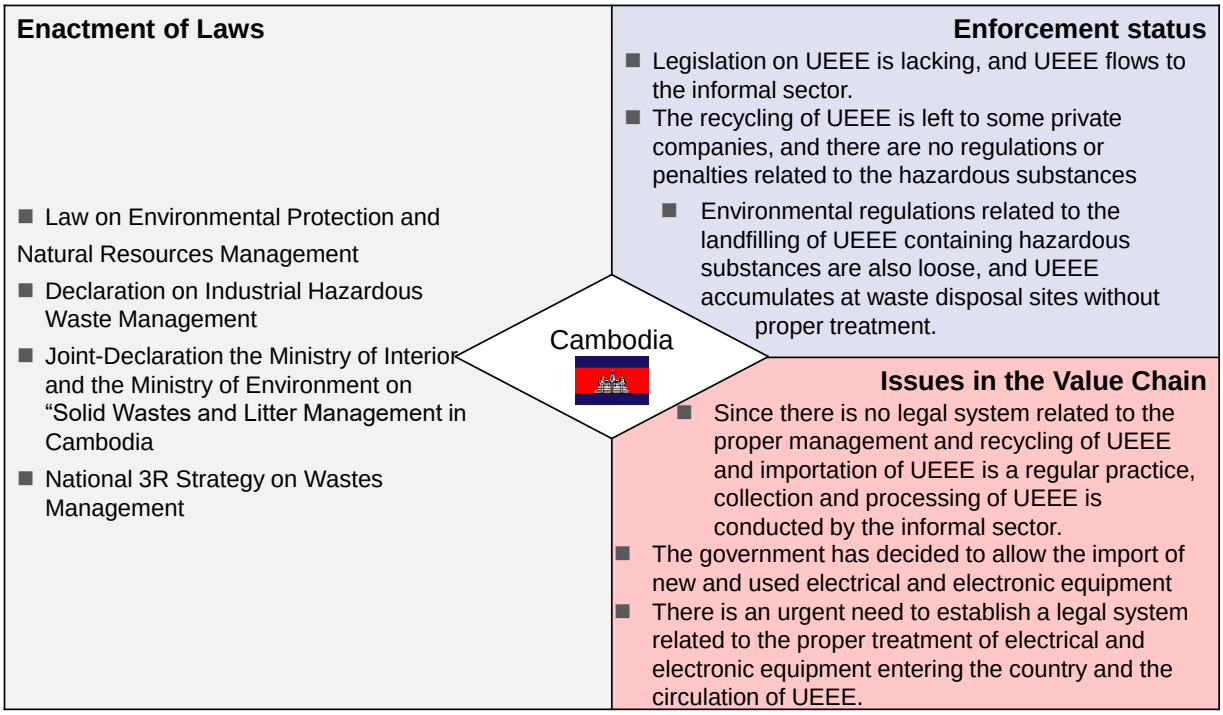



ASEAN = Association of Southeast Asian Nations, UEEE = used electrical and electronic equipment.
Source: Authors.

### 4.2. Cambodia

Cambodia has a well-developed legal system for industrial waste management, including hazardous substances. It also developed a strategy on the 3Rs as well as guidance on e-waste management (Chin, 2010). Yet the majority of imported used EEE flows to private operators and the informal sector without government control, and the legal system is lagging behind as well. A legal system for the proper collection and recycling of e-waste is needed (Figure 2.6).

**Figure 2.6. Waste-Related Legal System in Cambodia**

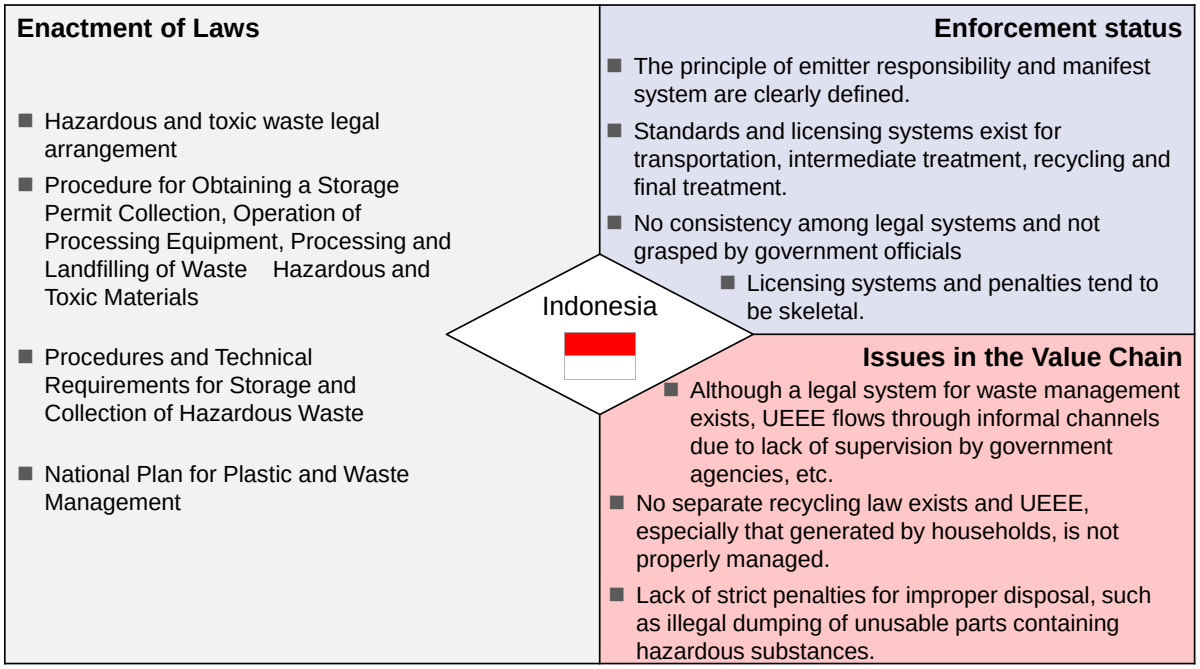



3Rs = reuse, reduce, recycle; UEEE = used electrical and electronic equipment.
Source: Authors.

### 4.3. Indonesia

In Indonesia, e-waste falls within the framework of waste management. The 3Rs concept is stipulated here, focussing on the reduction of waste generation. On the other hand, the obligations of the general public, manufacturers, retailers, processors, and others involved in waste management are not defined. Furthermore, the regulation of used EEE and e-waste – which often illegally enter the country – has not been kept up to date (MOE, 2016). Therefore, detailed management rules for e-waste and a recycling system for used EEE are required (Figure 2.7).

**Figure 2.7. Waste-Related Legal System in Indonesia**

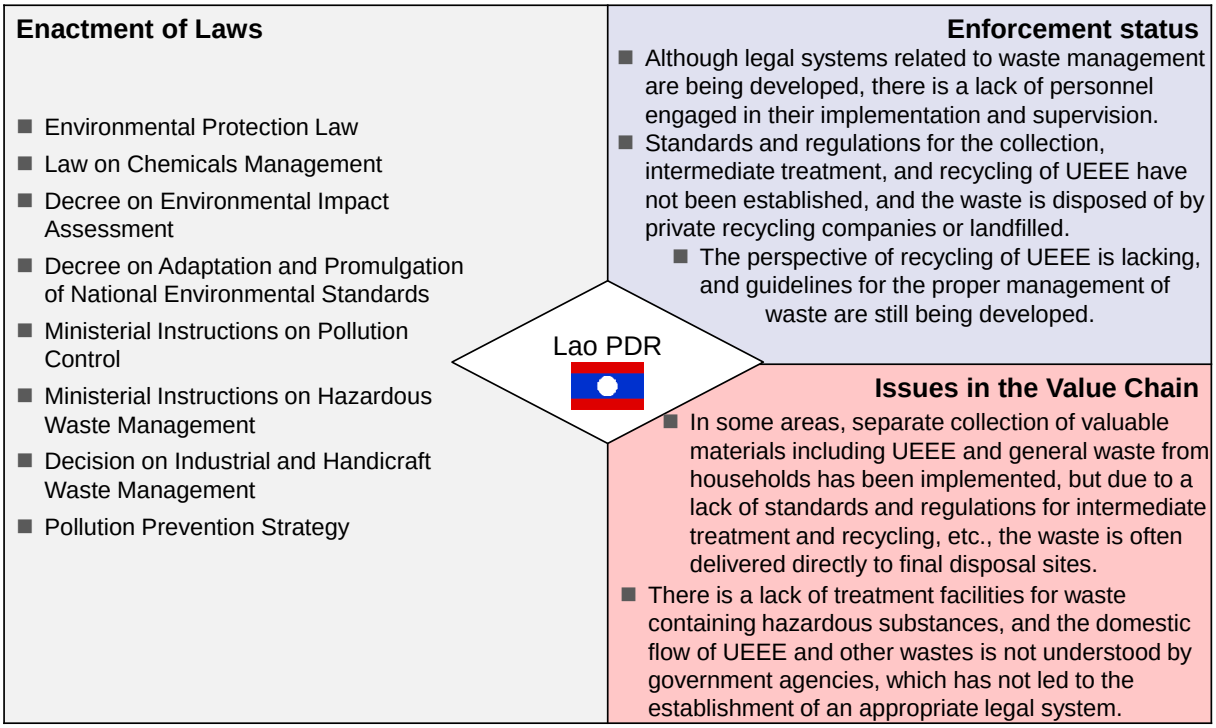



UEEE = used electrical and electronic equipment.
Source: Authors.

### 4.4. Lao People's Democratic Republic

The Lao People's Democratic Republic (Lao PDR) has a basic framework for waste management as well as regulations for waste containing hazardous substances. However, the general public is generally unfamiliar with EEE such as home appliances, so the problem of e-waste is not as dire as it is in other countries (JICA, 2021). In anticipation of the spread of home appliances and influx of foreign consumers as the economy develops, it will be necessary to establish a legal system for the proper management of e-waste (Figure 2.8).

**Figure 2.8. Waste-Related Legal System in the Lao People's Democratic Republic**



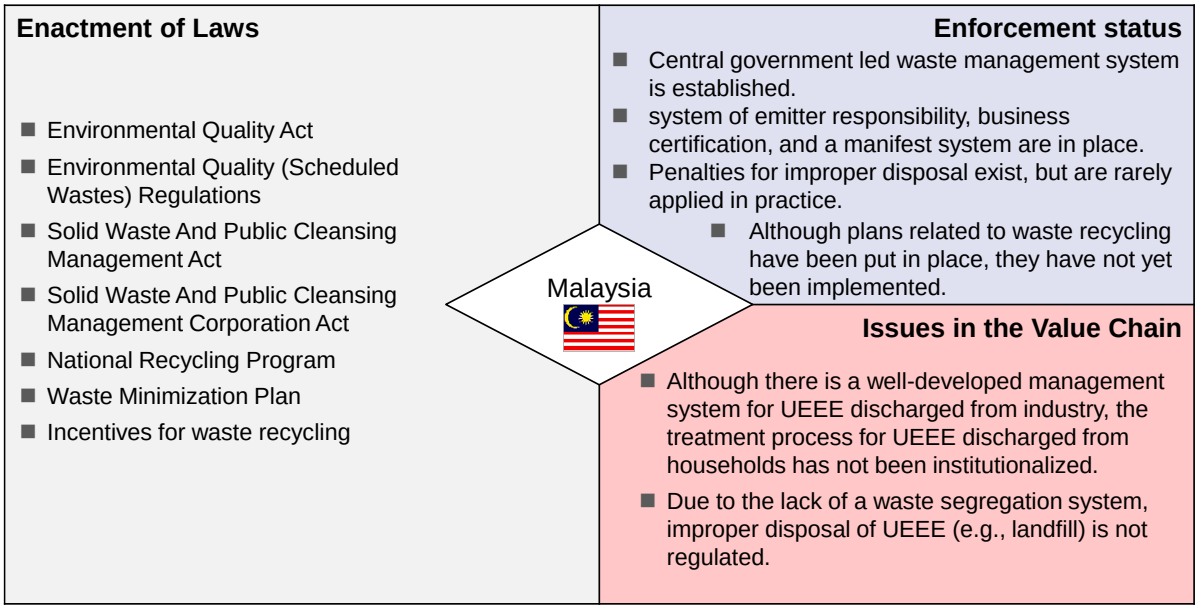

UEEE = used electrical and electronic equipment.
Source: Authors.

### 4.5. Malaysia

In Malaysia, the establishment of a system for the proper management of e-waste – mainly derived from industrial waste – is ahead of those of other AMS. In collaboration with the Japan International Cooperation Agency (JICA), a project is being carried out from October 2021 to March 2025 to establish a sustainable household e-waste management system, specifically for televisions, refrigerators, washing machines, air conditioners, personal computers, and cell phones. It includes the development of a database module to license and to monitor contractors who collect and process household e-waste; help with the selection, training, monitoring, and review of each contractor; establishment and operation of a financial management system; and development of a recycling support system and staff training. Legislation is being accelerated to implement this e-waste management system as well.

There is also a regulatory framework for the import of e-waste and transboundary movements of used EEE. However, regulations for intermediate businesses that process e-waste domestically are not well developed, and there is no management framework for e-waste generated from households (DOE, 2021). Therefore, the establishment of a domestic e-waste recycling system in Malaysia is needed (Figure 2.9).

**Figure 2.9. Waste-Related Legal System in Malaysia**

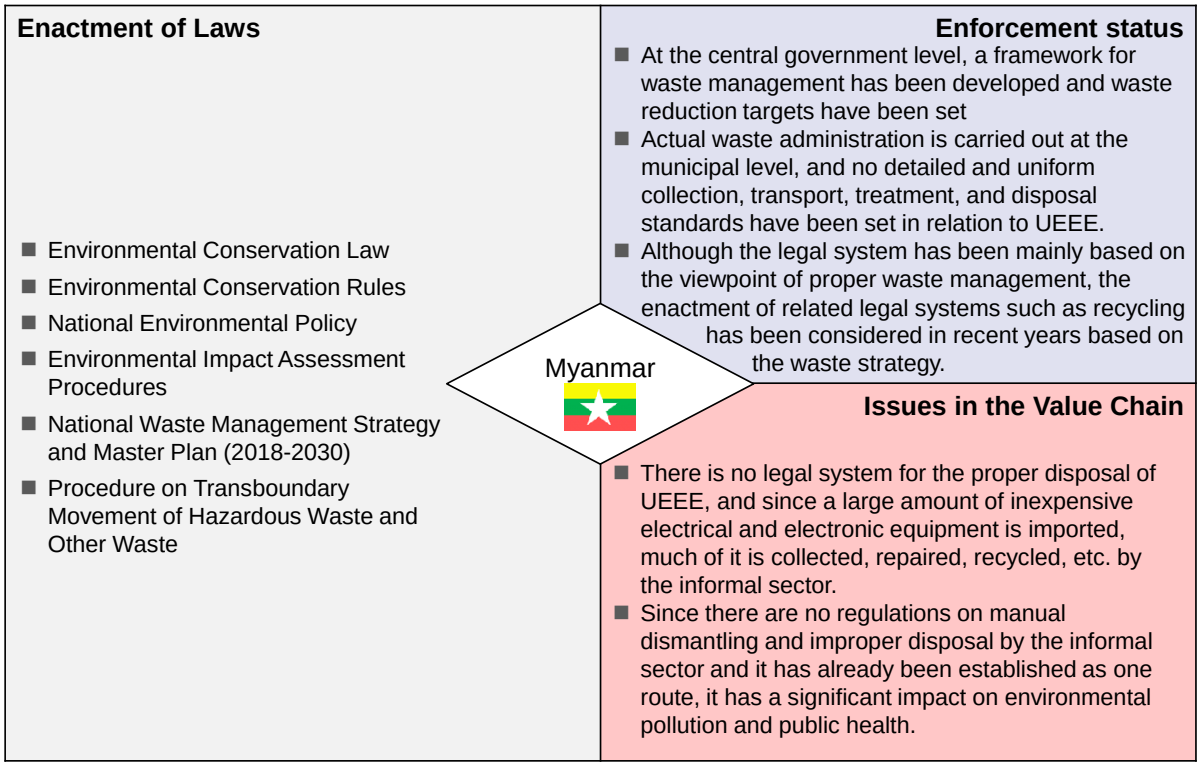



UEEE = used electrical and electronic equipment.
Source: Authors.

### 4.6. Myanmar

In Myanmar, strict waste management and waste reduction targets have been set at the government level. As in the Lao PDR, EEE is not widespread in households, so problems related to e-waste have not yet become apparent. Yet with economic growth in recent years, the general public is expected to increase their income and consumption, and the market related to used EEE is expected to expand, and e-waste is expected to increase (IGES, 2017). In the future, it will be necessary to establish a legal system for the proper management of e-waste and effective utilisation of used EEE (Figure 2.10)

**Figure 2.10. Waste-Related Legal System in Myanmar**

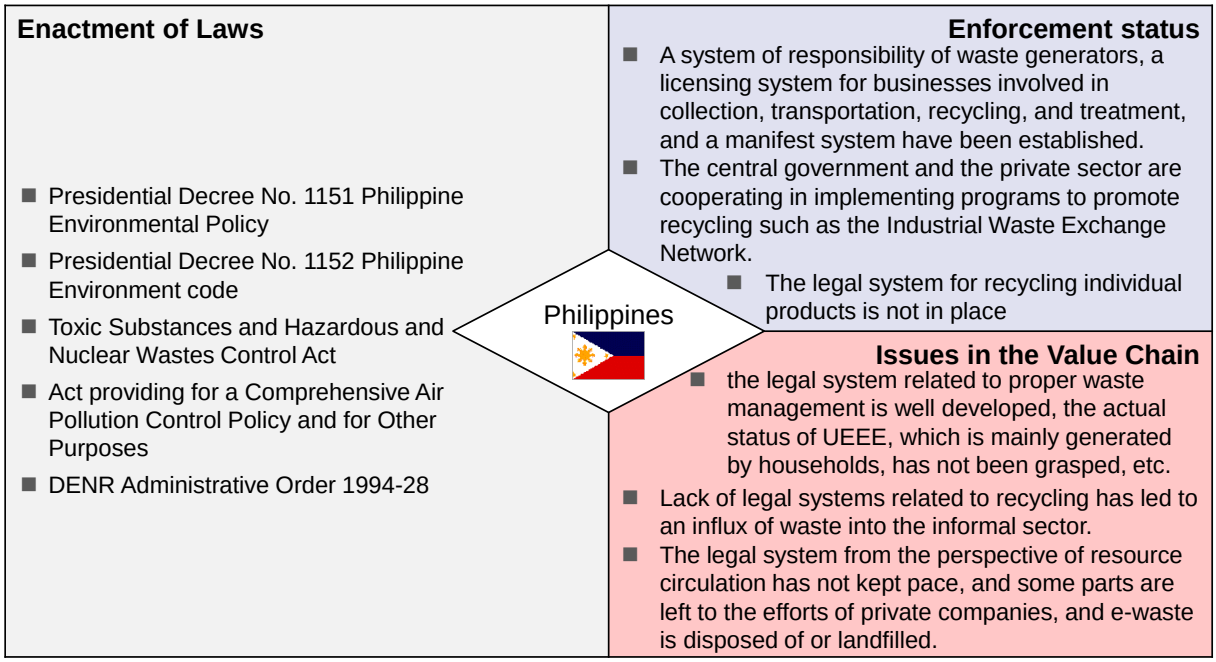



UEEE = used electrical and electronic equipment.
Source: Authors.

### 4.7. Philippines

The Philippines has a well-developed waste management system that incorporates the concept of emitter responsibility, business certification, and a manifest system. The construction of a waste management system is progressing with the cooperation of the public and private sectors (JETRO, 2020). There is a growing market for imported used EEE, mainly in urban areas, and informal sector does work to recover useful metals from e-waste. Legal systems encompassing these activities thus need to be improved (Figure 2.11).

**Figure 2.11. Waste-Related Legal System in the Philippines**




DENR = Department of the Environment and Natural Resources, UEEE = used electrical and electronic equipment.
Source: Authors.

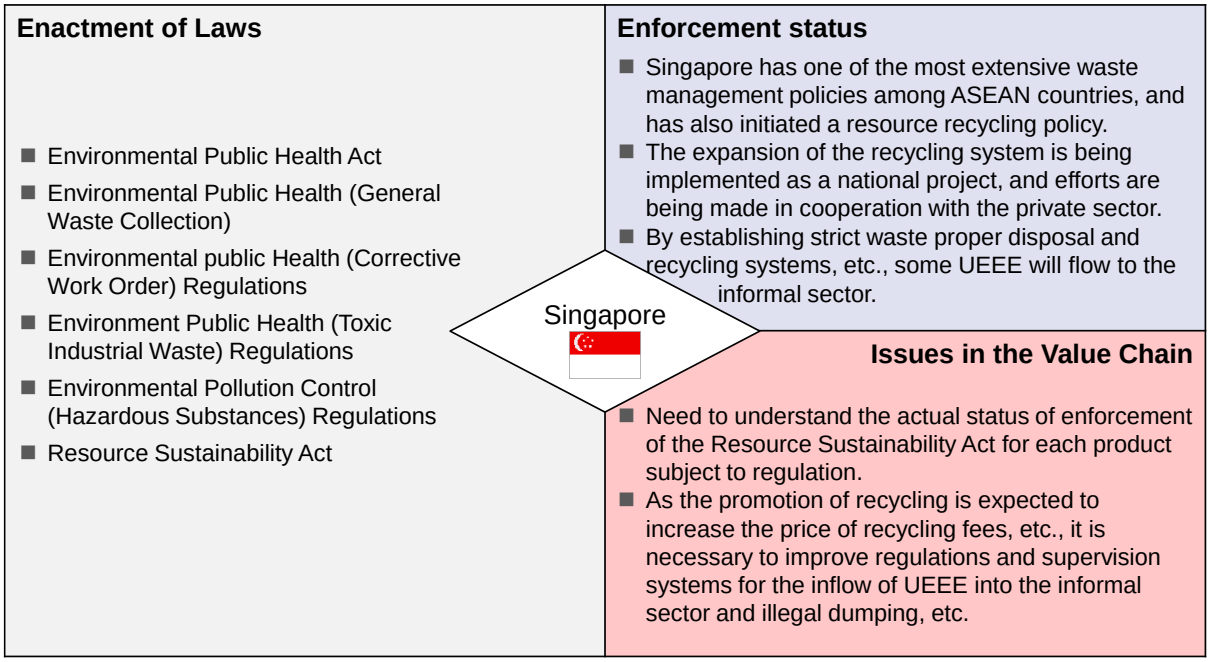
### 4.8. Singapore

Singapore has a well-developed legal system for the proper management of waste as well as an associated well-functioning supervision system at the central and municipal government levels. Legislation for the proper collection and disposal of e-waste is also being developed.

Singapore has been creating and revising its e-waste management framework since 2015 and has made more progress in its efforts than any other AMS. In 2019, it enacted the Resource Sustainability Act and introduced EPR for EEE. The act imposes high numerical targets for reuse and recycling on certain large waste generators. Target products include printers, computers, routers, modems, air conditioners, refrigerators, televisions, batteries, electric vehicle batteries, lighting, and solar panels.

The management of the large volume of used EEE entering the country has not kept pace, and there is a lack of regulation of its flow into the informal sector (Goh, 2020). Therefore, it is necessary to strengthen the appropriate management system for e-waste, including regulations for the informal sector, and to establish a legal system for the collection and utilisation of used EEE (Figure 2.12).

**Figure 2.12. Waste-Related Legal System in Singapore**



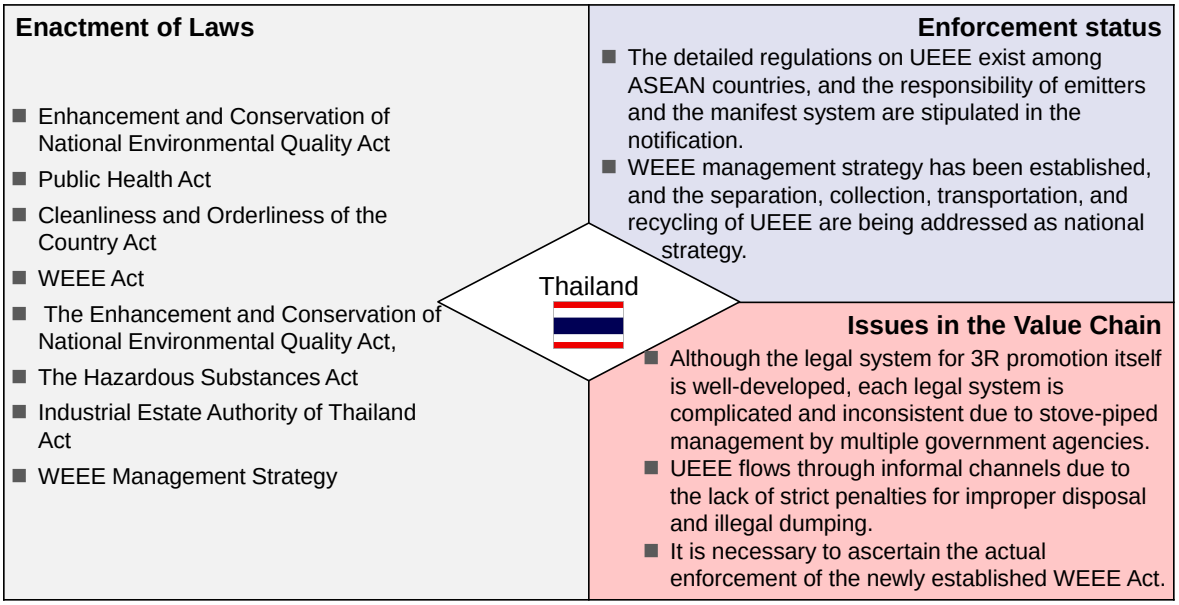

ASEAN = Association of Southeast Asian Nations, UEEE = used electrical and electronic equipment.
Source: Authors.

### 4.9. Thailand

In addition to a basic framework for proper waste management, Thailand has been working on the proper management of e-waste and effective utilisation of used EEE since the ratification of the Basel Convention in 1989.[22] In December 2022, the Department of Foreign Trade conduced public hearings to revise the current regulations that provide for a ban on e-waste imports; a new notification will be issued within FY2023. The legal systems for the recycling of e-waste and utilisation of used EEE are still being developed (Figure 2.13).

[22] Enviliance Asia, Waste Management in Thailand, https://enviliance.com/regions/southeast-asia/th/th-waste

**Figure 2.13. Waste-Related Legal System in Thailand**




ASEAN = Association of Southeast Asian Nations, UEEE = used electrical and electronic equipment, WEEE = waste from electrical and electronic equipment.
Source: Authors.

### 4.10. Viet Nam

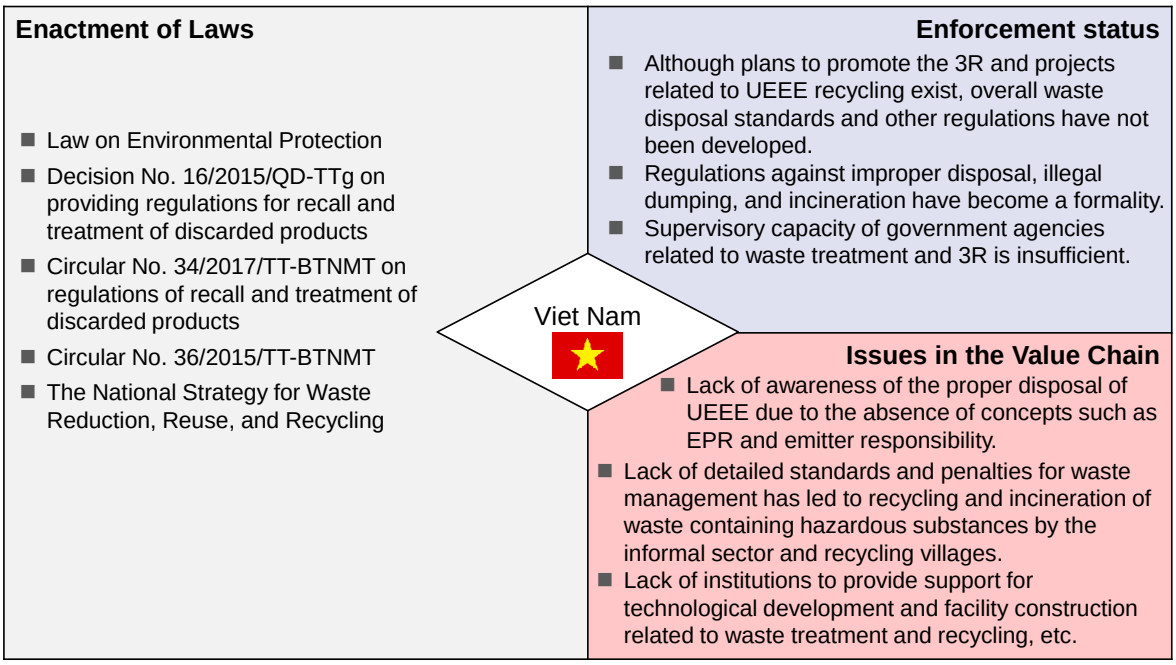
In Viet Nam, the Decision on Collection and Treatment of Waste Products (50/2013/QD-TTg) was issued in relation to a basic waste management framework and the collection and recycling of e-waste. This regulation covers personal computers, cell phones, televisions, air conditioners, refrigerators, and washing machines. The clarification of the responsibility of operators involved in collection and treatment activities and the certification of operators are in progress. Recycling by authorised recyclers is also being promoted.

In 2020, the Law on Environmental Protection (No. 72/2020/QH14) took effect. As of 1 January 2024, it requires product manufacturers and importers to have, under EPR, a recycling system for EEE. It provides detailed rules for the recycling of EEE, establishing a list of regulated products and mandatory recycling rates, payments to an environmental protection fund, obligations for producers to develop recycling plans, disclosure of product information, and reporting of recycling performance.

Regulation of the informal sector, which competes with legitimate recyclers, has not kept pace, and improper disposal of e-waste is rampant.[23] Therefore, it is necessary to tighten the e-waste management system, including regulation of the informal sector, and to establish a recycling system (Figure 2.14).

[23] Vietnam Environment Administration (2020), 'E-Waste Management in Viet Nam', https://www.iep-global.org/wp-content/uploads/2020/01/8.-Vietnam.pdf

**Figure 2.14. Waste-Related Legal System in Viet Nam**




3R = reduce, reuse, recycle; EPR = extended producer responsibility; UEEE = used electrical and electronic equipment.
Source: Authors.

## 5. Needs of the Waste-Related Legal Systems in ASEAN

### 5.1. Collaborative Mechanisms to Establish a Legal System

Proper management of waste and the promotion of resource recycling require a high level of public awareness. In Japan, the government has undertaken initiatives to raise public awareness, including the development of community-based recycling projects involving local governments, residents, and businesses. Similar efforts have been implemented in Singapore. Cebu, Philippines signed an environmental technical cooperation agreement with Kitakyushu, Japan, showing potential effectiveness. For example, Kitakyushu City has dispatched personnel to Cebu City to provide guidance and advice for the collection of home appliances and the establishment of a recycling system.

However, AMS face challenges due to a lack of technology and facilities for waste treatment and recycling. To address this, Japan has collaborated with AMS through various frameworks, such as the Asian 3R Promotion Forum, E-Waste Training Workshop for Asia and the Pacific, and Asian Network for Prevention of Illegal Transboundary Movement of Hazardous Wastes.[24] These initiatives involve knowledge sharing, information exchange, and the transfer of recycling technology, often supported by Japanese private sector investment. While technical efforts are underway – particularly in Indonesia, Malaysia, and Thailand – e-waste management projects with countries such as the Lao PDR and Myanmar have not been substantial. In addition, efforts focussed on the development of waste-

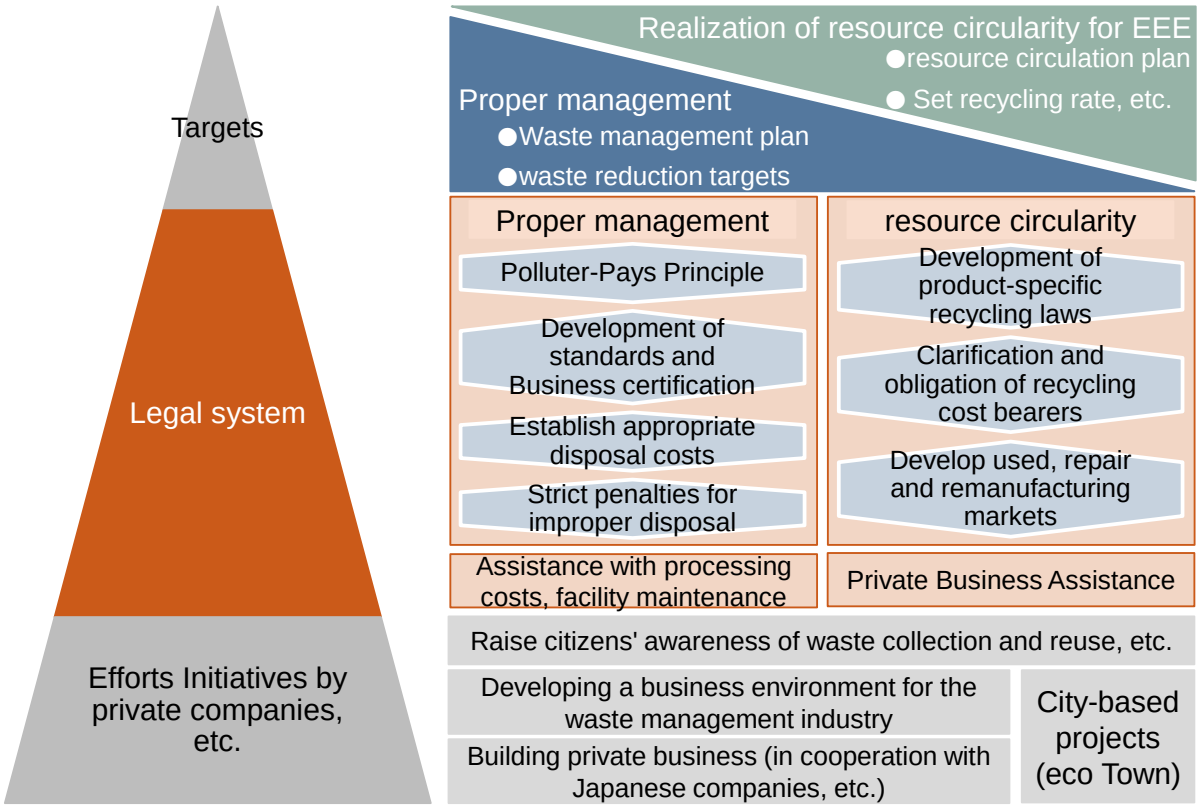
[24] MOE (2009); Government of Japan, MOE, Regional 3R Forum in Asia, http://www.env.go.jp/recycle/3r/en/forum_asia/index.html; Government of Japan, MOE, The Asian Network for Prevention of Illegal Transboundary Movement of Hazardous Wastes, http://www.env.go.jp/en/recycle/asian_net/

related legal systems continue to be lacking.

At the intergovernmental level, AMS and Japan can cooperate in examining legal texts and designing systems that align with the specific conditions of each AMS. This includes clarifying the responsibilities and roles of stakeholders; establishing standards for waste collection, transport, and treatment; defining technical requirements for recycling facilities; and setting up recycling fees. Additionally, providing various types of support, such as capacity building for local staff, is crucial for effective enforcement and the long-term sustainability of waste management and recycling systems.

To develop a well-developed social infrastructure such as waste treatment and recycling facilities necessitates ongoing subsidies and technology transfer, and expansion of waste-related legal systems. These efforts can be facilitated through by promoting cooperation with Japan and other countries. By strengthening these collaborations, AMS can enhance their waste management practices, promote resource recycling, and move towards a more sustainable future (Figure 2.15).

**Figure 2.15. Improving the Value Chain through the Waste-Related Legal System**




EEE = electrical and electronic equipment.
Source: Authors.

Finally, it would be beneficial to take advantage of ASEAN's unique characteristics as a federation to set a common goal of moving beyond the waste management phase and achieving resource recycling that contributes to the economic growth of the region as a whole. Although no agreed-upon targets have been set for ASEAN, it may be useful to determine common but distinctive numerical targets based on the needs and economic conditions of each AMS, based on discussions amongst representatives of each country. As in the EU, promoting cooperation and coordination amongst

member states would facilitate the development of harmonised policies, sharing of best practices, and establishment of common standards for resource recycling. Although best practices have already been shared amongst AMS, comparative analysis of national management systems and implementation of standards and codes of practice based on such systems have not yet been pursued.

### 5.2. Enhancement of Legal Systems for Resource Circulation

In ASEAN, most AMS have their own legal systems for waste management, including e-waste. However, there are common challenges that persist throughout the region. One challenge is the lack of an EPR perspective. EPR holds manufacturers accountable for their products throughout their life cycle, including managing the waste generated from their products. Implementing EPR can incentivise producers to design products with recyclability in mind and take responsibility for proper disposal at the end of their life.

Another challenge is the absence of detailed standards and penalties for each stage of the waste management value chain. Without clear standards and penalties, ensuring compliance with environmental and safety requirements becomes difficult. Moreover, the lack of penalties for improper disposal undermines accountability and encourages unsustainable waste management practices. Furthermore, there is a shortage of human resources in administrative agencies responsible for supervising waste management operators, which hampers effective monitoring and enforcement of waste management regulations, leading to non-compliance and improper disposal practices.

To address these challenges, strengthening the waste management value chain is crucial. This can be achieved by developing a comprehensive waste-related legal system that incorporates key elements from established systems, such as that of Japan. Elements to consider include the polluter-pays principle, EPR, the development of standards and business certification, establishment of appropriate disposal costs, and implementation of strict penalties for improper disposal.

In ASEAN, some AMS like Malaysia and Thailand have developed legal systems that encompass recycling and aim to promote the circulation of used EEE beyond the scope of proper waste management. However, these legal systems often lack specific regulations tailored to product-specific recycling. As a result, there may be limited understanding of the value chains specific to different products and the potential for higher value-added circulation. To address this, product-specific recycling laws should be established that provide clear guidance and requirements for recycling various types of products. These laws should include provisions that clarify the responsibilities and obligations of recycling cost bearers. By implementing such laws, it becomes easier to identify the specific recycling needs and opportunities for value-added circulation within product-specific value chains. Japan's legal system related to resource circularity can serve as a valuable reference in this endeavour.

Moreover, AMS possess significant market potential for used and repaired EEE. Looking to the development of reuse and repair legislation in the EU – which is structured to guarantee the right to repair, facilitate access to repair parts, and reduce the cost of repair from the perspective of protecting the general public – efforts should be made to promote reuse and repair initiatives. Initiatives focussed on reuse and repair can contribute to resource conservation, waste reduction, and the development of a circular economy.

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# Chapter 3

# International Rules and Standards on the Trade of Used Electrical and Electronic Equipment and E-Waste

## 1. Introduction

Some import regulations have been established in Association of Southeast Asian Nations (ASEAN) Member States (AMS) to prevent the importation of used electrical and electronic equipment (EEE) and e-waste that can cause environmental pollution and health damage. This chapter provides information on the presence or absence of regulations in AMS and best practices on the trade of used EEE and e-waste.

## 2. Basel Convention

The Basel Convention on the Control of Transboundary Movements of Hazardous Wastes and Their Disposal was adopted in 1989 to reduce hazardous waste generation, promote environmentally sound management of hazardous waste, restrict transboundary movements of hazardous waste except when in accordance with the principles of environmentally sound management, and create a regulatory system for cases where transboundary movements are permissible.[25] All AMS are parties to the Basel Convention.

E-waste is categorised as hazardous or non-hazardous waste under the Basel Convention.[26] Both hazardous and non-hazardous e-waste transboundary movements will be subject to the Prior Informed Consent Procedure, according to the Basel Convention, from 1 January 2025 (due to amendments in 2022). The Basel Convention does not cover used EEE, so it is important to distinguish used EEE and e-waste when they are traded globally. Draft technical guidelines on the transboundary movements of EEE and used EEE – in particular regarding the distinction between waste and non-waste under the Basel Convention – were adopted on an interim basis on 4 May 2006 under the Basel Convention. The latest draft was adopted on an interim basis on 4 May 2023. This document includes criteria to distinguish used EEE and e-waste (UNEP, 2023). Used EEE should be considered waste if

(i) the equipment is destined for disposal or recycling, instead of failure analysis or reuse, or its fate is uncertain;

(ii) the equipment is not complete (i.e. essential parts are missing, and/or the equipment cannot perform its key functions);

(iii) the equipment shows a defect that affects its functionality and fails relevant functionality tests;

(iv) the equipment shows physical damage that impairs its functionality or safety, as defined in relevant standards, and cannot be repaired at a reasonable cost;

[25] Secretariat of the Basel Convention, Convention Overview, https://www.basel.int/TheConvention/Overview/tabid/1271/Default.aspx

[26] Secretariat of the Basel Convention, E-Waste Overview, https://www.basel.int/Implementation/Ewaste/Overview/tabid/4063/Default.aspx

(v) the protection against damage during transport, loading, and unloading operations is inappropriate (e.g. the packaging or stacking of the load is insufficient);

(vi) the equipment is particularly worn or damaged in appearance, and its appearance reduces its marketability;

(vii) the equipment – amongst its constituent parts – has a hazardous component or contains hazardous substances to an extent that the equipment is required to be disposed of;

(viii) there is no regular market for the equipment to be reused, including when the equipment contains a cathode ray tube, except when there is a regular market for equipment for professional use containing a cathode ray tube;

(ix) the equipment is destined for disassembly and cannibalisation; and/or

(x) the price paid for the equipment is significantly lower than would be expected for fully functional equipment intended for reuse.

## 3. Regulations on Imports in ASEAN

AMS have enforced various regulations on the import of used EEE and e-waste (Table 3.1). Since China created regulations on the importation of waste in 2018, illegal importation of waste – including e-waste – has increased in AMS (Kojima, Sasaki, Yoshida, 2021). Due to this phenomenon, some AMS have developed strict regulations on import of used EEE and e-waste in recent years. For example, Indonesia permits the importation of used EEE only by direct user companies and reconditioning companies in bonded areas, based on a regulation enacted in 2021. Myanmar prohibited the importation of used EEE in 2022. Thailand has prohibited the import of used EEE temporarily since 2017, while Viet Nam has prohibited the importation of second-hand information technology equipment since 2018.

Used EEE can be imported in Cambodia, Indonesia, Malaysia, Philippines, and Singapore if it meets the criteria of each AMS. Criteria are not standardised across AMS. For example, used EEE for reuse and recycling can be imported to the Philippines, but only that for reuse can be imported to Cambodia. In addition, some AMS have their own standards to distinguish used EEE and e-waste. For example, in Malaysia, used EEE within 5 years from the date of manufacture can be imported for direct reuse purposes. Used EEE within 3 years from the date of manufacture can be imported for sale or reuse.

To promote proper e-waste trade management and the smooth trade of permitted used EEE and e-waste, establishing commonly understood and reliable standards for used EEE and e-waste across ASEAN is important. Domestic laws and regulations of each AMS should be taken into account, especially regarding business-to-business collaboration and trade facilitation matters related to used EEE, e-waste, and remanufactured goods as well.

**Table 3.1. Overview of E-Waste and Used Electrical and Electronic Equipment Import Regulations in ASEAN**

| Member State | Regulation | Items | Jurisdiction | Overview |
|---|---|---|---|---|
| **Singapore** | E-Waste and Used Electrical and Electronic (EEE) Import and Export Control Notice (1998) | Used EEE | National Environment Agency | • Importer demonstrates that the used EEE is in good working condition in a survey report issued by an authorised third-party inspection agency in the exporting country.<br>• Importer certifies that the used EEE purchased is intended for reuse.<br>• Importer enters a contract with the manufacturer of the EEE to certify that it is repaired and reconditioned.<br>• Importer certifies that it has a repair facility and that the repaired/refurbished EEE has a distributor. |
| | | End-of-life telecommunications equipment | Information and Communication Media Development Agency (IMDA) | • Importer/user ensures that used telecommunications equipment imported for direct re-use by individuals/companies conforms to the relevant technical specifications of IMDA prior to use.<br>• Importer/user ensures that the repaired/refurbished telecommunications equipment is sold/provided/rented in the domestic market or re-exports it, and it must obtain the relevant telecommunications carrier authorisation from IMDA. |
| **Thailand** | Factory Department Notice on Used EEE Import Standards Considered as Hazardous Substances (2007) | Used EEE considered hazardous materials | Department of Industrial Works (DIW) | • Importer demonstrates that the used EEE or its components have the necessary functionality for special use, adequacy, and applicability.<br>• Importer shows that the part or parts remain in their original form and that the importation is for spares to replace damaged parts, together with evidence of necessity.<br>• Importer shows that the used EEE complies with Thai Industrial Standards. |

| Member State | Regulation | Items | Jurisdiction | Overview |
|---|---|---|---|---|
| | Industry Bureau Notification on Import Standards for Used Electronic and Electric Machinery (2003) | Used EEE | DIW | • Imports of used EEE are prohibited for the purpose of sale or reuse that are more than 3 years old from the date of manufacture.<br>• Imports for recycling purposes are permitted if they have economic value, can be processed in DIW-registered factories including all residues, and are imported from Basel Convention member countries. |
| | Hazardous Substances Law (1992) | E-waste | Pollution Control Department | • Hazardous substance lists are defined by a public notice related to the Hazardous Substances Act.<br>• Importers need a permit to import e-waste designated as hazardous waste. |
| **Philippines** | Revised Procedures and Standards for Hazardous Waste Management (2013) | E-waste<br>Used EEE | Department of Environment and Natural Resources | • Importer certifies that the product is for reuse (including direct use) or for recycling or recovery purposes. |
| **Viet Nam** | Notification of Second-Hand Information Technology Product Import Prohibition List and Applicable Harmonized System (HS) Codes (2018) | HS 84 and 85 in used EEE | Ministry of Information and Communications | • Importation of second-hand information technology equipment such as second-hand printers, computers, and mobile phones, is prohibited.<br>• Specific to used EEE, the provision is designed to prevent importation. |
| | Foreign Trade Management (2018) | Imported items on the banned list<br>Imported items on the prohibited list | Ministry of Industry and Trade | • Imports of items on the banned list are prohibited regardless of their intended use. |

| Member State | Regulation | Items | Jurisdiction | Overview |
|---|---|---|---|---|
| **Malaysia** | Customs Orders on Import Regulations (2017) | Used EEE | Ministry of Investment, Trade and Industry | • Importer declares imported products to customs and pays duties if they are subject to taxation.<br>• Importer checks whether the product falls into one of the following categories – (i) completely prohibited items, (ii) items requiring an import license, (iii) items requiring an import license due to protective measures, or (iv) items with conditions attached to the import method – and secures a certificate of approval as necessary. |
| | Guidelines for Classification of Used Electrical and Electronic Equipment (2008) | Used EEE | Ministry of Natural Resources, Environment and Climate Change | • Used EEE within 5 years from the date of manufacture can be imported for direct reuse purposes.<br>• Importer must obtain a license from the relevant authority. |
| **Indonesia** | Regulation: Importation of Used Capital Goods, in Not New Conditions (2021) | Used EEE | Directorate General for Foreign Trade | • This covers used capital goods imported into Indonesia.<br>• Importer certifies that the product is usable in one package, still functional, less than 5 years old from the year of manufacture, and to the latest specifications.<br>• Importation is subject to approval from the Director General of the Trade Control Department of the Ministry of Commerce. |
| **Myanmar** | Notification of Ministry of Commerce (2022) | Used EEE | Department of Commerce | • Importation of used equipment, such as refrigerators, air conditioners, washing machines, office automation equipment, and televisions, is prohibited. |
| | Procedure on Transboundary Movement of Hazardous Waste and Other Waste (2023) | E-waste | Environmental Conservation Department | • Importation of e-waste is not allowed due to insufficient technology with environmentally sound management. |

| Member State | Regulation | Items | Jurisdiction | Overview |
|---|---|---|---|---|
| **Cambodia** | Ministerial Decree on Waste Management of Electrical and Electronic Equipment (2016) | Used EEE | Ministry of Environment (MOE) | • For used EEE, permission from MOE is required for import for reuse.<br>• Importation of used EEE is prohibited for the purpose of repair and recovery. |
| **Brunei Darussalam** | Hazardous Waste (Control of Export, Import, and Transit) Order (2013) | E-waste | MOE | • The Authority for Info-communications Technology Industry regulates the applicable requirements for some types of used EEE.<br>• Except for waste regulated by the Authority for Info-communications Technology Industry, used EEE is classified as e-waste, and its import is prohibited. |
| | Telecommunications (Composition of Offences) Regulations (2019) | Used EEE | MOE | • Individuals or corporations importing electrical and wireless communication equipment require a permit from the Authority for Info-communications Technology Industry. |
| **Lao People's Democratic Republic** | Decision No. 1687/MONRE on Pollution Control (2021) | E-waste | Environment Bureau | • Importation of waste and used batteries that are contaminated by chemicals is prohibited.<br>• No distinction is made between e-waste and used EEE. |

Source: Authors.

## 4. Case Study: The United States

The United States (US) has been promoting remanufacturing since around 2000; tax incentives for remanufacturing firms have been introduced in New York State, and a system for distinguishing remanufactured goods has been established there (Kojima, 2022). To expand remanufacturing business to other countries, the US has added articles on remanufactured goods to various free trade agreements (FTAs) to which it is a party. The definitions of remanufactured goods, recovered goods, and origin in these FTAs help foster the smooth trade of remanufactured goods and apply for tariff exemption and reduction (Table 3.2). This also helps distinguish remanufactured goods from used goods and recovered goods from waste. Kojima (2022) suggested that by defining remanufactured goods and used goods in FTAs, the US is preventing import restrictions on used goods.

The US defines remanufactured goods as those (i) entirely or partially composed of recovered goods; (ii) with a similar life expectancy to, and meeting the same performance standards as, a new good; and (iii) having a factory warranty similar to a new good. In AMS, remanufactured goods are defined in the FTA between Viet Nam and the European Union and the US and Singapore . In these, a remanufactured good is one classified in Harmonized System (HS) Chapters 84, 85, 87, or 90 or Heading 94.02, except those listed in Appendix 2-A-5 (Goods Excluded from the Definition of Remanufactured Goods), which:

(i) are entirely or partially composed of parts obtained from goods that have been used beforehand; and

(ii) have similar performance and working conditions, as well as life expectancy, compared to the original new good and are given the same warranty as the original new good.

AMS can refer to the definitions of remanufactured goods and the origin of remanufactured goods to promote remanufacturing. These descriptions could be added to international agreements in ASEAN such as the ASEAN Trade in Goods Agreement (ATIGA).

## 5. Conclusion

Some AMS ban the import of used EEE, and some permit used EEE that meets certain criteria. Domestic laws and regulations of each AMS should be considered, especially regarding business-to-business collaboration and trade facilitation matters related to used EEE, e-waste, and remanufactured goods. To promote proper e-waste trade management and smooth trade of permitted used EEE and e-waste, establishing commonly understood and reliable standards for used EEE and e-waste is important as well. As for remanufactured goods, ASEAN can refer to the definitions of remanufactured goods and origin of remanufactured goods in the US to promote remanufacturing.

**Table 3.2. Articles Related to Recovered Goods and Remanufactured Goods United States Free Trade Agreement**

| Country | Year | Document | Related article |
|---|---|---|---|
| Australia | 2004 | US–Australia FTA | 5. Good wholly obtained or produced entirely in the territory of one or both of the Parties means a good that is:<br>(i) waste and scrap derived from<br>(i) production there; or<br>(ii) used goods collected there, provided such goods are fit only for the recovery of raw materials;<br>(j) a recovered good derived there, from goods that have passed their life expectancy, or are no longer useable due to defects, and utilized there in the production of remanufactured goods |
| | | | 18. Recovered goods means materials in the form of individual parts that result from:<br>(a) the complete disassembly of goods which have passed their life expectancy, or are no longer useable due to defects, into individual parts; and<br>(b) cleaning, inspecting, or testing, or other processes as necessary for improvement to sound working condition of such individual parts |
| | | | 19. Remanufactured good means an industrial good assembled in the territory of a Party, falling within Chapter 84, 85, or 87 or heading 90.26, 90.31, or 90.32, except a good under heading 84.18, 85.16, or 87.01 through 87.06 that:<br>(a) is entirely or partially comprised of recovered goods;<br>(b) has a similar life expectancy to, and meets the same performance standards as, a new good; and enjoys a factory warranty similar to such a new good |
| | | | Article 4.5: Value of Materials:<br>1. For purposes of this Chapter, each Party shall provide that the value of a material produced in the territory of one or both of the Parties includes:<br>(c) the cost of waste or spoilage, less the value of recoverable scrap |
| Bahrain | 2004 | US–Bahrain FTA | Article 4.14: Definitions<br>Goods wholly the growth, product, or manufacture |

| Country | Year | Document | Related article |
|---|---|---|---|
| | | | of one or both of the Parties means goods consisting entirely of one or more of the following:<br>(j) waste and scrap derived from:<br>(i) production or manufacture in the territory of one or both of the Parties, or<br>(ii) used goods collected in the territory of one or both of the Parties, provided such goods are fit only for the recovery of raw materials;<br>(k) recovered goods derived in the territory of a Party from used goods, and utilized in the Party's territory in the production of remanufactured goods; |
| | | | Article 4.14: Definitions<br>Recovered goods means materials in the form of individual parts that are the result of:<br>(1) the complete disassembly of used goods into individual parts; and<br>(2) the cleaning, inspecting, testing, or other processing of those parts as necessary for improvement to sound working condition |
| | | | Article 4.14: Definitions<br>Remanufactured goods means industrial goods assembled in the territory of a Party that:<br>(1) are entirely or partially comprised of recovered goods;<br>(2) have similar life expectancies and meet similar performance standards as new goods; and<br>(3) enjoy similar factory warranties as such new goods |
| Canada/Mexico | 2020 | Protocol of Amendment to the Agreement between the United States of America, the United Mexican States, and Canada | Article 4.3: Wholly Obtained or Produced Goods<br>Each Party shall provide that, for the purposes of Article 4.2 (Originating Goods), a good is wholly obtained or produced entirely in the territory of one or more of the Parties if it is:<br>(j) waste and scrap derived from:<br>(i) production there, or<br>(ii) used goods collected there, provided the goods are fit only for the recovery of raw materials |
| | | | Article 4.4: Treatment of Recovered Materials Used in the Production of a Remanufactured Good |

| Country | Year | Document | Related article |
|---|---|---|---|
| | | | 1. Each Party shall provide that a recovered material derived in the territory of one or more of the Parties is treated as originating when it is used in the production of, and incorporated into, a remanufactured good.<br>2. For greater certainty:<br>(a) a remanufactured good is originating only if it satisfies the applicable requirements of Article 4.2 (Originating Goods); and<br>(b) a recovered material that is not used or incorporated in the production of a remanufactured good is originating only if it satisfies the applicable requirements of Article 4.2 (Originating Goods). |
| Chile | 2003 | Chile–US FTA | Article 4.14: Obligations Relating to Importations<br>3. Each Party shall provide that an importer claiming preferential tariff treatment for a good imported into the Party's territory shall maintain, for a period of five years after the date of importation of the good, a certificate of origin or other information demonstrating that the good qualifies as originating, and all other documents that the Party may require relating to the importation of the good, including records associated with:<br>(b) where appropriate, the purchase, cost, value of, and payment for, all materials, including recovered goods and indirect materials, used in the production of the good |
| | | | Article 4.15: Obligations Relating to Exportations<br>2. Each Party shall provide that an exporter or producer that has issued a certificate of origin for a good exported from the Party's territory shall maintain, for a period of at least five years after the date the certificate was issued, all records and supporting documents related to the origin of the good, including:<br>(b) where appropriate, the purchase, cost, value of, and payment for, all materials, including recovered goods, used in the production of the good |
| | | | Article 4.18: Definitions<br>goods wholly obtained or produced entirely in the territory of one or both of the Parties means: |

| Country | Year | Document | Related article |
|---|---|---|---|
| | | | (i) waste and scrap derived from<br>(i) production in the territory of one or both of the Parties, or<br>(ii) used goods collected in the territory of one or both of the Parties, provided such goods are fit only for the recovery of raw materials;<br>(j) recovered goods derived in the territory a Party from used goods, and utilized in the Party's territory in the production of remanufactured goods |
| | | | Article 4.18: Definitions<br>Recovered goods means materials in the form of individual parts that are the result of:<br>(1) the complete disassembly of used goods into individual parts; and<br>(2) the cleaning, inspecting, testing, or other processing of those parts as necessary for improvement to sound working condition one or more of the following processes: welding, flame spraying, surface machining, knurling, plating, sleeving, and rewinding in order for such parts to be assembled with other parts, including other recovered parts in the production of a remanufactured good of Annex 4.18 |
| | | | Article 4.18: Definitions<br>Remanufactured goods means industrial goods assembled in the territory of a Party, listed in Annex 4.18, that:<br>(1) are entirely or partially comprised of recovered goods; and<br>(2) have the same life expectancy and meet the same performance standards as new goods; and (3) enjoy the same factory warranty as such new goods |
| | | | Annex 4.18<br>Goods classified in the following Harmonized System subheadings may be considered remanufactured goods, except for those designed principally for use in automotive goods of Harmonized System headings or subheadings 8702, 8703, 8704.21, 8704.31, 8704.32, 8706, and 8707 |

| Country | Year | Document | Related article |
|---|---|---|---|
| Colombia | 2006 | US–Colombia Trade Promotion Agreement | Article 4.23: Definitions<br>Goods wholly obtained or produced entirely in the territory of one or more of the Parties means:<br>(j) waste and scrap derived from:<br>(i) manufacturing or processing operations in the territory of one or more of the Parties, or<br>(ii) used goods collected in the territory of one or more of the Parties, provided such goods are fit only for the recovery of raw materials;<br>(k) recovered goods derived in the territory of one or more of the Parties from used goods and utilized in the territory of one or more of the Parties in the production of remanufactured goods |
| | | | Article 4.23: Definitions<br>Recovered goods means materials in the form of individual parts that are the result of:<br>(a) the disassembly of used goods into individual parts; and<br>(b) cleaning, inspecting, testing, or other processes as necessary for improvement to sound working condition |
| | | | Article 4.23: Definitions<br>Remanufactured goods means industrial goods assembled in the territory of a Party classified under Harmonized System Chapter 84, 85, 87, or 90 or heading 94.02, except goods classified under Harmonized System heading 84.18 or 85.16, that:<br>(a) are entirely or partially comprised of recovered goods; and<br>(b) have a similar life expectancy and enjoy a factory warranty similar to such new goods |
| Costa Rica/<br>Dominican Republic/<br>El Salvador/<br>Guatemala/<br>Honduras/<br>Nicaragua | 2004 | The Dominican Republic–Central America–US FTA | Article 4.22: Definitions<br>Goods wholly obtained or produced entirely in the territory of one or more of the Parties means:<br>(j) waste and scrap derived from<br>(i) manufacturing or processing operations in the territory of one or more of the Parties, or<br>(ii) used goods collected in the territory of one or more of the Parties, provided such goods are fit only for the recovery of raw materials; |

| Country | Year | Document | Related article |
|---|---|---|---|
| | | | (k) recovered goods derived in the territory of one or more of the Parties from used goods, and utilized in the territory of one or more of the Parties in the production of remanufactured goods |
| | | | Article 4.22: Definitions<br>Recovered goods means materials in the form of individual parts that are the result of:<br>(a) the disassembly of used goods into individual parts; and<br>(b) cleaning, inspecting, testing, or other processes as necessary for improvement to sound working condition |
| | | | Article 4.22: Definitions<br>Remanufactured goods means goods classified under Harmonized System chapter 84, 85, or 87 or heading 90.26, 90.31, or 90.32, except goods classified under heading 84.18 or 85.16, that:<br>(a) are entirely or partially comprised of recovered goods; and<br>(b) have a similar life expectancy and enjoy a factory warranty similar to such a new good |
| Israel | 1985 | Agreement on the Establishment of a Free Trade Area between the Government of Israel and the Government of the US | Annex 3<br>6. (a) For the purposes of this Agreement, the cost or value of materials produced in a Party includes:<br>(iii) The actual cost of waste or spoilage (material list), less the value of recoverable scrap |
| Jordan | 2001 | Agreement between the United States of America and the Hashemite Kingdom of Jordan on the Establishment of a Free Trade Area | Annex 2.2: Rules of Origin<br>6. (a) For purposes of this Agreement, the cost or value of materials produced in a Party includes:<br>(iii) The actual cost of waste or spoilage (material list), less the value of recoverable scrap |
| Korea | 2012 | US–Korea FTA | Article 6.22: Definitions<br>Goods wholly obtained or produced entirely in the territory of one or both of the Parties means:<br>(j) waste and scrap derived from:<br>(i) manufacturing or processing operations in the territory of one or both of the Parties; or<br>(ii) used goods collected in the territory of one or both of the Parties, provided such goods are fit only for the recovery of raw materials; |

| Country | Year | Document | Related article |
|---|---|---|---|
| | | | (k) recovered goods derived in the territory of one or both of the Parties from used goods and utilized in the territory of one or both of the Parties in the production of remanufactured goods |
| | | | Article 6.22: Definitions<br>Recovered goods means materials in the form of individual parts that are the result of:<br>(a) the disassembly of used goods into individual parts; and<br>(b) cleaning, inspecting, testing, or other processes as necessary for improvement to sound working condition |
| Morocco | 2006 | US–Morocco FTA | Article 5.5: Value of Materials<br>1. For purposes of this Chapter, each Party shall provide that the value of a material produced in the territory of one or both of the Parties includes:<br>(c) the cost of waste or spoilage, less the value of recoverable scrap |
| | | | Article 5.14: Definitions<br>Goods wholly the growth, product, or manufacture of one or both of the Parties means goods consisting entirely of one or more of the following:<br>(j) waste and scrap derived from:<br>(i) production or manufacture in the territory of one or both of the Parties, or<br>(ii) used goods collected in the territory of one or both of the Parties, provided such goods are fit only for the recovery of raw materials;<br>(k) recovered goods derived in the territory of a Party from used goods and utilized in the Party's territory in the production of remanufactured goods |
| | | | Article 5.14: Definitions<br>Recovered goods means materials in the form of individual parts that are the result of:<br>(1) the complete disassembly of used goods into individual parts; and (2) the cleaning, inspecting, testing, or other processing of those parts as necessary for improvement to sound working condition |

| Country | Year | Document | Related article |
|---|---|---|---|
| | | | Article 5.14: Definitions<br>Remanufactured goods means industrial goods assembled in the territory of a Party that:<br>(1) are entirely or partially comprised of recovered goods; (2) have similar life expectancies and meet similar performance standards as new goods; and (3) enjoy similar factory warranties as new goods |
| Oman | 2009 | Agreement between the Government of the United States of America and the Government of the Sultanate of Oman on the Establishment of a Free Trade Area | Article 4.14: Definitions<br>Goods wholly the growth, product, or manufacture of one or both of the Parties means goods consisting entirely of one or more of the following:<br>(j) waste and scrap derived from:<br>(i) production or manufacture in the territory of one or both of the Parties; or<br>(ii) used goods collected in the territory of one or both of the Parties, provided such goods are fit only for the recovery of raw materials;<br>(k) recovered goods derived in the territory of a Party from used goods, and utilized in the Party's territory in the production of remanufactured goods |
| | | | Article 4.14: Definitions<br>Recovered goods means materials in the form of individual parts that are the result of:<br>remanufactured goods mean industrial goods assembled in the territory of a Party that:<br>(1) the disassembly of used goods into individual parts; and<br>(2) the cleaning, inspecting, testing, or other processing of those parts as necessary for improvement to sound working condition;<br>(1) are entirely or partially comprised of recovered goods;<br>(2) have similar life expectancies as new goods; and<br>(3) enjoy similar factory warranties as such new goods; |
| Panama | 2012 | US–Panama Trade Promotion Agreement | Article 4.23: Definitions<br>Goods wholly obtained or produced entirely in the territory of one or both of the Parties means:<br>(j) waste and scrap derived from |

| Country | Year | Document | Related article |
|---|---|---|---|
| | | | (i) manufacturing or processing operations in the territory of one or both of the Parties, or<br>(ii) used goods collected in the territory of one or both of the Parties, provided such goods are fit only for the recovery of raw materials;<br>(k) recovered goods derived in the territory of one or both of the Parties from used goods, and utilized in the territory of one or both of the Parties in the production of remanufactured goods |
| | | | Article 4.23: Definitions<br>Recovered goods means materials in the form of individual parts that are the result of:<br>(a) the disassembly of used goods into individual parts; and<br>(b) cleaning, inspecting, testing, or other processes as necessary for improvement to sound working condition |
| | | | Article 4.23: Definitions<br>Remanufactured goods means goods classified under Harmonized System Chapter 84, 85, 87, or 90, or heading 94.02, except goods classified under heading 84.18 or 85.16 |
| Peru | 2006 | US–Peru Trade Promotion Agreement | Article 4.23: Definitions<br>Goods wholly obtained or produced entirely in the territory of one or more of the Parties means:<br>(a) are entirely or partially comprised of recovered goods; and<br>(b) have a similar life expectancy and enjoy a factory warranty similar to such a new good;<br>(j) waste and scrap derived from:<br>(i) manufacturing or processing operations in the territory of one or more of the Parties, or<br>(ii) used goods collected in the territory of one or more of the Parties, provided such goods are fit only for the recovery of raw materials;<br>(k) recovered goods derived in the territory of one or more of the Parties from used goods and utilized in the territory of one or more of the Parties in the production of remanufactured goods |

| Country | Year | Document | Related article |
|---|---|---|---|
| | | | Article 4.23: Definitions<br>Recovered goods means materials in the form of individual parts that are the result of:<br>(a) the disassembly of used goods into individual parts; and<br>(b) cleaning, inspecting, testing, or other processes as necessary for improvement to sound working condition |
| | | | Article 4.23: Definitions<br>Remanufactured goods means industrial goods assembled in the territory of a Party classified under Harmonized System Chapter 84, 85, 87, or 90 or heading 94.02, except goods classified under Harmonized System heading 84.18 or 85.16, that:<br>(a) are entirely or partially comprised of recovered goods; and<br>(b) have a similar life expectancy and enjoy a factory warranty similar to such new goods |
| Singapore | 2003 | US–Singapore FTA | Article 3.19: Definitions<br>13. Recovered goods means materials in the form of individual parts that result from:<br>(a) the complete disassembly of used goods into individual parts; and<br>(b) the cleaning, inspecting, or testing, and as necessary for improvement to sound working condition one or more of the following processes: welding, flame spraying, surface machining, knurling, plating, sleeving, and rewinding in order for such parts to be assembled with other parts, including other recovered parts in the production of a remanufactured good of Annex 3C |
| | | | Article 3.19: Definitions<br>14. Remanufactured good means an industrial good assembled in the territory of a Party, designated under Annex 3C, that:<br>(a) is entirely or partially comprised of recovered goods;<br>(b) has the same life expectancy and meets the same performance standards as a new good; (c) enjoys the same factory warranty as such a new good; and |

| Country | Year | Document | Related article |
|---|---|---|---|
| | | | 15. used means used or consumed in the production of goods |
| | | | Annex 3C<br>Remanufactured Goods<br>Annex 3C is attached as a separate volume. |

FTA = free trade agreement, US = United States.
Source: Authors.

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# Chapter 4

# Improving the Circular Value Chain of Electrical and Electronic Equipment

## 1. Introduction

In Japan, Europe, and the United States (US), used electrical and electronic equipment (EEE) and e-waste are properly used as secondary resources. For example, e-waste is sorted and crushed into iron, non-ferrous metals, waste substrates, and plastics, and each material is processed by plastic recycling companies, electric furnaces, blast furnaces, and non-ferrous smelters. However, it is difficult for Association for Southeast Asian Nations (ASEAN) Member States (AMS) – which have insufficient capacity – to complete the circular value chains of EEE domestically. In this chapter, business cases that set examples to improve these circular value chains are collected.

## 2. Sources for Business Cases

The cases related to the circular value chains of EEE in AMS, Europe, Japan, and US were collected based on databases and reports outlined in Table 4.1. Roughly 150 cases were examined.

**Table 4.1. Databases and Reports Referenced in This Chapter**

| Reference | Details |
|---|---|
| Business Europe, Circulary Sectors, http://www.circulary.eu/sectors | A platform managed by BusinessEurope, it features examples of innovation across Europe. Cases are categorised by 21 sectors. |
| Ellen MacArthur Foundation, Our Network, https://ellenmacarthurfoundation.org/network/who-is-in-the-network | Strategies and business cases of each partner company are introduced in the foundation's website. |
| European Union, European Circular Economy Stakeholder Platform, https://circulareconomy.europa.eu/platform/en/good-practices | As a knowledge hub, it collects good practices related to the circular economy. |
| Japan Partnership for Circular Economy (J4CE), Cases, https://j4ce.env.go.jp/en/casestudy | J4CE was founded to strengthen public–private partnerships, with the aim of fostering understanding of the circular economy amongst stakeholders. There are more than 150 companies and industrial organisations in the partnership, and over 160 cases have been submitted by these members, which are introduced on the partnership's website. |
| Japan Environmental Management Association for | The award contributes to the promotion of |

| Reference | Details |
|---|---|
| Industry (JEMAI), Resource Recycling Technology and System Award, https://www.cjc.or.jp/commend/tech-sys.html | circular business by widely soliciting and awarding excellent projects and initiatives that contribute to the 3Rs. |
| Government of Japan, Ministry of Economy, Trade and Industry | This is creating a survey for establishing methods for evaluating companies implementing resource recycling efforts. |
| New Energy and Industrial Technology Development Organization (Japan) | This is a recycling technology research and development project that aims to build a highly efficient resource circulation system. It seeks to build an information linkage system to advance resource circulation. |

Source: Authors.

## 3. Screening Business Cases

The collected cases that can contribute to improving the EEE circular value chains were screened based on two criteria.

### 3.1. First Screening Criterion

The first criterion is the identification of gaps that need to be addressed to establish EEE circular value chains in AMS. Due to the insufficient capacities of AMS, some functions are missing in the circular value chains. Incomplete value chains cause problems, such as environmental pollution, health risks, and resource waste.

The business cases featured address these issues effectively. As mentioned in Chapter 1, there are five gaps in the circular value chains of used EEE and e-waste between Japan and AMS. Therefore, the business cases presented provide beneficial implication to these challenges:

(i) There is no well-managed reuse activity.

(ii) Licensed collectors and recyclers do not participate in the circular value chains.

(iii) A lot of e-waste is disposed of in landfills mixed with municipal waste.

(iv) There is insufficient domestic capacity to recycle metal scraps.

(v) There is a lack of remanufacturing activities.

### 3.2. Second Screening Criterion

The second screening criteria is the possibility of collaboration with AMS. It is difficult for AMS – which do not have advanced technologies, business ecosystems, and legal systems – to complete EEE circular value chains only domestically. The business cases presented seek to promote collaboration between AMS and other countries, such as Japan, while improving technical standards and increasing skilled researchers and employees in AMS.

Recently, some AMS have developed plans or strategies focussing on a circular economy. For example, Indonesia has an initiative, *The Future is Circular: Concrete Steps for Circular Economic Initiatives*; Cambodia has made an action plan for the circular economy; Thailand has announced a concept and main policies related to the circular economy; and the deputy prime minister of Viet Nam signed a decision approving a circular economy development scheme. Based on these plans, it is assumed that governments and businesses will promote various initiatives to implement circular businesses in these AMS. Companies that implement businesses related to these circular value chains in other countries have high potential to collaborate with these stakeholders.

As the second criterion, functions that are commonly featured were extracted:

(i) **Indonesia.** Refuse, rethink, reduce, reuse, repair, refurbish, remanufacture, repurpose, recycling, and recover.

(ii) **Cambodia.** Raw materials and design, production remanufacturing and distribution, consumption reuse and repair, collection, recycling, and residual waste.

(iii) **Thailand.** Reuse, refurbishment, repair, remanufacturing, recycling, and composting.

## 4. Summary of Business Cases

As a result, 34 business cases were extracted. Fourteen cases are business cases related to reuse, refurbishment, repair, and remanufacturing (Table 4.2). These cases comprise a wide variety of products: printers, refrigerators, air conditioners, computers, information technology equipment, mobile phones, and e-waste. The locations of the businesses vary. While the business cases in Japan tend to be mostly related to home appliances, the targets of most cases in the US and Europe are information technology equipment, such as computers and mobile phones.

Twenty cases relate to recycling and various products (Table 4.3). Those in the US and AMS cover the value chains of collection, dismantling, classification, and sorting; the recycling of non-ferrous metals and plastics is only confirmed in Japan and Europe.

**Table 4.2. Business Cases Related to Reuse, Refurbishment, Repair, and Remand**

| No. | Value Chain | Object | Country | Company | Overview |
|---|---|---|---|---|---|
| 1 | Collect Refurbish Reuse | Mobile phones | Singapore | **Mercantile Pacific Asia** | It provides business-in-lifecycle management of smart devices and has shipped repurposed devices to over 100 countries worldwide. Due to strategic collaboration with telecommunications operators, OEMs, and brands in their buyback programmes, quality used devices can be collected from various geographies at scale. After data wiping, testing, grading, and certification, phones that need repairs are refurbished with original parts. End-of-life cycle products are recycled through partners. |
| 2 | Collect Refurbish Dismantle Remand | Printers | Japan | **Ricoh** | It manufactures and sells products that have undergone a refurbishment process, such as parts that are guaranteed to meet prescribed quality standards and parts that are required to be replaced according to prescribed quality standards. |
| 3 | | | Japan | **FUJIFILM Business Innovation** | It implements a comprehensive approach for resource circulation by adopting advanced design for reuse and recycle, promoting the use of recycled plastic, supporting the efficient use of products, and promoting the use of reused parts included in used equipment and recycling of parts that are difficult to reuse. |
| 4 | | | Japan | **Canon** | It collects used equipment and disassembles it into components. These components are washed by suitable methodology. Deteriorated and worn parts are replaced according to strict remanufacturing standards. The same production and inspection lines as new products are applied to improve quality to the same level as new products. |
| 5 | Collect Refurbish | Refrigerators | Japan | **Panasonic** | By monitoring the operation status of commercial freezing and refrigeration equipment, the 'cooling function' as a service is provided. Used products are reused in other stores after inspection. |
| 6 | | Personal computers | Japan | **NEC** | It collects used computers and refurbishes them. Processed computers are shipped as 'NEC refurbished personal computers'. |
| 7 | | Personal computers Information technology equipment | US | **IBM** | It provides computer-leasing services and produces certified second-hand products. In 2020, 17,000 tonnes of end-of-life products were processed, of which 96.5% (weight ratio) of parts and materials were reused and remanufactured. |
| 8 | | | US | **Dell** | Used products are refurbished after sorting units based on appearance and function and restoring and repairing damaged parts with certified recycling companies. By 2030, it aims to convert all products purchased by customers to reused or recycled products. |
| 9 | Reuse | Mobile | Japan | **Reuse** | It established guidelines for the evaluation of reusable mobiles and authenticates |

| No. | Value Chain | Object | Country | Company | Overview |
|---|---|---|---|---|---|
| | | phones | | **Mobile Japan** | businesses and stores in accordance with these guidelines. The guidelines compile information on laws and regulations, standards, or desirable implementation methods for purchasing, inspection/grading, and sales in the reuse mobile business. |
| 10 | Refurbish | Air conditioners | Japan | **Daikin** | It provides products that can be replaced only with compressors and control boards, which are the main components of multi-split air conditioners for buildings, with new ones. This saves energy and shortens the construction period by partial replacement. |
| 11 | | Electronic equipment | Europe (Denmark) | **Refurb** | It erases data and repairing hardware of information technology equipment collected from public institutions and companies. Then, it sells them to the original institutions or companies or on their own platform. |
| 12 | Dismantle Repair | Mobile phones | Europe (Nether-lands) | **Fairphone** | By designing and developing modules for mobile phones that can be assembled without tools, it manufactures and sells smartphones that can be easily repaired and upgraded by customers as well as being easy to dismantle. |
| 13 | Dismantle Remand Recycle | Information technology equipment | US | **Microsoft** | It established Circular Centers in the Netherlands, Ireland, Singapore, and the US for on-site processing of end-of-life server hardware and sorting into reusable and non-reusable parts. Recycling functions will be planned in the future. |
| 14 | Repair | Electronic equipment | US | **iFixit** | It provides an online platform for promoting repair, on which various EEE are shared and updated. The repair information is expanded in collaboration with OEMs and brand owners. |

EEE = electric and electronic equipment, OEM = original equipment manufacturer, US = United States.

Sources: ASEAN (2022); J4CE, *Reuse Products Business: RICOH Company, Ltd.* https://j4ce.env.go.jp/en/casestudy/081; JEMAI, 'Resource Recycling Technology/System Award' [in Japanese] https://www.cjc.or.jp/cjc_news/31syshyo/r01_sys_hapyou.pdf#page=2; FUJIFILM Business Innovation, 'Promotion of Resource Circulation' [in Japanese] https://www.fujifilm.com/fb/company/csr/svp2030/environment/recycle.html; J4CE, Remanufacturing of Multifunction Devices: Canon Inc. [in Japanese] https://j4ce.env.go.jp/casestudy/133; J4CE, Refurbishment Scheme: Panasonic Corporation [in Japanese], https://j4ce.env.go.jp/casestudy/044; NEC, NEC Refreshed PC [in Japanese], https://www.nec-lavie.jp/products/refreshedpc/index.html; IBM, IBM Refreshed PC [in Japanese], https://www.ibm.com/jp-ja/financing/pre-owned/ibm-certified-used-equipment; Reuse Mobile Japan, *Reuse Mobile Guideline Version 2* [in Japanese], https://rm-j.jp/pdf/RMJ_Guidelines2.pdf; Daikin (2017); Microsoft (2021).

**Table 4.3. Business Cases Related to Recycling**

| No. | Value Chain | Object | Country | Company | Overview |
|---|---|---|---|---|---|
| 15 | Collect<br>Recycle | E-waste | Cambodia | **EcoBatt-Energy Cambodia** | It deals with battery sales, data centres, solar panel installation, and batteries and e-waste collection. Collected e-waste is classified into those that can be reused and those that can be recycled. It has constructed a collection network in collaboration with various actors. |
| 16 | | | Viet Nam | **Vietnam Recycling** | It provides a free e-waste take-back and recycling programme initiated by electronic manufacturers. It complies with Prime Minister's Decision No. 16/2015, which expresses the manufacturers' responsibilities to the environment and community. E-waste is collected from households or enterprises, transported to waste treatment facilities by licensed trucks, classified, and recycled. |
| 17 | Collect<br>Recycle | Mobile phones | Japan | **Telecommunications Carriers Association**<br>**Information and communications network industry** | It collects used devices at retail stores regardless of manufacturers of devices and delivers collected devices to recycling companies. It has assessment guidelines for 3R evaluation items and criteria. 32 items are defined for recycling, and these items are used as a standard for pre-evaluation conducted by each company. |
| 18 | | Mobile phones, computers | Europe<br>(Nether-lands) | **Closing the Loop** | A waste compensation service provides equivalent offset or compensation to newly manufactured and distributed mobile devices by collecting and recycling end-of-life devices. The service was adopted by ITOCHU and FCNT in Japan. |
| 19 | Collect<br>Dismantle | Mobile phone | US | **Apple** | Materials such as gold, cobalt, tungsten, and rare earth elements are recovered from collected used devices by decomposition robots. These materials are supplied to the raw materials market. It advocates the goal |

| No. | Value Chain | Object | Country | Company | Overview |
|---|---|---|---|---|---|
| | Recycle | | | | of making some parts 100% from recycled resources. |
| 20 | | E-waste | Thailand | **Wongpanit Garbage Recycle Separation Plant** | It collects and treats used paper, waste plastic, scrap metal, food waste, glass bottles, waste oil, and e-waste. Within Thailand, it has 3 dismantling plants, 1 purchase collection base, and more than 1,500 franchised collection bases. The informal sector (i.e. scavengers) also bring municipal waste to franchise collection bases. |
| 21 | | | Europe (Spain) | **Revertia** | It developed business related to e-waste management, reuse, data deletion, and reporting. It analyses the carbon footprint of refurbishment and recycling and reports to companies on quantified environmental and social contributions. |
| 22 | | | Japan | **TES-AMM Japan**<br>**Sojitz** | It uses on-site trucks equipped with crushable equipment on the customer's premises to promote effective utilisation of information technology assets such as used equipment and waste electronic substrates while ensuring security. |
| 23 | Collect<br>Dismantle<br>Recycle | Home appliances | Japan | **Panasonic**<br>**Petec**<br>**Tokyo Steel Manufacturing** | It established a scheme to manufacture electric furnace steel sheets using iron scrap generated in the home appliance recycling process as a raw material and circulate them as products. |
| 24 | Dismantle<br>Recycle | E-waste | Malaysia | **Jaring Metal** | The company is a licensed company for treating used EEE and recycling of unfinished EEE through hydrometallurgical methods. It recycles e-waste through processes including cutting, crushing, milling, separating, smelting, and refining. The recycled materials are exported. |
| 25 | | | Japan | **Dowa Holdings** | It recovers metals from smelting residue and recycled materials of |

| No. | Value Chain | Object | Country | Company | Overview |
|---|---|---|---|---|---|
| | | | | | smartphones and waste electronic substrates. It collects metals from a wide variety of scraps, such as incineration residue from the waste incineration plant and waste substrates from home appliance recycling plants. |
| 26 | | | Japan | **JX Metals** | It produces copper ingots with a purity of 99.99% through a highly efficient smelting process from copper ore and recycled materials such as used home appliances and electronic devices. Saganoseki Smelter & Refinery has adopted an advanced method that uses the heat of the oxidation reaction of the sulphur content in the ore to melt ore itself and recycled materials, resulting in low environmental impact. It also established a global scale collection system for recycled materials. By 2040, the ratio of recycled materials will increase up to 50% of the raw materials handled at the copper smelters. |
| 27 | | | Japan | **Mitsubishi Materials** | It processes scraps containing copper and precious metals as secondary raw materials through a copper smelting process. In addition, lead, tin, and rare metals can be recovered to almost the same grade as bare metals. The Mitsubishi Continuous Copper Refining Process was developed to achieve the lowest environmental impact. |
| 28 | | | Europe (Belgium) | **Umicore** | Through 2 types of recycling processes, 28 kinds of metals are recovered. At the recycling centre in Hoboken, scraps such as printed circuit board and mobile phones are processed as raw materials. Other bases carry out recycling processing of process waste. It has a sales and storage base in Thailand. |
| 29 | Collect | Home | Japan | **Panasonic** | From shredder residues generated in the home appliance recycling process, resins with different applications and physical properties are |

| No. | Value Chain | Object | Country | Company | Overview |
|---|---|---|---|---|---|
| | Dismantle Recycle | appliances | | **PETEC** | sorted with a purity of 99% or higher. Recovered materials are purified and restored to high purity and physical properties at a resin circulation plant. |
| 30 | | | Japan | **Mitsubishi Electric** | It recovers high-purity single plastics from mixed plastics generated by the crushing process of used home appliances. It implemented material recycling to be used in newly manufactured home appliances. Approximately 70% of resin recovered from used home appliances is recycled. |
| 31 | | Refrigerators | Europe (Germany) | **BASF**<br>**KraussMaffei**<br>**RAMPF Eco Solutions**<br>**REMONDIS Electrorecycling** | For the polyurethane insulation of used refrigerators, it circulates it as a material through chemical recycling instead of energy recovery. |
| 32 | | E-waste | Japan | **Pranic**<br>**Toyota Tsusho**<br>**Veolia Japan**<br>**Kojima Sangyo** | It recycles used plastics from automobiles and home appliances as well as product plastics such as packaging materials, used pallets, and containers. It aims to produce high-quality, low-cost recycled plastics by utilising advanced specific gravity sorting technology. |
| 33 | | | Europe (France) | **Veolia**<br>**Suez** | It recovers e-waste in France and elsewhere. At a plant in Angers, an advanced process can sort resin into 10 types. Suez established a factory in Thailand to manufacture resin from plastic containers and packaging. |
| 34 | Recycle | Televisions | Japan | **Sony** | It adopts recycled plastic SORPLAS, which has a high recycled usage rate and promotes designs that contributes to reducing environmental impact. SORPLAS is a product that uses used water bottles collected from the |

| No. | Value Chain | Object | Country | Company | Overview |
|---|---|---|---|---|---|
| | | | | | market, waste discs discharged from factories and markets, and flame-retardant recycled plastics made from flame retardants. |

3Rs = reduce, reuse, recycle; EEE = electrical and electronic equipment.

Sources: EcoBatt-Energy Cambodia, https://ecobatt-energy.com/; Vietnam Recycle, https://www.vietnamrecycles.com/en; Mobile Recycle Network, https://www.tca.or.jp/mobile-recycle/; Apple, Environment, https://www.apple.com/jp/environment/; Toyama Kankyo Seibi (2017); J4CE, Reuse and Recycling of IT Assets: Sojitz Corporation TES-AMM JAPAN K.K. [in Japanese], https://j4ce.env.go.jp/casestudy/124; J4CE, Building a Recycling Scheme for Scrap Iron: Panasonic Corporation [in Japanese], https://j4ce.env.go.jp/casestudy/052; Jaring Metal, https://www.jaringmetal.com/index.html; J4CE, Recovering Various Types of Valuable Metals by a Large-Scale Smelting and Recycling Complex: Dowa Holdings [in Japanese], https://j4ce.env.go.jp/casestudy/042, J4CE, Contributing to the Promotion of Resource Circulation through Large-Scale Processing of Recycled Materials in the Copper Smelting and Refining Business: JX Nippon Mining & Metals Corporation [in Japanese], https://j4ce.env.go.jp/casestudy/053; JX Metals (2022); Mitsubishi Materials, Environmental and Recycling Technologies, https://www.mmc.co.jp/corporate/ja/product/environment.html; Umicore, Sustainability Champion, https://www.umicore.com/en/sustainability; J4CE, Enhanced Use of Recycled Resin: Panasonic Corporation [in Japanese], https://j4ce.env.go.jp/casestudy/049; Mitsubishi Electric, Plastic Material Recycling, https://www.mitsubishielectric.co.jp/corporate/randd/list/appliance/b11/index.html; BASF (2022); J4CE, Contributing to a Recycling-Oriented Society by Recycling Plastics: Toyota Tsusho Corporation and Veolia Japan K.K. Kojima Sangyo [in Japanese], https://j4ce.env.go.jp/casestudy/105; Veolia, Treating WEEE: Waste Electrical and Electronic Equipment, https://www.veolia.com/en/solution/recycling-weee-electronic-waste; J4CE, SORPLAS, Sony's Proprietary Flame-Retardant Recycled Plastic with up to 99% Recycled Material Utilisation Rate: Sony Group Corporation [in Japanese], https://j4ce.env.go.jp/casestudy/150

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# 5. Solved Issues and Enablers of Business Cases

## 5.1. Solved Issues

Circular businesses aim to maximise the efficient utilisation of resources. Additionally, these businesses have the potential to address social problems related to the environment, society, and economy. For instance, by effectively using existing products, circular businesses can reduce the amount of new product inputs, subsequently reducing carbon dioxide emissions from materials production, parts manufacturing, product manufacturing, mining activities, and resources transport. Furthermore, promoting proper waste treatment can lead to improvements in public health, and the traceability of natural and recycled resources can help eradicate illegal labour practices. Lastly, the introduction of new services through circular businesses can create new employment opportunities and contribute to the development of new industries.

Due to these outcomes from circular businesses, cases were solved regarding industry creation, improving public health, effective use of resources, promotion of decarbonisation, and consideration for human rights.

## 5.2. Enablers

There are various challenges to implementing circular businesses. For example, it is essential for any company to prepare sufficient financial resources. Furthermore, well-educated executives and employees, current goods and fixed assets, and information resources containing intellectual property are crucial. It is important to apply the management resources of individual companies, build networks, and formulate rules that encourage behavioural changes in stakeholders. In this chapter, these factors are defined as enablers, which are categorised as financial resources, human resources, physical resources (i.e. materials, parts, end-products, sites, and factories), informational resources, system networks, and rules and standards.

## 5.3. Reuse

As many business cases relate to reuse, two cases were extracted (Table 4.4). One promotes the reuse of mobile phones through Reuse Mobile Japan, which is an industrial organisation concerned with mobile phones. It developed guidelines for the evaluation of used mobile phones to help second-hand shops judge if the device is reusable. The fact that collection of used devices is encouraged by Japan's the Act on the Promotion of Effective Utilisation of Resources is an enabler of this case. The another manages the life cycle of smart devices effectively by Mercantile Pacific Asia. It was possible to promote reusing through technological development in data erasing and reusing and wide network with stakeholder.

**Table 4.4. Values, Issues Solved, and Enablers Business Cases Related to Reuse**

| Company | Value Created | | | | Issue Solved | Enablers |
|---|---|---|---|---|---|---|
| | ① | ② | ③ | ④ | | |
| Reuse Mobile Japan | | ● | | | Effective use of resources | Rules<br>Promoted reuse/development of guidelines under the Act on the Promotion of Effective Utilization of Resources |
| Mercantile Pacific Asia | | ● | | ● | Effective use of resources<br>Promotion of decarbonisation | Informational Resource<br>Developed technology for data erasing and reusing (diagnosis and grading)<br>Network<br>Collaborated with carriers, manufacturers, brand owners<br>Rules<br>Developed software certification |

Notes: ① Creating added values with design and technologies, ② Retaining values through efficient uses, ③ Recovering the values of used products, ④ Maintaining circulation for rebuilding lost values.
Source: Authors.

### 5.4. Repair

Two business cases related to repair were found (Table 4.5). One is the case of a sharing platform conducted by iFixit, which shares information useful to repair a wide variety of products, such as mobile phones and computers, and provides the tools needed for the repairs. It has the strength of a network with various stakeholders, especially partnerships with original equipment manufacturers like Google, Microsoft, and Samsung. This differentiates it from other platforms, resulting in increased social impact. Another case is the development of new mobile phones with high repairability by Fairphone. Its phones can be easily dismantled into components and replaced or upgraded without any tools. The environment friendly design was developed with support from the European Union Horizon 2020 project.

**Table 4.5. Values, Issues Solved, and Enablers of Business Cases Related to Repair**

| Company | Value Created | | | | Issues Solved | Enablers |
|---|---|---|---|---|---|---|
| | ① | ② | ③ | ④ | | |
| iFixit | | ● | | | Effective use of resources | Informational Resource<br>Accumulated information about repairs<br>Network<br>Created a network with various stakeholders (i.e. manufacturers, repair shops, private persons) |
| Fairphone | ● | ● | ● | | Effective use of resources<br>Promotion of decarbonisation | Financial Resources<br>Obtained research grant from the European Union Horizon 2020 project (sustainablySMART project)<br>Informational Resource<br>Developed technology towards phones that are easy to dismantle, repair, and upgrade |

Notes: ① Creating added values with design and technologies, ② Retaining values through efficient uses, ③ Recovering the values of used products, ④ Maintaining circulations for rebuilding lost values.
Source: Authors.

### 5.5. Refurbishment and Remanufacturing

Related to refurbishment and remanufacturing, four business cases implemented by Japanese manufacturers (i.e. FUJIFILM Business Innovation, NEC, Panasonic, and Daikin) were found (Table 4.6). To implement a refurbishment and remanufacturing business model, human resources, information resources, physical resources, and rules are important factors. In terms of human resources, employees must have sufficient skills of inspection, replacement, assembly, and quality assurance. While educating employees, technologies need to be developed such as appropriate inspection methods, monitoring systems, parts design suitable for replacement, and guidelines or standards for quality assurance.

Stable procurement of used products is also essential. Building solid reverse logistics is required with a high management level of individual recognition of each product and care. In the business cases, some companies collect used products through product-as-a-service model or trade-in service. Laws, such as the Act on the Promotion of Effective Utilization of Resources, is also thought to contribute to effective collection.

**Table 4.6. Values, Issue Solved, and Enablers of Business Cases Related to Refurbishment and Remanufacture**

| Company | Value Created | | | | Issues Solved | Enablers |
|---|---|---|---|---|---|---|
| | ① | ② | ③ | ④ | | |
| FUJIFILM Business Innovation | ● | | ● | ● | Creation of industries and jobs<br><br>Effective use of resources<br><br>Promotion of decarbonisation<br><br>Consideration for human rights | <u>Human Resources</u><br>Developed human resources who carry out inspections and quality assurance<br><u>Informational Resources</u><br>Developed technology for refurbishment<br><u>Network</u><br>Created a network with recyclers around Japan<br><u>Rules</u><br>Matched quality assurance in terms of performance, reliability, and machine life with internal standards. |
| NEC | ● | | ● | ● | Creation of industries and jobs<br><br>Effective use of resources<br><br>Promotion of decarbonisation<br><br>Consideration for human rights | <u>Human Resources</u><br>Developed human resources who carry out inspections and quality assurance<br><u>Physical Resources</u><br>Collected used computers<br><u>Informational Resources</u><br>Developed technology for refurbishment<br><u>Rules</u><br>Promoted collecting used computers under the Act on the Promotion of Effective Utilization of Resources |
| Panasonic | ● | | ● | ● | Creation of industries and jobs | <u>Physical Resources</u><br>Procured used products through product-as-a service model |

| Company | Value Created | | | | Issues Solved | Enablers |
|---|---|---|---|---|---|---|
| | ① | ② | ③ | ④ | | |
| | | | | | Effective use of resources<br><br>Promotion of decarbonisation<br><br>Consideration for human rights | Informational Resources<br>Developed technology for refurbishment |
| **Daikin** | ● | | | ● | Effective use of resources<br><br>Promotion of decarbonisation<br><br>Consideration for human rights | Informational Resources<br>Developed technology for refurbishment |

Notes: ① Creating added values with design and technologies, ② Retaining values through efficient uses, ③ Recovering the values of used products, ④ Maintaining circulations for rebuilding lost values.
Source: Authors.

### 5.6. Recycling

For business cases related to recycling, six business models were found (Table 4.7). Panasonic/Petec/Tokyo Steel Manufacture and Wongpanit built solid networks. The former case promotes collaboration across the value chain with manufacturers, recyclers, and electric furnace operators. Through the collaboration, technologies for utilising used home appliances as raw materials were developed. The latter case built a network with companies, households, and informal sectors. In addition to the network, it has a high collection capacity because it established franchise collection bases. The enablers of other cases, which are implemented by Apple, JX Metals, Mitsubishi Electric, and Umicore, are mainly informational and physical resources. In terms of information resources, technologies on sorting and smelting are the key factors, and collection bases and recycling plants as physical resources are also required.

**Table 4.7. Values, Issue Solved, and Enablers of Business Cases Related to Recycling**

| Company | Value Created | | | | Issues Solved | Enablers |
|---|---|---|---|---|---|---|
| | ① | ② | ③ | ④ | | |
| **Panasonic/**<br>**Petec/**<br>**Tokyo Steel Manufacture** | ● | | ● | | Effective use of resources<br><br>Promotion of decarbonisation | Informational Resources<br>Technological development for thinning steel sheets and improving coating corrosion resistance to ensure quality performance<br>Rules<br>Stable procurement of used products according to the Act on Recycling of Specified Kinds of Home Appliances |
| Wongpanit Garbage Recycle Separation Plant | | | ● | ● | Creation of industries and jobs<br><br>Improving public health<br><br>Effective use of resources<br><br>Consideration for human rights | Physical Resources<br>Created various franchise collection points<br>Network<br>Developed a purchase network involving companies, households, and scavengers |
| EcoBatt-Energy Cambodia | | ● | ● | ● | Creation of industries and jobs<br><br>Improving public health<br><br>Effective use of resources<br><br>Consideration for | Informational Resource<br>Developed data-erasing and diagnosis technology<br>Network<br>Created a collection network with various stakeholders |

| Company | Value Created | | | | Issues Solved | Enablers |
|---|---|---|---|---|---|---|
| | ① | ② | ③ | ④ | | |
| | | | | | human rights | |
| Apple | ● | | ● | | Effective use of resources<br><br>Promotion of decarbonisation<br><br>Consideration for human rights | <u>Informational Resources</u><br>Developed automatic sorting equipment |
| JX Metals | | | ● | | Creation of industries and jobs<br><br>Effective use of resources | <u>Physical Resources</u><br>Established collection and sales bases in Japan, Taiwan, and the United States<br><u>Informational Resources</u><br>Developed technologies for recovering valuable metals and controlling impurities |
| Umicore | | | ● | | Creation of industries and jobs<br><br>Effective use of resources | <u>Physical Resources</u><br>Installed a recycling plant<br><u>Informational Resources</u><br>Developed technologies for metal recovery and refining<br><u>Rules</u><br>Participated in the CEWASTE Project to formulate certification for collection, transport, and processing |
| Mitsubishi Electric | | | ● | | Effective use of resources | <u>Informational Resources</u><br>Developed sorting and colour-matching technologies for valuable recycled materials<br><u>Rules</u><br>Procured used products according to the Act on Recycling of Specified Kinds of Home |

| Company | Value Created | | | | Issues Solved | Enablers |
|---|---|---|---|---|---|---|
| | ① | ② | ③ | ④ | | |
| | | | | | | Appliances |

Notes: ① Creating added values with design and technologies, ② Retaining values through efficient uses, ③ Recovering the values of used products, ④ Maintaining circulations for rebuilding lost values.
Source: Authors.

## 6. Reuse, Remanufacturing, Refurbishment, and Repair Cases

### 6.1. FUJIFILM Business Innovation (Japan)

FUJIFILM Business Innovation has built a closed-loop system that produces and sells remanufactured multifunction peripherals (MFPs) to achieve zero waste. Used MFPs are collected, classified, and reused to remanufacture MFPs. The quality of the reused parts is assured through this unique process. Assembled machines are inspected in the same way as new products; then, these machines are shipped as products that have the same quality and safety levels as those of the new machines. Parts and machines that cannot be reused due to damage or wear are entrusted to recycling companies.

Development of human resources who carry out inspections and quality assurance seem to be an enabler in this case. Technological development for the remanufacturing process also seems to be a key factor. Various technologies, such as monitoring the operation status of each machine, inspection for parts reusability, and a lifetime expectancy database for each part, were developed. Furthermore, networks with recyclers around Japan and quality assurance in terms of performance, reliability, and machine life matched to internal standards also seem to be enablers.

### 6.2. Reuse Mobile Japan (Japan)

Reuse Mobile Japan is an industry group consisting of second-hand goods dealers. The organisation aims to create a society in which diverse and inexpensive communication services are provided to consumers safely and securely by developing the reusable mobile communication device market. In 2019, it established reused mobile guidelines that summarise laws and regulations that must be complied with as well as standard methods of implementation and desirable implementation methods for the purchase, inspection, grading, and sales in the reused mobile businesses. Furthermore, it formulated reused mobile operator certification in 2020, which enables consumers to purchase and to sell reusable mobile devices safely and securely. Reused mobile operators are certified after checking ‘compliance with reusable mobile guidelines’, ‘management status’, and ‘governance’.

### 6.3. Mercantile Pacific Asia (Singapore)

Mercantile Pacific Asia has conducted business related to mobile phones for the last 2 decades. It expanded its business in life-cycle management of smart devices about 10 years ago, shipping repurposed devices to over 100 countries through the strategic collaboration with telecommunications operators, OEMs, and brands in their buyback programme. This network is an enabler in collecting high-quality used devices from various geographies at scale. After data wiping, testing, grading, and certificating the devices with in-house software, phones that need repairs are refurbished with original parts. End-of-life-cycle products are recycled through partners. Certified

phones are sold to a network of over 10,000 retailers and wholesalers across the world. Technical development of the repair and refurbishment process and certification methods are important to implementing this business. It also saved a significant carbon footprint by preventing each phone from going to landfills. In the last 2 years alone, it saved 160 million litres of water, more than 1 million tonnes of carbon dioxide, and 52,000 tonnes of mineral ore (ASEAN, 2020).

## 7. Dismantling, Classification, and Sorting Cases

### 7.1. Panasonic, PETEC, and Tokyo Steel Manufacturing (Japan)

Panasonic, PETEC, and Tokyo Steel Manufacturing have established a scheme to manufacture electric furnace steel sheets using iron scraps with high efficiency and purity. Waste home appliances are transported to the PETEC factory, then dismantled, classified, sorted, and recycled as raw materials. In accordance with the Act on Recycling of Specified Kinds of Home Appliances, it is possible to collect waste home appliances efficiently and consistently.

Steel sheets for some uses, such as construction, are produced by Tokyo Steel Manufacturing. Controlling impurities and adjusting supply and demand to increase usage of iron scraps are difficult. By adopting advanced technologies and processes developed through a collaboration between Panasonic and Tokyo Steel Manufacturing, high-quality recycled materials are obtained. Their collaboration was made possible because of the relationship built by joint technology development. Technological development and stable procurement of used products, according to the Act on Recycling of Specified Kinds of Home Appliances, are enablers of this case.

### 7.2. Wongpanit (Thailand)

Wongpanit is a recycling company located in Thailand. It purchases recyclable goods from households, waste from retailers and wholesalers, and industrial waste. Through waste treatment processes, raw materials are collected from collected goods and waste. Indeed, it collects and treats a wide variety of waste and goods, including used paper, waste plastic, scrap metal, food waste, glass bottles, waste oil, and e-waste. It has 3 dismantling plants, 1 purchase collection base, and 1,500 franchised collection bases in Thailand, Cambodia, Lao People's Democratic Republic, Malaysia, Myanmar, and the US. Prices for purchasing waste and goods fluctuate daily according to the amount of demand. The informal sector also brings municipal waste to franchise collection points. Multiple franchise collection points and the purchase network involving companies, households, and scavengers are enablers in this case.

### 7.3. EcoBatt-Energy Cambodia (Cambodia)

EcoBatt-Energy Cambodia was founded in 2019. In 2022, it signed an official memorandum of understanding with the Ministry of Environment in Cambodia. A wide variety of waste management and recycling solutions are provided to battery sellers and users complying with royal decrees, cabinet orders, and the Basel Convention through the collaboration with the company and ministry. It provides a wide variety of businesses related to battery sales, battery installation for data centres, solar panel installation, energy audit services, and battery and e-waste collection. Its collection service covers many stakeholders, such as offices, schools, and other workplaces. As to January 2023, 35 companies have become members of the battery collection service, which collects waste batteries

and reports the quantity to the ministry. Items that can be reused are provided for reuse, and other items are provided for recycling. Data erasing and diagnosis technology and collection network with various stakeholders are enablers of this case.

# 8. Recycling

## 8.1. JX Metals (Japan)

JX Metals conducts global business operations in non-ferrous metals, focussing primarily on copper and rare metals. Its operations cover resources development, smelting and refining, and development and manufacture of advanced materials. The group's operations also encompass recycling for end-of-life electronic equipment and devices. Moreover, it produces copper ingots with a purity of 99.99% through a highly efficient smelting process from copper ore and recycled materials, such as those derived from used home appliances and electronic devices. Saganoseki Smelter and Refinery has adopted an advanced method that uses the heat of the oxidation reaction of the sulphur content in ore to melt ore itself as well as recycled materials, resulting in low environmental impact. In addition, its industrial waste detoxification business does not generate secondary waste that requires landfill disposal by applying incineration and melting technologies cultivated through smelting and refining.

In 2010, it set up a collection base for recycled materials in Taiwan, and in 2014, it established a sales base in the US. It aimed to raise the ratio of recycled raw materials consumed at copper smelters to 50% by 2040. Collection bases and sales bases in Japan, Taiwan, and the US – as well as technologies for recovering valuable metals and controlling impurities – are enablers in this case.

## 8.2. Dowa Holdings (Japan)

Dowa Holdings have advanced technologies for recovering around 20 types of valuable metals, including various rare metals, which are contained in minute quantities in ore as well as copper and zinc from various raw materials. The company has cultivated these technologies through many years of mining and smelting business operation, and these technologies are applied to recycled metals from various scrap materials.

At Kosaka Smelting and Refining, smelting residues from Akita Zinc are processed, and metals from recyclable materials (e.g. discarded electronic substrates and smartphones) are recovered. Moreover, it built a business model that has enabled the recovery of metals from incineration residues generated at the group's waste incineration plant as well as diverse scraps, including discarded electronic substrates from household appliance recycling plants. It recovers zinc from steel dust generated at steel plants. Technological developments and cooperation of neighbouring facilities are enablers in this case.

## 8.3. Mitsubishi Materials (Japan)

Mitsubishi Materials conducts a recycling business that processes scraps containing copper and precious metals as secondary raw materials through its copper smelting process. In addition to copper smelting, it has strengths in lead smelting, tin smelting, precious metal smelting, and platinum group metals refining. It has constructed a strong business ecosystem by linking the fields in which each production base excels, such as efficient processing and recovery of lead-containing by-products generated from copper smelters at lead smelters, and efficient processing and recovery of tin-

containing by-products generated from lead smelters at tin smelters. It also developed the Mitsubishi Continuous Copper Refining Process, which achieves the lowest environmental impact in the industry. As mentioned in the business case of Dowa Holdings, technology and advanced networks are keys to the smelting business.

### 8.4. Jaring Metal (Malaysia)

Jarling Metal is a licensed company for treating and recycling e-waste through hydrometallurgical methods. It recycles e-waste by cutting, crushing, milling, separating, smelting, and refining. The recycled materials are then exported. It can treat e-waste, including printed circuit board, properly thanks to its technology. Technological development for treating hazardous materials and hydrometallurgy and sales channels of recycled materials are enablers in this case.

## 9. Conclusion

In this chapter, business cases are introduced in line with the circular value chains of EEE. The created value, solved issues, and enablers were outlined as well. These cases can be referenced when collaboration amongst AMS and Japan is considered.

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# Chapter 5

# Circular Economy Strategies and Plans in ASEAN

## 1. Introduction

This chapter provides information on circular economy strategies and plans in Association of Southeast Asian Nations (ASEAN) Member States (AMS). In addition, it introduces circular economy strategies and plans in Japan and the European Union (EU), which can be examples of best practices in specific sectors to AMS.

## 2. Current Circular Economy Situation in ASEAN

ASEAN has developed the *Framework for Circular Economy for the ASEAN Economic Community* in 2021 (ASEAN, 2021). In addition, Cambodia, Indonesia, Thailand, and Viet Nam published national strategies or plans focussing on the circular economy (Table 5.1). Thailand announced a bio-circular-green (BCG) economy model in 2021 as a national development and post-pandemic recovery strategy. The deputy prime minister of Viet Nam signed Decision No. 687/QD-TTg, approving a circular economy development scheme, in 2022. Meanwhile, Indonesia, in collaboration with the United Nations Development Programme (UNDP), published circular economic initiatives (UNDP, 2022). Cambodia also published a circular economy strategy and action plan in 2021, in collaboration with UNDP.

Brunei Darussalam, the Lao People's Democratic Republic (Lao PDR), Malaysia, Myanmar, the Philippines, and Singapore have published various environmental strategies and plans . However, these do not focus specifically on a circular economy.

**Table 5.1. Circular Economy Plans in ASEAN**

| Country | Plan | Year | Focus on the Circular Economy |
|---|---|---|---|
| Brunei Darussalam | *Towards A Dynamic and Sustainable Economy: Economic Blueprint for Brunei Darussalam* | 2020 | |
| Cambodia | *National Circular Economy Strategy and Action Plan 2021* | 2021 | ✓ |
| Indonesia | *The Future is Circular: Concrete Steps for Circular Economic Initiatives in Indonesia* | 2022 | ✓ |
| Lao PDR | *9th Five-Year National Socio-Economic Development Plan (2021–2025)* | 2021 | |
| Malaysia | *Twelfth Malaysia Plan, 2021–2025* | 2021 | |
| Myanmar | *National Waste Management Strategy and Master Plan for Myanmar, 2018–2030* | 2020 | |
| Philippines | *Philippine Action Plan for Sustainable Consumption and* | 2020 | |

| Country | Plan | Year | Focus on the Circular Economy |
|---|---|---|---|
| | *Production* | | |
| Singapore | *Zero Waste Masterplan* | 2019 | |
| Thailand | Bio-Circular-Green Economy Strategic Plan, 2021–2026 | 2021 | ✓ |
| Viet Nam | Circular economy development scheme | 2022 | ✓ |

Source: Authors.

## 3. Circular Economy Strategies in ASEAN

### 3.1. ASEAN

ASEAN developed the *Framework for Circular Economy for the ASEAN Economic Community* in 2021. It sets out an ambitious long-term vision of the circular economy, building on the strengths of existing ASEAN initiatives, and identifies priority focus areas for action along with enablers to accelerate the realisation of a circular economy throughout the region (ASEAN, 2021). The strategic goals of the framework are a resilient economy, resource efficiency, and sustainable growth. The guiding principles are promoting ASEAN integration and development of regional value chains, considering the broader impact on the economy and society, recognising the unique circumstances of each AMS, encouraging ASEAN-wide coordination on knowledge and technology sharing, evaluating financial and institutional feasibility and sustainability prior to implementation, and functioning within the reality of international production linkages. Policy framework and institutions, enhanced awareness and competency across sectors, Industry 4.0 for a circular economy, and partnership and collaboration are regarded as enablers (ASEAN, 2021).

ASEAN will develop the implementation plan for this framework in the future. AMS will implement circular economies in alignment with the framework, and the collaboration amongst AMS will be promoted under the framework.

### 3.2. Indonesia

Indonesia created *The Future is Circular: Concrete Steps for Circular Economic Initiatives in Indonesia* as an initiative to promote a circular economy. It focusses on five sectors: food and beverages, textiles, construction, wholesale and retail trade, and electronics (i.e. electrical and electronic equipment [EEE]) (UNDP, 2022). Cumulatively, the economic, social, and environmental benefits derived from the 36 initiatives include savings in operating costs of more than $30 million, job creation for 14,270 workers, emissions reductions of more than 1.4 million tonnes of carbon dioxide equivalent, energy savings of more than 4.8 million megawatt-hours, water consumption reduction by more than 252,000 billion cubic metres, and waste reduction of more than 827,000 tonnes (UNDP, 2022). The circular economy concept described in this initiative includes refuse, rethink, reduce, reuse, repair, refurbish, remanufacture, repurpose, recycle, and recover. Indonesia will develop specific policies to implement the circular economy from these broad perspectives.

### 3.3. Cambodia

Cambodia developed the *Circular Economy Strategy and Action Plan 2021* with UNDP, featuring a pilot project for e-waste recycling. The vision aims to achieve a prosperous economy, thriving and inclusive society, and healthy environment (MOE, 2021). Both economic and environmental impacts are expected by implementing this strategy and plan.

The action plan features raw materials design; production remanufacturing and distribution; consumption reuse and repair; and the collection, recycling, and use of residual waste. Cambodia will develop specific policies to implement the circular economy from those broad perspectives. Various approaches, including those relating to fines, regulations, and infrastructure and technology, will be featured.

### 3.4. Thailand

In 2021, Thailand announced the BCG concept and related policies, including utilisation of a circular economy system. The BCG model promotes sustainability of biological resources, strengthens communities and the grassroots economy, enhances sustainable competitiveness of industries, and builds resilience to global changes.[27] The competitiveness of the manufacturing and services industry will be enhanced by employing knowledge, technology, and innovation to improve efficiency, reduce waste, and enable circularity. The circular economy concept in BCG includes reuse, refurbishment, repair, remanufacturing, recycling, and composting (APEC, 2022).

### 3.5. Viet Nam

The deputy prime minister of Viet Nam signed Decision No. 687/QD-TTg in 2022 to develop a circular economy to promote innovation and to improve productivity. It also seeks to promote green growth together with restructuring of the economy; renovate the growth model by increasing effectiveness and interconnectedness within the circular economy; improve the competitiveness and resistance of enterprises and supply chains to external shocks to achieve economic prosperity, environmental stability, and societal equality; aim for a green economy and carbon neutrality; and contribute towards global warming mitigation.

## 4. Circular Economy Strategies in Japan and the European Union

### 4.1. Japan

Japan's Ministry of Economy, Trade and Industry published the *Growth-Oriented, Resource-Autonomous Circular Economy and Strategy* in 2023. The strategy points out that the circular economy contributes to economic goals such as economic growth and social goals such as economic security, sustainability, and well-being. This strategy will tackle economic challenges such as resources supply risks as well as economic growth and environmental challenges like resource depletion, limited waste management capacity, and carbon neutrality (METI, 2023). It comprises approaches related to reduce, reuse, recycle, share, repair, and refurbish.

[27] NSTDA, Vision, https://www.bcg.in.th/eng/vision/

### 4.2. European Union

The European Commission published the *Circular Economy Action Plan* in 2020. The circular economy will contribute to achieving climate neutrality, decouple economic growth from resource use, ensure long-term competitiveness, create new jobs, increase the profitability of manufacturing firms, and shelter manufacturing firms from resource price fluctuations (European Commission, 2020). Therefore, environmental and economic impacts are expected.

This plan includes approaches related to reduce, reuse, repair, remanufacture, repurpose, and recycle. In addition, it regards electronics and information and communications technology as a key value chain and outlines specific approaches for the area. For example, it seeks to introduce regulatory measures to promote the design for energy efficiency and durability, reparability, upgradability, maintenance, reuse, and recycling.

## 5. Conclusion

ASEAN, Cambodia, Europe, Indonesia, Japan, Thailand, and Viet Nam have developed circular economy strategies and plans. These strategies and plans aim to achieve both economic impacts and environmental impacts. Economic impacts include economic growth, savings in operation costs, job creation, enhancing the competitiveness of the manufacturing and services industries, improved efficiency, resistance of enterprises and supply chains to external shocks, decreased resource supply risk, more profitability of manufacturing firms, and sheltering manufacturing firms from resource price fluctuations. Environmental impacts include carbon neutrality, energy savings, water consumption reduction, waste reduction, a healthy environment, cession of resource depletion, and solving the limitation of waste management capacity.

These strategies and plans describe various approaches, and the involvement of various players, such as manufactures, retailers, and waste management companies, is needed to implement those strategies and plans. To achieve both economic and environmental goals while involving various players, economic and environmental policies should be consistent. For that, close cooperation is important.

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# Chapter 6

# Policy Recommendations

## 1. Introduction

Gaps between Association of Southeast Asian Nations (ASEAN) Member States (AMS) and Japan, as well as challenges contributing to each gap, are described in Chapter 1. This chapter contains policy recommendations under exchanging experiences about legal systems, promoting business collaboration amongst AMS and Japan, and harmonising standards to promote reuse and remanufacturing amongst AMS and Japan. In addition, the progress of legal systems (Chapter 3) and different situations of the electrical and electronic equipment (EEE) value chains (Chapter 1) in AMS should be considered. Promoting appropriate cooperation should thus be conducted.

## 2. Exchanging Specific Experiences and Capacity Building on Legal Systems

A lack of waste collection systems, high costs associated with environmentally sound collection and treatment, lack of product design for remanufacturing, and poor awareness are challenges encountered in most AMS. Establishment of appropriate waste-related legal systems would help solve these challenges. Some waste-related legal systems in AMS are sufficient; for example, some contain extended producer responsibility (EPR), which could substitute for the common lack of collection systems. Recycling fee systems require consumers or producers to pay for collection and recycling of e-waste, and these work for solving high costs associated with environmentally sound collection and treatment.

Japan has established laws regarding used EEE, including EPR and recycling fee systems. The Home Appliance Recycling Law, which was enacted in 2001, requires retailers to take back e-waste from consumers and producers. The law also requires consumers to pay a fee for collection and recycling of e-waste when consumers deliver it to retailers, manufacturers, or municipalities. Finally, recycling fees are incurred on manufacturers to recycle e-waste. The Ministry of Economy, Trade and Industry (METI) (2022) reported that the collection rate of televisions, refrigerators, washing machines/dryers, and air conditioners in 2019 was 64.1%, which increased by about 15.0% compared with 2012. It also reported that illegal dumping of those four home appliances in 2019 decreased by about 70,400 units compared with 2000.

Exchanging the experiences of establishment and enforcement of the Home Appliance Law in Japan with AMS would be invaluable. Japan and AMS could hold workshops; the countries have, in the past, had various cooperation exchanges related to the establishment of EEE circular value chains of EEE. Most were just exchanges of general information, although specific cooperation has started with Malaysia and Thailand.[28] Such specific cooperation is needed in other AMS, because it is important to exchange the experiences depending on the progress of legal systems and different situations of EEE

[28] Government of Malaysia, Department of Environment Water, E-Waste Management in Malaysia, https://ewaste.doe.gov.my/; and NEDO, E-Waste Recycling System in Thailand [in Japanese], https://www.nedo.go.jp/news/press/AA5_101433.html

value chains.

Additionally, it is helpful to promote capacity building amongst AMS regulators, policymakers, and relevant entities in the e-waste management sector. AMS governments struggle to regulate unlicensed collectors and recyclers; thus, the enforcement of regulations is challenging. Viet Nam and Singapore have enacted laws for e-waste management, which include EPR principles and recycling fee systems, but enforcement is insufficient. Capacity building for entities in charge of the enforcement of the regulations are necessary and should:

(i) seek to increase AMS and stakeholder knowledge on how an e-waste circular economy is managed, and explore effective approaches to responsibly recover, repair, and trade e-waste and used EEE;

(ii) facilitate AMS ability to strengthen recyclable materials management, such as the efficient and traceable movement of known recoverable materials to pre-approved recovery facilities, which supports a sustainable circular economy approach to the recovery of e-waste and used EEE;

(iii) provide an opportunity to learn about the economic benefits afforded by an e-waste circular economy mechanism and to identify solutions that modernise regulatory processes to manage the recovery of e-waste and used EEE responsibly;

(iv) share best practices of using regulatory frameworks to manage e-waste to reduce adverse environmental, climate, and health impacts, while facilitating cross-border movement of used EEE and recoverable e-waste to re-enter the manufacturing process;

(v) share best practices of the implementation of other alternative measures (e.g. allowing the importation of remanufactured goods) besides trade facilitation matters in second-hand goods;

(vi) share best practices in the cooperation between customs administrations with other bodies (e.g. environmental agencies) in controlling the importation of second-hand EEE, recoverable e-waste, and remanufactured goods; and

(vii) update relevant development in Basel Convention implementation as well as international negotiations of relevant legal instruments related to the control of e-waste.

## 3. Fostering ASEAN–Japan Business Collaboration

Business collaboration amongst AMS and Japan could help alleviate some challenges, such as a lack of technologies and equipment for e-waste processing. Business collaborations are classified into technical cooperation; establishment of joint ventures; and international resource circulation like international trade of used EEE, reused goods, remanufactured goods, and scraps.

To create opportunities for business matching amongst AMS and Japan, joint ventures in ASEAN could promote business collaborations. In addition, international resources circulation could create circumstances in which private sectors can participate in the global trade of used EEE, reused goods, remanufactured goods, and scraps smoothly. Business collaboration would contribute to the establishment of circular value chains of more valuable but less harmful used EEE, because such used

EEE could be positively processed by the private sector without regulation.

These business cases in Chapter 4 could contribute to business collaboration:

(i) **Reuse Mobile Japan.** Reuse Mobile Japan established guidelines to evaluate reusable mobile phones and to authenticate businesses and stores involved with these phones in accordance with these guidelines. Collaboration with this company could contribute to solving a lack of systems to distinguish used EEE for reuse and e-waste and a lack of quality assurance standards for reused goods.

(ii) **Dowa Holdings.** Dowa Holdings recovers metals by smelting residue and recycled materials (i.e. smartphones and waste electronic substrates) generated in the market. It collects metals from a wide variety of scraps, such as incineration residues from a waste incineration plant and waste substrates from home appliance recycling plants. This company could help compensate for the poor capacity of recycling in most AMS. Collaboration with such a company could contribute to ensuring e-waste recycling capacity, solving a lack of technologies and equipment for e-waste processing.

(iii) **JX Metals.** JX Metals processes copper ore and recycled raw materials to refine copper, precious metals, and rare metals. The company collects metal scraps for recycling and has set up a collection base in Taiwan. Such a company could help compensate for the poor capacity of recycling in AMS. Collaboration could help contribute to ensuring e-waste recycling capacity, solving a lack of technologies and equipment for e-waste processing.

(iv) **Mitsubishi Materials.** Mitsubishi Materials makes full use of its copper smelting facilities by undertaking recycling activities that process scrap as secondary materials containing copper and precious metals. It is operating an integrated system, spanning the assessment, collection, and processing of recycled materials. Such a company could help compensate for the poor capacity of recycling in AMS. Collaboration could contribute to ensuring e-waste recycling capacity, helping address a lack of technologies and equipment for e-waste processing.

(v) **Jaring Metal.** Jaring Metal is a licensed company for treating e-waste and the recycling of unfinished EEE through hydrometallurgical methods. It recycles e-waste through cutting, crushing, milling, separating, smelting, and refining, and recycled materials are exported. Collaboration with this company could help contribute to ensuring e-waste recycling capacity, solving a lack of technologies and equipment for e-waste processing.

(vi) **FUJIFILM Business Innovation.** FUJIFILM Business Innovation produces and sells remanufactured multifunction peripherals. It has its own take-back system, unique technology for remanufacturing, standards for distinguishing parts that can be used for remanufacturing, and quality and safety assurance standards. Collaboration could help contribute to solving the challenges for promoting remanufacturing.

(vii) **Wongpanit and EcoBatt-Energy Cambodia.** Wongpanit has formalised collection systems with informal waste collectors in Thailand. Likewise, EcoBatt-Energy Cambodia has constructed a collection network with various actors in Cambodia. Both companies have the know-how of collaboration with various actors involved in waste collection. Formalising informal collectors is one of the common and critical issues in AMS, and these companies could help.

## 4. Aligning with International Rules and Standards, and Advancing Trade Openness between ASEAN and Japan

Some used EEE is imported into AMS as reused goods, but it turns out to be e-waste and is then recycled improperly (Kojima, 2014). One cause is the inconsistent judgement of administrative agencies in import and export countries. In fact, sometimes used EEE has been shipped back, due to the differences in the judgement of exporters and that of importers.[29] To ensure the enforcement of e-waste trade regulations and smooth trade of used EEE, the introduction of standards to distinguish between used EEE and e-waste is important. Draft technical guidelines on transboundary movements of e-waste and used EEE, under the Basel Convention, includes criteria to distinguish between them. AMS and Japan can introduce these guidelines in closer alignment with international rules and standards, and it is necessary for importers, exporters, and customs to utilise them appropriately.

To promote remanufacturing, standardisation of the definition of remanufactured EEE and origin of remanufactured goods amongst AMS and Japan is needed. The United States has harmonised the definitions of remanufactured goods and origin of remanufactured goods with other countries, making it possible to trade remanufactured goods smoothly. They can avoid cases where the importation of EEE identified as a remanufactured good in one country is refused in another country because the EEE is instead regarded as a reused good. This circumstance is motivating the private sector to trade remanufactured goods, and the remanufacturing of EEE is thus promoted. Closer alignment with international rules and standards for quality and safety assurance for remanufactured goods are important as well. Those description can be added to international agreements in ASEAN such as the ASEAN Trade in Goods Agreement (ATIGA).

[29] Government of Japan, Ministry of Environment, 'Background of Developing the Standard to Distinguish Reusable UEEE' [in Japanese], https://www.env.go.jp/recycle/yugai/conf/conf25-01/H260318_03.pdf

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