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E-waste and Sound International Resource Circulation in ASEAN

Economic Research Institute for ASEAN and East Asia

E-waste and Sound International Resource Circulation in ASEAN

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Chapter 1

Background, Objective, and Method of the Study

The Fifth Fundamental Plan for Establishing a Sound Material-Cycle Society, established by Cabinet Decision in Japan on 2 August 2024, stipulates the realisation of the transition to a circular economy as a national strategy and outlines five important directions for its implementation. Amongst these, the fifth direction emphasises the formulation of appropriate international resource circulation systems and the promotion of the international expansion of circular economy-related industries.[1] Within the fifth important direction on the plan, the Association of Southeast Asian Nations (ASEAN) is identified as one of the priority regions (Ministry of the Environment, Japan, 2024).

To strengthen co-operation with ASEAN, Japan has developed several regional initiatives. One such initiative is the Strategic Program for ASEAN Climate and Environment (SPACE), launched in August 2023, which aims to promote climate action and environmental protection in the ASEAN region (Ministry of the Environment, Japan, 2023). As part of these co-operation efforts, the ASEAN Regional Policy Dialogue on Environmental Cooperation functions as a platform for policy dialogue and collaboration with ASEAN Member States (AMS) to advance these shared objectives.

Building on these regional frameworks, this study is a collaborative research project related to electrical and electronic equipment (EEE), including used EEE and electronic waste (e-waste), conducted in collaboration with academic institutions, experts, and universities in AMS and the Economic Research Institute for ASEAN and East Asia (ERIA). This study was conducted from January to November 2025.

[1] The 5th Fundamental Plan proposes the following five important directions: (i) create sustainable communities and a sustainable society by transitioning to a circular economy with the aim of forming a sound material-cycle society; (ii) thoroughly circulate resources throughout the life cycle through resource circulation-oriented co-ordination between business operators; (iii) build diverse regional circulation systems and revitalise regions; (iv) improve the resilience of the platform for circulating resources and managing waste and restore the environment; and (v) build a proper global resource circulation system and promote the overseas expansion of Japan's resource circulation industry (Ministry of the Environment, Japan, 2024).

The purpose of this research project is to clarify the status of and outlook for EEE-related material circulation between ASEAN and Japan and to examine whether such international material circularity is being conducted in a sound and sustainable manner. The analysis covers five major AMS: Indonesia, Malaysia, the Philippines, Thailand, and Viet Nam. However, the case of Indonesia is not included in this report and will be published separately.

The study followed the methodology and timeframe outlined below. Although the schedule varied by country, it began with a literature review drawing on academic publications, reports, government websites, and national trade statistics. Subsequently, between July and September 2025, field surveys were conducted, including interviews with government authorities and relevant stakeholders, to collect information on the situation on the ground and supplement the findings and issues identified in the literature review. These activities covered all target countries except Indonesia.

In addition, field surveys of EEE recycling facilities and a validation workshop with relevant stakeholders were conducted to verify the findings and gain further insights, particularly into whether the policy recommendations set out in the draft country reports could be effectively implemented in practice. The research outputs for the four target countries other than Indonesia are presented in detail in Chapters 3–6.

ERIA also examined whether an econometric methodology exists to measure the social and economic impacts of the international circularity of metal and non-metal materials in the ASEAN region. As no established methodology was found in the literature, although the studies reviewed were not directly relevant to the international resource circularity of e-waste, Chapter 7 proposes a methodology that can be applied to measure the benefits and losses of international material circularity in the ASEAN region and lays the groundwork for future pilot testing.

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Chapter 2

Outlook for the E-waste and Material Circulation of EEE-relevant Materials in the Selected Four ASEAN Member States

2.1. Introduction

The progress of digitalisation has accelerated the production and consumption of electrical and electronic equipment (EEE), which has increased waste EEE (WEEE), commonly referred to as electronic waste (e-waste). According to Baldé et al. (2024), global e-waste generation rose from 34 billion kilograms (kg) in 2010 to 62 billion kg in 2022 and is projected to reach 82 billion kg by 2030. Despite rising e-waste generation, the global report indicates that only 22.3% was formally collected and recycled in 2022, with the remaining 77.7% managed outside formal collection and recycling systems. As a result of a substantial share of e-waste being managed outside formal treatment systems, significant quantities of metals are lost each year and hazardous chemicals and plastics are released into the environment (Baldé et al., 2024).

The Association of Southeast Asian Nations (ASEAN) region is experiencing rising incomes and expanding markets driven by rapid economic growth. Along with that, the region is expected to see further increases in both general waste and e-waste generation. At the same time, the development of waste management infrastructure remains insufficient, and waste management and handling are still dominated by the informal sector (United Nations Environment Programme, 2017).

Differences in regulatory stringency, enforcement capacity, and treatment infrastructure across ASEAN, combined with expanding second-hand markets, shape cross-border movements of used EEE (UEEE) and e-waste. Given Japan's strong trade ties with the region, clarifying these flows is of policy relevance. Yet the magnitude, routes, and regulatory compliance of transboundary e-waste movements are not well characterised, particularly in trade with Japan.

Against this background, this chapter provides an overview of the transboundary e-waste trade between four ASEAN Member States (AMS) – Malaysia, the Philippines, Thailand, and Viet Nam – and Japan based on the respective country reports and organised around the following seven items:

(i) Domestic e-waste generation and policy frameworks
(ii) Cross-border regulation and Basel Convention implementation
(iii) Risks from misdeclaration and illegal imports
(iv) Informal sector conditions and associated problems
(v) Strengthening formal treatment capacity
(vi) Urban mining[1] and resource recovery
(vii) Policy recommendations

Section 2.2 provides an overview of each country report based on these seven items. Section 2.3 conducts a thematically structured cross-country comparison grounded in the country reports and develops the overarching discussion. Section 2.4 concludes the discussion and summarises the prospects for econometric evaluation methods to evaluate the impact of e-waste on the economy and society.

2.2. Overview of each country report

2.2.1. Malaysia

a. Domestic e-waste generation and policy frameworks

Malaysia is a strategically important country as a manufacturing and export hub for EEE in this region. In 2024, electrical and electronic products accounted for 39.9% of total exports, reflecting the continued expansion of international trade (Ministry of Investment, Trade and Industry, 2025). According to the Ministry of Natural Resources and Environmental Sustainability (2025), 'Malaysia generates approximately 250,000 metric tons of E-waste annually, yet only 17.4% is properly recycled or managed through environmentally sound practices – that must change'.[2] No legislation is exclusively dedicated to e-waste in Malaysia; however, e-waste is designated as hazardous waste and regulated within the framework of existing hazardous waste regulations, notably the Environmental Quality (Scheduled Wastes) Regulations 2005 categorising hazardous items such as scheduled waste (SW)110 – with the Electronic Scheduled Waste Information System (eSWIS) already in operation for SW reporting and tracking, while the Uniform Reporting System (URS) has been under development.

UEEE in Malaysia is managed under the broader hazardous waste framework, with import controls and handling requirements aimed at preventing environmental harm. Imported UEEE is generally allowed only for direct reuse, repair, or refurbishment, while import for material recovery or disposal is prohibited (Department of Environment, 2021). These

[1] Urban mining refers to the systematic recovery of valuable materials from anthropogenic stocks, including WEEE, buildings, infrastructure, and other human-made stocks (Cossu and Williams, 2015).
[2] While the Malaysian country report does not refer to Baldé et al. (2024), Malaysia generated 411,000 tons – equivalent to 12.2 kg per capita – in 2022.

regulations provide a legal foundation for managing UEEE, although enforcement challenges and gaps remain.

b. Cross-border regulation and Basel Convention implementation

At the international level, Malaysia banned the import of e-waste in 2012 and tightened controls in 2017 by requiring Department of Environment (DOE) approval for imports – only consignments authorised by the DOE are permitted (Raja, 2025). In principle, Malaysia only allows UEEE that meets strict criteria, e.g. UEEE that is not SW110 and is less than 5 years old, properly packaged, free of chlorofluorocarbons (CFCs) or hydrochlorofluorocarbons (HCFCs) for cooling equipment, destined for compliant facilities, and not for material recovery or disposal. The amendment to the Basel Convention in 2022[3] reinforced comprehensive management of e-waste. In accordance with the amendment, Malaysian authorities have strengthened restrictive measures on UEEE imports; however, accurate identification and documentation at customs require specialised knowledge, leaving room for misdeclarations and mislabelling, which may allow e-waste to enter the country (Department of Environment, 2021; Wong, Wong, and Nabila, 2024). In effect, since January 2025, the DOE has encountered challenges in distinguishing hazardous waste from non-hazardous waste (Kamarulzaman, 2025).

c. Risks from misdeclaration and illegal imports

Despite these formal restrictions, Malaysia has been identified as one of the destinations for low-value and unsorted e-waste, especially after China's import bans (Greenpeace Malaysia, 2025). In addition, the report on Malaysia in Chapter 3 highlights that imported UEEE may enter material recovery or disposal streams through informal recycling channels or be dismantled for parts, contrary to the regulatory framework. Allegations of transnational criminal involvement further complicate enforcement, with high-profile cases reported such as the seizure of over 100 containers of electronic waste from Los Angeles, reportedly en route to illegal smelters allegedly operated by Chinese syndicates (Azmi, 2024; CNA, 2024). Some of these unlawful import cases have involved shipments from developed countries, including Japan.

[3] The amendment in 2022 (with effect from 1 January 2025) listed non-hazardous e-wastes under the code Y49 and hazardous e-wastes under a new code A1181. Under this amendment, non-hazardous wastes under the entries B1110 and B4030 were deleted, and the code A1180 will be substituted by the new code A1181 with clarification as to which types and forms of e-waste are covered, including whole equipment, components, and waste arising from processing. From 1 January 2025, both hazardous and non-hazardous e-waste transboundary movements have been subject to the Prior Informed Consent (PIC) Procedure (Secretariat of the Basel Convention, n.d.).

d. Informal sector conditions and associated problems

The informal e-waste sector in Malaysia remains pervasive and hazardous, with a significant share handled outside licensed facilities (Alias et al., 2014; Honda, Khetriwal, and Kuehr, 2016; Sofian Azizi et al., 2023). These operators use open burning, acid baths, and rudimentary incinerators that release toxic fumes from plastics and heavy metals (Jayaseelan, 2025; Rasnan et al., 2016). Although licensed facilities exist, infrastructure remains at an early stage, while informal collectors and brokers erode traceability and material quality, raise costs, and enable entries under false pretences (Forti, Baldé, and Kuehr, 2018). According to a source, around 1,000 informal collectors are estimated to be active in Malaysia, compared with only 200 formal recyclers. Formal recyclers must invest in environmental safeguards, such as functioning filters and safety infrastructure, while covering the cost of collection, transportation, and public awareness campaigns, making them less competitive. In contrast, informal operators recover profits within a couple of months, making e-waste recycling a lucrative business (Jayaseelan, 2025). Beyond economics, dispersed illegal sites in forest and plantation fringes impede enforcement (Berita Harian, 2024), while the informal sector contributes to environmental and health risks (Andeobu, Wibowo, and Grandhi, 2021).

e. Strengthening formal treatment capacity

The formal e-waste system in Malaysia is based on the Environmental Quality (Scheduled Wastes) Regulations (2005) and the Prescribed Premises (Scheduled Wastes Treatment and Disposal Facilities) Regulations (1989) (Department of Environment, 1989; 2005). According to the DOE guidance, the transboundary movement of UEEE allows only complete UEEE intended for direct reuse and repair and does not permit imports for material recovery or disposal (Department of Environment, 2021).

Capacity and traceability remain uneven. At the stakeholder meeting in September 2025, one of the participants mentioned that illegal and informal operators depress costs and erode the competitiveness of licensed recyclers, and that clearer direction from the federal authorities is needed. Therefore, enforcement has intensified through amendments to the Environmental Quality Act, 1974 that raise penalties and through joint operations with customs and other agencies (Bernama, 2025; Lee, 2024). Furthermore, to strengthen the capacity of the formal recycling industry, the Malaysian government has set out plans to integrate extended producer responsibility (EPR), strengthen value chain traceability, and promote green technology partnerships (Ministry of Natural Resources and Environmental Sustainability, 2025).

f. Urban mining and resource recovery

The concept of urban mining is relatively new in Malaysia but has gained increasing institutional attention. The potential in Malaysia is substantial, especially in high-value components and materials such as printed circuit board assembly (PCBA), neodymium (NdFeB) magnets, nickel-metal hydride (NiMH) batteries, lamp phosphor powders, and cathode-ray tube (CRT) residues. PCBAs typically represent only 5%–10% of WEEE by weight yet can carry most of the recoverable economic value, making them a priority stream.

Institutional and market signals are emerging: through the KITAR programme, the Malaysian Communications and Multimedia Commission (MCMC) builds public awareness and nationwide collection points, while private initiatives demonstrate monetisable recovery models.

On the technology front, leading environmentally sound management operators deploy advanced pre-processing and metallurgical routes to recover base and precious metals at high purities in collaboration with MCMC. However, scale-up is constrained by uneven feedstock supply, difficulty in obtaining import permits for UEEE and 'e-scrap'[4], and persistent informal practices that degrade yields and elevate health risks.

Short-term priorities are to standardise pre-processing; channel PCBA-rich fractions to compliant plants; align the DOE and the Ministry of Investment, Trade and Industry on traceable 'green lanes'; and invest in skills and plant upgrades that convert secondary resources into bankable, environmentally sound value.

g. Policy recommendations

Based on the literature review, field visits, and stakeholder meeting, the authors of the Malaysia chapter propose 10 policy recommendations:

(i) Regulate EEE imports based on Malaysia's technological capability to handle hazardous wastes.
(ii) Criminalize waste trafficking and hold host-country forwarding agents liable.
(iii) Extend product life through company-to-company EPR.
(iv) Strengthen UEEE imports through company-to-company EPR and technology transfer.
(v) Reevaluate licensing of recycling factories considering limited EEE supply.
(vi) Develop a UEEE-based EPR policy.
(vii) Centralise the policy framework.
(viii) Carry out communication, education, and public awareness (CEPA) campaigns

[4] E-scrap is the precious metals and copper-concentrated components obtained by dismantling and sorting e-waste.

by the government.

(ix) Encourage Japanese technology companies to invest in Malaysia's formal e-waste recycling sector.

(x) Integrate the informal sector and enhance system traceability.

2.2.2. The Philippines

a. Domestic e-waste generation and policy frameworks

In 2022, the Philippines was the third largest producer of e-waste in Southeast Asia, generating an estimated 537,000 tons, equivalent to 4.7 kg per capita (Baldé et al., 2024). E-waste management is governed by the Toxic Substances and Hazardous and Nuclear Wastes Control Act, 1990 (Republic Act No. 6969) and its implementing rules and regulations, issued by the Department of Environment and Natural Resources (DENR). Under DENR Administrative Order (DAO) No. 2013-22,[5] WEEE is listed as hazardous waste code M506, defined as WEEE containing hazardous components such as lead, cadmium, mercury, hexavalent chromium, polybrominated biphenyls, and polybrominated diphenyl ethers (DENR EMB, 2013). Household-generated appliances fall under code M507 ('Special Wastes') in line with the Ecological Solid Waste Management Act, 2000 (Republic Act No. 9003). Recognising the diversity of WEEE and the limitations of the current classification, DENR is revising DAO 2013-22 to introduce more detailed WEEE subcategories under M506 and a WEEE-specific subcategory under M507, aligning national nomenclature more closely with European Union and UNU-KEYS[6] classifications (DENR, n.d.).

b. Cross-border regulation and Basel Convention implementation

The Philippines ratified the Basel Convention in October 1993, and the DENR is the focal agency. Although it is still in the process of ratifying the 2019 Ban Amendment, the Philippines is bound to comply with the E-waste Amendment (effective 1 January 2025) as a party to the Basel Convention. This renders all electrical and electronic waste subject to Prior Informed Consent (PIC) requirements. Importantly, registered treatment storage and disposal (TSD) facilities import hazardous materials, including 68 that process electronic assemblies/scrap; in 2024, these recyclers collectively imported 8,524 tons of electronic assemblies/scrap (nearly 0.8% of the total hazardous imports cleared by the DENR Environmental Management Bureau (EMB)), indicating a regulated channel for certain transboundary movements that intersect with Basel obligations.

[5] DAO No. 2013-22 dated 4 December 2013 on Revised Procedures and Standards for the Management of Hazardous Wastes (revising DAO 2004-36),

[6] UNU-KEYS is a classification that 'groups electronic products into homogeneous groups of average weight, market behaviour, and environmental relevance' (Baldé et al., 2015: 51).

However, implementation faces challenges, including complex PIC procedures, permit validity constraints, and legal disputes over the application of Republic Act No. 6969 and DAO No. 2013-22 in special economic and freeport zones.

c. Risks from misdeclaration and illegal imports

Risks from misdeclaration and illegal imports arise where regulatory controls on hazardous and e-waste are circumvented. Discrepancies came to light during a review of import data, as certain goods were recorded using the wrong Harmonised System (HS) code. For example, lead-acid batteries, which should be classified under HS85.48, were recorded under HS85.49. These inconsistencies underscore the need for operational guidance to align the HS code usage with WEEE definitions. Furthermore, distinguishing between new and second-hand items or scrap is not possible based solely on HS codes. To address this, customs records were analysed using descriptors such as 'secondhand', 'second hand', 'scrap', 'surplus', or 'used', providing a broader perspective on domestic and transboundary flows. Analysis of over 78 million records from 2012 to 2024 indicated an average annual volume of 470,000 tons of 'used' cargo, with Japan as the predominant source (Abante, 2020). However, there is no evidence that the number of illegal shipments from Japan is greater than that from other countries, as only one waste shipment from Japan was intercepted (Annex 1 to Chapter 4).

Philippine authorities have intercepted several high-profile cases in which cargoes were declared 'EEE accessories' or 'used TV and electronic parts' but were actually mixed plastic waste or e-waste, including shipments from Hong Kong and the Republic of Korea (ABS-CBN News, 2019; Roxas, 2019). Such incidents highlight how mislabelling can be used to evade Basel and Republic Act No. 6969 controls and shift the burden of environmentally sound management to the receiving country. Moreover, as the legal interpretation of Republic Act No. 6969 is unclear in special economic zones and freeport zones, risks from misdeclaration and illegal imports arise. These gaps indicate that misdeclaration and illegal imports remain a significant concern despite formal Basel-aligned control systems.

d. Informal sector conditions and associated problems

In the Philippines, the management of e-waste is formally governed by Republic Act No. 6969 and its implementing rules and regulations. DAO No. 2013-22 classified WEEE as hazardous waste and established permitting and manifest requirements for generators, transporters, and TSD facilities. However, despite this regulatory framework, a research report by Environweave Integrative Environmental Research noted that most household-generated e-waste still enters a widespread informal recycling network rather than

licensed TSD facilities (Environweave Integrative Environmental Research, 2023).[7]

The existing TSD facilities licensed to accept WEEE are geographically concentrated in Luzon. In addition, interviews with EMB staff and other stakeholders in this study emphasise that, without concrete policies and incentives to integrate informal collectors into environmentally sound management, most household e-waste (M507) is likely to remain outside authorised treatment systems (DENR EMB, 2025; n.d.; Environweave Integrative Environmental Research, 2023).[8]

e. Strengthening formal treatment capacity

The Philippines has a network of 36 TSD facilities authorised to accept WEEE (M506). Most operate as recyclers undertaking manual dismantling and physical recovery, while a smaller group provides final treatment through chemical or thermal processes, immobilisation, or secure landfilling (DENR EMB, 2025; n.d.). Declared daily capacity across these sites exceeds 1,500 tons, but this figure reflects permitted rather than actual throughput and is not disaggregated by specific e-waste streams (DENR EMB, 2025). Capacity is concentrated geographically: most WEEE-registered TSDs are in Central Luzon and CALABARZON,[9] with only a few facilities in the Visayas and Mindanao (DENR EMB, n.d.). Recent initiatives, notably the Safe Polychlorinated Biphenyls and E-waste Management Project of the United Nations Industrial Development Organization (UNIDO), have pilot tested upgrading barangay material recovery facilities into e-waste TSDs, offering a model for more distributed, compliant pretreatment (United Nations Industrial Development Organization, 2024). Strengthening formal capacity will also require implementing draft amendments to DAO No. 2013-22 to refine the WEEE nomenclature (DENR EMB, 2024), as well as improving the connection of household e-waste (M507) to appropriately equipped facilities with TSD facilities.

f. Urban mining and resource recovery

In the Philippines, 'urban mining' has no formal legal definition, but the term is increasingly used in circular economy debates to describe recovering valuable materials from end-of-life products and in-use stocks in urban areas.

In the context of the Philippines, Ballesteros et al. (2023) reframed e-waste from a liability to a potential source of rare earth elements, while acknowledging that current informal

[7] Also based on Environweave field interviews on e-waste during 2012–2025.

[8] Also based on the Economic Research Institute for ASEAN and East Asia (ERIA) and Environweave field interviews on e-waste in 2025.

[9] The CALABARZON region consists of five provinces on Luzon Island. Its name is derived from the first syllables of Cavite (CA), Laguna (LA), and Batangas (BA), the first letter of Rizal (R), and the last syllable of Quezon (ZON).

'urban mining' exposes workers and communities to health risks. Their study explored business models for converting barangay-level material recovery facilities into TSDs that receive e-waste from households in partnership with a larger recycler, finding that the most viable option is a scheme in which the formal recycler purchases dismantled WEEE from the local TSD material recovery facilities.

Parallel long-term collaborations between Filipino and Japanese researchers have documented contamination and health impacts from informal metal recovery, while the Safe PCBAs and E-waste Management Project by UNIDO funded by the Global Environment Facility pilot tested e-waste material recovery facilities of TSDs to bring informal dismantlers into the formal system, although only the Bakakeng Central facility remains active as of October 2025.

g. Policy recommendations

Based on the literature review, field visits, and stakeholder meeting, the authors of the Philippine chapter propose four policy recommendations:

(i) Develop implementation guidelines and official statistics to regulate and monitor the currently unmonitored import of used or poor-quality EEE into the Philippines.
(ii) Review the import of EEE-related items into the Philippines, taking into consideration the repair and refurbishment business and the clearance procedures relevant to the freeport zone.
(iii) Improve the PIC procedure for transboundary e-waste trade for proper recycling, with digitalisation of procedures and a clear and unified definition of 'waste'.
(iv) Establish international and domestic policies to address e-waste arising from technology shifts or forced obsolescence.

2.2.3. Thailand

a. Domestic e-waste generation and policy frameworks

Thailand is one of the largest generators of e-waste in Southeast Asia, producing 753,000 tons (10.5 kg per capita) in 2022, but collects only 4% formally (Baldé et al., 2024).[10] The Ministry of Commerce (MOC) Notification on Prohibiting the Import of Electronic Waste B.E. 2563 (2020) defined e-waste as parts or scraps of EEE, excluding generator scraps. Strategically, Thailand is implementing the National E-waste Management Plan (2018) and

[10] The Thailand country report refers to another online database (The Global E-Waste Statistics Partnership, 2022), but the figure for e-waste generation in Thailand is consistent. However, at the stakeholder meeting, one of the panellists stated that 'Thailand generates approximately 400,000 tonnes of e-waste annually, with the volume steadily increasing' (refer to Chapter 5). 'Tons' is used throughout this chapter, except for direct quotes from the Thailand country report (Chapter 5), where 'tonnes' is used in line with the original source.

the Strategic Plan on Integrated E-waste Management (2022–2026). Current laws in force, such as the Hazardous Substance Act, 1992, and announcements by the MOC and Department of Industrial Works (DIW), provide partial control but lack comprehensive e-waste-specific regulation. Therefore, an EPR-based WEEE Act is being prepared for Cabinet consideration (Pollution Control Department, 2024).

b. Cross-border regulation and Basel Convention implementation

Thailand ratified the Basel Convention in 1997 and implements it under the Hazardous Substance Act, with the DIW as the national competent authority and the Pollution Control Department (PCD) as the focal point.[11] As a rule, imports of waste considered hazardous under the Basel Convention were permitted only when used as raw materials in manufacturing, though subsequent measures have narrowed this in practice. DIW notifications on Permitting Criteria for the Import of Used Electrical and Electronic Equipment – B.E. 2539 (1996), B.E. 2546 (2003), and B.E. 2550 (2007) – restricted imports of 23 items of UEEE other than e-waste until 2003 and then 32 categories of UEEE and parts thereof, and required compliance with Basel obligations for dismantling/recycling purposes in 2007. The MOC Notification on Prohibiting the Import of Electronic Waste, B.E. 2563 (2020) banned imports of 428 e-waste items, identified under HS Chapters 84 and 85 (statistical code 899). Thailand accepted the Basel Ban Amendment in March 2023, which bans exports of Basel hazardous wastes from Annex VII Parties to non-Annex VII Parties; consequently, Thailand no longer receives such imports – even for recovery (Secretariat of the Basel Convention, 2024). Under the MOC Notification on Prohibiting the Import of Plastic Scrap, B.E. 2567 (2024), all plastic scrap imports were prohibited from 1 January 2025. A 2025 Cabinet-approved draft updated the alignment to HS 2022 and expanded the e-waste prohibition list to 463 items.

c. Risks from misdeclaration and illegal imports

Despite robust prohibitions, Thailand still faces mis-declared and illegal e-waste imports. Common tactics include declaring consignments 'scrap metal' or 'second-hand products'. In January 2025, authorities seized 10 containers – nine from Japan and one from Hong Kong – holding over 256 tons of unusable e-waste mis-declared as scrap metal (Thai Customs, 2025). Data issues such as incorrect HS classifications and transshipment further obscure flows. Such activities contribute to pollution, particularly from dismantling and open burning at informal sites, releasing lead, mercury, cadmium, PCBAs, and dioxins into the air, soil, and water.

[11] These entities oversee the implementation of the Basel Convention in Thailand.

Thai Customs operates a risk-based checking system for UEEE and e-waste. Preset risk profiles route low-risk declarations to 'green line' automatic release, reducing costs and speeding clearance, while focusing inspections on high-risk consignments (Thai Customs, 2020a; 2020b; Thibedeau, 2019). However, when profiles are incomplete or data are inaccurate, green line processing can be exploited, underscoring the need for clearer UEEE and e-waste screening, better data quality, and stronger inter-agency information sharing.

d. Informal sector conditions and associated problems

Domestically, the informal recycling sector dominates Thailand's e-waste flow, with operations spread across small villages and households. Thongkaow, Prueksasit, and Siriwong (2022) showed that over 90% of material mass in appliances (e.g. fans, refrigerators, washing machines, microwaves, and air conditioners) is recoverable. The same study revealed that informal recyclers can earn US$800–US$1,200 per month, reflecting strong economic incentives. At the same time, most households still store e-waste or turn to informal buyers due to limited formal collection options and uncertainty about disposal methods (Khaikham, 2022; Mangmeechai, 2022). However, a case study in Thailand indicated that while informal dismantling of household appliances can achieve high material recovery rates, mismanagement of hazardous components imposes additional environmental burdens (Arain et al., 2022; Thongkaow, Prueksasit, and Siriwong, 2017). Government authorities such as the Department of Primary Industries and Mining (DPIM), DIW, and PCD provide supporting tools – policy planning, technology research and development (R&D), and legal frameworks – but capacity gaps persist (Senate Commission on Commerce and Industry, 2022).

e. Strengthening formal treatment capacity

Thailand has 213 e-waste dismantling and recycling factories, mainly located in the central and eastern regions (Senate Commission on Commerce and Industry, 2022). At the same time, the proportion of e-waste collected and recycled through the formal system remains low compared with the total volume of waste (Asia Green Rescrap Co. Ltd., 2025).

In Thailand, local governments are responsible for collecting targeted waste and WEEE from local communities. The corresponding transportation and disposal fee depends on the rates defined in the relevant regulation. However, household e-waste continues to be collected and processed by informal actors, reflecting constraints in budget, human resources, and technological capacities. Moreover, a specific act or comprehensive legislation covering the entire e-waste management chain is lacking.

To improve e-waste management, the Ministry of Industry's DPIM is engaged in R&D activities on e-waste recycling technologies (Department of Primary Industries and Mining,

2025), including metal recovery. In addition, Japan's Ministry of Environment held a joint meeting in Thailand on 9 July 2024, as part of the 4th Thailand–Japan Environmental Policy Dialogue,[12] to exchange knowledge, experience, and technology on future studies on e-waste management and resource circulation in Thailand.

f. Urban mining and resource recovery

Thailand has promoted the urban mining concept since 2009 through the DPIM, with the Industry Transformation Center (ITC) established to advance recycling technologies and material innovations. The centre has developed more than 70 commercial-scale, environmentally sound recycling technologies and innovation prototypes, which can generate value-added investment of over B150 million per year (Senate Commission on Commerce and Industry, 2022). E-waste that meets environmental and safety requirements (e.g. Restriction of Hazardous Substances (RoHS)) can be treated in category 105 and 106 facilities under the Ministerial Regulation Prescribing Categories, Types and Sizes of Factory, B.E. 2563 (2020). Thailand has 213 dismantling and recycling facilities in the central and eastern regions (Senate Commission on Commerce and Industry, 2022), but local governments face budget and capacity constraints. Thailand's EEE urban mining agenda faces low public awareness and moderate industry interest, despite support from the DPIM, DIW, and PCD. The resource circularity of urban mining sources hinges on sufficient waste quantity, the collection and transportation system, the utilisation potential, the available technologies at commercial scale, the environmental hazards, and the readiness of manufacturers and investors (Senate Commission on Commerce and Industry, 2022). Priority actions include the prohibition of WEEE exports, public–private partnerships to maximise the use of existing logistics networks and collection points, financing mechanisms, market-based management, and a national data platform aligned with the draft WEEE law.

g. Policy recommendations

Based on the literature review, field visits, and stakeholder meeting, the authors of the Thailand chapter propose nine policy recommendations:

(i) Strengthen e-waste governance and regulatory enforcement.
(ii) Improve e-waste collection, tracking, and recycling systems.
(iii) Empower formalisation and collaboration across the recycling chain.
(iv) Promote public awareness and responsible consumer behaviour.
(v) Institutionalise Thailand–Japan bilateral corporation on e-waste.

[12] The policy dialogue was organised with the participation of the Parliamentary Vice-Minister of the Environment and Vice-Minister for Global Environmental Affairs from Japan and the Vice Minister of Natural Resources and Environment from Thailand, amongst others.

(vi) Advance technology transfer and recycling standards alignment.
(vii) Create a bilateral used materials exchange hub.
(viii) Establish a joint data and traceability platform.
(ix) Mobilise private sector participation through EPR.

2.2.4. Viet Nam

a. Domestic e-waste generation and policy frameworks

Viet Nam generated 516,000 tons of e-waste (5.3 kg per capita) in 2022, placing it in the mid-range in Southeast Asia (Baldé et al., 2024). Rapid urbanisation, rising incomes, and expanding electronics consumption drive this surge. E-waste management is primarily handled by the informal sector, while the formal collection system remains underdeveloped and official distribution data are limited (Department of Science and Technology in Ho Chi Minh City, 2021). A single comprehensive definition of e-waste has not yet been established in Viet Nam, but Appendix 3C of Circular No. 02/2022/TT-BTNMT prescribes the types of EEE waste to be considered as hazardous. These categories are aligned with Viet Nam's hazardous waste classification system and the Basel Convention codes, providing a practical framework for the management and regulation of e-waste in the country.[13] The circular was amended by Circular No. 07/2025/TT-BTNMT.[14]

On the institutional side, Decree No. 08/2022/ND-CP establishes EPR for producers and importers of EEE with mandatory recycling rates, although the effective dates vary by actor and product group.[15] Implementation remains at an early stage, reflecting incomplete EPR provisions, a lack of standardised classification and data systems, and limited collection and treatment capacity. In 2025, the decree was amended by Decree No. 05/2025/ND-CP.[16] Therefore, scaling infrastructure and guidance will be essential to ensure compliance and monitoring.

b. Cross-border regulation and Basel Convention implementation

Viet Nam prohibits the import of e-waste in principle, while under Decision No. 13/2023/QĐ-TTg, certain types of metal waste and scrap may be imported as production materials with individual permits issued by the Government of Viet Nam.[17] This regulatory framework

[13] Ministry of Natural Resources and Environment Circular No. 02/2022/TT-BTNMT dated 10 January 2022 on Detailing a Number of Articles of Law on Environmental Protection.
[14] Ministry of Natural Resources and Environment Circular No. 07/2025/TT-BTNMT dated 28 February 2025 on Detailing a Number of Articles of Law on Environmental Protection.
[15] Decree No. 08/2022/ND-CP dated 10 January 2022 Detailing a Number of Articles of the Law on Environmental Protection.
[16] Decree No. 05/2025/ND-CP dated 6 January 2025 Detailing a Number of Articles of the Law on Environmental Protection.
[17] Decision No. 13/2023/QĐ-TTg dated 22 May 2023 on the Promulgation of the List of Waste Permitted for Import as Production Materials.

provides the foundation for managing transboundary movements of EEE-related materials. In parallel, Decision No. 222/QĐ-TTg established a national circular economy action plan that identifies EEE and batteries as priority areas.[18]

For exports, shipments must comply with the Basel Convention control procedures, while domestically, hazardous e-waste codes are mapped to Basel lists, providing an operational basis for classification and control.[19] However, monitoring remains challenging since the absence of specific HS codes for e-waste complicates tracking of cross-border flows (Baldé et al., 2024).

Strengthening data harmonisation, customs risk screening, and transparency around individual scrap import permits would tighten Basel implementation while preserving legitimate secondary-material inputs for manufacturing (footnote 19).

c. Risks from misdeclaration and illegal imports

Illegal imports of e-waste continue to pose significant challenges. Common practices include mis-declaring shipments as second-hand goods (Ignatuschtschenko, 2017; Tran and Salhofer, 2018). The consignments routed as 'second-hand goods' or 'scrap' through informal channels complicate traceability across borders. Within this broader landscape, Japan plays a prominent role in e-waste trade: imports from Japan are substantial, while on the export side flows are dominated by the Republic of Korea in value terms and by Japan in volume terms, according to the United Nations (UN) Comtrade Database (United Nations, 2025). Yet, despite this quantitative significance, there have been no publicly reported cases of illegal shipments involving Japan as a source or destination country. Between January 2020 and December 2023, Vietnamese authorities, in co-operation with relevant agencies, addressed numerous cases of illegal imports, including over 9 million electronic products and more than 2,300 tons of scrap materials (Viet Nam Environmental Police Department, 2025). However, since late 2023, no new cases of scrap smuggling have been detected or prosecuted, with all incidents promptly managed. This outcome reflects sustained enforcement efforts, particularly in response to the high volume of imported scrap prior to 2022.

d. Informal sector conditions and associated problems

E-waste collection and dismantling in Viet Nam continue to be driven by the informal economy, craft villages, and small family workshops. Typical practices include manual dismantling, open burning to extract copper and lead, and acid leaching of PCBAs, which

[18] Decision No. 222/QĐ-TTg of the Prime Minister dated 23 January 2025 Promulgating the National Action Plan for Circular Economy Implementation to 2035.

[19] Ministry of Natural Resources and Environment Circular No. 02/2022/TT-BTNMT dated 10 January 2022 on Guiding a Number of Articles of Law on Environmental Protection.

generate high environmental and occupational health risks in some areas. While these activities provide livelihoods and convenient collection channels for households, they generate significant environmental and occupational health risks and erode traceability. Formal collection and treatment remain underdeveloped in many localities. For example, households typically sell old devices to itinerant collectors. Priority actions to address the challenges are to expand official collection schemes and provide incentives for participation in the formal recycling system, strength public awareness and education on e-waste, and improve official collection data and monitoring systems for e-waste management.

e. Strengthening formal treatment capacity

As of 2020, Viet Nam had 117 licensed hazardous waste treatment facilities, with 75 companies authorized for three e-waste categories: waste fluorescent lamps, waste lead-acid batteries, and electronic components (Ministry of Natural Resources and Environment, 2021). In Viet Nam's formal e-waste sector, technologies span pre-processing (e.g. dismantling, shredding, and mechanical sorting) and end-processing (e.g. pyrometallurgy, hydrometallurgy, bioleaching, and PCBA-targeted lines) to recover high-value metals. When deployed, these systems raise material recovery rates and reduce pollution relative to informal practices. However, effectiveness is constrained by small plant scale, unstable feedstock, competition from low-cost informal recyclers, and limited investment.

f. Urban mining and resource recovery

Urban mining in Viet Nam is nascent but promising. Rapid urbanisation is increasing municipal waste volumes and demand for secondary materials. However, domestic recycling technologies, especially for precious metal recovery, remain limited, prompting exports of selected e-waste fractions to countries with advanced refining (e.g. Japan and Singapore).

Vietnamese researchers have published numerous studies and implemented practical projects. Several results have been transferred to practice, creating value for enterprises while improving environmental outcomes (Department of Science and Technology in Ho Chi Minh City, 2021; Nguyen and Bui, 2024). Still, uptake is constrained by outdated recycling technologies, limited foreign direct investment, and only recently rising stakeholder awareness. Meanwhile, policy signals are strengthening. Resolution No. 29-NQ/TW (2022) prioritises recycling and regenerative industries,[20] and Decision No. 1894/QĐ-TTg (2025) sets capacity targets for collection, sorting, and recycling.[21]

[20] Resolution No. 29-NQ/TW dated 17 November 2022 on Continuing to Promote the Industrialization and Modernization of the Country until 2030, with a vision to 2045.

[21] Decision No. 1894/QD-TTg dated 4 September 2025 on Approving the Program for Development of Viet Nam's Environmental Industry for the 2025–2030 Period.

g. Policy recommendations

Based on the literature review, field visits, and stakeholder meeting, the authors of the Viet Nam chapter propose eight policy recommendations:

(i) Shift to circular e-waste management.
(ii) Implement targeted incentives for strategic EEE segments.
(iii) Strength comprehensive EPR across the product life cycle.
(iv) Establish a regional circular economy hub for refurbishment, remanufacturing, and high-value recycling.
(v) Set up a bilateral framework for e-waste flows and capacity building.
(vi) Operationalise enhanced tracking: granular HS codes and digital systems.
(vii) Establish joint R&D programmes on advanced EEE and recycling technologies.
(viii) Develop stronger legal frameworks for Japan–Viet Nam flows.

2.3. Discussion

2.3.1. Introduction

This comparative section synthesises the findings of the four country studies on Malaysia, the Philippines, Thailand, and Viet Nam. While Section 2.2 summarises each country report, and the chapters on the country studies (Chapters 3–6) examine the status of e-waste management in detail, the aim of this section is to identify patterns, contrasts, and complementarities across the four cases and to derive implications for sound international resource circulation involving Japan.

In general, all four countries have seen rapid growth in EEE markets, increasing the stock of devices that will eventually become e-waste. Furthermore, all are parties to the Basel Convention and are affected by the E-waste Amendments that entered into force on 1 January 2025. However, the legal status and domestic effects of the Ban Amendment differ across the four countries. In particular, the Philippines is still in the process of ratifying the 2019 Ban Amendment.

By comparing the four country cases along shared analytical axes, this section seeks to clarify where policy alignment is needed, where differentiated approaches are appropriate, and how Japan and the four ASEAN Member States can work together to promote environmentally sound management and resource circulation of e-waste.

2.3.2. Domestic e-waste management structures

Domestic e-waste management structures in Malaysia, the Philippines, Thailand, and Viet Nam share a common overarching challenge: rapidly growing e-waste generation and only partially developed systems for environmentally sound collection and treatment.

Those four countries' domestic e-waste generation has increased steadily as incomes have risen and digitalisation has accelerated. Large household appliances and electronic equipment constitute major product groups, alongside business and institutional equipment.

While precise estimates vary, the country reports uniformly highlight upward trends in e-waste volume and the growing importance of hidden flows such as stockpiled devices in households, equipment discarded with mixed municipal waste, and EEE embedded in vehicles or industrial machinery. These dynamics imply that even in the absence of cross-border inflows, domestic systems must cope with significantly larger e-waste streams in the coming decade.

2.3.3. Policy and regulatory frameworks

All four countries recognise e-waste as an environmental priority and have moved towards frameworks that restrict hazardous imports and encourage domestic control. However, policy and regulatory frameworks for e-waste differ considerably amongst those countries. While Viet Nam has introduced EPR-based schemes in stages, others regulate e-waste primarily under broader hazardous waste or solid waste legislation. In Malaysia and Thailand, EPR-based legislation is under consideration though the status of consideration differs across them.

2.3.4. Cross-border controls

Although the Philippines is still in the process of ratifying the 2019 Ban Amendment, all four countries are parties to the Basel Convention and are affected by the amendment to the Basel Convention that became effective as of 1 January 2025. This amendment subject transboundary movements of e-waste listed under the entries Y49 and A1181 to the PIC procedure, enlarging the control of cross-border movements of e-waste. Due to resource constraints on the relevant authorities, these countries face two major challenges: (i) misdeclaration and (ii) classification ambiguity.

Moreover, the expanded scrutiny, additional documentation, and compliance management required by the amendments to the Basel Convention would compound the administrative burden and intensify capacity constraints in national authorities. To address this, a local stakeholder approached during a project field study suggested that the most effective way to reduce import-side administrative frictions would be for exporting jurisdictions to undertake prior vetting and to avoid dispatching shipments whose contents may be mislabelled or miscategorised.

The four countries have different national import policies for e-waste. Thailand has effectively introduced a broad ban on the import of e-waste and certain categories of UEEE, with the aim of preventing the country from becoming a destination for problematic waste.

Malaysia applies strict control procedures to hazardous e-waste but allows some import of UEEE on condition that it is genuinely destined for direct reuse, repair, or refurbishment. The other two countries have more mixed regimes, in which imports of certain scrap fragments or used equipment are possible subject to permits and quality standards. On the export side, all four countries comply with PIC procedures for exporting countries and ensure that exports do not serve as a channel for the uncontrolled disposal of hazardous components.

2.3.5. Illegal shipments

Risks from misdeclaration and illegal imports are a common concern. The country studies provide evidence that shipments of e-waste and low-quality UEEE may be mis-declared as other categories with less stringent controls. In some instances, problematic shipments have been detected and returned or seized, revealing weaknesses in customs screening, inspection capacity, and co-ordination amongst agencies. According to the four country reports, some detected illegal shipments are linked to Japan. However, although Japan accounts for a substantial share of recorded e-waste trade with the four countries, this does not necessarily imply a disproportionately high number of cases of illegal shipment involving Japan.

Moreover, free trade zones, bonded areas, and secondary ports may serve as entry points where monitoring is more challenging. In these areas, not only differences in HS code classification practices, but also the difficulty of distinguishing high-quality UEEE from e-waste based on paperwork alone, exacerbate the problem.

2.3.6. Informal sector and its inclusion

Informal e-waste recycling plays a central but divergent role in the four countries. In Malaysia, about 1,000 informal collectors use open burning and acid baths, creating risks and undercutting around 200 formal recyclers. In the Philippines, WEEE is regulated as hazardous waste, yet most household e-waste still flows through informal channels due to limited WEEE-capable TSD capacity and weak incentives for integration. In Thailand, village- and household-based dismantling dominates flows. In Viet Nam, informal sectors such as craft villages and family workshops provide convenient collection channels for household e-waste but rely on manual dismantling, open burning, and acid leaching of PCBAs – prompting proposals for registration, safety standards, and linkages to licensed facilities.

2.3.7. Utilise urban mining

Across the four countries, 'urban mining' is emerging as a strategic response to rising e-waste volumes as an important approach to recover high-value materials from e-waste. In

Malaysia, it is a relatively new concept that is rapidly institutionalising, focused on high-value fractions such as PCBAs and magnets, with advanced metallurgical routes constrained by uneven feedstock, permit frictions, and informal practices. In the Philippines, the term has no legal status but features in circular economy debates, with pilot tests linking barangay-level material recovery facilities to larger recyclers. Thailand has institutionalised urban mining since 2009 via the DPIM and ITC, developing over 70 commercial-scale technologies, yet faces low awareness and capacity gaps. In Viet Nam, urban mining is nascent but promising, supported by growing research uptake and recent policy resolutions and decisions.

2.3.8. Policy recommendations

The four countries targeted in this project have proposed policy recommendations tailored to their respective domestic contexts: 10 for Malaysia, four for the Philippines, nine for Thailand and eight for Viet Nam. Across the four countries, policy recommendations converge on several themes:

- Malaysia and the Philippines place **strong emphasis on stricter import management, trafficking control, and clearer procedures for transboundary EEE and e-scrap flows**.
- **EPR-based WEEE legislation and enforcement** were recommended in Thailand, and circular management, tracking systems, and legal frameworks for Japan–Viet Nam flows in Viet Nam.
- **EPR and broader circular e-waste management** feature in Malaysia, Thailand, and Viet Nam, alongside calls in Thailand and Viet Nam to expand domestic recycling and recovery capacity.
- Malaysia and Thailand stress **integration of the informal sector, traceability, and public awareness**.
- Thailand and Viet Nam further highlight **data transparency and regional or bilateral co-operation**.
- Malaysia, Thailand, and Viet Nam also propose **targeted incentives or investment, as well as technology-related and knowledge-related collaboration**, with Japan mentioned explicitly in the recommendations for all three countries.

2.4. Conclusion

The aim of this research project has been to identify the status of and prospects for EEE-related material flows between ASEAN and Japan, and to assess whether this cross-border circulation of materials is being carried out in an environmentally sound and sustainable way. The detailed country-specific information is compiled in Chapters 3–6; however, as discussed above, **sound international circularity has not yet been achieved**.

On the other hand, as shown in Chapter 7, **econometric methods for evaluating e-waste impacts on the economy and society have not been established**. While evaluation studies have been conducted on domestic e-waste measures, no studies extend this to international trade. Hence, in Chapter 7, **we propose the evaluation method based on research on trade and social and economic benefits in other fields**. The method refers to recent advances in trade–environment and health studies, which demonstrate the value of quasi-experimental designs.

However, **the field data constraints and specificities remain key challenges to using the proposed method**. To overcome the issues, **the establishment of a dataset will be necessary** in AMS, and the scope choice of the research will matter. As a result, the effectiveness of the evaluation method has not yet been tested in this report.

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Chapter 3
Malaysia

Overview

Malaysia, ranked as the sixth-largest economy in Southeast Asia and 36th globally (IMF, 2024), continues to experience steady economic growth. As with global trends, this growth is accompanied by rising electronic waste (e-waste) generation. E-waste management in Malaysia is overseen by the Department of Environment (DOE) under the Ministry of Natural Resources and Environmental Sustainability (NRES).

According to YB Nik Nazmi Nik Ahmad, Minister of NRES, '**Malaysia generates approximately 250,000 metric tonnes of e-waste annually, yet only 17.4% is properly recycled or managed through environmentally sound practices — that must change**' (Nik Ahmad, 2025). He emphasised the government's commitment to strengthening the national e-waste framework by integrating extended producer responsibility (EPR), improving traceability across the value chain, and fostering green technology partnerships to support a circular economy.

At present, e-waste is managed under the Environmental Quality (Scheduled Wastes) Regulations 2005 (DOE, 2025) and the Environmental Quality (Prescribed Premises) (Treatment and Disposal Facilities for Scheduled Waste) Regulations 1989 (DOE, 1989). Additional guidance is provided by DOE in the 2008 *Guidelines for the Classification of Used Electrical and Electronic Equipment (UEEE)*.

This report is grounded in extensive evidence-based research and supported by data from seven interviews with prominent non-governmental stakeholders (i.e., recyclers, remanufacturers, an urban miner, a retailer, and a research consultant) involved in e-waste management. **Our findings reveal that high-value e-waste is often retained by developed countries for domestic processing, while low-value or hazardous waste is exported illegally to developing nations through illegal means**.

This global imbalance underscores the urgent need for a more equitable and transparent e-waste management framework – particularly between Malaysia and Japan. In response, Malaysia is shifting from a cradle-to-grave to a cradle-to-cradle model, aiming to link waste generators, manufacturers, and recovery facilities (DOE, 2025). While Japan does export UEEE to Malaysia, such trade is only permitted when the equipment is not classified as e-waste under the Environmental Quality (Scheduled Wastes) Regulations 2005. In other words, Malaysia does not issue import permits for e-waste in principle; only UEEE that meets regulatory requirements (e.g., less than 5 years old and free from contamination) may enter the country. Despite these safeguards, Malaysia faces mounting environmental

risks due to unregulated e-waste handling in the informal sector. Practices such as 'cherry-picking' – where developed countries retain high-value e-waste and offload low-value or hazardous waste – further exacerbate these challenges.

To promote sustainable and equitable e-waste governance, this report offers insights into key topics related to electrical and electronic equipment (EEE). Section 1 examines international material flows and resource circularity between Malaysia and Japan. Section 2 explores domestic EEE management and future considerations, including recycling and disposal technologies, alternative materials, regulatory frameworks and enforcement, and urban mining.

Finally, this report proposes a framework with targeted policy recommendations to guide both countries towards a shared vision of responsible e-waste management – one that safeguards both environmental sustainability and human well-being.

1. Situational Analysis on the International Material Flow Relevant to EEE between Malaysia and Japan

1.1 Overview

We begin this report by illustrating the direct consequences of the e-waste problem arising from Japan's export of used and waste electrical and electronic equipment (UW/EEE) to Malaysia

Trade context: Import of hazardous wastes to Malaysia prohibited at the national level

Malaysia has made notable progress in managing waste electrical and electronic equipment (WEEE) through the DOE under the Environmental Quality (Scheduled Wastes) Regulations 2005, which officially designates e-waste as scheduled waste. This regulation grants Malaysian authorities the power to control the transboundary movement of e-waste. In Malaysia, SW103 – waste from batteries containing cadmium, nickel, mercury, or lithium – and SW109 – waste containing mercury and its compounds – are related to e-waste, although SW110 is the more well-known category for electronic waste.

- SW103 – Waste from batteries containing cadmium, nickel, mercury, or lithium
- SW109 – Waste containing mercury and its compounds
- SW110 – Waste from electrical and electronic assemblies with components such as accumulators, mercury switches, glass from cathode-ray tubes and other activated glass, or polychlorinated biphenyl capacitors, or waste contaminated with cadmium, mercury, lead, or nickel

Source: DOE (2005).

The policy governing the transboundary movement of UEEE is specified as follows:

a) UEEE does not meet the definition of SW110 and is not contaminated with any scheduled waste under the Environmental Quality (Scheduled Wastes) Regulations, 2005.

b) The age of equipment and its components must be 5 years or less from the date of manufacture.

c) UEEE must be appropriately protected against damage during transport, loading, and unloading, ensuring suitable packaging and stacking.

d) Cooling equipment must not contain chlorofluorocarbons (CFCs) or hydrochlorofluorocarbons (HCFCs), as these cooling agents are banned.

e) The receiving facility must comply with the Environmental Quality Act, 1974, and all relevant regulations.

f) Importation of material recovery and disposal is strictly prohibited.

Source: Department of Environment (2021).

Notably, clause (f) prohibits the importation of UEEE for the direct purpose of material recovery or disposal. This is intended to prevent the use of UEEE imports for waste dumping, reduce environmental harm caused by improper recycling practices, and avoid the misclassification of UEEE as reusable equipment when it is actually intended for scrapping. Before any transboundary movement takes place, UEEE should be assessed to determine whether it is suitable for direct reuse, repair, or refurbishment.

However, evidence suggests that illegal UEEE importations into Malaysia often lead to material recovery and disposal – either through informal recycling sectors or by being scrapped for parts – contrary to regulatory intent. Unfortunately, Malaysia has been reported as an unwanted recipient of low-value and unsorted e-waste, raising environmental concerns – particularly since China implemented its waste import bans (e.g., Greenpeace Malaysia, 2025). Ironically, our interviews and a reported cases including CNA news suggest the involvement of transnational criminal syndicates in Malaysia's e-waste trade. In one instance, over 100 containers of electronic waste from Los Angeles were seized en route to illegal smelters run by Chinese gangs (Azmi, 2024; CNA, 2024). The relevant procedures and requirements for importers, exporters, waste generators, waste transporters, and authorities involved in UEEE management are outlined in the Guidelines for the Classification of UEEE published by DOE, Malaysia, 2021.

Figure 3.1 illustrates the critical considerations that must be given to the transfer of WEEE derived from UEEE between Japan and Malaysia.

Figure 3.1. Critical Considerations Must Be Given to the Transfer of WEEE from UEEE Between Japan and Malaysia



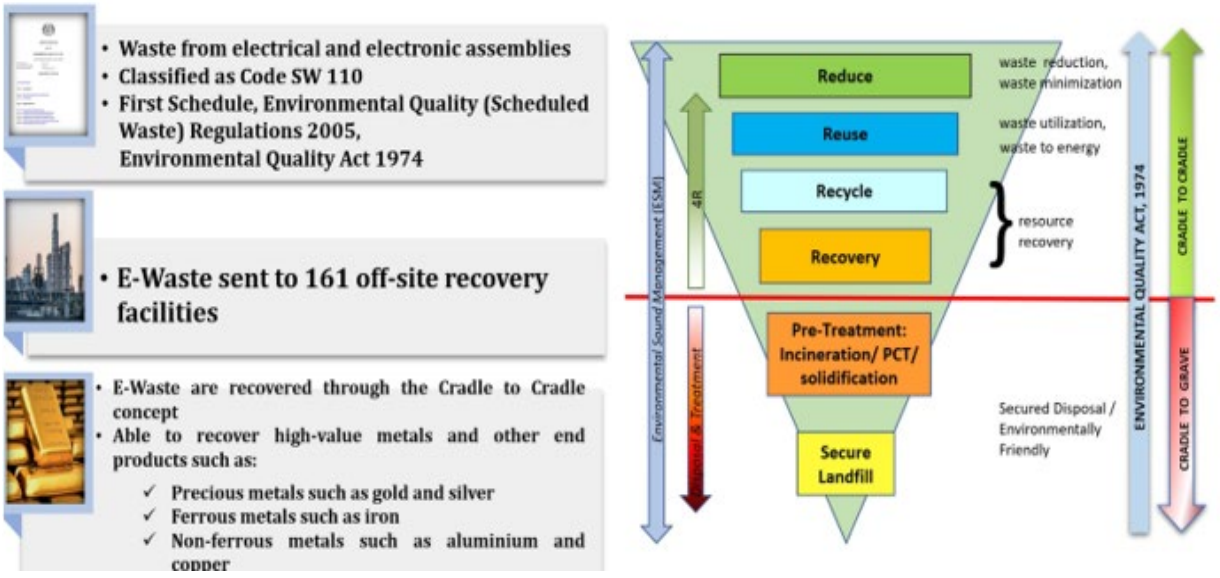
Becomes WEEE (e-waste): EEE that has expired, can no longer be used, and is disposed of in an environmentally sound manner (DOE, 2025). This process remains highly questionable due to gaps in governance and weak enforcement.

Critical consideration must be given to UEEE imported from more developed countries.

Source: authors

Within Malaysia, the government has been encouraging industries to adopt the 4Rs to advance the circular economy and minimize hazardous waste (Figure 3.2). The government has emphasised this as an opportunity for income generation for both industries and the country. Recognising this positive transformation, UEEE could serve as a valuable resource to strengthen Malaysia's circular economy agenda, presenting not only an opportunity for waste reduction but also for income generation for both industries and the nation – reflecting a more positive and strategic national stance. For example, UEEE has supported B40 groups, demonstrating its positive influence. However, Japanese producers may need to consider how to provide support when UEEE eventually becomes WEEE in Malaysia.

Figure 3.2. E-Waste from Industrial Sector



Source: Kamarulzaman (2025).

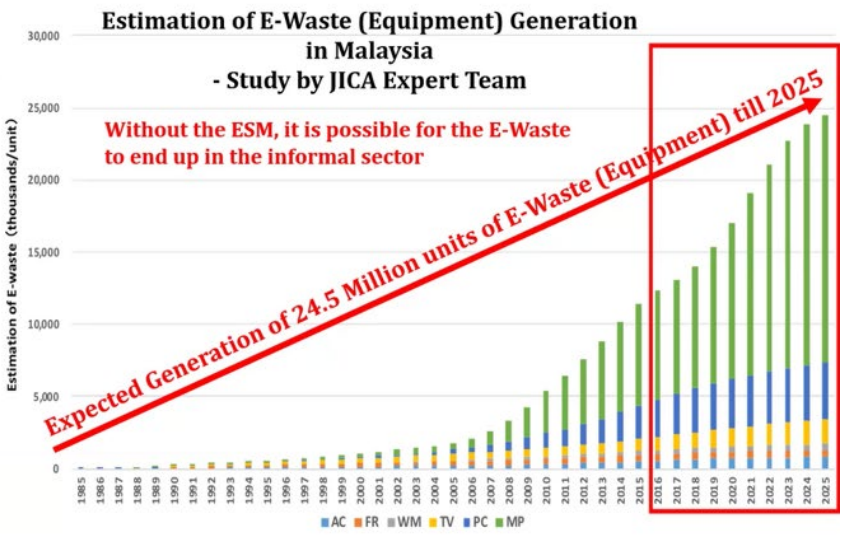
Considering the rapidly escalating e-waste issue in Malaysia (Figures 3.3 and 3.4), Japan needs to understand the indirect consequences of U/EEE exports to the country.

Figure 3.3. Escalating E-Wastes in Malaysia

Current Issues of E-Waste (Household)

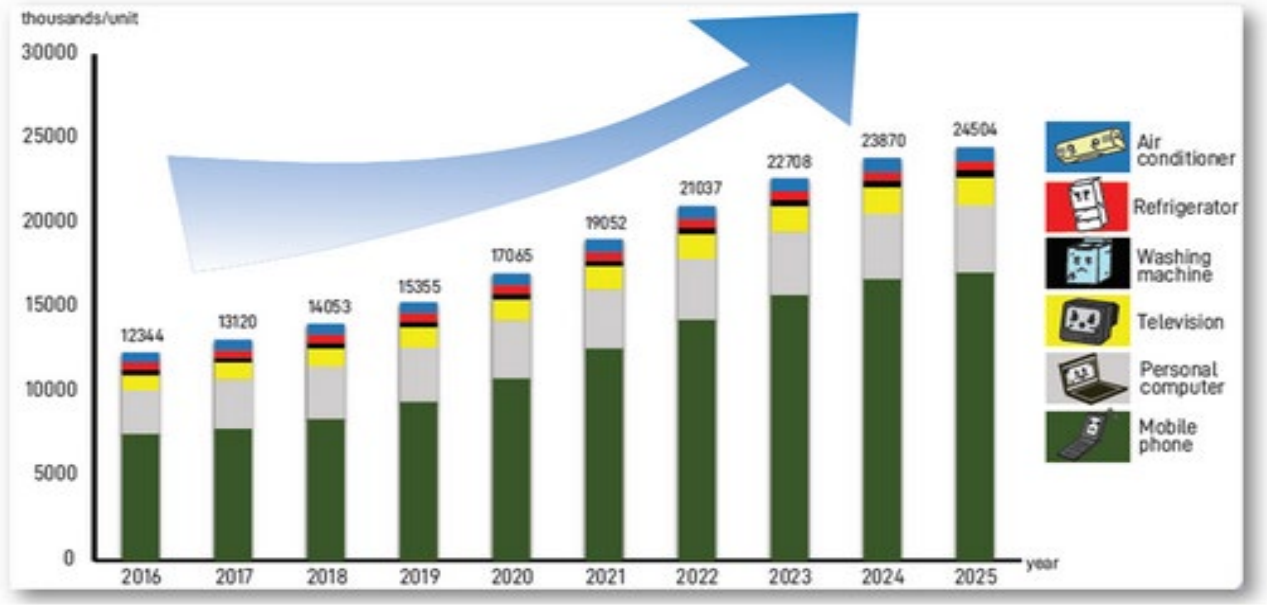
- One type of waste that is becoming increasingly prevalent globally
- Contains various toxic and dangerous substances that need to be handled in accordance with Environmental sound management (ESM)
- Potential risk to human health and impact to the environment
- Contains valuable materials that can be recovered and used through the concept of circular economy





Source: Kamarulzaman (2025)

Figure 3.4. Projection of E-Waste Generation in Malaysia



Source: DOE (2022).

- E-waste in Malaysia accounted for **10–15% of scheduled waste** in 2012, a number expected to rise with expanded household collection (Suja et al., 2014).
- The Global E-Waste Statistics Partnership (2017) reports, published by the Global E-Waste Statistics Partnership and written by Baldé and colleagues, that global e-waste generation continues to rise at 50 million metric tonnes per year, or **6.1 kg**

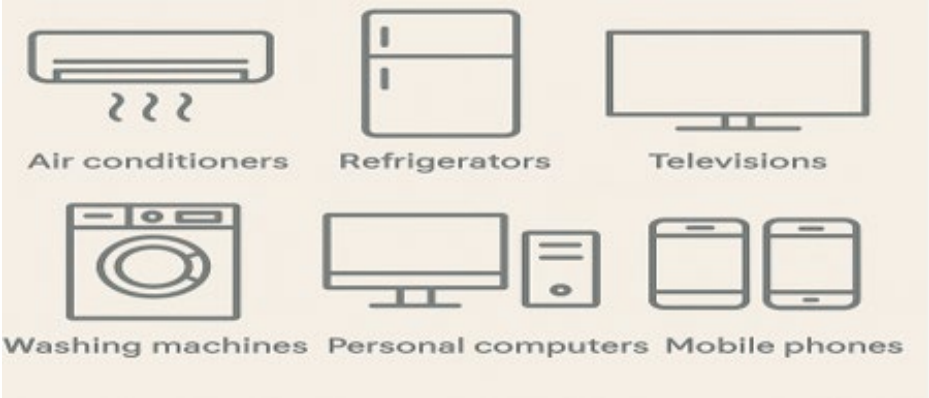
per person (Shad, Ling, and Karim, 2020).

- With a strong economy, Malaysia's e-waste volume is projected to rise further (Andeobu, Wibowo, and Grandhi, 2021).
- Malaysia's e-waste per capita reached 7.6 kg per person in 2021 (Azizi et al., 2023).
- Asia generated 1.2 million tonnes of e-waste in 2020, with Malaysia amongst the largest contributors (El-Gawhari, Mameed, and Sami, 2024).

1.2 Identification of the EEE-relevant materials for the analysis

Based on data gathered from DOE reports, including academic and non-academic sources, we summarised EEE-relevant materials and analysed the nature of international material flows between Malaysia and Japan. The department categorises e-waste into the following groups: (i) air conditioners, (ii) refrigerators, (iii) televisions, (iv) personal computers, and (v) mobile phones (Figure 3.5)

Figure 3.5. Six Categories of E-Waste



Source: Kamarulzaman (2025).

A) Existing research articles

Research has commented on the movement of WEEE from Japan to Malaysia, without clearly identifying the classification of the devices. For example:

- There are suggestions of increasing demand for second-hand EEE in Malaysia, necessitating imports from developed countries such as Japan, but without specifying which categories of EEE are involved (Andeobu, Wibowo, and Grandhi, 2021; Alias et al., 2014).
- There are also observations of the export of low-gold-quality ingots obtained from locally recycled EEE for further refining in Japan. These ingots are assumed to be extracted from the processing of electronic circuit boards across various EEE categories (Suja et al., 2014).

No major research in the past 5 years has established empirical evidence on the actual status of the e-waste trade between these two countries. Details of our search process are explained in Appendix 1.

Notably, Shad et al. (2020) published a table of e-waste descriptions in Malaysia based on the DOE report and the work of Forti, Baldé, and Kuehr (2018). (Refer to Table 3.1).

Table 3.1. EEE Considered as E-Waste in Malaysia

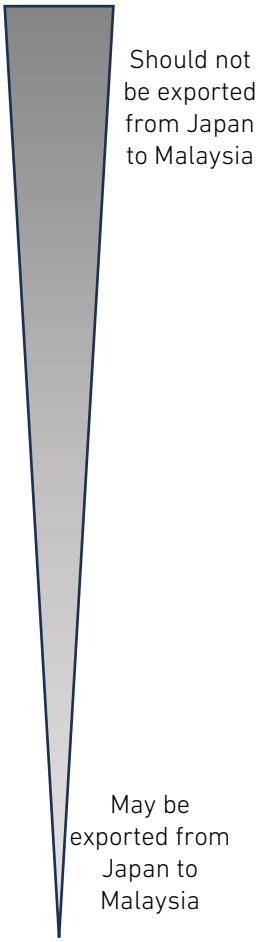
No.	Waste Description
1.	Waste metal, contaminated with heavy metals such as cadmium, mercury, lead, nickel, chromium, copper, lithium, silver, or manganese
2.	Wastes or products processed out of the partial recovery facilities
3.	Printers including accessories
4.	Audio amplifier and radio
5.	Integrated circuit and microwave/oven
6.	Ink cartridges and facsimile machine
7.	Printed circuit board and video recorder
8.	Patterned wafer and photocopy machine
9.	Lead-frame and telephone
10.	Hard disk drive and washing machine
11.	Motherboard and refrigerator
12.	Computers and mobile phones
13.	Cathode ray tube and television
14.	Electric cable and air-conditioner

Source: Shad, Ling, and Karim (2020).

Based on research articles that examined the main EEE categories (as defined by the Basel Convention) in relation to hazardous materials, Table 3.2 summarises the EEE categories from most to least hazardous and its relation to Japan–Malaysia flow.

Table 3.2. Ranking of EEE Categories by Hazardous Material Content

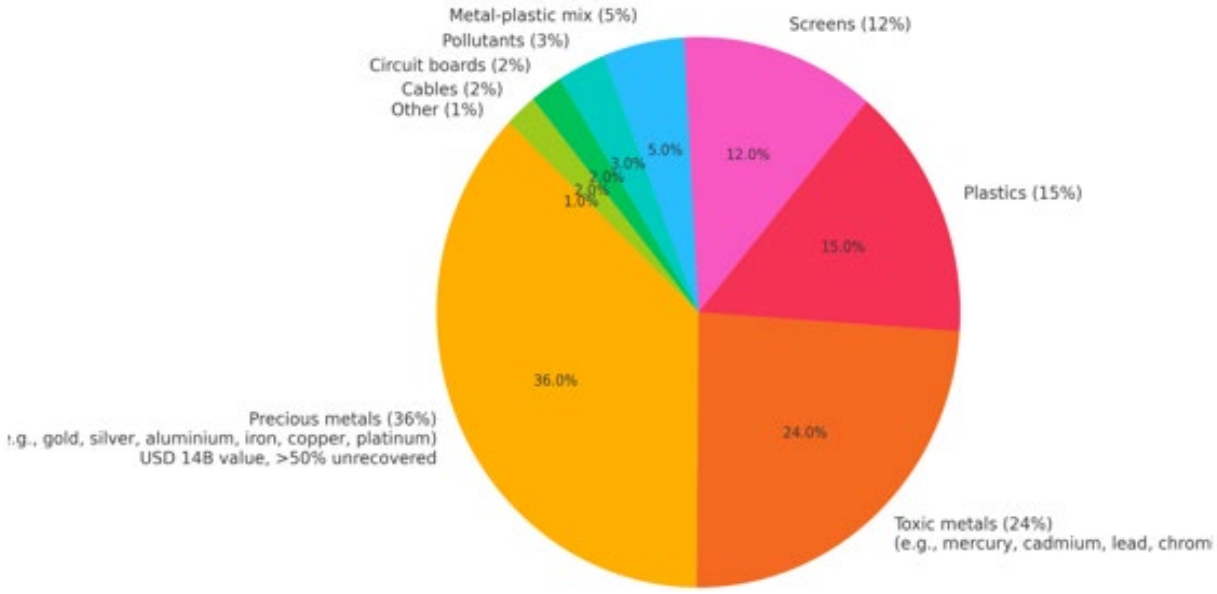
EEE Category	Key Hazardous Materials	References
TV screens (CRTs, LCDs, LEDs)	Lead (in CRTs), Mercury (in LCDs), Arsenic, Indium, Gallium (in LEDs)	Kiddee et al. (2013); Schluep et al. (2009)
Refrigerators, cooling, and heating equipment	CFCs/HCFCs/The Ss (refrigerants), oil, polyurethane foam (with isocyanates)	Tsai (2005); Wang et al. (2012); Vevere et al. (2024)
Audio and video equipment	Lead solder, cadmium, brominated flame retardants (BFRs), phthalates	Robinson (2009); Brigden et al. (2005)
Computing equipment (laptops, desktops, tablets)	Lead, cadmium, mercury, BFRs, beryllium, lithium-ion batteries	Puckett et al. (2002); Ongondo et al. (2011)
Mobile phones	Lead, cadmium, nickel, BFRs, lithium, rare earth elements (REEs)	Osibanjo and Nnorom (2007); Sepúlveda et al. (2010)



Source: authors

Although not specifically focused on Malaysia, the review paper by Andeobu, Wibowo, and Grandhi (2021) on e-waste generation and management practices in Asia-Pacific countries, including Malaysia, articulates the distinctive contents of e-waste, as depicted in Figure 3.6.

Figure 3.6. Distinctive Contents of E-Waste



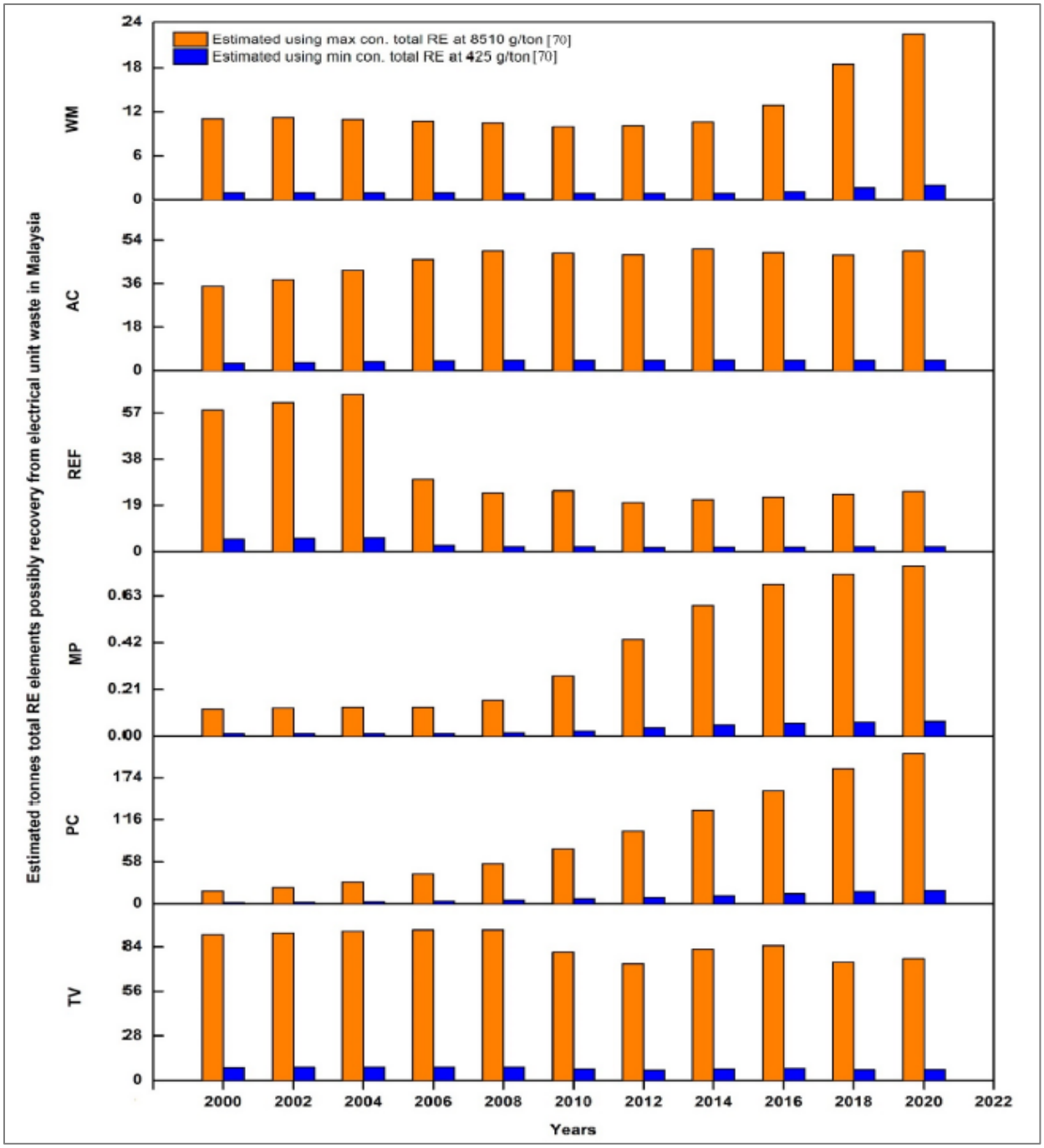
Source: Andeobu, Wibowo, and Grandhi (2021).

Printed circuit boards (PCBs) for rare earth elements (REEs)

Aziman, Ismail, and Rahmat (2023) did not specify REEs in relation to EEE flows between Malaysia and Japan. However, the topic remains highly relevant to this report due to its high value. Regarding PCBs, e-waste from discarded televisions, computers, and mobile phones contain PCBs that are rich in valuable metals, including REEs, which are essential for manufacturing various high-tech devices (Figure 3.7).

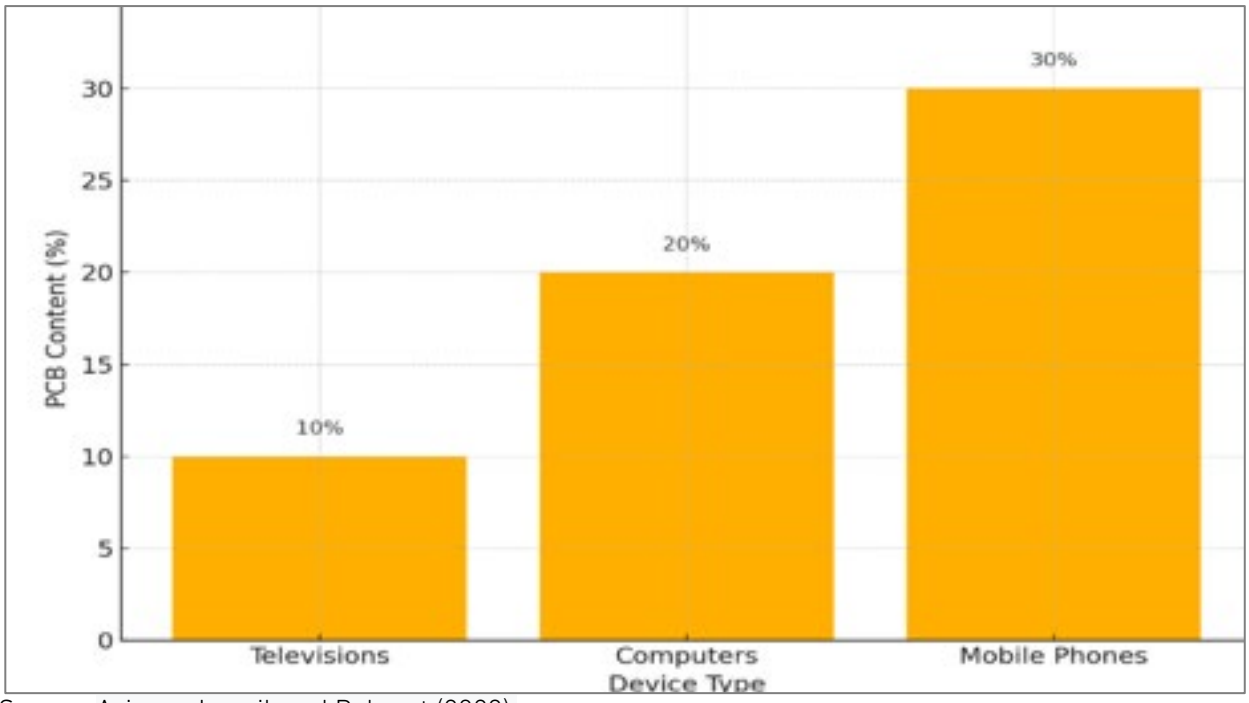
PCBs constitute approximately 4–7% of the total weight of e-waste, with higher percentages observed in specific devices: **(i) around 10% in televisions, (ii) 20% in computers, and (iii) 30% in mobile phones**. In Malaysia, based on these figures, between 0.36 and 1,019.56 tonnes of REEs could be recovered from e-waste across six different categories (i.e., TVs, PCs, mobile phones, refrigerators, air conditioners, and washing machines). This **highlights the economic attractiveness of recycling e-waste to reclaim these critical materials** (Aziman, Ismail, and Rahmat, 2023). Figure 3.8 illustrates PCB content by televisions, computers, and mobile phones.

Figure 3.7. Estimated Tonnes of Possible Rare Earth Elements Recovery from E-Waste Recycling



Source: Aziman, Ismail, and Rahmat (2023).

Figure 3.8. PCB Content by Televisions, Computers, and Mobile Phones



Source: Aziman, Ismail, and Rahmat (2023).

Conclusion:

To ensure environmentally sound and mutually beneficial trade between Japan and Malaysia, it is recommended that Japan export only low-risk UEEE for reuse or repair – such as mobile phones and laptops containing lower levels of hazardous materials – that meet Malaysia's UEEE conditions, with no flows intended for material recovery or disposal. Higher-risk UEEE should only be exported if licensed recycling companies with the technological capabilities to manage such materials are properly identified (e.g., Shan Poornam Metals Sdn Bhd as a potential partner). To prevent the externalisation of recycling and disposal burdens onto Malaysia, such exports should be accompanied by a formal bilateral agreement that includes:

- Identification of licensed remanufacturing, repurposing, or recycling partners in Malaysia with a proven track record of renewing UEEE or recycling WEEE to support material sustainability.
- Technology transfer and infrastructure support from Japan to enhance Malaysia's capacity for material recovery and safe recycling when UEEE from Japan becomes WEEE.
- Economic and social benefits for Malaysia, such as job creation, skills development, and integration of informal sector workers into the formal waste management system.

It is recommended to identify licensed remanufacturing, repurposing, and recycling partners in Malaysia with a proven track record of renewing UEEE or recycling WEEE to

promote material sustainability. Partnerships should also be established with certified remanufacturing or repair companies that can receive UEEE strictly for direct reuse, repair, or refurbishment.

B) Basel Convention

As a signatory to the Basel Convention, Malaysia is required to regulate the import and export of EEE in accordance with the convention's procedures. Previously, Malaysia applied strict controls to hazardous e-waste, while permitting the import of certain UEEE for reuse or refurbishment under regulated conditions. However, effective 1 January 2025, significant changes have been introduced under the Basel Convention, requiring stricter oversight of all e-waste-related shipments. This section reports on the key changes as well as the e-materials highlighted in the most recent Basel Convention report.

Key Changes Applicable to Malaysia's E-Waste Regulations Under the Basel Convention

B-1) All e-waste is now considered potentially hazardous

One of the most critical changes introduced under the Basel Convention is the requirement that all e-waste shipments be subjected to control procedures unless they are clearly proven to be non-hazardous. This reflects a precautionary approach, ensuring tighter regulation of the transboundary movement of e-waste. Under the new rules:

- Prior written approval from Malaysia's DOE remains mandatory, as per Section 34B(1)(b) and (c) of the Environmental Quality Act, 1974.
- An additional prior informed consent (PIC) from the importing country's government is now required for all e-waste exports (Basel Convention, 2022). This applies to a wide range of e-scrap items, including whole devices, components, and shredded materials that use electricity to function. While certain exceptions remain, most such exports will now fall under Basel Convention regulatory oversight (Staub, 2024).
- PIC exemptions are only allowed on trading processed e-waste with non-contaminated components falling under Annex IX, B1010 Waste (metal and metal-alloy wastes in metallic, non-dispersible form).
- These changes reflect recent amendments to the Basel Convention's classification codes, affecting how e-waste is categorised for international trade:
    - Previously: Listing B1110 classified certain e-waste types as non-hazardous (Basel Convention, 2022).
    - Now: Listing Y49 replaces B1110, indicating that all e-waste must be treated as potentially hazardous (Basel Convention, 2022). The provision is intended to provide transparency in cases where improper e-waste management is likely (e.g., informal recycling or dumping when proper recycling is considered uneconomic) or when the activity falls under the Basel Ban Amendment.

- Additionally, Listing A1181 replaces A1180 under Annex VIII, expanding the definition of hazardous e-waste to include full units, components, and fractions from shredding (Basel Convention, 2022).

Notably, **Japan's resistance to the adoption of new Y49 listing into the Waste Trade Decision of the Organisation for Economic Co-operation and Development (OECD) created tension and disruption within the OECD framework** (Wong, Wong, and Zulkeflee 2024). **Malaysia is going beyond the Basel Convention by implementing stricter policies that do not allow the import of UEEE**. However, it is not feasible to test every EEE to determine whether incorrect descriptors were used at customs to gain entry.

Since January 2025, DOE has been encountering challenges in **distinguishing hazardous waste from non-hazardous waste** (Kamarulzaman, 2025). Nevertheless, this fundamental shift may eliminate previous regulatory ambiguity and ensure that all cross-border e-waste shipments undergo **stricter scrutiny** before being processed.

B-2) Expanded definition of e-waste under the Basel Convention

The second major change is the broader definition of e-waste. As of June 2022, the Basel Convention officially defines e-waste to include:

- Mobile phones
- Computing equipment (e.g., laptops, desktops, tablets, power packs, mice, keyboards)
- TV screens (including LEDs, LCDs, CRTs)
- Audio and video equipment
- Refrigerators, cooling, and heating equipment
- Electronic car parts
- Electronic bicycle parts, motorcycles

Under the new definition, any part of these devices – whether a complete unit, a component, or a shredded fraction – must be treated as potentially hazardous and is therefore subject to the Basel Convention's trade restrictions. This new requirement removes the costly burden for tests to prove whether traded e-waste is hazardous or not. **Notably, the Basel Convention prohibits developed countries, such as Japan, from exporting hazardous waste to less developed countries like Malaysia,** due to concerns that the latter may lack the capacity to manage such waste in an environmentally sound manner (Admin_Ec., 2019).

These changes align with the amendments to the Basel Convention, which indicate that:

- **Basel Party countries must obtain written approval from any importing nation (including Basel Convention signatories) before exporting any e-waste or electronic scrap through the PIC procedure**.
- Malaysia must revise its policies to align with these stricter classifications and

update e-waste disposal and handling regulations (DOE, 2025). The previous challenge of differentiating hazardous from non-hazardous e-waste is now obsolete – all traded e-waste must be treated as potentially hazardous.

In addition to the existing categories of EEE in Malaysia, both Malaysia and Japan need to monitor an **additional category of EEE – audio and video equipment,**[1] electronic car parts, electronic bicycle parts, motorcycles[2] – to ensure comprehensive oversight.

These new regulations will impact the transportation classification, and management of e-waste materials between Malaysia and Japan, **requiring updated guidelines for identifying specific hazards in traded shipments.**

The most recent data from the Basel Convention publication related to e-waste flows between Malaysia and Japan is as follows (Tables 3.3 and 3.4):

[1] **Audio equipment** includes microphones (wired, wireless, lavalier, condenser, dynamic), speakers (studio monitors, PA systems, surround sound systems), headphones and earphones (wired, wireless, noise-canceling), mixers and audio interfaces (for sound processing and recording), amplifiers and receivers (for boosting audio signals), digital audio recorders (portable and professional-grade), soundbars (for home theater systems), and equalisers and processors (for sound customisation).
Video equipment includes cameras (DSLR, mirrorless, camcorders, action cameras, webcams), video recorders (DVRs, external video recorders, NVRs), monitors and screens (LED, OLED, projectors, studio monitors), projectors and projection screens, streaming and broadcasting equipment (capture cards, switchers, encoders), lighting equipment (softbox lights, LED panels, ring lights), tripods and stabilisers (gimbals, dollies, sliders), and editing and production software (video and audio editing tools).
[2] **Electronic car parts, electronic bicycle parts and motorcycles** include parts of motor vehicles, electronic bicycles, and motorcycles with computer or electronic material, such as car radios or car media components, batteries on electronic bicycles, or any other parts with PCBs.

Table 3.3. ERS Basel 2020 Malaysia: Export of Hazardous Wastes and Other Wastes in 2019

Basel Annex VIII, II, or IX	Y Code	National Code	Materials	HS Code	Amount Exported (metric tonnes)	Trade Direction
A1180	Y22, Y31	SW110	Electronic Waste*	8549	70	MY to JP
A1180	Y22, Y31	SW110	Electronic Waste*	8549	300	MY to JP (JP is the transit country, the destination is US)
A1050	Y17	SW204	Sludge**	3825	160	MY to JP
A3190	Not stated in report	SW501	Dried Silicon Carbide Mixture***	2849.20	180	MY to JP

*Electronic waste aligns with SW110, Malaysia's code for hazardous e-waste, which includes 'waste from electrical and electronic assemblies containing components such as accumulators, mercury switches, glass from cathode-ray tubes, other activated glass, or polychlorinated biphenyl capacitors.' It also corresponds to the HS code for 'waste and scrap of primary cells, primary batteries, and electric accumulators; spent primary cells, spent primary batteries, and spent electric accumulators.

**Sludge is a by-product of e-waste processing, often containing hazardous residues from metal recovery, wastewater treatment, and chemical processing of PCBs, cathode ray tubes (CRTs), batteries (Li-ion, Ni-Cd, lead-acid), electronic coated components, display panels and screens, soldered and plated parts.

***Dried silicon carbide mixture is commonly used in SiC MOSFETs (silicon carbide metal-oxide-semiconductor field-effect transistors), an advanced semiconductor device used in high electrical power and frequency applications.

Source: Adapted from Malaysia export of hazardous wastes and other wastes 2020 report (Basel Convention, 2022).

Table 3.4. ERS Basel 2022 Japan: Import of Hazardous Wastes and Other Wastes in 2021

Basel Annex VIII, II or IX	Y Code	National Code	Materials	HS Code	Amount Exported (metric tonnes)	Trade Direction
A1050	Y17	Not stated in report	Sludge*	3825	62.204	MY to JP

Source: Adapted from Malaysia export of hazardous wastes and other wastes 2020 report (Basel Convention, 2022).

Descriptors of Identified HS Code

HS 8549 (i.e., electrical and electronic waste and scrap): Waste and scrap of primary cells, primary batteries, and electric accumulators; spent primary batteries and spent electric accumulators (HTS, 2025a).

HS 3825: Residual products of the chemical or allied industries, not elsewhere specified or included municipal waste; sewage sludge; other wastes specified in note 6 to this chapter: Municipal waste, Sewage sludge, Other wastes from the chemical or allied industries (HTS, 2025b).

HS 2849.20: Carbides, whether chemically defined: Of silicon (HTS, 2025c).

Key differences between SW110 and HS code (Table 3.5)

Table 3.5. Key Differences between SW110 and HS Code

Feature	SW110 (Malaysia)	HS Code (International)
Purpose	Environmental protection and hazardous waste control	Trade regulation and customs classification
Focus	Hazardous materials in e-waste	Type of electronic waste as trade goods
Regulatory Use	Domestic (Malaysia's environmental law)	Global trade and customs enforcement

Source: Adapted from Malaysia export of hazardous wastes and other wastes 2020 report (Basel Convention, 2022).

C) International Trade Statistics

Tables 3.6 and 3.7) were derived from United Nations Comtrade (2022).

Table 3.6. Top Five EEE Materials Exported from Malaysia, 2019–2021

No.	EEE Materials	HS Code	Value (million US$)		
			2019	2020	2021
1	Electronic integrated circuits	8542	4,4791.4	49,255.2	59,635.0
2	Diodes, transistors, and similar semiconductor devices	8541	8,725.8	7,610.6	8,235.1
3	Automatic data processing machines and units thereof	8471	6,612.0	4,972.3	6,295.5
4	Prepared unrecorded media for sound recording	8523	4,251.5	5,830.6	6,672.9
5	Electrical apparatus for line telephony or line telegraphy	8517	4,057.8	5,315.2	6,307.6

Source: Created by the authors using data from United Nations Comtrade (2022).

Table 3.7. Top Six EEE Materials Imported to Malaysia, 2019–2021

No.	EEE Materials	HS Code	Value (million US$)		
			2019	2020	2021
1	Electronic integrated circuits	8542	3,1927.1	33,372.1	42,808.6
2	Electrical apparatus for line telephony or line telegraphy)	8517	4,043.4	3,916.9	4,189.1
3	Diodes, transistors, and similar semiconductor devices	8541	3,038.5	3,280.8	4,180.1
4	Automatic data processing machines and units thereof	8471	2,767.0	2,535.5	3,690.6
5	Gold (including gold plated with platinum)	7108	2,406.4	2,251.2	4,209.7
6	Printed circuit boards (PCBs)	8534	2,161.5	2,557.7	3,098.7

Note: There was no data on trade between Malaysia and Japan, in either direction.
Source: Created by the authors using data from United Nations Comtrade (2022).

HS Code:

HS 8542: Electronic integrated circuits; parts thereof (HTS, 2025d)

HS 8541: Semiconductor devices (for example, diodes, transistors, semiconductor-based transducers); photosensitive semiconductor devices, including photovoltaic cells whether assembled in modules or made up into panels; light-emitting diodes (LED), whether assembled with other LEDs; mounted piezo-electric crystals; parts thereof (HTS, 2025e)

HS 8471: Automatic data processing machines and units thereof; magnetic or optical readers, machines for transcribing data onto data media in coded form and machines for processing such data, not elsewhere specified or included (HTS, 2025f)

HS 8523: Discs, tapes, solid-state non-volatile storage devices, 'smart cards' and other media for the recording of sound or of other phenomena, whether or not recorded, including matrices and masters for the production of discs, but excluding products of Chapter 37 (HTS, 2025g)

HS 8517: Telephone sets, including smartphones and other telephones for cellular networks or for other wireless networks; other apparatus for the transmission or reception of voice, images, or other data, including apparatus for communication in a wired or wireless network (such as a local or wide area network), other than transmission or reception apparatus of heading 8443, 8525, 8527, or 8528; parts thereof (HTS, 2025h)

HS 7108: Gold (including gold plated with platinum) unwrought or in semi-manufactured forms, or in powder form (HTS, 2025i)

HS 8534: Printed circuits (HTS, 2025j)

D) Identified materials for the analysis

We have identified the following materials from non-academic sources and academic articles related to materials found in Malaysia (Table 3.8).

Table 3.8. Key E-Waste Materials identified in Malaysia

No.	Six Equipment Categories	EEE Material (HS Code)
1	Temperature exchange, equipment	Refrigerators, air conditioners (blower), and air conditioners (compressor) (8418)
2	Screens and monitors	Televisions and monitors: Liquid crystal display (LCD) monitors and cathode ray tube (CRT) monitors (8528); used CRT-TVs (8540)
3	Lamps	Used pendarfluor light/fluorescent light (8539)
4	Large equipment	Washing machines (8450); Used waste metal contaminated with heavy metals such as cadmium, mercury, lead, nickel, chromium, copper, lithium, silver, and manganese (8549.12); Used electrical and electronic equipment/product imported from other countries,

No.	Six Equipment Categories	EEE Material (HS Code)
		server (big) (8471); e-waste, wastes, or products processed out of the partial recovery facilities (8549); Larger printers such as scanners, multi-functional machines, mix scrap) (8443); Kitchen hoods (8414.60)
5	Small equipment	Used microwave (8516.50); Used oven (8516.60); Used radio (8525); Used audio amplifier (8518); Prepared unrecorded media for sound recording (8523); Cables and wiring, mix wire (8544); Used batteries, car battery, UPS battery (8507); Used waste metal contaminated with heavy metals such as cadmium, mercury, lead, nickel, chromium, copper, lithium, silver, and manganese (8549.12); Used electrical and electronic equipment/product imported from other countries (8471); e-waste, wastes, or products processed out of the partial recovery facilities (8549); Vacuum cleaner/ robotic vacuum (8505); Sewing machine (8452); Electric pan, induction stove (8516); Personal care equipment (e.g., tooth brushes, hair dryers, razors); Household medical equipment (e.g. thermometers, blood pressure monitors); Fire extinguisher (8424); Camera (9006)
6	Small IT and telecommunication equipment	Computer desktop central processing units (CPUs) (complete; incomplete, big; incomplete, small; motherboard only; empty; all-in-one), laptops (complete, big; complete, small; incomplete or scrap),and tablets (8471); Used telephone, mobile phones, modem, switch, and smartphone (8517); Used video recorder (8521); Used motherboard, ram (8473.30); Used hard disk drive (8471.70); electronic integrated circuits, processors (8542); Used ink cartridges (3215); Used or rejected or waste of integrated circuit (8549); Cables and wiring (8544); Used batteries, car battery, UPS battery (8507); Printed circuit boards (PCBs) (8534); Used lead frame (2603.00.00.20); Used patterned wafer (3818); Used waste metal contaminated with heavy metals such as cadmium, mercury, lead, nickel, chromium, copper, lithium, silver, and manganese (8549.12); Used electrical and electronic equipment/product imported from other countries, server (small/blade) (8471); e-waste, wastes, or products processed out of the partial recovery facilities (8549); Semiconductor devices (8541); Printers (e.g., scanners, multi-functionals, faxes) (8443); Keyboards, external drives and accessories, routers, mouse (8471); Pendrive (8523)

Source: DOE (2008) and other sources.

Based on information provided by a prominent e-waste recycling actor, Table 3.9 lists the monetary value of each e-product, arranged from highest to lowest.

Table 3.9. EEE Materials with Monetary Value, as Shared by the Leading Formal Waste Collector in Malaysia

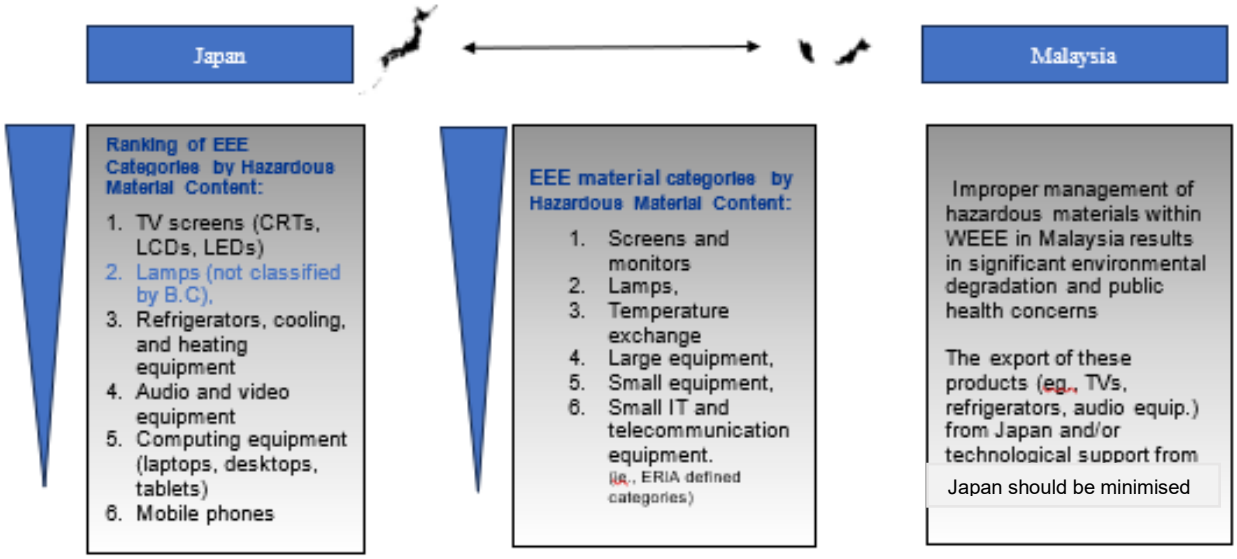
Item Description	Price per Kg (RM)	Price per Unit (RM)
RAM	100	
Processor	60	
Smartphone	55	
Motherboard	30	
Desktop CPU (all-in-one)	15	150
Laptop (complete – big/small)	15	30
Laptop (incomplete/scrap)	12	25
Hard disk drive (HDD)	13	
Tablet	11	
Mix wire	10.5	
Air conditioner (compressor)	10	
Server (small/blade/big)	6.5	
Modem/Switch	6.5	
Desktop CPU (complete)	5	35
Air conditioner (blower)	5	
UPS battery	5	
Desktop CPU (incomplete – big/small)	4	25 / 20
Car battery	4	
Desktop CPU (motherboard only)	3	15
Mix Scrap/Printer	3	
LCD monitor	2.5	10
LCD/LED TV (big/small)	2.5	25
Desktop CPU (empty/*kosong*)	2	10
CRT monitor/CRT TV	2	
Washing machine	-	12
Fridge	-	12
Camera	-	3.5

Source: Authors.

Conclusion

Figure 3.9) presents an overarching framework spanning EEE, ranked by hazardous material content. The framework underscores the importance of Japan considering the hazardous materials in EEE flowing into Malaysia, which must be minimised and properly managed once they enter Malaysian territory.

Figure 3.9. The Transboundary Flow of EEE Materials from Japan to Malaysia Requires Careful Attention



Source: Authors.

1.3 Identification of issues on the international material flow between Malaysia and Japan

This section highlights the status quo of international material flows, followed by two key areas: (i) issues related to material flows between Malaysia and Japan, and (ii) domestic challenges arising from these flows.

A) Status quo and trends of the international material flow

EEE product is the top category for both imports and exports. In 2024, EEE exports reached RM601.18 billion – a 4.5% increase from the previous year – and **accounted for 39.9% of total exports**. On the import side, EEE products rose significantly, from RM356 billion in 2023 to RM455 billion in 2024, representing a 28% increase (MITI, 2025).

From Malaysia to Japan

Japan ranks as Malaysia's fifth-largest export market, following Singapore, the United States (US), China, and Hong Kong (MITI, 2025). Key exports to Japan include EEE products, machinery, equipment and parts, and optical and scientific equipment. **Malaysia also exports certain types of e-waste to Japan, where these materials are processed using advanced recycling technologies**. For instance, Japan's sophisticated facilities enable the recovery and refinement of materials such as low-gold-content ingots (Suja et al., 2014), highlighting the value-added potential of transboundary e-waste flows.

From Japan to Malaysia

In contrast, **Japan exports second-hand electronic devices to Malaysia and other Southeast Asian countries, where they are reused or recycled**. While some of these flows occur through legal commercial channels, **others are routed informally, contributing to concerns about the illegal e-waste trade** (El-Gawhari, Abdel Hameed, and Sami, 2024). Japan's export of obsolete electronics to Malaysia is often driven by relatively lower labour costs and less stringent regulatory enforcement in the recipient country (Alias et al., 2014).

Technological and Policy Learning

Malaysia continues to benchmark Japan in advancing its e-waste processing and policy frameworks. **Japan's Home Appliance Recycling Law and its 3R (Reduce, Reuse, Recycle) initiatives serve as regulatory models for Malaysia's evolving e-waste governance** (Rasnan et al., 2016). Technical and policy knowledge is transferred through bilateral collaboration, including training programmes, e-waste inventory projects, and joint initiatives to strengthen Malaysia's regulatory capacity (JICA, 2019). However, significant contextual differences between Malaysia and Japan require a customised approach.

Table 3.10 summarises the export performance of Malaysia's six leading EEE products in 2024.

Table 3.10. Top Six EEE Goods Manufactured and Exported from Malaysia to Other Countries, including Japan in 2024

No.	Manufactured Goods (Materials)	2024 Malaysia Export Value (RM)	% Increase Compared to 2023
1	Electronic integrated circuits	313.1 billion	4.8%
2	Computers	32.31 billion	77.7%
3	Other computers and data processing equipment	15.43 billion	53%
4	Parts and accessories for office machines	13.72 billion	24.5%
5	Electro-diagnostic apparatus, medical and radiological apparatus	5.54 billion	75.8%
6	Parts and accessories for computers	10.68 billion	16.3%

Source: MITI (2025, p. 10).

The flow of second-hand EEE materials **from Japan to Malaysia** is shown in Table 3.11). Notably, **these EEEs contain highly hazardous materials**, for which Malaysia will require technological and other forms of support to protect the environment. Most of the data is outdated, except for CRT monitors.

Table 3.11. Export of Second-Hand Items from Japan to ASEAN, 2022

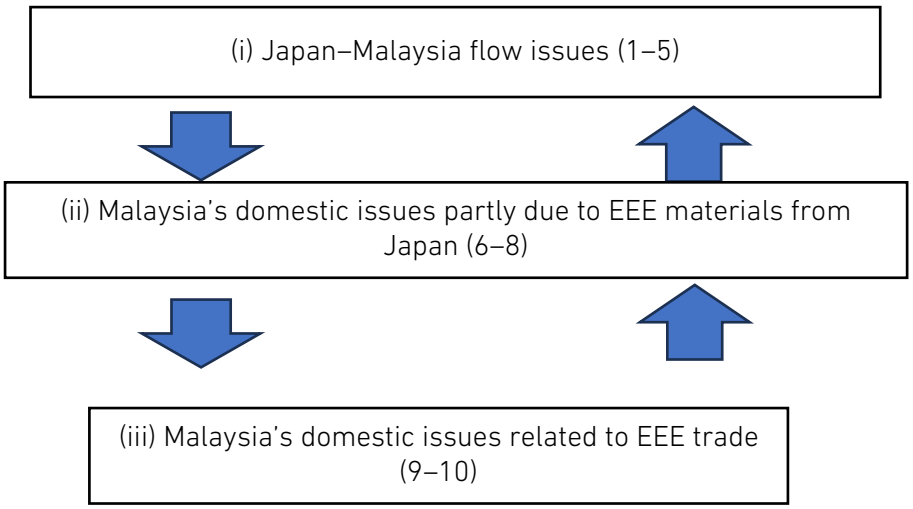
No.	Second-Hand EEE Materials	HS Code	Direction (JP-> MY) (MY->JP)	Notes
1	Air conditioner	8418	JP-> MY	In 2008, 13 units of second-hand air conditioners were exported from Japan to Malaysia (IGES, p.6). In 2022, second-hand air conditioners were exported from Japan primarily to Cambodia, Myanmar, and Viet Nam. While Malaysia was not a primary destination, some units were exported to Malaysia (Oikawa and Iwasaki, p.15).
2	LCD TV (liquid crystal, plasma, others)	8524	JP-> MY	in 2008, 323 second-hand TV units were exported from Japan to Malaysia Japan exported 303,676 units of second-hand LCD televisions in 2022 with 1.5% exported to Malaysia (Oikawa and Iwasaki, p. 17).
3	CRT monitors	8528	JP->MY	A total of 2,166,473 units of second-hand CRT monitors were exported from Japan in 2022, with 1% exported to Malaysia (Oikawa and Iwasaki, p. 16).
4	CRT-TV	8540	JP-> MY	In 2008, 59,924 units of second-hand CRT-TVs were exported from Japan to Malaysia (IGES, p. 6).

Source: Oikawa and Iwasaki (2023); IGES (n.d.).

B) Issues

This section is divided into (i) issues related to material flow between Malaysia and Japan, (ii) Malaysia's domestic issues related party due to EEE materials from Japan; and (iii) Malaysia's domestic issues related to EEE trade. Figure 3.10 indicates the structure of this section.

Figure 3.10. Relationship Between Material Flow and Domestic Issues



Source: Authors.

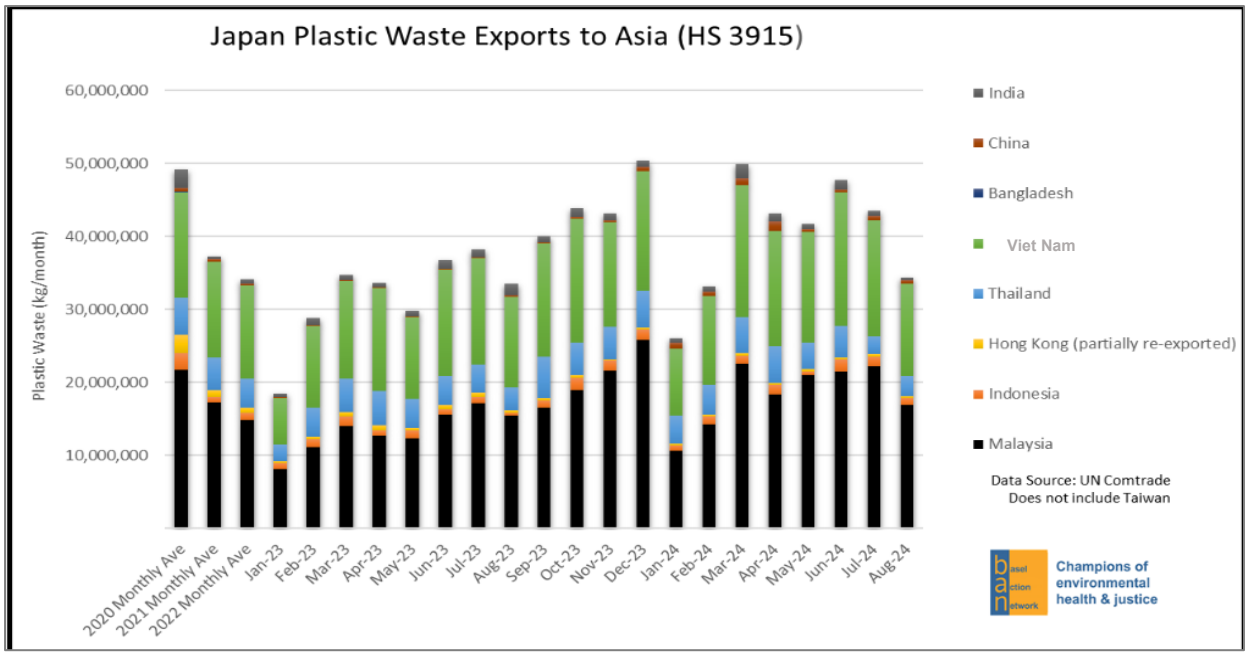
i) Issues related to material flows between Malaysia and Japan

B-i-1) Rapid increase in illegal e-waste imports in Malaysia

- **Malaysia acts as a recipient of end-of-life electronic products and components from developed countries like Japan for recycling and recovery**. Japan exports its obsolete electronic products, which may be sent to Malaysia due to lower labour costs and less stringent regulatory frameworks (Alias et al., 2014).
- Malaysia was in the past listed as one of the largest e-waste importers from developed countries (Andeobu, Wibowo, and Grandhi, 2021).
- Notably, estimates from DOE show that Malaysia is expected to generate 24.5 million units of e-waste in 2025 (DOE, n.d.-b).
- Much of the e-waste smuggled into Malaysia consists of plastic casings from electronic devices – materials with low market value that may contain hazardous 'forever chemicals' (Trisha, 2025).

Figure 3.11 illustrates Japan's plastic waste exports to Asia, including Malaysia. It is included in this report because plastics make up about 10% of most EEE and therefore have significant implications for the e-waste trade.

Figure 3.11. Japan Plastic Waste Exports to Asia (HS 3915)



Source: Basel Action Network (2025).

B-i-2) UEEE from Japan turning into e-waste (Malaysia as a dumping ground)

- The demand for second-hand electronics in developing countries is driven by poverty and affordability, making Malaysia a prime destination for e-waste from developed nations (Andeobu, Wibowo, and Grandhi, 2021).
- Japan's rapid technology turnover generates large amounts of e-waste, **much of which is exported to Southeast Asia** (Andeobu, Wibowo, and Grandhi, 2021).

B-i-3) Illegal trade: Disguised e-waste via informal and illegal e-waste trading

The UN Office on Drugs and Crime's (UNODC) *UNwaste* analysis showed that in Asia, 1,814 kilotonnes – over 62% – of imported e-waste in 2019 were undocumented, revealing systemic blind spots in customs oversight and reporting (UNODC, 2024a). Malaysia is no exception; it has emerged as a hub for illegal e-waste shipments and incineration, with most recent inflows originating from China (Jayaseelan, 2025). The illicit trade in obsolete and non-functional electronics has persisted in Malaysia for more than a decade.

Notably, Malaysia banned the import of e-waste in 2012 and tightened regulations in 2017 by requiring companies to obtain approval from DOE before importing any e-waste (Raja, 2025). Under current law, only shipments accompanied by movement documents issued by DOE are permitted.

Despite Malaysia's strict ban on e-waste imports, illegal shipments persist. For example, in June 2024, customs detained 301 containers flagged by the Basel Action Network, including 106 filled with e-scrap illegally imported from the US – highlighting ongoing enforcement gaps despite licensing requirements (Smith, 2024).

Illegal e-waste trafficking spans both domestic and international domains, typically involving the movement of hazardous materials from developed to developing countries. Trade flows are commonly observed from the global north – including the European Union (EU), Japan, the US, and Australia – to the global south, particularly Africa, Asia, and South America.

Appendix 3 summarises UNODC data on e-waste imports into Malaysia, showing that the volume is significantly lower compared to Thailand, along with a marked reduction in illegal shipment cases and a persistent number of containers being repatriated. Appendix 3 also highlights a UNODC report indicating that illegal waste shipments to Malaysia were facilitated through websites operated by a company based in China, which expanded to the US in 2018 and to Malaysia, Thailand, Pakistan, Japan, and Hong Kong in 2021.

This illegal trade involves a complex network of actors, including illicit companies, organised criminal groups, and, in some cases, compromised enforcement officials. Waste trafficking is recognised as one of the most profitable yet low-risk environmental crimes, with violators often facing minor administrative penalties rather than criminal prosecution (Wong, Wong, and Zulkeflee, 2024).

Criminal syndicates engaged in illegal e-waste operations are primarily motivated by profit, focusing on the extraction of high-value materials such as copper and gold while bypassing the costs associated with pollution control. The remaining toxic waste is then illegally dumped, causing severe environmental degradation (Trisha, 2025).

In February–March 2025, there has been a surge in informal and illegal e-waste trading, driven by criminal groups seeking to quickly extract valuable materials such as copper and gold. These operations circumvent pollution control requirements and illegally dump toxic residues at minimal cost, causing severe environmental harm (Jayaseelan, 2025). Notable reports have also been broadcasted by CNA (2024).

Notably, over 140 containers of illegal e-waste, worth an estimated US$2.2 million, were intercepted in Malaysia in the first half of 2024, most of which were traced to shipments from the US and EU, destined for illegal smelters operated by Chinese criminal syndicates. The trade is fuelled by fake documents, false declarations, and complex international networks, making enforcement increasingly difficult.

B-i-3-1) Disguised e-waste flows to Malaysia: Mislabelling as UEEE and second-handgoods to bypass import bans

Despite Malaysia's full ban on e-waste imports, exporters frequently disguise e-waste as UEEE or second-hand goods to bypass customs restrictions (Wong, Wong, and Zulkeflee, 2024). These shipments are often labeled as '**repairable electronics**', a tactic that allows hazardous end-of-life electronics to be funnelled into informal recycling channels (Azizi et al., 2023).

Waste consignments are often routed through third-party transit hubs to conceal their true origin, making detection difficult and complicating repatriation once seizures occur (UNODC,

2025a). Brokers increasingly rely on digital platforms, including encrypted messaging apps, to arrange waste shipments, falsify paperwork, and negotiate sales, creating new challenges for traceability and enforcement (UNODC, 2024b).

The practice of mislabelling e-waste as UEEE or second-hand goods is widespread and presents serious health and environmental hazards when such waste is dismantled without proper controls. For example, shipments originating from Japan have repeatedly failed to meet import requirements and have been repatriated by recipient countries, as reported on the Ministry of the Environment Japan (MOEJ) website and summarised in Table 3.12 (Wong, Wong, and Zulkeflee, 2024), with additional information from various sources summarised in Table 3.13.

The shipments of containers with fraudulent declarations had been smuggled through major ports and land borders. According to official statements, criminal syndicates *used falsified documentation and middlemen to facilitate these imports, making it difficult for enforcement agencies to identify and prosecute the masterminds behind these operations* (CNA, 2024; Mahari, 2024).

Enforcement efforts have been undermined by the frequent misuse of the label for UEEE, which is commonly exploited to disguise illegal e-waste imports. This has resulted in growing piles of non-recyclable scrap in the country. In response, DOE has ramped up enforcement operations to identify and shut down unlicensed e-waste processing facilities. According to the customs department, these illegal consignments are often brought in through fraudulent means – false declarations, falsified paperwork, and, in some cases, bribery of enforcement personnel (Raja, 2025). However, it is notable that news coverage tends to focus solely on the detection of illegal imports, while formal recyclers with high technological capabilities are often neither informed nor considered when bidding for e-waste as a potential resource.

In Malaysia, migrant and undocumented workers are often subjected to forced labour under hazardous conditions at illegal processing facilities. The broader consequences of waste trafficking – ranging from air and water pollution to threats to public health, biodiversity, and the rule of law – are profound, yet largely underreported and externalised onto communities least equipped to respond (Wong, Wong, and Zulkeflee, 2024).

Cases of e-waste shipback: This is therefore common and has resulted in significant regulatory failures. For instance, MOEJ recorded 25 rejected shipments in recent years – 18 of which contained e-waste, and 3 plastic wastes – that were repatriated after failing border inspections in recipient countries. While Japan has stringent domestic e-waste laws, these shipments likely departed its ports due to misdeclaration of contents under loosely regulated categories with many end-of-life e-waste shipments arriving in Malaysia as repairable electronics. These incidents raise concerns not only about traceability and export controls, but also about the financial and diplomatic costs of repatriation, as exemplified by the Canadian waste stranded in the Philippines for 6 years (Wong, Wong, and Zulkeflee, 2024).

Table 3.12. Waste Shipments Repatriated to Japan from Malaysia, 2013–2022

No.	Date	Cargo	Reason for Return
1	December 2013	Used cathode ray tube monitors, etc.	Determined as hazardous waste under recipient country's regulations
2	December 2018	Harness	As above
3	April 2019	Metal scrap	As above
4	May 2019	Metal scrap	As above
5	May 2019	Waste plastic	The importer of the recipient country did not obtain the necessary import permission in accordance with the laws and regulations of the recipient country.
6	July 2019	Metals and metal containing waste	Determined as hazardous waste under recipient country's regulations
7	August 2019	Waste plastic	As above
8	November 2019	Waste plastic	As above
9	4 May 2020	Metal scrap mixed with WEEE (including waste circuit boards)	As above
10	20 May 2020	Used printers (including damaged items)	As above
11	6 October 2020	WEEE	As above
12	20 November 2020	Used central processing unit)	As above
13	8 January 2021	Cable (sheathed conductor)	As above
14	8 January 2021	Aluminium cable (sheathed conductor)	As above
15	25 February 2021	Metal scrap mixed with WEEE (incl. waste circuit boards)	As above
16	9 April 2021	Cable (sheathed conductor)	As above
17	26 April 2021	WEEE (including waste circuit boards)	As above
18	26 April 2021	Cable (sheathed conductor)	As above

No.	Date	Cargo	Reason for Return
19	26 April 2021	Cable (sheathed conductor)	As above
20	31 April 2021	Cable (sheathed conductor)	As above
21	14 September 2021	Cable (sheathed conductor)	As above
22	14 September 2021	Cable (sheathed conductor)	As above
23	21 September 2021	Toner cartridge	As above

Sources: Wong, Wong, and Zulkeflee, (2024), based on data from MOEJ.

Table 3.13. Waste Shipments Repatriated to Japan and/or Other Countries from Malaysia, 2013–2022

No.	Date	Cargo: E-Wastes	Entry Point	Country of Origin	Amount of Waste (no. of containers)	Enforcement Agency	Enforcement Action	Reason for Return
1	1 July 2020 DOE (2020)	E-waste	Port Klang, Selangor	US	4 22 others reported for Jan–Jun 2020	DOE and Royal Malaysian Customs (RMC)	Notices were issued to the company owner and shipping liner. Competent authorities in US were notified.	Found to have brought in e-waste without prior informed consent
2	13 July 2021 Mok (2021)	E-waste including waste electronic screen pads, electric board parts and various electronic components	North Butterworth Container Terminal (NBCT), Penang	US	One container	DOE	An order under Sections 31 and 37 of the Environmental Quality Act 1974 was issued to the importer to send the container back to the US.	Found to have brought in e-waste without prior informed consent.
3	17 October 2022 Sinnappan (2023)	Most e-waste is declared as scraps or other permissible goods.	East Port and West Port, Klang, Selangor; Tanjung Pelepas and Pasir Gudang in Johor; Kuantan in	US, **Japan,** Germany, and the United Kingdom (UK)	More than 1,000 containers with tonnes of e-waste are illegally imported monthly.	DOE and RMC	Environmental Quality Regulations (Scheduled Waste) 2005 and Environmental Quality Act 1974	Determined as hazardous waste under recipient country's regulations

No.	Date	Cargo: E-Wastes	Entry Point	Country of Origin	Amount of Waste (no. of containers)	Enforcement Agency	Enforcement Action	Reason for Return
			Pahang; and NBCT, Penang					
4	17 October 2022 Sinnappan (2023)	Lithium-cadmium battery waste	Air cargo	N/A	Penang DOE seized 250 air-cargo containers in a factory raid.	DOE and RMC	Environmental Quality Regulations (Scheduled Waste) 2005 and Environmental Quality Act 1974	Determined as hazardous waste under recipient country's regulations
5	17 October 2022 Sinnappan (2023)	E-waste or wire contents	NBCT	N/A	Not specified	DOE and RMC	Customs department wrote to the Finance ministry to auction the e-waste containers	Determined as hazardous waste under recipient country's regulations
6	17 October 2022 Sinnappan (2023)	Mixture of plastic and e-waste	NBCT	Japan	2	DOE and RMC	N/A	Determined as hazardous waste under recipient country's regulations
7	15 December 2022	E-waste, and several containers	West Port Klang, Selangor	Japan, US, Spain, Australia,	59 (January–November 2022)	DOE and RMC	DOE issued 18 instruction notices under the	Determined as hazardous

No.	Date	Cargo: E-Wastes	Entry Point	Country of Origin	Amount of Waste (no. of containers)	Enforcement Agency	Enforcement Action	Reason for Return
	Mardhiah (2022)	containing scrap metal		Belgium.	31 contained scheduled waste - 19 (December 2022) returned including Japan		Environmental Quality Act 1974 to return containers with e-waste shipped without permission.	waste under recipient country's regulations
8	15 December 2022 Mardhiah (2022)	Used computer gear and wires classified as e-waste and declared as aluminium scrap	West Port Klang, Selangor	US and Spain	3 (Held and examined on 8 December)	DOE and RMC	DOE issued 18 instruction notices under the Environmental Quality Act 1974 to return containers with e-waste shipped without permission.	Determined as hazardous waste under recipient country's regulations
9	9 December 2022 Malay Mail (2022)	Used computer hardware, wires declared as aluminium scrap	West Port, Klang, Selangor	US, Spain	3 containers (100 tonnes)	DOE and RMC	Instruction notices under Sections 31(1) and 37(1) of the Environmental Quality Act 1975 issued and containers returned	Returned under Basel Convention
10	9 December 2022 Malay Mail (2022)	E-waste, used plastic, used batteries, and engine components	West Port, Klang, Selangor	US, Latvia, South Korea, and Mexico	30 containers	DOE and RMC	Instruction notices under Sections 31(1) and 37(1) of the Environmental Quality Act 1975 issued and containers returned	Returned under Basel Convention

No.	Date	Cargo: E-Wastes	Entry Point	Country of Origin	Amount of Waste (no. of containers)	Enforcement Agency	Enforcement Action	Reason for Return
11	27 June 2024 Smith (2024)	E-scrap	Klang, Selangor	Los Angeles, US	106 containers	DOE, RMC	Determined as illegal to import. Basel Action Network works with the US Department of Justice to charge US recyclers that traffic e-waste with fraud and other crimes.	Returned under Basel Convention
12	20 February 2025 Zolkepli (2025)	E-waste	Nationwide	N/A	509 (inspected at ports nationwide between 2023 (47) and 2024 (462)	DOE and RMC	DOE works with the RMC which inspects containers. If e-waste is suspected, DOE is called in for investigations. If confirmed to contain e-waste, an order notice is issued for the items to be returned. DOE officers are not stationed at the ports 24/7.	Determined as hazardous waste under recipient country's regulations
13	19 February 2025 Ali (2025)	E-waste	West Port Klang, Selangor	US, Japan, Germany, and the UK	Over 1,000 containers (October 2023)	DOE and RMC	Illegally imported and processed in Malaysia	Determined as hazardous waste under recipient

No.	Date	Cargo: E-Wastes	Entry Point	Country of Origin	Amount of Waste (no. of containers)	Enforcement Agency	Enforcement Action	Reason for Return
								country's regulations
14	19 February 2025 Ali (2025)	E-waste	West Port Klang, Selangor	US, Spain, Australia, Belgium, and Japan	19	DOE& RMC	Returned to countries of origin	Determined as hazardous waste under recipient country's regulations
15	4 March 2025 Raja (2025)	E-waste and scrap metal		Port of Los Angeles, US, developed countries, particularly North America	301 (March–June) 106 with e-waste and scrap metal from the US	- DOE - The Enforcement Agency Integrity Commission found several DOE officers attempted to allow the release of illegal e-waste from Port Klang in May 2024.	- Enforcement has intensified at entry points into the country and raids on illegal e-waste factories have increased (Environmental Quality Act 1974). - Seizure of RM3.8 billion in materials - 538 people arrested - Illegal e-waste processing factory in Tikam Batu, Kedah, generated over RM10 million a month from precious	Determined as hazardous waste under recipient country's regulations

No.	Date	Cargo: E-Wastes	Entry Point	Country of Origin	Amount of Waste (no. of containers)	Enforcement Agency	Enforcement Action	Reason for Return
							metals.	

Source: Authors based on various sources.

B-i-3-2) Situation of any restrictions regarding e-waste trade

Overview

An overview of the restrictions regarding e-waste trade is as follows:

- Illegal imports. NRES intends to strengthen its monitoring and enforcement efforts regarding the importation of e-waste used by the recycling industry. Strict punishment will be considered against perpetrators involved in any misconduct to ensure that Malaysia is not used as a hazardous waste disposal site by irresponsible parties (Lee, 2024)
- Illegal recycling operations. Malaysia maintains strict restrictions on the trade of e-waste, particularly targeting illegal imports and unauthorised recycling operations. For example, the current Ops Hazard 2.0 enforcement operation exemplifies the country's regulatory stance, as illegally processed e-waste was seized as evidence in legal proceedings before being auctioned to licensed recycling facilities.
- Enforcement capacity. To ensure adequate capacity to enforce the restrictions, DOE has recruited 3,000 additional personnel to strengthen enforcement capabilities (Zolkepli and Gimino, 2025).
- Institutional integrity. The Enforcement Agency Integrity Commission uncovered attempts by DOE officers to illegally release containers filled with e-waste from Westports, Port Klang, without proper authorisation or documentation. This highlights serious institutional integrity issues that threaten the credibility and effectiveness of Malaysia's environmental enforcement efforts (Camoens, 2025a).

Table 3.14 further summarises the key issues related to Malaysia's efforts to enforce illicit e-waste trade restrictions. These findings are documented by the main authorities responsible for enforcing different restrictions and associated penalties, namely, DOE, Royal Malaysian Customs (RMC), Malaysian Anti-Corruption Commission (MACC), Royal Malaysia Police, and Malaysian Immigration Department.

Malaysia is a focus country under the UNODC–WCO Container Control Programme: Plastic and Hazardous Waste Project (with Cambodia, the Philippines, Thailand, and Viet Nam), which strengthens port risk-profiling, inter-agency coordination, and targeting of misdeclared waste (UNODC, 2021).

Table 3.14. Status of Restrictions on E-Waste Trade

Issues	Examples	Consequences
Key restriction issue 1: Illegal importation		
General import of illegal e-waste	January–November 2022 Between January and November 2022, a total of 59 containers were detained by the Selangor DOE and the RMC, of which 31 were found to contain scheduled waste. 8 December 2022 ● containers held and examined at Westports in Klang ● uncovered used computer gear and wires classified as electrical and e-waste, imported from the US and Spain	Issuance of instruction notices DOE issued 18 instruction notices under Sections 31 and 37 of the Environmental Quality Act 1974, ordering the containers to be returned. 19 containers returned to country of origin (US, Spain, Australia, Belgium, and Japan) Assurance by the Minister that DOE will continue to tighten monitoring and enforcement of e-waste importation for the recycling business. Strict action will be taken against importers failing to adhere to legislation. Source: Mardhiah (2022).
	2024 29 containers inspected by the Selangor DOE ● 18 contained e-waste ● 11 filled with scrap metal and plastic waste	29 instruction notices issued by the Selangor DOE involving 93 containers to importers on 30 April 2024. Source: Muthiah (2024).
Syndicated imports	Syndicate used false documentation to import waste for recycling, mainly from the US and frequently used middlemen or 'front' (or fake) companies to manage waste imports	The government successfully dismantled a major illegal waste import syndicate, seizing 106 containers filled with e-waste, and several others containing scrap metal. Containers with e-waste were investigated by the DOE under Section 34B of the Environmental Quality Act 1974. The offense is punishable by up to 5 years in prison, a fine of up to RM500,000, or both. Source: Mahari (2024).
False declarations of imported waste	March–June 2024 301 containers suspected of containing e-waste from March to June 2024 were seized (many falsely declared). 106 contained e-waste and	Investigations: 195 (of the 301) containers were investigated by the Customs department under Section 135 (1a) of the Customs Act 1967 for the import of prohibited items. Source: Lee (2024).

	scrap metal from developed countries such as the US.	
Key restriction issue 2: Illegal recycling operations widespread across the country		
Widespread operations across many premise types	Operations found in: - Industrial areas, - Remote areas, - Inside palm oil plantations, - on the outskirts of forests - Government reserve lands	47 premises raided (only 6 had valid DOE licenses). E-waste seized in the recent Op Hazard operations used as evidence in litigation and later auctioned to legal recycling operations. Source: Zolkepli and Gimino (2025).
Nationwide operations involving high value investments in assets and equipment	January 2024–February 2025: False declarations on illegal e-waste materials imported by sea (declared as scrap metals and plastic waste) - 47 factories raided nationwide - RM2.68 billion in e-waste seized, weighing 22.9 million kgs. - RM83 million worth in facilities and equipment - 128 vehicles worth RM29 million - RM67.8 million worth of oil, plastics, and smelting blocks Value of e-waste seized: - RM1.61 billion (the General Operations Force Northern Brigade) - RM701.68 million (Central Brigade) - RM401.1 million (Southeastern Brigade) - RM76.4 million (Sarawak Brigade) - RM65.1 million (Sabah Brigade) Sarawak: Factory bought e-waste from local suppliers who would collect e-waste	Raids and confiscation of materials and assets through Op Hazards - 90 raids on illegal waste factories - RM3.8 billion in materials and assets seized. Op Hazard was sparked as e-waste posed various threats to the public such as crime, abuse of power, corruption as well as health risks and threats to the economy. Source: Camoens (2025b).

	from people in the area and sell it to the illegal processing plant.	
	- 538 individuals were detained mostly in Teluk Panglima Garang, Selangor, and Perak on 15 February 2025. - 246 people detained (218 men, 27 women and 1 child). - 70 locals, 56 from China, 70 from Myanmar, 28 from Bangladesh, 15 from Indonesia, 4 from Cambodia, and 3 from the Philippines	Individuals were physically arrested.
Syndicated illegal operations involving both locals and foreigners	Illegal operations run by criminal syndicates seek to maximise profits by extracting copper, gold, and other valuable materials from electronic scrap coming from countries like the US and Japan. E-waste factories registered to Malaysians but potentially managed by proxies from abroad Syndicates are believed to have smuggled e-waste in through shipping containers that were usually declared as scrap metal and plastic to avoid detection. Copper, tin, platinum, palladium, silver and gold are extracted and exported abroad.	DOE, RMC, Royal Malaysia Police, Malaysian Immigration Department, and MACC stepped up operations ensuring that Malaysia meets international obligations in implementing the Basel Convention. Source: Dermawan (2025). Federal authorities investigated the possibility of illegal e-waste factories registered to Malaysians but managed by proxies from abroad. On 15 February 2025, the General Operations Force Northern Brigade raided a plant at Sungai Siput, one of the individuals arrested was a scientist from *China who worked at the plant for over a year and specialised in analysing and sorting e-waste particles for gold, copper, tin, and aluminium. He was also experienced in analysing and monitoring the smelting process.* Discussions are being made with other agencies such as the Inland Revenue Board, RMC, and local councils on follow-up action against these e-waste factories. Source: Camoens (2025c).

	Facilities operating without permits, managed by foreign nationals and supported by local landlords who lease industrial spaces at high rates in Johor and Penang, for example.	Johor: Authorities seized over 46,000 kg of e-waste and components worth RM23.8 million. Penang: Enforcement teams found e-waste valued at RM60.5 million and machinery worth RM106.7 million. Source: Noh (2025).
Key restriction issue 3: Institutional integrity		
Enforcement officers protecting problematic e-waste collection centres.	Company owners and trade officers bribing enforcement personnel to process and dispose of prohibited electronic waste The case was investigated under Section 16(b)(A) of the MACC Act 2009. - 26 individuals (company owners, directors, and enforcement officers) were arrested. - 420 foreign workers at e-waste disposal sites were detained by the Immigration department. - 12 electronic waste factories in Telok Panglima Garang, Selangor, and Buloh Kasap, Segamat, Johor, were raided during a joint operation involving MACC, the Immigration Department, and the Department of Environment	MACC froze 61 bank accounts with a total value of RM15 million, in connection with the illegal processing and disposal of e-waste. Source: The Star (2025).
Key restriction issue 4: Legislative reforms		
Increased penalty rates and fines against importation of illegal scheduled wastes)	Section 34B of Act 127, illegal dumping of scheduled waste onto Malaysian land or into its waters, now has a maximum fine of RM500,000, 5 years' jail time, or both. The amended Environmental Quality (Amendment) Bill 2023 of the Act came into effect on 7 July 2024.	Amended penalty rates and fines: - a minimum fine range of RM500,000, - maximum fine of RM10 million - mandatory imprisonment of 5 years. Source: Lee (2024); Bernama (2025).
International	A large part of falsely	*Japanese authorities will*

cooperation and border control to restrict the transboundary movement of e-waste movement between Malaysia and Japan	declared e-waste that reached Malaysia originated from Japan and the US - Between 1 January and 13 May 2025, DOE confirmed 122 containers arrived in Malaysia carrying e-waste.	- *collaborate closely with Malaysian counterparts to prevent any unlawful shipments to Malaysia* - share relevant information - take necessary enforcement actions, including issuing guidance to non-compliant exporters, to ensure strict adherence to regulations. *More than 20 cases of illegal electronic waste exports have been successfully prevented from reaching Malaysia.* Source: Seraj (2025).

Source: Compiled by the authors based on the relevant secondary sources.

UNODC's UNwaste convened a regional technical seminar in Kuala Lumpur on 29 January 2025 and a closing conference on 25 April 2025, where ASEAN states – including Malaysia – committed to intensify joint action against illegal waste traffic (UNODC, 2025b). These developments underscore Malaysia's firm position on controlling the e-waste trade.

B-i-3-3) Loopholes in governance and trade classification

Malaysia's current **e-waste governance framework** contains loopholes that enable these disguised imports. When hazardous e-waste streams face restrictions under **international agreements like the Basel Convention**, traders often **redirect shipments** through **grey zones** – **labelling goods under categories such as UEEE or second-hand items**. This circumvention tactic allows banned or regulated items to enter the country with minimal scrutiny.

Such regulatory ambiguities **undermine the effectiveness of formal mechanisms** and perpetuate unsafe processing in the **informal sector**. Descriptive statistics from regional e-waste flows reveal a **persistent rise in misclassified or unaccounted-for imports**, particularly from developed countries such as Japan, highlighting the urgent need for improved trade transparency and regulatory harmonisation (Wong, Wong, and Zulkeflee, 2024.)

B-i-4) High-value recovery in Japan vs low-value burden in Malaysia (i.e., economic damage by environmental harm > economic return)

Despite regulatory restrictions, Malaysia continues to face significant challenges related to the importation of UEEE, including from Japan. While Japan typically imports higher-value e-waste, Malaysia has increasingly become a *destination for low-value and unsorted e-waste,* especially after China's waste import ban. This has strained local enforcement, *undermined domestic recycling efforts*, and exposed communities to environmental and health risks from informal and often illegal recycling operations. The influx of foreign e-waste also risks *depressing the local e-waste economy*, threatening the livelihoods of

small-scale recyclers and waste pickers. Critics argue that allowing imports under the guise of green technology opens the door to 'waste colonialism', where Malaysia bears the environmental burden without clear long-term benefits (Greenpeace Malaysia, 2025).

The imported e-waste is difficult to recycle, producing 'economic damage from this environmental harm [that] outweighs the economic returns', as stated in a joint statement by the Basel Action Network (BAN) and Sahabat Alam Malaysia (SAM) (Trisha, 2025).

> We have become the new destination for toxic, difficult-to-recycle waste from all over the world, which history has proven will bring more negative consequences than positive value…Most e-waste is of negative or marginal value. Only some portions of the material are economically viable to be recycled (Trisha, 2025).

Since January 2023, Bukit Aman's Internal Security and Public Order Department seized RM3.8 billion worth of items from illegal e-waste factories. This includes RM3.4 billion in e-waste, RM217 million in equipment, and RM116 million in vehicles. A total of 538 individuals were arrested during this period (Zolkepli, 2025).

B-i-5) Imbalance between the number of licensed e-waste recycling facilities and e-waste supply: encouraging informal trade

One reason cited by informants for the rise in informal trade and recycling is the significant mismatch between the number of licensed recycling facilities and the actual supply of e-waste. The government has approved substantially more licensed facilities despite the limited volume of e-waste available, inadvertently encouraging competition with – and reliance on – the informal sector.

Our qualitative research also revealed the presence of a highly technologically capable company – namely, Shan Poornam Metal (SPM) – that promotes the circular economy by importing UEEEs. However, its capabilities are significantly underutilised due to competition from companies that specialise solely in the illegal trade of UEEEs and WEEEs. These competitors benefit from cost advantages, as they do not bear the expenses associated with material recovery.

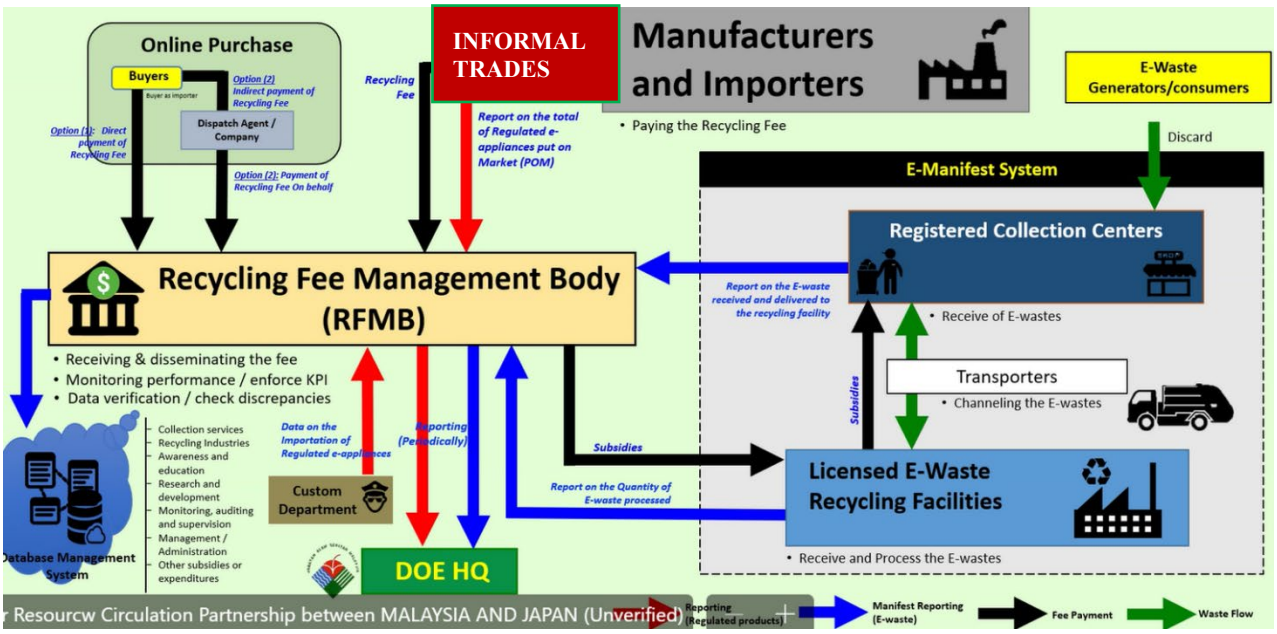
This is a notable finding: companies that specialise solely in 'trade' are outperforming those that genuinely aim to 'recycle' and have heavily invested in advanced recycling technologies

ii) Domestic EEE concerns resulting from material flows partly from Japan to Malaysia

In addition to issues 1–5 related to the Japan–Malaysia flow, this section examines the domestic issues related to material flows into Malaysia (see Figure 3.12):

Figure 3.12 shows that informal trade often occurs between importers and the recycling sector.

Figure 3.12. E-Waste Flow Structure with Informal Trade Routes



Note: The author has added annotations indicating where informal trade becomes salient
Source: Kamarulzaman (2025).

B-ii-1) Significant air, land, and water pollution due to illegal recycling

In Petaling Jaya and beyond, smuggled e-waste is being illegally processed with minimal oversight. Shipped from abroad, the waste is burned or smashed to extract valuable metals, releasing highly toxic substances such as lead, cadmium, brominated flame retardants, and polychlorinated biphenyls. These chemicals pose severe health risks, especially to children and pregnant women, and threaten Malaysia's environment amid weak enforcement and rising global demand for e-waste metals (Jayaseelan, 2025).

Plastic waste imports, including those from electronic sources (e.g. acrylonitrile butadiene styrene, or ABS), continue to damage Malaysia's environment, harming community and worker health while contaminating the air, soil, and water (Wong, Wong, and Zulkeflee, 2024) Some appeared to be shredded 'lumps', contaminated material filtered out during the extrusion process in mechanical recycling. **No conclusive answers were given by our sources, except that these are rejects from waste processing, likely to be imported waste as they were not ubiquitous in illegal dumpsites before 2018** (Wong, Wong, and Zulkeflee, 2024).

DOE, RMC, MACC, the Royal Malaysia Police, and the Immigration department – working to meet the country's international obligations and are implementing the Basel Convention on the Control of Transboundary Movements of Hazardous Wastes and Their Disposal – have increased monitoring to forbid the most egregious forms of dumping by *industrialised countries that prey on developing or emerging economies* (Trisha, 2025). The consequences are serious as pollution from mismanaged e-waste can **cause cancer, affect brain development, disturb endocrine systems and cause birth defects. These effects are irreversible and will affect future generations** (Trisha, 2025).

Notably, Figure 3.13 illustrates Japan-linked electronic plastics that were reportedly dumped illegally, as documented by a local researcher.

Figure 3.13. Japan-Linked Electronic Plastics Dumped Illegally



Note: Electronic plastics with Japanese characters found in an illegal dumpsite opposite a plastic waste recycling facility.
Left: Ipoh (Perak), 23 February 2024
Right: Telok Panglima Garang (Selangor), 18 January 2024
Source: C4 Center published in Wong, Wong, and Zulkeflee (2024).

B-ii-2) Informal recycling and hazardous processing practices

Asia produces about **24.9 million tonnes of e-waste each year**, but only **2.9 million tonnes** are formally treated. **Printed circuit boards (~561 kt)** remain a key driver of **illegal recovery practices** due to their high material value (UNODC, 2025c).

Malaysia remains a top destination for global e-waste, with a significant portion processed through informal and often illegal means (Alias et al., 2014; Honda, Khetriwal, and Kuehr, 2016; Azizi et al., 2023) (see Figure 3.14). These operations dominate the sector, using unsafe methods such as open burning, acid baths, and low-grade incinerators that release toxic fumes from plastics, rubber, heavy metals, and sulphur-based materials (Jayaseelan, 2025; Rasnan et al., 2016).

Although some formal recycling facilities exist, the country's e-waste infrastructure remains in its early stages (Forti, Baldé, and Kuehr, 2018). I**nformal intermediaries** – especially **collectors and brokers outside the formal system** – reduce the **traceability** of imported goods, degrade **material quality**, and increase **processing costs** for licensed recyclers in Malaysia. Their presence in the cross-border trade network complicates regulatory oversight and increases the risk that low-quality or hazardous goods enter the country under false pretenses. Our informants reported a growing awareness of Chinese

syndicates operating a large proportion of informal trade and recycling businesses since the ban on waste imports into China (Sipalan, 2024). UNODC further flags cyber-enabled waste crime, where brokers leverage online platforms/closed groups to source loads and arrange fraudulent paperwork, complicating traceability (UNODC, 2024b).

Dominance and profitability of the informal sector: Informal recyclers thrive due to minimal overhead and high profit margins, often undercutting formal operators. Around 1,000 informal collectors are active in Malaysia, compared to only 200 formal recyclers (Informant 1). Formal recyclers must invest in environmental safeguards, such as functioning filters and safety infrastructure, while also covering the costs of collection, transportation, and public awareness campaigns – making them less competitive. In contrast, informal operators recover profits within just 3 months, making e-waste recycling a lucrative business (Jayaseelan, 2025).

Dispersed illegal operation sites: Illegal recycling sites are often located in remote areas such as forests and plantations, complicating enforcement (Berita Harian, 2024). Major raids across Johor, Penang, and Perak have revealed the scale of these operations.

Structural barriers and early-stage infrastructure: DOE, with support from the Japan International Cooperation Agency (JICA), is developing a formal household e-waste management mechanism. Although some recycling facilities are equipped to recover valuable materials, Malaysia's infrastructure remains underdeveloped. Formal recyclers are further constrained by high operational costs and limited state support, while illegal actors continue to ignore environmental regulations (Shad, Ling, and Karim, 2020; Suja et al., 2014).

Regional comparison and persistent risks: Malaysia's e-waste challenges reflect broader regional trends. Countries such as China, India, and Indonesia also rely heavily on informal recycling methods for hazardous components like printed circuit boards, CRTs, and LCD screens (Andeobu, Wibowo, and Grandhi, 2021). These practices pose ongoing risks to both environmental and human health. Despite the establishment of material recovery facilities (MRFs), they remain overwhelmed by the growing volume of e-waste and struggle to manage associated hazards.

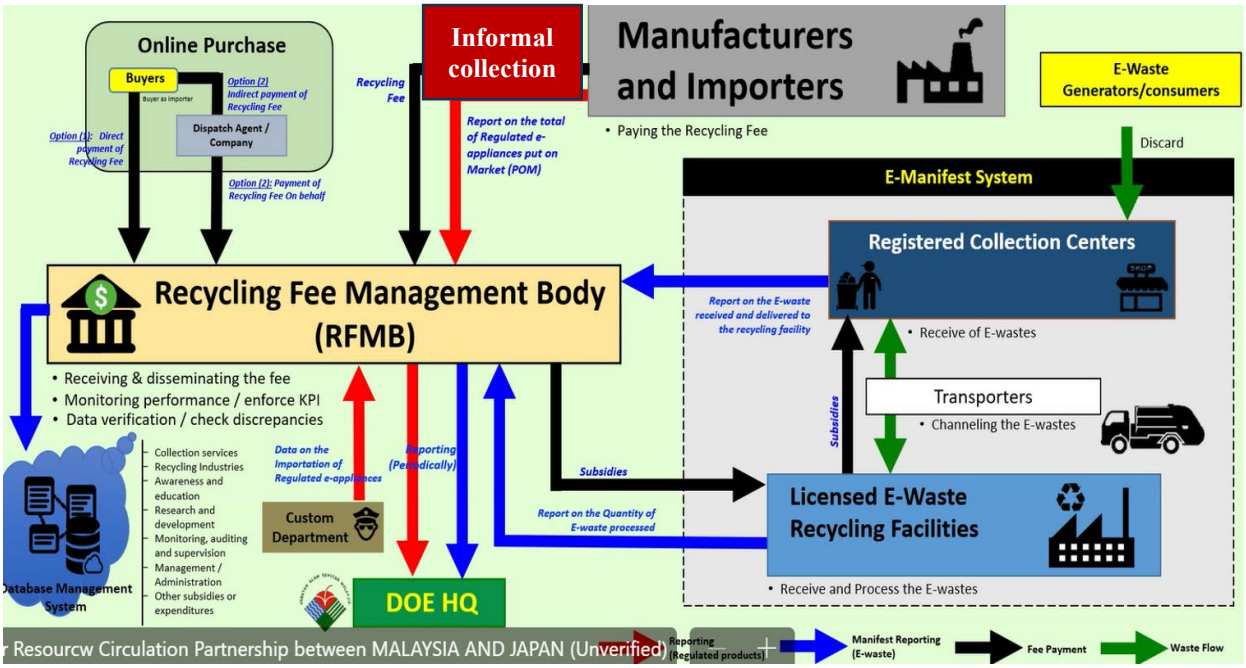
Figure 3.14. Reported E-waste Seizure at an Illegal Scrap-Processing Facility in Kota Tinggi, Johor (2025)

Reported seizure value	RM23.8 million
Location	Kota Tinggi, Johor, Malaysia
Enforcement case	Police seizure at an illegal scrap-processing facility (March 2025)

Source: Compiled by the author based on Noh (2025).

YUKA Figure 3.15 proposes a recycling fee and an e-waste flow structure that incorporates informal collection routes.

Figure 3.15. Proposed Recycling Fee and E-Waste Flow Structure with Informal Collection Routes



Notes: The author has added annotations indicating where informal trade becomes salient. According to DOE Director Wan Abdul Latiff, there are currently 156 licensed e-waste processing plants in Malaysia (Zolkepli and Gimino, 2025).
Source: Kamarulzaman (2025).

B-ii-3) Weak enforcement and regulatory gaps (Most Cited Issue by various sources)

Industry sources warn that Malaysia's enforcement gaps may be fuelling a crisis worse than in countries like Thailand and Indonesia, where stricter controls are in place. E-waste is often incinerated to extract high-value metals like gold and silver (Jayaseelan, 2025).

Notably, our qualitative research identified a lack of adequate collaboration between DOE and the Ministry of Investment, Trade and Industry (MITI). While DOE restricts the

import of UEEEs, MITI has established a circular economy blueprint that encourages the import of UEEEs to be recycled as resources. Our informants urged a shift in 'mindset' to see waste as a resource, not as rubbish.

According to the 2023 Corruption Perceptions Index, there is a global trend of weakening justice systems, leading to diminished accountability for public officials and enabling corruption such as bribery and abuse of power. Malaysia scored 50 and ranked 57th worldwide – slightly above the regional average – due to relatively strong electoral processes and an active anti-corruption commission. In contrast, Japan scored 73, while Indonesia (34), Viet Nam (41), the Philippines (34), and Thailand (35) continue to face substantial corruption-related challenges (Wong, Wong, and Zulkeflee, 2024).

Several research articles point out regulatory and governance shortcomings that hinder Malaysia's ability to control illegal dumping, promote sustainable recycling practices, and enforce environmental accountability across the EEE sector. Examples are as below:

- Enforcement of existing WEEE regulations is weak, resulting in inadequate collection and tracking of e-waste (Azizi et al., 2023; Rasnan et al., 2016; Andeobu, Wibowo, and Grandhi, 2021).
- Loopholes in import policies allow e-waste to enter Malaysia disguised as second-hand goods, despite restrictions (DOE, n.d.-a; IGES, n.d.; Andeobu, Wibowo, and Grandhi, 2021).
- The absence of a coherent national framework has led to fragmented and inconsistent policy enforcement (Rasnan et al., 2023; Berita Harian, 2024).
- In the absence of a mandatory take-back scheme, manufacturers and importers rely on voluntary efforts, which remain limited and uneven (DOE, n.d.-a).

In relation to the fourth bullet above, EEE manufacturers play a pivotal role in promoting the environmentally sound management of WEEE. In Malaysia, several companies have voluntarily introduced take-back programmes to reduce the volume of discarded EEE in municipal landfills and to raise public awareness (Shad, Ling, and Karim, 2020). However, the country lacks a formal regulatory framework mandating such programmes. While EPR has been piloted in limited areas, it remains largely voluntary, with no comprehensive incentives to support wider implementation (Shad, Ling, and Karim, 2020).

iii) Domestic EEE recycling issues in Malaysia

B-iii-1) Recycling facilities below capacity and insufficient recycling infrastructure

Malaysia lacks advanced e-waste processing facilities, which limits efficient material recovery (Malay Mail, 2025). Tracking and monitoring systems are also weak, enabling undocumented trade and illegal dumping (IGES, n.d.). To improve recycling efficiency, Malaysia requires knowledge transfer from Japan. While several MRFs have been established, the country continues to face major challenges in handling the growing volume of e-waste (Andeobu, Wibowo, and Grandhi, 2021, p. 10) and in addressing widespread

mismanagement of waste collection.

However, our qualitative research found that **formal, technologically capable operations are underutilised.** Notably, SPM's advanced technological capabilities appear to be underused due to their inability to compete on costs with other competitors – both formal and informal – who focus solely on trade. Rentwise is a remanufacturer capable of repurposing obsolete laptops to extend the lifespan of used devices. However, **their capabilities appear to be underutilised due to authorities' prevailing perception of e-waste as material primarily for recycling rather than remanufacturing**.

Relevant research articles and government reports are listed below:

- **Many licensed recycling facilities in Malaysia operate below capacity** due to inconsistent e-waste collection (Suja, Abdul Rahman, and Yusof, 2014). By 2020, Malaysia generated an estimated 1.11 million metric tonnes of e-waste but had only 138 licensed recovery facilities (DOE, n.d.-a).
- **Poor collection centre availability** hinders Malaysia's e-waste management (Rasnan et al., 2016).
- Most Southeast Asian countries, including Malaysia, **lack well-developed e-waste infrastructure for collection, storage, transportation, recycling, and disposal** (Andeobu, Wibowo, and Grandhi, 2021).
- **Limited technological capacity** prevents Malaysia from recovering valuable materials efficiently (DOE, n.d.-a).

B-iii-2) Consumers' preference to sell to informal collectors

- Many households keep unwanted WEEE due to reluctance to discard high-priced gadgets, the potential to reuse parts, or, more commonly, the expectation that scrap collectors will buy them. As a result, most e-waste continues to be sold to informal collectors at scrap rates, rather than through formal collection channels.
- Customers used to pay for e-waste collection, but now retailers compensate customers for returning e-waste in the spirit of environmental, social, and governance despite incurring losses. Consumer awareness and education are still lacking in Malaysia, and the government needs to do more to address this (Informants 1 and 2).

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C) Analysis and discussion

The transboundary flow of EEE between Malaysia and Japan illustrates a complex intersection of trade dynamics, regulatory frameworks, and environmental risks. **While Japan exports second-hand EEE to meet the demand for affordable electronics in Malaysia, many of these products quickly become e-waste upon arrival, thereby shifting the environmental burden downstream**. This trade pattern not only undermines Malaysia's waste infrastructure but also raises ethical concerns over environmental

justice.

Although both countries are bound by national and international regulations – including Malaysia's Environmental Quality (Scheduled Wastes) Regulations and the Basel Convention – gaps in enforcement, loopholes in trade classification, and mislabelling of goods allow low-value or hazardous materials to bypass regulatory scrutiny. Informal trade practices and weak oversight continue to undermine formal systems designed to ensure environmentally sound management.

Our qualitative findings further reveal that Malaysia's circular economy ambitions are being compromised by these flows. UEEE from Japan, often imported under special permits and facilitated by large corporations, contributes to growing pressure on the domestic recycling ecosystem. Informants noted that informal processing chains in Malaysia can involve up to eight layers of intermediaries. This not only reduces material quality and increases costs for legitimate recyclers but also weakens traceability and accountability.

Moreover, the underutilisation of technologically capable recyclers and remanufacturers in Malaysia reflects a broader institutional void. Despite having advanced facilities, many formal recyclers are unable to compete with informal actors who operate with lower overheads and fewer compliance obligations. This discrepancy highlights the urgent need to foster direct partnerships between Malaysian recyclers and Japanese exporters to ensure that only manageable and properly sorted e-waste enters the country. Such bilateral cooperation would help close the gap between policy intention and implementation, while reducing environmental and social harm.

1.4. Conclusion

The ongoing movement of EEE between Japan and Malaysia calls for a reassessment of current regulatory and operational practices governing transboundary e-waste trade. While frameworks such as the Basel Convention and national environmental laws are in place, their enforcement has been inconsistent, enabling the import of misclassified and high-risk materials into Malaysia.

Evidence of repatriated shipments, informal collection networks, and unregulated processing points to significant governance weaknesses on both ends of the trade flow. In response, Japan and Malaysia must work collaboratively to strengthen bilateral agreements that regulate material flows based on risk and recovery potential, and that ensure compliance with international environmental standards.

Central to these efforts is the recognition and integration of formal recyclers and remanufacturers who have the technological capacity to manage complex e-waste streams. Their current underutilisation represents a missed opportunity for advancing a circular e-waste economy. By prioritising traceability, transparency, and targeted partnerships, both governments can move towards a more equitable and environmentally responsible e-waste trade system – one that protects ecosystems, supports human health, and delivers long-term economic and social value.

2. Background research of the issues on the international material flow on the EEE-relevant materials between Malaysia and Japan

2.1. Overview

This section provides a comprehensive analysis of Malaysia's current challenges and opportunities in managing EEE-relevant material flows, with a particular emphasis on trade with Japan. Drawing on findings related to technological capacity, informal trade, regulatory frameworks, and bilateral cooperation, the section outlines 10 policy recommendations. These include regulating imports based on Malaysia's recycling capabilities, revising outdated classifications, criminalising waste trafficking, promoting responsible UEEE trade, and requiring technology transfer from Japan. Additional recommendations address EPR implementation, communication, public awareness (CEPA), Japanese investment, and formal integration of the informal sector – together forming a blueprint for a more transparent, accountable, and circular e-waste governance system.

2.2. Results of background research on the issues

This section offers a situational overview of Malaysia's capabilities, gaps, and potential in managing EEE-related material flows, especially in relation to Japan. It identifies key challenges in recycling infrastructure, urban mining readiness, and the use of alternative materials, while highlighting regulatory and enforcement gaps. Based on these findings, this section proposes policy recommendations to enhance Malaysia's transition to a circular economy – namely, by improving regulatory clarity, integrating the informal sector, facilitating technology transfer from Japan, and developing responsible circular trade mechanisms.

A) Technologies on EEE recycling and waste disposal

This section highlights a) private sector–led digital platforms for EEE Recycling and b) physical and chemical technologies for EEE recycling

a) Private sector–led digital platforms for EEE recyclin

a-1) Riiicycle mobile application: A notable example of technological innovation in Malaysia's e-waste management sector is Riiicycle (https://www.riiicycle.com/), a local recycling company promoting full circularity.

Riiicycle connects four key actors through a mobile application:

1. Waste generators
2. Waste collectors (both formal and informal)
3. The marketplace (retailers and consumers)
4. Recyclers

Riiicylcle offers an app that collects e-waste data from both consumers and collectors.

Consumers are rewarded with points that can be redeemed, while collectors receive cash incentives for the e-waste they collect. This model not only encourages greater participation in recycling but also contributes to the gradual integration of informal collectors into more structured waste management systems.

a-2) Government-led digital infrastructure initiatives: development of Uniform Reporting System (URS): In addition to private sector innovations, the Malaysian government is advancing digital infrastructure to support e-waste management.

The Hazardous Materials Division of DOE Malaysia, in collaboration with JICA, has initiated the development of the URS database.

This initiative is part of the Third Phase (2021–2023) of the DOE–JICA collaboration under the project for the 'Implementation of Scheduled E-Waste Management Mechanism in Malaysia'. A technical meeting chaired by Puan Nur Lizrin Binti Johari, Chief Assistant Director of the Scheduled E-Waste Section, oversaw the planning of the URS database.

The URS database is designed to:

- Enhance monitoring, reporting, and enforcement capabilities for scheduled e-waste management nationwide
- Strengthen regulatory compliance
- Track waste movements
- Support data-driven decision-making across stakeholders

Once fully implemented, the system is expected to significantly strengthen Malaysia's e-waste governance framework.

b) Physical and chemical technologies for EEE recycling

Managing EEE waste has become an increasingly important priority in Malaysia, driven by rising consumption of electronics and growing environmental concerns. To address this, various recycling and waste disposal technologies have been developed and implemented across the country. These technologies are designed to recover valuable resources from discarded electronic items while minimising environmental harm.

The technology utilised in Malaysia for EEE recycling and waste disposal vary depending on the size of the e-waste material or the fraction of its components at different processing stages. The dominant methods follow the key steps outlined by Jaibee et al. (2015) and are further informed by technological insights from Bin Mohamed and Rosli (2024); Yong, Lim, and Ilankoon (2019); Shumon, Ahmed, and Islam (2014); and Razali et al. (2021).

From the interviews, literature listed above, and secondary sources, this subsection describes the following:

b-1) Notable example of advanced technologies

b-2) Typical steps of EEE recycling

b-3) Cost and labour considerations

b-4) Evaluation of status quo and outlook

b-5) Outlook and improvement pathways.

b-1) Notable example of advanced technologies:

Cenviro Sdn Bhd, Malaysia's leading integrated environmental solutions provider, oversees several subsidiaries with advanced e-waste recycling capabilities. Its wholly owned subsidiary Shan Poornam Metals Sdn Bhd (SPM) is widely recognised for cutting-edge refining technologies, including platinum group metal recovery, copper refining, aluminium ingot production, surface cleaning, air pollution control, and research and development (R&D) in green pre-treatment processes, and primarily processes hard disk drives (Shan Poornam Metals, 2025). Kualiti Alam Sdn Bhd operates integrated hazardous waste treatment facilities with specialised lines for e-waste fractions, including automated sorting and metal recovery units (Cenviro, 2024). E-Idaman Sdn Bhd manages material recovery facilities in Penang and Kedah with semi-automated dismantling lines for e-waste, enabling component segregation for downstream refining (E-Idaman, 2024).

Alongside the Cenviro Group, TES-AMM (Malaysia) Sdn Bhd – part of the TES Sustainable Technology Group – employs advanced hydrometallurgical processes for lithium-ion battery recycling, recovers valuable metals such as cobalt, nickel, and lithium, and provides ISO-certified secure IT asset destruction (TES-AMM, 2024).

Together, these companies represent the forefront of Malaysia's technological recycling capacity, strengthening the country's ability to manage complex e-waste streams domestically.

Potential: The problem of hardware–software incompatibility needs to be addressed. The advent of Google's open-source ChromeOS Flex may help extend device cycles up to 20 years.

b-2) Typical steps of EEE recycling:

Step 1: Manual dismantling

The recycling process typically begins with manual dismantling, where trained workers carefully disassemble electronic devices to separate individual components. This step facilitates the recovery of homogeneous and recyclable materials, such as plastics, glass, and metal parts, while isolating hazardous components – including batteries, mercury-laden items, LCD panels, motors, and CRT glass – for safe handling.

According to Bin Mohamed and Rosli (2024, p. 52), this pre-treatment stage is essential in preparing e-waste for downstream processes, enhancing both safety and recovery efficiency. Innovations in pre-treatment are critical for ensuring that toxic substances are properly managed before further processing.

In Malaysia, common pre-treatment techniques include manual crushing, solder melting, and thermal separation. These methods are generally labour-intensive but cost-effective, particularly in contexts where low-cost solutions are prioritised. Solder

melting is often used to detach electronic components from circuit boards and recover precious metals, non-ferrous metals, ferrous metals, and plastic materials (Shumon, Ahmed, and Islam, 2014). However, manual dismantling, especially in the informal sector, poses significant occupational and environmental hazards, underscoring the need for regulatory improvements.

Step 2: Size reduction using specialised machinery

After dismantling, larger or more complex items, such as PCBs, are subjected to size reduction using machines like crushers and shredders. This step breaks down materials into smaller, manageable pieces necessary for efficient sorting and further treatment. These physical and mechanical processes are crucial for enabling subsequent material separation and are considered core early-stage technologies in e-waste recycling (Bin Mohamed Zaini and Rosli, 2024, pp. 51–52). In Malaysia, ball milling and dry crushing are also employed, although they tend to be energy intensive. These methods, while effective in disintegration, often generate non-hazardous solid waste typically disposed of in approved local landfills (Shumon, Ahmed, and Islam, 2014).

Step 3: Material separation based on physical properties

Once materials have been reduced in size, they undergo separation processes based on physical characteristics, such as size, weight, density, shape, magnetic behaviour, and electrical conductivity. Common methods include:

- Magnetic separation for extracting ferrous metals
- Screening and density-based sorting for isolating non-ferrous metals (e.g. copper, aluminium)
- Air- or water-based separation for distinguishing lighter non-metallic materials, such as plastics

In Malaysia, Wilfley shaker tables are amongst the most commonly used technologies for separating metallic and valuable non-metallic components. Corona electrostatic separation is also employed to distinguish materials based on electrical conductivity (Shumon, Ahmed, and Islam, 2014). These methods, often applied after shredding, are being continually refined through sensor-based automation to improve recovery efficiency and selectivity (Bin Mohamed Zaini and Rosli, 2024, p.52).

Step 4: Metallurgical treatments for metal recovery

Following physical separation, metal-rich fractions undergo metallurgical treatment to extract and refine high-value metals. This stage involves chemical, thermal, and biological processes designed to maximise recovery while minimising environmental impacts. In Malaysia, the most commonly used techniques are hydrometallurgy and pyrometallurgy, with increasing interest in biometallurgical methods (Bin Mohamed Zaini and Rosli, 2024, p.52).

1. Hydrometallurgical treatment

   Hydrometallurgy is widely adopted in Malaysia for its low cost and accessibility,

though it typically yields lower purity levels than international benchmarks (e.g., 99% vs. 99.99% for gold). One common method is acid leaching, which uses sulphuric acid to dissolve metals such as copper, gold, and nickel from finely ground e-waste.

Recovery efficiency depends on technical factors like temperature, particle size, and material density. While hydrometallurgy has a lower energy footprint than thermal methods, it also creates toxic liquid waste requiring controlled disposal (Bin Mohamed Zaini and Rosli, 2024, p.52).

Malaysia also employs selective leaching to target specific metals. Agents such as cyanide, thiourea, and thiosulfate are favoured for their simplicity and cost-effectiveness, although they are highly toxic, especially if used near human water sources. Related processes like stripping and electrolysis generate hazardous sludge, which is disposed of in designated hazardous waste landfills (Shumon, Ahmed, and Islam, 2014).

2. Pyrometallurgical processes

Pyrometallurgy involves the use of high temperatures to melt and separate metals. This method is widely used in copper smelting, followed by electrolytic refining. It is globally recognised for its high efficiency and ability to process complex materials.

However, pyrometallurgy is energy-intensive and produces significant air pollutants. Its application is therefore more common in developed countries, where advanced emission control infrastructure is available (Bin Mohamed Zaini and Rosli, 2024, p.52).

3. Biometallurgical (bioleaching) methods

Bioleaching – using microorganisms to extract metals – is gaining traction as a sustainable alternative. In Malaysia, Razali et al. (2021) demonstrated its use to extract copper from PCBs without extensive mechanical pre-treatment. This method reduces residual waste and energy use, although it remains at a pilot stage for large-scale application (Bin Mohamed Zaini and Rosli, 2024, p.52).

Step 5: Metal recovery sub-processes

After extraction, metals are refined through methods such as:

- Electro-winning, which deposits dissolved metals onto electrodes (commonly used in hydrometallurgical systems)
- Smelting, which may serve as both a recovery and purification step in pyrometallurgical systems

Both methods are widely used and straightforward, but generate hazardous by-products (e.g., toxic fumes, metal-laden sludge), necessitating strict environmental controls.

b-3) Cost and labour considerations

Malaysia's reliance on **low-cost, labour-intensive technologies** reflects economic pragmatism. All metallurgical methods – hydro-, pyro-, and biometallurgical – are selected based on affordability and the availability of **low-skilled labour** (Shumon, Ahmed, and Islam, 2014).

b-4) Evaluation of status quo and outlook

Despite technological progress, several challenges limit the effectiveness of Malaysia's EEE recycling sector:

1. **Inefficient collection, dismantling, and transportation systems:**
   The absence of an integrated design leads to **fragmented and inconsistent collection and dismantling efforts**, particularly for bulky items such as refrigerators and washing machines.
2. **Lack of integrated reprocessing facilities:**
   Existing facilities often **handle only specific types of e-waste**, resulting in inefficiencies and lost opportunities for material recovery.
3. **Logistical inefficiencies for bulk e-waste:**
   Transportation and storage of large-volume appliances remain cost-prohibitive and environmentally taxing due to **a lack of specialised logistics infrastructure**.
4. **Obsolete precious metal recovery technologies:**
   Many facilities rely on **outdated hydrometallurgical techniques** with low metal recovery rates and generate significant hazardous by-products, indicating a need for technological upgrades (Bin Mohamed Zaini and Rosli, 2024).
5. **Occupational hazards from manual dismantling:**
   Informal sector workers involved in **manual dismantling face direct exposure to hazardous materials** without appropriate safety equipment or regulatory oversight, creating severe health and environmental risks.

b-5) Outlook and improvement pathways

To enhance Malaysia's EEE waste management, the following steps are necessary:

- **Technology upgrades:**
  Investment in advanced, cleaner hydrometallurgical and pyrometallurgical systems, as well as scale-up of biometallurgical methods (Razali et al., 2021), is needed to improve recovery efficiency and minimise environmental impacts.
- **Integration of digital solutions:**
  Platforms like Riiicycle demonstrate the potential of digital technology to formalise informal sector involvement and improve waste data tracking for better system optimisation.
- **Development of centralised facilities:**
  Establishing integrated, multi-material recovery hubs would optimise dismantling,

separation, and recovery processes.

- Public awareness and policy incentives:
  Enhanced public education and financial incentives (e.g., rebates, deposit-return schemes) can improve collection rates and consumer engagement.
- Strengthened regulatory frameworks:
  Mandatory safety standards for dismantling workers and enforcement of environmental regulations for e-waste processors are critical for protecting both human health and the environment.

B) Alternative materials to the EEE-relevant materials

Potential alternative materials to certain EEE-relevant materials are available in Malaysia, especially in light of efforts to promote sustainable manufacturing and reduce reliance on imported or hazardous substances. These alternatives fall into several categories, ranked according to Malaysia's current industrial capacity, resource availability, and strategic priorities. The following presents an updated and prioritised list of six alternative materials relevant to EEE:

B-1) Silica from sand: substitute for silicon (used in semiconductors and glass displays)

B-2) Recycled plastics: as substitute for virgin plastic

B-3) Bioplastics from natural oils: substitute for non-degradable petroleum plastics.

B-4) Lead-free solders: substitute for lead-based solders

B-5) Halogen-free flame retardants (HFFRs): substitute for halogenated flame retardants (e.g., bromine)

B-6) Alternative materials to REEs

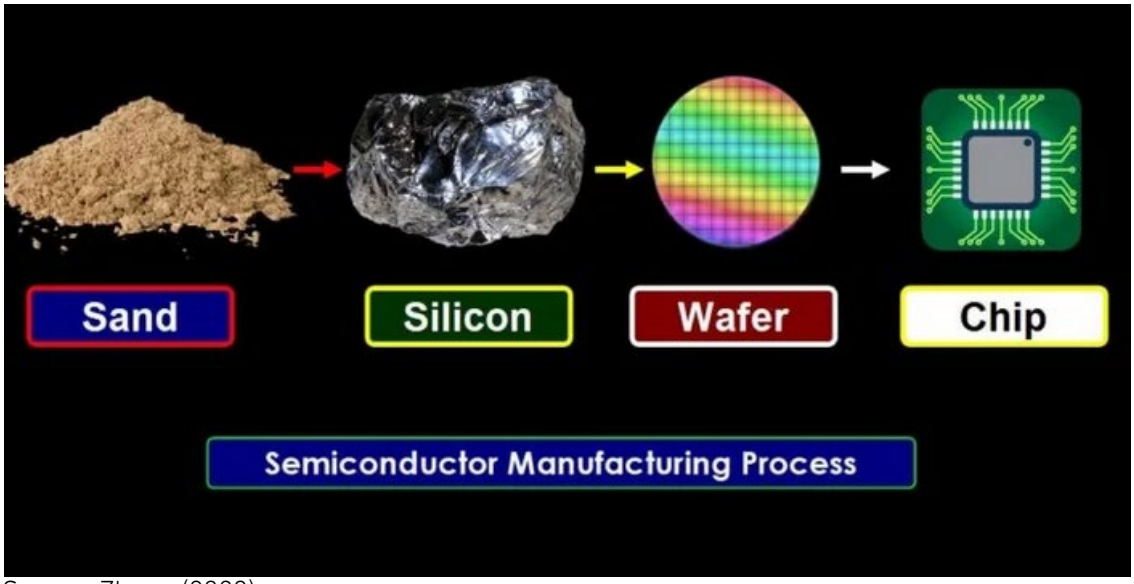
B-1) Silica from sand: substitute for silicon (used in semiconductors and glass displays)

Malaysia is a significant exporter of silica sand, ranking third in 2023 after the US and Australia (OEC, 2025). Malaysia possesses approximately 640 million tonnes of silica sand, with 148 million tonnes in natural deposits and 492 million tonnes in tin tailings. This is essential for manufacturing semiconductors, solar panels, and glass products. Figure 3.16 explains the extraction process of silica from sand in the semiconductor manufacturing process.

Challenges:

The mechanical properties of silica make it a possible alternative to plastic as a good insulator. However, supporting the electronics industry with high-purity silica for semiconductors and glass components will require appropriate processing infrastructure.

Figure 3.16. Extraction of Silica from Sand in the Semiconductor Manufacturing Process



Source: Zhang (2023).

Key Players: Terengganu Silica operates Asia and Oceania's largest silica mining and beneficiation plant (refer to https://terengganusilica.com.my/ and https://www.mida.gov.my/mida-news/tsm-to-invest-rm500-million-to-develop-silica-industry-in-mercang/).

B-2) Recycled Plastics: as substitute for virgin plastic

Malaysia's recycled plastics market generated US$752.9 million in revenue in 2023 and is projected to reach US$1,331.6 million by 2030 (Grand View Horizon, 2024). Plastics are reported to constitute 27% of non-packaging end use on EEEs in Malaysia (World Bank, 2021). Instead of manufacturing virgin plastic for use, there are opportunities for improving the circularity of existing waste plastic to cut on new manufactured plastic output. They are to be used in manufacturing electronic casings, packaging materials, and other components.

Challenges:

There is a capacity shortage in Malaysia as only PET packaging recycling has a more advanced collection and recycling system than the other polymer plastics. The other resins, such as high-density polyethylene, low-density polyethylene, and polypropylene which are used in electronics generally as packaging material, have more complex requirements and limited recycling infrastructure to facilitate their circularity.

B-3) Bioplastics from natural oils: substitute for non-degradable petroleum plastics

Malaysia is actively advancing the development of bioplastics derived from palm oil and other natural oils as part of its green technology transition. These natural oils offer

degradable and environment-friendly alternatives to conventional petroleum-based plastics used in EEE.

Notably, SIRIM Berhad, in partnership with Universiti Putra Malaysia and Universiti Sains Malaysia (USM), has established a pilot plant in Shah Alam to produce polyhydroxyalkanoates bioplastics using palm oil mill effluent and crude palm kernel oil (Teysha Technologies, n.d.). Complementing this, researchers at USM have developed biodegradable plastic films from hemicellulose extracted from palm oil waste, demonstrating potential for plastic pollution reduction through the valorisation of agricultural by-products (Phys.org, 2020).

The Malaysian Palm Oil Council and Malaysian Palm Oil Board have both underscored the strategic role of palm oil derivatives in bioplastic innovation. Palm-based bioplastics are part of a broader stream of bio-based plasticisers – including rapeseed oil, karanja oil, rubber seed oil, and cellulose – that are being explored as sustainable alternatives to non-degradable plasticisers used in PVC casings and packaging for EEEs (Zulkifli, 2017; Omar, et. al., 2021).

Beyond their ecological appeal, some studies indicate that bio-based plasticisers can enhance specific mechanical properties. For instance, palm oil–based alkyds have been shown to increase the degradation temperature of PVC, suggesting improved thermal stability in plasticised blends (Lim, Ching, and Gan, 2015).

Challenges:

These alternatives are currently more expensive (Zulkifli, 2017), and evidence on their mechanical performance is mixed. While some research finds that bio-based plasticizers improve tensile strength (Lim et al., 2015), others report reduced performance compared to petroleum-based blends (Omar et al., 2021). These inconsistencies highlight the need for further experimentation before bio-based plasticizers can be considered commercially viable substitutes in EEE manufacturing.

B-4) Lead-free solders: substitute for lead-based solders

Malaysia is progressively transitioning towards lead-free solders in its electronics manufacturing sector, in alignment with global directives such as the EU's Restriction of Hazardous Substances. Historically, tin–lead (Sn–Pb) solders have been widely used in chip attachment and surface-mount processes due to their cost-effectiveness, good wettability, appropriate melting point, and mechanical durability (Noor, Mhd. Nasir, and Idris, 2016).

In response to health and environmental concerns, Malaysia has begun implementing regulatory and industrial reforms to promote the adoption of safer alternatives. Lead-free soldering alloys such as Sn–Bi (tin–bismuth), Sn–Ag (tin–silver), Sn–Au (tin–gold), Sn–Sb (tin–antimony), Sn–Pd (tin–palladium), and Sn–Zn (tin–zinc) are increasingly being explored in the semiconductor and electronics sectors (Noor, Mhd. Nasir, and Idris, 2016). Amongst them, Sn–Ag–Cu alloys have emerged as a preferred option due to their reliability and compatibility with modern soldering techniques (Cheng and Huang, 2023).

Challenges:

Despite their environmental advantages, lead-free solders face several practical challenges. Lead-based solders have long been favoured for their affordability, ease of processing, and dependable performance. Their replacements tend to be more expensive and require higher reflow temperatures, which can affect energy efficiency and strain manufacturing equipment (Salleh et al., 2022; Noor, Mhd. Nasir, and Idris, 2016). These alternatives also involve trade-offs in balancing strength, reliability, and cost-effectiveness, creating barriers to widespread adoption.

B-5) Halogen-free flame retardants (HFFRs): substitute for halogenated flame retardants (e.g., bromine)

Alongside the shift to lead-free solders, Malaysia is also promoting the use of halogen-free flame retardants (HFFRs), especially in wire insulation, casings, and PCBs where fire safety and environmental sustainability are priorities. HFFRs help reduce the toxicity and environmental risks associated with traditional halogenated compounds, aligning with broader goals for green electronics manufacturing.

Challenges:

While HFFRs are safer and more eco-friendly, their implementation is not without obstacles. These alternatives often require changes in product design and the use of advanced materials, which increase technological complexity and cost. Manufacturers must balance compliance with environmental standards against the demands of performance and affordability, which can slow down adoption across the sector (Salleh et al., 2022).

Table 3.15 presents alternative materials available in Malaysia that directly substitute conventional materials used in EEE.

Table 3.15. Summary of the Status of Alternative materials for EEE in Malaysia

Alternative Material	Conventional EEE Material Replaced	Application in EEE	Remarks
1.Silica from sand	Silicon	Semiconductors, glass panels, solar cells	Abundant in Malaysia; critical for chips and displays
2.Recycled plastics	Virgin plastics	Casings, cable insulation, packaging	Supports circular economy and reduces fossil-based inputs
3.Bioplastics from natural oils	Petroleum-based plastics	Casings, biodegradable components, packaging	Emerging; requires scaling and cost competitiveness

Alternative Material	Conventional EEE Material Replaced	Application in EEE	Remarks
4.Lead-free solders	Lead-based solders	Printed circuit board (PCB) interconnects	Aligns with Restrictions of Hazardous Substances (RoHS) directives, and global safety standards
5.Halogen-free flame retardants (HFFRs)	Halogenated flame retardants (e.g., bromine)	Casings, cable jackets, insulating materials	Less toxic during combustion; eco-friendly

Source: Compiled by the authors.

B-6) Alternative materials to REEs

While the search for alternative materials to REEs remains a global priority, **Malaysia's strategic focus includes diversifying the sourcing of rare earth minerals through e-waste recycling**. Technologies for extracting rare earth from different types of e-waste are increasingly sophisticated, offering a sustainable supply option (Aziman Ismail, and Rahmat, 2023). The technologies for obtaining rare earth minerals from e-waste depend on the e-waste material being processed as follows:

1. Waste nickel-metal hydride (NiMH) batteries: Extraction and precipitation process
2. Permanent magnet scraps: Membrane solvent extraction
3. Electrolytic slags, fluorescent lamp waste, computer monitor scraps and waste CRT phosphors: cracking and leaching
4. Discarded neodymium (NdFeB) magnets: Absorption

C) Policy and regulations on EEE recycling and waste disposal

C-1) Malaysia's Transition to a Circular Economy

Malaysia is steadily shifting from a linear 'take-make-dispose' model towards a circular economy that emphasises resource efficiency, pollution reduction, and sustainable development. This transition is supported by key national frameworks, **including the Circular Economy Policy Framework for the Manufacturing Sector (2024)** and **the National Circular Economy Blueprint for Solid Waste (2025–2035)** (officially available in the Malay language*).* These policies are aligned with international obligations such as the Basel Convention, which governs the transboundary movement of hazardous waste.

In the context of e-waste, however, Malaysia's management system remains in a developmental phase. Since 2005, r-waste has been classified as scheduled waste under Code SW110 of the Environmental Quality (Scheduled Wastes) Regulations, regulated by DOE under the NRES. This falls within the broader legal framework of the Environmental

Quality Act 1974 (EQA 1974). While the regulatory base exists, enforcement remains fragmented, and current policies do not provide sufficient guidance to consumers or local authorities on proper collection, reuse, or disposal.

The Department of Solid Waste Management under the Ministry of Housing and Local Government (KPKT) now oversees e-waste previously handled as municipal waste.

Despite the establishment of several MRFs, the country faces mounting challenges due to increasing domestic generation and imports of e-waste from developed countries. Weak enforcement, limited formal recycling infrastructure, and a lack of coordination across agencies have allowed the informal sector to dominate e-waste processing, often using unsafe and environmentally harmful practices.

To address these systemic issues, Malaysia is introducing forward-looking initiatives, such as the Zero Waste to Landfill Certification (2025–2030) and a Pay-As-You-Throw (PAYT) Scheme, which promotes waste reduction through volume-based accountability. Strengthening EPR, expanding formal recycling systems, and launching public awareness campaigns are essential next steps. Equally important is the integration of environmental, economic, and public health priorities to ensure Malaysia is prepared for the rapid growth of electronic consumption and waste.

Identification of Policy and Regulations on EEE Recycling and Waste Disposals in Malaysia

The regulatory landscape governing e-waste management in Malaysia is built upon several key policies (Table 3.16).

Table 3.16. Summary of Policy and Regulations on EEE Recycling and Waste Disposal in Malaysia

No.	Policy/Regulation	Description	Citation
1	Environmental Quality Act 1974 and Environmental Quality (Scheduled Wastes) Regulations 2005	Governs hazardous waste classification, handling, storage, and disposal, including e-waste (SW110)	DOE (2005)
2	Guidelines for the Transboundary Movement of Used EEE (2021)	Regulates the import/export of used EEE under the Basel Convention; prohibits importation for disposal	DOE (2021)
3	Solid Waste and Public Cleansing Management Act 2007 (Act 672)	Governs waste management systems in Peninsular Malaysia and Federal Territories	Commissioner of Law Revision (2017)
4	E-waste collection initiatives	Voluntary programmes for household e-waste collection through designated drop-off	IGES (2010)

No.	Policy/Regulation	Description	Citation
		points.	
5	Circular Economy Policy Framework for the Manufacturing Sector (2024)	Introduces circular practices including EPR and life cycle design in manufacturing industries	MITI (2024)
6	Circular Economy Blueprint for Solid Waste (2025–2035)	Guides businesses and municipalities toward circular waste management practices	KPKT (2024)
7	Extended Producer Responsibility (EPR) Policy (to be mandated by 2030)	Obligates producers to manage products throughout their lifecycle, including end-of-life recovery and recycling.	KPKT (2024)
8	Zero Waste to Landfill Certification (2025–2030)	Certification scheme encouraging businesses and municipalities to achieve zero landfill waste through improved recycling, reuse, and waste minimisation practices	KPKT (2024)
9	Pay-As-You-Throw (PAYT) Scheme (to be implemented)	Introduces volume-based waste charging to incentivise waste reduction at the household and business levels	KPKT (2024)

Note: Upcoming initiatives include the Zero Waste to Landfill Certification (2025–2030) and the implementation of a PAYT scheme to promote volume-based waste accountability.
Source: Compiled by the authors.

C-2) Overview of the Circular Economy Blueprint

Malaysia's **Circular Economy Blueprint for Solid Waste (2025–2035)**, launched by the KPKT in August 2024, outlines **a comprehensive strategy to transition the nation's waste management system from a linear to a circular model**. This blueprint aims to enhance sustainability, reduce landfill dependency, and promote resource efficiency across various sectors, including EEE.

The blueprint is structured around five strategic pillars:

1. **Governance and legislation**: Establishing a robust legal framework to support circular economy practices
2. **Guidelines and procedures**: Developing standardised processes for waste management and recycling
3. **Digitalisation and technology**: Leveraging digital tools and technologies to optimise waste management systems

4. **Infrastructure and facilities**: Enhancing physical infrastructure to support recycling and waste processing
5. **Market creation**: Stimulating demand for recycled materials and products through economic incentives

(See Appendix 4 for presentation slides by Kamarulzaman, 2025)

These pillars are supported by **20 targeted initiatives** designed to foster a circular economy in solid waste management (Table 3.17). Key initiatives include the implementation of EPR schemes, the establishment of the National Circular Economy Association, and the development of waste eco-parks and integrated waste management facilities.

Table 3.17. Initiatives Under the Circular Economy Blueprint and Their Relevance to EEE

Strategic Pillars	Circular Economy Initiatives (CEI)	Initiative	Status	Timeline	Relation to EEE
Strategic Pillar 1 Governance and Legislation	CEI 1	Legislative Transformation for Solid Waste Management	Planned	Long Term 2025 – 2035	Direct – enables uniform laws, including e-waste
	CEI 2	Implementation of EPR for Solid Waste	Phased Implementation	Long Term 2025 – 2035	Direct – applies to electronics and packaging
	CEI 3	Establishment of the National Circular Economy Association	Proposed	Short Term 2025 – 2026	Indirect – industry coordination, includes electronics
	CEI 4	Provision of Circular Economy Facilities by Housing Developers	Planned	Long Term 2025 – 2035	Indirect – encourages household recycling
	CEI 5	Licensing System for Solid Waste Management Ecosystem	Planned	Long Term 2025 – 2035	Indirect – applies to recyclers and e-waste handlers

Strategic Pillars	Circular Economy Initiatives (CEI)	Initiative	Status	Timeline	Relation to EEE
Strategic Pillar 2 Guidelines and Procedures	CEI 6	Legislation on Packaging	Planned	Medium Term 2025 – 2030	Direct – labelling of EEE for recyclability
	CEI 7	Development of Product Design Guidelines	Planned	Medium Term 2025 – 2030	Direct – affects EEE design for reuse/recycle
	CEI 8	Zero-Waste-to-Landfill Certification	In Development	Medium Term 2025 – 2030	Indirect – incentivises electronics reuse/recovery
	CEI 9	Development of Local Recycling Market	Planned	Medium Term 2025 – 2030	Direct – boosts demand for recycled EEE materials
	CEI 10	Solid Waste E-Commerce Digital Platform	Planned	Medium Term 2025 – 2030	Indirect – enables online trade in EEE waste
Strategic Pillar 3 Digitalisation and Technology	CEI 11	Solid Waste Data Management System	Planned	Medium Term 2025 – 2030	Direct – supports tracking EEE waste flows
	CEI 12	Investment in R&D Facilities	Planned	Long Term 2025 – 2035	Direct – enables recycling innovation, including EEE
Strategic Pillar 4 Infrastructure and Facilities	CEI 13	Upgrade of Landfills including material Recovery Facility (MRF)	Planned	Long Term 2025 – 2035	Direct – facilitates EEE separation and recycling
	CEI 14	Development of MRF & Integrated Waste Management	Planned	Long Term 2025 – 2035	Direct – essential infrastructure for e-waste processing

Strategic Pillars	Circular Economy Initiatives (CEI)	Initiative	Status	Timeline	Relation to EEE
		Facility (IWMF)			
	CEI 15	Development of Waste Eco Parks	Planned	Long Term 2025 – 2035	Indirect – may include e-waste processing zones
Strategic Pillar 5 Market Creation	CEI 16	Economic Instruments for Private Sector	Planned	Medium Term 2025 – 2030	Indirect – financial incentives may apply to EEE
	CEI 17	Human Capital Development Programme	Planned	Long Term 2025 – 2035	Indirect – EEE sector skill development
	CEI 18	PAYT Scheme for Commercial, Industrial, and Construction Sectors	Planned	Long Term 2025 – 2035	Direct – commercial e-waste volume accountability
	CEI 19	Industry-Driven Communication, Education, and Public Awareness (CEPA) Programme	Planned	Long Term 2025 – 2035	Direct – public awareness, including e-waste
	CEI 20	Development of Circular Economy Act	In Development	Long Term 2025 – 2035	Direct – provides legal basis for EEE circularity

Source: Compiled by the authors.

Appendix 6 outlines three key policy recommendations proposed by a leading e-waste recycler as essential for improving e-waste management in Malaysia.

C-3) Evaluation of status quo and outlook

To enhance e-waste management in Malaysia, several strategic actions are necessary. **First**, **strengthening enforcement** is essential to ensure that existing regulations are upheld through consistent inspections and the imposition of penalties for non-compliance.

Second, the implementation of a mandatory EPR framework would help hold producers accountable for the entire life cycle of their products, including their end-of-life treatment. Third, investment in infrastructure is also critical; developing formal recycling facilities and establishing accessible e-waste collection points nationwide will support proper waste handling and reduce reliance on informal systems. Fourth, increasing public awareness through targeted educational campaigns can encourage households and businesses to participate in safe and responsible e-waste disposal. Lastly, fostering collaboration across government agencies, industry players, and civil society is vital to build a cohesive and effective e-waste management strategy. By addressing these areas, Malaysia can transition towards a more sustainable and robust e-waste management system that aligns with international best practices while protecting environmental and public health.

C-4) Policy performance and enforcement

Malaysia should strengthen its enforcement of circular economy principles, particularly by shifting from recycling to repurposing, as demonstrated in France, Indonesia, and Thailand.

- Weaker market norm for EPR in Malaysia: Unlike Japan and Western countries where producers pay for proper disposal, Malaysia's market norm expects payment for UEEE, undermining true EPR. Foreign firms often adopt this flawed local practice.
- Solid Waste and Public Cleansing Management Act 2007 (Act 672): Though Act 672 centralised waste management under Solid Waste and Public Cleansing Management Corporation, it is ineffective for e-waste due to inadequate infrastructure, low public awareness, and weak enforcement – especially in low-income areas where informal recycling activities are prevalent.
- Circular economy frameworks: Malaysia's 2024–2035 circular economy frameworks promote EPR and eco-design, but implementation is nascent, with few tangible outcomes to date.
- Potential of energy recovery technologies as an interim solution: A life cycle study suggests energy recovery via incineration may outperform other strategies environmentally, pointing to the need for context-specific waste solutions beyond recycling alone.
- Urgent regulatory needs and emerging responses: Malaysia faces persistent gaps in e-waste collection and recycling. Stronger legal enforcement is urgently needed to protect health and the environment.
- Mandatory e-waste reporting: Malaysia requires e-waste data under its sustainability reporting guide, signaling a shift towards greater transparency and accountability.

Appendix 7 provides a more detailed section on policy performance and enforcement, along with considerations of environmental and social impacts.

C-5) Stakeholder expectations

We identified key stakeholders and outlined their respective expectations based on our interviews and secondary sources (Table 3.18).

Table 3.18. Key Stakeholders and Their Respective Expectations

Stakeholders	Expectations
Registered Recyclers with Advanced Technological Capabilities	To permit greater legal imports of UEEE as a resource and ensure that such materials are channelled to qualified facilities
Registered Recyclers	Request for the government to strengthen the enforcement of EPR regulations, requiring multinational corporations and manufacturers to bear a greater share of (i) end-of-life environmental costs (e.g. RM50), (ii) logistics-related costs, and (iii) CEPA initiatives.
Registered re-manufacturers	Request for the government to change their mindsets from recycling to repurposing UEEEs
Legal experts	For legal scholars and practitioners to urge the establishment of mandatory EPR legislation and call for stronger, coordinated enforcement mechanisms across regulatory agencies (Andeobu, Wibowo, and Grandhi, 2021; KPKT, 2024).
Environmental non-governmental organisations (NGOs) (e.g., Friends of the Earth Malaysia)	Environmental NGOs, particularly Friends of the Earth Malaysia (2023), advocate stricter regulations and greater accountability in relation to illegal e-waste imports and informal processing activities. They emphasise the severe environmental and health impacts arising from unregulated e-waste activities.
Industry players	Industry players generally support Malaysia's movement towards circular economy frameworks (MITI, 2024) but request clearer regulatory guidelines, consistent enforcement, and financial or policy incentives to facilitate compliance with new waste management requirements.

Stakeholders	Expectations
Academics	Academic researchers emphasise the need for integrated, multi-agency collaboration, greater transparency in data reporting, and the development of adaptive regulatory systems to address the evolving composition of e-waste streams and new recycling technologies (Ismail and Hanafiah, 2021; Andeobu, Wibowo, and Grandhi, 2021).
Public advocacy groups	Public advocacy groups stress the importance of widespread educational campaigns to enhance consumer awareness about the dangers of informal recycling practices and to promote responsible disposal behaviours (Friends of the Earth Malaysia, 2023; KPKT, 2024).

Source: Compiled by the authors.

D) Definition and discussion on urban mining

Urban mining is the recovery of secondary raw materials from anthropogenic sources using biological, chemical, or physical procedures and technological input. The concept remains relatively new in Malaysia but has been associated with the extraction of common base metals, precious metals, potentially toxic metals, secondary resources, secondary raw materials, and rare earth minerals, the definitions of which are provided in Table 3.19. Extraction of such materials reduces environmental degradation, alleviates public resistance to mining, and supports national economic goals while minimising reliance on conventional mining of limited natural mineral deposits.

Table 3.19. Urban Mining and Related Concepts

Key Concepts	Definitions
Base or common metals	Inexpensive materials that are widely available as natural resources. Examples are copper (Cu), aluminium (Al), nickel (Ni), lead (Pb), tin (Sn), zinc (Zn), and iron (Fe) and steel (iron alloy)
Precious metals	High value materials that are scarce as natural resources. Precious metals have physical and chemical properties, such as catalytic activity, good electrical conductivity and corrosion resistance, and, therefore, are widely used in industry.
Potentially toxic metals	Elements found in various concentrations in all ecosystems or released from anthropogenic sources. Examples are arsenic (As), cadmium (Cd), cobalt (Co), nickel (Ni), lead (Pb), antimony (Sb), vanadium (V), zinc (Zn), platinum (Pt), palladium (Pd), rhodium (Rh), and chromium (Cr).
Secondary resources	Resources capable of lifetime extension by reuse or energy recovery. Examples are obsolete electrical and electronic equipment, products, and components made of plastic or other energetic materials, scrap, tailings, low-grade ores.
Secondary raw materials	Type of raw material that can be recovered from secondary resources through reuse or recycling
Rare earth elements (REEs)	Referred to as the 'vitamins of modern industry' due to their electromechanical and electrochemical properties. these metals are critical to technological development and of strategic importance for future economic growth. The metals are very expensive due to their limited supply and strong demand.

Source: Adapted from Xavier, Ottoni, and Abreu (2023); Aziman, Ismail, and Rahmat (2023).

D-1) Urban mining's potential in e-waste recovery

Since urban mining is broadly applicable across different waste types, **its implementation in the e-waste sector should prioritise components with high concentrations of economically valuable metals**. For example, NiMH batteries, permanent magnet scraps, electrolytic slags, fluorescent lamps, computer monitor scraps, waste CRT phosphors, discarded NdFeB magnets, and PCBs contain recoverable base metals (e.g., gold, silver, copper) and REEs (e.g., neodymium, dysprosium, yttrium), as detailed in Table 3.20 (Aziman, Ismail, and Rahmat, 2023; Yong, Lim, and Ilankoon, 2019).

Additional facts on PCBs necessitate their prioritisation. Though they account for only 5–10% of the total WEEE weight, they contribute up to 80% of its recoverable economic value (Aziman, Ismail, and Rahmat, 2023). Therefore, prioritising the urban mining of PCBs offers

a focused approach to tackling a high-value segment – approximately 5–10% – of Malaysia's e-waste stream.

Table 3.20. EEE Materials Containing Valuable Metals

Source EEE Material	Present Metals	Type of Metals
Waste nickel-metal hybride (NiMH) batteries	Lanthanum, cerium, neodymium, praseodymium	Rare earth elements (REEs)
Permanent magnet scraps	Neodymium, praseodymium, dysprosium	REEs
Electrolytic slags	Neodymium, praseodymium, dysprosium	REEs
Fluorescent lamp waste	Cerium, yttrium, europium	REEs
Computer monitor scraps	Europium, yttrium	REEs
Waste cathode ray tube phosphors	Europium, yttrium	REEs
Discarded NdFeB magnets	Neodymium, praseodymium, gadolinium	REEs
PCBs	Gold, silver, copper	Base metals

Sources: Aziman, Ismail, and Rahmat (2023); Yong, Lim, and Ilankoon (2019).

Moreover, PCBs vary in constitution depending on the size of EEE material as in televisions (10%), washing machines (30%), computers (20%), and mobile phones (30%) (Aziman, Ismail, and Rahmat 2023). Even with such different compositions, Aziman, Ismail, and Rahmat (2023) estimated REE content in PCBs to be approximately 0.36–1019.56 tonnes of total REE elements across Malaysia's six EEE waste material categories, i.e. televisions, washing machines, air conditioners, refrigerators, personal computers, and mobile phones, including their batteries. Attainment of such a target also depends on collection rates and recovery efficiency based on a REE concentrate of between 425 g/tonne to 8,510 g/tonne of PCB waste.

Overall, incorporating urban mining into Malaysia's rare earth strategy would support broader circular economy objectives by:

- Reducing reliance on virgin extraction, which often triggers environmental and social resistance
- Diversifying supply chains, especially amid geopolitical risks associated with REE imports
- Encouraging domestic innovation in recycling technologies and green processing methods (Aziman, Ismail, and Rahmat, 2023).

All these aspects align with national frameworks such as the Circular Economy Policy Framework for the Manufacturing Sector (2024) and the National Circular Economy Blueprint for Solid Waste (2025–2035).

D-2) Malaysia's status quo and outlook

1) Institutional support and public engagement in urban mining

The concept of urban mining has **gained increasing institutional attention** in Malaysia. The Malaysian Communications and Multimedia Commission (MCMC) has been a key driver of public awareness through its recycling programme, KITAR. **Rebranded in 2022 as 'KITAR: Old Device, New Breath', the initiative promotes responsible disposal of e-waste and educates communities on circular economy principles**. Operated in partnership with five designated universal service providers – CelcomDigi, Maxis, RedTone, Telekom Malaysia, and Webe – the programme funds the maintenance of 125 nationwide collection centres through device buy-back revenue. These centres also serve as digital literacy and outreach hubs for micro-entrepreneurs and the public. **Since 2015, the programme has collected over 4.7 metric tonnes of e-waste**, supported by various stakeholders, including NGOs, government agencies, and schools (Bernama, 2022; Wiser.my, 2023).

Complementing these efforts**, a local private enterprise has operationalised an urban mining model originally introduced by Professor Hideo Nanjyo**. The initiative recovers high-purity gold and silver from e-waste and rewards participants according to the value of the materials they recycle (Disruptr MY, 2024). This demonstrates the growing monetisation potential of urban mining in Malaysia's sustainability landscape.

2) Technological leadership and regulatory challenges

Notably, **MCMC has collaborated with Shan Poornam Metals Sdn Bhd (SPM), one of Malaysia's most technologically advanced urban mining companie**s. Established in 1960, SPM has emerged as a pioneer in electronic and industrial waste recovery. Its environmentally sound management facilities specialise in extracting base and rare earth metals – including gold, silver, platinum, and copper – at high purity levels. Nationally recognised for its contributions to sustainable industrial practices, SPM has received accolades, such as the Prime Minister's Hibiscus Award and the MITI Industrial Excellence Award (InvestPenang, 2023).

However, despite its technological readiness, **SPM's full potential remains constrained**. According to a person familiar with the matter, DOE imposes restrictive import regulations on U/WEEE, limiting material inflow for processing. While MITI actively promotes the circular economy, DOE's stance does not yet treat e-waste as a valuable resource. In contrast, **some import approvals have been granted to less capable, trade-focused firms, leading to frustration within the industry and the underutilisation of advanced urban mining facilities like SPM's**. SPM is said to have adequate technical capabilities to handle all potential e-waste imports for the circular economy.

3) Informal practices and the need for capacity building

Despite institutional support and technological capabilities, urban mining in Malaysia remains underdeveloped at the national scale. **A significant portion of e-waste continues to be processed through informal or semi-formal channels, often using**

environmentally harmful techniques such as aqua regia or cyanide to extract gold – methods that pose serious health and ecological risks (Choke and Hsu, n.d.). These informal actors face multiple constraints: uncoordinated collection systems, limited recovery sites, low-skilled labour, and outdated technologies that yield impure outputs with limited tradability.

Research by Yong, Lim, and Ilankoon (2019) highlighted that advanced technologies and technical upskilling are urgently needed to boost the economic and environmental returns of secondary material recovery. Without strategic investment in training and infrastructure, Malaysia risks falling short of its circular economy goals despite growing interest and foundational initiatives in urban mining.

4) Urban mining policy and institutional gaps

On the regulatory front, policies and regulations in Malaysia have focused more on e-waste disposal than on material recovery. For example, DOE has proposed new legislation mandating that EEE goods be disposed of through licensed recyclers or collectors. However, progress on the enactment of this proposal has yet to be reported (Tan, 2021) The proposed regulation covers televisions, air conditioners, refrigerators, washing machines, personal computers, and mobile phones. Currently, the management and control of e-waste in Malaysia is governed by the Environmental Quality (Scheduled Wastes) Regulations 2005, Section 34B of the Environmental Quality Act 1974, and the Basel Convention. However, DOE has clarified that current enforcement measures apply only to industrial premises. There remains an absence of a dedicated legal framework to regulate e-waste originating from households. DOE notes that no formal system is presently in place to ensure the environmentally sound management, recovery, or disposal of household e-waste, highlighting a significant regulatory gap in national e-waste management policies. The new regulation proposed by DOE is expected to address this gap and would likely adopt an EPR mechanism (The Straits Times, 2019).

Table 3.21. Synthesis of Urban Mining Drivers, Barriers, Technologies and Impacts in Developing Countries

Urban Mining Process	Driver	Barrier	Technology	Impact
Collection of e-waste	- Growing demand and cheaper prices of electronic devices - Increasing calls for environmental	- Lack of logistics network for the take-back scheme and collection of e-waste - Lack of	- Extended producer responsibility - Reverse logistics - Outdated transportation modes for e-waste collection. For example, push carts, bicycles, and tricycles	- Provides options to dispose of e-waste - Improves proper disposal of e-waste - Source of

Urban Mining Process	Driver	Barrier	Technology	Impact
	preservation - Growing numbers of informal e-waste collectors - Faster depleting life span of electronic devices due to rapid innovation - Emergence of government regulations and legislation	financing for e-waste collection - Lack of innovation, poor monitoring, and evaluation of e-waste policies - Lack of disposal incentives and consumer awareness of e-waste disposal points - Data privacy concerns and emotional attachment - Consumers' reluctance towards e-waste recycling	- Items collected at this stage include personal computers (PCs), laptops, TVs, mobile phones, air conditioners, radios, notebooks, and other electronic devices	income - Poor e-waste collection knowledge and handling practices - Health complications and environmental pollution

Source: Erdiaw-Kwasie, Abunyewah, and Baah (2024).

Secondly, despite Malaysia's recognised potential for urban mining, **current REE policies remain heavily skewed towards upstream exploration** – particularly the extraction of ion-adsorption clay deposits – while largely overlooking the recovery of REEs from urban waste streams. This policy imbalance is further reinforced by:

- A lack of **R&D funding and institutional capacity** for secondary REE recovery
- **Weak enforcement and coordination** across relevant ministries and agencies
- Public opposition due to concerns over radioactive residues and poor waste management histories.

The absence of integrated legislation or incentive mechanisms for urban mining further limits the development of formal recovery infrastructure. A more **robust regulatory**

framework—such as EPR—alongside greater public awareness and investment in formal recycling infrastructure, is needed to realise the full benefits of urban mining.

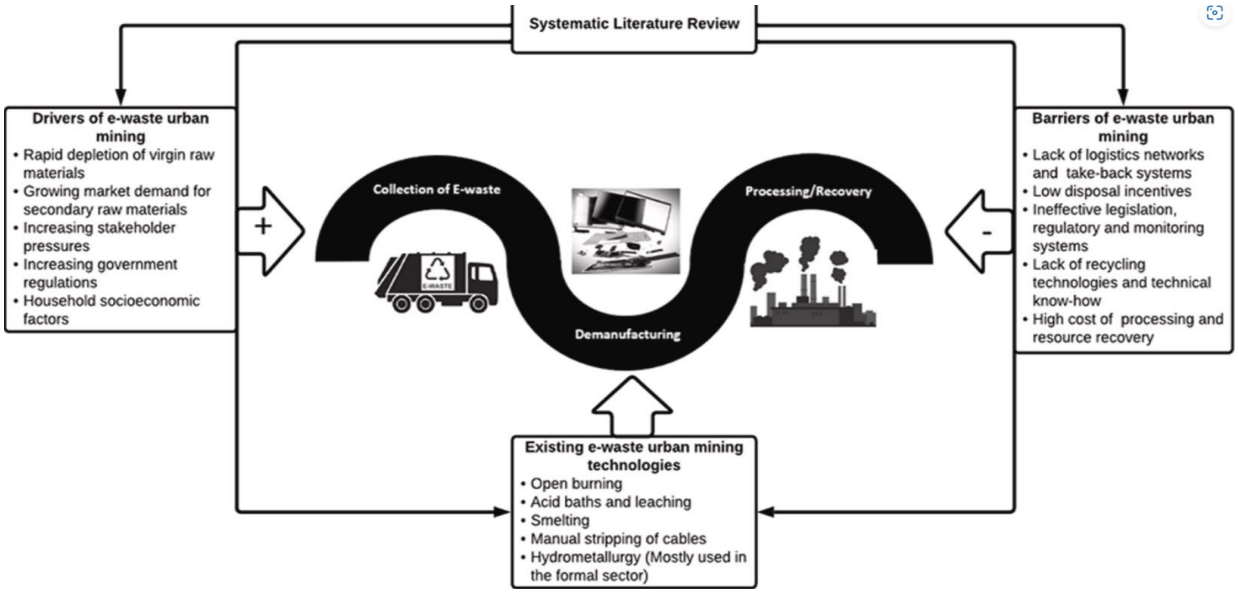
5) Recommendations

To realise the potential of urban mining, Malaysia should:

- **Optimise the technological capabilities** of licensed private urban mining specialists, notably SPM.
- **Prioritise secondary recovery** in national rare earth policies and roadmaps.
- **Establish a regulatory framework** for REE recovery from industrial and electronic waste.
- **Support public–private R&D partnerships** to develop efficient, low-impact extraction technologies;
- **Promote 3R incentives and tax benefits** for industries engaging in REE recycling and reuse.
- **Engage the public transparently** to rebuild trust in the sector, particularly concerning radioactive waste handling.

Figure 3.17 illustrates the drivers and barriers of e-waste urban mining, with typical urban mining technologies positioned at the centre to represent the status quo. The current context highlights a critical need for collaborative partnerships and targeted interventions to bridge existing gaps in urban mining activities.

Figure 3.17. Drivers, Barriers, and Processes in E-Waste Urban Mining



Source: Erdiaw-Kwasie, Abunyewah, and Baah (2024).

2.3. Analysis and discussion

The current policy and regulatory backdrop in Malaysia present both opportunities and constraints in managing international material flows, particularly concerning W/UEEE, and REEs. Malaysia's classification of UEEE older than 5 years as WEEE under SW110 significantly limits the inflow of potentially reusable equipment from countries such as Japan, despite growing demand for circular trade practices notably by private sector (SPM) with high technological capability for urban mining or remanufacturing capability (Rentwise). While this restriction aims to mitigate illegal waste dumping, it inadvertently accelerates domestic waste accumulation and discourages legitimate cross-border reuse markets.

Additionally, the lack of clear protocols to distinguish between UEEE and WEEE creates enforcement ambiguity at customs checkpoints, undermining Malaysia's credibility as a responsible trade partner under Basel Convention guidelines. The absence of a unified tracking system for material flow – from importation to final processing – further fragments accountability across multiple agencies. Moreover, although the country possesses infrastructure like the Electronic Scheduled Waste Information System (eSWIS) and digital platforms such as Riiicycle, these systems are not yet fully integrated into transboundary monitoring or compliance reporting. This gap is particularly problematic iconsidering Malaysia's increasing reliance on imported REE-containing materials, such as monazite and e-waste fractions. Without coordinated regulatory reform and standardised import evaluation criteria, Malaysia risks becoming both a bottleneck and a blind spot in the regional circular economy value chain.

2.4. Conclusion

To enhance the integrity and efficiency of international material flows into and within Malaysia, regulatory clarity and institutional coherence must be prioritised. A differentiated policy that distinguishes high-quality UEEE from true WEEE, combined with standardised inspection and certification procedures at borders, will be critical to ensuring compliance with global agreements while promoting circular trade. At the same time, Malaysia should scale up investment in traceability systems and harmonise data infrastructure across enforcement bodies to track the movement and transformation of imported materials. Establishing such systems will not only reduce illegal or disguised imports but also position Malaysia as a credible hub for responsible e-waste recovery and REE urban mining. Strengthening these capabilities is essential for Malaysia to participate meaningfully in global circular economy networks and to safeguard environmental and economic interests simultaneously.

3. Policy Recommendations on the International Material Flow on the EEE-relevant Materials between Malaysia and Japan

Malaysia's political leadership is more stable now compared to a couple of years ago. Thus, now is the time to create a robust material flow policy for e-wastes. **Sections 3.1 to 3.4**

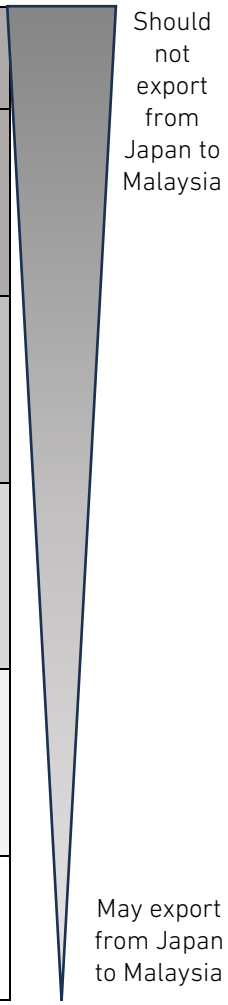
contain policy recommendations related to the international material flow of EEE-relevant materials, with a particular focus on trade between Malaysia and Japan. **Sections 3.5 to 3.10** contain e-waste-related domestic policy recommendations for Malaysia.

3.1. Policy Recommendation 1: Regulate EEE Imports based on Malaysia's Technological Capability to Handle Hazardous Waste

As a country, Malaysia faces significant limitations in its technological capacity to manage certain types of recycling, particularly those involving hazardous waste. Therefore, the importation of EEE containing hazardous components that cannot be adequately processed domestically should be strictly prohibited. Such EEE includes items like TV screens, refrigerators, and cooling and heating equipment (e.g., air conditioners and freezers). As EEE categories continue to evolve, **material-based risk assessments should remain central to policy decisions**, as highlighted in Table 3.22. In addition, export and import decisions should be guided by technological capability. Until Malaysia can manage at least 80% of its own e-waste domestically, this recommendation should be treated as a national priority to mitigate environmental pollution.

Table 3.22. Ranking of EEE Categories by Hazardous Material Content

EEE Category	Key Hazardous Materials	References
TV screens (CRTs, LCDs, LEDs)	Lead (in CRTs), mercury (in LCDs), arsenic, indium, gallium (in LEDs)	Kiddee, Naidu, and Wong (2013); Schluep et al. (2009)
Refrigerators, cooling, and heating equipment	CFCs/HCFCs/HFCs (refrigerants), oil, polyurethane foam (with isocyanates)	Tsai (2005); Wang, Huisman, and Meskers (2012); Vevere et al., (2024)
Audio and video equipment	Lead solder, cadmium, brominated Flame Retardants (BFRs), phthalates	Robinson (2009); Brigden et al. (2005)
Computing equipment (laptops, desktops, tablets)	Lead, cadmium, mercury, BFRs, beryllium, lithium-ion batteries	Puckett et al. (2002); Ongondo, Williams, and Cherrett (2011)
Mobile phones	Lead, cadmium, nickel, BFRs, lithium, REEs	Osibanjo and Nnorom (2007); Sepúlveda et al. (2010)



Source: Compiled by the authors.

3.1.1. Direct partnership with technologically capable local companies (e.g., SPM, Rentwise) should be promoted by shifting the mindset towards viewing e-waste as a valuable resource. This can be achieved by establishing clear criteria to identify recycling companies that are qualified to import UEEE for full circularity. These criteria may include:

a) operating R&D-driven, technology-led recycling processes,

b) utilising green technologies, and

c) having the capacity to manage residuals and effluents through self-regulation of water and air pollution.

By clearly articulating and selecting capable recycling companies or remanufacturing companies based on specific material expertise, Malaysia can enhance its capacity to build a robust circular economy framework.

3.1.2. Promoting responsible UEEE trade: To ensure environmentally sound and mutually beneficial trade between Japan and Malaysia, it is recommended that Japan export only low-risk UEEE, such as mobile phones and laptops, that contain lower levels of hazardous materials. To prevent the externalisation of recycling and disposal burdens onto Malaysia, this export should be accompanied by a formal bilateral agreement as described above.

3.1.3 The government urges Japan not to export e-waste fractions or components to Malaysia for processing. Under DOE rules, any permitted flows must consist only of complete UEEE units intended for reuse or repair.

3.2. Policy recommendation 2: shift waste trafficking cases to criminal prosecution, holding host-country forwarding agents (e.g., logistics firms, brokers, or shipping agents) liable.

Given the involvement of compromised enforcement officials, Malaysia must strengthen its legal response to waste trafficking. Offenders currently face low-risk administrative penalties, but elevating these offenses to criminal status with stricter sanctions is essential to deter violations.

Forwarding agents – typically nationals of the exporting country – are critical intermediaries who manage customs clearance, documentation, and port operations. Prosecuting them under their own jurisdiction can more effectively disrupt illegal e-waste flows and shift accountability back to source countries. This approach aligns with UNODC's framing of waste trafficking as organised crime, but its impact will depend on exporting countries' cooperation and on extending prosecutions beyond small intermediaries to the networks financing these shipments.

Given the growing evidence of large informal criminal syndicates from mainland China, stricter visa and entry investigations are necessary to curb informal trade and unregulated

labour. For example, individuals reportedly use 1-month tourist visas to continue their activities, leaving Malaysia briefly each month solely to renew their stay.

3.3. Policy recommendation 3: extend product life through company-to-company EPR

Malaysia's current policy classifies UEEE over 5 years old as WEEE under SW110, leading to the premature disposal of still-functional equipment and higher domestic e-waste. This policy should be revised so classification is based on actual functional life span and condition, rather than an arbitrary age threshold. A company-to-company approach, supported by local actors, can promote durable product design, refurbishment, and reuse. Embedding these measures in EPR ensures producers manage their own waste while enabling proper recycling and resource recovery.

As noted by one informant, Malaysia currently applies a standard 10-year life span for UPS units, which may no longer reflect technological realities. A reassessment of this life span, along with a more nuanced approach to SW110 classification, is needed. The informant also recommended the establishment of battery collection centres to enable reuse and extend the life cycle of battery components.

3.4 Policy recommendation 4: strengthen UEEE imports through company-to-company EPR and technology transfer

Any export of UEEE to Malaysia must be tied to company-to-company arrangements that extend product life span through durable design, refurbishment, and producer-led waste management under EPR. Technology transfer and capacity-building support from Japan should be a prerequisite for supporting refurbishment and Malaysia's domestic recycling of locally generated e-waste. Drawing on Japan's advanced EPR framework, consumer education strategies, and proven systems for regulatory enforcement and public engagement can help Malaysia strengthen its infrastructure while ensuring that producers take responsibility for their own waste. Table 3.23 compared the role of stakeholders in e-waste management system amongst two countries and a region. This collaboration – backed by Japanese agencies and multinational corporations – can deliver both environmental protection and socio-economic benefits such as skills development, job creation, and integration of informal waste workers.

Table 3.23. Role of Stakeholders in E-Waste Management System

	Japan	Taiwan	Malaysia
Consumers	Pay mandatory recycling fee upon disposal	No formal obligation, voluntary participation	Segregate waste, voluntary participation
Collectors	Retailers collect WEEE from consumers and transport to collection centres	Contractors collect WEEE and sell to registered recyclers	Waste concessionaires compete with scrap collector for WEEE
Recyclers	EEE producers recycle their own WEEE or delegate to recycling companies	Voluntary contractors conduct safe recycling and receive subsidy	DOE-licensed contractors and scrap recyclers conduct recycling
Producers	Bear physical obligation of WEEE treatment	Bear financial obligation of WEEE treatment	No formal obligation
Local Government	Collect SHEA and illegally dumped WEEE	Collect WEEE voluntarily for the system	Comply with state government in waste regulation

SHEA = small home electrical appliances.
Source: Rasnan et al. (2016).

3.5 Policy recommendation 5: reevaluate licensing of recycling factories considering limited EEE supply

Given the insufficient supply of recyclable EEE, there is a need to reassess the number of licensed recycling factories. This supply–demand imbalance is indirectly encouraging informal traders and the informal sector to secure materials, potentially undermining regulatory oversight and environmental safeguards.

3.6 Policy recommendation 6: UEEEs based EPR policy: holding producers accountable for e-waste in Malaysia

3.6.1. EEE producers are responsible for collecting their distributed equipment, and consumers may pay a recycling fee upon purchasing electronic products.

3.6.2. EEE producers are required to internalise logistics costs, including take-back and waste collection fees, typically covered by recycling companies such as ERTH.

3.7. Policy recommendation 7: centralisation of policy framework

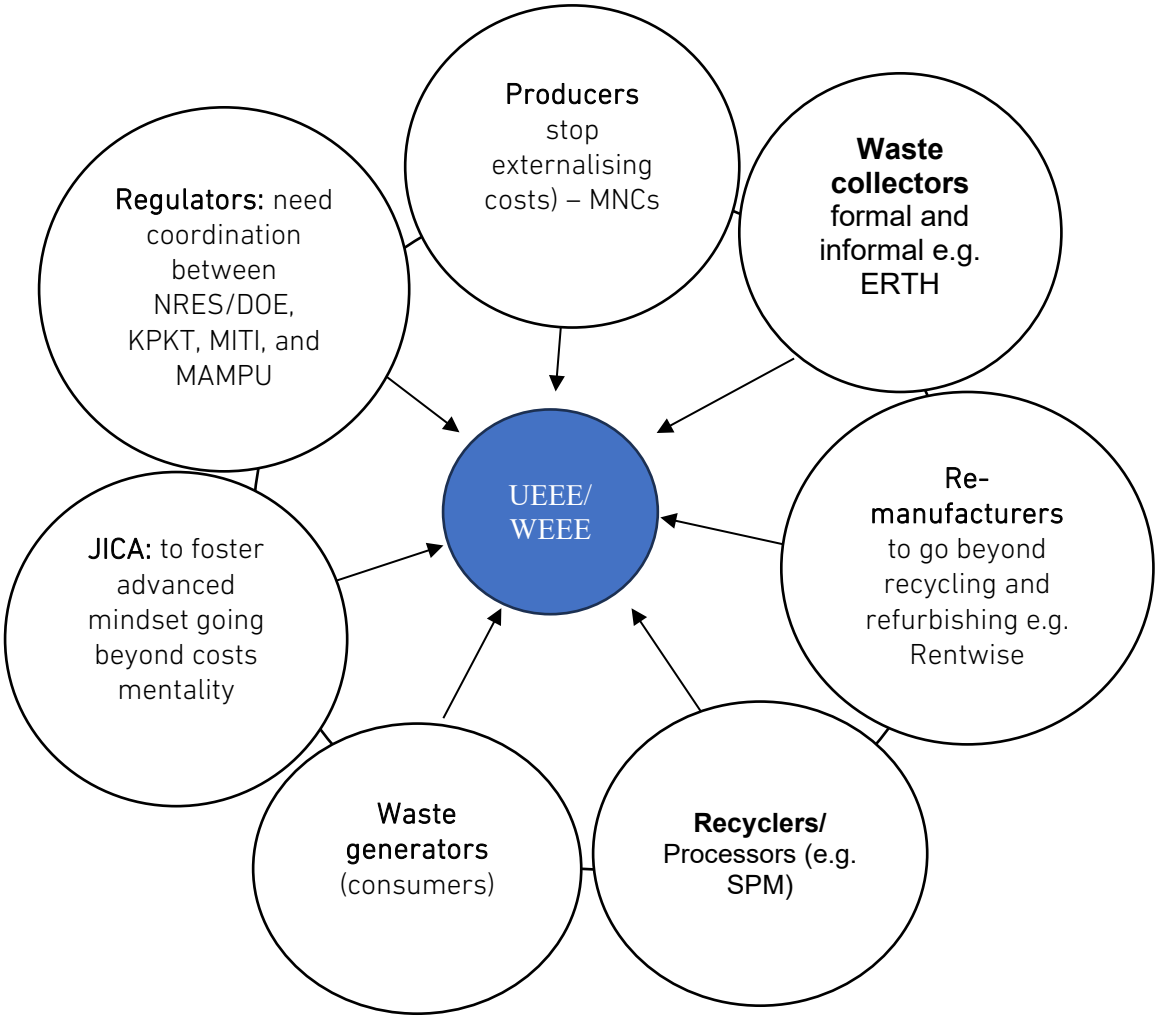
There is a need for greater coordination between MITI (manufacturing sector), the Department of Environment, which operates under NRES; KPKT (Ministry of Local Government Development), and MAMPU (Malaysian Administrative Modernisation and Management Planning Unit – asset management) to harmonise EEE management. Given Malaysia's weak e-recycling infrastructure – highly fragmented and dominated by the

informal sector, which contributes to air, water, and land pollution – the country should strengthen its remanufacturing initiatives while simultaneously advancing recycling efforts.

Multi-stakeholder harmonious approach: 'Several participants to sing one song'.

The problem with e-waste management is enormous in Malaysia. With the support of Japan, Malaysia urgently needs a multi-stakeholder approach to solve multi-stakeholder problems. Figure 3.18 shows the key stakeholders and collaborative roles in Malaysia's UEEE/WEEE management ecosystem.

Figure 3.18. Key Stakeholders and Collaborative Roles in Malaysia's UEEE/WEEE Management Ecosystem



Note: Appendix 6 shows stakeholder frameworks developed in the past.
Source: Diagram created by the author based on insights from this research.

3.8 Policy recommendation 8: CEPA campaign by government

Public participation in e-waste recycling is low, due to limited awareness and inadequate collection facilities. Educational campaigns and accessible recycling options are necessary to enhance public engagement (Roslan, Rahman, and Omar, 2023; Todi, 2023). Local governments should fund CEPA initiatives to discourage consumers from selling EEE to the informal sector. Many consumers lack awareness and require targeted education, unlike in Japan. Most informants in this study emphasised the urgency of this need.

3.9 Policy recommendation 9: Japanese technology companies to invest

Riding on what JICA has begun, technology transfer and investment by Japan are highly timely. One of the examples is shown in Figure 3.19. Malaysia's formal recycling sector urgently needs to scale up with advanced technology to convert WEEE into valuable materials. Japan has a timely opportunity to collaborate with the Malaysian government. Meanwhile, China has been selling affordable EEE that many Malaysians can purchase, which is also contributing to the growing volume of e-waste in Malaysia.

Figure 3.19. Technical Cooperation with JICA



Source: Samuel (2025).

3.10 Policy recommendation 10: integrating informal sector and enhancing system traceability

- Transform informal actors into recognised service providers
  Establish formal mechanisms to integrate informal collectors and dismantlers into the regulated waste management system, transitioning their role from price-driven material buyers to accredited service providers. This integration not only enhances livelihoods and social protection for informal workers but also strengthens regulatory

compliance, improves traceability, and increases material recovery efficiency within a unified, streamlined system.

- Ensure end-to-end traceability
  Implement systems like Riiicycle to trace e-waste flows from waste generators to licensed recovery facilities, ensuring transparency and accountability throughout the value chain.
- Strengthen pro-recycler partnerships

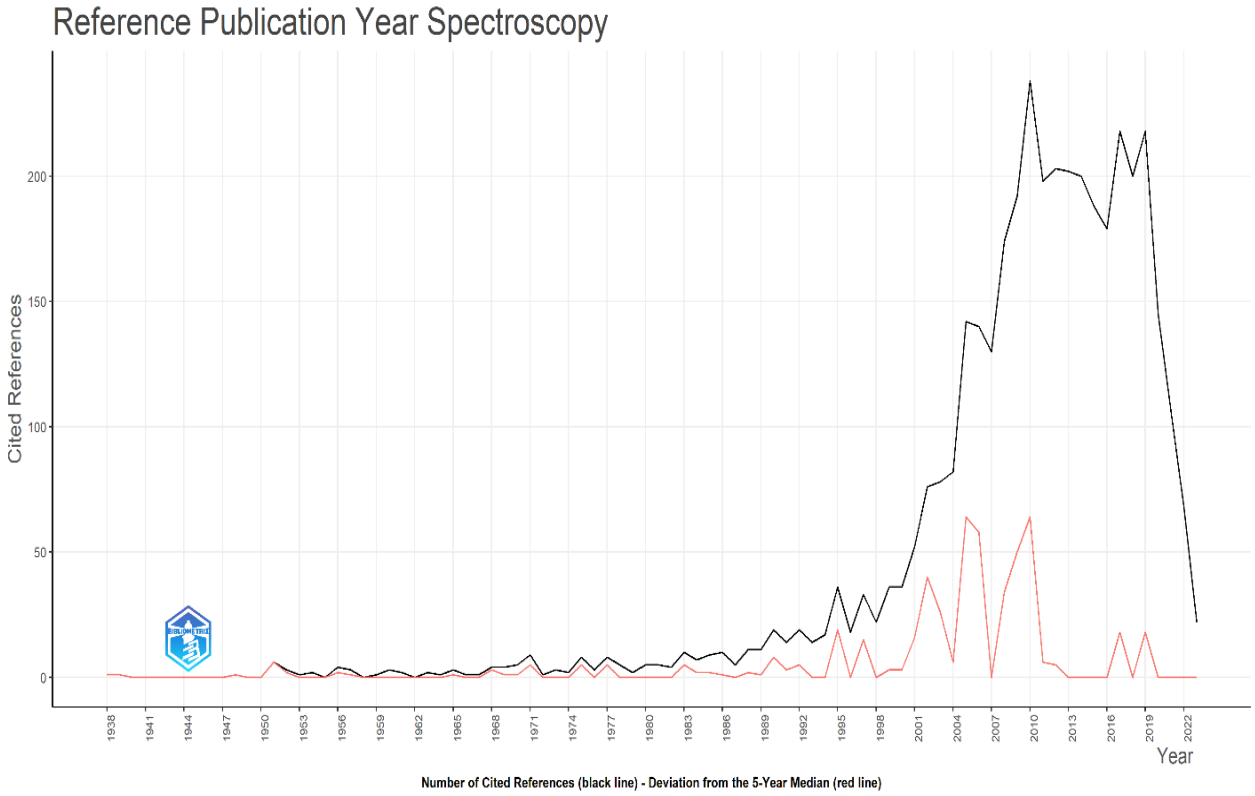
  Require producer responsibility organisations to partner exclusively with fully licensed recovery operators to reduce operational fragmentation and minimise regulatory and environmental risks. These partnerships also improve cost accountability across the system.

Appendix 1

To assess the state of e-waste research in Malaysia, an article search was conducted on the Scopus database in January 2025. The search utilised the search string with the parameters 'Electrical and electronic equipment' OR 'EEE' OR 'E-waste' OR 'ewaste' AND Malaysia and another independent search with the following parameters 'Electrical and electronic equipment' OR 'EEE' OR 'E-waste' OR 'ewaste' AND Malaysia. The first and second search strings retrieved 87 and 95 articles, respectively. After removing duplicates and conference papers, 61 peer-reviewed journal articles remained. Amongst these, only nine articles were related to e-materials flow between Malaysia and Japan, 10 focused on e-waste management in Malaysia, and seven addressed e-equipment. None of the articles on Scopus were published in the local language.

Given the urgency of e-waste challenges in Malaysia – characterised by exponential growth in e-waste generation and a looming public health crisis (Andeobu, Wibowo, and Grandhi, 2021) – the volume of publications reflects a surprisingly low level of scholarly interest in the subject. Reference Publication Year Spectroscopy shows that this interest was relatively short-lived, experiencing rapid growth between 2000 and 2020, followed by a sharp decline in the post-COVID period (see Figure A-1.1).

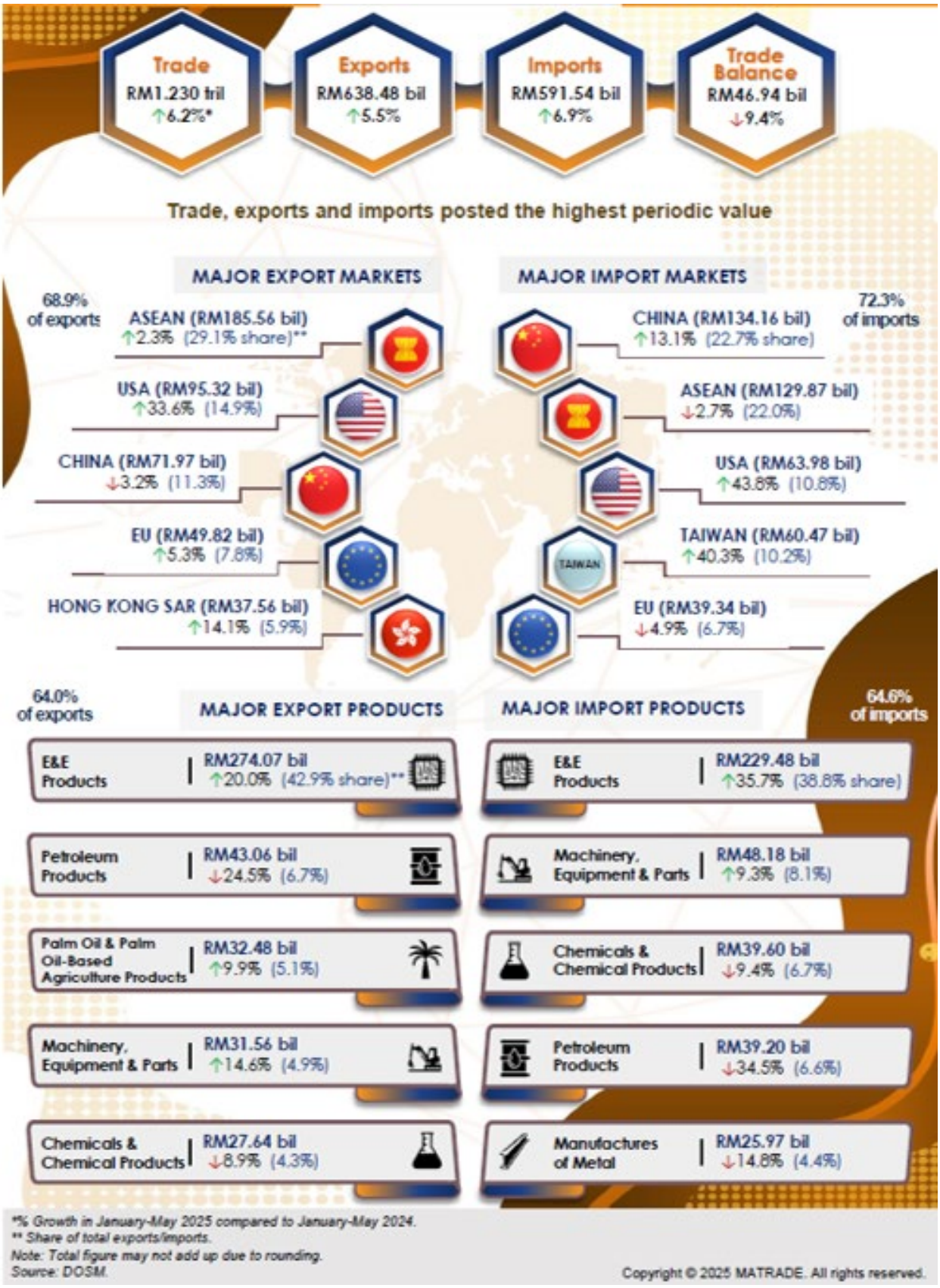
Figure A-1.1. Sharp Decline in E-Waste Publications Related to Malaysia in the Post-COVID Era



Source: Own work. The figure was produced from a bibliometric analysis conducted on the Bibliometrix platform of all e-waste in Malaysia academic research articles listed on the Scopus Database. This analysis was undertaken by the research team.

The reality is that e-waste generation continues to be a concerning environmental issue (e.g., Yusof et al., 2023). Such low research interest implies that minimal research support is being committed to further investigating a phenomenon that has severe repercussions on public health. This limited research also slows down and limits the future development of viable solutions to resolve the e-waste problems, which are worsening every year.

Appendix 2. Malaysia's Trade Performance, January–May 2025



Appendix 3

Figure A-3.1. Hazardous Wate Imported into Malaysia and Thailand, 2017–2020 (thousand tonnes)

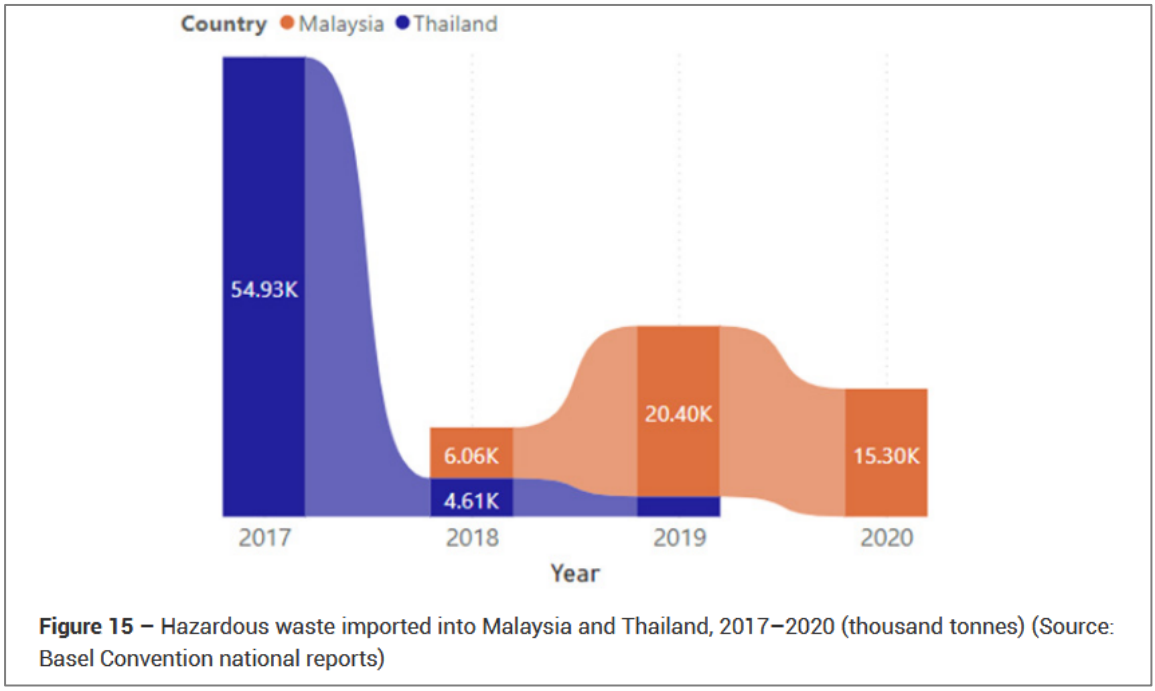


Figure 15 – Hazardous waste imported into Malaysia and Thailand, 2017–2020 (thousand tonnes) (Source: Basel Convention national reports)

Source: United Nations Office on Drugs and Crime (UNODC, 2024, Turning the Tide, Figure 15, p. 55), based on Basel Convention national reports.

Figure A-3.2. Types of Hazardous Waste Imported into Malaysia and Thailand, by Quantity, 2017–2021 (thousand tonnes)

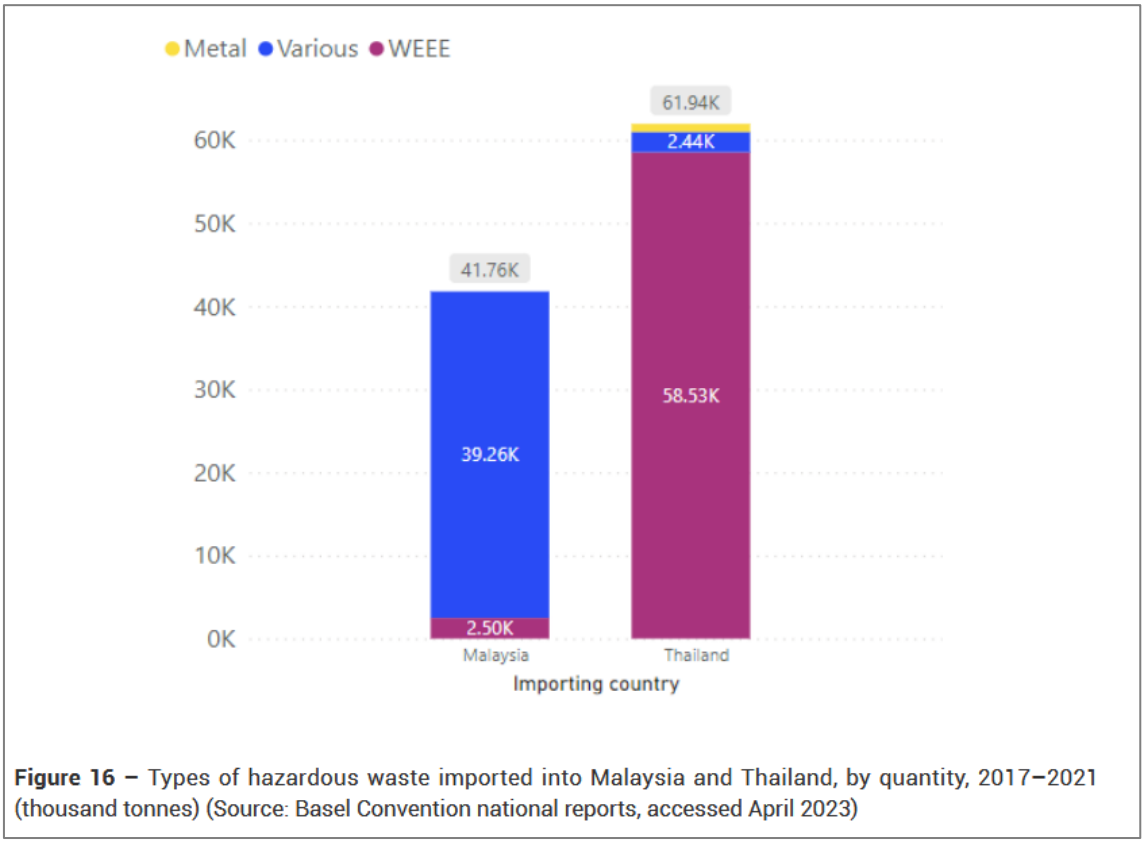


Figure 16 – Types of hazardous waste imported into Malaysia and Thailand, by quantity, 2017–2021 (thousand tonnes) (Source: Basel Convention national reports, accessed April 2023)

Source: UNODC (2024, Figure 16, p. 56), based on Basel Convention national reports.

Figure A-3.3. Top Exporting Countries of Waste (10 HS Codes) to Malaysia, by Quantity 2017–2021

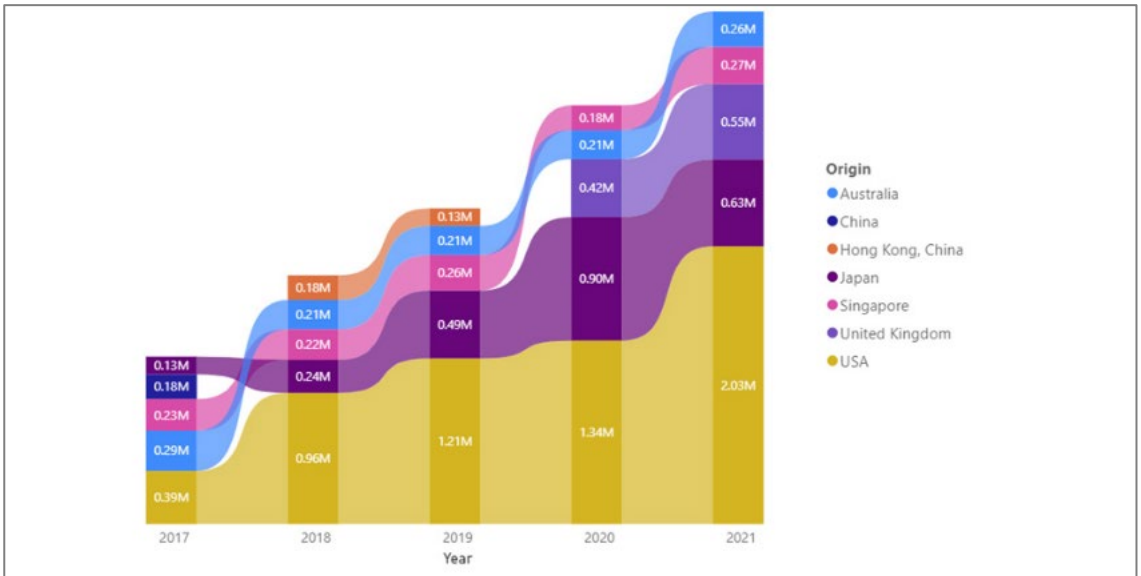


Figure 44 – Top exporting countries of waste (10 HS codes) to Malaysia, by quantity, 2017–2021 (million tonnes) (Source: UN Comtrade, accessed September 2023)

Source: UNODC (2024, Figure 44, p. 109), based on UN Comtrade data.

Figure A-3.4. Illegal Shipments of Hazardous Waste into Malaysia, 2015–2021

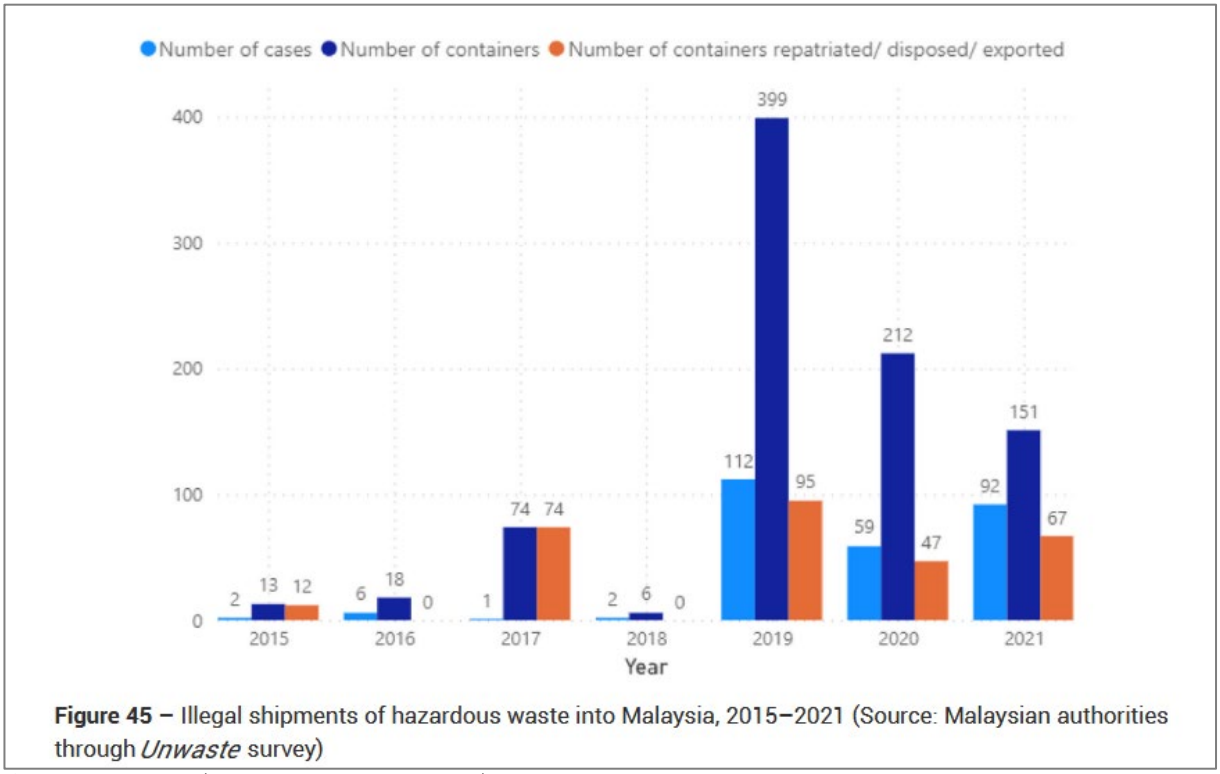


Figure 45 – Illegal shipments of hazardous waste into Malaysia, 2015–2021 (Source: Malaysian authorities through *Unwaste* survey)

Source: UNODC (2024, Figure 45, p. 110), based on data provided by Malaysian authorities through the Unwaste survey.

Figure A-3.6. Example from Malaysia



Source: UNODC (2024).

Appendix 4

Figure A-4.1. Circular Economy Blueprint: Collaborative Framework for Malaysia's Solid Waste Sector



Source: Malaysian presentation, Achievements – Latest Policies and National Platform, available through UNCRD. https://uncrd.un.org/sites/uncrd.un.org/files/12th3r_cp-malaysia.pdf

Figure A-4.2. Circular Economy Vision Statement

By 2050, Malaysia will have transformed its solid waste management system into a **circular economy** that **maximises resource efficiency** & **minimises waste generation**, while promoting **economic growth, social well-being** & **environmental sustainability**

Source: Ministry of Housing and Local Government (KPKT, 2024), Circular Economy Blueprint for Solid Waste in Malaysia (2025–2035).

Figure A-4.3. Circular Economy Strategic Framework



Source: KPKT (2024).

Integration of EEE under the Blueprint

The national circular economy blueprint addresses EEE through several initiatives, aiming to reduce the environmental footprint of EEE, promote resource recovery, and align with global best practices in electronic waste management.

1. Governance and Legislation

- Circular Economy Initiative (CEI) 1 – Legislative Transformation for Solid Waste Management
  Establishes uniform national laws to transition towards a circular economy, improving enforcement and regulatory clarity for EEE producers and recyclers.
- CEI 2 – Implementation of EPR for Solid Waste
  Introduces EPR, mandating producers to manage product end-of-life including collection, recycling, and reporting. A phased roll-out will transition from voluntary to mandatory compliance.

2. Guidelines and Procedures

- CEI 6 – Legislation on Packaging
  Requires clear labelling for recyclability, including for electrical and electronic (E&E) product packaging, improving material sorting and consumer disposal practices.
- CEI 7 – Product Design Guidelines
  Promotes circular product design in the EEE sector – designs must be easier to repair, disassemble, upgrade, and recycle, thus extending product life cycles.

- CEI 9 – Development of Local Recycling Market
  Boosts domestic demand for recycled materials from EEE waste, including precious and rare metals, creating a viable circular EEE materials economy.

3. Digitalisation and Technology

- CEI 11 – Solid Waste Data Management System
  Enables real-time tracking of EEE waste streams, helping regulators and recyclers optimise recovery rates, monitor compliance, and identify leakage points.
- CEI 12 – Investment in R&D Facilities
  Supports research into EEE recycling technologies such as material recovery for PCBs, batteries, and complex plastics, and drives local innovation.

4. Infrastructure and Facilities

- CEI 13 – Upgrade of Landfills
  Landfills may be modernised to include sorting infrastructure that facilitates EEE extraction and segregation.
- CEI 14 – Development of MRF & IWMF
  Dedicated facilities equipped to handle dismantling and resource recovery from EEE streams through automation and specialised processing lines.

5. Market Creation

- CEI 18 – PAYT Scheme for Commercial, Industrial, and Construction Sectors
  Implementation of 'Pay-As-You-Throw' (PAYT) schemes to ensure proper separation and disposal of EEE.
- CEI 19 – Industry-Driven CEPA Programme
  Raises awareness on EEE disposal and repair practices amongst consumers, retailers, and informal collectors through targeted campaigns and workshops.
- CEI 20 – Development of Circular Economy Act
  Will enshrine circularity into law, including rights, responsibilities, and compliance mechanisms for EEE producers, importers, and recyclers.

Appendix 5: Circular Economy Policy Framework for the Manufacturing Sector in Malaysia

MITI has developed the Circular Economy Policy Framework to transition the manufacturing sector – including EEE – towards a sustainable, resource-efficient model. This initiative aligns with national strategies such as the New Industrial Master Plan 2030 (NIMP 2030) and the Twelfth Malaysia Plan (RMK-12).

A cornerstone of the framework is the introduction of an EPR system by 2029. This policy mandates that producers are accountable for the entire life cycle of their products, including end-of-life disposal. The goal is to incentivise sustainable product design and reduce environmental impact.

Increasing the use of recycled, reused, and remanufactured materials in manufacturing is emphasised and targets include quadrupling the circular material use rate from 0.3% in 2019 to 1.2% by 2030. This approach aims to reduce reliance on virgin resources and promote a closed-loop production system.

Manufacturers are encouraged to adopt resource-efficient practices. The framework sets a target to increase the economic output per tonne of raw material by 30% compared to 2019 levels. This involves implementing the best environmental practices and leveraging technological advancements.

The policy promotes the reduction of manufacturing waste at source and the innovative reuse of by-products. This includes redirecting waste materials for use in other manufacturing applications, thereby minimising environmental impact and fostering industrial symbiosis.

Malaysia's move towards a circular economy in the EEE sector is part of a broader green transition strategy. However, challenges such as infrastructure limitations, policy integration, public awareness, and financial constraints need to be addressed to ensure successful implementation.

Appendix 6: Three Key Policy Recommendations Proposed by a Leading E-Waste Recycler as Essential for Improving E-Waste Management in Malaysia

1. Designated collection points with shelters: Establishing specific locations for e-waste collection equipped with shelters is crucial to protect collected materials from environmental elements like rain, ensuring the quality and safety of the waste during storage.
2. Registration and monitoring by local authorities: Local councils, known as Pihak Berkuasa Tempatan, should be responsible for registering and monitoring recycling facilities as well as the vehicles (trucks) used to transport e-waste. This includes ensuring that transport vehicles are licensed and tracked appropriately to prevent illegal dumping and ensure safe handling of hazardous materials. Facilities must also obtain business licences, which require approvals from regulatory bodies such as DOE, Department of Occupational Safety and Health, and the Fire and Rescue Department.
3. Utilisation of the eSWIS Platform: The Electronic Scheduled Waste Information System (eSWIS) is an online portal developed by DOE that allows waste generators and recovery facilities to record and report scheduled waste inventory and consignments. Proper use of eSWIS ensures transparency and compliance with the Environmental Quality (Scheduled Wastes) Regulations 2005. (https://eswis.doe.gov.my/)
4. Regarding regulations, the recycler emphasised that collectors are not permitted to process e-waste. Processing activities must be conducted by licensed facilities that comply with environmental impact assessment requirements, ensuring environmental safety and adherence to legal standards.

Appendix 7: Policy Performance and Enforcement with Environmental and Social Impact

The circular economy focuses on 'repurposing' rather than just recycling needs to be more strongly enforced, as seen in France where this norm has been established for many years, and in countries like Indonesia and Thailand, which have developed similar practices for heavy machinery.

Weaker market norm for EPR in Malaysia: In the Malaysian market, corporations expect to be paid for UEEE. In contrast, market norms in Western countries and Japan typically require corporations to bear the costs of proper UEEE disposal. When corporations from Japan and Western countries operate in Malaysia, they often adopt the local expectation of being paid, which one informant described as an 'attitude' (greed) problem.

Solid Waste and Public Cleansing Management Act 2007 (Act 672): Act 672 centralises waste management under the Solid Waste and Public Cleansing Management Corporation (SWCorp). However, its effectiveness in managing e-waste is constrained by limited infrastructure, low public awareness, and weak enforcement (Commissioner of Law Revision, 2017). Informal e-waste recycling practices expose workers and communities to hazardous substances, leading to health issues. The lack of formal collection systems exacerbates these risks, particularly in low-income areas where informal recycling is prevalent (Todi, 2023).

Circular economy frameworks: Malaysia has introduced frameworks such as the Circular Economy Policy Framework for the Manufacturing Sector (2024) and the National Circular Economy Blueprint for Solid Waste (2025–2035). These aim to promote sustainable practices, including EPR, eco-design, and recycling. However, implementation remains in its early stages, and measurable outcomes have yet to be observed (MITI, 2024; KPKT, 2024).

Potential of energy recovery technologies as an interim solution: A life cycle assessment study by Ismail and Hanafiah (2021) evaluated four e-waste management strategies: landfill disposal, direct incineration with energy recovery, materials recovery without energy recovery and materials recovery with energy recovery. Interestingly, direct incineration with energy recovery showed the best environmental performance amongst the options considered. While this finding is context-specific and may not be generalised across all e-waste types, it highlights the importance of adapting waste management practices to Malaysia's realities and the need for diversified technological solutions beyond conventional recycling and landfill disposal (Ismail and Hanafiah, 2021).

Urgent Regulatory Needs and Emerging Responses

Challenges in e-waste collection and recycling: Significant challenges persist across Asian countries, including Malaysia, in effectively collecting and recycling e-waste, creating a substantial gap between waste generated and waste properly recycled (Baldé et al.,

2017).

Need for stronger regulatory actions: Urgent and effective regulatory actions are essential to safeguard public health and mitigate environmental degradation stemming from e-waste mismanagement (Murthy and Ramakrishna, 2022).

Mandatory e-waste reporting: E-waste reporting under the environmental aspect of sustainability is now compulsory under Malaysia's sustainability reporting guide, reflecting regulatory emphasis on transparency and accountability (Rudyanto and Pirzada, 2021).

Environmental and Social Impact

Health and environmental risks from informal recycling: Informal e-waste recycling practices expose workers and surrounding communities to hazardous substances such as heavy metals (e.g., lead, cadmium, mercury) and persistent organic pollutants (Andeobu, Wibowo, and Grandhi, 2021; Ismail and Hanafiah, 2021). These risks are particularly acute in low-income areas where formal collection systems are lacking, exacerbating health inequalities and environmental degradation (Friends of the Earth Malaysia, 2023).

Environmental degradation through improper disposal: Improper disposal practices, including dumping in unregulated landfills and informal recycling clusters, continue to cause soil, water, and air contamination (Ismail and Hanafiah, 2021). While enforcement actions have recently increased, systemic environmental damage from legacy practices remains significant (DOE, 2025).

Low public participation and awareness: Public participation in formal e-waste recycling remains low, primarily due to limited public awareness campaigns, inadequate access to certified collection facilities, and a general lack of incentives to dispose of e-waste responsibly (KPKT, 2024; Friends of the Earth Malaysia, 2023).

Regulatory enforcement challenges: Regulatory efforts, while formally established under the Environmental Quality (Scheduled Wastes) Regulations 2005 and the Solid Waste and Public Cleansing Management Act 2007 (Act 672), suffer from weak enforcement mechanisms (DOE, 2025).

Absence of mandatory producer responsibility: The absence of a mandatory EPR scheme continues to limit producer accountability for product end-of-life management (KPKT, 2024). This weakens incentives for eco-design, sustainable production, and the development of formalised recycling infrastructures, slowing Malaysia's transition to a circular economy (MITI, 2024).

Appendix 8

Table A-8.1. Key Stakeholder Map

Stakeholder map

Stakeholder	Website	Responsibility
Department of Environment	http://apims.doe.gov.my/	To formulate legislation on safe environmentally safe management of e-waste, guiding on application of environmental standards, approving impact assessment reports related to treatment of e-waste
National Solid Waste Management Department, Ministry of Local Government and Housing	http://jpspn.kpkt.gov.my/	To enact the Solid Waste Management and Public Cleansing Act 2007
E-waste Alam Alliance Programme	http://www.doe.gov.my/household-ewaste/wp-content/uploads/2015/10/Information-for-inclusion-in-the-DOE-Portal.pdf	To provide a sustainable collection and recycling system for e-waste
Informal e-waste Collectors		To participate in door-to-door collection services, scavenging for e-waste from municipal waste
Formal & Informal Recyclers		To recycle e-waste in an environmentally safe manner (formal facilities); to ensure safe and environmentally activities such as dismantling and depollution (Informal recyclers)
Ministry of Environment, Japan		To support capacity-building efforts and studies on transboundary movements of e-waste
Japan International Cooperation Agency (JICA)	http://www.jica.go.jp/malaysia/english/office/others/c8h0vm00001udat-att/newsletter201302.pdf	To support capacity building, technical cooperation and assistance on waste management and material recycling technologies
Civil Society Organisations		To create awareness and advocacy for environmentally sound disposal practices and policies
Multinational Companies and Retailers		To offer voluntary take-back of e-waste and conduct e-waste awareness programmes (eg. Toshiba Malaysia, Senheng Electrical)

Source: Honda, Khetriwal, and Kuehr (2016).

Table A-8.2. E-Waste Management Matrix, Malaysia

Malaysia is in transition from an unregulated informal e-waste management system to a more formalised system within a legal mechanism.

Pillar	Stage	Description
Legal Framework	Medium	Malaysia does not have specific e-waste legislation; however, there are other rules and guidelines under the hazardous waste framework that are applicable for e-waste handling and processing. • Environmental Quality (Scheduled Wastes) Regulation in 2005 under the Environmental Quality Act. The amended regulation categorises E-waste as a scheduled waste SW110. • Guidelines for the Classification of Used Electrical and Electronic Equipment in Malaysia in 2008 (the first edition) and 2010 (the second edition) from the Department of Environment, Malaysia that provide guidance on determining whether used electrical and electronic equipment is E-waste or second-hands goods.
Collection Mechanism	Low	The collection and take-back system in Malaysia is still largely done by itinerant informal collectors and small agents/buyers. Retail drop-off at Senheng occurs under the E-waste Alam Alliance Program. Consumers can request free pick-up of bulky EEE products, such as refrigerators or washing machines.
Processing Infrastructure	Medium	There are two types of formal e-waste facilities: a full recovery facility and a partial recovery facility. Although there is no clear definition to distinguish between the two, a full recovery facility is capable of dismantling of e-waste, crushing and segregating recyclable materials and recovering precious metals by hydrometallurgy. A partial recovery facility is capable of one or some of those operations. There are 138 e-waste recovery facilities with a total capacity to handle 288,000 tonnes/year. Of these, 39 are full recovery facilities, and 98 are the partial recovery facilities as of November 2015.[75] Informal recyclers are also engaged in dismantling and metal recovery operations.
EHS Standards	Low	The Environmental Quality (Prescribed Premises) (Scheduled Waste Treatment Disposal Facilities) Regulation issued in 1989 prescribes the control measures on collection, treatment, recycling and disposal of as well as inventory of the scheduled wastes, including e-waste.

Table 20: E-waste Management Matrix, Malaysia

75 http://www2.epa.gov/sites/production/files/2014-08/documents/malaysia_country_presentation.pdf

Source: Honda, Khetriwal, and Kuehr (2016).

Appendix 9: Investment Opportunities Highlighted by DOE

Figure A-9.1. Major Sources of Foreign Investment



Source: Samuel (2025).

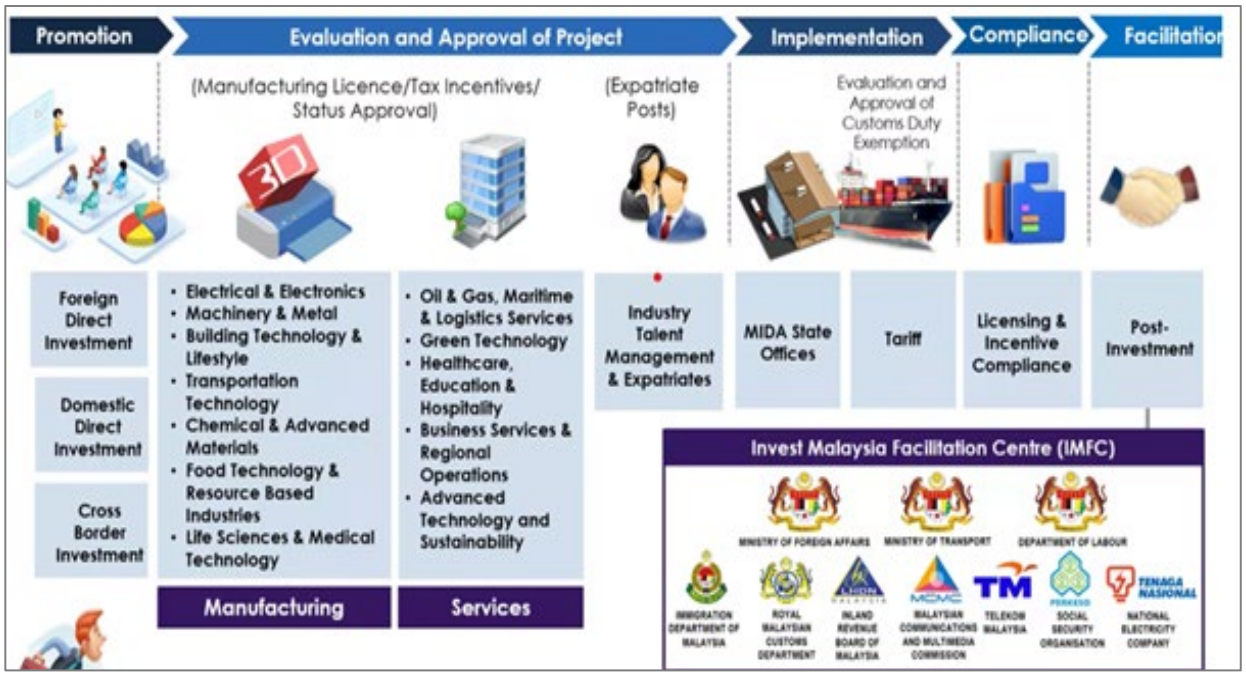
Appendix 10

Figure A-10.1. Malaysian Investment Development Authority (MIDA) Japan Offices: Key Contacts in Tokyo and Osaka



Source: Samuel (2025).

Figure A-10.2. Investor's Journey in Malaysia: MIDA's Organisational Structure and EPR Integration



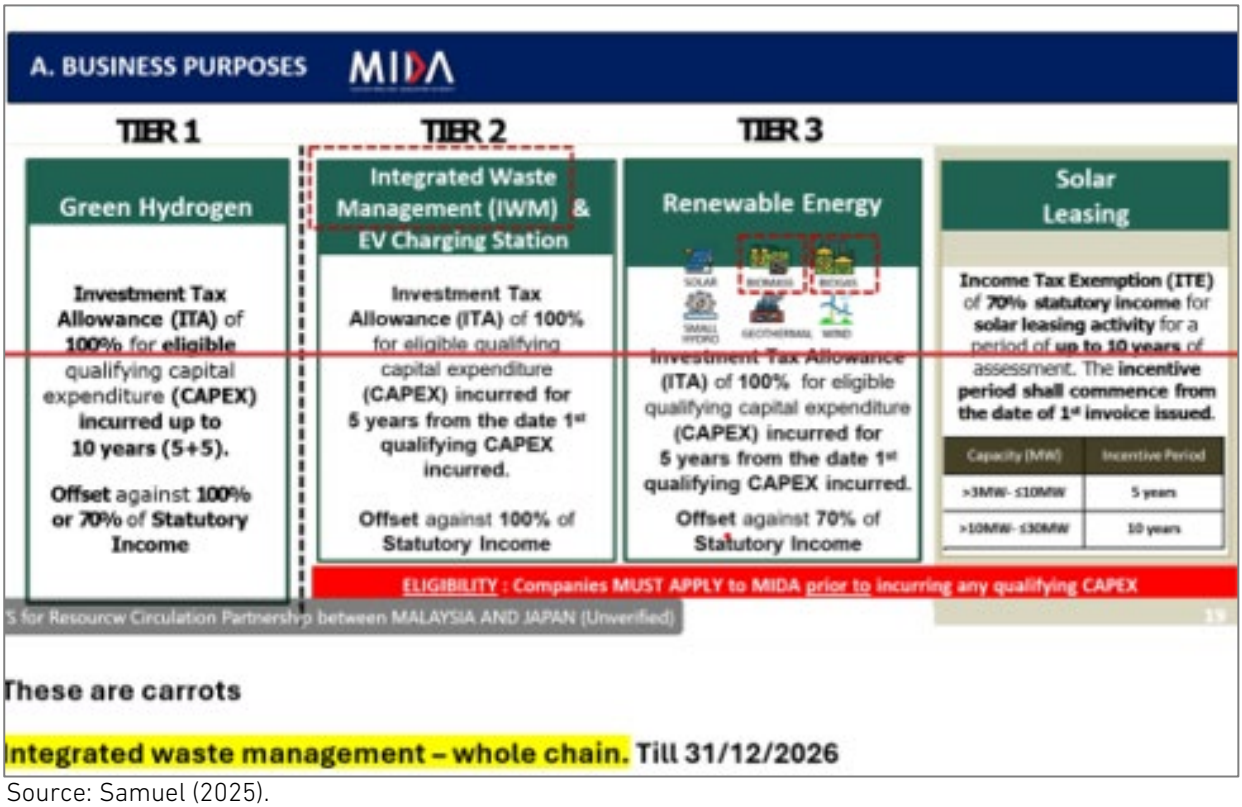
Including EPR to guide what we are supposed to do: the landscape is changing and is now guided by EPR (the responsibility of manufacturers.
Source: Samuel (2025).

Figure A-10.4 Green Investment Opportunities



Source: Samuel (2025).

Figure A-10.5. Green Technology Incentives



Source: Samuel (2025).

Example: Japanese Ministry of Environment, JICA and MNCs to support local capacity including CEPA: JICA is involved in pilot projects to enhance e-waste management practices in Malaysia to improve local capacity for handling e-waste responsibly, including education and awareness campaigns (Alias et al., 2014). Japan plays a significant role in supporting e-waste management in Malaysia through knowledge-sharing, training programmes, and financial aid. Japan's Ministry of Environment has actively funded projects to improve Malaysia's recycling infrastructure and regulatory compliance. Japanese multinational corporations, such as Toshiba Malaysia, contribute to voluntary take-back programmes.

Appendix 12: Record of Field Visits Conducted for this Report

Date and Time	Site/Organisation	Company Type/Description	Key Discussion Points
19 March 2025 12:00 pm–1:00 pm	ERTH https://erth.app/	Recycling of e-waste	The importance of reducing the licensing of incapable recyclers to minimise pollution.
22 April 2025 3:30 pm–4:30 pm	Riiicyle https://www.riiicycle.com/	Recycling of all kinds of waste	The importance of digitalising e-waste recycling for traceability and to ensure complete recycling beyond mere collection
30 April 2025 11:00 am–1:00pm	Rentwise https://www.rentwise.com/	Mainly a remanufacturer of laptops	The importance of remanufacturing to lengthen the life of e-products as much as possible
24 May 2025 2:00 pm–3:00 pm	Research Consultant	Consultant	The importance of developed countries halting the dumping of low-value e-waste into Malaysia
27 May 2025 12:00 pm–1:00 pm	Sheng Heng https://www.senheng.com.my/	Electronic retailer	The importance of returning second-hand e-products and implementing buy-back schemes for circularity
3 June 2025 6:00 pm–7:00 pm	Shan Poornam Metal https://www.shanpoornammetals.com/	Recycling of e-wastes	The importance lies in providing highly capable recyclers with greater access to recyclable materials, given their advanced technologies. This approach would help reduce the licensing or involvement of low-capability recyclers that

Date and Time	Site/Organisation	Company Type/Description	Key Discussion Points
			extract materials without green technologies in place, thereby preventing pollution from inefficient or non-sustainable recycling practices.
25 August 2025 9:00 am– 1:00 pm	Shan Poornam Metal https://www.shanpoornammetals.com/	Recycling of e-waste	Further discussions based on the draft report and site visit to recycling facilities
25 August 2025 2:00 pm– 3:00 pm	ESCATEC Electronics https://www.escatec.com	Original design manufacturer and service provider that extends the lifespan of electronic equipment	The importance of life-extension services for electronic equipment and design for recycling and remanufacturing
26 August 2025 2:00 pm– 4:00 pm	Rentwise https://www.rentwise.com/	Mainly a remanufacturer of laptops	Further discussions based on the draft report and site visit to remanufacturing processes

Source: Authors

Stakeholder Dialogue on Circular Economy and E-Waste Management

Date: Wednesday, 27 August 2025
Time: 9:30 am–2:00 pm
Venue: Level 12, Meeting Room, Sunway Business School, Sunway University, Selangor, Malaysia

Background

This stakeholder workshop formed part of the **Research on Sound International Resource Circulation in the ASEAN Region**, an ongoing initiative led by the **Economic Research Institute for ASEAN and East Asia (ERIA)**. Established in Jakarta in 2008 through the agreement of 16 East Asia Summit member countries (including Malaysia), ERIA conducts policy-relevant research to support economic integration and sustainable development across the region.

As part of ERIA's regional study on **Waste from Electrical and Electronic Equipment (WEEE)** and material circularity in ASEAN, **Sunway Business School** is leading the Malaysian research component. Activities include data analysis on Malaysia's e-waste and e-scrap trade dynamics, aimed at contributing to **evidence-based policymaking** and promoting **sound international resource circulation**.

The workshop served to validate draft research findings and foster collaborative discussion amongst key government agencies, industry representatives, and other stakeholders.

Workshop Agenda

- **9:30 am** – Arrival of Stakeholders
- **10:00 am** – Opening and Welcome Remarks by ERIA (Mr. Kawamura)
- **10:10 am** – Objectives of the E-Waste Research Project by ERIA (Mr. Iwasaki)
- **10:20 am** – Overview of the E-Waste Report by Sunway University (Prof. Fujimoto)
- **10:40 am** – Stakeholder Discussion (5-minute self-introduction by each participant)
- **12:00 pm** – Networking Lunch
- **2:00 pm** – Program End

Summary of Dialogue

Key Concerns: Role of the Informal/Illegal Sector

Non-government stakeholders (recyclers and manufacturers) identified the **illegal sector** in e-waste trade and domestic management as the most pressing challenge. This sector perpetuates environmentally harmful practices affecting air, land, and marine systems.

DOE's Position

DOE emphasised the need to separate **formal and informal/illegal activities**. However, participants argued that this separation is unrealistic due to:

1. The extensive presence of illegal e-traders and collectors, which undermines the cost competitiveness of licensed recyclers and sustains the illegal market.
2. The need for **market redesign** that recognises the role of the informal sector and seeks pathways to **formalise** it within e-waste governance.

Clarity on Governance

Participants stressed the importance of **clearer direction from NRES and DOE** on current and future strategies to address these challenges. It was suggested that **Japan's experience** could provide valuable guidance on creating such clarity.

Additional Concern: Licensing

Concerns were also raised regarding the **excessive number of licensed recyclers**, which has led to oversupply relative to available e-waste. This issue appears linked to **lenient licensing criteria**, pointing to the need for stricter standards to ensure sustainability and operational efficiency.

Meeting on Circular Economy and E-Waste Management in the Office of the Ministry of Natural Resources and Environmental Sustainability (NRES)

Date: Wednesday, 28 August 2025
Time: 2:00 pm–4:00 pm
Venue: Blok F11, Kompleks F Presint 1 Pusat Pentadbiran Kerajaan Persekutuan, 62000, Wilayah Persekutuan Putrajaya

Meeting Agenda

- Introduction of ERIA by Mr. Kawamura
- Presentation of ERIA's findings by Prof. Fujimoto
- Feedback and revision by NRES

Summary of Dialogue

Key concerns: Government stance and UEEE management

(1) The paper should be revised to avoid any misinterpretation that the Malaysian government welcomes e-waste. Prof. Fujimoto has made revisions to eliminate any potentially misleading sentences.

(2) NRES made it clear that no e-waste is permitted in Malaysia. Accordingly, the policy recommendations have been articulated to emphasise that forwarding agents in Japan or host countries should be severely punished for exporting e-waste to Malaysia as a criminal offence. Additionally, the management of UEEE should be addressed through company-to-company arrangements between Malaysia and Japan.

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Chapter 4

Philippines

1 Situational Analysis on the International Material Flow Relevant to the EEE Between the Philippines and Japan

1.1 Overview

The global volume of e-waste has surged, nearly doubling in the last decade. It is possible that a significant amount of e-waste generated globally is linked to transboundary shipments of used electrical and electronic equipment (UEEE). The Philippines received 19.4 kilotonnes (kT) of UEEE from Japan between 2012 and 2024, with screens and monitors being the most prevalent imports. The flow of these materials is subject to international agreements like the Basel Convention and domestic laws such as the Toxic Substances and Hazardous and Nuclear Wastes Control Act of 1990.[1] Despite this, inconsistencies in customs declarations and the import process in special economic zones pose challenges for effective regulation.

Although the volume of large electrical and electronic equipment (EEE) imports has dropped sharply since 2016, a trend confirmed by observations of closed 'surplus' shops, several issues continue to complicate trade. These include some cases of likely intentional misdeclaration of goods, although most involved municipal waste from other countries classified as plastic scrap. The current regulatory framework struggles to monitor all shipments, particularly those entering through private ports or as small, less-than-container-load packages. Therefore, establishing more definitive criteria for classifying used goods and strengthening oversight is essential to prevent the country from becoming a dumping ground for items approaching end-of-life, not just for EEE, but for other goods that continue to enter the Philippine market, such as used vehicles.

1.2 Identification of EEE-relevant materials for analysis

Global e-waste generation reached 65,000 kT in 2022, nearly doubling from 2010, according to estimates from The Global E-waste Monitor (ITU et al., 2024). The Philippines contributed an estimated 537 kT of this total, with an estimated e-waste generation of 4.7 kg per capita.

The transboundary movement of UEEE is also a significant concern, with Japan identified as the top source. A detailed analysis conducted by the authors for this report based on Bureau of Customs (BOC) importation records from 2012 to 2024 revealed that 19.4 kT of used EEE were imported from Japan. The most common imported items were screens and monitors, followed by small household tools and appliances.

[1] Republic Act (RA) 6969. https://emb.gov.ph/wp-content/uploads/2015/12/RA-6969.pdf

A) Existing research articles on e-waste generation and transboundary movement

According to the *Global E-Waste Monitor* published by UNITAR, in 2022, 65,000 kT of e-waste was generated globally, nearly double the estimated 34,000 kT in 2010 (Baldé et al., 2024).

For the Philippines, the UNITAR report pegged e-waste generated for that year at 537 kT, or 4.7 kg per capita in 2022. The country ranked third in Southeast Asia, though ranking is still relatively low compared to other countries in the rest of Asia, the top five of which generate at least 19 kg per capita. A closer look at the data sets provided as Annex 2 of the UNITAR 2024 report, however, did not indicate any local source for country statistics. Thus, the estimated 4.7 kg per capita likely comes from calculations using the put-on-market values of EEE, based on the procedure detailed in Annex 1 of the UNITAR report.

Under a previous study for the Economic Research Institute for ASEAN and East Asia (ERIA), Environweave compiled the results of municipal waste analysis and characterisation studies (WACS) submitted by local government units as part of their solid waste management plans, as required by law (Environweave Integrative Environmental Research, 2023). All WACS results provide a municipal waste composition based on four categories outlined by the Ecological Solid Waste Management Act, namely, biodegradable waste, recyclables, residual waste, and special waste (e.g., hazardous waste, bulky waste, including e-waste). Based on results from 551 cities and municipalities all over the country, each Filipino generated an estimated 5.8 kg per capita of special waste in the year 2022. Considering that this is not just specific to e-waste but also includes other types of waste considered hazardous or needing specialised disposal, this may be considered close to the calculated estimate by UNITAR.

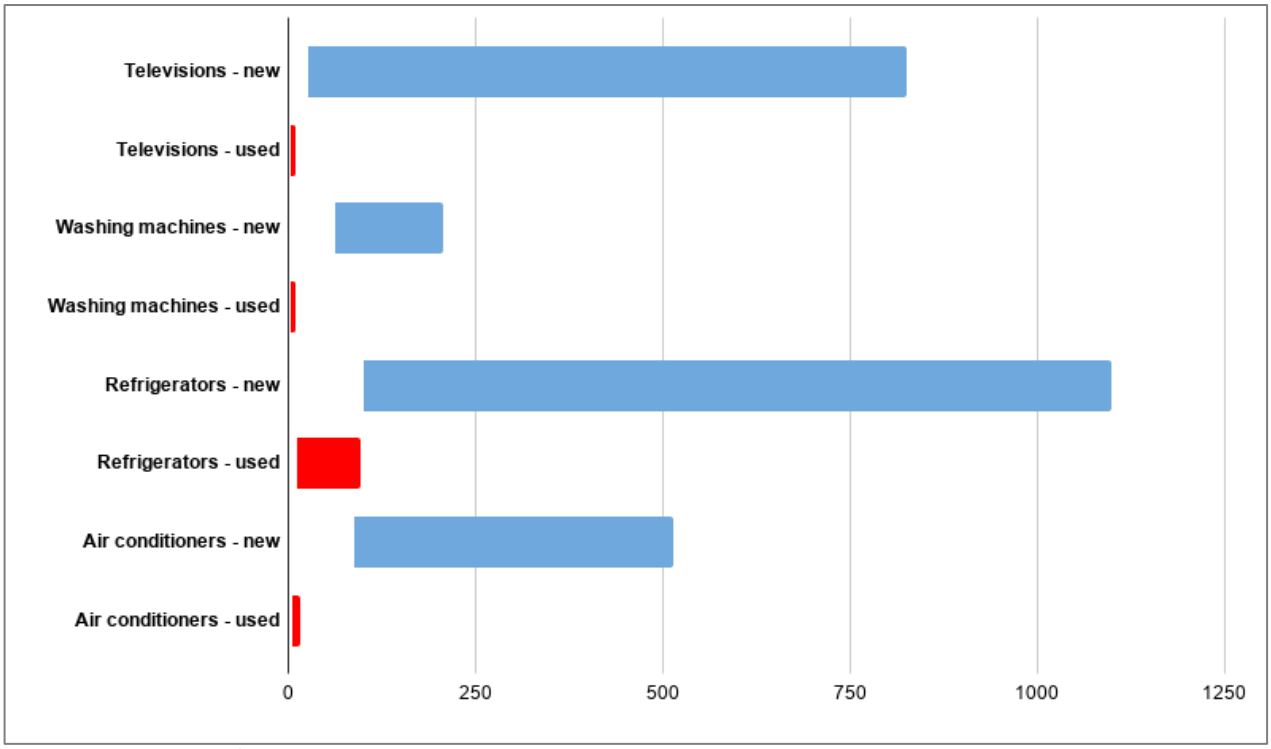
Academic publications also look into estimating amounts of waste generated from various types of EEE in the Philippines. A study by Peralta and Fontanos (2006) focused on common Philippine household appliances such as televisions, washing machines, refrigerators, air conditioners, and radios. Using domestic sales data from 1985 to 2003, they estimated the volume of e-waste generated 10 years after sale, corresponding to the expected end-of-life or obsolescence of the appliances. Based on this study, from 1995 until 2010, an estimated 23 million units of household appliances would be landfilled. Another study by the Institution for Global Environmental Strategies focused on the obsolescence rate of household appliances and gadgets in Cebu City resulted in about 33 kg per capita worth of EEE becoming obsolete in 2013 (Premakumara, 2016). Using the Peralta and Fontanos (2006) estimates that 15% of EEE would be landfilled at the year of obsolescence gives a national projection of about 501 kT of e-waste landfilled for 2013. As for mobile phones, a 2018 study found that average phone ownership in the Philippines was 1.2 units per capita and, using artificial neural network computations, projected that nearly 25 million mobile phones would become e-waste by 2021 (Galang and Ballesteros, 2018). While electronic purchases generally decreased during the first year of the pandemic, there was still a projected increase in mobile phone e-waste due to the shift to online learning and telework (Sioco et al., 2025).

Aside from domestic e-waste generation, transboundary movement of potential e-waste is also of concern, particularly the importation of UEEE. One of the earliest studies looking into

this was commissioned by the Ministry of Economy, Trade and Industry, Government of Japan, and conducted in 2006 by SAGIP Environment, analysing importation data from 2002 to 2006 for specific household appliances such as televisions, refrigerators, washing machines, and air conditioners (Cardenas et al., 2006). This methodology employed text filter analysis of shipments that were described as 'used', but limited the data extraction to the Harmonized System (HS) Codes that corresponded to household EEE of interest.

A subsequent study conducted in 2006 for the National Institute for Environmental Studies (NIES) employed a different strategy to identify shipments that were likely 'used' (Cardenas et al., 2007). Instead of referring to the description of each shipment based on its bill of lading, the study adopted threshold values employed by the Foreign Trade Statistics Section of the then National Statistics Office (now the Philippine Statistics Authority) to determine if shipments are to be considered as new EEE, second-hand EEE, or parts of EEE. These threshold values are based on the freight on board value per unit or per kilogram, in which entries below these values are considered second-hand items or lumped up with parts and accessories of the appropriate EEE (see Figure 4.1). Under this study, an estimated 66 kT of used televisions were imported into the Philippines collectively from 2001 to 2005, as well as 14.9 kT of refrigerators, 17.1 kT of air conditioners, 15.9 kT of washing machines, and 2.3 kT of personal computers (Cardenas, 2007).

Figure 4.1. Threshold Values to Determine Used vs New EEE (2007)



Price per unit (US$ per unit)
Note: Threshold values used by the Foreign Trade Statistics Section, National Statistics Office.
Source: Graph based on data from Cardenas (2007).

B) International and domestic policies covering waste electrical and electronic equipment

In the Philippines, waste electrical and electronic equipment (WEEE) is governed by RA 6969, or the Toxic Substances and Hazardous and Nuclear Wastes Control Act of 1990. While e-waste was not initially listed as a hazardous waste category in the Implementing Rules and Regulations released by the Department of Environment and Natural Resources (DENR) in 1992[2] as well as the first version of its procedural manual released in 2004[3], the latest version of the manual issued in 2013 specifies WEEE under Hazardous Waste Code M506.[4] Under this classification, WEEE is defined as 'all waste electrical and electronic equipment that contain hazardous components such as lead, cadmium, mercury, hexavalent chromium, polybrominated biphenyls (PBBs), and polybrominated diphenyl ethers (PBDEs) including their peripherals, i.e., ink cartridges, toners, etc.' Furthermore, under category M507 (special wastes) that cover household-generated waste, consumer electronics and white goods (i.e., refrigerators, washing machines, air conditioners, etc.) are also considered hazardous. However, given the diversity of electrical appliances and electronic gadgets, the current classification system is undergoing revision to now include 12 subcategories of WEEE under M506, and a subcategory for household special waste specific to WEEE under M507.

RA 6969 was enacted shortly after the adoption of the Basel Convention on the Control of Transboundary Movements of Hazardous Wastes and their Disposal on 22 March 1989 (Secretariat of BRSC, n.d.-a). The Philippines is a party to the convention, having ratified it in October 1993, with DENR designated as the focal agency for its implementation. With the Basel Ban Amendment entering into force in December 2019, the transboundary movement of hazardous waste to states not included in Annex VII[5] is now prohibited even if it is destined for reuse, recycling, or recovery (Secretariat of BRSC, n.d.-b). The Ban Amendment is still undergoing the steps towards ratification by the Philippine Congress, although DENR has expressed strong support for it (DENR, 2022). As there are locally registered treatment, storage, and disposal (TSD) facilities licensed by the DENR Environmental Management Bureau (DENR-EMB) that accept hazardous materials generated not only domestically but also from abroad, an economic impact assessment involving TSD facilities and recyclers is currently under way. There are 138 registered facilities that are also licensed importers of hazardous materials, including 68 that process electronic assemblies and scrap. In 2024, these registered recyclers collectively imported 8,524 tonnes of electronic assemblies, scrap, or used EEE. This amount comprises only 0.8% of the total amount of hazardous materials that entered the Philippines in 2024 through importation clearances obtained from DENR-EMB (Environmental Management Bureau, 2025. Sheet 1 (Annex 1) provides further

[2] Implementing Rules and Regulations of Republic Act 6969. Department Administrative Order No. 1992-29. https://emb.gov.ph/wp-content/uploads/2015/12/DAO-1992-29.pdf#page=13.35

[3] Procedural Manual of Hazardous Waste Management. Department Administrative Order No. 2004-36. https://emb.gov.ph/wp-content/uploads/2016/06/dao20041.pdf#page=9.00

[4] Revised Procedures and Standards for the Management of Hazardous Wastes (Revising DAO 2004-36). Department Administrative Order No. 2013-22. https://emb.gov.ph/wp-content/uploads/2025/02/DAO-2013-22-Procedures-and-Standards-for-Hazwaste-1.pdf

[5] Annex VII of the Basel Convention lists Parties and other States that are members of the Organisation for Economic Co-operation and Development, the European Commission, or Liechtenstein

information.

Meanwhile, the Philippines, as a party to the Basel Convention, is bound by the amendments covering e-waste, which have been in effect since 1 January 2025. These e-waste Amendment expands the list of materials subject to the prior informed consent (PIC) procedure to include all electronic and electrical waste (Basel Convention, n.d.). The technical guidelines under the convention, Report No. UNEP/CHW.16/INF/10/Rev.1), distinguish between equipment and e-waste as follows (Secretariat of the Basel Convention, 2023):

- 'Equipment is electrical and electronic equipment that is dependent on electric currents or electromagnetic fields in order to work properly, including components that can be removed from equipment and can be tested for functionality, and either be subsequently directly reused or reused after repair or refurbishment';
- Waste electrical and electronic equipment is waste, including all components, sub-assemblies and consumables that are part of the equipment at the time the equipment becomes waste'.

The technical guidelines also discuss the transboundary movement of used equipment and whether such equipment should be considered e-waste. In this respect, parties can determine their evaluation criteria by considering the possible fate of these items, for example:

- whether the used equipment is intended for direct reuse or extended use for its original intended purpose;
- whether such direct reuse or extended use will be undertaken by the original owner;
- whether the equipment is intended for failure analysis; and
- whether the equipment is intended for repair or refurbishment.

The definition used in the *Global E-Waste Monitor* published by UNITAR is adopted from a white paper published by the United Nations University (StEP Initiative, 2014; ITU et al., 2024). EEE becomes e-waste once it has been discarded by its owner as waste without the intent of reuse.

In the Philippines, under the current Hazardous Waste Procedural Manual (DAO 2013-22), electronic assemblies and scrap are not explicitly listed. However, DENR-EMB and other government agencies consider them hazardous waste subject to permitting procedures and regulatory requirements for proper collection, transportation, treatment, and final disposal.

Furthermore, while the Philippines has enacted Republic Act (RA) 11898, or the Extended Producer Responsibility Act of 2022, this only currently covers provisions for recovery targets for plastic packaging[6] and does not yet include any extended producer responsibility (EPR) system or take-back scheme for household EEE. An upcoming department administrative order entitled 'Environmentally Sound Management of Waste EEE' is being finalised to provide a general framework for an EPR system to address this issue.[7]

[6] Extended Producer Responsibility on Plastic Packaging Waste. RA 11898. ttps://legacy.senate.gov.ph/republic_acts/ra%2011898.pdf

[7] ERIA interview with DENR-EMB Hazardous Waste Management Section for this report.

As for UEEE, there is no explicit definition if this is considered e-waste under the current DAO 2013-22 nor in its draft amendment. The text of the policy includes a section on definition of terms, but no specific one is given for 'waste', and at what point a certain item is considered as such. For instance, mobile phones that leave the possession of the original owner may be swapped or traded in for an upgraded version at small gadget shops, with the possibility that these will be bought by another customer for intended continued use as a mobile phone. In the case of broken bulky white goods such as refrigerators, owners will likely purchase an immediate replacement even though the unit may still be repairable. Filipino households would often just store this broken appliance at home, pass on the task of having it repaired to a member of their extended family or their household staff, allow the appliance delivery crew to pull it out and use/repair/dispose of it, or sell it to ambulant waste pickers that will likely dismantle it through informal methods to recover metals or plastics that can still be sold to junk shops.[8]

From 2016 until the present, only three bills have been filed related specifically to e-waste management (see Table 4.1), although at least 12 other bills address the importation of various types of waste into the country. No e-waste-related bills have been filed in the current 20th Congress covering the period July 2025 until June 2028.

Table 4.1. Bills Related to E-Waste, 2016–present

Congress and Bill Number	Short/Long Title	Principal Author(s)	Date Filed	Legislative Status
17th Congress, House Bill 5901	An Act Promoting the Environmentally Sound Management of E-Waste In the Philippines, and for Other Purposes	De Jesus, Emmia, et al.	21 June 2017	Approved by the committee, Transmitted to the Appropriations and Ways and Means committees
18th Congress, House Bill 7876	An Act Establishing an Electronics Donation and Recycling Program to Provide Additional Resources for Public School Students, Address the Demands of the Modern Society and to Promote Effective Electronic Waste Management	Cuaresma, Luisa Lloren	14 October 2020	Pending with the Committee on Basic Education and Culture since 15 October 2020
19th Congress, Senate Bill 751	E-Waste Management Act	Tolentino, Francis 'Tol' N.	18 July 2022	Pending in the Committee on Environment, Natural Resources and Climate Change

Sources: House of Representatives (n.d.), Senate of the Philippines (n.d.).

[8] Environweave field interviews on e-waste, 2012–2025.

C) International trade statistics for e-scrap and used EEE

DENR-EMB maintains an online permitting and monitoring system for hazardous waste. This includes data related to the application of importation clearances of 'electronic assemblies and scrap', either as WEEE for recycling activities, or as UEEE for local trade. Figure 4.2 shows the annual amounts of EEE-related materials for recycling or retail from 2016 until 2024, totaling 71.3 kT of waste EEE and 39.4 kT of UEEE that were imported with proper permits over the past 9 years[9]. The details of these figures are available on Sheet 2 of Annex 1. This number reflects the shipments that were legally imported into the Philippines, following proper Basel procedures.

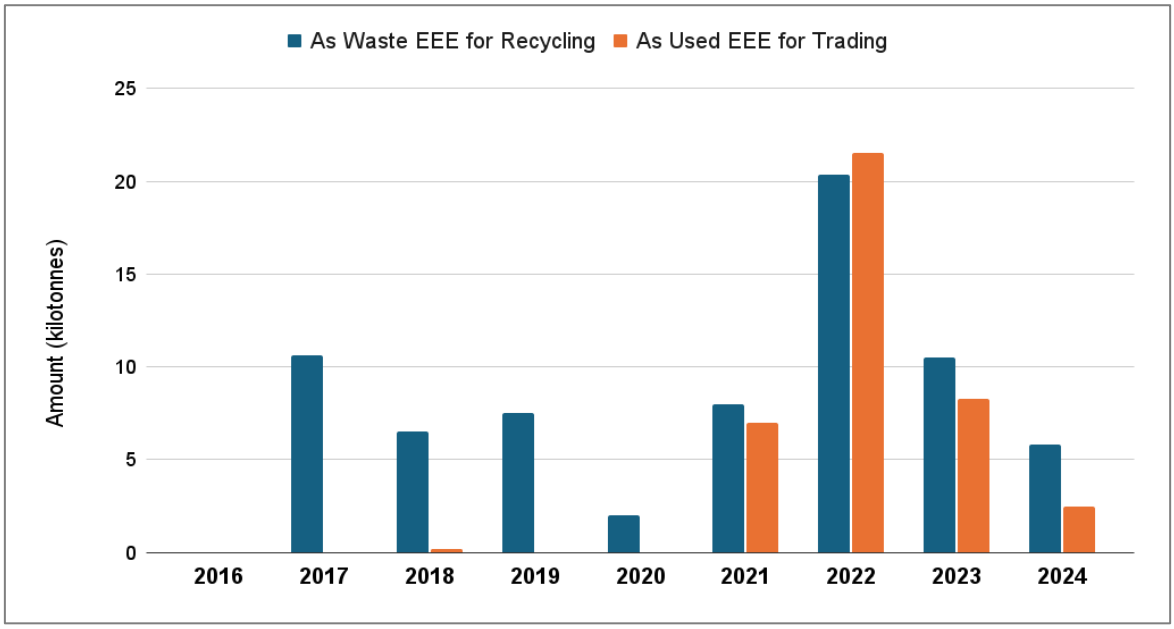
Based on DENR-EMB HWMS 2024 data, Japan is the top recipient of hazardous waste, receiving more than 10,319 tonnes through 15 instances of shipments. These may include e-scrap and mercury-containing crushed lamps (EMB, 2025). WEEE-specific data on export clearances for 2023 provided by DENR-EMB showed that of the total 13,346 tonnes of WEEE, 47% of shipments were sent to the Republic of Korea (henceforth Korea) for further processing, with Japan a close second at 42.6%. Two other countries received WEEE shipments from the Philippines in that year, namely, Singapore and Belgium (see Figure 4.3, with details provided in Sheet 3 of Annex 1).

Until recently, the transboundary movement of e-scrap has been difficult to monitor since it does not have its own HS code that is required for import and export procedures. In the seventh edition of the HS (HS 2022) nomenclature, a dedicated code for electrical and electronic waste (HS Code 85.49) was introduced, taking effect on 1 January 2022.

Entry of shipments with the HS Code 85.49 started to be reflected in Philippine importation data in September 2022. Figure 4.4 shows the amount of these shipments by country of origin until the end of July 2025, covering 34 months. Note that e-scrap shipments originate not just from neighbouring Asian countries but also from North and South America, Europe, and Africa, with the largest volume of e-scrap at 434 kg coming from Great Britain that arrived as one shipment in Q4 of 2023. That same quarter records the highest volume of shipments (627 kg) tagged under HS Code 85.49 until present. Figure 4.5 provides the total amount per quarter. The details of these figures are available on Sheet 4 of Annex 1.

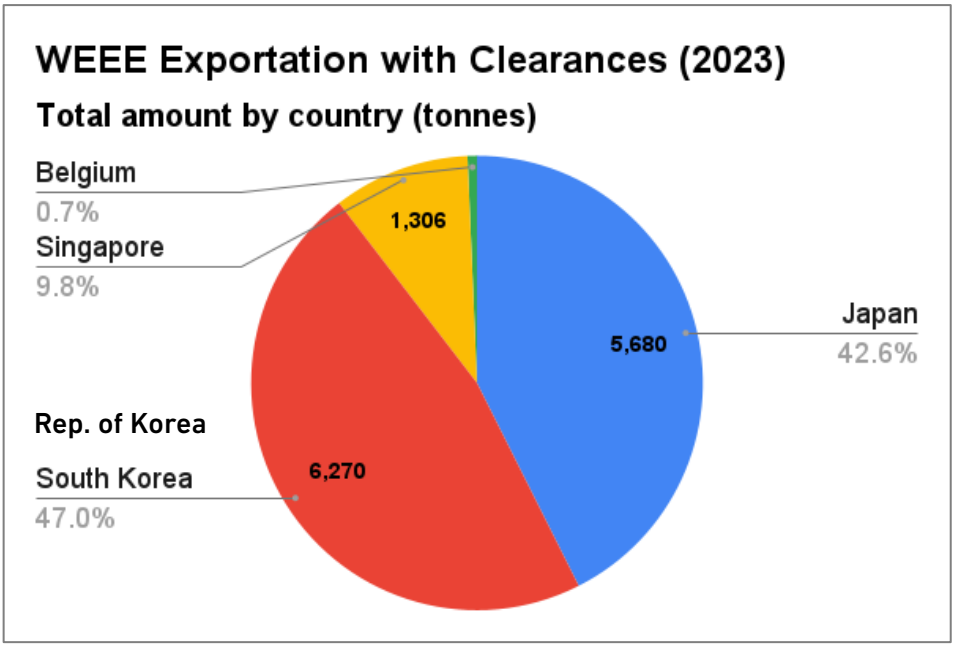
[9] Data provided upon request by DENR Environmental Management Bureau Hazardous Waste Management Section, October 2025.

Figure 4.2. Importation of Electrical and Electronic Assemblies, E-Scrap, and UEEE into the Philippines Covered by Import Clearances (2016–2024)



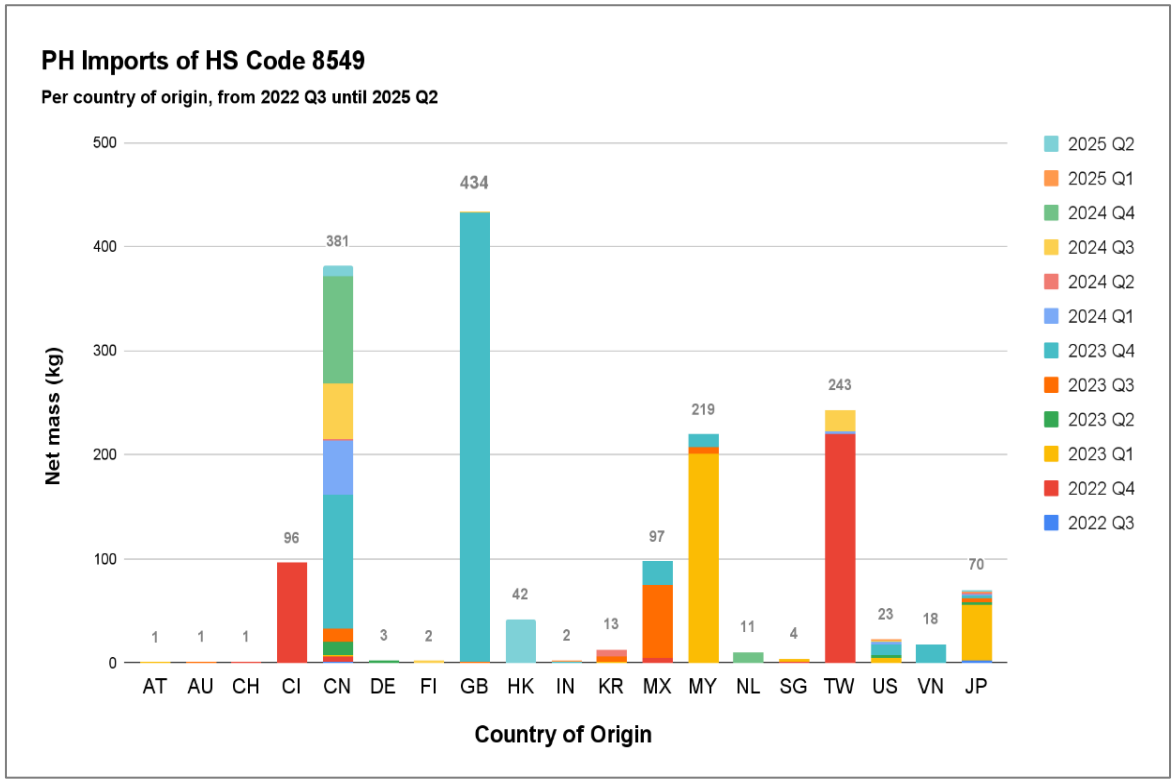
Note: Based on data provided by the DENR-EMB Hazardous Waste Management Section for this report.
Source: All data presented are sourced from the Online Permitting and Monitoring.
System (OPMS), an online platform of the Environmental Management Bureau (EMB). For hazardous waste management, OPMS serves as the centralised system for importer registration, importation clearance applications, and tracking the actual importation of recyclable materials containing hazardous substances. However, the 2019 data were sourced manually rather than extracted from the OPMS. Graph produced by Environweave for this report.

Figure 4.3. Exportation of Electrical and Electronic Assemblies, E-Scrap, and UEEE from the Philippines Covered by Export Clearances (2023)



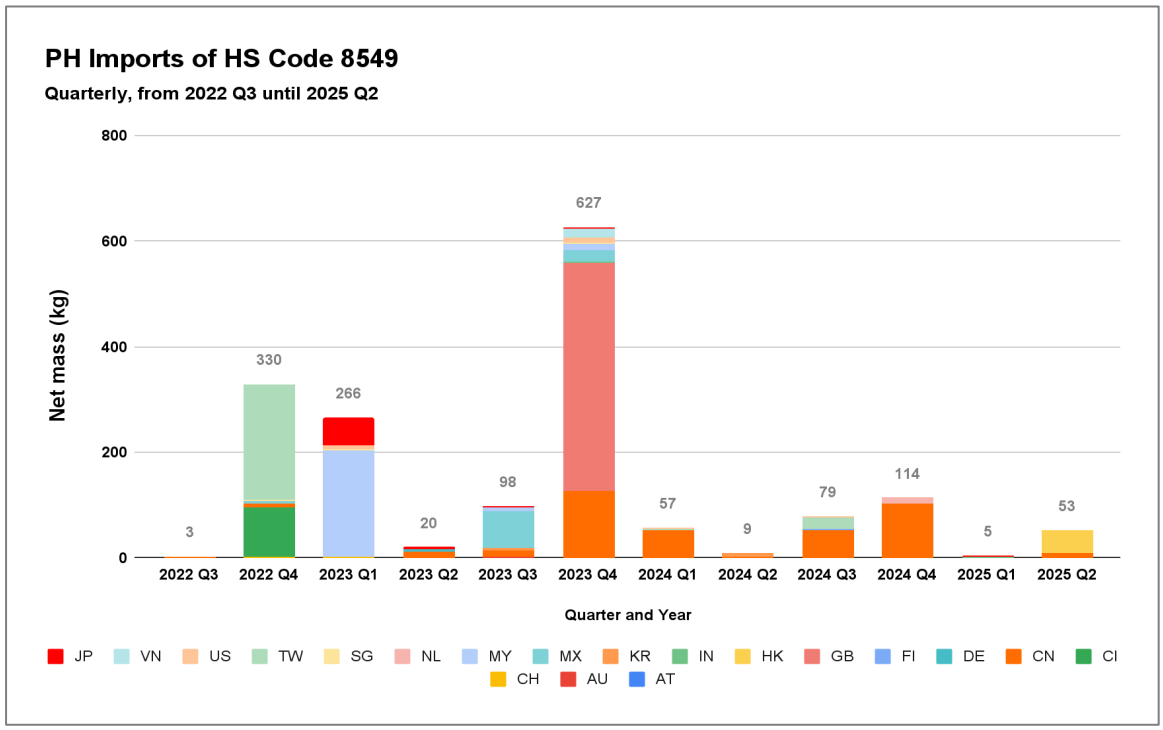
Note: Based on data provided by the DENR-EMB Hazardous Waste Management Section for the Sustainable E-Waste Management and Recycling bilateral project between DENR and the Ministry of the Environment, Japan (MOEJ).
Source: Graph produced by Environweave for this report.

Figure 4.4. Importation of Electrical and Electronic Waste and Scrap (HS 8549) into the Philippines by Country of Origin



Source: Based on BOC importation data (2022–June 2025), data processing and graph by Environweave for this report.

Figure 4.5. Importation of Electrical and Electronic Waste and Scrap (HS 8549) into the Philippines by Quarter (Q3 2022–Q2 2025)



Source: Based on BOC importation data (2022–June 2025); data processing and graph by Environweave for this report.

D) Estimating UEEE importation

The bigger challenge is how to categorise and monitor other freight that are described as 'used', and other related terms such as 'scrap', 'second hand', or 'surplus'. In general, HS codes can distinguish whole items vs. parts for these items, but not to distinguish between new vs. used goods. Thus, these do not automatically reflect in trade statistics processed based on HS codes but rather require a deeper big data analysis looking at the 'goods description' entry in the bill of lading document and can be found as a separate column in the spreadsheet files of importation data.

For the Philippines, monthly importation data from 2021 to July 2025 can be accessed from the BOC website. Older data until 2012 is made available through an open-access data set developed by Abante (2020).

The importation data spreadsheets each contain the following information:

- HS code up to 10 digits
- Country of origin and country of export
- Gross mass and net mass in kilograms
- Information related to computing the duties and customs to be paid for the freight
- Description of the goods.

Other information, such as importer and exporter details, is redacted due to provisions of RA 10173, or the Data Privacy Act of 2012.[10]

Each file contains at least half a million records of shipments covering either a 1-month period (for 2014 until the present) or a 3-month period (for 2012 and 2013). Environweave processed a total of 128 spreadsheet files equivalent to at least 78 million records.

In determining shipments that are likely used goods, text filters were employed to tag entries under the 'goods description' column as shipments of interest:

- contains the text 'secondhand' or 'second hand'
- contains the text 'scrap' or 'surplus'
- contains the text '(used)', e.g., entries that are formatted as 'TV (used)'
- text that starts with 'used', e.g., entries that are formatted as 'used TV'

The last two conditions reduce erroneous tagging for entries that contain the word 'used' but in the context of describing its function, e.g., 'Instruments and appliances used in medical, surgical, dental, or veterinary sciences'.

Through this text filter method, each file contains around 10,000–15,000 records that are tagged as used/second-hand/scrap/surplus, or about 2% of the shipment incidents in a month. For each month, analysis was done at the HS chapter level (2-digits), the heading level (4-digits), and the subheading level (6-digits). Relevant records were compiled into a base

[10] RA 10173. Data Privacy Act of 2012. https://privacy.gov.ph/data-privacy-act/

table and analysed at varying levels of detail:

- Level 1A: annual total net mass of used goods per HS chapter (2 digits);
- Level 1B: annual total net mass of used goods per country of origin;
- Level 2: all used goods from Japan, annual total net mass per HS chapter (2 digits);
- Level 3: all used goods from Japan, annual total net mass per HS Heading (4 digits);
- Level 4: using results from Level 3, isolating all used EEE from Japan identified based on HS headings that would fall under the six major EEE categories.
- Level 5: further analysis of used EEE shipments from Japan at the HS subheading level (6 digits), for more accurate matching to UNU-KEYS categories and their final placement under the six major EEE categories.

When necessary, some analysis was also conducted at the HS section level, which is a broader category under which several HS chapters fall under. In particular, HS Section 16 covers Chapter 84 (nuclear reactors, boilers, machinery, and medical appliances; parts thereof) and Chapter 85 (electrical machinery and equipment and parts thereof; sound recorders and reproducers, television image and sound records and reproducers, and parts and accessories of such articles).

To make the processing of the large amount of data manageable, the first level of analysis (Level 1A) is done according to the types of used goods grouped by HS chapter, denoted by the first two digits of the HS code. Figure 4.6 shows the amount of used goods that entered the Philippines over the past 13 years, totaling 6,116 kT, with an annual average of 470 kT. Before the pandemic, the highest total mass was in 2017 at 600 kT. However, this level was exceeded in 2024, when the total mass reached 647 kt. There was also a shift in the dominant goods type through the years: up until 2022, used goods shipments under HS Chapter 87 (road vehicles) are the dominant type. However, for the past 2 years, used goods under HS Chapter 72 (iron and steel) have ranked first. This may be reflective of the Philippine national government policy towards cleaner road vehicles, including the modernisation of public transport vehicles, some of which were imported as second-hand vehicles, such as buses, or containing second-hand diesel engines, such as jeepneys. The author further surmises that the increased importation of scrap iron and steel may be intended to increase local steel production during the construction of several railway and metro lines; however, this requires verification through further research.

Figure 4.7 shows the dominant types of used goods that entered the Philippines in the 13-year period, based on weight. Overall, used goods under HS Chapter 87 (road vehicles) have the highest total mass at 2,109 kT (34.4%). When HS Chapter 89 (vessels) is included, used shipments related to transportation account for more than 42% of used goods by weight. This is expected, given that these goods are inherently heavy and bulky. Meanwhile, HS Chapter 72 (iron and steel) and 73 (iron and steel products) comprise nearly 15% of the total mass of shipments. Details are available in Sheet 5 of Annex 1.

In terms of goods that may be considered UEEE, these would generally fall under HS Section 16, which covers Chapter 84 (machinery and mechanical appliances; their parts, etc.), and Chapter 85 (electrical machinery and equipment, their parts and accessories, etc.). HS Chapter 84 ranked third in terms of total mass (829 kT). However, it should be noted that this also includes heavy construction equipment such as bulldozers and cranes that are not considered EEE. As for HS Chapter 85, electrical machinery and equipment rank seventh in terms of total mass at 192 kT over the 13-year period. Furthermore, some EEE of interest listed in the UNU-KEYS master list are also found in HS Section 18 (optical, medical, musical instruments, etc.) and HS Section 20 (other manufactured products). These items such as game consoles, toys, and medical equipment are also included in the top 25 types of goods.

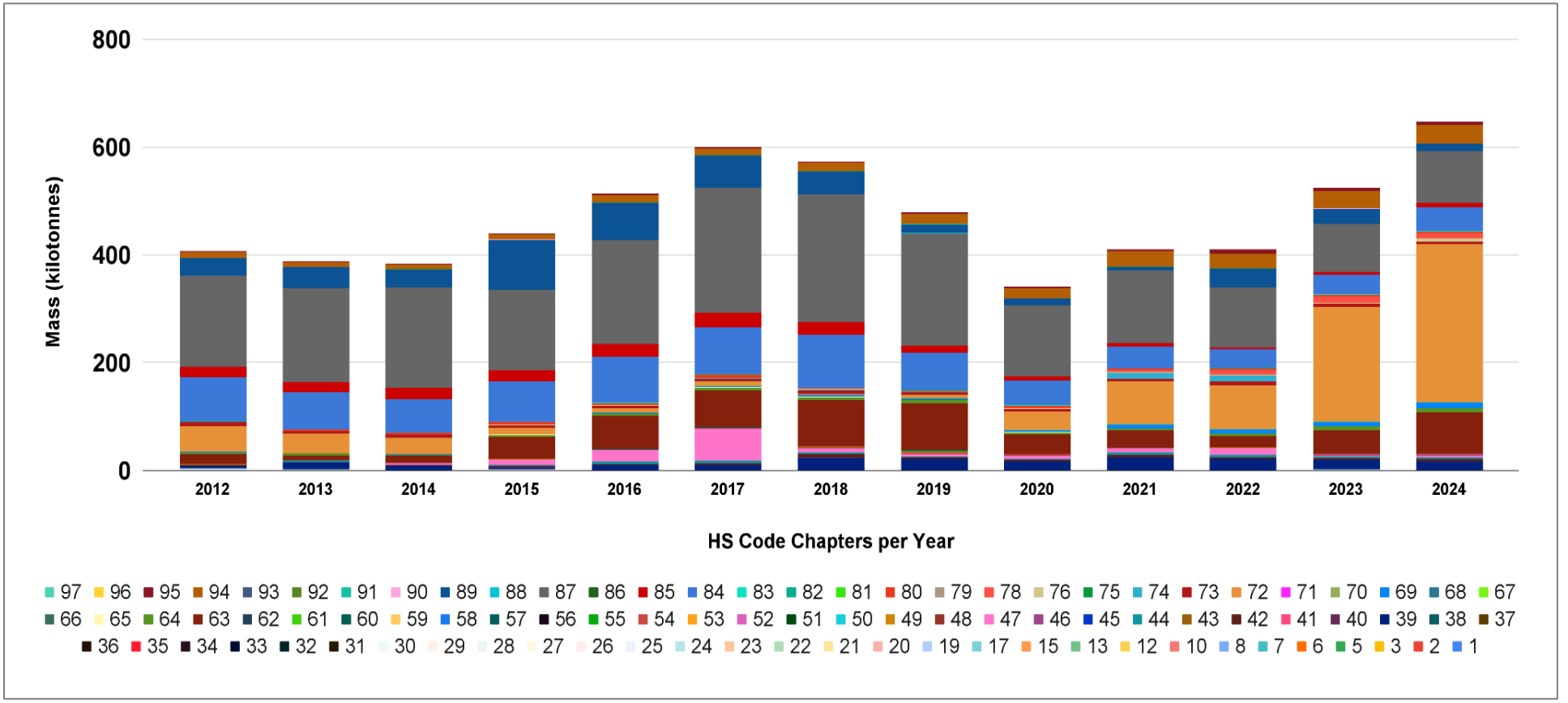
It is worth noting that household items that are difficult to recycle, such as worn clothes (HS Chapter 63) and bulky furniture (HS Chapter 94) rank high at fourth and sixth, respectively. Importation of used and scrap plastics (HS Chapter 39) is also significant at 180 kT, ranking eighth. Given the Plastic Waste Amendments under the Basel Convention that entered into force in 2020, this also needs to be closely monitored and analysed for appropriate action.

Used goods analysis at the HS chapter level can also be done based on where the shipment originated (Level 1B), as shown in Figures 4.8 and 4.9, based on data summarised in Sheet 6, Annex 1. Japan has consistently been the top source of used goods imported into the Philippines throughout 2012 to 2024, averaging nearly 280 kT per year. In the absence of local industries that produce delivery trucks, construction equipment, and heavy machinery, Japan has been the Philippines' primary source of second-hand vehicles and equipment. Inevitably, this would mean that used vehicles and machinery from Japan would reflect the largest total in terms of mass, yielding 59% of all used goods importation for the past 13 years.

More than 20% of used goods come from other parts of East Asia, with Korea ranking second after Japan. Used goods from the United States and Australia are also significant, totaling 399 kT and 111 kT, respectively. Shipments from Malaysia, Singapore, and Germany complete the top 10 list of sources.

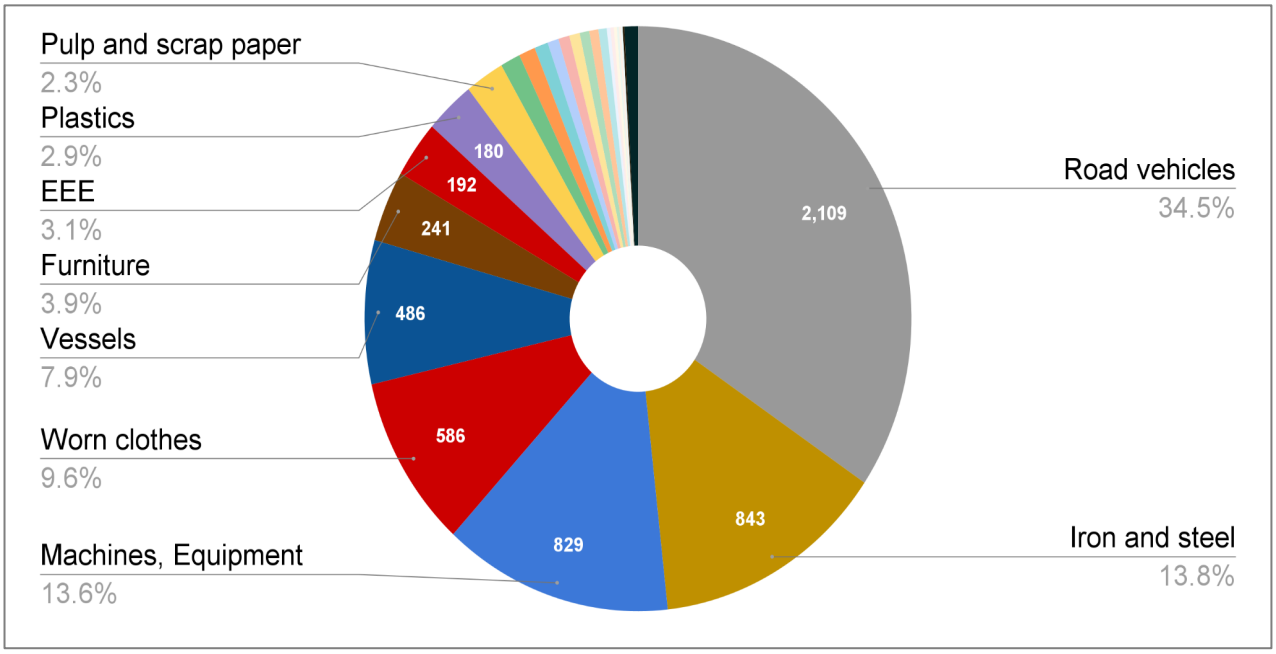
Annex 2 provides the base table of used goods importation from 2012 to 2024.

Figure 4.6. Importation of Used Goods into the Philippines per Year, by HS Chapter (2012–2024)



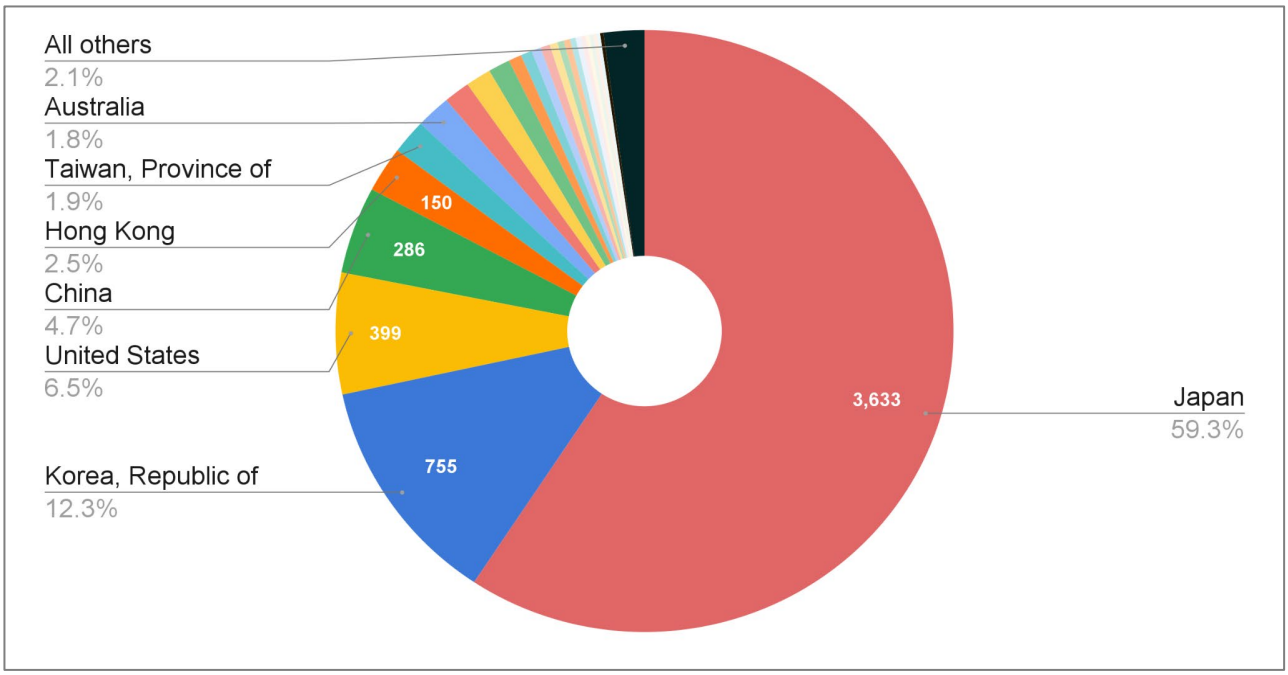
Note: Gray bars: road vehicles; orange bars: iron and steel; blue: machinery and appliances; red: electrical equipment.
Source: Processed and graphed by Environweave for this report based on BOC importation data (2012–2024) obtained from Abante (2020)

Figure 4.7. Distribution of Used Goods into the Philippines by HS Chapter (total mass of 6,116 kilotonnes, 2012–2024)



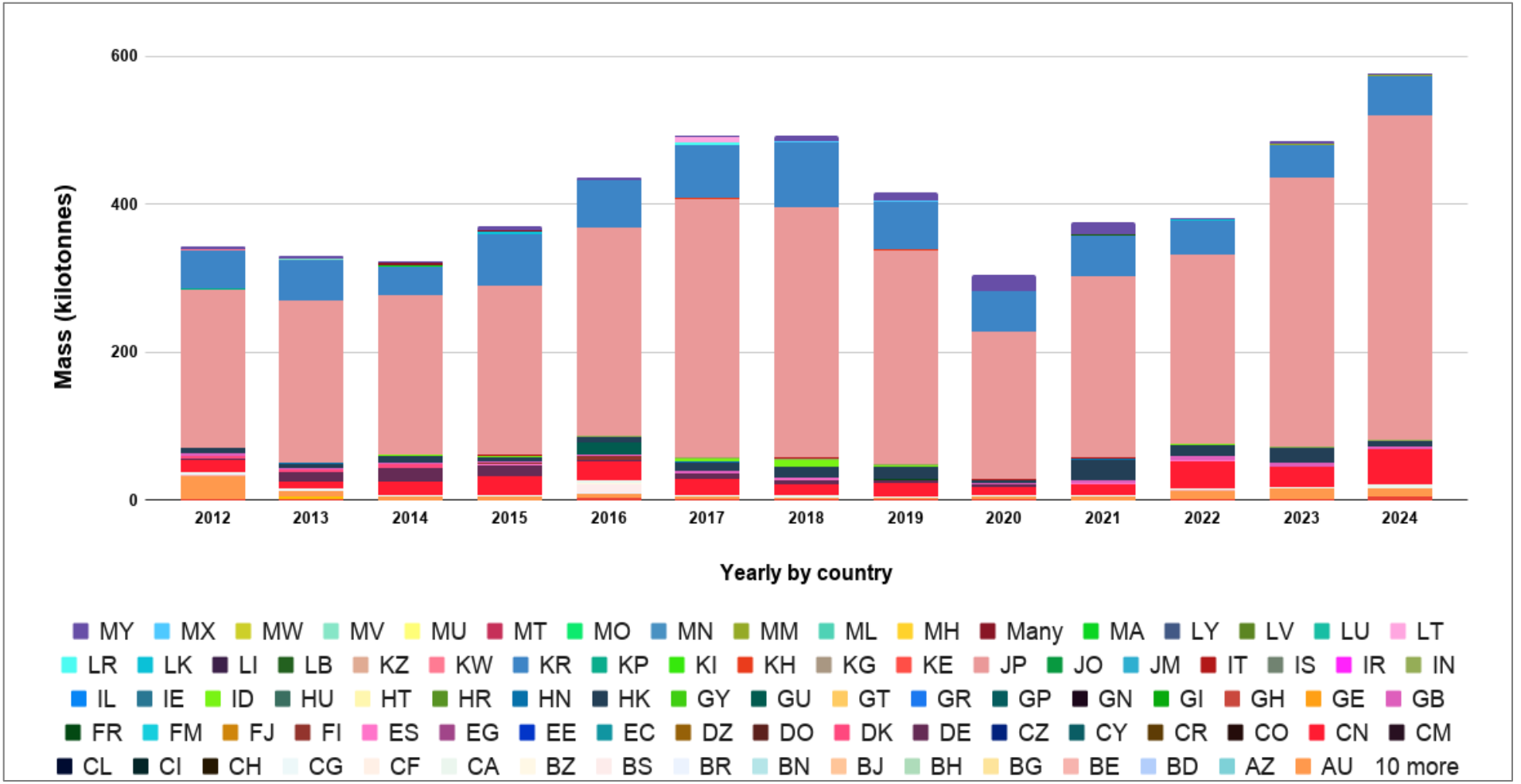
Source: Processed and graphed by Environweave for this report based on BOC importation data (20122024) obtained from Abante (2020).

Figure 4.8. Distribution of Used Goods into the Philippines per Year, by Origin (total mass of 6,116 kilotonnes, 2012–2024)



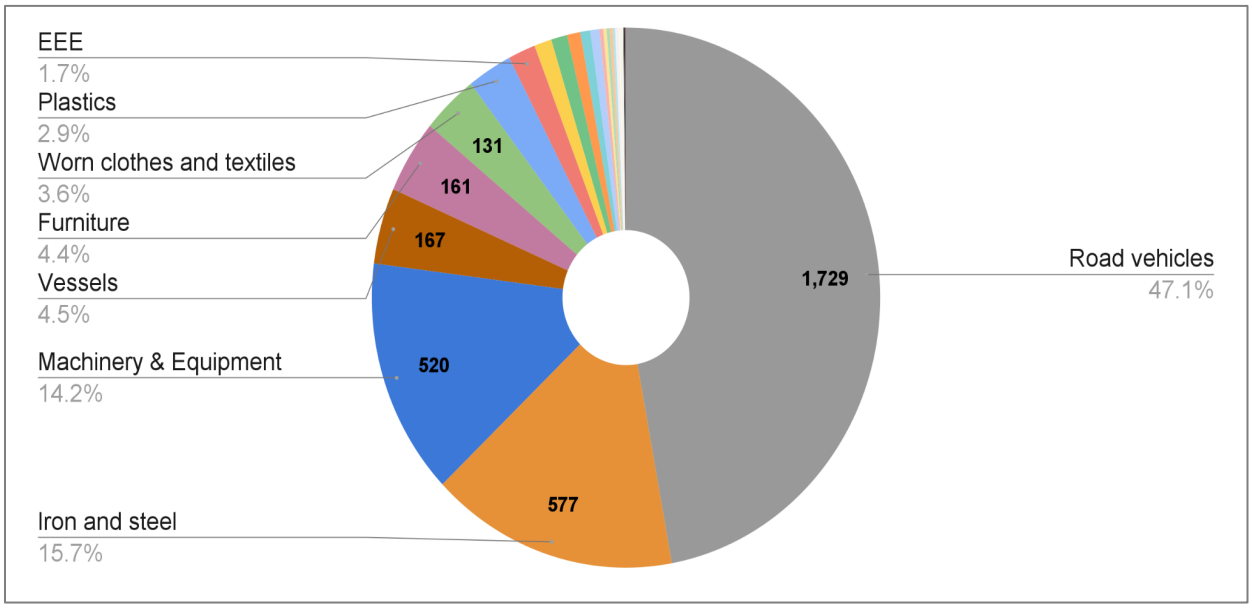
Source: Processed and graphed by Environweave for this report based on BOC importation data (2012–2024) obtained from Abante (2020).

Figure 4.9. Importation of Used Goods into the Philippines per Year, by Origin (total mass per year, 2012–2024)



Note: Pink bars: used goods from Japan; Blue bars: used goods from Korea.
Source: Processed and graphed by Environweave for this report based on BOC importation data (2012–2024) obtained from Abante (2020).

Figure 4.10. Distribution of Used Goods from Japan by HS Section
(total mass of 3,3369 kilotonnes, 2012–2024)



Source: Processed and graphed by Environweave for this report based on BOC importation data (2012–2024) obtained from Abante (2020).

Given that Japan is the principal source of used goods entering the Philippines and the focus of this study, a further breakdown of item types by HS chapter was undertaken for shipments identified as originating from Japan (Figure 4.10). As suspected, road vehicles (HS Chapter 87) rank the highest in terms of total mass, with 1,729 kT imported into the Philippines for the past 13 years (47.1%). A far second would be shipments of scrap iron and steel (HS Chapter 72), at around 16% of mass. Machinery and equipment (HS Chapter 84), which include some home appliances, rank third totalling 520 kT, while other EEE, classified under a separate HS Chapter 85, total 64 kT. Other HS chapters that include items which may fall under the six EEE categories used by the UNITAR *Global E-Waste Monitor* are Chapter 90 (cameras and medical equipment), Chapter 92 (musical instruments), Chapter 95 (toys, including gaming consoles), and Chapter 96 (other manufactured articles). Detailed data is provided in Sheet 7, Annex 1.

Annual amounts of used goods from Japan, grouped by HS Chapter (2-digit level), are shown in Figure 4.11. It should be noted that annual fluctuations in volume mirror those shown in Figure 4.8, which presents imports of used goods from all sources. Some interesting trends may reflect international policy shifts, as well as the enactment or implementation of domestic policies in both Japan and the Philippines:

- **Decreasing amounts of used machinery, appliances, and electric/electronic equipment are being shipped from Japan to the Philippines.** This may reflect more efficient collection systems in Japan for items covered by the Home Appliance Recycling Law (covering TVs, air conditioners, refrigerators and freezers, washing

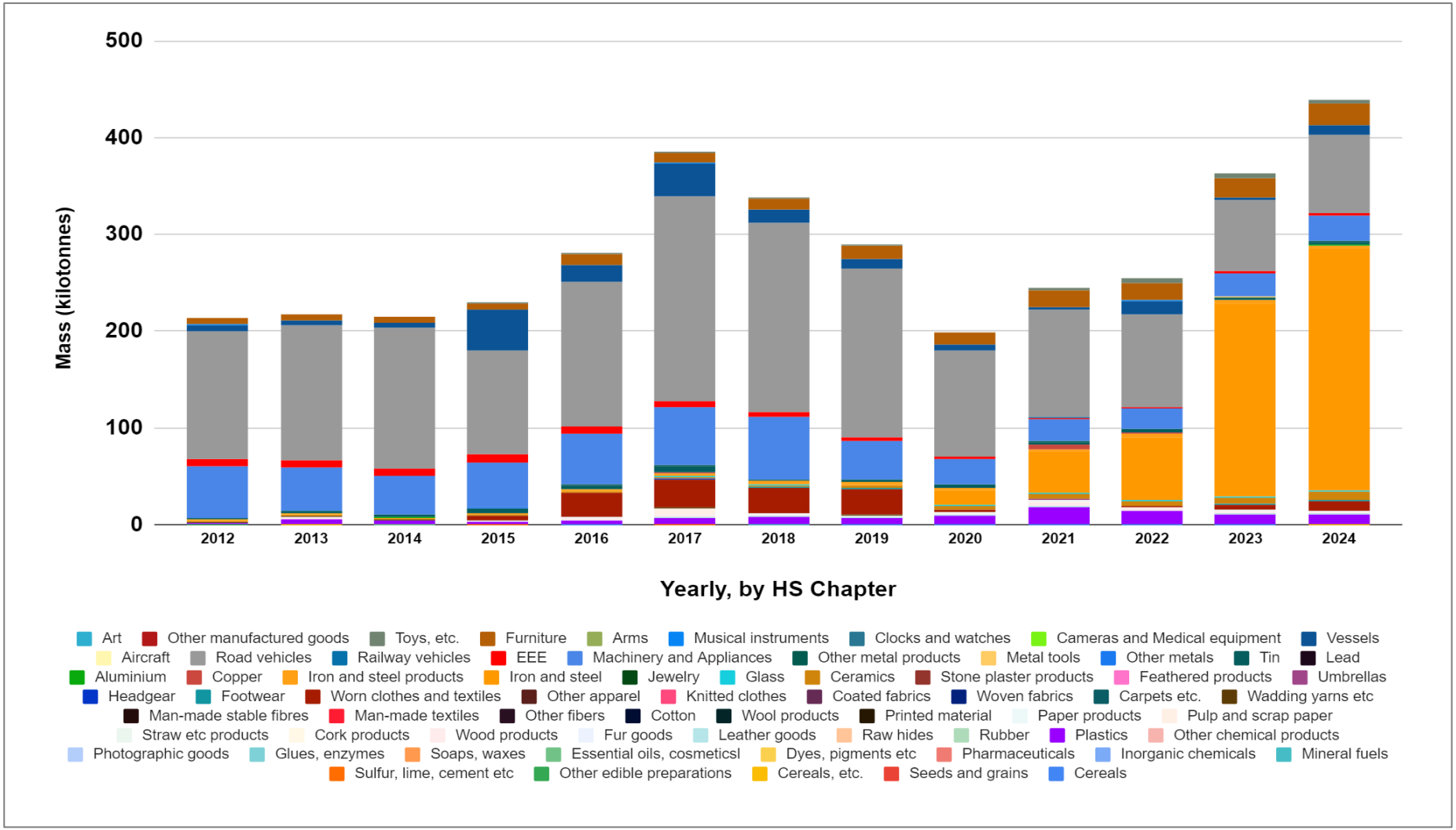
machines and dryers)[11] and the Small Home Appliances Recycling Law (covering items such as mobile phones, gaming consoles, digital cameras, etc.)[12]

- Decreasing importation of used vehicles and engines into the Philippines from Japan since the start of the Public Utilization Vehicle Modernization Program in 2017 under the Department of Transportation. At its inception, this programme aimed to replace jeepneys that used old diesel engines with vehicles equipped with at least Euro 4-compliant engines. The goal was to lessen air pollution and replace units that were not deemed roadworthy (Roces, 2023).

[11] Law for the Recycling of Specified Kinds of Home Appliances (Home Appliance Recycling Law). English translation: https://www.env.go.jp/content/900452888.pdf

[12] Law for the Promotion of Recycling of Small Home Appliances. English translation: https://www.env.go.jp/en/recycle/asian_net/Country_Information/Law_N_Regulation/Japan/Law_for_the_Promotion_of_Recycling_of_Small_Home_Appliances_English.pdf

Figure 4.11. Used Goods from Japan per Year, by 2-Digit HS Chapter (2012–2024)



Note: Gray bars: road vehicles; orange bars: iron and steel; blue: machinery and appliances; red: electrical equipment; dark brown: furniture; maroon: worn clothes; purple: plastics.

Source: Processed and graphed by Environweave for this report based on BOC importation data (2012–2024) obtained from Abante (2020).

However, there are increasing amounts of scrap plastics and bulky furniture from Japan that are entering the Philippines. This may be due to shifting business models of exporters and importers that were previously involved in international trade of UEEE, appliances, or vehicles.

As for exportation of used items from the Philippines, unfortunately, detailed data files are not available for export from the Philippines to other countries. As explained during a key informant interview with the Department of Trade and Industry (DTI) – Export Marketing Bureau, detailed descriptions are primarily used for the valuation of customs duties and taxes and are recorded in the import records of the receiving country[13]. Summaries of export records are available through the DTI Tradeline Portal (DTI, n.d.) that can be filtered using the HS codes of products of interest or country of destination, but the description of each shipment for export is not available (DTI , n.d.). Furthermore, in the Tradeline Portal, there are no records yet for the importation/exportation of e-waste and e-scrap under the newly designated HS code for e-waste and e-scrap (HS 85.49).

E) Identifying relevant UEEE types

Analysis of all used goods imported into the Philippines from Japan at the HS heading level (4-digits) as described in the methodology in Section 1.2 D revealed the following:

- From 2012 to 2024, 3,669 kT of used/second-hand/scrap goods were imported from Japan.
- There were 590 different types of items based on the HS heading classification. All HS sections are included, except for live animals, animal products, and fats.

Sheet 8, Annex 1 shows the summarised results for this Level 3 analysis of all 590 types of used items from Japan classified at the 4-digit HS heading level.

Using these results, all HS headings that are identified as possibly containing EEE are extracted. The results of this Level 4 analysis can be found as Sheet 9, Annex 1. At the 4-digit level, this may be sufficient to estimate the amount of used EEE importation categorised by the six major categories. Table 4.2 gives a list of the top 15 used EEE types that entered the Philippines in the past 13 years analysed at the 4-digit HS code level, with their corresponding headings, their total mass and rankings with respect to other used goods, as well as their groupings based on the six major EEE categories used in Baldé et al. (2024), namely:

1. Temperature exchange equipment;
2. Screens, monitors, and equipment with screens (this includes laptops and gadgets);
3. Lamps;
4. Large equipment, with 4b as a subcategory specific to photovoltaic panels;
5. Small equipment, the most diverse category that includes household tools, cameras,

[13] Interview with DTI-EMB, 10 July 2025.

small kitchen appliances, musical instruments, etc.;

6. Small information technology (IT) and telecommunications equipment, which includes desktop computers and their peripherals, telephone sets, etc.

These categories are based on the classifications used by the European Union, with further specific subcategories under the UNU-KEYS system, which are also shown in Sheets 12a and 12b, Annex 1.

Notice that at the 4-digit HS code level, some items may fall under two of the EU categories. In fact, not all items under this nomenclature level are included in the 54 detailed EEE categories under UNU-KEYS. Thus, there is a need to extract shipment details at the HS subheading (6-digit level) to have a more accurate picture (Level 5 analysis). The top 15 EEE types resulting from this more granular classification, which follows the UNU-KEYS listing of what should be included or excluded as EEE, are listed in Table 4.3, while Sheet 10, Annex 1 provides detailed computations.

Table 4.2. Top 15 Used EEE from Japan Imported into the Philippines at HS Heading Level

EEE Type (4-Digit Level)	Total Mass (Tonnes) 2012–2024	% Total Mass of Used EEE	EU-6 PV	UNU KEYS	4-Digit HS Code
TV, monitors, projectors	29,598	46.70%	2	0308, 0309, 0407, 0408	8528
Refrigerators	8,273	13.05%	1	0108	8418
Pumps/ compressors/ ventilators	8,194	12.93%	4a, 5	0106, 0201	8414
Lamps	3,134	4.94%	3	0503, 0504	8539
Welding tools, etc.	2,661	4.20%	5	0601	8515
Printers	1,550	2.45%	6, 4a	0304, 0307	8443
Computers	1,247	1.97%	6, 2	0301, 0302, 0303	8471
Sewing machines	1,088	1.72%	5	0201	8452
Dish washers	1,075	1.70%	4a	0102	8422
Loudspeakers, microphones...	977	1.54%	5	0401, 0403, 0405	8518
Pneumatic tools..	913	1.44%	5	0601	8467
Electric musical instruments	656	1.04%	4a	0703	9207

EEE Type (4-Digit Level)	Total Mass (Tonnes) 2012–2024	% Total Mass of Used EEE	EU-6 PV	UNU KEYS	4-Digit HS Code
Air conditioners	621	0.98%	1	0111	8415
Vending machines	617	0.97%	1, 4a	1001, 1002	8476
Washing machines	604	0.95%	4a	0104	8450
All others	2,175	3.43%			
TOTAL UEEE	63,385	**1.73%** of all used goods from Japan by mass (13-year period)			

Source: Processed by Environweave for this report based on BOC importation data (2012–2024) obtained from Abante (2020).

Table 4.3. Top 15 Used EEE from Japan Imported into the Philippines at HS Subheading Level

EEE Type (6-Digit Level)	Total Mass (Tonnes) 2012–2024	% Total Mass of Used EEE	EU-6 PV	UNU KEYS	# of Applicable 6-Digit HS Codes
Flat monitors	7,544	38.83%	2	0309	3
CRT monitors	1,986	10.22%	2	0308	4
Household tools	1,677	8.63%	5	0601	12
Small household EE	1,024	5.27%	5	0201	28
Flat TVs	689	3.55%	2	0408	1
Players and audio	634	3.26%	5	0403	26
Keyboards, guitars	631	3.25%	5	0703	2
Desktop PCs	608	3.13%	6	0302	3
Non-cooled dispensers	545	2.81%	4a	1001	2
Washing machines	493	2.54%	4a	0104	4
Small IT	406	2.09%	6	0301	13
Air conditioners	397	2.04%	1	0111	3
Professional cooling	355	1.83%	1	0113	3
Refrigerators	350	1.80%	1	0108	3

EEE Type (6-Digit Level)	Total Mass (Tonnes) 2012–2024	% Total Mass of Used EEE	EU-6 PV	UNU KEYS	# of Applicable 6-Digit HS Codes
CRT TVs	307	1.58%	2	0407	3
All others	1,782	9.17%			
TOTAL UEEE (6-digit level)	**19,428**	**0.53%** of all used goods from Japan by mass (13-year period)			

Source: Processed by Environweave for this report based on BOC importation data (2012–2024) obtained from Abante (2020).

If we are to use the results of the import data extraction only at the HS heading level as shown in Table 4.2, the conclusion would be that UEEE-related items total about 63 kT during the 13-year period, equivalent to 1.73% of all used goods from Japan by mass, and that 29.6 kT of used televisions, monitors, and projectors entered the Philippines during this period.

However, analysis at the HS heading level would likely result in an overestimation, since we may be including shipments that are not actually considered as EEE based on the UNU-KEYS classification. For instance, HS 84.14 (air pumps, compressors, and ventilators), ranking second in Table 2, will likely include industrial equipment or machinery that would not be considered EEE typically used in households. Similarly, HS 85.39 (lamps), ranked third in the list, might include heavy duty lighting equipment, or parts associated with vehicles.

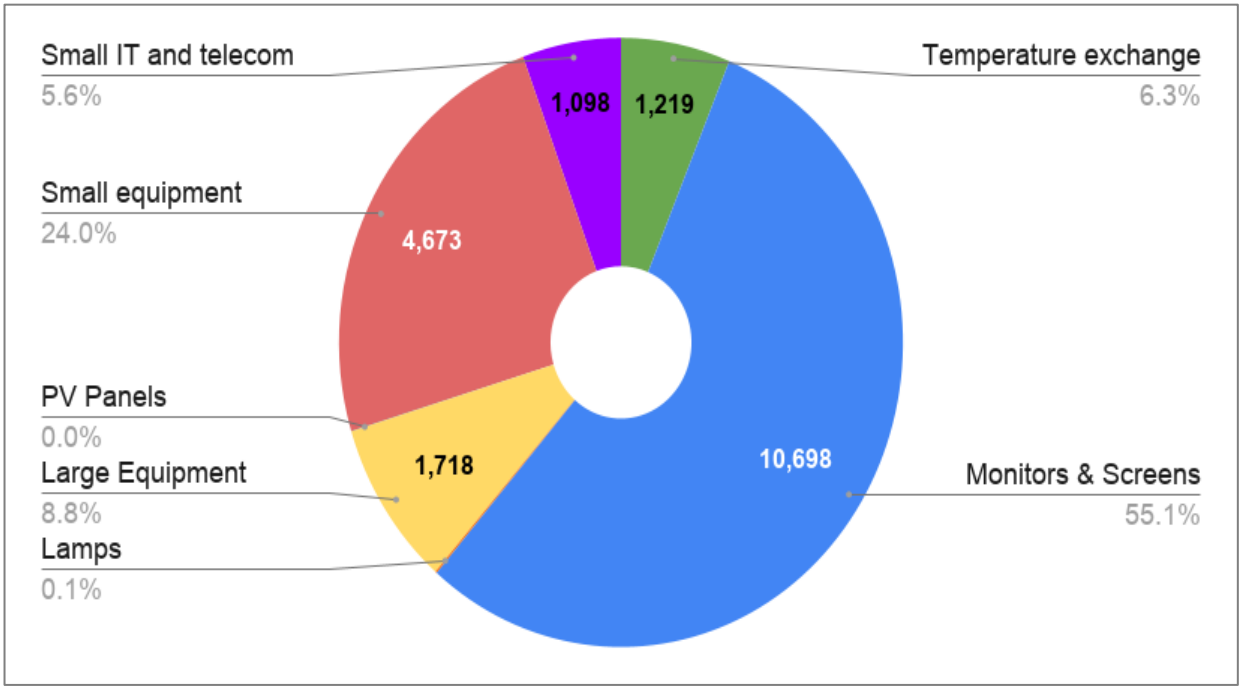
Data extraction at the HS subheading level (the first six digits of the HS code) yields a more realistic picture of the UEEE importation over the last 13 years, with a cumulative mass of 19.4 kT, or only 0.53% of all the used goods from Japan. This amount is less than one-third of the initial estimates at the HS heading level of 4-digits. Details are found in Sheet 11, Annex 1.

There is also clarity on the specific EEE types that were imported most frequently into the Philippines: monitors, both flat-screen and cathode ray tube (CRT) types. Next in rank would be small household tools and appliances, while other EEE that fall under Category 5 (small equipment), such as audio equipment and musical instruments, also rank high. IT equipment such as desktop computers and peripherals is also in the middle of the list, while large EEE types are non-cooled dispensers and washing machines. Temperature exchange equipment is already outside the top 10. Interestingly, CRT TVs, which used to dominate the UEEE import market in the Philippines prior to 2012, have dwindled to 307 tonnes, less than 2% of all UEEE by mass for this period.

Figure 4.12 shows that Category 2, monitors and screens, account for more than half of the used EEE from Japan, while small equipment comprises nearly a quarter of the shipments. Bulky EEE, such as large appliances and temperature exchange equipment, make up a combined 15%, while small IT equipment contributes a little over 5% of the total mass. Notice that Category 3, lamps, which ranked very high in the list at the HS heading level analysis, is not at all significant at this more disaggregated analysis.

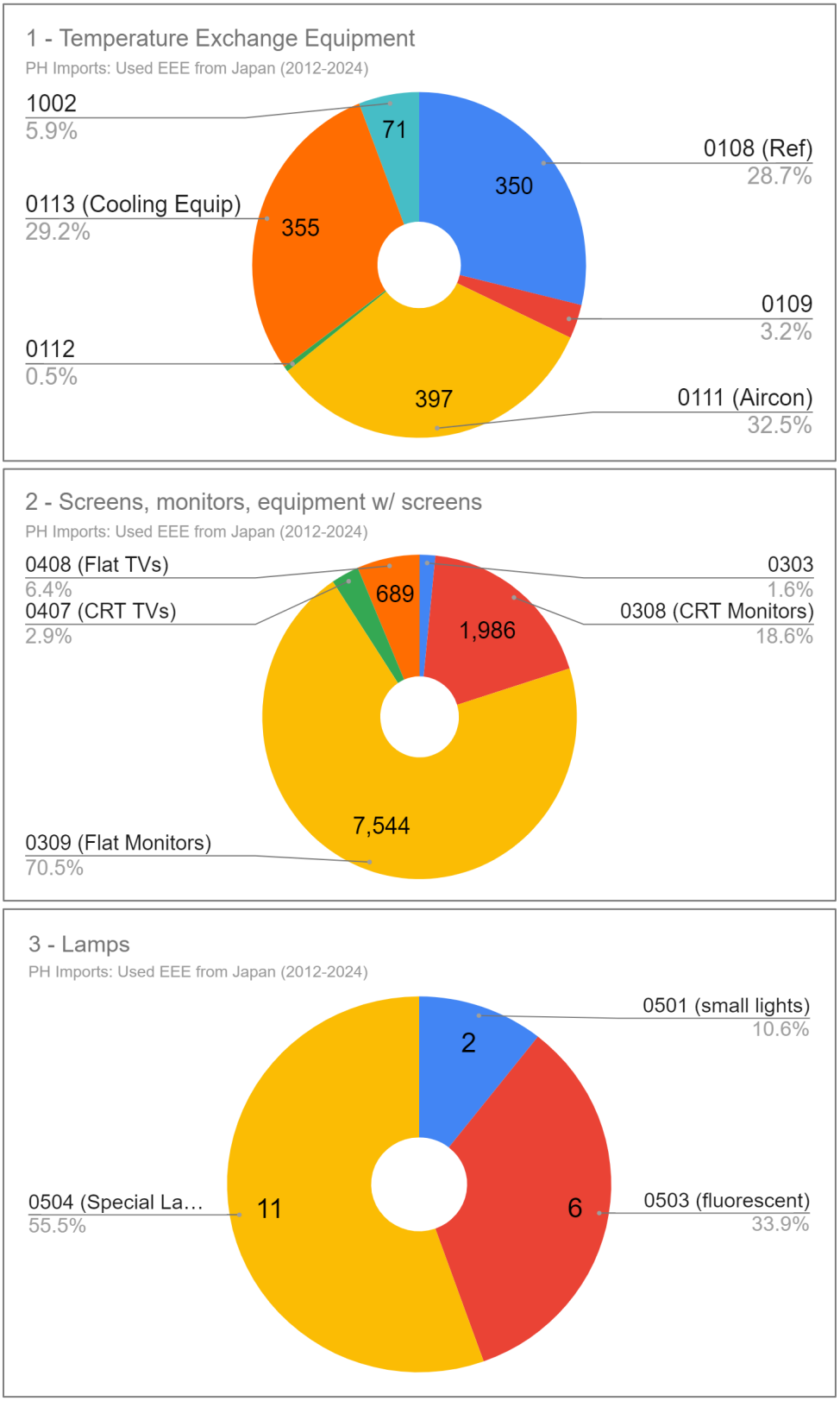
The detailed composition of equipment subtypes by UNU KEYS classifications under each of the six major EEE categories for 2012–2024 are found in Figures 4.13 and 4.14. The accompanying data tables are provided in Sheet 12a, Annex 1.

Figure 4.12. Percentage Distribution of Used Goods from Japan by Six Major EEE Categories (total mass of 19,429 tonnes, 2012–2024)



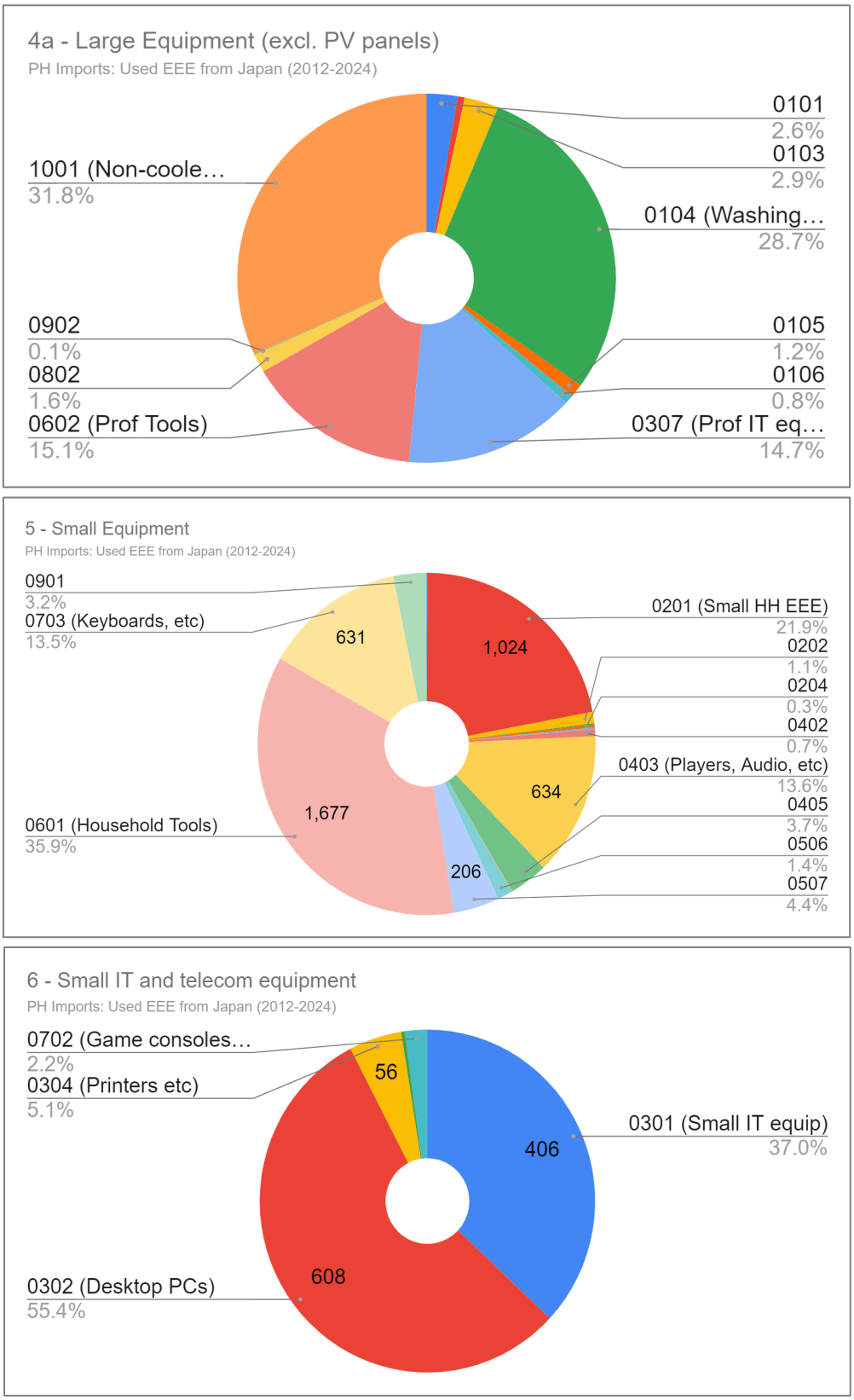
Source: Importation data processed at the HS subheading (6-digits) level and graphed by Environweave for this report based on BOC importation data (2012–2024) obtained from Abante (2020).

Figure 4.13. Percentage Distribution of Used Goods from Japan, Categories 1 to 3 (total mass in tonnes, 2012–2024)



Source: Importation data processed at the HS subheading (6-digits) level and graphed by Environweave for this report based on BOC importation data (2012–2024) obtained from Abante (2020).

Figure 4.14. Percentage Distribution of Used Goods from Japan, Categories 4a to 6 (total mass in tonnes, 2012–2024)



Source: Importation data processed at the HS subheading (6-digits) level and graphed by Environweave for this report based on BOC importation data (2012–2024) obtained from Abante (2020).

1.3 Identification of issues on the EEE international material flow between the Philippines and Japan

UEEE importation from Japan to the Philippines has been sharply declining, a trend that can be attributed to the effectiveness of Japan's recycling laws for home appliances, as well as a shift in domestic consumer preferences and consumption patterns in the Philippines. While monitors and screens once dominated these shipments until 2018, the composition has since shifted towards smaller household and IT equipment. Field observations confirm this, with many 'surplus' shops in the Philippines that once sold large EEE now closed or transitioned to selling other used goods like furniture and bicycles.

Several issues persist with the international trade of used EEE and scrap. (i) There are some possible inconsistencies regarding how the HS nomenclature classifies batteries as under the new HS code for e-waste. Additionally, (ii) the analysis of importation data is limited as it does not include shipments entering special economic zones, less-than-container-load shipments, or goods entering through private ports. (iii) Misdeclarations of shipments have also been a problem, with cases of plastic or electronic waste disguised as other goods. While the entry of used EEE from Japan is decreasing, the need for clear classification criteria and stricter monitoring is essential to prevent the Philippines from becoming a destination for other countries' end-of-life goods.

A) Status and trends of the EEE international material flow

The annual amount of UEEE items from Japan has sharply decreased after its highest recorded importation of 3 kT in 2016 (Figure 4.15). The lowest volumes were recorded during the pandemic, and these have remained below 500 tonnes since then. This is welcome news and reflects the effectiveness of the implementation of the Japanese government for both the Home Appliance Recycling Law, enacted in 2001, and the Small Home Appliance Recycling Law, enacted in 2012.

Figure 4.16 shows the disaggregated data of the various UEEE types based on their HS subheadings (6-digits), grouped by the six major EEE categories. Monitors and screens dominated shipments for a period, peaking at 73% of the total mass of UEEE in 2016, before steadily declining thereafter. From 2019 until the present, most UEEE were mainly under the small household equipment category, with similarly high contributions from the small IT equipment category.

The annual amounts of importation for the UEEE subtypes by UNU-KEYS classifications are illustrated in Figures 4.17–4.18, grouped under each of the six major equipment categories. The corresponding data tables are also found in Sheet 12b, Annex 1. Note that for most equipment categories, importation of UEEE is on the downward trend, except for some types of lamps, as well as desktop personal computers and peripherals. However, the total mass of these items entering the Philippines over the past 3 years are on a smaller scale compared to other UEEE that were previously imported regularly.

Overall, UEEE importation has declined since 2016. However, as seen in Figure 4.19, the actual **peak of UEEE importation was in 2010, at more than 30 kT, more than 10 times**

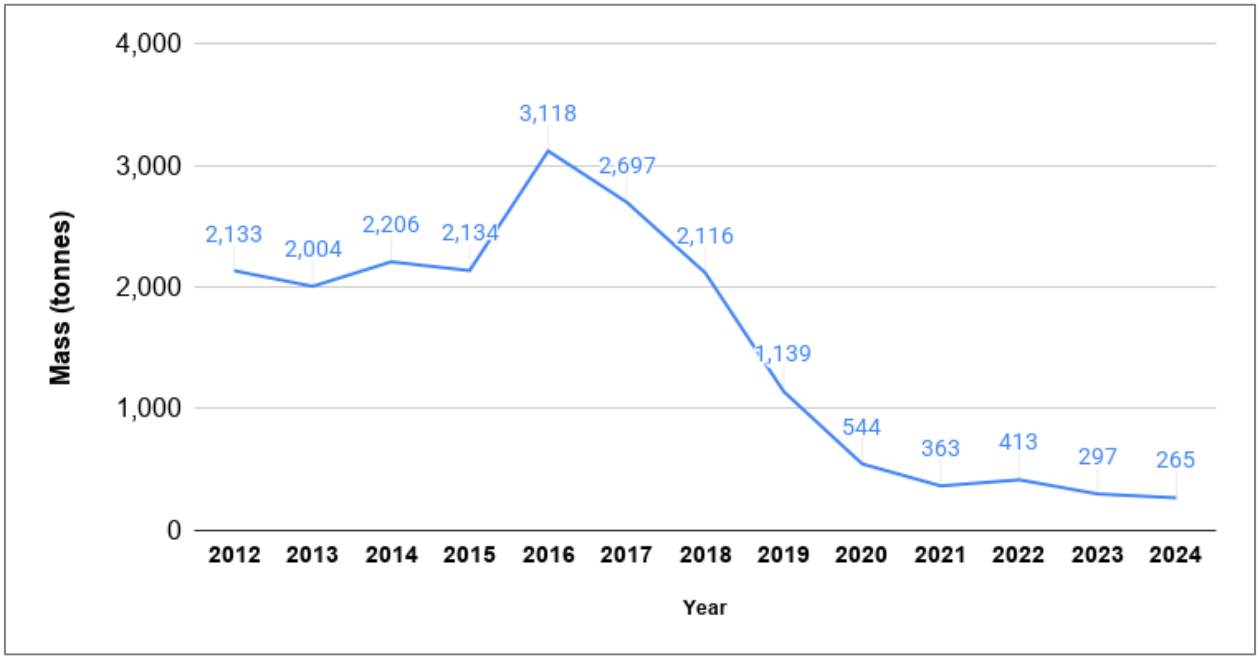
that of the 2016 peak volume covered in this current study. This is based on a previous analysis of importation data done by this author covering the period 2007–2012 (Cardenas et al., 2013). Figure 4.20 combines the two graphs showing annual amounts of UEEE importation from Japan at-scale, to show the trends over 18 years.

Indeed, 2010 marked a peak year in which a substantial volume of CRT TVs and monitors was shipped into the Philippines and sold domestically through wholesale or retail channels. This surge was likely driven by the disposal of CRT TVs during the transition from analogue to digital television broadcasting. Starting 2013, however, these were replaced by used flat display monitors, which caused the 2016 peak in UEEE shipments. Since then, the annual mass of importation sharply declined, with the composition of UEEE shifting to smaller items, particularly those that fall under the 'small IT equipment' category.

Field visits undertaken by the author since 2008 in relation to UEEE, e-scrap, and e-waste corroborate this trend (Figure 4.21). These field visits were sometimes done with Japanese consultant teams for research commissioned by the Ministry of the Environment, Japan (MOEJ). Note that, in one of the photographs of used CRT TVs from 2012, a unit bears a sticker issued by Japan's Ministry of Internal Affairs and Communications stating that analogue TV broadcasts would end in 2011 and that a digital broadcast tuner would be required.

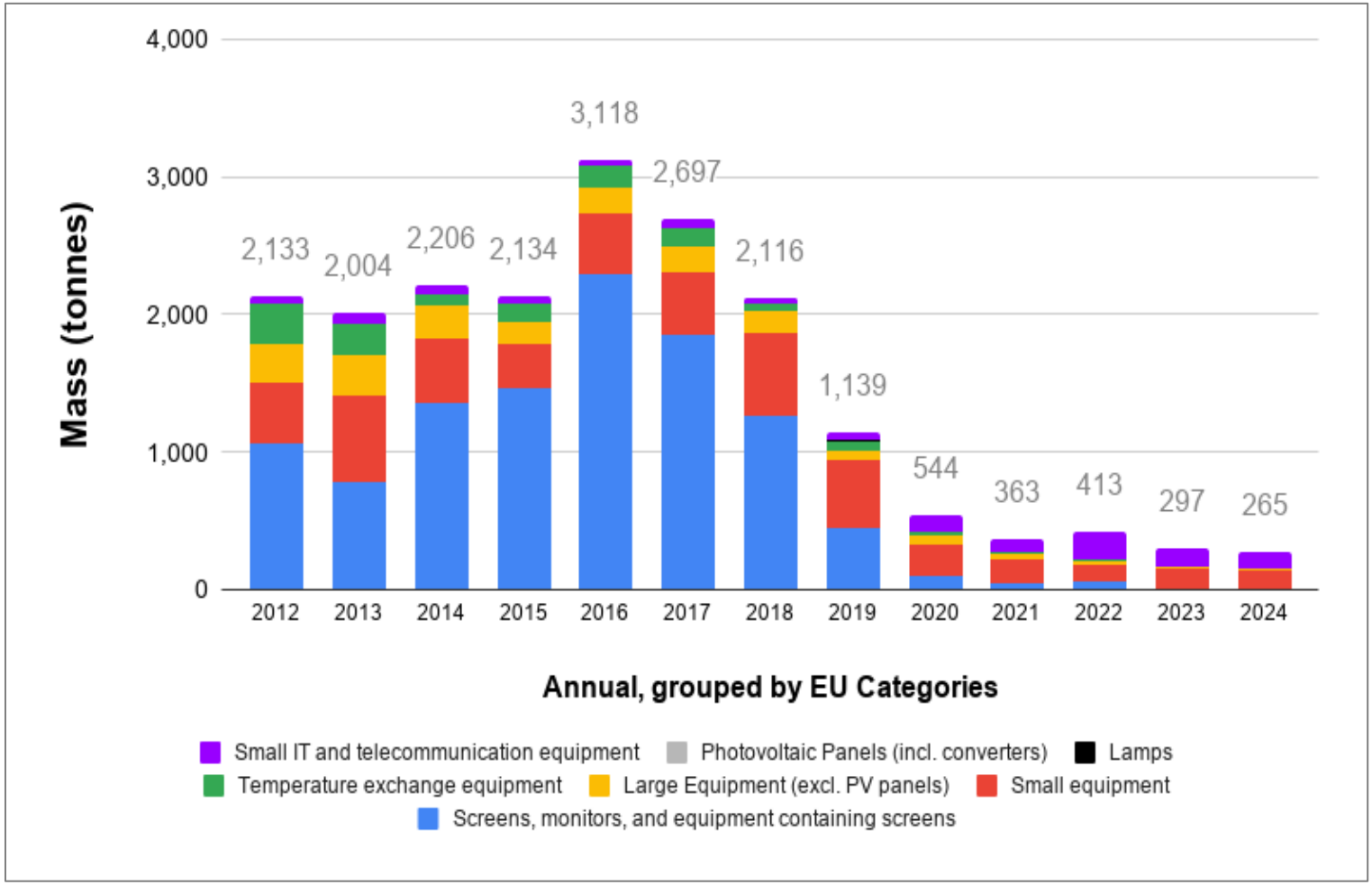
It was observed that, although there were numerous importers, wholesalers, and retailers of so-called 'surplus' CRT TVs and household appliances from Japan around 15 years ago, subsequent visits to areas in Metro Manila where these shops had been densely concentrated (such as Caloocan, Malabon, Parañaque, and Las Piñas) indicate that many of these retailers have since closed. Those that are still operating in Metro Manila are significantly reduced in shop floor areas, or have transitioned to retail shops for second-hand furniture, sofas, and cabinets. This transition towards the importation of other types of used household items was observed as early as 2012, when UEEE importers began filling their shipping containers with alternative items, such as bicycles and musical instruments, as the supply of used home appliances, such as refrigerators and washing machines, was already diminishing. Some 'surplus' retailers also expanded operations to provinces outside Metro Manila; however, many closed during the pandemic and have not reopened.

Figure 4.15. UEEE from Japan per Year, Annual Total Mass (total mass of 19,429 tonnes, 2012–2024)



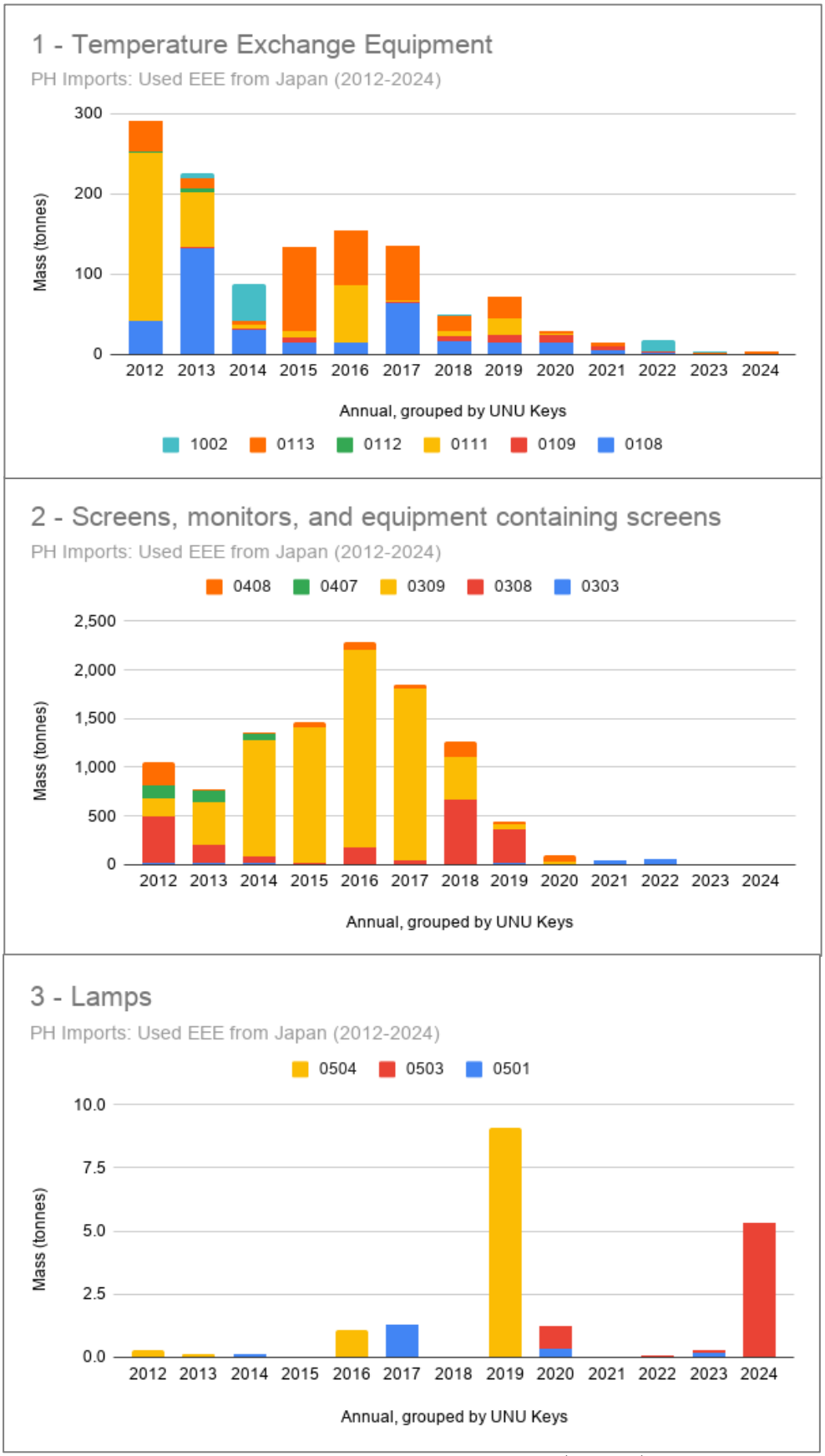
Source: Importation data processed at the HS Subheading (6-digits) level and graphed by Environweave for this report based on BOC importation data (2012–2024) obtained from Abante (2020).

Figure 4.16. UEEE from Japan per Year Grouped by Six Major EEE Categories (2012–2024)



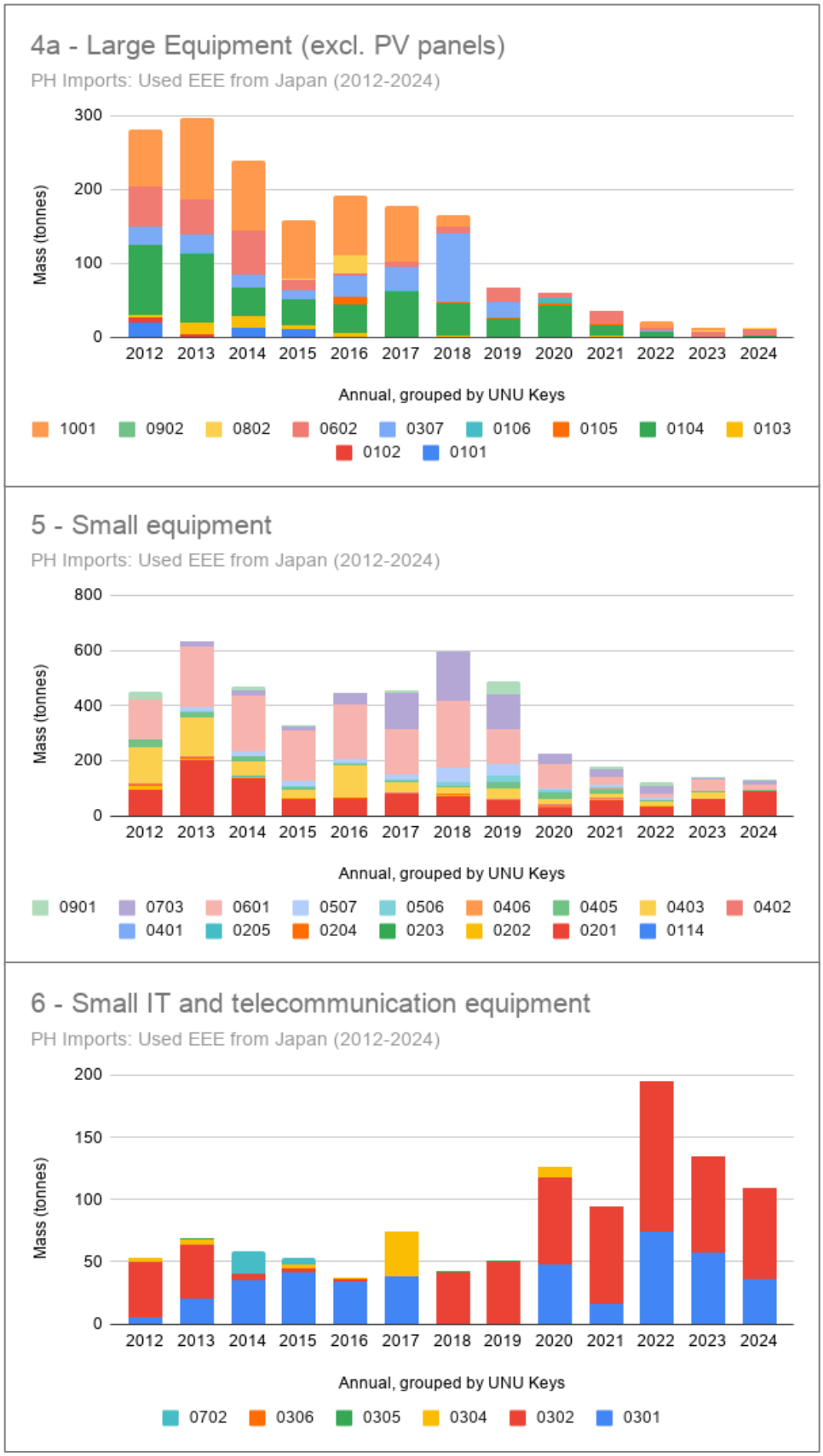
Source: Importation data processed at the HS subheading (6-digits) level and graphed by Environweave for this report based on BOC importation data (2012–2024) obtained from Abante (2020).

Figure 4.17. UEEE from Japan per Year for Categories 1–3



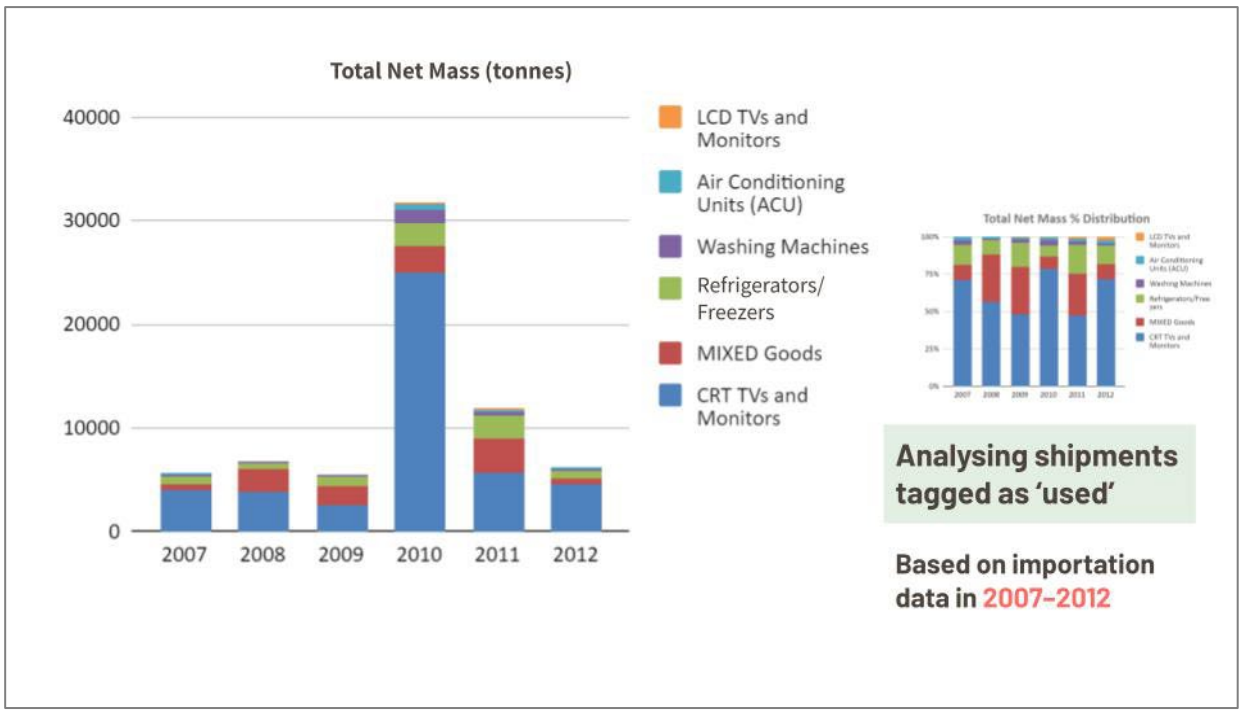
Source: Importation data processed at the HS Subheading (6-digits) level and graphed by Environweave for this report based on BOC importation data (2012–2024) obtained from Abante (2020).

Figure 4.18. UEEE from Japan per year for Categories 4a–6



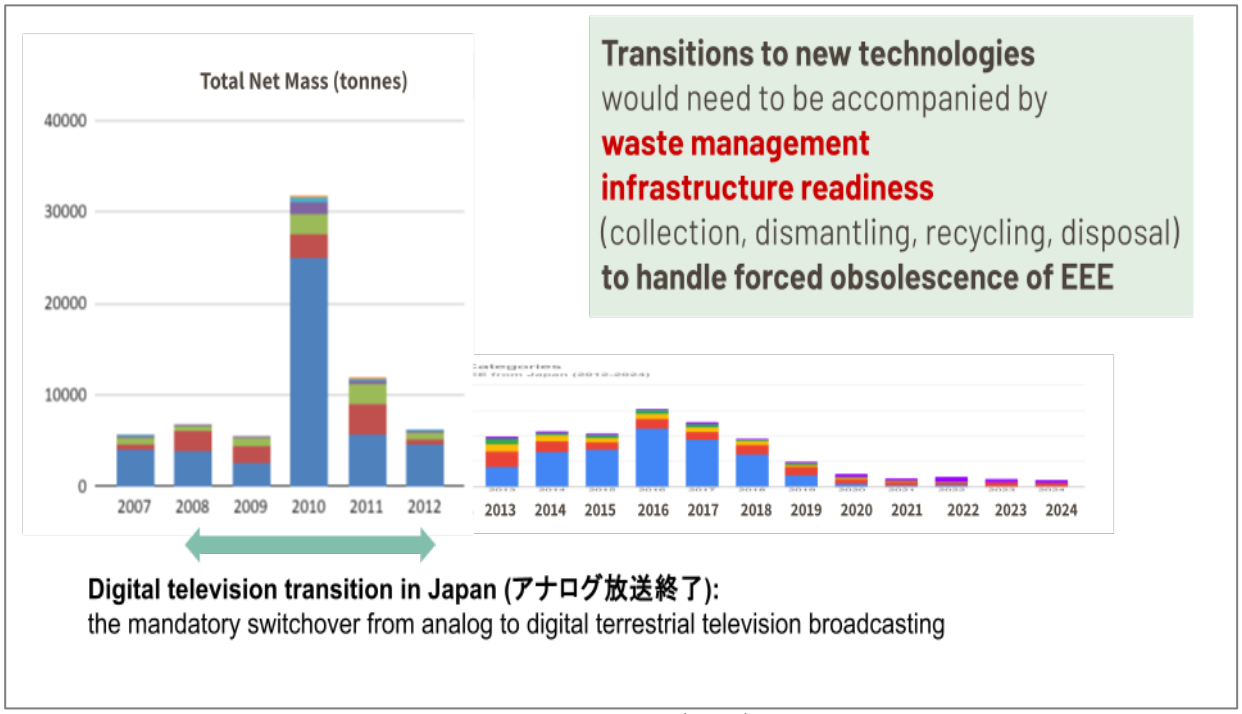
Source: Importation data processed at the HS Subheading (6-digits) level and graphed by Environweave for this report based on BOC importation data (2012–2024) obtained from Abante (2020)

Figure 4.19. UEEE from Japan per Year, by Appliance Type (2007–2012)



Source: Cardenas et al. (2013).

Figure 4.20. UEEE from Japan per Year (2007–2024)



Source: Combined findings of this study and Cardenas et al. (2013).

Figure 4.21. Importers and Retailers of Used EEE and Other Used Goods from Japan (2008–2025)



2008: Used EEE importers, wholesalers, and retailers (Metro Manila)



2012: Used EEE importers, wholesalers, and retailers (Metro Manila)



2012: Used EEE and other used goods from Japan (Metro Manila)



2024–2025: Used EEE and other used goods from Japan (MIMAROPA)



2025: Used Japan goods retail shops, closed or reduced in size (Metro Manila)

Source: All photographs taken by Melissa M.F. Cardenas.

B) Importation activities that need closer monitoring

In the process of examining import data on EEE-related items, several observations were made regarding possible classification inconsistencies.

It is worthwhile to note that for imported goods with HS Code 85.49 (e-waste and e-scrap), a significant volume of shipments from Canada starting from 2024 Q1 was described as 'Batteries wet filled with acid (UN 2794 Class 8) (used lead acid batteries (ULABs)/lead scrap under LOA No. 24-0030)'. These shipments may be better classified under HS Code 85.48, or waste and scrap of primary cells, primary batteries, and electric accumulators. As the total volume of these shipments amounts to more than 7,500 tonnes compared to the 1.6 tonnes of total e-scrap to date, Figures 4.1 and 4.2 do not include these shipments of ULABs, to be consistent with this study's definition of WEEE established by UNITAR. However, since these shipments carry a letter of authorisation likely issued by DENR-EMB, it may be that those tagged as hazardous waste needing PIC whether related directly to WEEE, are listed under HS Code 85.49. This case shows the need to clarify the use of the new dedicated code for e-waste/e-scrap internationally and domestically.

Furthermore, during the processing of shipments under the 6-digit HS codes, items under the following codes registered very high volumes that may indicate that these items were likely large equipment (Category #4a) instead of small equipment (Category #5):

- Items under HS Subheading 852871 – Reception apparatus for television, whether incorporating radio-broadcast receivers or sound or video recording or reproducing apparatus – currently classified under UNU-KEYS 0404 and as small equipment (EU Category 5), with a total mass of 18.6 tonnes (2012–2024);
- Items under HS Subheading 950490 – Other table or parlor games, including pinball tables, billiards, special tables for casino games and automatic bowling equipment, amusement machines – currently classified under UNU-KEYS 0701 and as small equipment (EU Category 5), with a total mass of 12.9 tonnes (2012–2024).

Given their descriptions under the ASEAN Harmonized Tariff Nomenclature of 2022, these HS subheadings may have to be transferred under Category 4a (large equipment). For the purposes of this report, shipments with these codes are omitted in the final graphs. The details of their annual shipment volumes are still provided in Sheet 12, Annex 1.

There are, of course, limitations when using import data from BOC. While these records provide a very comprehensive picture of macroeconomic trade into the Philippines, shipments are not inherently incorporated into the data analysis of this report:

- Shipments that enter special economic zones are generally not subject to duties and taxes unless these are meant to leave the economic zone and enter the domestic market. Shipments that are processed within these economic zones are intended for direct re-export from the zone. These shipments are included in the Philippine import data, with the entry for 'customs duties paid' recorded as zero. The data analysis in this report did not differentiate these entries from regular shipments.

- 'Less than container load' shipments, such as those shipped in boxes from overseas as personal packages containing assorted goods. One major example is cardboard boxes measuring 0.2 cubic metres or less (locally referred to as *balikbayan* boxes) containing gifts such as chocolates, clothing, toys, and other household items sent by Filipinos working or residing overseas to their families in the Philippines. However, with the rise of online shopping platforms such as Amazon, Shopee, and Lazada, small packages are consolidated and shipped through specialised international shipping or logistics forwarding companies.
- Items that enter the Philippines through the numerous private ports and small fishing ports all over the country that are not under the BOC's jurisdiction are also included in the importation database.

The three situations above would need closer monitoring as the limited access or jurisdiction of BOC and other national government agencies such as DENR might be exploited for the entry of regulated items into the Philippines. The extensive coastline of the Philippines, ranking third globally in terms of length, would be very difficult to monitor. Aside from concerns about drugs smuggled into the country, an environmentally sensitive, globally regulated item that clandestinely enters the Philippines would be liquid mercury, used in artisanal small-scale gold mining (Lorenzo, 2019).

Online shopping platforms may also be an avenue for importation or domestic selling of items that otherwise would fail health or environmental standards set by DTI or DENR. For instance, skin lightening creams containing mercury being sold online have been reported by civil society groups (EcoWaste Coalition, 2025). On the other hand, these same online marketplaces can help promote reuse or extended use of mobile phones, tablets, even laptops. In fact, the laptop used in writing this report was purchased online as a second-hand item that was barely used by the original owner.

Currently, the most pressing issue that needs immediate clarification regarding EEE-related shipments would be the importation of e-scrap by recycling or processing facilities meant for re-export. Recently, BOC and DENR filed a case against several importers of electronics scrap that did not procure importation clearances from DENR-EMB, reasoning that these are for processing within the economic zone and for re-export. DENR maintains that, although these shipments are exempt from duties and taxes, they remain subject to environmental clearances, as the items enter economic zones located within Philippine territory. The courts ruled in favour of the e-scrap importers, but DENR and BOC filed an appeal.[14]

Misdeclarations of shipments were also discovered by BOC. One shipment from Hong Kong that arrived in May 2019 declared its contents as assorted EEE accessories but were plastic waste. This was discovered at the Mindanao Container Terminal subport in Misamis Oriental and was shipped back after a month (Roxas, 2019). Another shipment, this time from Korea and discovered in November 2019, indicated its contents as 'used TV and

[14] Discussions during the stakeholder forum on EEE-related International Material Flow for the Philippines, 11 September 2025, Quezon City, Philippines.

electronic parts' but was evaluated as containing electronic waste. This was seized by BOC and deportation was recommended as the next course of action, as well as revocation of the accreditations of the importer and customs broker involved in the shipment (ABS-CBN News, 2019). There have been other incidents of waste shipments to the Philippines in recent years, but these mainly involve plastic scrap or municipal waste declared as plastic scrap. These are summarised in Sheet 13, Annex 1.

C) Analysis and discussion

The significant amount of UEEE, and by extension, used goods in general, highlights the need for more definitive criteria on how to classify these items depending on their intended use and eventual fates, both before departure and arrival at the respective countries or territories.

Certain items are imported with the intention of extending their useful life – for instance, the bulk importation of monitors for use in local offices or computer shops, or CRT TVs bought by lower-income households. In the early 2000s, some used CRT TVs may have been purchased for use as additional television sets in households or as components of karaoke machines rented out by microbusinesses. More than a decade ago, even middle-income households frequented so-called 'TV surplus' shops near the Manila port to purchase large-screen television sets from Japan that were still in working condition. Even as flat-screen televisions became available in the domestic market, some consumers continued to buy second-hand CRT TVs from Japan, as these were perceived to be more durable and easier to repair (Cardenas, 2008).

Used CRT TVs from Japan had to undergo some modifications such as conversion from 110 volts to 220 volts, and adjustments so that they can receive signals from local channels. However, based on interviews with importers, in a shipment, an estimated 5–10% of used CRT TVs that did end up in Philippine soil were no longer working, even after functionality tests and repairs. These units would just be cannibalised for spare parts. TV repair technicians keep the circuit boards from these old televisions to harvest for parts, as even these were observed to be more reliable than new parts produced by non-Japanese manufacturers (Cardenas, 2008).

Eventually, once flat-screen TVs became more dominant in the market and became less expensive, Filipino households also replaced their old CRT units. An important change in consumer purchasing behaviour also started in the early 2010s, when appliance retail shops offered flexible payment options that did not entail the use of a credit card. This allowed lower-income families to acquire brand new appliances at equal or lower cost than the up-front payment needed to purchase a second-hand TV, washing machine, or refrigerator from Japan. CRT TVs continue to be sold in some areas of the Philippines, particularly in communities with lower-income households. These units do not carry names of popular brands and cost around US$60 and are considered 'Class A' appliances, a term

used for refurbished or non-original equipment manufacturing good.[15]

Another consequence of the change in how Filipino households buy new appliances as mentioned above would be the **reduced demand for electrical and electronic repair shops** for home appliances. The numerous TV repair shops found in downtown Manila, Caloocan, and Quezon City in the early 2010s have now shifted their business to include other types of EEE appliances. Oftentimes, since broken LED TVs usually need replacement of the panel itself, consumers opt to buy a new unit. Consequently, some EEE repair shops are now showing signs of e-waste accumulation.[16] Some photos are shown in Figure 4.22.

Meanwhile, some shipments marked as **UEEE may be intended for refurbishment**, such as computers and laptops, with the aim of reselling them as lower-cost equipment either domestically or abroad. These may be under business-to-business contracts between an international manufacturer and a local repair/refurbishment/recycling company in the Philippines as part of increasing circularity by extending the life of EEE. Nevertheless, other **importers of electronic assemblies and scrap** undertake further processing, such as sorting, crushing, and consolidation, prior to re-export and final metal recovery overseas. These local recyclers are likely licensed by the appropriate government agencies, and their shipments are likely subject to import and export clearance requirements issued by DENR-EMB. This trade flow may, however, be affected by the Basel E-Waste Amendments, and EMB has commissioned an impact assessment amongst waste recyclers and treaters as part of the national government's ratification process for these amendments (ERGONS PMC, 2025).

One major learning from the analysis of used EEE trade flows is that **widescale transitions to new technologies would need to be accompanied by an equal level of widescale waste management infrastructure readiness**. For instance, during Japan's transition from analogue to digital broadcasting, intensified collection efforts beyond regular home appliance disposal schedules likely helped manage the flow of CRT TVs rendered obsolete, directing them towards proper dismantling, recycling, material recovery, and disposal systems within Japan. This would also be applicable to technological transitions for other appliances, mobile phones, computers, or even non-EEE items, such as the shift towards electric vehicles.

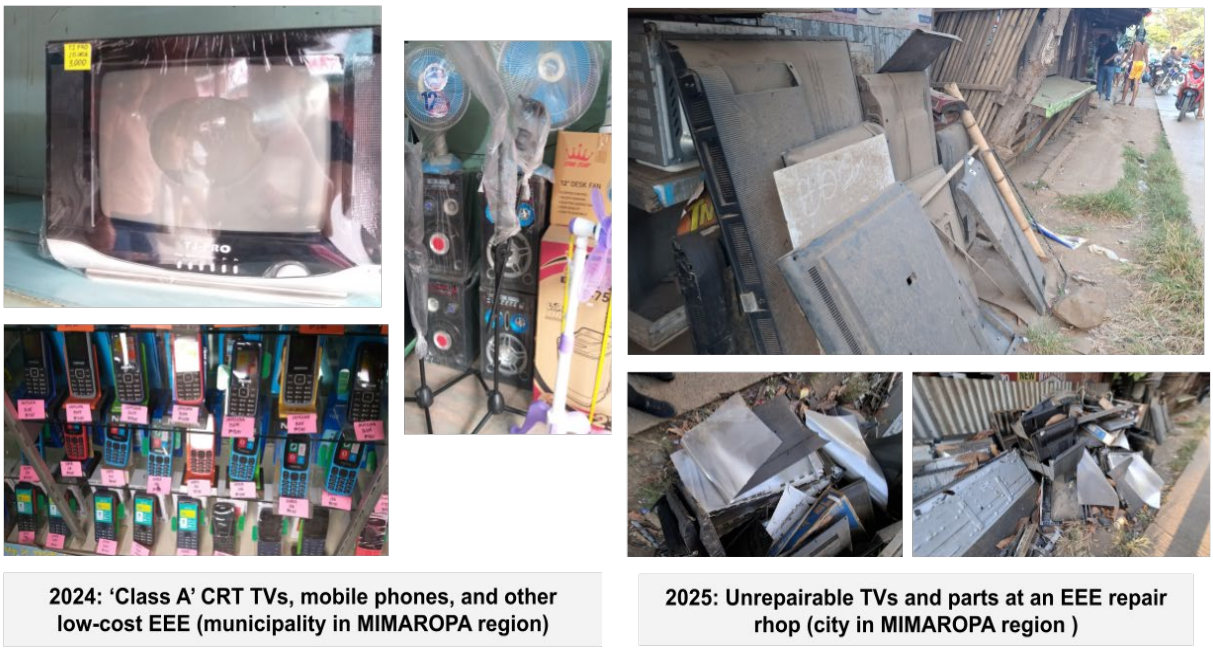
The Philippines would also benefit from more stringent importation criteria for used or second-hand goods. As importers of UEEE appliances shifted their business to bulky household furniture such as old sofas and cabinets, these shipments still include small, assorted appliances such as old rice cookers, cassette/DVD/VHS players, or old gaming consoles that have little to no demand in the local market. Based on UEEE field surveys conducted by Environweave in various cities and municipalities in the Philippines from 2023 to September 2025, these 'Japan and Korea surplus shops' were also found to contain an assortment of household items, including eating utensils such as melamine bento boxes, glassware, ceramic ware, used clothing, shoes, toys, paintings, watches, jewellery, and

[15] Environweave field visits, 2024 and 2025.
[16] Environweave field visits, 2024 and 2025.

even personal memorabilia, such as framed handmade drawings made by someone's grandchild. It is possible that these items were cleared from old houses that transferred ownership. A policy needs to be put in place for the management of used household goods in countries with ageing populations, such as Japan and Korea. Otherwise, such items may end up staying in an almost end-of-life limbo in overseas warehouses before ultimately being disposed of in landfills in recipient countries.

More importantly, while UEEE contains potentially hazardous material that needs close monitoring and management, the impact of their entry into the Philippines is much less if compared to used road vehicles. Aside from comprising the largest portion of used items shipment by mass, old delivery vehicles are using engines that would not pass Philippine air quality standards. They also pose a danger to other road users given reduced roadworthiness.

Figure 4.22. EEE Retail and Repair Shops Outside Metro Manila (2024 and 2025)



2024: 'Class A' CRT TVs, mobile phones, and other low-cost EEE (municipality in MIMAROPA region)

2025: Unrepairable TVs and parts at an EEE repair rhop (city in MIMAROPA region)

Source: All photographs taken by Melissa M.F. Cardenas.

1.4 Conclusion

From 2012 to 2024, the Philippines imported a cumulative 19.4 kT of UEEE, primarily originating from Japan. This trade forms part of a larger global trend of increasing e-waste generation, which reached 65,000 kT worldwide in 2022. While the influx of UEEE from Japan has significantly declined since its peak in 2016 due to Japan's effective recycling laws, the Philippines continues to receive shipments of smaller EEE, such as screens and monitors. This movement of goods faces challenges, including inconsistent classification in customs data and the misdeclaration of shipments, as well as a lack of comprehensive data on items entering special economic zones. As a party to the Basel Convention, the

Philippines must navigate these issues to prevent becoming a repository for other nations' hazardous waste while continuing to regulate the entry of UEEE under its domestic laws, such as RA 6969.

2 Situational Analysis on the Domestic Material Flow of EEE-Relevant Materials in the Philippines and the Effect on International E-scrap Trade with Japan

2.1 Overview

Section 2 provides a detailed situational analysis of the domestic material flow of EEE. It begins by examining the current regulatory and infrastructural landscape on domestically generated WEEE, which is governed by DENR's Department Administrative Order 2013-22 under the Toxic Substances and Hazardous and Nuclear Wastes Control Act (RA 6969). The section analyses the roles of three key stakeholders: hazardous waste generators, transporters, and TSD facilities, and critically assesses the challenges faced in the proper management of e-waste. This includes the limitations of the formal recycling sector, which finds it difficult to compete with informal, local backyard recyclers, thereby reducing the flow of EEE materials available for export to countries such as Japan for further metal recovery. The section aims to connect domestic disposal issues with the complexities of the international material flow and the adoption of more sustainable, formal recycling systems.

2.2 Domestic flow of EEE-relevant materials in the Philippines

A closer look at the material flow of WEEE from industrial, commercial, and residential sources reveals a multifaceted challenge in Philippine e-waste management, primarily rooted in the lack of comprehensive infrastructure and low public awareness. Current regulations classify e-waste as hazardous, but the informal sector remains the dominant handler of discarded electronics, leading to environmentally unsound practices like open burning that release toxic substances and pose severe health risks. Although there is a general awareness of e-waste hazards, this does not translate into consistent proper disposal, as many consumers either store old gadgets or dispose of them alongside municipal solid waste.[17] Furthermore, e-waste volumes continue to increase due to technological obsolescence and the ongoing importation of second-hand electronics, overwhelming the limited formal TSD facilities that are often unevenly distributed across the country, as discussed in the next section of this report.

A) Technologies on EEE recycling and waste disposals

As mentioned in Section 1, the management of WEEE is covered under DENR Department Administrative Order (DAO) 2013-22, which serves as the procedural manual for the

[17] Environweave field interviews on e-waste, 2012–2025.

implementation of RA 6969, or the 'Toxic Substances and Hazardous and Nuclear Wastes Control Act of 1990'.

DAO 2013-22 defines the key actors at the different stages of hazardous waste material flow:

1. Hazardous waste generators are entities that produce hazardous waste through institutional, commercial, industrial, or trade activities. Generators are categorised as large, medium, or small based on the volume and type of waste they produce annually. Sheet D of Annex 3 provides detailed information.
2. Hazardous waste transporters are entities that receive these properly packed and labelled hazardous waste with accompanying manifests, and transport these in their entirety to a registered TSD facility.
3. In TSD facilities, hazardous waste can be stored, recycled, reprocessed, treated, or disposed of in an environmentally sound manner. These facilities are categorised based on the types of services they provide; some might only serve as temporary storage, while others can do different levels of waste processing. Sheet E of Annex 3 lists these categories in detail.

Hazardous waste generators, transporters, and TSD facilities must be registered with DENR-EMB and possess corresponding identification numbers. A business or facility can be registered under any or all of these categories. For instance, a licensed TSD recycling facility that receives certain types of e-waste may also have a transporter permit enabling it to collect e-waste from registered sources. The same facility may, in turn, be classified as a hazardous waste generator, requiring another entity to process its sludge or receive contaminated materials for chemical stabilisation and entombment. It is important to note that, to ensure the proper treatment of any hazardous waste generated from any activity – whether arising from residential areas, commercial establishments, offices, or factories – an entity must be registered under the DENR-EMB Hazardous Waste Manifest System. Otherwise, hazardous waste transporters or treatment facilities will not be allowed to receive such waste.

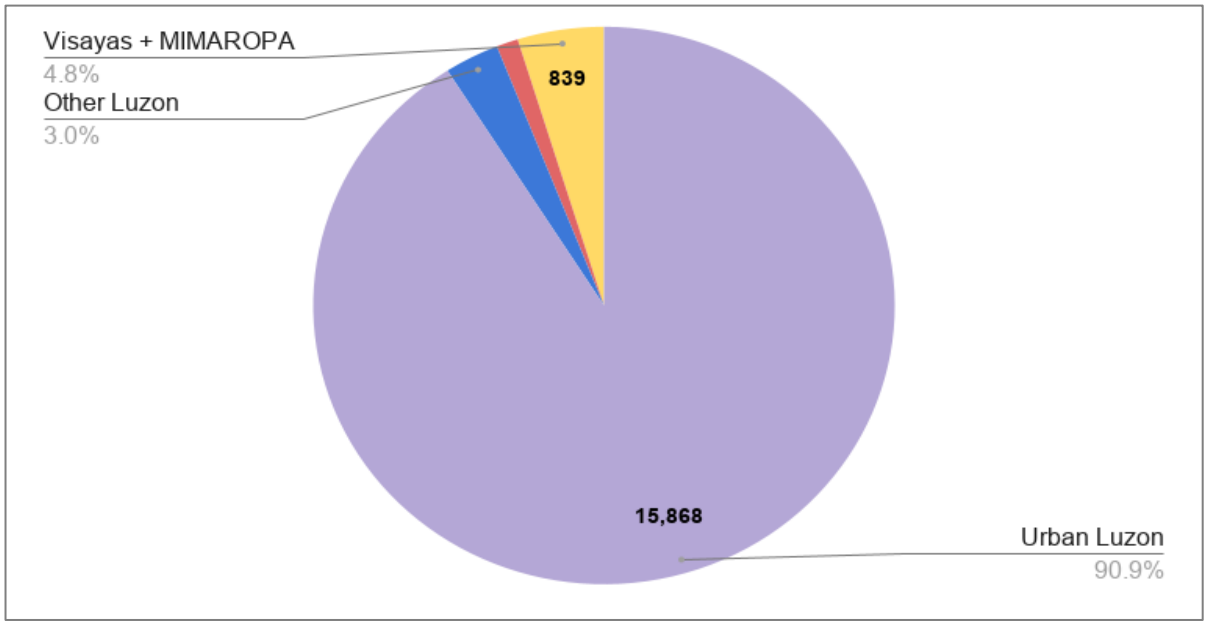
A list of companies registered as hazardous waste transporters and TSD facilities is openly available at the DENR-EMB website. For hazardous waste generators, the names of companies are redacted, although the nature of their business and regional location is provided (EMB, n.d.). All three types of entities also must identify what hazardous wastes these are based on waste codes provided in the 2013 Procedural Manual. Waste electrical and electronic equipment are assigned to the hazardous waste code M506, although special waste coming from municipal sources (M507) may also include e-waste.

For the past 5 years, a total of 17.4 kT of WEEE was generated from industrial and commercial sources that were registered as hazardous waste generators under DENR-EMB's Online Permitting and Monitoring System (OPMS). Nearly 91% of this amount was generated in three highly urbanised regions in Luzon, namely, the National Capital Region (Metro Manila) and the adjacent regions of Central Luzon and CALABARZON, where many

industrial parks are located (see Figure 4.23). Annual amounts generated per region are available on Sheet 14 of Annex 1.

In the Philippines, 36 TSD facilities accepting WEEE (M506) have active licences from August 2025 until August 2026, based on the online list of hazardous waste TSD facilities from the DENR-EMB website (see Figure 4.24). Out of these 36 facilities, 23 specialise in accepting only WEEE (M506), while 7 also accept special waste from residential areas and commercial establishments, which may include e-waste (M507). Five facilities also have the capacity to treat other types of hazardous waste, implying that the fate of WEEE is likely subjected to thermal treatment, chemical immobilisation, or encapsulation, together with other hazardous waste types. One facility, located in Cavite (south of Metro Manila), can receive WEEE, municipal special waste, as well as other hazardous waste.

Figure 4.23. WEEE Generated by Registered M506 Hazardous Waste Generators (in tonnes, 2020–2024)



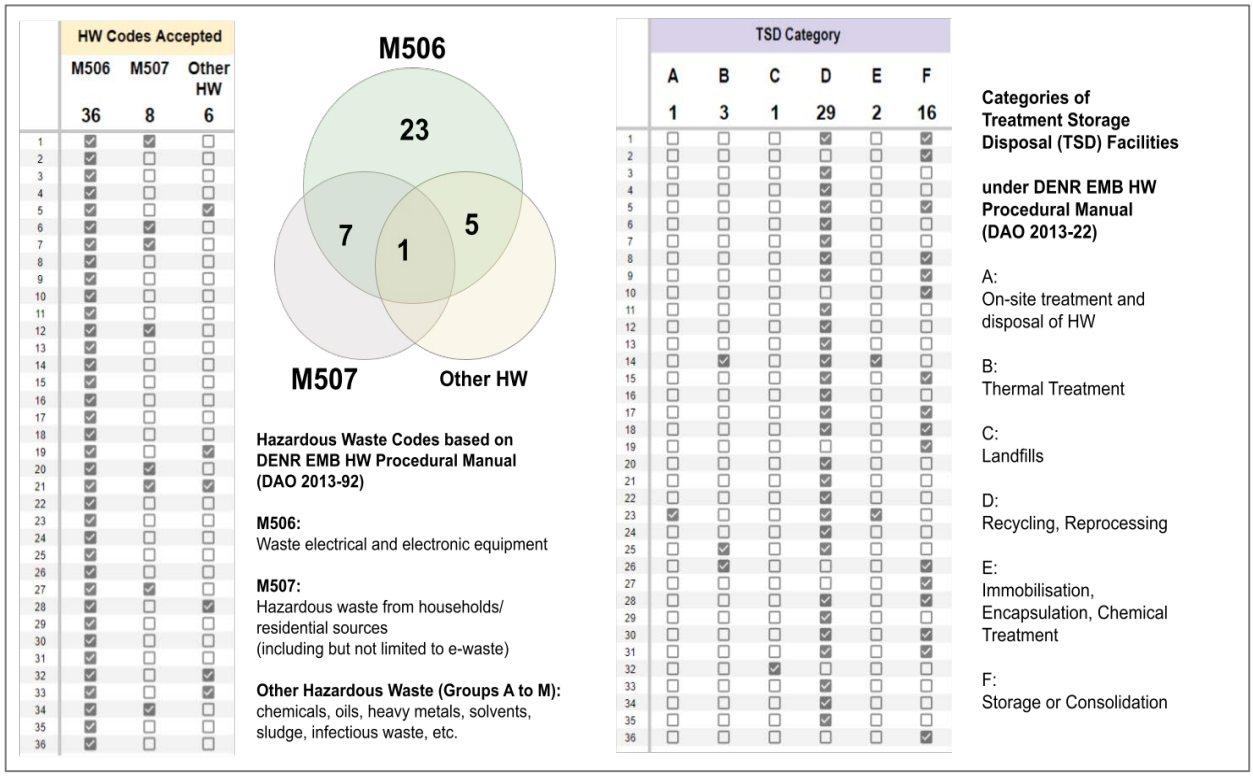
Source: Based on DENR-EMB Hazardous Waste data provided under the Sustainable E-Waste Management and Recycling bilateral project with MOEJ, extracted from OPMS.
Chart generated by Environweave for this report.

Figure 4.24 also shows how these TSD facilities are registered based on categories specified in the 2013 Procedural Manual. Twenty-nine (29) facilities registered as Category D undertake various recycling and reprocessing activities, typically involving manual dismantling to recover plastic and metal parts. In contrast, six TSDs facilities may be considered endpoints of EEE-related hazardous materials, which are treated through thermal processes (Category B), immobilisation, encapsulation, or chemical treatment (Category E), or disposed of through final landfilling (Category C).

The DENR-EMB database of TSD facilities contains information on how each facility processes received WEEE, including general treatment methods selected from a drop-

down list, as well as descriptions of the processes employed by the facility, as provided during registration or annual renewal of their licences. Figure 4.25 shows these more specific activities of WEEE processing based on what was self-declared by these registered TSD facilities, as well as from information obtained by Environweave during recent field visits in the past 12 months. Most WEEE TSD facilities do manual or physical dismantling for recyclables recovery, likely to be sold to other facilities that receive plastics or metals for recycling, or further treatment of parts contaminated with hazardous waste, as applicable. A few facilities recover copper, precious metals, or other metals. Environweave knows two TSD facilities that can do chemical refining, one in Central Luzon, and another in Central Visayas; however, these operate with modest capacities and only receive select types of e-scrap. Two TSD facilities reported importing e-scrap, while 12 indicated that the export of processed e-scrap forms part of their operations.

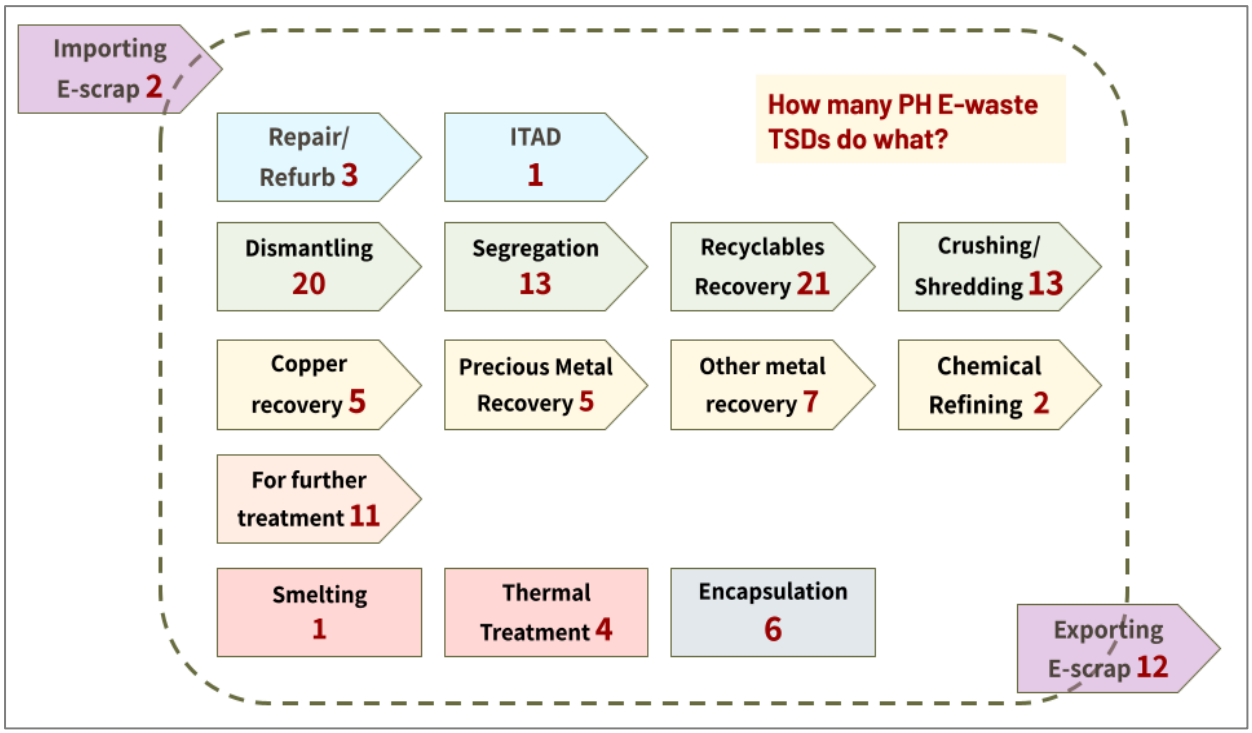
Figure 4.24. TSD Facilities Accepting WEEE with Active Licences (August 2025–August 2026)



HW = hazardous waste.
Source: Data from DENR-EMB Hazardous Waste TSD online database extracted on 4 September 2025 and processed by Environweave for this report.

Figure 4.25. Processes Undertaken in the Philippines by Licensed TSD Facilities Accepting WEEE (August 2025–August 2026)

Source: DENR-EMB Hazardous Waste TSD online database (extracted on 4 September 2025; prior visits to selected facilities (2024–2025); and processing by Environweave for this report.



Based on available information from the online TSD database, the 21 registered facilities that do dismantling and physical recovery of recyclable materials have a collective capacity of around 1 kT per day (Table 4.4). Approximately 340 tonnes per day of WEEE can be received by eight facilities for thermal treatment, immobilisation, or encapsulation, while the export consolidation capacities declared by seven facilities collectively total slightly more than 40 tonnes per day. Note that these are only declared capacities and may not reflect actual amounts of treated WEEE. Figure 4.26 shows the amount of WEEE treated as reflected in DENR-EMB's OPMS, per TSD category. Detailed information is provided on Sheet 15 of Annex 1.

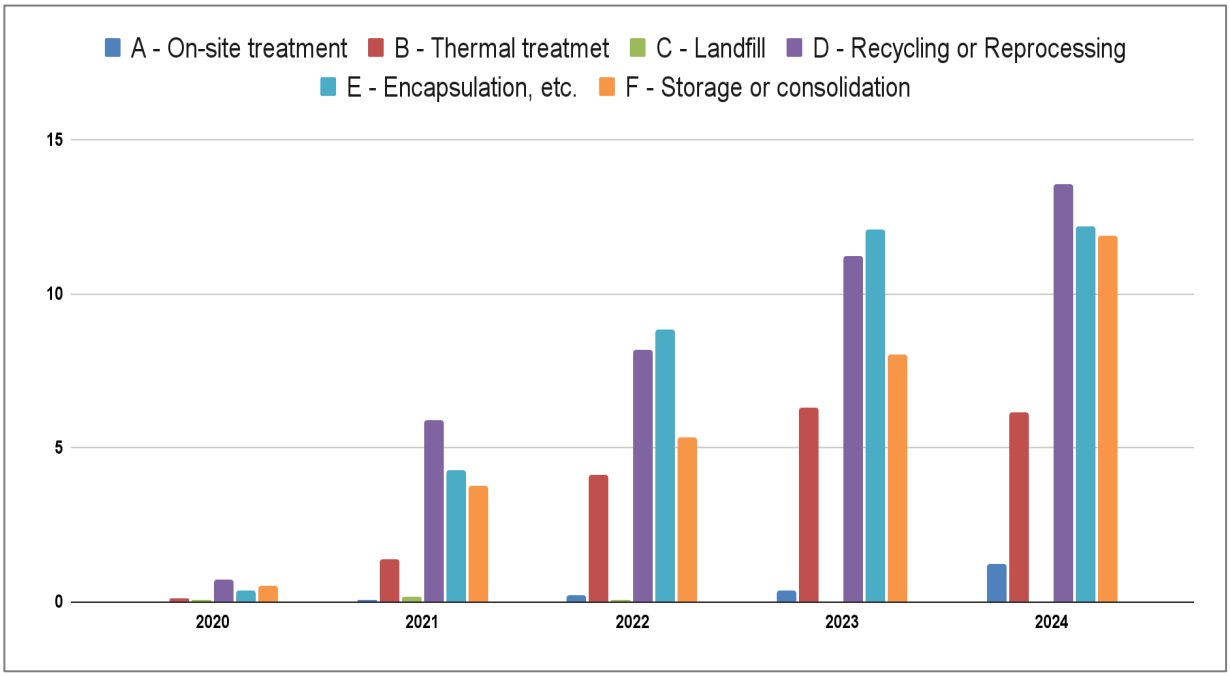
A map of the locations of WEEE TSD facilities was developed by Environweave for this report, with a link to the interactive online map containing details of each facility, such as company name, address, treatment processes done, and declared capacities. Figure 4.27 provides a snapshot of the geographic distribution of these facilities, with 32 out of 36 located within Luzon, 27 of which are found in the Central Luzon and CALABARZON regions (north and south of Metro Manila). Only three are in the Visayas, and the sole registered WEEE TSD facility in Mindanao only serves as temporary storage (TSD Category F). Only a few TSD facilities are capable of precious metal extraction from e-scrap, one of which is Semirecycling, Inc. located in Clark Freeport Zone in Pampanga.

Table 4.4. Declared Capacities for Treatment, Storage, or Disposal

Activity	Capacity (tonnes/ day)	Number of TSD Facilities That Provided Capacity Data
Storage	10.83	4
Physical recovery	1,100.94	21
Chemical recovery	14.60	4
Thermal treatment or encapsulation	343.77	8
Export consolidation	41.89	7
TOTAL	**1,512.03**	**40** (some facilities provide more than one service)

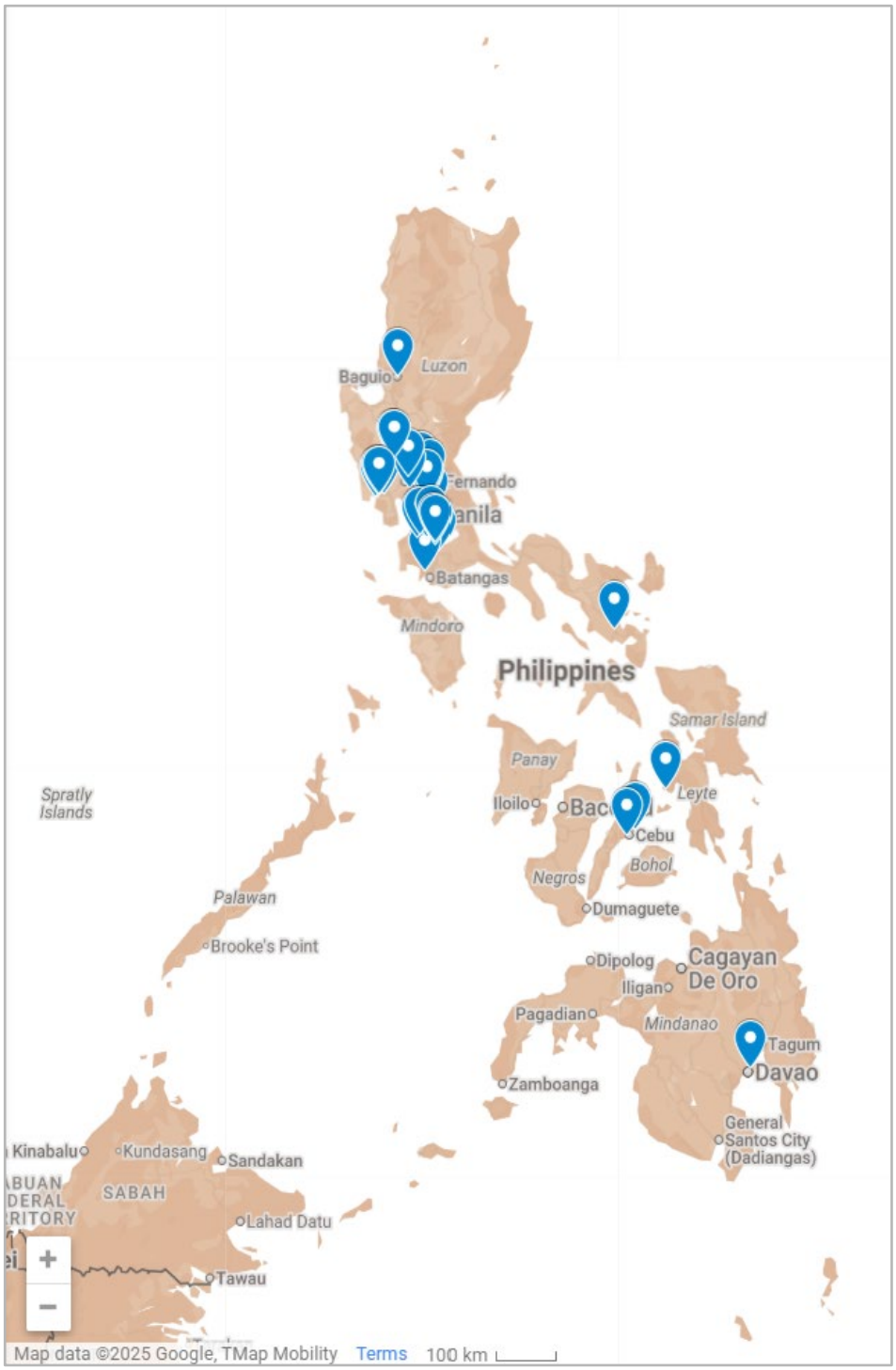
Source: DENR-EMB Hazardous Waste TSD online database extracted on 4 September 2025, processed by Environweave for this report.

Figure 4.26. Amount of Treated WEEE per TSD Category (kilotonnes per year, 2020—2024)



Source: Based on DENR-EMB Hazardous Waste data provided under the Sustainable E-Waste Management and Recycling bilateral project with MOEJ, extracted from OPMS.
Chart generated by Environweave for this report.

Figure 4.27. Geographic Distribution of TSDs for WEEE (M506)



Source: DENR-EMB Hazardous Waste TSDs online database, extracted on 4 September 2025. Map generated by Environweave for this report. Link to online map

B) Green alternatives for EEE-relevant materials and ecolabelling criteria

Currently, no specific policies in the Philippines require or push the use of alternative materials for locally produced electronic assemblies and EEE. There is a voluntary programme under the National Ecolabelling Program – Green Choice Philippines (NELP-GCP), which sets criteria for various kinds of products and services, including electrical appliances and electronic products ((PCEPSDI, n.d.). Under the NELP-GCP programme, ecolabelling criteria were developed for the following EEE, as listed in Table 4.5:

Table 4.5. Electrical Appliances and Electronic Products with Green Choice Philippines Ecolabelling Criteria

EEE Category	Criteria Code and EEE Product	Relevant Criteria for Voluntary Ecolabelling
Temperature exchange equipment	GCP 20250036 – Refrigerators and Freezers GCP 20250039 – Room Air Conditioners	• Compliance to the Implementing Guidelines of the Philippine Energy Labeling Program for Air Conditioners or Refrigerating Appliances • Refrigerants must have ozone depletion potential of zero (ODP = 0). • Limits to global warming potential of refrigerants in the refrigerating circuit as cooling agents for the appliance • RoHS-compliant • Lead content in paints should be within standards. • Take-back system for retrieval of its product from end users • Recyclability of 75% of its weight or higher
Screens, monitors, and equipment with screens	GCP 20080023 – Laptop Computer GCP 20170024 – Computer Monitor	• Product shall not contain substances listed in the DENR AO 2005-05 and/or RoHS. • Limits to heavy metal content in batteries and other specified parts • Limits to hazardous components in plastic parts • 3R design • Take back programme of 10% of units sold
Lamps	GCP 20070010 – Fluorescent Lamps GCP PRP 2009002 – Induction Lamp Luminaires GCP PRP 2016008 – LED Light	• Limits to applicable hazardous substances, e.g., mercury content, lead, cadmium, hexavalent chromium, PBBs, PBDEs • Energy efficiency and low power consumption • Retrieval and disposal programme
Small IT and telecom equipment	GCP 20080022 – Desktop Computer GCP 20080025 –	• Product shall not contain substances listed in the DENR AO 2005-05 and/or RoHS.

EEE Category	Criteria Code and EEE Product	Relevant Criteria for Voluntary Ecolabelling
	Printers GCP 20080026 – Photocopier GCP 20080027 – Multi-Function Printing Devices (MFPD) GCP 20080028 – Facsimile Machine	• Limits to heavy metal content in batteries and other specified parts • Limits to hazardous components in plastic parts • Limits to emissions for ozone, particulate matter, or VOCs (for printers/photocopiers) • The inks and toners shall comply with the requirements of GCP Criteria 2008022 and GCP 2008023. • 3R design • Take-back programme of 10% of units sold
Other EEE-related components, parts, or energy storage	GCP 20030003 – Zinc-Carbon & Zinc-Alkaline Manganese Dioxide Batteries GCP 20070011 – Electronic Ballasts GCP PRP 2011005 – LED	• Limits to mercury and cadmium content • Zinc-Carbon/Zinc-Alkaline MnO2 batteries shall comply with the requirements of PNS 08-1995. • Limits to applicable hazardous substances, e.g., mercury content, lead, cadmium, hexavalent chromium, PBBs, PBDEs

DENR-AO = Department of Environment and Natural Resources–Administrative Order, GCP = polybrominated diphenyl ethers, PBBs = polybrominated biphenyls, PBDEs = polybrominated diphenyl ethers, RoHS = Restriction on Hazardous Substances Directive, VOCs = volatile organic compounds.
Source: Based information from the Green Choice Philippines website, summarised and organised according to major EEE categories by Environweave for this report.

C) Policy and regulations on domestic EEE recycling and waste disposals

As mentioned in Section 1, WEEE is listed as hazardous waste under DENR Department Administrative Order (DAO) 2013-22, which serves as the procedural manual for the implementation of RA 6969, or the 'Toxic Substances and Hazardous and Nuclear Wastes Control Act of 1990'. Under Table 2.1 of the 2013 Procedural Manual, WEEE is listed under Class M or 'miscellaneous waste', with waste code **M506** (DAO 2013-22, 2013), added as a new category that was not included in the first version of the procedural manual issued in 2004. These waste codes are used for proper monitoring under the online Hazardous Waste Manifest System implemented by EMB. Table 4.6 lists the types of miscellaneous waste identified under the current procedural manual.

Hazardous Waste Code M506 serves as a **general category for all WEEE**, defined mainly based on the harmful chemicals that are contained in their parts. Note, however, that other **post-consumer EEE** are listed in another Waste Code, M507, or 'special wastes', which are generated by households and residential areas. This takes into account another national law, the Ecological Solid Waste Management Act of 2000, under a separate municipal waste category for items requires specialised treatment or disposal methods (RA 9003, 2000). Special wastes from households include items that may release harmful chemicals or

cause significant ecological harm when improperly disposed of, such as busted fluorescent lamps, car batteries, and used oil. They may also include bulky waste, such as furniture and construction materials. Thus, while the M507 waste code could be used to classify broken household appliances, this code is not exclusively used for household e-waste.

While not explicitly defined in DAO 2013-22, in practice, wastes classified as M506 are usually applied for electronic scrap such as trimmings or quality control rejects from the manufacturing line, or, say, obsolete equipment disposed of from industrial sources. These often come from locators in special economic zones. During past visits to TSD facilities authorised to accept M506 waste, operators often emphasised that they do not accept 'e-waste', but they accept 'e-scrap', implying that they do not receive EEE discarded directly by consumers. Meanwhile, wastes classified as M507 originate from residential or commercial areas and may or may not include EEE at the time of collection. Thus, in consolidating data on the quantities of e-waste generated, transported, stored, treated, exported, or disposed of domestically, post-consumer e-waste is grouped together with non-EEE hazardous waste under M507. Furthermore, given the diversity of EEE types and, consequently, the diversity of treatment methods that need to be employed to address specific hazardous characteristics per type, waste code M506 does not provide disaggregation for the six major categories of EEE. In processing national data on the quantities of M506 generated, transported, treated, or disposed of, it is not possible to determine whether these materials comprise equipment containing refrigerants, LED or LCD panels, lead-contaminated glass, mercury- or arsenic-contaminated lamps, or lead-containing electronic assemblies. To do so, a thorough analysis of manifest records and self-monitoring reports that are required to be submitted by hazardous waste generators, transporters, and treaters needs to be done. This would entail that pertinent information such as the specific descriptions of the type of WEEE be in the form of a digital (i.e., machine readable) database.

The need for defining what are EEE in Philippine environmental policy and the further disaggregation of WEEE types have been incorporated into the ongoing revisions of DAO 2013-22[18] (DENR, 2024). This proposed third version of the procedural manual provides the definition of 'EEE':

> '"EEE" refers to electrical and electronic equipment that is dependent on electric currents or electromagnetic fields to work properly, including components that can be removed from equipment and can be tested for functionality, and either be subsequently reused or reused after repair or refurbishment. This shall include equipment that needs household batteries or power sources (e.g., solar) to run or operate. This term does not include large-scale stationary industrial tools or large-scale fixed installations'.

[18] Revised Procedures and Standards for the Management of Hazardous Waste (DAO 2013-22 Amendment Draft) [Unpublished draft administrative order]. Environmental Management Bureau. https://emb.gov.ph/wp-content/uploads/2024/08/DAO-2013-22-Amendment-DRAFT-LUZON-STAKEHOLDERS.pdf

The proposed amendments include detailed subgroupings under the hazardous waste codes, including 14 new subcategories for M506 (WEEE) and 13 subcategories for M507 (special waste). Table 4.7 presents the proposed WEEE subcategories under M506, as well as selected EEE-related codes under M507, together with their equivalent classifications under other nomenclatures, such as those used in the European Union (6 major categories), the UNU-KEYS (54 major categories), and Annex VIII (List A) of the Basel Convention. Table 4.8 presents the nomenclature comparison in reverse, with the proposed M506 and M507 subcategories aligned with their equivalent UNU-KEYS groupings.

Table 4.6. Hazardous Waste under Class M: Miscellaneous Wastes

Class	Description	Code
Pathological or infectious wastes	Includes healthcare wastes from hospitals, medical centres and clinics containing pathological, pathogenic and infectious wastes, sharps, and others	M501
Asbestos waste	All asbestos wastes (refer to Chemical Control Order)	M502
Pharmaceuticals and drugs	Expired pharmaceuticals and drugs stocked at producers and retailers' facilities that contain hazardous constituents harmful to the environment such as antibiotics, veterinary and phytopharmaceuticals, and others	M503
Persistent Organic Pollutants (POPs) wastes	Wastes listed in the Stockholm Convention on POPs such as, but not limited to, aldrin, chlordane, dieldrin, endrin, heptachlor, hexachlorobenzene, mirex, toxaphene, and dichlorodiphenyltrichloroethane (DDT). Polychlorinated Biphenyl (PCB) wastes are categorised as L404 and excluded from this sub-category.	M505
Waste electrical and electronic equipment (WEEE)	Include all waste electrical and electronic equipment that contain hazardous components such as lead, cadmium, mercury, hexavalent chromium, polybrominated biphenyls (PBBs) and polybrominated diphenyl ethers (PBDEs) that includes its peripherals, i.e., ink cartridges, toners, etc.	**M506**
Special wastes	Household hazardous wastes such as paints, thinners, household batteries, lead-acid batteries, spray canisters, and the like that are consolidated by material recovery facilities (MRFs). These include wastes from residential and commercial sources comprising **consumer electronics, white goods (i.e. refrigerators, washing machines, and air conditioners)** batteries, used oil and **busted lamps**.	**M507**

Source: Based on Table 2.1 in DAO 2013-22, 'Revised Procedures and Standards for the Management of Hazardous Wastes (Revising DAO 2004-36)'. Bold text emphasis is done for this report.

Table 4.7. Proposed Amendments to Hazardous Waste Codes for EEE-Related Items vs. Other EEE Nomenclature

	Proposed WEEE Subcategories (DAO 2013-22 Amendments)	Proposed Code	EU6 -PV	UNU-KEYS	Basel
1	Lighting products containing arsenic and its compounds	M506-A1	3	0505	
2	Lighting products containing mercury and its compounds	M506-A2	3	0502, 0503, 0504	
3	Other lighting products containing regulated substances	M506-A3	3	0501, 0504	
4	**Information technology (IT) equipment, devices, and accessories** Include, but are not limited to routers, repeaters, switches, servers, modems, computer hardware (e.g., keyboards, automatic voltage regulators, mice, etc.); computer units (e.g., desktops, laptops, netbooks, etc.) including computer screens (e.g., CRT, LCD, LED, etc.); central processing units (CPUs); external data storage devices (e.g., flash drives and hard disk drives); photocopiers, scanners, printers, etc.	M506-B	6 2 4a	0301, 0302, 0304, 0303, 0308, 0309, 0307	
5	**Telecommunication devices** Include, but are not limited to telephones, fax machines, wireless telephones, mobile phones, tablets, radios, etc.	M506-C	6 2	0305, 0306, 0303	
6	**Electrical and electronic appliances** Include, but are not limited to: ● Consumer appliances such as TV sets (including CRT, plasma, LCD, or LED TV sets), microwaves, coffee makers, toasters, automatic dispensers, electric fans, vacuum cleaners, cooking ranges/ovens, refrigerators, washing machines, heating/air conditioning units, etc. ● Industrial electronic and electrical appliances except those fixed and stationary industrial electronic and electrical appliances	M506-D	2 1 4a 5	0407, 0408, 0108, 0109, 0111, 0112, 0113, 1002, 0001, 0101, 0102, 0103, 0104, 0105, 0106, 1001, 0114, 0201, 0202, 0203, 0204, 0205, 0401	
7	**Electric process equipment** containing **printed wiring boards**	M506-E	parts of 1, 2, 4a, 5, 6		A1180
8	**Entertainment, sports, leisure, and recreational devices/equipment** Include, but are not limited to gaming consoles (e.g., PlayStation, Xbox, Wii, etc.); portable gaming devices (e.g., 3DS, PSP, etc.); portable music players, electronic toys, etc.	M506-F	4a 5	0703, 0402, 0403, 0701	

	Proposed WEEE Subcategories (DAO 2013-22 Amendments)	Proposed Code	EU6 -PV	UNU-KEYS	Basel
9	**Image-producing devices** Include, but are not limited to cameras, camcorders, video recorders, DVDs, VCDs, CDs, and other tape readers, etc.	M506-G	5	0404, 0406	
10	**Sampling and laboratory equipment** Include, but are not limited to high performance liquid chromatography, atomic absorption spectrometer, UV-VIS spectrophotometer, etc.	M506-H	4a	0902	
11	**Medical equipment and devices except all implanted and infected products** Including, but are not limited to, ultrasound, urinalysis system, patient monitor, defibrillator, jaundice metre, ventilator, radiotherapy equipment, cardiology, dialysis, pulmonary ventilators, analysers, freezers, and other appliances for detecting, preventing, monitoring, treating, alleviating illness, injury, or disability	M506-I	4a 5	0802, 0801	
12	**Monitoring and control instruments** Include, but are not limited to smoke detectors, heating regulators, thermostats, measuring, weighing or adjusting appliances for household or laboratory equipment, and other monitoring and control instruments used in industrial installations	M506-J	4a 5	0902, 0901	
13	**Energy storage devices** Include, but are not limited to, lithium-ion batteries, solar panels, uninterruptible power supply (UPS), and power banks	M506-K	4b (PV panels) the rest not WEEE	Batteries as a separate category, not considered WEEE	
14	**Ink cartridges, toners**	M506-L	parts of 6	0304	
Select special waste from residential and commercial sources					
15	**Used lead acid batteries (ULABs)** from municipal waste	M507-A	Not WEEE	Not WEEE	A1160
16	**Busted fluorescent lamps** from municipal waste	M507-H		0502, 0503	A1030
17	**Busted LED Light** from municipal waste	M507-I		0505	A1030
18	**E-waste or WEEE** from municipal waste	M507-J	1, 2, 4a, 4b, 5, 6	43 different categories	

Source: Based on proposed amendments for Table 2.1 in DAO 2013-22, and compared against listed categories using EU, UNU-KEYS (UNITAR, 2024), and Basel Convention Annex VIII (List A). Table created by Environweave for this report.

Table 4.8. Proposed Amendments to Hazardous Waste Codes for EEE-Related Items vs. Other EEE Nomenclature

EU-6PV	Major EEE Category	UNU-KEYS	Description	Proposed M506	Proposed M507
1	Temperature exchange equipment	0108	Fridges (including combi-fridges)	M506-D	J
		0109	Freezers	D	J
		0111	Air conditioners (household installed and portable)	D	J
		0112	Other cooling equipment (e.g., dehumidifiers, heat pump dryers)	D	J
		0113	Professional cooling equipment (e.g., large air conditioners, cooling displays)	D	Not applicable
		1002	Cooled dispensers (e.g., for vending, cold drinks)	D	Not applicable
2	Screens, monitors, and equipment containing screens	0303	Laptops (including tablets)	B	J
		0308	Cathode ray tube (CRT) monitors	B	J
		0309	Flat display panel monitors (LCD, LED)	B	J
		0407	CRT TVs	D	J
		0408	Flat display panel TVs (LCD, LED, Plasma)	D	J
3	Lamps	0501	Small lighting equipment (excluding LED and incandescent)	A3	Not specified
		0502	Compact fluorescent lamps (including retrofit and non-retrofit)	A2	H
		0503	Straight tube fluorescent lamps	A2	H
		0504	Special lamps (e.g., professional mercury, high- and low-pressure sodium)	A2, A3	Not applicable
		0505	LED lamps (including retrofit LED lamps)	A1	I
4a	Large equipment (excluding PV panels)	0001	Central heating (household installed)	D	J
		0101	Professional heating and ventilation (excluding cooling equipment)	D	J
		0102	Dish washers	D	J
		0103	Kitchen equipment (e.g., large furnaces, ovens, cooking equipment)	D	J

EU-6PV	Major EEE Category	UNU-KEYS	Description	Proposed M506	Proposed M507
		0104	Washing machines (including combined dryers)	D	J
		0105	Dryers (wash dryers, centrifuges)	D	J
		0106	Household heating and ventilation (e.g., hoods, ventilators, space heaters)	D	J
		0307	Professional IT equipment (e.g., servers, routers, data storage, copiers)	B	J
		0602	Professional tools (e.g., for welding, soldering, milling)	D	J
		0703	Leisure equipment (e.g., sports equipment, electric bikes, juke boxes)	F	J
		0802	Professional medical equipment (e.g., hospital, dentist, diagnostics)	I	Not applicable
		0902	Professional monitoring and control equipment (e.g., laboratory, control panels)	H, J	Not applicable
		1001	Non-cooled dispensers (e.g., for vending, hot drinks, tickets, money)	D	J
4b	Photovoltaic panels	0002	Photovoltaic panels (including inverters)	K	J
5	Small equipment	0114	Microwaves (including combined, excluding grills)	D	J
		0201	Other small household equipment (e.g., small ventilators, irons, clocks, adapters)	D	J
		0202	Equipment for food preparation (e.g., toaster, grills, food processing, frying pans)	D	J
		0203	Small household equipment for hot water preparation (e.g., coffee, tea, water cookers)	D	J
		0204	Vacuum cleaners (excluding professional)	D	J
		0205	Personal care equipment (e.g., toothbrushes, hair dryers, razors)	D	J
		0401	Small consumer electronics (e.g., headphones, remote controls)	D	J
		0402	Portable audio and video (e.g., MP3, e-readers, car navigation)	F	J
		0403	Musical instruments, radio, hi-fi (including audio sets)	F	J

EU-6PV	Major EEE Category	UNU-KEYS	Description	Proposed M506	Proposed M507
		0404	Video (e.g., video recorders, DVD, Blue Ray, set-top boxes) and projectors	G	J
		0405	Speakers	D	J
		0406	Cameras (e.g., camcorders, photo and digital still cameras)	G	J
		0506	Household luminaires (including household incandescent fittings and household LED luminaires)	Not applicable	H, I
		0507	Professional luminaires (offices, public space, industry)	A1, A2, A3	Not applicable
		0601	Household tools (e.g., drills, saws, high pressure cleaners, lawn mowers)	D	J
		0701	Toys (e.g., car racing sets, electric trains, music toys, bikes, computers, drones)	F	J
		0801	Household medical equipment (e.g., thermometers, blood pressure meters)	I	J
		0901	Household monitoring and control equipment (alarm, heat, smoke, excluding screens)	J	J
6	Small IT and telecommunication equipment	0301	Small IT equipment (e.g., routers, mice, keyboards, external drives and accessories)	B	J
		0302	Desktop PCs (excluding monitors, accessories)	B	J
		0304	Printers (e.g., scanners, multi-functionals, faxes)	B, L	J
		0305	Telecommunication equipment (e.g., [cordless] phones, answering machines)	C	J
		0306	Mobile phones (including smartphones, pagers)	C	J
		0702	Game consoles	F	J

Source: Based on proposed amendments for Table 2.1 in DAO 2013-22, and compared against listed categories using EU, UNU-KEYS (Baldé et al., 2024) and Basel Annex VIII. Comparison table developed by Environweave for this report.

D) Definition and discussion on urban mining

In the Philippines, there is no legal text yet that defines 'urban mining', although this concept is widely used in discussions of circular economy in general in the context of recovering valuable materials from end-of-life projects, particularly those found in urban areas.

Recent academic literature has investigated the history of this concept, citing seminal ideas that developed as early as 1969 by the author and urban theorist Jane Jacobs, and citing a 1988 statement by the Japanese professor Randolph Nanjo that the accumulation of materials on the Earth's surface may be regarded as 'urban mines' (Aldebei and Dombi, 2021). This same paper identifies a definition from Johansson et al. (2013) as comprehensive and inclusive, since this includes in-use stocks, landfills, tailing ponds, slag heaps, and dissipated metal resources.

For the Philippine local context, a paper by Filipino and Japanese academics focused on shifting the perspective of e-waste as a liability towards looking at it as a potential source for rare earth elements, while facing the current reality of informal urban mining as a source of health risks to workers and the surrounding community (Ballesteros et al., 2023). This study looks at different business modalities for turning existing material recovery facilities (MRFs) at the barangay (sub-municipal local government level) into TSD facilities that can receive e-waste from residential areas, in partnership with a larger recycler. Their findings indicated that a business structure wherein the formal recycler receives and pays for the dismantled items from WEEE from the local MRF-TSD would be the most financially viable option.

For more than a decade, Ballesteros and de Sales of the University of the Philippines have been collaborating with Atsushi Terazono and Aya Yoshida of the NIES and several Japanese universities in studying the effects of informal dismantling of WEEE on the health of workers and community members, as well as possible environmental contamination. These include papers on the effects of various heavy metals in surface matrices (Fujimori et al., 2012), lead speciation, and oral bioaccessibility (Fujimori et al., 2018), chlorinated and brominated polycyclic aromatic hydrocarbons in soils from e-waste open burning (Nishimura et al., 2017), as well as comparative case studies of CRT TVs and monitors in three Southeast Asian countries, including the Philippines (Yoshida et al., 2016). The author participated in several of these sampling and data collection activities and accompanied other field researchers and community health advocates, including representatives of Médecins du Monde, who were focusing on heavy metal exposure from informal dismantling and metal recovery activities associated with e-waste. Figure 4.28 shows pictures taken by the author showing informal recycling activities for various studies on e-waste from 2008 to present.

Over the years, environmental researchers and advocacy groups have identified certain hotspots for informal e-waste dismantling within Metro Manila and its outlying areas. These were chosen as pilot areas under a project of the United Nations Industrial Development Organization (UNIDO) through funding from the Global Environment Facility, called the 'Safe Polychlorinated Biphenyls and E-Waste Management Project' (Figure 4.29). This project, launched in 2020 and concluded 4 years later, was implemented in partnership with DENR-

EMB, EcoWaste Coalition, the local governments of identified e-waste hotspots, and telecommunications providers. One of the project goals is to set up a proper dismantling facility to support informal e-waste dismantlers to become part of the formal e-waste recycling system (UNIDO, 2024). This included organisational development under a co-operative, improvement of occupational safety and health by providing proper tools, personal protective equipment, and a well-ventilated facility, and linking them with accredited hazardous waste treaters that can treat contaminated components like plastic casings with flame retardants and picture tube glass with lead. Unfortunately, only the e-waste MRF in Barangay Bakakeng Central is still active as of October 2025, with the support of Baguio City and its private sector partners.

Figure 4.28. Informal Metal Recovery from E-Waste in the Philippines (2008–2024)



Above: Backyard e-scrap dismantling and precious metal recovery (Bulacan, 2008)

Above: Children exposed to hazardous material from e-waste (Metro Manila, 2012)



Above: Gold extraction from e-scrap using acid baths and smelting techniques (Bulacan, 2015)





Right: Copper wire extraction from e-scrap through open burning or dismantling (Metro Manila, 2024)

Source: All photos taken by Melissa M.F. Cardenas.

Figure 4.29. MRFs Converted to E-Waste TSD Facilities Under a Project by UNIDO Philippines



MRF = material recovery facility, TSD = treatment, storage, and disposal.
Note: Pilot e-waste MRFs set up under the 'Safe Polychlorinated Biphenyls and E-Waste Management Project' through a partnership of UNIDO Philippines, the Global Environment Facility, DENR, EcoWaste Coalition, local governments, and the private sector.

2.3 Analysis and discussion

A) Proposed Philippine hazardous waste nomenclature for WEEE

It should be noted that several overlaps exist between the proposed Philippine WEEE subcategories and the six major EEE categories and UNU-KEYS nomenclature. For instance, M506-B – IT equipment, devices, and accessories – includes items that fall under three different EU-6 categories and seven codes under UNU-KEYS. Electrical and electronic appliances, M506-D, include temperature exchange equipment, screens and monitors, large equipment, and small appliances (under the EU-6 system), and 23 codes under the UNU-KEYS classification. The proposed M506-D category would cover different EEE that have varied needs in terms of collection system, recycling, and hazardous waste treatment technology.

Furthermore, the proposed M507-J, e-waste or WEEE from residential and commercial sources, includes all the major EU EEE categories except for lamps, and includes 43 of the 54 UNU-KEYS categories. Although special municipal waste is to be managed by MRFs that are also registered with the EMB, these facilities may be registered both as TSD facilities under M507-J – serving as temporary storage sites or undertaking mechanical dismantling and the recovery of non-hazardous recyclables – and as generators of hazardous waste under the more specific M506 subcategories.

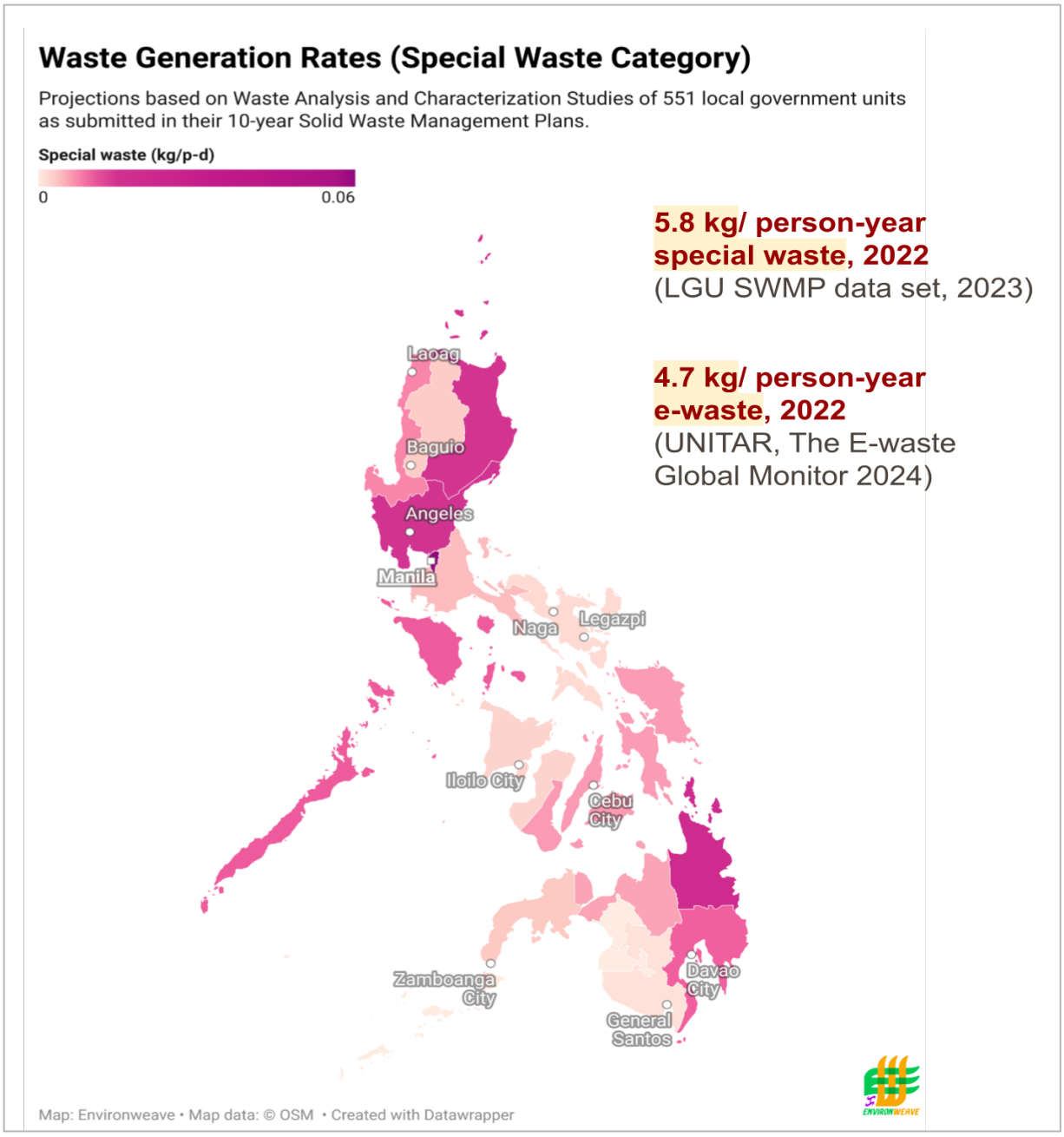
That said, the overlapping categories in the proposed new local WEEE nomenclature will pose a challenge in data analysis and monitoring policy effectiveness or usage of proper treatment technology. For instance, when matching with TSD facilities that have the capacity to properly treat lead-contaminated CRT glass – which all fall under EU Category 2 (screens, monitors, and equipment containing screens) – under the proposed coding system, these items can be part of M506-B (CRT computer monitors, grouped with other IT equipment); M506-D (CRT TVs, grouped with other electrical and electronic appliances); or M507-J (grouped with all e-waste or WEEE from residential areas and commercial establishments).

B) Lack of proper household e-waste collection and recycling

It is difficult to quantify how much e-waste is generated from households across the country; however, this can be indirectly estimated from waste analysis and characterisation studies done by cities and municipalities as part of their solid waste management plans. WEEE is part of the fraction classified as 'special waste', which includes all kinds of hazardous waste generated by households. Using data from 551 plans submitted by local government units to the National Solid Waste Management Commission, about 5.8 kg of special waste was generated per person-year as of 2022 (Environweave Integrative Environmental Research, 2023). This is relatively close to the UNITAR estimate of 4.7 kg per capita e-waste generation in the Philippines for the same year. Figure 4.30 shows the geographical distribution of special waste generation across the regions of the Philippines. About two-thirds of special waste is generated just within the highly urbanised regions of Luzon, with about 1,900 tonnes of special waste generated daily, based on population projections for 2025 (Figure

4.31, see detailed data in Sheet 16, Annex 1).

Figure 4.30. Geographic Distribution of Special Waste (M507) Generation for 2025

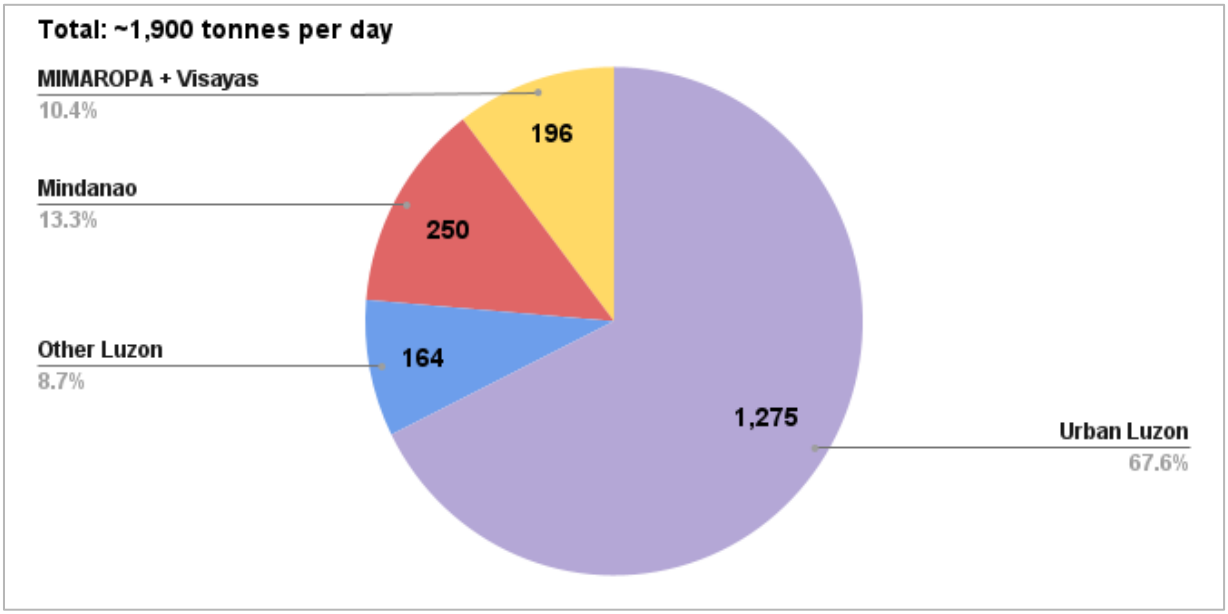


Sources: Projections based on Waste Analysis and Characterization Studies of 551 local government units as submitted in their 10-year solid waste management plans.
Detailed data available in Sheet 16, Annex 1.
Data set developed by Environweave Integrative Environmental Research, under the 'Market Size of Solid Waste Management in the Philippines', report for the Economic Research Institute for ASEAN and East Asia (2023).
Choropleth map generated by Environweave for this report using the Datawrapper App.

The dominance of informal e-waste pickers that can penetrate residential areas owes a lot to small-scale, nimble collection supported by the junk shop network all over the country.

Because backyard e-waste dismantling and metal recovery microenterprises are able to operate without environmental permits, they can offer competitive buying prices, as they incur minimal overhead and labour costs. In addition, the heterogeneity of household e-waste types and the irregularity of their disposal would make it difficult for formal e-waste recyclers to operate at economies of scale to address post-consumer WEEE.

Figure 4.31. Daily Special Waste Generation Estimates for 2025



Sources: Projections based on Waste Analysis and Characterization Studies of 551 local government units as submitted in their 10-year Solid Waste Management Plans.
Detailed data available in Sheet 16, Annex 1.
Data set developed by Environweave Integrative Environmental Research, under the 'Market Size of Solid Waste Management in the Philippines', report for the Economic Research Institute for ASEAN and East Asia (2023). Chart generated by Environweave for this report.

2.4 Conclusion

The Philippines' e-waste dilemma is a pressing challenge characterised by rapidly increasing generation, driven by high consumption and forced obsolescence, and set against an underdeveloped formal management system. While existing policy instruments, such as RA 6969 and DAO 2013-22, recognise e-waste as a hazardous stream, implementation is hampered by the persistent reliance on the informal recycling sector, which – despite offering an economic lifeline, relies on primitive, toxic methods to extract iron, steel, copper, and other precious metals. Furthermore, the continued lack of a specific and comprehensive national e-waste law, the slow ratification of the Basel Ban Amendments, and significant gaps in public awareness collectively contribute to an unsustainable material flow. To truly transition towards a circular economy and safeguard public health, a concerted effort is required to define 'waste' clearly, invest heavily in formal TSD infrastructure that can capture household-generated e-waste, and urgently pass a comprehensive EPR scheme that mandates the safe take-back and recycling of EEE from the point of sale.

The future sustainability of the electronics sector in the Philippines hinges on closing these

policy and infrastructure gaps. We recommend specific next steps focused on strengthening local government capacity to track and enforce e-waste segregation, integrating the informal sector into a formalised system to mitigate environmental pollution, and launching targeted national campaigns to boost consumer awareness regarding proper disposal routes. Addressing these drivers and barriers will be critical to establishing a resilient and environmentally sound e-waste management system that protects the nation's ecosystem and public health from the growing threat of hazardous electronic waste.

3 Key Informant Interviews, Stakeholders' Forum, and Field Visits in the Philippines

3.1 Overview

This section summarises insights from interviews, roundtable discussions, and field visits to augment and validate desktop research and importation data analysis on EEE-relevant material flows from both international and domestic trade.

3.2 Key informant interviews

To augment and validate desktop research on the transboundary movement of EEE-related materials into and from the Philippines, key informant interviews were conducted with the following relevant government agencies:

- Hazardous Waste Management Section of the Environmental Quality and Management Division, DENR-EMB, which is mandated under RA 6969 and its supporting policies to issue importation and exportation clearances for items listed in DAO 2013-22, consistent with the provisions of the Basel Convention;
- Environmental Protection and Compliance Division of BOC (BOC-EPCD) under the Department of Finance, which serves as the primary enforcing agency responsible for upholding national environmental, health, and toxic substance legislation at the point of importation;
- Import Facilitation Division of the Bureau of Import Services, Department of Trade and Industry (DTI-BIS), which manages import procedures, addresses regulatory and shipment concerns, and acts as a central clearinghouse for information;
- Export Marketing Bureau of the DTI (DTI-EMB), which, in co-operation with DENR-EMB, regulates exported e-scrap and hazardous materials, as well as maintaining and enforcing a continuously updated Non-exhaustive List of Prohibited and Regulated Products.

Ahead of the interviews, conducted online in July and August of 2025, the research team provided discussion points and questions pertaining to updates on the Basel Ban ratification process, policies on transboundary movement of UEEE/WEEE/e-scrap, as well as past incidents or attempts of improperly documented EEE-related trade:

- We understand that the Philippines has yet to ratify the Basel Ban Amendments,

with some concern that this may affect some local industries. For instance, this will affect businesses that import electronic scrap for local recycling or processing. Is there an update on the ratification process?

- With the entry into force of the Basel Ban Amendments this year, are there changes in the procedure for the export of e-scrap and parts from EEE for further processing outside the Philippines?
- Have there been incidents of attempted importation of wastes into the Philippines, including WEEE/e-waste, over the last 10 years? If so, what was the fate of these shipments (e.g., repatriated to the country of origin, etc.)?
- Are there specific policies and procedures regarding the entry of used goods into the Philippines, including household items, including but not limited to electric and electronic equipment?

Data on UEEE/WEEE/e-scrap import and export amounts with proper clearances were also requested from the mentioned agencies, if available. The following subsections summarise the results of these interviews. Unless otherwise specified, the information presented is drawn from said interviews. Detailed interview notes are provided in Annex 4.

A) Updates on the Philippine ratification process of the Basel Ban Amendments

As mentioned in Section 1, although the Philippines remains a state party to the core Basel Convention, it has not yet ratified the Basel Convention E-Waste Amendments, which will now also cover non-hazardous e-waste and e-scrap. The primary reason for this deferral is the economic impact on Philippine-based recyclers that have been processing e-assemblies and e-scrap from other countries. These local recyclers specialising in the recovery of metal alloys and other materials from EEE-related items rely on the import of clean secondary materials to provide a stable feedstock to maintain operational viability, given inadequate, unreliable, or heterogenous domestic supplies of e-scrap. This is also true for other regulated items such as plastics, used lead acid batteries, fly ash and bottom ash, amongst others. During key informant interviews with DTI-EMB, officials confirmed that several industries need to augment their raw material supply with imported used materials.

To address this concern, DENR-EMB commissioned a formal regulatory impact assessment (RIA), which involved a closer look at importation data for materials of concern, economic valuation of the impact with tighter trade flows, and consultations with importers and recycling industry stakeholders. At the time of the key informant interviews, the assessment was still in progress. However, as of October 2025, the RIA had completed its last round of consultations and was finalising the recommendations on the Ban Amendment, which are to be transmitted to the Philippine Senate.

B) Challenges in regulating and monitoring transboundary movement of EEE-related materials

Given the length of the Philippines' coastline and the numerous private ports, it is very difficult to monitor the entry of shipments and prevent the smuggling of goods into the country. Since it is physically impossible to monitor the entirety of the border as well as inspect each shipment container that enters international ports, the first level of screening is based on the HS codes and the technical goods description as reflected in the bill of lading documents. As noted in Section 1C, the HS Code 85.49 for electrical and electronic waste only took effect starting 2022. Consequently, reliance on voluntarily provided information in the goods description column makes it difficult to flag items that may constitute e-waste.

Based on the key informant interviews with BOC-ECPD, problematic shipments typically enter the national customs territory under deliberately vague classifications such as 'assorted scrap materials,' 'plastic materials,' or 'reconditioned parts,' thus obscuring the presence of toxic components in actual e-waste. When a consignment is flagged as suspicious, BOC-EPCD initiates a physical inspection and co-ordinates closely with DENR-EMB to conduct waste classification and subsequently determines the appropriate action, which includes potential repatriation or condemnation.

Recent enforcement efforts by BOC-EPCD have identified a shift in the sources of misdeclared EEE-related materials, which of late have originated from European countries. In response to this, BOC has officially alerted the European Union's Anti-Fraud Unit. This, however, is indicative of intercontinental movements of these shipments of concern originating beyond the Asian region. Furthermore, DENR-EMB pointed out that a bilateral agreement with non-party to the Basel Convention is being exploited by importers to bypass the mandatory PIC procedure, further complicating border control efforts. These shipments frequently comprise surplus military or government apparatus, not necessarily EEE-related goods.

BOC-EPCD highlighted the inherent difficulty and expense associated with the successful management of illegal waste after its entry into the Philippines. For the past 2 decades, there were only two successful repatriations of illegally imported mixed plastic waste consignments (see Sheet 13, Annex 1 for details). Furthermore, the alternative measure of condemnation and secure destruction is rarely viable for large volumes of waste materials, primarily due to prohibitive costs and the challenge of identifying an accredited, secure domestic facility capable of handling these materials for proper treatment and final disposal, if needed.

C) Policy hierarchy challenges within special economic and freeport zones

A considerable impediment for DENR-EMB and BOC-EPCD is the implementation of RA 6969 across the national territory, particularly special economic and freeport zones (SEFZs). While shipments entering or passing through these SEFZs are exempted from customs duties and taxes, both agencies argue that these must still comply with the PIC procedures

specified by the Basel Convention and should be subject to inspection.

In 2023 and 2024, over 80 containers of e-scrap and EEE-related materials entered an SEFZ, with the consignees asserting that these did not contain hazardous materials, and that these items would be processed within the SEFZ and re-exported as metals and other materials. However, these containers were seized by BOC-EPCD due to the absence of importation clearances from DENR-EMB. The importers concerned subsequently initiated legal action and successfully obtained a temporary restraining order from the Regional Trial Court, resulting in the release of the shipments into their custody. This court ruling affects the enforceability of RA 6969 and the Basel Convention in SEFZs and currently constrains the mandates of DENR-EMB and BOC pending resolution of the motion for reconsideration before the Court of Appeals. The consensus amongst BOC, DENR, and DTI is that a successful court ruling or definitive legislative action is urgently required to affirm the supremacy of national environmental laws over local SEFZ exemptions.

D) Policy on entry of UEEE and other used items into the Philippines

The import of used items is governed by a multi-agency network, with DTI-BIS acting as the co-ordinator for trade aspects. In addition to DENR and BOC, other key agencies involved include the Department of Information and Communications Technology and the Optical Media Board, which address counterfeit products. In addition, the Bureau of Philippine Standards (BPS) is responsible for establishing mandatory product certification requirements for household appliances to ensure consumer safety.

As shown in the importation data processed for this report, a significant regulatory challenge is the circumvention of the used vehicle import ban, where importers exploit a loophole by classifying completely dismantled vehicles as 'scrap' or 'parts' rather than whole vehicles. These parts are then illegally reassembled domestically into 'reconditioned' left-hand drive vehicles, often without adhering to required Philippine safety and environmental standards. The 2002 issuance of a ban on used motor vehicles importation was primarily to protect the government's Motor Vehicle Development Program, and provided exemptions to trucks, buses, and special purpose vehicles such as crane lorries, boom trucks, garbage trucks, etc.[19]. This policy was challenged by vehicle importers based in the Subic Freeport, leading to a Supreme Court ruling permitting the importation of used vehicles into Subic, subject to the condition that such vehicles 'may only be stored, used or traded, or exported out of Philippine territory, but [these] cannot be imported into the Philippines outside the secured fenced-in former Subic Naval Base area'[20]. After this ruling, other free ports attempted to become hubs for used vehicle importation, challenging the constitutionality of EO 156, resulting in a 2011 Court of Appeals ruling that lifted this ban at Port Irene in the Cagayan Economic Zone (Philippine Daily Inquirer, 2013). The recent e-scrap shipments entering the concerned SEFZ appear to be similar to the earlier case

[19] Article 3, Executive Order [EO] 156 S. 2002. https://lawphil.net/executive/execord/eo2002/eo_156_2002.html

[20] Executive Secretary v. Southwing Heavy Industries, Inc. 518 Phil. 103 (2006), Supreme Court of the Philippines. https://elibrary.judiciary.gov.ph/thebookshelf/showdocs/1/40918

involving the importation of used vehicles.

With regard to UEEE, DENR-EMB, in practice, issues import clearances for such shipments to applicants that are registered recycling or refurbishing companies. However, its regulatory reach is limited with respect to importers that are not formally registered. The key informant interviews validated the desk research findings that the country has yet to adopt an explicit national policy banning the entry of UEEE or defining what constitutes UEEE. As the Basel Convention and the Basel Ban Amendment leave this definition to the party, this is a policy gap that needs to be addressed for clearer implementation of this transboundary agreement.

E) Domestic E-waste management and its effects on international EEE-material trade

The fate of domestically generated e-waste in the Philippines can generally be grouped into two flows: a formal regulated sector that primarily addresses e-scrap from industries and a dominant informal sector that has access to WEEE generated by households. Formal e-waste management consists of DENR-accredited TSD facilities and substantial recyclers equipped to dismantle and process EEE, e-assemblies, and e-scrap classified under the hazardous waste code M506. Conversely, the informal sector, primarily composed of ambulant waste collectors supported by the junk shop network, engages in collecting the predominant volume of post-consumer e-waste. As discussed in Section 2, household e-waste is categorised under M507 together with other hazardous wastes generated in residential areas. However, for TSD facilities to be allowed to collect such wastes, the sources must also be properly registered as hazardous waste generators. The informal sector and junk shop network then inevitably have more access to household WEEE, leading to backyard dismantling and contamination of the surrounding environment. This situation is acknowledged by DENR-EMB, and the agency is looking for ways to expand the formalisation of household WEEE waste management, similar to what was done under the UNIDO project, as well as other similar programmes under the International E-Waste Management Network.

DTI-EMB echoed this concern. DTI-EMB (not to be confused with the DENR Environmental Management Bureau) is the trade department's lead unit for matters concerning the Basel Convention, instead of the DTI Bureau of Import Services, with the latter's mandate mainly providing supportive documentation and input on trade implications. DTI-EMB also regulates exported e-scrap and hazardous materials under EO 1016, S. 1985 and maintains and enforces a continuously updated Consolidated List of Prohibited and Regulated Products[21]. The regulation of hazardous e-waste is a shared responsibility, requiring formal clearance from DENR for the export of materials, such as ULABs. Furthermore, DTI-EMB mandates the stringent use of HS code for electronic scrap to ensure transparency and prevent illegal shipments from being disguised or misclassified as non-hazardous materials. However, the agency acknowledges that e-assemblies and e-scrap from household WEEE are partially

[21] Resolution No. 01, s. 2016: Revised List of Prohibited and Regulated Products for Export as of December 2016. Philippine National Trade Repository. https://www.pntr.gov.ph/wp-content/uploads/2021/04/PRPEX.pdf

processed for precious metals through backyard smelting, and the remaining EEE parts exported clandestinely without proper clearances.

DTI-EMB stressed that any effective future policy must focus on financially and technically incentivising the integration of these informal collectors and junk shops into accredited, formal recycling facilities, not just to mitigate environmental pollution from improper dismantling and dumping but to ensure all e-scrap exports comply with international environmental and trade laws.

F) Data management for policy analysis

A core function of DTI-BIS is to maintain the Philippine National Trade Repository, which serves as the definitive centralised information hub for verifying import compliance. To keep this repository accurate and up to date, BIS co-ordinates with approximately 54 other trade regulatory government agencies to centralise and update all rules, regulations, and documentary requirements related to the importation of all commodity types, including those that would fall under UEEE or WEEE.

When asked about estimates for trade data on EEE-related materials that may be considered e-scrap or e-waste, both DTI-BIS and BOC-EPCD noted significant difficulty in retrieving and providing granular, consistent trade data on these over extended periods. DENR-EMB keeps a record of the type and volume of hazardous waste (including e-waste) through import and export clearances that were granted; however, these are initiated through applications by licensed recyclers and TSD facilities. Data summaries are not automatically generated by their database and would need manual processing. All the agencies interviewed shared that inconsistent recording standards and poor data systems turnover have made it challenging to generate a reliable 10-year historical data set, which hinders effective long-term policy analysis.

3.3 Stakeholders' forum

Another activity under this study was a Stakeholders' Forum, held on 11 September 2025 at Park Inn by Radisson, Quezon City. The forum presented the preliminary outcomes of the research to the key informants and selected stakeholders to validate the findings.

Invited participants include representatives from national government agencies, international development organisations, academic institutions, recyclers, and civil society organisations. This broad mix underscored the need for collaboration in addressing transboundary movement of UEEE/WEEE, as well as the current lack of domestic collection, proper recycling and treatment for household WEEE. Participants included the following:

- Government agencies: DENR-EMB, three bureaus under DTI, and BOC
- Local government: representatives from Baguio City involved in local e-waste collection, attending online
- Industry: representatives from the appliance sector (e.g., Sharp Philippines) and local recycling companies

- Non-governmental organisations (NGOs) and student organisations: Ban Toxics, EcoWaste Coalition, and University of the Philippines Circuit
- International research institutes and development organisations: the organisers from ERIA, consultants from EX Research Institute, and the Overseas Environmental Cooperation Center, representatives from UNIDO Philippines.

This whole-day event included presentations, stakeholders sharing, and round-table discussions on the following topics:

- Session 1 (morning) covered the entry of EEE-relevant materials (e.g., UEEE, e-scrap, etc.) into the Philippines.
- Session 2 (afternoon) tackled the fates of EEE-relevant materials in the Philippines (e.g., domestic e-waste management and material recovery from e-scrap, whether locally or abroad).

For the round-table discussion, participants were invited to share their insights into these three questions:

- What policy or implementation gaps that, when addressed, will have a significant impact on reducing entry of unwanted EEE-relevant materials into the Philippines?
- What policy or implementation gaps that, when addressed, will have a significant impact on reducing improper e-waste dismantling and disposal?
- Are there opportunities for proper recycling, treatment, and disposal in co-operation with other countries in ASEAN and East Asia?

The following subsections summarise the results of the round-table discussions. The presentations, forum concept notes, list of participants, and session executive summaries are provided in Annex 5.

A) International trade flows of EEE-relevant materials

Representatives from DTI-BIS and DTI-EMB, agencies that were part of the key informant interviews, also attended the stakeholders' forum. During the round-table discussions, participants provided input on the existing regulatory environment governing the international trade in EEE waste. DTI-BIS focuses primarily on providing trade regulatory guidance to importers and suggests the need for stricter enforcement by trade regulatory agencies with respect to imported EEE waste. Meanwhile, DTI-EMB provides guidance to exporters by referencing EO 1060, which sets out the official list of prohibited and regulated commodities for export.

Citing data from the Philippine Statistics Authority, DTI-EMB also highlighted the Philippines' robust involvement in the global e-waste recycling supply chain. Specifically, local TSD facilities demonstrate significant success in the export market, with one notable company, Semirecycling Inc., having exported approximately US$8.2 million worth of electrical and electronic waste scrap in 2020. This activity underscores the existing capacity of the Philippines to process e-waste and its active role in the international resource circulation

market.

B) EEE refurbishing and recycling standards related to international trade

Forum participants provided insights into the operational practices of ASEAN companies involved in EEE refurbishment and recycling. These recyclers target international markets, particularly in Europe and Japan, to sell their processed materials and any refurbished goods. This orientation necessitates that companies in Southeast Asia heavily rely on the specific standards and specifications of their foreign counterparts in developed countries to ensure their materials are accepted to sustain their business. This reliance is largely due to the current absence of comprehensive, specific ASEAN-wide standards for the refurbishment and circulation of these items.

In the absence of a direct refurbishment standard, some recycling companies are proactively seeking ISO certification, primarily to address clients' critical concerns, particularly the need to safeguard sensitive data contained in devices such as personal computers during recycling and disposal. This demonstrates that local companies are using international best practices to bridge the current gaps in national and regional regulatory frameworks.

C) Persistence of obsolete and non-compliant EEE products in the Philippine market

One of the study's findings was that a significant volume of CRT televisions and monitors entered the Philippine market at a time when this technology was being phased out in other countries. A substantial portion of the discussion focused on the continued existence of CRT televisions in the market, which are now considered non-compliant EEE. These products have generally been phased out but remain available in provincial areas, where they are often sold at very low prices. Sometimes retailing for around Php3,000 for a large model, they are frequently labelled by sellers as 'Class A' or 'brand new', often complete with new-looking packaging, despite being visibly refurbished goods. A major concern is the lack of quality control and the legal ambiguity surrounding the sale of these unverified items.

A photo shown of a CRT TV being sold in a rural municipality outside of Metro Manila deepened the discussion of the challenges for ensuring consumer protection from non-compliant products. Upon closer inspection of the licence numbers associated with the Philippine Standard (PS) Mark for product safety and quality on the CRT TVs being sold, participants from DTI Bureau of Product Standards (DTI-BPS) indicated that the licence number was counterfeit. They explained that the PS mark is issued only to manufacturing companies. Therefore, if a PS mark is found on a product sourced from a non-manufacturing entity, or one that is clearly refurbished or from an obscure factory, the mark is definitively fake. This proliferation of counterfeit certification on obsolete or refurbished technology poses a significant risk to consumer protection and market integrity, highlighting a failure in enforcement against non-compliant sales practices.

The discussion further delved into the necessary enforcement measures to protect consumers from unsafe and non-compliant products. DTI, through its Fair Trade

Enforcement Bureau, has the authority to investigate and act on potential product certification violations. If a fake PS mark is reported, DTI can issue a show cause order or a notice of violation to the establishment selling the non-compliant goods. Consumers are encouraged to report instances of suspicious or uncertified products to DTI to aid in these enforcement efforts.

D) Establishing local quality standards for remanufactured, refurbished, or used EEE in the context of circular economy

The findings on UEEE importation into the Philippines raised the question of how to distinguish between utilising recycled content in new products and the practice of refurbishment and resale of UEEE. A question was raised about whether a product incorporating a high percentage (e.g., 60%) of recycled parts could still be legally classified as 'brand new', highlighting a policy gap between eco-branding and the formal acceptance of refurbished goods. Internationally, there is growing advocacy for the circulation of remanufactured, refurbished, or repurposed goods, but this movement requires clear international standards and supporting local policies to be effective.

DTI-BPS confirmed that, under current regulations, they cannot issue certificates to products that have had their internal or external parts replaced. This policy limitation currently makes the formal certification and legal sale of refurbished goods extremely challenging, even if the goods are otherwise of high quality.

A major barrier to the formal integration and acceptance of refurbished goods into the domestic retail market is the potential for health and safety concerns. This includes the risk of transmitting viruses, bacteria, or insects (like termites) from products that were previously used in other countries. This would be particularly applicable to other used goods such as clothes, mattresses, sofas, cabinets, and other household items. Therefore, any future national standard developed for refurbishment must include rigorous requirements to ensure the product is not only made 'good as new' but is also thoroughly sanitised and free of contaminants before being resold to consumers.

E) Skills and capacity building to address informal dismantling of household WEEE

A persistent issue raised during the forum is the informal dismantling of WEEE conducted by local ambulant buyers after purchasing broken electronics directly from neighbourhoods. These informal practices often lead to improper dismantling, creating environmental and health risks. The case of the community e-waste TSD facility established in Barangay 177 of Caloocan City was cited as an example that while an existing e-waste dismantlers co-operative was already established under the UNIDO project, not all e-waste pickers in the Bagong Silang area were fully integrated. This shows the continuous challenge of sustaining gains beyond the end of the formal project. That said, it was also pointed out during the forum that the facility established in Barangay Bakakeng Central has now been expanded and integrated into the larger waste management system of Baguio City, illustrating that community-based WEEE collation needs strong support at higher levels of local government,

so that its continued operation is not solely dependent on income generated by material recovery from the collected WEEE.

As shown by UNIDO Philippines' e-waste project, to successfully transition e-waste processing out of the informal sector and into a formal, safe, and quality-controlled environment, apart from upgrading a material recovery facility into a TSD facility for domestic WEEE, significant investment in trained personnel and capacity building is required. This is vital not only for ensuring the safe and specialised recycling and dismantling of hazardous e-waste components but also to align with the broader circular economy goals.

Linking these efforts to repair and refurbish EEE, training programmes are necessary to formalise efforts to extend EEE life and provide a possible alternative to simple disposal. By co-ordinating with agencies like the Technical Education and Skills Development Authority, the government can develop and certify training programmes for EEE repair technicians and specialised dismantling personnel, thereby fostering a skilled workforce essential for both safe e-waste handling and the promotion of resource circulation.

3.4 Field visits

Following the Stakeholders' Forum, the research team conducted field surveys and meetings with stakeholders involved in EEE-related material recovery, recycling, processing, and trade. The facility visits and meetings were conducted in Central Luzon (Region III) located north of Metro Manila, or the National Capital Region. Many registered TSD facilities and e-scrap recyclers are in this region, which is also where several SEFZs are located, such as Clark Economic Freeport Zone and Subic Bay Freeport Zone. Licensed TSD facilities are heavily concentrated in Central Luzon and CALABARZON (Region IV-A) because they can be strategically located near major seaports and airports, facilitating the import and export of materials. Furthermore, many are located within these freeport zones and industrial parks because these provide a more business-friendly environment and come with many economic incentives, including minimal or no duties and taxes for imported goods.

Aside from formally arranged facility visits, oculars of retail shops of used goods from Japan were conducted, as well as attempts to visit or interview gold smelters in Bulacan said to be involved in precious metal recovery from e-scrap obtained from informal waste pickers. The next sections summarise insights from the field visits, with highlighted notes in Annex 6.

A) Meeting with freeport zone administration

The special economic zones in Subic Bay and Clark were created by virtue of RA 7227, or the Bases Conversion and Development Act of 1992. This was enacted to accelerate the sound and balanced conversion of former United States military bases, particularly the Clark and Subic reservations, into productive civilian uses to promote economic and social development (Section 1, Bases Conversion and Development Act of 1992, RA 7227). The act created the Bases Conversion and Development Authority to implement a comprehensive development plan for these areas, establishing them as special economic zones (Section 3,

Bases Conversion and Development Act of 1992, RA 7227). The overarching policy was to encourage private sector participation and generate job opportunities by transforming these strategic properties into self-sustaining industrial, commercial, and financial investment centres.

The fact that many e-scrap recyclers and WEEE TSD facilities are located within the Subic and Clark freeport zones could be attributed to the fiscal and operational incentives provided by RA 7227, designed to facilitate trade and investment. The primary advantages include being treated as a separate customs territory for the free flow of goods and capital, allowing for tax and duty-free importation of raw materials, capital, and equipment. In lieu of paying all national and local taxes, businesses only remit a flat 5% tax on gross income. Additionally, the zones implement a liberalised financial environment with no exchange control policy, and significant foreign investors (with at least US$250,000 in continuing investment) are granted permanent resident status, along with their dependents[22].

During the meeting with representatives from the Subic Bay Metropolitan Authority (SBMA), the research team consulted the SBMA Ecology Center, which is responsible for implementing all environmental and natural resource conservation and protection programmes within the zone, as well as performing functions related to environmental management, including enforcement, monitoring, permitting, training and education, and contingency and emergency planning (SBMA, n.d.).

The meeting provided insight into the operational environment for formal recyclers concentrated within the Subic Bay Freeport Zone. SBMA acknowledged that the freeport zone's strategic location and business-friendly policies are key factors in attracting regulated facilities, distinguishing the area as a compliant hub for the import and processing of e-waste materials, mainly for direct export of metals and other materials extracted while remaining within the confines of the freeport zone.

The discussion also delved into the contrast between formal e-scrap recyclers that are sourcing their materials from overseas vis-a-vis what the SBMA staff recognised as the widespread, informal recycling sector that often operates without oversight or effective enforcement, largely handling the collection of household e-waste. The core problem identified was the lack of a clear, operational policy framework for integrating this dominant informal network into the formal, regulated system, while at the same time having e-scrap trade policies that make it challenging for formal recyclers to maintain a consistent level of operations that would allow them to be financially viable.

B) Meeting with freeport recyclers' association

The Subic Bay Freeport Recyclers Association (SBFRA) is composed of companies located within the Subic Bay Freeport Zone, a special economic zone and freeport area facing the West Philippine Sea. As registered TSD facilities, these recyclers are licensed to handle both

[22] Bases Conversion and Development Act of 1992 (RA 7227), Section 12. https://bcda.gov.ph/sites/default/files/documents/RA_7227_0%20(1).pdf

hazardous and non-hazardous material. They mainly source their materials, which include e-scrap, either from abroad or from fellow locators within the freeport zone.

The discussion with SBFRA representatives focused on the specific operational and regulatory hurdles faced by recyclers primarily engaged in the import, dismantling, and export of scrap materials from the Subic Bay Freeport Zone. The association pointed to cumbersome bureaucratic requirements, particularly those related to the permitting process related to e-scrap trade, as a major bottleneck. To streamline operations, SBFRA specifically recommended revising DAO 2013-22 to extend the validity of importation and exportation clearances from 6 months to 1 year. They also noted that e-waste volume in the Philippines is about five times lower than in other ASEAN recyclers they are familiar with, particularly in Thailand and Indonesia. This, combined with the largely untapped domestic sources of WEE, makes the local industry dependent on international sources of e-scrap to be financially viable.

In terms of policy, SBFRA called for greater clarity and efficiency in regulation, proposing a more granular sub-categorisation of e-waste codes to simplify processes for less hazardous materials. They also urged the harmonisation of e-waste definitions across ASEAN to reduce trade friction and encourage investment, citing past instances of confusion in obtaining PIC documents from countries that did not include EEE/WEEE as hazardous material, prior to the entry into force of the Basel E-Waste Amendment at the start of 2025.

C) Facility visit to a formal recycler and TSD processing e-assemblies and e-scrap

Semirecycling Co., Inc. (SRCI) is a licensed TSD facility in the Clark Freeport Zone. SRCI's business strategy focuses primarily on acquiring the industrial business-to-business WEEE stream, sourcing mainly from industries that are also located within economic zones. These WEEE, e-assemblies, and e-scrap, classified under Hazardous Waste Code M506 pursuant to DAO 2013-22, are generated from semiconductor manufacturing activities and are rich in valuable materials, such as precious and semi-precious metals.

SRCI outlined major policy and operational challenges, including intense competition from the unregulated informal sector. Although the company is located within a freeport zone, where procedures for transboundary movement and export of recovered valuable materials are expected to be more streamlined, it continues to experience logistical hurdles arising from new export permit requirements and the refusal of shipments labelled with the word 'waste', likely reflecting the impact of the Basel E-Waste Amendments that took effect in January 2025.

To enhance the formal sector's competitiveness, the company called for government support through incentives, clearer definitions and guidelines for e-waste categories, and an immediate focus on creating a formal collection system for household e-waste (as part of other household-generated hazardous waste collectively under Code M507). This would divert materials away from backyard processing and into authorised facilities, ensuring proper environmental management. The heterogeneous composition of household WEEE, which also includes a high percentage of toxic materials, makes it difficult to develop a viable recycling business model to process them. Consequently, the company explicitly stated that

it does not accept e-waste lacking valuable content and refers generators seeking disposal of these kinds of WEE to other TSD facilities.

SRCI noted that the e-scrap business has become more competitive in recent years, with foreign companies establishing local facilities and sales offices, making it more difficult to secure a stable supply of materials. This suggests that while the total volume in the Philippines may be low compared to regional neighbours, market demand for high-value industrial scrap is increasing.

D) Facility visit to an end-of-life vehicle recycling facility planning to expand to WEEE recycling

En Tsumugi is a formal recycler specialising in end-of-life vehicles (ELVs) in Mexico, Pampanga, in close proximity with several steel mills. En Tsumugi was created through support from the Japan International Cooperation Agency, through close mentorship by Japanese companies involved in metal and ELV recycling such as Mitsui and Tsuruoka. The En Tsumugi team visited Japan in January 2024 to study the Japan Automobile Recycling Promotion Center model. The company is currently the sole accredited vehicle dismantler recognised by Toyota, Philippines.

Unlike SRCI, it is not located within an economic or freeport zone and has more business ties with metal scrappers and traders, including junk shop networks. The company purposefully chose to establish its facility outside of the economic zones, since this would otherwise make it difficult for them to bring in ELVs sourced domestically.

The company is planning to expand into household e-waste recycling, acknowledging that most WEEE TSD facilities are mainly doing metal recovery for international trade, and not necessarily addressing the significant amount generated by the domestic market. The meeting revealed the critical financial barriers to environmentally sound recycling in the Philippines. The company emphasised that the high operational costs associated with proper processing, such as labour, electricity, and compliant disassembly, make formal dismantling and pretreatment unprofitable compared to the low-cost methods of the informal sector. The fundamental issue is the lack of a financial mechanism or recycling fee in the country to offset these costs and provide a positive return on investment for formal facilities.

To address this, En Tsumugi is strongly advocating for the government to finalise and implement an extended producer responsibility (EPR) system that includes a recycling fee collected at the point of product sale, similar to the model used in Japan. Beyond the EPR fee, the company is also exploring alternative revenue streams, such as establishing a facility for the proper collection and destruction of refrigerants both from vehicles and household appliances, which would enable it to capitalise on the Joint Credit Mechanism by earning carbon credits.

E) Meeting with regional environmental regulatory agency

DENR-EMB's organisational structure includes the central office in Metro Manila and regional offices across the country. Developing and implementing hazardous waste management policies, including those for WEEE, are part of the mandate of the central office. Import and export clearances for WEEE are also processed by the central office. Meanwhile, regional offices oversee processing licences and other operational permits for TSD facilities, as well as monitoring compliance with the conditions stipulated in a company's environmental compliance certificate.

The research team had the opportunity to meet with both the Permitting and Monitoring Sections for Chemicals and Hazardous Waste. The meeting highlighted Central Luzon's significance as a hub for formal, regulated hazardous waste management, including e-waste, with numerous accredited TSD facilities located there. Since the regional office's core mandate is environmental enforcement, focusing on monitoring the compliance of these formal facilities and hazardous waste transporters, the enforcement of proper waste management generated by households is primarily the purview of the environmental offices of the local governments. However, EMB Region III staff acknowledged the profound challenge posed by the country's dominant, unregulated informal recycling sector. The absence of a clear, operational policy that effectively integrates the informal sector's collection capabilities into the formal, environmentally sound processing system was identified as a major policy gap that prevents the proper flow of most household-generated e-waste (M-507) to authorised facilities.

F) Visit to used Japanese goods shop

The research team also visited a warehouse that contained used goods shipped from Japan. The owners are a Japanese–Filipino couple based in Japan who collect used household items. Based on conversations with the sales staff, the items were likely acquired through buy-and-sell wholesale auctions of goods from foreclosed or abandoned houses, an activity called *chūko-hin oroshiuri* (**中古品 買い取り中古品卸売」**). Most of the UEEE items are small kitchen appliances, audio equipment, and musical instruments. Some washing machines and personal refrigerators are included in the shipment. This is consistent with the findings of the importation data analysis in Section 1.

3.5 Conclusion

The key informant interviews, stakeholders' forum, and field visits consistently showed a fundamental disparity between the Philippines' formal and informal e-waste recycling sectors. While the formal sector, composed of accredited TSD facilities largely concentrated in strategic zones like Clark and Subic, operates under regulatory compliance, it remains highly selective, focusing on high-value industrial e-scrap under hazardous waste code M506, through business-to-business streams. This is primarily a profit-driven business model, though it is severely undermined by high operational costs and permits that are sometimes deemed too strict, or redundant. e-scrap recyclers voiced a need to streamline bureaucratic processes, such as extending the validity of importation and exportation

clearances, and clarifying the roles of multiple agencies (DENR, BOC, DTI, and the Bases Conversion and Development Authority) to reduce overhead and delays for formal operators.

Conversely, most household-generated e-waste enters the informal sector through junk shops and backyard recyclers. Although this informal network serves as the crucial collection backbone for domestic WEE, its methods, such as crude dismantling and burning, pose significant risks to public health and the environment, which allow them to buy e-scraps at higher prices than the formal recyclers. The failure of the current system to divert this material into environmentally sound channels undermines government authority to strictly impose environmental regulations on formal recyclers.

Another common insight is the need for a sustainable financial mechanism to bridge the economic gap between formal compliance and the realities of the domestic WEEE generation. Formal recyclers stated that environmentally sound processing is financially unviable without external support. The strong recommendation from stakeholders is the implementation of a robust EPR system for EEE. This financial intervention is essential to level the playing field, making formal TSD facilities competitive with the informal sector while simultaneously incentivising the safe handling of hazardous components. This will hopefully be addressed by the draft Department Administrative Order 'Environmentally Sound Management of WEEE', as well as an ongoing 5-year bilateral project funded by MOEJ, to develop a pilot project for household WEEE collection under an EPR scheme.

Finally, a policy is needed to formalise and integrate the informal sector. This could be achieved through targeted incentive schemes, capacity building, and clearer guidelines for local government units and local collectors, leveraging their collection efficiency while ensuring they are adhering to environmentally safe pre-processing standards.

4 Policy Issues and Recommendations on the International Material Flows of EEE-Relevant Materials between the Philippines and Japan

4.1 Unmonitored importation of used or poor-quality EEE into the Philippines

As shown and discussed extensively in Section 1, there should be a closer examination of how to deal with importation of used EEE. Even the Basel E-Waste Ban Amendments allow for parties to 'define and evaluate the distinction between waste and non-waste in different manners when considering used equipment destined, e.g., for direct reuse or extended use by the original owner for the purpose for which it was conceived, or for failure analysis, repair, and refurbishment' (Secretariat of the Basel Convention, 2023). Currently, there is no explicit clarification as to whether used EEE is considered e-waste under the current Procedural Manual for Hazardous Waste (DAO 2013-22) or in its draft amendment. Furthermore, although the manual includes a section on definition of terms, it does not provide a specific definition of 'waste', or specify the point at which an item is considered waste. This legal definition of 'waste' is likewise not explicitly stated in related national legislation, such as the Ecological Solid Waste Management Act (RA 9003).

The absence of clear and feasible implementation guidelines on regulating and monitoring the movement of 'used' or 'second-hand' EEE and other goods is a major loophole. This applies to both transboundary trade from high- to middle- and low-income countries, as well as domestic movement from highly urbanised cities to rural areas. The eventual fate of these goods at their end-of-life increases the waste management burden for areas that serve as their final destination, not just for items that contain hazardous materials (e.g., containing heavy metals, persistent organic pollutant wastes, PBDEs) but also items that are difficult to recycle or incinerate (e.g., melamine plasticware) or can leak microplastics into the environment (e.g., second-hand polyester clothes and microfibre rags).

In addition, official import statistics do not reflect EEE that enter through 'less than container load' shipments. As discussed in Section 1, UEEE can enter the Philippines in small amounts through so-called *balikbayan* boxes declared as personal items. Online shopping platforms using a drop-shipping model may also serve as a source of low-cost but poor-quality or substandard gadgets and small EEE, whereby items are sourced remotely from warehouses or factories and are unlikely to be tested for functionality prior to shipment. Estimating the impact of such small-volume but high-frequency trade flows is challenging and would require large-scale data scraping and analysis. It is even more difficult to impose quality standards on these online platforms, whether for EEE or other hazardous or controlled goods.

4.2 Importation of EEE-related items into the Philippines

Repair and refurbishment are key activities in advancing the circular economy, especially for EEE. However, in the context of global trade, low- and middle-income countries are inadvertently made recipients of functional EEE that may have been discarded or phased out due to more stringent standards or technology shifts in high-income countries. Some 'used EEE' imports also include relatively new EEE that have just been removed from shelves owing to fast-paced consumer behaviour. Meanwhile, some companies in the Philippines operate business models centred on the refurbishment of EEE appliances, computers, and other electronic devices for reuse. Several have established or are developing partnerships with foreign IT companies to create procurement channels for refurbished equipment.[23]

With the Basel E-Waste Amendments entering into force on 1 January 2025, the ease of doing business for offshore repair and refurbishment is likely to be affected. EEE refurbishing and recycling companies that set up facilities within freeport zones or export processing zones to take advantage of tax breaks and other incentives may find it more difficult to sustain a stable business model. This is also felt by other recyclers or TSD facilities that import fly ash or scrap plastics. Hence, there is an ongoing Basel Ban Amendments impact assessment commissioned by DENR-EMB to be considered in the

[23] Field interviews by Environweave under the Sustainable E-waste Management and Recycling bilateral project between the Philippines and Japan, funded by the Ministry of the Environment (Japanese Fiscal Year 2024 to present).

deliberation process towards Philippine ratification of these amendments.

Furthermore, there is an ongoing legal case regarding the entry of scrap EEE and metals into one of the freeport zones without importation clearances granted by DENR-EMB and subsequently seized by BOC. However, a regional trial court decision has rendered a temporary restraining order on the implementation of DAO 2013-22 in freeport zones, arguing that this conflicts with certain provisions of the Philippine Constitution and other national policies governing freeport zones (discussion during the stakeholder forum, 11 September 2025). A general sentiment amongst recyclers in these freeport zones is that stringent environmental compliance requirements hamper the efficiency of legitimate international recycling operations that are already compliant with environmental standards set by the freeport authorities, while e-waste pollution continues domestically through unregulated informal dismantling and backyard smelting (ERIA and Environweave field interviews, September 2025). Meanwhile, DENR and BOC have issued an appeal, citing that DAO 2013-22 is consistent with RA 6969, and that this is also consistent with internationally binding treaties such as the Basel Convention to which the Philippines is a party. The implementation of the Basel Convention, as well as RA 6969 and its supporting issuances, covers the entirety of the Philippines, including freeport and transshipment zones. Environmental watchdogs agree with upholding the importation clearance procedures, since this is a key tool in monitoring possible shipments of waste into the country. They have expressed dismay that this sets a dangerous precedent, especially for a country that already has inherent challenges in monitoring its trade borders.[24]

4.3 Challenges in the PIC procedure vis-à-vis e-scrap trade for proper recycling

EEE recyclers in the Philippines have expressed difficulty in complying with the existing requirements under the Basel Convention. For instance, they face long waiting times for the granting of either import or export permits from the DENR-EMB central office, since these cannot be granted by regional offices. Other clearances from DTI and/or BOC also need to be obtained after this. Then, once all these government clearances are granted, they still need to obtain a PIC from the receiving entity for further treatment or recycling. Only then can they contract a logistics company to process the shipment. By the time these steps are fulfilled, the 6-month validity of the import/export permit issued by DENR-EMB has already lapsed.

Domestic EEE recycling activities primarily involve manual dismantling and physical processing like crushing and baling, with a focus on exporting the resulting materials, mainly to China, Korea, and Japan. However, after China's National Sword policy, the country became stricter on importing scrap, requiring it to be in a completely dismantled form, and shipments as one uniform material or item (e.g., a container of only aluminium). Korean regulations also require a notification and importation clearance from the country of destination, to be submitted by the exporting company from the Philippines.

[24] While key informant interviews were conducted by Environweave for this report, due to the ongoing court case, further details could not be provided.

Meanwhile, Japan is open to importing e-scrap. But this does not necessarily lead to a smooth trading procedure and can become complicated, resulting in shipment delays and financial losses, as conveyed by interviews with Philippine e-scrap recyclers and exporters interviewed during the field visits. Because e-scrap classification is different between Japan and the Philippines in terms of whether it is 'scheduled' waste, it is harder to get a notification of acceptance from Japan's government agencies and partner recyclers. Since the documents for potential e-scrap shipments get processed together with other regular shipments, there must be further explanations of the need for the Philippine exporter to obtain this notification of acceptance as a requirement to be submitted to DENR under the Basel PIC procedures. This leads to a significant delay, which, coupled with the short duration of validity for the export clearance of 6 months, makes it very difficult for actual shipment to occur.

There is recognition that the PIC procedure needs to be improved, with suggestions towards digitalisation of certain steps. A small intersessional working group was formed under the Secretariat of the Basel, Rotterdam, and Stockholm Conventions to look into improving the PIC procedure in terms of information exchange between parties, timeliness of decision-making, varying capacities for internal co-ordination, financial guarantees, and transit/shipping concerns (World Customs Organization, 2024). There is a lack of a clear, unified definition of what constitutes 'waste' versus 'scrap' or 'recyclable material', particularly in relation to international standards like the Basel Convention and HS codes. The Basel Convention leaves this definition to the importing country, leading to inconsistencies. For instance, an item considered recyclable in Japan (due to their advanced recycling technology) might be classified as hazardous waste in the Philippines. There are also challenges in implementing the convention for shipments coming from or going to countries that are not parties to the convention.

4.4 International and domestic policies are needed to address e-waste arising from technological shifts or forced obsolescence

The evolution of technology will naturally generate waste. As illustrated by the demise of CRT technology and its replacement by flat screens starting in the mid-2000s, the displacement of EEE based on outdated technology that can no longer be sold in certain markets may result in its diversion to other countries where it continues to retain value. While this extends the life of EEE that are still in good condition instead of immediately becoming waste, it transfers the burden of end-of-life management in regions where proper treatment and disposal options are lacking.

Some of these technology shifts are associated with 'green' efforts towards decarbonisation and energy efficiency, phase down of refrigerants with high global warming potential, reduction of toxic fire retardants or heavy metal content, or requirements to include recycled plastics in EEE. As high-income countries push for cleaner materials in their EEE, the economic benefit of selling the remaining stock of these 'less green' items in other markets with less stringent environmental requirements should be weighed against the eventual environmental pollution that will still be generated at end-of-life. This would be felt more

during sudden nationwide or large-scale bans or phase-outs, like the shift from analogue to digital broadcasting. Prior to the rollout of these bans, there should be increased logistic support for collection, recycling, treatment, and disposal, ideally within the country or territory, in anticipation of the high volume of waste generated during the phase-out period. In opting for '"cleaner' environment-friendly products, we must be cognisant that the transition period will produce a lot of waste at a faster rate than usual, and there should be readiness of all the players involved in waste management to capture this large volume. The concept of 'just transition', while addressing the need to provide options for livelihood for displaced waste workers, should also ensure that there is also 'clean transition', both upstream and downstream.

This market dynamic of older and 'less green' EEE migrating out from higher-income cities to poorer municipalities also exists at the domestic level. In the Philippines, families with more disposable income will tend to upgrade their computers, gadgets, and appliances at a faster rate, even if these are still in working condition. The tendency is to give these items to extended family members in the provinces, sell them to second-hand shops, or sell them to ambulant scrap buyers who are part of the informal dismantling and junk trade network. Thus, there are pockets of e-waste pollution across the country, far from the reach of proper recycling facilities that are mainly located in Central and Southern Luzon.

We are living in a world that is highly dependent on EEE, and even highly addicted to gadget use. Typical consumer behaviour would be to constantly upgrade to the latest model, wanting faster gaming consoles, sleeker mobile phones, bigger televisions. It is fed by a profit-driven model that is dependent on the purchase of new, shiny things that will likely be obsolete in a few years, or new, cheap gadgets that are not meant to last. There needs to be not just a policy shift but also a paradigm shift where a strong economy is not only dependent on fast-paced retail but also on slow, thoughtful, community-based activities of a truly circular economy.

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Annexes 1–3 (Data Spreadsheets)

Republic of the Philippines

Annex 1:

Philippines: Data Tables

online spreadsheet

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Annex 2:

Philippines: Used Goods Importation Data Base

Tables

online spreadsheet

5 **This spreadsheet compiles the results from monthly importation records that are relevant to the study:**

Sheet 1	All imports under HS 85.49 (electronic waste and scrap) from the first recorded entry since the adoption of the new HS Code
Sheet 2	Total net mass of used goods per Country of Origin by year, quarter, and month
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Sheet 6	Total net mass of used goods from Japan under relevant EEE chapters per HS Subheading (6 digits) by year, quarter, and month

6 **From the base data tables, pivot tables were created:**

Sheet 7	Pivot table: All imports under HS 85.49 (electronic waste and scrap) from the first recorded entry since the adoption of the new HS Code
Sheet 8	Pivot table: Total net mass of used goods per Country of Origin by year, quarter, and month
Sheet 9	Pivot table: Total net mass of used goods per HS Chapter (2 digits) by year, quarter, and month
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7 **Additional tables relevant to the study are also provided:**

Sheet 13	HS Section and Chapter list
Sheet 14	HS Headings (4 digits) list
Sheet 15	UNU KEYS and corresponding HS Codes
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Annex 3:

Philippines: WEEE Treatment Storage and Disposal Facilities

online spreadsheet

2) **Sheet A** Raw results from the extraction are in Sheet A

3) **Sheet B** List of E-waste TSDs (analyzed by Environweave)
   1 First level sorting by Region (Column C): Regions numbered by geographic location, from north to south of the Philippines
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4) **Sheet C** Distribution of TSDs per region, with focus on those catering to M506 (WEEE) and M507 (municipal special waste)
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5) **Sheet D** Categories for Hazardous Waste Generators. Red text are proposed amendments to DAO 2013-22

6) **Sheet E** TSD Categories. Red text are proposed amendmets to DAO 2013-22

7) **Sheet F** Proposed amendments to WEEE Hazardous Waste Codes, comparison with EU, UNU, and Basel codes

8) **Sheet G** Comparison table of EEE Nomenclature - EU, UNU-KEYS, and proposed new Hazardous Waste Codes (DENR-EMB)

Annex 4: Key Informant Interviews

1. Department of Environment and Natural Resources – Environmental Management Bureau Central Office, Hazardous Waste Management Section

Meeting conducted online on 8 July 2025.

I. EMB Mandate and Regulatory Framework for E-Waste

The Hazardous Waste Management Section of the DENR-EMB is the primary regulatory body responsible for classifying, tracking, and controlling the movement of hazardous wastes, including many forms of electronic and electrical equipment (EEE) scrap.

A. Core Legislation and Permitting

The EMB's authority is anchored in the **Toxic Substances and Hazardous and Nuclear Wastes Control Act of 1990 (Republic Act 6969)**. This law dictates that the transboundary movement (importation, exportation, transit) of all wastes classified as hazardous must be regulated.

- **Prior Importation Clearance (PIC):** Any company intending to import materials classified as hazardous waste, including certain types of e-scrap, must first secure a PIC from the EMB. The EMB reviews the application to ensure the receiving facility is accredited and capable of safely managing the waste.
- **Classification:** The DENR uses the **Basel Convention classification** (A List for hazardous, B List for non-hazardous) as the primary guide for determining if

a PIC is necessary, alongside national criteria.

B. E-Waste Management and Informal Sector Challenges

The EMB acknowledges that the e-waste management landscape in the Philippines operates in two parallel spheres:

1. **Formal Sector:** Consists of DENR-accredited treatment, storage, and disposal (TSD) facilities and a few larger, legitimate recyclers (e.g., those processing metals or components).
2. **Informal Sector (Junk Shops):** The majority of post-consumer e-waste is handled by '**junk shops**' that operate as small and medium-sized enterprises. These junk shops act as the critical primary collection and dismantling point for domestic e-waste.

- **Policy Challenge:** The challenge is to formalise this vital informal sector to ensure environmental compliance and worker safety during dismantling, particularly for hazardous processes like acid leaching or improper component segregation. Current programmes, such as the **International E-Waste Management Network**, are aimed at improving collaboration with these smaller players and fostering better circularity.

II. Legal Authority and Enforcement Battles

The EMB faces significant hurdles in asserting its authority over certain import channels, particularly those involving international agreements and special economic zones.

A. The Challenge to National Jurisdiction (RA 6969)

The DENR-EMB is also engaged in a major legal struggle to maintain the supremacy of **RA 6969** across the entire Philippine territory.

- **Freeport Zones:** Recyclers operating within **special economic zones** (such as the Subic Bay Freeport Zone) that import items containing scrap metal content – some of which were sourced from or are yet to be sourced from e-scrap – have challenged the DENR's jurisdiction, arguing for exemption for the need to acquire import clearances, including the PIC requirement.
- **The United States (US) Bilateral Agreement:** The EMB specifically noted a complication arising from a **bilateral agreement with the US**, which is *not* a party to the Basel Convention. Importers of US-origin e-waste often cite this agreement, claiming exemption from the mandatory PIC.

B. Historical Enforcement and Repatriation

The EMB referenced past incidents to contextualise the difficulty of successful enforcement and repatriation:

- **Canadian Waste:** The successful **repatriation of Canadian waste** (trash mislabelled as recycling) was confirmed to have occurred on **31 May 2019**.

The success of this high-profile case required extraordinary diplomatic pressure and political will.

- **Illegal Japanese Waste:** Acknowledgement was made of historical issues, notably the **illegal export of Japanese medical waste** to the Philippines approximately 2 decades ago. This history underscores Japan's current commitment to enhancing sound international material circulation and preventing recurrences.

III. Basel Ban Amendment and Policy Direction

A central focus of the meeting was the Philippines' long-standing position on the **Basel Convention Ban Amendment** and the policy steps required for ratification.

A. Unratified Status and Economic Rationale

The Philippines is a party to the main Basel Convention but has **not yet ratified the Ban Amendment**. This amendment would prohibit the export of hazardous waste from developed countries (Organisation for Economic Co-operation and Development (OECD), the European Union) to developing countries.

- **Local Industry Dependence:** The primary reason for the delay is the concern that ratifying the Ban Amendment would **cripple local recycling industries**. These industries, particularly those processing certain metal alloys, paper, and specific plastic scraps, rely on the legal importation of **secondary materials (feedstock)** to sustain operations, as the domestic supply is insufficient.
- **Need for Differentiation:** The policy debate revolves around how to implement the ban on truly hazardous waste (for example, toxic sludge or infectious waste) without cutting off the supply of clean, legitimate, and non-hazardous secondary materials vital for local manufacturing.

B. Regulatory Impact Assessment (RIA)

To resolve the impasse and finalise the Philippines' position, the Export Marketing Bureau (EMB) confirmed that it is initiating a thorough policy review:

- **Consultation Process:** The EMB is actively re-starting the consultation process, which includes a hybrid stakeholder meeting (25 July was mentioned) involving government agencies, industry representatives, and environmental non-governmental organisations (NGOs).
- **RIA:** The core of the policy review will be a RIA. This formal assessment will analyse the cost–benefit trade-offs of ratification across all affected sectors (importers, exporters, recyclers, government) before a final recommendation is made to the Senate. The RIA will also cover the proposed **Plastic Waste Amendments** to the Basel Convention.

The perspective of the Department of Environment and Natural Resources

(DENR)-EMB confirms the legal complexity of the Philippines' position, caught between international obligations, the needs of domestic industry, and the challenges of national enforcement in special economic zones.

2. Bureau of Customs – Environmental Protection and Compliance Division (BOC-EPCD), Enforcement and Security Service

Meeting conducted online on 10 July 2025.

I. EPCD Mandate and Border Enforcement Framework

The meeting began by establishing the core function of the BOC's EPCD. EPCD is responsible for enforcing all environmental, health, and toxic substance laws at the point of importation, acting as the Philippine's primary defence against the entry of illegal waste.

A. EPCD's Role in Inter-Agency Co-ordination

While the DENR sets the policy and issues the necessary import clearances (such as the Prior Importation Clearance for hazardous materials), the BOC is the enforcing agency.

- Gatekeeper Function: The EPCD is tasked with preventing the entry of goods that violate national laws like the Toxic Substances and Hazardous and Nuclear Wastes Control Act of 1990 (RA 6969).
- Data Challenges: The EPCD chief noted that while the research team requested 10 years of import data on misdeclared e-waste, the ability to provide comprehensive, granular data is challenging due to frequent turnover and the need to rely on the highly technical, transaction-specific goods description field in customs records.

B. E-waste Identification and Misdeclaration

The BOC confirmed that the illicit entry of electronic waste is a continuing problem, usually involving misdeclaration to evade mandatory clearances.

- Illegal shipments typically enter under vague or benign descriptions, such as ‘assorted scrap materials’, ‘plastic materials’, or ‘reconditioned parts’, disguising hazardous e-waste that contains precious metals and toxic components.
- When a shipment is flagged as suspicious, EPCD initiates a physical inspection and co-ordinates with the DENR's EMB to classify the waste and determine if it requires repatriation or condemnation.

II. Legal Challenges to RA 6969

The central and most critical discussion point was a recent, highly challenging legal case that has revealed a significant policy loophole affecting the enforcement of environmental laws within the country's economic zones.

A. The Case of the 88 Containers in Subic

The EPCD detailed a major recent case concerning the attempted importation of over **80 containers** of electronic waste into the **Subic Bay Freeport Zone**.

- **Court Intervention:** Despite BOC's interdiction based on clear violations of DAO 2013-22 and the Basel Convention – especially the absence of a prior import permit) – the importers filed a case and successfully secured a **temporary restraining order (TRO)** from the Regional Trial Court.
- **The Unconstitutional Ruling:** The most damaging outcome was the initial court ruling that stated that **RA 6969 could not be enforced** within the freeport zone. This ruling effectively treated the freeport zone as an area outside the jurisdiction of national environmental law, allowing importers to claim exemption and secure the release of **88 containers** of e-waste, despite EPCD's strong objections.
- **Enforcement Blockage:** Currently, BOC is blocked from implementing its mandate to enforce environmental laws (such as requiring DENR clearance) until the pending **motion for reconsideration** at the Court of Appeals is resolved. This legal precedent creates a major gap where environmental protection is suspended inside special economic zones.

B. Repatriation Hurdles and Disposal

BOC highlighted the extreme difficulty and rarity of successfully managing illegal waste once it has entered the Philippines:

- **Historical Precedent:** The Philippines has only managed **two successful repatriations** of illegally imported waste (to Canada and the Republic of Korea) in recent history. Repatriation is complex, expensive, and requires intensive bilateral diplomatic effort.
- **Alternative Disposal:** Condemnation and destruction are rarely utilised for large volumes of e-waste due to the cost and the challenge of finding an accredited, secure facility. Consequently, preventing these wastes from entering the country in the first place is the only truly effective measure.

III. International Trade Flows and Regulatory Gaps

The consultation provided crucial intelligence regarding the origin of illicit shipments and identified major policy gaps beyond the freeport issue.

A. Origin of Illicit E-Waste Shipments

A significant finding discussed was the geographical origin of illegal waste:

- Contrary to assumptions focused on East Asian trade, most of the recent illegal e-waste shipments intercepted by BOC originated from North America and Europe
- BOC confirmed it has alerted the **European Union's Anti-Fraud Unit** regarding these deceptive trade practices, shifting the focus from regional to intercontinental enforcement.

B. Policy Recommendations and Next Steps

BOC EPCD confirmed its commitment to policy reform and collaboration:

1. **Addressing the Freeport Gap:** EPCD views the legal precedent in the Freeport Zones as the most critical policy gap that needs to be permanently closed through definitive legislation or a successful appeal of the court's ruling.
2. **Stakeholder Engagement:** EPCD confirmed its intention to participate in the ERIA project's upcoming **stakeholder validation meeting** in September, alongside the DTI-EMB, DTI-BIS, DENR, and Bureau of Philippine Standards (BPS), to collaboratively develop robust, implementable policy recommendations.

Future Data Sharing: While long-term data acquisition is difficult, BOC remains open to working with the ERIA team to refine data requests and facilitate data access within their legal capacity.

3. Department of Trade and Industry – Bureau of Import Services (BIS), Import Facilitation Division

Meeting conducted online on 6 August 2025.

I. BIS Regulatory Mandate and Import Control Framework

The meeting began with an overview of the **BIS**, emphasising its role in safeguarding the Philippine domestic industry and ensuring transparency in trade.

A. BIS Organisational Structure and Core Functions

The BIS is mandated to provide support and protective measures to local industries. Its work is structured across three key divisions:

1. **Import Revenue Measures Division:** This unit is responsible for handling **trade remedy measures**, including initiating and enforcing cases related to anti-dumping, safeguard measures, and countervailing duties to protect domestic producers from unfair foreign competition.
2. **Import Facilitation Division (IFD):** The division consulted is responsible for managing **import procedures** and addressing various regulatory and shipment concerns. It serves as a central clearinghouse for information and resolution.
3. **Import Policy Monitoring Division:** This division focuses on **data analysis** and compliance. Through a working memorandum of agreement with BOC, the BIS monitors import volumes, tracks potential surges, and conducts *motu proprio* investigations to ensure national safety and economic stability.

B. The Philippine National Trade Repository (PNTR)

A critical function of BIS is maintaining the **Philippine National Trade Repository (PNTR)**. BIS co-ordinates with approximately 54 other trade regulatory government agencies to centralize and update all rules, regulations, and

documentary requirements related to importation. This ensures that the PNTR is the definitive information hub for verifying import compliance across all commodity types, including used and waste EEE.

C. Multi-agency Regulation of Used EEE

The importation of used EEE and appliances is regulated by a complex network of agencies, including the **DENR**, the **Department of Information and Communications Technology**, the **Optical Media Board**, and the **BOC**. The BIS acts as the co-ordinator for the trade aspects, while the **Bureau of Philippine Standards (BPS)** sets mandatory product certifications for used household appliances to ensure consumer safety.

II. UEEE Research Findings: The Shifting Import Landscape

Environweave presented its methodology and preliminary findings, highlighting a fundamental change in the composition of used goods being imported into the Philippines.

A. Research Scope and Data Methodology

The study on 'Sound International Resource Circulation' involves analysing BOC trade data from 2012 to the present. The research methodology focuses on accurately isolating used and waste items:

- **Data Filtration:** The team analyses raw BOC data, including HS codes and the crucial 'goods description' field, using filters like 'used', 'second-hand', and 'scrap' to quantify relevant shipments.
- **HS Code Classification:** The data resolution is being analysed at the **four-digit HS code level**, which is considered highly detailed and effective for tracking major commodity movements.

B. Shift in Import Dominance

Analysis of the import data revealed a significant change in the types of used goods entering the country over the last decade:

1. **Decline of Used EEE:** In earlier years (around 2012), the importation of used household EEE (such as CRT TVs, refrigerators, and washing machines) ranked highly in terms of net mass and volume. However, in recent years, used EEE has **fallen substantially** out of the top 20 list.
2. **Rise of Heavy Imports:** The current importation of used goods is overwhelmingly dominated by high-value, bulky items: **Vehicles and Vehicle Parts (HS Chapter 87)** and **Machinery (HS Chapter 84)**, such as heavy equipment and construction machinery. This shift indicates that current regulatory priorities for the BIS regarding used goods must focus less on appliances and more on industrial safety and vehicle compliance.

C. End-of-Life Responsibility Transfer

The meeting highlighted the economic issue of the Philippines receiving high volumes of '**surplus' or near-new items** (e.g., large screen TVs from the US with short life cycles). Because the Philippines is not the original manufacturing country, it inherently inherits the **end-of-life disposal responsibility** without having initially benefited from the item's production cycle. This transfer of disposal cost and environmental burden is a significant policy challenge.

III. Key Regulatory Loopholes and Policy Challenges

The consultation detailed specific loopholes and ongoing policy challenges the BIS faces in regulating used item importation.

A. Circumvention of Import Bans via Vehicle Reassembly

A major regulatory hurdle involves the **used vehicle import ban**. Importers exploit a loophole by importing vehicles completely **dismantled into parts**, classifying them as scrap or parts rather than whole vehicles.

- These parts are then **illegally reassembled** domestically into 'reconditioned' left-hand drive vehicles, often without adhering to Philippine safety and environmental standards.
- This method is logistically efficient, as importers can fit up to 15 dismantled vehicles into a single 40-foot container, maximising volume while skirting the import prohibition and related regulatory oversight.

B. Special Economic Zone Exemption (PEZA)

A separate challenge involves importers operating within **Philippine Economic Zone Authority (PEZA) zones**. These companies sometimes claim exemption from the standard DENR or BPS import clearances, citing their status within the special economic zones. This legal precedent creates a loophole that complicates the enforcement of national import regulations for used and waste materials, particularly for components intended for electronic manufacturing and recycling operations within the zones.

C. Status of the Basel Ban Amendment

The discussion touched upon the potential ratification of the **Basel Ban Amendment**, which would impact both import and export trade:

- **Philippine Position:** The Philippines has not yet ratified the amendment. One of the historical concerns is that some **local recycling industries** need to import secondary materials (feedstock), like used paper or certain metal scraps, to sustain their operations, as local supply is insufficient. The amendment's ratification would severely restrict this vital supply line.

- **Agency Lead:** It was clarified that the **Export Marketing Bureau (EMB)** is the lead DTI unit for the Basel Convention, with the BIS providing supporting documentation and input on trade implications.

D. Next Steps and Action Items

The meeting concluded with the next key steps focused on strengthening the regulatory framework:

1. **BPS Co-ordination:** The BIS agreed to share its list of **mandatory product certifications** from the BPS for used appliances, which is crucial for the ERIA research team.
2. **Stakeholder Validation:** The ERIA team confirmed plans to hold a larger stakeholder validation meeting in September, with invitations extended to the BIS, BOC, DENR, and BPS to collaboratively review the final policy recommendations.

4. Department of Trade and Industry – Export Marketing Bureau

Meeting conducted online on 10 July 2025.

I. DTI-EMB Mandate and Export Policy Regulation

The DTI-EMB is the lead government agency responsible for the promotion, development, and regulation of Philippine exports. Its work is divided between two crucial areas: the **Industrial Division**, which provides sectoral support and expertise for key industries like **electronics**, and the **Export Assistance and Business Matching Division**, which handles overarching policy, trade facilitation, and resolution of export issues. This dual focus ensures that policy supports the commercial goals of the nation's exporters.

A. Regulation of Exported E-Scrap and Hazardous Materials

The DTI-EMB's authority to regulate what leaves the Philippines is formalised under **Executive Order No. 1016**, which establishes the framework for governing all regulated or prohibited commodities for export.

- **The Consolidated List:** The EMB actively maintains and enforces a **Consolidated List of Prohibited and Regulated Products**. This list is continuously updated in collaboration with other regulatory agencies, acting as a crucial guide for exporters.
- **Inter-agency Clearance:** The regulation of **hazardous e-waste** and scrap is a shared responsibility, executed in close co-ordination with the **DENR**. Specifically, the exportation of hazardous waste, such as Used Lead-Acid Batteries (ULAB) and used oils (though the latter is currently proposed for removal from the prohibited list), requires formal DENR clearance before export permits can be issued. This process ensures environmental safeguards are met before transboundary movement.

- HS Codes for Transparency: The Harmonized System (HS) Codes are the key regulatory mechanism used to categorise and track all traded goods. The EMB mandates that exporters be fully transparent about the specific HS codes used for electronic scrap and recycled materials. This stringent requirement is necessary to prevent illegal shipments from being disguised or misclassified as usable parts or non-hazardous materials, which is a common tactic in illicit e-waste trade.

II. Policy Challenge: The Basel Ban Amendment and Trade Impact

A central and critical topic of the meeting was the potential ratification of the Basel Ban Amendment by the Philippines and the profound economic and structural impact it would have on the e-waste trade and the domestic recycling industry.

A. The Policy Constraint and Japan's Historical View

The ERIA research team emphasised that the Basel Ban Amendment is designed to prevent the export of hazardous waste (which includes most types of e-scrap) from developed countries (specifically OECD members like Japan) to developing nations.

- Past Incidents: The discussion highlighted the sensitivity of the Japanese government regarding this topic. Japan's Ministry of the Environment maintains heightened caution regarding the international e-waste trade due to past incidents of illegal waste export from Japan to the Philippines and other Southeast Asian nations in prior decades. This history drives their support for stronger regional regulation.
- Shifting Compliance Standards: If the Philippines formally ratifies the amendment, the legal landscape will shift dramatically. The country would be legally required to accept only non-hazardous materials, even from its major developed trading partners. This will fundamentally necessitate an upgrade in local material analysis, classification, and recycling compliance standards across the entire domestic recycling industry.

B. Sectoral Importance and the Informal Economy Gap

- Electronics Sector Vitality: The Philippines' semiconductor and electronics industry is the undisputed anchor of the nation's export market, accounting for the largest share of foreign earnings. A robust and sound resource circulation policy is therefore not just an environmental imperative but a commercial necessity to sustain and support this vital manufacturing and export sector, ensuring a stable domestic supply of recovered secondary materials.
- The Informal Sector's Role: The vast informal sector, composed of local 'junk shops' and independent collectors, is responsible for collecting a

significant volume of scrap materials from households and small businesses. This critical sector remains largely outside the formal regulatory framework. Any effective future policy recommendations must therefore focus on financially and technically incentivising the integration of these junk shops and informal collectors into the formal, accredited recycling facilities. This transition is essential for increasing the volume of legally traded e-scrap and ensuring all exports comply with international environmental and trade laws.

III. Conclusion and Next Steps

The consultation established the DTI-EMB's regulatory perspective and confirmed the Basel Ban Amendment as the most critical forthcoming issue that will shape Philippine trade policy for e-scrap.

Key Action Items Agreed Upon:

1. Export Data Sharing: To complete the trade flow analysis, the ERIA team formally requested an equivalent detailed export data set from the DTI-EMB (matching the import data previously accessed from Customs) to accurately analyse the volume, value, and destinations of Philippine e-scrap trade flows.
2. DENR/EMB Co-ordination: The DTI-EMB committed to continuing its close co-ordination with the DENR-EMB, specifically regarding the DENR's ongoing consultation process and requirements necessary for the ratification of the Basel Ban Amendment.
3. Future Collaboration: The parties agreed to participate in an upcoming in-person stakeholder validation meeting scheduled for September to collaboratively finalise the policy recommendations stemming from the entire ERIA research project.

Annex 5: Philippines: Stakeholder Validation Workshop

Introduction:	Session 1:	Session 2:
International Circulation of EEE- materials in ASEAN + East Asia	**Data Crunch: Importation of Used EEE and other items into the Philippines**	**Where do WEEE go? Fates of post-consumer WEEE in the Philippines**
presentation	**presentation**	**online spreadsheet**

1. Stakeholders Forum Concept Note

The research on the international and domestic resource circulation of EEE-related materials in the Philippines is being finalised by Environweave Integrative Environmental Research. Aside from a review of related literature on Philippine e-waste studies and key informant interviews, the research includes a deep analysis of importation data from 2012 until 2024, as well as a collation of insights from reconnaissance work and field studies on e-waste conducted by Environweave since 2007 until the present.

This forum aims to present the preliminary outcomes of the research to the key informants and select stakeholders to validate the findings and consolidate additional insights. Invited participants include representatives from national government agencies, international development organisations, academic institutions, recyclers, and civil society organisations.

This whole day event will include presentations, stakeholders sharing, and round-table discussions on the following topics:

1) Entry of EEE-relevant materials (e.g., UEEE, e-scrap, etc.) into the Philippines
2) Fates of EEE-relevant materials in the Philippines (e.g., domestic e-waste management, material recovery from e-scrap locally or abroad)

The floor will be open for participants to discuss their ongoing or upcoming programmes or plans related to the two session topics listed above. Visual aids such as infographics, a poster, or brochures, may be presented or distributed. Participants shall be given 5 minutes to share.

For the round-table discussion, we invite participants to share their insights into these three questions:

- What are the policy or implementation gaps that, when addressed, will have a significant impact on reducing entry of unwanted EEE-relevant materials into the Philippines?
- What are the policy or implementation gaps that, when addressed, will have a significant impact on reducing improper e-waste dismantling and disposal?
- Are there opportunities for proper recycling, treatment, and disposal in co-operation with other countries in ASEAN and East Asia?

2. Participants Attending the Stakeholders' Forum

The following stakeholders attended (30 pax):

1. DENR Environmental Management Bureau - Hazardous Waste Management Section
2. DENR Environmental Management Bureau - Solid Waste Management Division
3. DENR Environmental Management Bureau - Policy, Planning and Program Development Division
4. Bureau of Customs Environmental Protection and Compliance Division
5. Department of Trade and Industry - Bureau of Import Services
6. Department of Trade and Industry - Bureau of Philippine Standards
7. Department of Trade and Industry - Export Marketing Bureau
8. United Nations Industrial Development Organization (UNIDO) Philippines
9. ERGONS Project Marketing Consultant
10. University of the Philippines, Diliman, College of Engineering - Environmental Engineering
11. The E-Waste Project (student-led e-waste collection initiative on its 13th year)
12. We Solve Foundation
13. BAN Toxics
14. Ecowaste Coalition
15. HMR Envirocycle
16. Six organisers and three observers

3. Programme of the Stakeholders' Forum

EEE-Related International and Domestic Resource Circulation in the Philippines

11 September 2025 (Thursday)

9:00 am–4:00 pm

Park Inn by Radisson North EDSA

Banahaw Meeting Room, Ground Floor

Opening Programme	
9:00–10:00	Registration and networking over coffee and snacks
10:00–10:30	Invocation and Philippine National Anthem
	Welcome Remarks Reo KAWAMURA, Director for Environmental Policy, ERIA
	Introduction and Objectives of the Forum Fusanori IWASAKI, Research Fellow, ERIA Research on Sound International Resource Circulation in the ASEAN Region
Session 1: Entry of EEE-relevant materials into the Philippines	
10:30–11:00	Data Crunch: Importation of Used EEE and Other Items into the Philippines Melissa Cardenas, Head, Environweave
11:00–11:40	Stakeholders Sharing 1: Initiatives on EEE/UEEE/WEEE international material circulation Moderator: Reo HIRATA, Editorial team
11:40–12:20	Round-table discussion 1: What are the policy or implementation gaps that, when addressed, will have a significant impact on reducing entry of unwanted EEE-relevant materials into the Philippines?
Session 2: Fates of EEE-relevant materials in the Philippines	
12:20–13:30	Buffet Lunch
13:30–14:00	Where do WEEE go? Fates of post-consumer EEE-materials in the Philippines Melissa Cardenas, Head, Environweave
14:00–14:45	Stakeholders Sharing 2: Initiatives towards environmentally-sound e-waste management and recycling Moderator: Reo HIRATA, Editorial team
14:45–15:30	Round-table discussion 2: What are the policy or implementation gaps that, when addressed, will have a significant impact on reducing improper e-waste dismantling and disposal?

	Are there opportunities for proper recycling, treatment, and disposal in co-operation with other countries in ASEAN and East Asia?
Closing Programme	
15:30–16:00	Closing Remarks Representative from DENR-EMB
	Post-event survey and networking over afternoon snacks and drinks

4. Stakeholders Forum – Summary of Session 1

I. Executive Summary

The first session of the Stakeholders' Forum, 'EEE Related International and Domestic Resource Circulation Study in the Philippines', convened a crucial multi-sectoral dialogue, gathering representatives from key government agencies (DTI, Bureau of Customs, Philippine Standards), industry leaders (Sharp Philippines), recycling companies, and international organisations (ERIA).

The discussion centred on the complex challenges and opportunities related to the management of EEE waste and the promotion of a circular economy in the Philippines. Key issues addressed included: (i) the proliferation of non-compliant and refurbished EEE, particularly CRT televisions, and the associated consumer protection risks; (ii) the current regulatory limitations regarding remanufactured and refurbished goods, including the issue of fake Product Standards (PS) marks that are licensed by DTI; and (iii) the role of local recyclers in the international e-waste market and the reliance on foreign standards.

The forum highlighted the immediate need for enhanced consumer awareness, stricter enforcement mechanisms against non-compliant products, and the development of national standards and policies to formally integrate the refurbishment and remanufacturing sectors into the national resource circulation framework.

II. Attendance and Opening Remarks

The session began with traditional opening formalities, followed by welcoming remarks and introductions. The host emphasised the intentional limited size of the group to facilitate a more in-depth and productive discussion.

Participants represented a broad mix of stakeholders, underscoring the collaborative nature of the e-waste challenge:

- Government agencies: Department of Trade and Industry (DTI), Export Marketing Bureau (EMB), Bureau of Customs (BOC), and the Bureau of Philippine Standards (BPS)
- Industry: Representatives from the appliance sector (e.g., Sharp Philippines) and local recycling companies
- International: Delegates from ERIA, providing a regional perspective

- Non-governmental organisations (NGOs): Also represented, contributing to a diverse dialogue

The session proceeded with presentations and a round-table discussion, with a notable focus on consumer protection and the definition of a 'new' product in the context of recycled content.

III. Discussion: The Appliance Market and Regulatory Challenges

A. The Case of CRT Televisions and Non-compliant Products

A significant segment of the discussion revolved around the continuing existence of cathode ray tube (CRT) televisions in the market, particularly in provincial areas like Romblon, despite their general phase-out.

Key Issues Raised:

- Market Persistence: CRT TVs, often sold at low prices (around PHP3,000 or US$60 for a 36-inch model), remain available, with some retailers claiming to sell 'Class A or 'brand new' items, even complete with what appear to be new boxes.
- Refurbishment Concerns: Speakers noted that these products are often obviously refurbished. The concern is the lack of quality control and the legal status of such goods.
- Fake PS Marks: A representative from the BPS clarified that the PS mark is only issued to manufacturing companies. If the PS mark is found on a product sourced from a non-manufacturing entity – especially one that is clearly refurbished or sourced from an obscure factory – it is definitively fake.

B. Consumer Protection and Enforcement

The conversation quickly shifted to the immediate actions required to protect consumers from these non-compliant and potentially unsafe products.

- DTI Enforcement: The DTI has an enforcement bureau that can investigate and report potential product certification violations. If a fake PS mark is reported, DTI can issue a show cause order or a notice of violation to the establishment selling the non-compliant goods.
- Consumer Responsibility: Consumers were strongly encouraged to report all instances of suspicious or uncertified products to the DTI to aid in enforcement.
- Certification Limitations: The BPS confirmed that, as of the time of the forum, they cannot issue certificates to products that have had their internal or external parts replaced, making the sale of certified refurbished goods challenging under current regulations.

C. The Status of Remanufactured and Refurbished Goods

The forum addressed the emerging concept of incorporating recycled or refurbished parts into new products.

- Recycled Content vs. Refurbishment: A question was posed regarding whether a product using 60% recycled plastic parts could still be considered a 'brand new'. This highlights the policy gap between eco-branding (using recycled materials in new manufacturing) and refurbishment (re-selling UEEE).
- International Standards: It was noted that internationally, there is a growing advocacy for remanufactured,, refurbished, or repurposed goods, especially in First World countries. However, this depends on having clear international standards and appropriate local policies in place.
- Health and Safety Issues: A major hurdle for the formal acceptance of refurbished goods is potential health and safety concerns, such as the transmission of viruses or bacteria/insects (e.g., termites) from products used in other countries. Any future standard for refurbishment must ensure that the product is restored to a condition 'as good as new' and is free of such contaminants before resale.

IV. The Role of Filipino Companies in International E-Waste Circulation

A. Export Activity and Regulatory Guidance

The Bureau of Import Services (BIS) and the Export Marketing Bureau (EMB) provided input on the existing regulatory framework for international trade in EEE waste.

- Import regulation: The BIS primarily provides trade regulatory guidance to importers, suggesting that trade regulatory government agencies need to strictly enforce regulations on imported EEE waste.
- Export Regulation: The EMB references Executive Order No. 1060, which provides a list of prohibited and regulated commodities to guide exporters.
- Success in Exporting: Data from the Philippine Statistics Authority (PSA) highlighted the strength of local e-waste processing. In 2020, ESEMI Recycling Company, one of the listed TSD facilities, exported approximately US$8.2 million worth of electrical and electronic waste scrap. This confirms the Philippines' active role in the global e-waste recycling supply chain.

B. Reliance on International Standards

The international participants provided critical insight into the practices of ASEAN companies engaged in e-waste processing and recycling.

- Global Target Markets: ASEAN recyclers often target international markets, particularly in Europe and Japan, for their processed materials (or refurbished goods).
- External Specification Reliance: Due to the absence of specific, comprehensive ASEAN-wide standards for refurbishment and the circulation of these items, local companies often rely heavily on the specifications and standards of their foreign counterparts in developed countries (Europe, Japan) to maintain business continuity

and ensure their materials are accepted.

- ISO Certification for Data Protection: While a direct standard for refurbishment is not currently established, some recycling companies are joining ISO standards to obtain certification, primarily to address crucial concerns like protecting data contained in devices like PCs during the recycling process.

V. Key Gaps and Recommendations for Future Sessions

The first session successfully defined the scope of the e-waste and resource circulation challenge in the Philippines, leading to the identification of several key policy and enforcement gaps.

Gap/Challenge	Recommendation for Action/Policy Development
Lack of standards for refurbished goods	Develop an internationally aligned national standard (potentially a 'PS mark for remanufactured/refurbished goods') that includes rigorous quality control and sanitation requirements (e.g., preventing health hazards like pests or viruses).
Fake PS marks and non-compliant sales	Increase joint enforcement operations between the DTI Enforcement Bureau and local police against retailers selling non-compliant EEE, especially in second-tier cities and provinces. Launch a widespread consumer information campaign on how to identify and report fake PS marks.
Definition of 'new' product	Develop clear regulatory guidelines for products that incorporate a high percentage of recycled content (eco-branding) versus products that are refurbished EEE, ensuring appropriate labelling and consumer transparency.
Data and supply chain transparency	Explore mechanisms to enhance the tracking and reporting of domestic EEE waste collection, dismantling, and processing, providing clearer data to inform policy.

The subsequent sessions should focus on developing concrete policy proposals and standard operating procedures based on these gaps, particularly by leveraging the established export capacity of local TSDs and harmonising national standards with regional best practices.

5. Stakeholders Forum – Session 2 Summary

I. Executive Summary

Session 2 of the Stakeholders' Forum transitioned the dialogue from policy gaps to actionable strategies for enhancing e-waste management and resource circulation in the Philippines. The central focus was on the successes and challenges of existing e-waste collection programmes, the difficulties presented by the informal recycling sector, and the crucial need for cross-departmental and public–private sector co-ordination.

Key findings include the positive results of year-round collection initiatives by academic institutions (University of the Philippines [UP] Diliman, UP Baguio) and the continued challenge of integrating the informal sector (local 'ambulance buyers') into the formal recycling co-operative structure.

The session concluded with several concrete, government-led action items, including:

1. Skills Development: Co-ordinating with TESDA for certification programmes for EEE repair technicians
2. Regulatory Clarity: DTI to clarify policies on e-waste and e-scrap definitions
3. Investment Focus: Supporting investment, export capacity building, and awareness programs for e-waste recycling

The prevailing theme was the necessity of moving beyond pilot projects to establish a scalable, unified, and well-regulated national e-waste management system.

II. Focus and Scope of Discussion

The second session was primarily dedicated to detailed reports and discussions regarding the operational realities of e-waste management in the country, including both collection mechanisms and intricacies of the recycling/disposal process.

A. E-Waste Collection Programmes and Pilot Projects

Participants reviewed several initiatives that serve as models for future national programs:

- JICA Pilot Project (2006–2008): The session began with a review of historical efforts, specifically the Collection Cell Phone and Waste Collection pilot project under the JICA Recycling Industry Development Project. This historical context set the stage for discussing current progress.
- Academic-Led Collection: The E-Waste Project of UP Circuit, a student organisation in UP Diliman, demonstrated successful institutional engagement:
    - UP Diliman via UP Circuit organization: Implemented a year-round e-waste collection system utilising dedicated drop boxes across its campus
    - UP Baguio: Recently launched its e-waste collection programme in late May or early June

- Scope of Collection: Current successful collection efforts extend beyond simple gadgets to include:
    - Household appliances and other EEE
    - Hazardous materials like used lead-acid and car batteries
    - Bulky waste such as used tires and construction materials, indicating a broad approach to waste resource management

B. E-Waste Recycling and Disposal Challenges

The discussion highlighted structural challenges in processing and disposal, particularly concerning hazardous and bulky items.

- CRT Dismantling: A specific investigation into CRT dismantling process in the Philippines was mentioned, underscoring the ongoing difficulty in safely handling hazardous components, like leaded glass, associated with older electronics.
- Informal Sector Integration: The persistent and significant challenge of the informal sector was a major topic:
    - Ambulant Buyers: Local buyers informally purchase broken electronics directly from neighbourhoods. These practices often involve improper dismantling, posing environmental and health risks.
    - Co-operative Gaps: The Bagong Silang area was cited as an example of a community whose residents are not yet fully integrated into the existing electronic waste co-operative, indicating a major gap in the formal collection network.
- Specialised Waste: The forum explored specific waste streams, such as Meralco electric metres, to understand the necessary recycling options for specialisd, utility-owned equipment.
- Focus on Physical Recovery: There was emphasis on the focus of current local efforts, which centre primarily on the physical recovery of electronic waste materials.

III. Policy and Implementation Gaps

A core segment of the discussion addressed the policy and implementation failures that perpetuate improper e-waste dismantling and disposal across the country. The prevailing sentiment was that while regulation exists, enforcement and clarity are lacking.

A. Lack of Clarity and Co-ordination

Participants agreed that the national e-waste management efforts suffer from insufficient cross-departmental co-ordination and unclear definitions, creating

enforcement and investment hurdles. A key gap identified was the need for regulatory clarity and simplified processes for both local recyclers and potential exporters.

B. Need for Skills and Capacity Building

To move e-waste processing into a formal, safe, and quality-controlled environment, a significant need for trained personnel was identified. This is essential for both safe recycling/dismantling and for promoting the repair and refurbishment economy as an alternative to simple disposal.

IV. Concrete Action Items and Recommendations

The second session culminated in a clear list of next steps and responsibilities for the various stakeholder groups, highlighting a collaborative path forward:

Responsible Agency	Action Item	Goal
Department of Trade and Industry – Bureau of Import Services, Export Marketing Bureau, and Bureau of Product Standards	Clarify policies and definitions for 'e-waste', 'e-scrap', and potentially 'refurbished/remanufactured EEE' to streamline legal export and domestic circulation.	Regulatory certainty for industry and enforcement agencies
TESDA (under the Department of Labor and Employment)	Co-ordinate the development and certification of training programmes for EEE repair technicians and specialised dismantling personnel.	Formalise the repair sector and ensure safe handling/processing of e-waste.
Government agencies (Collective)	Support investment programmes and export capacity building initiatives for local TSD facilities.	Scale up the formal recycling industry and increase the Philippines' share in the global resource circulation market.
All stakeholders	Increase awareness-building campaigns for the public and exporters regarding proper e-waste disposal and the risks of the informal market.	Drive higher participation in formal collection programmes.
Government agencies (Collective)	Pursue cross-departmental collaboration (e.g., DTI, DENR, BOC) to create a unified and efficient enforcement and reporting mechanism.	Reduce improper disposal and close policy implementation gaps.

Responsible Agency	Action Item	Goal
Forum organisers	Plan stakeholder workshops to refine the draft report and solidify concrete standard operating procedures (SOPs) for the proposed actions.	Translate forum discussions into tangible, enforceable policies.

The commitment to expand and multiply collective e-waste management efforts through partnership opportunities underscored the conclusion of the session, setting a strong agenda for future collaboration.

Annex 6: Field Visits

1. Field Visit Concept Note and Itinerary

The e-waste field survey in the Philippines will include meetings with stakeholders that are involved in e-waste management policy drafting and implementation, including international trade as well as businesses involved in both formal or informal dismantling of e-waste and material recovery.

Target stakeholders for the field survey include the following:

1. National Government Agencies that include the Department of Environment and Natural Resources – Environmental Management Bureau
    a. An in-person study session with the DENR-EMB Central Office groups handling e-waste, household special waste, policy and data management is scheduled for 10 September (Wednesday).
    b. This will include a visit to the EMB Regional Office in Central Luzon, where most of the licensed recyclers/TSD facilities for e-waste are located.
    c. These TSDs handle hazardous waste through issuances under RA 6969.
2. TSD Facilities/E-Scrap Importers that are licensed to accept and treat e-scrap (M506) and/or special waste from households (M507)
    a. TSDs listed in the DENR-EMB database are mostly located in Central Luzon (Region III) and CALABARZON (Region IV-A).
    b. These TSDs have varying capacities, with only 12 out of 128 facilities having a daily capacity of 100 MT or more.
    c. Some of these high-capacity e-waste TSD facilities are located within the export processing zone of Subic Bay Metropolitan Authority, and import e-scrap for dismantling and mechanical processing prior to re-export to final recyclers abroad.
3. Scrap Metal Buyers that are part of the material recovery value chain linked to junk shops, which, in turn, are involved in informal dismantling of post-consumer e-waste.
    a. It is suggested to have a visit to En Tsumugi, a newly operational recycler of end-of-life vehicles, since the Hung family is also involved in the scrap metal business.
    b. Some steel mills are located beside the En Tsumugi facility that would be worth visiting.

Site visits will be geographically located within Metro Manila and Central Luzon (Region III), particularly in the provinces of Bulacan, Pampanga, and Zambales.

Agency/Company	Stakeholder Type	Significance
DENR-EMB Region III	The DENR-EMB regional office manages the highest concentration of e-waste TSDs in the Philippines.	Issues TSD licence and import/export clearances covering the Central Luzon region
Pampanga/Tarlac TSDs like Semi Recycling	E-waste TSDs	Some refine precious metals, some are involved in the import/export of e-scrap from dismantled e-waste
En Tsumugi	ELV recycling facility	The Hung family also has links with metal scrap activities. The family tried to do household e-waste recycling but did not see financial viability.
Premium steel works and Trading Corp., Pentagon Steel, United Pentagon Steel	Steel mills	Metals harvested from locally dismantled e-waste are likely sold by junk shops to these steel mills
Subic-based TSDs like Jack Electronic Metal, Cresc Inc., Misung Subic, etc.	E-waste TSDs/ e-scrap importers/exporters	Some TSDs import e-scrap for further processing prior to re-export
Subic Bay Metropolitan Authority	Manages the export processing zone in Subic Bay	Had a recent issue involving the import of e-scrap without DENR permits

2. Field Visit Meeting Notes

Meeting with Semirecycling Co., Inc.

http://www.semirecycling.com/index.html

Discussion on E-Waste Treatment, Storage, and Disposal for a Formal E-Waste Recycler

12 September 2025, 10 am–12:30 noon

Overview: The discussion highlights the dual nature of e-waste management in the country, with a formalised, regulation-heavy sector (like SRCI), and a dominant, informal sector that operates without permits. Key challenges for formal recyclers include competition from

these informal groups and bureaucratic hurdles related to export permits. The identified next steps include establishing a formal collection system for household e-waste and streamlining government policies to support the formal recycling industry of Japan.

Discussion with En Tsumugi and End-of-Life Vehicle Recycler

12 September 2025, 2 pm–4 pm

Overview: En Tsumugi, a Filipino recycling company owner, together with Environweave, ERIA, IDE-JETRO, OECC, and Mr. John, a third-generation scrapper and CFO of En Tsumugi, discussed e-waste circularity in ASEAN and the Philippines. The company highlighted the major challenges they face, including a lack of government support, high operating costs, and competition from informal scrappers who often burn e-waste, which is harmful to the environment. The group explored solutions inspired by Japan's successful extended producer responsibility (EPR) system. This model uses fees paid by consumers to financially support formal recycling companies. The meeting concluded with a commitment to collaborate on new e-waste policies, including a plan to help En Tsumugi expand its operations to include appliances and refrigerants, which also offers an opportunity to earn carbon credits from proper refrigerant disposal.

Meeting with Subic Bay Metropolitan Authority

Ecology Center and Trade Facilitation and Compliance Division

15 September 2025

Overview: The discussion explores the dual nature of e-waste and vehicle recycling in the Philippines, which consists of a formal, regulated sector and an informal one operating without oversight. The discussion reveals that formal recycling facilities are heavily concentrated in Luzon's freeport zones, benefitting from strategic locations and business-friendly policies. A key challenge is a lack of effective enforcement and monitoring, as the informal sector often goes unreported. The speakers propose solutions like real-time tracking systems, EPR policies, and government subsidies to help formalise the informal sector and improve domestic waste collection.

Meeting with SB Freeport Recyclers Association

15 September 2025

Overview: A discussion on the current state of e-waste management and recycling in the Philippines between the Subic Bay Freeport Recyclers Association (SBFRA), ERIA, and Environweave. The conversation focused on the regulatory environment, logistical challenges, and the potential for international collaboration.

Meeting with DENR-EMB Region III

15 September 2025

Overview: The meeting with DENR-EMB Region III revealed that Central Luzon is the hub for e-waste TSD facilities, driven by strategic location and business incentives. However, the informal sector continues to handle most household e-waste. Key challenges include policy gaps, a limited EMB mandate, and the unsustainability of donor-driven projects. The discussion explored solutions such as a new e-waste EPR framework, a QR-coded tracking system, and ways to integrate informal recyclers.

Chapter 5

Thailand

Introduction

In 2022, Thailand ranked as the second-largest generator of electronic and electrical wastes (e-waste) in Southeast Asia (ITU, 2025). One of the country's key policy initiatives is the National E-waste Management Plan, launched in 2018, by the Pollution Control Department (PCD) under the Ministry of Natural Resources and Environment. The plan aims to create a more sustainable and efficient system for e-waste management in the country. It outlines a set of strategies and actions focused on reducing e-waste generation, promoting recycling and proper disposal, and improving overall management practices. In 2021, Thailand introduced the Strategic Plan on Integrated E-waste Management (2022–2026) to build on the 2018 National Plan. While the National Plan provides a long-term framework for e-waste management, the Strategic Plan sets short- and medium-term targets to be achieved by 2026.

One key challenge facing e-waste management in Thailand is the lack of a comprehensive regulatory framework. While regulations exist for hazardous and solid waste management, no specific regulations currently govern e-waste management. As of August 2025, a draft Waste Electrical and Electronic Equipment (WEEE) Act developed by the PCD based on the extended producer responsibility (EPR) principle is currently in preparation for submission to the Cabinet for consideration and subsequent legislative procedures. In the absence of a consensus on the draft act, e-waste management continues to suffer from a fragmented approach, with different agencies being responsible for different management aspects. Another challenge is the prevalence of the informal sector, which plays a significant role in e-waste recycling in Thailand. While informal recyclers provide an important service, they often work in unsafe conditions and without proper training or equipment.

In September 2019, the Department of Industrial Works (DIW) signed a memorandum of understanding with the New Energy and Industrial Technology Development Organization of Japan to implement a demonstration project for e-waste recycling in Chachoengsao Province. Using Japan's advanced and environment-friendly technology, the plant is capable of process approximately 100 tonnes of e-waste per month. It serves as a model for the use of circular resources and supports Thailand's efforts to improve the efficiency of its e-waste management.

Currently, the concept of the circular economy is increasingly being adopted and extended to cover the pre-end-of-life stage of electrical and electronic products. This includes considerations such as maintenance, repair, reuse, exchange, repurposing, and second-hand

use, which enhance the value of products and serve as a strategy to reduce the amount of future e-waste.

1. Situational Analysis on the International Material Flow Relevant to the EEE between Thailand and Japan

1.1 Overview

E-waste refers to all items of electrical and electronic equipment (EEE) and its parts that have been discarded by its owner as waste without the intent of re-use. E-waste is also referred to as WEEE (waste electrical and electronic equipment), e-waste, or e-scrap in different regions and under different circumstances in the world. It includes a wide range of products – almost any household or business item with circuitry or electrical components with power or battery supply. E-waste is one of the fastest-growing and most complex waste streams in the world, affecting both human health and the environment, and proliferating a loss of valuable raw materials (The Global E-Waste Statistics Partnership, 2025).

According to the Directive 2012/19/EU on Waste Electrical and Electronic Equipment (WEEE), the term of EEE refers to equipment that uses electricity or electromagnetic fields to function, and is intended to generate, transfer, and measure electric current or electromagnetic fields. It is designed for use with a maximum voltage of 1,000 volts for alternating current and 1,500 volts for direct current.

On 14 September 2020, the Ministry of Commerce (MOC) issued an announcement in the Royal Gazette titled 'Prohibiting the Importation of E-waste into the Kingdom, B.E. 2563 (2020)', which came into effect on 15 September 2020. The announcement defines 'e-waste' as electrical and electronic parts or scraps (excluding waste from power generators) that include components such as electrical capacitors and other batteries, mercury-containing switches, cathode ray tube (CRT) glass waste, and other activated glass. It also includes capacitors containing polychlorinated biphenyls (PCBs) or contaminated with cadmium, mercury, lead, or PCBs, which are classified as chemical waste under Item 2.18, List 5.2 of the Ministry of Industry's 2013 Hazardous Substances List, in accordance with hazardous substances legislation.

E-waste refers to electrical appliances and electronic devices that have reached the end of their useful life, become deteriorated, or are no longer wanted, and are therefore discarded as waste. This type of waste contains toxic substances and cannot naturally decompose. If not properly managed, it may release harmful chemicals that pollute the environment. Examples include mobile phones, computers, televisions, batteries, photocopiers, printers, refrigerators, and washing machines (Department of Health, 2015; National Science and Technology Development Agency (NSTDA), 2011). E-waste accounts for only 2.9% of the world's total waste, yet its growth rate is 1.2 times faster than the global growth of overall

waste (Figure 5.1). This rapid increase is driven by the expansion of the electrical and electronic appliance industry, making products more affordable and accessible. In addition, continuous technological advancements lead to the development of new models, encouraging consumers to replace devices more frequently. Global economic growth also raises consumers' income, thereby increasing their purchasing power for electronic products.

Figure 5.1. World E-Waste



Sources: United Nations (UN), United Nations Institute for Training and Research (UNITAR), PCD and data collected by the Strategy and Research Department, GSB Research Center (2022).

Hazardous waste generated within communities and discarded EEE, if not properly separated or if mixed with general solid waste, may be difficult to collect for appropriate treatment or disposal. Improper dismantling of such products within communities can cause heavy metal components found in hazardous waste to contaminate the environment, including soil, surface water, and groundwater, potentially affecting public health (WHO, 2024).

There may also be public complaints regarding the burning of discarded products and leftover materials from the dismantling process, such as electrical wires, LCD screens, plastic scraps, and refrigerator insulation foam. Such activities generate air pollution, including PM2.5 particles, carbon monoxide, hydrogen chloride gas, phosgene gas, and dioxins. These pollutants can harm dismantling workers and nearby residents through

inhalation. Prolonged exposure to such toxic gases or fine particle matter poses health risks and is considered carcinogenic (WHO, 2024).

Therefore, it is important to study the sources of e-waste for effective management. The origins of e-waste can be categorised as follows:

- Household e-waste: Generated from daily use in homes, this type is often mixed with general solid waste.
- Industrial e-waste: Produced during manufacturing processes in factories, including components containing chemicals, discarded scraps from production, and non-standard products.
- Imported e-waste: Brought into the country from abroad, as governed by the Hazardous Substances Act, B.E. 2535 (1992).

1.2 Identification of the EEE-relevant materials for the analysis

The identification of EEE-relevant materials for analysis involves recognising the key components within electronic devices that need to be assessed for recycling, hazardous substance management, and environmental impact. Here is a detailed breakdown of the materials that are typically analysed in e-waste (Table 5.1).

Table 5.1. Types of Materials Related to EEE

Types of Materials	Details
1) Metals	• Precious Metals: These are valuable for recovery and recycling, including: o Gold (Au): Found in connectors, circuit boards, and other electronic parts. o Silver (Ag): Often used in conductors and soldering. o Platinum (Pt): Found in some electronic components, especially in automotive sensors and connectors. • Base Metals: o Copper (Cu): Common in wires and circuit boards. o Aluminum (Al): Used in casings and heat sinks. o Iron (Fe): Found in structural components of many electronics. • Other Metals: o Lead (Pb): Found in solders and older electronics. o Tin (Sn): Used in soldering. o Zinc (Zn): Often used for corrosion-resistant coatings.

Types of Materials	Details
	○ Nickel (Ni): Found in some batteries, connectors, and other electronic parts.
2) Plastics	• Polyvinyl Chloride (PVC): Common in cables and some casings. • Polystyrene (PS): Used for insulation and some casing. • Polycarbonate (PC): Found in transparent casings and some display screens. • Acrylonitrile Butadiene Styrene (ABS): Often used in durable electronic casing. • Polyethylene (PE): Found in insulation, wiring, and casings.
3) Glass	• LCD Glass: Used in display screens (e.g., in smartphones, televisions, and monitors). • Glass from Cathode Ray Tubes (CRT): Used in older television and computer monitors. • Glass Fibre: Found in printed circuit boards and other electronic components.
4) Batteries	• Lithium-ion Batteries: Found in many modern portable electronics like smartphones, laptops, and electric vehicles. • Nickel-Cadmium (NiCd) and Nickel-Metal Hydride (NiMH): Found in older portable devices and some power tools. • Lead-Acid Batteries: Often found in automotive and backup power systems.
5) Semiconductors	• Silicon (Si): A primary material in microchips and integrated circuits. • Gallium (Ga): Used in semiconductors, especially in LED and solar panels. • Germanium (Ge): Sometimes found in semiconductor devices.
6) Hazardous Substances	• Lead (Pb): Found in solders, glass, and CRTs. • Mercury (Hg): Found in fluorescent lights and some older electronic components. • Cadmium (Cd): Found in batteries and certain types of semiconductors. • Brominated Flame Retardants (BFRs): Used in plastics to reduce flammability, found in circuit boards and casings. • Polychlorinated Biphenyls (PCBs): Found in older electronic equipment, such as capacitors.
7) Insulating Materials	• Foams: Used in packing, insulation, and cushioning, particularly in refrigeration units (e.g., chlorofluorocarbons: CFCs or hydrochlorofluorocarbons: HCFCs).

Types of Materials	Details
	• Ceramics: Found in certain capacitors and insulating parts of electronics.
8) Other Components	• Printed circuit board: This often contains a mix of metals (such as copper, gold, silver) and plastics, making them important for recycling and analysis. • Connectors, Capacitors, Resistors: These small components often contain precious metals, ceramic materials, or other recyclable materials.
9) Composite Materials	• Many electronic devices, particularly modern smartphones and laptops, use a combination of materials, including plastics, metals, and glass, which require special handling during recycling.

Sources: Adapted from Forti et al. (2020); Baldé et al. (2024); ISWA (2024).

E-waste management can be divided into three components based on material types as follows: metal materials (iron, aluminium, and other metals) account for approximately 58%, plastic materials account for about 40% (DIW, 2018). These materials are compressed into bales for sale to authorized processing facilities, such as metal smelting plants or plastic pellet manufacturing plants. The sale price depends on the prevailing scrap market prices.

The remaining approximately 2% consists of electronic components and printed circuit boards, which include both high-grade components such as circuit boards from small IT devices, mobile phones, computers, and notebooks, and low-grade components such as circuit boards from other devices like power supplies, refrigerators, air conditioners, heaters, or washing machines.

After sorting by grade, the materials will go through a shredding process to reduce size and prepare for smelting and extraction processes to recover valuable metals such as gold and copper to be reused in the original production process in factories (DIW, 2018).

A) Existing research articles

The study team reviewed research related to the material flow of e-waste. However, the related research reviewed has not yet found any studies on the material flow of e-waste between Thailand and Japan. The key points can be summarised in Table 5.2.

Table 5.2. Summary of Relevant Research Conducted in Thailand

No.	Title Case	Key Points
1	Urban mining of e-waste management globally (Ouro-Salim, 2024)	E-waste is rapidly increasing worldwide, creating environmental and health risks. Urban mining – the recovery of valuable resources from e-waste – shows strong potential for promoting sustainable resource use and advancing the Sustainable Development Goals. A review of 124 studies highlights growing interest, key technologies, and research gaps, while stressing the need for legal support, producer responsibility, and participation from consumers and informal workers.
2	Material flow analysis and life cycle assessment of WEEE dismantling into recycled materials in Thailand (Borrirukwisitsak et al., 2023)	E-waste in Thailand is generated in large volumes and contains diverse materials, making waste and resource management a critical issue. This study applied Material Flow Analysis (MFA) and Life Cycle Assessment (LCA) to evaluate environmental impacts of manual dismantling across several device types: refrigerators (RF), personal computers (PC), CRT and LCD televisions, air conditioners (AC-in and AC-out), feature phones (FP), and smartphones (SP). Results show that the most recoverable materials are steel, compressors, and plastics, while LCD TVs and smartphones contain more non-recyclable than recyclable parts. Increasing recyclable components could reduce negative environmental impacts, and the findings provide insights for policymakers to strengthen sustainable e-waste management.
3	Towards sustainable metal recovery from e-waste (Manikandan, et. al., 2023)	Precious metals play a vital role in the global economy and extracting them from e-waste is considered a clean technology for efficient material recovery. E-waste arises from the widespread use of electrical and electronic devices such as household appliances, computers, consumer electronics, power tools, and medical equipment. If improperly disposed of, it can release hazardous substances that threaten human health. Recovering metals from this waste stream is therefore a key strategy for sustainable e-waste management.
4	Material flow, economic and environmental life-cycle performance of informal	Thailand's informal e-waste recycling sector shows high potential for material recovery. This study analysed end-of-life management of four household appliances –

No.	Title Case	Key Points
	electronic waste recycling in a Thai community (Arain et. al., 2022)	washing machines, refrigerators, CRT televisions, and fans – using MFA and LCA. Results indicate that over 93% of original material mass can be recovered, with more than 460,000 kg of e-waste recycled annually, generating a net value of about THB2.1 million per year. Environmental benefits include reducing greenhouse gas emissions by 2.7–25.4 kg CO_2 eq per unit, lowering human health impacts by 0.2 DALY (disability adjusted life years per year, and avoiding nearly 400,000 MJ of resource damage per month.
5	Quantification and characterisation of recovered materials in the cycle of the informal household electronic waste dismantling in Buriram province, Thailand: A challenge towards sustainable management and circular economy (Thongkaow, Prueksasit, and Siriwong, 2022)	This study analysed informal e-waste dismantling in Buriram Province communities (2017–2018) using MFA. Annual e-waste inflows ranged from 1,593 to 12,943 tonnes, with over 90% of materials from fans, refrigerators, washing machines, microwaves, and air conditioners being recoverable. Recovered materials provided strong economic incentives, with small households earning about US$798 per month and larger households about US$1,262 per month.
6	WEEE Management by Bangkok Metropolitan Administration: Public Awareness in Bang Khen, Lat Phrao, and Chatuchak Districts (Khaikham, 2022)	This study examined e-waste management in Bangkok through a survey of 422 respondents. Findings show that 93% were already aware of e-waste, with most generating one to five items per week, mainly from electrical tools and lighting equipment. However, 22% reported storing e-waste due to uncertainty about disposal methods. Effective e-waste management therefore requires collaboration amongst government agencies, state enterprises, the private sector, and the public.
7	The LCA of greenhouse gas emissions and life-cycle costs of e-waste management in Thailand (Mangmeechai, 2022)	Most households in Thailand store e-waste at home due to a lack of disposal options, while informal dismantlers – often farmers or unlicensed labourers – have long collected and processed e-waste without proper health or environmental standards. They gain only small profits from reusable parts, while non-recyclables are discarded with municipal waste, releasing greenhouse gases,

No.	Title Case	Key Points
		particularly from improper transport and refrigerants such as CFCs and HFCs (Hydrofluorocarbons). Recycling is further constrained by geography: most dismantling occurs in poorer northeastern regions, far from central recycling industries, and high-tech processes for extracting valuable metals remain unavailable domestically, forcing exports of circuit boards and batteries. To advance a circular economy, Thailand needs clear E-waste regulations, cost internalisation for proper treatment, and investment in a complete domestic recycling industry.
8	Design for Circularity Guidelines for the EEE Sector (Berwald et al., 2021)	Plastics in EEE are increasingly complex, making recycling difficult. While WEEE recycling is driven by metal recovery, plastics remain a challenge. The Design for Circularity approach addresses this through five principles: avoiding hazardous substances, enabling easy removal of hazardous parts, using recycled materials, designing for easier separation, and promoting recycled content. This guides designers, producers, and policymakers in advancing the circular economy.
9	E-waste: Bridging the Knowledge Gaps in Global Production Budgets, Composition, Recycling and Sustainability Implications (Ghimire and Ariya, 2020)	Electronic device production has surged due to urbanisation, technological advances, and consumer tech awareness. In 2019, global e-waste reached 53.6 million tonnes (Mt), but only 17.4% was properly collected and recycled. China generated the most (~19%), followed by the United States. E-waste contains diverse organic and inorganic substances, with metals and plastics increasing most rapidly. Key challenges include unreliable data, incomplete assessment of new materials, limited recycling efficiency, lack of advanced detection and recycling technologies, and insufficient international policies and co-operation.
10	Material flow of informal electronic waste dismantling in rural area of Northeastern Thailand (Thongkaow, Prueksasit, and W. Siriwong, 2017)	In rural northeastern Thailand, informal dismantlers process 12 types of e-waste – from CRT TVs to mobile phones – recovering mainly steel, copper, aluminium, plastics, and wires. Recoverable materials account for 69–97% of total weight, driving participation despite health and environmental risks from improper handling.

Source: Author.

In Thailand, e-waste management faces major challenges due to the lack of clear laws and regulatory measures, leading to unclear systems for collection, sorting, and disposal. Most households store e-waste at home, while informal dismantling – using rudimentary methods like hammers, chisels, and open burning – continues to expand, especially in the northeast, far from the central region where most e-waste is generated. This creates high transport costs, greenhouse gas emissions, and limited recycling capacity, as advanced metal recovery technologies are unavailable domestically, forcing exports.

Opportunities lie in promoting urban mining to recover valuable and rare metals, advancing EPR to ensure producers take responsibility across the product life cycle, and developing a comprehensive domestic recycling industry. Strengthening recycling infrastructure would reduce dependence on exports, conserve high-value resources, generate economic returns, and support Thailand's transition towards a circular economy.

B) Basel Convention

- **Basel Convention's provisions on the EEE-relevant materials in Thailand**

Thailand signed the Basel Convention in 1990 and ratified the Convention in 1997 (Secretariat of the Cabinet, 2018a, 2018b). Then, **the Convention entered into force for Thailand in February 1998**. In implementing the Basel Convention, pursuant to Cabinet decisions dated 20 March 1990 and dated 7 July 1997, the Hazardous Substance Act 1992 *(*HSA 1992*)* was designated as the legal instrument governing the control of the import (including transit) and export of hazardous wastes. The DIW and the PCD have been designated to serve as the national competent authority and focal point to the convention, respectively (Secretariat of the Cabinet, 2018a, 2018b). All wastes subject to the transboundary movement control (under Annex I to the Convention) were listed as hazardous substance type III under the chemical waste category by the Ministry of Industry in 1995 (Notification of the Ministry of Industry (MIND) on List of Hazardous Substance, B.E.2538, 1 May 1995).

As defined in the permitting criteria on the import of chemical waste in 1996 (Notification of the DIW on Permitting Criteria for the Import of Chemical Wastes, 31 May 1996), **only chemical wastes that are intended to be used as raw materials in the factory and met with all import criteria shall be allowed to be imported into the country**. These criteria were also applied for the early implementation phase of the convention when Thailand became a signatory and have been implemented since the convention entered into force in Thailand.

After the entry into force of Annex VIII and IX to the Convention in 1998, all waste in Annex VIII (List A) have been consequently updated as hazardous substance type III under the chemical waste category by the Hazardous Substance Committee to be in line with the 1998

amendment. The previous list of chemical waste was accordingly provoked (Notification of the MIND on List of Hazardous Substance (No. 2) B.E 2543, 8 May 2000).

In addition, Thailand implements a national ban policy prohibiting the import of specified wastes into the country under domestic legislation, including administrative orders issued by the designated and authorised national body. It includes the decision of the National Environment Board (NEB) and its sub-committees recognising the target item as domestic hazardous wastes and, consequently, deeming it subject to the ban under Article 1 to the convention. For example, NEB's Decision No. 6/2536 dated 15 December, B.E. 2536 (1993) prohibits the import of used lead-acid batteries.

Those relevant decisions will be considered in issuing the import permit under HSA 1992 and the import consent under the convention by DIW.

Indeed, this prohibition policy is not only a tool to prevent Thailand not serving as one of global waste bins, but also an indirect driving force supporting the domestic resource efficiency. It works well together with other robust measures such as a tax incentive for used lead-acid batteries recycling program considering the environmental and operational monitoring (PCD, 2005) or the promotion of waste-to-energy investment included in the National Alternative Energy Development Plan 2015–2036 (AEDP2015) (Energy Policy and Planning Office, 2015)

In order to strengthen industrial waste management and facilitate the investment in industrial waste facilities, the government amended the Ministry of Industry on Factory Types in 2001 (Regulation No.15 [B.E. 2544]), issued pursuant to the Factory Act, B.E.2535 (1992) on 19 December 2001) to classify factories dealing with industrial waste into three categories under the Factory Act 1992. Factory No. 101 is designated for central waste treatment (wastewater treatment plants and industrial waste incinerator plants); Factory No.105 for material segregation and industrial waste landfilling (hazardous and non-hazardous waste); and Factory No. 106 for waste recycling or recovery.

In 2003, MIND issued its notification prescribing UEEE as hazardous substance type III (Notification of the Ministry of Industry on List of Hazardous Substance, B.E. 2546, 30 September 2003) to control the import of 29 items of used commodities for purposes of resale, reuse, repair, refurbish, dismantle, or recycle, according to the importing criteria set out by DIW in 2003 (Notification of the DIW on Permitting Criteria for the Import of Used Electrical and Electronic Equipment, 2 October 2003) as tabulated in Table 5.3 (left column). In addition to the commodity list, the criteria also set the minimum requirements for the importer.

Later in 2007, the importing criteria were amended by DIW to expand to 32 items of used EEE and 31 items of parts or components of those used commodities and specify minimum requirements for each importing purpose (Notification of the DIW on Permitting

Criteria for the Import of Used Electrical and Electronic Equipment [No. 3], B.E. 2550, 29 September 2007) as tabulated in Table 5.3 (right column). In the case of imports for dismantling. and recycling purposes, it was also required to comply with obligations of the Basel Convention.

Table 5.3. List of UEEE Items and Their Parts or Components Restricted to be Imported in 2003 and 2007

No.	Notification of DIW in 2003	Notification of DIW in 2007
1	Refrigerator (84.18) or its parts or components (8418.19 and 8419.99)	Refrigerator (84.18) or its parts or components (8418.99)
2	TVs (85.28) or their parts or components (85.29)	TVs (85.28) and their parts or components (85.29)
3	Radio (85.27) or its parts or components (85.29)	Radio (85.27) and its parts or components (85.29)
4	Video (85.21) and its parts or components (85.22)	Video (85.21) and its parts or components (85.22)
5	DVD (85.21) or its parts or components (85.22)	DVD (85.21) or its parts or components (85.22)
6	VCD (85.21) or its parts or components (85.22)	VCD (85.21) or its parts or components (85.22)
7	Tape cassette recorder (85.19 and 85.21) or its parts or components (85.22)	Tape cassette recorder (85.19) or its parts or components (85.22)
8	Air-conditioning machine (84.15) or its parts or components (8418.91 and 8418.99)	Air-conditioning machine (84.15) or its parts or components (8415.90)
9	Washing machine (84.50) or its parts or components (8450.901 and 8450.902)	Washing machine (84.50) or its parts or components (8450.90)
10	Drying machine (8451.21 and 8451.29) or its parts or components (8451.901 and 8451.909)	Drying machine (8451.21.00 and 8451.29.00) or its parts or components (8451.90)
11	Dry-cleaning machine (8451.10) or its parts or components (8451.901 and 8451.909)	Dry-cleaning machine (8451.10.00) or its parts or components (8451.90)
12	Electric rice cooker (8516.60) or its parts or components (8516.90)	Electric rice cooker (8516.60.10) or its parts or components (8516.90)
13	Electric kettle (8516.10) or its parts or components (8516.90)	Electric kettle (8516.79.10) or its parts or components (8516.90)
14	Microwave oven (8516.50) or its parts or components (8516.90)	Microwave oven (8516.50.00) or its parts or components (8516.90)
15	Electric oven (8516.60) or its parts or components (8516.90)	Electric oven (8516.60.90) or its parts or components (8516.90)
16	Telephone (8517.11 and 8517.19) or its parts or components (8517.90)	Telephone (8517.11.00 and 8517.18.00) or its parts or components (8517.70)

No.	Notification of DIW in 2003	Notification of DIW in 2007
17	Facsimile machine (8517.21) or its parts or components (8517.90)	Facsimile machine (8443.31, 8443.32 and 8443.39) or its parts or components (8443.99)
18	Telegraph machine (8525.20) or its parts or components (85.29)	Telegraph machine (8517.62) or its parts or components (8517.70)
19	Calculator (84.70) or its parts or components (85.73)	Calculator (84.70) or its parts or components (85.73)
20	Electric typewriter (84.69) or its parts or components (84.73)	Electric typewriter (84.69) or its parts or components (84.73)
21	Photocopy machine (90.09) or its parts or components (9009.91, 9009.92, 9009.93 and 9009.99)	Photocopy machine (84.43) or its parts or components (8443.99)
22	Mobile telephone (8525.20) or its parts or components (85.29)	Mobile telephone (8517.12.00) and its parts or components (8517.70)
23	Computer and accessories such as monitor, printer, scanner, etc. (84.71) or its parts or components (84.73)	Computer (84.71) or its parts or components (84.73)
24	Electric fan (8525.20) or its parts or components (8414.90)	Monitor (85.28) or its parts or components (85.29)
25	Cold water dispenser (8414.69) or its parts or components (8418.91 and 8418.99)	Printer (84.43) or its parts or components (8443.99)
26	Hair dryer (8516.31) or its parts or components (8516.90)	Scanner (84.71) or its parts or components (84.73)
27	Electric iron (8516.40) or its parts or components (8516.90)	Electric fan (8525.20) or its parts or components (8414.90)
28	Burglar alarm system (8531.10) or its parts or components (8531.90)	Cold water dispenser (8414.69) or its parts or components (8418.91 and 8418.99)
29	Compressors used in refrigerating Equipment (8414.30)	Hair dryer (8516.31) or its parts or components (8516.90)
30	-	Electric iron (8516.40) or its parts or components (8516.90)
31	-	Burglar alarm system (8531.10) or its parts or components (8531.90)
32	-	Compressors used in refrigerating Equipment (8414.30)

Sources: Notification of the DIW on Permitting Criteria for the Import of Used Electrical and Electronic Equipment, 2 October 2003; Notification of the DIW on Permitting Criteria for the Import of Used Electrical and Electronic Equipment (No.3), B.E.2550, 29 September 2007.

Aiming to address the environmental issues arising from illegal trafficking and recycling of e-waste and ensure proper management of e-waste within the country as the Cabinet's resolution dated 3 July 2018 (Secretariat of the Cabinet, 2018c), Thailand has decided to exercise the ban policy on the import of e-waste by issuing the Notification of MOC in 2020

(Notification of the MOC on Prohibiting the Import of Electronic Waste, B.E. 2563, 14 September 2020). It prescribes the following key points:

- **Prohibition of Import: E-waste is classified as prohibited goods for import into Thailand**. This includes **428** types of EEE waste, such as capacitors, batteries, mercury-containing switches, CRT glass, and other activated glass as summarised into Table 5.4.
- **Customs Tariff Codes:** The specific types of e-waste covered by this prohibition are listed under Customs Tariff Codes **84** and **85**, with specific Statistical Code **899**.
- **Effective Date:** The prohibition came into effect the day after its publication in the Royal Gazette on 14 September **2020**.

Table 5.4. List of E-wastes under the Basel Convention, Totally Banned by Domestic Regulation

No.	E-waste Items	Tariff and Statistical Codes for the Basel Convention's E-wastes
1	4 items of compressors of a kind used in refrigerating equipment	8414.30.40.899, 8414.30.90.899, 8414.80.42.899, and 8414.80.43.899
2	47 items of air-conditioning machines, comprising a motor-driven fan and elements for changing the temperature and humidity, including those machines in which the humidity cannot be separately regulated	8415.10.10.899, 8415.10.90.899, 8415.20.10.899, 8415.20.90.899, 8415.81.11.899, 8415.81.12.899, 8415.81.19.899, 8415.81.21.899, 8415.81.29.899, 8415.81.31.899, 8415.81.39.899, 8415.81.91.899, 8415.81.93.899, 8415.81.94.899, 8415.81.99.899, 8415.82.19.899, 8415.82.21.899, 8415.82.29.899, 8415.82.31.899, 8415.82.39.899, 8415.82.91.899, 8415.82.99.899, 8415.83.11.899, 8415.83.19.899, 8415.83.21.899, 8415.83.29.899, 8415.83.31.899, 8415.83.39.899, 8415.83.91.899, 8415.83.99.899, 8415.90.13.899, 8415.90.14.899, 8415.90.15.899, 8415.90.19.899, 8415.90.24.899, 8415.90.25.899, 8415.90.26.899, 8415.90.29.899, 8415.90.34.899, 8415.90.25.899, 8415.90.36.899, 8415.90.39.899,

No.	E-waste Items	Tariff and Statistical Codes for the Basel Convention's E-wastes
		8415.90.44.899, 8415.90.45.899, and 8415.90.46.899
3	24 items of refrigerators, freezers, and other refrigerating or freezing equipment, electric or other; heat pumps other than air-conditioning machines of heading 84.15	8418.10.11.899, 8418.10.19.899, 8418.10.20.899, 8418.10.90.899, 8418.21.10.899, 8418.21.90.899, 8418.21.90.899, 8418.29.00.899, 8418.30.10.899, 8418.30.90.899, 8418.40.10.899, 8418.40.90.899, 8418.50.11.899, 8418.50.19.899, 8418.50.91.899, 8418.50.99.899, 8418.61.00.899, 8418.69.10.899, 8418.69.30.899, 8418.69.41.899, 8418.69.49.899, 8418.69.50.899, 8418.69.90.899, 8418.91.00.899, and 8418.99.10.899
4	1 item of printing machinery used for printing by means of plates, cylinders, and other printing components of heading 84.42; other printers, copying machines, and facsimile machines, whether combined; parts and accessories thereof.	8443.32.60.899
5	8 items of household or laundry-type washing machines, including machines which both wash and dry	8450.11.10.899
6	2 items of machinery (other than machines of heading 84.50) for washing, cleaning, wringing, drying, ironing, pressing (including fusing presses), bleaching, dyeing, dressing, finishing, coating or impregnating textile yarns, fabrics or made-up textile articles and machines for applying the paste to the base fabric or other support used in the manufacture of floor	8451.21.00.899 and 8451.29.00.899

No.	E-waste Items	Tariff and Statistical Codes for the Basel Convention's E-wastes
	coverings such as linoleum; machines for reeling, unreeling, folding, cutting or pinking textile fabrics.	
7	7 items of calculating machines and pocket-size data recording, reproducing, and displaying machines with calculating functions; accounting machines, postage-franking machines, ticket-issuing machines and similar machines, incorporating a calculating device; cash registers	8470.10.00.899, 8470.21.00.899, 8470.29.00.899, 8470.20.00.899, 8470.50.00.899, 8470.90.10.899, 8470.90.20.899 and 8470.90.90.899
8	25 items of automatic data-processing machines and units thereof; magnetic or optical readers, machines for transcribing data onto data media in coded form and machines for processing such data, not elsewhere specified or included.	8471.30.20.899, 8471.30.90.899, 8471.41.10.899, 8471.41.90.899, 8471.49.10.899, 8471.49.90.899, 8471.50.10.899, 8471.50.90.899, 8471.60.30.899, 8471.60.40.899, 8471.60.90.899, 8471.70.10.899, 8471.70.20.899, 8471.70.30.899, 8471.70.40.899, 8471.70.50.899, 8471.70.91.899, 8471.70.99.899, 8471.80.10.899, 8471.80.70.899, 8471.80.90.899, 8471.90.10.899, 8471.90.30.899, 8471.90.40.899, and 8471.90.90.899
9	3 items of other office machines (for example, hectograph or stencil-duplicating machines, addressing machines, automatic banknote dispensers, coin-sorting machines, coin-counting or wrapping machines, pencil-sharpening machines, perforating or stapling machines).	8472.90.41.899, 8472.90.49.899 and 8472.90.50.899
10	8 items of parts and accessories (other than covers, carrying cases	8473.21.00.899, 8473.29.00.899, 8473.30.10.899, 8473.30.90.899,

No.	E-waste Items	Tariff and Statistical Codes for the Basel Convention's E-wastes
	and the like) suitable for use solely or principally with the machines of headings 84.70 to 84.72	8473.40.10.899, 8473.40.20.899, 8473.50.10.899, and 8473.50.90.899
11	11 items of primary cells and primary batteries	8506.10.10.899, 8506.10.90.899, 8506.30.00.899, 8506.40.00.899, 8506.50.00.899, 8506.60.10.899, 8506.60.90.899, 8506.80.10.899, 8506.80.20.899, 8506.80.91.899, and 8506.80.99.899,
12	26 items of electric accumulators, including separators therefore, whether or not rectangular (including square)	8507.10.10.899, 8507.10.92.899, 8507.10.95.899, 8507.10.96.899, 8507.10.97.899, 8507.10.98.899, 8507.10.99.899, 8507.20.10.899, 8507.20.94.899, 8507.20.95.899, 8507.20.96.899, 8507.20.97.899, 8507.20.98.899, 8507.20.99.899, 8507.30.10.899, 8507.30.90.899, 8507.40.10.899, 8507.40.90.899, 8507.50.00.899, 8507.50.90.899, 8507.60.10.899, 8507.60.20.899, 8507.60.90.899, 8507.80.10.899, 8507.80.20.899, and 8507.80.90.899
13	9 items of electric instantaneous or storage water heaters and immersion heaters; electric space heating apparatus and soil heating apparatus; electro-thermic hair-dressing apparatus (for example, hair dryers, hair curlers, curling tong heaters) and hand dryers; electric smoothing irons; other electro-thermic appliances of a kind used for domestic purposes; electric heating resistors, other than those of heading 85.45	8516.10.11.899, 8516.10.19.899, 8516.10.30.899, 8516.10.50.899, 8516.60.10.899, 8516.60.90.899, 8516.72.00.899, 8516.79.10.899, and 8516.79.90.899
14	2 items of telephone sets, including	8517.11.00.899 and 8517.12.00.899

No.	E-waste Items	Tariff and Statistical Codes for the Basel Convention's E-wastes
	telephones for cellular networks or for other wireless networks; other apparatus for the transmission or reception of voice, images or other data, including apparatus for communication in wired or wireless networks (such as a local or wide area network), other than transmission or reception apparatus of heading 84.43, 85.25, 85.27 or 85.28	
15	6 items of transmission apparatus for radio broadcasting or television, whether or not incorporating reception apparatus or sound recording or reproducing apparatus; television cameras, digital cameras and video camera recorders	8525.60.00.899, 8525.80.31.899, 8525.80.39.899, 8525.80.40.899, 8525.80.51.899, and 8525.80.59.899
16	13 items of reception apparatus for radio broadcasting, whether or not combined, in the same housing, with sound recording or reproducing apparatus or a clock	8527.12.00.899, 8527.13.10.899, 8527.13.90.899, 8527.19.20.899, 8527.19.90.899, 8527.21.00.899, 8527.29.00.899, 8527.91.10.899, 8527.91.90.899, 8527.92.20.899, 8527.92.90.899, 8527.99.20.899 and 8527.99.90.899
17	18 items of monitors and projectors, not incorporating television reception apparatus; reception apparatus for television, whether or not incorporating radio-broadcast receivers or sound or video recording or reproducing apparatus	8528.42.00.899, 8528.49.10.899, 8528.49.20.899, 8528.52.00.899, 8528.59.10.899, 8528.59.20.899, 8528.62.00.899, 8528.69.10.899, 8528.69.90.899, 8528.71.11.899, 8528.71.19.899, 8528.71.91.899, 8528.71.99.899, 8528.72.19.899, 8528.72.91.899, 8528.72.92.899, 8528.72.99.899, and 8528.73.00.899
18	18 items of parts suitable for use solely or principally with the	8529.10.21.899, 8529.10.29.899, 8529.10.30.899, 8529.10.40.899,

No.	E-waste Items	Tariff and Statistical Codes for the Basel Convention's E-wastes
	apparatus of headings 85.25 to 85.28.	8529.10.60.899, 8529.10.90.899, 8529.10.99.899, 8529.90.20.899, 8529.90.40.899, 8529.90.51.899, 8529.90.52.899, 8529.90.53.899, 8529.90.54.899, 8529.90.55.899, 8529.90.59.899, 8529.90.91.899, 8529.90.94.899, and 8529.90.99.899,
19	9 items of electrical capacitors, fixed, variable or adjustable (pre-set)	8532.10.00.899, 8532.21.00.899, 8532.22.00.899, 8532.23.00.899, 8532.24.00.899, 8532.25.00.899, 8532.29.00.899, 8532.30.00.899, and 8532.90.00.899
20	8 electrical resistors (including rheostats and potentiometers), other than heating resistors	8533.10.10.899, 8533.10.90.899, 8533.21.00.899, 8533.29.00.899, 8533.31.00.899, 8533.39.00.899, 8533.40.00.899 and 8533.90.00.899
21	4 items of printed circuits.	8534.00.10.899, 8534.00.20.899, 8534.00.30.899, and 8534.00.90.899
22	13 items of electrical apparatus for switching or protecting electrical circuits, or for making connections to or in electrical circuits (for example, switches, relays, fuses, surge suppressors, plugs, sockets, lamp-holders and other connectors, junction boxes), for a voltage not exceeding 1,000 volts; connectors for optical fibres, optical fibre bundles or cables.	8535.21.10.899, 8535.21.20.899, 8535.21.90.899, 8535.29.10.899, 8535.29.90.899, 8535.30.11.899, 8535.30.19.899, 8535.30.20.899, 8535.30.90.899, 8535.40.00.899, 8535.90.10.899, 8535.90.20.899, and 8535.90.90.899,
23	35 items of boards, panels, consoles, desks, cabinets and other bases, equipped with two or more apparatus of heading 85.35 or 85.36, for electric control or the distribution of electricity, including those incorporating	8536.20.11.899, 8536.20.12.899, 8536.20.13.899, 8536.20.19.899, 8536.20.20.899, 8536.20.91.899, 8536.20.99.899, 8536.30.10.899, 8536.30.20.899, 8536.30.90.899, 8536.41.10.899, 8536.41.20.899, 8536.41.30.899, 8536.41.40.899,

No.	E-waste Items	Tariff and Statistical Codes for the Basel Convention's E-wastes
	instruments or apparatus of Chapter 90, and numerical control apparatus, other than switching apparatus of heading 85.17.	8536.41.91.899, 8536.41.99.899, 8536.49.10.899, 8536.49.90.899, 8536.61.10.899, 8536.61.91.899, 8536.61.99.899, 8536.69.11.899, 8536.69.19.899, 8536.69.23.899, 8536.69.24.899, 8536.69.29.899, 8536.69.32.899, 8536.69.39.899, 8536.69.92.899, 8536.69.99.899, 8536.90.22.899, 8536.90.29.899, 8536.90.93.899, 8536.90.94.899 and 8536.90.99.899
24	37 items of electric filament or discharge lamps, including sealed beam lamp units and ultraviolet or infra-red lamps; arc-lamps; light emitting diode (LED) lamps.	8539.10.10.899, 8539.10.90.899, 8539.21.20.899, 8539.21.30.899, 8539.21.40.899, 8539.21.90.899, 8539.22.20.899, 8539.22.31.899, 8539.22.32.899, 8539.22.33.899, 8539.22.39.899, 8539.22.91.899, 8539.22.92.899, 8539.22.93.899, 8539.22.99.899, 8539.29.11.899, 8539.29.19.899, 8539.29.20.899, 8539.29.30.899, 8539.29.50.899, 8539.29.60.899, 8539.29.90.899, 8539.31.10.899, 8539.31.20.899, 8539.31.30.899, 8539.31.90.899, 8539.32.00.899, 8539.39.10.899, 8539.39.20.899, 8539.39.30.899, 8539.39.90.899, 8539.41.00.899, 8539.49.00.899, 8539.50.00.899, 8539.90.10.899, 8539.90.20.899, and 8539.90.90.899
25	12 items of thermionic, cold cathode or photo-cathode valves and tubes (for example, vacuum or vapour or gas-filled valves and tubes, mercury arc rectifying valves and tubes, cathode ray tubes, television camera tubes).	8540.11.00.899, 8540.12.00.899, 8540.20.00.899, 8540.40.10.899, 8540.60.00.899, 8540.71.00.899, 8540.79.00.899, 8540.81.00.899, 8540.89.00.899, 8540.91.00.899, 8540.99.10.899, and 8540.99.90.899

No.	E-waste Items	Tariff and Statistical Codes for the Basel Convention's E-wastes
26	12 items of diodes, transistors and similar semiconductor devices; photosensitive semiconductor devices, including photovoltaic cells whether or not assembled in modules or made up into panels; light-emitting diodes (LED); mounted piezo-electric crystals.	8541.10.00.899, 8541.21.00.899, 8541.29.00.899, 8541.30.00.899, 8541.40.10.899, 8541.40.21.899, 8541.40.22.899, 8541.40.29.899, 8541.40.90.899, 8541.50.00.899, 8541.60.00.899, and 8541.40.90.899
27	5 items of electronic integrated circuits.	8542.31.00.899, 8542.32.00.899, 8542.33.00.899, 8542.39.00.899, and 8542.90.00.899
28	5 items of video recording or reproducing apparatus, whether or not incorporating a video tuner.	8521.10.90.899, 8521.90.11.899, 8521.90.19.899, 8521.90.91.899, and 8521.90.99.899
29	10 items of parts and accessories suitable for use solely or principally with the apparatus of heading 85.19 or 85.21	8522.10.00.899, 8522.90.20.899, 8522.90.30.899, 8522.90.40.899, 8522.90.50.899, 8522.90.91.899, 8522.90.92.899, 8522.90.93.899, 8522.90.99.899, and 8523.52.00.899

Source: Notification of the MOC on Prohibiting the Import of Electronic Waste. B.E. 2563, 14 September 2020

In March 2023, Thailand accepted the Basel Ban Amendment, which entered into force for Thailand in June 2023 (Secretariat of the Basel Convention, 2024b). Therefore, since then, **no waste has been imported under the Basel Convention from Annex VII parties (which exclude Japan, as it has not yet ratified the Amendment) even for use as feedstock in the manufacturing processes**. Exports, however, remain subject to the convention and the domestic laws of the importing parties.

After facing illegal trafficking and recycling of plastic scraps in the territory for several years, **Thailand has decided to ban the import of plastic scrap into the country through a Cabinet resolution dated 21 February 2023** (Secretariat of the Cabinet, 2018d). According to the aforementioned Cabinet's resolution, the MOC has issued its notification to prohibit plastic scrap in 2024 (Notification of the MOC on Prohibiting the Import of Plastic Scrap, B.E.2567, 16 December 2024) as follows:

- **Plastic scrap is prescribed as a prohibited commodity for import** into the Kingdom of Thailand.

- This prohibition has been effective since 1 January 2025.

In this regard, there are no imported plastic scraps including those originating from EEE from outside country. In securing the domestic circularity of plastic material, the government has been actively exploring and providing various alternatives through several national policies and plans related to circular economy and plastic waste management (PCD, 2021; 2023).

- Thailand's Roadmap on Plastic Waste Management (2018–2030): This road map aims to achieve 100% recycling of plastic waste by 2027. It includes measures such as reducing single-use plastics, promoting eco-friendly materials, and enhancing recycling infrastructure (PCD, 2021).
- Circular Economy: Thailand is adopting the circular economy model, which focuses on reducing, reusing, and recycling materials to minimise waste. This approach encourages sustainable consumption and production practices (NSTDA, 2022; NESDC, 2023).
- Eco-friendly Alternatives: The government is promoting the use of biodegradable and compostable materials as alternatives to traditional plastics. This includes items like biodegradable plastic bags, utensils, and packaging (PCD, 2021; 2023).
- Public Awareness Campaigns: Efforts are being made to educate the public about the importance of reducing plastic waste and adopting sustainable practices. These campaigns aim to change consumer behaviour and increase participation in recycling programmes (NSTDA, 2022; NESDC, 2023).
- Incentives for Businesses: Economic incentives including tax benefits are provided to businesses that invest in eco-friendly technologies and practices or green investments (NSTDA, 2022; NESDC, 2023).

These strategies collectively aim to create a sustainable future by reducing plastic waste and promoting environmentally friendly alternatives.

According to the Cabinet's resolution dated 4 February 2025 (Secretariat of the Cabinet, 2018e), the proposal of the MOC to issue its draft notification to update the prohibition of e-waste import has been approved. The draft notification includes several key updated points:

- Revocation of previous notification: The previous notification in 2020 (B.E. 2563) will be revoked.
- Alignment with the latest version of the Harmonized System and Custom Tariff Code: The update aims to align Thailand's regulations with the latest international standards, specifically the 2022 Harmonized System. This ensures that the customs tariff codes and statistical codes for e-waste are up-to-date and consistent with global practices.
- Prescription of the e-waste definition: E-waste includes parts of electrical and electronic equipment or scraps (excluding generator scraps) that contain components such as

capacitors, batteries, mercury switches, cathode ray tube glass, activated glass, PCBs-containing capacitors, or those contaminated with cadmium, mercury, lead, polychlorinated biphenyls, which are chemical waste under List 5.2 according to the Notification of Ministry of Industry on Hazardous Substances List, B.E. 2556 and hazardous waste defined under Annex VIII (List A) of the Basel Convention.

- Expansion of prohibited items: The updated notification includes additional e-waste items under Customs Tariff Codes 84 and 85, specifically Statistical Code 899, which are now prohibited from import. This expansion helps cover more types of e-waste, such as flat display modules and webcams, which were not previously included. The draft notification includes 463 prohibited items of e-waste.

Overall, the update is a proactive measure to enhance Thailand's regulatory framework to reduce the amount of waste imported for disposal within the country, thereby decreasing pollution and protecting public health and the environment. It will come into effect the day after its publication in the Royal Gazette.

The prohibition on importing e-waste into Thailand has several impacts on electronic recycling (Nation Thailand, 2025; Chemical Compliance, 2025; AP News, 2025; Thailand Business News, 2025a; National Center for Biotechnology Information (NCBI), 2020):

- Reduction in imported waste: By banning the import of e-waste, Thailand aims to reduce the influx of hazardous materials from other countries. This helps prevent environmental contamination and health risks associated with improper handling and disposal of e-waste.
- Focus on domestic recycling: The ban encourages the development of domestic recycling infrastructure. Thailand needs to enhance its capacity to manage and recycle its own e-waste, promoting sustainable practices and reducing reliance on imported waste.
- Economic opportunities: Strengthening the local recycling industry can create job opportunities and stimulate economic growth. Effectively managed recycling facilities can contribute to a circular economy where materials are reused and repurposed.
- Environmental benefits: Improved recycling practices can lead to better environmental outcomes. Properly recycling e-waste reduces the release of toxic substances into the environment, helping to protect ecosystems and public health.

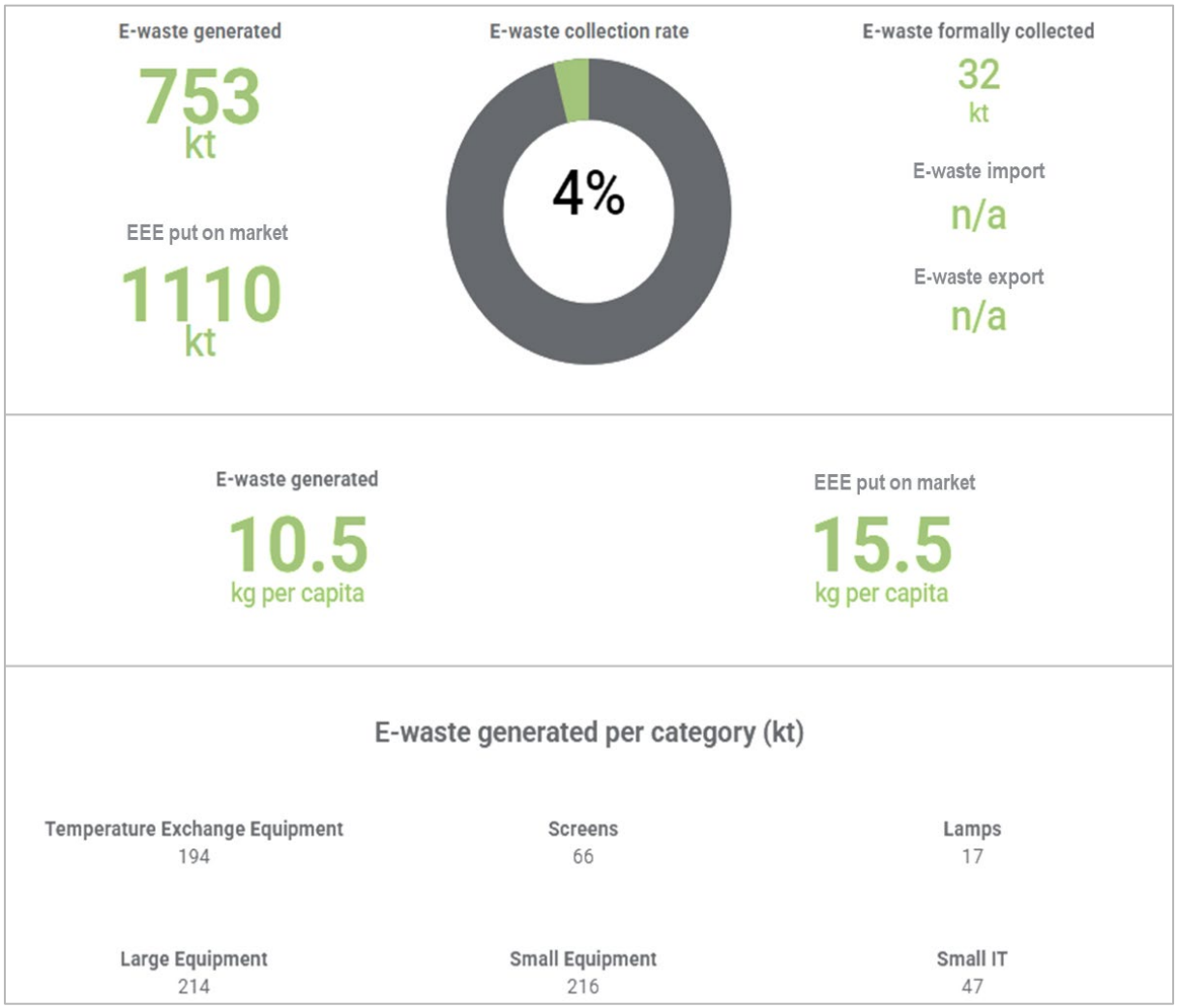
C) International trade statistics

Global e-waste

In 2022, Thailand generated a total of 753 kt of e-waste, comprising small equipment (216 kt), large equipment (214 kt), temperature exchange equipment (194 kt), screens (66 kt), small IT (47 kt), and lamps (17 kt). However, only 32 kt were collected, accounting for only

4% of the total e-waste generated in Thailand (The Global E-Waste Statistics Partnership, 2022; Figure 5.2).

Figure 5.2. Thailand E-Waste Statistics



Source: The Global E-Waste Statistics Partnership (2022).

In the Global E-Waste Statistics Partnership (2022) statistics, **EEE put on market** is defined as any supply of a product for distribution, consumption, or use on the market in the course of a commercial activity, whether in return for payment or free of charge. In the **Global E-waste Statistics Partnership (2022)** statistics, **EEE put on the market** is defined as any supply of a product for distribution, consumption, or use on the market in the course of a commercial activity, whether in return for payment or free of charge.

E-waste generated refers to the amount of discarded electrical or electronic products (e-waste) due to consumption within national territory in a given reporting year, prior to any collection, reuse, treatment, or export.

E-waste formally collected represents the waste collected as e-waste and regulated by environmental protection laws specifically designed for e-waste. This includes e-waste that is collected and later exported and treated according to the national standards of another country.

E-waste imported/exported is the e-waste that is imported or exported.

E-waste collection rate is the formal collection of e-waste/e-waste generated.

Thailand's industrial economic situation

Thailand's industrial economic situation in 2023, when considering the Manufacturing Production Index (MPI), declined by 4.8% compared to the same period of the previous year. This was due to the global economic slowdown, geopolitical tensions that affected the supply chain broadly, as well as high energy prices and interest rates that caused a decline in consumption and investment (Office of Industrial Economics [OIE], 2024).

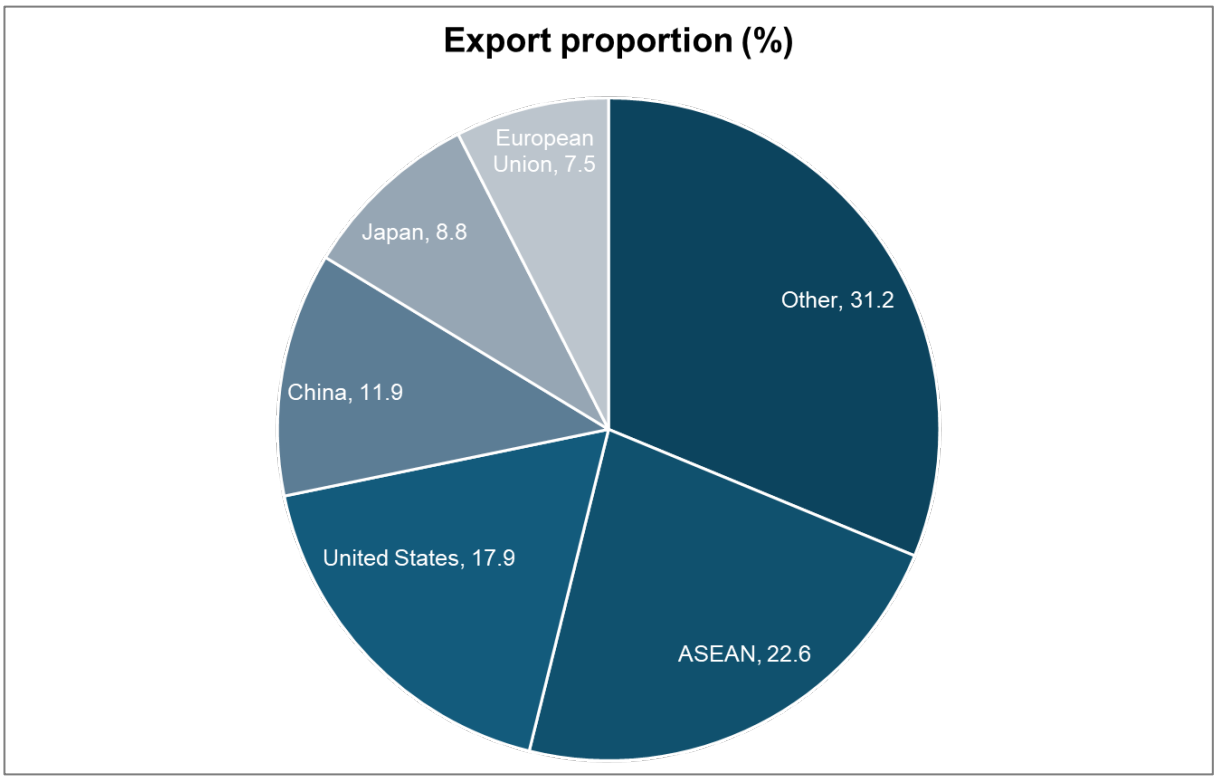
Key industries that slowed down in 2023 include computers and peripheral equipment. The production conditions declined mainly in hard disk drives and printers, as manufacturers reduced production plans due to continuously weakening demand resulting from the global economic condition. Printers also decreased from the previous year because of production orders to substitute for the Viet Nam branch, which was unable to produce (OIE, 2024).

Industries that expanded in 2023 include automobiles, with increased production mainly in small and medium-sized passenger cars, driven by the expanding export market. Gasohol and aviation fuel also increased, largely due to the rise in domestic travel activities. Sugar production grew mainly from white sugar and refined white sugar, in line with continuously increasing consumption demand in both domestic and export markets (OIE, 2024).

In 2023, Thailand's exports to five major trading partners accounted for 68.8% of total exports, including ASEAN at 22.6%, the United States (US) at 17.9%, China at 11.9%, Japan at 8.8%, and the European Union (EU) (27 countries) at 7.5%. The proportion of exports to other markets accounted for 31.2% of total exports (OIE, 2024; Figure 5.3).

The total export value was US$236,648.20 million, contracting by 2.72% compared to the same period of the previous year (%YoY). The EU (27 countries) experienced the highest contraction at 18.45%, followed by ASEAN at 9.48%, China at 0.69%, and Japan at 0.08%. The country with export growth was the US at 0.15% (OIE, 2024).

Figure 5.3. Thailand's Export Share to Trading Partners' Markets in 2023

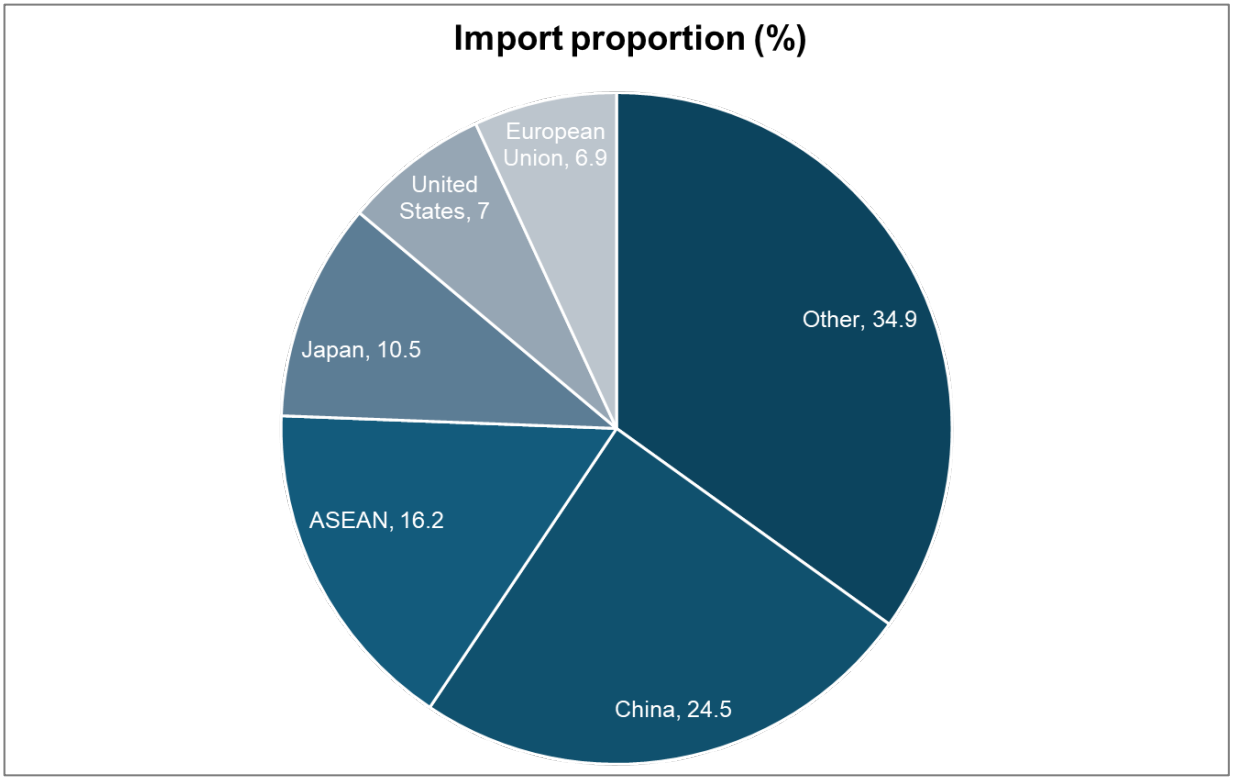


Source: OIE (2024).

Thailand's imports from five main markets accounted for 65.1% of total imports. These markets were China at 24.5%, ASEAN at 16.2%, Japan at 10.5%, the US at 7.0%, and the EU (27 countries) at 6.9%. Imports from other markets accounted for 34.9% of total imports (OIE, 2024; Figure 5.4).

The total import value was US$243,313.20 million, contracting by 4.59% compared to the same period of the previous year (%YoY). ASEAN experienced the highest contraction at 6.75%, followed by China at 1.22%. The countries with the most significant import growth were the EU (27 countries) at 9.94%, followed by the US at 9.69%, and Japan at 0.76% (OIE, 2024).

Figure 5.4. Thailand's Import Share to Trading Partners' Markets in 2023

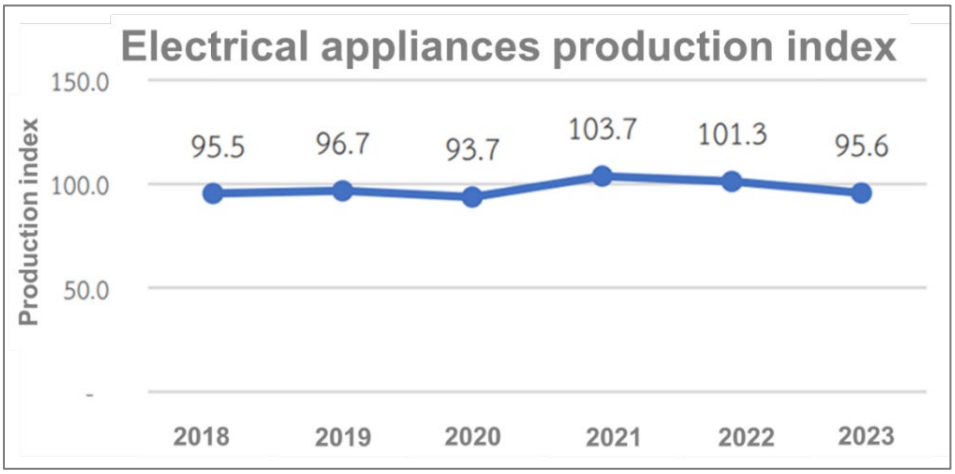


Source: OIE (2024).

Electrical appliances

In 2023, the production of electrical appliances contracted by 5.6%, with the Manufacturing Production Index (MPI) standing at 95.6, representing a 5.6% contraction (%YoY). This was due to continuously rising production costs, declining global demand, and the sluggish recovery of the global economy (OIE, 2024; Figure 5.5).

Figure 5.5. Thailand's Electrical Appliances Production Index

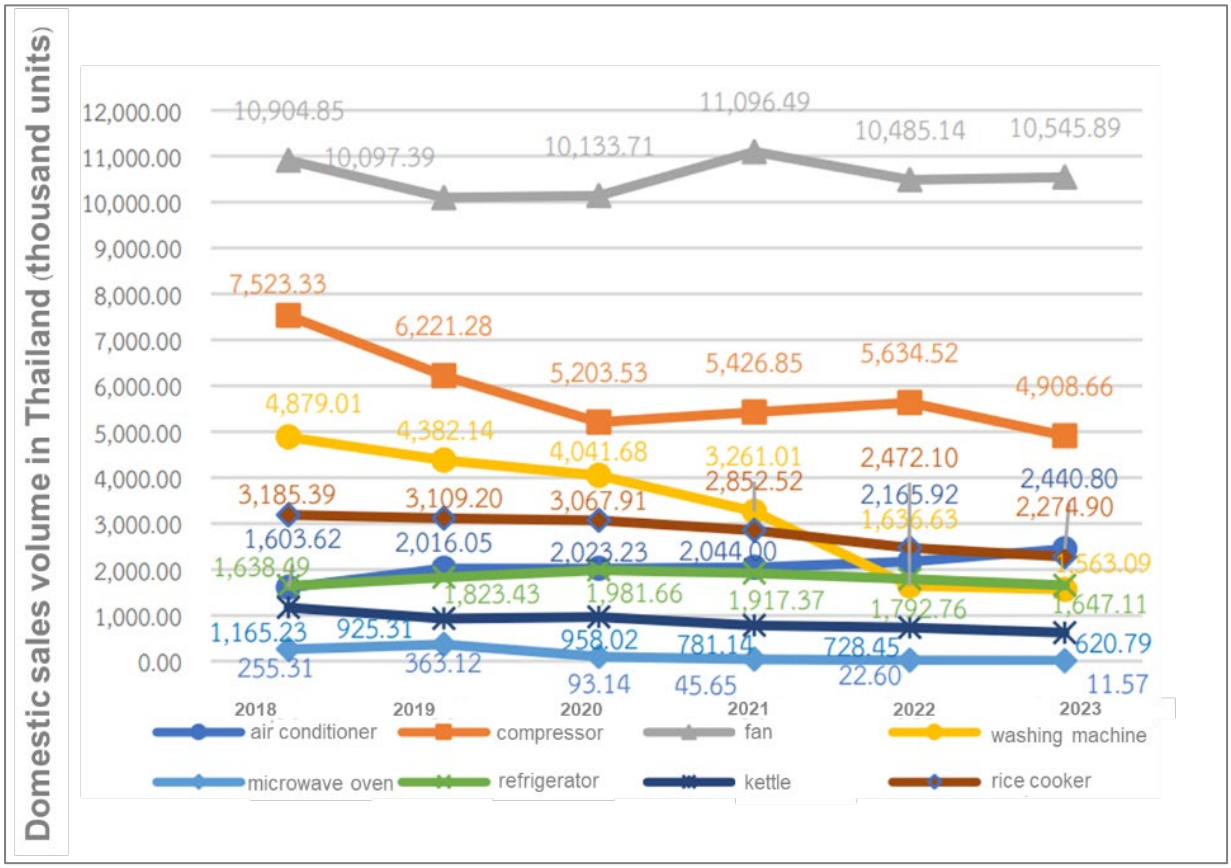


Source: OIE (2024).

In 2023, the electrical appliances that showed a decrease in production included electric motors (28.0%), electric kettles (21.4%), compressors (19.2%), microwave ovens (10.5%), refrigerators (10.0%), rice cookers (9.0%), electric fans (6.6%), and transformers (6.0%), due to reduced domestic sales and foreign purchase orders. Meanwhile, products with increased production included electric wires (14.4%), followed by washing machines (11.7%), cables (10.8%), and air conditioners (0.1%) as a result of increased foreign orders.

Accordingly, the domestic sales of electrical appliances decreased in 2023. Products showing a decline included microwave ovens (23.7%), followed by electric kettles (16.1%), compressors (14.9%), refrigerators (9.7%), rice cookers (8.5%), and washing machines (3.8%). Meanwhile, air conditioners increased by 8.1% and electric fans by 2.8%. The import value of electrical appliances was US$18,826.2 million, expanding by 4.0% from the previous year (%YoY), mainly from the import of transformers, air conditioners, microwave ovens, and refrigerators (OIE, 2024; Figure 5.6).

Figure 5.6. Domestic Sales Volume of Electrical Appliances in Thailand

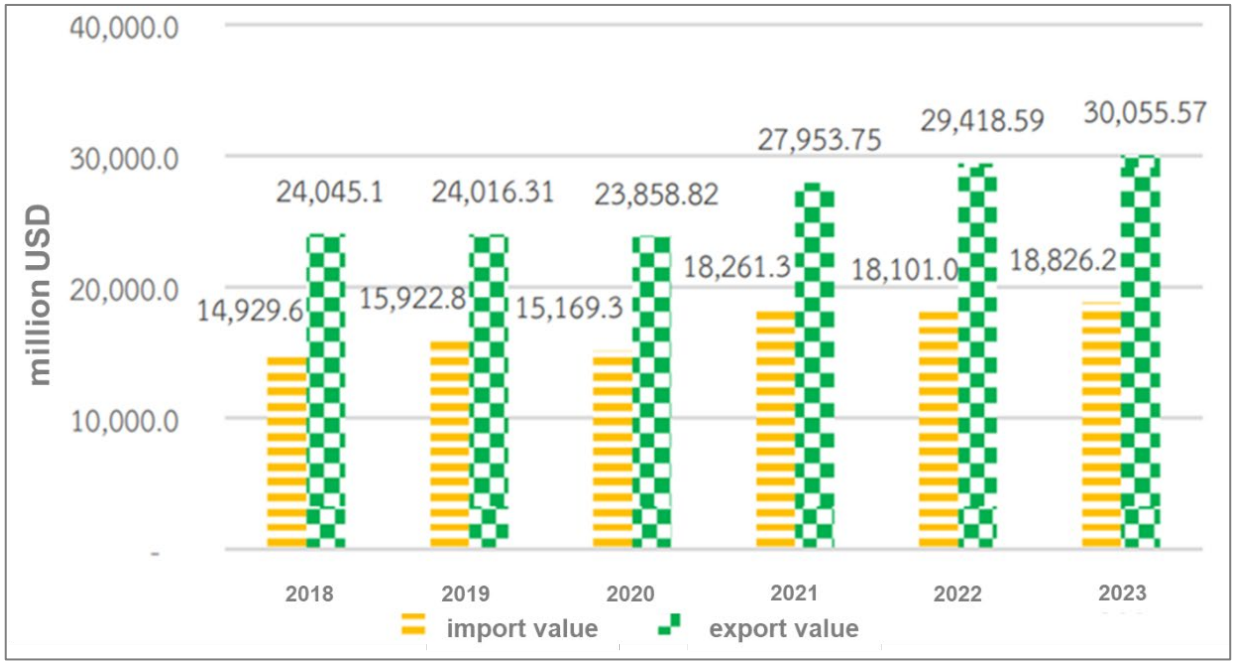


Source: OIE (2024).

In 2023, the export value of electrical appliances was US$30,055.6 million, expanding by 2.2% from the previous year (%YoY), due to the export of washing machines and

transformers in response to global market demand. In particular, parts and components of washing machines from Thailand are important to the production chain in industries such as Argentina and Viet Nam, allowing entrepreneurs to increase exports (Electrical and Electronics Institute (EEI), 2023; Figure 5.7).

Figure 5.7. Value of Electrical Appliances Imports and Exports

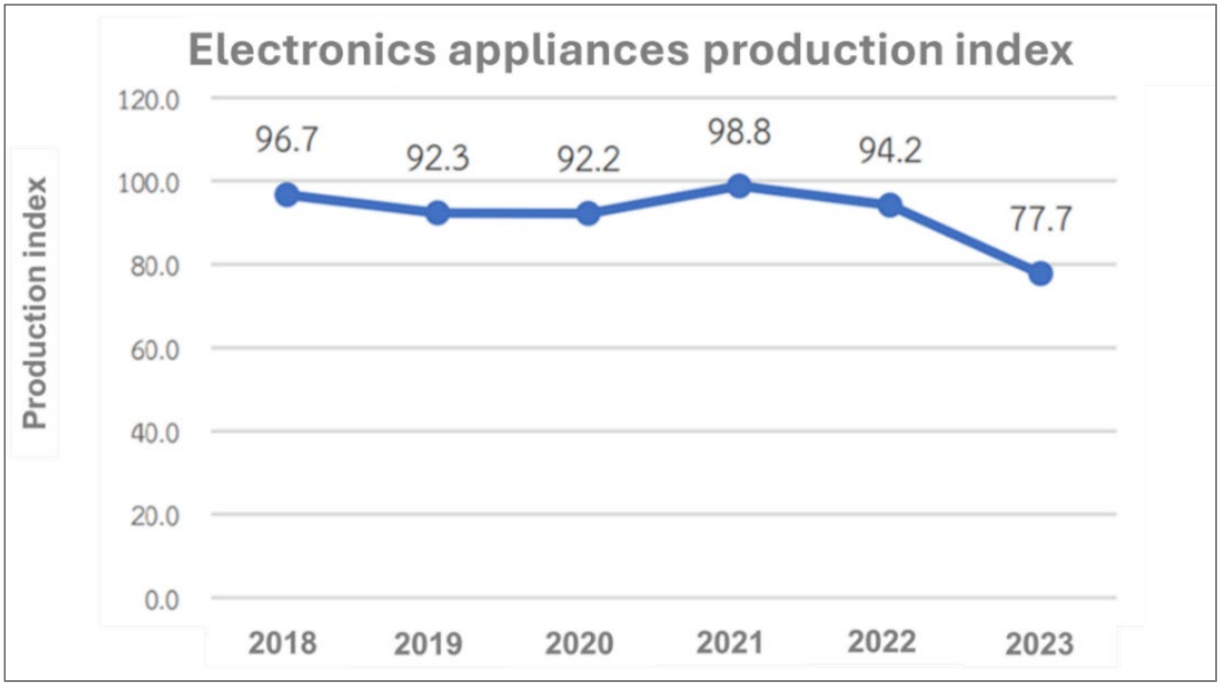


Source: EEI (2023)

Electronics

The production of electronic products in 2023 contracted by 17.5%, with the MPI at 77.7, a contraction of 17.5% from the previous year (%YoY). Electronic products that showed a decline included printers (25.9%), followed by hard disk drives (25.5%), semiconductor devices transistors (25.3%), printed wiring boards (PWBs) (16.5%), printed circuit board assemblies (13.8%), and integrated circuits (ICs) (11.8%) due to shortages of raw materials for electronic product manufacturing and rising production costs (OIE, 2024; Figure 5.8).

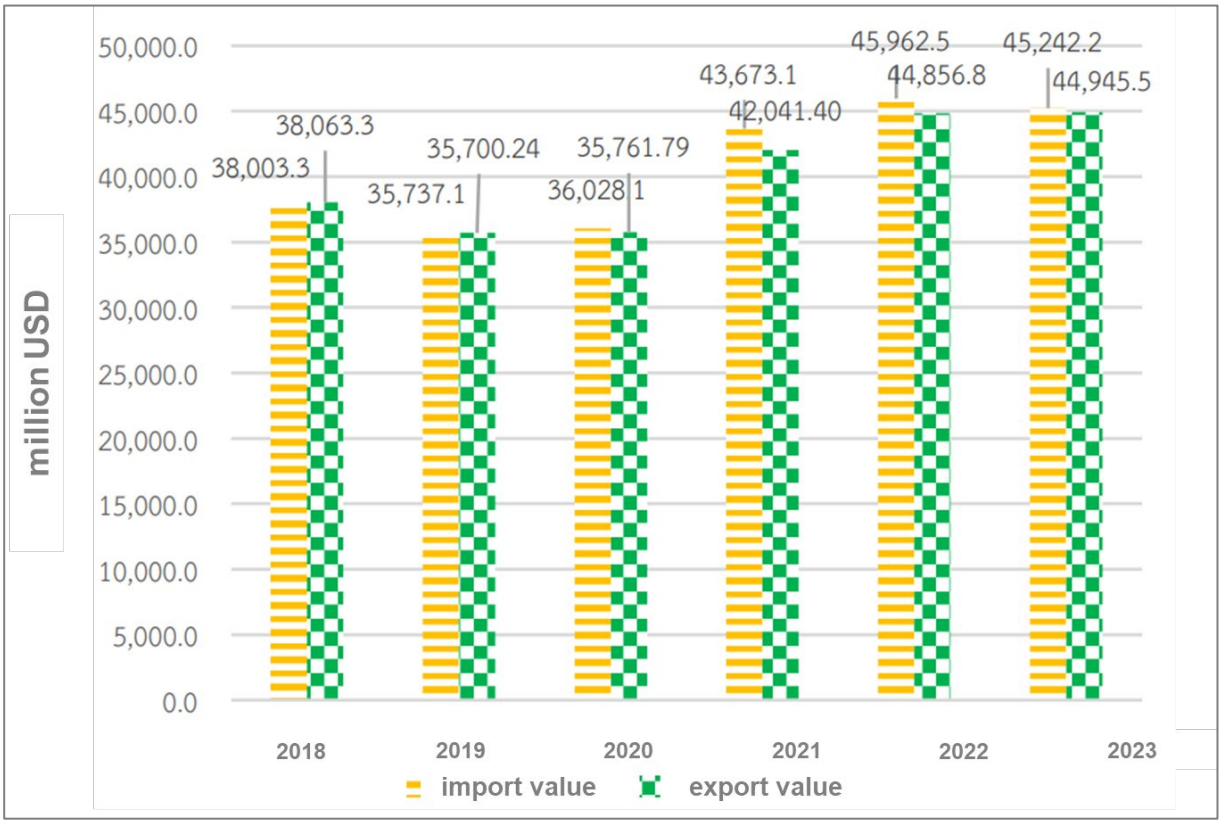
Figure 5.8. Thailand's Electronics Production Index



Source: OIE (2024)

The import value of electronic products was US$45,242.2 million, a contraction of 1.6% from the previous year (%YoY), from decreased imports of printed circuits, printers, copiers and parts, and ICs. The export value of electronic products was US$44,945.5 million, a slight expansion of 0.2% from the previous year (%YoY), due to exports of computers and ICs driven by the demand for technology development, IT infrastructure, and new innovative devices, leading to continued demand for electronic components in the global market (EEI, 2023; Figure 5.9).

Figure 5.9. Value of Electronics Imports and Exports



Source: EEI (2023).

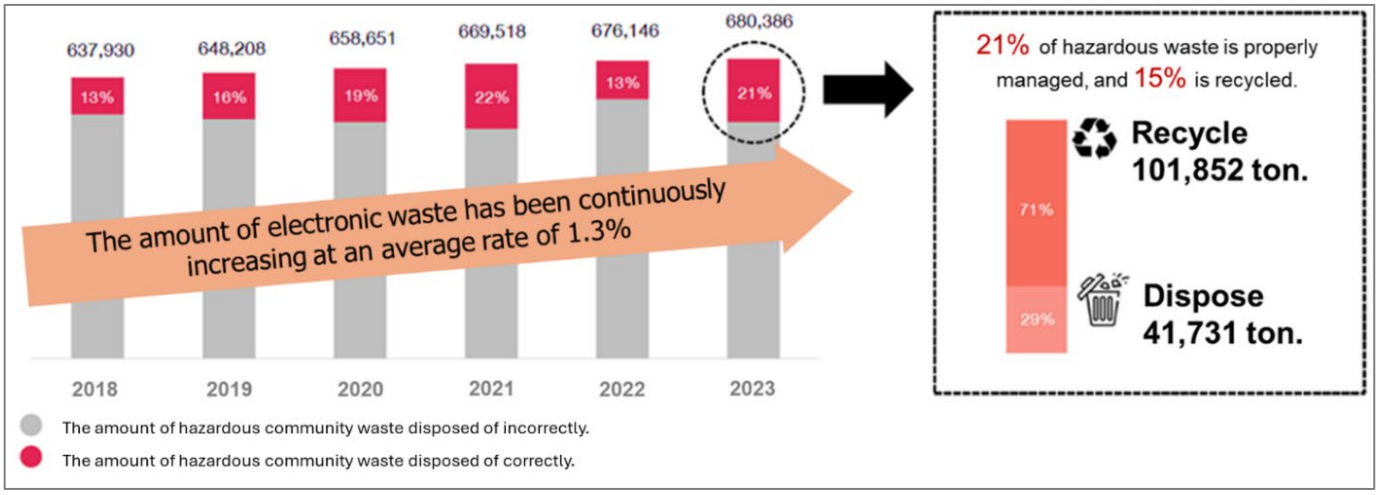
Thailand's e-waste situation

The municipal solid waste situation in Thailand in 2023 showed that 26.95 Mt or approximately 73,840 tonnes/day of municipal solid waste were generated. This represents about a 5% increase from 2022, when 25.70 Mt of waste was generated. The Central region had the highest amount of waste, at 31,339 tonnes/day (with provinces in the Central region generating 18,591 tonnes/day and Bangkok generating 12,748 tonnes/day), followed by the Northeastern region (17,873 tonnes/day), the Southern region (9,705 tonnes/day), the Eastern region (7,073 tonnes/day), the Northern region (4,582 tonnes/day), and the Western region with 3,268 tonnes/day (PCD, 2024c).

The Hazardous Community Waste in Thailand in 2023 amounted to 680,386 tonnes, an increase of 0.63% from 2022 (676,146 tonnes). The majority came from WEEE, amounting to 442,251 tonnes (65%). Other types of hazardous community waste, such as fluorescent lamps, batteries, chemical containers, and spray cans, amount to approximately 238,135 tonnes (35%). Amongst the total hazardous community waste, including WEEE, only 152,160.65 tonnes (22%) were collected. Of the collected hazardous community waste, 143,583.24 tonnes (94%) were properly managed. This includes 101,852.52 tonnes utilised for beneficial use and 41,730.72 tonnes disposed of. Consequently, only 21.10% of hazardous community waste was properly managed, which is lower than the target of 30%

as set out in the Second National Waste Management Action Plan (2022–2027) (PCD, 2024c; Figure 5.10; Table 5.5).

Figure 5.10. Volume of Hazardous Community Waste including E-waste Generated in Thai Communities



Source: PCD (2024c).

The reasons for this include the insufficient collection of hazardous community waste from the source, particularly WEEE, into proper management systems; limited and inconsistent private sector participation in taking responsibility for managing their product waste; the lack of hazardous waste treatment or disposal facilities across all regions; and regulatory limitations related to the management of discarded electrical and electronic products, which result in unclear responsibilities amongst relevant agencies (PCD, 2022; 2024c).

Table 5.5. Volume of Hazardous Waste from Thai Communities (2019–2023)

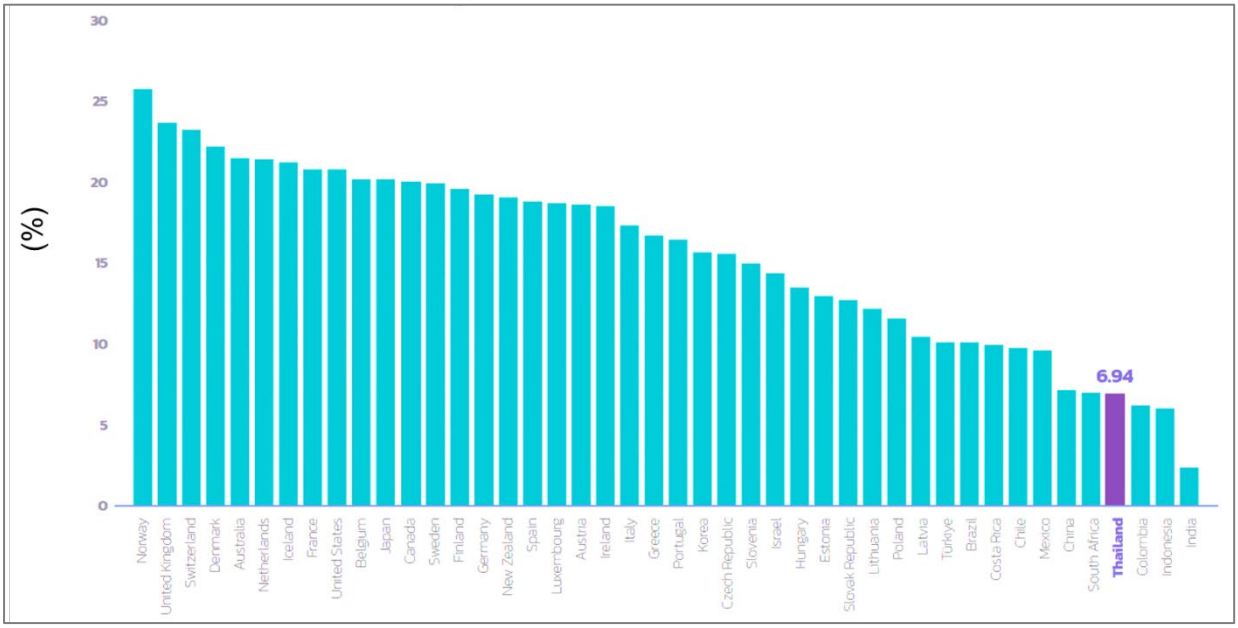
Year (B.E.)	Volume of Hazardous Community Waste (tonnes/year)	Growth/Decline Rate (%YoY)	Volume of WEEE (tonnes/year)	Volume of Other Hazardous Community Waste (tonnes/year)
2019 (2562)	648,208	+ 1.61	421,335	226,873
2020 (2563)	658,651	+ 1.61	428,113	230,538
2021 (2564)	669,518	+ 1.65	435,187	234,331
2022 (2565)	676,146	+ 0.99	439,495	236,651

Year (B.E.)	Volume of Hazardous Community Waste (tonnes/year)	Growth/Decline Rate (%YoY)	Volume of WEEE (tonnes/year)	Volume of Other Hazardous Community Waste (tonnes/year)
2023 (2566)	680,386	+0.63	442,251	238,135

Source: PCD (2022).

According to the *Thailand Digital Outlook Annual Report 2024* by the Office of the National Digital Economy and Society Commission (ONDE), Thailand generated an average of 6.94 kilograms of e-waste per capita in 2023, which is low compared to the OECD member country average of 19.34 kilograms per capita (Figure 5.11).

Figure 5.11. Volume of E-Waste Generated in Thailand Compared to OECD Member Countries and Outreach Countries



Source: DIW & PCD as cited in Thailand Digital Outlook Annual Report 2024 by ONDE (2024)

From the data collected on discarded electrical and electronic products in 2021–2022 by the PCD, it was found that Thailand shows an increasing trend in the volume of e-waste. This is especially true for nine specific product types: televisions, air conditioners, refrigerators, washing machines, computers, telephones, fans, rice cookers, and microwaves. Details are shown in Table 5.6.

Table 5.6. Volume of Discarded Electrical and Electronic Products in 2021–2022

Type	E-Waste (Tonnes/Year)	
	2021	2022
Television	90,010	96,190
Washing Machine	85,715	95,453
Air Conditioner	75,918	91,685
Fan	59,980	59,494
Computer	53,629	49,909
Refrigerator	32,681	30,295
Telephone	25,020	3,116
Rice Cooker	8,741	8,032
Microwave	3,491	3,043

Source: PCD (n.d.).

Observations on determined EEE -relevant materials for Thailand according to the combination of the material list found in the Basel Convention and international trade statistics are as follows.

(1) Basel Convention

Details related to e-waste under the Basel Convention are presented in Table 5.7.

Table 5.7. List of the E-waste under the Basel Convention

Annex	Details
Original Basel E-Waste List [before January 2025]	
VIII	A1180 Waste electrical and electronic assemblies or scrap containing components such as accumulators and other batteries included on list A, mercury switches, glass from cathode ray tubes and other activated glass and PCB-capacitors, or contaminated with Annex I constituents (e.g., cadmium, mercury, lead, polychlorinated biphenyl to an extent that they

Annex	Details
	possess any of the characteristics contained in Annex III (note the related entry on list B: B1110) [deletion since 1 January 2025]
IX	B1110 Electrical and electronic assemblies: • Electronic assemblies consisting only of metals or alloys • Waste electrical and electronic assemblies or scrap (including printed circuit boards) not containing components such as accumulators and other batteries included on list A, mercury switches, glass from cathode ray tubes and other activated glass and PCB capacitors, or not contaminated with Annex I constituents (e.g., cadmium, mercury, lead, polychlorinated biphenyl) or from which these have been removed, to an extent that they do not possess any of the characteristics contained in Annex III (note the related entry on list A: A1180) • Electrical and electronic assemblies (including printed circuit boards, electronic components and wires) destined for direct reuse, and not for recycling or final disposal
[deletion since 1 January 2025]	
	B4030 Used single-use cameras, with batteries not included on list A [deletion since 1 January 2025]
New Basel E-Waste List [Since January 2025]	
II	Y49 • Waste components of electrical and electronic equipment (e.g., certain circuit boards, certain display devices) not containing and not contaminated with Annex I constituents to an extent that the waste components exhibit an Annex III characteristic, unless covered by another entry in Annex II or by an entry in Annex IX • Wastes arising from the processing of waste electrical and electronic equipment or waste components of electrical and electronic equipment (e.g., fractions arising from shredding or dismantling) and not containing and not contaminated with Annex I constituents to an extent that the waste exhibits an Annex III characteristic, unless covered by another entry in Annex II or by an entry in Annex IX

Annex	Details
VIII	A1181 Electrical and electronic waste (note the related entry Y49 in Annex II) • Waste electrical and electronic equipment - containing or contaminated with cadmium, lead, mercury, organ halogen compounds or other Annex I constituents to an extent that the waste exhibits an Annex III characteristic, or - with a component containing or contaminated with Annex I constituents to an extent that the component exhibits an Annex III characteristic, including but not limited to any of the following components: ○glass from cathode ray tubes included on list A ○a battery included on list A ○a switch, lamp, fluorescent tube, or a display device backlight which contains mercury ○a capacitor containing PCBs ○a component containing asbestos ○certain circuit boards ○certain display devices ○certain plastic components containing a brominated flame retardant

Source: Secretariat of the Basel Convention (2023).

Drawing from the context of the Basel Convention and domestic regulations, findings related to the flow of e-waste between other countries, including Japan and Thailand, are as follows:

- Since becoming a party to the Basel Convention in 1998, both hazardous waste covered by the convention and domestically generated hazardous waste have been classified as national hazardous waste and are subject to the convention. Such waste may be imported only for use as feedstock in manufacturing processes. On the other hand, the export of hazardous waste shall be obligated by the provisions of the convention and the domestic laws of its importing party. Hence, this inferred that EEE materials determined as the Basel Convention's hazardous waste were allowed to be imported only when they meet this criterion.
- Until 2003, the import of 23 items of UEEE, other than e-waste, into the Kingdom of Thailand was restricted under specific criteria. The list was later expanded to 32 restricted import items in 2007. Meanwhile, e-waste could still be imported, provided that it complied with the criteria for importing chemical waste and the provisions of the Basel Convention.
- Nevertheless, after the Notification of the MOC on Prohibiting the Import of e-Waste, B.E. 2563 (2020) entered into force, 428 items of EEE materials and e-waste identified under the Basel Convention as e-waste were totally banned from import, but may still be exported as mentioned above.

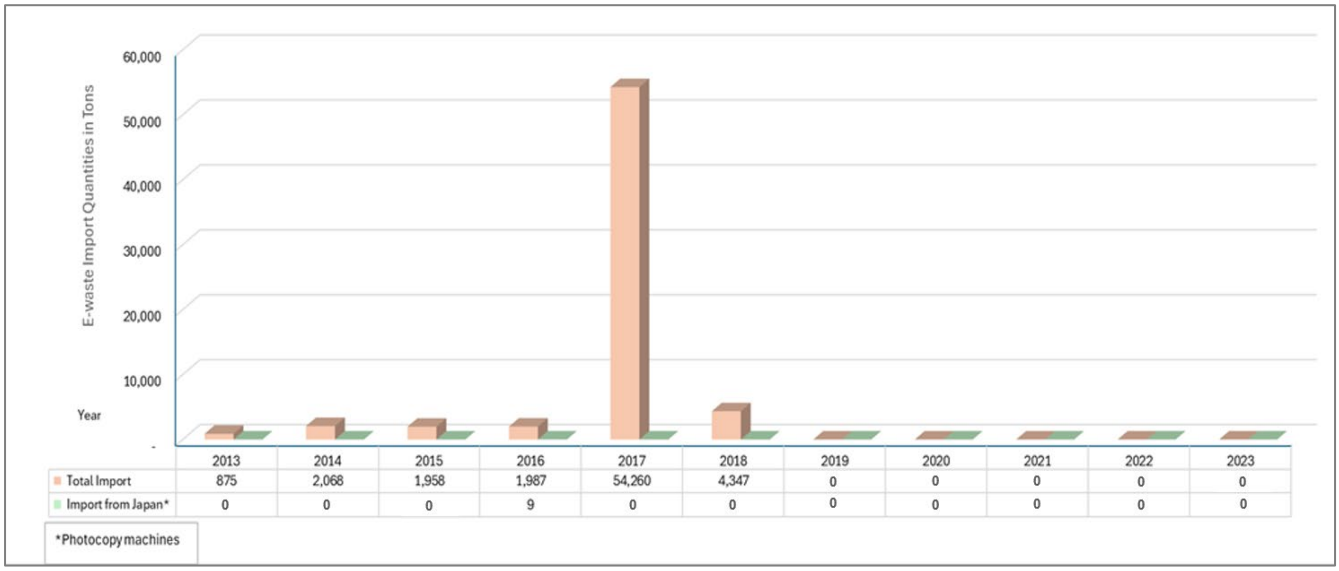
- In addition, after the entry into force of the Basel Convention's Ban Amendment in June 2023, it has been complementary to the domestic import ban regulation, which imposes a total ban on the export of the convention's hazardous wastes, including e-wastes, from Annex VII countries (excluding Japan).

Upon the entry into force of the Basel Convention E-Waste Amendment in January 2025, revisions to the chemical waste list under the Hazardous Substance Act 1992 and the above-mentioned Notification of the MOC will consequently be required for further implementation.

According to the Basel Convention national reports, the above-mentioned findings indicate that a transboundary flow of e-waste, under the scope of the convention, occurred between Thailand and other countries, including Japan. However, this import flow was completely terminated in 2020 as a result of the national import ban policies and related regulations (PCD, 2024b; Secretariat of the Basel Convention, 2024f; Figures 5.12–5.13).

Figure 5.12. Thailand's Import and Export Quantities of E-Waste with Other Countries and Japan in 2013–2023 (tonnes)

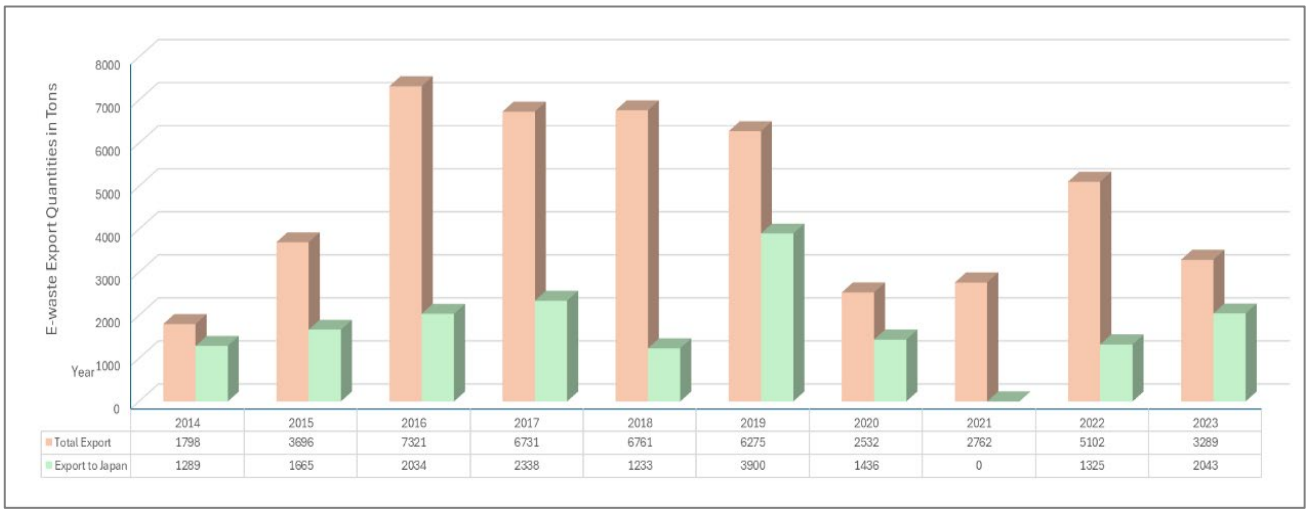
(a) Import Quantities of E-waste: Total Compared with Japan



	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023
Total Import	875	2,068	1,958	1,987	54,260	4,347	0	0	0	0	0
Import from Japan*	0	0	0	9	0	0	0	0	0	0	0

Figure 5.12. *Continued*

(b) Export Quantities of E-waste: Total Compared with Japan

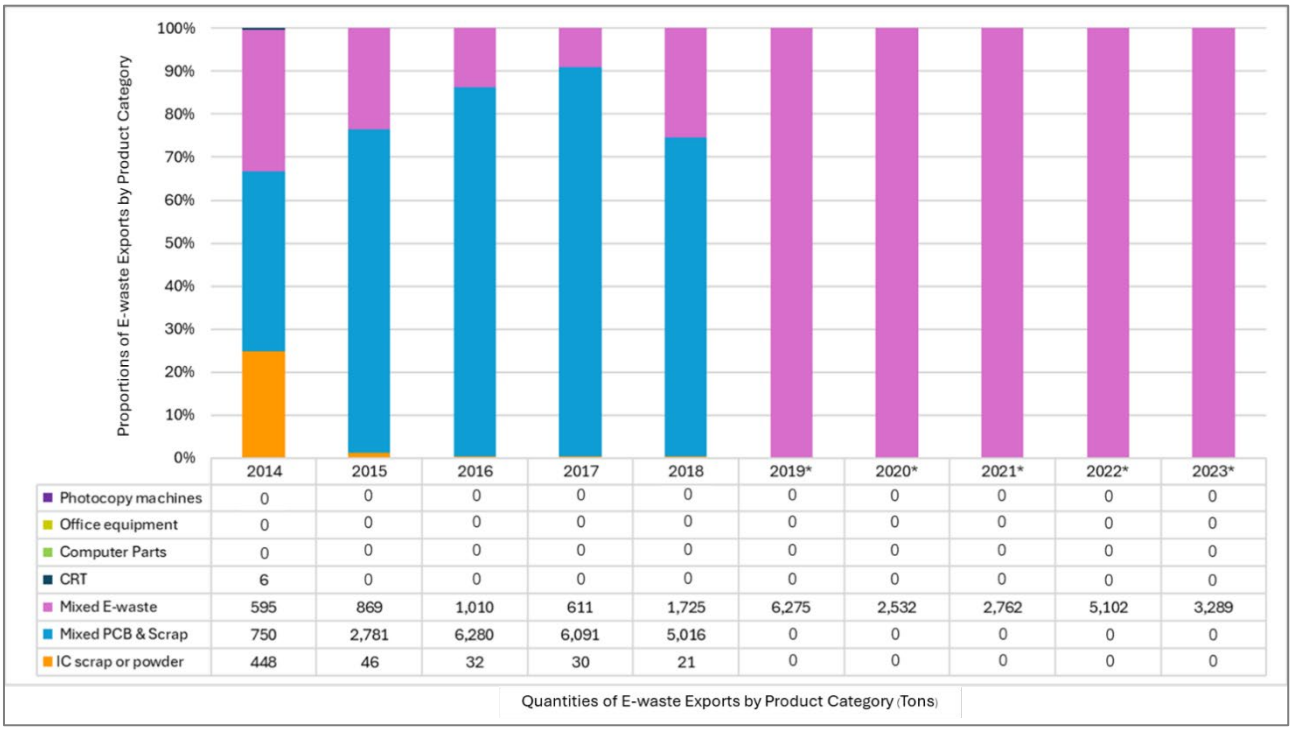


	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023
Total Export	1798	3696	7321	6731	6761	6275	2532	2762	5102	3289
Export to Japan	1289	1665	2034	2338	1233	3900	1436	0	1325	2043

Source: PCD (2024b).

Figure 5.13. Proportions and Quantities of Thailand's E-Waste Imports and Exports by Product Category in 2013–2023 (tonnes)

(a) Proportions and Quantities of E-waste Exports by Product Category



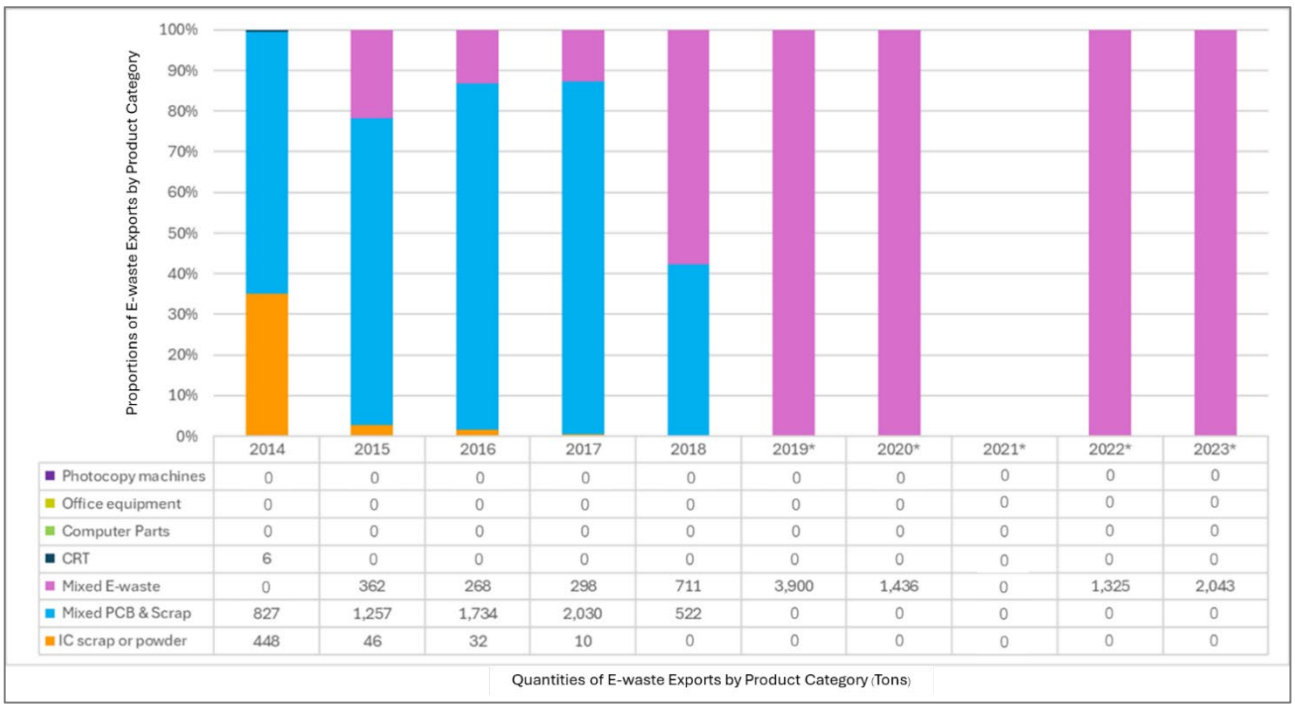
	2014	2015	2016	2017	2018	2019*	2020*	2021*	2022*	2023*
Photocopy machines	0	0	0	0	0	0	0	0	0	0
Office equipment	0	0	0	0	0	0	0	0	0	0
Computer Parts	0	0	0	0	0	0	0	0	0	0
CRT	6	0	0	0	0	0	0	0	0	0
Mixed E-waste	595	869	1,010	611	1,725	6,275	2,532	2,762	5,102	3,289
Mixed PCB & Scrap	750	2,781	6,280	6,091	5,016	0	0	0	0	0
IC scrap or powder	448	46	32	30	21	0	0	0	0	0

Quantities of E-waste Exports by Product Category (Tons)

Remarks: *Reported only in total quantity.

Figure 5.13. *Continued*

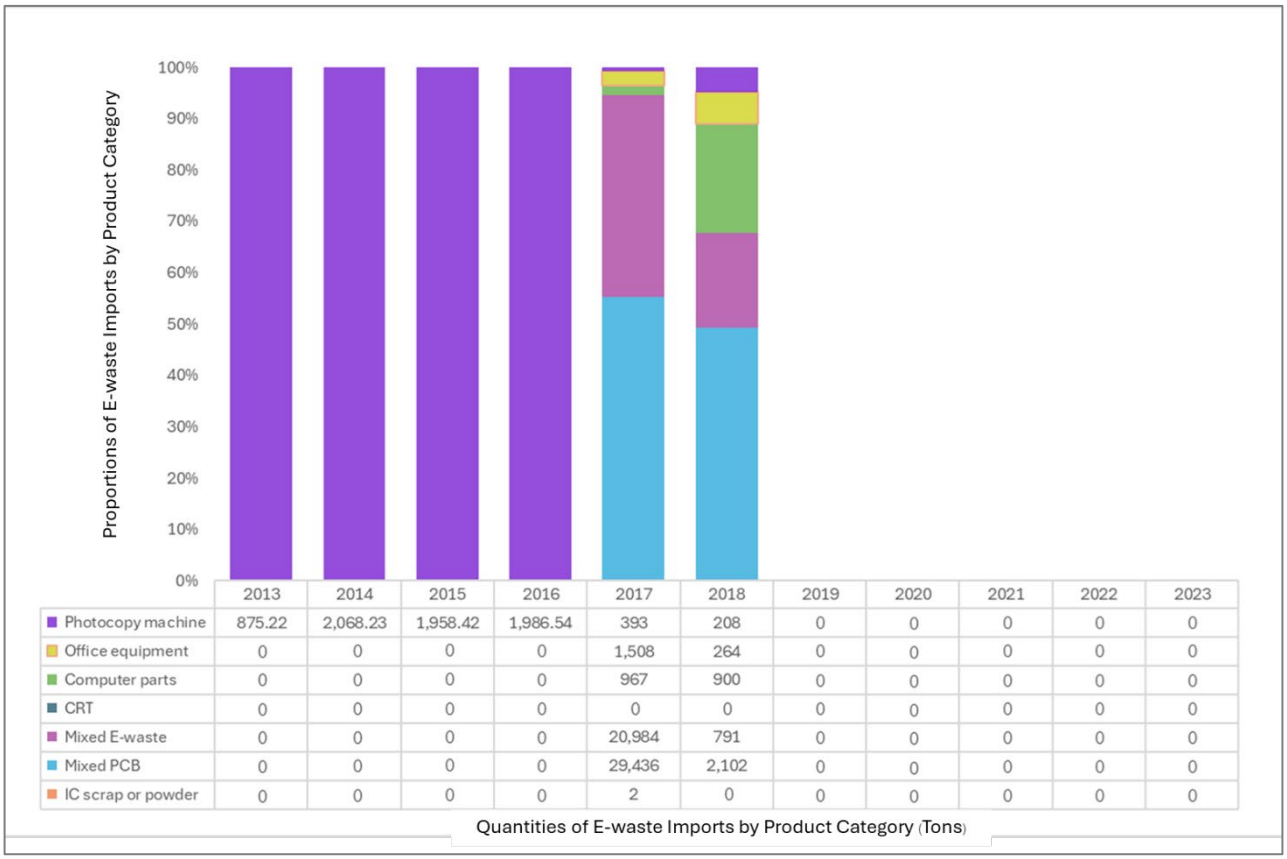
(b) Proportions and Quantities of E-waste Exports by Product Category between Thailand and Japan



	2014	2015	2016	2017	2018	2019*	2020*	2021*	2022*	2023*
Photocopy machines	0	0	0	0	0	0	0	0	0	0
Office equipment	0	0	0	0	0	0	0	0	0	0
Computer Parts	0	0	0	0	0	0	0	0	0	0
CRT	6	0	0	0	0	0	0	0	0	0
Mixed E-waste	0	362	268	298	711	3,900	1,436	0	1,325	2,043
Mixed PCB & Scrap	827	1,257	1,734	2,030	522	0	0	0	0	0
IC scrap or powder	448	46	32	10	0	0	0	0	0	0

Quantities of E-waste Exports by Product Category (Tons)

(c) Proportions and Quantities of E-waste Imports by Product Category



	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023
Photocopy machine	875.22	2,068.23	1,958.42	1,986.54	393	208	0	0	0	0	0
Office equipment	0	0	0	0	1,508	264	0	0	0	0	0
Computer parts	0	0	0	0	967	900	0	0	0	0	0
CRT	0	0	0	0	0	0	0	0	0	0	0
Mixed E-waste	0	0	0	0	20,984	791	0	0	0	0	0
Mixed PCB	0	0	0	0	29,436	2,102	0	0	0	0	0
IC scrap or powder	0	0	0	0	2	0	0	0	0	0	0

Quantities of E-waste Imports by Product Category (Tons)

Remarks: *Reported only in total quantity.

Source: Secretariat of the Basel Convention (2024b).

According to the Basel Convention National Reports, most imported flows of e-waste consisted of used office equipment (such as photocopying machines, computers, and other devices) and separated parts or components (such as printed circuit board assemblies and computer parts), as well as mixed e-waste. By contrast, export flows mainly comprised mixed components or certain disassembled parts, such as PCB and IC scraps or crushed IC powder. EEE materials associated with some types of imported and exported e-waste under the Basel Convention are shown in Table 5.8.

Table 5.8. Average EEE Materials Associated with Some Types of Imported and Exported E-Waste into and from Thailand in 2013–2023

Type of E-Waste	Average Export Amount (tonnes)	Average Import Amount (tonnes)
IC scrap (SnPb)	133.83	-
Scrap of electric component parts	318.18	-
Scrap of printed circuit board with parts	601.69	-
Electronic components	5.02	-
Printed circuit boards	426.75	-
Electrical and electronic assemblies	1,802.36	-
Mixed metal scrap	169.65	-
Precious metal bearing e-waste	353.81	-
Used Xerox office equipment	-	9.13

Source: Secretariat of the Basel Convention (2013–2023).

(2) The international trade statistics

It is necessary to consider the limitations of a series of banning policies and regulations, including the ban on e-waste imports introduced in 2020 (covering 428 items), its ongoing amendment in 2025 (35 items), and obligations under the Basel Ban Amendment, which prohibit the import of hazardous waste from Annex VII countries).

The customs office classifies goods and assigns codes to impose tariffs on the internationally traded products. The Harmonized Commodity Description and Coding System, also known as the Harmonized System (HS), is a standardised system for classifying goods and assigning product codes by using a universally defined numeric system (coding) to label items. This system was developed and is maintained by the World Customs Organization (WCO) to support various international trade-related activities and ensure consistency in customs procedures and trade practices. It is used to determine import–export duties and collect

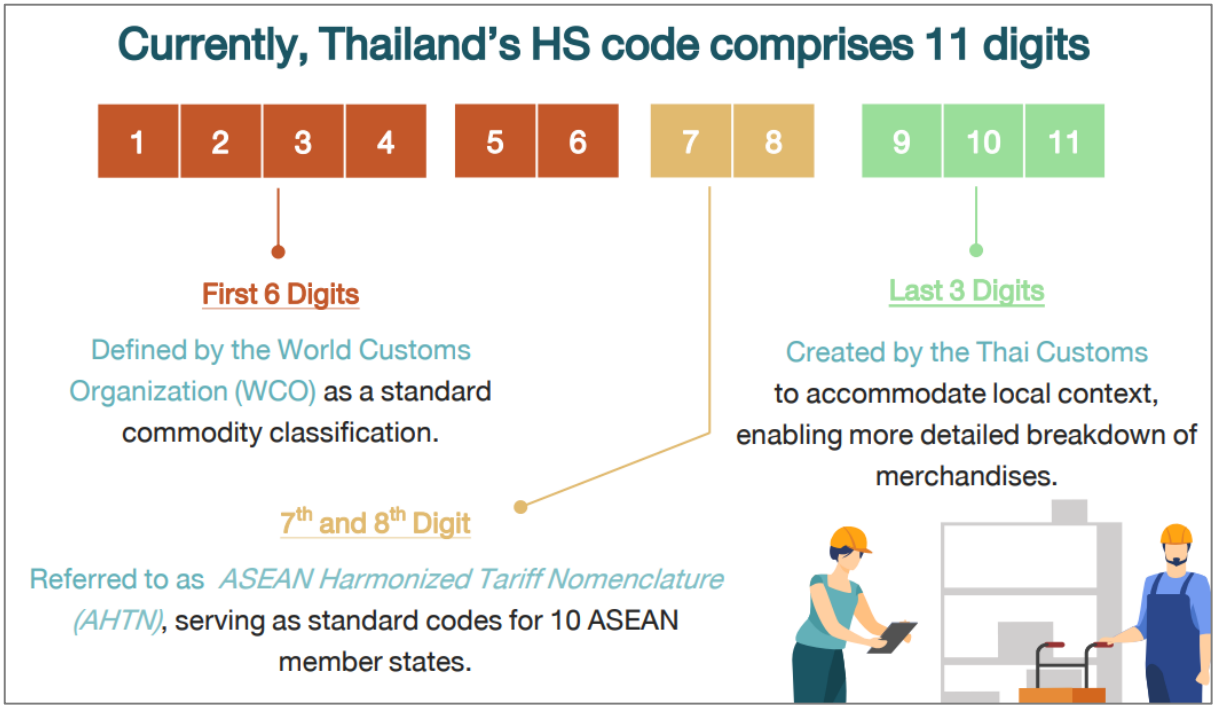
international trade statistics, which allows for the analysis and comparison of trade statistics with partner countries (Thai Customs, 2022).

Currently, Thailand has adopted the Harmonized System 2020, which is reviewed every 5 years based on updates from the WCO. The transition from HS2017 to HS2022 came into effect on 1 January 2022. The revision included the addition of tariff/statistical codes for important products, especially those with high trade value and significant for national policy analysis, while low-value items were consolidated into related categories for greater clarity in classification (Royal Gazette, 2021).

The classification of goods under customs tariffs consists of 11 digits (Figure 5.14). The first six digits are assigned according to the international Harmonized System. The seventh and eighth digits are based on the ASEAN Harmonized Tariff Nomenclature. The last three digits are statistical codes used specifically by each country, which may indicate either specific types of goods or product groups. These codes are followed by a unit code consisting of three letters, such as KGM (kilogram), C62 (piece/unit), LTR (litre), MTR (metre), or PRS (pair) (Figure 5.14).

The last three digits are statistical codes set by the Thai Customs Department to further classify goods for the purpose of trade statistics. These include codes such as Code 001: Product details, Code 090: Others, Code 800: Used goods, Code 899: E-waste under the Basel Convention, Code 999: Complete parts, etc.

Figure 5.14. HS Code of Thailand

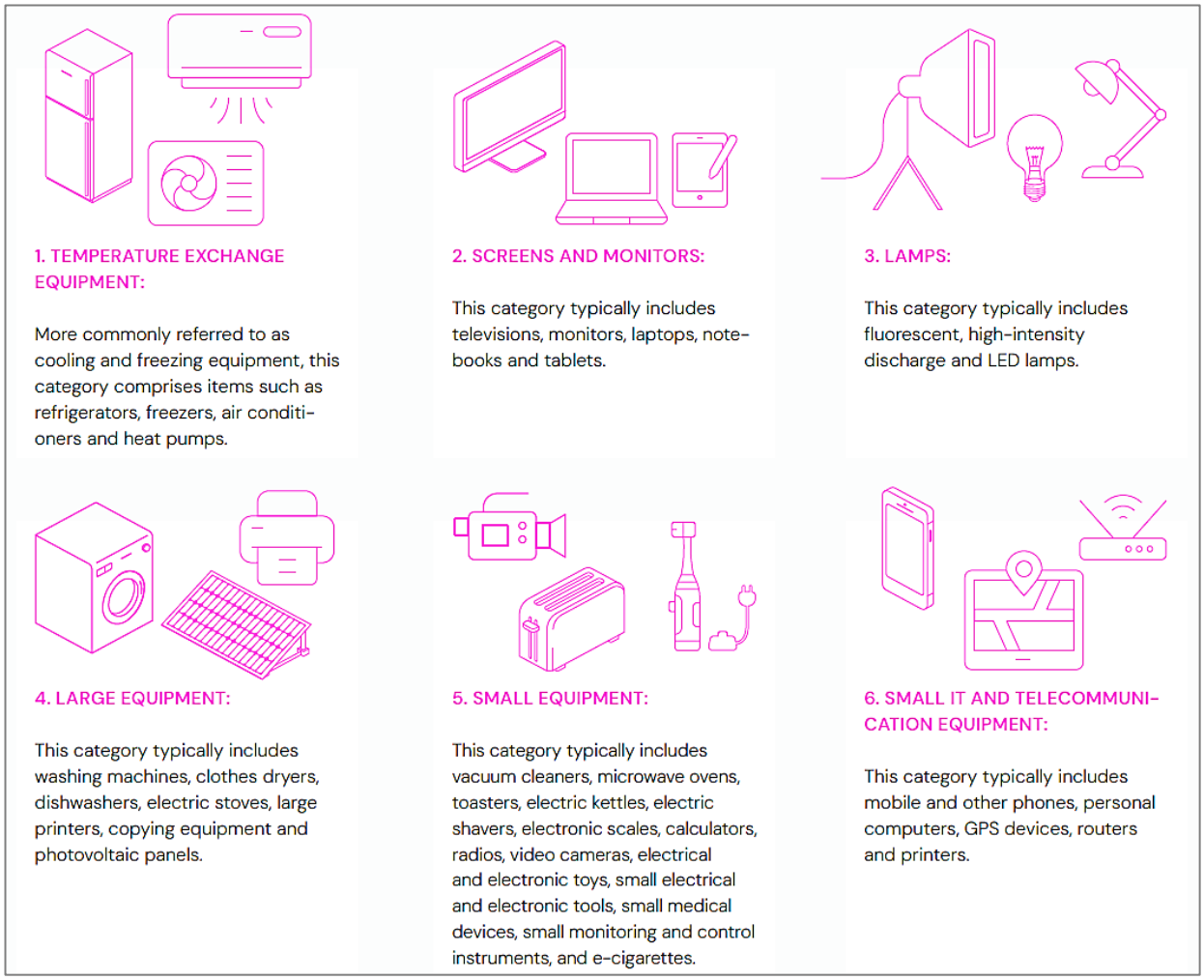


Source: Bank of Thailand (n.d.)

According to data from the Information and Communication Technology Center, Office of the Permanent Secretary, MOC, in collaboration with the Customs Department, and reported in the Thailand International Trade Report 2023, Japan was Thailand's third-largest trading partner in 2023, and while Thailand was Japan's sixth-largest trading partner. Major exports from Japan include automobiles, machinery, electrical machinery, commodities, and medical equipment. Major export markets for Japan include the US, China, the Republic of Korea, Taiwan, and Hong Kong (Thailand ranked sixth in 2023). Major imports to Japan include fuel oil, electrical machinery, machinery, pharmaceuticals, and medical equipment. Major import markets for Japan include China, the US, Australia, the United Arab Emirates, and Taiwan (Thailand ranked ninth in 2023).

According to the trade statistics report on e-waste, Chapter 84 (Nuclear reactors; fuel elements [cartridges], non-irradiated, for nuclear reactors; machinery and apparatus for isotopic separation) and Chapter 85 (Electric motors and generators, excluding generating sets) consist of 86 and 48 items, respectively. The study group selected items related to the project that are connected with Equipment Categories EEE-relevant materials into the six equipment categories, namely, (i) temperature exchange equipment, (ii) screens and monitors, (iii) lamps, (iv) large equipment, (v) small equipment, and (vi) small IT and telecommunication equipment (Please refer to Baldé et al. [2024] for more details; Figure 5.15).

Figure 5.15. Classification of E-Waste



Source: Adapted from 'E-waste Statistics – Guidelines on Classification Reporting and Indicators', in Baldé et al. (2024).

This study focuses on used electrical and electronic equipment, as well as electronic waste, by classifying products according to HS codes and categorising them into six groups as defined in *The Global E-Waste Monitor 2024*. The details are as follows:

1) Temperature exchange equipment

- 8415: Air conditioning machines, comprising a motor-driven fan and elements for changing the temperature and humidity, including those machines in which the humidity cannot be separately regulated
- 8418: Refrigerators, freezers, and other refrigerating or freezing equipment, electric or other; heat pumps other than air-conditioning machines of heading 84.15

2) Screens and monitors

- 8524: Flat panel display modules, whether or not incorporating touch-sensitive screen
- 8528: Monitors and projectors, not incorporating television reception apparatus; reception apparatus for television, whether or not incorporating radio-broadcast receivers or sound or video recording or reproducing apparatus

3) Lamps

- 8539: Electric filament or discharge lamps, including sealed beam lamp units and ultraviolet or infrared lamps; arc lamps; light-emitting diode (LED) lamps

4) Large equipment

- 8450: Household or laundry-type washing machines, including machines which both wash and dry

5) Small equipment

- 8508: Vacuum cleaners
- 8516: Electric instantaneous or storage water heaters and immersion heaters; electric space heating apparatus and soil heating apparatus; electro-thermic hair-dressing apparatus (for example, hair dryers, hair curlers, curling tong heaters) and hand dryers; electric smoothing irons; other electro-thermic appliances of a kind used for domestic purposes; electric heating resistors, other than those of heading 85.45

6) Small IT and telecommunication equipment

- 8517: Telephone sets, including smartphones and other telephones for cellular networks or for other wireless networks; other apparatus for the transmission or reception of voice, images or other data, including apparatus for communication in a wired or wireless network (such as a local or wide area network), other than transmission or reception apparatus of heading 84.43, 85.25, 85.27 or 85.28

7) Waste

- 8549: Electrical and electronic waste and scrap

Based on Thailand's international trade data over the past decade (2015–2024), focusing only on the category of UEEE, including e-waste, under the Harmonized System (HS) Code, China has consistently been the number one trading partner (MOC, 2025). This reflects China's role as the world's manufacturing hub and a key source of EEE. During 2015–2021, Japan played a significant role as the second-largest trading partner, particularly in the automotive and electronics industries, which are Japan's technological strengths. However, since 2022, Japan's trade share has steadily declined, allowing the US to rise to second place from 2022 onwards. The top trading partners for EEE and e-waste under the HS Code (MOC, 2025) can be summarised in Table 5.9

Table 5.9. Top Five Import–Export Trading Partners for UEEE and E-Waste, 2015–2024

HS Code	Import	Export
1) Temperature exchange equipment		
8415: Air-conditioning machines, comprising a motor-driven fan and elements for changing the temperature and humidity, including those machines in which the humidity cannot be separately regulated	1)China (56.62%) 2)Malaysia (14.46%) 3)Japan (12.47%) 4)US (3.95%) 5)Rep. of Korea (3.48%)	1)US (11.51%) 2)Australia (9.97%) 3)Viet Nam (9.09%) 4)Japan (6.01%) 5)India (5.43%)
8418: Refrigerators, freezers and other refrigerating or freezing equipment, electric or other; heat pumps other than air-conditioning machines of heading 84.15	1)China (60.28%) 2)Indonesia (5.34%) 3)US (5.16%) 4)Japan (4.47%) 5)Italy (3.31%)	1)US (14.54%) 2)Japan (14.19%) 3)Viet Nam (10.00%) 4)Australia (9.22%) 5)Malaysia (4.45%)
2) Screens and monitors		
8524: Flat panel display modules, whether or not incorporating touch-sensitive screen	1)China (94.54%) 2)Japan (2.56%) 3)Taiwan (0.72%) 4)Philippines (0.66%) 5)Malaysia (0.44%)	1)China (58.25%) 2)Malaysia (16.63%) 3)Japan (12.74%) 4)Singapore (5.57%) 5)Hong Kong (5.06%)
8528: Monitors and projectors, not incorporating television reception apparatus; reception apparatus for television, whether or not incorporating radio-broadcast receivers or sound or video recording or reproducing apparatus	1)China (41.39%) 2)Viet Nam (21.36%) 3)Malaysia (13.83%) 4)Indonesia (11.57%) 5)Japan (4.01%)	1)US (44.61%) 2)Japan (13.87%) 3)India (7.92%) 4)Netherlands (3.39%) 5)Germany (3.28%)
3) Lamps		
8539: Electric filament or discharge lamps, including sealed beam lamp units and ultraviolet or infrared lamps; arc lamps; light-emitting diode (LED) lamps	1)China (61.41%) 2)Japan (12.80%) 3)Germany (8.95%) 4)US (3.39%) 5)Taiwan (2.21%)	1)US (16.46%) 2)Indonesia (15.10%) 3)Germany (7.31%) 4)Cambodia (5.36%) 5)Lao PDR (5.25%) * 7) Japan (4.66%)

HS Code	Import	Export
4) Large equipment		
8450: Household or laundry-type washing machines, including machines which both wash and dry	1)China (53.89%) 2)Rep. of Korea (22.99%) 3)Viet Nam (7.55%) 4)Italy (3.18%) 5)US (2.23%) * 10) Japan (0.90%)	1)US (17.70%) 2)Viet Nam (10.40%) 3)Japan (10.28%) 4)Rep. of Korea (8.85%) 5)Australia (6.83%)
5) Small equipment		
8508: Vacuum cleaners	1)China (69.62%) 2)Viet Nam (9.52%) 3)Malaysia (9.14%) 4)Rep. of Korea (2.03%) 5)Italy (1.99%) *6) Japan (1.51%)	1) United Arab Emirates (21.61%) 2) US (20.37%) 3) Saudi Arabia (15.35%) 4) Japan (13.13%) 5) Viet Nam (5.83%)
8516: Electric instantaneous or storage water heaters and immersion heaters; electric space heating apparatus and soil heating apparatus; electro-thermic hair-dressing apparatus (for example, hair dryers, hair curlers, curling tong heaters) and hand dryers; electric smoothing irons; other electro-thermic appliances of a kind used for domestic purposes; electric heating resistors, other than those of heading 85.45	1)China (56.47%) 2)Malaysia (8.54%) 3)Japan (5.79%) 4)Viet Nam (5.17%) 5)Rep. of Korea (3.82%)	1) USA (37.64%) 2) Japan (27.28%) 3) Canada (7.68%) 4) Viet Nam (4.31%) 5) Australia (2.53%)
6) Small IT and telecommunication equipment		
8517: Telephone sets, including smartphones and other telephones for cellular networks or for other wireless networks; other apparatus for the transmission or reception of voice, images or other data, including apparatus for communication in a wired or wireless	1)China (68.83%) 2)Viet Nam (12.95%) 3)Thailand (4.82%) 4)Taiwan (2.53%) 5)Japan (2.50%)	1) USA (39.38%) 2) Japan (14.41%) 3) Hong Kong (7.78%) 4) Netherlands (5.02%) 5) Mexico (3.98%)

HS Code	Import	Export
network (such as a local or wide area network), other than transmission or reception apparatus of heading 84.43, 85.25, 85.27, or 85.28		
7) E-waste		
8549: Electrical and electronic waste and scrap	1)China (66.71%) 2)New Zealand (15.53%) 3)France (13.07%) 4)Japan (9.17%) 5)Papua New Guinea (4.41%)	1) Japan (51.75%) 2) China (7.61%) 3) Brazil (6.95%) 4) Singapore (6.22%) 5) Rep. of Korea (6.19%)

Source: MOC (2025).

According to Thailand's trade statistics (2015–2024), Japan is one of Thailand's key trading partners, consistently ranking amongst the top five in total trade value. However, the volume of imports and exports of UEEE between the two countries remains very low, as the majority of trade value comes from new products. The trade volume of UEEE, including e-waste, between Thailand and Japan fluctuates from year to year, with some years showing no trade at all. This variation may be influenced by factors such as global trade trends, policy changes, and the COVID-19 pandemic, which significantly reduced the movement of goods across borders. Additionally, revisions to the HS Code, updated every 5 years-with Thailand currently using the 2022 version, may lead to discrepancies in reporting certain product categories. There are also challenges arising from unclear data declarations by businesses, such as incorrect HS code classification or mismatches between the code and the actual product characteristics, which hinder accurate trade data tracking and analysis.

The international trade statistics between Thailand and Japan for products under Chapters 84 and 85, using data from the statistical codes defined by the Thai Customs Department (last 3 digits), specifically code 800 Used, will focus on the flow of materials for the items under the 11-digit classification. Data from the past 10 years (2015–2024) can be summarised for global import–export trends and trade between Thailand and Japan, referencing information from the Information and Communication Technology Center, Office of the Permanent Secretary, MOC, in collaboration with the Customs Department (2025). An overview is presented in Table 5.10.

Table 5.10. Summary of the Import and Export Percentages of UEEE and E-Waste Between Thailand and Japan

List		Proportions of Imports and Exports Between Thailand and Japan (%)									
		2015	2016	2017	2018	2019	2020	2021	2022	2023	2024
•UEEE	Import	88.28	0.85	4.29	2.58	0.32	0.15	0.25	0.07	0.99	5.39
	Export	6.38	-	0.14	0.06	0.62	0.30	0.03	0.74	-	0.14
•E-waste	Import	-	-	-	-	-	-	-	75.72	0.40	16.23
	Export	-	-	-	-	-	-	-	77.55	81.09	70.09

Notes: UEEE include:

1) Temperature exchange equipment (8415: Air conditioner and 8418: Refrigerators and freezers)

2) Screens and monitors (8524: Flat panel display modules and 8528: Monitors and projectors)

3) Lamps (Code 8539: Electric filament or discharge lamps)

4) Large equipment (8450: Washing machines)

5) Small equipment (8508: Vacuum cleaners and 8516: Electric instantaneous or storage water heaters and immersion heaters)

6) Small IT and telecommunication equipment (8517: Telephone sets)

*The data in this table specifically represent imports and exports between Thailand and Japan from the Ministry of Commerce database.

Source: Based on statistical data from the Thai Customs (2025) and MOC (2025)

The proportion of UEEE and e-waste traded between Thailand and Japan over the past decade remains relatively low compared to Thailand's total trade volumes. Most import and export percentages are below 1% annually, except for a few isolated spikes, such as a high import share in 2015 and significant movements in e-waste trade between 2022 and 2024. However, due to inconsistencies and gaps in the data across several years, it remains difficult to establish a clear or consistent trend at this stage.

In addition, the limited nature of cross-border trade in e-waste is largely due to the fact that end-of-life or damaged EEE often contains components with economic value, such as copper, gold, silver, or other rare metals. As a result, most countries tend to retain e-waste within their borders to undergo dismantling and recycling processes in order to recover these valuable materials for reuse in industrial systems. This approach not only reduces reliance on imported minerals or materials but also lowers waste management costs and minimises environmental impacts. Furthermore, international legal restrictions on the transport of hazardous waste-especially e-waste that may contain toxic substances or heavy metals pose additional challenges, making cross-border trade in this category of waste difficult and subject to stringent regulations. Consequently, e-waste management is

typically carried out domestically (United States Environmental Protection Agency (EPA), 2024).

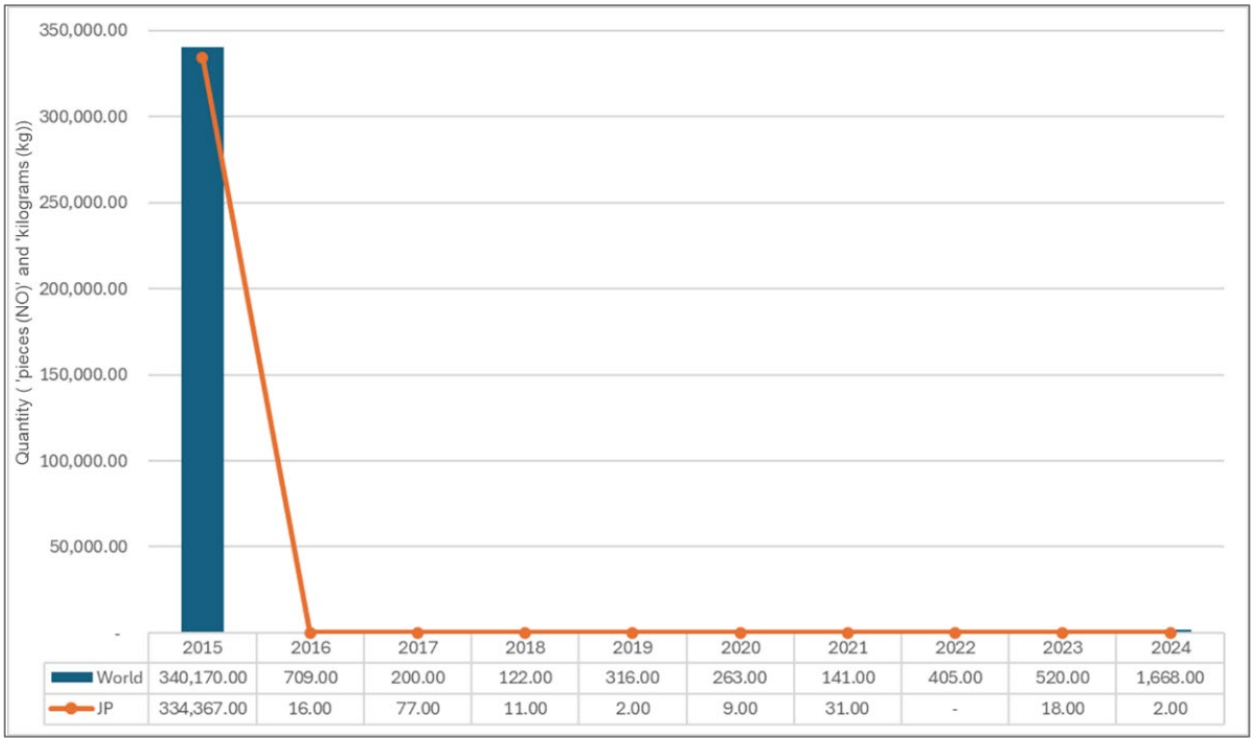
The details of UEEE and e-waste imports and exports, broken down by product type, are presented in Figures 5.16–5.23:

1) Temperature exchange equipment

- 8415: Air-conditioning machines, comprising a motor-driven fan and elements for changing the temperature and humidity, including those machines in which the humidity cannot be separately regulated.

Figure 5.16. Import–Export Statistics for 8415[a]

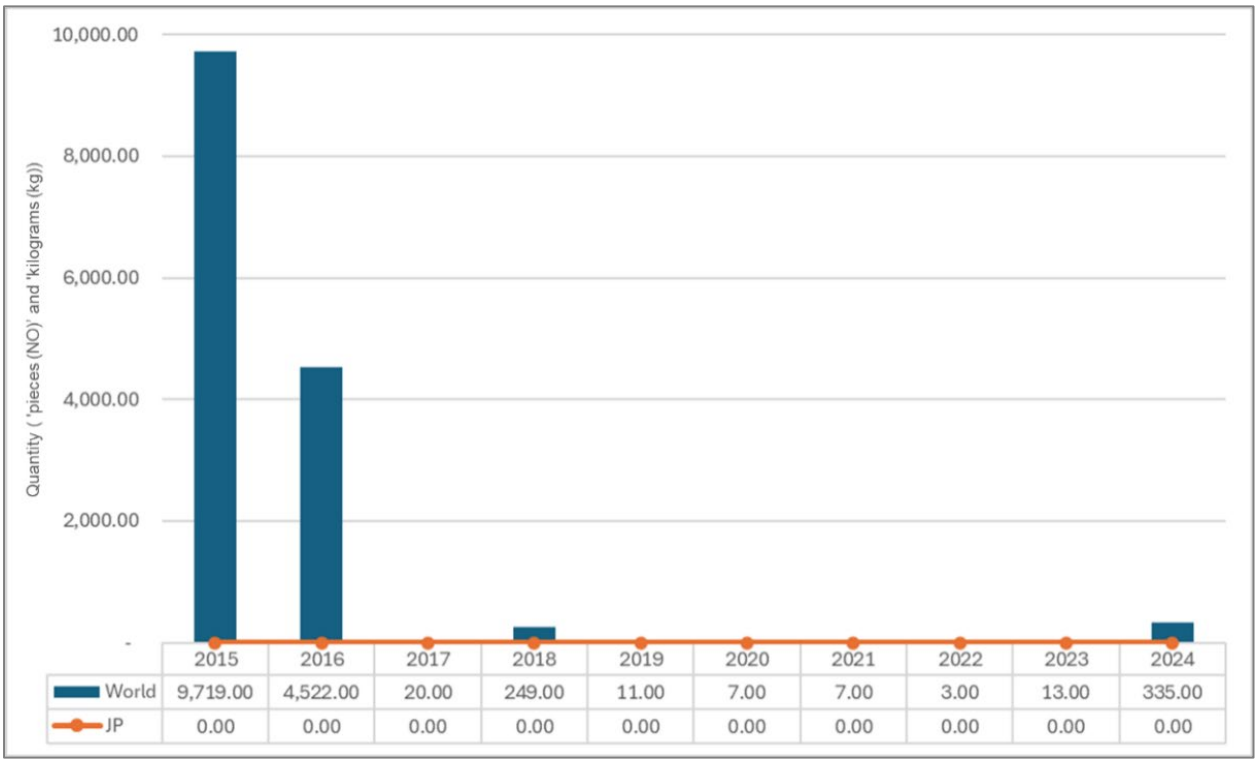
(a) Import Quantity for HS Code 8415 for World and Japan



	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024
World	340,170.00	709.00	200.00	122.00	316.00	263.00	141.00	405.00	520.00	1,668.00
JP	334,367.00	16.00	77.00	11.00	2.00	9.00	31.00	-	18.00	2.00

Figure 5.16. *Continued*

(b) Export Quantity for HS Code 8415 for World and Japan



	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024
World	9,719.00	4,522.00	20.00	249.00	11.00	7.00	7.00	3.00	13.00	335.00
JP	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00

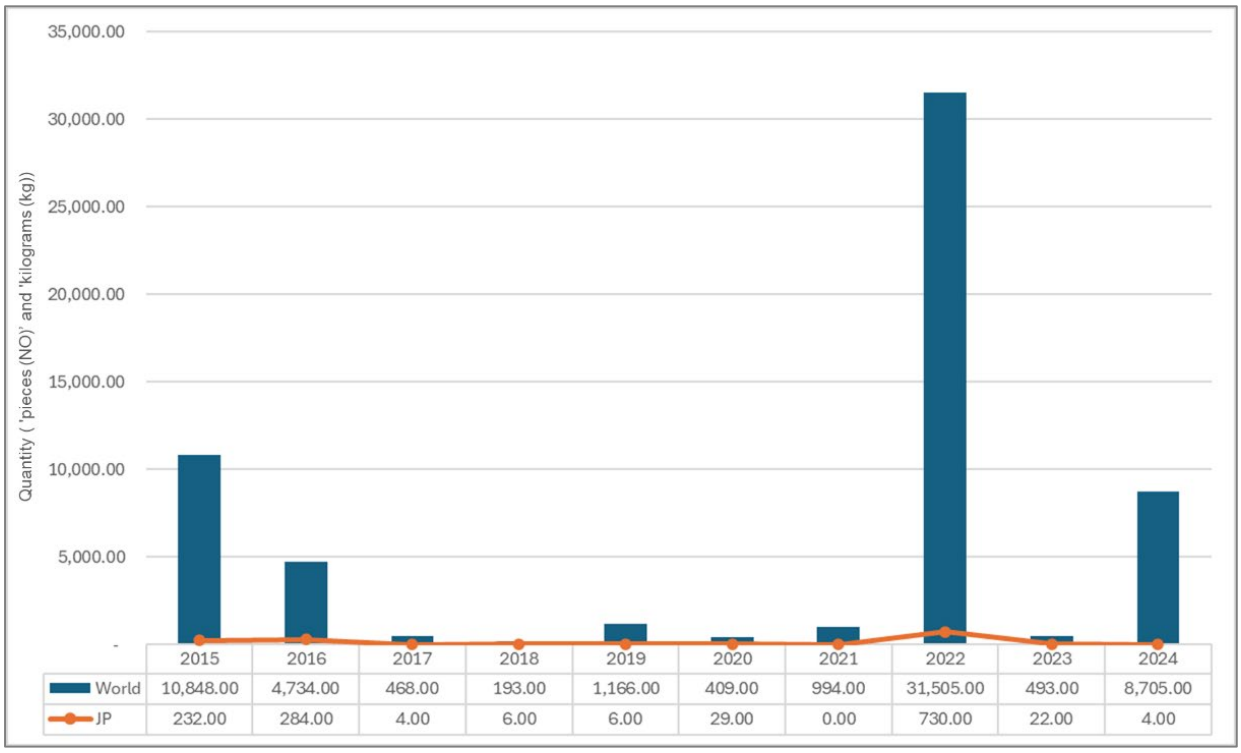
[a] Air-conditioning machines, comprising a motor-driven fan and elements for changing the temperature and humidity, including those machines in which the humidity cannot be separately regulated.

Source: Based on statistical data from the Thai Customs (2025) and MOC (2025).

- 8418: Refrigerators, freezers and other refrigerating or freezing equipment, electric or other; heat pumps other than air-conditioning machines of heading 84.15.

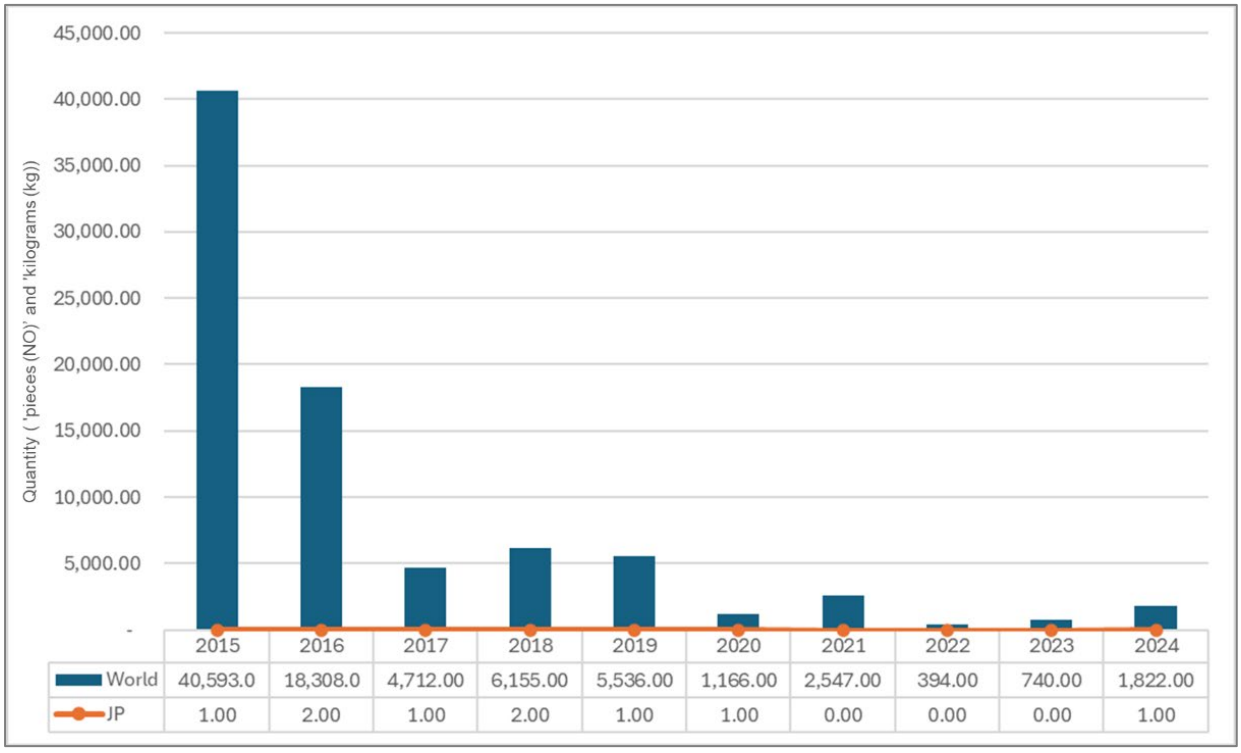
Figure 5.17. Import–Export Statistics for 8418[a]

(a) Import Quantity for HS Code 8418 for World and Japan



	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024
World	10,848.00	4,734.00	468.00	193.00	1,166.00	409.00	994.00	31,505.00	493.00	8,705.00
JP	232.00	284.00	4.00	6.00	6.00	29.00	0.00	730.00	22.00	4.00

(b) Export Quantity for HS Code 8418 for World and Japan



	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024
World	40,593.0	18,308.0	4,712.00	6,155.00	5,536.00	1,166.00	2,547.00	394.00	740.00	1,822.00
JP	1.00	2.00	1.00	2.00	1.00	1.00	0.00	0.00	0.00	1.00

[a] Refrigerators, freezers, and other refrigerating or freezing equipment, electric or other; heat pumps other than air-conditioning machines for heading 84.15.

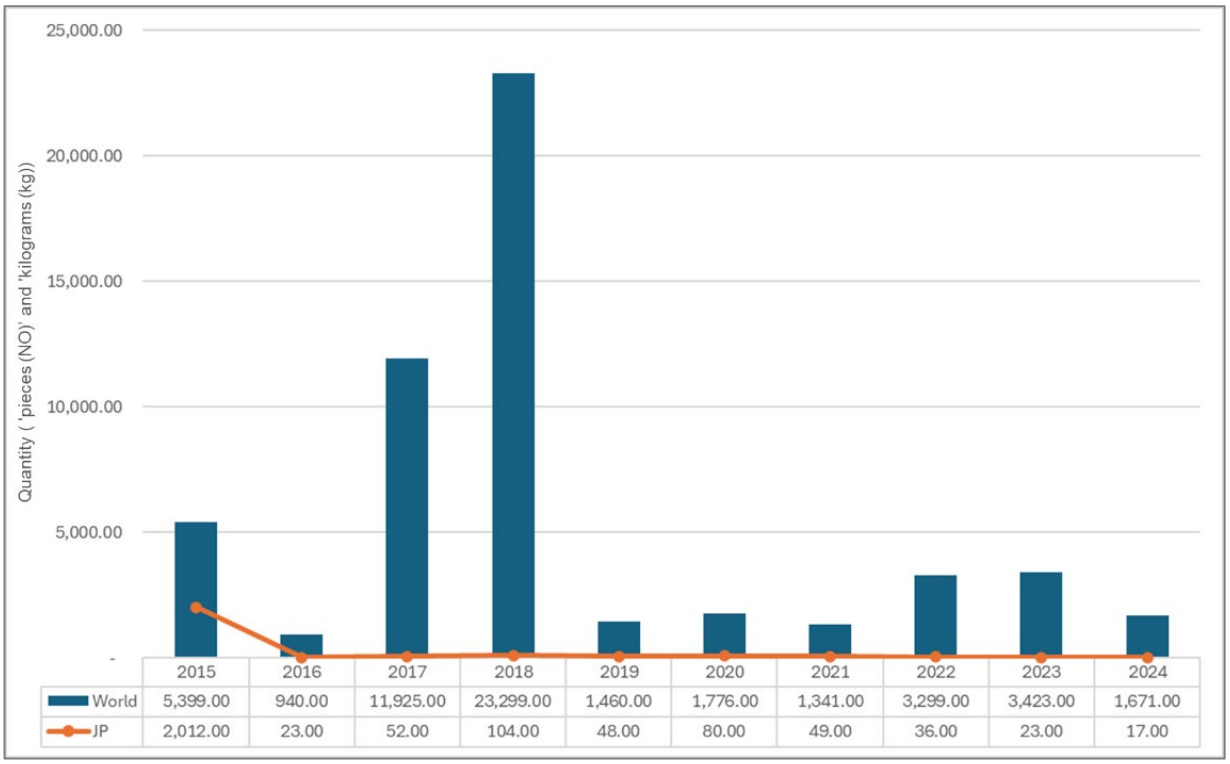
Source: Based on statistical data from the Thai Customs (2025) and MOC (2025).

2) Screens and monitors

- 8524: Flat panel display modules, whether or not incorporating a touch-sensitive screen and consisting of (i) those without drivers or control circuits and (ii) other types in the past 10 years, no import–export statistics have been found for the subheading 800 (used), based on the last three-digit code) in trade between Thailand and Japan.
- 8528: Monitors and projectors, not incorporating television reception apparatus; reception apparatus for television, whether or not incorporating radio broadcast receivers or sound or video recording or reproducing apparatus.

Figure 5.18. Import–Export Statistics for 8528[a]

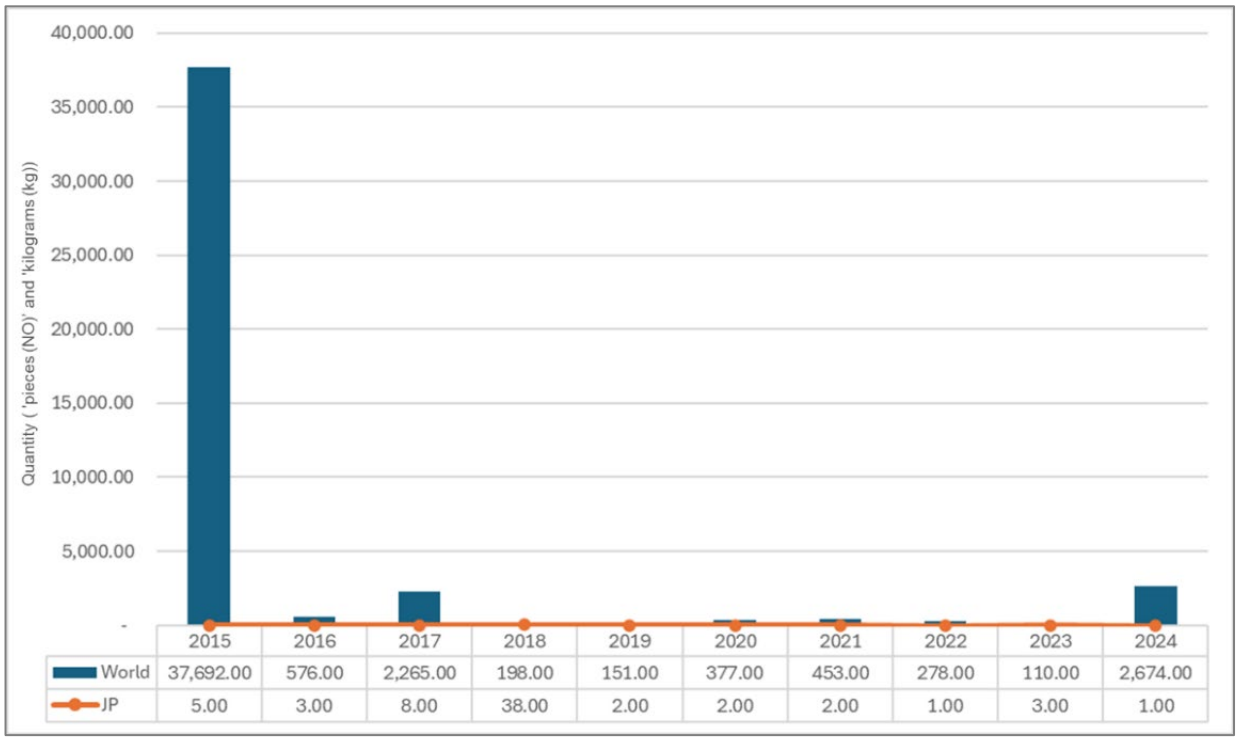
(a) Import Quantity for HS Code 8528 for World and Japan



	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024
World	5,399.00	940.00	11,925.00	23,299.00	1,460.00	1,776.00	1,341.00	3,299.00	3,423.00	1,671.00
JP	2,012.00	23.00	52.00	104.00	48.00	80.00	49.00	36.00	23.00	17.00

Figure 5.18. *Continued*

(b) Export Quantity for HS Code 8528 for World and Japan



	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024
World	37,692.00	576.00	2,265.00	198.00	151.00	377.00	453.00	278.00	110.00	2,674.00
JP	5.00	3.00	8.00	38.00	2.00	2.00	2.00	1.00	3.00	1.00

[a] Monitors and projectors, not incorporating television reception apparatus; reception apparatus for television, whether incorporating radio broadcast receivers or sound or video recording or reproducing apparatus.

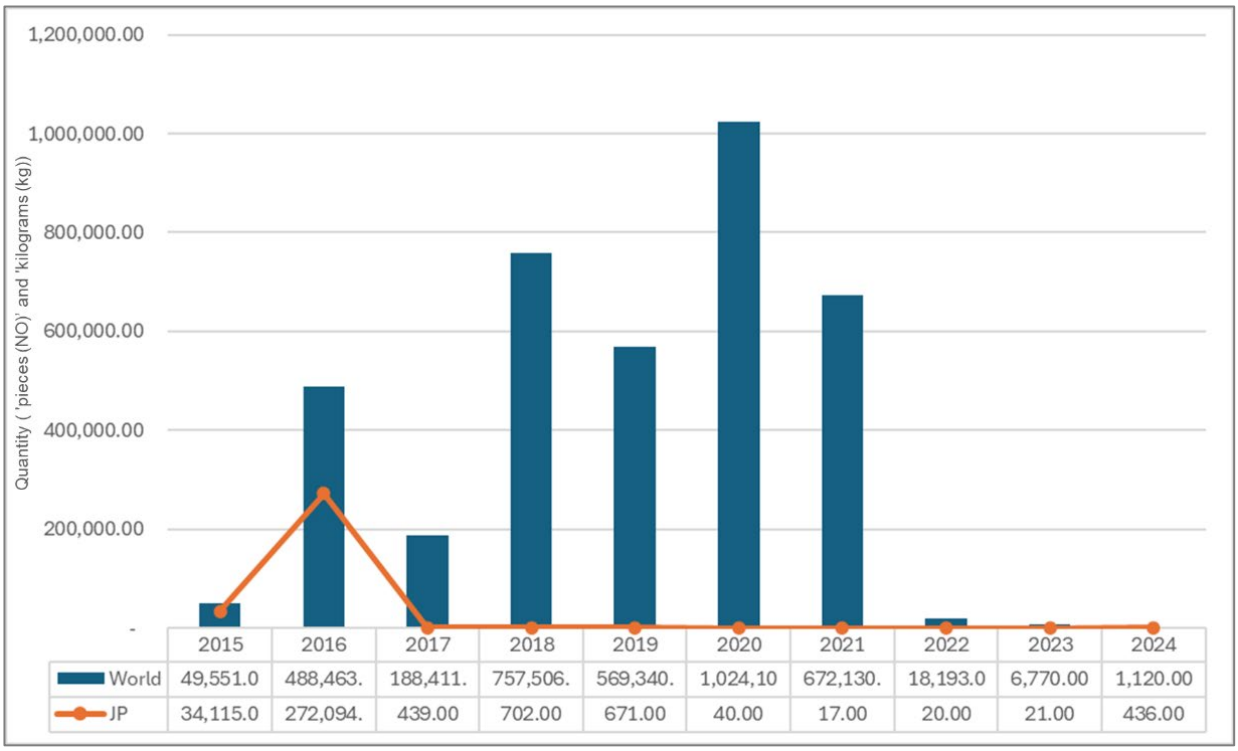
Source: Based on statistical data from the Thai Customs (2025) and MOC (2025)

3) Lamps

- 8539: Electric filament or discharge lamps, including sealed beam lamp units and ultraviolet or infrared lamps; arc lamps; light-emitting diode (LED) lamps.

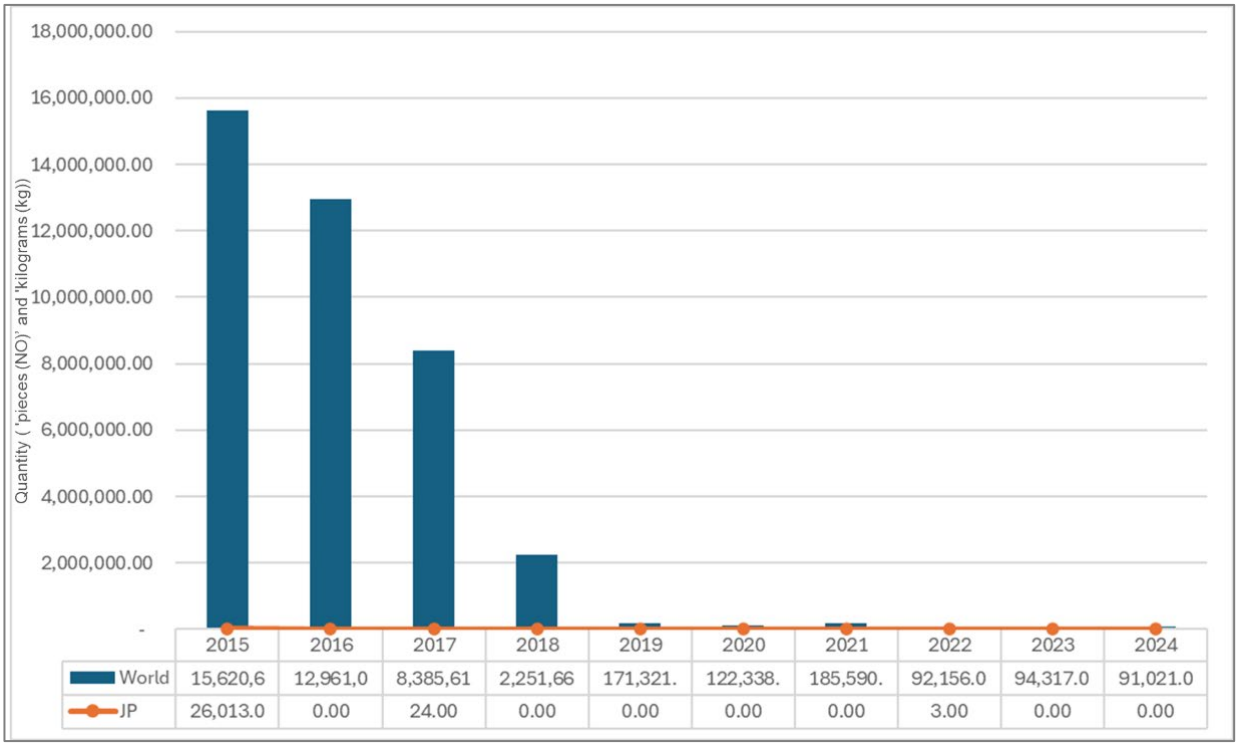
Figure 5.19. Import–Export Statistics for 8539[a]

(a) Import Quantity for HS Code 8539 for World and Japan



	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024
World	49,551.0	488,463.	188,411.	757,506.	569,340.	1,024,10	672,130.	18,193.0	6,770.00	1,120.00
JP	34,115.0	272,094.	439.00	702.00	671.00	40.00	17.00	20.00	21.00	436.00

(b) Export Quantity for HS Code 8539 for World and Japan



	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024
World	15,620,6	12,961,0	8,385,61	2,251,66	171,321.	122,338.	185,590.	92,156.0	94,317.0	91,021.0
JP	26,013.0	0.00	24.00	0.00	0.00	0.00	0.00	3.00	0.00	0.00

[a] Electric filament or discharge lamps, including sealed beam lamp units and ultraviolet or infrared lamps; arc lamps; light-emitting diode (LED) lamps.

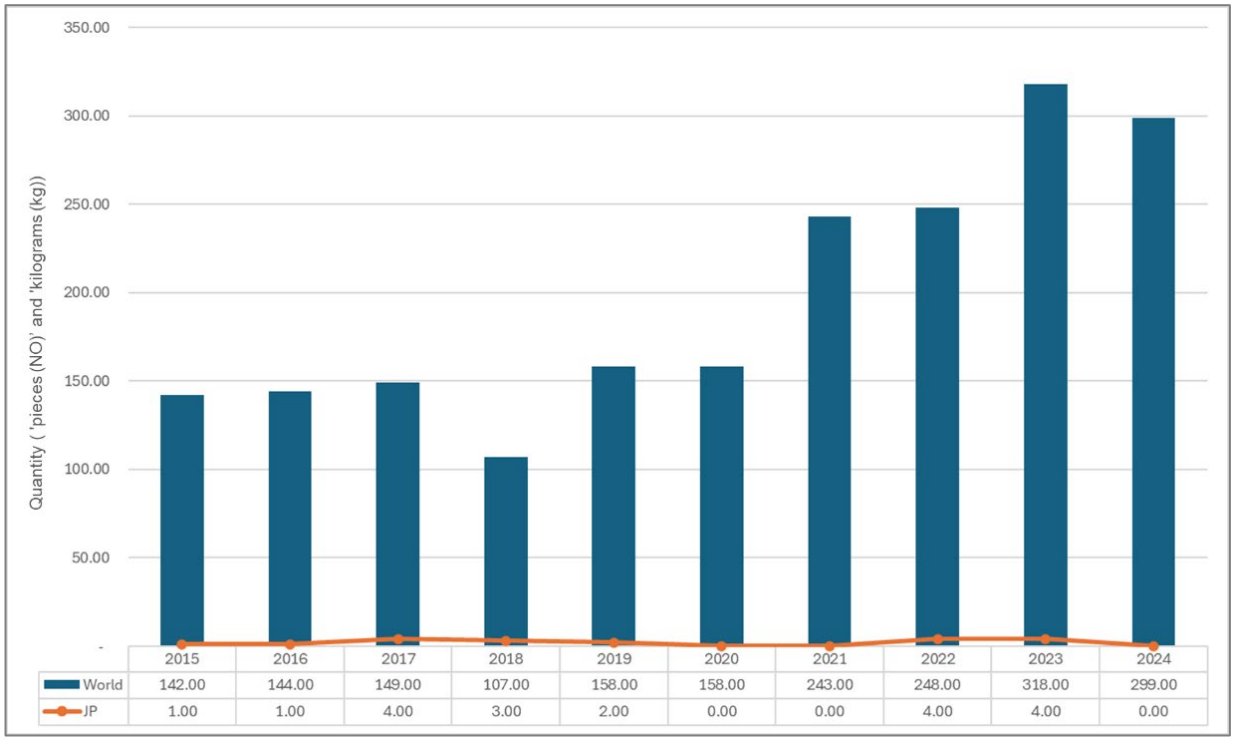
Source: Based on statistical data from the Thai Customs (2025) and MOC (2025)

4) Large equipment

- 8450: Household or laundry-type washing machines, including machines which both wash and dry.

Figure 5.20. Import–Export Statistics for 8450[a]

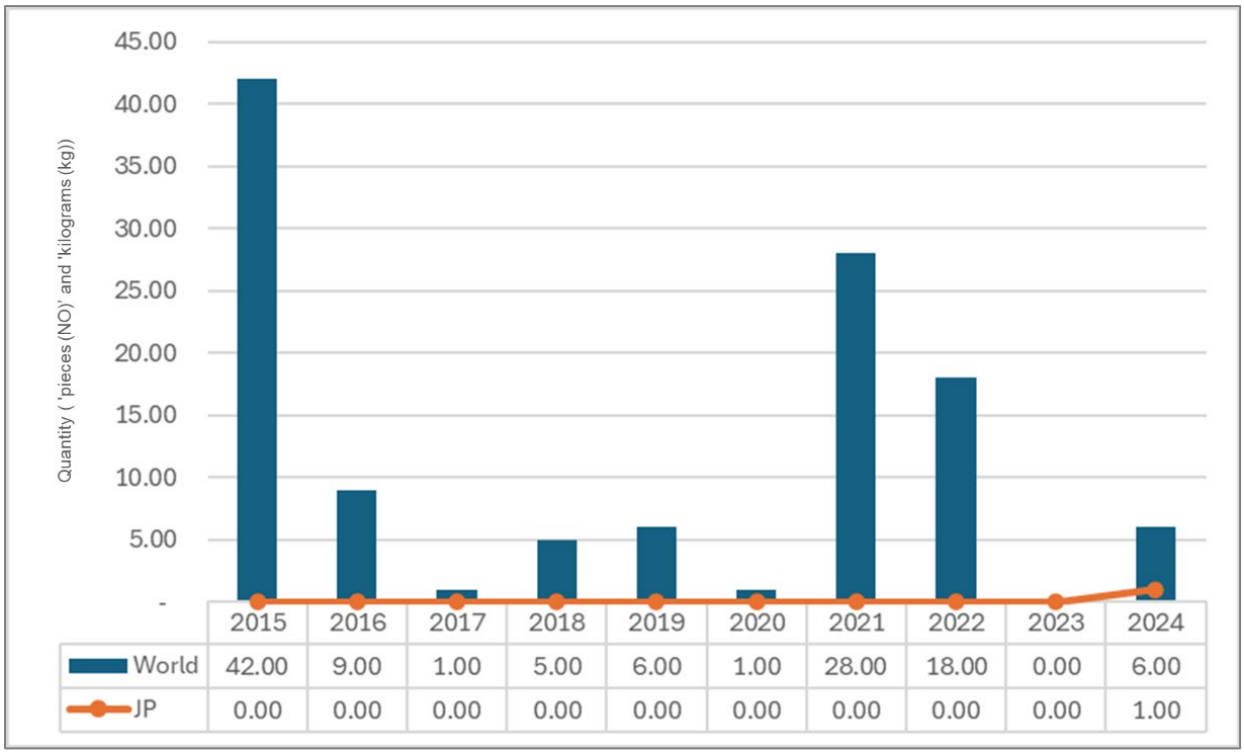
(a) Import Quantity for HS Code 8450 for World and Japan



	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024
World	142.00	144.00	149.00	107.00	158.00	158.00	243.00	248.00	318.00	299.00
JP	1.00	1.00	4.00	3.00	2.00	0.00	0.00	4.00	4.00	0.00

Figure 5.20. *Continued*

(b) Export Quantity for HS Code 8450 for World and Japan



	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024
World	42.00	9.00	1.00	5.00	6.00	1.00	28.00	18.00	0.00	6.00
JP	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	1.00

[a] Household- or laundry-type washing machines, including machines that both wash and dry. Household- or laundry-type washing machines, including machines that both wash and dry.

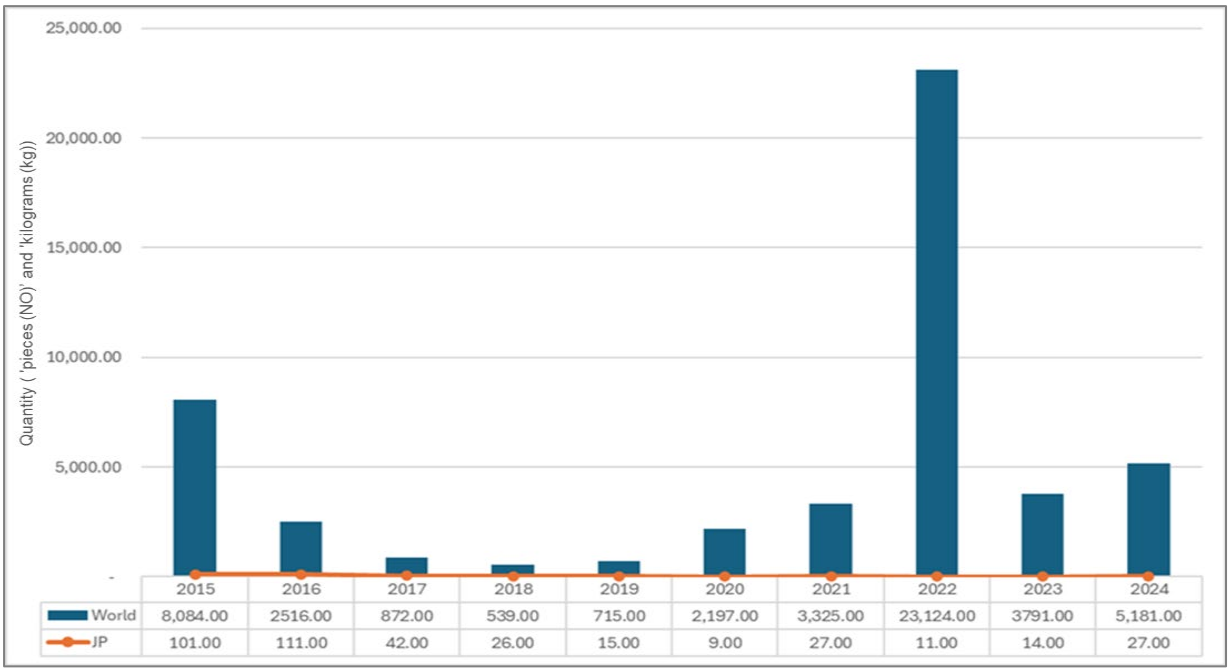
Source: Based on statistical data from the Thai Customs (2025) and MOC (2025)

5) Small equipment

- 8508: Vacuum cleaners: in the past 10 years, no import–export statistics have been recorded for subheading 800 (used), based on the last three-digit code, in trade between Thailand and Japan.
- 8516: Electric instantaneous or storage water heaters and immersion heaters; electric space heating apparatus and soil heating apparatus; electro-thermic hair-dressing apparatus (for example, hair dryers, hair curlers, curling tong heaters) and hand dryers; electric smoothing irons; other electro-thermic appliances of a kind used for domestic purposes; electric heating resistors, other than those of heading 85.45.

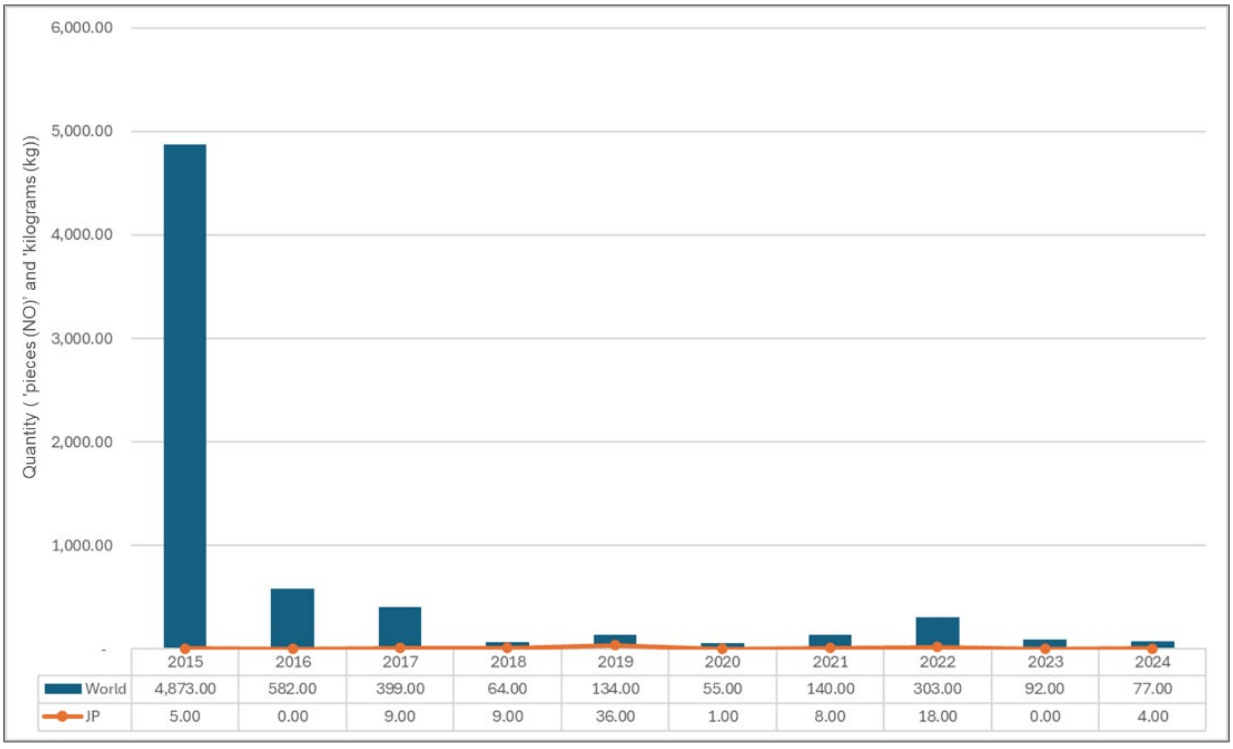
Figure 5.21. Import–Export Statistics for 8516[a]

(a) Import Quantity for HS Code 8516 for World and Japan



	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024
World	8,084.00	2516.00	872.00	539.00	715.00	2,197.00	3,325.00	23,124.00	3791.00	5,181.00
JP	101.00	111.00	42.00	26.00	15.00	9.00	27.00	11.00	14.00	27.00

(b) Export Quantity for HS Code 8516 for World and Japan



	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024
World	4,873.00	582.00	399.00	64.00	134.00	55.00	140.00	303.00	92.00	77.00
JP	5.00	0.00	9.00	9.00	36.00	1.00	8.00	18.00	0.00	4.00

[a] Electric instantaneous or storage water heaters and immersion heaters; electric space heating apparatus and soil heating apparatus; electro-thermic hair-dressing apparatus (for example, hair dryers, hair curlers, curling tong heaters) and hand dryers; electric smoothing irons; other electro-thermic appliances of a kind used for domestic purposes; electric heating resistors, other than those of heading 85.45.

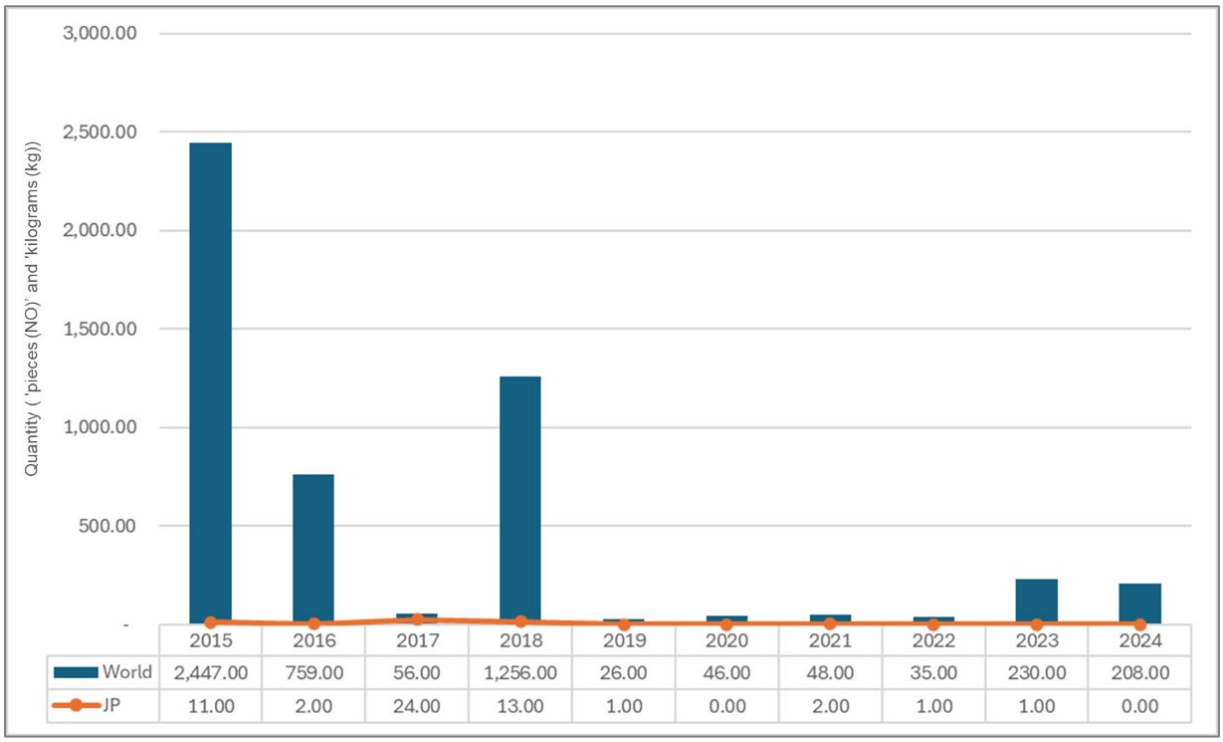
Source: Based on statistical data from the Thai Customs (2025) and MOC (2025)

6) Small IT and telecommunication Equipment

- 8517: Telephone sets, including smartphones and other telephones for cellular networks or for other wireless networks; other apparatus for the transmission or reception of voice, images or other data, including apparatus for communication in a wired or wireless network (such as a local or wide area network), other than transmission or reception apparatus of heading 84.43, 85.25, 85.27, or 85.28.

Figure 5.22. Import–Export Statistics for 8517[a]

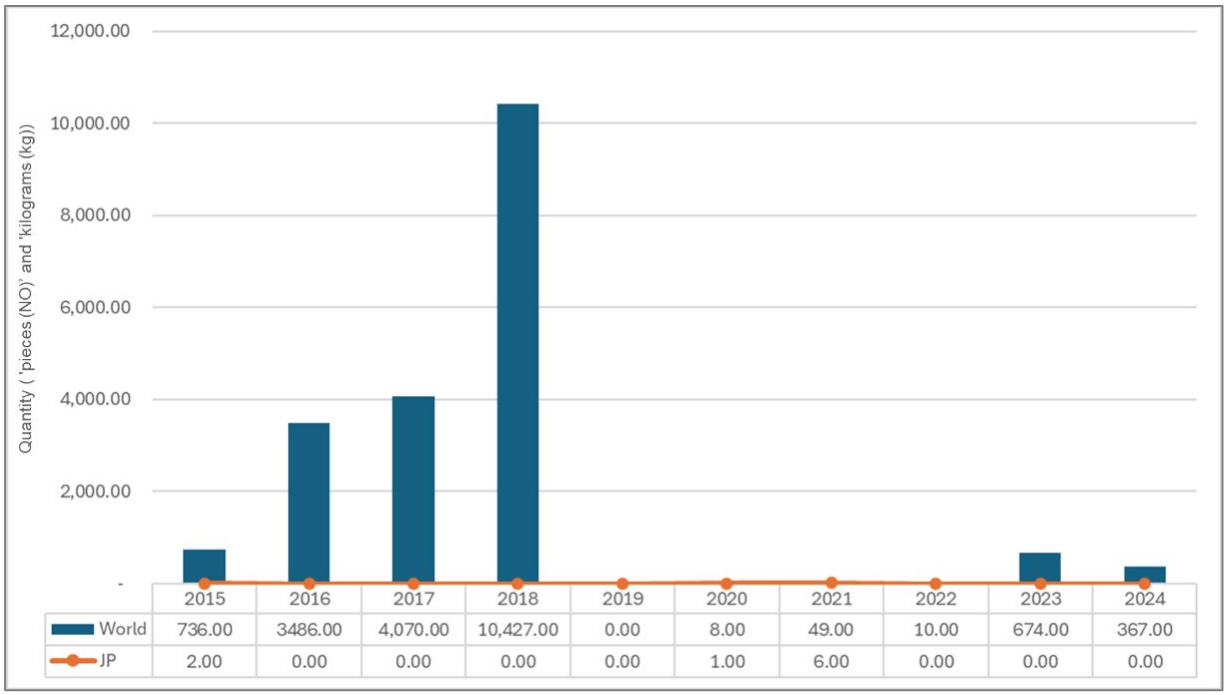
(a) Import Quantity for HS Code 8517 for World and Japan



	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024
World	2,447.00	759.00	56.00	1,256.00	26.00	46.00	48.00	35.00	230.00	208.00
JP	11.00	2.00	24.00	13.00	1.00	0.00	2.00	1.00	1.00	0.00

Figure 5.22. *Continued*

(b) Export Quantity for HS Code 8517 for World and Japan



	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024
World	736.00	3486.00	4,070.00	10,427.00	0.00	8.00	49.00	10.00	674.00	367.00
JP	2.00	0.00	0.00	0.00	0.00	1.00	6.00	0.00	0.00	0.00

[a] Telephone sets, including smartphones and other telephones for cellular networks or for other wireless networks; other apparatus for the transmission or reception of voice, images or other data, including apparatus for communication in a wired or wireless network (such as a local or wide area network), other than transmission or reception apparatus of heading 84.43, 85.25, 85.27, or 85.28.

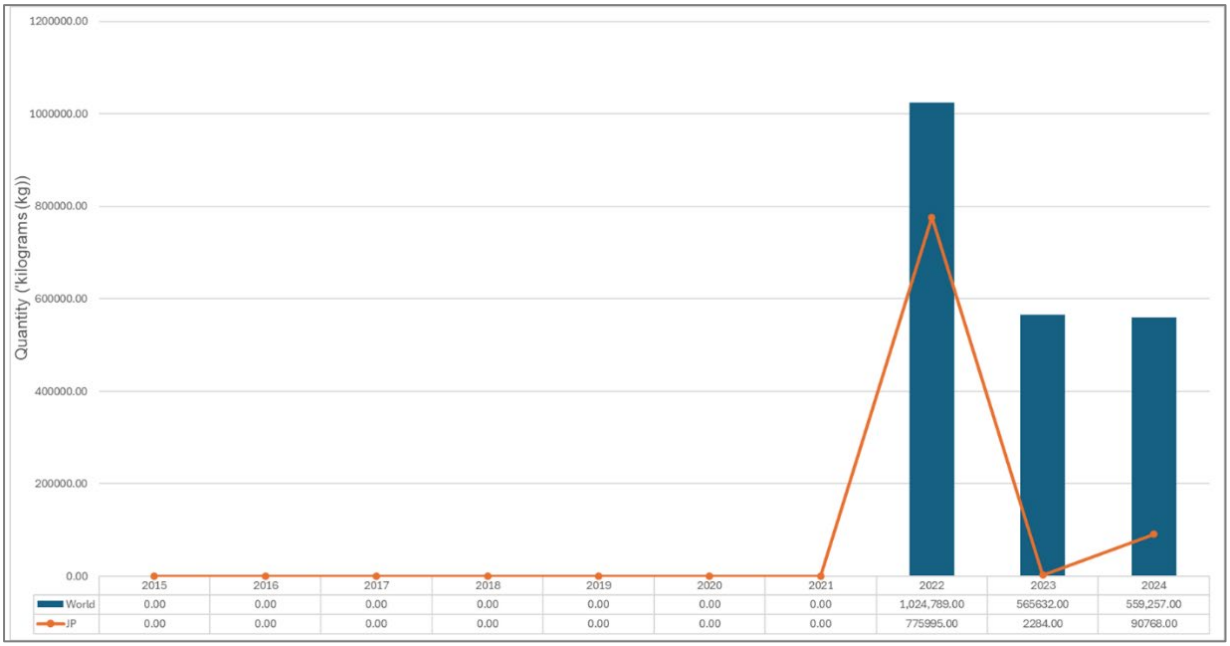
Source: Based on statistical data from the Thai Customs (2025) and MOC (2025).

7) Waste

- 8549: Electrical and electronic waste and scrap.

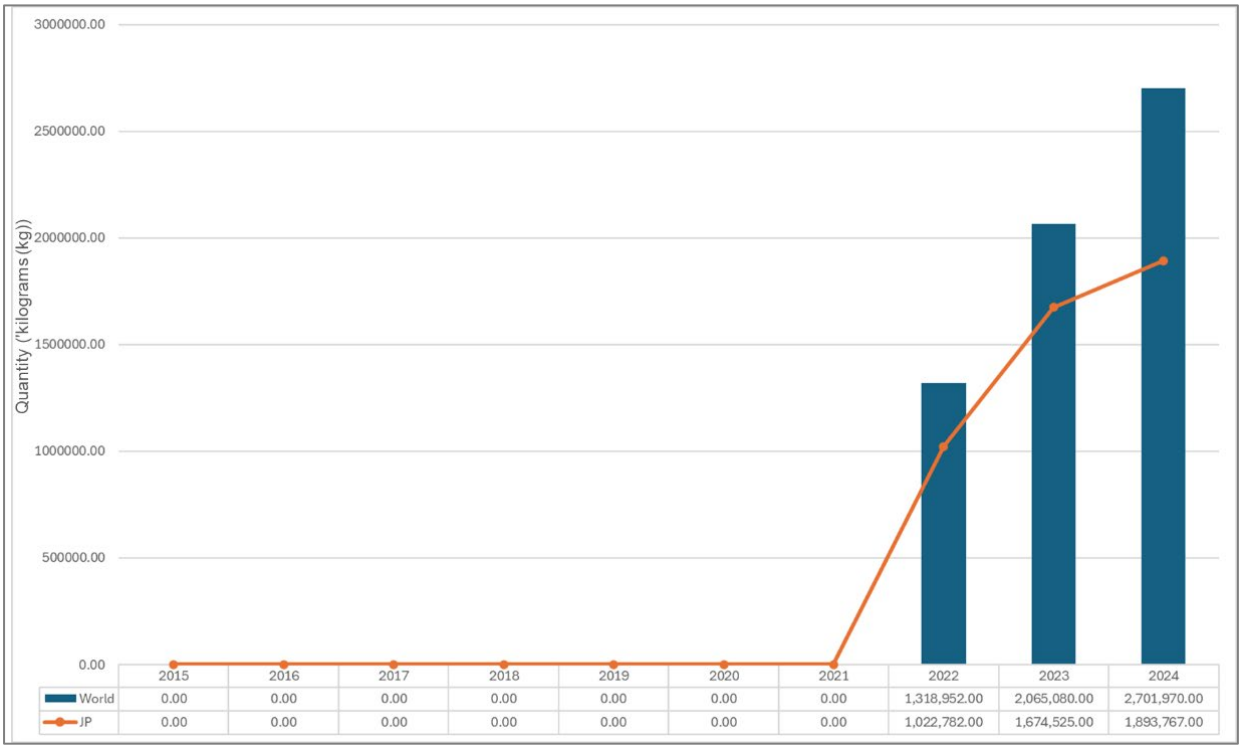
Figure 5.23. Import–Export Statistics for 8549[a]

(a) Import Quantity for HS Code 8549 for World and Japan



	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024
World	0.00	0.00	0.00	0.00	0.00	0.00	0.00	1,024,789.00	565632.00	559,257.00
JP	0.00	0.00	0.00	0.00	0.00	0.00	0.00	775995.00	2284.00	90768.00

(b) Export Quantity for HS Code 8549 for World and Japan



	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024
World	0.00	0.00	0.00	0.00	0.00	0.00	0.00	1,318,952.00	2,065,080.00	2,701,970.00
JP	0.00	0.00	0.00	0.00	0.00	0.00	0.00	1,022,782.00	1,674,525.00	1,893,767.00

[a] Electrical and electronic waste and scrap.

Source: Based on statistical data from the Thai Customs (2025) and MOC (2025).

D) Identified materials for the analysis

Currently, Thailand does not have concrete measures to promote the recycling of e-waste. A primary reason may be the lack of specific laws governing the management of such waste. As a result, there is no clear definition of what qualifies as e-waste and which electronic products are considered waste once they have reached the end of their service life. Table 5.11 presents the average service life of representative EEE.

Table 5.11. Average Service Life of Electrical and Electronic Products

Product	Average Service Life
Television	18 years
Refrigerator	14 years
Washing machine	12 years
Air conditioner	10 years
Computer	7 years
CRT computer monitor	9 years
Mobile phone	2 years
Mobile phone battery	1 year
Fluorescent tube	1 year
Flashlight battery	2 months

Source: PCD (2007)

A study of e-waste management practices in other countries reveals that many countries have clear and systematic laws in place to manage e-waste. For example, Japan classifies e-waste into four categories: cathode ray tube (CRT) televisions, washing machines, refrigerators, and air conditioners. These large household appliances have become a burden for municipalities in Japan, leading to the enactment of the Home Appliances Recycling Law (SHARL) and the Law for the Promotion of Effective Utilization of Resources (LPEUR), which regulate personal computers and rechargeable batteries (Center of Excellence in Hazardous Substance and Waste Management, Chulalongkorn University, 2020).

The Department Primary Industries and Mines (DPIM) has created a database of household waste that can serve as secondary resources, developed for the PCD. The project focuses on managing household waste and WEEE, with the goal of solving problems and supporting sustainable waste management. The database includes 18 types of household waste from EEE, as shown in Table 5.12.

Table 5.12. Waste Account as a Resource Substitute from Households (E-Waste)

Type of Waste	Waste Type	Recycled Products
Television	1. CRT television	Glass scraps, plastic pellets, iron, copper
	2. LCD television	Glass scraps, plastic pellets, iron, copper
Mobile phone	3. Mobile phone	Plastic, copper, iron, gold, silver, palladium, glass, rubber
Fluorescent tube	4. Straight fluorescent tube	Glass scraps, aluminium, mercury, plastic
	5. Compact fluorescent tube	Glass scraps, glass powder, aluminium, mercury, plastic
Office electrical appliances	6. Desktop computer	Copper, gold, glass scraps, iron, plastic, aluminium
	7. Copier	Iron, plastic, copper, aluminium, glass scraps
	8. Printer	Plastic, iron, copper, aluminium
	9. Electronic circuit boards	Copper, gold, platinum, silver, rhodium, tin, zinc, aluminium, plastic
Batteries	10. Lead-acid battery	Plastic, lead ingots
	11. Alkaline and zinc-carbon batteries	Iron, zinc, manganese, plastic, paper
	12. Lithium-ion battery	Copper, iron, lithium blocks, compressed carbon sheets, plastic, paper
	13. Nickel-metal hydride battery	Nickel alloy, plastic, iron
	14. Nickel-cadmium battery	Iron, cadmium, nickel
General electrical appliances	15. Rice cooker	Iron, plastic, copper, aluminium
	16. Refrigerator	Iron, urethane foam, plastic, copper, aluminium
	17. Washing machine	Iron, plastic, aluminium, copper
	18. Air conditioner	Iron, plastic, copper, aluminium

Source: DPIM (2013).

The Center of Excellence in Hazardous Substance and Waste Management, Chulalongkorn University, studied the transportation, collection, storage, and dismantling processes of e-waste. The study identified seven types of e-waste most commonly purchased in the study area: fan, washing machine, television, rice cooker, refrigerator, iron, and kettle. These e-waste products contain materials with recycling potential, as well as waste materials that need to be properly disposed of (Table 5.13).

Table 5.13. E-Waste Products and Recyclable/Non-recyclable Materials from Them

E-Waste Products	Recyclable Materials	Non-recyclable Materials
Fan	- Iron, 50.00% - Plastic, 32.09% - Aluminium, 4.84% - Copper, 4.10% - Wire, 3.36%	- Plywood, 4.48% - Flame-retardant plastic, 1.84%
Washing machine	- Plastic, 56.17% - Iron, 35.96% - Copper, 4.19% - Aluminium, 3.78%	- Rubber, 1.13% - Water leakage, 0.95%
CRT television	- Plastic, 47.21% - Printed circuit board with other components, 4.95% - Wire, 1.49% - Copper, 1.14% - Aluminium, 0.88%	- Glass screen, 63.24% - Flame-retardant plastic, 0.88%
Rice cooker	- Iron, 47.91% - Plastic, 22.79% - Metal alloy, 19.53% - Aluminium, 5.12% - Wire, 3.26%	- Rubber, 1.40%
Refrigerator	- Iron, 57.48% - Plastic, 18.11% - Copper, 4.88% - Aluminium, 3.41% - Wire, 0.57%	- Foam, 13.37% - Refrigerant, 0.76% - Rubber, 1.42%
Iron	- Metal alloy, 34.11% - Iron, 31.90% - Plastic, 12.31% - Wire, 11.61%	- Flame-retardant plastic, 11.69%
Kettle	- Plastic, 40.38% - Iron, 25.64% - Aluminium 24.36% - Stainless steel, 4.49% - Wire, 2.56%	- Rubber, 1.92% - Glass, 0.64%

Source: Center of Excellence in Hazardous Substance and Waste Management, Chulalongkorn University (2020).

Before dismantling e-waste, it should be checked. If the products are still in good condition, they should be repaired and reused as second-hand items. For products that are beyond repair, reusable parts should be separated and sold as second-hand spare parts. Waste products unsuitable for recycling should be dismantled by material type and sent for proper recycling. Residual waste from sorting should be collected, stored, and disposed of properly and should not be mixed with general waste.

1.3 Identification of issues on the international material flow between Thailand and Japan

The issue of material flow between Thailand and Japan is complex and involves international law, trade agreements, industry standards, and environmental transparency. Without a connected system and mutual understanding, it may lead to conflicts, delays, or impacts on the economy and society. Currently, Thailand and Japan still have differences in laws and international requirements, particularly in the definition of 'materials' or 'waste'. Japan views an item as recyclable material or resources, while Thailand may classify it as hazardous waste under the law. An example is the case in which Japan considers UEEE as recyclable material, while Thailand classifies it as hazardous waste. For instance, electronic circuit boards, which are components of end-of-life electronic equipment are viewed in Japan secondary resources from which valuable metals such as gold, copper, and silver can be extracted through efficient recycling processes. In contrast, Thailand enforces strict regulations on the import of electronic waste containing hazardous substances such as lead, mercury, and flame retardants, which are present in circuit boards. This results in different approval processes because the customs systems of both countries are not directly connected (Basel Convention Secretariat, 2025; Ministry of Foreign Affairs of Japan (MOFA), 2025; International Trade Administration (ITA), 2022).

Multiple documents are required, such as the JTEPA (Japan–Thailand Economic Partnership Agreement) form, certificate of origin, and import permit for the trade of relevant items. There are also delays in approval due to the need for permission from various agencies on both the Thai and Japanese sides, such as the PCD, the Industrial Works Department, Customs Department, or Japan's environmental agencies (Basel Convention Secretariat, 2025; MOFA, 2025; ITA, 2022).

Additionally, there are limitations regarding the use of different product standards; Thailand uses Thai Industrial Standards Institute (TISI) (Thai Industrial Standards), while Japan uses JIS (Japanese Industrial Standards). Without a mutual recognition agreement, the inspection must be repeated at the destination, leading to delays in transportation (MOFA, 2025; TISI, 2024). Moreover, there is a lack of a shared information system as no real-time material flow tracking system is currently in place. This means that the import of certain materials, such as used plastics or e-waste, without proper management, could impact

public health and the environment in Thailand (World Bank, 2022; NEC Corporation, 2024; and Thailand Business News, 2025b).

A) Status quo and trends of the international material flow

Thailand has become a party to the Basel Convention, which establishes international agreements to control the import–export, transit, and management of hazardous waste, ensure safety, prevent environmental and human health impacts as well as illegal transport. In response to illegal e-waste imports, Thailand issued an MOC notification in 2020 prohibiting the import of e-waste into the Kingdom of Thailand. Under this notification, the import of e-waste is banned, and violators may face imprisonment of up to 10 years, confiscation of goods, or fines up to five times the value of the goods.

Statistics on illegal e-waste imports (HS Codes 84 and 85, Statistical Codes 800 and 899) from the Customs Department from 2015 to 2022 show the total value of confiscated illegal e-waste at THB4,877,849. Typically, e-waste is smuggled mixed with other goods (Thai Customs, 2022; Table 5.14).

Table 5.14. Statistics on the Confiscation of E-Waste, HS Codes 84 and 85, Statistical Codes 800 and 899 (2015–2022)

Year	Number of Cases	Confiscated Goods	Value of Confiscation (THB)
2015	5	Compressors, batteries, monitors	1,289,387
2016	2	Mobile phones, electronic device parts	91,724
2018	1	LCD monitors	3,267,555
2020	1	Compressed computer parts	229,183

Source: Anti-smuggling system (149), Thai Customs, as of 24 February 2022.

The Ministry of Industry, through the DIW, was informed by Japan's Ministry of the Environment to monitor and inspect electrical appliances and electronic devices that are subject to cross-border control. The Industrial Works Department co-ordinated with the Customs Department to monitor the import of such goods into Thailand. On 28 August 2014, officers from the Industrial Works Department and Customs at Laem Chabang Port, Chonburi, inspected eight containers arriving from Japan, declared as metal scrap (copper scrap, aluminium scrap). After inspection, one container was confirmed to contain valid scrap, but the other seven contained used electrical appliances and electronic devices totalling 196.11 tonnes, classified as hazardous waste under the Basel Convention. The importation violated the Hazardous Substances Act, B.E. 2535 (1992) and the Customs Act,

B.E. 2469 (1926). The case was resolved through co-ordination with relevant authorities, and the Japanese government approved the return of the waste (MGR Online, 2016).

On 3 and 6 January 2025, the Thai Customs, through the Investigation and Suppression Division, in collaboration with Laem Chabang Port Customs, inspected 10 suspicious containers at Laem Chabang Port, Chonburi Province. The goods were declared on the shipping documents as 'scrap metal and used metals' in an attempt to avoid inspection. The containers were therefore seized for detailed examination. The inspection revealed that nine containers originated from Japan and one container from Hong Kong. The containers were found to contain unusable parts or components of electrical and electronic appliances classified as e-waste, totalling more than 256 tonnes (Thai Customs, 2025).

Statistics for fiscal year 2025 (1 October 2024–14 January 2025) show 19 e-waste cases weighing 256,643 kilograms, six plastic scrap cases weighing 322,980 kilograms, totalling 25 cases and 579,623 kilograms. In fiscal year 2024, municipal waste was confiscated in nine cases, totalling 1,259,942 kilograms (Thai Customs, 2025).

The Customs Department employs a risk-based checking system to oversee the import of UEEE and e-waste, as stipulated in the Customs Department Notification on the Inspection of Imported–Exported Goods under Other Relevant Customs Laws, B.E. 2563 (2020). In practice, the Customs Department establishes a pre-determined 'risk profile' to assess whether tariff classification, valuation, and goods verification are required. If an import declaration does not fall under the specified risk conditions, the computer system automatically issues a customs declaration with the notification 'No inspection of tariff classification, valuation, and goods required,' and releases the goods immediately through the Green Line channel once the information is complete and accurate. This process is carried out in co-ordination with other agencies such as the Department of Industrial Works and the PCD.

Furthermore, the Customs Department has developed a risk management plan, prepared by the Strategy and Planning Division, to ensure that inspections are efficient, transparent, and aligned with relevant legal measures (Thai Customs, 2020a, 2020b). The use of risk-based checking reduces inspection costs and improves resource efficiency by focusing on high-risk goods while minimising checks on low-risk goods. This approach shortens processing times and accelerates customs clearance (World Customs Organization, 2019).

B) Issues

Legal loopholes and alternative methods or workarounds used for importing e-waste between Thailand and Japan include avoiding the ban through technical definitions. As shown in the previous section, Japan's exporter uses terms like 'used electrical equipment' or 'second-hand product' instead of 'e-waste' to avoid Basel Convention restrictions. Thailand's authority, however, lacks a comprehensive legal definition of 'e-waste', and

struggles to screen out illegal imports. Moreover, e-waste is often transshipped through third countries, making it difficult to trace the actual origin of the goods. These loopholes do not explicitly violate the law but exploit the ambiguity of definitions. The absence of an efficient material flow tracking system and limited data sharing between countries allows banned materials to slip through. A recent example in January 2025 involved the illegal importation of 256 tonnes of e-waste from Japan and Hong Kong to Thailand, disguised as 'metal scrap' to evade customs checks (Thai Customs, 2025). These violated Thai regulations and the Basel Convention, which require prior approval from the Industrial Works Department.

C) Analysis and discussion

The issue of e-waste imports has become a matter of broad concern both nationally and internationally, particularly for developing countries like Thailand, which are often used as destinations for waste shipments from developed nations. In the context of Thailand–Japan relations, various methods have been employed to circumvent bans on e-waste imports, exploiting loopholes in legal definitions and the lack of effective tracking systems for material movements. This problem does not necessarily stem from direct violations of the law, but rather from the exploitation of regulatory ambiguities and technical exemptions, which can have serious long-term impacts on waste management systems, the environment, and public health.

Based on a review of relevant information, combined with an analysis of key issues drawn from statistical data, in-depth interviews with stakeholders from the public sector, private sector, academia, and civil society, as well as first-hand accounts from affected areas, the findings clearly highlight problems, obstacles, and gaps in Thailand's e-waste management system. These findings form a critical foundation for developing comprehensive policy recommendations that align with the country's context and realities. The key issues can be summarised into three main areas: (i) legal and regulatory gaps, and (ii) systemic obstacles in e-waste management. Issues and solutions are sorted out in Table 5.15.

Table 5.15. Causes and Solutions for E-Waste Management Issues in Thailand

Causes	Solutions
1. Legal and Regulatory Gaps	
1*)* Ambiguity in Definitions	
Thailand still lacks a comprehensive and clear legal definition for e-waste, resulting in uncertainty over what constitutes 'waste' and what is considered a 'product', particularly in the case of UEEE, which may still be functional. In some instances, exporting countries opt to use terms such as 'second-hand products' or 'UEEE' instead of 'e-waste' to circumvent the restrictions under the Basel Convention, which regulates the transboundary movement of hazardous waste.	A clear legal definition should be established for 'e-waste' and 'UEEE' to clearly distinguish between 'products' intended for use and 'waste' that must enter recycling or disposal processes. The definition should integrate relevant legislation, such as hazardous waste laws, customs laws, and pollution control laws, while also referencing internationally recognised definitions to ensure consistency and enforceability both domestically and internationally.
2*)* Lack of specific legislation for e-waste management	
At present, Thailand has not yet enacted a specific act that directly covers e-waste management, resulting in a control system that does not comprehensively address all stages of the product life cycle – from collection and transportation to the safe and efficient disposal of waste.	Addressing the absence of a specific act that comprehensively governs e-waste management in Thailand requires an integrated approach encompassing both legal and systemic measures. The process should begin with drafting dedicated legislation that defines key terms, scope, and the role of all stakeholders, while incorporating the principle of EPR to promote the full-cycle take-back and management of products. In addition, a national master plan should be developed, along with strengthened regulatory mechanisms, to enhance the effectiveness of e-waste management. Such measures would not only close existing legal gaps but also lay the foundation for a systematic, sustainable approach to e-waste management in line with circular economy principles.
3*)* Licensing and regulation of recycling facilities do not yet fully address the associated risks	
Current licensing and inspection criteria do not adequately address the specific risks associated with e-waste, particularly the	Specific licensing criteria for e-waste management operations should be established, requiring operators to have a

Causes	Solutions
complexity of its diverse hazardous components and the intricate management processes involved. As a result, some facilities are able to engage in e-waste-related activities without appropriate or sufficient pollution prevention and control measures, posing long-term risks to the environment and public health.	comprehensive management plan covering all stages – from intake to final disposal – along with systems for tracking and monitoring management pathways. The frequency and rigour of inspections should be increased, both on-site and through online systems, to ensure that operations fully comply with pollution prevention and control measures.
4*)* The product inspection system leaves loopholes that allow the smuggling of prohibited goods.	
Thailand currently applies a risk-based control approach to regulating the import of electrical and electronic equipment, including e-waste, which may create loopholes for the illegal importation of unwanted waste. While the random inspection system helps reduce the workload and costs for government agencies in inspecting imported goods, it has several practical limitations, particularly in the context of e-waste imports, which are often concealed within goods declared as 'UEEE' or presented as donated items. Inspecting only a portion of goods in each shipment cannot guarantee that all items are free from waste or materials prohibited under environmental laws and standards.	A risk-based control framework should be enhanced by analysing data on the origin, product type, and exporter's history to increase inspection stringency for high-risk goods. For products with very high risk, consideration should be given to shifting from random inspections to 100% inspection of imported goods to prevent illegal imports prohibited under the Basel Convention and related regulations. In addition, a tracking and monitoring system should be developed to integrate information between relevant agencies – such as the Customs Department, PCD, and DIW – to enhance transparency and improve the effectiveness of tracking the movement of imported goods.
2. Systemic obstacles to e-waste management	
1*)* More than 90% of total e-waste is handled by the informal sector.	
Thailand is currently facing approximately 600,000 tonnes of hazardous waste from the municipal sector each year, of which e-waste accounts for as much as 400,000 tonnes – or over 65% – with a continuously increasing trend. The management of e-Waste remains limited in terms of efficiency. At present, only about 10% of discarded products are properly managed, being collected by producers or	Thailand should do as listed. • Promote the integration of the informal sector – such as scrap shops, itinerant buyers, and independent waste pickers-into the formal e-waste management system. This requires economic incentives and improved working conditions to facilitate the transition.

Causes	Solutions
importers and subsequently sent to dismantling and recycling facilities equipped with pollution control systems that meet established standards. The remaining 90% of e-waste is handled inappropriately, collected by itinerant buyers or independent scrap dealers, dismantled manually, and often burned in the open to recover valuable materials for sale to recycling plants.	• Create economic incentives by establishing competitive purchase mechanisms for discarded equipment, ensuring guaranteed buy-back prices at levels that encourage informal sector participation, and allocating subsidies based on the volume collected (e.g., bonus payments when products are delivered to certified collection points). Tax incentives should also be provided for participants who consistently operate within the formal system. • Implement clear, transparent, and fair regulatory measures in parallel, enabling the informal sector to adapt securely to the formal e-waste management framework. This approach would create shared benefits for the environment, the circular economy, and community safety.
2*)* There is no system to track the transboundary movement of materials.	
Thailand still lacks a fully integrated system for tracking the movement of materials and e-waste, making it impossible to monitor them continuously and comprehensively from the point of origin (manufacturers or exporters) to the end destination (disposal or recycling facilities). This gap in control and enforcement allows some e-waste to be illegally routed through third countries to conceal its true origin during customs and documentation checks, preventing Thai authorities from accurately tracing whether the waste is legally classified as 'used equipment' or 'waste'.	A digital tracking system should be established to monitor data from production, export, and transportation to final disposal or recycling. This system should integrate databases from the Customs Department, DIW, PCD, and other relevant agencies, creating a real-time information-sharing mechanism to strengthen comprehensive monitoring and control.
3*)* International information sharing remains limited.	
International information sharing remains limited, hindering the effective and timely tracking, monitoring, and control of transboundary movements of hazardous waste, particularly e-waste. This limitation	International co-operation should be strengthened through negotiated agreements on data sharing to promote transparent and secure information exchange. Mechanisms for inter-agency information sharing should be

Causes	Solutions
poses an obstacle to fulfilling the principles of the Basel Convention.	established, with an emphasis on using digital technologies for real-time tracking and monitoring. In addition, common standards and frameworks for collaboration should be developed to enhance the reliability and speed of cross-border co-ordination.

Source: Author.

1.4. Conclusion

Preventing illegal e-waste imports requires control from source to destination, leveraging technology, shared data, penalties, and public involvement. Enhancing inspection and product analysis at import points using X-ray scanners and artificial intelligence (AI) for container verification will reduce opportunities for data concealment, such as transshipping through third countries. Establishing a real-time customs data exchange system will allow Thai customs to directly view export information from Japan and compare product listings before arrival. Clearly defining 'e-waste' in Thai law and imposing penalties on violators will help curb the illegal importation of hazardous materials. In summary, the solution involves prevention through 'data and technology' at the start, 'precise inspection systems' in the middle, and 'penalties and multi-sector participation' at the end.

2. Background Research on Issues Related to the International Material Flow on the EEE-Relevant Materials Between Thailand and Japan

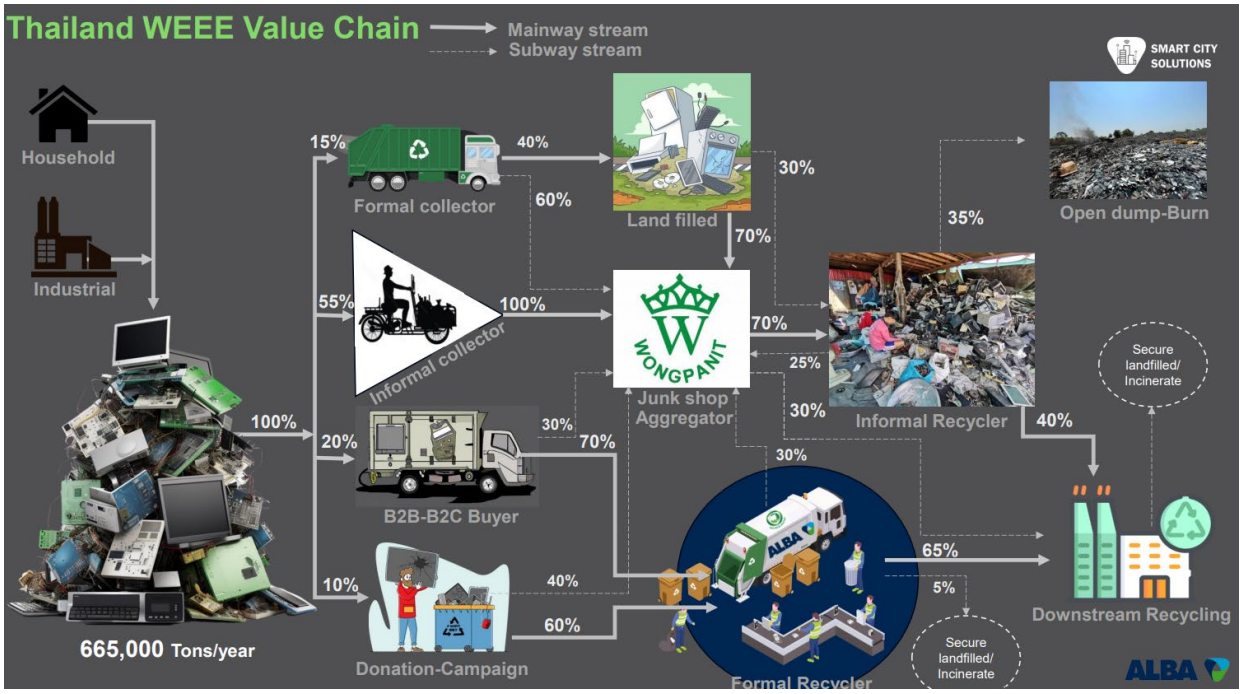
2.1 Overview

Thailand has experienced a continuous increase in the amount of e-waste each year, with televisions being the most commonly discarded item, followed by air conditioners, refrigerators, washing machines, and computers. Other electronic items such as VCD/DVD players, telephones, and digital cameras also contribute to the growing volume of e-waste (PCD, 2023). Traditionally, the management of e-waste in Thailand has primarily focused on the disposal phase. However, there has been a growing shift towards applying circular economy principles, which emphasise managing products before they become waste. This expanded approach includes activities such as maintenance, repair, reuse, exchange, modification of usage patterns, and repurposing items into second-hand goods to extend their useful life and maximise their value. Such preventive strategies aim to significantly reduce the volume of e-waste generated and delay the need for end-of-life recycling interventions.

Despite these efforts, the management of e-waste in Thailand remains at an early stage, with limited research and insufficient development of supporting mechanisms to promote a circular economy model effectively. One particularly important group within the e-waste management ecosystem is the waste sorters, who play a crucial role in extending the lifespan of electronic products. By disassembling devices to retrieve still-functional parts for reuse as spare components or repairing items for resale, these actors help minimise the volume of waste requiring final disposal. Strengthening the organisation, skills, and recognition of waste sorters, along with improving legal frameworks and market incentives, will be essential to foster a more sustainable and efficient e-waste management system in Thailand.

The sources of e-waste in Thailand come from both the household and industrial sectors. Once products reach the end of their life cycle, they are passed through various collection channels, including formal collectors, informal collectors, business-to-business (B2B) and business-to-consumer (B2C) buyers, as well as donation campaigns. A key problem is that most e-waste flows into the informal sector, where disposal methods often involve landfilling or open burning, increasing environmental risks. At the same time, the proportion of e-waste collected and recycled through the formal system remains low compared to the total volume of waste (Asia Green Rescrap Company Limited, 2025). Details are illustrated in the e-waste management flow diagram for Thailand as Figure 5.24.

Figure 5.24. E-Waste Management Flow in Thailand



Source: Asia Green Rescrap Company Limited (2025).

2.2. Results of background research on the issues

From the review of studies and relevant information on Thailand's e-waste management, it is evident that the country is facing significant challenges. One of the main issues is **the absence of a clear legal definition for UEEE and e-waste**, which creates uncertainty in management. Thailand also **lacks a specific act or comprehensive legislation covering the entire e-waste management chain – from collection and transportation to safe and efficient disposal.** Moreover, the licensing and inspection of recycling facilities do not fully address the specific risks associated with toxic components and complex processes. As a result, some facilities can operate e-waste-related activities without adequate pollution prevention and control measures.

In terms of technology, **Thailand's e-waste management remains a mix of traditional informal-sector practices and the limited use of modern technologies**. A fully integrated recycling system and advanced domestic facilities are still lacking. Manual dismantling remains the primary method, conducted mainly by informal workers, scrap shops, or community-based dismantlers.

Regarding the material circulation of electrical and electronic equipment between Thailand and Japan, the volume remains relatively low. The main reason is that most e-waste is managed domestically due to its value and recoverable materials. Thailand has developed various recycling technologies for e-waste; however, these technologies have not yet been widely applied, as advanced recycling plants and high-tech facilities for precious metal recovery remain limited. Consequently, some portions of e-waste must still be exported

abroad for further processing. This restricts material circulation between Thailand and Japan, despite the high potential for resource recovery and contribution to the circular economy.

A) Technologies on EEE recycling and waste disposals

According to the DIW, e-waste recycling in Thailand tends to focus primarily on high-value materials such as precious metals, while other materials that are difficult or costly to recycle – such as mixed plastics or circuit boards without precious metals – are often incinerated or discarded without proper treatment (DIW, 2018). Relevant to this issue, Japan's Ministry of the Environment held a joint meeting in Thailand on 9 July 2024, as part of the 4th Thailand–Japan Environmental Policy Dialogue to exchange knowledge, experience, and technology regarding future studies on e-waste management and resource circulation in Thailand. The meeting aimed to improve the management of industrial waste in Thailand. Improper management of e-waste affects two areas: e-waste contains various metals that may contaminate the environment, posing health risks to those involved. At the same time, it represents an economic loss, as the metals in e-waste are valuable resources that can be reused in the production process if managed or recycled properly (MOEJ, 2024).

To improve e-waste management in Thailand, the Department of Primary Industries and Mines (DPIM) at the Ministry of Industry is undertaking research and development (R&D) on e-waste recycling technologies (DPIM, 2025). The focus areas include:

1. Gold recovery from electronic circuit boards – A technology for recycling electronic circuit boards containing gold by extracting and producing pure gold. This method helps reduce the use of cyanide in industrial production processes, particularly in the precious metal recycling industry from e-waste or in Type 106 factories that process unused industrial products or waste materials, including hazardous substances, into raw materials or new products through licensed industrial production methods. The use of cyanide in precious metal extraction processes in Thailand is estimated at up to 1,500 tonnes per year. DPIM has developed a technology to recycle pure gold from e-waste without the use of cyanide, offering an alternative for operators. The goal is to make this technology cost-effective, reduce extraction time, and ensure environmental friendliness and worker safety. Widespread adoption of this technology in e-waste recycling processes is believed to reduce cyanide use – harmful to both workers and the environment – by at least 50%, as well as help reduce the overall volume of e-waste in Thailand.

2. Silver recovery from electrical contacts – A technology has been developed to recycle silver-containing electrical contacts from deteriorated circuit breakers by extracting and producing pure silver. This process efficiently and environmentally recovers silver from worn-out contacts, enhancing the material's value while reducing waste generated from electrical equipment.

3. Copper recovery from electronic circuit boards – The process uses high-temperature smelting to melt all metals coated on the circuit board, followed by refining techniques to separate and recover base metals and rare precious metals. Electronic circuit boards often contain copper as a major component, which is a base metal widely used across various industries. After the electrorefining process, the resulting copper has a purity level of approximately 99.99%.

4. Utilisation of non-metallic components from electronic circuit boards – A technology for recycling the non-metallic components of electronic circuit boards by using them as raw materials in the production of artificial wood. The process involves compounding high-density polyethylene (HDPE) with NM-PCB powder. It begins with premixing the NM-PCB powder and moisture-dried plastic pellets using a tumble mixer. The mixed materials are then fed into a twin-screw extruder, followed by a cutter to produce plastic pellets, which are subsequently molded into finished products.

5. Neodymium oxide production from high-power magnet waste – A technology for recycling sediment from the grinding process of high-power magnets and waste high-power magnets containing neodymium (Nd) by producing neodymium oxide. In recovering rare earth metals such as neodymium from sludge generated during the preparation of Nd-Fe-B magnets (composed of neodymium, iron, and boron) – which typically contain more than 30% neodymium – a combination of thermal extraction and solution-based extraction is used. The process involves selectively oxidising neodymium with oxygen or iron oxide, which can also be applied to other rare earth metals, converting them into high-content oxide slag. This thermal process is known as selective or thermal oxidation. The high-neodymium-content oxide slag is then processed through solution extraction, or alternatively, waste high-power magnets can be directly leached without the thermal step. In either case, the material is dissolved in acid solutions such as sulfuric acid (H_2SO_4 50%) or hydrochloric acid (HCl), after which the solution is purified to separate neodymium or other rare earth metals through methods, such as solvent extraction or precipitation.

6. Comprehensive recycling of damaged or expired solar panels – A closed-loop technology for fully recycling damaged or expired solar panels. This process is designed to manage solar panels comprehensively, starting from dismantling, sorting various materials such as silicon, glass, aluminium, and electronic components, to reusing those materials in the manufacturing of new solar panels or repurposing them in other industries.

7. Nano-copper particle production from copper etching solutions – A technology for recycling copper-containing solutions from the etching of printed circuit boards (PCBs) by converting the copper solution into nano-copper particles. These particles possess special properties and are of high value, making them applicable in various industries. This process not only reduces waste and pollution from the disposal of copper etching solutions but also

transforms waste into high-value products, enhancing resource efficiency and supporting the circular economy in the sustainable production of electronic products.

8. Recovery of lithium and metal compounds from used electric vehicle batteries – A technology for recycling used electric vehicle batteries to recover lithium and other metal compounds as raw materials for new battery production. The recovered materials can be reused in the electronics, energy, and advanced materials industries, reducing waste and increasing value while promoting environment-friendly practices in battery life cycle management.

9. Separation of components from deteriorated lithium-ion batteries – A technology designed to separate and recover valuable materials from end-of-life primary lithium-ion batteries. The process begins with mechanical dismantling to remove the battery casing, followed by shredding to reduce size and separating components through methods, such as magnetic separation and air classification. The internal cell components are then milled to less than 2 millimeters to improve chemical leaching efficiency. Subsequent steps involve separating the cathode from the aluminium foil and the anode from the copper foil, enabling the recovery of lithium, cobalt, and other metals for reuse in the production of new batteries.

B) Alternative materials to the EEE-relevant materials

DPIM has set a key objective to promote and develop the utilisation of waste as an alternative resource for minerals, metals, and metal compounds, in line with the Thailand 4.0 policy, which emphasises upgrading Thai industries through innovation, fostering multi-stakeholder participation, and advancing environmentally sustainable development.

In this context, DPIM organised an academic seminar on the topic 'Innovation for Materials for Value-Added' on 22 February 2018 at the Golden Tulip Sovereign Hotel, Bangkok. The objectives were to discuss directions and trends in the demand for raw materials in both Thai and international industries, to promote research and development (R&D) in material innovation and waste utilisation, and to strengthen collaboration amongst government, the private sector, and academic institutions to drive Thailand's industries towards sustainability.

This seminar marked an important starting point in advancing the concepts of urban mining and the circular economy in Thailand. The focus was on ensuring that industrial waste and end-of-life electronic products are reused as substitute raw materials, thereby reducing dependence on imported minerals and metals while minimising long-term environmental impacts.

According to DPIM (2018), the discussion in this section presents arguments related to alternative materials for EEE-relevant materials. The DPIM aims to promote and develop

waste as a source of substitute raw materials for minerals, metals, and metal compounds to support the development of Thailand's Industry 4.0. This initiative focuses on driving industries through innovation, encouraging participation, and promoting environmentally friendly practices, in line with the policy to advance industrial development towards Industry 4.0. The Ministry of Industry has restructured itself to focus on driving industries with innovation, creating participation, and environmental development. DPIM is one of the agencies that has proactively adjusted its role and structure, focusing on sourcing and managing raw materials to ensure a stable supply of raw materials for the industrial sector, including raw materials from natural mineral resources (primary raw materials), recycled waste or secondary raw materials (secondary raw materials), and advanced raw materials (advanced raw materials), which are high-quality minerals, metals, and metal compounds. This supports the development of the country's targeted industries, particularly the potential traditional industries (First S-curve), such as modern automotive, smart electronics, high-income tourism and health tourism, agriculture and biotechnology industries, and food processing industries. It also includes future industries (New S-curve) such as robotics, aviation and logistics, biofuels and biochemicals, digital industries, and integrated medical industries (DPIM, 2018).

Regarding substitute raw materials derived from recycling waste or by-products, the DPIM emphasises the recycling of waste or by-products to recover minerals and metals for reuse, as well as processing them into renewable energy. This practice is commonly referred to in many countries as 'urban mining'. Since fiscal year 2008, DPIM has continuously implemented projects to promote the reuse of waste, residual materials, and by-products from production processes as alternative resources for the industrial sector. This approach reduces the use of new natural resources, minimises waste generation, and mitigates environmental and community pollution. It also encourages the transition towards a zero-waste society, leveraging the department's expertise in mineral processing and metallurgy, which form the foundation of recycling technologies. The DPIM collaborates with consultants and experts from various agencies to transform the approximately 50 Mt of waste generated annually in Thailand into important raw materials for minerals, metals, and renewable energy. Follow-up evaluations of past operations show that entrepreneurs trained and educated by the DPIM in recycling technologies have created added value in the country from investments and/or recycling of target waste, amounting to THB100–130 million per year (DPIM, 2018).

The key to success is the creation of a three-way collaboration between the government, the private sector, and academic institutions. I believe that with innovation and effective management, we can transform waste into an important source of substitute resources to support the development of the country's targeted industries in the future, just as developed countries have done, many of which lack natural mineral resources. Additionally, it will reduce the use of new natural resources, reduce waste generation, and mitigate

environmental and community pollution issues in line with environment-friendly industrial development practices, and promote the transition to a zero-waste society (DPIM, 2018).

C) Policy and regulations on EEE recycling and waste disposals

Thailand faces several significant challenges in managing e-waste due to their increasing amount and their variety of valuable and hazardous compositions. To address such challenges, it requires a combination of legislative reforms, improved infrastructure, public education, and stakeholder co-operation to ensure responsible e-waste management. Notable outcomes of the Thai government's actions are the development of the Integrated Action Plan on the Management of Electrical and Electronic Waste (2022–2027) (PCD, 2021) and the consideration of a draft specific law – the Draft Act on the Management of Waste Electrical and Electronic Waste (PCD, 2024a), which are expected to complement the existing waste legislation. Furthermore, national policy and plans provide the framework on the circular economy, related to the management of resources from wastes, namely, the Bio-Circular-Green (BCG) Economy Action Plan (2021–2027) (NSTDA, 2022) and the 13th National Economic and Development Plan (2023–2027) (NESDC, 2023).

1) National policy and plans related to EEE recycling and waste disposals in Thailand

1.1) Bio-Circular-Green Economy Action Plan (2021–2027)

On 19 January 2021, the Thai Cabinet endorsed the proposal to declare the Bio-Circular-Green Economy or BCG model in line with the National Strategy 2018–2037. As a result, the BCG Action Plan 2021–2027 was formulated and endorsed by the Cabinet on 8 February 2022, aiming to create sustainable and high-quality growth through science, technology, and innovation, while enabling higher incomes, an improved quality of life, and a balanced use and conservation of biological and natural resources. The circular economy focuses on reducing, reusing, and recycling materials to minimise waste and emphasises areas of energy, material, and biochemicals (NSTDA, 2022).

1.2) The 13th National Economic and Social Development Plan (2023–2027)

The 13th National Economic and Social Development Plan (2023–2027) endorsed by the government set up the turning point target for Thailand's economy to the circular economy by 2027 at its Milestone 10 (NESDC, 2023).

1.3) The Integrated Action Plan on the Management of Electrical and Electronic Waste (2022–2027)

The Integrated Action Plan on the Management of Electrical and Electronic Equipment Waste (2022–2026), developed by Thailand's PCD under the Ministry of Natural Resources and Environment, was approved by the Thai Cabinet in July 2021 (PCD, 2021), This action plan identifies significant challenges in managing e-waste, as below (PCD, 2021):

- Rising e-waste generation: Thailand generated over 400,000 metric tonnes of e-waste in

2021.

This increase is driven by rapid technological advancement, economic growth, and urbanisation.

- Informal recycling sector: A large portion of e-waste is handled by the informal sector, which often operates without proper regulations. This leads to unsafe recycling practices, environmental pollution, and health risks.
- Lack of recycling infrastructure: Many regions in Thailand lack adequate recycling facilities and proper disposal methods. This forces individuals and businesses to resort to informal disposal methods, such as dumping or burning e-waste.
- Illegal e-waste imports: Thailand has become a destination for illegal e-waste imports, which contain hazardous materials and toxins. This exacerbates environmental pollution and poses significant health hazards.
- Public awareness and education: There is a general lack of awareness amongst the public about the environmental and health impacts of improper e-waste disposal. Many people are unaware of the importance of recycling e-waste, or the potential hazards of toxic substances found in electronic devices.

The action plan also aims to address the environmental and health hazards posed by e-waste, focus on three key pillars: the collection and recycling of e-waste, the promotion of eco-friendly product design, and raising public awareness about waste management. It has a clear vision, objective, targets, and key collective measures each year:

Vision: 'WEEE are managed in the environmentally and safely sound manner'

Objectives:

- To manage targeted WEEE products in an environmentally and safely sound manner;
- To develop the data management center of WEEE;
- To create an effective and sustainable collection system of WEEE generated from people's consumption and their community with multi-stakeholder's collaboration.
- To enhance the establishment of environmental-friendly WEEE dismantling and recycling factories; and
- To raise the environmental awareness of WEEE management.

Targets:

(1) Having the effectively sound segregation and collection scheme of WEEE in place, aiming to achieve the following collection rate targets:

(1.1) 10% of the total average generation amount in 2026: (i) computers, (ii) telephones and wireless telephones, (iii) air conditioners, (iv) televisions sets, and (v) refrigerators, and

(1.2) 5% of the total average generation amount in 2026: the new emerging WEEE such as solar cell apparatuses, electric vehicle batteries, etc.

(2) Ensuring the sound dismantling, recycling, and disposal of WEEE, with the aim of achieving the following targets:

(2.1) 10% of the total average generation amount in 2026: (i) computers, (ii) telephones and wireless telephones, (iii) air conditioners, (iv) televisions sets, and (v) refrigerators, and

(2.2) 5% of the total average generation amount in 2026: the new emerging WEEE such as solar cell apparatuses, electric vehicle batteries, etc.

(2.3) Supporting the establishment of at least one environmentally sound dismantling and recycling facility in each of the three following regions by 2026: Northern, Northeastern, and Lower Southern regions.

Principles:

(1) Developing of the Bio- Circular- Green Economy (BCG) Model to in line with the Sustainable Development Goals;

(2) Applying the polluter pays and extended producer responsibility (EPR) principles to end-of-life products by establishing proper collection, reverse logistics, treatment, and disposal systems;

(3) Applying 3R principles in WEEE management;

(4) Creating the economic mechanism to stimulate the take-back and reversed logistic system of WEEE from consumers and supporting the private sector to establish a knowledge learning center for WEEE management;

(5) Developing and amending the related regulations in reducing the domestic WEEE generation amount; and

(6) Promoting public–private partnership by engaging multi-stakeholders through the whole life cycle management of WEEE.

Key collective measures and activities:

In brief, the plan consists of key activities designed to progressively build a robust system for managing e-waste, ensuring environmental sustainability, and the protection of public health. Several key activities to be undertaken each year to achieve these objectives:

Year 1 (2022):

- Establish collection points: Set up initial e-waste collection points across major cities.
- Public awareness campaigns: Launch campaigns to educate the public about e-waste and its proper disposal.
- Regulatory framework: Develop and implement regulations for e-waste management.

Year 2 (2023):

- Expand collection network: Increase the number of collection points and recycling facilities.
- Eco-friendly product design: Collaborate with manufacturers to promote eco-friendly designs.
- Training programmes: Conduct training for stakeholders on e-waste management practices.

Year 3 (2024):

- R&D: Fund research projects to develop new recycling technologies.
- Monitoring and evaluation: Assess the effectiveness of the implemented strategies and make necessary adjustments.
- Community engagement: Strengthen community involvement in e-waste collection and recycling efforts.

Year 4 (2025):

- Enhance recycling processes: Improve the efficiency of recycling facilities and processes.
- Policy review: Review and update policies based on the progress and challenges encountered.
- International collaboration: Engage in international partnerships to share best practices and technologies.

Year 5 (2026):

- Final evaluation: Conduct a comprehensive evaluation of the plan's impact and outcomes.
- Sustainability measures: Implement measures to ensure the sustainability of e-waste management practices.
- Future planning: Develop a new action plan based on the lessons learned and achievements.

2) Laws and regulations related to EEE recycling and waste disposals in Thailand

Although several laws related to waste management, including WEEE, exist in Thailand – such as the Enhancement and Conservation of National Environmental Quality Act, B.E. 2535 (1992), the Hazardous Substances Act, B.E. 2535 (1992), the Public Health Act, B.E. 2535 (1992); and the Factory Act, B.E. 2535 (1992) – they do not adequately govern the establishment of a proper and environmentally sound management system for WEEE.

WEEE requires a different and more specific management scheme than ordinary waste, including, for example: (i) a take-back system for collecting and storing WEEE after taking back from consumers; (ii) an incentive system to support the return of WEEE to producers' responsibility; and (iii) proper recycling or disposal facilities. These recognitions led to formulation of the Draft Act on the Management of Electrical and Electronic Equipment (Thailand, 1992a–1992d).

2.1) The Enhancement and Conservation of National Environmental Quality Act, B.E. 2535 (1992) and its amendments govern the management of environmental quality and pollution by providing a range of management and abatement tools. These include the establishment of dedicated bodies, namely the National Environment Board and the Pollution Control Committee: policies and planning related to environmental quality and pollution control; the environmental impact assessment (EIA) system; ambient, effluent, and emission standards for pollution point sources; the designation of special areas for environmental conservation and pollution control; the Environment Fund; and the operation of central waste and wastewater treatment plants, amongst others. The disposal facilities (waste incinerator and wastewater treatment plant) under factory category 101 (the final disposal of hazardous residues from WEEE recycle and dismantle facilities) must be compiled with the EIA and the emission standards according to this act.

2.2) The Hazardous Substance Act, B.E. 2535 (1992) and its amendments regulate the handling of hazardous substances, including their production, import, export, and possession. The act establishes the Hazardous Substances Committee and assigns responsibilities to the relevant major relevant ministries, including the Ministry of Industry, the Ministry of Agriculture and Cooperatives, and the Ministry of Public Health, depending on the intended use of the hazardous substances. It also classifies hazardous substances into four categories according to the degree of regulatory control. This act also regulates the import and export of WEEE under the Basel Convention and the manifest system for the movement of hazardous waste, including WEEE, out of the factory.

2.3) The Public Health Act, B.E. 2535 (1992) and its amendments have empowered the local government to deal with public health–related issues in their territories, including public nuisances, management of sewage and waste (including the community hazardous waste and e-waste), building sanitation, business hazardous to health through the public and the provincial public health committees. The act also regulates the collection, transportation, storage, and disposal of household hazardous waste, including WEEE, and classifies community dismantling facilities as hazardous businesses.

2.4) The Factory Act, B.E. 2535 (1992) and its amendments govern the classification of factories by category, type, and size, as well as the licensing and registration requirements for the establishment, operation, and expansion of factories. The act also imposes strict controls on safety measures and environmental protection, including pollution abatement.

It also covers the establishment and operation of the dismantling, recycling, and disposal facilities for industrial waste, including WEEE. Certain types of factories, including industrial waste incineration plants, require EIA approval before licensing and registration.

2.5) The Industrial Product Standard Act, B.E.2511 (1968) and its amendments regulate both voluntary and compulsory industrial product standards established by consensus and approved by the relevant committee to ensure consistency, quality, safety, and interoperability across industries. These standards also set criteria for the efficiency, safety, and environmental sustainability of industrial products. These also include the voluntary standard on the restriction of hazardous substances in the electrical and electrical equipment or Thai RoHS (Restriction of Hazardous Substances in Electrical and Electronic Equipment), which limits the use of specific hazardous substances (heavy metals, flame retardants, etc.) to ensure safer products and reduce environmental impact. It includes 10 categories of EEE such as large and small appliances (refrigerator, washing machine, air condition, vacuum cleaner, hair dryer, etc.); IT and telecommunication equipment (computers, mobile telephone, etc.); lighting equipment (lamps, light bulbs, etc.); toys; medical devices; and others (TISI, 2021).

2.6) The Draft Act on the Management of Electrical and Electronic Equipment Waste, B.E. (under consideration) was outlined in the public hearing document released from 20 February to 5 March 2024. The PCD is currently in the process of proposing the Draft Act (PCD, 2024a). The substantive elements of the Draft Act include:

(1) The establishment of the committee on WEEE management, which is tasked to provide recommendations to the Minister of the Natural Resources and Environment in governing this (draft) Act.

(2) Key recommendations focus on the WEEE management scheme, which is based on the principles of the circular economy and EPR. These include provisions on the list of WEEE, the disposal fee, and the roles and responsibilities of key stakeholders – including producers and importers, product responsibility organisations (PROs), consumers, local governments, and the PCD. The recommendations also cover the criteria for the collection, dismantling, recycling, and disposal of WEEE, as well as guidance on WEEE management plans to be prepared by producers, importers, or PROs.

3) The status quo and outlook of e-waste relevant policies and regulations in Thailand

(1) Performance of relevant policies and regulations

The BCG Economy Action Plan (2021–2027) and the 13th National Economic and Social Development Plan (2023–2027) related to the circular economy provide opportunities in driving the circularity of resources from waste.

The Integrated Action Plan on the Management of Electrical and Electronic Waste (2022–2027) provides a more detailed conceptual framework, objectives, targets, and annual

activities to support the achievement of each target and the overall objectives of the plan. It includes the prescription of dedicated targets on products of (i) computers, (ii) telephones and wireless telephones, (iii) air conditioners, (iv) television sets, (v) refrigerators, and (vi) new emerging WEEE such as solar cells apparatuses, electric vehicle batteries, etc. as well as the establishment of one environmentally sound dismantling and recycling factories in each of the following regions: Northern, Northeastern, and Lower Southern regions. Indeed, the accomplishment of the integrated plan will anticipate addressing all e-waste challenging aspects.

The existing laws have already provided a wide legislation framework for recycling and disposal facilities, transportation with the manifest tracking system, but the current waste management system still has some loopholes in ordinary collection and disposal of waste and all expenditures on only the governmental fiscal budgetary year. The draft law also aims to shift from the general waste management system to a specific strategy or scheme for taking back WEEE from consumers. It also seeks the establishment of the financial mechanism to subsidy the take-back scheme and others to facilitate proper recycling and recovery of precious or valuable materials and proper treatment or disposal of segregated hazardous components to support the achievement of each target in the integrated plan. Moreover, the efficient data tracking system of recycling and disposal facilities will be set up to connect with producers and importers or PRO databases to provide a mapping of all data in the whole supply chain of EEE to enhance the efficiency of WEEE management system.

(2) Expected performance of the draft act in terms of environmental and social impacts

If the draft act is enacted and becomes effective, the evaluated impacts resulting in closing the environmental and social impact gaps include:

(2.1) At least within 3 years after the enactment of the law, the collection rate is expected to increase to 30% of the total annual WEEE generation, based on the EPR principle.
(2.2) At least within next 3 years after the enactment of the law, recovered materials such as plastic, aluminium, iron, copper, and others from dismantling facilities will increase to 50% of total yearly WEEE generation.
(2.3) The informal sectors will be included in the setting up of collection scheme.

2.3. Definition and discussion on urban mining

In Thailand, the urban mining concept has been promoted by the DPIM, Ministry of Industry, since 2009 as an important policy to secure industrial feedstocks while supporting environmental sustainability by transforming waste into industrial resources. The DPIM has also established the Industry Transformation Center to advance recycling technologies and material innovations. The center has developed commercial scale recycling technology and innovation prototypes in an environmentally sound manner with more than 70 proven

technologies, which can create value-added investment for over THB150 million per year (Senate Commission on Commerce and Industry, 2022).

Sorting, smelting, and utilising recovered metals offer more environmentally and economically sustainable solutions than relying on natural resource extraction, particularly in situations where smelting mines have ceased operations. According to a previous study by DPIM (2021), 12 types of products – including fans, TV sets, washing machines, irons, refrigerators, rice cookers, kettles, printers, feature mobile phones, smartphones, and notebook computers – contain various recyclable parts. The main materials recovered include iron, plastics, printed circuit boards (PCBs), mixed metals, aluminium, copper wire, printer motors, stainless steel, and hard drives from notebook computers. Moreover, PCBs are 3%–7% of WEEE by weight, comprising of high contents of precious metals (e.g., Au, Ag, Pt, Po, etc.), base metals (e.g., Cu, Fe, Ni, Al, Zn, Sn, etc.), and rare earth elements (e.g., Nd, Sr, etc.) compared to natural resources. For example, 1 tonne of smartphones, excluding batteries, contains precious metals such as 270 g of gold, 2.78 kg of silver, 100 g of palladium (Pd); base metals such as 10 kg of copper; and rare earth elements, including about 150 g of neodymium and 40 g of praseodymium . By comparison, 1 tonne of gold ore from a natural gold mine typically contains only 1–2 g of gold (Thailand Institute of Scientific and Technological Research (TISTR), 2021; Kasetsart University, 2021). Although e-waste contains hazardous substances, such as antimony, arsenic, lead, and mercury, it may be processed in factories classified under Categories 105 and 106, provided that it meets environmental and safety requirements, such as compliance with the Restriction of Hazardous Substances in Electrical and Electronic Equipment (RoHS). This is permitted under the Regulation Prescribing Categories, Types and Sizes of Factory, B.E. 2563 (Senate Commission of Commerce and Industrial, 2022). Factories classified under Categories 105 and 106 – namely waste segregation and landfilling factories and recycling factories – are defined under the Regulation Prescribing Categories, Types and Sizes of Factories, B.E. 2563, (5 August 2020). These facilities extract metals, metal compounds, and ores for use as raw materials, and can therefore be considered industries relevant to urban mining.

There are 213 dismantling and recycling factories of e-waste, which are densely located in the central and eastern regions (Senate Commission of Commerce and Industrial, 2022). However, the collection of target waste and WEEE from communities is the responsibility of local governments under the Regulation on the Management of Household Hazardous Waste, B.E. 2562 (22 October 2020). The collection, transportation, and disposal fees are determined according to the rates specified in the Regulation Prescribing Permit, Notification, and Service Fees for Waste Management, B.E. 2559 (30 September 2016). These regulations establish a legal framework and assign clear responsibilities for the management of household hazardous waste, including e-waste. They also define the responsibilities of local administrative organisations, as well as service fees for collection and disposal. In practice, however, many local administrative organisations face constraints

in budget, human resources, and technical capacity. As a result, the collection and transportation of e-waste are often insufficient and delayed. Consequently, a large share of e-waste continues to be handled by the informal sector, which increases environmental and health risks. While these regulations have laid the foundation for improvements, the current situation shows only partial progress, with significant challenges remaining. Strengthening enforcement, creating incentives, and enhancing the capacity of local administrative organisations are necessary to address these gaps (Subongkot, 2017).

The status quo and outlook of policy and regulations related to EEE-relevant urban mining concept in Thailand can be summarised here.

1) Lack of public awareness and recognition

There is still a lack of public knowledge and awareness regarding the segregation of WEEE from ordinary waste and its return to WEEE management schemes and urban mining industries (Senate Commission of Commerce and Industrial, 2022).

2) Lack of opinions leaders, experts, and NGOs

Investors or recyclers and producers have a moderate interest in urban mining industries. The relevant authorities, including DPIM, DIW, and PCD, have provided the relevant supporting tools (feasibility study, national policy and planning, recycling technology innovation, and related laws) to facilitate the establishment of urban mining industries for WEEE (Senate Commission of Commerce and Industrial, 2022). As reported in the news, NGOs support the proper WEEE management system to mitigate primitive artisanal recycling facilities or illegal dumping of hazardous e-waste.

3) Any related issues

3.1) Feasibility of WEEE urban mining: As evaluated by the Senate Commission of Commerce and Industry, the success factors for achieving resource circularity from urban mining sources include: (i) sufficient quantities of waste; (ii) effective collection and transportation systems; (iii) potential for resource utilisation; (iv) availability of technologies at a commercial scales; (v) management of environmental hazards; and (vi) readiness of manufacturers and investors. It also indicated that WEEE is the most feasible category, while solar cell panels and used' vehicles are considered moderately feasible for investment in dismantling and recycling facilities (Senate Commission of Commerce and Industrial, 2022).

3.2) Social impacts: To reduce the social drawbacks, the take-back system requires the incentive instrument (deposit–refund system, etc.) and public awareness raising campaigns to stipulate social engagement in the system (Senate Commission of Commerce and Industrial, 2022).

3.3) Legislation system: Supportive policies and laws, in particular, the prohibition of WEEE export to prevent the urban mining feedstock deficiency in competition with foreign countries, are acquired in supporting the urban mining sector (Senate Commission of

Commerce and Industrial, 2022).

3.4) Investment incentive tools: To avoid placing a burden on the government budget, an appropriate mechanism is needed to pool resources for establishing or expanding urban mining industries, such as dismantling, recycling, and material recovery facilities).

3.5) Infrastructure and utilities: Although more than 70 innovative recycling technologies have been developed by DPIM, financial resources remain limited for establishing urban mining industries and collection points nationwide. Investment support is therefore required to address this challenge (Senate Commission of Commerce and Industrial, 2022).

3.6) Collection and reverse logistics systems: The collection and transportation systems stipulated in the draft WEEE management law can maximise the use of existing logistics networks and collection points by promoting public– private partnerships in collaboration with local governments and other actors (such as community malls or retail stores). This approach can also reduce capital investment and operating costs (Hub of E-waste, 2023; PCD, 2024a).

3.7) Market-based management: The highlights the importance of applying market-based management principles in the supply chain of the electrical and electronic equipment (EEE) industry, both domestically and internationally. In particular, it emphasises the use of materials recovered through urban mining processes – such as waste or by-products from the electronics recycling industry – to enhance value and promote the circular economy. Implementing this approach can improve the efficiency of e-waste management and reduce environmental impacts (Senate Commission of Commerce and Industrial, 2022).

3.8) Data management centre: Similar to the Urban Mine Platform developed by the European Union (EU) and Switzerland (Senate Commission of Commerce and Industry, 2022), and in parallel with the issuance of the draft law on WEEE management, it is necessary to complement the efficient data tracking system required by the draft law (PCD, 2024a). The data management centre, containing information on the quantity of in-market or in-stock commodities, waste volumes, material composition and flows, hazardous substances, and the potential locations of urban mining sources and related industries, should be established to support investment decision-making in urban mining industries and to assist the government in formulating supportive laws (Senate Commission of Commerce and Industrial, 2022).

2.4. Conclusion

The majority of e-waste in Thailand originates from households and the industrial sector. However, certified recycling facilities primarily handle e-waste from the industrial sector, while household e-waste is largely managed by the informal sector, using manual labour to dismantle electrical and electronic equipment. This situation highlights the distinction

between the formal industrial sector and the informal household sector in Thailand's e-waste management system, reflecting challenges in governance, law enforcement, and establishing a comprehensive recycling system.

Thailand places emphasis on the concept of urban mining, which involves extracting valuable metals and materials from e-waste. This approach enables materials to be reused as industrial raw materials, reduces dependence on natural resources from mining, and promotes the development of the circular economy. In recent years, DPIM has developed a variety of new e-waste recycling technologies, including:

1.Gold recovery from electronic circuit boards

2.Silver recovery from electrical contacts

3.Copper recovery from electronic circuit boards

4.Utilisation of non-metallic components from electronic circuit boards

5.Neodymium oxide production from high-power magnet waste

6.Comprehensive recycling of damaged or expired solar panels

7.Nano-copper particle production from copper etching solutions

8.Recovery of lithium and metal compounds from used electric vehicle batteries

9.Separation of components from deteriorated lithium-ion batteries

However, the application of these technologies is still limited, as only facilities with sufficient readiness and interest are able to implement them. The informal sector currently has limited access to or the ability to utilise these technologies, resulting in potential losses of recyclable materials and underutilisation of e-waste management capacity.

3. Consolidating the Stakeholders' Consultation Meeting Outputs with the Result of the Survey/Analysis and Policy Recommendations

3.1. In-depth interviews with stakeholders

In-depth interviews are an effective qualitative research tool for collecting information from stakeholders involved in e-waste management. This method enables the collection of in-depth insights into facts, perspectives, experiences, and recommendations from those directly engaged in the e-waste management system.

In the context of Thailand, in-depth interviews play a crucial role in providing a comprehensive understanding of the situation at both policy and practical levels – for example, the management structure, relevant laws and regulations, economic mechanisms that incentivise take-back and recycling, as well as structural issues such as overlapping agency mandates or gaps in law enforcement.

The analysis of data obtained from these interviews is highly valuable for designing feasible and effective policies, both at the national level and in the context of international co-operation. The aim is to develop a sustainable circular economic system capable of addressing the continuously growing volume of e-waste in the future. The research team conducted interviews with relevant stakeholders from May to June 2025 (Table 5.16).

Table 5.16. Mandates of Agencies and Overview of Operations Related to E-Waste Management

Agencies	Main Mandates and Related Operations
Government Agencies	
Department Primary Industries and Mines (DPIM), Ministry of Industry	Manages raw materials and resources to meet industrial sector demands; promotes circular economy practices and recycling technologies. Implements the development of e-waste recycling and valuable recovery technologies; supports the formation of recycling industry clusters.
Pollution Control Department (PCD), Ministry of Natural Resources and Environment	Formulates policies, laws, and guidelines for e-waste management; promotes the implementation of EPR; monitors waste management practices and controls the import of waste. Leads the drafting of the Waste Electrical and Electronic Equipment (WEEE) Management Act and co-ordinates activities under the Basel Convention.
Thai Customs, Ministry of Finance	Controls the import and export of e-waste to prevent smuggling and false declarations; conducts document and cargo inspections in accordance with the Basel Convention; and facilitates the return of illegally imported waste.

Agencies	Main Mandates and Related Operations
Marine Department, Ministry of Transport	Manages commercial ports and maritime transport; oversees cargo handling to ensure compliance with laws and environmental regulations.
Office of Industrial Economics (OIE), Ministry of Industry	Formulates industrial policies and strategic plans, particularly in the smart electronics sector; implements the Smart Electronics Industry Development Action Plan (2023–2027).
Department of Foreign Trade, Ministry of Commerce	Controls the import and export of e-waste and special regulated goods under the Basel Convention; sets the list of controlled e-waste items in line with the convention.
Department of Health, Ministry of Public Health	Supports and supervises health aspects related to e-waste management; disseminates information on the hazards of e-waste and promotes safe handling practices.
Academic organisations	
Electrical and Electronics Institute (EEI), Ministry of Industry	Develops the electrical and electronics industry and supports e-waste management. Implements projects such as the E-waste Management Simulation, Digital WEEE Manifest, refrigerant management projects, and the 'Old for New' campaign.
National Metal and Materials Technology Center (MTEC), Ministry of Higher Education, Science, Research and Innovation	Conducts R&D on metals and materials technology, including recycling and efficient resource utilisation, including implements initiatives such as precious metal recycling technology development, metal extraction from e-waste projects, and support for the recycling industry.
Center of Excellence on Hazardous Substance Management, Chulalongkorn University	Develops knowledge and pilot projects on hazardous waste management, particularly e-waste. Implements initiatives such as the 'Chula Rak Lok' project, E-waste Phases 1–2, Digital WEEE Manifest, PRO Sandbox, and refrigerant management from refrigerators and air conditioners.
Private Sector and Civil Society Organisations	
Ecological Alert and Recovery – Thailand (EARTH)	Protects, restores, and promotes environmental rights; monitors industrial pollution; conducts surveillance on the impacts of e-waste; and builds collaborative networks for e-waste management.
Association of Junk Shop and Waste Collectors	Supports proper, safe, and environment-friendly waste management by promoting and enhancing the capacity of junk shop operators and itinerant waste buyers to gain knowledge and skills in proper material sorting.

Agencies	Main Mandates and Related Operations
Asia Green Rescrap Company Limited	Recycle and dispose of hazardous waste in a legal and environment-friendly manner, providing e-waste recycling services to reduce environmental impacts.
Better World Green Public Company Limited	Manages industrial waste comprehensively, recycling and reusing e-waste, and converting non-recyclable parts into energy.

Source: Author.

Based on in-depth interviews with stakeholders from various sectors involved in e-waste management, including government agencies, the private sector, academia, and civil society, information and perspectives were gathered on issues related to the collection, sorting, recycling, and regulation of e-waste. The interviews covered a wide range of key topics, and the findings provided valuable insights and recommendations for improving Thailand's e-waste management system, as well as for the management of e-waste between Thailand and Japan. The key points are summarised as follows:

1) International material flow of EEE-relevant items' and resource circularity between Thailand and Japan

The study on material flows and resource use between Thailand and Japan highlights both opportunities and challenges in managing EEE and e-waste. Data from various agencies reflect an overall picture of the issues, including smuggling of goods, legal and regulatory loopholes, the lack of a centralised database and tracking mechanisms, and the risks associated with importing second-hand products nearing the end of their service life – which may become a domestic waste burden in the future.

1.1) Gaps in the volume and management of e-waste in Thailand – The country generates approximately 400,000 tonnes of e-waste per year, but only about 10% enters proper management processes. The remaining 90% mostly flows into the informal recycling sector, such as itinerant waste buyers or unregulated facilities, posing risks to the environment and public health.

1.2) Thailand is not yet ready to become an e-waste management hub – Due to insufficient infrastructure, sorting systems, and recycling technologies, developing the country into a hub for e-waste management could lead to an increase in illegal imports, as well as risks from unsafe recycling processes that threaten the environment and public health.

1.3) Second-hand goods, smuggling, and false declarations in imports – There are still cases of misdeclaration, such as labelling items as 'second-hand goods' or 'recyclable raw materials', as well as using third countries as transit points. Although imports from Japan are relatively low due to strict controls, second-hand goods entering Thailand still carry the

risk of containing electronic components nearing the end of their service life, particularly appliances and parts with circuit boards, which can quickly deteriorate and become waste. The lack of effective sorting and tracking systems increases the risk of unintentional waste imports.

1.4) Fluctuations in Thailand–Japan trade – The volume of imports and exports of second-hand EEE from Japan fluctuates, influenced by various factors: economic conditions affecting demand for second-hand goods, disruptions to supply chains during the COVID-19 pandemic, and revisions to the HS code every 5 years, which can cause confusion in product declarations and lead to incorrect product coding – whether from misunderstanding or deliberate attempts to circumvent controls. This results in inaccurate statistical data and increases the risk of importing products that may soon become waste.

1.5) Ship-back measures and law enforcement – In cases of illegal e-waste imports, Thai authorities such as the Customs Department, PCD, and DIW take action to return the waste to its country of origin. This applies in situations where imports are unauthorised, declarations are falsified, or hazardous waste is imported under the Basel Convention, including smuggling disguised as recycling or second-hand goods. When detected, the goods are confiscated, and the importer or the country of origin is required to bear the cost of shipment for immediate return.

1.6) Lack of quantitative data and a national database – There is still no accurate centralised database on the volume of EEE and e-waste. Most available data are estimates based on small-scale surveys, resulting in an incomplete overall picture. It is therefore necessary to develop a reliable centralised data system to support future planning and management of e-waste.

2) Existing recycling and waste disposal technologies for EEE-relevant materials within the country

Currently, Thailand has developed technologies and supporting measures for e-waste management. However, it still faces key limitations, including outdated recycling technologies, inadequate infrastructure for sorting and collection, and inefficient collection systems. These constraints hinder the ability to manage e-waste in a fully sustainable manner and remain significant obstacles to achieving sustainable management. The key points can be summarised as follows:

2.1) Development of domestic recycling technologies – The DPIM has developed over 85 types of recycling technologies covering various materials, including specialised technologies for recycling e-waste such as precious metal extraction, plastic recycling, hazardous material management, and battery and solar panel recycling. These efforts aim to support the circular economy and resource security.

2.2) Limitations in recycling technology – Currently, Thailand has about 150 recycling plants, most of which use basic technologies such as manual disassembly, shredding, and simple sorting. Although DPIM has continuously developed advanced e-waste recycling technologies, these technologies are only applied in a few interested recycling facilities and do not cover all plants in the country, including informal dismantlers. Some materials are still exported abroad for value recovery due to the lack of advanced technologies, such as automated sorting systems. Developing such advanced technologies is essential for modernising the domestic recycling industry and making it more sustainable.

2.3) Dependence on manual labour in the informal sector – Most household e-waste disassembly in Thailand still relies heavily on manual labour, often without proper tools or protective equipment. In addition, a substantial portion of e-waste is handled by the informal sector, such as itinerant waste buyers, junk shops, and community enterprises, which often operate without strict environmental and safety controls, resulting in pollution and hazards to communities and the environment. However, e-waste from offices and industrial factories is generally managed through certified recycling facilities, where basic protective equipment is provided to workers to ensure safe handling and minimise environmental impacts.

2.4) Impacts of substandard management from the informal sector – The lack of personal protective equipment use and inadequate pollution control measures in e-waste management expose workers to toxic and hazardous substances such as mercury, lead, and arsenic, increasing the risk of respiratory, neurological, and other chronic diseases. Furthermore, the release of toxins into the air, water, and soil causes community pollution, damaging the environment and public health on a broad scale.

3) Existing alternative materials to the EEE-relevant materials

Key issues regarding the use of alternative materials to replace those used in EEE play a key role in reducing environmental impacts and enhancing sustainability in production and recycling processes. The focus is on developing safer materials, using readily available and low-cost raw materials, and employing materials that can be easily reused or biodegraded. This helps reduce reliance on toxic substances or limited resources. The adoption of alternative materials also fosters innovation in product design and manufacturing processes, making them more environmentally friendly. The key points can be summarised as follows:

3.1) Use of substitute resources and safe management – Secondary raw materials obtained from recycling e-waste play a key role in developing the circular economy, as they help reduce the use of primary raw materials extracted directly from nature. It can also lower production costs, mitigate environmental impacts from mining, and

enhance long-term resource security for the country. The development of substitute materials for EEE must be carefully considered in terms of performance, safety, and environmental impacts. In particular, the management of refrigerants from discarded electrical appliances, such as air conditioners and refrigerators, requires strict control measures during dismantling and collection to prevent leaks that could cause fires, air pollution, and ozone depletion. Safe processes for recovering and reusing refrigerants are therefore a crucial part of supporting efficient and sustainable resource use.

3.2) Design for circularity – Product design should prioritise the concept of design for recycling, enabling products to be easily disassembled and reused efficiently. This approach not only helps reduce the continuously growing volume of e-waste, but also promotes efficient resource utilisation, reduces dependence on new raw materials, and mitigates long-term environmental impacts.

3.3) Reuse and new business models – Extending the lifespan and reusing components of EEE is a key strategy for reducing the use of new energy and materials. However, Thailand still lacks a concrete system to support remanufacturing from used components, resulting in the loss of resources and economic value that could otherwise be recovered. Conversely, new business models such as product-as-a-service (PaaS), where equipment is leased rather than sold, have the potential to promote systematic collection, sorting, and reuse of components, thereby supporting efficient long-term resource management.

4) Regulatory frameworks (existing and prospective) for the EEE-relevant materials and their degree of enforcement

The existing and developing laws, policies, and measures for managing waste from e-waste in Thailand, based on interviews with relevant agencies, reflect progress in advancing draft legislation, issuing control announcements, and setting management standards. They also reveal challenges in enforcement and the readiness of local agencies, which are key factors affecting the future effectiveness of the e-waste management system. The key points can be summarised as follows:

4.1) Status and challenges in enacting core e-waste legislation – Thailand is in the process of advancing key draft acts, namely the Draft Act on the Management of WEEE and the Draft Act on Industrial and Electronic Waste, which incorporate the principles of EPR and the circular economy. However, these laws have yet to be enacted, resulting in a lack of a clear system for e-waste management. The country still relies on community labour without proper regulatory measures for safe operations and pollution prevention.

4.2) Control of imports and transboundary movement of e-waste – Measures are in place to prohibit the import of various types of e-waste and waste from EEE, with the list of prohibited imports expanded from 428 items to 463 items. This aligns with

international standards and obligations under the Basel Convention, enhancing the effectiveness of preventing illegal imports of waste from abroad.

4.3) Local-level guidelines and announcements related to e-waste management –– The PCD issued the 2023 Announcement on Standard Disposal Fees for Hazardous Waste, providing a reference for local administrative organisations to manage hazardous waste effectively. It has also drafted guidelines for regulating the management of discarded EEE in junk shops, aiming to improve worker safety and reduce environmental impacts. The Public Health Act, B.E. 2535 empowers local administrative organizations to manage waste hygienically, but small e-waste items are still often discarded with general waste. Therefore, there is a need to increase collection points, promote public participation, and foster co-operation with the private sector for proper collection and disposal.

4.4) Enforcement gaps and readiness of agencies – Despite the existence of laws and master plans, enforcement remains weak due to a lack of integration amongst agencies, as well as limited infrastructure, personnel, and budgets, especially at the local level. Furthermore, the draft laws emphasise legal provisions more than clear operational measures, resulting in less effective implementation and an inability to fully address the issues, thereby affecting the overall e-waste management system.

4.5) Need to enhance awareness and incentives – Raising awareness and creating incentives are essential to encourage the public and various sectors to recognise the impacts of e-waste and participate in proper management. This also supports behavioural changes to reduce, avoid, and eliminate improper waste disposal, while promoting recycling and sustainable resource use – key factors for building an efficient and sustainable waste management system in the long term.

5) Definition and discussion on urban mining in Thailand

The concept of urban mining in Thailand focuses on managing e-waste as a resource that can be recovered and reused, rather than relying on the extraction of finite natural ores. E-waste contains valuable materials such as gold, silver, copper, aluminium, and plastics, which can be dismantled and reintegrated into production processes. Applying this concept can create added economic value and reduce environmental impacts if managed in accordance with environmental and safety standards, supported by appropriate systems and legislation. The key points can be summarised as follows:

5.1) Linkage with the circular economy – The urban mining concept is an essential part of the circular economy, helping reduce dependence on natural resources and new mineral extraction by turning waste into reusable resources. With an efficient management system and supportive policies, urban mining can increase the value of recycled materials, reduce environmental impacts, and create economic opportunities,

such as job creation and income generation for communities. It also promotes long-term resource security and enables more sustainable and efficient resource management.

5.2) Economic value of e-waste – E-waste has high economic value because it contains valuable materials such as gold, silver, copper, aluminium, and plastics that can be recovered and reused. Thailand therefore emphasises domestic recycling and dismantling rather than exporting, to sustainably return materials into production processes. Developing recycling technology capacity and establishing efficient collection systems are essential to maximise value and minimise environmental impacts. This also helps create jobs and income for communities, while supporting the circular economy and strengthening the country's long-term resource security.

5.3) Community participation and grassroots economy – In many areas, particularly urban and peri-urban zones, there are groups of workers and communities engaged primarily in dismantling and sorting e-waste, generating income for local communities. However, most operate informally, lacking safety and environmental standards, which puts workers at risk of exposure to toxic substances and causes pollution in surrounding communities and environments. Support and regulation are needed to improve safe management, including training on safe working practices and monitoring impacts to reduce risks and improve the quality of life for workers and communities.

6) Comments and recommendations for improving e-waste management

The comments and recommendations from in-depth interviews focus on developing Thailand's waste EEE management system to be systematic, comprehensive, and safe by integrating the roles of the public sector, private sector, communities, and the informal sector through key mechanisms. These include enforcing EPR principles, establishing truly accessible take-back systems, setting strict factory standards and regulatory oversight, creating economic incentives, and investing in technology and knowledge. Such measures aim to foster a sustainable circular economy while reducing health and environmental risks.

In addition, realistic collection targets should be set based on local contexts, starting with pilot projects to test digital mechanisms, incentive schemes, and models for integrating the informal sector before scaling up nationwide. This phased approach will help ensure effective and sustainable implementation in the long term. The key points can be summarised as follows:

6.1) Enforcing EPR in practice – The EPR principle should clearly define the roles and responsibilities of producers, importers, and distributors, covering registration and data reporting, along with clear penalties to ensure genuine accountability. The take-back system should be linked to appropriate indicators aligned with Thailand's context, so that e-waste collection is efficient and measurable in practice.

6.2) Developing a decentralized take-back and logistics system – Collection points should be expanded for easy access, such as in shops, department stores, and community centres, while recycling facilities should be located close to e-waste aggregation sites to reduce transportation costs. In addition, digital systems such as the Digital WEEE Manifest should be used to link, track, and verify the flow of discarded EEE, ensuring transparency, accuracy, and efficient waste management.

6.3) Facilitating the transition of the informal sector into the formal system – Informal actors such as itinerant waste buyers, junk shops, and community enterprises should be given opportunities to participate formally through proper registration and training, supported by benefit-sharing models or other incentives to encourage sustained participation. Appropriate rights and benefits should be provided to prevent them from operating outside the system, thus promoting a more organised and effective e-waste management process.

6.4) Upgrading recycling plant standards and regulatory oversight – Licensing standards for dismantling, recycling, and hazardous waste management facilities should be set, with strict criteria for emissions control and regular inspections. The role of local administrative organisations and inspection agencies should be strengthened to improve monitoring and enforcement, ensuring safe e-waste management.

6.5) Economic and financial measures – Consumer incentives for product returns should be created, such as coupons, discounts, or trade-in programmes, to encourage continuous and widespread returns of old devices. Collection points should also be established in remote areas for greater convenience and to reduce consumer burdens. In addition, tax incentives or subsidies should be considered for recycling facilities that operate in compliance with the law, to promote sustainable e-waste management, improve resource recovery efficiency, and reduce environmental impacts.

6.6) Training and public awareness – Community-level e-waste dismantling standards should be set, covering the use of personal protective equipment, proper procedures, and safe hazardous waste storage. Informal sector workers should be trained to acquire knowledge and skills for safe operations. Public awareness campaigns should also be conducted on the value of e-waste, extending product lifespan, and source separation, to promote effective waste management from the outset.

6.7) Promoting R&D, eco-design, and e-waste recycling technologies – Investment in research on technologies for precious and rare metal recovery should be encouraged, along with promoting product designs that are easy to dismantle and recycle in line with eco-design principles to improve reuse efficiency. The development of downstream recycling industry clusters should also be supported to help reduce the export of recyclable materials and increase the economic value retained within the country.

3.2. Stakeholders' meeting

The Stakeholders' Meeting on Resource Circulation from EEE in ASEAN – Thailand Case was held on 16 July 2025 at The Sukosol Hotel, Bangkok. It was organised in collaboration amongst the Economic Research Institute for ASEAN and East Asia (ERIA), the PCD, and the Thailand Environment Institute (TEI), with participation from 60 representatives from government, the private sector, academia, and civil society. Prior to the stakeholders' meeting, the core members from TEI and ERIA conducted field visits to Asia Green Rescrap Co., Ltd., Prachinburi Province, and the Innovation Research Center for Raw Materials and Recycling Technologies, Samut Prakan Province, on 15 July 2025. The project aims to study and analyse the current situation and future trends in resource circulation related to EEE and e-waste in five countries: Indonesia, Malaysia, the Philippines, Thailand, and Viet Nam.

For the Thailand case, the study involved reviewing statistical data, research reports, and academic articles, as well as conducting interviews with representatives from government agencies, the private sector, and academic institutions. The collected information will be analysed to develop policy recommendations.

A. Summary of Key Speeches

During the opening session, **Wijarn Simachaya, President of the Thailand Environment Institute (TEI),** emphasised the importance of applying the principles of EPR and the urban mining concept to manage rare earth elements efficiently, while reducing environmental impacts from mining activities, such as heavy metal contamination in northern Thailand.

Reo Kawamura, Director for Environmental Policy and Director for the Regional Knowledge Centre for Marine Plastic Debris (RKC-MPD) at the Economic Research Institute for ASEAN and East Asia (ERIA), presented an overview of global waste management and recycling, highlighting statistical data, investment promotion strategies, and sustainable policy approaches for e-waste management. He cited examples of Thailand's progress, such as safe e-waste recycling operations by Asia Green Rescrap Co., Ltd., and pilot recycling technology development by the DPIM, both of which align with the urban mining concept that views waste as a valuable resource.

Thananchai Wannasuk, Deputy Director-General of the PCD, addressed the current situation in which Thailand generates approximately 400,000 tonnes of e-waste annually, with the volume steadily increasing. He stressed the need for legislation to regulate e-waste management, such as the Draft WEEE Act, to establish a clear and sustainable management framework consistent with the National Strategy on Sustainable Development. The draft law is currently under consideration by the Cabinet.

Wanich Sawayo, Acting Expert in Waste and Hazardous Substances Management, PCD, presented data showing that the amount of e-waste in Thailand continues to increase. Key challenges include technological and lifestyle changes, legal limitations, the capacity of

local authorities, and practices inconsistent with national policies and international commitments. Currently, only 10% of e-waste is managed properly, while the remaining 90% is mostly dismantled manually or burned in open areas. Relevant policies and laws include the Act on Control of Auction Sales and Trade in Second-Hand Goods, the Public Health Act, the Factory Act, and the draft WEEE Act, which incorporates circular economy and EPR principles, requiring producers/importers to take responsibility for proper take-back and disposal of waste to ensure sustainable e-waste management.

B. Summary of Study Results

At the event, information was presented on the e-waste situation in Thailand, along with findings from the study on international resource circulation in ASEAN, focusing on the Thailand case. The key details are as follows:

Fusanori Iwasaki, Representative from ERIA, stated that the project has two key objectives: (i) to study the domestic e-waste management situation in each country, and (ii) to analyse regional resource security, focusing on the impacts of international environmental laws such as the Basel Convention. The study covers four main themes: (i) recycling and waste disposal technologies, assessing each country's technological capacity; (ii) the use of safe and easily recyclable alternative materials to replace risky or scarce raw materials; (iii) regulatory frameworks, reviewing laws, policies, and enforcement on transboundary waste; and (iv) the concept of urban mining to recover valuable materials from waste. The work is conducted with five ASEAN member states – Indonesia, Malaysia, the Philippines, Viet Nam, and Thailand – using methods such as statistical data analysis, cross-border material flow analysis, stakeholder interviews, and site visits, alongside stakeholder meetings to promote understanding and support safe, sustainable resource circulation in the region.

Sirintip Boonyoung, Researcher at TEI, presented findings from a study on international resource circulation between Thailand and Japan. Analysis of trade data for UEEE and e-waste from 2015 to 2024 showed that China has consistently been Thailand's top trading partner. Japan ranked second in 2015–2021 but fell after 2022, with the US taking second place. Although Japan remains amongst Thailand's top five trading partners, most trade value is in new products. Trade in used goods and e-waste between Thailand and Japan is small and volatile, with some years showing no trade at all, due to global trade conditions, policy changes, and the COVID-19 pandemic. Other obstacles include changes in HS codes and unclear declarations. Cases of smuggling were also found, such as the January 2025 seizure of 10 containers carrying 256 tonnes of e-waste – nine from Japan and one from Hong Kong – declared under mixed product categories.

Sirintip Boonyoung further stated that, based on statistical data analysis, interviews with relevant agencies, and on-site observations, several issues, obstacles, and gaps in Thailand's e-waste management were identified: Legal and regulatory gaps, most of e-

waste is handled by the informal sector, stakeholder does not yet prioritise eco-design. These findings have led to the development of two main areas of policy recommendations.

C. Key Points from the Panel Discussion

The panel discussion featured representatives from relevant agencies as listed:

- Theerawut Tannukit, Director of Engineering Services Division, Acting Director of Raw Materials and Downstream Industries Innovation Division, DPIM
- Suras Tangphaitoon, Director of Industrial Development, EEI
- Nuchanat Suphansri, Expert Scientist, DIW
- Pattanachai Kaewkanha, General Manager Thailand, Asia Green Rescrap - ALBA Group Asia

The key issues from the panel discussion covered Thailand's e-waste management, including recycling technologies, material circulation, challenges in import control, and management approaches. The main points discussed are as follows:

1) E-waste recycling technologies in Thailand – Efforts are underway to develop e-waste recycling technologies to promote urban mining by applying mineral processing and metallurgy technologies to recover metals and minerals for reuse. The DPIM has established the Raw Materials and Downstream Industries Innovation Research and Development Center in Samut Prakan Province as a hub for technology transfer and training – both theoretical and practical – and to provide machinery and equipment support to recycling industry operators. This aims to strengthen domestic raw material security. Key recycling technologies developed include:

- Recycling of waste printed circuit boards
- Recycling of waste solar panels
- Recycling of spent lithium-ion batteries

2) Study on material circulation of EEE in Thailand – This R&D initiative aims to assess the potential for material recovery, develop management approaches suitable for the national context, promote the circular economy, and foster collaboration amongst government, the private sector, and consumers. Notable projects include:

- Simulation research on WEEE management processes, developing the Digital WEEE Manifest to monitor, control, and record the movement of WEEE using QR codes
- Research on collection and management of used refrigerants from air conditioners
- Promotion of proper reclamation processes for end-of-life air conditioners and refrigerants to reduce greenhouse gas emissions, in partnership with major appliance

retailers under the 'Old for New' campaign, promoting safe management and reducing environmental impacts

3) Challenges in controlling e-waste imports in Thailand – Strict measures are in place to control e-waste imports due to environmental and health risks. These are regulated under the Hazardous Substances Act, B.E. 2535 (List 5.2, Item 2.18) and through licensed recycling plants (Type 105 = 33 facilities; Type 106 = 214 facilities). E-waste imports are prohibited under the 2025 MOC Notification (effective 24 June 2025) and the 2020 Ministry of Industry Notification banning the use of foreign electronic parts as raw materials in factories. Exports are also controlled under the Basel Convention. A common issue is smuggling, with false declarations labelling shipments as scrap metal to bypass regulations, often mixed with prohibited items. Major sources include the US. Monitoring networks, such as the Basel Action Network through 'Operation Can Opener', track and alert on illegal waste trade. Co-operation between the DIW, Customs Department, and PCD ensures inspection of suspicious shipments at ports/border checkpoints and mandates clearance of detained goods within 30 days.

4) E-waste management in Thailand – Thailand generates approximately 400,000 tonnes of e-waste annually within the formal sector, mostly from households (e.g., televisions, refrigerators, air conditioners, and computers). Additionally, about 200,000 tonnes per year are generated outside the formal sector, primarily from industry (e.g., electrical equipment in factories and obsolete electronic machinery). A key strength is Thailand's high recovery rate – about 80% – which means almost no e-waste is sent to landfills. This reflects the success of the country's e-waste management and recycling systems.

This panel reflected Thailand's e-waste management efforts, which focus on advancing recycling technologies to promote urban mining – applying mineral processing and metallurgy to recover metals and minerals from waste. These efforts are supported by the DPIM Innovation Center in Samut Prakan, which provides technology transfer, training, and equipment to recyclers. Research on material circulation is also underway to enhance recovery potential, develop context-appropriate management models, and promote circular economy practices through initiatives such as the Digital WEEE Manifest, refrigerant collection systems, and 'Old for New' campaigns. While strict import controls are enforced under national laws, Basel Convention obligations, and licensing requirements, smuggling through false declarations remains a challenge. Thailand generates around 400,000 tonnes of household e-waste and 200,000 tonnes from industry annually, achieving a high recovery rate of approximately 80 %, with minimal landfill disposal – demonstrating the effectiveness of its recycling and resource recovery systems.

3.3. Conclusion

E-waste management remains a significant challenge in terms of legislation, technology, and enforcement, with the public and private sectors, academia, and civil society, all playing roles and making efforts to develop a sustainable management system. However, incomplete and ineffective law enforcement, along with issues such as illegal imports and incomplete data collection, continue to pose major obstacles to the effective management of e-waste.

At the same time, Thailand has opportunities to develop a modern and efficient recycling system through the concepts of urban mining and the circular economy, which transform waste into valuable resources. Integrating the informal sector into the formal system, combined with the promotion of new technologies and innovations, can help raise standards and improve safety in recycling processes.

To achieve maximum efficiency in e-waste management, Thailand must expedite the enactment of comprehensive and clear legislation, while developing modern digital technologies for product take-back and data tracking. Furthermore, co-operation should be strengthened both locally and internationally to strictly control the import of prohibited goods and enhance the efficiency of domestic management. Public awareness and workforce capacity development in the recycling sector are also key drivers for advancing this system toward sustainable results.

Through collaboration and integration across all sectors, Thailand can overcome these challenges and establish an effective e-waste management system that aligns with circular economy principles and Sustainable Development Goals, ensuring long-term stability and resilience in the future.

4. Policy Recommendations on the International Material Flow on the EEE - Relevant Materials between Thailand and Japan

Based on the compilation and analysis of relevant information from statistical studies, in-depth interviews with relevant agencies, and field observations, several key issues have been identified that reflect the problems, obstacles, and gaps in Thailand's e-waste management system. These findings form the basis for developing comprehensive policy recommendations appropriate to the national context. The study team has formulated policy recommendations under two main categories as follows:

A. Policy Recommendations for E-waste Management in Thailand – comprising four key areas:

1) Legal and regulatory measures

- Strictly enforce EPR principles, requiring producers and importers to take responsibility across the full product life cycle – from design and take-back to recycling – and establish a transparent system for tracking and reporting producers' performance.
- Regulate and upgrade recycling facility standards, setting technical, safety, and environmental requirements in line with international standards. This should include thorough inspections before licensing and periodic re-evaluations.
- Improve import inspection systems by shifting from random checks to 100% inspection of high-risk product categories, using technologies such as X-ray scanners and artificial intelligence systems to increase accuracy and speed, thereby preventing illegal imports and improper handling.
- Establish dismantling standards for end-of-life equipment, with clear operational guidelines to ensure dismantling is carried out safely and in an environmentally sound manner.

2) Technical and management systems

- Develop easily accessible e-waste take-back channels, establishing collection points that cover all areas – particularly near aggregation sites and communities – to facilitate public participation. Distribute recycling points to reduce transportation costs and improve collection efficiency, while setting realistic and achievable take-back targets.
- Develop a digital platform for easily locating e-waste collection points, such as a website or application equipped with mapping features and complete information.
- Implement a Digital WEEE Manifest system linking data from take-back, transportation, dismantling, to recycling stages, with tracking mechanisms to prevent unauthorised movement or improper handling.

- Develop community-level dismantling standards, providing training and knowledge to both formal and informal sector workers in methods suited to the community context, ensuring operations are carried out correctly and safely. Assign local administrative organisations to strictly monitor and oversee the implementation.

3) Collaboration

- Support the transition of informal operators into the formal e-waste management system by building their capacity and providing training on technical skills, safety, and environmental requirements to enable compliance with established standards.
- Create economic incentives and financial support by establishing a dedicated support fund to help informal operators upgrade tools and equipment to meet standards, as well as offering tax benefits or subsidies for those who formally join the system.
- Promote co-operation and profit-sharing mechanisms by developing collaboration frameworks between formal and informal operators to establish efficient e-waste collection and sorting networks and implement fair revenue-sharing systems from recycling to encourage participation and operational sustainability.

4) Awareness and behavioural change

- Raise awareness of the 'value' of e-waste by launching public communication campaigns to highlight its worth and recycling potential, using diverse communication channels – such as television, online media, and community events – to stimulate public participation in e-waste management.
- Encourage sustainable use of electrical products by promoting care, maintenance, and repair to extend product lifespan and reduce e-waste generation.
- Communicate e-waste take-back channels to the public consistently and widely through various online and offline media, to improve accessibility and encourage proper e-waste disposal practices.

B. Policy Recommendations for Strengthening Thailand–Japan Co-operation on E-Waste Management

1) Promote bilateral co-operation

Establish a memorandum of understanding (MoU) between the regulatory agencies of Thailand and Japan to create a clear and systematic framework for e-waste management co-operation. The MoU should set out joint procedures for controlling, inspecting, and monitoring the transboundary movement of e-waste in strict compliance with the Basel Convention, as well as ensuring transparent and timely information exchange to improve the effectiveness of preventing illegal imports and exports of waste. In addition, a regular joint meeting mechanism should be established to provide a platform for both officials from

both sides to exchange information, discuss challenges, share best practices, and present new technologies related to e-waste management. These meetings should also serve to jointly monitor and evaluate the implementation of the agreement, enabling timely and effective adjustments to approaches and solutions.

2) Transfer of advanced recycling technologies and standards from Japan

Facilitate the transfer of advanced recycling technologies from Japan, particularly technologies for extracting precious metals from e-waste, which can enhance economic value and reduce environmental impacts. Promote knowledge and personnel exchange between enterprises and research institutes in both countries to build the understanding and skills necessary for effective technology application. In addition, accelerate the development of recycling facility standards in Thailand to align with international standards or equivalent Japanese standards, thereby building confidence in the quality and safety of recycling processes. Encourage operators to adopt these standards as strict operational guidelines. Furthermore, establish a dedicated training centre for recycling technologies to transfer knowledge and modern skills to Thai personnel, and promote joint R&D between Thailand and Japan to develop recycling technologies suitable for Thailand's context and responsive to future needs.

3) Establish an international used materials exchange centre

Create an international hub between Thailand and Japan for sorting and storing valuable materials recovered from e-waste. This centre would serve as a central hub for improving the efficiency of recyclable material management, ensuring that materials are channelled back into the recycling system in an environmentally sound and legally compliant manner. It would also enhance transparency and help prevent illegal imports or improper handling. A digital tracking system should be developed to monitor and record material movements in real time, linking data with relevant agencies in both Thailand and Japan. In addition, quality control measures should be promoted before materials enter the recycling system, such as contaminant analysis and material property assessment, to ensure that the materials are suitable and safe for recycling. Such measures would help reduce illegal waste handling, improve recycling efficiency, and promote sustainable resource use in the region.

4) Develop a joint data infrastructure and database

Establish a centralised database covering information on EEE, UEEE, and e-waste between Thailand and Japan to support effective life cycle planning and management. This database should be linked to the customs systems and relevant agencies in both countries to accurately track the movement of goods and waste, with real-time verification of data accuracy. The creation of a joint central database would be a key tool in strengthening Thailand–Japan co-operation and driving sustainable and efficient e-waste management.

5) Private sector participation

Encourage co-operation between Japanese original equipment manufacturers operating in Thailand and take-back systems for end-of-life products under EPR principles, ensuring that producers play a central role throughout the product life cycle – from design and manufacturing to efficient take-back and recycling. This full life-cycle responsibility would also strengthen collaboration between producers, consumers, and relevant agencies in sustainable e-waste management, while increasing the economic value of recycled materials.

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Chapter 6

Viet Nam

Introduction

The increasing production and consumption of electrical and electronic equipment (EEE) have led to a surge in electronic waste (e-waste), posing significant environmental and resource management challenges globally. In the context of the ASEAN region, where economic growth and industrialisation are accelerating, managing the material flow of EEE-relevant materials has become a critical issue. The project 'Research on Sound International Resource Circulation in ASEAN Region (ET Remaining Balance)' aims to address this pressing concern by examining the current status and future outlook for the circularity of EEE-relevant materials, focusing on five ASEAN member states: Indonesia, Malaysia, Philippines, Thailand, and Viet Nam.

This study specifically pertains to Viet Nam, where the increasing volume of EEE imports and domestic consumption has resulted in a growing stockpile of e-waste. To understand the international material flow related to EEE between Viet Nam and Japan, the research will employ quantitative analysis based on two primary data sets: the Basel Convention and international trade statistics. This approach will facilitate the identification of existing issues in promoting international resource circulation, with a particular focus on the trade and management of EEE-relevant materials.

Additionally, the study will conduct a comprehensive survey on the technological, regulatory, and definitional aspects of urban mining in Viet Nam. This includes an analysis of the current regulatory framework governing the handling and recycling of EEE materials, as well as the identification of key technological challenges and opportunities for resource recovery. By integrating both quantitative and qualitative data, the study will provide a comprehensive overview of the current state of resource circulation in Viet Nam.

The findings from this study will inform policy recommendations for ASEAN Member States and the Government of Japan, emphasising strategies to enhance the sound international resource circulation of EEE-relevant materials in accordance with the Basel Convention.

1 The International Material Flow Relevant to the EEE and E-waste between Viet Nam and Japan

1.1 Overview

The international flow of EEE materials between Viet Nam and Japan represents a significant dimension of the economic partnership between these two nations, reflecting broader patterns of technological exchange, resource utilisation, and waste management challenges in the Asia-Pacific region. This chapter presents a comprehensive analysis of the current state, patterns, and trends of EEE-relevant material flows connecting Viet Nam and Japan, with particular attention to their economic, environmental, and regulatory implications.

Viet Nam, as a rapidly industrialising economy with an expanding manufacturing base, has become increasingly integrated into global supply chains for electronic products. Meanwhile, Japan, with its advanced technological capabilities and mature recycling systems, represents both a significant market for Vietnamese electronic exports and a source of high-value components and materials. This relationship has evolved within the context of international frameworks such as the Basel Convention, which governs transboundary movements of hazardous wastes, including certain types of e-waste.

Our analysis draws on multiple data sources to present a holistic picture of EEE material flows, including trade statistics, academic research, policy documents, and industry reports. We examine not only the volume and value of trade in EEE-relevant materials but also the composition of these flows, highlighting key categories such as electrical machinery, accumulators, and electronic waste. Additionally, we identify significant trends and patterns that have emerged over the 2020–2022 period, including persistent trade imbalances and the concentration of trade in specific product categories.

This chapter also addresses critical challenges in monitoring and managing EEE material flows, particularly the difficulties posed by current classification systems and the lack of harmonisation between waste management frameworks and trade nomenclatures. The absence of specific Harmonized System (HS) codes for e-waste, for instance, complicates efforts to track cross-border movements of end-of-life electronics and their components.

Through this analysis, we seek to provide a foundation for understanding the current state of EEE material flows between Viet Nam and Japan, establishing a baseline for identifying issues, opportunities, and potential policy interventions to promote sustainable resource circulation between these two important economic partners.

1.2 Literature review

Legal Framework on EEE and Waste Electrical and Electronic Equipment Directive (WEEE)

Viet Nam has established specific regulations for waste management, including e-waste. According to Decision No. 13/2023/QĐ-TTg, Viet Nam prohibits the import of e-waste in principle. However, under Decision No. 13/2023/QĐ-TTg, certain types of metal waste and scrap may be imported as production materials with individual permits issued by the Government of Viet Nam, including copper, nickel, aluminum, zinc, and tin waste and scrap (Prime Minister of Viet Nam, 2023a). This regulatory framework provides the foundation for managing transboundary movements of EEE-related materials.

In January 2025, Viet Nam introduced Decision No. 222/QĐ-TTg, establishing a national action plan for implementing the circular economy until 2035. This policy specifically identifies EEE waste as target materials for circular economy implementation, recognising both the environmental risks and resource recovery potential of e-waste (Prime Minister of Viet Nam, 2025a).

National Strategy for EEE and WEEE

The Vietnamese government's the National Export Strategy of Viet Nam – Action Plan,

developed by the Ministry of Industry and Trade with support from the International Trade Centre, provides a situational analysis of the international material flow relevant to EEE between Viet Nam and Japan, emphasising Viet Nam's export potential in this sector. The document highlights Viet Nam's robust economic growth, with electronics identified as a key export sector with significant untapped potential (e.g. US$19.7–22 million for various EEE products). This growth is driven by demand from markets such as Japan, which accounted for 7.43% of Viet Nam's exports in 2019. Challenges include limited technological innovation, dependence on foreign direct investment (FDI) for high-tech production, and inadequate co-ordination of trade policies, impacting efficient material flows. The strategy proposes enhancing export competitiveness through innovation ecosystems, leveraging free trade agreements such as the Comprehensive and Progressive Agreement for Trans-Pacific Partnership, and diversifying markets, with Japan as a critical partner due to its advanced EEE demand. Compared to Japan's sophisticated recycling and production systems, Viet Nam's EEE sector relies heavily on assembly and lacks comprehensive waste management, underscoring the need for technology transfer and sustainable trade practices to optimise material flows.

The National Export Strategy for Viet Nam's Electronics Sector, published by the Ministry of Industry and Trade of Viet Nam, outlines a strategic framework to enhance the country's electronics industry by boosting exports and integrating into global value chains, with implications for international material flows of EEE between Viet Nam and Japan. The document emphasises increasing competitiveness, fostering innovation, and strengthening domestic supply chains, while highlighting Viet Nam's participation in global trade through free trade agreements and its role in the electronics value chain. In the context of material flows with Japan – a key player in the electronics sector with advanced manufacturing and stringent environmental standards – the strategy underscores the need for Viet Nam to align with international benchmarks, potentially influencing the management of EEE material cycles. By promoting technology transfer and capacity building, the strategy aims to elevate Viet Nam's production capabilities, which could increase the volume of electronics traded with Japan and necessitate improved handling of associated material flows, including end-of-life products and e-waste, to meet Japan's regulatory expectations.

The National Export Strategy for Environmental Goods (Prime Minister of Viet Nam, 2022), developed by the Ministry of Industry and Trade, provides a situational analysis of the international material flow relevant to EEE between Viet Nam and Japan, focusing on the environmental goods sector. The document identifies key challenges, including Viet Nam's heavy reliance on imported technologies – often from advanced economies such as Japan – limited domestic production capacity, and fragmented policy frameworks, which hinder efficient material flows and recycling processes. The strategy aims to establish a coherent policy mechanism, reduce import dependency by fostering a competitive domestic industry, and promote exports of environmental goods, such as EEE components, to markets like Japan. It proposes actions like enhancing research and development, strengthening local producer–international partnerships (notably with Japanese firms), and aligning with global environmental standards to facilitate sustainable trade. Compared to Japan, which boasts

advanced EEE recycling systems and extended producer responsibility (EPR) frameworks, Viet Nam's approach emphasises building domestic capacity while leveraging trade agreements to enhance material flows, reflecting its developing economy status.

Status Quo of E-Waste Disposal and Recycling in Viet Nam

According to Nguyen and Tran (2019), Viet Nam's e-waste recycling sector faces significant challenges due to the absence of a formal collection and recycling system. The study highlights that the informal sector dominates e-waste management, resulting in environmental pollution and health risks from the improper handling of hazardous materials. In 2018, Viet Nam generated approximately 116,000 tonnes of e-waste, much of which is manually recycled and exported to China. Compared to countries such as Japan and Singapore, which have robust e-waste management systems, Viet Nam lacks the infrastructure and regulatory frameworks needed for sustainable practices. The authors note that while electronics usage is rapidly increasing, the lack of formal systems exacerbates environmental degradation, with hazardous substances like lead and mercury contaminating soil and water. They recommend establishing a comprehensive e-waste management system, including formal collection networks, advanced recycling infrastructure, and public awareness campaigns, drawing lessons from successful models in Japan and Singapore.

According to the Department of Science and Technology in Ho Chi Minh city (2021), Viet Nam faces considerable challenges in managing its e-waste, generating 514,000 tonnes in 2019, or 5.6 kg per capita, yet its management systems lag behind those of more developed nations like China and Japan. The document highlights that Viet Nam's e-waste management is hindered by an underdeveloped formal collection system and a heavy reliance on the informal sector, which often employs rudimentary recycling methods. While global research on e-waste management has advanced, with 22,961 patents filed by December 2020 – predominantly led by China and Japan – Viet Nam has only 10 registered patents, nine of which are foreign-owned, indicating limited domestic innovation. Notable technological advancements in Viet Nam include hydrometallurgical techniques for recovering metals like copper (up to 99% efficiency) from circuit boards and processes for extracting rare earth elements such as yttrium and europium from fluorescent lamps (over 90% efficiency). However, these innovations remain nascent and insufficiently scaled. The study underscores the need for a comprehensive e-waste management system in Viet Nam, advocating for improved collection mechanisms, advanced recycling technologies, and robust regulatory frameworks, alongside the adoption of EPR to enhance sustainability.

According to Nguyen, Lam, and La (2021), the management of household e-waste in Can Tho city, Viet Nam, is predominantly informal, lacking established formal collection or recycling systems. The study, conducted across wards such as An Hoa, Ba Lang, Long Tuyen, and Tan Loc, revealed that e-waste is primarily managed through sales to scrap dealers or repair for reuse. This informal approach poses significant environmental and health risks due to the improper handling of hazardous materials. Additionally, the research highlights a notable lack of awareness amongst residents regarding the impacts of e-waste, with survey results indicating limited understanding of its consequences. The authors stress the need for further

studies to explore the causes of this awareness gap and advocate for educational initiatives and enhanced management frameworks to address these challenges effectively.

According to Bui and Bui (2024), Viet Nam is grappling with a significant e-waste challenge, producing approximately 100,000 tonnes annually, with forecasts suggesting a sharp rise, potentially reaching 250,000 tonnes from televisions alone by 2025. The management of e-waste is predominantly handled by the informal sector, employing outdated and hazardous techniques that contribute to severe environmental pollution and health risks due to toxic substances such as lead and mercury. The study underscores the absence of a formal management system and advocates for centralised collection, recycling, and the adoption of a circular economy model to address these issues. While technological advancements, such as furnaces for metal recovery from circuit boards, have been developed in Viet Nam, they remain inadequate to fully mitigate the escalating e-waste problem.

Monitoring of E-Waste Trade

The *Global E-Waste Monitor 2024* provided comprehensive data showing that globally, 62 billion kg of e-waste was generated in 2022, with only 22.3% formally collected and recycled. Asia, which includes Viet Nam, generates almost half of the world's e-waste (30 billion kg) but has made limited progress in e-waste management and legislation. These statistics provide important context for understanding Viet Nam's position within global e-waste flows.

Several research articles identify challenges of e-waste trade monitoring in Viet Nam. Ignatuschtschenko (2017) revealed that Viet Nam generates the lowest amount of e-waste per capita amongst China, Japan, and Viet Nam, but projections indicate substantial increases between 6 to 16.5 times greater for major household appliances from 2006 to 2020. Viet Nam's e-waste management approach is least consistent with the Integrated Sustainable Waste Management Framework, characterised by a dominant informal sector, underdeveloped formal collection systems, rudimentary recycling technologies, and insufficient regulatory frameworks. Despite Viet Nam's prohibition on importing e-waste and second-hand electronics, these items continue to enter the country through illegal channels and are sometimes re-exported to China, creating a circular flow of unregulated e-waste. The study highlights that informal e-waste recycling in Viet Nam leads to serious environmental pollution and associated health problems, with hazardous materials affecting soil, water resources, and air quality. This situation is compounded by Viet Nam's developing economy status, with limited recognition of e-waste as a distinct issue requiring targeted management approaches.

Tran and Salhofer (2018) also highlighted the significant challenges the country faces in managing e-waste, including the lack of specific legislation, the dominance of informal recycling through 'craft villages', and limited monitoring data. Their research reveals that Viet Nam generated approximately 1.9 kg of e-waste per capita in 2014, with projections reaching 3.7 kg by 2020. The study identifies three major sources of e-waste: domestic disposal of end-of-life electronics, transboundary movements (including illegal importation), and industrial waste from electronic manufacturing. Viet Nam's recycling system operates through a complex interplay between formal and informal sectors, with the latter dominating through specialised craft villages that dismantle, sort, and process specific

types of e-waste. The authors documented concerning environmental and health impacts from primitive recycling methods, particularly from processes such as open burning of copper wires, acid leaching, and improper disposal of hazardous components. When compared with other Asian countries, Viet Nam shares similarities with developing nations in the region regarding weak regulatory frameworks, illegal transboundary movements, and the prevalence of informal recycling sectors, while differing significantly from industrialised economies such as Japan and the Republic of Korea (henceforth Korea) that have established more comprehensive EPR systems.

A significant challenge in monitoring international e-waste flows involves the classification system used for trade statistics. Li and Zhao (2010) investigated the transboundary movement controls for e-waste amongst 11 Asian countries, highlighting the critical need for standardised identification criteria to distinguish between new, used, and waste electrical and electronic equipment (WEEE). World Customs Organization (WCO) has been working to establish specific HS codes for e-waste, which would improve tracking capabilities. A key proposal under consideration would create dedicated HS codes for e-waste (under Heading 85.49) and mechanical waste and scrap (under Heading 84.88) (UNEP, 2017). Currently, the lack of specific HS codes for e-waste makes it difficult to accurately track these materials between countries like Viet Nam and Japan. The WCO proposal aims to establish clearer definitions for e-waste based on objective criteria rather than intended use, which varies by country (UNEP, 2017).

The United Nations in their 'Recommendations on the Transport of Dangerous Goods: Model Regulations, Volume I' (UN, 2019) provided a detailed framework for the safe transportation of hazardous materials, which is highly relevant to the situational analysis of international material flow of EEE between Viet Nam and Japan. This document outlines a comprehensive classification system dividing dangerous goods into nine classes, including Class 9 for miscellaneous dangerous substances like lithium batteries commonly found in EEE, alongside specific guidelines for packaging, labelling, and consignment procedures to ensure safety across all transport modes. It emphasises the prevention of risks to people, property, and the environment, which is critical, given the hazardous components in EEE, such as batteries and chemicals, that require careful handling during transboundary movements. The recommendations support harmonised regulations, facilitating compliance for Viet Nam and Japan as they manage the increasing flow of EEE and associated e-waste, addressing safety concerns in their trade logistics. This global standard aids in mitigating the environmental and health hazards linked to improper transport practices, offering a foundational model that both nations can adapt to enhance their regulatory frameworks.

Viet Nam, as a signatory to the Basel Convention, is bound by its provisions regarding transboundary movements of hazardous wastes, including certain types of e-waste. Improved harmonisation between Basel Convention waste codes and HS codes would enhance monitoring and control of e-waste flows between Viet Nam and Japan.

1.3 Identification of the EEE-relevant materials for the analysis

Viet Nam's trade with Japan in materials related to EEE offers a window into the evolving

economic ties between these two nations, reflecting both Viet Nam's growing industrial capabilities and Japan's position as a leader in advanced technology. This section explores the flow of EEE-relevant materials over the period from 2020 to 2022, highlighting the broader patterns and strategic implications of this trade relationship. The analysis focuses on the categories of goods exchanged, specifically those tied to electrical machinery, accumulators, and related components, while also considering materials that may have indirect relevance to the EEE sector. By examining these trade dynamics, this section contributes to a deeper understanding of Viet Nam's integration into the global EEE supply chain and its partnership with Japan, a key player in this industry.

Methodology of Categorisation

The HS codes chosen for this study were determined by mapping the Basel Convention's Annex VIII and Annex IX waste list, and categories that include EEE-related wastes subject to international control, to their HS equivalents. This mapping process, informed by the document's amendment proposals to the HS nomenclature, ensures that the selected codes encompass both finished EEE products and their associated waste streams, such as components, scrap, and materials linked to the EEE supply chain. For instance, codes directly tied to EEE, like HS 85 (electrical machinery), HS 850710 and HS 850720 (lead-acid accumulators), and HS 854810 (battery waste), were prioritised alongside codes indirectly related to EEE, such as HS 84 (machinery), HS 741300 (copper cables), and HS 90 (optical instruments). This dual categorisation allows the research to address the full scope of EEE trade, from production inputs to end-of-life disposal, thereby providing a holistic view of Viet Nam's role in the global EEE market and its trade dynamics with Japan.

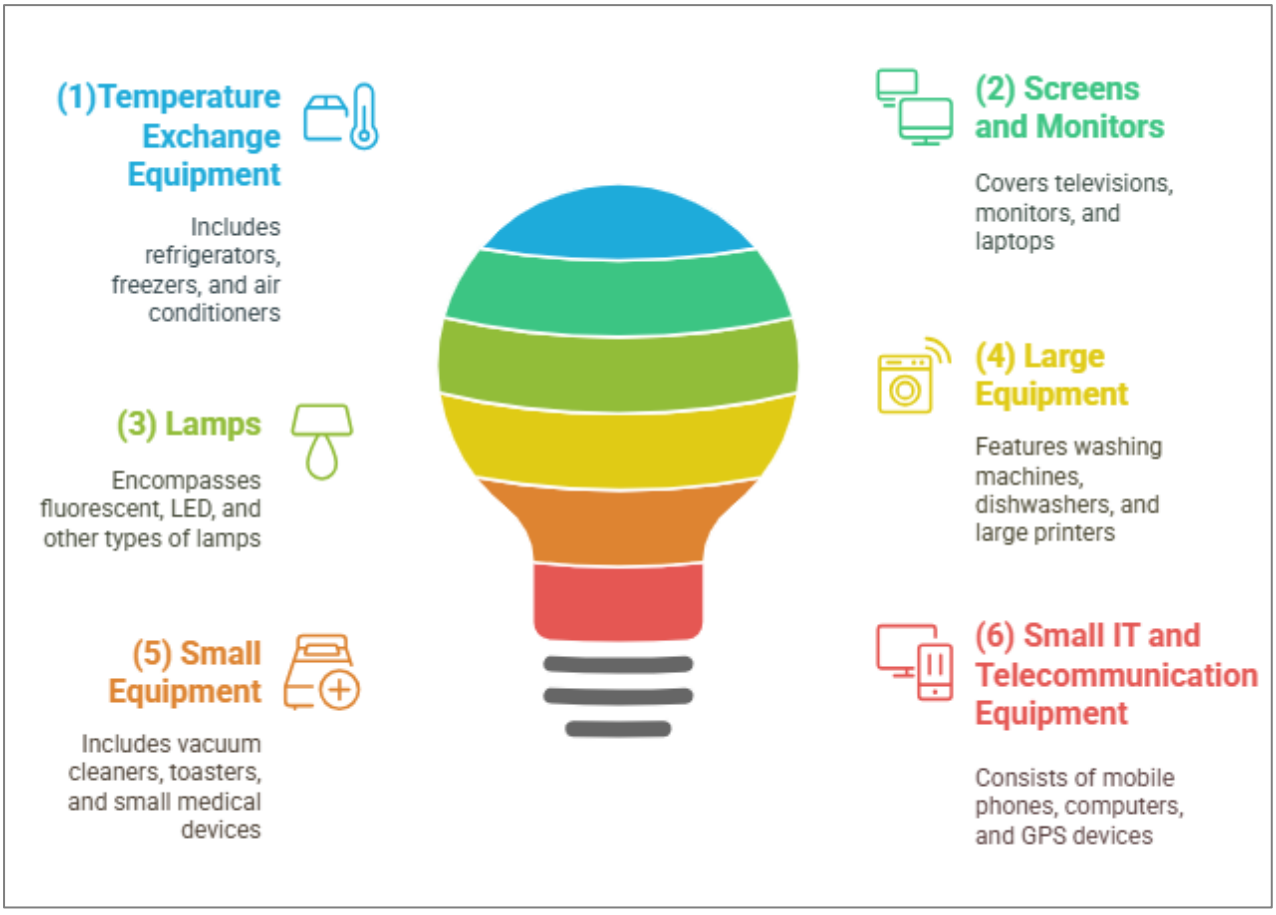
It is important to clarify that the broader HS codes used in this analysis (such as HS 85 and HS 84) include both new products and waste/scrap materials. According to the proposals of the World Customs Organization (UNEP, 2017, pp. 22–45), these chapters encompass waste categories relevant to the Basel Convention, though they are not always disaggregated at detailed levels. For waste-specific codes, our data set shows limited data availability, with information for HS 854999 (electronic and electrical waste and scrap) only available for 2022, as this specific subheading was introduced in the 2022 HS nomenclature update to better track e-waste flows.

Amongst the key HS codes relevant to EEE trade between Viet Nam and Japan, HS 854999 (electronic and electrical waste and scrap) deserves special attention as it represents a critical component of end-of-life material flows. This code covers waste and scrap of electrical and electronic assemblies or printed circuit boards (PCBAs) containing components such as accumulators, mercury switches, glass from cathode ray tubes, and other hazardous components. The flow of these materials is particularly important in understanding the circular economy aspects of the Viet Nam–Japan trade relations, as it reflects both waste management practices and resource recovery potential. Monitoring trade patterns in this category provides valuable insights into how both countries manage their electronic waste streams and the extent to which Viet Nam participates in the processing and recovery of valuable materials from discarded Japanese electronics.

The trade patterns observed in the directly EEE-related categories reveal a multifaceted relationship between Viet Nam and Japan. **This analysis draws on trade data compiled in an Excel file covering Viet Nam's trade with Japan from 2020 to 2022, with partial insights for 2023**. For readers seeking a deeper exploration of the trade volumes, quantities, and values underpinning these trends, a detailed table is available in Annex A. This resource provides a comprehensive breakdown of the data by HS code, offering a granular view of the statistics summarised here.

Within the scope of this study, **the EEE-relevant materials identified in the Viet Nam–Japan trade from 2020 to 2022 are classified into the six equipment categories outlined in the *Global E-Waste Monitor 2024*** (Baldé et al., 2024), **excluding batteries and other electricity storage devices, as specified in Figure 6.1**. Additionally, the analysis of EEE-relevant material flows is conducted through the extraction, synthesis, and analysis of data using the HS codes of related EEE products obtained from the UN Comtrade database (https://comtradeplus.un.org/) (UN, 2025).

Figure 6.1. Categories of Electrical and Electronic Equipment (EEE)



Source: Baldé et al. (2024).

Table 6.1 maps each HS code to its primary and secondary equipment category, noting that some codes (e.g. HS 85, HS 741300) support multiple categories due to their role as

components. Notably, categories like temperature exchange equipment and screens and monitors are underrepresented, as the trade data focuses on components rather than finished products.

This categorisation provides insight into how Viet Nam's trade materials align with global e-waste classifications, though further analysis of finished products could enhance coverage of all categories, particularly for temperature exchange equipment and screens and monitors.

Table 6.1. Identification of the EEE-Relevant Materials for the Analysis

HS Code	Description	Primary Category	Secondary Category	Notes
HS 85	Electrical machinery and equipment	(6) Small IT and telecommunication equipment	(5) Small equipment, (4) Large equipment	Circuits and wiring are common in phones (6), appliances (5), and industrial systems (4)
HS 850710, 850720	Lead-acid accumulators	(4) Large equipment	(5) Small equipment	Primarily used in industrial backup systems (4) but also in portable tools (5).
HS 850790	Parts of electric accumulators	(4) Large equipment	(5) Small equipment	Aligns with accumulators, used in similar equipment types.
HS 854810	Waste and scrap of batteries	By product (not equipment)	N/A	Waste from accumulators; linked to (4) large and (5) small equipment.
HS 84	Machinery and mechanical appliances	(6) Small IT and telecommunication equipment	(4) Large equipment	Computers fit (6); other machinery (e.g. industrial robots) fits (4).
HS 741300	Copper stranded wire, cables	Component (supports all categories)	N/A	Used in wiring across all equipment types; not specific to one category.
HS 90	Optical, electronic instruments	(5) Small equipment	(6) Small IT and telecommunication equipment	Sensors and medical devices fit (5); smart devices may fit (6).
HS 91	Clocks and watches	(5) Small equipment	(6) Small IT and telecommunication equipment	Clocks are (5); smart watches may overlap with (6).
HS 92	Musical instruments	(5) Small equipment	(4) Large equipment	Electronic instruments like synthesizers are (5); larger ones may be (4).
HS 94	Furniture, lamps, lighting fittings	(3) Lamps	(4) Large equipment	Lamps fit (3); furniture with electronics fits (4).
HS 95	Toys, games	(5) Small equipment	(6) Small IT and telecommunication equipment	Electronic toys are (5); gaming consoles may fit (6).

Source: Compiled by the authors (2025).

Additional Notes

Categories (1) and (2) – Missing Equipment Types: The trade data provided does not include HS codes directly corresponding to (1) temperature exchange equipment (e.g. refrigerators, air conditioners) or (2) screens and monitors (e.g. TVs, computer displays). This absence likely reflects the data set's focus on components and materials rather than finished consumer products.

Component and By-Product Classifications:

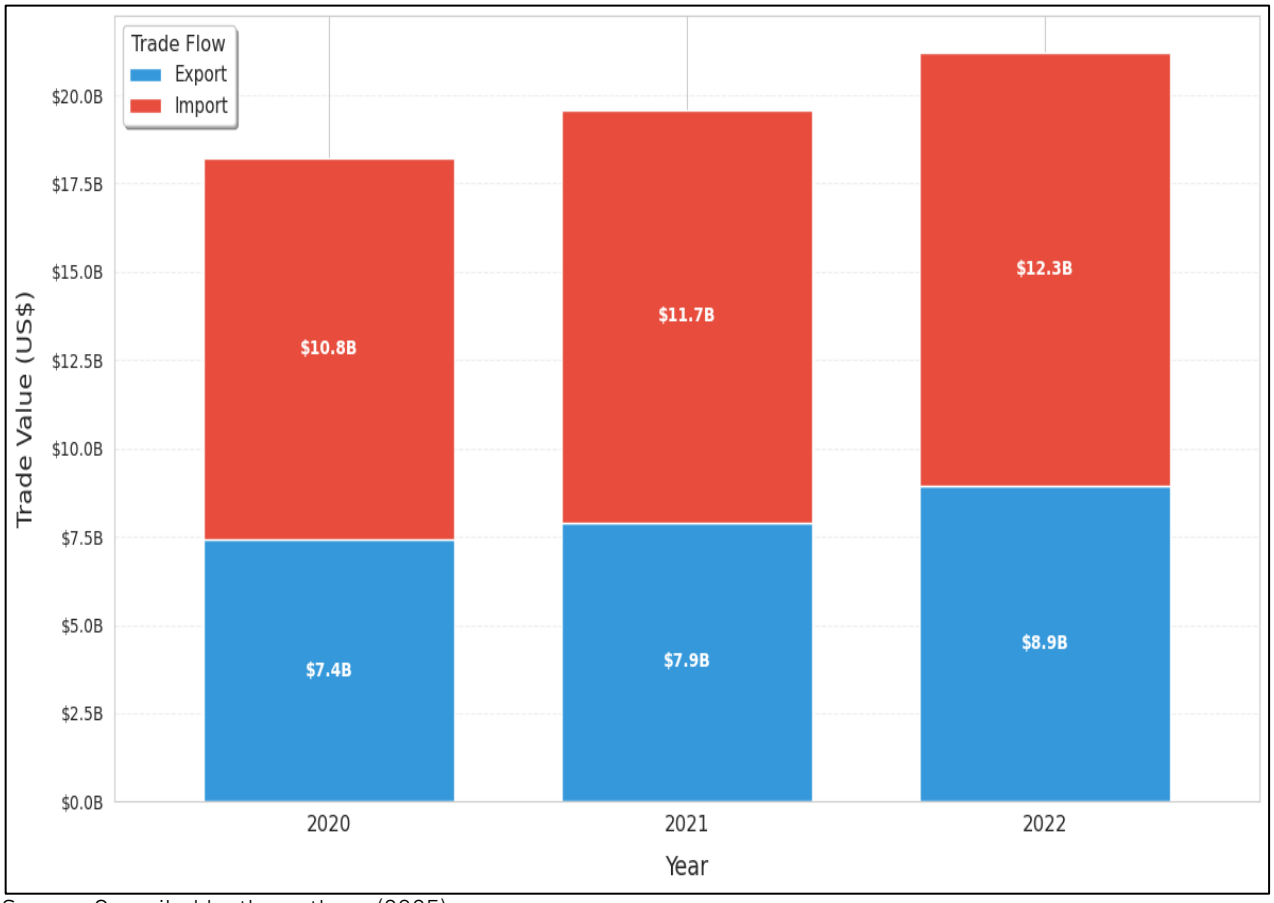
- HS 741300 (Copper cables): Classified as a 'Component' since copper wiring supports all EEE categories through electrical connectivity
- HS 854810 (Battery waste): Categorised as a 'by-product' rather than active equipment but remains linked to categories (4) large equipment and (5) small equipment throughout their operational life cycle.

1.4 EEE-relevant materials and e-waste analysis for Viet Nam and Japan

A) EEE-relevant materials in international trade statistics between Viet Nam and Japan

In this section, we examine the trade dynamics between Viet Nam and Japan from 2020 to 2022, with a focus on EEE. This category includes key products such as machinery, electrical machinery, and specialised items like electric accumulators. Through an analysis of trade values, quantities, and trends in the EEE sector, this study seeks to reveal patterns, pinpoint growth areas, and address challenges in the trade balance between the two nations. The accompanying charts offer a clear visual representation of the data, each supported by a detailed breakdown to explain the trends and their significance. These findings highlight the growing importance of EEE in the economic relationship between Viet Nam and Japan, providing actionable insights for trade policies and business strategies in this critical industry.

Figure 6.2. Total EEE Trade Flows Trends between Viet Nam and Japan over the Years



Source: Compiled by the authors (2025).

The trade of all EEE between Viet Nam and Japan from 2020 to 2023 shows distinct trends in material flow (Figure 6.2). **Viet Nam's exports of EEE to Japan remained a steady grow from around US$7.5 billion annually to US$8.9 billion annually, reflecting little growth** and suggesting challenges like limited production capacity or market barriers. Meanwhile, **imports from Japan grew steadily, rising from US$10.8 billion in 2020 to US$12.3 billion in 2022, driven by demand for high-quality Japanese EEE**.

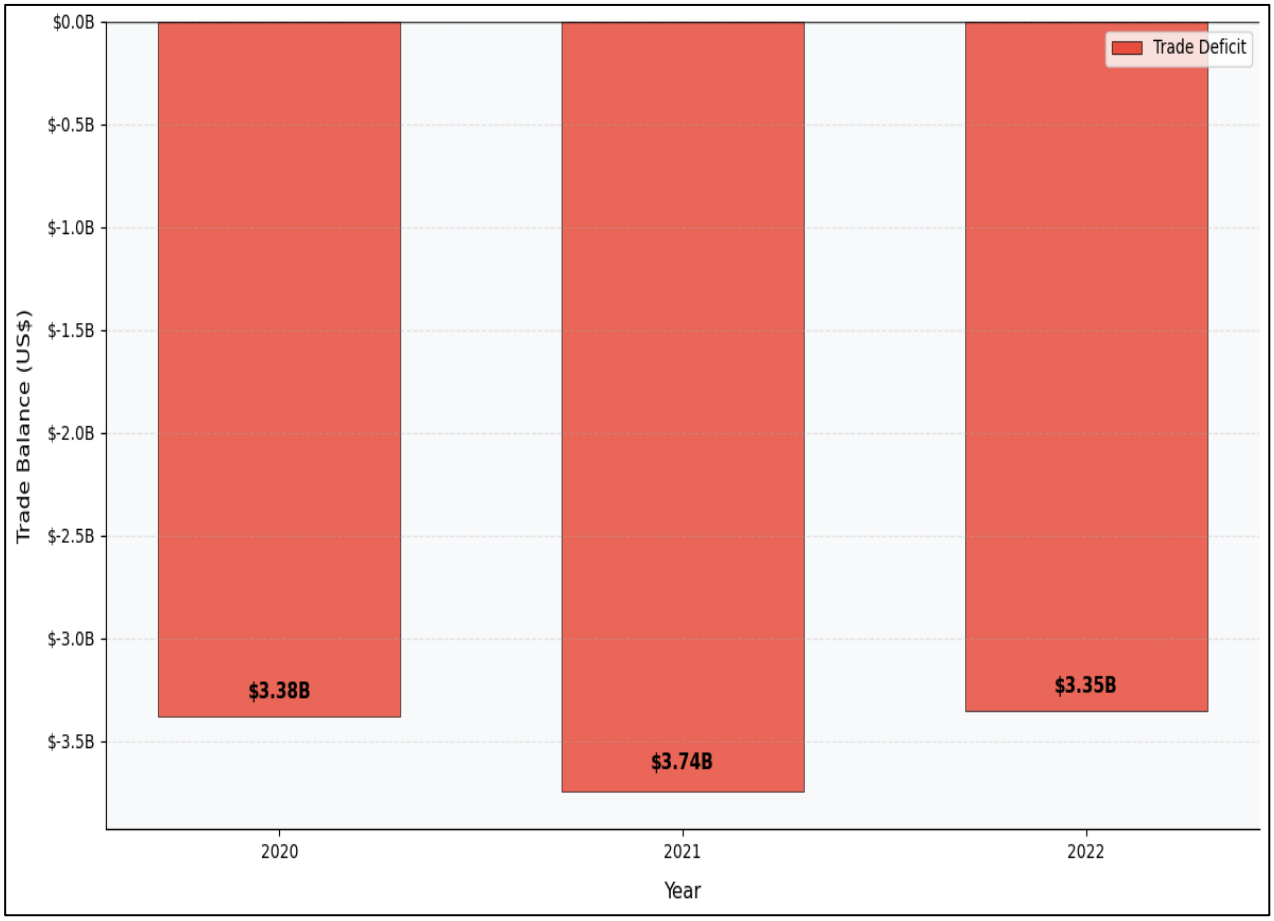
Total EEE Trade Balance over the Years

Figure 6.3 illustrates Viet Nam's trade balance with Japan from 2020 to 2022, specifically within the EEE sector. This balance, calculated as exports minus imports, remained consistently negative over the 3 years, indicating that Viet Nam imported significantly more EEE from Japan than it exported. In 2020, the trade deficit stood at approximately –US$3.38 billion, worsening to –US$3.7 billion in 2021, before showing a slight improvement to –US$3.35 billion in 2022. **This persistent shortfall emphasises Viet Nam's reliance on Japan's advanced EEE products**, likely driven by Japan's superior technological expertise and well-established manufacturing networks.

Looking at the trend, the trade deficit deepened from 2020 to 2021, possibly due to heightened demand for EEE in Viet Nam, supply chain issues, or currency exchange shifts that increased

the cost of imports. However, the modest recovery in 2022 suggests potential efforts to either enhance Viet Nam's EEE exports or reduce its dependence on Japanese imports. **Despite this small upturn, the deficit remained considerable, indicating that while some progress may have occurred, Viet Nam still faces significant hurdles in balancing its EEE trade with Japan**. This pattern points to a structural challenge rooted in the two countries' economic dynamics within this sector.

Figure 6.3. Total EEE Trade Balance Between Viet Nam and Japan



Source: Compiled by the authors (2025).

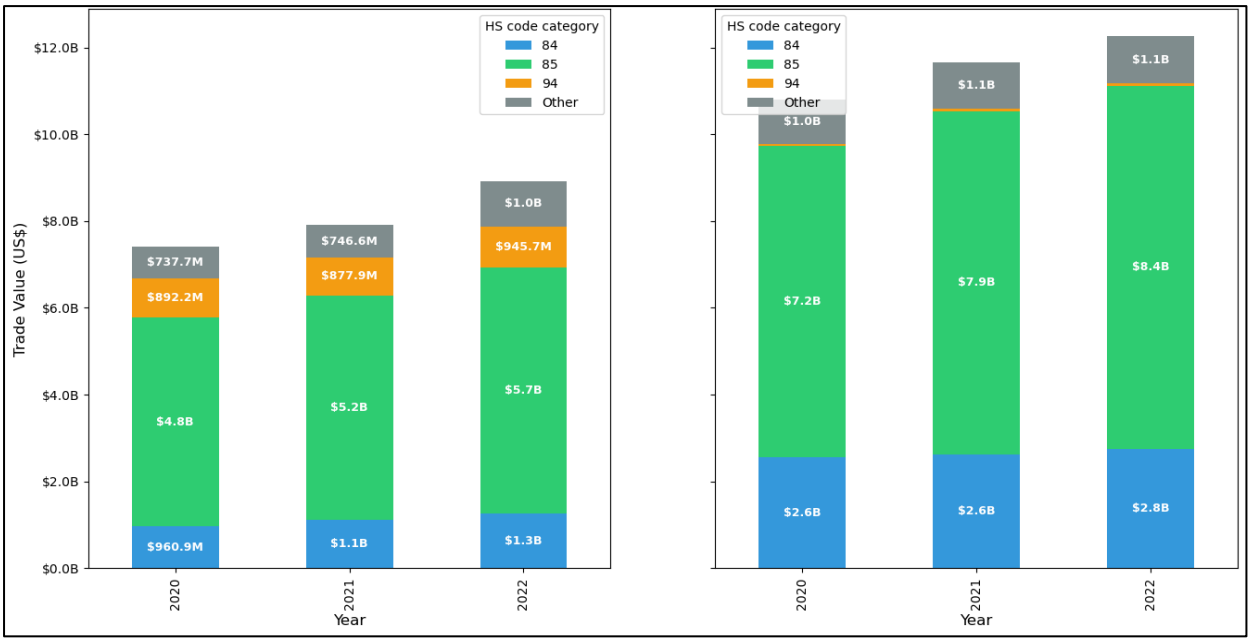
Viet Nam's ongoing trade deficit with Japan in the EEE sector highlights a deeper reliance on imports, likely stemming from limitations in domestic production capacity, technological know-how, or quality standards. To address this, Viet Nam could prioritise strengthening its EEE industry through investments in technology transfer, partnerships with Japanese companies, or policies that boost local manufacturing and export competitiveness. Such measures could gradually reduce the deficit, fostering a more sustainable trade relationship. The data from 2020 to 2022 serves as a clear indicator of both the challenge and the potential for growth in Viet Nam's EEE trade landscape with Japan.

Composition of Trade by Product Category

Figure 6.4 illustrates the composition of Viet Nam's exports to and imports from Japan in the

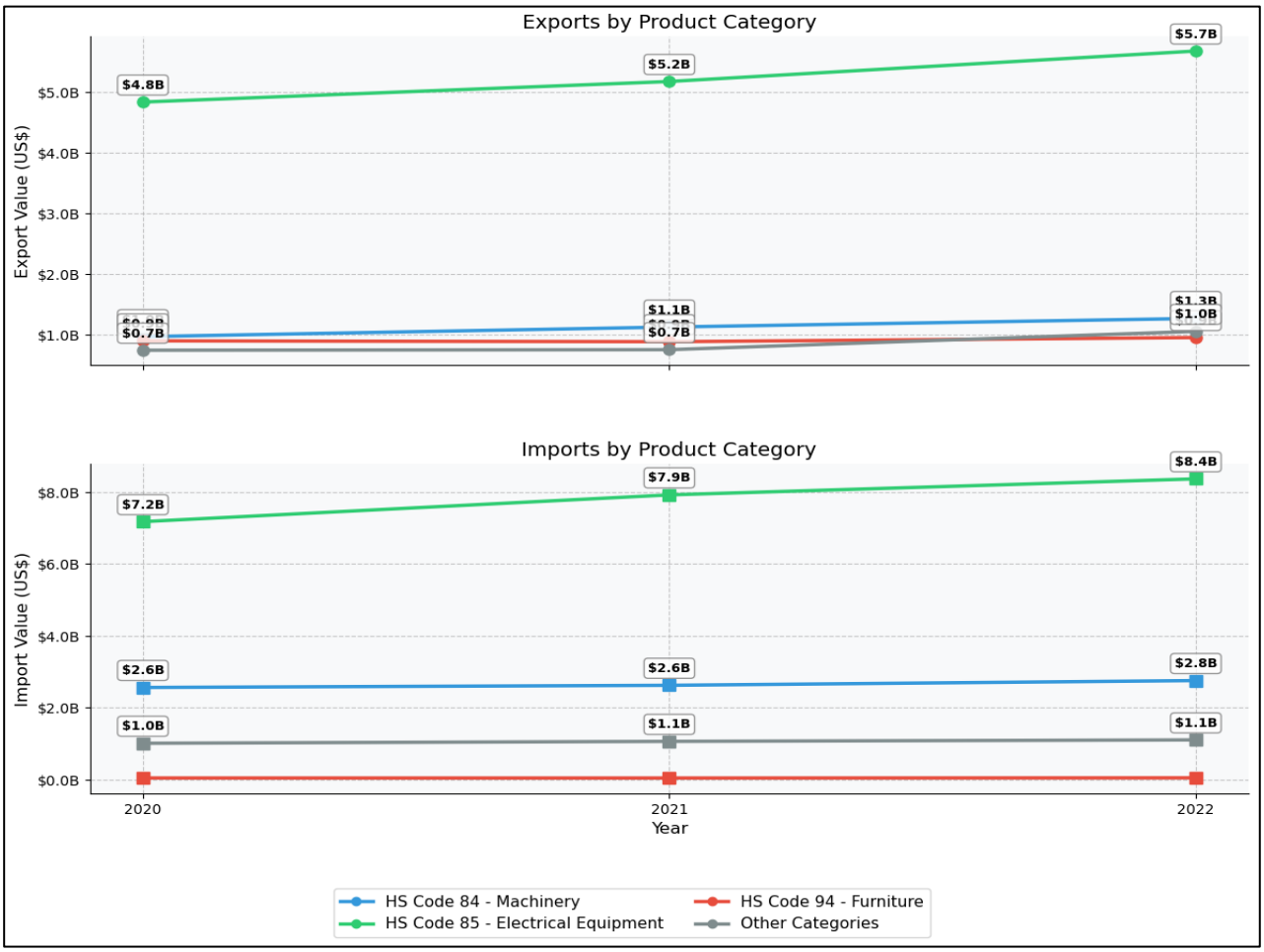
EEE sector from 2020 to 2022, categorised by HS codes. The left panel shows exports, and the right panel shows imports, with the y-axis representing trade value in billions of US dollars, ranging from US$0 to US$12 billion. The categories include HS 84 (machinery and mechanical appliances, blue), HS 85 (electrical machinery, green), HS 94 (furniture, orange), and other products (grey). The chart highlights the dominance of electrical machinery (HS 85) in both exports and imports, reflecting its central role in the EEE trade between the two countries.

Figure 6.4. Composition of Total EEE Imports and Exports by Product between Viet Nam and Japan



Source: Compiled by the authors (2025).

Figure 6.5. Trends in Product Categories within Total EEE between Viet Nam and Japan



Source: Compiled by the authors (2025).

According to Figure 6.5, **Viet Nam's total EEE exports to Japan show a consistent pattern over the 3 years**, with electrical machinery (HS 85) forming the largest segment, contributing around US$5 billion annually, roughly 60%–70% of total exports. Machinery (HS 84) follows, adding about US$1 billion each year, while furniture (HS 94) and other products contribute smaller shares, each around US$800–900 million and US$300–400 million. Total export value remains raised steadily from US$7.4 billion to approximately US$8.9 billion, indicating slight growth or diversification in Viet Nam's EEE export composition. In contrast, **total EEE imports from Japan are heavily dominated by electrical machinery (HS 85),** which rises from about US$7.1 billion in 2020 to US$8.3 billion in 2022, comprising over 80% of total imports by 2022. Machinery (HS 84) increased slightly from US$2.5 billion to US$2.7 billion while other categories remained stable at around US$1 billion. Furniture (HS 94) remained minor, each contributing an average of about US$50 million annually, with total imports growing from US$10 billion in 2020 to US$12 billion in 2022.

This disparity underscores Viet Nam's reliance on Japan for high-value electrical machinery (HS 85), likely due to Japan's advanced technology, while Viet Nam's exports, though also focused on HS 85, are smaller in scale and lack growth. **The minimal presence of HS 84 and HS 94 in imports suggests that Viet Nam either sources these elsewhere or**

produces them domestically, whereas the export composition indicates limited diversification beyond electrical machinery. To strengthen its position, Viet Nam could focus on expanding its HS 84 exports or developing other EEE categories, reducing dependence on imports and fostering a more balanced trade structure in this sector.

Trends for Key Product Categories amongst Total EEE

Exports Panel (Top):

- The most dominant category is HS Code 85 (electrical equipment), shown with a green line, which demonstrates consistent growth from US$4.8 billion in 2020 to US$5.2 billion in 2021, and reaching US$5.7 billion by 2022. This 19% growth over the 3-year period indicates strong and sustained demand for these products.
- HS Code 84 (machinery), represented by the blue line, shows a more modest but steady upward trend, increasing from approximately US$1.0 billion in 2020 to US$1.2 billion in 2022. This represents about a 20% increase over the period.
- HS Code 94 (furniture), shown in red, demonstrates a slight fluctuation, starting at around US$0.9 billion in 2020, dipping slightly to US$0.87 billion in 2021, before recovering to US$0.95 billion in 2022, ending with approximately 5.5% growth overall.
- The 'Other Categories' (grey line) remain relatively stable around US$1.0 billion throughout the 3-year period, suggesting minimal change in these residual product groups.

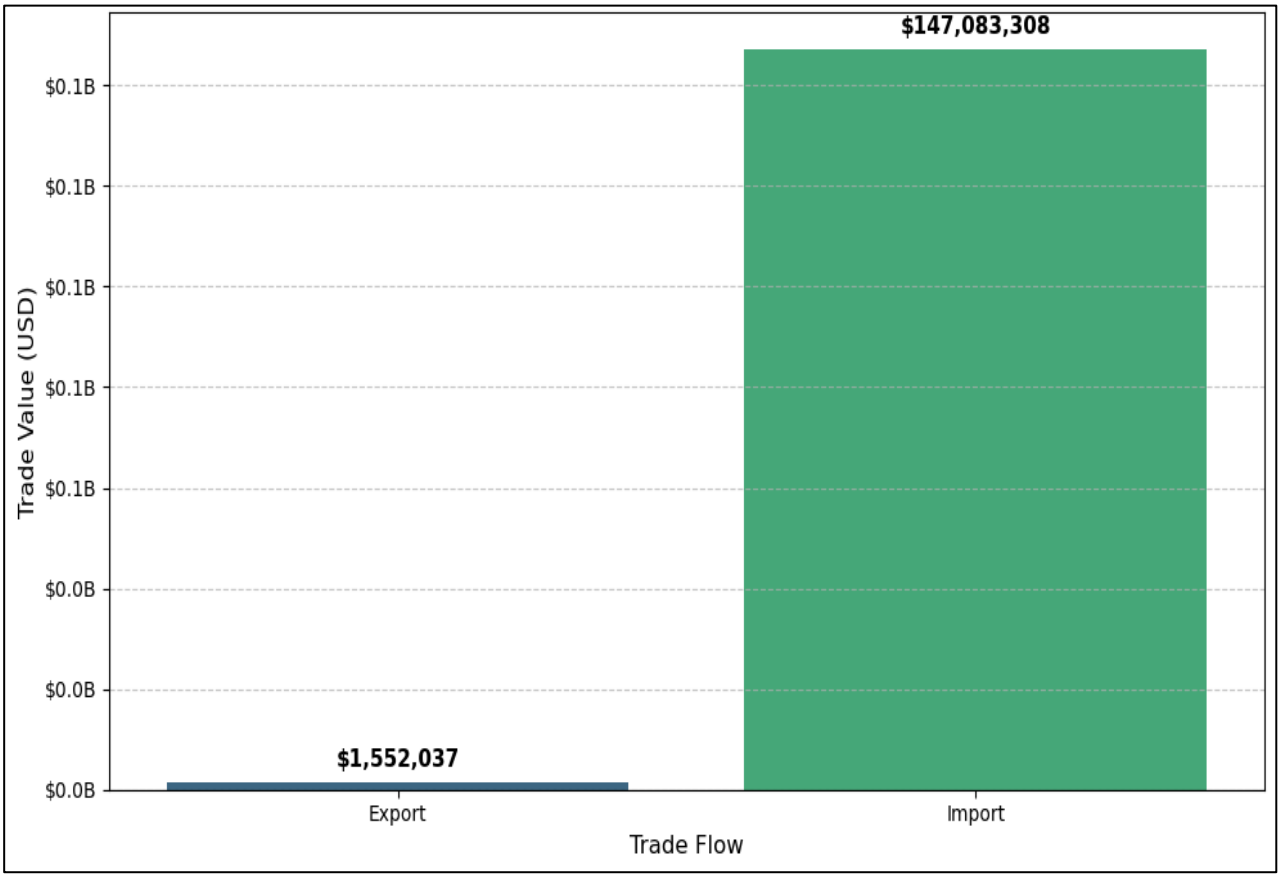
Imports Panel (Bottom):

- HS Code 85 (electrical equipment) dominates the import sector with significantly higher values than all other categories. Starting at approximately US$7.1 billion in 2020, it climbed steadily to around US$8.0 billion in 2021 and reached nearly US$8.4 billion by 2022, representing an 18% increase over the period.
- HS Code 84 (machinery) remained steady between US$2.5 billion and US$2.7 billion across all 3 years, showing only minor fluctuations.
- HS Code 94 (furniture) imports are notably low compared to other categories, hovering around just US$0.05 billion throughout the period with minimal change.
- 'Other Categories' imports remain stable at around US$1 billion, similar to their export counterparts.

B) E-waste in international trade statistics

B.1. E-waste and e-scrap (HS Code 854999) trade between Viet Nam and Japan in 2022

Figure 6.6. E-Waste and E-Scrap Trade Balance between Viet Nam and Japan for HS 854999



Source: Compiled by the authors (2025).

The bar chart of e-waste and e-scrap (HS 854999) trade between Viet Nam and Japan in 2022 reveals a significant imbalance in the flow of these materials (Figure 6.6). **Viet Nam's exports of e-waste to Japan (US$1,552,037) are substantially lower than its imports (US$147,083,308), creating a nearly 95:1 ratio in favour of imports. This pattern suggests Viet Nam may be serving as a major destination for Japan's electronic and electrical waste disposal,** potentially indicating differences in waste management capabilities, regulatory environments, or economic incentives between the two countries. **The substantial volume of imports could reflect Viet Nam's growing role in e-waste processing and recycling industries, where valuable materials are extracted from discarded electronics**, though it also raises questions about environmental management practices and whether this trade flow aligns with sustainable waste management goals for both nations.

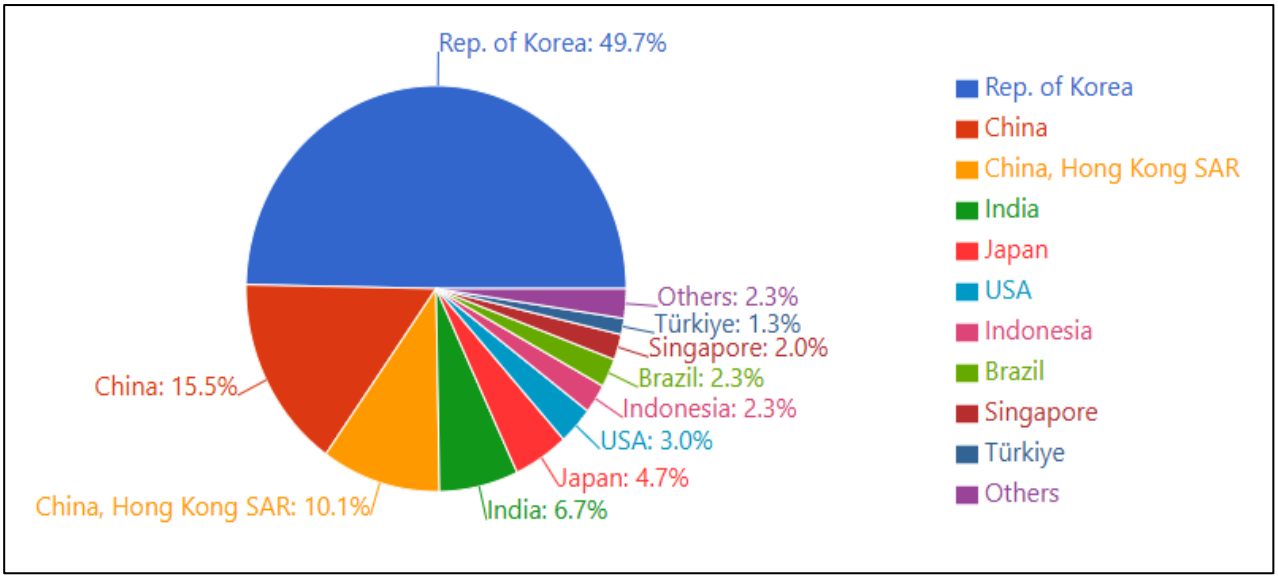
B.2. E-waste in international trade statistics between Viet Nam and other countries

This analysis examines Viet Nam's e-waste export patterns over a 5-year period, from 2020 to 2024, with a specific focus on destination countries and Japan's role in this trade relationship. It should be noted that the analysis relies only on available data for 2022 and 2023 only, as data for the other years within this period were not available. The data are based on HS Code 8549, which covers 'electrical and electronic waste and scrap'. Understanding these export dynamics provides valuable insights into Viet Nam's position in the global e-waste supply chain and the relative importance of its trading partners.

By value

Viet Nam's e-waste exports follow a concentrated distribution pattern dominated by a small number of countries. **East Asian economies collectively dominate as destinations for Vietnam's e-waste**, suggesting strong regional trade integration in this sector (Figure 6.7).

Figure 6.7. Destination Countries of E-Waste Exports from Viet Nam



Source: United Nations (UN) (2025), *UN Comtrade Database* 2025 https://comtradeplus.un.org

Viet Nam's e-waste exports follow a highly concentrated distribution pattern dominated by East Asian economies. Korea stands as the overwhelmingly dominant destination, receiving 49.7% of Viet Nam's total e-waste exports, while the top three destinations – Republic of Korea, China, (15.5%), and Hong Kong SAR (10.1%) – together account for 75.3% of all exports. This concentration suggests strong regional trade integration but also creates potential vulnerability to policy or market changes in these key destinations.

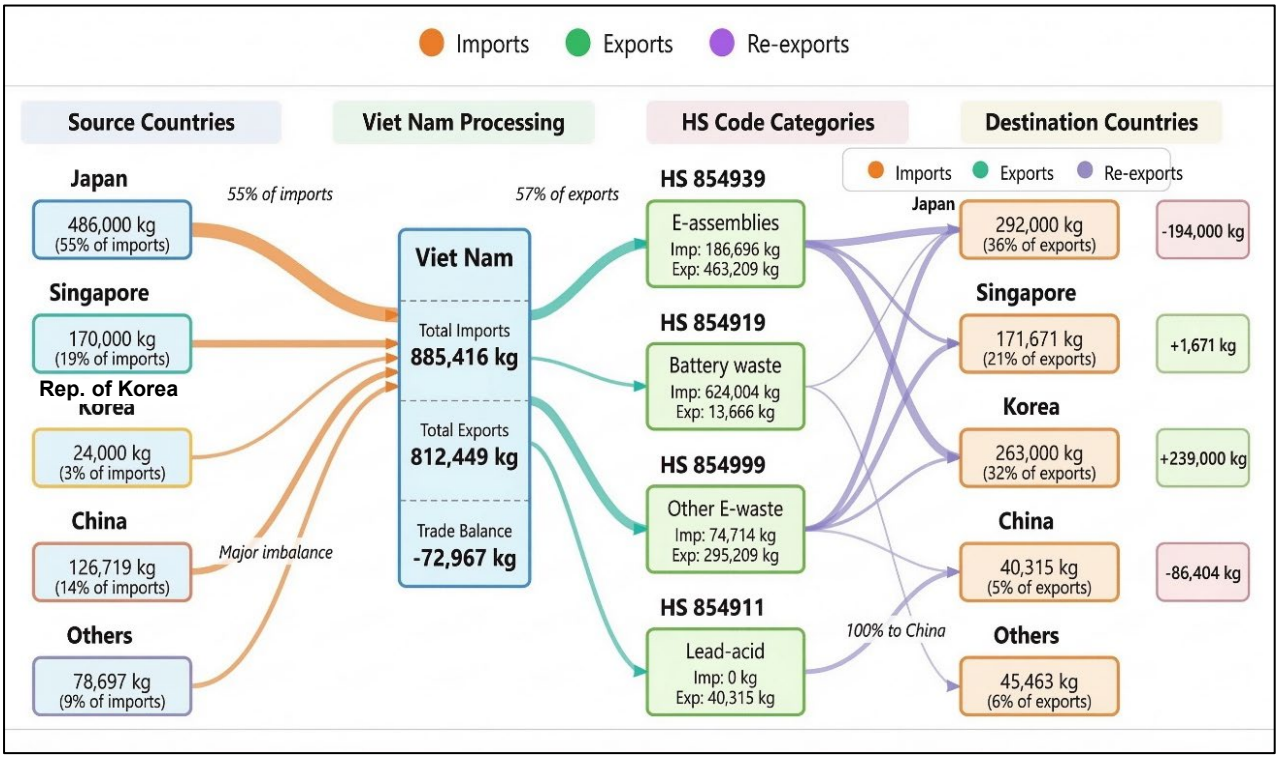
By value, Japan, while not the dominant destination, maintains strategic importance as the fifth largest destination country, accounting for 4.69% of Viet Nam's e-waste exports (approximately US$2.01 million). The dominance of East Asian economies, including Japan, reflects geographic proximity, established shipping routes, and complementary industrial capabilities in electronic waste processing. However, the heavy reliance on Korea (nearly 50% of exports) represents a significant vulnerability that may warrant diversification strategies to ensure market stability.

By weight

This trade data presents a critical analytical challenge: while Viet Nam legally prohibits e-waste imports in principle, the documented import flows suggest either systematic classification issues or gaps in enforcement mechanisms. These materials may have entered Viet Nam through several possible channels: (i) misclassification as 'metal scrap for production' under the permit system established by Decision No. 13/2023/QĐ-TTg, issued by the government in 2023 (Prime Minister of Viet Nam, 2023b), (ii) classification discrepancies between customs procedures and actual material content, or (iii) enforcement challenges at border checkpoints. Without access to individual import permits and customs classifications, it remains unclear whether these documented imports represent legally authorised materials or indicate systematic circumvention of the prohibition framework.

Figure 6.8 shows Viet Nam's e-waste trade in 2023 revealing a complex picture of material flows with a slight trade deficit. The total trade volume amounts to approximately 1.7 million kilograms, with imports (885,416 kg) slightly exceeding exports (812,449 kg), resulting in a negative trade balance of 72,967 kg.

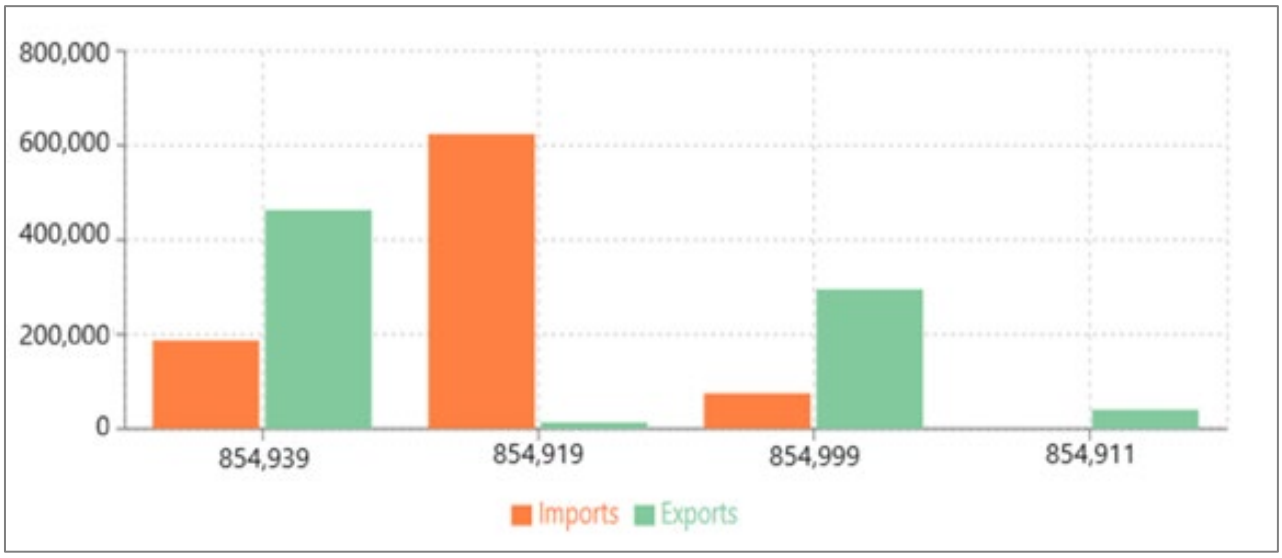
Figure 6.8. International E-Waste Flow Between Viet Nam and Countries



Source: Compiled by the authors (2025).

This overall trade deficit suggests that Viet Nam is positioned as a net consumer of electronic waste materials, likely indicating domestic processing capacity for resource recovery or recycling operations. However, the relatively balanced nature of imports versus exports (52% vs 48%) suggests that Viet Nam also plays a significant role in the regional e-waste processing and re-export ecosystem.

Figure 6.9. Import vs Export by EEE and WEEE Product Categories



Source: Compiled by the authors (2025).

Key trading partners demonstrate distinct patterns. **Japan stands out as Viet Nam's largest trading partner for e-waste, accounting for approximately 46% of total trade volume. The relationship with Japan shows significant two-way trade but a substantial deficit, with Viet Nam importing nearly 486,000 kg while exporting about 292,000 kg**. This suggests Viet Nam may be processing specific types of Japanese e-waste for material recovery while returning other processed materials.

Singapore represents another major trading relationship, with more balanced trade flows and a slight positive balance for Viet Nam. Korea's relationship is notably export-heavy from Viet Nam's perspective, potentially indicating specialised processing arrangements for certain waste streams.

The product analysis shows significant variation in trade balances across categories (Figure 6.9). **While Viet Nam heavily imports battery waste (HS 854919), it maintains a positive export balance in electronic assemblies and other e-waste categories**. This pattern suggests Viet Nam may be strategically positioned in specific segments of the e-waste value chain, particularly in handling complex electronic assemblies that potentially contain higher-value recoverable materials.

Trading Partners Analysis

Viet Nam's e-waste trading relationships reveal distinct regional patterns and strategic partnerships that shape its position in the electronic waste ecosystem. Figure 6.10 and Table 6.2 illustrate the e-waste trading partner analysis by countries.

Japan emerges as Viet Nam's dominant trading partner of e-waste, with bilateral flows reaching approximately 778,000 kg. This relationship shows Viet Nam primarily as an importer, with a trade deficit of nearly 194,000 kg. The substantial volume suggests established logistics channels and potentially preferential trading arrangements. **Japan's advanced electronic manufacturing sector likely generates significant quantities of high-quality e-waste, which Viet Nam may value for its recoverable materials.**

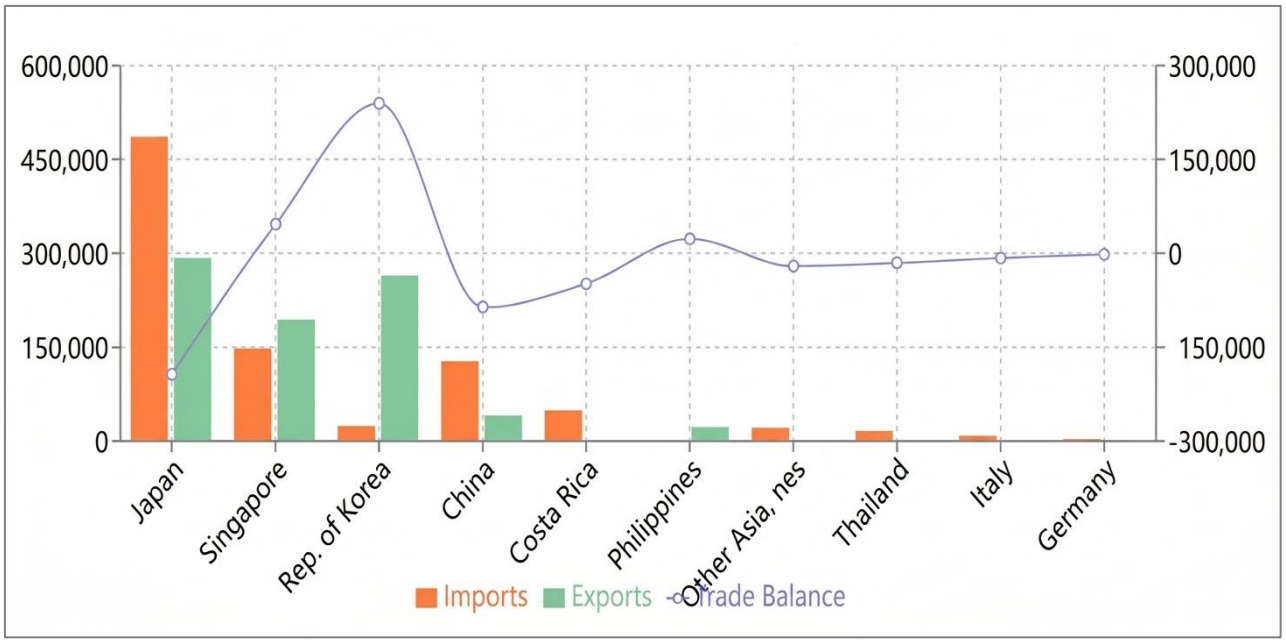
The Singapore relationship (341,671 kg total) demonstrates more balanced trade with a slight surplus for Viet Nam. As a regional trading hub with limited domestic processing capacity, Singapore may be both sourcing e-waste from throughout Southeast Asia and redistributing processed materials, using Viet Nam as a processing partner.

Korea's relationship shows a distinctive pattern: Viet Nam exports over 263,000 kg while importing only about 24,000 kg, creating a trade surplus of nearly 240,000 kg. This strongly positive balance suggests Viet Nam may be processing specialised waste streams for Korean entities, potentially tied to Korean electronics manufacturing operations in Viet Nam or the broader region.

China's e-waste trade with Viet Nam (167,034 kg total) shows Viet Nam primarily importing (126,719 kg) with more limited exports (40,315 kg). Notably, all exports to China are in lead-acid battery waste (HS 854911), suggesting specialised demand for these materials in China's recycling operations.

The relationship with smaller trading partners reveals Viet Nam's broader integration in the global e-waste ecosystem. **Western European nations (Germany, Italy, Denmark, the United Kingdom) have limited but notable trade, primarily as exporters to Viet Nam**. This may reflect regulatory environments in Europe that encourage proper e-waste disposition through certified channels.

Figure 6.10. Trading Partner Analysis



Source: Compiled by the authors (2025).

Table 6.2. Viet Nam's E-Waste Trade Balance by Partner Country

Partner	Imports (kg)	Exports (kg)	Total (kg)	Balance (kg)
Japan	485,678	292,031	777,710	-193,647
Singapore	147,893	193,778	341,671	45,885
Rep. of Korea	23,943	263,621	287,564	239,679
China	126,719	40,315	167,034	-86,404
Costa Rica	48,810	0	48,810	-48,810
Philippines	0	22,264	22,264	22,264
Other Asia, nes	20,716	0	20,716	-20,716
Thailand	16,128	0	16,128	-16,128
Italy	8,021	0	8,021	-8,021
Germany	2,265	0	2,265	-2,265

Source: Compiled by the authors (2025).

The geographical distribution of Viet Nam's e-waste trade is heavily concentrated in East and Southeast Asia (approximately 97% of total volume), reflecting regional integration, logistics efficiency, and potentially aligned regulatory environments. This regional concentration also suggests vulnerability to regional regulatory changes or economic disruptions.

Product Analysis

Viet Nam's e-waste trade by product category reveals strategic specialisation and varying trade positions across different waste streams (Table 6.3).

Table 6.3. Viet Nam's E-Waste Trade Balance by Product Category

HS Code	Description	Imports (kg)	Exports (kg)	Balance (kg)
854939	Waste and scrap; electrical and electronic assemblies and printed circuit boards, other than those used principally for the recovery of precious metal n.e.c. in item no 8549.31	186,698	463,300	276,602
854919	Waste and scrap; of primary cells, primary batteries and electric accumulators, n.e.c. in item no 8549.1	624,004	13,626	-610,378
854999	Waste and scrap; n.e.c. in item no 8549.91	74,714	295,209	220,494
854911	Waste and scrap of lead-acid accumulators; spent lead-acid accumulators	0	40,315	40,315

Source: United Nations (2025).

The largest category by volume is HS 854939 (waste and scrap of electrical/electronic assemblies), accounting for approximately 650,000 kg or 38% of total trade. Viet Nam maintains a strongly positive trade balance in this category (+276,602 kg), exporting 463,300 kg while importing 186,698 kg. **This suggests Viet Nam possesses specialised processing capabilities for these materials, potentially recovering valuable components or metals**. The primary export destinations for this category are Korea and Japan, suggesting integration with these countries' electronics manufacturing or recycling ecosystems.

The second largest category, HS 854919 (waste and scrap of primary cells and batteries), shows a dramatically different pattern. Viet Nam imports 624,004 kg but exports only 13,626 kg, creating a substantial trade deficit of 610,378 kg. This large imbalance indicates that Viet Nam is primarily a destination market for battery waste, likely possessing domestic processing capacity focused on material recovery – potentially for lead, lithium, cobalt, or other valuable battery metals – or refurbishment operations. Japan, Singapore, and China are the main sources for these imports.

HS 854999 (other electronic waste not elsewhere classified) accounts for approximately 370,000 kg of trade. Viet Nam maintains a positive trade balance in this category (+220,494 kg), suggesting specialised capabilities for processing these miscellaneous e-wastes. The heavy export orientation (295,209 kg exports vs 74,714 kg imports) indicates potential value addition occurring within Viet Nam before re-export. Singapore and Japan are the primary destinations for these processed materials.

The smallest category, HS 854911 (waste and scrap of lead-acid accumulators), shows only exports (40,315 kg) with no imports. This distinctive pattern suggests either domestic generation of these materials or stockpile reduction. All exports in this category are directed to

China, indicating specialised demand there, potentially due to established lead recycling operations.

These product-specific patterns reveal Viet Nam's varied positioning across different e-waste streams – from being a net importer of battery waste to a net exporter of e-assemblies and other e-waste. This suggests a strategic specialisation approach to e-waste management, potentially focusing on higher-value recovery operations for certain waste streams while serving as a processing destination for others.

The trade data indicates Viet Nam has developed specific technical capabilities and market relationships tailored to different e-waste categories, positioning it as a significant player in the regional e-waste processing ecosystem.

1.5 Conclusion

The analysis of EEE material flows between Viet Nam and Japan during the 2020–2022 period reveals a dynamic but imbalanced trade relationship that reflects both opportunities and challenges for sustainable resource circulation. Several key findings emerge from this situational analysis.

First, the total EEE trade relationship is characterised by a persistent deficit for Viet Nam, with imports from Japan consistently exceeding exports by approximately US$3.5 billion annually. This imbalance is particularly pronounced in the e-waste category (HS 854999), where Viet Nam's imports from Japan outweigh exports by a ratio of nearly 95:1, suggesting Viet Nam's emerging role as a destination for Japan's discarded electronic materials.

Second, the composition of EEE trade is heavily dominated by electrical machinery (HS 85), which constitutes about 66% of total trade value. This concentration indicates a narrow focus within the bilateral EEE trade that may limit opportunities for diversification and value addition in other categories. While Viet Nam's exports of lead-acid batteries and certain electronic components have shown growth, there remains significant potential for expansion in areas such as machinery (HS 84) and specialised electronic equipment.

Third, despite the growing importance of e-waste management globally, the lack of standardised classification systems for EEE waste presents a significant barrier to monitoring and regulating transboundary movements effectively. The recent introduction of specific HS codes for e- waste (854999) represents progress, but comprehensive tracking remains challenging.

Finally, the analysis points to Viet Nam's evolving position in the regional EEE value chain – transitioning from primarily assembly operations towards potentially higher value-added activities, while simultaneously managing increasing volumes of e-waste. This transition occurs within the context of Viet Nam's developing regulatory framework for e-waste management and its commitments under international agreements like the Basel Convention.

These findings underscore the need for co-ordinated policy approaches that address both the economic opportunities and environmental challenges of EEE material flows between Viet Nam and Japan. Enhancing Viet Nam's domestic capacity for higher-value production and

environmentally sound e-waste management, while simultaneously strengthening regulatory frameworks and data collection systems, will be crucial for promoting sustainable resource circulation between these two important trading partners in the years ahead.

2 The Context of E-Waste Management and Treatment in Viet Nam

2.1 Overview

The international material flow of EEE-relevant materials has gained increasing attention in the context of sustainable resource management and circular economy transition. Viet Nam and Japan, as two key economic partners in Asia, have established strong co-operation across trade, investment, and environmental policy. However, the transboundary movement of EEE-related materials – especially those containing valuable or hazardous substances – presents a complex array of environmental, regulatory, and logistical challenges.

There is a significant lack of accurate, harmonised data on the volume, composition, and destination of EEE-relevant material flows between Viet Nam and Japan. Informal trade routes and unreported shipments, particularly involving second-hand equipment or scrap materials, complicate efforts to trace and manage cross-border movements responsibly. The scale of Viet Nam's EEE production and consumption underscores both economic opportunity and environmental responsibility.

Viet Nam's legislation prohibits the import of second-hand electronics and e-waste, while allowing only organisations and individuals that directly use scrap materials as production inputs to import such scrap for their own facilities, within the limits of their designed production capacity.

The process of collecting, sorting, and treating e-waste in Viet Nam is still predominantly carried out manually. E-waste is mainly collected by scrap dealers, small- and medium-sized recycling facilities, and aggregated at craft villages for recycling. Current recycling practices largely rely on pyrometallurgical and hydrometallurgical methods using outdated technologies, which pose significant risks to human health and have direct negative impacts on the environment. In addition, a considerable portion of e-waste is reused and resold in the market. However, the volume of collected devices remains limited compared to the total amount of e-waste generated (Bui and Bui, 2024). Small-scale workshops manually dismantle equipment to recover metals and plastics, frequently resorting to open burning of insulated wiring and uncontrolled acid baths for precious-metal leaching. These practices release persistent organic pollutants (e.g. brominated flame retardants) and heavy metals (lead, mercury) into the environment (Baldé et al., 2024). Formalising the informal sector, scaling mechanical and metallurgical recovery technologies, and fully operationalising EPR are urgent priorities.

2.2 Status and quo of e-waste in Viet Nam

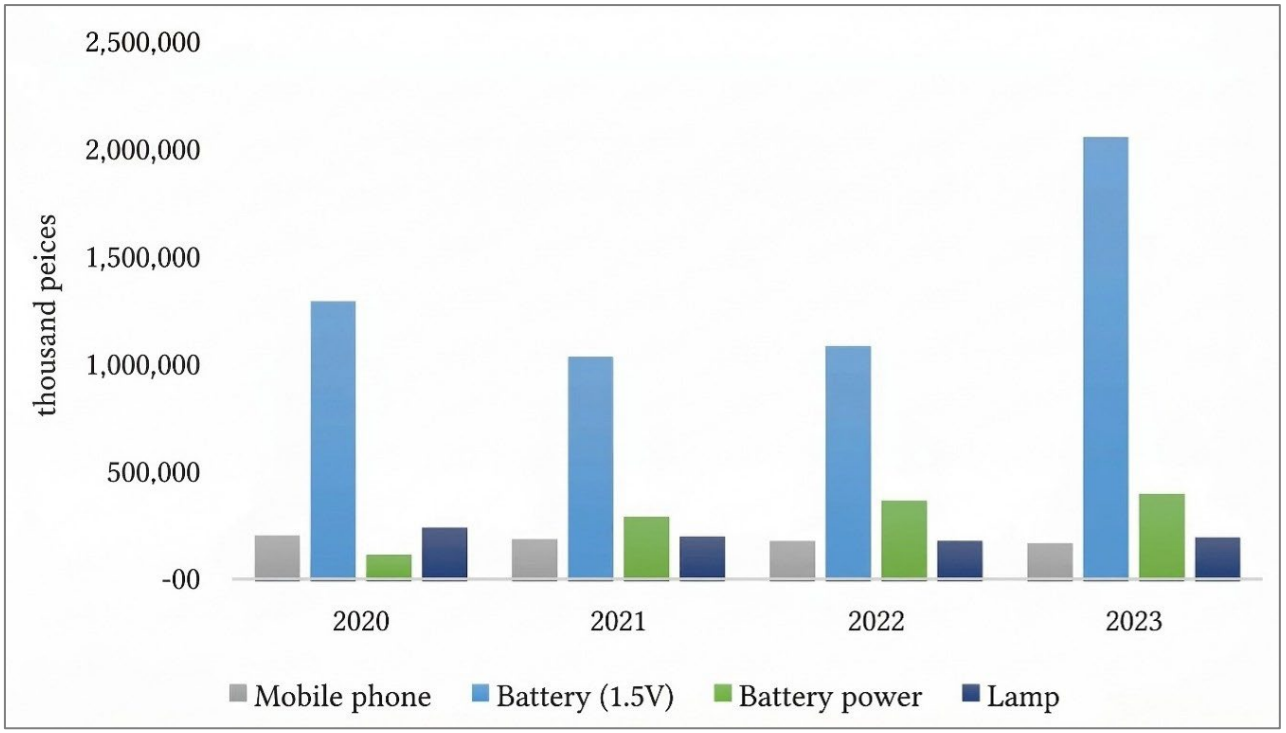
A) Viet Nam production and consumption for EEE

Domestic production

From 2020 to 2023, Viet Nam's electronics manufacturing sector grew steadily, with impressive output in strategic export products (phones, batteries, electronic components) and continued diversification in household electronics (Figure 6.11). Sharp output changes – such as the rise in battery production and decline in printers/TVs – mirror shifts in global demand, supply chains, and post-COVID consumption.

A significant disparity can be observed amongst different product groups, with some items having an exceptionally high number, while others remain relatively low. The product with the highest quantity is battery power, with over 2 million units. This is significantly higher than any other product on the list, indicating a strong demand for batteries in Viet Nam, likely due to the widespread use of portable electronics, battery-powered household devices, and the need for periodic battery replacements. Overall, Viet Nam is solidifying its position as a vital node in the global electronics value chain.

Figure 6.11. Electrical Equipment Production in Viet Nam, 2020–2023

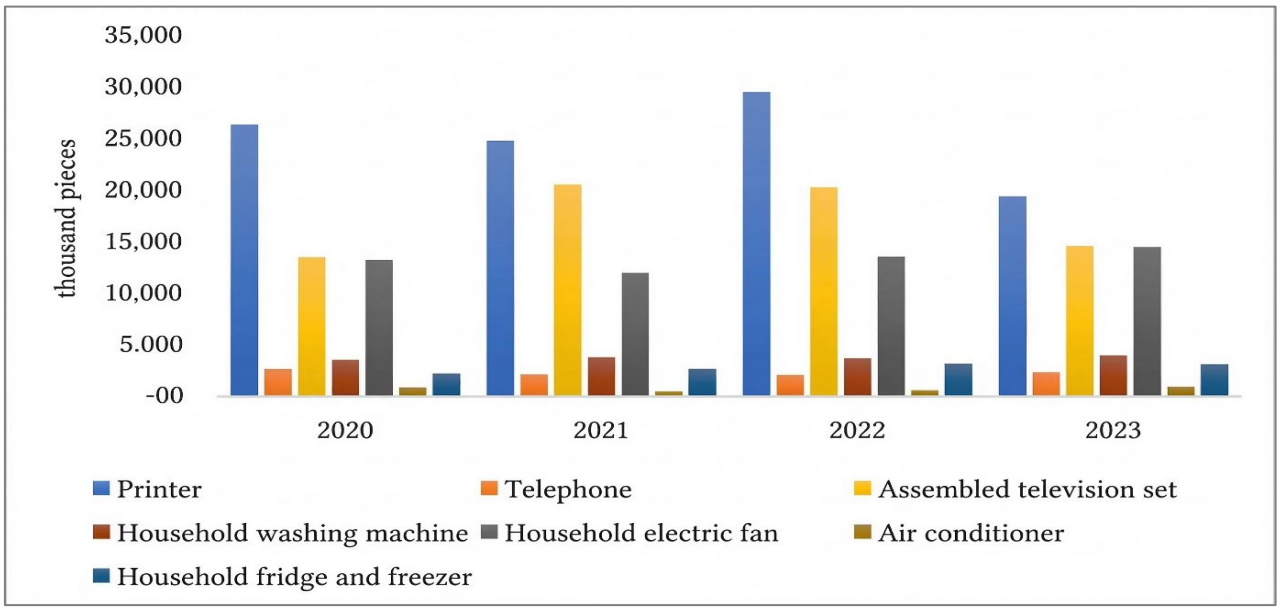


Source: Created by the author from the General Statistics Office (2024).

Figure 6.12 illustrates electronic device production in Viet Nam from 2020 to 2023. The extremely low quantity of landline telephones suggests mobile phones have completely replaced landline telephones. Similarly, air conditioners and refrigerators have lower numbers, likely because these are long-lasting appliances, and consumers do not replace them frequently.

The data from these charts reflect Viet Nam's consumption trends for EEE products, with a stark contrast between different categories. Fast-moving products like batteries and lamps dominate in quantity, reflecting their short lifespans and frequent replacement cycles. In contrast, durable appliances, including air conditioners and refrigerators, exhibit lower consumption volumes, which can be attributed to their longer service life and less frequent replacement. Mobile phones maintain a high volume but are not overwhelmingly dominant, possibly indicating a maturing market.

Figure 6.12. Electronic Device Production in Viet Nam, 2020–2023

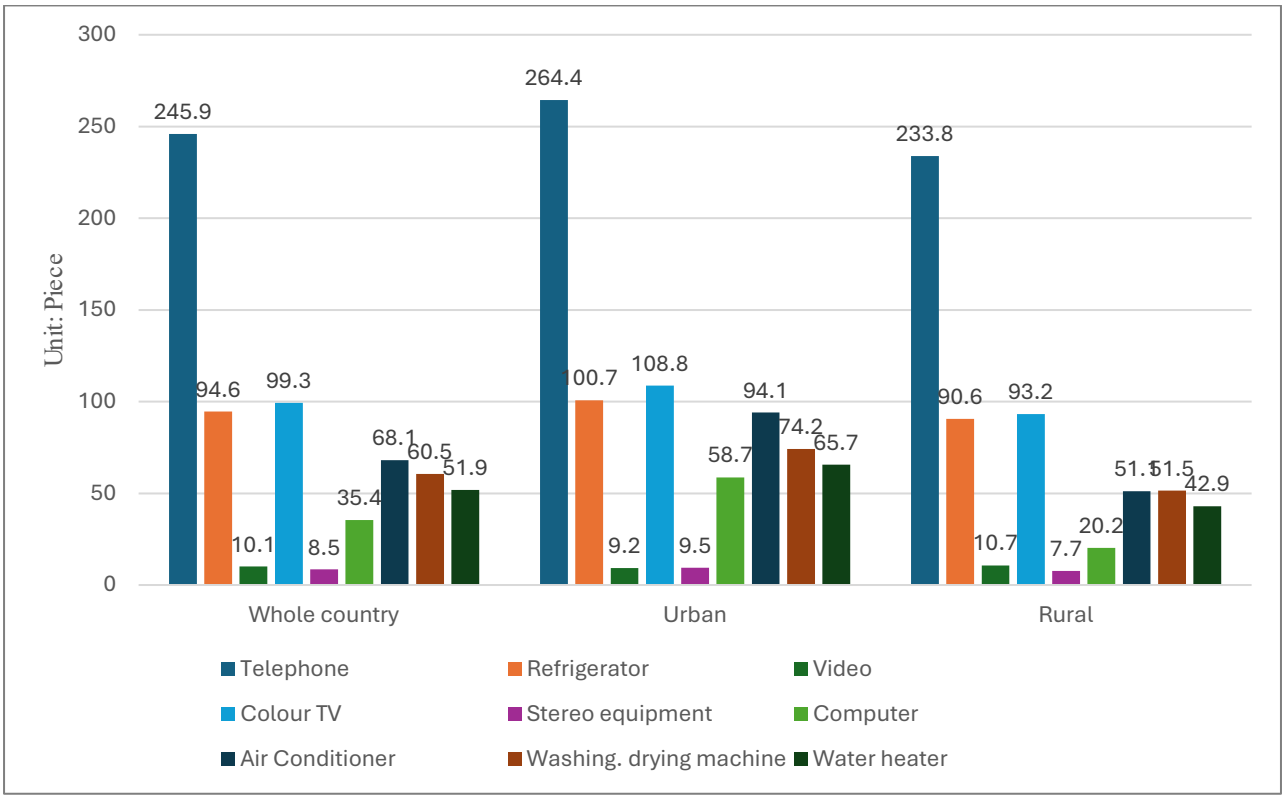


Source: Created by author from General Statistics Office (2024).

Domestic consumption

Figure 6.13 illustrates that some main EEE products per 100 households by region in 2022. **The number of mobile phones per 100 households is the highest, with an average of 2.5 per household. Items such as colour televisions, refrigerators, and washing machines are highly prevalent, especially in urban areas, where most households own a colour TV and a refrigerator**. In addition, about 74 out of every 100 households own a washing machine. Meanwhile, appliances such as air conditioners, computers, and water heaters show significant disparities between urban and rural areas, reflecting differences in living conditions and access to technology between the two regions.

Figure 6.13. Some Main EEE Products per 100 Households by Urban–Rural in 2022



Source: Created by the author from General Statistics Office (2024).

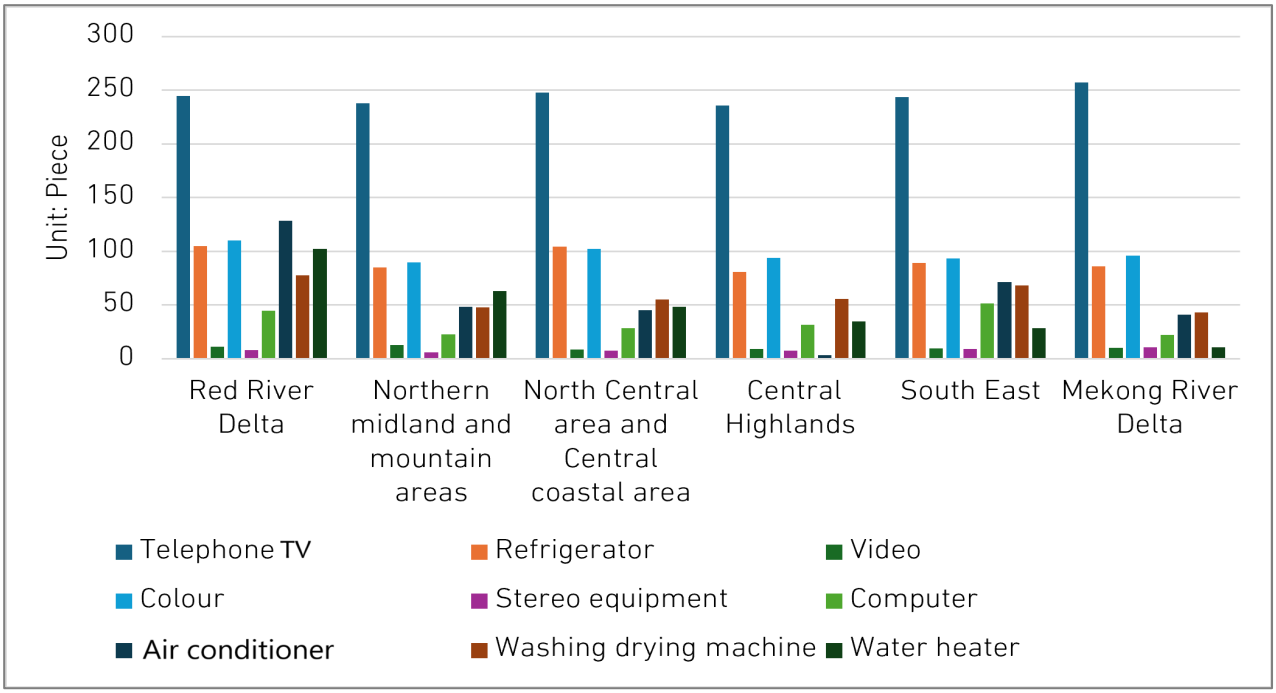
Overall, the level of ownership of durable goods is higher in urban areas than in rural areas, especially high-value appliances such as air conditioners and washing machines. This shows the difference in income, living conditions, and access to goods between the two regions.

Figure 6.14 indicates that the number of durable consumer goods per 100 households by region in Viet Nam in 2022. Some notable points:

- **Telephones are the most popular device in all regions**, with the number of households per 100 ranging from 237.6 (Northern Midlands and Mountains) to 257.2 (Mekong Delta).
- **Refrigerators have a higher ownership rate in developed urban areas, such as the Red River Delta (110.2 units per 100 households) and the Southeast** (93.1 units per 100 households), compared with the Midlands and the Northern mountainous region (68 units per 100 households).
- **Colour televisions have a high level of popularity in all regions**, ranging from 80.8 to 104.8 units per 100 households.
- **Washing machines and computers have large differences between regions**, especially low in the Northern Midlands and Mountains as well as the Central Highlands.
- **Air conditioners have the lowest ownership rate in most regions**, especially the Central Highlands (only 3.2 units per 100 households).

Overall, developed regions such as the Red River Delta and the Southeast have higher levels of ownership of most durable consumer devices, reflecting differences in income, living conditions, and access to technology between regions.

Figure 6.14. Some Main EEE Products per 100 Households by Region in 2022

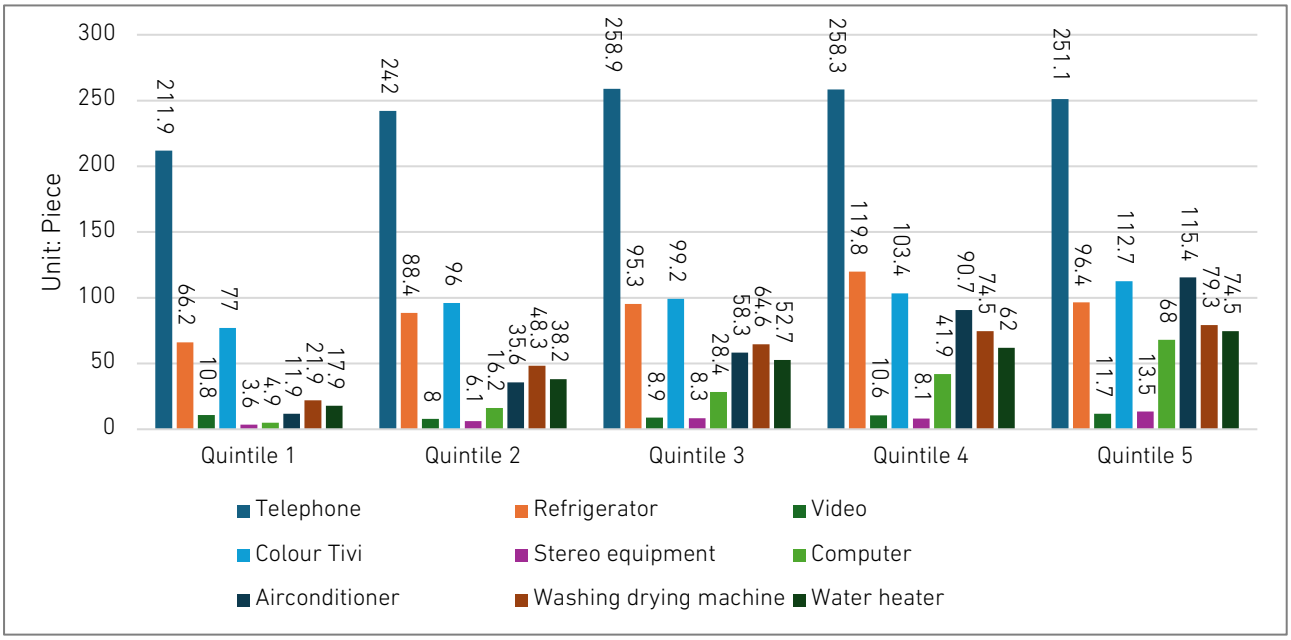


Source: Created by author from General Statistics Office (2024).

Figure 6.15 shows significant differences in the ownership of EEE between income groups. It reflects a divergence in electronic device ownership based on economic conditions, with high-income households being able to access and use more modern devices.

- **Phones are the most popular device across all income groups**, with ownership rates gradually increasing from 211.9 units (quintile 1) to 258.3 units (quintile 4) and decreasing slightly in the highest income group (quintile 5).
- **Refrigerator ownership also gradually increased in ownership according to income**, from 66.2 units per 100 households in the lowest income group to 112.7 units per 100 households in the highest income group.
- **Computers and air conditioners show a clear disparity between income groups**, with low ownership rates in the low-income group and a sharp increase in the highest-income group. This reflects greater access to technology and better living conditions amongst higher-income households.
- **Ownership of washing machines and water heaters also increases with income**, indicating that higher-income households tend to invest more in modern home appliances.

Figure 6.15. Some Main EEE Products per 100 Households by Income Quintile in 2022



Source: Created by author from General Statistics Office (2024).

B) E-waste generation in Viet Nam

Viet Nam is positioned in the mid-range amongst Southeast Asian countries in terms of e-waste generation per capita. According to Nguyen and Tran (2019), e-waste generation in Viet Nam was recorded at 116,000 tonnes in 2018. The *Global E-Waste Monitor 2020* reported that in 2020(Forti et al., 2020), the amount of e-waste generated increased to 257,000 tonnes, with a per capita generation of 2.7 kg. By 2022, these figures had risen to 5.3 kg per capita and a total of 516,000 tonnes (Table 6.4), **representing a 99% increase over 4 years. Compared to countries with similar population sizes, such as the Philippines and Malaysia, Viet Nam's total e-waste generation is higher, indicating a significant rise in electronic device consumption.**

Table 6.4. E-Waste Generation in Asia and Southeast Asian countries

No.	Country	E-Waste Generated in 2022 (kg/cap)	E-Waste Generated in 2022 (thousand tonnes)
1	China	8.5	12,066
2	Japan	21.2	2,638
3	India	2.9	4,137
4	Indonesia	6.9	1.866
5	Republic of Korea	17.9	930
6	Thailand	10,5	753
7	Pakistan	2.4	559
8	Philippines	4.7	537
9	**Viet Nam**	**5.3**	**516**
10	Malaysia	12.2	411
11	Singapore	20,3	121
12	Myanmar	1.4	76

Source: Created by author from Cornelis P. Baldé, et al. (2024).

C) Technologies on EEE recycling and waste disposals in Viet Nam

E-waste collection, reuse, recycling, and disposal in Viet Nam involve both the informal sector (scavengers, scrap yards/waste collectors, service shops, and craft villages) and the formal sector (hazardous waste treatment facilities licensed by the Ministry of Natural Resources and Environment) (Table 6.5). Currently, e-waste recycling in Viet Nam is primarily conducted by the informal sector, employing rudimentary collection, dismantling, and recycling methods. Traditional craft villages are the main hubs for this informal recycling activity. The Nhat Tao market in Ho Chi Minh City exemplifies the scale and vibrancy of this activity. Additionally, in the northern region, the Van Mon Scrap Recycling Craft Village in Bac Ninh and the Trang Minh Collection and Recycling Craft Village in Hai Phong are noteworthy examples. The existence and growth of these markets indicate an established e-waste collection and processing network, albeit with significant limitations in methodology.

The e-waste distribution ratio between the formal and informal sectors remains unquantifiable due to a lack of comprehensive and official data on e-waste generation in Viet Nam. Current figures are largely based on estimations from studies, hindering the development of effective and targeted e-waste management policies and strategies. Establishing a reliable and official data collection system is crucial for accurately assessing the scope of the issue and monitoring progress in e-waste recycling. The lack of official data can be attributed to the fragmented nature of e-waste management, dominated by an informal sector operating outside of formal reporting mechanisms.

Table 6.5. Comparison of Formal and Informal E-Waste Recycling Technologies in Viet Nam

Aspect	Formal	Informal
Technology used	Mechanical shredding, mechanical sorting, hydrometallurgy/ pyrometallurgy/ biometallurgy (limited scale)	Manual dismantling, open burning, acid leaching
Operational scale	Limited number of facilities, small processing capacity	Widespread in craft villages, many small workshops
Material recovery	Focuses on high-value metals (Cu, Au, Ag, Pd), some plastics	Primarily iron, copper, lead, tin, and some plastics
Environmental impact	Generally lower, but still poses pollution risks	High due to open burning, acid usage, and improper waste disposal
Workplace safety	Higher standards, but still needs improvement	Very low, with frequent exposure to hazardous substances
Economic feasibility	May face challenges due to high investment costs	Relies on low labour costs and informal operations
Regulatory oversight	Subject to legal regulations and licensing	Mostly unregulated

Source: Compiled by the authors (2025).

Informal sector

The primary activities of e-waste recycling craft village facilities consist of manual collection and sorting. Based on orders from purchasing entities (predominantly from China), collected electronic devices are manually disassembled, with remaining components being discarded (via incineration or landfill disposal).

Within the informal sector, prevailing technologies involve manual dismantling and the recovery of basic materials such as iron, copper, lead, tin, and plastics. Crude methods like open-air burning or combustion in rudimentary kilns are employed to extract lead and copper. Acids are also used to leach precious metals like gold, platinum, palladium, and silver from PCBAs. However, these practices often lack occupational safety measures, posing severe health risks to workers due to exposure to hazardous substances.

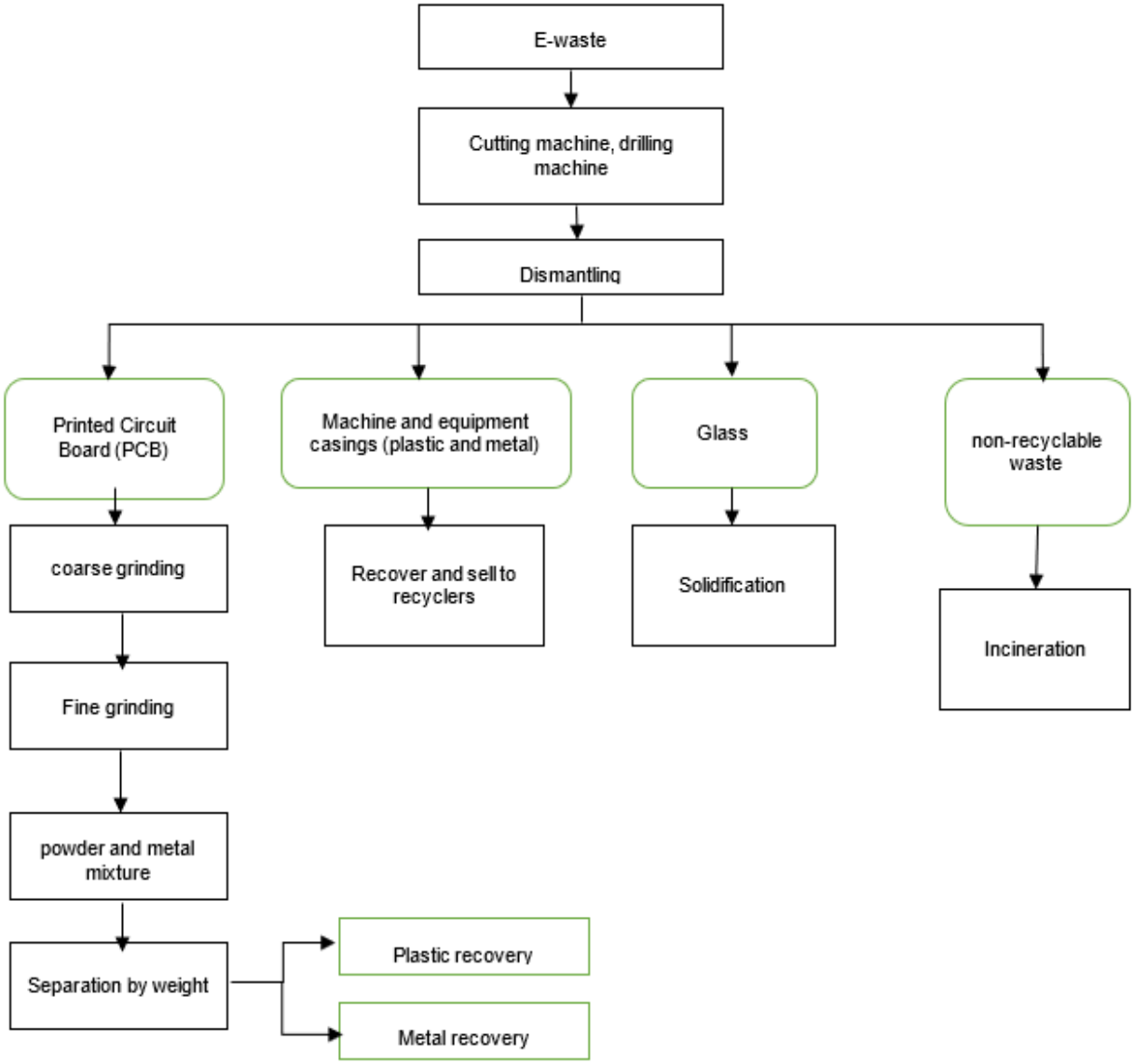
Due to financial constraints, the technologies utilised in this sector are generally rudimentary and pose significant environmental and human health risks. These recycling facilities are typically small-scale, family-run operations, employing techniques such as pyrometallurgy and hydrometallurgy, which are outdated and detrimental to worker health and the environment.

Formal sector

As of 2020, 117 hazardous waste treatment facilities (including e-waste) were licensed by the Ministry of Natural Resources and Environment (MONRE), of which 75 companies were registered to handle three categories of e-waste: (i) waste fluorescent lamps, (ii) waste lead-acid batteries, and (iii) electronic components. The total registered treatment capacity is estimated at over 340,000 tonnes per year (with registered processing capacities ranging from a minimum of approximately 150 tonnes/year to a maximum of over 5,000 tonnes/year) (MONRE, 2021). Notable facilities with substantial e-waste treatment capacities include the Thuan Thanh Environmental Joint Stock Company (900 tonnes/year), Sao Sang Bac Ninh Environmental Treatment Co., Ltd. (6,000 tonnes/year), and Urban and Industrial Environment Joint Stock Company No. 10 (500 tonnes/year), amongst others. The treatment methods employed by companies to handle e-waste involve dismantling and recovering recyclable components, followed by the cleaning and processing of recoverable waste. Non-recoverable waste is incinerated in hazardous waste incinerators, with the resulting ash solidified or encapsulated in containment facilities (Figure 6.16).

A semi-automated electronic waste pre-processing system primarily executes two stages: disassembly and sorting. Initially, the external casing of the equipment is automatically separated for the recovery of plastics and metals.

Figure 6.16. Basic E-Waste Treatment Process at Authorised Facilities in Viet Nam



Source: Created by author from Department of Science and Technology in Ho Chi Minh City (2021), (Thuan Thanh JSC, 2025).

In Viet Nam's formal e-waste sector, processing technologies include both pre-processing methods – methods such as dismantling, shredding, together with mechanical sorting – and end-processing methods – methods such as pyrometallurgy, hydrometallurgy, bioleaching, and specialised treatments for PCBAs because they contain high-value metals. These technologies have the potential to achieve higher material recovery rates. They also generate less environmental pollution compared with informal methods, and licensed facilities employ some of these technologies to process electronic circuit boards. Small-scale operations, unstable e-waste supply, competition because of the informal sector's low operating costs, and limited investment obstruct their effectiveness.

Recyclable e-waste materials

(1) Electronic circuit boards, motherboards, and wiring are dismantled and transferred to specialized recycling facilities.

(2) Recyclable plastic components are either sent to the plant's plastic recycling workshop or handed over to authorised processing units.

(3) F-gas (chlorofluorocarbon, hydrochlorofluorocarbon, and hydrofluorocarbon) recovered from discarded refrigeration equipment is transferred to the F-gas recycling system.

(4) Non-recyclable components of electronic devices, such as screens, insulation layers, toner cartridges, and rigid plastic parts, are subjected to thermal treatment in incinerators. Before incineration, bulky materials are crushed into smaller pieces for efficient processing. After combustion, residual ash and slag undergo solidification treatment or are handed over to specialised units for safe landfill disposal, ensuring no environmental contamination.

Typical technologies used in e-waste processing

✓ Pyrometallurgy (Smelting)

This method is applied by several companies, including Tan Thuan Phong and Hanoi Urban Environment One Member Limited Company (Urenco), for treating industrial waste containing PCBAs. The primary equipment used in this process is an incinerator, typically designed to ensure two-stage combustion for optimal efficiency. The operation of the furnace is automatically controlled to enhance safety and precision.

This method primarily focuses on recovering non-ferrous and precious metals, which are commonly found in circuit boards and mobile phones as conductive materials. During the process, metals such as iron and copper are melted, while some precious metals, like gold, remain solid at the combustion temperature.

- The ash collected from combustion is processed to extract valuable metals.
- The emitted gases can be either treated or utilised for energy recovery.
- The slag from the incineration process can be recycled for specific applications, such as brick or cement production.

However, pyrometallurgy has a low recovery rate and poses environmental risks, particularly air pollution due to the release of organic compounds and plastics. In practice, only a small fraction of Viet Nam's total e-waste is treated using this method.

✓ Hydrometallurgy (Leaching)

This technique involves immersing e-waste in acidic or organic solvents to dissolve metals into a solution. The dissolved metals are then recovered through chemical–physical processes or electrolysis.

This method is used by several companies in Viet Nam, including GECO (Hai Duong Province), Viet Xanh Environmental Services (Binh Duong Province), Hoa Binh Industrial Waste Recycling and Treatment JSC (Ha Noi).

The recovered products depend on the specific recovery stage used: GECO extracts copper sulfate ($CuSO_4$) using hydrometallurgical techniques; Hòa Bình recovers crude copper through electrolysis.

✓ Electrolysis (Electrowinning)

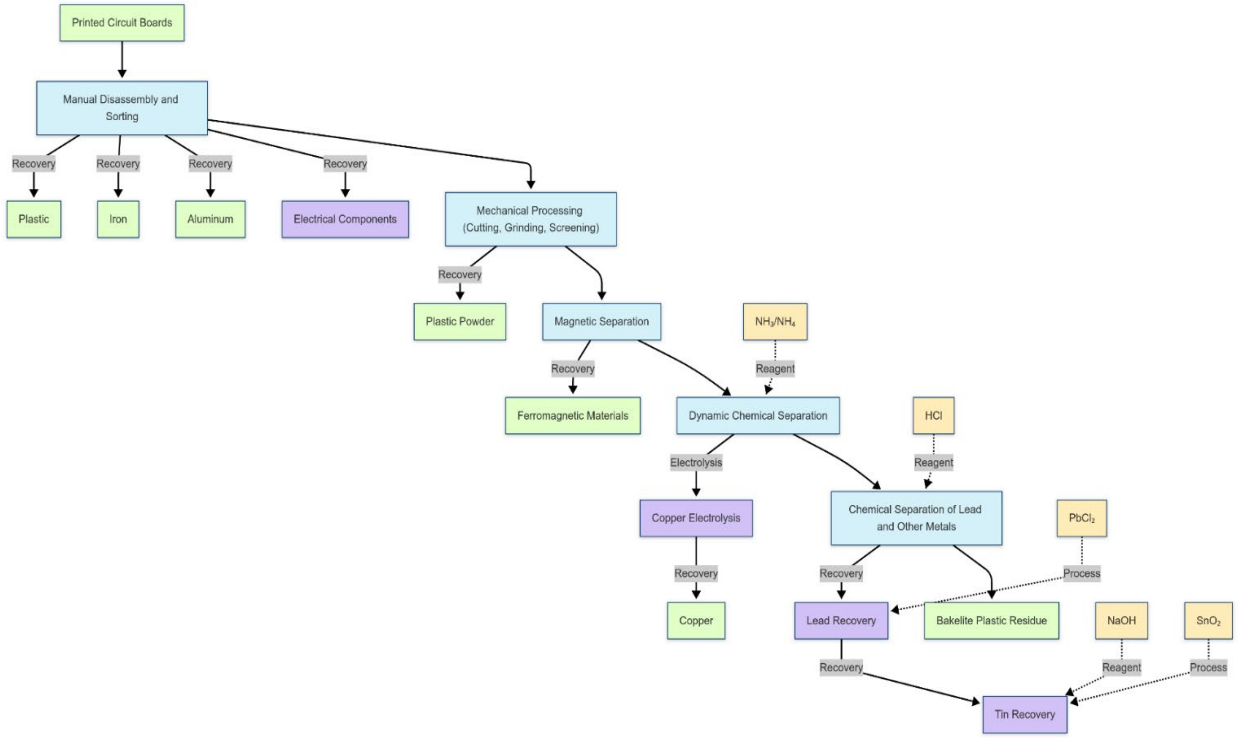
This is an advanced method that uses a special ionic solvent to separate metals without causing corrosion or releasing toxic gases. The method has been applied by Green Environment Production and Trade Service Co., Ltd. and Hoa Binh Xanh Environment Company.

The electrolytic refining process follows these steps (Figure 6.17):

- Disassembly and Sorting: Electronic circuit boards are manually dismantled, and key materials (plastics, iron, aluminium, capacitors) are separated.
- Grinding and Separation: The remaining materials are crushed and sieved to remove plastic particles.
- Chemical–Physical Separation: Magnetic separation is used to extract ferrous materials. NH_4/NH_3 leaching allows for the recovery of metallic copper (Cu) through electrolysis. HCl leaching enables the recovery of lead (Pb), zinc (Zn), and tin (Sn) via chemical reactions.
- Refining and Purification: The combination of electrolysis and chemical–physical processes results in high-purity recovered metals.

This method is particularly effective in enhancing metal purity and increasing recovery efficiency, making it one of the most advanced e-waste recycling techniques in Viet Nam.

Figure 6.17. Technological Process for Metal Recovery from PCBAs Using Electrolysis



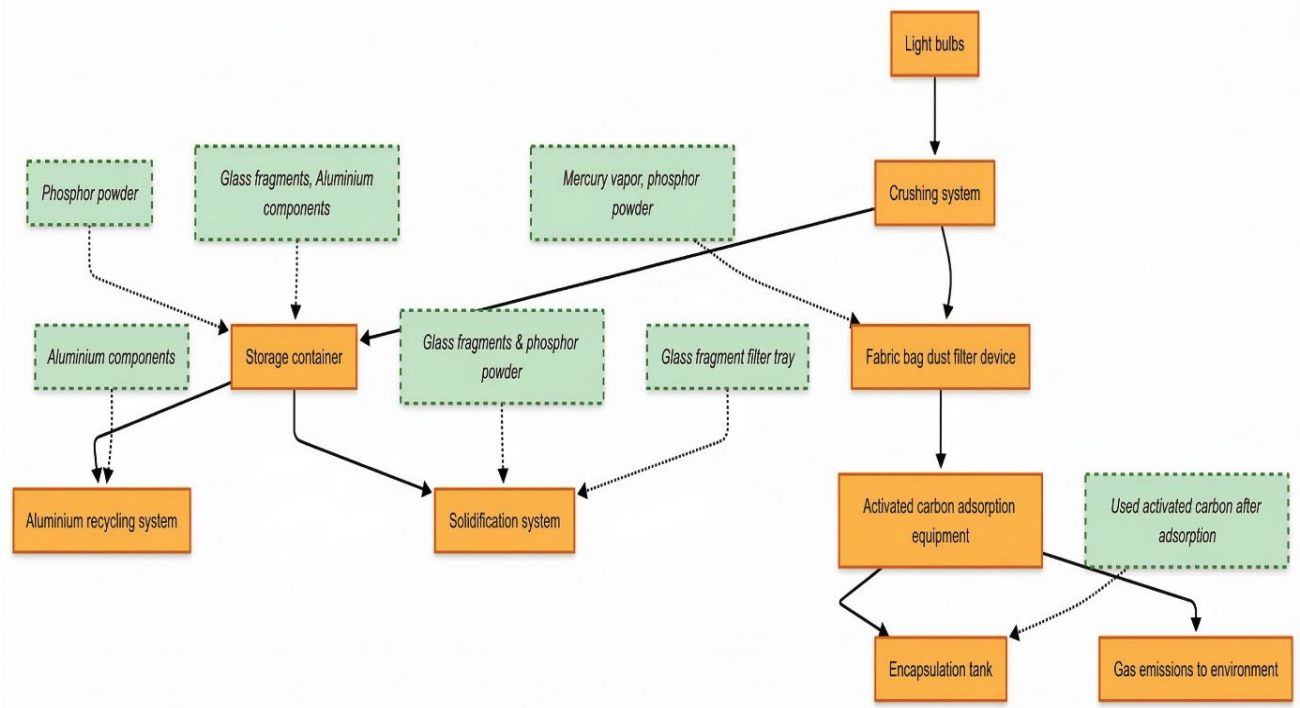
Source: Created by author from Thuan Thanh JSC (2025).

For each type of e-waste, specific treatment methods are applied, and all processes must be registered and approved before implementation, including treatment, recycling, and material recovery.

Fluorescent Lamp Waste Treatment

The primary treatment method for this type of waste involves disassembly, classification, material recovery, and metal ingot production. The components are then crushed and ground into glass powder or granules, which serve as raw materials for other manufacturing processes (Figure 6.18).

Figure 6.18. Specific Treatment Process for Waste Fluorescent Lamps in Thuan Thanh Company



Source: Created by the author from Thuan Thanh JSC (2025).

- The lamps are fed into a grinding chamber, where they are crushed into small fragments ranging from 0.2 to 0.5 cm in size.
- Separation of Main Components: Glass fragments and aluminium end caps fall into a collection container. Mercury vapour and fluorescent powder are extracted by a vacuum system and directed into a fabric filter unit for treatment.
- Further Filtration and Recovery: Glass fragments pass through a sieving tray and settle at the bottom of the container. Aluminium end caps are retained on the filter tray and separated. Fluorescent powder is captured in the dust filter bag.
- Final Processing and Disposal: Aluminium end caps are collected and sent to the aluminium recycling system. Fluorescent powder and glass fragments are processed in the solidification system to prevent environmental contamination. Activated carbon saturated with mercury vapour is securely disposed of in a sealed containment facility, ensuring environmental safety.

Anh Duong Vina Co., Ltd. in Ho Chi Minh City applies advanced recycling technology for fluorescent lamps. Fluorescent lamps and electronic components are dismantled to separate glass, metals, and hazardous substances. Batteries are classified according to their chemical type (lead-acid, lithium-ion, etc.). Mercury is recovered through a vacuum distillation system, preventing leakage into the environment. Metals such as copper, aluminium, and lead are separated and recycled. Non-recyclable components are treated using solidification technology or incinerated in specialised furnaces.

Source: Anh Duong Vina Co. (2025).

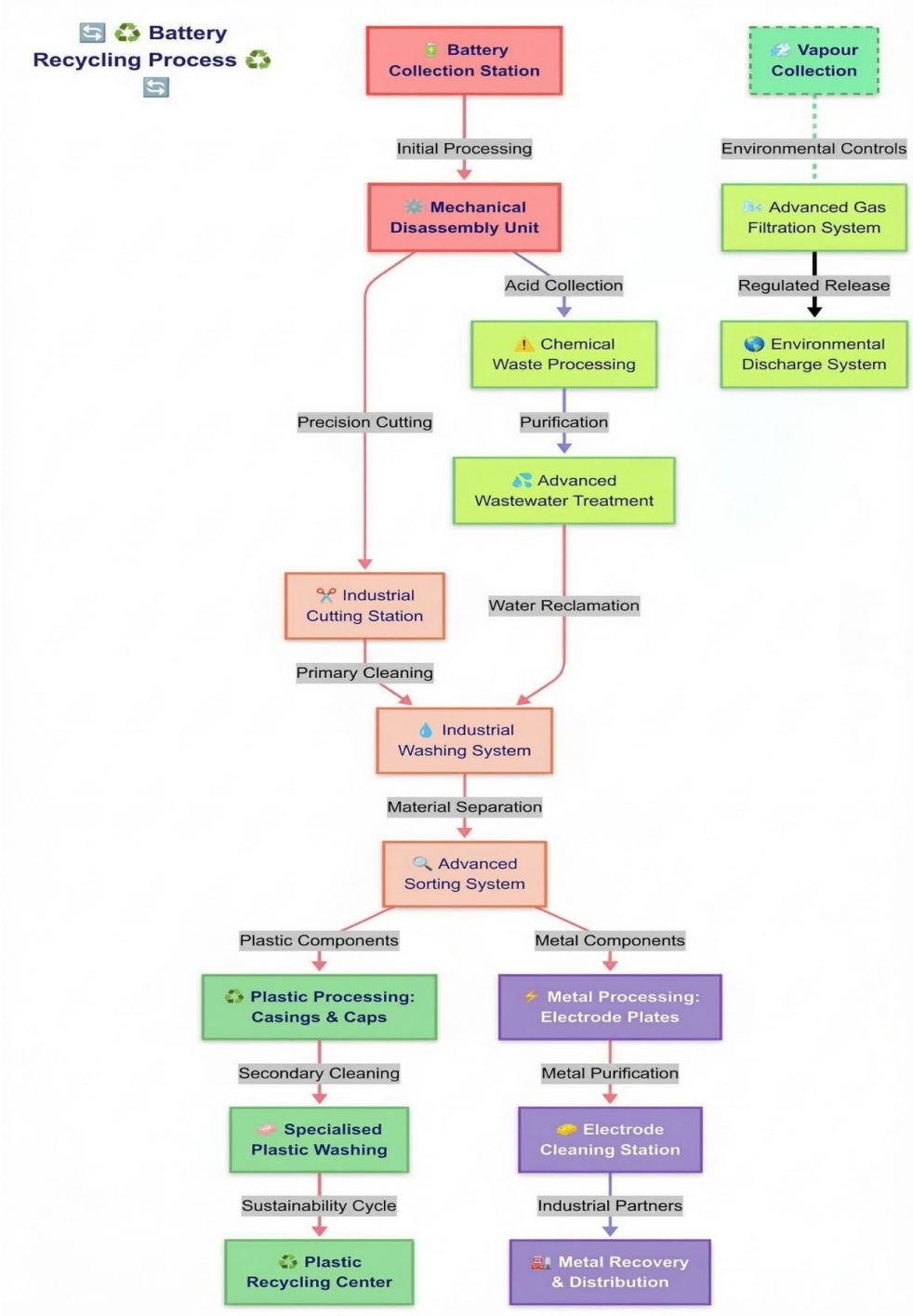
This process maximises material recovery while ensuring strict control of toxic mercury emissions, significantly reducing negative environmental impacts.

Waste Battery Treatment Process

Waste battery recycling activities have been registered for treatment by several prominent companies, including Hung Phat Urban Environment Co., Ltd., Sao Sáng Bac Ninh Environmental Treatment Co., Ltd., and Thuan Thanh Environment Company in Bac Ninh. The waste battery treatment process is illustrated in Figure 6.21.

- Waste batteries are dismantled to recover acid, plastic casings, and lead plates.
- The battery cover is manually removed and placed upside down to drain the acid into a collection tank located beneath the workbench. A diaphragm pump is used to transfer the acid into a storage tank.
- Acid vapours are extracted by a ventilation system, passing through activated carbon filtration before being released into the environment via an exhaust pipe.
- Depleted batteries are transported to a cutting machine, where a controlled blade mechanism slices them into smaller sections. These fragments are then transferred to a cleaning tank for washing.
- The components are separated and classified into plastic and lead, followed by thorough cleaning and recovery for recycling purposes.

Figure 6.19. Battery Recycling Process



Source: Created by author from Thuan Thanh JSC (2025).

Composition of Recyclable Material from e-waste

A survey was conducted at **Thuan Thanh Company, a prominent e-waste processing enterprise located in Bac Ninh Province, Viet Nam**. The objective of the survey was to assess the recovery and recycling capacities for different categories of e-waste and to evaluate the effectiveness of current recycling processes. The survey results are presented in Table 6.6.

Table 6.6 provides a comprehensive overview of the types of e-waste processed, the specific materials recovered/recycled, and the corresponding composition of recyclable material recovery rates by weight. The findings indicate significant variations in composition of recyclable material across different types of e-waste collected. Fluorescent lamps, for instance, achieve a composition of recyclable material of 2%–3% for aluminium lamp bases, while batteries and accumulators exhibit a higher recyclable composition rate of 44%–57% for lead oxide. End-of-life electronic devices and components present a lower recyclable composition rate ranging of 4.7%–4.9% for plastics and metals (steel, copper, aluminium), whereas PCBAs attain a relatively higher composition rate of 13.3%. Televisions, refrigerators, and other large appliances achieve a 50% recyclable composition rate for scrap materials (aluminium, steel, plastic).

Table 6.6. Recovered/Recycled Materials from E-Waste in Thuan Thanh Company

No.	Types of E-Waste	Recovered/Recycled Materials	Composition of Recyclable Material in the Product (%)
1	Fluorescent lamps	Aluminium lamp bases	2–3%
2	Batteries and accumulators	Plastic	10%
		Lead oxide	44%–57%
3	End-of-life electronic devices and components	Plastic; metals (steel, copper, aluminium)	4.7%–4.9%
4	Televisions, refrigerators, etc.	Printed circuit boards	13.3%
		Scrap (aluminium, steel, plastic)	50%

Source: Estimated by author from the field survey (2025).

The data underscores the necessity for further investment in advanced recycling technologies, particularly for plastics and mixed electronic components. Additionally, policy interventions are necessary to incentivise enterprises to adopt more comprehensive recycling practices and to strengthen the regulatory framework for e-waste management in Viet Nam.

D) Current status of e-waste import and export management in Viet Nam

Viet Nam strictly prohibits the import, temporary import, re-export, and transit of waste from abroad in all forms. However, the import of scrap materials for use in domestic production is permitted under the limited conditions (refer to Section 2.4 for detailed regulations).

Some organisations and individuals have exploited this allowance to illegally import hazardous waste, including e-waste (e.g. computer monitors, waste electronic circuit boards), into Viet Nam. The main areas where such activities occur are the northern border provinces (Cao Bang, Lang Son, Lao Cai), the southwestern border provinces (Tay Ninh, Kien Giang), and major seaports (Hai Phong, Quang Ninh, and Ho Chi Minh City) (MONRE, 2021).

Since the end of 2023, no cases related to the smuggling of imported scrap have been detected or prosecuted in Viet Nam. All incidents showing signs of waste or scrap smuggling have been promptly addressed. Relevant authorities have been actively involved in these

enforcement activities. This outcome is the result of sustained efforts over a prolonged period, as prior to 2022, the volume of imported scrap into Viet Nam was significantly high.

At that time, a nationwide campaign was launched to combat and apprehend smugglers. As a result, numerous cases involving the smuggling of hundreds of thousands of tons of scrap were prosecuted. In 2023, Viet Nam imported approximately 9,307,589.9 tonnes of scrap materials, of which iron, steel, and cast-iron scrap accounted for 48.39%, paper scrap for 43.73%, and the remainder consisted of glass scrap and plastic waste and fragments. As of 31 December 2023, the number of scrap cargo containers left idle at seaports stood at 945, representing a decrease of 1,071 containers compared to the same period in 2022 (Ministry of Finance, 2024). According to statistics from the Viet Nam Maritime Administration (now the Viet Nam Maritime and Inland Waterways Administration) in August 2023, nearly 8,000 containers had been stored for more than 90 days at seaports in Ho Chi Minh City, Hai Phong, Da Nang, and Ba Ria–Vung Tau. Of these, 3,100 containers have been left idle for more than 3 years, with approximately 1,000 containers containing scrap materials. Due to financial and procedural obstacles, the relevant parties halted the handling of the backlogged shipments after completing the inventory and classification of the goods (Bao Bao, 2025).

From January 2020 to December 2023, Vietnamese authorities, in co-ordination with relevant agencies, have detected and handled cases involving the illegal importation of over 9 million products, including electronic components and accessories (e.g. computers, mobile phones, etc.), as well as more than 2,300 tonnes of scrap materials (Viet Nam Environmental Police Department, 2025).

On 03 January 2017, at the port of Phuoc Long–Thu Duc, the customs inspection team searched four imported scrap containers belonging to CEM Joint Stock Company. All the goods in the containers were e-waste listed as goods banned from import.

On 24 May 2021, the Ho Chi Minh City Police, in co-ordination with the Saigon Port Area I Customs Sub-department and the Ho Chi Minh City Customs Department, inspected seven containers of goods consisting of used machinery and equipment based on seven customs declarations filed by three companies: Gia Cat Thanh Co., Ltd., Dai Loi Construction Engineering Co., Ltd., and Hoang Kim Manufacturing Technology Co., Ltd. The entire shipment, valued at approximately VND6.2 billion, consisted of used machinery and mechanical equipment originating from Japan and Taiwan and imported into Viet Nam.

Source: Viet Nam Environmental Police Department (2025)

Regarding exports, the registration for exporting hazardous waste is regulated under the Basel Convention. In 2019, nine companies were granted approval by MONRE to export hazardous waste. Amongst these companies, which were authorised to export a total volume of more than 3,958 tonnes of hazardous waste, four were permitted to export e-waste as follows:

- GSA Metals Co., Ltd.: Authorised to export 600,000 kg of electronic circuit boards to Japan.

- Matsuda Sangyo Viet Nam Co., Ltd.: Authorised to export 96,000 kg of waste electronic components to Japan.
- Schlumberger Services Co., Ltd.: Authorised to export 12,000 kg of waste batteries to a recycling facility in British Columbia, Canada.
- Sao Sang Bac Ninh Environmental Treatment Co., Ltd.: Authorised to export 500 tonnes of waste printed circuit board assemblies (PCBAs) to Korea.
- In 2020, Masuda Sangyo Viet Nam Co., Ltd. was authorised to export 200,000 kg of printed wiring boards to Japan for treatment and recycling.

2.3 Policy and regulations on e-waste management in Viet Nam

A) Regulations on e-waste management

Viet Nam does not stipulate a definition for e-waste; however, **the categories of e-waste are prescribed in Appendix 3C of Circular No. 02/2022/TT-BTNMT** (Table 6.7).

Table 6.7. List of E-Waste as Defined under Viet Nam Hazardous Waste Categories

Viet Nam Hazardous Code (19 02)	Wastes from Electrical and Electronic Equipment	Basel Code
15 02 14	Electronic devices or electronic components, as well as equipment or parts containing electronic components, arising from the dismantling or maintenance of inland waterway transport vehicles (excluding printed circuit boards from which electronic components have been removed and classified as hazardous waste)	A1180 A2011
16 01 12	Batteries and accumulators and unsorted batteries and accumulators containing these batteries	A1160 A1170
16 01 13	Household-generated discarded electrical and electronic equipment containing hazardous components	A1180 A2011
19 02 01	Transformers and capacitors containing polychlorinated biphenyls (PCBs)	A3180
19 02 02	Discarded equipment containing or contaminated by PCBs other than those mentioned above	A3180
19 02 03	Discarded equipment containing chlorofluorocarbons, hydrochlorofluorocarbons, hydrofluorocarbons	A3150
19 02 04	Discarded equipment containing free asbestos	A2050
19 02 05	Discarded equipment containing hazardous components other than those mentioned above	A1030 A2011 A3180
19 02 06	Hazardous components removed from discarded equipment	A1030 A2011 A3180
19 02 07	Discarded equipment other than those mentioned above	

Source: Ministry of Natural Resources and Environment (MONRE), 2022.

E-waste is classified within the list of hazardous waste categories and, as such, is subject to the general hazardous waste management regulations. The following legal instruments, currently in force and most recently updated, govern hazardous waste management in general and e-waste management in particular in Viet Nam (Table 6.8).

Table 6.8. List of Documents and Regulations on E-Waste Management in Viet Nam

No.	List of Relevant Legal Documents	Main Contents	Note
1	Decision No. 491/QĐ-TTg dated 17 May 2018 of the Prime Minister on the National Strategy for Integrated Solid Waste Management to 2025, with a vision to 2050	Sets the target that 100% of electrical and electronic equipment manufacturers must establish and publicly announce product take-back points	
2	Decision No. 45/QĐ-TTg dated 13 April 2022 of the Prime Minister on the National Strategy for Environmental Protection with a vision to 2030	Establishes tasks to strengthen the management of hazardous waste	
3	Decision No. 22/QĐ-TTg of the Prime Minister on the National Action Plan for Circular Economy implementation	Defines the action plan and targets for rolling out circular-economy measures across key sectors	
4	Law on Environmental Protection 2020 (Law No. 72/2020/QH14, effective 01 January 2022)	- Regulations on classification, collection, and treatment of solid and hazardous waste, and on import of scrap as raw material; - Promotion of recycling and reuse of waste; - Rules on extended producer responsibility (EPR) for discarded products; - Incorporation of the circular-economy concept into national law	
5	Law on Customs 2015 (Law No. 100/2015/QH13)	Governs customs procedures for the import and export of waste and scrap	Amended by Law No. 12/2017/QH14 of the National Assembly
6	Customs Law 2014	Specifies prohibited acts in the import and export of waste and scrap	
7	Decree No. 08/2022/NĐ-CP dated 10 January 2022	- Detailed provisions on the management of municipal,	Amended by Decree No. 05/2025/NĐ-CP

No.	List of Relevant Legal Documents	Main Contents	Note
	detailing several articles of the Law on Environmental Protection	industrial, and hazardous waste; - Regulations on EPR implementation.	(supplementing/amending Decree 08/2022) and by Circular No. 07/VBHN-BTNMT issued 10 January 2025
8	Decree No. 45/2022/NĐ-CP dated 07 July 2022 on administrative sanctions in the field of environmental protection	- Prescribes penalty levels for administrative violations across environmental sectors; - Includes specific penalties for breaches of waste-management regulations.	
9	Circular No. 02/2022/TT-BTNMT dated 10 January 2022	Provides detailed guidance on certain articles of the Law on Environmental Protection 2020; includes Appendix 3C	Amended by Circular No. 07/2025/TT-BTNMT

Source: Compiled by Authors (2025)

Environmental law clearly stipulates the authority to grant environmental licenses in detail in Article 41 of the Law on Environmental Protection 2020. Decree 08/2022/ND-CP stipulates that waste source owners must declare the substances and types of hazardous waste in their applications for environmental licences or in environmental documentation. Pursuant to Decree 08/2022/ND-CP, which details a number of articles of the Law on Environmental Protection, Appendix II of decree classifies electronic waste – from the production of components and large- and medium-capacity EEE – as a type of production, business, and service activity that poses a risk of harm to the environment.

The responsibility for preventing environmental incidents is stipulated in Article 122 of the Law on Environmental Protection 2020 (Vietnam National Assembly, 2020). The source owner of e-waste must be responsible for implementing plans, measures, and equipment to prevent and respond to environmental incidents, and must regularly inspect and apply management measures at the place where e-waste is stored, preventing the risk of environmental pollution incidents.

The responsibility for preventing environmental incidents does not only belong to the source of e-waste but also to the local state management agency (provincial people's committee), which is responsible for investigating, compiling databases, and building capacity to prevent environmental incidents in the locality. Regarding the management of e-waste, domestic electronic equipment manufacturers and foreign electronic waste importers must be granted environmental licences and are responsible for preventing environmental pollution, managing the entire process of generating, classifying, collecting, reusing, etc. e-waste or must be responsible for transferring it to a facility with the function and environmental licence for handling. The generator of e-waste is responsible for managing the waste it produces. If the waste cannot be properly classified, collected, and reused, it must be transferred to a facility that has the capacity to manage it. However, in reality, there are still cases where waste generators lack the capacity to classify and collect e-waste and instead

dispose of it directly into the environment, or transfer it to unqualified facilities that do not hold an environmental licence for treatment.

> In Bui Hamlet, Cam Xa Commune, Hung Yen Province, a large-scale illegal e-waste dump has existed for many years, posing a serious risk of environmental pollution. Most of the waste consists of discarded television screens, computer monitors, and various types of plastics from electronic devices. According to e-waste traders, these materials have no remaining value for reuse or recycling. Instead of being collected, transported, and sent to licensed facilities for proper treatment, they are illegally dumped and stockpiled at this site. At the e-waste dump, numerous computer and television screens are burned after being illegally discarded. The smouldering fires release thick plumes of white smoke that drift into the air with the wind. As these materials are not easily combustible, many television screens at the site are left only partially charred.
>
> Source: Tuan (2024).

The legal provisions indicate that responsibility for managing e-waste lies with the source at which it is generated. However, current regulations on e-waste management – implemented through the frameworks for solid waste and hazardous waste management –apply only to businesses and e-waste importers, not to consumers. As the state has not yet established mechanisms to manage e-waste generated by consumers, it has limited control over the disposal of e-waste outside formal management systems. And no competent authority or state management agency directly collects e-waste. It can be seen that, under the current legal regulations on the management of electronic waste at the source, all waste generators must comply with hazardous waste management regulations, including those applicable to electronic waste. However, these regulations remain general in nature and lack specific instructions. In addition, the classification of electronic waste is still carried out separately rather than through a unified and consolidated system.

Regulation on e-waste transportation

Pursuant to Clause 3, Article 83 of the Law on Environmental Protection 2020, hazardous waste must be stored and transported by appropriate specialised equipment and vehicles to waste treatment facilities. Hazardous waste transport vehicles must be equipped with positioning devices; operate on routes and at times prescribed by the provincial people's committee. During this process, waste source owners can collect and transport themselves if they meet all the conditions prescribed by law and are licensed. If the source owner of electronic waste does not have the capacity, ability, or qualifications to collect and transport such waste in accordance with the law, it must be transferred to a facility licensed to collect and transport electronic waste. Centralised collection facilitates the transport and recycling of electronic waste. In addition, the collection of e-waste contributes to reducing environmental pollution and minimising the costs associated with its transport and treatment.

In addition, according to Article 37 of Circular 02/2022/TT-BTNMT, the transportation of hazardous waste must comply with technical environmental protection requirements applicable to the means of transport. These include: (i) specific requirements for certain types

of vehicles used to transport hazardous waste; (ii) requirements applicable to the transportation of hazardous waste on ships, barges, trains; (iii) the requirement that vehicles transport hazardous waste be equipped with appropriate equipment, tools, and materials while in operation.

Accordingly, the transportation of e-waste must comply with the requirements prescribed by law. During transportation, e-waste must be carried using specialised vehicles design for transporting waste to treatment facilities. These vehicles must meet specific requirements; for example, open-body trucks must be covered with tarpaulins and equipped with communication devices, absorbent materials, and fire prevention and firefighting equipment.

These requirements are specified in detail to ensure that toxic substances are not released into the environment during transportation, thereby minimising potential risks associated with the transport of electronic waste.

Regulations on e-waste handling and destruction

activities According to Clause 3, Article 8 of Decree 08/2022/ND-CP, hazardous waste treatment refers to the process of applying technological and technical solutions (other than preliminary processing) to reduce, eliminate, isolate, quarantine, burn, destroy, and dispose of waste and the hazardous components contained in it. Accordingly, the treatment of e-waste also involves the application of appropriate technologies and technical solutions to remove, isolate, quarantine, burn, destroy, and safely dispose of hazardous substances and heavy metals in present in e-waste.

According to Article 84 of the Law on Environmental Protection 2020, hazardous waste must be treated using appropriate technologies and in compliance with the provisions of environmental protection legislation. In addition, the state provides preferential policies to encourage organisations and individuals to invest in and provide hazardous waste treatment services. Particular emphasis is placed on supportng enterprises and investors that develop regional hazardous waste treatment infrastructure and facilities for the co-processing of hazardous waste.

To handle and destroy electronic waste in particular, facilities and enterprises engaged in e-waste handling and disposal must comply with all relevant legal and regulatory requirements. These include obtaining the necessary environmental licenses; ensuring the presence of specialised personnel responsible for environmental protection; applying appropriate e-waste treatment technologies; and implementing safe operating procedures.

In addition, such facilities must have specialised vehicles and equipment, an environmental management plan, and adequate labour safety measures for workers. They are also required to provide an environmental protection deposit and ensure that e-waste treatment activities are consistent with the national environmental protection plan before undertaking e-waste treatment and disposal operations.

B) Regulation on import and export e-waste in Viet Nam

Import into Viet Nam

Viet Nam's legislation broadly prohibits the import of second-hand electronics and e-waste. Under Clause 6, Article 6 of the 2020 Law on Environmental Protection, Viet Nam strictly forbids the import of waste – including used vehicles, machinery, and equipment – for dismantling or recycling. Any act of introducing waste into Vietnamese territory is unlawful and, if detected, will be prosecuted under Criminal Law No. 100/2015/QH13, as amended by Law No. 12/2017/QH14. Depending on the quantity involved, penalties include fines and imprisonment. In the most serious cases, the importation of hazardous waste in quantities of 5,000 kg or more may result in a fine of up to D5 billion and imprisonment for up to 10 years. Moreover, the importation of e-waste is also constrained by Article 10 of the 2014 Customs Law, which expressly prohibits acts such as fraud or deception in customs procedures, smuggling or illicit cross-border transport of goods, commercial fraud, and tax evasion.

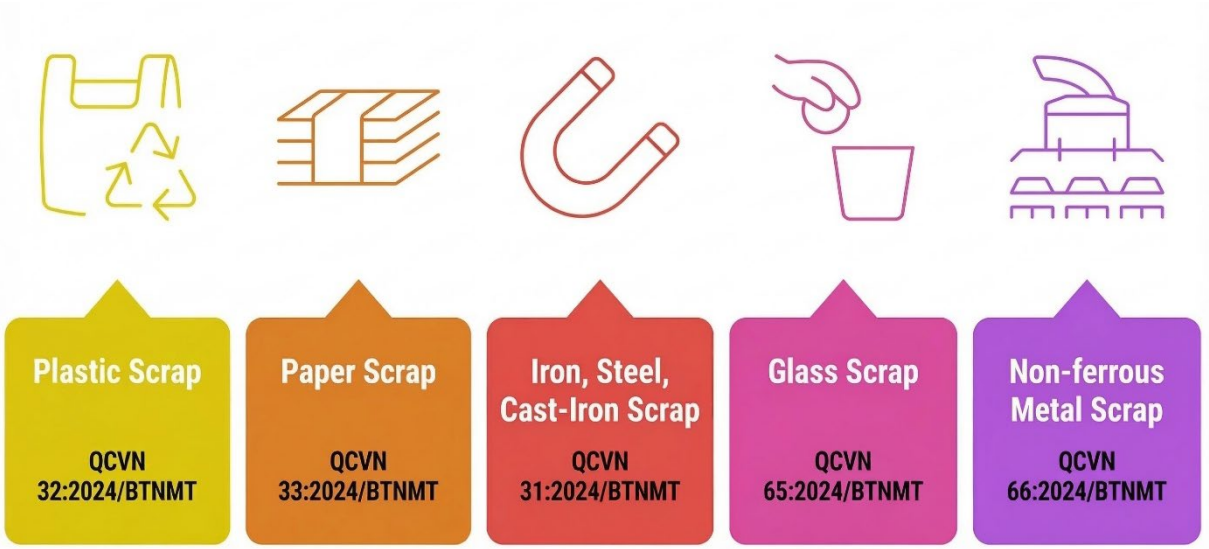
The Government of Viet Nam permits only those organisations and individuals who directly import scrap materials for use as production inputs to import such scrap exclusively for their own facilities, and only up to the design capacity required to manufacture products and goods. This requirement is set forth in Article 2 of Decision No. 13/2023/QĐ-TTg dated 22 May 2023 of the Prime Minister, which promulgates the list of scrap materials allowed to be imported from abroad as production inputs.

Specifically, the following scrap categories are permitted for import into Viet Nam as production inputs: (i) iron, steel, and cast-iron scrap; (ii) plastic scrap and fragments; (iii) paper scrap; (iv) glass scrap; and (v) non-ferrous metal scrap.

Most recently, five National Technical Regulations (QCVN) concerning the import of scrap materials for production purposes in Viet Nam were issued in 2024 and are scheduled to enter into force in June 2025 (see Figure 6.20).

- QCVN 32:2024/BTNMT – National Technical Regulation on Imported Plastic Scrap for Production Materials
- QCVN 33:2024/BTNMT – National Technical Regulation on Imported Paper Scrap for Production Materials
- QCVN 31:2024/BTNMT – National Technical Regulation on Imported Iron, Steel, and Cast-Iron Scrap for Production Materials
- QCVN 65:2024/BTNMT – National Technical Regulation on Imported Glass Scrap for Production Materials
- QCVN 66:2024/BTNMT – National Technical Regulation on Imported Non-ferrous Metal Scrap for Production Materials

Figure 6.20. National Technical Regulations on Imported Scrap Materials in Viet Nam



Source: Compiled by Authors (2025)

Export from Viet Nam

Viet Nam does not ban the export of e-waste. E-waste is treated as hazardous waste. Viet Nam is a party to the Basel Convention (and its e-waste amendments), so exports of hazardous and non-hazardous e-waste require Basel documentation. Exporters must provide details of waste content and destination and can only ship to countries that consent. Under current law, any entity exporting e-waste must register the shipment with the MONRE and obtain its approval, in accordance with **Article 38 of Circular No. 02/2022/TT-BTNMT,** which provides detailed guidance on several provisions of the Law on Environmental Protection 2020 (MONRE, 2022).

C) Regulations on Extended Producer Responsibility

Decree No. 08/2022/ND-CP clearly stipulates the road map for manufacturers and importers to fulfill their responsibility to recycle the products and packaging they manufacture and import. Under the decree, packaging and products such as batteries, lubricants, and tires have been subject to these requirements since 1 January 2024. **Manufacturers and importers of electrical and electronic products are required to fulfill their recycling responsibilities starting 1 January 2025**. For manufacturers and importers of means of transport, implementation will begin on 1 January 2027.

Specifically, **according to Article 77 and Appendix XXII of Decree No. 08/2022/ND-CP, electrical and electronic products that must fulfill recycling responsibilities** include refrigerators, freezers, automatic devices providing frozen products, and vending machines; fixed and mobile air conditioners; tablets and laptops; televisions and computer monitors, other types of screens. The list also includes compact light bulbs and fluorescent lamps; electric cookers, induction cookers, infrared cookers, ovens, microwave ovens; washing machines and dryers; cameras and camcorders; audio equipment (e.g. speakers and amplifiers); desktop computers; printers and photocopiers; mobile phones; solar panels.

However, **manufacturers and importers of electrical and electronic products do not have to fulfill recycling responsibilities if they fall under one of the following cases**: (i) manufacturing products and packaging for export; (ii) temporarily importing and re-exporting products and packaging; (iii) manufacturing or importing products for research, study, or testing purposes (not for commercial purposes); (iv) packaging manufacturers with sales revenue from goods and service provision in the previous year of less than D30 billion; (v) packaging importers with a total import value (calculated according to customs value) in the previous year of less than D20 billion.

According to the provisions of the Law on Environmental Protection 2020, **organizations and individuals producing or importing electrical and electronic products may choose to fulfill their recycling responsibilities through one of the following two options**: (a) organizing the recycling of products and packaging; or (b) making a financial contribution to the Vietnam Environmental Protection Fund to support the recycling of products and packaging. In cases where producers or importers choose to organize recycling, they may decide on the implementation method, including: (a) carrying out recycling themselves; (b) hiring a recycling service provider; (c) authorizing an intermediary organization to organize recycling (hereinafter referred to as the authorized party); or (d)a combination of the above approaches. In cases where producers or importers choose to make a financial contribution to the Vietnam Environmental Protection Fund, the contribution shall be calculated in accordance with the formula specified in Article 81 of Decree No. 08/2022/ND-CP.

Decree No. 08/2022/ND-CP also specifies the mandatory recycling rate, which is the minimum volume of products and packaging that must be recycled according to mandatory recycling standards over the total volume of products and packaging produced and brought to the market and imported in the year of implementation of the responsibility. The mandatory recycling rate for each type of product and packaging is determined based on the product and packaging life cycle, disposal rate, and collection rate, as well as national recycling targets, environmental protection requirements, and the socio-economic conditions of each period (Table 6.9).

Article 81. Financial contribution to the Vietnam Environmental Protection Fund to support the recycling of products and packaging

The financial contribution to the Vietnam Environmental Protection Fund for each type of product or packaging (F) is determined according to the following formula:

$$F = R \times V \times Fs$$

where:

- F is the total amount that producers or importers are required to contribute to the Vietnam Environmental Protection Fund for each type of product or packaging (unit: D);
- R is the mandatory recycling rate for each type of product or packaging as specified in Clause 1, Article 78 of this Decree (unit: %);
- V is the volume of products or packaging produced or imported and placed on the market

in the year subject to recycling responsibility (unit: kg);

- **Fs** is the reasonable and valid recycling cost norm per unit weight of product or packaging (unit: D/kg), including the costs of sorting, collection, transportation, and recycling of products and packaging (hereinafter referred to as recycling costs), as well as the costs of management, monitoring, and support for the implementation of recycling responsibilities by producers and importers.

Source: *Decree No. 08/2022/ND-CP.*

Table 6.9. Mandatory Recycling Rates and Recycling Cost Norms for Electrical and Electronic Equipment in Viet Nam

No.	Product Category Group	Product List	Mandatory Recycling Rate (R)	Recycling Cost Norm (Fs[a]) (D/kg)
D.1	Household Electrical Equipment	D.1.1. Refrigerators, freezers, air conditioners, electric stoves, induction cooktops, infrared cookers, ovens, microwaves	5%	
		– Refrigerators, freezers	5%	8,262
		– Air conditioners	5%	8,874
		– Electric stoves, induction cooktops, infrared cookers, ovens, microwaves	5%	7,466
		D.1.2. Washing machines, tumble dryers, loudspeakers, amplifiers		
		– Washing machines, tumble dryers	5%	7,589
		– Loudspeakers, amplifiers	5%	7,589
D.2	Display Equipment	D.2.1. Televisions, desktop computer monitors	9%	10,200
D.3	Mobile Electronic Equipment	D.3.1. Tablet computers, laptops, digital still cameras (including flash), film cameras		
		– Tablet computers, laptops	9%	10,159
		– Digital still cameras (including flash), film cameras	9%	13,831
		D.3.2. Mobile phones	15%	16,279
D.4	Office Electronic Equipment	D.4.1. Desktop computers (excluding monitors), printers, photocopiers		
		– Desktop computers (excluding monitors)	9%	9,751
		– Printers, photocopiers	9%	11,179
D.5	Lamps	D.5.1. Compact fluorescent lamps, fluorescent tubes	8%	6,202 9,792

No.	Product Category Group	Product List	Mandatory Recycling Rate (R)	Recycling Cost Norm (Fs[a]) (D/kg)
D.6	Solar Panels	D.6.1. Photovoltaic (solar) panels	4%	4,080

[a] Fs refers to the reasonable and valid recycling cost norm per unit of product or packaging. This includes the costs of sorting, collection, transportation, and recycling of products and packaging, as well as administrative management costs to support the implementation of recycling responsibilities by producers and importers. Fs includes recycling costs as well as the costs of management, monitoring, and support for the implementation of recycling responsibilities.
Source: Government of Viet Nam (2022).

D) Regulations on handling violations

Current laws provide for the handling of administrative, civil, and criminal violations. In addition, legal regulations on the prevention of and response to electronic waste are necessary, as such incidents can have very serious consequences. Therefore, efforts to prevent and respond to environmental incidents must be prioritised and implemented in accordance with technical criteria. Clearly defining the responsibilities of relevant actors in preventing and responding to environmental incidents helps ensure that they fulfill their obligations and perform their duties well; otherwise, they may be held legally accountable.

Under the Law on Handling of Administrative Violations 2012 (amended in 2020) and Decree No. 45/2022/ND-CP on sanctioning administrative violations in the field of environmental protection, waste source owners bear legal responsibility when they violate environmental regulations related to the management, classification, collection, and recycling of electronic waste. Administrative sanctions include warnings and fines, with maximum penalties of D1 billion for individuals and D2 billion for organisations. At the same time, depending on the type of violation, waste source owners may also be subject to additional sanctions such as temporary revocation of the right to use environmental licenses, confiscation of exhibits and means used to commit administrative violations, and temporary suspension of operations and corresponding remedial measures for violations.

E) Circular economy policy

The policy framework for the circular economy in Viet Nam is gradually becoming more comprehensive. Since 2020, the circular economy has been officially codified in Vietnamese law, with the Law on Environmental Protection 2020 providing a legal definition of the circular economy in the national context (Vietnam National Assembly, 2020). Subsequently, Decree No. 08/2022/ND-CP set out detailed provisions on circular economy criteria, the allocation of implementation responsibilities, and mechanisms to encourage the adoption of circular economy practices (Government of Viet Nam, 2022). Most recently, the National Action Plan for the Implementation of the Circular Economy to 2025, promulgated under Decision No. 222/QD-TTg dated 23 January 2025, identifies EEE as one of the 36 priority sectors and fields for circular economy implementation in the coming period. Proposed circular economy activities include the 'repair, refurbishment, and other services that support extending the life cycle of household and industrial electrical and electronic equipment' (Government of Viet Nam, 2025). In addition,

a range of circular economy–related policy documents and their relevance to e-waste management are analysed in Table 6.10.

Table 6.10. List of Circular Economy Policies Impacting E-Waste Management in Viet Nam

No.	Policy Instruments	Relevant Content
A. Economic instruments and market-based approaches		
Deposit–Return Scheme (DRS)	No specific regulation in place	Some businesses apply DRS on a small scale, but there is no nationwide DRS system.
Green credit, green bonds	List of 45 types of projects eligible for green credit and green bond issuance as stipulated in Decision No. 21/2025/QD-TTg dated 04/07/2025	Suitable for application to recycling enterprises, especially those involved in e-waste recycling
B. Command-and-control instruments		
EPR	Provisions in Decree No. 08/2022/ND-CP detailed in Section 2.3.C	EPR provisions for e-waste will take effect on 1 January 2025.
Export and import	Detailed provisions in the Law on Environmental Protection 2020, Decree No. 08/2022/ND-CP, and Circular No. 02/2022/TT-BTNMT	Ban on importing used EEE and e-waste. Scrap imports must meet QCVN standards and serve production purposes. E-waste exports must comply with the Basel Convention.
Violations and penalties	Provisions in Decree No. 45/QD-TTg, detailed in Section 2.3.D	Applicable to businesses that violate e-waste treatment regulations
C. Information and communication instruments		
Eco-label	Viet Nam has promulgated environmental labelling criteria for plastic products in line with Decision No. 3257/QD-BTNMT dated 07/11/2023 by the Ministry of Natural Resources and Environment	Not yet applied for e-waste
D. Circular economy		
Priority sectors and fields for circular economy	Provisions in the National Action Plan for the Implementation of the Circular	Applied to circular economy solutions for products such as EEE and batteries

No.	Policy Instruments	Relevant Content
	Economy by 2035 in Decision No. 222/QD-TTg dated 23/01/2025	

Source: Compiled by the authors (2025).

F) Other regulations

The legal provisions in Circular No. 21/2009/TT-BKHCN (amended and supplemented by Circular No. 16/2010/TT-BKHCN and Circular No. 21/2016/TT-BKHCN) stipulate the National Technical Regulation on the Safety of Electronic and Electrical Equipment. These provisions provide the basis for regulating the activities of entities engaged in the production, trading, and importation of electrical and electronic products and equipment. Such products may only be circulated on the market after being certified as conforming to the relevant technical regulations, bearing the conformity mark, and having their quality records registered in accordance with applicable regulations.

Decision No. 18/2019/QD-TTg (amended and supplemented by Decision No. 28/2022/QD-TTg) regulates the import of used machinery and technological lines, including EEE. The regulation is based on the principle of prohibiting the import of used machinery, equipment, and technological lines in the following cases:

(i) Exporting countries have announced to eliminate them due to obsolescence, poor quality, causing environmental pollution;

(ii) Do not meet the requirements on safety, energy saving, and environmental protection in accordance with the provisions of law. In addition, the regulation permits the import of used machinery, equipment, and technological lines only when they directly serve the production activities of enterprises in Viet Nam.

In addition, this document stipulates two criteria that must be met when importing used machinery and equipment:

(i) The age of the equipment must not exceed 10 years, except for certain machinery and equipment in the fields of mechanics, wood production and processing, and paper and pulp production, for which the maximum allowable age is 20 years;

(ii) The machinery and equipment must be manufactured in accordance with standards that comply with national technical regulations on safety, energy saving, and environmental protection.

In cases where there are no relevant national technical regulations applicable to the imported machinery and equipment such machinery and equipment must be manufactured in accordance with the technical specifications set out in Viet Nam's national standards or the national standards of one of the G7 countries or Korea concerning safety, energy saving, and environmental protection.

- Party Resolution 24/NQ-TW dated 03 June 2013 on Proactive Responses to Climate

Change, Enhanced Natural Resource Management, and Environmental Protection

- National Strategy for Green Growth for the period 2021–2030, Vision to 2050 (Decision 1658/QD-TTg, dated 01 October 2021)
- National Action Plan for Circular Economy (NAPCE) until 2035 (Decision No. 222/QĐ-TTg on 23 January 2025).

2.4 Urban mining in Viet Nam

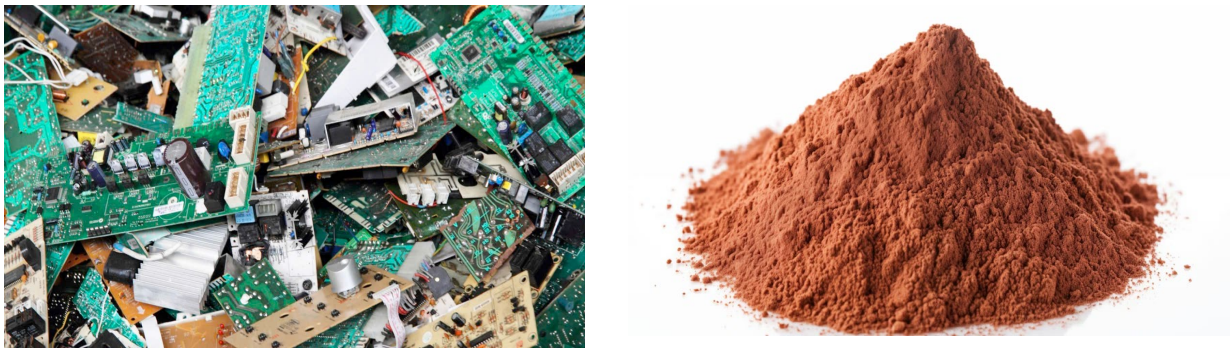
Urban mining is a term introduced by a group of authors from Japan (Nakamura and Halada, 2015) to refer to the recovery of useful materials through the extraction and recycling of precious metals such as gold, silver, copper, and rare earth elements from used EEE. In general, urban mining is based on the value obtained from secondary raw materials through biological, physical, and chemical processes. The approach of urban mining emphasises recycling and circular economy solutions rather than treating them as waste (Xavier, Ottoni, and Abreu, 2024). E- waste contains precious metals such as platinum group metals, which are known for their high melting points, corrosion resistance, and excellent electrical conductivity. Recovering these metals not only conserves valuable natural resources but also reduces the demand for new ore extraction, thereby mitigating the environmental impacts of traditional mining practices. In addition, e-waste, obsolete engines, and discarded industrial equipment carry significant amounts of valuable rare earth elements. Consequently, urban mining is emerging as a strategic pathway that not only addresses environmental challenges but also reshapes the resource landscape of the 21st century.

In Viet Nam, urban mining is still a relatively nascent field; however, its development potential is considerable. Driven by rapid urbanisation, the volume of municipal waste is steadily increasing, accompanied by a growing demand for recycled materials. Empirical evidence from e-waste management practices in Viet Nam highlights that one of the critical constraints to fully realising the potential of urban mining is the limitation of recycling technologies. Current domestic technologies exhibit low recovery efficiency for precious metals, which necessitates the export of many waste streams to technologically advanced countries, such as Japan and Singapore, for advanced extraction of precious metals from e-waste. Nonetheless, Viet Nam has undertaken a number of research initiatives and developed patents that propose technological solutions for improving the recovery of precious metals from e-waste. A notable aspect of e-waste treatment technology in Viet Nam is that scientists have published numerous studies and implemented practical projects for e-waste management, thereby proposing appropriate technological solutions.

Several research outcomes have been successfully transferred and applied in practice, generating value for investors and enterprises while contributing to the protection of the ecological environment. Prominent and effective solutions and technologies have been developed by Vietnamese scientists (Department of Science and Technology in Ho Chi Minh City, 2021). The invention for treating electronic circuit boards, researched and developed by Le Van Lu and his colleagues, has been accepted by the Ho Chi Minh City Department of Science and Technology. After dismantling and separating components such as integrated circuits (ICs),

capacitors, and resistors, PCBAs are processed using an incinerator to recycle metals. This technology has been applied in various locations and has received positive evaluations for its effectiveness, enabling the rapid recovery of precious metals while ensuring compliance with environmental emission quality standards (Figure 6.21).

Figure 6.21. PCBAs Hold Significant Potential for the Recovery of Precious Metals



Source: Le (2025).

The following section presents the technology for recovering yttrium and europium from used fluorescent lamps, developed by Ha Vinh Hung of Hanoi University of Science and Technology. In this process, end-of-life fluorescent lamps are broken using mechanical or ultrasonic methods, after which the phosphor powder is separated and recovered. Notably, this technology can also be applied to various other types of electronic waste, such as screens and LED lights (Department of Science and Technology in Ho Chi Minh City, 2021). The study of Nguyen and Bui (2024) evaluated the effectiveness of various hydrometallurgical methods for recovering precious metals from e-waste. For instance, nitric acid leaching proved effective in dissolving base metals such as nickel, iron, zinc, aluminium, copper, and silver, while thiosulfate leaching demonstrated higher dissolution efficiency for gold.

Viet Nam is currently underutilising the potential 'mine' of secondary raw materials contained in e-waste, despite growing demand. The primary reason lies in the level of awareness amongst stakeholders – including regulatory agencies, producers, and consumers – regarding the potential and value of resource recovery from e-waste, which has only improved in recent years. In particular, the technologies for recycling and recovering materials from e-waste remain outdated, resulting in low recovery rates. In addition, the attraction of foreign direct investment (FDI) – especially from countries with advanced technologies such as Japan – remains limited. At present, urban mining in Viet Nam remains scarcely addressed in academic research and, more critically, has yet to be incorporated into legal and regulatory frameworks. Consequently, the practical application and implementation of urban mining will require stronger incentives to motivate the active participation and engagement of all stakeholders.

From a policy perspective, industrialisation and modernisation have been consistent and overarching orientations of the Party and the state. Specifically, Resolution No. 29-NQ/TW (2022) on industrialisation and modernisation set out by the Party and the state identifies, amongst its priority tasks and solutions, the establishment of preferential mechanisms to

strongly promote the development of the recycling industry and the regenerative industry (Central Executive Committee, 2022). The government has also promulgated policies to promote recycling in general and, more specifically, the recovery of precious metals from e-waste. Most recently, the Prime Minister approved the Program for the Development of Vietnam's Environmental Industry for the period 2025–2030 under Decision No. 1894/QD-TTg dated 4 September 2025. The programme sets the objective of developing technologies, equipment, and products to meet 50%–60% of domestic demand for collection, transportation, transfer, and sorting, as well as 60%–70% of domestic demand for segregation and recycling (Prime Minister of Viet Nam, 2025b). In particular, private enterprises, household businesses, and individual business entities are entitled to a 2% annual interest rate subsidy on loans for implementing green and circular projects, as stipulated in Resolution No. 198/2025/QH15 on certain special mechanisms and policies for the development of the private economy. In addition, recycling, waste collection, and treatment projects are included in the list of project categories eligible for green credit and the issuance of green bonds, in accordance with Decision No. 21/2025/QD-TTg dated 4 July 2025, on environmental criteria and the certification of investment projects classified under the green category (Prime Minister of Viet Nam (2025c).

2.5 Conclusion

Drawing upon the preceding overview of Viet Nam's e-waste landscape and policy context, this chapter presents key findings regarding the nation's electronic waste management practices.

First, the analysis indicates that Viet Nam's e-waste generation rate falls within the mid-range compared to other Southeast Asian countries and remains relatively low within the broader Asian context. It is important to note, however, that the impacts of transboundary e-waste flows, specifically import and export activities, are beyond the scope of this chapter.

Second, the technological landscape for e-waste processing in Viet Nam requires significant advancement. Material recovery rates are notably lower than those achieved in developed nations, particularly Japan, underscoring the necessity for initiatives aimed at enhancing domestic E-waste recycling capabilities.

Third, the importation of e-waste into Viet Nam is legally prohibited and subject to criminal prosecution upon detection. While instances of illicit e-waste smuggling under the guise of scrap imports for production have occurred, Viet Nam maintains strict oversight of such activities.

Fourth, while the current regulatory framework for e-waste management falls under the general provisions for hazardous waste, encompassing collection, transportation, treatment, and storage, a nascent EPR framework is emerging. These EPR regulations are being progressively specified for distinct categories of EEE, signifying a move towards increased producer responsibility in the post-consumer phase.

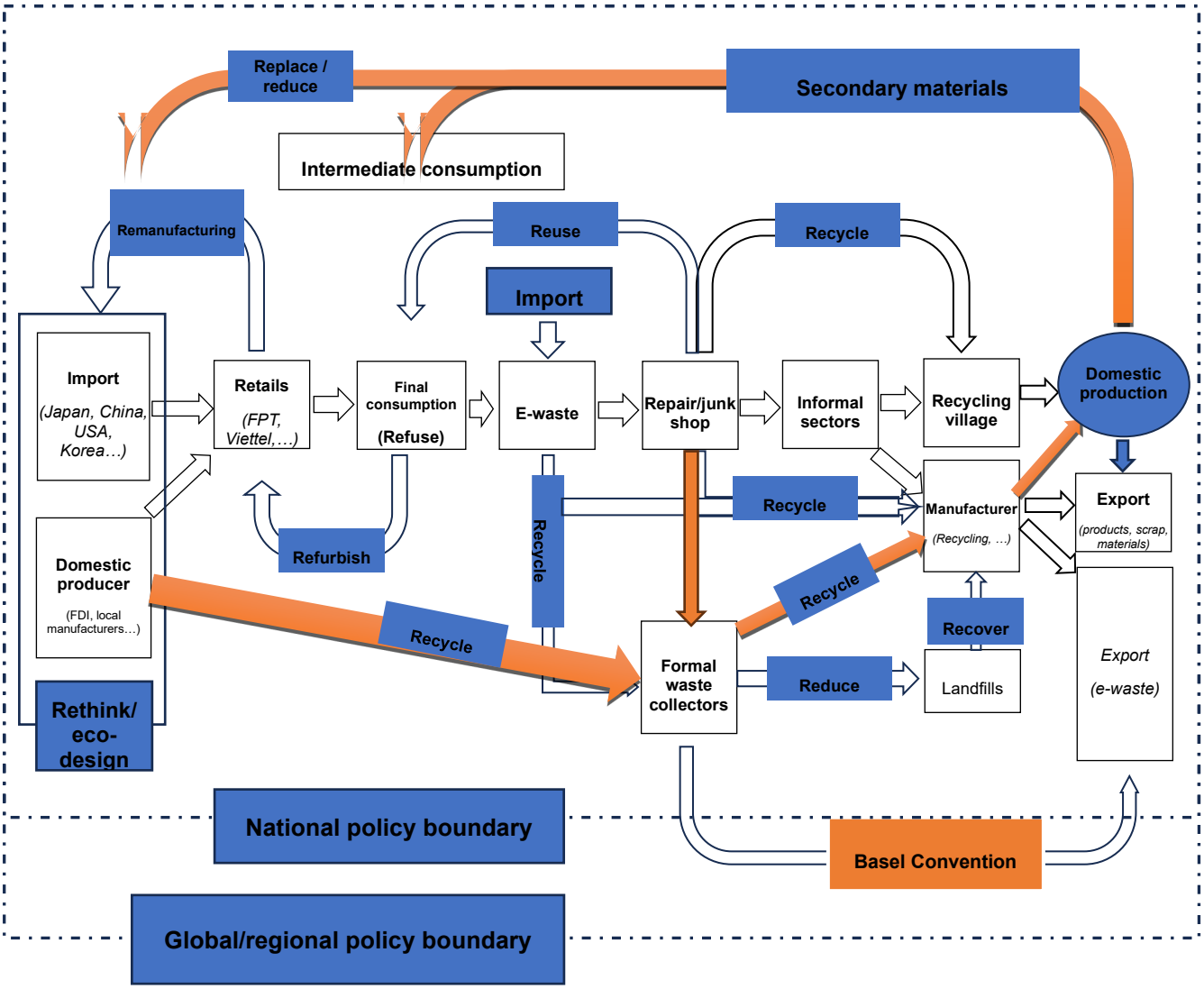
Subsequent sections of this chapter will critically evaluate the efficacy of the existing hazardous waste management infrastructure in addressing the specific attributes and challenges of e-

waste, alongside an assessment of the implementation progress and potential ramifications of the evolving EPR schemes across various EEE categories in Viet Nam.

3 Policy Recommendations on the International Material Flow on the EEE-relevant Materials between Viet Nam and Japan

System thinking is necessary to understand the material flow for electronic waste and the opportunities to create new added value for the economy through promoting circular economy approaches in Vietnam. The diagram of Figure 22 depicts three boundaries associated with different stakeholders participating in creating circular economy value for electronic waste. The three boundaries comprise: (i) within the current supply chain for electronic equipment and products, including manufacturers/importers, retail systems, and consumers; (ii) domestically through the addition of stakeholders/agents that promote the implementation of circular measures such as collection and recycling sectors; and (iii) beyond the national scope, including within the ASEAN region and ASEAN's engagement with the rest of the world such as Japan, Korea, China, India, and other countries.

Figure 6.22. System Thinking for Value Creation through Circularity Strategies for E-Waste in Viet Nam



Source: Compiled by the authors (2025).

The current status of waste flows and stakeholders participating in electronic waste streams in Viet Nam is characterized by the following main features:

(1) Origins of electronic products. Electronic products in Viet Nam originate from two primary sources:

(i) Domestic production for domestic consumption, generated by different types of manufacturing enterprises, including: FDI enterprises (primarily producing equipment such as refrigerators, televisions, air conditioners, and similar appliances) and domestic enterprises (primarily producing household electrical equipment such as fans, light bulbs, electrical wires, and other electrical devices);

(ii) Imports from foreign countries, including Japan, the United States, China, Korea, Thailand, Indonesia, and the Philippines. The importation of electronic equipment takes places through

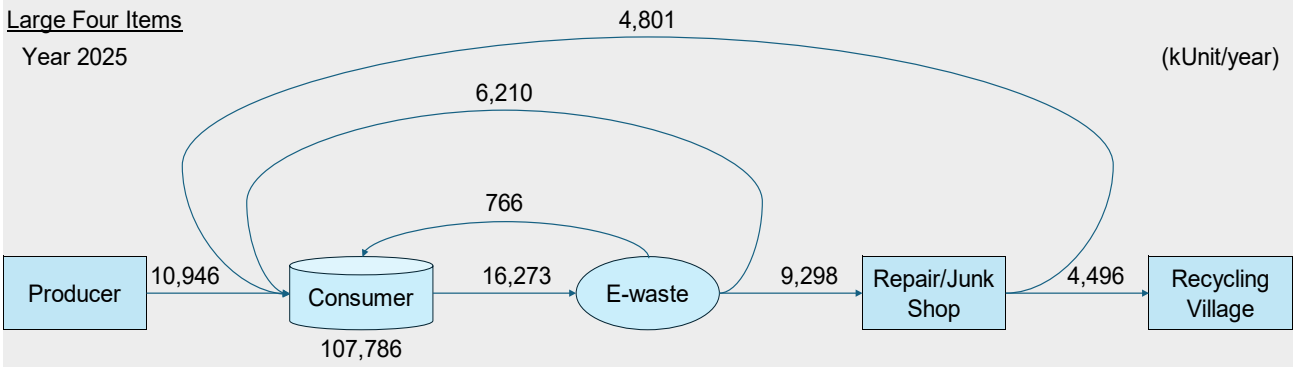
two main channels: (a) official import channels managed by major distributors or authorised dealers, and (b) e-commerce channels through online platforms such as Shopee, Lazada

(2) E-waste flows from the consumer sector primarily enter the system of repair shops and second-hand goods purchase stores (junk shop); the final surplus goes into informal recycling systems operated by craft villages. Formal collection systems have not yet participated extensively in this cycle.

(3) E-waste flows generated from the manufacturing sector primarily originate from defective and damaged products from domestic electronics factories (Foxconn, Samsung, LG, etc.) that are sorted, collected, and processed by environmental companies operating in the hazardous waste sector.

(4) Large volumes of damaged, obsolete, and expired electronic products and waste are still stored by consumers in households. Each type of e-waste differs in usage, storage, and disposal patterns by households. Some obsolete but still functional devices are reused by others or repaired for reuse at very high rates (over 60%) compared to Japan (Figure 6.23).

Figure 6.23. Four large E-waste Life Cycle in Viet Nam



Source: Hideki Wada (2025).

(5) The repair sector and second-hand goods purchase stores operate quite actively, serving as intermediaries to receive and transfer e-waste products or obsolete and damaged products (particularly mobile phones, computers, air conditioners, and refrigerators). This system operates extensively nationwide (especially in urban areas), with most operators having short-term training and working based on experience, with little connection to formal systems. Products/waste collected are processed through various methods such as repair and refurbishment for resale to consumers; reuse of components and parts from electronic devices for use in other similar products; and disposal or transfer to waste collection forces (formal or informal). However, some types of electronic equipment such as televisions and household electronic products show a declining trend in the number of second-hand collection and repair shops. Some types that cannot be repaired are typically discarded immediately after damage or when of poor quality, such as light bulbs and batteries, and are usually transferred to waste collection forces along with other waste.

(6) Collection systems by manufacturers/importers currently operate primarily through retail networks such as FPT Shop, Thegioididong, Sellphone, Viettel, etc., through buy-back or product exchange programmes. They primarily apply refurbishment or remanufacturing approaches through trade-in programmes for mobile phones. Some retail stores selling household electrical goods have begun establishing e-waste collection systems in urban areas, but the scale remains small and operations are not yet effective due to citizens' lack of established habits.

(7) The electronic waste recycling and processing sector in Viet Nam is very low, with only about 0.2% of electronic equipment being recycled, divided into two main groups: formal and informal. The informal sector typically consists of craft villages or manual recycling workshops in residential areas. Modern recycling plants are licensed and meet requirements. Currently, due to environmental and health concerns, many craft villages and informal facilities are under stricter management controls.

(8) Secondary raw materials produced include plastic pellets (Figure 6.24), precious metals, and aluminium created from electronic waste after processing. The market for consuming these secondary raw materials consists primarily of domestic factories, with a small portion exported abroad in accordance with Basel Convention regulations on hazardous waste. The informal sector typically applies low technology with low quality and resells or sells to facilities that recycle simple products for daily use; the formal sector creates high-value materials that can be transferred back to the same factories or to other sectors to produce products with high economic value.

Figure 6.24. Recycled Plastic Pellets



Source: Le (2025).

3.1 Limitations, constraints, and underlying causes

Viet Nam currently lacks a clear and consistent legal definition of e-waste, which creates difficulties in management, monitoring, and statistical reporting. Once dismantled, an electronic device consists of multiple types of waste, including municipal solid waste, industrial waste, hazardous waste, and recyclable or reusable materials.

At present, waste management regulations in Viet Nam classify waste into three main categories: municipal solid waste, industrial solid waste, and hazardous solid waste. As a result,

a clear legal definition of e-waste has not yet been formally established. Instead, electrical and electronic equipment and components are generally categorised as hazardous waste and are therefore subject to the regulations governing hazardous waste management in Viet Nam.

One notable concern is that e-waste is not being managed and utilised in accordance with the material and resource value it contains. From a circular economy perspective, e-waste can serve as a 'secondary resource mine' due to its high content of precious and rare metals, as well as other valuable reusable materials. However, in Viet Nam, much of this value remains untapped due to the absence of an effective management system, advanced technologies, and appropriate policy mechanisms.

A prominent characteristic of the current e-waste management value chain in the country is the significant disparity in access to waste streams between the formal and informal sectors. Field surveys reveal that the majority of e-waste generated by households is collected by street waste pickers, itinerant buyers, and small junk dealers, or transferred through second-hand electronics repair shops. Owing to their extensive collection networks, low transaction costs, and reliance on cash-based exchanges, the informal sector has become the primary 'gateway' controlling e-waste flows. By contrast, formal recycling facilities face considerable difficulty in directly accessing e-waste from consumers. In practice, recycling plants generally obtain e-waste through two channels: (i) recovery contracts with businesses and organisations, or (ii) secondary purchases from junk shops after multiple rounds of sorting and dismantling.

As a result, most high-value components and materials are stripped away before reaching the formal sector, leaving behind fractions that are difficult to treat and often contain hazardous substances. This raises treatment costs for the formal sector, erodes their competitive advantage, and undermines their ability to secure stable feedstock to justify investments in modern technologies. Such fragmentation not only diminishes the effectiveness of the EPR mechanism but also slows progress towards building a circular economy in e-waste management. While the formal sector possesses the technological and regulatory capacity, it controls only a minor portion of the waste stream, whereas the informal sector – with its labour-intensive, environmentally unregulated practices – plays the dominant role. This structural bottleneck represents a major challenge in e-waste management in Viet Nam, highlighting the urgent need for mechanisms to co-ordinate and integrate both sectors to ensure economic efficiency and environmental sustainability. Table 6.11 summarises the key limitations, constraints, and underlying causes affecting e-waste management in Viet Nam, providing insights into the structural, regulatory, and operational challenges within the sector.

Table 6.11. Limitations, Constraints, and Underlying Causes in E-Waste Management in Viet Nam

No.	Limitations, Constraints	Causes
1	The rate of e-waste recovery and recycling in Viet Nam remains very low,	- Recycling technologies remain outdated. - The scale and number of enterprises engaged in collection and recycling activities remain limited.
2	The quality of recycling remains low.	Most recycling activities remain at a rudimentary level, primarily carried out within the informal sector and traditional craft villages, which limits the economic value obtained. As a result, many valuable electronic materials and components are neither optimally reused nor fully recovered, leading to resource wastage and missed opportunities for advancing the circular economy.
3	The formal collection rate of household e-waste remains very low, with the majority being channeled into small-scale collection networks and processed at informal facilities.	- A dedicated collection and treatment system for e-waste has yet to be established, particularly with regard to collection from the consumer sector. - The financial value of recycled materials is often low and volatile, while the costs of safe separation and treatment remain high, making it difficult for formal enterprises to compete with informal recycling facilities.
4	Several policies on e-waste management have not yet proven effective.	- There is no clear legal definition or classification of e-waste management within Viet Nam's regulatory framework. - Policies on EPR for e-waste remain incomplete. - Policies supporting the development of recycling technologies and equipment have proven ineffective. - Policies on green financial support have not been given sufficient attention. - Most e-waste is managed under the same framework as hazardous waste, creating difficulties in complying with regulations specific to e-waste.
5	Environmental pollution risks from craft village activities	E-waste recycling craft villages often make use of household living spaces for dismantling, burning electrical wires, and soaking circuit boards in acid, without any systems in place for the collection and treatment of emissions, wastewater, or solid waste.
6	Life cycle management of equipment and e-waste has not been given adequate attention.	EPR has only been implemented at an initial stage and has not yet created a clear incentive for life cycle product management.

No.	Limitations, Constraints	Causes
7	The data and information system for electrical and electronic equipment, including e-waste, remains incomplete and insufficiently monitored.	- There is no clear definition or classification of e-waste. - No mechanism exists for data and information sharing between producers, importers, and relevant stakeholders.
8	Secondary products, recycled materials, and outputs from recycling face difficulties in market consumption.	- Secondary raw materials and recycled products encounter significant challenges in market uptake. - Recycled products and secondary materials face limited demand and difficulties in market penetration.
9	E-waste continues to be predominantly collected and processed within the country.	E-waste is still managed in accordance with the provisions of the Basel Convention (and as specified under the HS code).
10	There is a lack of incentives to transition towards recycling and circular economy models.	There is a lack of incentive mechanisms and financial support, such as investment incentives for clean technologies, capital support for formal treatment enterprises, and recycling collection funds, along with the absence of clear market orientation for recycled materials, including the absence of product standards for recycled content, public procurement policies, or preferential government purchasing).

Source: Compiled by the authors (2025).

3.2 Policy recommendations

A) E-waste management towards circular economy in Viet Nam

Transitioning towards a circular economy in e-waste management emphasises resource efficiency, material recovery, and the extension of product life cycles through the application of R-strategies, including reduce, reuse, recycle, refurbish, and recover (Table 6.12). In practice, these strategies aim to minimise the extraction of virgin materials by promoting product longevity, encouraging repair and refurbishment, enabling material recovery, and closing the loop through efficient recycling processes. For example, source segregation and proper collection schemes facilitate recycling and urban mining, allowing the recovery of valuable metals from discarded electronics. Reuse and refurbishment reduce the demand for new products, while eco-design ensures that products are easier to disassemble, repair, and recycle. For Viet Nam, a country experiencing rapid e-waste generation, implementing a circular economy approach to e-waste management requires a combination of regulatory, economic, and awareness-raising measures.

Table 6.12. Policy Framework Recommendations for Viet Nam to Promote E-Waste Management in Line with the Circular Economy

No.	R-Strategies	Target	Policy Recommendations
A	Current supply chain boundary		
1	Rethink/ Eco-Design	Advancing circular design	- Issue eco-design standards to ensure that EEE products are easily disassembled, repairable, and highly recyclable. - Develop and implement detailed eco-design guidance and criteria for businesses. - Strengthen communication and raise awareness of the benefits of using recycled materials instead of virgin resources. - Apply environmental taxes on products that heavily consume virgin resources, encouraging substitution with recycled materials.
2	Refuse	Advocating against the use of virgin material products	- Introduce tax breaks, subsidies, or preferential procurement policies for businesses and consumers who choose reused or refurbished electronic products instead of new items made from virgin materials. - Implement nationwide campaigns and mandatory eco-labelling schemes that highlight the environmental benefits of choosing reused or refurbished products, thereby reducing demand for products made from virgin resources.
3	Replace	Substitution with recycled materials	- Introduce incentive mechanisms to encourage businesses to use recycled materials in production. - Establish certification and labelling systems for products containing recycled content to build consumer trust. - Implement regulations prioritising green public procurement, favouring products with recycled materials in public projects and programmes.
4	Remanufacturing	Support	- Apply and expand EPR in product collection and remanufacturing. - Establish a deposit–return system to encourage consumers to return used products.
5	Refurbish	Ensure the protection of consumer rights	- Implement insurance and warranty policies for refurbished products to protect consumer rights.

No.	R-Strategies	Target	Policy Recommendations
			- Develop management and monitoring systems for refurbishment activities to ensure transparency and safety.
B	Domestic policy boundary		
6	Reuse	Promote	- Improve the quality of repair services through technical support and quality inspection. - Expand warranty and insurance policies for reused products. - Provide vocational training and foster linkages between the formal and informal repair sectors.
7	Recycle	Support	- Promote extended producer responsibility for e-waste, requiring companies to contribute to collection and recycling costs. - Mobilise green finance for recycling projects, encouraging private investment. - Enhance the transfer of advanced technologies, particularly for recovering precious metals from e-waste (urban mining). - Plan eco-industrial zones dedicated to recycling and waste treatment. - Orient waste management towards a circular economy with a focus on e-waste. - Establish standards for secondary raw materials derived from e-waste and eco-labelling for recycled products that comply with technical regulations. - Issue standards for recycled materials from e-waste, specifying quality requirements and eco-labelling. - Develop a road map for reducing taxes and fees on recycled products. - Attract foreign direct investment in the e-waste recycling sector to enhance technological capacity and processing scale.
7	Reduce	Support	- Enhance the capacity for source-level waste segregation, particularly for electronic devices, to facilitate recycling and reuse.
8	Recover	Support	- Improve technologies for energy and material recovery from e-waste, ensuring high efficiency while minimising secondary pollution.
B	Global/regional policy boundary		
9	E-waste	Harmonising regulations and road maps	- Develop and implement regulations for e-waste classification in accordance with the Basel Convention to ensure international compliance.

No.	R-Strategies	Target	Policy Recommendations
			- Develop a road map for market liberalisation and trade facilitation (ASEAN–Japan). - Integrate e-waste considerations into bilateral and multilateral declarations and free trade agreements.
10	Scrap/secondary material	Harmonising regulations and road maps	- Promote market liberalisation and trade facilitation for recycled materials within the region (ASEAN–Japan). - Incorporate regulations on SCRAP (recycled scrap materials) into bilateral and multilateral agreements to ensure legal and safe supply.

Source: Compiled by the authors (2025).

B) EEE circulation between Viet Nam and Japan

Based on the analysis of EEE-relevant materials trade between Viet Nam and Japan from 2020 to 2022, the following policy recommendations are proposed to address identified challenges and optimise bilateral material flows.

Viet Nam should implement targeted policies and incentives to expand its EEE production and export capabilities in underrepresented categories, particularly machinery (HS 84), temperature exchange equipment, and screens/monitors. The analysis shows over-dependence on electrical machinery (HS 85), which accounts for 66.3% of total trade value, while machinery (HS 84) represents only 19.1% and other categories remain minimal. This concentration creates vulnerability to market fluctuations and limits Viet Nam's ability to move up the value chain, making diversification essential to reduce trade deficits, create more balanced trade relations, and develop domestic manufacturing capabilities across a broader range of EEE products.

Viet Nam should establish comprehensive EPR policies that require EEE manufacturers and importers to take responsibility for the entire life cycle of their products, including collection, recycling, and proper disposal of end-of-life equipment. The massive inflow of e-waste from Japan to Viet Nam (US$147 million in 2022) indicates a need for improved end-of-life management. An EPR framework would ensure that manufacturers bear responsibility for the environmental impacts of their products, create incentives for sustainable design, and generate funding for proper e-waste management infrastructure. This would align with Viet Nam's circular economy action plan and help balance the e-waste trade relationship with Japan.

Viet Nam should position itself as a regional hub for EEE circular economy activities, focusing on refurbishment, remanufacturing, and high-value recycling of electronic components in partnership with Japan and other ASEAN countries. Viet Nam's growing role in EEE processing, combined with Japan's advanced technology and substantial e-waste generation, creates an opportunity to develop a regional circular economy hub that would

transform waste flows into resource flows, create high-value jobs, and position Viet Nam strategically in the global EEE value chain while addressing environmental concerns.

Viet Nam and Japan should establish a comprehensive bilateral agreement to manage electronic and electrical waste flows, including technical co-operation, technology transfer, and capacity building programmes. The analysis reveals a severe e-waste trade imbalance, with Viet Nam importing US$147 million worth of electronic waste compared to only US$1.5 million in exports (a 95:1 ratio) in 2022, indicating Viet Nam is serving as a major destination for Japan's e-waste disposal. A bilateral framework would ensure proper handling of e-waste, promote resource recovery, and prevent environmental degradation while creating economic opportunities through urban mining and recycling industries.

Viet Nam and Japan should develop improved tracking mechanisms for EEE materials by adopting more detailed HS code classifications, particularly for e-waste flows, and implementing digital tracking systems for better monitoring of material flows. Current trade statistics focus primarily on components rather than finished products, limiting visibility into specific EEE categories like temperature exchange equipment and screens/monitors, while the analysis reveals limited data availability for waste-specific codes, with HS 854999 only introduced in 2022. Improved classification and monitoring would strengthen policy-making, enhance compliance with international agreements such as the Basel Convention, and support the more effective implementation of a circular economy.

Viet Nam and Japan should establish joint research and development programmes between companies from both countries, focusing on advanced EEE manufacturing technologies, recycling innovations, and circular economy applications. The persistent US$3.5 billion annual trade deficit of total EEE reflects Viet Nam's technological dependence on Japan's advanced manufacturing capabilities. Technology transfer partnerships would help Viet Nam develop domestic production capabilities, reduce import dependence, and create more value-added manufacturing opportunities in the EEE sector.

Finally, policy recommendations to optimise the international material flow of EEE-related materials between Viet Nam and Japan should prioritise strengthening legal and regulatory frameworks. Viet Nam can learn from Japan's successful Home Appliance Recycling Law (2001), which has demonstrably improved collection rates. Collaborative intergovernmental workshops are crucial for adapting such provisions, sharing enforcement strategies, and establishing effective fee-financed collection systems. To address the limitations of Vietnamese customs authorities and environmental regulators in controlling unlicensed EEE collectors, joint training programs funded by the Japan International Cooperation Agency can significantly enhance their capacity for tracing and validating recoverable materials at ports, thereby bolstering compliance with existing national decrees and circular economy action plans. Furthermore, the establishment of bilateral green financing and circularity funds, leveraging Japanese concessional loans and Vietnamese green bonds, can provide vital financial support to small and medium-sized enterprises operating in the repair, reuse, and recycling sectors, aligning economic incentives with environmental objectives. Concurrently, efforts to harmonise international rules and standards, coupled with state support for developing a closed-loop

recycling value chain in Viet Nam – encompassing collection, sorting, processing, remanufacturing, and consumption – are essential. This necessitates a specific legal framework and guidelines to ensure the efficient operation of each stage.

Finally, technical assistance and communication initiatives, including specialised training and consultation on circular economy principles, life cycle assessment, and eco-design, are vital for empowering Vietnamese businesses and fostering a sustainable transition.

4 Conclusion

The analysis of EEE material flows and e-waste management between Viet Nam and Japan reveals a complex and evolving trade relationship characterised by significant economic potential and environmental challenges. The persistent trade imbalance, particularly in electronic waste (HS 854999), highlights Viet Nam's emerging role as a recipient of discarded electronic materials from Japan, raising concerns regarding the adequacy of domestic recycling infrastructure and regulatory frameworks. While Viet Nam's exports of certain electronic components have demonstrated growth, the overall trade composition remains heavily concentrated in electrical machinery (HS 85), limiting the potential for diversification.

The findings further underscore the substantial disparity in technological capacity for e-waste processing between Viet Nam and more advanced economies like Japan. Current material recovery rates in Viet Nam remain significantly lower, indicating an urgent need for capacity-building initiatives to improve domestic recycling capabilities and reduce dependency on imported materials. Additionally, the lack of standardised classification systems for e-waste continues to impede effective monitoring of transboundary movements, complicating regulatory enforcement and data collection.

Despite the strict prohibition against e-waste imports and the emerging EPR framework, significant regulatory gaps persist, particularly in the identification and management of specific e-waste categories. Viet Nam's transition towards higher value-added production within the regional EEE value chain further emphasises the importance of establishing comprehensive systems for e-waste management, encompassing collection, treatment, and recovery of valuable materials.

Recommendations for Future Research

- Development of comprehensive EEE waste classification systems: Future research should explore the establishment of standardised classification systems for e-waste to facilitate accurate tracking and reporting of transboundary movements, in alignment with international frameworks such as the Basel Convention.
- Assessment of technological gaps in e-waste recycling: Detailed assessments of existing recycling facilities should be conducted to identify specific technological deficiencies and inform targeted capacity-building programmes aimed at enhancing material recovery rates.

- Evaluating the implementation of EPR frameworks: An in-depth evaluation of the EPR schemes across various EEE categories is necessary to assess the effectiveness of current regulations in promoting sustainable resource circulation and mitigating e-waste accumulation.
- Quantitative analysis of EEE material flows: Further quantitative studies are recommended to assess the material flow of specific EEE categories, particularly e-waste, to better understand Viet Nam's positioning within regional and global EEE value chains.
- Policy analysis on e-waste management: Comparative policy analysis should be undertaken to examine best practices in e-waste management and circular economy strategies implemented by other ASEAN member states and Japan, with a view to informing Viet Nam's regulatory and policy development.
- Exploration of urban mining potential: Research into the potential for urban mining in Viet Nam, focusing on the recovery of critical raw materials from end-of-life electronics, could provide valuable insights for both economic development and environmental sustainability.

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Annex A: EEE Trade Data Between Viet Nam and Japan

Year	Reporter	Trade Flow	Partner	Second Partner	HS Code	Description	Unit	Quantity	Net Weight (kg)	Trade Value (US$)
2020	Viet Nam	Import	Japan	World	262019	Slag, ash, and residues; (not from the manufacture of iron or steel), containing mainly zinc, other than hard zinc spelter	kg	13,821	13,821	18,819
2020	Viet Nam	Export	Japan	World	262019	Slag, ash, and residues; (not from the manufacture of iron or steel), containing mainly zinc, other than hard zinc spelter	kg	8,994	8,994	9,833
2021	Viet Nam	Import	Japan	World	262019	Slag, ash, and residues; (not from the manufacture of iron or steel), containing mainly zinc, other than hard zinc spelter	kg	231,929	231,929	393,052
2021	Viet Nam	Export	Japan	World	262019	Slag, ash, and residues; (not from the manufacture of iron or steel), containing mainly zinc, other than hard zinc spelter	kg	18,706	18,706	27,511
2022	Viet Nam	Export	Japan	World	262019	Slag, ash, and residues; (not from the manufacture of iron or steel), containing mainly zinc, other than hard zinc spelter	kg	12,187	12,187	23,126
2022	Viet Nam	Export	Japan	World	262099	Slag, ash, and residues; (not from the manufacture of iron or steel), containing mainly metals or their compounds, n.e.c. in heading no. 2620	N/A	-		278,069
2020	Viet Nam	Export	Japan	World	711291	Waste and scrap of precious metals; of gold, including metal clad with	kg	69	-	2,499,346

Year	Reporter	Trade Flow	Partner	Second Partner	HS Code	Description	Unit	Quantity	Net Weight (kg)	Trade Value (US$)
						gold but excluding sweepings containing other precious metals				
2021	Viet Nam	Export	Japan	World	711291	Waste and scrap of precious metals; of gold, including metal clad with gold but excluding sweepings containing other precious metals	kg	29	29	1,229,152
2022	Viet Nam	Import	Japan	World	711291	Waste and scrap of precious metals; of gold, including metal clad with gold but excluding sweepings containing other precious metals	kg	0	0	2,866
2022	Viet Nam	Export	Japan	World	711291	Waste and scrap of precious metals; of gold, including metal clad with gold but excluding sweepings containing other precious metals	kg	19	19	789,181
2020	Viet Nam	Export	Japan	World	711292	Waste and scrap of precious metals; of platinum, including metal clad with platinum but excluding sweepings containing other precious metals	kg	307	-	203,175
2021	Viet Nam	Export	Japan	World	711292	Waste and scrap of precious metals; of platinum, including metal clad with platinum but excluding sweepings containing other precious metals	N/A	-	-	121,605
2022	Viet Nam	Export	Japan	World	711292	Waste and scrap of precious metals; of platinum, including metal clad with platinum but excluding sweepings containing other precious metals	N/A	-		852,770

Year	Reporter	Trade Flow	Partner	Second Partner	HS Code	Description	Unit	Quantity	Net Weight (kg)	Trade Value (US$)
2020	Viet Nam	Export	Japan	World	711299	Waste and scrap of precious metals; waste and scrap of precious metals including metal clad with precious metals, other than that of gold and platinum and excluding ash which contains precious metal or precious metal compounds	kg	104,560	-	6,715,470
2021	Viet Nam	Export	Japan	World	711299	Waste and scrap of precious metals; waste and scrap of precious metals including metal clad with precious metals, other than that of gold and platinum and excluding ash which contains precious metal or precious metal compounds	N/A	-	-	6,562,991
2022	Viet Nam	Export	Japan	World	711299	Waste and scrap of precious metals; waste and scrap of precious metals including metal clad with precious metals, other than that of gold and platinum and excluding ash which contains precious metal or precious metal compounds	N/A	-		8,074,605
2020	Viet Nam	Import	Japan	World	741300	Copper; stranded wire, cables, plaited bands and the like, not electrically insulated	kg	337,869	337,869	2,625,200
2020	Viet Nam	Export	Japan	World	741300	Copper; stranded wire, cables, plaited bands and the like, not electrically insulated	kg	30,356	30,356	261,154

Year	Reporter	Trade Flow	Partner	Second Partner	HS Code	Description	Unit	Quantity	Net Weight (kg)	Trade Value (US$)
2021	Viet Nam	Import	Japan	World	741300	Copper; stranded wire, cables, plaited bands and the like, not electrically insulated	kg	350,995	350,995	3,877,961
2021	Viet Nam	Export	Japan	World	741300	Copper; stranded wire, cables, plaited bands and the like, not electrically insulated	kg	31,822	31,822	348,206
2022	Viet Nam	Import	Japan	World	741300	Copper; stranded wire, cables, plaited bands and the like, not electrically insulated	kg	262,495	262,495	3,125,919
2022	Viet Nam	Export	Japan	World	741300	Copper; stranded wire, cables, plaited bands and the like, not electrically insulated	kg	6,008	6,008	68,714
2020	Viet Nam	Import	Japan	World	84	Nuclear reactors, boilers, machinery and mechanical appliances; parts thereof	N/A	-	-	2,563,780,894
2020	Viet Nam	Export	Japan	World	84	Nuclear reactors, boilers, machinery and mechanical appliances; parts thereof	N/A	-	-	960,929,926
2021	Viet Nam	Import	Japan	World	84	Nuclear reactors, boilers, machinery and mechanical appliances; parts thereof	N/A	-	-	2,623,998,253
2021	Viet Nam	Export	Japan	World	84	Nuclear reactors, boilers, machinery and mechanical appliances; parts thereof	N/A	-	-	1,119,176,240
2022	Viet Nam	Import	Japan	World	84	Machinery and mechanical appliances, boilers, nuclear reactors; parts thereof	N/A	-	-	2,755,593,940

Year	Reporter	Trade Flow	Partner	Second Partner	HS Code	Description	Unit	Quantity	Net Weight (kg)	Trade Value (US$)
2022	Viet Nam	Export	Japan	World	84	Machinery and mechanical appliances, boilers, nuclear reactors; parts thereof	N/A	-	-	1,261,340,140
2020	Viet Nam	Import	Japan	World	85	Electrical machinery and equipment and parts thereof; sound recorders and reproducers; television image and sound recorders and reproducers, parts and accessories of such articles	N/A	-	-	7,169,804,959
2020	Viet Nam	Export	Japan	World	85	Electrical machinery and equipment and parts thereof; sound recorders and reproducers; television image and sound recorders and reproducers, parts and accessories of such articles	N/A	-	-	4,827,391,220
2021	Viet Nam	Import	Japan	World	85	Electrical machinery and equipment and parts thereof; sound recorders and reproducers; television image and sound recorders and reproducers, parts and accessories of such articles	N/A	-	-	7,914,292,844
2021	Viet Nam	Export	Japan	World	85	Electrical machinery and equipment and parts thereof; sound recorders and reproducers; television image and sound recorders and reproducers, parts and accessories of such articles	N/A	-	-	5,166,387,064
2022	Viet Nam	Import	Japan	World	85	Electrical machinery and equipment and parts thereof; sound recorders	N/A	-	-	8,359,587,679

Year	Reporter	Trade Flow	Partner	Second Partner	HS Code	Description	Unit	Quantity	Net Weight (kg)	Trade Value (US$)
						and reproducers; television image and sound recorders and reproducers, parts and accessories of such articles				
2022	Viet Nam	Export	Japan	World	85	Electrical machinery and equipment and parts thereof; sound recorders and reproducers; television image and sound recorders and reproducers, parts and accessories of such articles	N/A	-	-	5,668,261,511
2020	Viet Nam	Import	Japan	World	850710	Electric accumulators; lead-acid of a kind used for starting piston engines, including separators, whether or not rectangular (including square)	u	11,985	193,116	576,973
2020	Viet Nam	Export	Japan	World	850710	Electric accumulators; lead-acid of a kind used for starting piston engines, including separators, whether or not rectangular (including square)	u	24,239	437,013	1,231,547
2021	Viet Nam	Import	Japan	World	850710	Electric accumulators; lead-acid of a kind used for starting piston engines, including separators, whether or not rectangular (including square)	u	14,040	236,841	735,569
2021	Viet Nam	Export	Japan	World	850710	Electric accumulators; lead-acid of a kind used for starting piston engines, including separators, whether or not rectangular (including square)	u	27,751	495,122	1,402,228
2022	Viet Nam	Import	Japan	World	850710	Electric accumulators; lead-acid of a kind used for starting piston engines,	u	12,344	216,775	706,322

Year	Reporter	Trade Flow	Partner	Second Partner	HS Code	Description	Unit	Quantity	Net Weight (kg)	Trade Value (US$)
						including separators, whether or not rectangular (including square)				
2022	Viet Nam	Export	Japan	World	850710	Electric accumulators; lead-acid of a kind used for starting piston engines, including separators, whether or not rectangular (including square)	u	31,728	593,018	1,695,597
2020	Viet Nam	Import	Japan	World	850720	Electric accumulators; lead-acid (other than for starting piston engines), including separators, whether or not rectangular (including square)	u	6,173	131,695	525,831
2020	Viet Nam	Export	Japan	World	850720	Electric accumulators; lead-acid (other than for starting piston engines), including separators, whether or not rectangular (including square)	u	53,684	996,466	4,038,246
2021	Viet Nam	Import	Japan	World	850720	Electric accumulators; lead-acid (other than for starting piston engines), including separators, whether or not rectangular (including square)	u	2,361	55,519	223,644
2021	Viet Nam	Export	Japan	World	850720	Electric accumulators; lead-acid (other than for starting piston engines), including separators, whether or not rectangular (including square)	u	57,365	829,736	3,437,268
2022	Viet Nam	Import	Japan	World	850720	Electric accumulators; lead-acid (other than for starting piston engines), including separators,	u	2,668	53,521	229,195

Year	Reporter	Trade Flow	Partner	Second Partner	HS Code	Description	Unit	Quantity	Net Weight (kg)	Trade Value (US$)
						whether or not rectangular (including square)				
2022	Viet Nam	Export	Japan	World	850720	Electric accumulators; lead-acid (other than for starting piston engines), including separators, whether or not rectangular (including square)	u	99,450	1,413,051	5,925,068
2020	Viet Nam	Import	Japan	World	850790	Electric accumulators; parts n.e.c. in heading no. 8507	kg	80,962	-	995,023
2020	Viet Nam	Export	Japan	World	850790	Electric accumulators; parts n.e.c. in heading no. 8507	kg	338	-	3,086
2021	Viet Nam	Import	Japan	World	850790	Electric accumulators; parts n.e.c. in heading no. 8507	N/A	-	-	333,610
2021	Viet Nam	Export	Japan	World	850790	Electric accumulators; parts n.e.c. in heading no. 8507	N/A	-	-	101,863
2022	Viet Nam	Import	Japan	World	850790	Electric accumulators; parts n.e.c. in heading no. 8507	N/A	-		784,897
2022	Viet Nam	Export	Japan	World	850790	Electric accumulators; parts n.e.c. in heading no. 8507	N/A	-		463,943
2020	Viet Nam	Import	Japan	World	854810	Waste and scrap of primary cells, primary batteries and electric accumulators; spent primary cells, spent primary batteries, and spent electric accumulators	kg	776	776	660
2020	Viet Nam	Import	Japan	World	90	Optical, photographic, cinematographic, measuring, checking, medical or surgical instruments and apparatus; parts and accessories	N/A	-	-	978,981,320

Year	Reporter	Trade Flow	Partner	Second Partner	HS Code	Description	Unit	Quantity	Net Weight (kg)	Trade Value (US$)
2020	Viet Nam	Export	Japan	World	90	Optical, photographic, cinematographic, measuring, checking, medical or surgical instruments and apparatus; parts and accessories	N/A	-	-	354,893,798
2021	Viet Nam	Import	Japan	World	90	Optical, photographic, cinematographic, measuring, checking, medical or surgical instruments and apparatus; parts and accessories	N/A	-	-	1,028,161,415
2021	Viet Nam	Export	Japan	World	90	Optical, photographic, cinematographic, measuring, checking, medical or surgical instruments and apparatus; parts and accessories	N/A	-	-	383,383,735
2022	Viet Nam	Import	Japan	World	90	Optical, photographic, cinematographic, measuring, checking, medical or surgical instruments and apparatus; parts and accessories	N/A	-	-	1,062,372,517
2022	Viet Nam	Export	Japan	World	90	Optical, photographic, cinematographic, measuring, checking, medical or surgical instruments and apparatus; parts and accessories	N/A	-	-	384,792,561
2020	Viet Nam	Import	Japan	World	91	Clocks and watches and parts thereof	N/A	-	-	2,174,773
2020	Viet Nam	Export	Japan	World	91	Clocks and watches and parts thereof	N/A	-	-	11,073,011

Year	Reporter	Trade Flow	Partner	Second Partner	HS Code	Description	Unit	Quantity	Net Weight (kg)	Trade Value (US$)
2021	Viet Nam	Import	Japan	World	91	Clocks and watches and parts thereof	N/A	-	-	2,094,468
2021	Viet Nam	Export	Japan	World	91	Clocks and watches and parts thereof	N/A	-	-	10,786,728
2022	Viet Nam	Import	Japan	World	91	Clocks and watches and parts thereof	N/A	-		1,559,417
2022	Viet Nam	Export	Japan	World	91	Clocks and watches and parts thereof	N/A	-		14,278,785
2020	Viet Nam	Import	Japan	World	92	Musical instruments; parts and accessories of such articles	N/A	-	-	9,285,458
2020	Viet Nam	Export	Japan	World	92	Musical instruments; parts and accessories of such articles	N/A	-	-	5,330,501
2021	Viet Nam	Import	Japan	World	92	Musical instruments; parts and accessories of such articles	N/A	-	-	7,728,432
2021	Viet Nam	Export	Japan	World	92	Musical instruments; parts and accessories of such articles	N/A	-	-	5,091,673
2022	Viet Nam	Import	Japan	World	92	Musical instruments; parts and accessories of such articles	N/A	-		10,461,922
2022	Viet Nam	Export	Japan	World	92	Musical instruments; parts and accessories of such articles	N/A	-	-	6,113,962
2020	Viet Nam	Import	Japan	World	94	Furniture; bedding, mattresses, mattress supports, cushions, and similar stuffed furnishings; lamps and lighting fittings, n.e.c.; illuminated signs, illuminated nameplates, and the like; prefabricated buildings	N/A	-	-	49,174,605
2020	Viet Nam	Export	Japan	World	94	Furniture; bedding, mattresses, mattress supports, cushions, and	N/A	-	-	892,159,970

Year	Reporter	Trade Flow	Partner	Second Partner	HS Code	Description	Unit	Quantity	Net Weight (kg)	Trade Value (US$)
						similar stuffed furnishings; lamps and lighting fittings, n.e.c.; illuminated signs, illuminated nameplates, and the like; prefabricated buildings				
2021	Viet Nam	Import	Japan	World	94	Furniture; bedding, mattresses, mattress supports, cushions, and similar stuffed furnishings; lamps and lighting fittings, n.e.c.; illuminated signs, illuminated nameplates, and the like; prefabricated buildings	N/A	-	-	48,239,502
2021	Viet Nam	Export	Japan	World	94	Furniture; bedding, mattresses, mattress supports, cushions, and similar stuffed furnishings; lamps and lighting fittings, n.e.c.; illuminated signs, illuminated nameplates, and the like; prefabricated buildings	N/A	-	-	877,903,787
2022	Viet Nam	Import	Japan	World	94	Furniture; bedding, mattresses, mattress supports, cushions, and similar stuffed furnishings; lamps and lighting fittings, n.e.c.; illuminated signs, illuminated nameplates, and the like; prefabricated buildings	N/A	-	-	53,124,075
2022	Viet Nam	Export	Japan	World	94	Furniture; bedding, mattresses, mattress supports, cushions, and similar stuffed furnishings; lamps	N/A	-	-	945,740,473

Year	Reporter	Trade Flow	Partner	Second Partner	HS Code	Description	Unit	Quantity	Net Weight (kg)	Trade Value (US$)
						and lighting fittings, n.e.c.; illuminated signs, illuminated nameplates, and the like; prefabricated buildings				
2020	Viet Nam	Import	Japan	World	95	Toys, games, and sports requisites; parts and accessories thereof	N/A	-	-	18,514,906
2020	Viet Nam	Export	Japan	World	95	Toys, games, and sports requisites; parts and accessories thereof	N/A	-	-	351,424,639
2021	Viet Nam	Import	Japan	World	95	Toys, games, and sports requisites; parts and accessories thereof	N/A	-	-	22,773,658
2021	Viet Nam	Export	Japan	World	95	Toys, games, and sports requisites; parts and accessories thereof	N/A	-	-	334,124,818
2022	Viet Nam	Import	Japan	World	95	Toys, games, and sports requisites; parts and accessories thereof	N/A	-	-	27,894,236
2022	Viet Nam	Export	Japan	World	95	Toys, games, and sports requisites; parts and accessories thereof	N/A	-	-	624,528,463
2022	Viet Nam	Import	Japan	World	854999	Waste and scrap; n.e.c. in item no 8549.91				147,083,308.4
2022	Viet Nam	Export	Japan	World	854999	Waste and scrap; n.e.c. in item no 8549.91				1,552,036.978

Source: United Nations (2025).

Annex B: List of Survey Objects

No.	Name	Adress	Location	Proposed Survey Content
Regulatory Agencies				
1	EPR office (MONRE)	No. 10 Ton That Thuyet street (MONRE)	Ha Noi	Regulatory framework (existing and prospective) for the EEE-relevant materials
2	Harzardous waste control Department (MONRE)	No. 10 Ton That Thuyet street (MONRE)	Ha Noi	Regulatory framework (existing and prospective) for the EEE-relevant materials
3	Department of Import and Export (MOIT)	54 Hai Ba Trung Street, Tran Hung Dao Ward, Hoan Kiem District, Ha Noi.	Ha Noi	Data on trade and import of EEE
Enterprises and Associations				
4	Vietnam Electronic Industries Association	11th Floor, MIPEC TOWER, 229 Tay Son, Dong Da District, Ha Noi	Ha Noi	Data on trade and import of EEE
5	Viet Nam Waste Recycling Association	282 Kim Ma Street, Ba Dinh District, Ha Noi	Hanoi	Data on status of collection, recycling of e-waste in Viet Nam
6	Thuan Thanh Environment Joint Stock Company.	Ngoc Kham, Thuan Thanh, Bac Ninh	Bac Ninh	- Existing recycling and waste disposal technologies for EEE - Status of recovery of valuable and critical Metals
7	Vietcycle (Collection E-waste company)	Room 805 - Tòa nhà Toyota số 315 Trường Chinh, Khương Mai, Thanh Xuân, Hà Nội	Ha Noi	Data on e-waste collection
8	Thanh Lap Environmental Treatment Trading Co., Ltd	Lot 147, Group 3, Bau Tran Hamlet, Nhuan Duc Commune, Cu Chi District, Ho Chi Minh City	Ho Chi Minh City	- Existing recycling and waste disposal technologies for EEE - Status of recovery of valuable and critical metals
Craft Villages				
9	Nhat Tao market	District 10, Ho Chi Minh City	Ho Chi Minh City	- Existing recycling and waste disposal technologies for EEE - Status of recovery of valuable and critical metals

Source: Compiled by authors (2025).

Annex C: Workshop and Field Survey Documenting the Research Implementation Process

C.1. The workshop at ISPAE, Viet Nam on 21 August 2025

On 21 August 2025, the Institute of Strategy and Policy on Agriculture and Environment (ISPAE), in collaboration with the Economic Research Institute for ASEAN and East Asia (ERIA), successfully organised the workshop entitled 'E-Waste Management Towards Circular Economy', with the aim of presenting and discussing the research findings of the project 'Research on Sound International Resource Circulation in the ASEAN Region: Viet Nam', as well as exchanging experiences and proposing solutions to promote e-waste management in line with the circular economy approach.

C.2. Field survey at the waste treatment plant in Thuan Thanh, Bac Ninh

On 21 August 2025, the expert team from ISPAE and ERIA conducted a field visit to the waste treatment facility of Thuan Thanh Environment Joint Stock Company in Bac Ninh. During the visit, the research team held discussions and exchanges with company representatives and conducted an on-site tour of the company's e-waste treatment system.

C.3. Field survey at formal collection point and second-hand EEE shop in Ha Noi

The photos illustrate the field survey activities conducted by the ISPAE and ERIA expert team in Ha Noi, including visits to a formal e-waste collection point and a second-hand EEE shop on 22 August 2025. These visits aimed to observe existing collection practices and gain insights into the reuse and recycling market.



Source: Authors (2025).

Chapter 7

Proposed Methodology for Calculating the Benefits and Losses of International Resource Circulation (E-waste Trade)

1. Introduction

Transboundary flows of waste electrical and electronic equipment (e-waste) sit at the heart of sound international resource circulation (SIRC). When well-managed, cross-border movements can recover valuable materials, reduce the need for primary extraction, and support circular economy jobs. When poorly managed, however, they impose severe environmental externalities and health harms on the receiving communities. This duality highlights the need for a methodology that can accurately quantify the benefits and losses of e-waste trade – informing domestic regulations and international cooperation. This report combines two objectives: (i) to review the latest research on e-waste trade and its environmental and health consequences; and (ii) to propose how econometric methods from adjacent literatures can be adapted to build a robust evidence base for the e-waste context.

A review of nearly 100 studies on e-waste trade reveals four main strands: measuring flows, examining determinants, assessing environmental and health impacts (largely descriptively), and synthesising policy insights. Yet no study has directly linked e-waste trade to health and environmental outcomes using causal designs. While early trade–environment research (e.g. Antweiler, Copeland, and Taylor, 2001; Frankel and Rose, 2005) employed simpler approaches, newer studies in adjacent fields (Adda and Fawaz, 2020; Tanaka, Teshima, and Verhoogen, 2022; Guo, Walls, and Zheng, 2023) have shown how stronger causal strategies – such as instrumental variables, policy shocks, difference-in-differences (DiD), and regression discontinuity – can credibly identify impacts but require richer data. For e-waste trade, available sources such as United Nations (UN) Comtrade and Basel reports understate the actual flows, underscoring the need to complement them with material flow analysis (MFA), national administrative data, and field-based geospatial mapping of hotspots. Balancing breadth and precision will require combining Harmonised System (HS)-level trade coverage with product-specific studies, while adapting newer identification methods to build a robust and policy-relevant evidence base.

Against this background, this report aims to propose a practical and replicable methodology for assessing the net benefits and losses of SIRC in e-waste trade. The chapter outlines how empirical designs from other domains can be adapted to the e-waste

context; identifies candidate environmental and health outcome variables from survey, administrative, and monitoring sources; and sketches a data pipeline that integrates customs records, Basel reporting, MFA reconstructions, and national administrative data. Therefore, the chapter provides an operational blueprint for moving beyond descriptive assessments towards rigorous causal evidence – evidence that can show not only how much e-waste trade contributes to resource recovery and avoided emissions, but also where and for whom it creates environmental and health risks.

2. Literature Landscape on E-Waste, Trade, Environment, and Health

2.1. E-waste research trends

This section synthesises insights from survey articles on e-waste to trace how the field has evolved over the past decades. Much of the early work established the scale and urgency of the problem, documenting the rising volumes of discarded electronics, the environmental hazards associated with informal recycling, and the diffusion of international policy frameworks. Subsequent studies broadened the focus to include the economic potential of e-waste as a secondary resource, advances in recycling technologies, and the role of extended producer responsibility (EPR) in shaping collection systems. More recent contributions adopt an interdisciplinary lens, linking e-waste management to circular economy strategies, sustainability goals, and climate action, while exploring technological innovations such as robotics, artificial intelligence (AI), and Internet of Things (IoT)-enabled systems. These strands of research reveal the dynamism of the field and the central role of policy and technological change in redefining e-waste from a toxic liability into a potential resource within sustainable development frameworks.

Early studies highlighted the rapid growth of e-waste, particularly in Asia, and documented the severe environmental and health impacts arising from informal recycling. Heavy metal contamination, toxic emissions, and unsafe recovery practices were widely reported, with implications for soil, water, and human health (Herat and Agamuthu, 2012; Premalatha et al., 2014). The informal sector's dual role – as an efficient collector and a source of degradation – was also recognised (Herat and Agamuthu, 2012). Policy debates in this period emphasised the global influence of the European Union (EU) Waste Electrical and Electronic Equipment (WEEE) and Restriction of Hazardous Substances Directives, Japan's Home Appliance Recycling Law, 2001, and the Basel Convention, while cautioning against uncritical transfer of advanced technologies to low- and middle-income countries without adaptation to local contexts (Premalatha et al., 2014).

By the mid-2010s, the literature shifted towards the economic and material potential of e-waste. The concept of urban mining gained traction as researchers demonstrated that metal concentrations in e-waste often exceed those of natural ores (Kumar, Holuszko, and Romano Espinosa, 2017). Advances in quantification methodologies (e.g. sales obsolescence models and mass balance approaches) were applied to estimate waste flows (Kumar, Holuszko, and Romano Espinosa, 2017). At the same time, studies evaluated

a range of recycling technologies – mechanical pre-processing and pyro-, hydro-, and bio-metallurgical techniques – and assessed their trade-offs in cost, efficiency, and scalability (Ilankoon et al., 2018). Comparative studies of EPR frameworks highlighted lessons from countries such as China, Japan, and the Republic of Korea (Patil and Ramakrishna, 2020; Borthakur, 2020).

E-waste research has become increasingly interdisciplinary, situating the issue within broader debates on the circular economy, the Sustainable Development Goals, and climate action (Shittu, Williams, and Shaw, 2020; Serpe et al., 2025). Research on advanced technologies, including robotics, AI-based dismantling, IoT-enabled monitoring, and precision sorting, has expanded (Liu et al., 2023; Ahmad et al., 2021). Methodologically, life cycle assessment has become a widely used tool for identifying environmental hotspots, guiding eco-design, and evaluating policy effectiveness (Ismail and Hanafiah, 2019; Abalansa et al., 2021). Comparative policy analyses reveal the diffusion of EU-inspired frameworks globally, though adoption and enforcement remain uneven (Patil and Ramakrishna, 2020; Borthakur, 2020), while legislation is consistently highlighted as a driver of innovation, awareness, and the reframing of e-waste from a hazard to a secondary resource (Serpe et al., 2025).

2.2. Broader trade–environment–health literature

Parallel to these developments, the broader trade–environment literature has converged on a set of foundational questions: how trade policy interacts with climate mitigation; whether trade contributes to deforestation and biodiversity loss; how globalisation affects air and water quality; whether regulatory competition induces a 'race to the bottom'; and the magnitude of transport-related emissions (Copeland, Shapiro, and Taylor, 2022). Syntheses increasingly integrate theory and empirics into stylised facts that chart a forward research agenda. Yet credible causal links between trade, environment, and health remain rare.

Two studies stand out in moving beyond descriptive correlations to provide causal evidence. The first is Tanaka, Teshima, and Verhoogen (2022), which examined the tightening of United States (US) lead standards in 2009. By making compliance more costly for domestic recyclers, the regulation led to a surge in exports of used lead-acid batteries to Mexico, where environmental standards were weaker. Recycling activity in Mexico expanded significantly, and the study links this growth to negative health outcomes in nearby communities. Specifically, infants born to mothers living within 2 miles of battery-recycling plants had a higher incidence of low birthweight, with impacts particularly pronounced amongst families using public hospitals. This study is important for two reasons: first, it demonstrates an archetypal pollution-haven mechanism, where tighter rules in one country reduce domestic pollution but shift risks abroad; second, it provides direct evidence of health harms – something rarely captured in trade–environment studies. The limitations are also noteworthy: air quality monitoring data were sparse in Mexico, so

the precise pollution pathways were not observed, and the results focus on one highly specific industry, leaving open questions about generalisability to other types of e-waste.

The second key contribution is Guo, Walls, and Zheng (2023), which studied China's 2018 ban on imported waste. Unlike the Mexico case, which highlighted cross-border displacement, this study focused on domestic environmental gains from restricting foreign e-waste inflows. Using detailed pollution monitoring data, the study compared air quality in e-waste towns before and after the ban, relative to nearby control areas less exposed to waste imports. They found that concentrations of harmful pollutants – including particulate matter with a diameter of 2.5 micrometres or less (PM2.5) and particulate matter with a diameter of 10 micrometres or less (PM10) and ozone – fell by 15% to 28% following the ban. These improvements are robust to alternative explanations, such as changes in weather or concurrent national anti-pollution campaigns, thereby strengthening the case that the ban itself was the primary driver. The study also compared costs and benefits, showing that the health improvements from cleaner air far outweigh the modest costs to industries that had relied on imported scrap materials. Its limitations lie in scope: the analysis tracked pollution but not direct health outcomes, and while local air quality in China improved, the diverted e-waste was likely redirected to Southeast Asia and Africa, a displacement effect beyond the study's frame.

2.3. Mapping the field of e-waste trade research

Compared with the broader trade–environment literature, research on trade in used electrical and electronic equipment and e-waste remains limited. Most studies are descriptive, focusing on reviews, stock-flow consistent model estimates, or network mapping, with only a handful employing formal econometric identification methods (Abalansa et al., 2021; Liu et al., 2023; Serpe et al., 2025). Subnational analyses at the port, provincial, or city level are particularly scarce, even though localised exposure is highly relevant. Health outcomes are also less frequently examined than environmental ones.

Our review of nearly 100 studies (see Appendix) revealed four broad strands: (i) measurement of trade volumes or reconstruction where customs data are incomplete; (ii) analysis of determinants such as prices, policy, institutions, and enforcement; (iii) estimates of environmental and health impacts, though usually indirect; and (iv) survey and policy syntheses offering broad guidance on risks and management. Despite this breadth, the field continues to rely heavily on descriptive analyses such as stock-flow consistent models or case studies. As a result, the field lacks causal analysis linking e-waste trade directly to environmental or health outcomes, and endogeneity between trade, income, and environmental outcomes remains unaddressed.

A central limitation concerns data coverage and quality. UN Comtrade, Basel Convention reports, and national statistics are the main sources of cross-border e-waste data, yet all understate flows because of illegality, misclassification, and inconsistent product definitions. MFA has been employed to fill gaps, but weak harmonisation across countries and patchy national reporting limit its effectiveness. In addition, research has paid little

systematic attention to emerging waste categories – such as electric vehicle batteries, photovoltaic panels, and IoT devices (Shittu, Williams, and Shaw, 2020; Bakhiyi et al., 2018) – which present new material complexities and recycling challenges. Together, these weaknesses constrain the ability to generate reliable global or regional comparisons and slow progress towards evidence-based policy.

3. Empirical Strategies for Modelling E-Waste Trade Impacts

Designing policies for e-waste trade requires more than documenting where waste flows or how much is generated; it also requires credible evidence on how these flows affect the environment and public health. Simple correlations can be misleading, as countries that trade more may also regulate pollution more strictly or differ in terms of income, technology, and enforcement. To address this, researchers have developed modelling approaches that separate correlation from causation. Classic studies show how trade can influence pollution through three channels – scale, composition, and technique (SCT) – while others use natural experiments or geographical instruments to identify the actual impact of trade on environmental outcomes. More recent work has applied quasi-experimental designs, such as DiD or regression discontinuity, to trace the health and pollution impacts of specific policy shocks. This section reviews these modelling strategies, highlights their relevance for e-waste research, and discusses the practical challenges – data gaps, informal recycling, and instrument validity – that policymakers must consider when interpreting results and designing evidence-based regulations.

3.1. Country-level analysis

Antweiler, Copeland, and Taylor (2001) introduced the SCT framework to explain how trade affects pollution. Their estimation model linked sulphur dioxide (SO_2) concentrations in over 40 countries to income, trade intensity, and factor endowments. The study used the Global Environment Monitoring System air pollution data (SO_2), World Bank accounts for income and trade, and Penn World Tables for capital–labour ratios.

The basic regression can be summarised as:

$$\ln(SO_{2it}) = \alpha + \beta_1 \ln(Y_{it}) + \beta_2[\ln(Y_{it})]^2 + \beta_3(Trade/GDP_{it}) + \beta_4(K/L_{it}) + \mu_i + \lambda_t + \epsilon_{it}$$

where SO_{2it} is air pollution, Y_{it} income per capita, $Trade/GDP$ trade openness, and K/L the capital–labour ratio (to capture comparative advantage in cleaner and dirtier industries). The quadratic income term tests the environmental Kuznets curve.

In their framework, the scale effect implies that if economic output doubles, pollution should also rise proportionally unless offset by other forces. The technique effect captures any deviation from this proportionality: as incomes grow, societies often demand stricter regulations and adopt cleaner technologies, leading pollution to rise more slowly – or even fall – despite economic expansion. Finally, the composition effect reflects how trade

openness interacts with a country's factor endowments, shifting its industrial structure. Capital-abundant countries tend to specialise in cleaner industries, while labour-abundant countries are more likely to expand pollution-intensive sectors. The limitations pertain to assumptions about the proportionality between output and pollution, as well as the endogeneity of trade.

Considered as an extension of Antweiler, Copeland, and Taylor (2001), Frankel and Rose (2005) advanced the literature by explicitly addressing causality. They recognised that trade, income, and pollution are jointly determined (endogeneity issues). To solve this, they applied an instrumental variables approach.

Their reduced-form model is:

$$Env_i = \alpha + \beta_1 \ln(GDPpc_i) + \beta_2[\ln(GDPpc_i)]^2 + \beta_3(Trade/GDP_i) + \beta_4(Institutions_i) + \epsilon_i$$

where Env_i represents environmental indicators (SO_2, nitrogen dioxide (NO_2), particulates, carbon dioxide (CO_2), deforestation, and access to clean water).

Trade openness is instrumented with geographical determinants drawn from gravity models, such as distance from major markets, common borders or language, and whether a country is landlocked. Income is instrumented with lagged income, investment rates, and demographic factors. This approach matters because it helps separate the true effect of trade from confounding influences, reducing bias from the fact that richer countries often both trade more and regulate pollution more effectively. The analysis uses a cross-country dataset from 1990, combining urban air pollution monitoring data with trade and income measures from the Penn World Tables and democracy scores from the Polity dataset. However, there are limitations. The data represent a single snapshot in time, coverage is uneven between rich and poor countries, and the pollutants considered are mostly urban air emissions. Moreover, the instrumental variables approach rests on strong assumptions, particularly that geographical factors influence pollution only through their effect on trade, not directly.

Application to e-waste trade research

Research on trade and the environment has shown that rigorous methods are needed to separate correlation from causality. Classic contributions by Antweiler, Copeland, and Taylor (2001) and Frankel and Rose (2005) highlighted two key strategies: (i) decomposing the effects of trade into SCT channels, and (ii) addressing endogeneity by instrumental variables. Both approaches can be adapted to the study of e-waste trade.

A first step is to develop an estimation model that links e-waste trade to environmental and health outcomes. A baseline specification takes the form:

$$Outcome_{it} = \alpha + \beta \left(\frac{EwasteImports_{it-1}}{GDP_{it-1}} \right) + \gamma_1 \ln(GDPpc_{it}) + \gamma_2[\ln(GDPpc_{it})]^2 + \gamma_3 X_{it} + \mu_i + \lambda_t + \varepsilon_{it},$$

Where $Outcome_{it}$ is an environmental or health indicator (such as PM2.5 concentration, soil contamination, or birth outcomes); *EwasteImports/GDP* is the main regressor of interest; and X_{it} includes controls such as governance quality, enforcement, or industrial structure. Country (μ_i) and year (λ_t) fixed effects account for unobserved heterogeneity and global shocks. The coefficient β measures the impact of e-waste import intensity on outcomes of interest.

The use of instrumental variables potentially helps address endogeneity. Richer countries both import differently and regulate pollution differently, while pollution itself may trigger trade restrictions. Credible instruments could include geographical determinants (distance to major exporters, shipping routes, and port access) (Frankel and Rose, 2005); policy shocks (such as China's 2018 import ban, Basel Convention ratification, or EU Directive changes); and shift–share measures combining global e-waste flows with a country's historical exposure.[1] These approaches generate plausibly exogenous variation in e-waste imports, helping identify the causal impact of trade on environmental and health outcomes.

Applying these models requires a mix of data sources. Trade data can be drawn from UN Comtrade (HS code 8549 and related subcategories) and Basel Convention reports, with corrections using MFA to account for under-reporting and illegal flows. Environmental indicators may include satellite-based air quality measures (PM2.5 and NO_2), toxic release inventories, and data on soil or water contamination. Health outcomes can be tracked through demographic and health surveys or national health records. Socio-economic effects, such as employment in informal recycling and child labour, provide important complementary evidence.

Applying trade–environment methods to e-waste research is not without limitations. A first challenge lies in data quality and coverage, since e-waste trade is often misclassified in customs records, under-reported in Basel Convention submissions, and partly invisible due to illegal flows. Environmental and health data are also highly localised – soil and water contamination or birth outcomes are measured only in a few hotspots – making cross-country comparisons difficult. A second issue is the informal sector, which dominates recycling in many developing countries but remains poorly documented; this weakens attempts to capture composition effects and risks bias if informal activity responds differently to trade shocks than formal operations. Third, the validity of the instruments is not guaranteed: geographical variables, such as distance or port access, may correlate with unobserved industrial patterns, while policy shocks, like China's 2018 import ban, can have global spillovers that affect outcomes through multiple channels. Similarly, shift–share instruments rely on the assumption that global shocks are unrelated

[1] A shift–share measure (also known as a Bartik instrument) combines a country's historical exposure to certain industries or products (the 'share') with global shocks or trends in those industries (the 'shift'). In the e-waste context, this could mean interacting a country's past import shares of specific waste categories with global changes in exports of those categories. The resulting measure provides plausibly exogenous variation in exposure to e-waste trade, helping address endogeneity concerns by capturing how global shocks interact with local economic structures rather than current domestic conditions.

to local conditions, an assumption that may not always hold. A fourth limitation concerns generalisability, as earlier trade–environment studies focused on air pollutants like SO_2, whereas e-waste involves a more complex mix of heavy metals, plastics, and persistent organic pollutants, with very different pathways and health impacts. Finally, there is a trade-off between causality and mechanisms: instrumental variables approaches provide credible estimates of whether e-waste imports affect pollution or health, but not how; SCT decomposition helps identify mechanisms such as scale, technique, and composition effects, but is weaker in terms of causal identification. These challenges suggest that results should be interpreted cautiously and combined with broader evidence. They also emphasise the urgent need for improved data collection and international cooperation to better understand and manage e-waste flows.

3.2. Community/region-level analysis

The three studies – Adda and Fawaz (2020); Tanaka, Teshima, and Verhoogen (2022); and Guo, Walls, and Zheng (2023) – share a concern with tracing the hidden human and environmental costs of global trade and regulation, with different empirical strategies to establish causality. Adda and Fawaz (2020) used an instrumental variables approach combined with two-stage least squares (2SLS) panel regressions to link rising Chinese imports to worsening health outcomes in the US, with survey-based individual-level health as the dependent variable and import penetration (predicted using Chinese exports to other rich countries) as the main independent variable. Tanaka, Teshima, and Verhoogen (2022) exploited the 2009 tightening of US lead standards as a natural experiment in a DiD design, comparing infant health outcomes near Mexican recycling plants before and after the regulation, with proximity and timing as the key independent variables. Guo, Walls, and Zheng (2023) analysed China's 2018 waste import ban using both DiD and regression discontinuity designs, with daily air quality readings as outcomes and the treatment defined by proximity to e-waste hubs after the ban. All three studies combine quasi-experimental methods with rich observational data to address endogeneity, using different units of analysis (individual health survey data, infant birth records, and daily air quality data); various key techniques (instrumental variables-2SLS, DiD, and regression discontinuity); and differing assumptions about the nature of their identification. Table 7.1 compares their research methods, estimation models and equations (simplified), dependent variables, independent variables of interest, control variables, techniques, endogeneity strategies, limitations, and applications to e-waste research, providing a clear view of how different methodological approaches can generate credible evidence on the environmental and health effects of trade, and offering lessons for future research on e-waste flows.

Table 7.1. Comparison of Key Studies on Trade, E-Waste, and Health/Environment

Aspect	Adda and Fawaz (2020)	Tanaka, Teshima, and Verhoogen (2022)	Guo, Walls, and Zheng (2023)
Research method	Instrumental variables, 2SLS panel regressions	Quasi-experiment using DiD	Quasi-experiment using DiD and regression discontinuity
Estimation models	Instrumental variables –2SLS with shift–share instrument	DiD with locality, municipality-year, hospital-year fixed effects	DiD with station/day/quarter fixed effects and regression discontinuity with augmented local linear regression
Equation (simplified)	Health outcome = α + β·(import penetration) + controls + fixed effects; instrumental variables uses Chinese exports to other rich countries	Infant health = α + β·(Near×Post) + controls + fixed effects	Air quality = α + β·(treated×post) + controls + fixed effects; regression discontinuity compares outcomes before/after ban cut-off
Dependent variables	Self-reported health, BMI/obesity, poor mental health days, healthcare access	Infant birthweight, low birthweight incidence	Air quality indicators: Air Quality Index, PM2.5, PM10, ozone
Independent variable of interest	Import penetration per worker (lagged)	Living within 0–2 miles of plant × post-2009 tightening	E-waste town proximity × post-ban (after 1 January 2018)
Control variables	Demographics (age, sex, race, education); commuting zone, year, state-trend fixed effects	Mother's age, baseline locality characteristics (water, electricity, population); locality, municipality-year, hospital-year fixed effects	Weather variables, month/weekend/holiday, heating periods; station, quarter, day fixed effects
Techniques	Instrumental variables with shift–share design, lag structure	Spatial DiD using near/far comparison and temporal cut-off	DiD and regression discontinuity (two-step augmented local linear specification) and event study

Aspect	Adda and Fawaz (2020)	Tanaka, Teshima, and Verhoogen (2022)	Guo, Walls, and Zheng (2023)
Endogeneity strategy	Instrumental variables uses exogenous variation from Chinese exports to other countries	Quasi-exogenous US regulation change as natural experiment	Exploits sharp timing of China's ban and within-province control stations
Limitations	Self-reported health data; instrumental variables validity depends on exclusion restriction; may not generalise outside advanced economies	Limited monitoring data, small number of plants, cannot fully identify mechanisms	Overlapping policies (Atmospheric Pollution Prevention and Control Law, 2018), possible spillovers, short window of analysis, limited generalisability
Application to e-waste research	Construct e-waste import penetration measures (per worker, per capita, per area) as exposure indices	Use bans/shocks (e.g. China's 2018 ban) as natural experiments and DiD on communities near recycling hubs	Apply DiD/regression discontinuity to pollution or health near e-waste hubs before/after bans or regulatory cut-offs (e.g. China's 2018 ban)

2SLS = two-stage least squares, BMI = body mass index, DiD = Difference in Differences, PM2.5 = particulate matter with a diameter of 2.5 micrometres or less, PM10 = particulate matter with a diameter of 10 micrometres or less, US = United States.
Source: Author's compilation.

3.2.1. The health toll of import competition

Adda and Fawaz (2020) examined whether rising import competition from China translated into measurable declines in health at the population level. Beyond employment and wages, the study argued that trade shocks could affect health through three main channels: loss of income and insurance coverage, psychosocial stress from job insecurity, and reduced access to healthcare. To test this, it used individual-level survey data from the Behavioral Risk Factor Surveillance System (BRFSS) covering 1997–2011, a period when Chinese imports surged following China's accession to the World Trade Organization.

A key methodological concern is endogeneity: US imports from China may not be purely exogenous, as they could reflect local demand conditions that also affect health. For example, a local economic downturn could simultaneously increase demand for cheap Chinese imports and worsen health outcomes, biasing estimates. To address this, the study used the instrumental variables strategy and 2SLS panel regressions, a method designed to isolate causal effects when the main explanatory variable may be endogenous (i.e. correlated with unobserved shocks that also influence health). By relying on Chinese

exports to other high-income countries, the variation used to identify health effects originates from global Chinese supply shocks, rather than from local US demand. The inclusion of commuting zone and year fixed effects, along with state-specific trends, further helps to isolate causal effects.

The baseline second-stage equation is:

$$Y_{i,c,t} = \alpha + \beta\, IPW_{c,t-k} + \gamma X_{i,c,t} + \mu_c + \lambda_t + \delta_s t + \epsilon_{i,c,t}$$

where:

- $Y_{i,c,t}$ is the health outcome for individual *i* in commuting zone *c* and year *t*. Outcomes include self-reported health status, BMI for obesity, days with poor mental health, and indicators of healthcare access such as having health insurance, visiting a doctor, or receiving preventive care.
- $IPW_{c,t-k}$ is import penetration per worker in commuting zone *c*, lagged up to 6 years (k = 0, ..., 6), to capture both immediate and delayed effects.
- $X_{i,c,t}$ are demographic controls (age, sex, race, education).
- μ_c are commuting zone fixed effects that absorb time-invariant regional differences.
- λ_t are year fixed effects that capture national shocks.
- $\delta_s t$ are state-specific linear time trends to account for unobserved regional trajectories.

The first-stage regression predicts local import penetration using the instrumental variables:

$$IPW_{c,t} = \pi\, Z_{c,t} + \theta W_{c,t} + \nu_{c,t}$$

where $Z_{c,t}$ is constructed from Chinese exports to other high-income countries (e.g. Denmark, Germany, and Japan), interacted with each commuting zone's initial 1990 industry employment structure (a shift–share design). This instrument captures global Chinese export supply shocks while filtering out US-specific demand factors.

Limitations

The BRFSS analysis has several limitations. First, survey-based health measures are self-reported and may suffer from under-reporting or misclassification (e.g. individuals underestimating weight or not reporting mental health problems). Second, while the instrumental variables estimation improves causal inference, its validity hinges on the assumption that Chinese exports to other advanced economies are not correlated with unobserved shocks affecting US health – a strong but not incontrovertible claim. Third, although lags are included, the long-term health consequences of import shocks (e.g. cancer incidence) may not be fully captured within the 1997–2011-time frame. Fourth, the

BRFSS analysis focuses on adults aged 18–65, potentially missing health effects amongst children or older persons in exposed communities.

Finally, there are broader concerns about the portability of the 'China shock'[2] instrumental variables strategy outside the US context. The instrument works best in large, advanced economies, such as the US, the United Kingdom, or Germany, where Chinese export growth is plausibly exogenous to local demand. In middle-income or small developing countries, however, the exclusion restriction may be weaker, as Chinese exports to third countries can be correlated with global demand cycles that also affect local economies. In such cases, the instrumental variables might need adaptation – for instance, excluding close peers from the instrument set, using global exports minus the country studied, or turning to alternative instruments such as gravity-predicted trade flows or policy shocks (e.g. World Trade Organization accession and tariff reforms). This means that while the method provides credible causal identification in the US, its direct transferability to other settings requires scrutiny and robustness checks.

Application to e-waste trade research

To adapt the China shock framework to e-waste trade, exposure can be measured in several complementary ways. One option is e-waste import penetration per worker, which mirrors the labour-market logic of import penetration per worker by linking e-waste inflows to employment in recycling and disposal industries. This measure highlights occupational risks but requires reliable employment data, which may be scarce in informal sectors. A second option is e-waste import penetration per capita, calculated as e-waste imports relative to the local population. This captures broader community-level exposure, including children and non-working residents, and is easier to link with health survey or registry data, though it cannot easily distinguish between safe and unsafe recycling. A third option is e-waste import penetration per area, which measures the spatial intensity of imports relative to land area. This helps identify geographical 'hotspots', such as densely populated port cities or recycling towns, and is particularly useful for linking with environmental indicators like soil, water, or air pollution, but may exaggerate exposure in low-density areas. These indices provide a multidimensional picture of exposure, allowing researchers to triangulate results and test robustness across labour-market, community, and environmental perspectives.

3.2.2. North–south displacement effects of environmental regulation: the case of battery recycling

Tanaka, Teshima, and Verhoogen (2022) examined whether the 2009 tightening of US lead standards, which displaced battery recycling to Mexico, worsened infant health near Mexican recycling plants. Their empirical strategy exploited the sudden regulatory shift as a quasi-experiment. They implemented a DiD design comparing infants born to mothers living within 2 miles of a recycling plant with those living 2–4 miles away, before and after

[2] China shock refers to China's 2018 ban on imported waste.

2009. The main outcomes are birthweight (in grams) and the incidence of low birthweight (below 2.5 kilograms), both well-established indicators of early-life health. To minimise endogeneity concerns, the specification incorporates multiple layers of fixed effects – locality, municipality year, and hospital year – and controls for the mother's age and baseline locality characteristics. This approach reduces bias from socio-economic sorting, differences in hospital quality, or pre-existing neighbourhood disparities. The results indicate a significant deterioration in infant health near the plants, with increases in low birthweight incidence concentrated amongst mothers from disadvantaged backgrounds.

The estimation specification is a DiD model of the form:

$$Health_{ijmht} = \alpha + \beta(Near_j \times Post_t) + \rho X_{it} + \phi(Z_{j,2005} \times Post_t) + \mu_{mt} + \gamma_j + \lambda_{ht} + \varepsilon_{ijmht}$$

where $Health_{ijmht}$ is an infant health outcome (birthweight in grams, or an indicator for low birthweight <2.5 kilograms) for infant i born to a mother in locality j, municipality m, hospital h, in year t. The key regressor is $Near_j \times Post_t$, which captures whether the mother lived within 0–2 miles of a recycling plant (relative to 2–4 miles) after the 2009 US reform. X_{it} includes the mother's age, while $Z_{j,2005}$ are baseline locality characteristics (e.g. access to water, electricity, sewerage, and population size). Fixed effects for municipality year, locality, and hospital year absorb unobserved local shocks and hospital quality changes.

The study relied on multiple data sources: the US Census Bureau trade data for exports, Mexico's Economic Censuses and pollutant registries for plant output and locations, and both the Ministry of Health hospital discharge records and national birth certificates for infant health. Identification hinged on the exogenous nationwide tightening of US lead standards, with robustness checks addressing potential biases, such as endogenous monitoring placement and mother-hospital sorting. Nonetheless, limitations remain. Mexico lacked systematic air monitoring outside Mexico City, and census data allowed only snapshots of plant activity. The number of plants in both countries was small, making estimates sensitive, and the mechanisms behind health effects could not be fully disentangled. Moreover, battery recycling is a highly mobile and pollution-intensive industry, so the findings may not generalise across sectors. Even with these caveats, the study provides rare causal evidence of a pollution-haven effect: stricter US standards reduced local lead emissions but displaced hazards to Mexico, where infant health deteriorated, particularly amongst disadvantaged mothers.

Application to e-waste trade research

A promising way to study the health consequences of e-waste trade is to apply the quasi-experimental approach used by Tanaka, Teshima, and Verhoogen (2022). In their battery recycling study, the US tightening of lead standards in 2009 created an exogenous shock that forced firms to adjust, providing a natural experiment. For e-waste, similar opportunities arise from major regulatory shifts such as China's 2018 e-waste import ban, amendments to the Basel Convention, or new EU waste shipment rules. These abrupt

policy changes redirect e-waste flows across borders and can be exploited as quasi-experiments to identify causal impacts.

The next step is to trace how displaced e-waste moves through trade and production channels. In the battery case, tighter US rules reduced domestic lead emissions, increased exports of used batteries to Mexico, and fuelled an expansion of Mexican recycling plants. For e-waste, researchers can track how trade flows shift after a ban by using customs data, such as UN Comtrade (HS 8549), alongside government reports and plant-level surveys to verify which countries or local facilities experienced expanded activity. Evidence from the years after China's 2018 ban, for example, shows surges of imports to Southeast Asia and Africa, suggesting that these regions became new hubs of informal dismantling and recycling.

With the displacement of activity established, the focus turns to health outcomes near recycling sites. The battery study employed a DiD strategy, comparing infants born within 2 miles of Mexican recycling plants to those slightly farther away (2–4 miles), before and after the 2009 reform. A parallel design can be applied to e-waste by using spatial DiD around known dismantling hubs such as emerging clusters in Thailand and Viet Nam. Communities closer to these sites would be expected to experience greater exposure to pollution, allowing researchers to compare their health outcomes with those of nearby but less exposed communities before and after trade shocks.

The estimation framework can be directly adapted from the health equation of Tanaka, Teshima, and Verhoogen (2022). The dependent variable would capture health outcomes such as biomarkers of exposure (blood lead, cadmium, and mercury); birth outcomes (low birthweight and prematurity); or hospital records of respiratory and neurological conditions. The key regressor is the interaction between proximity to a recycling site (within 0–2 miles) and the post-shock period. Control variables would include mother and child demographics and baseline community characteristics, while locality, municipality-year, and hospital-year fixed effects would help absorb unobserved differences across space and time.

3.2.3. Waste import bans and environmental quality: evidence from China's electronic waste disposal towns

Guo, Walls, and Zheng (2023) examined whether China's 2018 ban on imported waste improved air quality in the country's major e-waste disposal towns, which had long been hotspots for pollution from informal dismantling and open burning of plastics. Using daily station-level air quality data between 2017 and 2019, the authors focused on four pollutants – Air Quality Index (AQI), PM2.5, PM10, and ozone. The treatment group consisted of monitoring stations nearest to five e-waste towns (Guiyu, Dali, Longtang, Taizhou, and Huangyi), while the control group included 57 stations located within the same provinces but at least 200 kilometres away to avoid spillovers from wind and transboundary pollution. Control variables include weather conditions (temperature, moisture, wind speed, and daylight hours) as well as month, holiday, and heating season

indicators, while the model also incorporated fixed effects for station, calendar quarter, and day of the year to account for unobserved shocks.

The primary empirical strategy is a DiD model, which compares pollution changes in e-waste towns before and after the ban with those in control stations. The DiD equation estimated the log of daily pollution outcomes on a treatment–post interaction term, with coefficients interpreted as the effect of the ban. The results show significant reductions in pollution – AQI, PM2.5, PM10, and ozone fell by 21%–26%. To validate these results, the study also applied an event study design, which tested for parallel trends and confirmed no significant pre-treatment differences, while pollution dropped sharply immediately after 1 January 2018. As a complementary approach, a regression discontinuity design in time was used, exploiting the precise cut-off date of the ban. Implemented with a two-step augmented local linear (ALL) method to address seasonality and autocorrelation, the regression discontinuity analysis found consistent results: pollution in e-waste towns fell by 15%–28% in the short run and by as much as 37%–42% in the long run.

The estimation specification is a DiD model of the form:

$$y_{it} = \alpha + \beta(Treated_i \times Post_t) + \mu_i + \tau_t + SC_{it} + \delta X_{it} + \epsilon_{it}$$

Where:

y_{it} is the logarithm of daily air quality measures (AQI, PM2.5, PM10, or ozone) for station *i* on day *t*;

$\beta(Treated_i \times Post_t)$ is the key variable of interest;

$Treated_i$ is the indicator (dummy) for whether station *i* is near an e-waste town (treatment group);

$Post_t$ is the indicator (dummy) for whether day *t* is after the ban (from 1 January 2018);

$Treated_i \times Post_t$ captures the treatment effect of the ban on e-waste towns, relative to the control group and pre-period;

β is the DiD estimate of the impact of the ban on air quality;

μ_i refers to station fixed effects, which control for the unobserved, time-invariant characteristics of each monitoring station (e.g. local geography, baseline pollution levels, and long-standing industrial activity);

τ_t refers to day-of-year fixed effects, which capture shocks common to all stations on a given day (e.g. national holidays, macroeconomic conditions, and nationwide weather trends);

SC_{it} refers to station-by-calendar-quarter fixed effects, which allow for time-varying unobserved heterogeneity at the local level (e.g. quarterly shifts in local enforcement or industrial activity specific to that town); and

δX_{it} refers to the vector of observed time-varying controls, including weather conditions (temperature, humidity, wind speed, and daylight hours), month dummies, weekend/holiday dummies, and heating season indicators.

Nevertheless, the study acknowledged several limitations. First, it was difficult to fully separate the effect of the waste ban from other overlapping environmental regulations. Second, although control stations were carefully selected, some residual spillovers or local policy differences may remain. Third, the 3-year window provided limited evidence on longer-term industrial adjustment. Finally, the results are context-specific: China's regulatory capacity and economic structure may not be replicable in poorer countries, where bans could impose higher costs and yield smaller net benefits. Moreover, the study does not trace global spillovers – waste diverted to Southeast Asia and Africa after China's ban may have worsened environmental conditions elsewhere.

Overall, the study demonstrated that combining DiD and regression discontinuity approaches provides credible causal evidence of the policy's effectiveness. For policymakers, the key message is that China's waste import ban led to a substantial reduction in air pollution in affected towns, with estimated health benefits far exceeding the modest costs to downstream industries. However, the transferability of such bans to other developing countries depends on local industrial structures, enforcement capacities, and broader welfare considerations.

Application to e-waste trade research

A DiD approach can be applied to e-waste trade research by treating policy changes – such as China's 2018 waste import ban – as quasi-experiments. In this framework, e-waste hubs or port cities that receive imported waste serve as the 'treated' group, while comparable inland or non-waste-intensive regions act as the 'control' group. The DiD model then compares changes in environmental or health outcomes, such as PM2.5 levels, heavy metal contamination, or hospital admissions, before and after the ban in both groups. The interaction term captures the causal impact of diverted e-waste flows on local conditions, controlling for weather, demographics, and fixed local differences. This design provides a broad estimate of how international trade shocks alter pollution, health, or economic indicators across exposed regions relative to less affected ones.

By contrast, a regression discontinuity design in time focuses narrowly on the exact cut-off date when a ban or regulatory shift takes effect. Instead of relying on a control group, regression discontinuity compares outcomes immediately before and after the policy within the same e-waste hub. For example, a regression discontinuity study could examine whether daily pollution or health indicators in Philippine port cities exhibit a sharp discontinuous drop after 1 January 2018, when China's ban redirected waste flows. This method is powerful for detecting sudden policy-induced shifts because it relies on the assumption that other factors evolve smoothly around the cut-off date. In practice, DiD offers a broader picture by contrasting treated and control regions across time, while regression discontinuity provides sharper evidence of immediate changes in outcomes

tied directly to the policy's implementation. Using both approaches together strengthens causal claims: DiD establishes medium-term relative effects across space, and regression discontinuity validates the presence of an immediate policy-driven break in local outcomes.

4. Conclusion and Way Forward

This chapter has aimed to (i) review the latest research on e-waste trade and its environmental and health implications; and (ii) propose preliminary pathways for adapting methods from adjacent fields – trade and health economics, environmental regulation, and applied econometrics – to the context of e-waste flows. The review has revealed that, while e-waste research has expanded rapidly, much of it remains descriptive, focusing on stock–flow estimates, recycling technologies, and policy frameworks. Causal evidence linking trade flows directly to environmental and health outcomes is still rare. By contrast, recent advances in trade–environment and health studies – such as the use of instrumental variables by Adda and Fawaz (2020); the use of DiD by Tanaka, Teshima, and Verhoogen (2022) on displaced pollution; and the use of combined DiD and regression discontinuity by Guo, Walls, and Zheng (2023) on China's waste ban – demonstrate the value of quasi-experimental designs. These studies highlight a broader methodological trajectory: older research relied on simpler specifications with higher endogeneity risk, whereas newer work achieves stronger identification through instrumental variables, policy shocks, and exposure measures, albeit with heavier data requirements (detailed matching, precise timing, and policy metadata such as enforcement details).

For e-waste trade research, the way forward lies in adapting these tools while recognising the field data constraints and specificities. Scope choices will matter. Product-specific analyses (e.g. photovoltaic panels, TVs, and batteries) allow precise mechanism tracing, while HS-group studies offer broader coverage and comparability. To overcome the pervasive issue of poor data quality, two complementary data solutions are proposed: (i) MFA to reconstruct true import/export flows and implied outflows from in-use stocks, thereby addressing misclassification and underreporting; and (ii) domestic administrative data from Association of Southeast Asian Nations (ASEAN) governments, secured through collaboration with local counterparts, to validate and enrich trade measures with environmental releases, health records, and enforcement data. These can be linked with satellite-based monitoring, sentinel indicators, and fieldwork at ports and recycling hubs to capture localised exposure.

In conclusion, the report lays the groundwork for how such estimates could be generated. By showing how established methods from other domains can be repurposed for the e-waste context, the study charts a pathway towards a next generation of research that is both methodologically rigorous and policy-relevant. Future work should build on these proposals by pilot testing quasi-experimental designs in ASEAN hotspots, systematically improving data quality, and embedding findings into regional and global policy processes. This iterative approach – reviewing, adapting, and testing – will be critical for moving the

field beyond descriptive diagnosis towards evidence-based strategies that reduce environmental harm, safeguard public health, and advance circular economy goals.

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