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Securing reverse supply chains for a resource efficient and circular economy

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Abstract

Securing reverse supply chains for a resource efficient and circular economy

Shunta Yamaguchi

Circular economy business models often rely on reverse supply chains and reverse logistics to close material loops, such as recycling waste and scrap into secondary raw materials, and extending product life by promoting direct reuse, repair, refurbishment and remanufacturing. Such activities can extend beyond borders and require the transboundary movement of end-of-life products to enable economies of scale. At the same time, recent developments in trade in waste and scrap have mainly focused on increasing transboundary controls, such as the import bans for certain categories of waste and scrap introduced in China, and the plastics and e-waste amendments to the Basel Convention on the Control of Transboundary Movements of Hazardous Wastes and their Disposal.

In this context, this report explores the opportunities and challenges for governments to facilitate cross-border reverse supply chains for a resource efficient and circular economy. It mainly focuses on the role of trade facilitation mechanisms and standards, and provides potential ways forward in utilising them to improve and strengthen cross-border reverse supply chains. The report also investigates other relevant policy responses such as addressing trade restrictions, combatting illegal waste trade, and introducing upstream policies such as eco-design initiatives that may work to support cross-border reverse supply chains.

JEL classification: F13, F18, Q53, Q56

Keywords: Trade and environment, trade policy, environment policy, resource efficiency, circular economy, reverse supply chains, reverse logistics, trade facilitation, standards

Résumé

Les modèles d’affaires de l'économie circulaire s'appuient souvent sur des chaînes d'approvisionnement et logistiques inversées pour fermer les boucles de matériaux, tels que le recyclage des déchets en matières premières secondaires et l'allongement de la durée de vie des produits en favorisant la réutilisation directe, la réparation, le reconditionnement et la remanufacture. Ces activités peuvent s'étendre au-delà des frontières étatiques et nécessitent le mouvement transfrontalier de produits en fin de vie pour permettre des économies d'échelle. Dans le même temps, les évolutions récentes du commerce international des déchets et de la ferraille se sont principalement concentrées sur le renforcement des contrôles transfrontaliers, tels que les interdictions d'importation de déchets et de ferraille en Chine, et les amendements relatifs aux plastiques et aux déchets électroniques à la Convention de Bâle sur le contrôle des mouvements transfrontaliers de déchets dangereux et de leur élimination.

Dans ce contexte, ce rapport explore les opportunités et les défis pour les gouvernements de faciliter les chaînes d'approvisionnement inversées transfrontalières pour favoriser une économie efficace en ressources et circulaire. Le rapport se concentre principalement sur le rôle des mécanismes et des normes de facilitation des échanges, et fournit des pistes pour les utiliser afin d'améliorer et de renforcer les chaînes d'approvisionnement inversées transfrontalières. Le rapport étudie également d'autres réponses pertinentes en termes de politiques publiques, telles que le traitement des restrictions commerciales, la lutte contre le commerce illégal de déchets et l'introduction de politiques publiques en amont, comme les initiatives d'éco-conception, qui peuvent contribuer à soutenir les chaînes d'approvisionnement inversées transfrontalières.

Classification JEL: F13, F18, Q53, Q56

Mots clés: Commerce international et environnement, politique commerciale, politique environnementale, efficacité des ressources, économie circulaire, chaînes d'approvisionnement inversées, logistique inverse, facilitation des échanges, normes

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Executive Summary

In today's highly interconnected global economy, a range of circular economy business models are exploring ways to establish or scale up reverse supply chains across borders. For example, manufacturers often set up reverse logistics to collect end-of-life products and reinject reusable components back into the production process. Reverse supply chains can make the economy more circular by closing material loops for recycling, reuse, repair, and remanufacturing. Such activities often extend beyond borders and require the transboundary movement of end-of-life products to enable economies of scale.

At the same time, recent developments in trade in waste and scrap have mainly focused on increasing transboundary controls. These include the import bans for certain categories of waste and scrap introduced in China and subsequently other countries since 2018, and the plastic waste amendments to the Basel Convention on the Control of Transboundary Movements of Hazardous Wastes and their Disposal (i.e. the Basel Convention) which entered into force in 2021. New amendments to the Basel Convention, on e-waste, have been adopted in June 2022 and will enter into force in 2025.

In this context, this report explores the opportunities and challenges for governments to facilitate cross-border reverse supply chains. It focuses on trade facilitation mechanisms and standards, and also briefly explores other responses such as addressing trade restrictions, illegal waste trade, and eco-design. In doing so, it classifies cross-border reverse supply chains into three main forms: (i) controlled waste under international legal frameworks, (ii) non-controlled waste, and (iii) non-waste products.

Regarding the first category, transboundary movements of waste are primarily controlled under two international legal frameworks, namely the Basel Convention, and the OECD Decision on the Control of Transboundary Movements of Wastes destined for Recovery Operations (hereafter referred to as the OECD Decision). The Basel Convention aims to restrict the transboundary movements of hazardous wastes with respect to its parties, whereas the OECD Decision aims at facilitating trade of recyclables in an environmentally sound and economically efficient manner within OECD member countries. Despite these differences in intent and membership, the two instruments share similar features. In particular, they require prior agreement between import, export and transit countries, known as “prior informed consent (PIC)” procedures, to ensure that shipments of hazardous waste and other waste are managed in an environmentally sound manner. Between 2012 and 2018, the share of waste trade subject to controls under the Basel Convention remained relatively low, however increased from 2% to 8% of global waste and scrap trade by weight.

The other categories of non-controlled waste (e.g. non-hazardous waste exempt from international controls), and non-waste products (e.g. second-hand goods, remanufactured goods, secondary raw materials) are often subject to standard commercial controls, with additional national requirements depending on each jurisdiction.

Many businesses pursuing circular business models have raised concerns over difficulties in establishing reverse logistics and shipping end-of-life products across borders for their circular use. This is mainly due to: (i) a patchwork of different definitions and classification of end-of-life products between countries and with trade classifications (i.e. the Harmonized System codes), and (ii) procedural burden and delays, and associated costs in the cross-border transportation of end-of-life products. Anecdotal evidence suggests that some recyclers needed 14 to over 42 months to obtain consent for particular waste shipments under PIC procedures (OECD, 2020[1]; WEF, 2020[2]; EERA, 2019[3]; PREVENT and StEP, 2022[4]). This is much longer compared to the standard procedures of one month under the OECD Decision or two months under the Basel Convention. These regulatory hurdles and ambiguities work against business predictability.

One potential way forward to deal with these challenges is the use of trade facilitation mechanisms. The Authorized Economic Operator (AEO) concept of the World Customs Organization (WCO) aims to optimise custom procedures by shifting controls from the border to on-site facilities. Traders with AEO status demonstrate established levels of security management and legal compliance, and benefit from preferential treatment such as expedited customs procedures. Furthermore, single window mechanisms managed by customs, allow traders to lodge information with a single body to fulfil import and export related regulatory requirements, aiming to make border procedures easier and transparent.

Another way forward is the use of harmonised or mutually acceptable standards. Standards on recovery facilities can guide operators to demonstrate their sufficient capacity and environmentally sound management levels. Standards on end-of-life products can also support reverse supply chains, by creating a common understanding of environmental requirements and conformity assessment procedures between traders and regulators.

Countries can refer to trade facilitation mechanisms and standards to help establish cross-border reverse supply chains. A possible response for “controlled waste” is to improve the efficiency of PIC procedures under the Basel Convention and the OECD Decision. Several steps can be taken as follows:

- Countries can act to better clarify the actual implementation of PIC procedures.
- Adherents to the OECD Decision can exploit the potential of “pre-consented facilities”, which can expedite these procedures by partly shifting controls from the border to material recovery facilities. This may help meet industry demands to establish "fast tracks" or "green lanes" based on the AEO concept.
- Linking the experience of custom authorities in working with AEOs, with the expertise of competent authorities (e.g. environmental protection agencies) in managing PIC procedures may help identify best practices. Regulatory co-operation between countries can help bridge gaps in PIC procedures and also address regulatory fragmentation of waste classification systems.
- Countries can consider establishing electronic systems to streamline PIC procedures that are often paper based. These efforts by competent authorities could be further bridged with single windows administered by customs to facilitate border controls.

Countries can also be concerned about the actual fate of end-of-life products once it exits or enters their country. Thus, ensuring the status and fate of trade in “non-controlled waste” and “non-waste products” is critical to help establish reverse supply chains. This is important as regulatory requirements make trade difficult if products are (mis-) labelled as (non-compliant) waste rather than non-waste products. Possible steps are as follows.

- While still in its infancy, the application of AEO concepts, with possible reflection of environmental criteria, may help increase the regulatory confidence in trading these products by partially shifting controls from the border to on-site. Available standards on recovery facilities may assist in this process. Effective risk assessment and audit techniques would be essential to ensure their environmentally sound management.
- For second-hand goods, countries may wish to extend electronic systems to register information that clarifies their status, in-line with the Basel Convention technical guidelines on waste and used electronics. Such efforts by competent authorities could be linked with single windows administered by customs to ease border controls.
- Countries can clarify whether the use of standards on waste and scrap, or used and remanufactured goods may help distinguish shipments from illegal fractions.

Further policy responses beyond trade facilitation mechanisms and standards can also help to establish reverse supply chains.

- Countries can review and, where possible, avoid the use of trade restrictions that hinder reverse supply chains. Countries may consider alternative measures, such as encouraging traders to assume some responsibility for the fate of imports and exports.
- Countries can place efforts to tackle illegal waste trade that hampers legitimate trade and competition in reverse supply chains.
- Countries can incentivise circular products that are conducive to cross-border reverse supply chains through the adoption of eco-design policies.

1. Introduction

1.1. Background

A transition towards a resource efficient and circular economy is gaining attention across the globe as a way to use material resources more efficiently across their lifecycle. This concept is becoming increasingly important as, in the absence of further policy action, material consumption is expected to double between 2017 and 2060, reaching 167 gigatonnes in 2060, due to global demographic and economic growth (OECD, 2019[5]). By using material resources more efficiently throughout the product lifecycle, a transition towards a resource efficient and circular economy may reduce the environmental pressures associated with the production, consumption and disposal of products and materials. It also offers a sustainable pathway for economic growth and employment opportunities (Bibas, Chateau and Lanzi, 2021[6]; Chateau and Mavroeidi, 2020[7]).

As our world is highly interconnected through economic integration and global value chains, a resource efficient and circular economy transition has broad interlinkages with international trade. This takes place through three main channels: (i) global circular supply chains of products and materials, (ii) trade in end-of-life value chains, such as trade in waste and scrap, secondary raw materials, second-hand goods and goods for refurbishment and remanufacturing, and (iii) trade in services (Yamaguchi, 2021[8]).

Concerning trade in waste and scrap, recent developments have mainly focused on increasing controls on their transboundary movement. Since 2018, China has imposed import bans on certain fractions of waste and scrap with the stated motivation to prevent and control environment pollution.[1] In 2019, Parties to the Basel Convention on the Control of Transboundary Movements of Hazardous Wastes and their Disposal (hereinafter, the Basel Convention) adopted amendments to increase controls on the transboundary movement of on plastic waste and scrap in order to reduce the amount of plastic waste entering into the environment.[2] These plastics amendments have been in force since January 2021. In 2022, Parties to the Basel Convention further agreed on amendments to increase controls for the transboundary movement of e-waste.[3] This e-waste amendment will be in force from January 2025.

At the same time, a range of circular economy business models are emerging and exploring ways to expand their activities by establishing and scaling up reverse supply chains and reverse logistics across borders. In particular, several circular economy business models heavily rely on reverse supply chains and reverse logistics to close material loops, such as those aiming at recovering resources through recycling waste and scrap into secondary raw materials, and extending product life by promoting direct reuse, repair, and refurbishment and remanufacturing (OECD, 2019[9]). For example, manufacturers in the heavy industry often set up reverse logistics to collect their end-of-life products, feed reusable components back into the production process, and resell them as remanufactured goods, with a circular business in mind. Furthermore, original equipment manufacturers of printers may wish to establish reverse supply chains to

[1] These categories announced in 2017 mainly included on plastic waste and scrap, unsorted paper waste and scrap, and certain fractions of metal waste and scrap, as well as other specific waste fractions. More recently, China has stopped importing all solid waste from January 2021. See: https://phys.org/news/2020-11-china-imports-jan.html.

[2] The Basel Convention amendment on plastic waste was agreed by Parties in 2019 and came into force from January 2021. See: http://www.basel.int/TheConvention/ConferenceoftheParties/Meetings/COP14/tabid/7520.

[3] The Basel Convention amendment on e-waste was agreed by Parties in 2022. See: http://www.brsmeas.org/MediaHub/News/PressReleases/BRS2022COPsconclude/tabid/9214/language/en-US/Default.aspx.

collect their used toner cartridges, refurbish and recondition them according to certain quality standards, and redistribute them for a second product life. Box 1 indicates the similarities and differences between reverse supply chains and reverse logistics.

Box 1. Reverse supply chains and reverse logistics

"Reverse supply chains" generally refer to a set of activities and actors involved in collecting end-of-life goods, recovering residual value through reuse, repair, refurbishment, remanufacturing, and recycling, and redistributing products and materials that can be used again in the economy (Nuss, Sahamie and Stindt, 2014[10]). In a slightly narrower sense, "reverse logistics" generally encompasses the logistical activities to support reverse supply chains (Nuss, Sahamie and Stindt, 2014[10]).

These circular business models can also extend beyond borders and require the transboundary movement of end-of-life products. Therefore the potential role of international trade in facilitating circular economy business models and the better use of materials through reverse supply chains is significant in this respect.

However, some industry representatives have claimed that they face challenges in recovering end-of-life products and channelling them across borders to achieve high quality recycling or undertaking remanufacturing operations in pursuit of resource efficiency and circular economy objectives (OECD, 2020[1]; Business at OECD, 2020[11]). These challenges in establishing and scaling up reverse supply chains appear to be associated with regulatory barriers, and with the definition and classification of end-of-life products and waste (Yamaguchi, 2021[8]; OECD, 2020[1]; Business at OECD, 2020[11]). Limited transparency and traceability of traded products and materials, including their end-of-life status and treatment method pose additional challenges (Yamaguchi, 2021[8]; OECD, 2020[1]).

Many of these issues are not new in themselves, but are becoming ever more important to address with the emergence of cross-border circular business models. These issues are increasingly raised at various international dialogues, including the OECD workshop on international trade and circular economy (OECD, 2020[1]), and more recently at the World Trade Organization (WTO), Trade and Environmental Sustainability Structured Discussions (TESSD) (WTO, 2022[12]).

For trade to work for a resource efficient and circular economy transition, there is need to further distinguish trade policies and practices that would create opportunities for materials to be better used from those that would hinder such initiatives, such as environmental dumping. Trade facilitation mechanisms and standards may potentially assist in making this distinction and overcoming these challenges (Yamaguchi, 2021[8]; OECD, 2020[1]).

1.2. Objective and outline

This report explores the opportunities and challenges for governments to facilitate cross-border reverse supply chains that can contribute to a resource efficient and circular economy transition. In particular, it focuses on the role of trade facilitation mechanisms and standards that would help support such a transition. In addition, the report investigates other relevant responses such as, addressing trade restrictions, combatting illegal waste trade, and introducing upstream policies such as eco-design initiatives that may work to support cross-border reverse supply chains.

The report sets out the landscape of cross-border reverse supply chains, including the current trade situation and the trade impediments encountered by businesses, and looks specifically at trade facilitation mechanisms and standards as possible solutions. The analysis is based on a review of (i) trade data available at the international and regional level including UN COMTRADE[4] and National Reports from the Basel Convention (UNEP, 2022[12]; 2018[13]); (ii) studies related to trade, resource efficiency and circular economy;[5] (iii) data, documents and studies related to the transboundary movements of waste (e.g. Basel Convention, OECD, World Customs Organization); (iv) documentation on trade facilitation mechanisms (e.g. OECD, World Trade Organization, World Customs Organization); and (v) documentation on standards related to resource efficiency and circular economy.[6]

The following sections provide information on the different elements covered in this report. Section 2 clarifies the role, importance and scope of reverse supply chains in the transition to a resource-efficient and circular economy. Section 3 unpacks these reverse supply chains according to different characteristics that distinguish cross border end-of-life material flows, the international legal frameworks that govern transboundary movement of waste, and the potential barriers to establish reverse supply chains. Sections 4 and 5 focus on two available mechanisms that could help establish reverse supply chains for a resource efficient and circular economy, namely trade facilitation mechanisms and standards respectively. Sections 6 and 7 present possible policy responses, and Section 8 provides concluding remarks.

[4] See: https://comtrade.un.org/.

[5] An example of such studies include (Yamaguchi, 2021[8]; de Sa and Korinek, 2021[45]; WEF, 2020[2]; 2020[37]).

[6] For example, this refers to the standards related to the circular economy covered by Laubinger and Borkey (2021[75]), Yamaguchi (2021[8]), and RPA (2012[74]).

2. Why are reverse supply chains important for a resource efficient and circular economy?

This section describes the focus and scope of cross-border reverse supply chains and specifies its rationale in contributing to a resource efficient and circular economy. Under a resource efficient and circular economy transition, the concept of establishing reverse supply chains is increasingly relevant. These reverse supply chains can also extend beyond borders and rely on trade. It is therefore essential to discuss the importance of reverse supply chains and its cross-border elements in the context of resource efficiency and circular economy.

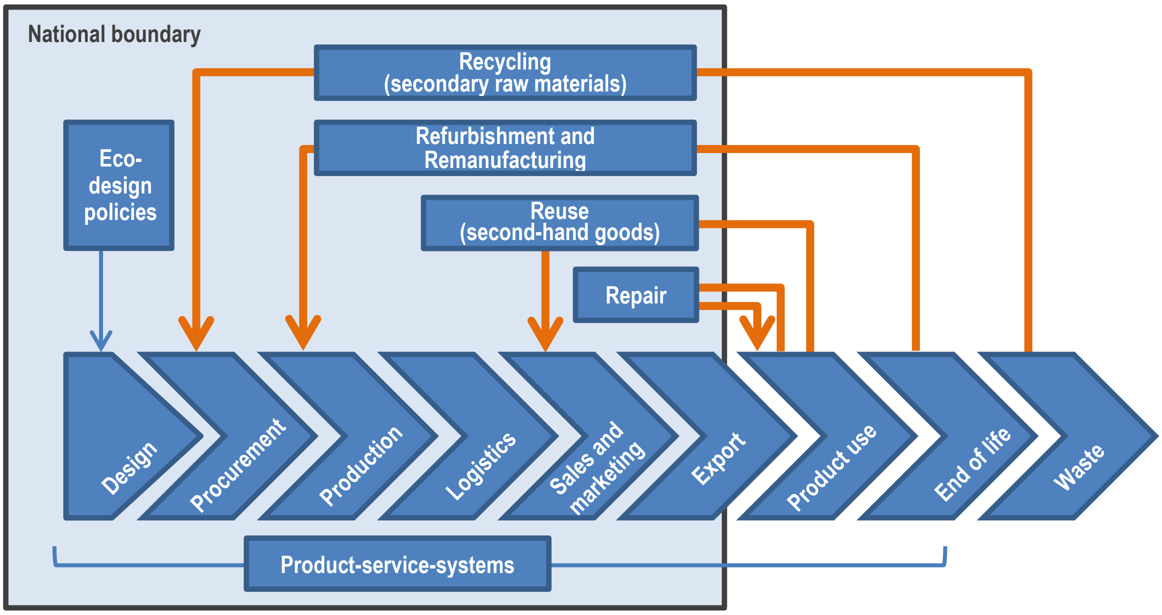
There is no universally agreed definition of circular economy to date.[7] The circular economy concept, as illustrated by McCarthy, Dellink and Bibas (2018[14]), is an approach to: (i) close material resource loops through recycling, reuse, repair, refurbishment and remanufacturing; (ii) extend (slow) material resource loops through eco-design; and (iii) narrow material resource loops through the efficient use of natural resources, materials, and products. Through these channels, a circular economy transition is seen as a process that eventually may lead to lower rates of natural resource extraction and use.

In this context, reverse supply chains play an important role in a circular economy especially in "closing material loops" for recycling, reuse, repair, refurbishment and remanufacturing. They are necessary to collect end-of-life products, to channel them to recovery facilities for sorting and processing, and to redistribute products and materials for a second life. Furthermore, upstream efforts to "extend material resource loops" such as eco-design to make products last longer and phase out hazardous substances are also conducive in establishing reverse supply chains to close the loop.

This current report focuses on the role of trade in establishing reverse supply chains for recycling, reuse, repair, and remanufacturing for more efficient use of materials towards a resource efficient and circular economy. It thus mainly elaborates on the cross-border elements of "closing the resource loop". In addition, the role of "extending the resource loop" through product design is also briefly covered. The concept of reverse supply chains and its relation with trade is visually expressed as bold orange arrows in Figure 1 below.

[7] The OECD (2020[109]) report describes defines circular economy as a concept that aims to: (i) maximise the value of the materials and products that circulate within the economy; (ii) minimise material consumption, paying particular attention to virgin materials, hazardous substances, and waste streams that raise specific concerns (such as plastics, food, electric and electronic goods); (iii) prevent waste from being generated; (iv) reduce hazardous components in waste and products. For the purpose of informing international work on monitoring progress towards a resource efficient and circular economy, the OECD is also developing a headline working definition of a circular economy, as follows (OECD, n.d.[108]) develops a draft headline working definition: "A circular economy is an economy where: (i) the value of materials in the economy is maximised and maintained for as long as possible; (ii) the input of materials and their consumption is minimised, (iii) the generation of waste is minimised, and (iv) negative environmental impacts are reduced throughout the life-cycle of materials."

Figure 1. Schematic of cross-border reverse supply chains for a resource efficient and circular economy



Note: The focus of this report is on securing cross-border reverse supply chains for more circular use of materials (bold orange arrows above). For simplicity, the figure shows typical examples of reverse supply chains between two countries and is not exhaustive. In reality, reverse supply chains can involve multiple countries interconnected through international trade. For example, a good can be produced in one country, exported to and consumed in another country, refurbished or remanufactured in a third country and further re-exported to another destination.
Source: Author based on (Yamaguchi, 2021[8]).

A question arises on the extent to which international trade in end-of-life products would contribute to a resource efficient and circular economy transition. Some studies point to a possible contribution of international trade in end-of-life value chains for better use of material resources. For example, Yang (2020[15]) argues that valuable fractions of waste can be traded for material recovery while ensuring their environmentally sound management at destination. Shinkuma and Huong (2009[16]) investigate e-waste flows in Asia and recommend preserving trade in end-of-life products through proper recycling activities and better traceability systems.

Businesses have also suggested that trade is necessary to scale up circular business models that involve reverse logistics of end-of-life products across borders. The OECD workshop on international trade and circular economy in 2020 highlighted that trade is essential to accumulate sufficient end-of-life products and materials and to help achieve economies of scale and make circular business activities viable (OECD, 2020[1]; Business at OECD, 2020[11]). For example, this may include circular business models such as processes to achieve high quality material recycling or remanufacturing operations that can involve reverse logistics in end-of-life products.[8]

At the same time, the environmental impacts of trade in end-of-life products must also be taken into account. This aspect is particularly crucial among trading partners with different levels of environmental regulation and enforcement. Trade in end-of-life products and materials can pose a serious threat to the environment if they are not properly managed at their destination. In particular, poorly managed waste can have negative impacts on human health and the environment (OECD, 2007[17]). Empirical analysis shows that waste trade generally occurs between countries with divergent environmental policy stringency –

[8] The concept of reverse supply chains covered in this report can also be mapped against circular economy business models (see Annex A).

exports tend to flow from countries with relatively high environmental standards to those that have relatively low environmental policy stringency (Kellenberg, 2012[18]). Many of these destinations have serious problems related to illegal waste trade and the informal waste management sector, which frequently involves substandard processing techniques such as open burning and chemical leaching that result in severe health and environmental effects (OECD, 2016[19]; Shinkuma and Managi, 2011[20]; Huisman et al., 2015[21]).[9]

Focussing on plastics, OECD (2022[22]) finds that of the 353 Mt of plastic waste generated worldwide in 2019, 22% (78 Mt) was not adequately managed,[10] and 6% (22 Mt) leaked into the environment. It was further estimated that this varied considerably between countries, with mismanagement rates ranging from 6% on average in OECD countries to 37% on average in non-OECD countries. OECD (2022[23]) projects that plastics use may triple until 2060, leading to significant increases in the associated environmental impacts. Furthermore, despite improvements in waste management infrastructure and litter collection, plastics leakage can double to 44 Mt by 2060.

In some cases, the comparative advantage of lower processing costs stem from lax environmental regulations and compliance, and therefore the issue may be inherent to country level differences in environmental policy stringency (Grant and Oteng-Ababio, 2016[24]). Furthermore, potential additional environmental costs related to the logistics of trade also need to be considered, such as emissions associated with transporting products for refurbishment, remanufacturing and recycling from the country where they are exhausted and reach their end-of-life.

While processing end-of-life products such as refurbishment and remanufacturing, or recycling in the proximity of the source of waste may be generally preferable from an environmental perspective, this may not always be economically feasible (OECD, 2010[25]). In this case, trade may be an option under the precondition that these end-of-life products are processed or recycled at their destination in an environmentally sound manner.

The policy challenge is how to strike the right balance between trade in end-of-life products as a part of reverse supply chains and environmental protection, which particularly requires efficient and environmentally sound management of end-of-life products at the same time. This calls for a detailed examination of the various characteristics of these end-of-life value chains and how they are governed by international legal frameworks. The following section sheds light on these different features and explores how they could be better managed.

[9] While illegal waste trade is a reality on the ground, estimating its magnitude as well as quantifying its environmental impacts is a challenging task. See Annex B for further details.

[10] In the context of the OECD (2022[22]) report, mismanaged waste includes those disposed of in uncontrolled dumpsites, burned in open pits, and leaked into the environment.

3. Unpacking the policy landscape of cross-border reverse supply chains

This section aims to illustrate how reverse supply chains across borders are specified by different concepts and international legal frameworks that govern the transboundary movement of waste, trends in trade of these products, and the potential barriers to establish and scale up reverse supply chains.

3.1. Key concepts related to cross-border reverse supply chains

Reverse supply chains in the context of a circular economy can take many forms, as shown in Figure 1. The most basic type involves collecting waste for recycling to produce secondary raw materials. Another type is to collect end-of-life products for refurbishment and remanufacturing. In addition, products that are still in the use phase can be repaired and returned to the original consumer, or re-enter the market as a second-hand good. An important feature of these reverse supply chains is that these products are collected at different stages in the value chain, either as waste, as end-of-life products or materials, or as products still being consumed, and their status becomes extremely important when trade is involved.

The physical properties and characteristics of end-of–life products provide an important distinction in determining international and national controls for their transboundary movement. The property of these goods are often classified by national authorities (including customs and competent authorities) as well as by applicable international legal frameworks (see Section 3.1.2). Two main distinctions can be made. First is whether they are classified as waste or non-waste products (e.g. second-hand goods, secondary raw materials) by regulators.[11] The second is whether or not they are classified as controlled waste under international legal frameworks (e.g. hazardous waste, other waste requiring special consideration such as mixed waste). These two concepts are further explored in the sub-sections below.

3.1.1. Distinguishing "non-waste" products from waste

A frequently encountered challenge in establishing reverse logistics across borders is the classification of non-waste products such as products for reuse and repair, end-of-life products for refurbishment and remanufacturing, and secondary raw materials, and clearly distinguishing their status from waste. In some countries, end-of-life products and materials destined for recovery operations may not be considered as waste and are instead referred to as recyclable materials or scrap materials,[12] while other countries often consider them as a subset of waste (OECD, 2007[17]). Distinguishing material status can be important as products and materials labelled as waste rather than non-waste products, are generally more difficult to ship across borders due to international and national requirements and pose potential challenges in establishing reverse supply chains (OECD, 2010[25]).

Often, end-of-life products that can potentially be preserved in reverse supply chains are (mis-)classified as waste. For example, end-of-life products that are intended to be traded for high-quality material recovery (recycling) can be classified as waste and subject to national or international controls (OECD, 2020[1]). Another example is trade in core components for remanufacturing. While it can be essential for some

[11] "Non-waste" generally refers to products that are not regarded as waste. For further details, see OECD (1998[28]) guidance document on for distinguishing waste from non-waste.

[12] For example, most processed metal scrap in solid form is classified as non-waste in the United States (OECD, 2010[25]).

businesses to bring core components back across borders to regional hubs in order to remanufacture products that have reached their end-of-service-life and to ensure a viable scale of operations, these core components can be classified as waste and subject to transboundary restrictions in certain jurisdictions (UNEP, 2018[26]).

At present, there is no universal definition of waste. Importantly, products considered as waste in one jurisdiction can be classified as non-waste in another jurisdiction due to their commodity or raw material characteristics (OECD, 2009[27]). Main differences lie in the concept of end-of-life, for instance whether these products are considered as waste, or alternatively as non-waste products such as by-products or residuals for input into another production process or as products for reuse. Considerations by countries in distinguishing the product in question, such as used or end-of-life products as non-waste rather than waste include whether it: i) has been intentionally produced, ii) has an intended use, market demand, and positive economic value, iii) can be considered to be part of normal commercial cycle or utility chain, and iv) does not require further processing[13] for the material to be directly used in manufacturing operations or commercial applications (OECD, 1998[28]).

Another key distinction is the point at which waste ceases to be waste after collection, sorting and processing and becomes a commodity or a secondary raw material. This is particularly important as secondary raw materials may have different quality levels (at times allowing a certain level of contamination), and the distinction between waste and scrap is not always straight forward. Waste is generally considered to cease its status as a waste when a recovery process: i) diminishes its negative environmental affects, and ii) yields materials of sufficient beneficial use (OECD, 1998[28]). Materials resulting from an environmentally sound recovery process and meeting a certain standard or specification may offer clarity that the waste was transformed into a commodity or a secondary raw material. At the same time, this also appears to depend on the extent and type of the recovery process in certain cases. For example, some countries do not consider the simple sorting of an end-of-life product or material to be an adequate means of recovery or recycling.[14] For these reasons, some countries have set forth "end-of-waste" criteria to better clarify the status of non-waste products (further elaborated in Section 5.2.1. Table 3).

While the trade regime, through Customs and the Harmonized System to classify traded products, distinguishes goods based on their physical characteristics and properties to achieve objectivity of border controls, national and supra-national efforts to clarify the status of "non-waste" products or waste have also placed considerations on how they are processed (e.g. what kind of recovery process is applied). This asymmetry between trade policy and environment policy can pose potential challenges in bringing these two domains closer together. These aspects are further explored in Section 5.2.1.

3.1.2. Distinguishing "controlled waste" under international legal frameworks

At the global level, transboundary movements of waste are primarily controlled under two international legal frameworks, namely the Basel Convention, and the OECD Decision on the Control of Transboundary Movements of Wastes destined for Recovery Operations (hereinafter, the OECD Decision). Details of these instruments are compiled in Annex C.

[13] Under this criteria, materials collected for recycling that require further processing (cleaning, shredding, sorting etc.), would qualify as waste, whereas secondary raw materials (post recycling processes) as well as by-products and residuals that could be directly reused in another production process would qualify as non-waste.

[14] Further discussion on the distinction of waste can be found in (OECD, 2009[27]; OECD, 1998[28])

There are several other international legal frameworks that prohibit imports of hazardous waste into a particular region, including the Bamako Convention,[15] the Waigani Convention,[16] and the Central American Regional Agreement on the Transboundary Movements of Hazardous Wastes.[17] As these legal instruments provide for import bans and an intra-regional control mechanism for a smaller set of countries than the Basel Convention or the OECD Decision, they are not covered in this report.[18]

The Basel Convention aims to restrict the transboundary movements of hazardous wastes with respect to its parties, whereas the OECD Decision aims at facilitating trade of recyclables in an environmentally sound and economically efficient manner within OECD member countries.

Despite these differences in intent and membership, the two instruments share similar features. In particular, they require, *inter alia*, prior agreement between import, export and transit countries, known as "prior informed consent (PIC)" procedures, in shipping hazardous waste and other waste that may pose a risk for human health and the environment.[19] Consignments under PIC procedures operate under international legal frameworks as well as additional national requirements depending on each countries' regulation, and therefore they constitute shipments intended for environmentally sound management of waste at destination.

Under the PIC procedures, exporters need to notify and obtain consent from the competent authorities (normally environmental protection agencies) of import, export and transit countries before a shipment is made (shipments made without consent are illegal). The procedure provides an additional layer of safeguard for transboundary movements of hazardous waste and other waste that may pose significant risks to the environment if improperly managed. Waste subject to these trade controls are closely interlinked between the two frameworks with some adjustments. These controlled waste categories are specified as "hazardous waste and other waste" under the Basel Convention, and "waste subject to amber control procedures" under the OECD Decision.

Another notable feature of the Basel Convention and the OECD Decision is that signatory countries also have the discretion to introduce additional national requirements within their jurisdiction in order to better protect the environment. These requirements can be additional trade controls or additional set of waste

[15] The Bamako Convention, in force since 1998, prohibits imports of any hazardous waste (including radioactive waste) into 29 African Parties including: Angola, Benin, Burkina Faso, Burundi, Cameroon, Chad, Comoros, Congo, Côte d'Ivoire, Democratic Republic of the Congo, Egypt, Ethiopia, Gabon, Gambia, Guinea-Bissau, Liberia, Libya, Mali, Mauritius, Mozambique, Niger, Rwanda, Senegal, Sudan, Togo, Tunisia, Uganda, United Republic of Tanzania, and Zimbabwe. See: https://www.unep.org/events/conference/third-conference-parties-bamako-convention.

[16] The Waigani Convention, in force since 2001, bans the importation of Hazardous and Radioactive Wastes and to Control the Transboundary Movement of Hazardous wastes within the South Pacific Region. It has been ratified by 12 countries in the South Pacific area, including: Australia, Cook Islands, Federated States of Micronesia (FSM), Fiji, Kiribati, New Zealand, Niue, Papua New Guinea, Samoa, Solomon Islands, Tonga, and Tuvalu. See: https://www.sprep.org/convention-secretariat/waigani-convention.

[17] The Central American Regional Agreement on the Transboundary Movements of Hazardous Wastes, entered into force in 1995, and aims to prevent the import and transit of hazardous wastes to Central America from States which are not Parties to the Agreement. The Agreement is ratified by five countries including: Costa Rica, El Salvador, Guatemala, Nicaragua, and Panama. See: https://www.ecolex.org/details/treaty/regional-agreement-on-the-transboundary-movement-of-hazardous-wastes-tre-001167/.

[18] To clarify, these regional conventions and agreements fall under the bilateral, multilateral and regional agreements provided for in Article 11 of the Basel Convention. These regional conventions and agreements provide for bans on the import of hazardous wastes and can be considered more stringent and complementary to the requirements of the Basel Convention.

See: http://www.basel.int/Countries/Agreements/tabid/1482/Default.aspx.

[19] See: Basel Convention, Articles 4.2(a)-(b) and 4.9, and OECD Decision, Chapter II, Article D.

categories to be controlled under these frameworks. For the OECD Decision, such specific national controls can be in place to shift certain fractions of waste subject to PIC procedures, or conversely, remove certain fractions from the PIC procedure provided that they do not exhibit any harmful characteristics. These specific national controls should be applied on an exceptional basis to protect human health and the environment and conform with domestic legislation and the rules of international law.[20] The OECD Decision also suggests that these types of differentiated control procedures should be temporary in nature rather than a long-term measure.

While these two frameworks are very similar in introducing controls for the transboundary movement of waste, there are a number of differences. First, the membership of these instruments are different. As of June 2022, 189 countries and the European Union are parties to the Basel Convention. As of June 2022, 38 OECD member countries are subject to the OECD Decision. Notably, while the United States adheres to the OECD Decision, it is not a party to the Basel Convention. Second, the Basel Convention introduces additional trade controls: (i) to prohibit trade of hazardous waste and other waste with non-parties,[21] and (ii) to prohibit the OECD, EU, and Liechtenstein from exporting hazardous wastes to other group of countries (known as the Ban Amendment).[22] Third, the PIC procedure is also slightly different between the Basel Convention and the OECD Decision. The Basel Convention sets a consideration period of 60 days requiring written consent from import, export and transit countries. In contrast, the OECD Decision has a shorter consideration period of 30 days requiring only tacit consent between export, import and transit countries (responses are only made if there are objections to the transboundary movement). Furthermore, the OECD Decision also offers the use of pre-consented facilities, which are recovery facilities that meet environmentally sound management requirements authorised by competent authorities, to expedite the transboundary movement with a target consent period of seven days.

3.1.3. Different status and controls affecting cross-border reverse supply chains

Understanding the requirements for the transboundary movement of waste and non-waste products is essential to establish cross-border reverse supply chains. As described above, the status of end-of-life products - waste or non-waste products, and whether they are controlled waste subject to international legal frameworks - shapes the landscape of cross-border reverse supply chains.

Securing a "non-waste" status can be important for cross-border reverse supply chains wherever applicable, so that second-hand goods, goods for repair, refurbishment and remanufacturing, and secondary raw materials can be preserved in reverse supply chains without being (mis-)classified as waste. Goods for repair, reuse, refurbishment or remanufacturing, and secondary raw materials, classified as "non-waste" are often subject to standard commercial controls and are not normally subject to additional trade controls. Exceptionally, a few countries impose import restrictions or bans on second-hand goods such as used vehicles and used textiles (Yamaguchi, 2021[8]; Preston, Lehne and Wellesley, 2019[29]); see Section 7.1 for further details on import and export restrictions.

Furthermore, distinguishing between "controlled waste" subject to PIC procedures from "non-controlled waste" is another important aspect to help establish reverse supply chains. In particular, when waste streams subject to PIC procedures are intentionally or unintentionally misclassified as non-hazardous waste or non-waste products, and do not follow notification procedures, they are identified as illegal waste trade (See Section 7.2 for a further discussion on illegal waste trade).

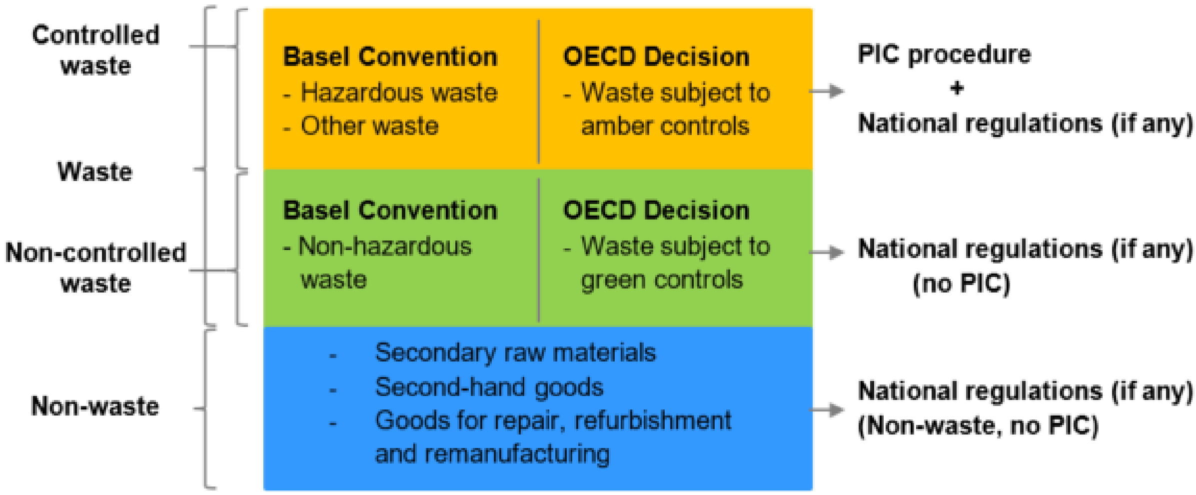
[20] See: OECD Decision, Chapter II. B. 4. As of December 2019, no Adherent to the OECD Decision has informed the OECD Secretariat that is has applied the provision on specific national controls.

[21] See: Basel Convention, Article 4.5.

[22] See: Basel Convention, Article 4A.

The status of different trade flows that constitute reverse value chains and their relationship with international legal frameworks and PIC procedures are compiled in Figure 2 below.

Figure 2. Rules for trade in waste and end-of-life products under international legal frameworks



Notes: Basel Convention – Basel Convention on the Control of Transboundary Movements of Hazardous Wastes and their Disposal.
OECD Decision – OECD Decision on the Control of Transboundary Movements of Wastes destined for Recovery Operations.
Waste entries under the Basel Convention and waste list under the OECD Decision are largely harmonised (see Annex C and Table A A.1 for detailed correspondences). Non-waste encompassing secondary raw materials, second-hand goods, and goods for repair, refurbishment and remanufacturing are not subject to international legal frameworks concerning waste (including PIC procedures) under the condition that they are not classified as waste subject to international and national controls. Under the OECD Decision, wastes subject to green control procedures are deemed to pose negligible risks for human health and the environment during their transboundary movement within the OECD area, and they are not controlled under the Decision.
Source: Author based on the Basel Convention, OECD Decision and (OECD, 2010[25]; 2009[27])

3.1.4. Trends and magnitude of cross-border reverse supply chains

A focus on actual trade flows is also essential to clarify the current status of reverse supply chains. Waste trade subject to PIC procedures under the Basel Convention follow an increasing trend, however only represent a fraction of overall trade in waste and scrap. Across the period of 2012 to 2018, the share of transboundary movements of waste under the Basel Convention (i.e. waste subject to PIC procedures) remained relatively low, however increased from 2% to 8% of global waste and scrap trade by weight (see Figure 3).[23] To note, the data stems from two different databases, where trade data reported under UN COMTRADE tends to be more complete than the national reports available from the Basel Convention. For this reason, the share of waste subject to PIC procedures under the Basel Convention in total waste trade presented in this current report may be underestimated and should be interpreted with caution. Nevertheless, this estimate shows that it is important not only to focus on the transboundary movement of waste subject to PIC procedures, but also to focus more broadly on waste and scrap and to understand the nature of these transboundary movements.

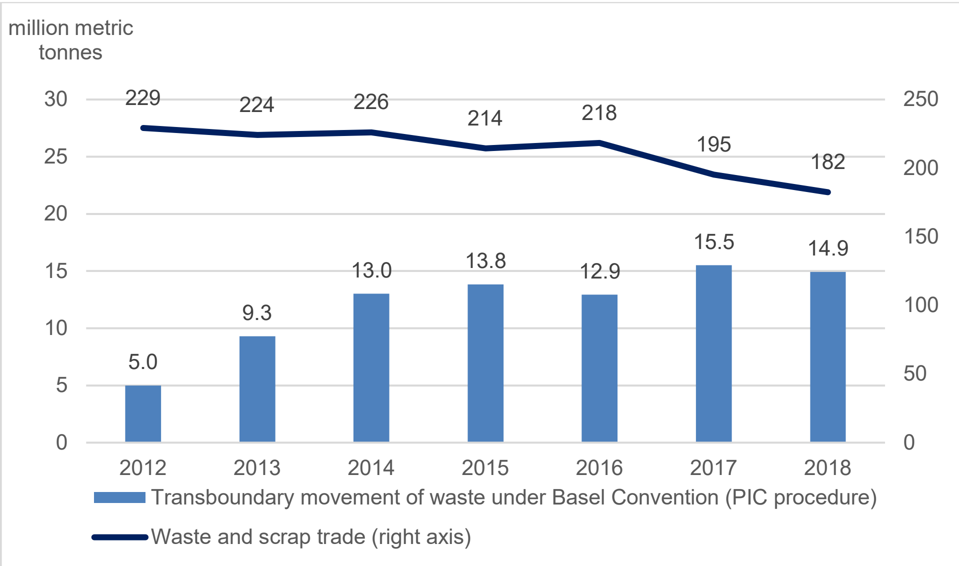
In addition, the magnitude of global trade in "non-waste" products such as second-hand goods, goods for repair, refurbishment and remanufacturing, and secondary raw materials also appears to be considerable, however, trade statistics are currently difficult to obtain. Global trade data on second-hand goods are currently only available for used textiles, and used and retreaded tyres. In 2018, global exports of used

[23] Further trends in waste and end-of-life products and implementation of PIC procedures are given in Annex C.

textiles reached 5 million metric tonnes worth USD 4.9 million, and used and retreaded tyres amounted to 1.1 million metric tonnes with a value of USD 2.3 million.[24]

Many other categories of goods for refurbishment and remanufacturing and second hand goods, such as used electronics, used vehicles, and heavy machinery are not distinguished in global trade statistics and only available at the national or regional level, if at all. In 2018, combined exports of used light weight passenger vehicles from the European Union, Japan and United States reached 3.9 million units according to UNEP (2020[30]). Distinguishing trade in used electric and electronic equipment (UEEE) is even more challenging with unclear boundaries between trade in waste electric and electronic equipment (WEEE) and limited data availability. In 2019, the Global E-waste Monitor estimated that transboundary movements of UEEE or WEEE is approximately 7-20 % of the e-waste generated globally (Forti, Baldé and Kueh, 2020[31]). In 2011, the United States exported around 7% of used electric products worth USD 1,439 million, where roughly one-third was for recycling, and two-thirds were for refurbishment (USITC, 2013[32]). Similarly, in 2013, a European Commission study estimated that the EU exported 15% of generated UEEE, mainly for reuse (BIO Intelligence Service, 2013[33]).

Figure 3. Trends of trade in waste and scrap



Note: Transboundary movement of waste data based on National Reports under the Basel Convention, and waste and scrap trade from customs data (UN COMTRADE). Both time series are based on export data.
Source: UNEP (2022[12]) and Garsous (2019[34]).

3.2. Potential issues and trade barriers in establishing cross-border reverse supply chains

Trade has an important role to play in establishing cross-border reverse supply chains for a resource efficient and circular economy. Therefore, trade barriers that work against reverse supply chains need to be identified and addressed. Trade considerations, including those for reverse supply chains, often start with a focus on the problems. Identifying trade impediments to the private sector in undertaking circular businesses across borders would be a logical point to start.

[24] UN COMTRADE trade data for used textiles (HS630900, HS631010, HS631090) and used and retreaded tyres (HS4012).

The private sector is expressing great interest in pursuing circular economy business models that can involve cross-border reverse logistics, such as the transboundary movement of end-of-life products. However, many businesses pursuing circular business models have raised concerns over difficulties in establishing reverse supply chains across borders (Bellmann, 2021[35]; OECD, 2021[36]; WEF, 2020[2]; 2020[37]). In particular, several issues and obstacles in shipping end-of-life products across borders for their circular use have been identified (Bellmann, 2021[35]; OECD, 2021[36]; WEF, 2020[2]; 2020[37]). Key issues converge in six main areas. These include: (i) procedural burden and delays, and associated costs in the cross-border transportation of end-of-life products; (ii) the nature of border controls by customs; (iii) a patchwork of different definitions and classification of end-of-life products between countries; (iv) trade restrictive measures including import and export restrictions; (v) illegal waste trade; and (vi) fragmentation of upstream eco-design initiatives. Each of them are further explored below.

First, some companies with interest to pursue circular business models have faced difficulties in establishing reverse supply chains due to procedural burden and delays, and associated costs in the cross-border transportation of end-of-life products. In particular, some industry representatives indicate that it has taken from 14 months to over 42 months to obtain consent for a waste shipment notification under the PIC procedure (OECD, 2020[1]; WEF, 2020[2]; EERA, 2019[3])(See Annex E for details). This is much longer compared to the standard procedures of one month under the OECD Decision or two months under the Basel Convention. Many argue that the process is too lengthy to satisfy business requirements and commercial operation cycles. Some studies indicate that reverse logistics for electronics can cost 31% more compared to conventional logistics for new products, and as much as 190% more for those with hazardous characteristics (WEF, 2020[2]). While the PIC procedures under the Basel Convention and the OECD Decision provides for a specific timeframe for the PIC procedures to be made,[25] it appears that the swift implementation of these PIC procedures needs to be checked and secured.

Second, the nature of border controls by customs also sets the boundaries on the establishment of cross-border reverse supply chains. A study by the World Customs Organization points to two fundamental roles of customs authorities in relation to waste and end-of-life products crossing borders (WCO, 2020[38]). The first role is to impose customs duties and compile trade statistics to all consignments by applying tariff schedules under trade classifications (i.e. the Harmonized System codes). The second role is to detect illegal waste shipments subject to PIC procedures and to facilitate legitimate trade. A critical aspect related to this first point is that the trade classifications (i.e. the Harmonized System codes) are typically based on the physical characteristics of goods that can be visibly checked or tested by customs at the point of import for the sake of objectivity and verifiability (WCO, 2020[38]). For this reason, standard custom procedures may be inappropriate to properly distinguish consignments destined for different treatment options, such as reuse, recycling, energy recovery, and final disposal, which have different environmental impacts (see also Annex F).[26] This begs the question how standard customs procedures could be supported by other available mechanisms (e.g. trade facilitation mechanisms, standards) to secure reverse supply chains.

Third, businesses often operate within a patchwork of diverging definitions and classifications of end-of-life products between countries, which creates a level of uncertainty for circular business transactions across borders. Many country-level divergences in definitions and classifications of end-of-life products

[25] Under the Basel Convention, the competent authorities have a time period of 60 days to either provide written consent or denial of a consignment under the PIC procedure. Under the OECD Decision, the time period for the PIC procedure is 30 days for the Competent Authorities to provide objections to the consignment (tacit consent), and 7 days for pre-consented facilities.

[26] Under the Basel Convention and the OECD Decision, this distinction is made by the designated Competent Authorities in each country (normally Environmental Protection Agencies). Other shipments under standard customs procedures are subject to national regulations and vary from country to country. It is important to discuss the role of other agencies present at the border, such as the environmental protection agencies, and the quality of cooperation between those agencies and customs.

appear to be between waste and non-waste products (e.g. for reuse, repair, refurbishment and remanufacturing) that would distinguish the extent of national regulations applied in addition to standard commercial controls, and hazardous and non-hazardous waste that would further distinguish those subject to international controls for their transboundary movement (Yamaguchi, 2021[8]; PACE, 2021[39]; WEF, 2020[2]; WEF, 2020[37]; WCO, 2020[38]; EU, 2020[40]; 2016[41]; Bellmann, 2021[35]). Furthermore, there is limited granularity of the trade classifications (i.e. the Harmonised System codes) in reflecting the different categories of downstream and secondary value chains, including waste and scrap, secondary raw materials, second-hand goods, and goods for refurbishment and remanufacturing (Yamaguchi, 2021[8]) (see Box 2). Annex G further describes the details of these trade impediments related to diverging definitions and classifications.

Box 2. The Harmonised System for a more resource efficient and circular economy?

The Harmonised Commodity Description and Coding System "Harmonized System" is an international nomenclature of trade flows of goods developed by the World Customs Organization (WCO). It covers over 5,000 commodity groups, each identified by a six digit code, to provide a uniform classification. The HS classification is used by over 200 countries and economies to structure their Customs tariffs and to gather international trade statistics. More than 98% of goods in international trade are classified according to the HS. The system is, in principle, revised and updated every five years (WCO, 2022[42]).

In 2022, the HS made updates to include new dedicated heading (HS8549) for electric and electronic waste and scrap suitable only for disposal or recovery operations, in order to give more visibility to these cross-border flows. Subheadings further cover waste containing primary cells, primary batteries, electric accumulators, mercury-switches, glass from cathode ray tubes or other activated glass, or electrical or electronic components containing cadmium, mercury, lead or polychlorinated biphenyls (PCBs) (WCO, 2022[43]).

Looking ahead towards 2027, the WCO is considering HS amendments to the definition of plastics waste in order to support the Basel Convention amendments on plastics waste in force since 2021 (WTO, 2022[44]).

Nevertheless, there are still remaining gaps to fill in the HS classification, to provide transparency and traceability for trade to work for a resource efficient and circular economy. First, current HS codes often include waste and scrap of a certain material as one subheading, and do not distinguish between waste, scrap and secondary raw materials. Second, the coverage of used goods and second-hand goods is only limited to a few categories of used tyres (HS401220) and used textiles (HS630900, HS631010, HS631090). Other significant categories such as used electric and electronic waste, and used vehicles, are not specifically classified under the HS. Third, goods for refurbishment and remanufacturing do not have dedicated HS codes, except for retreaded tyres (HS401211, HS401212, HS401213, HS401219). Further work is needed to narrow these gaps and provide more transparency and traceability for circular value chains.

Fourth, import and export restrictions on end-of-life products and materials can also hinder cross-border reverse supply chains (OECD, 2020[1]; WEF, 2020[37]). Some recycling industries claim that trade restrictions on end-of-life materials lead to excess supply and reduced prices of these materials in some countries, resulting in decreased returns for the recycling industry (OECD, 2020[1]). De Sa and Korinek (2021[45]) examined the status of metal waste and scrap and find that export restrictions appear to be more prevalent than import restrictions. Main forms of restrictions include export prohibitions, quotas, taxes, and non-automatic export licensing requirements. In 2014, 40% of copper, 30% of aluminium, and 20% of iron in globally traded waste and scrap, were subjected to at least one type of export restriction. Furthermore, representatives of the remanufacturing industry also claim that trade restrictions imposed on remanufactured goods and core components have hindered circular business models, providing examples from Brazil and China (OECD, 2020[1]). Some countries impose import restrictions on certain waste and scrap, such as those by China since 2018 followed by similar practices in neighbouring economies (Yamaguchi, 2021[8]). Some other countries apply import restrictions and bans on certain second-hand goods to avoid lock-in into sub-standard technologies (e.g. old and inefficient second-hand vehicles), and to protect the environment as well as the domestic industry (e.g. from excessive in-flows of used textiles) (Yamaguchi, 2021[8]). While these restrictions are in place for various – and sometimes valid – reasons, such as increasing domestic supply of particular materials or ensuring environmental protection, they can potentially work against establishing reverse logistics across borders.

Fifth, illegal waste trade can undermine legitimate fractions of trade. It can put pressure on customs and competent authorities for proper law enforcement at the border, distort a level-playing field for circular economy business models, and pose a serious threat to human health and the environment. While the magnitude of illegal waste trade is difficult to determine due to its hidden nature, some studies estimate that illegal trafficking and dumping of toxic and electronic waste reached USD 10–12 billion annually in 2016 (Nellemann et al., 2018[46]). They often occur through mislabelled consignments or fraudulent documents, including: (i) waste falsely declared for recycling, recovery, or reuse; (ii) waste mis-declared as raw materials; (iii) concealed contaminated waste exceeding standards, (iv) mis-declaration of waste supporting tax evasion, and (v) mis-declaration of final destination using a transit country or free trade zone (OECD, 2020[1]; INTERPOL, 2020[47]).[27] Illegal waste trade can distort competition in the recycling industry, lead to increased controls for the transboundary movement of waste and end-of-life products, and ultimately undermine legitimate efforts to establish cross-border reverse supply chains (Yamaguchi, 2021[8]; OECD, 2020[1]). A better clarification and alignment on the definitions and classifications of end-of-life products, between controlled waste, non-controlled waste and non-waste products, would also facilitate legitimate trade for reverse supply chain trade flows, while tackling illegal trade at the same time. (See also Annex B for the prevalence of illegal waste trade, and Annex G for issues related to definitions and classifications).

Sixth, many of the challenges in establishing reverse supply chains can be traced back to upstream aspects of the product life cycle, such as eco-design. For products to be better utilised at their end-of-life through recycling, they need to be designed for easy dismantling and to be free of hazardous substances to the extent possible (OECD, 2016[48]). Furthermore, promoting eco-design and preventing planned obsolesce for products placed on the market appear to be crucial elements in ensuring that trade in second-hand goods is aligned with resource efficiency and circular economy objectives (OECD, 2020[1]).

These issues highlight the potential challenges to establish cross-border reverse supply chains for a resource efficient and circular economy. While trade is necessary to channel end-of-life products and secure the commercial scalability of recovery operations, restrictions, ambiguities, and delays in these processes can create mismatches between business requirements and policy interventions, posing challenges to cross-border reverse supply chains.

With the view to support ways to overcome some of these issues and challenges, the following sections focus on the role of trade facilitation mechanisms (Section 4) in addressing the first and second challenge related to procedural burden and nature of custom controls, and the role of standards (Section 5) in addressing the third challenge related to definitions and classifications. Furthermore, additional policy measures (Section 7) are also explored in relation to trade restrictions, illegal waste trade, and eco-design.

[27] The share or scale of each *modus operandi* is extremely difficult to determine, as this is not always clear or specified when illegal waste shipments are identified or seized at the border. A study by Huissman et al. (2015[21]) estimates that among the undocumented exports of end-of-life electronics that are shipped from the EU, 70% are shipped as used electrical and electronic equipment (UEEE) and 30% as waste electrical and electronic equipment (WEEE), both of which are potentially subject to different legal interpretations (may or may not be illegal, since estimated).

4. Trade facilitation mechanisms to help establish cross-border reverse supply chains

Trade facilitation mechanisms can potentially contribute to establishing reverse supply chains by helping to ensure transparent, predictable and straightforward border procedures that facilitate the cross-border movement of goods. While border procedures are generally required to be fair, uniform and neutral regardless of the type of products involved, there are several examples where trade can be facilitated on the basis of trusted traders and digital solutions.

Building on the discussion in Section 3, two particular areas of trade facilitation appear to offer possible avenues to help establish reverse supply chains, namely: (i) Authorized Economic Operators; and (ii) single window mechanisms and electronic data solutions. Each of these areas are explored below.

4.1. Authorized Economic Operators

The use of the Authorized Economic Operator (AEO) concept to help secure reverse logistics of end-of-life products has been proposed by several studies and organisations (EERA, 2021[49]; WCO, 2020[38]; 2019[50]; EU, 2016[41]; OECD, 2010[25]). This sub-section investigates the AEO concept and identifies how AEOs can potentially help establish reverse logistics, as well as challenges and knowledge gaps for its potential application.

4.1.1. Definitions and concepts

The AEO concept introduced by the World Customs Organization (WCO) aims to share supply chain security responsibilities between customs and reliable businesses by shifting controls from the border to on-site establishments of importing and exporting companies (WCO, 2021[51]).[28] Under an AEO programme, companies with AEO status are considered as "trusted traders" and entitled to special treatment for simplified and expedited customs procedures (WCO, 2021[51]).[29] Custom administrations have the authority to grant AEO status to reliable manufacturers, importers, exporters, and carriers (WCO, 2021[51]). The eligibility criteria for an AEO include: (i) demonstrated compliance record; (ii) satisfactory management system of commercial records; (iii) financial viability; and (iv) established security levels (WCO, 2018[52]). In addition to faster clearance of low-risk shipments, AEOs can enjoy other benefits including: improved security levels, optimised supply chain costs, enhanced reputation and increased business opportunities (WCO, 2018[52]).

The Authorized Operators (AOs) under the WTO Trade Facilitation Agreement (TFA), which is in force since 2017, [30] serves similar purposes. The difference between the two mainly stems from the fact that AEOs must meet security management requirements as a prerequisite, whereas AOs are more flexible

[28] The AEO concept was adopted in 2005 mainly in response to the 9/11 terrorist attacks, when strengthening security controls within Customs, while also ensuring the continuation of legitimate trade transactions became paramount (WCO, 2009[101]).

[29] The AEO programme is based on the WCO's SAFE Framework of Standards (WCO, 2021[51]).

[30] WTO TFA Article 7.7. Trade Facilitation Measures for Authorized Operators.

and may include supply chain security as one of the criteria among others such as appropriate compliance records, document control, and financial solvency (WCO, 2018[52]). Fulfilling an AEO programme is generally considered to satisfy provisions of Authorized Operators under the WTO TFA, as AEO programmes sets forth more stringent requirements (WCO, 2018[52]).

4.1.2. Opportunities and challenges in applying the Authorized Economic Operator concept to help establish reverse logistics

The specific application of AEO concepts to promote reverse logistics is still at a very early stage (WCO, 2019[50]). So far, some exporters of non-controlled waste (e.g. non-hazardous recyclable materials) are already registered with AEO status and benefit from preferential treatment in the trading process under existing AEO programmes (OECD, 2010[53]). In addition, several ideas to further utilise AEO programmes to promote reverse logistics have been shared in the context of considering waste trade to promote a circular economy (EERA, 2021[49]; WCO, 2020[38]; WCO, 2019[50]; EU, 2016[41]; OECD, 2010[25]).

First, AEO programmes could enhance trade between trusted importers and exporters of waste for recovery. A potential benefit of an AEO programme is to shift the point of control of shipments from the border to companies (OECD, 2010[25]). Pre-authorisation of competent recycling facilities could also speed up and improve border controls (OECD, 2010[25]). This would also free up resources of customs to focus on controlling illegal waste trade (WCO, 2020[38]).

Second, the AEO concept could be useful to better indicate legitimate fractions of waste trade and secure the quality of recycling facilities at destination (WCO, 2020[38]; EU, 2016[41]). The creation of dedicated AEO programmes for competent recovery facilities could assist customs to be confident about the environmentally sound management of waste at destination (EU, 2016[41]). It could also help facilitate trade and promote recycling without lowering environmental standards (OECD, 2010[25]) and promote cross border co-operation towards better controls of transboundary movement of waste (WCO, 2019[50]).

Third, the application of AEOs in reverse supply chains could complement the idea of establishing "fast tracks" and "green lanes" to enable the transboundary movement of waste to enable cross-border reverse logistics, as proposed by industry (EERA, 2021[49]; WCO, 2020[38]). The feasibility of such schemes could be tested through pilot projects (OECD, 2010[25]).

Fourth, the AEO concept, if applied to securing reverse logistics, would be closely related to prior informed consent procedures and pre-consented facilities under the OECD Decision (EERA, 2021[49]; OECD, 2010[25]). The similarities and differences between these schemes are further explored in Box 3 below.

Box 3. Similarities and differences between Authorised Economic Operators and pre-consented facilities under the OECD Decision on Transboundary Movements of Wastes

There are similarities between the concepts of Authorised Economic Operators (AEO) and pre-consented facilities under the OECD Decision on Transboundary Movements of Waste. Both systems work on a basis to promote legitimate fractions of trade, while ensuring necessary controls on unwanted fractions. They aim to simplify and accelerate border procedures or notification procedures by partially shifting controls to on-site certification processes for better security and risk management.

The AEO concept introduced by the WCO, aims to facilitate trade while ensuring the security of international logistics (WCO, 2021[51]). This is achieved through a mechanism whereby Custom authorities certify businesses that have established systems for cargo security management and legal compliance, and in return simplifies and expedites customs procedures (e.g. pre-authorisation of shipments, reduced frequency of inspections).

Pre-consented facilities under the OECD Decision are designated by competent authorities to simplify and accelerate the notification procedure of transboundary movements of waste for recovery (OECD, 2009[27]). These facilities benefit from expedited notification procedures of seven days, tacit consent to a shipment by competent authorities, and an extended validity of the consent period of three years compared to a standard of one year under the Decision. These specific provisions are granted to facilities based on their ability to undertake environmentally sound management of waste, and the type of waste they can recover (OECD, 2009[27]; OECD, 2007[17]).

While AEOs and pre-consented facilities are similar in these aspects, there are also notable differences in terms of scope, number of entities, and authorisation processes. Regarding the scope, pre-consented facilities under the OECD Decision are specific to handling hazardous waste and other waste that are subject to PIC procedures, and generally applied within its membership. In contrast, the AEO can cover a wide-range of commodities, and it can be applied by WCO members. In terms of the number of entities, there are 454 pre-consented facilities in 24 OECD countries and 3 non-OECD countries as of January 2022 (OECD, 2022[54]). In turn, 97 operational AEO programmes exist worldwide as of 2020 (WCO, 2020[55]). Finally, concerning the authorisation process, pre-consented facilities are designated by competent authorities, usually a national or sub-national environmental protection agency. The pre-consent status is granted based on the capacity and environmental performance of the facility, and the type of waste it recovers. The criteria applied usually depends on each jurisdiction (EU, 2016[41]). AEO status is authorised by custom agencies and is based on the performance and security management levels of each entity. Table 1 summarises these similarities and differences.

Table 1. Summary of similarities and differences between Authorised Economic Operators and pre-consented facilities under the OECD Decision

	Pre-consented facilities	AEO
Function and controls	Promote legitimate fractions of trade and ensure controls for illegal fractions of trade	
	Simplify and accelerate notification procedures by shifting controls to on-site certification	Simplify and accelerate border procedures by shifting controls to on-site certification
Benefits	Simplified and accelerated waste shipment notifications, such as: - tacit and expedited consent (7 days) - extended validity of consent period (3 years)	Simplified and accelerated customs procedures, such as: - pre-shipment authorisation - reduced frequency of inspections
Commodity	Hazardous and other waste subject to prior informed consent procedure	All commodities (economy-wide)
Applicants	Recovery facilities	Producers, exporters, importers, transporters etc.
Membership	OECD member countries	WCO member countries
Number of schemes	24 OECD countries and 3 non-OECD countries (454 pre-consented facilities) as of Jan. 2022	97 AEO programmes as of 2020
Authorising body	Competent authorities (e.g. national or sub-national environmental protection agencies)	Custom agencies
Authorisation criteria *	Capacity and performance to undertake environmentally sound management of waste	Established systems for cargo security management and legal compliance
	Type of waste for recovery	

Source: Author based on (WCO, 2021[51]; 2020[38]; 2020[55]), (OECD, 2022[54]; 2009[27]).

Note:* The authorisation criteria for pre-consented facilities can vary between jurisdictions.

Notwithstanding the potential of AEO programmes to support reverse logistics, a number of limitations also emerge.

First, an obvious limitation is that the customised application of AEO programmes referring to a specific set of environmental criteria to promote reverse logistics is still in a very nascent stage (WCO, 2019[50]). There are very few real-life examples to draw upon (Garcia, 2020[56]).

Second, the relevance of AEO programmes to secure the environmental sound management of waste at destination is unclear (OECD, 2010[25]). In particular, while enhanced security is the main concept of AEO programmes, extending the AEO criteria into environmental aspects is at a very nascent stage, if not considered at all (WCO, 2020[38]; 2020[57]; Garcia, 2020[56]).

Third, AEOs need to conform, at a minimum, with requirements set forth under various international rules (WCO, 2021[51]; EU, 2020[58]). If the AEO concept were extended to cover environmental and circular economy related criteria, including for the transboundary movement of waste and recycling facilities, it would need to be compatible with the Basel Convention and the OECD Decision.[31] In particular, while the AEO status is granted to an entity based on its performance records and security management, the designation of pre-consented facilities is based on a broader set of conditions, as it would not only depend on the performance of the recovery facility, but also on the type of waste traded.

Taking these issues into consideration, the possible application of AEO concepts to help establish reverse logistics, potentially appear not as a replacement but rather as a complementary role to preceding instruments available at the international level, namely the Basel Convention and the OECD Decision.

Regarding controlled waste under international legal frameworks, one possibility is to utilise the experience of AEO programmes for better implementation of pre-consented facilities under the OECD Decision. Industry representatives have reported that the pre-consent status of the recovery facility at destination sometimes makes no effective difference in expediting actual shipments. This is partly because of the lack of compliance with tacit consent procedures (i.e. ability to undertake shipments if objections are not registered by the competent authorities of import, export and transit within a timeframe of seven days) and different criteria used in different jurisdictions to grant pre-consent status to recovery facilities (EERA, 2019[3]; EU, 2016[41]). While the AEO programme is organised by custom authorities, the pre-consent and PIC procedures are overseen by competent authorities (e.g. environmental protection agencies), and there could be scope to enhance mutual learning and identify best practices from both experiences. More work is needed to reveal the actual implementation of PIC procedures in this area.

Concerning waste that are not subject to controls under international legal frameworks (i.e. non-controlled waste) as well as non-waste products, another possibility is to utilise AEO programmes to facilitate trade in used products and end-of-life products for reuse, repair, refurbishment, remanufacturing or recycling. While reported delays in shipment procedures are largely limited to controlled waste, facilitating legitimate trade in non-hazardous waste, secondary raw materials and second-hand goods, and distinguishing them from illegal waste trade is equally important. This is particularly relevant as illegal waste trade often occurs as mislabelled fractions under these categories (e.g. non-waste, non-controlled waste) (Waste Force, 2020[59]; 2020[60]; INTERPOL, 2020[47]; Huisman et al., 2015[21]). The application of AEO schemes for trade in non-controlled waste and non-waste products that are often subject to standard custom procedures may help trade in legitimate fractions and preserve cross-border reverse supply chains (OECD, 2010[53]). Utilising the AEO concept to ensure legitimate fraction of trade while ensuring controls for illegal waste trade could be a possible contribution to secure cross-border reverse supply chains.

Finally, shippers and traders in waste and non-waste may not necessarily need to apply to an AEO programme the way they are currently designed. In some advanced AEO programmes, there are separate schemes designed for different types of operators, such as importers, exporters, custom brokers, and

[31] To be clear, Article 11 under the Basel Convention, confers for Parties to enter into bilateral, multilateral, or regional agreements with Parties or non-Parties provided that such agreements do not derogate from the environmentally sound management of wastes under the Convention. Notable agreements include the OECD Decision and those between Canada, Mexico, and the United States. While Article 11 provides potential opportunities for a “fast-track” system embracing the AEO concept, some stakeholders have raised potential concerns over the compatibility with international rules (EU, 2020[58]).

manufacturers, with different conditions and privileges.[32] Such flexibility may offer the opportunity to promote a new AEO scheme designed specifically to work with trade in waste and non-waste. Such considerations are still at a very nascent stage, if any, and are subject to further analysis.

4.2. Single window mechanisms and electronic systems

Single window programmes and electronic data interchange systems are core elements of trade facilitation mechanisms that can potentially contribute to establishing reverse supply chains.

4.2.1. Definitions and concepts

A single window approach allows individuals and businesses to access government services through a single interface. It is often applied in certain parts of the government, such as local authorities providing public services under a "one-stop-shop". The aim of this reform is to minimise inconvenience and meet the needs of citizens through a single service delivery point.

The same concept can be applied to the regulatory procedures for cross-border trade in goods and services.[33] In this context, a single window concept would "allow parties involved in trade and transport to lodge standardised information and documents with a single entry point to fulfil all import, export, and transit-related regulatory requirements" (UN/CEFACT, 2005[61]). The aim is to consolidate the set of customs procedures under a single window. Its application would help promote better co-ordination between cross-border regulatory agencies, improve efficiency of regulatory procedures and required documentation, and ultimately simplify cross-border trade procedures (WCO, 2017[62]). Although not explicitly stated, these requirements for a single entry point strongly encourage the use of electronic systems (WCO, 2017[62]).

The term "single window" has received increased attention in the area of trade, particularly in the context of the WTO Trade Facilitation Agreement (TFA).[34] The WTO TFA defines single windows as a platform for single-entry and non-duplicative submission of trade documentation, ideally supported by information technology (OECD, 2018[63]). In particular, the WTO TFA, Article 10(4) states that: "Members shall endeavour to establish or maintain a single window, enabling traders to submit documentation and/or data requirements for importation, exportation, or transit of goods through a single entry point to the participating authorities or agencies. […] In cases where documentation and/or data requirements have already been received through the single window, the same documentation and/or data requirements shall not be requested by participating authorities or agencies except in urgent circumstances and other limited exceptions which are made public. […] Members shall, to the extent possible and practicable, use information technology to support the single window."

The single window concept can be applied at the national level, or extend beyond borders for international collaboration (WCO, 2017[62]). A national single window concept would involve co-ordination between customs and other government agencies to streamline regulatory processes within a country. An international single window could involve multiple countries, such as those sharing borders or expressing common interests to facilitate trade procedures. This can particularly be the case when a permit, licence or certificate issued in one country needs to be used in another country, whether at the point of export,

[32] For example, the AEO programme in Japan provides for separate AEO schemes tailored to different economic operators including importers, exporters, warehouse operators, logistical operators, custom brokers, and manufacturers, with specific benefits according to each type of AEO (Ministry of Finance, Japan, 2018[104])

[33] The single window concept can encompass various trade relationships, between business operators and cross-border regulation, or business-to-business transactions regarding trade and transport. This report focuses on the prior business-to-government transaction and related aspects of a cross-border regulatory single window (WCO, 2017[62]).

[34] See WTO Trade Facilitation Agreement: https://www.wto.org/english/tratop_e/tradfa_e/tradfa_e.htm.

transit or import (see also Box 4 for the relevance of regulatory co-operation between cross-border regulatory agencies).

Box 4. How is regulatory co-operation between cross-border regulatory agencies important?

Cross-border regulatory agencies (as specified by the World Customs Organization) can encompass multiple government bodies that are involved in cross-border regulation of international trade. These can include customs as well as related agencies responsible for respective areas of competence at the border in managing goods that affect public security, human health, and environmental protection. These agencies for example involve plant and animal quarantine agencies, sanitary and phytosanitary inspection agencies, food safety agencies, border police and transport departments (WCO, 2017[62]).

These cross-border regulatory agencies have a legitimate right to stop and inspect goods crossing the border within their respective capacity. The lack of information sharing between these agencies has created an inconvenient situation for traders, who may have to provide the same information to different government agencies. As a result, multiple inspections can be conducted by different agencies at various points in time. The assessment of the risk profile is usually based on internal information specific to each agency. For these reasons, regulatory co-operation and information sharing within and across governments is essential to promote legitimate trade (WCO, 2017[62]).

4.2.2. Opportunities and challenges in applying the single window concept and electronic solutions to help establish reverse logistics

From an environmental perspective, single windows are relevant to streamline regulatory procedures amongst border agencies to implement prohibitions and restrictions for goods that are of potential concern for the environment (WCO, 2017[62]). For this reason, their possible application may focus on areas that are subject to regulatory controls, more so for controlled waste, rather than non-controlled waste or non-waste, in the context of reverse supply chains. Regulatory co-ordination may be essential where the advance submission of information and pre-approval is required before a shipment is made, and where a shipment needs to be accompanied by specific documentation (so-called movement documents), as in the case of prior informed consent (PIC) procedures under the Basel Convention and the OECD Decision on the transboundary movements of waste.

Single window mechanisms and electronic systems are yet to be fully utilised for co-ordinated border management to help establish reverse logistics for a circular economy. Its possible use is raised in the literature, in particular, to enhance cross-border co-operation and information sharing to implement effective control regimes for hazardous waste, and to potentially streamline and simplify prior informed consent procedures under the Basel Convention and the OECD Decision on Transboundary Movements of Waste (WCO, 2020[38]; 2019[50]).

National cross-border regulatory single window systems and related electronic systems may offer a starting point. According to the World Customs Organization, the majority of customs administrations process more than 90% of their import and export declarations electronically, and more than half of them have some kind of national single window systems in place (WCO, 2020[38]).[35] Should these electronic declarations and national single window systems extend to notified waste shipments under prior informed consent procedures, allowing systematic electronic information exchange between custom authorities and competent authorities (e.g. environment protection agencies), it could significantly contribute to improved

[35] The information is based on the WCO Annual Report 2019-2020. To be clear, the 90% coverage of electronic systems is limited to customs administrations. It does not mean that they are always shared between border agencies, and there are likely gains for expanding national electronic system in place.

efficiency and effectiveness of waste controls at the border (WCO, 2020[38]). In particular, if waste shipment notification documents and movement documents are made available to customs in electronic form, this is expected to reinforce risk management as well as better understanding of legitimate fractions of waste trade, and potentially improve trade statistics in this area (WCO, 2020[38]).

National single windows and related electronic systems that are generally co-ordinated by custom authorities could tap into existing and on-going initiatives on electronic data interchange that are administered by competent authorities (e.g. environmental protection agencies) to facilitate prior informed consent procedures (see Box 5 for details).

Box 5. National and international co-ordination of electronic systems for waste shipments

In parallel with the development of single windows and related electronic systems to co-ordinate trade and customs data on imports and exports, separate efforts are being made to develop dedicated electronic systems to better manage information on waste shipments under prior informed consent procedures.

Some proposals include: (i) electronic exchange of documents and acceptance of electronic signatures for pre-consents and notification requests; (ii) electronic forms of movement documents; and (iii) electronic exchange of transport planning, receipt and treatment confirmations between parties (Digital Europe, 2019[64]; EERA, 2019[3]; 2019[65]). In addition, centralising information and co-ordinating activities of competent authorities in one unit have been indicated as good practices if multiple competent authorities (e.g. at the subnational level) are active in one country (EERA, 2019[3]).

National electronic data interchange of waste shipment information is already reported to be available, for example in Finland, France, Germany, Portugal, Slovakia, and the United Kingdom (UNEP, 2020[66]; EERA, 2019[3]).

Furthermore, international co-ordination of electronic notification systems is also being proposed at the multilateral and supra-national level and already available in some regions, notably North America and certain parts of Europe, to streamline data requirements for waste shipment notification procedures.

Since 2016, the Basel Convention has been investigating the potential application of electronic approaches for the notification and movement documents (UNEP, 2016[67]). More recently in 2020-21, it reviewed the experiences available at the national and international level in establishing electronic systems for waste shipment notification and movement documents (UNEP, 2020[66]), and conducted consultations with stakeholders to explore possible options for its application (UNEP, 2021[68]).

At the regional level, there are a number of electronic waste-shipment notification systems already in place, in particular in North America and certain parts of Europe. Between the US, Canada and Mexico, there is an interoperable electronic system called the North American Notice and Consent Electronic Data Exchange (NCEDE), which allows effective and efficient processing of notifications and consent procedures of waste shipments between these three countries. The system is in place since 2012 and hosted under the Commission for Environmental Cooperation (CEC) (UNEP, 2021[68]; 2020[66]; CEC, 2021[69]).

Concerning Europe, the European Data Interchange for Waste Notification System (EUDIN), aims to support the interoperability of various electronic data systems used in different countries (UNEP, 2020[66]). While the system facilitates the seamless exchange of information between the Competent Authorities, the interface with industry remains through conventional applications to respective Competent Authorities. The initiative has been joined by Austria, Belgium, Luxembourg, Switzerland, Germany, Netherlands, Slovenia, Finland and Sweden. Since 2017, EUDIN is used between Austria and Switzerland to connect e-government services between these two countries for the electronic data interchange and management for the transboundary movement of waste.[36] In addition, the Nordic TFS (trans-frontier shipments of waste) has been in place between Finland and Sweden to enable the electronic interchange of information and data concerning the notification and tracking of waste shipments. The system was used by exporters and importers of waste, and also manages digital applications of notification and movement documents. Although deemed successful, the Nordic TFS was reported to be replaced by national schemes in 2021. More recently, the European Commission includes a possible development of an EU-wide electronic data interchange as a part of its proposed Waste Shipment Regulation amendments in November 2021 (EU, 2021[70]).

Regarding non-controlled waste and non-waste, single windows and electronic systems can also help facilitate trade in these categories that are often subject to standard commercial controls. A particular area of concern is how to better distinguish legitimate trade in second-hand goods from illegal waste trade. Focussing on e-waste, the Basel Convention has adopted, on an interim basis, technical guidelines on the distinction between waste and non-waste (UNEP, 2019[71]).[37] While these guidelines reaffirm that the rules for distinguishing waste and non-waste remain under the responsibility of national authorities, it recommends that used goods that are subject to direct reuse or extended use should be accompanied by supplementary documentation of testing results (or documentation on the purpose of the shipment if it is destined for repair, refurbishment or failure analysis). Should these additional documents be accessible through electronic data interchange systems and linked to single window mechanisms or electronic systems managed by custom authorities, this would increase the efficiency of such shipments by legitimate traders, while reinforcing the ability to detect mislabelled illegal shipments at the border.[38]

While the single window concept and electronic solutions may help establish reverse logistics, its potential application comes with several challenges.

First, the OECD (2018[63]) trade facilitation report indicates that although single window systems are expected to bring significant benefits to trade, including predictable clearance procedures, productivity gains, better risk management and cross-border co-operation, their implementation remains an area with least progress made across the provisions of the Trade Facilitation Agreement (TFA). The anticipated reason for this limitation is the need for synchronised and co-ordinated border agency processes as a prerequisite for an operational single window. Furthermore, aligning border procedures and data requirements with partner countries, and enabling electronic cross-border exchange of data, are also seen as challenges.[39]

Second, another main challenge in applying single windows and electronic data interchange to reverse logistics appears to be the significant time and resources required to establish such electronic systems. The OECD (2018[63]) report indicates that the majority of single window systems run on government financing, while self-funding through service fees is also used. In a similar vein, electronic systems currently

[36] See: https://eudin.org/.

[37] The technical guidelines on “transboundary movements of electrical and electronic waste and used electrical and electronic equipment, in particular regarding the distinction between waste and non-waste under the Basel Convention” are adopted on an interim basis. Some countries have asserted that these guidelines still fall short in closing potential loopholes for goods claimed as repairable (e-Stewards, 2022[106]), and some stakeholders have suggested alternative proposals (BAN, 2019[107]).

[38] Single windows aim to streamline border procedures such as through one access point for necessary documents accompanying consignments, and it does not necessarily reduce the engagement of different border authorities. There is no evidence to suggest that single window influences fraud.

[39] National systems can play a role if national level co-ordination is deemed important. This is especially the case when decisions require cross-border regulatory co-operation, as in the case of PIC procedures that involve both customs as well as competent authorities, such as environmental protection agencies.

in place for waste shipment procedures also appear to be mixed, some organised through government funds, and others through the application of fees (UNEP, 2020[66]; 2016[67]). A clear mandate in establishing these schemes appear to be critical for their successful introduction and implementation.

Notwithstanding these limitations, there are several global examples that can be exploited in two ways, namely by establishing dedicated international data interchange systems for reverse logistics, and by connecting such efforts with single windows and related electronic systems managed by trade and custom authorities.

First, regarding the development of dedicated international data interchange systems for reverse logistics, perhaps the most relevant example is the electronic approach to monitor movement of environmentally sensitive goods by the Convention on International Trade in Endangered Species (CITES), which introduced an electronic system to process permits in 2010, and made relevant updates in 2013. Furthermore, work is underway to develop a system to facilitate electronic exchange and verification of CITES permit data among cross-border regulatory agencies. In addition, the experience of the Electronic Phytosanitary Certification (ePhyto) managed by the International Plant Protection Convention (IPPC) can further inform the development of certificates that can be exchanged electronically between countries. These systems are regarded as successful examples in establishing centralised systems for electronic exchange of information, and generating substantial saving over the years.

Second, countries that have interest in establishing linkages between their single windows mechanisms and electronic data interchange systems regarding reverse logistics, may wish to take account of UN/CEFACT standards for information exchange, that aims to harmonise and simplify information flows in order to benefit both commercial and governmental international transactions (UNEP, 2016[67]). It is also crucial to refer to the WCO Customs Data Model, which establishes a standard on international and harmonised data set requirements that form the basis for automated Custom procedures (UNEP, 2016[67]). Such initiatives would ultimately help custom authorities collect better data and information about the legitimacy of waste and non-waste shipments.

In addition to trade facilitation mechanisms, standards may also play a role in help establishing reverse logistics for a circular economy. Trade facilitation mechanisms also rely on common standards for their effective implementation. The potential role of standards are explored in the next section.

5. Standards to help establish cross-border reverse supply chains

Standards can be used to support public policy objectives and be referenced in technical regulations at the national level. The ISO defines them as a "formalized set of harmonized, consistent and acknowledged or established requirements applied to manufacturing processes, products, services and procedures" (ISO, 2020[72]). Standards are voluntary until they are referenced in regulation.[40]

Standards can play a key role in promoting reverse supply chains for a resource efficient and circular economy. They can form the basis of circular economy policies, such as eco-design, eco-labelling, green public procurement, and introducing differentiated fees for extended producer responsibility schemes (Yamaguchi, 2021[8]). They can also serve as a reference on how used products and materials can be reutilised within the economy and the role that trade can play in this process. This section particularly explores two areas of high stakes, which are (i) standards on recovery facilities,[41] and (ii) quality standards on end-of-life products and materials. The latter are standards on the goods themselves, rather than on the recovery facilities to which they are destined.

5.1. Standards on recovery facilities

A critical point in establishing reverse logistics is ensuring that the recipient facility can manage and recover waste in an environmentally sound manner. Standards on recovery facilities can play a key role in this endeavour, as they set out the necessary requirements for environmental capacity and performance. This section looks into the current state of play as well as opportunities and challenges in using standards on recovery facilities to help establish reverse logistics for a circular economy.

5.1.1. State of play

Competent authorities (e.g. environmental protection agencies) usually regulate recovery facilities, as their management and performance have a significant impact on the environment. To guide these efforts, the OECD Council Recommendation on the Environmentally Sound Management (ESM) of Waste sets forth six criteria of "Core Performance Elements" for waste management facilities (OECD, 2007[17]; 2004[73]):

[40] The WTO Technical Barriers to Trade (TBT) Agreement, defines a standard as a "Document approved by a recognized body, that provides, for common and repeated use, rules, guidelines or characteristics for products or related processes and production methods, with which compliance is not mandatory. It may also include or deal exclusively with terminology, symbols, packaging, marking or labelling requirements as they apply to a product, process or production method". See: https://www.wto.org/english/docs_e/legal_e/17-tbt_e.htm.

Standards can be built into policies in two different ways, namely: (i) mandatory references, and (ii) open references (OECD, 2020[1]). Mandatory references are often used to set forth mandatory requirements such as on air quality. However, in some cases, they may not offer the necessary flexibility for compliance. Open reference allows policies to provide clarity for economic operators by referring to standards with the presumption of conformity. In this case, standards would be one way to comply with regulations, but this leaves the possibility for economic operators to demonstrate other ways of complying, if necessary.

[41] A recovery facility is a facility which, under applicable domestic law, is operating or is authorised or permitted to operate in the country of import to receive wastes and to perform recovery operations on them (OECD, 2009[27]). It can include recycling, reclamation, or regeneration of waste into secondary materials and substances.

- The Facility should have an Applicable Environmental Management System (EMS) in Place
- The Facility should take Sufficient Measures to Safeguard Occupational and Environmental Health and Safety
- The Facility should have an Adequate Monitoring, Recording and Reporting Programme
- The Facility should have an Appropriate and Adequate Training Programme for the Personnel
- The Facility should have an Adequate Emergency Plan
- The Facility should have an Adequate Plan for Closure and After-Care

In line with these guiding principles, competent authorities typically refer to environmental management standards, such as ISO 14000 standards or the Eco-Management and Audit Scheme (EMAS) in the context of the EU. These standards are industry-wide and are not specific to recovery facilities. However, they are frequently part of the criteria used to determine whether a recovery facility is managing its waste in an environmentally sound manner (RPA, 2012[74]).

There are several additional standards used by the industry to set forth quality and performance standards for recovery facilities. In the United States, two standards are frequently referred to, namely R2 Standards and E-Stewards. In the EU, standards to ensure the quality of recovery facilities include the EUCertPlast, WEEELABEX, CENELEC standards, and CEWASTE. The governments of Australia and New Zealand have also jointly created a management standard of e-waste activities. These standards for recovery facilities, depending on their set-up, can be considered as technical standards specifying the technical properties of the recovery processes, or management standards on the organisation of specific procedures, or a combination of the two. Furthermore, some standards are used in combination with third party certification systems. These initiatives are compiled in Table 2 below.

Table 2. Available standards on recovery operations and facilities[42]

Standard	Description	Issued by	Year
R2 Standard	Voluntary certification of e-waste recycling facilities to ensure their quality, transparency, and environmental and social responsibility.	US	Updated in 2013
e-Stewards	Voluntary certification scheme with a set of performance requirements created specifically for electronics recycling.	US	Since 2009 Updated in 2020
EuCertPlast	Voluntary certification standard for plastics recycling and reprocessing facilities to standardise and encourage environmentally-friendly plastics recycling processes.	EU	Since 2009
WEEE label of Excellence (WEEELABEX)	Voluntary standard for operators related to the collection, handling, storage, recycling, preparation for re-use and disposal of e-waste.[43]	EU	Since 2011
AS/NZS 5377	Voluntary management system standard developed to provide a uniform approach management of e-waste activities, mostly around safety and environmental concerns.	AU-NZ	Since 2013
CENELEC Standards (EN 50625 series)	Voluntary standards to define the requirements for WEEE treatment, collection and logistics. Laws and regulations may refer to these standards however their use remains voluntary.	EU	Since 2015
CEWASTE	Voluntary certification scheme for the collection, transport and treatment facilities of key types of waste containing significant amounts of valuable materials, such as WEEE and batteries.	EU	Since 2021

Note: R2 Standards, e-Stewards, EuCertPlast, WEEELABEX, and CEWASTE are voluntary third party certification schemes, while AS/NZS 5377 and CENELEC (EN 50625 series) are voluntary standards. These are all used to recognise recovery facilities operating at high standards.
Source: Author based on Laubinger and Borkey (2021[75]), Yamaguchi (2021[8]), PACE (2021[39]), EU (2020[58]), and RPA, (2012[74]).

A number of standards have already been developed in different jurisdictions, but these are largely concentrated in the e-waste sector, with one exception on plastics recycling processes. Furthermore, these standards are either country or region-specific, and there are no internationally agreed standards on recovery facilities to date. For this reason, some studies point out the need to establish standards that are internationally acceptable (WEF, 2020[2]; EU, 2016[41]).

In addition, standards alone will not guarantee anticipated outcomes if the compliance of these recovery facilities against prescribed quality standards are not checked or verified. For this reason, conformity assessment of recovery facilities also plays a critical role, often in the form of third-party verification (Böni, 2012[76]; Deubzer, 2012[77]).[44] Conformity assessment procedures can be costly and duplicative if recovery facilities need to comply with multiple standards used in different markets (OECD, 2017[78]; Deubzer, 2012[77]). For this reason, the development of globally recognised standards for recovery facilities as well as mutual recognition of conformity assessment procedures may also help to harmonise and align these procedures across different countries and jurisdictions (OECD, 2017[78]; Deubzer, 2012[77]).[45]

[42] Additional standards have been raised in the literature including the EPEAT Registry, IEEE1680.2, IEEE1690.3, Canadian Stewardship programs, and UL2799 Zero Waste (EU, 2020[58]). However, these standards mainly focus on environmental performance of a product or environmental management to reduce waste within organisations, and are excluded from this analysis. Furthermore, the “Manufactured Again Certification Program” sets forth standards on remanufacturing, maintenance, repair and overhaul (MRO), and refurbishing facilities to the same international quality standards. Nevertheless, these are based on existing quality standards such as ISO 9001 and are also excluded from this analysis.

[43] According to EU (2016[41]), the compliance to WEEELABEX standards are mandatory in the Netherlands, Ireland, Flanders and France.

[44] Conformity assessments can take three forms (ISO, 2020[72]):

- first party assessment – by a person or organisation that provides an object or service (e.g. self-assessment),
- second party assessment – by a person or organisation that has a user interest in an object or service (e.g. hired expert, sub-contractor)
- third party assessment - by a person or body that is independent of the person or organization that provides the object or service and of user interests in that object or service (e.g. certification body)

[45] For further discussion on conformity assessment and trade, see (OECD, 2017[78]).

5.1.2. Opportunities, challenges and knowledge gaps

One notable challenge is that, in the absence of globally recognised standards on recovery facilities, it is difficult for an operator seeking to establish reverse supply chains for a circular economy to refer to a clear and uniform set of criteria to demonstrate that it has sufficient capacity and environmentally sound management levels. For this reason, there are recommendations to develop harmonised standards for the handling of waste that are recognised and accepted by regulators internationally (WEF, 2020[2]).

In particular, the criteria used to certify pre-consented facilities under the OECD Decision on Transboundary Movement of Waste, are not very clear and not uniform across the countries that utilise this process (See also Annex D). For example, it is reported that Austria requires 14 sets of criteria to be met to obtain a pre-consented facility status (EU, 2016[41]), while in Flanders, Belgium, an environmental permit is required for an application as a pre-consented facility and at least five aspects are taken into account when assessing applications.[46] In other OECD countries, the used criteria and process can differ significantly, if the pre-consented facility status is considered at all. These national level differences in the granting and use of pre-consented facilities can arise as a challenge to ensuring a level playing field in the trade in end-of-life products and in cross-border reverse supply chains. In addition, even when pre-consented facilities are designated against an agreed set of criteria, tacit consent procedures are not always applied by governments to make the PIC procedure more efficient. For these reasons, industry stakeholders have argued that the pre-consented recovery facility status is not making any effective difference in simplifying and expediting waste shipments destined for recovery (EU, 2016[41]).

Moreover, the conditions for consenting to a transboundary movement under a prior informed consent procedure under the OECD Decision are highly dependent on whether the recovery facility at destination can recover waste in an environmentally sound manner in accordance with national laws, regulations and practices (OECD, 2009). While the precise implementation of prior informed consent procedures is unclear, many industries claim that the criteria used for these procedures are not clear or harmonised, and place a heavy burden on legitimate operators (PACE, 2021[39]; WEF, 2020[2]; 2020[37]; WCO, 2020[38]; EERA, 2019[3]; Digital Europe, 2019[64]; EU, 2016[41]).

Nevertheless, some efforts have been made to harmonise and streamline these processes. The North Sea Resources Roundabout is a collaborative initiative between industry and governments to advance resource efficiency and circular economy issues within Flanders, France, the Netherlands, and the UK (EERA, 2019[3]). As a part of this initiative, the group is undertaking work on “Fast Track Notification” and pilot projects to see how prior informed consent procedure and pre-consent procedures can be improved. Notably, work has been done to clarify and simplify the criteria of prior informed consent and pre-consented facilities, through a dialogue between five Competent Authorities and industry stakeholders. While the work is limited to certain countries with a handful of participating authorities and industry stakeholders, such a dialogue can form the basis to agree on standard requirements for recovery facilities, and streamline and simplify pre-consents and prior informed consent procedures.

Furthermore, there are proposals to establish “fast tracks” of waste shipments that are destined for high-quality material recovery and to legitimate facilities to manage and process the waste in an environmentally sound manner (EERA, 2019[3]; Digital Europe, 2019[64]; EU, 2016[41]).

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[46] These five aspects for application assessments for pre-consented facilities in Flanders include:

- the proven environmental quality of the recovery of the waste during the past years;
- the proven experience with the recovery of the waste materials for which registration as a pre-approved facility is requested;
- the extent to which the method of recovery is in line with the Flemish waste and materials policy;
- the extent to which the proposed recovery contributes to the effective material recycling of the waste;
- the violations and abuses of environmental regulations that have already been identified.

See: https://navigator.emis.vito.be/mijn-navigator?woId=78978; and https://navigator.emis.vito.be/mijn-navigator?woId=78980.

In this vein, setting forth clear and harmonised standards or certification criteria for recovery facilities will provide further opportunities to establish reverse logistics. In support of this effort, the WTO TBT "Decision on Principles for the Development of International Standards, Guides and Recommendations" can serve as an important reference to ensure that such a standard may be considered as an international standard under the TBT Agreement.[47] In line with this TBT Decision and its six principles (transparency, openness, impartiality and consensus, effectiveness and relevance, coherence, and the development dimension), these standards should be developed in an open and transparent manner involving all relevant stakeholders. Governments can contribute to the work, and may choose to refer to these standards in order to support the establishment of reverse logistics.

5.2. Standards on waste and non-waste products

Another area of possible intervention is around quality standards on waste and non-waste products involved in reverse supply chains. These are standards on the goods themselves, rather than on the recovery facilities where they are destined. The current state of play and its possible use are discussed below.

5.2.1. State of play

Standards on goods involved in reverse supply chains encompass those on waste and scrap quality and contamination levels, end-of-waste criteria,[48] quality of secondary raw materials, and standards on used goods and remanufactured goods.

The utilisation of material quality standards on waste and scrap is receiving great interest in the transition towards a resource efficient and circular economy. Nevertheless, not many standards are available to date.

One notable set of criteria is the ISRI Scrap Specifications Circular developed in the United States. The circular is available in its current form since 1989 and regularly updated.[49] The aim of the circular is to assist scrap traders in the buying and selling of their materials and products, by setting forth quality specifications, allowable tolerance levels of prohibitive materials (ISRI, 2021[79]; 2021[80]). The circular issued in 2021 covers those for ferrous and non-ferrous scrap, glass, paper, plastics, electronics and tyre scrap. The circular is used by industry, especially guiding transactions at the global level as a means of ensuring consistency and quality in the trade of waste and scrap. In some countries such as Australia, India and the U.S., relevant authorities use the circular to inform regulatory processes and to differentiate valuable recyclable materials from unacceptable fractions (ISRI, 2021[80]).

The "end-of-waste" criteria is another important point of consideration in the shift towards a circular economy. In particular, the EU is developing the "end-of-waste" criteria, with an aim to create legal certainty and a level playing field for the uptake of secondary materials. So far, the end-of-waste criteria have been issued for iron, steel, aluminium, copper scrap, and glass cullet.[50] Furthermore, the EU's second circular economy action plan announced in 2020, mentions the further development of common "end-of-life" criteria and "by-product" criteria to harmonise national level initiatives and to support cross-border co-operation (EU, 2020[81]).

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[47] The WTO TBT "Decision on Principles for the Development of International Standards, Guides and Recommendations" aim to help international standards work better for global trade. Since their adoption in 2000, they remain widely referenced by standards bodies seeking international relevance.

For further details, see: https://www.wto.org/english/tratop_e/tbt_e/principles_standards_tbt_e.htm.

[48] End-of-waste criteria defines when to treat recycled or reused waste as a product or raw material.

[49] At the point of writing this report, the latest version of the ISRI Scrap Specifications Circular is in 2021 (ISRI, 2021[79]).

[50] See: Commission Regulations (EU) N° 333/2011, N° 1179/2012, and N° 715/2013.

The development of quality standards on secondary raw materials is also considered to be critical to enable a resource efficient and circular economy transition (Yamaguchi, 2021[8]; OECD, 2020[1]; Business at OECD, 2020[11]; WEF, 2020[2]; 2020[37]). Securing the quality and content of these materials is essential to establish reverse logistics and facilitate their uptake for a circular economy. As an example, the Circular Electronics Partnership established in 2020 gathering over 80 experts from 40 companies, identifies the development of industry-wide standards and definitions on the characteristics of secondary-raw materials, as part of their industry strategy towards circularity (PACE, 2021[39]). Nevertheless, standards in this area are limited and the field is still in its infancy.

Quality standards on used and remanufactured goods are also important. Although this is a rather new area, there have been several developments in the past few years. Regarding standards on used goods, the International Organization for Standardization (ISO) developed a standard on the “cross-border trade of second-hand goods” in 2017 with the aim to establish a minimum screening criteria for second-hand goods that are traded between countries.[51] Furthermore, the European Committee for Electrotechnical Standardization (CENELEC) is currently developing standards on secondary batteries for industrial applications (CEN-CENELEC, 2020[82]).[52] There are additional initiatives to set quality standards on remanufactured goods, as those from the UK, [53] the US, [54] and Canada.[55]

These standards related to end-of-life products and materials are compiled in Table 3 below. The majority of these standards have been issued or updated over the past few years and some are currently under development, reflecting the growing interest for a circular economy. However, apart from the standard on “cross-border trade of second-hand goods” by the ISO, there are still very few standards that are recognised and used at the international level to date, and this remains as an area for possible future development.

[51] To note, the ISO Standard on “cross-border trade of second-hand goods” does not cover goods that are remanufactured, rebuilt or refurbished. See: https://www.iso.org/standard/68820.html.

[52] CENELEC standards on secondary batteries for industrial applications are being developed as part of their technical committee on secondary cells and batteries (i.e. CLC/TC 21X). The work aims to set forth product standards of cells, modules, batteries entering into their second life, by establishing standards on technical performances, associated qualification tests, and safety risk considerations. In particular, performance testing standards of secondary lithium ion cells for electric road vehicles have already been issued as of 2019 (i.e. EN 62660-1:2019).

[53] See: the British Standards Institute (BSI) “Design for manufacture, assembly, disassembly and end-of-life processing” established in the UK in 2010 - BS 8887-220:2010.

[54] See: Specifications for the Process of Remanufacturing developed by the Remanufacturing Industries Council (RIC), and approved by the American National Standards Institute (ANSI) in the US in 2017 - RIC001-1:2016.

[55] See: Underwriters Laboratories certification scheme for “Reconditioned Equipment Certification and Safety Compliance” in Canada (UL, n.d.[103])

Table 3. Standards on end-of-life products and materials

Standards	Examples	Issued by	Year
Material quality (waste and scrap)	•Institute of Scrap Recycling Industries (ISRI) Scrap Specifications Circular	US	Since 1989 Updated in 2021
	•EU end-of-waste criteria, for iron, steel, aluminium, copper scrap, and glass cullet (Commission Regulations (EU) No 333/2011, No 1179/2012, and No 715/2013).	EU	Since 2011, 2012, & 2013
Material quality (secondary raw materials)	•Circular Electronics Partnership - industry-wide standards and definitions on the characteristics of secondary-raw materials (proposed as part of their industry strategy towards circularity, 2021)	N/A	Forthcoming
Product quality (second-hand goods and remanufactured goods)	•International Organization for Standardization (ISO) "Cross-border trade of second-hand goods" - Establishes minimum screening criteria for second-hand goods that are traded between countries (ISO 20245:2017).	ISO	Since 2017
	•European Committee for Electrotechnical Standardization (CENELEC) developing standards on secondary batteries for industrial applications, under technical committee on secondary cells and batteries (CLC/TC 21X).	EU	Forthcoming
	•British Standards Institute (BSI) - Design for manufacture, assembly, disassembly and end-of-life processing (BS 8887-220:2010).	UK	Since 2010
	•American National Standards Institute (ANSI) "Specifications for the Process of Remanufacturing - RIC001.1-2016" developed by Remanufacturing Industries Council (RIC).	US	Since 2017

Note: The ISRI Scrap Specifications are commonly used by industry traders to specify material quality. However they are technically not international standards developed through a consensus-based process. The ISO standards on "cross-border trade of second-hand goods" does not apply to goods that are remanufactured, rebuilt or refurbished.
Source: Author based on available references.

5.2.2. Opportunities, challenges and knowledge gaps

The lack of an internationally agreed definition of end-of-life products and the absence of international waste quality standards are reported to be major barriers to establish reverse supply chains across borders (IEEP, 2019). In this context, there is a need to improve and harmonise standards on end-of-life products and materials to enhance their circular use and trade.

There are two main possibilities for using standards on waste and non-waste products for reverse logistics. As explored in Section 3, the first possibility is to ensure that a given commodity is not considered as waste when it can be classified as non-waste, and the second is to clarify that a particular consignment is not subject to waste controls under international legal frameworks.

Regarding the first point, some standards appear to be useful in deciding whether a given material is waste or not. This would particularly be around quality standards on second-hand goods and remanufactured goods. As raised in the previous subsection, available ISO standards on the minimum screening criteria for second-hand goods that are traded between countries (ISO 20245:2017) as well as forthcoming standards on secondary batteries for industrial applications by CENELEC, British Standards on the process and quality for remanufactured goods, and Specifications for the Process of Remanufacturing by ANSI may provide confidence to regulatory authorities that these materials meeting such requirements are considered as non-waste products. In addition, quality standards for secondary raw materials could also contribute to distinguishing them as non-waste items, although these initiatives are under development.

Furthermore, a clear definition of "end-of-waste" status (see Section 3) could inform regulators to better distinguish them from waste. However, the harmonisation of "end-of-waste" criteria between countries seems to be a difficult path to explore and is left for future study.[56]

[56] The "end-of-waste" criteria is often different between jurisdictions, and sometimes even result in regional differences within a country (OECD, 2021[110]). While some authorities grant "end-of-life" status based on physical characteristics

Concerning the second point, using internationally accepted standards to guide whether a certain consignment is exempt from waste controls under international legal frameworks is also a complicated task. The Basel Convention and OECD Decision both indicate the criteria to use, on the waste entries and the characteristics they exhibit, in deciding whether certain fractions of waste would be covered under these frameworks. Nevertheless, decisions can be supplemented by additional national criteria. While ISRI specifications are used by the industry to inform commercially accepted levels of material quality and contamination, their uptake by regulatory authorities appear to be mixed. While they are already used by some countries to distinguish valuable recyclable materials from unacceptable fractions, there have been claims that certain categories would not be in compliance with some recipient governments (ISRI, 2021[80]). There have been voices from regulators in the past that these specifications are at times not clear nor detailed enough to inform such regulatory processes (OECD, 2010[53]).

of a good, others take decisions based on specific transactions between the exchanging facilities (producer and receiver of the good), and some placing decisions with a combination of these two elements. Moreover, decisions on “end-of-life” status can be granted on an ad-hoc basis depending on the examination of the competent authority in question (MiW & IMPEL, 2019[96]).

6. Policy responses considering trade facilitation mechanisms and standards

This section consolidates possible ways forward to facilitate cross-border reverse supply chains through trade facilitation mechanisms and standards by unpacking these issues into “controlled waste”, “non-controlled waste”, and “non-waste” products, following the structure provided in Section 3.1 (Figure 2). First, regarding “controlled waste” under international legal frameworks, possible ways to promote reverse supply chains for this category largely emerge as regulatory improvements for PIC procedures under the Basel Convention and the OECD Decision. Second, cross-border reverse supply chains for “non-controlled waste” and “non-waste” products are often subject to standard commercial controls, and can be considered together. For these categories, proposals to facilitate cross-border reverse supply chains are largely focused on making their status clearer. Each of them are presented below.

6.1. Swift implementation of prior informed consent procedures

One way for countries to help establish and scale up reverse supply chains for a resource efficient and circular economy is through securing the swift implementation of prior informed consent (PIC) procedures. Securing the prompt implementation of prior informed consent procedures may partially alleviate industry concerns in moving end-of-life products across borders for their circular use.

While the share of waste trade subject to PIC procedures under the Basel Convention has remained relatively low, at 8% of the overall volume of waste and scrap trade in 2018 (see Figure 3), additional waste categories have been considered and reflected under Basel Convention controls. These include the plastics amendments in force since 2021, and the forthcoming e-waste amendments coming into force from 2025. In this context, there appears to be increasing relevance to secure the effective implementation of PIC procedures.

The first step in this direction would be to establish a better understanding on the actual implementation of PIC procedures under the Basel Convention and the OECD Decision. While many companies have reported substantial barriers and delays in undertaking waste notification procedures, overall information and data on the implementation of the PIC procedures are lacking significantly.

There is currently insufficient understanding of the bottlenecks in PIC procedures, and it is not clear whether the reported delays are due to the cumbersome procedures themselves, a lack of staff, resources, training, or communication between cross-border regulatory agencies, or whether other barriers dominate. Media reports suggest that some developing countries lack the resources to administer the PIC process (E-SCRAP NEWS, 2022[83]). A survey by PREVENT and StEP (2022[4]) indicates some potential barriers to PIC procedures being: (i) the lack of experience and awareness of cross-border regulatory agencies, (ii) fragmentation of definitions, tariff codes, administrative processes and documentation needs, and (iii) slow approval or no response from transit countries. In terms of the OECD Decision, the number and location of pre-consented facilities are available under the database, however, the quantity of waste that are subject to the PIC procedures, as well as the number of notifications, and traded fractions benefiting from pre-consent procedures are also unavailable (See also Annex D). More work is needed to understand the actual implementation of PIC procedures.

Countries can also place efforts to clarify and align the criteria of consenting to a PIC procedure, which is currently not very clear and fragmented between countries (PACE, 2021[39]; WEF, 2020[2]; EERA, 2019[3]; EU, 2016[41]). OECD member countries can exploit the potential of pre-consented facilities, which can speed up and simplify the process by partly shifting controls from the border to on-site facilities. In theory, the pre-consent process can simplify and expedite notification procedures to seven days and with tacit consent from importing, exporting and transit countries. This will particularly work towards reflecting requests from industry to establish "fast tracks" or "green lanes" based on the Authorized Economic Operator (AEO) concept (EERA, 2021[49]; PACE, 2021[39]; WEF, 2020[2]; EU, 2016[41]). The criteria in obtaining pre-consent status of recovery facilities and the use of tacit consents also do not seem to be uniform (WEF, 2020[2]; EERA, 2019[3]; Digital Europe, 2019[64]). For this reason, clarifying conditions for granting pre-consent status to facilities, as well as utilising tacit consent would be important steps in this direction. Linking the experience of custom authorities in utilising AEOs, with the expertise of Competent Authorities (e.g. environmental protection agencies) in undertaking PIC procedures may help identify best practices to optimise cross-border co-operation.

Another important set of instruments are the "single window" mechanisms and electronic systems that may help to streamline and facilitate PIC procedures. These potential solutions can be useful as these PIC procedures have been reported to be largely paper based (WEF, 2020[2]; EU, 2016[41]; PREVENT and StEP, 2022[4]). In particular, three initiatives can significantly increase the transparency in the system and speed up these processes, namely: (i) the electronic exchange of documents and acceptance of electronic signatures for pre-consents and notification requests; (ii) electronic forms of movement documents; and (iii) electronic exchange of transport planning, receipt and treatment confirmations between all parties. A number of pioneering examples of regional electronic systems are available, including those used between Canada-Mexico-US, as well as Austria-Switzerland. There are also preceding examples in other areas such as electronic systems by CITES and ePhyto by IPPC. Creating linkages between electronic data interchange for PIC procedures managed by Competent Authorities and single window programmes administered by custom authorities, may help identify the legitimate fractions of trade and facilitate cross-border movements. Best practice for establishing single windows includes reference to available international standards, such as UN/CEFACT and the WCO Customs Data Model (WCO, 2017[62]). These available examples and tools can help inform on-going efforts, including those by the Basel Convention and the EU Waste Shipment Regulation amendment proposals (UNEP, 2020[66]; EU, 2021[84]).

The interplay between trade facilitation and standards can also be further examined to help establish cross-border reverse supply chains. For example, inspections at the border often involve checking compliance with certain criteria and standards. Clarifying the criteria and standards used for border controls as well as exploiting the potential of existing standards on end-of-life products may help narrow information gaps (WCO, 2020[38]).

Other gaps appear in areas of the complexity in the application of financial guarantees, differences in allocation of administrative costs, and fragmentation of the waste classification system in use (PACE, 2021[39]; EU, 2020[58]; WEF, 2020[2]; EERA, 2019[65]; PREVENT and StEP, 2022[4]). Countries can work towards streamlining these processes (See also Annex G).

Regulatory co-operation between countries can help bridge these gaps, and align differences in procedures that hinder efforts by the industry. There could also be efforts to align the criteria and norms for PIC procedures between countries. Notable efforts are underway to align and simplify these processes between likeminded stakeholders such as by the North Sea Resources Roundabout (EERA, 2019[3]; 2019[65]). These examples emerge as best practices to streamline PIC and pre-consent procedures.

6.2. Securing the status of "non-controlled waste" and "non-waste" products

Clarifying the status of non-controlled waste and non-waste products that are frequently subject to standard commercial controls is another important aspect to help establish reverse supply chains. This is important as international and national requirements generally make trade difficult if products or materials are (incorrectly) labelled as waste rather than non-waste products, or if waste is subject to controls under PIC procedures. This distinction is also important as illegal waste trade frequently occurs through the channels of non-controlled waste as well as non-waste such as used and second-hand goods.

The AEO status obtained by importers and exporters of non-controlled waste and non-waste products may assist customs to better distinguish them from illegal fractions and preserve them in reverse supply chains. While still in its infancy, the possible application of AEO concepts reflecting environmental criteria may help increase confidence in the system by partially shifting controls from the border to the recovery facilities. If AEO programmes are further developed to reflect environmental criteria into their systems, this would need to rely on a clear set of criteria based on globally recognised standards (WEF, 2020[2]; EU, 2016[41]). For this reason, available standards on recovery facilities may help support this process. Nevertheless, ensuring the availability of risk assessment and audit techniques would be a critical aspect to ensure that these end-of-life materials and products are processed and utilised in an environmentally sound manner. More work is required in this area.

For used goods, countries may wish to extend electronic systems to cover consignments that are accompanied by supplementary documentation of testing results or purpose of shipments, as recommended by the Basel Convention technical guidelines on waste and used WEEE. Furthermore, linking such efforts with single window mechanisms in place by custom authorities may help facilitate cross-border trade in such goods.

Countries can also elaborate whether the use of standards on waste and scrap, or used and remanufactured goods would provide more confidence in these consignments, and work towards distinguishing them from illegal transactions. The ISO standard on the Cross-border trade of second-hand goods may serve as an important reference point in this regard. As a related example, Parties to the EU-Japan Economic Partnership Agreement (EU-Japan EPA), requires that parties to the agreement treat remanufactured goods as new goods, in order to clarify their status in reverse supply chains.[57]

Further efforts to develop international standards on waste and scrap, secondary raw materials, goods for repair, refurbishment and remanufacturing, can pave the way to establish and scale up reverse supply chains across borders. Such efforts can refer to the WTO TBT "Decision on Principles for the Development of International Standards, Guidelines and Recommendations" to ensure that these standards are considered as international and developed in an inclusive and transparent manner.

[57] See: EU-Japan EPA, Article 2.18, Remanufactured Goods.

7. Policy responses beyond trade facilitation mechanisms and standards

In addition to trade facilitation mechanisms and standards, additional policy responses can help establish cross-border reverse supply chains. These include: (i) addressing import and export restrictions; (ii) combating illegal waste trade; and (iii) upstream policies that affect reverse supply chains. In principle, these additional measures would work towards promoting reverse supply chains and are cross-cutting for "controlled waste", "non-controlled waste", and "non-waste" products. These are explored below.

7.1. Addressing import and export restrictions

International trade in end-of-life products is hampered by restrictions on imports and exports when they apply to waste or non-waste products. For example, since 2018, China imposes import restrictions on certain fractions of waste and scrap with a stated motivation to prevent and control environment pollution (Yamaguchi, 2021[8]). Furthermore, some countries have imposed import restrictions and bans on second-hand goods, such as used and inefficient vehicles, as part of their commitments under the Paris climate accord (Brandi, 2017[85]). OECD work on trade restrictions on metals and minerals reveal that export restrictions generally prevail over import restrictions for waste and scrap metals (de Sa and Korinek, 2021[45]).

In some cases, domestic regulations preventing the movement of end-of-life products may effectively act as import and export restrictions. In particular, representatives from the remanufacturing industry have indicated that transboundary restrictions on the movement of end-of-life products have hindered their business model to establish and scale up cross-border reverse logistics and to bring back core components to regional refurbishment and remanufacturing centres abroad (OECD, 2020[1]). In some countries, such as Brazil and India, it has been reported that the movement of used products and core components for remanufacturing is restricted (UNEP, 2018[26]). In other countries, such as China and Indonesia, import restrictions have been imposed on core components, as well as refurbished and remanufactured goods (UNEP, 2018[26]; Kojima, 2017[86]).

While there may be valid reasons for introducing import and export restrictions, such as environmental protection or preservation of valuable materials, their excessive application may impede the movement end-of-life products and work against the establishment of cross-border reverse supply chains. Further efforts are needed to ensure the transparency of these import and export restrictions. Countries can also review their import and export restrictions affecting reverse supply chains to ensure that they are aligned with circular economy objectives.

Likeminded countries have already begun to introduce commitments, as a part of regional trade agreements, to alleviate trade restrictions that work against cross-border reverse supply chains. For example, parties to the Comprehensive and Progressive Agreement for Trans-Pacific Partnership (CPTPP) as well as the United States-Canada-Mexico Agreement (USMCA) have agreed on specific provisions to limit the use of import restrictions on remanufactured goods.[58]

Trading blocs that have a particular interest in promoting circular value chains may also face serious concerns over environmental dumping through imports and exports, such as obsolete second-hand goods. Such countries may avoid trade restrictions by considering alternative mechanisms that may be less trade

[58] See: CPTPP, Article 2.11, Remanufactured Goods; and USMCA, Article 2.18, Remanufactured Goods.

distortive. For example, importers and exporters could assume some responsibility for the circular use of goods, such as by ensuring a certain warranty or guarantee period, or a minimum lifetime requirement of a second-hand good (Laubinger and Börkey, 2021[75]; Laubinger et al., 2021[87]; Yamaguchi, 2021[8])). Importers can also assume some responsibility for the end-of-life management of an imported (second-hand) good, such as by subjecting imported (second-hand) products to extended producer responsibility schemes (OECD, 2016[19]; OECD, 2014[88]; Yamaguchi, 2021[8]). These mechanisms should be considered in a non-discriminatory manner and aligned with multilateral trade rules. This would also require a certain level of regulatory capacity of the importing country. Therefore, development co-operation and Aid-for-Trade may play a positive role in supporting these efforts.

7.2. Combating illegal waste trade

The prevalence of illegal waste trade is an increasing concern for both the public and private sector. Illegal waste trade can constitute hazardous waste and often circumvent controls as being falsely declared as secondary raw materials, second-hand goods, or waste exempt from controls under the Basel Convention and the OECD Decision. They can pose serious risks to human health and the environment if they are mismanaged during transport or at their destination (See also Annex B).

Illegal waste trade can also undermine legitimate efforts to establish and scale up cross-border reverse supply chains, by triggering increased controls for the transboundary movement of waste and end-of-life products, and distorting competition in the recycling industry (Yamaguchi, 2021[8]; OECD, 2020[1]). Policies to combat illegal waste trade may imply elaborate procedures and therefore hamper legitimate trade for reverse supply chains. For example, the threat of having mis-classified waste could make governments act more strictly to control waste trade at the border, and thus work against promoting cross-border reverse supply chains. In addition, compliant recovery facilities (e.g. with pre-consent status) applying proper notification procedures can be disadvantaged over recyclers taking the risk of not applying such procedures through illegal waste trade (EERA, 2019[3]).

Targeted policy measures to enable the cross-border movement of legitimate goods to be preserved in reverse supply chains, and to prevent illegal waste trade are two sides to the same coin. Better identification, compliance and enforcement at the border to combat illegal waste trade would hinge on targeted efforts (such as risk assessment and intelligence sharing). Hence, effectively preventing illegal waste trade, could work towards identifying and facilitating trade in legitimate goods for reverse supply chains. The reverse also holds; enhanced identification and facilitation of legitimate trade for reverse supply chains can also contribute to the effective implementation of cross-border controls of reverse logistics, thereby freeing up resources to combat illegal waste trade (OECD, 2020[1]).

Governments willing to help support circular business models could acknowledge that efforts to tackle illegal waste trade may help establish cross-border reverse supply chains and a level playing field for these circular businesses. Furthermore, a common understanding among border agencies on legitimate fractions of trade in waste and end-of-life products would help support reverse supply chains while effectively tacking illegal waste trade at the same time (WCO, 2020[38]). Efforts towards improved law enforcement, intelligence sharing, and cross-border co-operation appear to be critical aspects to better identify and tackle illegal waste trade. These efforts would work towards preserving legitimate fractions of trade (OECD, 2021[36]; 2020[1]).

7.3. Upstream policies that affect reverse supply chains

Reverse supply chains heavily depend on product characteristics determined at their design stage, such as considerations to extend product life and to make them easy to repair, refurbish, remanufacture and recycle. In contrast, products designed with planned obsolesce or the inclusion of hazardous substances would be technologically and economically more difficult to establish and scale up reverse supply chains to reutilise materials in the economy.

In this context, countries are placing efforts upstream in the value chain by setting forth eco-design policies to help achieve circular economy objectives. These can include providing incentives for recycled content, avoiding hazardous content, encouraging increased recyclability, reparability and durability of products, and to create markets for circular use of products and materials (Yamaguchi, 2021[8]). Such eco-design initiatives are being considered and introduced in various forms. For example, these could include introducing modulated fees to as a part of extended producer responsibility schemes to incentivise recyclability and avoidance of hazardous substances (Laubinger et al., 2021[87]). Eco-labelling schemes and green public procurement can also increase demand for products with recycled content or without hazardous content (Laubinger and Börkey, 2021[75]; OECD, 2020[89]). Eco-design efforts can also focus on extending the guarantee period and ensuring the availability of spare parts for a given product (OECD, 2016[48]).

These efforts would also help establish reverse logistics across borders. The introduction of eco-design policies would be supportive of establishing cross-border reverse supply chains, by making products last longer and easier to repair, dismantle, and recycle. Eco-design policies can incentivise products that are capital intensive and have a longer lifespan, and thus turn them into more suitable candidates for cross-border reverse supply chains (OECD, 2020[1]). Furthermore, eco-design for increased recyclability and reparability, such as securing the ease of dismantling, using uniform materials, and avoiding hazardous content can also be supportive of reverse supply chains. In particular, enabling easy and simple dismantling of products into hazardous and non-hazardous components could make them more suitable for cross-border reverse supply chains. For example, enabling the removal of batteries and other potentially hazardous components from smart phones, could make the remaining components easier to channel across borders when they reach their end-of-life.

The alignment of eco-design standards across countries can also help products designed for the environment enter into various markets and benefit from economies of scale (Yamaguchi, 2021[8]). In the same vein, the OECD updated guidance on extended producer responsibility calls for the possible alignment of eco-design standards for globally traded products (OECD, 2016[19]). In a general sense, harmonised or aligned eco-design standards could also contribute to the wider adoption of cross-border reverse supply chains. Such efforts are already underway. For example, in 2020, the ISO developed standards on eco-design and circularity of materials (ISO, 2020[90]). Furthermore, between 2019-2020, the EU, as part of its efforts under its standardizing body CEN-CENELEC, has developed nine standards related to “material efficiency aspects for products in scope of eco-design legislation” (CEN-CENELEC, 2021[91]).

Such eco-design standards and initiatives can support the free movement of goods to establish and scale up cross-border supply chains. These upstream policies for a circular economy are quickly emerging and its trade implications deserve further investigation.

8. Concluding remarks

This report has explored the opportunities and challenges for governments to facilitate cross-border reverse supply chains that can contribute to a resource efficient and circular economy transition, with a particular focus on trade facilitation mechanisms and standards. These possible approaches are compiled in Table 4 below.

The report does not aim to give priority to a specific approach among the possibilities identified in Table 4. However, it may perhaps be easier for countries to reinforce existing mechanisms (e.g. securing the swift implementation of PIC procedures), rather than creating new dedicated mechanisms (e.g. reflecting environmental criteria into AEO concepts, creating electronic data interchange) to secure reverse supply chains.

Many options for moving forward in securing reverse supply chains involve various stakeholders throughout a product value chain, including trade negotiators and environmental policy makers, as well as representatives from intergovernmental organisations, academia, private sector and civil society. For this reason, inclusive dialogues among stakeholders are essential to forge meaningful solutions. Given that the main actors in reverse supply chains are often private sector operators. Public-private sector collaboration is particularly important to address supply chain challenges and reach pragmatic solutions on both controlled and non-controlled waste issues. Governments should also pay due attention to ensure that possible new entrants to the re-use, remanufacturing, and recycling markets are not disadvantaged by the introduction of new mechanisms proposed in this paper.

One issue beyond the reach of this report is whether reverse logistics are established as an exclusive channel for an individual company to “close the loop” or whether they allow for collective action. It was not able to conclude whether either approach is preferable from an environmental perspective, and a detailed or sector specific analysis would be required.

Furthermore, the analysis in this report largely builds on how trade facilitation mechanisms and standards can be utilised to improve and strengthen existing legal frameworks such as the Basel Convention and the OECD Decision. It does not however explore the possibilities of forging new bilateral, multilateral, or regional agreements or arrangements regarding the transboundary movement of hazardous wastes or other wastes under the Basel Convention (i.e. Article 11). Such analysis could be the subject of future studies.

Table 4. Possible ways forward to secure cross-border reverse supply chains

Policy areas	Possible approaches
Controlled waste (under international legal frameworks, i.e. Basel Convention and OECD Decision)	• Secure swift implementation of PIC procedures:
	• Establish better understanding on the actual implementation of PIC procedures under Basel Convention and OECD Decision.
	• Clarify and align the criteria of consenting to a PIC procedure, which is often unclear and fragmented between countries.
	• For OECD member countries, exploit the potential of pre-consented facilities to speed up and simplify PIC procedures: ○ expedite notification procedure to 7 days and consider the use of tacit consent, to reflect requests from industry to establish "fast tracks" or "green lanes" based on AEO concept. ○ clarify conditions for granting pre-consent status, and align them where appropriate. ○ identify best practices by linking experience of custom authorities in utilising AEOs, with the expertise of competent authorities (e.g. environmental protection agencies) in undertaking PIC procedures.
	• Consider electronic systems to streamline and facilitate PIC procedures, which are currently largely paper based, such as: ○ electronic exchange of documents and acceptance of electronic signatures for PIC procedures; ○ electronic forms of movement documents; ○ electronic exchange of transport planning, receipt and treatment confirmations between all parties. ○ draw on existing examples on waste shipments (e.g. Canada-Mexico-US, Austria-Switzerland. ○ draw on preceding examples in other areas (e.g. CITES, ePhyto (IPPC)). ○ refer to available international standards (e.g. UN/CEFACT, WCO Customs Data Model).
	• Consider linking single window mechanisms administered by custom authorities and electronic systems managed by Competent Authorities to help identify the legitimate fractions of trade and facilitate cross-border reverse supply chains/
	• Consider filling in additional gaps in areas of financial guarantees, differences in allocation of administrative costs.
	• Address fragmentation of the waste classification system.
	• Draw on regulatory co-operation initiatives (e.g. North-Sea Resources Roundabout).
Non-controlled waste and non-waste products	• Clarify the status of non-controlled waste and non-waste products to preserve in reverse supply chains.
	• Consider the application of AEO concepts, with possible reflection of environmental criteria, to increase the regulatory confidence of these trade flows: ○ standards on recovery facilities may help with this process. ○ ensure risk assessment and audit techniques.
	• For used goods, consider extending electronic systems if consignments will be accompanied by supplementary documentation (e.g. testing results) to clarify their status.
	• Elaborate whether the use of standards on waste and end-of-life products would provide more confidence in their status and distinguish them from illegal transactions (e.g. ISO standard on cross-border trade of second-hand goods).
	• Consider developing international standards on waste and scrap, secondary raw materials, goods for repair, refurbishment and remanufacturing. Such efforts could refer to the WTO TBT "Decision on Principles for the Development of International Standards, Guidelines and Recommendations".
	• Draw on existing examples to clarify the status of remanufactured good (e.g. EU-Japan EPA)
Trade restrictions	• Reconsider and avoid the use of trade restrictions on end-of-life products to the extent possible.
	• Draw on existing examples to limit the use of import restrictions for remanufactured good (e.g. CP-TPP, USMCA).
	• Trading blocs may consider alternative measures to trade restrictions, such as those encouraging traders to assume some responsibility for the circular use of traded goods (e.g. setting warranty periods), or their end-of-life management (e.g. via extended responsibility schemes).
Illegal waste trade	• Improve law enforcement, intelligence sharing, and cross-border co-operation to better identify and tackle illegal waste trade.
Eco-design	• Place efforts upstream of the value chain by setting forth eco-design policies, such as incentivising recycled content, avoiding hazardous content, encouraging increased recyclability, reparability and durability of products, to create markets for circular products.
	• Alignment of eco-design standards across countries to make products designed for the environment enter into various markets and benefit from economies of scale.

Source: Author based on various sources identified in this study.

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Annex A. Link between reverse supply chains and circular economy business models

The concept of establishing reverse supply chains across borders can be mapped against the five circular economy business models identified in OECD (2019[9]), namely: i) circular supply, ii) resource recovery, iii) product life extension, iv) sharing, and v) product service systems. The business model most relevant for this current report is the resource recovery model, which primarily involves material recovery operations (e.g. recycling). This also extends to the upstream and downstream components of the product life extension model, which includes direct reuse, repair, refurbishment and remanufacturing. Reverse supply chains can also involve the product service system model where leasing activities can take place across borders and products reaching their end-of-service-life are subject to reverse logistics back to the service supplier. A mapping of these focus areas against these circular business models are given in Table A.1 below (focus areas shaded in blue).

Table A A.1. Mapping of cross-border reverse supply chains against circular economy business models

Circular business model	Key characteristics	Business model sub-types
Circular supply	Replace traditional material inputs with renewable, biobased, recovered ones	Cradle to cradle
Resource recovery	**Produce secondary raw materials from waste**	**Industrial symbiosis**
		Recycling
		Upcycling
		Downcycling
Product life extension	**Extend product lives**	**Direct reuse**
		Repair
		Refurbishment
		Remanufacture
		Classic long life (e.g. eco-design)
Sharing	Increase utilisation of existing products and assets	Co-ownership
		Co-access
Product service systems	**Provision of services rather than products. Product ownership remains with supplier**	**Product-oriented**
		User-oriented
		Result-oriented

Note: The focus of reverse supply chains in this report is shaded in blue.
Source: Author based on OECD (2019[9]).

Annex B. Prevalence of illegal waste trade[59]

Illegal waste trade is a particular area of concern that hampers the legal fractions of trade, puts pressure on competent authorities for proper law enforcement, undermines the business model of legitimate economic operators, and poses a serious threat to human health and the environment.

The evidence of illegal waste trade often appears in the form of seizures when detected at the border. The Waste Force (2020[60]) report provides some examples. In September 2020, 21 containers carrying 260 tonnes of hazardous plastic and medical waste were seized and shipped back to the United Kingdom from Sri Lanka. These fractions were falsely declared as used mattresses and were in breach of international law. On a larger scale, 364 containers with 7,408 tonnes of hazardous waste, which were mis-declared as plastic synthetic flakes and found to be illegal under international law, were returned from the Philippines to South Korea in October 2020. In another case, Tunisian customs seized 70 containers with 120 tonnes of hazardous medical waste from Italy in November 2020. The Tunisian recipient company had an agreement with an Italian company to import 120,000 tonnes of waste per year at EUR 48 per tonne. The case is currently under investigation by the authorities.

While illegal waste trade is a reality on the ground, it is extremely difficult to ascertain the full extent and scale of these activities due to their concealing nature. Official documentation of seizures at the border is one way to shed light on these illegal transboundary movements. As an example, the World Customs Organization collects national reports from their members and also conducts periodic co-ordination activities at the border, namely under their project called DEMETER.[60] According to this information, 41 countries reported around 1,300 seizures reaching 394,187 tonnes of illegal waste trade between January 2011 and March 2020, averaging at approximately 42 kilotonnes per year (WCO, 2020[38]). In addition, national reports collected under the Basel Convention provide further sources of information.[61] During the period from 2016 to 2018, 35 countries reported a total of 2,200 cases reaching 224,446 tonnes of illegal transboundary movements of waste, amounting around to 75 kilotonnes per year (WCO, 2020[38]). At first glance, the magnitude of illegal waste trade appears relatively small representing only less than 1% of legitimate trade under the Basel Convention PIC procedure (see Figure 3). Nevertheless, this information needs to be interpreted carefully, as they are based on national reports submitted on a voluntary basis, and are unlikely to correctly reflect all seizures occurring at the border. Furthermore, reported seizures appear to cover only part of illegal waste trade taking place on the ground, as some fractions are suspected to by-pass border controls. These indications are therefore presumed to be a modest, if not an incomplete, representation of illegal waste trade.

Several studies have made efforts to quantify the magnitude and value of illegal waste trade. Nellmann et al. (2018[46]) estimate illegal trafficking and dumping of toxic and electronic waste at USD 10–12 billion annually in 2016. While this estimate is frequently referenced in the international sphere, other studies go beyond this relatively conservative estimate. For example, UNEP (2015[92]) evaluates unaccounted or illegally traded e-waste alone at USD 12.2-19 billion annually in 2015. The US Department of Justice estimated the annual value of illegal production and trade of waste at USD 10-20 billion in 2000 (OECD, 2012[93]).

59 International regulatory frameworks governing waste trade is further explored in Annex C.

60 http://www.wcoomd.org/en/media/newsroom/2020/october/operation-demeter-vi-thwarts-transboundary-shipments-of-illegal-waste-and-ozone-depleting-substances.aspx

61 http://www.basel.int/Countries/NationalReporting/OverviewandMandate/tabid/2314/Default.aspx.

Additional efforts have been made to quantify the environmental impacts related to illegal waste trade. A study by Waste Force (2020[59]) estimated the environmental impacts of individual shipments of illegal waste trade to be between EUR 4,000 and EUR 1.2 million with an average of EUR 320,000. According to the study, these environmental impacts were mainly related to climate change, ozone depletion and particulate matter. Nevertheless, the study also indicates that the results should be interpreted with caution and are rather conservative estimates, given the limited information and data.

Illegal waste trade is driven by a range of factors including lower labour costs available for dismantling of end-of-life products, lower environmental standards and compliance costs for processing, and weaker law enforcement mechanisms that can encourage illegal environmental dumping (Huisman et al., 2015[21]; INTERPOL, 2020[47]). The *modus operandi* of illegal waste trade usually occurs through mis-declaration of waste and fraudulent documents, such as: (i) waste falsely declared for recycling, recovery, or reuse; (ii) waste mis-declared as raw materials; (iii) concealed contaminated waste exceeding standards, (iv) mis-declaration of waste supporting tax evasion, and (v) mis-declaration of final destination using a transit country or free trade zone (OECD, 2020[1]; INTERPOL, 2020[47]).

Several international organisations, including the Basel Convention, INTERPOL, UN Environment, and the World Customs Organization, among others, have been working to address these issues associated with illegal waste trade. Achieving the right balance in enabling trade for legitimate fractions, while preventing illegal shipments of waste at the border appears to be the core challenge of this issue. Some industry representatives have shared that compliant recovery facilities with pre-consent status applying proper notification procedures are in competition with and disadvantaged over recyclers taking the risk of not applying such procedures (EERA, 2019[3]). Custom officials have expressed their intention to liberalise and simplify legitimate trade, in order to redirect resources and free up enforcement capacity to focus on other relevant enforcement issues such as criminal seizures and identification of untrusted shipments (OECD, 2021[36]; 2020[1]).

Annex C. International legal frameworks for the transboundary movements of waste

Hazardous waste can pose serious risks to human health and the environment if they are mismanaged. These risks can include an array of potential impacts from direct human exposure to toxic substances, to long term environmental effects such as leaching of chemicals and pollutants into the atmosphere including soil, ground water and oceans. As such, hazardous waste and their transboundary movement are subject to international controls under the Basel Convention and the OECD Decision on Transboundary Movement of Waste.

The Basel Convention on the Control of Transboundary Movements of Hazardous Wastes and their Disposal (hereinafter, the Basel Convention), and the OECD Decision on the Control of Transboundary Movements of Wastes destined for Recovery Operations (hereinafter the OECD Decision), are the two main international legal frameworks governing the control of transboundary movement of waste. These two frameworks are therefore the main focus of this section. There are several other international legal frameworks that prohibit imports of hazardous waste into a particular region, including the Bamako Convention,[62] the Waigani Convention,[63] and the Central American Regional Agreement on the Transboundary Movements of Hazardous Wastes.[64] As these legal instruments provide for import bans and an intra-regional control mechanism for a smaller set of countries than the Basel Convention or the OECD Decision, they are not covered in this report.

The Basel Convention is a Multilateral Environmental Agreement, which entered into force in 1992 and consists of 188 Parties as of May 2021.[65] It aims to restrict and establish controls over the transboundary movement of hazardous wastes and other wastes with the aim to protect human health and the environment against adverse effects, which may arise from uncontrolled imports and exports. On this basis, the Convention also stipulates fundamental principles for: i) minimising the generation of hazardous wastes, ii) promoting their environmentally sound management; iii) disposing them as close to the source of generation as possible; and iv) preventing their illegal movements. Wastes subject to transboundary controls under the Basel Convention are either "hazardous wastes", or "other wastes" designated

[62] The Bamako Convention, in force since 1998, prohibits imports of any hazardous waste (including radioactive waste) into 29 African Parties including: Angola, Benin, Burkina Faso, Burundi, Cameroon, Chad, Comoros, Congo, Côte d'Ivoire, Democratic Republic of the Congo, Egypt, Ethiopia, Gabon, Gambia, Guinea-Bissau, Liberia, Libya, Mali, Mauritius, Mozambique, Niger, Rwanda, Senegal, Sudan, Togo, Tunisia, Uganda, United Republic of Tanzania, and Zimbabwe. See: https://www.unep.org/events/conference/third-conference-parties-bamako-convention.

[63] The Waigani Convention, in force since 2001, bans the importation of Hazardous and Radioactive Wastes and to Control the Transboundary Movement of Hazardous wastes within the South Pacific Region. It has been ratified by 12 countries in the South Pacific area, including: Australia, Cook Islands, Federated States of Micronesia (FSM), Fiji, Kiribati, New Zealand, Niue, Papua New Guinea, Samoa, Solomon Islands, Tonga, and Tuvalu. See: https://www.sprep.org/convention-secretariat/waigani-convention.

[64] The Central American Regional Agreement on the Transboundary Movements of Hazardous Wastes, entered into force in 1995, and aims to prevent the import and transit of hazardous wastes to Central America from States which are not Parties to the Agreement. The Agreement is ratified by 5 countries including: Costa Rica, El Salvador, Guatemala, Nicaragua, and Panama. See: https://www.ecolex.org/details/treaty/regional-agreement-on-the-transboundary-movement-of-hazardous-wastes-tre-001167/.

[65] All OECD countries are Parties to the Basel Convention with the exception of the United States. See: http://www.basel.int/Countries/StatusofRatifications/tabid/1341/Default.aspx.

according to their specifications and characteristics.[66] The Basel Convention defines hazardous waste by containing a list of hazardous waste (Annex I) and a list of hazardous characteristics (Annex III).[67] The latter group of "other wastes" consists of household wastes and incineration residues of household wastes, and also includes a fraction of plastic wastes as of January 2021, in accordance with the Basel Convention amendment on plastic wastes agreed by Parties in 2019.[68] Wastes that do not typically exhibit hazardous characteristics are also identified and are not subject to transboundary controls under the Convention.[69]

The OECD Decision was adopted in 1992 and applies to 38 OECD member countries as of June 2021.[70] The Decision shares similar principles of the Basel Convention to set forth controls of the transboundary movement of waste, but aims to promote environmental and economic sound recycling, and to facilitate trade of wastes destined for recovery operations within the OECD (OECD, 2009[27]). Waste lists under the OECD Decision are subdivided into two lists, which are subject respectively to the "green control procedure" and the "amber control procedure". Wastes falling under green controls do not typically exhibit hazardous characteristics and are subject only to existing controls normally applied in commercial transactions according to national regulations.[71] Wastes falling under the amber controls usually (but not always) exhibit hazardous characteristics and are subject to specific controls.[72] The OECD Decision on the Transboundary Movement of Waste defines hazardous waste by indicating the type of hazardous waste (Appendix 4) and by listing hazardous characteristics (Appendix 2).[73]

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66 See Basel Convention, Annexes I, III, VIII and II:
https://www.basel.int/Portals/4/Basel%20Convention/docs/text/BaselConventionText-e.pdf.

67 The Basel Convention defines hazardous waste as:

a) Wastes that belong to any category contained in Annex I, unless they do not possess any of the characteristics contained in Annex III; and

b) Wastes that are not covered under paragraph (a) but are defined as, or are considered to be, hazardous wastes by the domestic legislation of the Party of export, import or transit.

See Article 1.1: https://www.basel.int/Portals/4/Basel%20Convention/docs/text/BaselConventionText-e.pdf.

68 See: http://www.basel.int/TheConvention/ConferenceoftheParties/Meetings/COP14/tabid/7520.

69 See Basel Convention, Annex IX:
https://www.basel.int/Portals/4/Basel%20Convention/docs/text/BaselConventionText-e.pdf.

70 The OECD Decision adopted in 1992 applies to 38 OECD member countries (as of June 2021). See:

https://legalinstruments.oecd.org/en/instruments/OECD-LEGAL-0266;

https://www.oecd.org/env/waste/theoecdcontrolsystemforwasterecovery.htm.

71 Waste lists falling under the green control procedures are indicated in Appendix 3 in the OECD Decision. These entries largely reflect the Basel Convention entries under Annex IX with some specific adjustments.

72 Waste lists falling under the amber control procedure are indicated Appendix 4 in the OECD Decision and largely reflect Basel Convention entries under Annexes II and VIII with specific adjustments

73 The OECD Decision defines hazardous waste as:

(i) Wastes that belong to any category contained in Appendix 1 to this Decision unless they do not possess any of the characteristics contained in Appendix 2 to this Decision;

(ii) Wastes that are not covered under sub-paragraph 2.(i) but are defined as, or are considered to be, hazardous wastes by the domestic legislation of the member country of export, import or transit. Member countries shall not be required to enforce laws other than their own.

See Chapter II, Article A.2: https://legalinstruments.oecd.org/en/instruments/OECD-LEGAL-0266.

The main instrument used to control the transboundary movement of hazardous waste and other waste under the Basel Convention, as well as those equivalents under the OECD Decision, is the prior informed consent (PIC) procedure that applies in addition to the standard customs procedure.[74] The PIC procedure requires consignments to be subject to prior agreement between the Competent Authorities[75] of the importing, exporting and transit countries before these shipments are made (shipments made without consent are illegal). The procedure provides an additional layer of safeguard for transboundary movements of hazardous waste and other waste that may pose significant risks to the environment if improperly managed.

While the Basel Convention and OECD Decision are closely interlinked, there are a number of differences between the two (OECD, 2009[27]). First, the membership of these instruments and Conventions are different.[76] Second, the Basel Convention introduces additional trade controls: (i) to prohibit trade of hazardous waste and other waste with non-parties,[77] and (ii) to prohibit the OECD, EU, and Liechtenstein from exporting hazardous wastes to other group of countries, known as the Ban Amendment.[78] Third, while the majorities of entries are common to both frameworks, there are OECD specific entries to the green list and amber list of waste. Furthermore, the Basel Convention Plastics Amendments are only partially reflected into the OECD Decision, excluding mixed plastic waste and non-hazardous plastic waste.[79] Fourth, the OECD Decision sets out specific PIC procedures allowing for tacit consent (compared to written consent under the Basel Convention), pre-consented facilities which enables simplified and expedited shipment procedures (no equivalent provisions exist under the Basel Convention), and shorter consideration period (30 days or 7 days for pre-consented facilities, compared to 60 days under the Basel Convention). Consignments under PIC procedures operate under international legal frameworks as well as additional national requirements depending on each countries' regulation, and therefore they normally constitute shipments destined to environmentally sound management of waste (these interlinkages and differences between these two frameworks are summarised in Table A C.1 below).

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[74] Parties to the Basel Convention also agreed on a Ban Amendment among Parties listed in Annex VII (members of OECD, EU, Liechtenstein) to prohibit immediately all transboundary movements of hazardous wastes which are destined for final disposal operations from OECD countries to non-OECD countries. The Ban Amendment was adopted in 1995 and came into force in December 2019. http://www.basel.int/Implementation/LegalMatters/BanAmendment/Overview/tabid/1484/Default.aspx.

[75] Competent Authorities are generally national environmental protection agencies that are designated by each Party to the Basel Convention.

[76] As of November 2020, 187 countries and the European Commission are parties to the Basel Convention. As of June 2021, 38 OECD member countries are subject to the OECD Decision. Notably, while the United States adheres to the OECD Decision, it is not a party to the Basel Convention.

[77] See: Basel Convention, Article 4.5.

[78] See: Basel Convention, Article 4A.

[79] See OECD Control System for waste recovery: https://www.oecd.org/env/waste/theoecdcontrolsystemforwasterecovery.htm.

Table A C.1. The Basel Convention and OECD Decision are closely interlinked

International Legal Framework	Basel Convention	OECD Decision
Definitions	Disposal (Basel Annex IV A + Basel Annex IV B)	Disposal (appendix 5A =Basel Annex IV A) + Recovery (appendix 5B = Basel Annex IV B)
Classification and controls		
Categories of wastes to be controlled	Annex I	= Appendix 1
List of hazardous characteristics	Annex III	= Appendix 2
Non-controlled waste (Green list)	Annex IX	Appendix 3 (73 waste items) Part I = Basel Annex IX • excluding Basel entry B3011 on non-hazardous plastic waste, • including Part II: 12 OECD-specific entries[80]
Controlled waste (Amber list)	Annex VIII + Annex II	Appendix 4 (84 waste items) Part I = Basel Annexes VIII & II • excluding Basel entry Y48 on mixed plastic waste, • including Part II: 23 OECD-specific entries
Notification procedure		
Consent	Written	Tacit
Consideration period	60 days	30 days or 7 days for pre-consented facilities

Note: This correspondence table does not reflect e-waste amendments by the Basel Convention agreed by Parties in June 2022.
Source: OECD Secretariat based on the Basel Convention and OECD Decision.

[80] This excludes solid plastic wastes of polymers of vinyl chloride GH013, as no consensus has been reached among OECD Member countries to incorporate Basel entry Y48 into this Decision. Also, no consensus has been reached among OECD Member countries on whether or not GH013 continues to apply in this Decision. As a result of this situation, each Member country retains its right to control waste of polymers of vinyl chloride in conformity with its domestic legislation and international law. See: https://www.oecd.org/environment/waste/appendix-modifications.pdf.

Annex D. Trends in waste trade and implementation of prior informed consent procedures

Comprehensive data is very scarce on trade in end-of-life products encompassing waste and scrap, secondary-raw materials, second-hand goods and goods for refurbishment and remanufacturing. One of the main reasons for this limited data availability stems from the limited granularity of custom codes (Harmonized System codes) that reflect trade flows that potentially contribute to a resource efficient and circular economy. Global trade data based on custom registries cover a certain range of commodities for waste and scrap, and only a few selected commodities of second-hand goods (i.e. used tyres, and used textiles).[81] Trade in secondary raw materials as well as goods for refurbishment and remanufacturing is so far, not very well distinguished under the Harmonised System.

An alternative source is the Basel Convention data compiled from annual national reports (UNEP, 2018[13]). While the data has limitations due to the partial and intermittent reporting by some Parties, it nevertheless gives an indication of the overall trends and magnitude of transboundary movement of waste occurring under the Basel Convention (i.e. under the PIC procedure).

Importantly, waste trade subject to PIC procedures under the Basel Convention follow an increasing trend, however only represent a fraction of overall trade in waste and scrap. Figure D.1 gives overall trends and volume of waste trade under the Basel Convention and the PIC procedures. Across the period of 2007 to 2015, the share of transboundary movements of waste under the Basel Convention (i.e. waste subject to PIC procedures) increased from 4% to 7% of global waste and scrap trade.[82] Among waste subject to PIC procedures, the transboundary movement of hazardous waste remained relatively stable at an average of 9.3 million tonnes per year, while the transboundary movement of other waste grew by nearly 7 times from 0.8 to 5.3 million tonnes per year across this period.[83]

[81] This refers to the data made available by UN COMTRADE (https://comtrade.un.org/). Commodities for waste and scrap are based on (Garsous, 2019[34]; Kellenberg, 2012[18]). Commodities for second-hand goods can be found in (Yamaguchi, 2021[8]).

[82] The difference between Figure 3 and Figure D.1 is due to the fact that the former relies on the Basel Convention National Reports Dashboard (UNEP, 2022[12]) that compiles raw data of national reports, whereas the latter relies on the UNEP (2018[13]) "Waste Without Frontiers II" report that verifies and calibrates the data with best estimates. The former gives indication of traded volumes in recent years, while the latter gives indications of traded volumes in previous years based on verified data by the Basel Convention Secretariat.

[83] "Other waste" under the Basel Convention in this context refers to household waste and incineration residues of household waste. As the covered period is for 2007 to 2015, it does not include plastic waste that forms part of "other waste" of the Basel Convention as of January 2021.

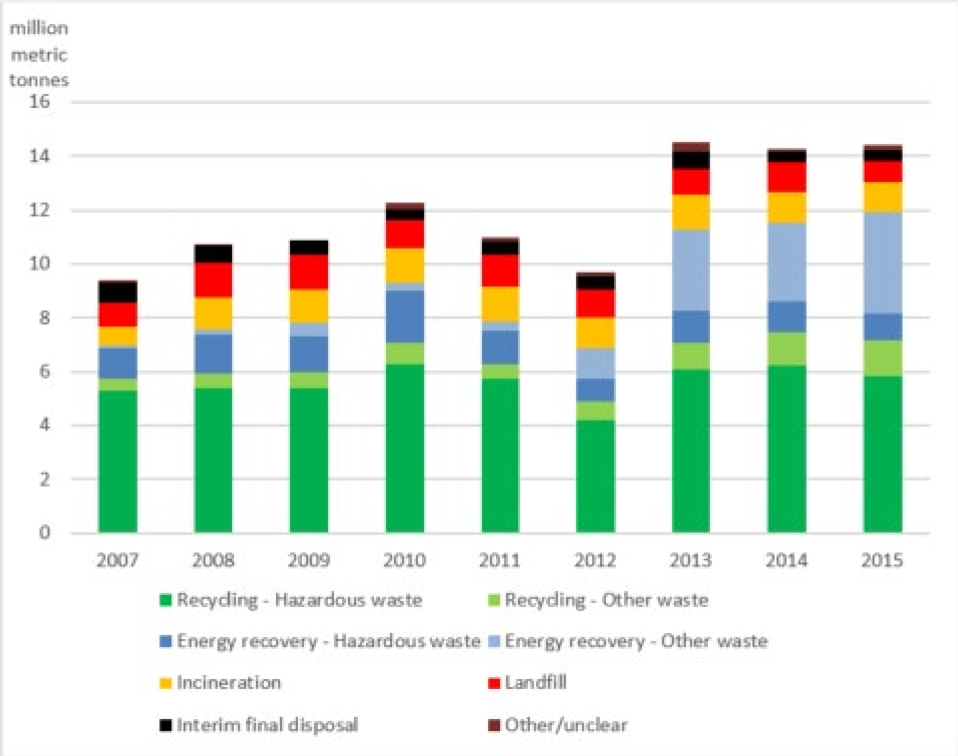
Figure D.1. Detailed trends of trade in waste and scrap

Note: Data based on National Reports under the Basel Convention, and waste and scrap trade from customs data. Data on hazardous waste (Basel Convention characteristics) refers to those under Article 1.1.a of the Convention. Data on hazardous waste (Domestic regulations) refers to those under Article 1.1.b of the Convention.
Source: UNEP (2018[13])and Garsous (2019[34]).

Furthermore, the majority of waste trade subject to PIC procedures under the Basel Convention appear to be destined to recycling or energy recovery operations. Figure D.2 gives a further breakdown of the transboundary movement of waste under the Basel Convention depending on their mode of treatment at destination. As of 2015, 12 million tonnes representing roughly 83% of hazardous waste and other waste subject to PIC procedures were destined to recovery operations, i.e. recycling and energy recovery (green and blue bars in Figure D.2). Waste destined to recycling operations represented half of transboundary movements in 2015 and increased by 24% from 5.8 million tonnes in 2007 to 7.2 million tonnes in 2015. Waste sent to energy recovery represented roughly one-third of transboundary movements in 2015 and grew more extensively by 289% from 1.2 to 4.8 million tonnes over the same period. Final disposal operations including incineration, landfilling and interim final disposal represented around 15% of the transboundary movements in 2015 and the overall trend appeared to be relatively stable (yellow, red and black bars in Figure D.2).

Figure D.2. Destination of waste trade under the Basel Convention by treatment options

Estimated transboundary movements wastes by treatment at destination under the Basel Convention



Note: Data based on National Reports under the Basel Convention. Estimates are based on the assumption that the volumes of global imports and exports are equal in a given year for a given entry (e.g. hazardous waste destined for recycling).
Source: UNEP (2018[13]).

Figure D.3 specifies major importers and exporters of waste under the Basel Convention. Top 20 importers covered 95% of waste trade under the Basel Convention from 2007 to 2015 and were largely represented by OECD countries with the exception of the Philippines and South Africa. Top 20 exporters represented 92% of waste traded under the Basel Convention between 2007 and 2015, and consisted of both OECD and non-OECD member countries.

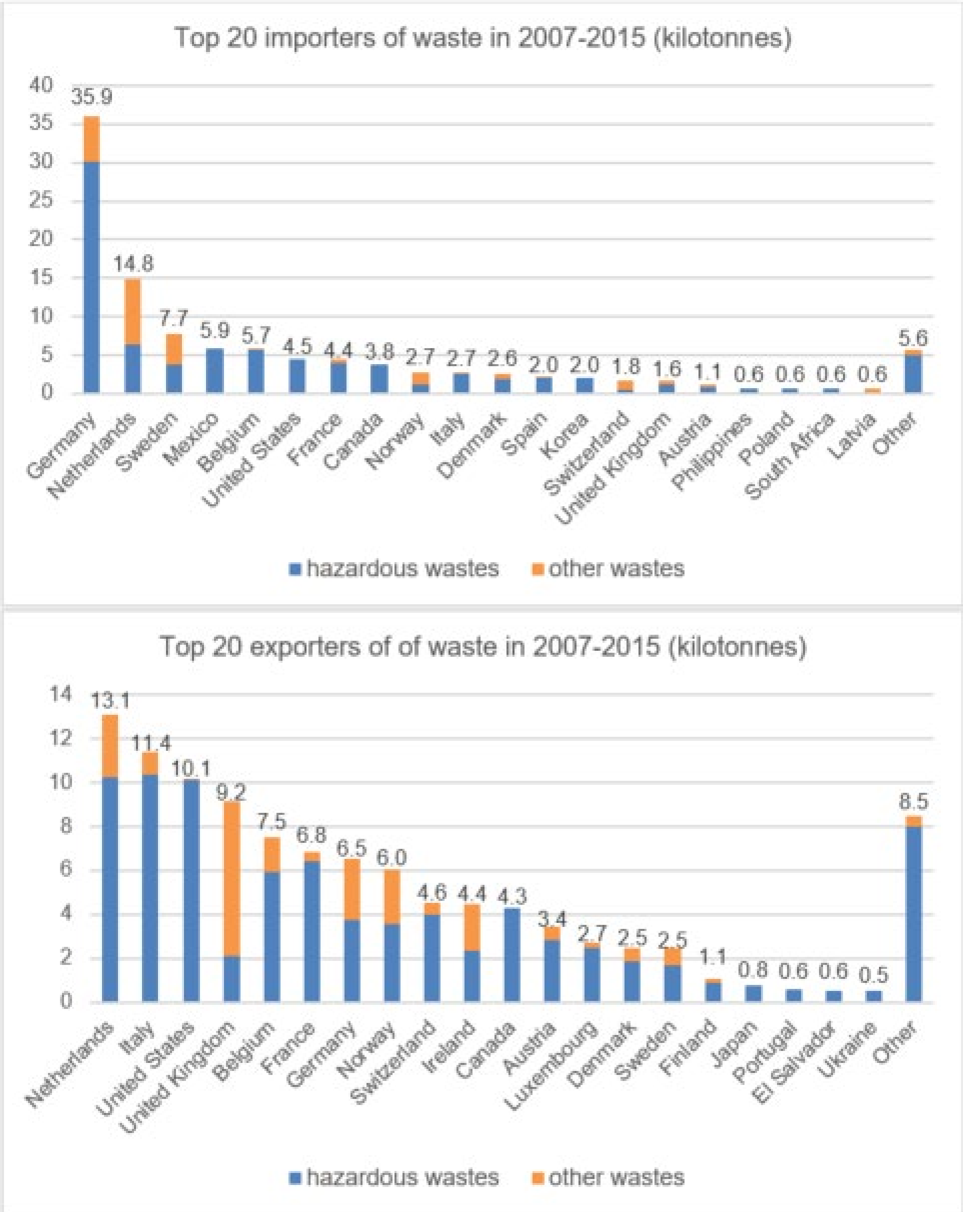
To note, the data does not reflect recent developments after 2015, and more recent trends can differ from what is illustrated here.[84] This includes developments such as the Basel Convention Ban Amendment that restricts the transboundary movement of hazardous waste from OECD countries to non-OECD countries came into force as of December 2019,[85] and the Amendment on Plastic Waste that direct certain fractions to increased controls under the PIC procedure.[86]

[84] More recent data from national reporting of the Basel Convention do not exist in compiled forms and therefore, cannot be shown in this report.

[85] See: http://www.basel.int/Implementation/LegalMatters/BanAmendment/Overview/tabid/1484.

[86] See: http://www.basel.int/TheConvention/ConferenceoftheParties/Meetings/COP14/tabid/7520.

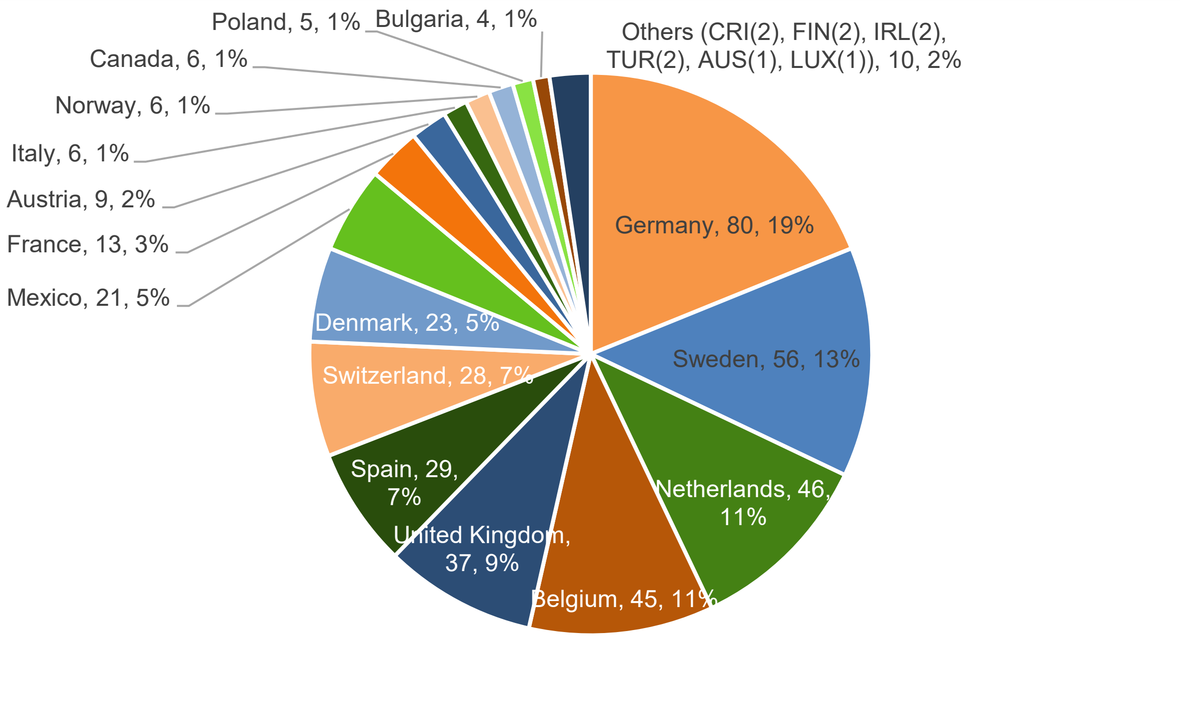
Figure D.3. Major importers and exporters of waste under the Basel Convention



Note: Numbers indicate aggregate volumes of trade in kilotonnes between 2007 and 2015 covering both hazardous and other waste under the Basel Convention.
Source: UNEP (2018[13])

While the magnitude of transboundary movement of waste that are subject to controls under the Basel Convention can be partially identified through National Reports, there is very little information available concerning the actual implementation of PIC procedures under the Basel Convention and the OECD Decision. Based on the OECD Database on Transboundary Movement of Waste, the number of pre-consented facilities can be identified (see: Figure D.4). Nevertheless, the actual implementation of PIC procedures as well as the utilisation of pre-consented facilities remain largely unknown and subject to further analysis.

Figure D.4. Number of pre-consented facilities under the OECD Decision on the Control of Transboundary Movements of Waste



Source: (OECD, 2022[54])

Annex E. Illustrative examples of trade impediments due to procedural requirements and delays in shipping end-of-life products across borders

Trade impediments to circular business models can relate to the alleged heavy and lengthy procedural requirements to ship end-of-life products across borders for their circular use. Many businesses have indicated that the complex and time-consuming nature of procedural and administrative requirements that allow these transboundary movements run against their intentions to use these fractions in a more circular way (OECD, 2020[1]; WEF, 2020[2]; EU, 2020[40]; Business at OECD, 2020[11]).

For example, a multinational enterprise specialising in consumer electronics aiming to establish reverse logistics of end-of-life products for high quality material recovery indicated that it took as much as 20 months to obtain a permit for such transboundary shipments (OECD, 2020[1]).

In another case, an Austrian recycling company specialising in e-waste management claimed that it took nearly two years to obtain consent for a notification of transporting cables to their recycling subsidiary in Romania (EERA, 2019[3]). The same company submitted a notification to transport CRT displays for recycling from Austria to Germany and the decision has been pending for three and a half years (EERA, 2019[3]).

Similarly, according to a stakeholder interview with recycling companies conducted by the World Customs Organization, a non intra-OECD waste shipment from Europe to Asia can typically take six months, which poses delays to the business cycle (WCO, 2020[38]). Similar interviews conducted by the World Economic Forum highlight that the administrative process for notifications of hazardous waste shipments can take up to 14 months (WEF, 2020[2]).

A study by PREVENT and StEP (2022[4]) has also examined the practical implementation of PIC procedures. Their survey highlights three examples where, notification procedures for shipments destined to Belgium from Nigeria, Japan, and Argentina, respectively took 8 months, 16 months, and 6 months. These examples are compiled in Table A E.1 below.

This ambiguous and time-consuming process can increase costs and work against business interests to pursue circular economy business models across borders. Some industry representatives estimate that establishing reverse logistics for used electronics can cost 31% more compared to outbound logistics for new products, and as much as 190% more for those with hazardous characteristics (WEF, 2020[2]).

Table A E.1. Examples of trade impediments due to procedural requirements and delays

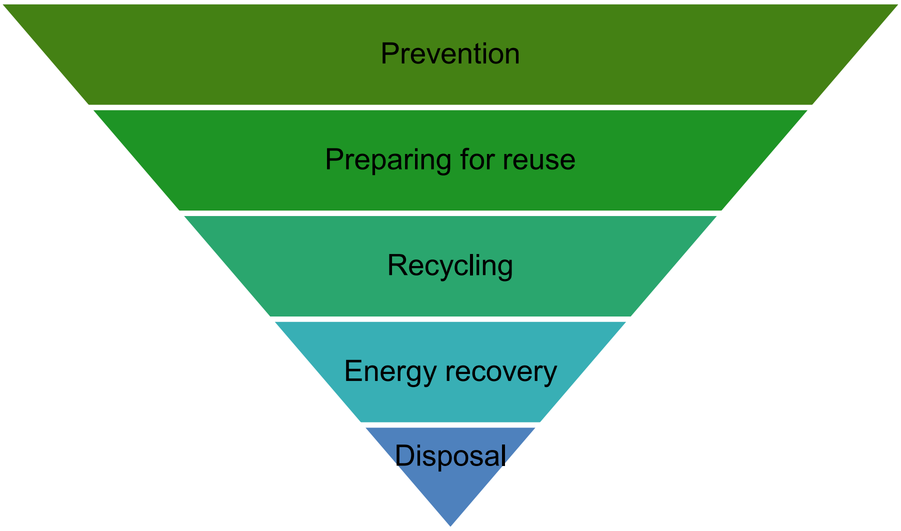
Operator	Transaction	Notification process	Source
E-waste recycler in Austria	Transport CRT displays for recycling in Germany	42 months	(EERA, 2019[3])
E-waste recycler in Austria	Transporting cables to recycling subsidiary in Romania	24 months	(EERA, 2019[3])
Multinational enterprise based in the US	Paperwork to establish reverse logistics of end-of-life products for high quality material recovery	20 months	(OECD, 2020[1])
Private sector actor	Completing the paperwork for PIC procedures.	14 months	(WEF, 2020[2])
Unspecified	Notification procedure for shipment from Japan to Belgium.	16 months	(PREVENT and StEP, 2022[4])
Unspecified	Notification procedure for shipment from Nigeria to Belgium.	8 months	(PREVENT and StEP, 2022[4])
Unspecified	Notification procedure for shipment from Argentina to Belgium.	6 months	(PREVENT and StEP, 2022[4])
Recycling company	Intra-OECD waste shipment from Europe to Asia.	6 months (including shipment)	(WCO, 2020[38])

Source: Author based on various sources identified.

Annex F. Waste treatment options and their environmental impacts

The environmental impacts of end-of-life products depend, in principle, on how they are managed at their destination. The waste hierarchy concept (Figure F.1) serves as a general guide to the environmental desirability of different waste management options. The concept is used in many OECD and non-OECD countries.87 Waste prevention is the most environmentally preferable option, followed by reuse, recycling, and energy recovery. Disposal is the least preferable option and should be the last resort for dealing with residues from other recovery processes.

Figure F.1. The waste hierarchy concept



Source: OECD (2019[9]; 2017[94])

The waste hierarchy is broadly consistent with the concepts of resource efficiency and circular economy, which aim to maintain the value of products, components, and materials at their highest level. The environmental footprint of outputs based on circular modes of operation, such as reuse and recycling, can be significantly smaller than traditional linear modes of operation based on primary production and their disposal (OECD, 2019[9]).

However, in some circumstances, there may be potential trade-offs to consider when the whole life cycle of the product is taken into account. In particular, while prolonging the product life through reuse can be a preferable option to recycling from a waste hierarchy or a circular economy perspective, extending the life of a product with obsolete emission standards or inefficient and energy intensive technologies may work to offset such environmental gains (Yamaguchi, 2021[8]; OECD, 2019[9]). Particular attention should be paid to product categories with long energy intensive use phases and rapid technological progress (OECD, 2019[9]).

87 The most cited concept of the waste hierarchy is perhaps those stipulated in the EU Waste Framework Directive (EU Directive 2008/98/EC).

Assessing the environmental impacts of different resource efficiency and circular economy initiatives is a difficult and complicated task. An OECD (2019[9]) study investigated the potential environmental impacts of five business models for a circular economy based on a review of life-cycle analysis available in the literature. It concluded that it is very difficult to compare the environmental assessment of different circular business models due to the multifaceted nature of the approaches taken in a resource efficient and circular economy, where various sectors are involved and where environmental impacts occur at various stages of a product's life-cycle. For this reason, the environmental outcomes of different circular business models need to be carefully assessed on a case-by-case basis.

However, in a general sense, reuse, repair, refurbishment and remanufacturing, recycling and energy recovery should take precedence over final disposal as long as these processes ensure that second-hand goods and end-of-life products are used or managed in an environmentally sound manner at their destination.

Annex G. Illustrative examples of trade impediments due to diverging definitions and classifications of end-of-life products

Properly distinguishing the physical properties and characteristics of consignments at borders, whether a material qualifies as waste or non-waste, and whether a material qualifies as hazardous waste or non-hazardous waste, is a particular issue to facilitate trade towards a resource efficient and circular economy.

For example, a study by Odeyingbo, Nnorom and Deubzer (2017[95]) examined actual consignments arriving at the ports of Nigeria and found that out of 760 used electrical and electronic equipment checked and tested at the border, at least about 19% of the equipment was dysfunctional.[88] While non-functional electrical and electronic equipment would normally qualify as hazardous waste and would require to go through a PIC procedure, these consignments circumvent the Basel Convention disguised as second-hand goods either intentionally or unintentionally.

Notwithstanding their importance, many country-level divergences appear in the definitions and classifications of end-of-life products, concerning hazardous waste, non-hazardous waste and non-waste goods for reuse, repair, refurbishment and remanufacturing, as well as for failure analysis. (Yamaguchi, 2021[8]; PACE, 2021[39]; WEF, 2020[2]; WEF, 2020[37]; WCO, 2020[38]; EU, 2020[40]; 2016[41]; Bellmann, 2021[35]). A further challenge emerges from country-level differences in the implementation of international waste shipment regulations (EU, 2020[40]; 2016[41]).

Some recyclers have claimed that it is difficult to classify waste correctly, especially for highly technical products such as end-of-life vehicles and e-waste, when there are major differences in interpretation between countries (EERA, 2019[3]). A product classified as a recycled material in one jurisdiction can be re-classified as waste subject to controls in another jurisdiction (EERA, 2019[3]; OECD, 2009[27]). As an example, lithium-ion batteries, which are currently not listed in the EU Waste Shipment Regulation, are considered as non-hazardous waste in Belgium, and, in contrast, as hazardous waste in some parts of Germany (Digital Europe, 2019[64]). In another case, a German company seeking to export waste – i.e. slag rich in copper - to a technical facility in Belgium that could extract the copper, encountered difficulties with the shipment due to the differing definition of waste between the two countries (EU, 2016[41]). In the same vein, the review process of the EU Waste Shipment Regulation, identified, among other things, the need to harmonise waste classifications and clarify the relationships between the various classifications currently in use, including the EU waste list under the Waste Framework Directive, custom codes (HS codes), the Basel Convention codes, and the OECD Decision codes (EU, 2021[70]; 2020[40]). In particular, the different interpretations of the accepted level of contamination among EU member states have been cited as a point of concern (EU, 2021[70]). These concerns also extend to different interpretations of the end-of-waste criteria (EU, 2020[40]; 2016[41]; MiW & IMPEL, 2019[96]).

Furthermore, representatives of the remanufacturing industry also point out that there are significant challenges in regulatory definitions of remanufactured goods. These industries have claimed that trade and regulatory barriers have been one of the main obstacles to establishing reverse logistics across

[88] The study indicates a lower bound of dysfunctional used electrical and electronic equipment, as they were only able to perform quick visual checks and simple operation tests at the border. The study implies that significantly more amounts of second-hand electric and electronic goods would have been dysfunctional even if some of them may be repaired and used again in Nigeria.

borders, such as retrieving their products at the end-of-service life and shipping them back to regional remanufacturing centres (OECD, 2020[1]; UNEP, 2018[26]). In particular, current custom codes only refer to new products and very rarely used products (e.g. tyres, textiles), and there are no dedicated entries for remanufactured goods (OECD, 2020[1]).

Other industry stakeholders claim that many countries prohibit the import of used products for direct reuse (Business at OECD, 2020[11]). In addition, some industry stakeholders indicate that regulations related to the transport of dangerous goods and trade can be a hurdle for shipping end-of-life products (National Board of Trade Sweden, 2020[97]). These regulations include those based on the UN Model Regulation, including the International Civil Aviation Organization's Technical Instructions (ICAO-TI), the European Agreement on International Carriage of Dangerous Goods by Road (ADR), and the International Carriage of Dangerous Goods by Rail (RID). These examples are compiled in Table A G.1. below.

Table A G.1. Examples of trade impediments due to diverging definitions and classifications

Challenges in diverging regulatory definitions of waste and scrap	Source
Difficulty encountered by recyclers in the classification of waste due to major differences in interpretation between countries	(EERA, 2019[3])
A product classified as a recycled material in one jurisdiction can be re-classified as waste subject to controls in another jurisdiction	(EERA, 2019[3]; OECD, 2009[27])
Lithium-ion batteries are considered as non-hazardous waste in Belgium, and, in contrast, as hazardous waste in parts of Germany	(Digital Europe, 2019[64])
A German company exporting waste (i.e. slag rich in copper) to a technical facility in Belgium faced difficulties with the shipment due to differing definition of waste between two countries	(EU, 2016[41])
Review process of the EU Waste Shipment Regulation identified the need to clarify and harmonise waste classifications between various classifications in use (e.g. EU waste list, HS codes, Basel Convention codes, and OECD Decision codes)	(EU, 2021[70]; 2020[40]).
Different interpretations of the accepted level of contamination among EU member states have been cited as a point of concern.	(EU, 2021[70])
Concerns over different interpretations of the end-of-waste criteria.	(EU, 2020[40]; 2016[41]; MiW & IMPEL, 2019[96])
Challenges in diverging regulatory definitions of remanufactured goods	**Source**
Industries claims on trade and regulatory barriers being a main obstacle to establishing reverse logistics across borders.	(OECD, 2020[1]; UNEP, 2018[26])
HS codes only refer to new products, some used products (e.g. tyres, textiles), with no dedicated entries for remanufactured goods.	(OECD, 2020[1])
Other related challenges in establishing reverse logistics across borders	**Source**
Industry stakeholders claiming that many countries prohibit the import of used products for direct reuse.	(Business at OECD, 2020[11])
Industry stakeholders indicating that regulations related to the transport of dangerous goods and trade can be a hurdle for shipping end-of-life products.	(National Board of Trade Sweden, 2020[97])

Source: Author based on various sources identified.