Expanding the knowledge base on intra-EU waste movements in a circular economy

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Trinomics

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Expanding the knowledge base on intra-EU waste movements in a circular economy

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Glossary

CDM	Construction and Demolition (typically the waste from this)
CEAP	Circular Economy Action Plan
CIF	Cost, insurance, freight
CN	Combined Nomenclature
Comext	Comext is Eurostat's reference database for detailed statistics on international trade in goods https://ec.europa.eu/eurostat/web/international-trade-in-goods/data/focus-on-comext
EEA	European Environmental Agency
EfW	Energy from Waste (largely interchangeable with WtE)
ELoW	European List of Wastes
ELV	End of Life Vehicles
Env_wasship	Summarised WShipR data, lower granularity. https://ec.europa.eu/eurostat/databrowser/view/env_wasship
Env_wasfac	Database for number and capacity of recovery and disposal facilities in Europe by NUTS 2 regions. http://appsso.eurostat.ec.europa.eu/nui/show.do?dataset=env_wasfac&lang=en
EoW	End-of-waste
EPL	Environmental Performance Level
EPR	Extended Producer Responsibility
EU	European Union
EUR	Euro
EuRIC	European Recycling Industries' Confederation
GDP	Gross Domestic Product
IMPEL	European Union Network for the Implementation and Enforcement of Environmental Law
MBT	Mechanical biological treatment
MSs	Member State(s)
MSW	Municipal Solid Waste
NGO	Non-governmental organisation
OECD	Organisation for Economic Co-operation and Development
RDF	Refuse derived fuel
SDRF	Solid recovered fuel
WEEE	Waste Electrical and Electronic Equipment
WFD	Waste Framework Directive
WSR	Waste Shipment Regulation
WShipR	The Eurostat reported data on Waste Shipments as reported under the Waste Shipment Regulations and Basel convention. https://ec.europa.eu/eurostat/web/waste/data
WtE	Waste to Energy

Executive Summary

Purpose

The purpose of this study is to improve the understanding of the movements of waste between EU Member States (MSs) by broadening the knowledge base, describing the dynamics and the drivers behind these movements and assessing the overall environmental benefit and risks that the movements bring to the overall EU waste management system. The work can be structured under the following three questions:

1. What can the available data tell us about the intra EU shipments of Waste?
2. What drives and constrains these waste movements?
3. What are the environmental benefits of these waste movements?

Methods

This report has involved extensive data extraction and analysis – using a novel combination of statistics on trade in waste (Comext) plus statistics on the generation, treatment and disposal of waste from Eurostat. The report also involved literature review and a small number of interviews with key stakeholders from the waste industry.

The work has primarily focussed on non-hazardous (recyclable) waste streams but also covers some hazardous streams, in order to make use of the available data and to reflect the environmental benefits available from recovering resources from hazardous waste.

What can the available data tell us about the intra EU shipments of Waste?

The table below presents total waste generated, excluding major mineral waste generation, compared to total waste imports and exports both within the EU and with third countries in millions of tonnes. It is apparent that transboundary shipments remain a small percentage of total waste generated, with over 90% of wastes generated treated within the Member States themselves, with transboundary movements representing a small percentage by total volume.

Table 0-1: Total EU waste generation, intra EU and Extra EU waste exports

	2004	2006	2008	2010	2012	2014	2016	2018
Total EU waste generated (excl. major mineral wastes)	781	790	760	759	758	770	785	809
Total waste exported (extra-EU)	18.6	19.5	24	30	32	28	29	31
Total waste imported (intra-EU)	42	44.5	46.4	46.4	46.4	46.4	45.3	49.2

Note: imports and exports are calculated on the bases on CN codes reported to the COMEXT database, see Annex A.

The economy and location of the countries plays an important role in their exports of imports of waste. Countries such as BE, NL and LU are generally transport hub countries, which is likely to account for their proportionally higher levels of exports of wastes than countries of a similar size in terms of population and economy.

Analysis of the patterns in the waste streams considered key to the circular economy, as they are the most resource rich (i.e. recyclable) revealed the following:

- ***Plastic waste:*** Some Member States (FR, DE and SE) consistently rely on exports whilst others appear to be expanding their imports (most notably CZ, and RO).
- ***Glass waste:*** Some Member States (BE, EL, HU, NL, RO, SE and SI) consistently rely on exports, whilst others appear either to be expanding their imports of glass waste overall (most notably CZ) or are large destinations for glass waste overall (DE and PT).
- ***Textile waste:*** Some Member States (AT, BE, DE, FI, FR, PT and SE) consistently rely on exports, whilst others are generally net importers of textiles waste (most notably BG, ES, HU, IT, LT, NL, PL and RO).
- ***Non-ferrous metals:*** There are a significant volume of shipments originating from or entering DE, and the difference between imports versus exports is relatively small. DK, FR and NL are the Member States that export the largest volumes and export more non-ferrous metal waste than they import, whereas AT, ES and IT show increasing trends of net volumes imported increasing over time.
- ***Ferrous metals:*** IT, BE, ES and LU appear to be the overall countries of destination for ferrous metal wastes from other EU Member States. DE, FR and NL appear to rely more heavily on exports to other Member States of their ferrous metal wastes. Imports into Italy are reported (industry interview) as being relatively high due to the high use of electric arc furnaces in iron and steel production in Italy, and these are capable of using a much higher proportion of waste material than blast furnaces (which are more common in German steel making plants). Germany appears to be the MS with largest volume of ferrous waste moving into and out of the country. This reflects Germany's position as the largest steel maker in the EU, they accounted for over 40M tonnes of crude steel production in 2019 (25% of crude steel production in the EU). With net exports of just under 3.5M tonnes, exports of ferrous metal waste represent just under 10% of total production. When compared with FR (with 14.5M tonnes of crude steel production in 2019), net exports as a percentage of production in FR are 30% of total production.
- ***Paper and cardboard***: AT, DE, ES, HU and NL appear to be the overall countries of destination for paper and cardboard wastes from other EU Member States. CZ, DK, FR and PL appear to rely more heavily on exports to other Member States of their paper and cardboard wastes.
- ***Refuse derived fuel, other wastes from mechanical treatment and mixed municipal waste for energy recovery and incineration***: DE and SE are net importers of these wastes for R1 and D10 activities but that the proportions imported are a small fraction of the total wastes subject to these activities. However, for SK, imports are an important fraction of the total feedstocks for R1 and D10 capacity. Conversely, IE and to a lesser extent SI are heavily reliant on exports for the incineration of their wastes.

With regard to the **value of Intra EU waste shipments**, the COMEXT database reports waste shipments both by quantity and value (see below for data on selected key recyclable streams).

Table 0-2: Total value of exported intra-EU recyclables in 2019

	Paper and Cardboard	Textiles	Plastics	Glass	Non-ferrous metals	Ferrous metals	TOTAL
Value (million Euro)	1,260	682	557	113	1,227	8,379	**12,217**

This data has been analysed to compare the relative performance of Member States in the types and value of waste they export and import. To illustrate this, and to compare two contrasting MSs in terms of GDP and resource use, the data for Germany and Bulgaria were compared. This comparison indicates that Germany imports higher-value waste compared to Bulgaria in ferrous metals, paper and cardboard, textiles and plastic, whereas Bulgaria imports higher value material in non-ferrous metals. Glass waste imports appear to have a similar value in the two countries. The analysis also shows that the ratio between waste exported and generated tends to be much higher in Germany compared to Bulgaria. This suggests a more independent waste management system in Bulgaria, which is able to cope with a larger share of its waste without resorting to shipping it to third countries.

With regard to the **treatments that intra-EU waste shipments receives** the analysis is constrained by the data. The Comext (trade) data does not specify the treatments that the waste receive. The Eurostat (WSR/Basel) data does give some information on waste treatment but does not cover non notifiable waste shipments and some of the waste classifications it provides lack detail. **Looking at the Eurostat (WSR/Basel) data**:

- Eight member states (Belgium, Germany, the Netherlands, France, Luxembourg, Italy, Austria and Ireland) are the main waste exporting countries for the highest volume Basel-coded waste categories.
- Most of the top 10 exporting member states are also listed in the individual MS's top three of receiving countries. This shows that the MSs cannot be categorised into receiving and exporting countries, but rather can be grouped into MSs that transfer high volumes of waste among each other, and others that are less involved in intra EU waste movements;
- Cross-border shipments of these flows, which mostly consist of hazardous waste, mainly go to neighbouring countries.
- Looking at the eight MSs' who export most notifiable waste, some have also specialised in the treatment of specific waste streams, and account for the treatment of more than half of the notified waste categories with the highest volumes transferred between EU member states. It can be observed that three MSs (Belgium, the Netherlands and Germany), are the main providers of treatment for 19 out of the 24 notified waste streams with the highest volumes transferred. Five other MSs (Denmark, France, Portugal, Slovakia and Spain) are the main treatment providers for the other five notified waste streams with the highest volumes transferred.

What drives and constrains these waste movements?

Articles 11 and 12 of the WSR allow MSs to impose restrictions on the import of certain waste streams for disposal or recovery..

The MSs which import the most waste for disposal or recovery purposes are Germany, the Netherlands, France, and Sweden. They have very little to no restrictions on waste imports, which matches with the high trend of imports these countries have within the time period analysed (2013-2018). The first three countries import waste either from each other or from Italy, Luxembourg or Austria. Sweden received more waste from extra-EU countries (Norway and United Kingdom).

The level of effectiveness of waste import restrictions in accordance with Article 11 and 12, WSR, is difficult to confirm. The largest waste flows for disposal or recovery purposes occur between large and centrally located countries which have no, or only partial restricting, measures in place. Following the

reported implementation of new restriction measures the volumes imported by smaller countries changed only slightly or showed no correlation. This lack of apparent impact could relate to data limitations (the broad scope of Eurostat data and time period limitations), or smaller treatment and import levels. Therefore, no clear conclusion on the effectiveness of waste import restriction measures can be drawn.

The literature suggests that **drivers for shipping waste** can be categorised into the following, five groups.:

- ***Economic:*** Include issues related to minimising the costs of treatment or disposal and transport. These include gate fees or taxes for sending waste to incineration plants. The cost and efficiency of transport also plays a key role -as it does for the transport of any material.
- ***Regulatory***; It is important to clarify that the administrative burden associated with regulation does not typically block shipments. Its typical impact is to increase waiting times and costs of shipments that ultimately decreases profit margins and / or slows resource movement.
- ***Technical***; Mainly relating to the presence or not of sufficient infrastructure to deal with all waste treatment and recycling needs within a country's boundary.
- ***Geographic***: Related to transport costs and infrastructure.
- ***Environmental***: Regarded as relatively minor by waste companies and closely related to economic and regulatory drivers.

These drivers cannot simply be ranked, although economic drivers always appear to be the most important, and there is clear interplay between the drivers. We have attempted to summarise and capture the influential factors and different considerations that waste holders face in a decision-tree. The decision tree for any specific waste is specific to it and influenced by legal, operational and economic considerations. Therefore, it should be stressed that this decision tree is only intended to illustrate the drivers, and how they interact with each other, and it cannot capture every option for every waste stream.

The first option facing a waste holder is if they wish to comply with the law or not. If not, the decision will be to pursue the cheapest option, with environmental considerations playing no role.

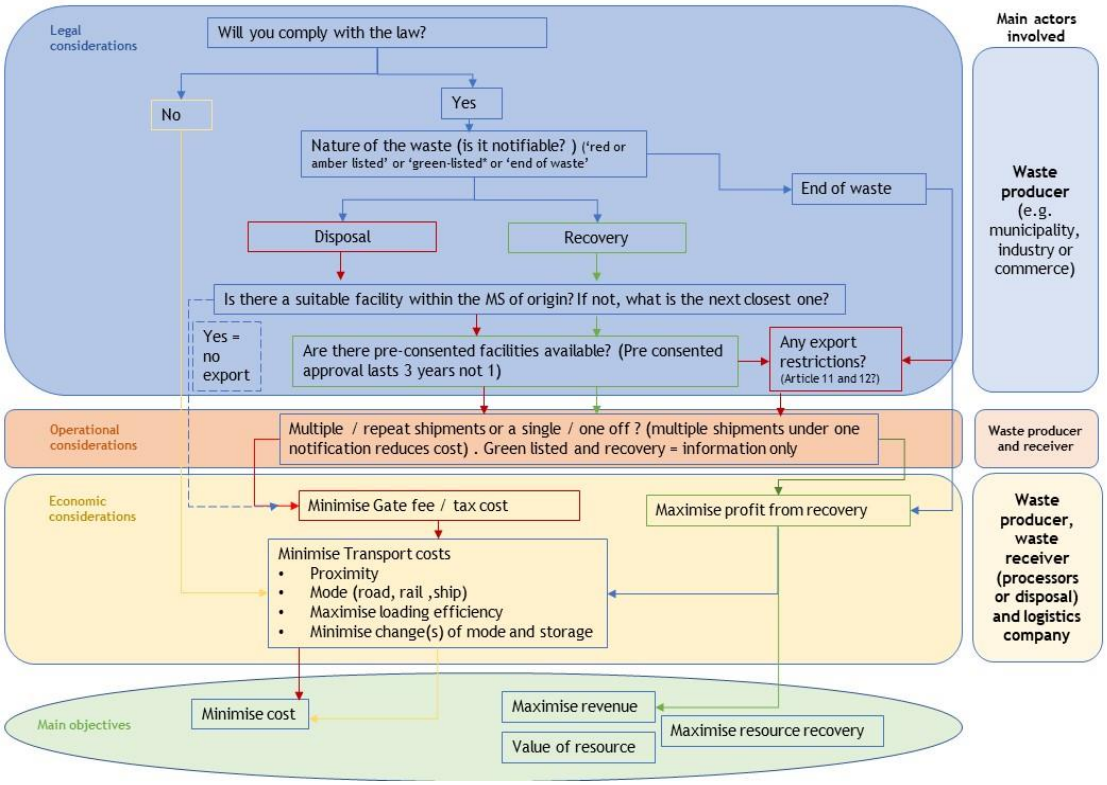
Assuming the waste holder wishes to comply with the law (which will apply to all the waste captured in the statistics), the first question is if the waste is green-, or amber-listed, or if it can actually be defined as a resource according to 'end of waste' definitions. In the case of green-listed waste, a suitable recovery facility has to be found, either within the country of origin or outside. If the facility is located in another MS, it also has to be checked if the respective MS imposes any restrictions on the import of the waste in question. Once options are clear, factors, such as transports costs and value of the resource, will determine where the waste will finally go for disposal or recovery.

In order to reduce administrative costs for shipments which require notification an important consideration is whether the destination facility is pre-consented. This would make future shipments significantly faster as consents can last for three years not one. Consenting multiple shipments as opposed to each individual shipment is another cost saving approach waste holders pursue.

The next consideration cluster relates to practical and operational factors (orange) which decide on the transport mode and method for the shipment. Thereafter, the economic considerations (yellow) relate

to treatment costs (gate fees and taxes). Depending on the waste type, the decision arrives at options representing either the minimisation of costs (for disposal) or maximising revenue through recovery.

Figure 0-1 Decision-tree for intra-EU waste shipments



Source: own table

What are the environmental benefits of these waste movements?

Intra EU (and any other) waste movements can provide environmental and circular economy benefits by:

- Enabling the increased recycling of waste into secondary raw materials that effectively are used as a su**bstitute for primary materials in production processes**, thus avoiding the resource consumption and associated environmental impacts from primary production;
- Providing **safe sinks** for substances and materials contained in wastes, that could damage human health and/or the environment, and should be kept out of new production loops.

The analysis of the environmental benefits of intra EU waste movements requires information on the nature of the waste, its potential for recycling or recovery, and the treatment that will be given at destination. Datasets on waste that is traded as goods use trade codes to classify the waste in different product categories (Comext), movements of wastes that are notified because of their potential hazard (Eurostat (Basel/WSR data)) including an indication on the type of treatment that is intended on reception. The Basel notified data (Eurostat) thus provides more precise information on the treatment provided, but is less specific on the waste characteristics and the potential for recycling or recovery. COMEXT data has more detail on the characteristics of the waste and its secondary raw material potential, but does not specify the actual treatment at destination.

Total volumes of intra-EU waste streams were analysed in terms of environmental performance level (EPL) for the six MSs which collectively account for approximately 70% of the total import or export of these streams: Germany, The Netherlands, France, Italy, Belgium and Austria. Both for the non-hazardous, CN-coded waste streams traded as goods (Comext data), and for the notified waste streams subject to the Basel Convention (Eurostat data). From the analysis, it is clear that:

- Both for the non-hazardous, CN-coded waste streams traded as goods, and for the notified waste streams subject to the Basel Convention, the more environmentally beneficial treatment options (R treatment codes) are favoured over the less beneficial ones (D treatment codes) as the disposal treatment options (D) represent around 10% of the final treatment quantity of exported waste
- The largest volumes of wastes that are moved between MSs usually go to the more beneficial waste treatments;
- Much larger volumes of waste are treated within MSs than are exported to other MSs.
- Volumes of waste traded and documented in the Comext database are much higher than the volumes of (hazardous) waste transported with Basel notification;
- The Countries most active in moving notified wastes are equally active in the trade of non-hazardous waste and waste-related goods.

Export will always be more complex and more burdensome as compared to local processing, so it a reasonable assumption that waste will not be (legally) exported without having a motive that makes it a more valuable choice than local treatment.

1 Introduction

1.1 This report

This report presents the final outcomes of the project 'Expanding the knowledge base on intra-EU waste movements in a circular economy' for the European Environmental Agency (EEA). The project has been developed in collaboration with Trinomics, Wood, Vito and Ricardo. Wood and Trinomics were responsible for Task 2 (mapping of waste movements within the EU), Trinomics developed Task 3 (Drivers motivating waste movements within the EU) and Vito led Task 4 (Environmental benefits and risks from intra-EU waste movements).

1.2 Overview of the project and its objectives

The purpose of this study is to improve the understanding of the movements of waste between EU Member States (MSs) by broadening the knowledge base, describing the dynamics and the drivers behind these movements and assessing the overall environmental benefit and risks that the movements bring to the overall EU waste management system. The work can be structured under the following three questions:

1. What can the available data tell us about the intra EU shipments of Waste? Covering:
    a. mapping of waste movements within the EU to understand what waste is shipped intra-EU, where MSs send their waste and how it is treated at the final destination;
    b. particular data gaps on green listed waste between EU MSs (their origin, volume and type of shipments) and how it is treated / disposed of.
2. What drives and constrains these waste movements? Covering:
    a. compiling a list of restrictions for waste imports based on Article 11 and 12 of the WSR;
    b. identifying drivers motivating waste movements within the EU to comprehend the decision-making process and criteria considered by the holders of waste.
3. What are the environmental benefits of these waste movements? Covering:
    a. defining environmental benefits and risks from intra-EU waste movements.
    b. the extent to which current waste shipment practices and volumes align with the European Commission's Circular Economy objectives

1.3 Scope of this study

The geographical scope of this study covers all 27 EU Member States and EEA members.

The scope of waste data considered includes all intra EU waste movements including hazardous and non-hazardous waste. The most relevant waste streams for this study are the non-hazardous waste streams (ferrous metal waste, non-ferrous metal waste, paper waste, plastic waste, textile waste, glass waste) as these represent the largest potentials in enhancing the Circular Economy within the EU. However, in two sections, waste treatment volumes and environmental benefits of waste movements, we have also included some analysis of hazardous waste streams. This has been done to make full use of the available data and to reflect the fact that environmental benefits are available from recovering resources from hazardous waste streams.

The data that is used for the most detailed analysis is the most recent that is available (typically at least 2016-2018), but where there are longer time series available, and there is a benefit in showing a longer trends older data has been presented.

1.4 Structure of this report

This report is structured as follows:

- **Chapter 2** provides an overview of the political context and scope of this study;
- **Chapter 3** presents and analyses the data on the volume of intra EU waste movements, their value and their treatment;
- **Chapter 4** covers WSR Article 11 and 12 restrictions (as they are a possible restriction on intra EU waste movements);
- **Chapter 5** presents and analyses drivers motivating waste movements within the EU;
- **Chapter 6** attempts to analyse the environmental benefits and risks from intra-EU waste movements;
- **Chapter 7** summarises the results.

2 Background

2.1 Policy background

The identification of the possible adverse impacts of waste shipments on the environment and public health dates back to the 1970s/1980s. The increase in the production of waste, combined with the development of a globalised economy, has led to growing volumes of waste being shipped across borders. Several events showed the potential harm to the environment and public health that shipments of waste (especially hazardous waste) could generate, in the absence of rules designed to ensure that it is carried out safely and with appropriate controls.

The need for international action to address this issue was recognised as one of the three priority areas in the United Nations Environment Programme's (UNEP) first Montevideo Programme on Environmental Law in 1981.

2.1.1 The Basel Convention — a global legal response

Following on from UNEP prioritising the control of waste shipments to mitigate their environmental impacts in 1981, the negotiations for the elaboration of a global convention on the control of transboundary movements of hazardous wastes commenced. Negotiations concluded in March 1989 with the adoption of the Basel Convention on the Control of Transboundary Movements of Hazardous Wastes and their Disposal (the Basel Convention). The Convention entered into force on 5th May 1992. Covering a wide range of wastes defined as "hazardous wastes" based on their origin and/or composition and characteristics, as well as two types of wastes defined as "other wastes" — household waste and incinerator ash, the Convention has the following three main aims:

1. Reducing hazardous waste generation and the promotion of environmentally sound management of hazardous wastes, wherever the place of disposal;
2. Restriction of transboundary movements of wastes except where it is perceived to be in accordance with the principles of environmentally sound management;
3. A regulatory system applicable where transboundary movements are allowed. The regulatory system is based on the concept of prior informed consent. It requires that, before export may take place, the authorities of the State of export notify the authorities of the prospective States of import and transit, providing them with detailed information on the intended movement. The movement may only proceed if all States concerned have given their written consent. In the event of a transboundary movement of hazardous wastes having been carried out illegally, or if it cannot be completed as foreseen, the Convention attributes responsibility to one or more of the States involved, and imposes the duty to ensure safe disposal, either by re-import into the State of generation or otherwise.

2.1.2 The OECD Decision — an OECD international response

OECD Council Decision C(92)39/FINAL on the Control of Transfrontier Movements of Wastes Destined for Recovery Operations addresses transboundary movements of wastes destined for recovery operations between member countries of the Organisation for Economic Co-operation and Development (OECD) with the intention of ensuring their environmentally sound and economically efficient management.

Importantly, and arguably the main reason for its continued existence, the Decision also applies to transboundary movements of recoverable wastes between OECD member countries in cases where an OECD member country is not a Party to the Basel Convention — this is particularly important for the US as a non-Party to the Basel Convention.

The OECD system, which has been amended over time to take into account developments in the Basel Convention, is based on two control procedures:

1. Green Control Procedure: for wastes presenting a low risk for human health and the environment and, therefore, not subject to any other controls than those normally applied in commercial transactions;
2. Amber Control Procedure: for wastes presenting sufficient risk to justify their control.

The principal procedural differences from the Basel Convention under the OECD include time limits for approval processes, tacit consents and pre-consent procedures.

2.1.3 The EU Waste Shipment Regulation (WSR) — the EU response

The European Community originally introduced measures on the supervision and control of shipments of waste in 1984 under Council Directive 84/631/EEC. The Directive took effect from 1 October 1985 and covered shipments of hazardous waste. It required prior notification to the countries involved, thereby allowing them to object to a specific shipment. The Directive was amended by Council Directive 86/279/EEC of 12 June 1986, which introduced additional provisions in order to improve the monitoring of exports of waste out of the Community. These initial legislative instruments were significantly hampered by delayed, incomplete or failure to transpose the legislation at all in some Member States.

In 1990, following international developments in the context of the Basel Convention and the OECD, the Commission put forward a proposal for a Waste Shipment Regulation with the Basel Convention and, latterly, the 1992 OECD Decision forming the main pillars of the resulting 1993 Regulation, applicable as of 6 May 1994. The move to a Regulation rather than a Directive was aimed specifically at addressing transposition and implementation issues encountered in the original Directive.

As both the Basel Convention and OECD Decision have evolved over time it has been necessary for the Regulation to be amended to take into account these developments. Problems with the Regulation identified in its operation within the EU have also led to changes. The Regulation applies to shipments of waste:

- Between EU countries within the EU or transiting via non-EU countries;
- Imported into the EU from non-EU countries;
- Exported from the EU to non-EU countries;
- In transit through the EU, on the way from or to non-EU countries.

There are two control procedures for the shipment of waste:

1. general information requirements: applicable to shipments for recovery of wastes, listed in Annex III ('green' listed wastes: non-hazardous, such as paper or plastics) or IIIA; and
2. prior written notification and consent - for other types of shipments of wastes, including:
    a. shipments of wastes listed in Annex IV ('amber' listed wastes containing both hazardous and non-hazardous parts) or in Part 2 of Annex V (European list of wastes, e.g. wastes from mining, quarrying and physical and chemical treatment of minerals); and

b. shipments for disposal of wastes listed in Annex III ('green' listed wastes).

In applying the Regulation all parties involved must ensure that waste is managed in an environmentally sound manner, respecting EU and international rules, throughout the shipment process and when it is recovered or disposed of. Exports to non-EU countries of waste for disposal are prohibited, except to EFTA countries that are party to the Basel Convention and exports for recovery of hazardous waste (i.e. that pose a risk to human health and the environment) are prohibited, except those directed to countries to which the OECD decision applies. Finally, imports from non-EU countries of waste for disposal or recovery are prohibited, except for imports from countries to which the OECD decision applies, from non-EU countries that are party to the Basel Convention, from countries that have concluded a bilateral agreement with the EU or EU countries or other areas during situations of crisis.

Several difficulties and/or gaps have been identified in the implementation of the WSR. Those applying to intra-EU waste shipments are:

- *Data quality* — discrepancies have been identified in relation to quantities of waste reported by countries of dispatch and countries of destination;
- *Classification of wastes* — despite the sharing of experiences between Parties to the Basel Convention on the use of Basel codes for the classification of waste and similar experience sharing between EU Member States on the use of European Waste List Codes the classification of waste remains inconsistent across the EU;
- *Illegal shipments* — despite improvements in inspection practices across Member States, including those expected from 2016 as a result of Regulation (EU) No 660/2014, the level of shipments of waste in violation of the WSR appears to remain relatively high;
- *Reporting by MSs* — compliance with reporting deadlines continues to demonstrate differing performance by Member States.[1]

In order to address these difficulties and to further integrate enabling principles for the Circular Economy — in particular the abiding principle of treating the waste as closely as possible to its source to achieve highest environmental outcomes (the proximity principle), the WSR is currently being reviewed in line with the European Commission's better regulation guidelines.

2.2 The efficient functioning of waste markets in the EU

The WSR must not only ensure protection of the environment in relation to shipments of waste but also forms the main legislative instrument through which the EU meets its commitments under multilateral environmental agreements. Its implementation to date has, however, not been without difficulty. This is rooted in the following main reasons:

- differing interpretations of the definition of 'waste', diverging classifications of waste as 'hazardous' or 'non-hazardous' and the application of national end-of-waste criteria;
- Waste Shipment Regulation's rules, e.g. the notification requirements and provisions concerning shipments through transit countries;
- the capacities for waste treatment, differing taxes or fees, and non-harmonisation of Enhanced Producer Responsibility (EPR) schemes;

[1] European Commission (2019) Study supporting the evaluation of Regulation (EC) No 1013/2006 on shipments of waste, Final report, p. 26

- the lack of EU-wide enforcement of waste legislation and the lack of a policy that either bans or severely discourages landfilling.

In order to address these challenges, a study on 'The efficient functioning of waste markets in the European Union'[2] suggested eight recommendations.

1. Develop Schengen area for waste for recycling and recovery.
2. Harmonise and strengthen the system of pre-consented facilities.
3. Ensure more harmonised classification system for waste shipments.
4. Facilitate waste shipments through an electronic system for notification (and information) requirements.
5. Address delays in shipping waste via transit countries.
6. Address problems of cooperation between authorities at different levels.
7. Upgrade waste management systems in the EU.
8. Improve enforcement in MS.

2.3 Circular economy and waste shipment

Circular economy policy response

The first and second Circular Economy Action Plan (CEAP), published in 2015[3] and 2020[4] respectively, include, inter-alia, a stepping up in the enforcement of the WSR and measures to facilitate waste shipment across the EU.

The most recent CEAP, released under the European Green Deal, aims to ensure that resources used are kept in the EU economy as long as possible. This includes enabling intra-EU waste movements which supports the application of the Waste Hierarchy while discouraging extra-EU shipments. For instance, secondary material markets are intended to stimulate increased and better-quality recovery waste materials. Waste exports can result in negative environmental and health impacts in the countries of destination due to treatment which does not comply with environmental standards or with the concept of circularity. Every waste export is also a potential loss of resources and economic opportunities for the recycling industry in the EU or MS. Recent import restrictions introduced by some third countries have exposed the dependence of the EU on foreign waste treatment, but they should also help mobilise the recycling industry to start increasing its capacity and adding value to waste in the EU.

Since the adoption of the Basel Convention, the EU has successfully created a Single Market for Goods and Services. Primary materials and products can flow easily and without controls across intra-EU borders. However, the Single Market for the Circular Economy is still a work in progress. The free movement of primary, but not secondary raw materials, was fully justified when the dominant method of waste treatment was disposal, however as this becomes less the case there is good reason to revisit environmental agreements and regulation related to waste shipment.

Circular economy approach to waste shipment

Circular economy strategies and policies expect material recycling and energy recovery from wastes to result in environmental benefits, which in turn, lead to increased sustainability of the production and

[2] European Commission (2016) The efficient functioning of waste markets in the European Union—Legislative and policy options. Final Report for the European Commission, 2016. , pp. 11-12
[3] European Commission (2015) Closing the loop - An EU action plan for the Circular Economy
[4] European Commission (2020) A new Circular Economy Action Plan - For a cleaner and more competitive Europe

consumption system. However, this requires recycled materials and energy from waste to substitute for primary material and energy production. Lack of displacement will significantly reduce the environmental benefits.

From this perspective it is possible in a circular economy context to pragmatically categorise waste that is exchanged between EU MS into three groups. This categorisation is not strictly related to the legal status of both the waste (good, end-of-waste, hazardous waste, chemical waste, etc.) or to the operations used for processing (e.g. recovery and disposal codes):

A. Wastes of which the material content can be partly recovered, at a competitive cost, and without the use of processes or methods likely to harm the environment, as secondary raw materials that meet material and/or product specifications, as well as health and quality standards, required to satisfy a market demand and substitute for primary raw materials. Often, but not always, the corresponding waste-related industrial feedstocks have a positive value and are traded as goods that are reported according to the Combined Nomenclature (CN-codes). Examples of such wastes are paper and cardboard, end-of-life vehicles, glass, some construction and demolition wastes, metal scrap, sewage sludge, batteries, waste oil, plastic packaging, ashes, etc. Wastes that are used in processes that combine the use of material properties with the delivery of heat, e.g. feedstock recovery in blast furnaces;
B. Wastes of which the energy content can be partly or completely recovered, without endangering human health and without the use of processes or methods likely to harm the environment. These wastes are typically used as a fuel or other means to generate energy. An example of such wastes are the millions of tonnes of refuse derived fuel (RDF) and solid recovered fuel (SRF) that are exported from the UK;
C. Wastes that are not recyclable and/or that contain hazardous substances of which the reintegration into subsequent production cycles should be avoided. These wastes, or their hazardous content, should be processed with appropriate methods and directed towards safe sinks.

Using this categorisation, it is possible to map the waste-based production systems that are expected to contribute to both circular economy and environmental objectives, by converting nationally produced and imported wastes into secondary raw materials that are used as a fuel or as material resources in new industrial production cycles. For those waste streams that are traded as goods, which is presumably the most important category from a circular economy point of view, values in euro are also available, in addition to the volumes in tonnes. By combining data on value and volume, quality differences can be observed between exchanged waste flows. It is safe to assume that the more the value of a waste-related good approximates the value of the supposedly substituted primary raw material, the less processing will be required and/or the better the quality of the exchanged waste stream.

2.4 Waste shipment mapping approaches to-date

Understanding the transboundary waste shipment conditions requires thorough modelling of waste flows. A number of approaches have been used to examine waste flows both intra- and extra-EU. However, there is no single approach that provides a comprehensive method to address all waste flows, both hazardous and non-hazardous, broken down to the level of the European List of Wastes (ELoW) within the EU. The most relevant approaches are summarised below.

2.4.1 ETC paper on Transboundary Shipments of Waste in the EU

The European Topic Centre (ETC) working paper examined the availability of data, methodologies and information on their drivers and environmental impacts in relation to Transboundary Shipments of Waste. Although now somewhat dated (the paper was issued in 2010), a number of the following conclusions reached remain valid:

- The majority of hazardous waste generated within the EU was treated within the countries of generation with only 9% of hazardous waste generated exported, primarily to other EU MS;
- The reporting based on the Basel Convention Y codes provides insufficient detail on the types of waste shipped and their reason for shipping;
- Reporting based on the ELoW codes would provide more detailed information on waste types than the Basel reporting. However, at the time of the report, only 11 MSs published data on transboundary shipments of waste according to the ELoW codes, with an additional 9 holding information that was not published on the basis of the ELoW codes.

More recently, data reported at the ELoW level has been made available by MSs. However, this only addresses movements that fall within the scope of the Basel Convention and therefore largely ignores non-hazardous shipments of waste. Given that non-hazardous wastes generally include those wastes most likely to be of value in respect to recovery and reuse this leaves a significant shortcoming in respect to accessing waste shipment data at a level that provides enough granularity to be of value.

2.4.2 European Reference model on Municipal Waste Management

The European Reference Model on Municipal Waste Generation and Management was originally developed to support the impact assessment for the review of waste targets proposed in the 2015 circular economy package. It addresses municipal waste generation and management, including waste-flow scenarios coupled with calculations of related costs and benefits.

The model does not address waste shipments. In relation to municipal waste management, key drivers for shipments are disparities in treatment capacities and differences in gate fees, neither of which are included in the model.

Furthermore, a rather significant gap in relation to the model is that it only addresses municipal waste generation and no other wastes. Given that municipal waste only accounts for about 10% of waste generated when compared with data reported according to the Waste Statistics Regulation, the model provides insufficient coverage of the waste types we need to address in this study.

2.4.3 Eurostat waste data

Under Regulation (EC) No 2150/2002 on waste statistics (as amended) (the Waste Statistics Regulation) MSs must submit data on waste. The Regulation specifies how waste should be reported, categorising waste types according to the ELoW into certain reporting categories. Note that there are discrepancies between this Regulation, the ELoW as it is presented in Commission Decision 2000/532/EC and the Commission Notice on technical guidance on the classification of waste (2018/C 124/01). This means that reporting under the Waste Statistics Regulation on different waste types may not correlate with waste streams identified according to the ELoW in the Commission Notice, meaning that for certain categories wastes may be under reported in total, or data could be hard to correlate with how shipped waste is actually classified on the ground.

Additionally, there are a number of Directives that require the measurement and reporting of data on particular waste streams, namely:

- Batteries;
- End of life vehicles;
- Hazardous waste;
- Municipal waste;
- Packaging and packaging waste;
- Waste electrical and electronic equipment.

Shipments of waste between countries are also addressed in Eurostat reporting. However, the reporting suffers from some of the same difficulties identified in the European Topic Centre Working Paper in 2010. These difficulties include that the data is not generally addressed at the ELoW level. This is largely because the results are used for reporting under the Basel Convention, so the Basel codes are used and these do not fully align with the ELoW definitions.

2.4.4 European international trade in goods statistics — COMEXT

In relation to customs controls and data on the trading of goods, the use of combined nomenclature (CN) codes data is collected in the Comext database. Comext is Eurostat's reference database for detailed statistics on international trade in goods. It provides access to:

- Recent and historical data of the EU and its individual MS;
- Statistics of a significant number of non-EU countries.

The data is captured in two different ways within COMEXT:

1. ***Extrastat:*** data on trade in goods with non-EU countries are collected by custom authorities and are based on the records of trade transactions in customs declarations. The dataset on trade with third parties is considered particularly robust as it is based on all reported customs movements;
2. ***Intrastat***: When the EU was created and the original MSs became part of the EU Single Market, customs and border formalities were removed. The dismantling of customs clearances and controls within the EU meant it was no longer possible to obtain information about the movement of goods (i.e. dispatches and arrivals) between EU MSs from customs documents. In order to address this gap in data the statistical system Intrastat was developed to replace the customs declarations and collect information directly from traders about dispatches and arrivals of goods among the MSs by collecting data directly from intra-EU trade operators once a month.

There are a number of points in relation to Intrastat data in particular that may be considered short comings, albeit minor in relation to the overall quality of the data available. These shortcomings include:

- Businesses and private individuals that are registered for VAT purposes and that dispatch or receive goods are required to submit Intrastat declarations if the dispatches or the arrivals exceed the ***relevant threshold***;
- The Intrastat system is based on EU Regulation No. 638/2004 (EU Regulation), supplemented Commission Regulation (EC) No. 1982/2004, which implements the EU regulation. Since the main Intrastat rules are provided in the Regulation the rules should normally be applied uniformly across the EU. However, there are ***differences in implementation*** as some MSs

provide guidelines on how the general principles in the Regulation should be applied in specific situations (e.g. commercial samples, return of goods, etc.). Consequently, these guidelines may produce different results for various situations in EU MS;

- ***The authorities responsible for Intrastat reporting differ from country to country***. Some MSs delegate oversight of Intrastat to their tax or customs authorities, others to their statistics office and still others to their national bank. The nature of reporting by each MS may, therefore, vary.

COMEXT has recently been used by Eurostat in the development of a publication on movement of waste from and into the European Union. The publication includes a presentation of export and imports from/to the European Union of ferrous metal, paper, other wastes, plastics, copper, aluminium, and nickel scrap, textiles, wood, animal and vegetable waste, municipal waste, glass and precious metal scraps.

Additionally, COMEXT not only includes information of the volume of materials traded but also their value. The value of the goods can be expressed in two ways:

- The taxable amount or invoice value, which is the value to be determined for tax purposes in accordance with the EU VAT Directive (Directive 2006/112/EC); and
- The statistical value, which is the value calculated at the national borders of the EU MS. It is based on the taxable amount or, where applicable, the value replacing the taxable amount. It includes incidental expenses (freight, insurance) incurred in the case of dispatches for the part of the journey located in the territory of the EU MS of dispatch. In the case of arrivals, it is the part of the journey located outside the territory of the EU MS of arrival. The statistical value is said to be an FOB value (free on board) for dispatches, and CIF (cost, insurance, freight) for arrivals.

Values are also allocated to the waste streams reported under Comext, albeit the reliability of these values is something that is commented on elsewhere in this study.

One of the difficulties in working with Comext in relation to waste movements is that the CN codes are changed frequently. A new version of the 'Combined Nomenclature' is published twice a year. Therefore, it has to be checked whether changes of waste-related CN codes have taken place. Changes can include the introduction of new codes, the elimination of codes, the split of codes or the aggregation of codes. Eurostat maintains a master file with the CN codes relevant for waste transfers that is updated annually.

A challenge, therefore, in respect to the use of CN codes to identify waste shipments is that the categorisation does not sit neatly with Basel Codes, the ELoW and the Commission Notice on the ELoW as referred to above.

An examination of the codes used by Eurostat undertaken by Wood (as part of the work on the WSR Impact Assessment whose publication is pending) indicates that in certain cases the choice of CN codes to be used to identify wastes falling under the above broad categories may be difficult to justify. For example, the CN codes include a general category '3915 Waste, parings, and scrap of plastics'. However, the category 'plastics' for the above-mentioned publication includes rubber materials that fall under Chapter 40 of the CN codes and are typically not considered 'plastic waste' on the ground.

Whilst the Commission Notice on ELoW includes a single category that includes rubber and plastics, it is considered that the categories of rubber included in the Eurostat master file are likely to be broader and include materials that would not typically be considered as plastics waste in the context of the operation of the Waste Shipments Regulation.

The modelling approach being applied under the exploration of potential policy responses to review the Waste Shipment Regulation

Noting the pros and cons mentioned above of existing approaches to collecting data on waste shipments the model developed and applied under the study exploring potential policy response to review the Waste Shipment Regulation addresses the following categories of waste shipment flows:

- All hazardous waste;
- All non-hazardous (excluding mixed municipal waste), ferrous metal waste, non-ferrous metal waste, paper waste, plastic waste, textile waste, glass waste.

Mixed municipal waste is not included in the model. Furthermore, the approach using CN codes means that there is not a direct correlation with the ELoW codes generally used for reporting movements of waste.

The totals for hazardous and non-hazardous waste are taken from env_wasship. In respect of the specific waste flows (ferrous metals, non-ferrous metals, paper, plastic, textiles and glass), the approach takes COMEXT data for both extra and intra-EU movements. Whilst other waste flows could also have been included, given the size of data and nature of the study being undertaken a selection of waste flows has been considered more reasonable.

It is acknowledged that there is not a perfect alignment in the categorisation of wastes under this approach with that applied under the ELoW. However, it is considered that overall, the reliability of the Comext dataset in terms of reporting warrants its use in this case. Note that under the abovementioned study, the costs and benefits of changes in flows will be gathered. For the purpose of this EEA study it is understood that the two main data elements required are quantity and value. Consequently, the cost element being developed under the European Commission study would be of less relevance for this EEA project.

3 Mapping of waste movements within the EU

3.1 Distribution of waste flows in the EU

3.1.1 Method

The core of the method is to use the outcomes of the model using COMEXT trade statistics developed by Wood for the current WSR IA project work for the European Commission. This model (and our approach for this work) uses a stream by stream approach, and provides a suitable basis for categorising waste (which includes what might be classified as 'tradeable secondary raw materials - that would not be picked up as waste (in waste statistics), because they are accepted as meeting 'end of waste criteria') movements and movement of waste between MSs for the period 2016-2019. The model also includes information on what might be classified as 'tradeable secondary raw materials'. Some of these materials would not be considered as waste e.g. in waste statistics, because they are accepted as meeting 'end of waste criteria'. The full list of COMEXT CN codes is provided in Annex 5.

In addition to these, there are some other waste / resource flows that have been mentioned by the EEA as being of potential interest to this study – whether because of their known high volume and the economic relevance of associated capital investments and trade-related financial transactions[5] (e.g. refuse derived fuel (RDF) or value as resource (e.g. textiles)). There are also other streams that are of potential interest (e.g. industrial slags, sludges, ashes). However, bearing in mind the limits for the study, it is not possible to cover all waste streams of potential interest. This was further addressed in the interim meeting for the project where reference was made to notified wastes i.e. those wastes subject to notification under the WSR. During that meeting it was referenced that a large spreadsheet already exists in relation to notified waste, the latest version of which can be found on the Eurostat website[6]. The Agency noted that duplication of the information held in this sheet was not the aim of the model to be developed and that, instead, the focus should be on Comext waste data.

The selection of waste streams has been made by an initial identification of reliable data on movements of wastes. In this context the work of Eurostat on wastes traded between Member States for recycling has been used as the starting point to identify those wastes of greatest interest. The dataset on trade in recyclable raw materials by waste held by Eurostat that uses Comext data builds on work undertaken by the JRC to identify the most relevant wastes from a circular economy perspective – plastic, paper and cardboard, precious metal, iron and steel, copper, aluminium and nickel. This list of wastes was then used to develop a long list of materials for consideration, alongside additional ferrous metal wastes, all non-ferrous metal wastes and textiles, thereby addressing by weight the vast majority of wastes not addressed in the env_wasship dataset referred to above. This list was then discussed with representatives of the JRC, Eurostat and the European Commission, following which the final set of wastes to be considered were agreed and used in the model for intra- and extra-EU shipments of these waste materials.

The model has been developed and shared with the EEA. The results presented below look at shipments by weight and by EUR value using the results of the model.

[5] Let's recycle (2019) RDF exporters 'face £50m cash drain' after Brexit; Let's recycle (2019) Dutch 'RDF tax' faces critical vote
[6] https://ec.europa.eu/eurostat/statistics-explained/images/9/9f/WshipR_LoW_Statistics_explained_Dec-20.xlsx

3.1.2 Limitations

The use of data from Comext for the purpose of assessing shipments of wastes is subject to some limitations (as described in the context chapter) including:

- Businesses and private individuals that are registered for VAT purposes and that dispatch or receive goods are required to submit Intrastat declarations **only** if the dispatches or the arrivals exceed the relevant threshold. Smaller shipments, therefore, are not captured by those declarations.
- The Intrastat system is based on EU Regulation No. 638/2004 (EU Regulation) and supplemented Commission Regulation (EC) No. 1982/2004, which implements the EU regulation. Since the main Intrastat rules are provided in the Regulation the rules should normally be applied uniformly across the EU. However, there are differences in implementation as some Member States provide guidelines on how the general principles in the Regulation should be applied in specific situations (e.g. commercial samples, return of goods, etc.). Consequently, these guidelines may produce different results for various situations in EU member states.
- The authorities responsible for Intrastat reporting differ from country to country. Some Member States delegate oversight of Intrastat to their tax or customs authorities, others to their statistics office and still others to their national bank. The nature of reporting by each Member State may, therefore, vary in approach accordingly.
- The value of the goods can be expressed in two different ways that may lead to discrepancies in the EUR values allocated, being:
  - The taxable amount or invoice value, which is the value to be determined for tax purposes in accordance with the EU VAT Directive (Directive 2006/112/EC); and
  - The statistical value, which is the value calculated at the national borders of the EU Member States. It is based on the taxable amount or, where applicable, the value replacing the taxable amount. It includes incidental expenses (freight, insurance) incurred in the case of dispatches for the part of the journey located in the territory of the EU member state of dispatch. In the case of arrivals, it is the part of the journey located outside the territory of the EU member state of arrival. The statistical value is said to be an FOB value (free on board) for dispatches, and CIF (cost, insurance, freight) for arrivals.
- CN categorisation does not sit neatly with Basel Codes, or the European List of Waste.
- An assumption has been made that ferrous metal, non-ferrous metal, plastic, paper and cardboard and textiles wastes identified in this study are subject to transboundary shipment for the purpose of recovery. Comext does not provide information on the fate of these materials at the point of destination. However, it is also clear that some of these materials will be rejected. In this context the following data has been found in respect to likely rejection rates for these materials at the point of treatment.

Table 3-1: Sources of data on typical waste processing residue values

Waste type	Residue percentage	Source of value
Glass	8%	Eunomia 2019 - Study to support the implementation of reporting obligations resulting from the new waste legislation adopted in 2018
Plastic	30%	Eunomia 2019 - Study to support the implementation of reporting obligations resulting from the new waste legislation adopted in 2018
Paper and cardboard	10%	Eunomia 2019 - Study to support the implementation of reporting obligations resulting from the new waste legislation adopted in 2018

Waste type	Residue percentage	Source of value
Textiles	10%	Norup et al 2019 - Evaluation of a European textile sorting centre: Material flow analysis and life cycle inventory
Non-ferrous metals	19%	Eunomia 2019 - Study to support the implementation of reporting obligations resulting from the new waste legislation adopted in 2018
Ferrous metals	19%	Eunomia 2019 - Study to support the implementation of reporting obligations resulting from the new waste legislation adopted in 2018

Furthermore, in relation to the use of waste shipment data (was_trd), the information does not provide information in respect to the EUR value of materials shipped. By way of example, this study has looked to identify the EUR value of RDF shipments within the EU. However, no definitive source of this information has been found, and ultimately the value appears to represent the lower cost of sending RDF for R1 and D10 treatment and disposal in comparison to landfilling, with R1 and D10 generally applying where the costs involved are lower than the costs of landfilling.

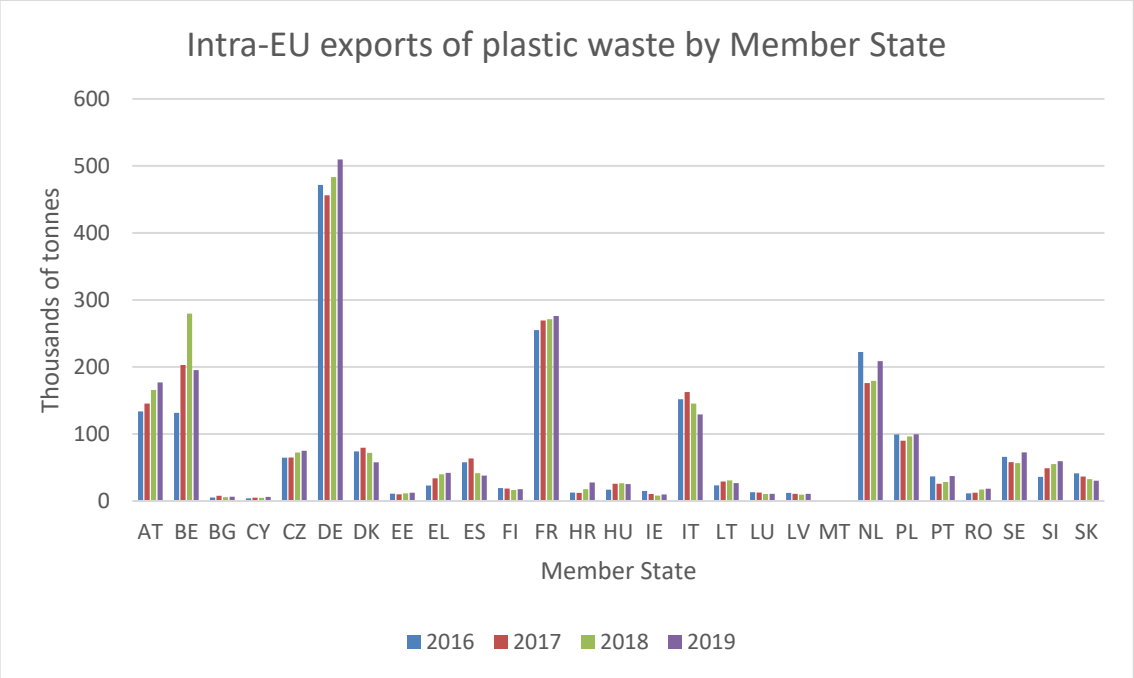
3.2 Intra-EU waste movements by weight

This section considers the volumes of weights of non-hazardous wastes against the categories of plastic, glass, textiles, non-ferrous metals, ferrous metals, paper and cardboard and totals of these wastes combined. These have been presented as it is considered that these are the materials of greatest interest to the European Environment Agency – given their relevance to the circular economy (i.e. they are recyclable).

3.2.1 Plastic wastes

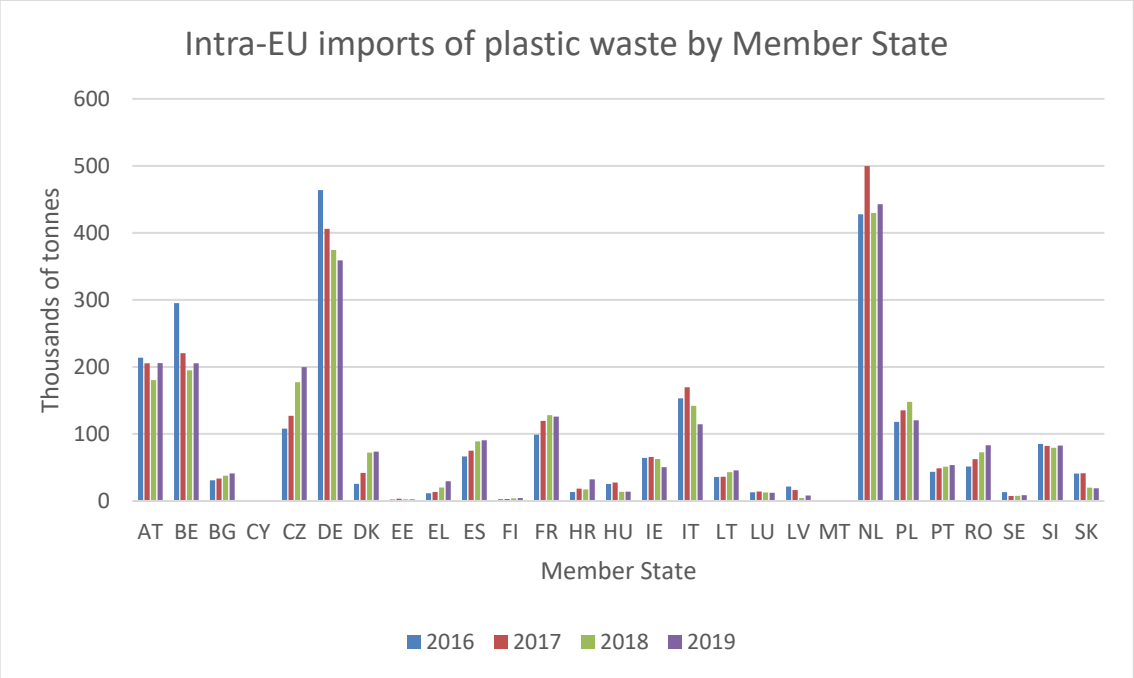
The figures below present reported export (reported as an export from the Member State concerned) and import (reported as an import into the Member State concerned) data for plastic wastes for Member States for the years 2016-2019.

Figure 3-1 Intra-EU exports of plastic waste by Member State



It is apparent from the figure above that for certain Member States (AT, DE, EL, HR, and SI) the trend is for increasing export of plastic waste to other EU Member States. SK is an apparent outlier in comparison to most Member States, with a clearer trend showing volumes exported decreasing.

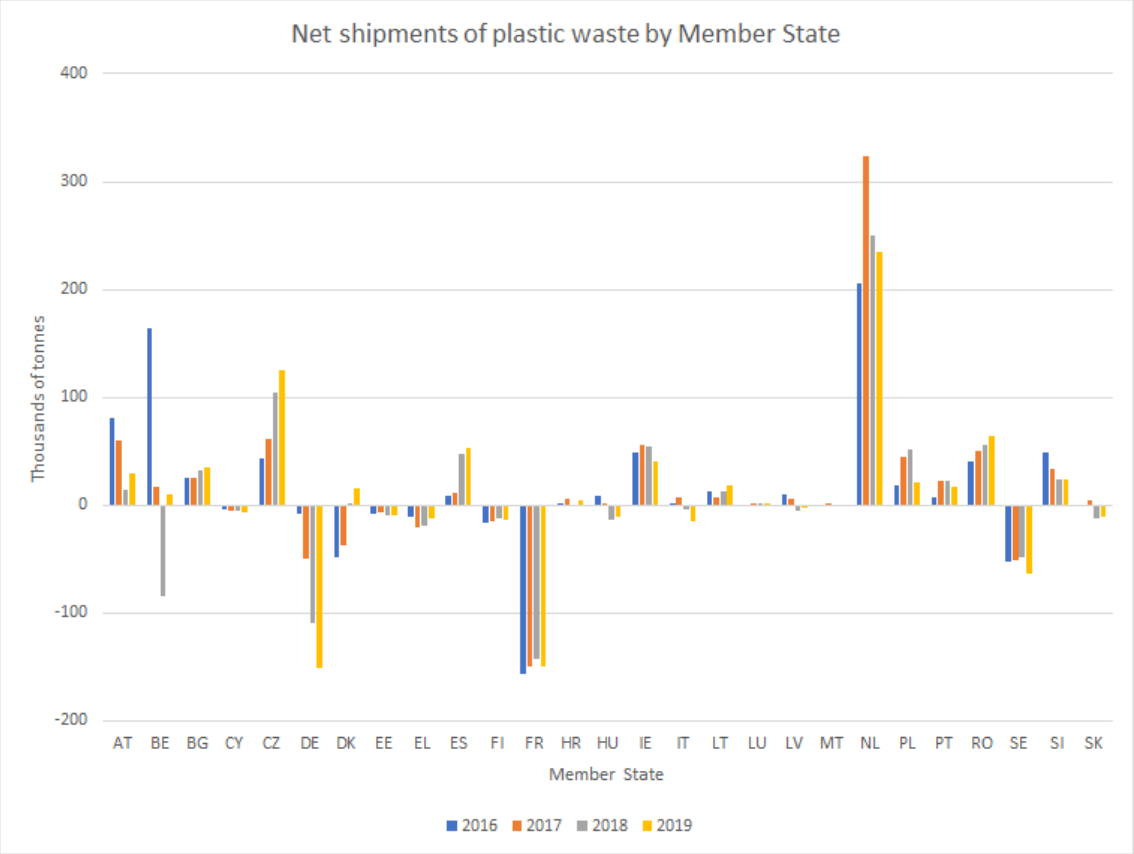
Figure 3-2 Intra-EU imports of plastic waste by Member State



DE, IT and LV show a reduction over time of imports of plastic waste from other Member States. However, BG, CZ, DK, EL, FR, LT, RO and, to some extent PT show an increase in imports of plastic waste from other Member States over the same period.

An examination of net values (considering imports versus exports) is presented below.

Figure 3-3 net shipments of plastic waste by Member State

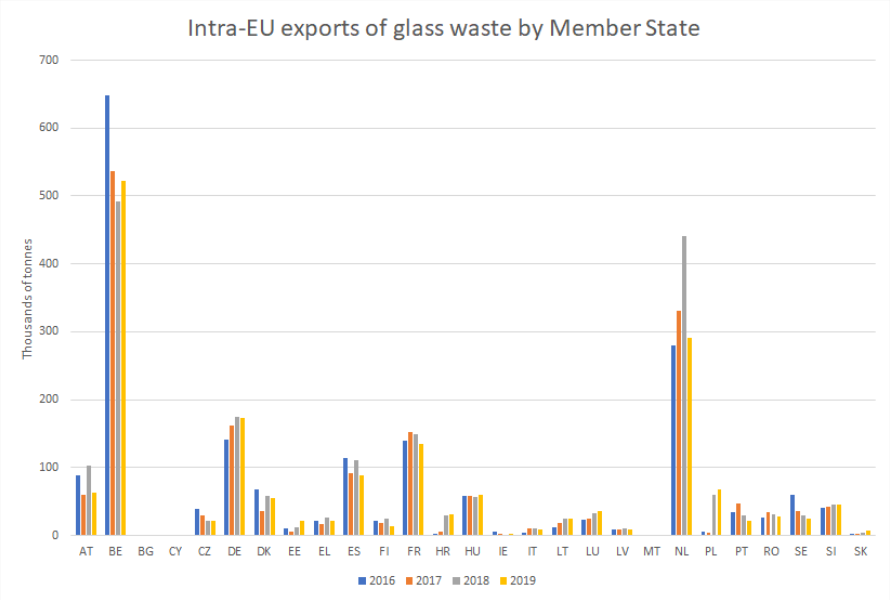


The figure above provides a clearer contrast in relation to shipment trends, with some Member States (FR, DE and SE) consistently relying on exports of plastic waste, whilst others appear to be expanding their imports of waste overall (most notably CZ, and RO).

3.2.2 Glass wastes

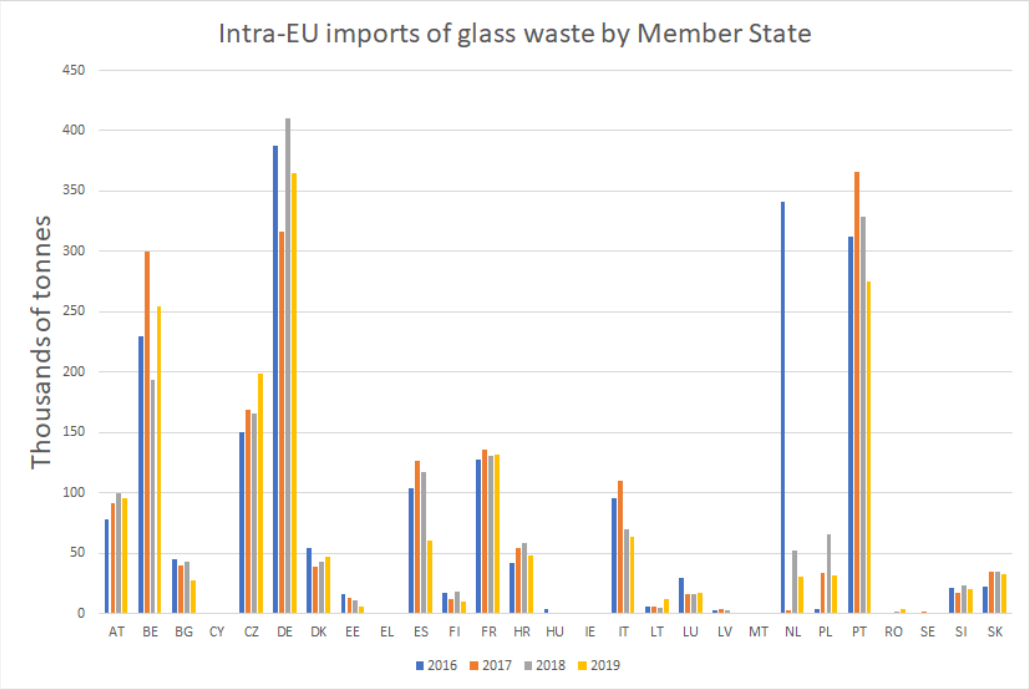
The figures below present reported export (reported as an export from the Member State concerned) and import (reported as an import into the Member State concerned) data for glass wastes for Member States for the years 2016-2019.

Figure 3-4 Intra-EU exports of glass waste by Member State



In contrast to plastic waste their appears to be a greater level of stability in exports of glass waste to other EU Member States. DE appears to be increasing its exports of waste glass, as does LU. However, CZ and SE appear to have decreasing exports over the same time period.

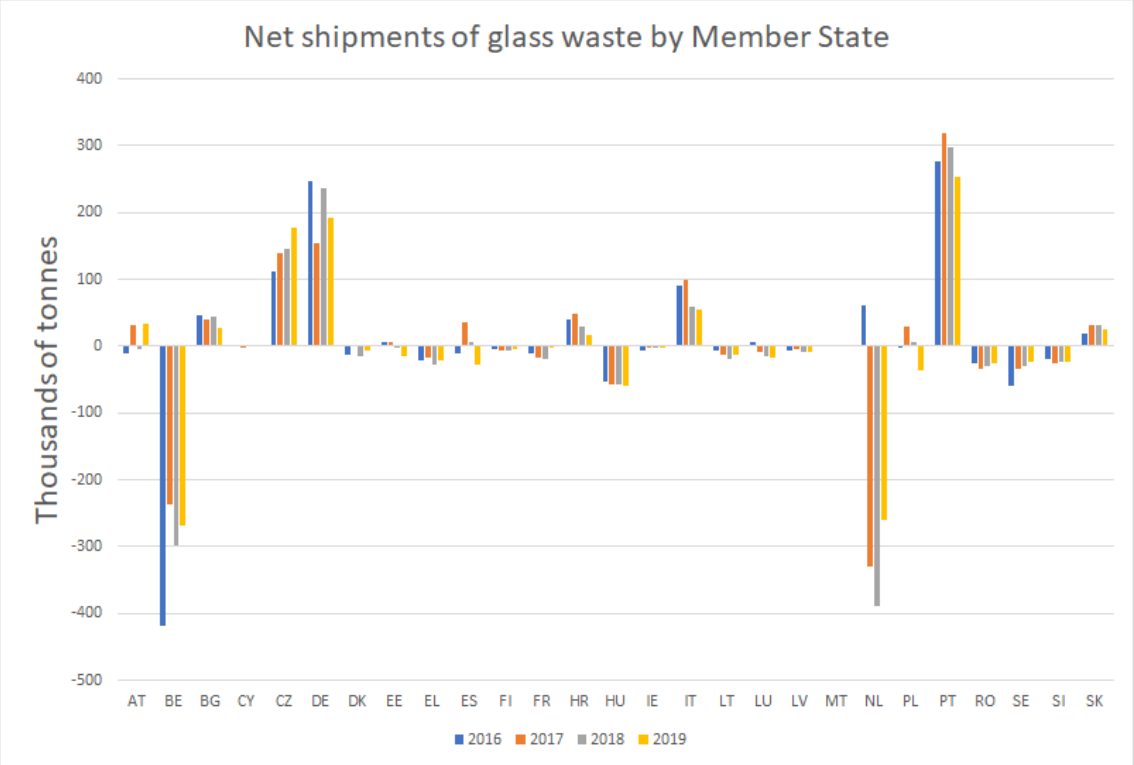
Figure 3-5 Intra-EU imports of glass waste by Member State



BG, EE and to some extent PT show a reduction over time of imports of glass waste from other Member States. However, AT, CZ, and PL show an increase in imports of glass waste from other Member States over the same period.

An examination of net values (considering imports versus exports) is presented below.

Figure 3-6 Net shipments of glass waste by Member State

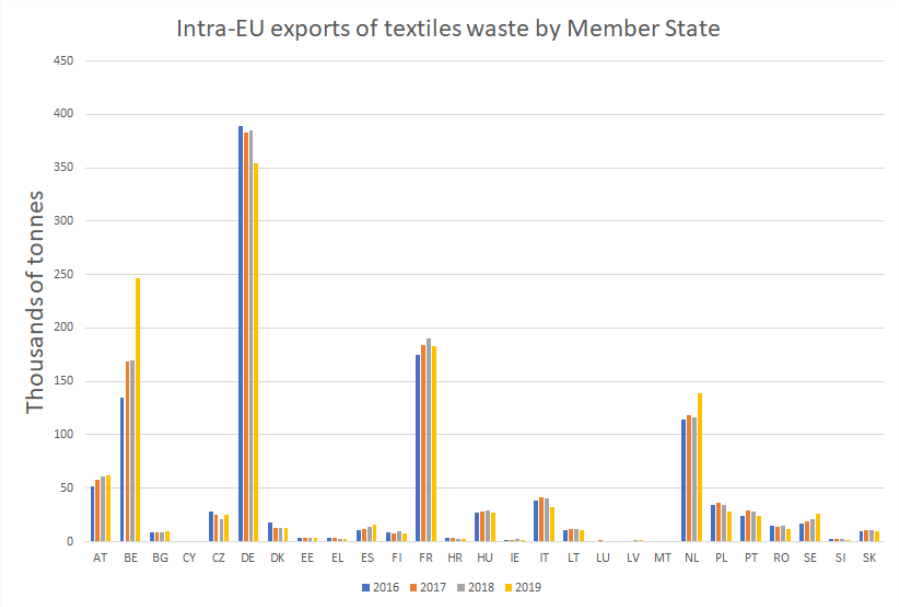


The figure above provides a clearer contrast in relation to shipment trends, with some Member States (BE, HU, EL, HU, NL, RO, SE and SI) consistently relying on exports of glass waste, whilst others appear either to be expanding their imports of glass waste overall (most notably CZ) or are large destinations for glass waste overall (DE and PT).

3.2.3 *Textiles waste*

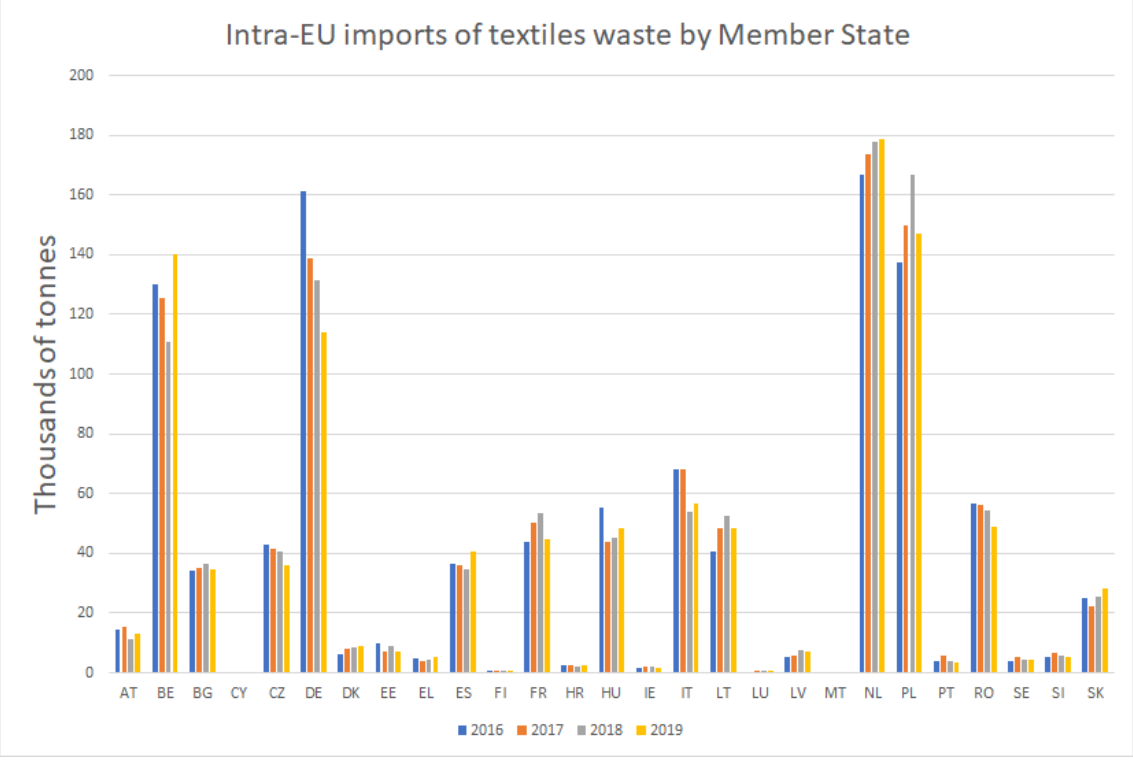
The figures below present reported export (reported as an export from the Member State concerned) and import (reported as an import into the Member State concerned) data for textiles wastes for Member States for the years 2016-2019.

Figure 3-7 Intra-EU exports of textiles waste by Member State



The largest exporters of textile waste to other EU Member States ad DE, FR, BE and NL. BE in particular shows a large increase in exports over the period 2016-2019. No Member States show a large reduction in exports over the same time period.

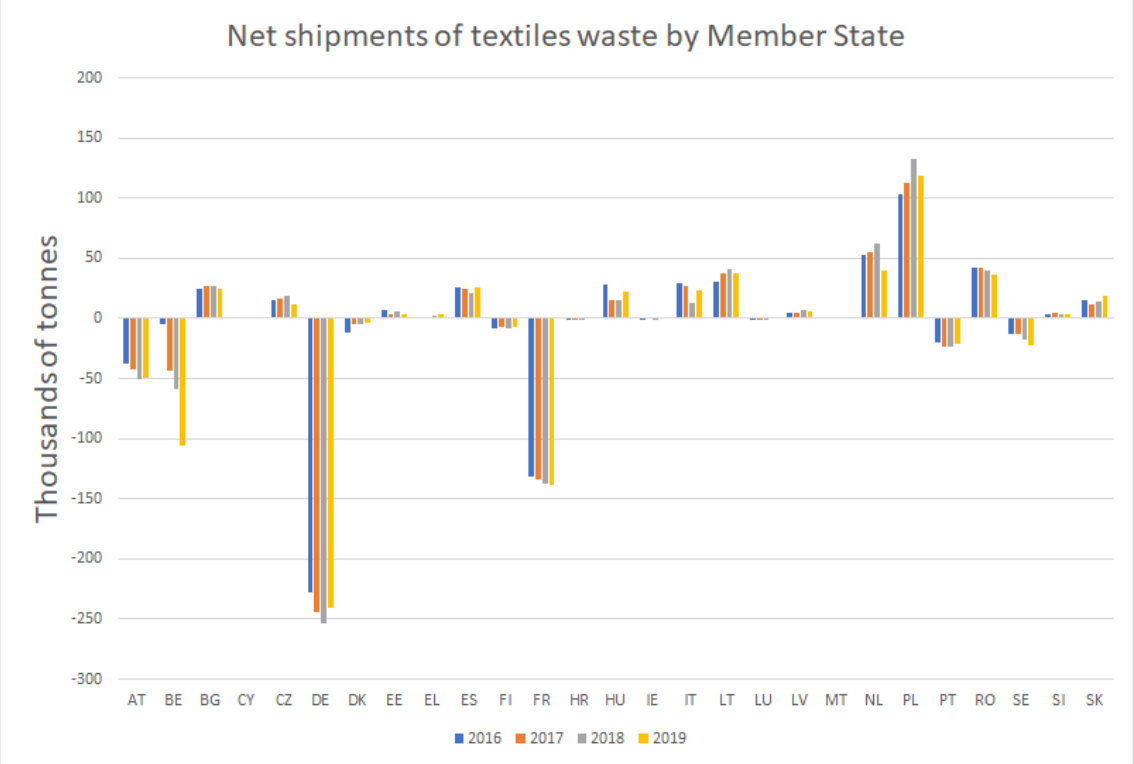
Figure 3-8 Intra-EU imports of textiles waste by Member State



CZ, DE, IT, and RO show a reduction over time of imports of textiles waste from other Member States. However, ES, FR, HU, NL, PL and SK appear to show a trend of increasing imports of textiles waste from other Member States over the same period.

An examination of net values (considering imports versus exports) is presented below.

Figure 3-9 net shipments of textiles waste by Member State

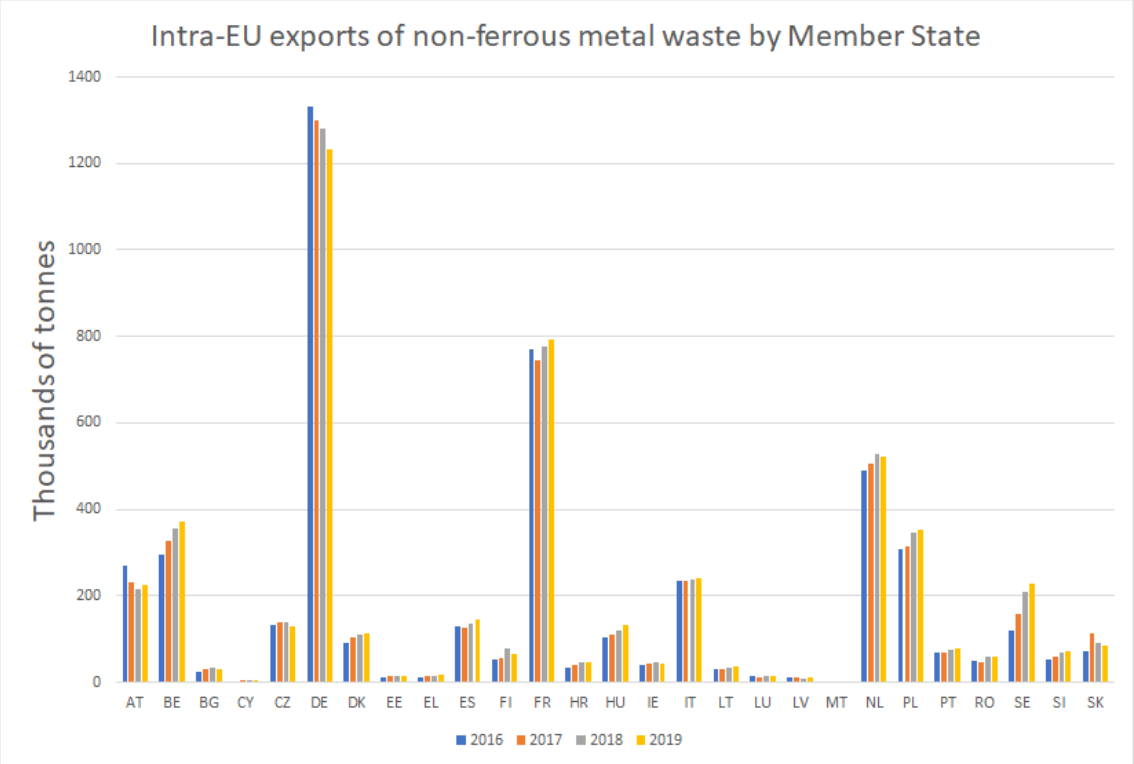


The figure above provides a clearer contrast in relation to shipment trends, with some Member States (AT, BE, DE, FI, FR, PT and SE) consistently relying on exports of textiles waste, whilst others are generally net importers of textiles waste (most notably BG, ES, HU, IT, LT, NL, PL and RO).

3.2.4 Non-ferrous metal waste

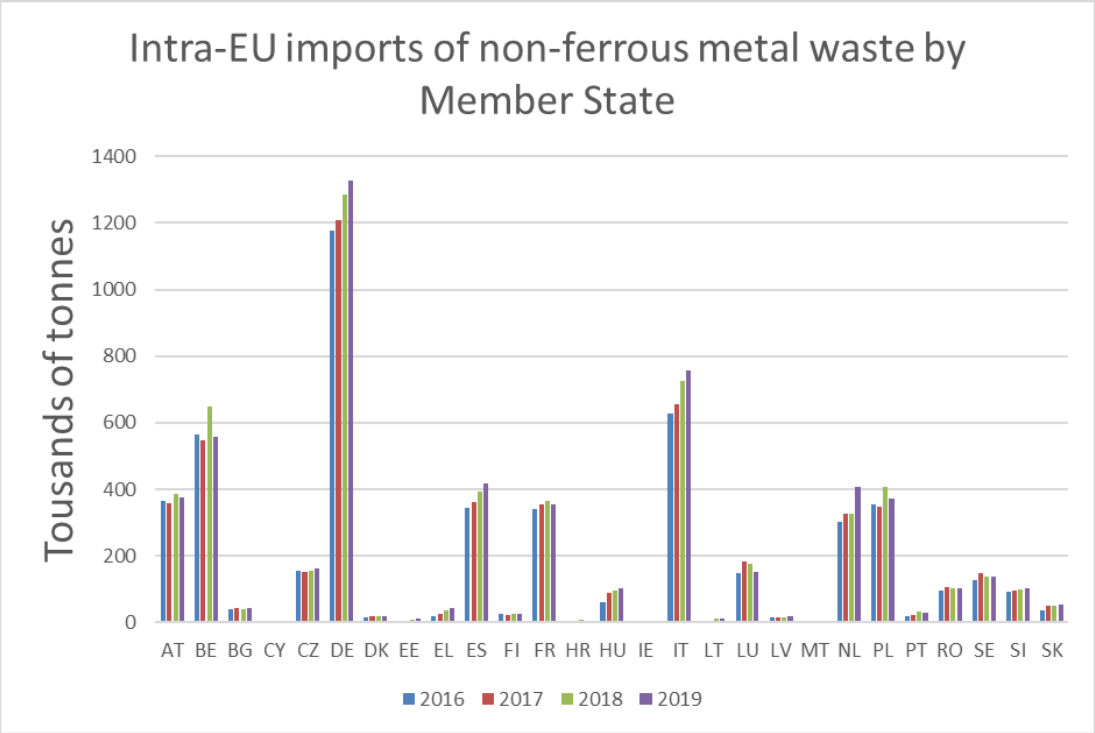
The figures below present reported export (reported as an export from the Member State concerned) and import (reported as an import into the Member State concerned) data for non-ferrous metal wastes for Member States for the years 2016-2019.

Figure 3-10 Intra-EU exports of non-ferrous metal waste by Member State



The largest exporters of non-ferrous metal waste to other EU Member States are DE, FR, NL, PL and BE. DE, as the largest exporter overall, shows a decreasing level of exports over the period 2016-2019. Conversely, BE, HU, PL, and SE show clearer trends of increases in exports over the same time period.

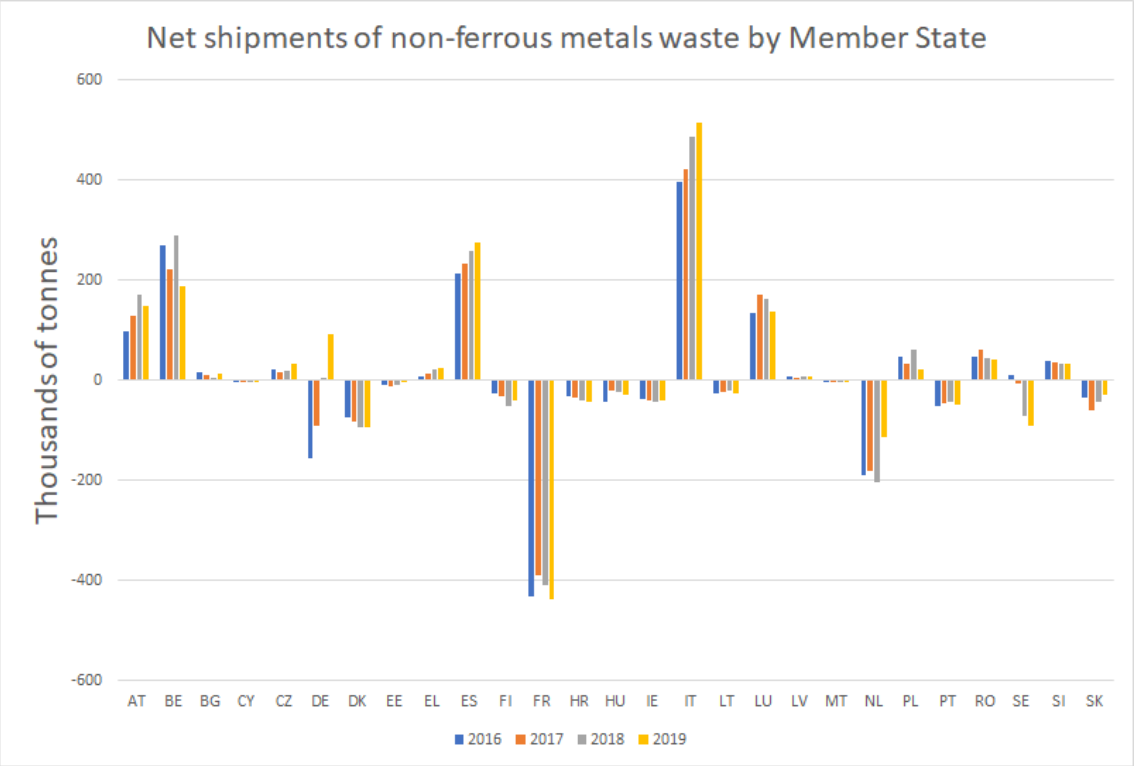
Figure 3-11 Intra-EU imports of non-ferrous metal waste by Member State



The trend for the EU overall appears to be one of stable or increasing imports of non-ferrous metal wastes from other EU Member States.

An examination of net values (considering imports versus exports) is presented below.

Figure 3-12 net shipments of non-ferrous metals waste by Member State

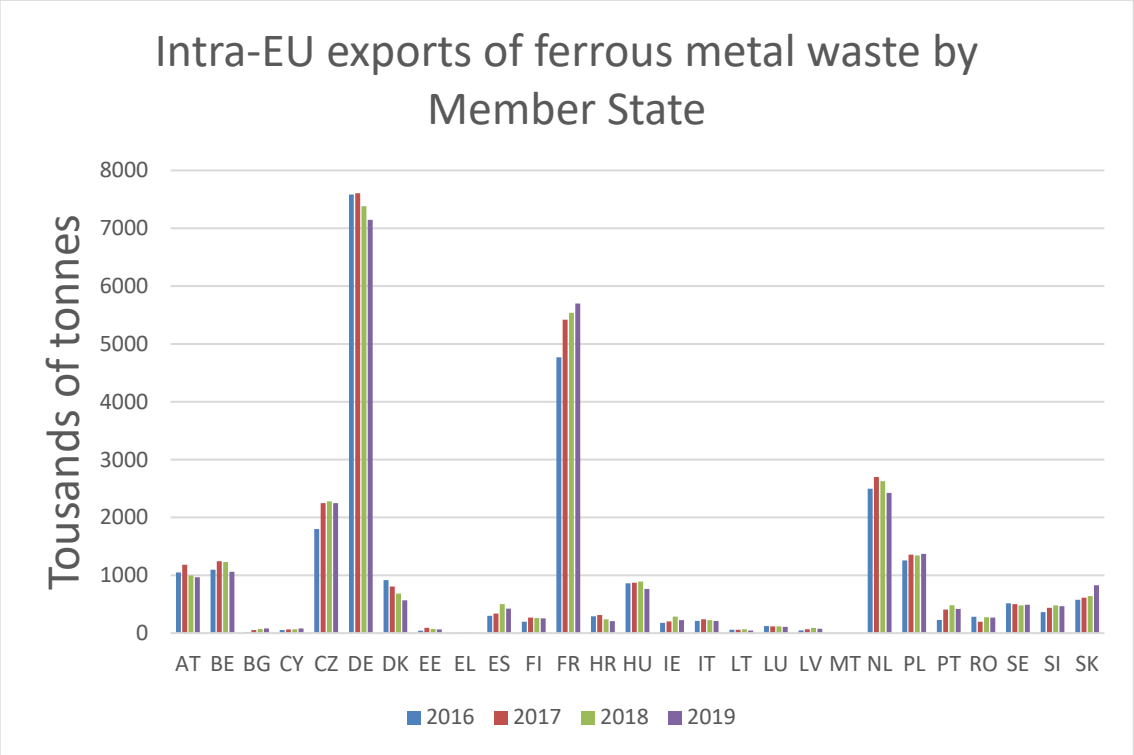


Interestingly, when considering the significant volume of shipments originating from or entering DE, the balance of imports versus exports is relatively small. DK, FR and NL are the largest Member States by volume that export more non-ferrous metal waste than they import, whereas the likes of AT, ES and IT show increasing trends of net volumes imported increasing over time.

3.2.5 Ferrous metal waste

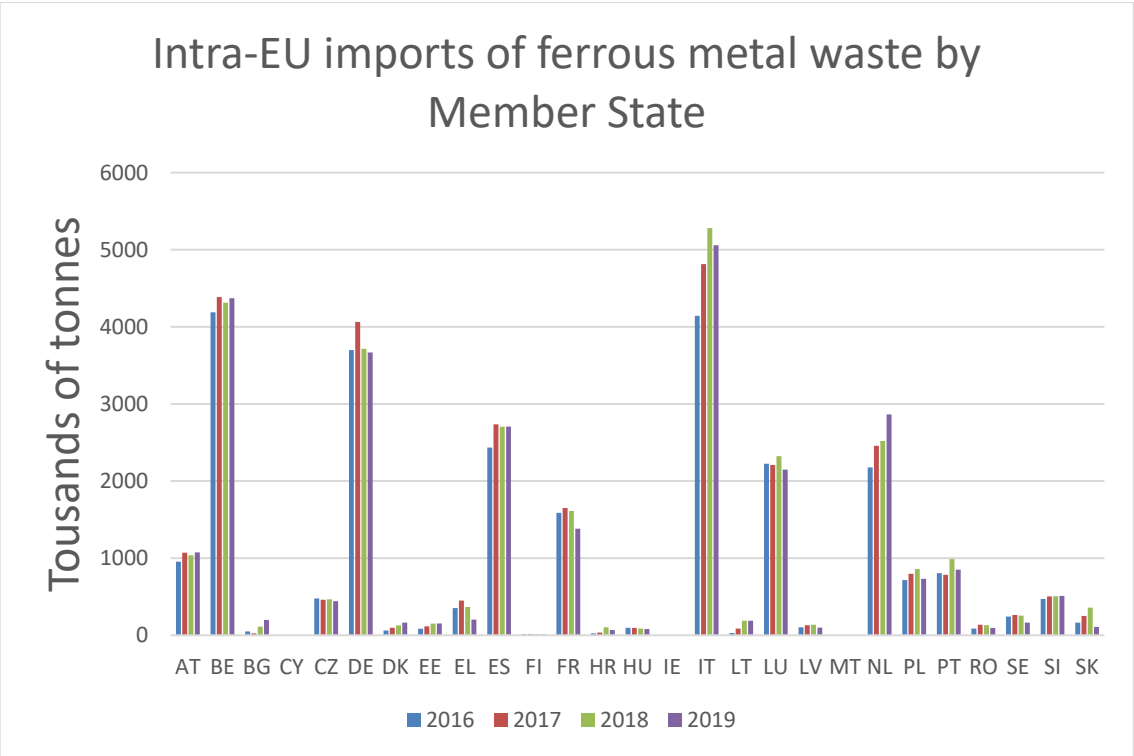
The figures below present reported export (reported as an export from the Member State concerned) and import (reported as an import into the Member State concerned) data for ferrous metal wastes for Member States for the years 2016-2019.

Figure 3-13 Intra-EU exports of ferrous metal waste by Member State



The largest exporters of ferrous metal waste to other EU Member States are DE, FR, NL, PL and CZ. DE, as the largest exporter overall, shows a decreasing level of exports over the period 2016-2019, whereas FR as the second largest exporter shows an increase. DK is the only other Member State that appears to show a clear trend of reducing exports of ferrous metal wastes over the same period.

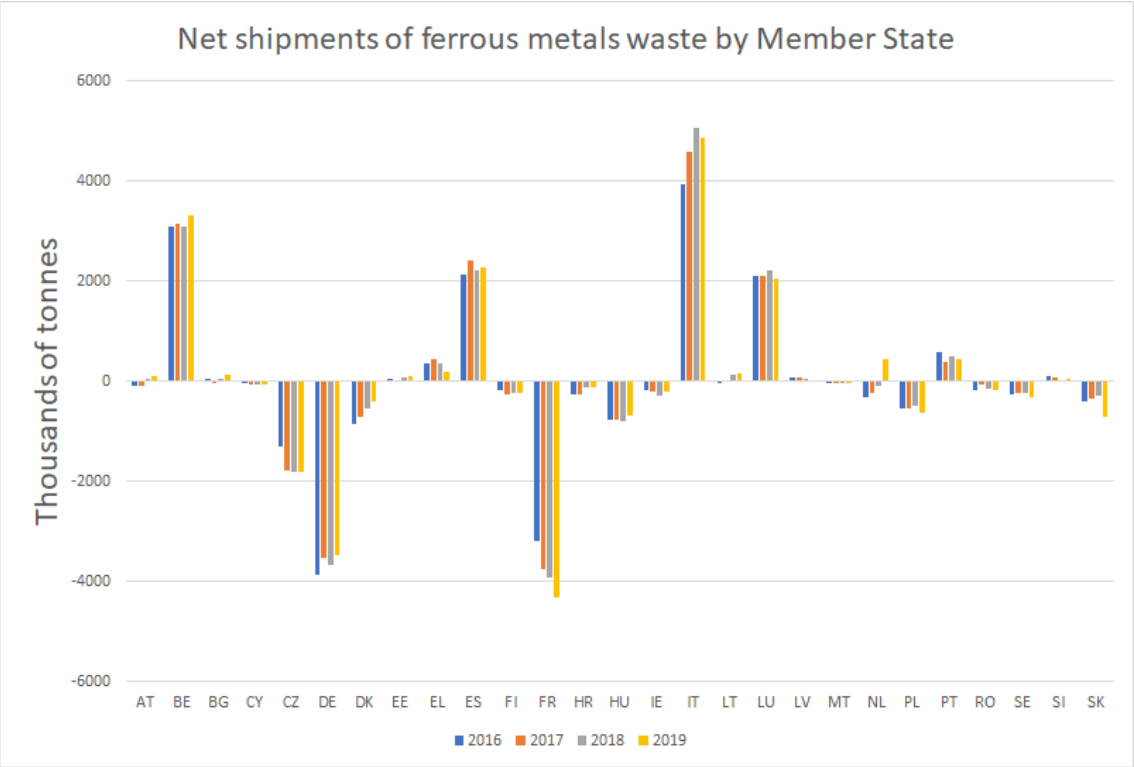
Figure 3-14 Intra-EU imports of ferrous metal waste by Member State



The trend for the EU overall appears to be one of stable or increasing imports of non-ferrous metal wastes from other EU Member States. IT, BE, DE, ES, NL and LU are largest importers of ferrous metal waste by weight. Imports into Italy are reported (industry interview) as being relatively high due to the high use of electric arc furnaces in iron and steel production in Italy, and these are capable of using a much higher proportion of waste material than blast furnaces (which are more common in German steel making plants).

An examination of net values (considering imports versus exports) is presented below.

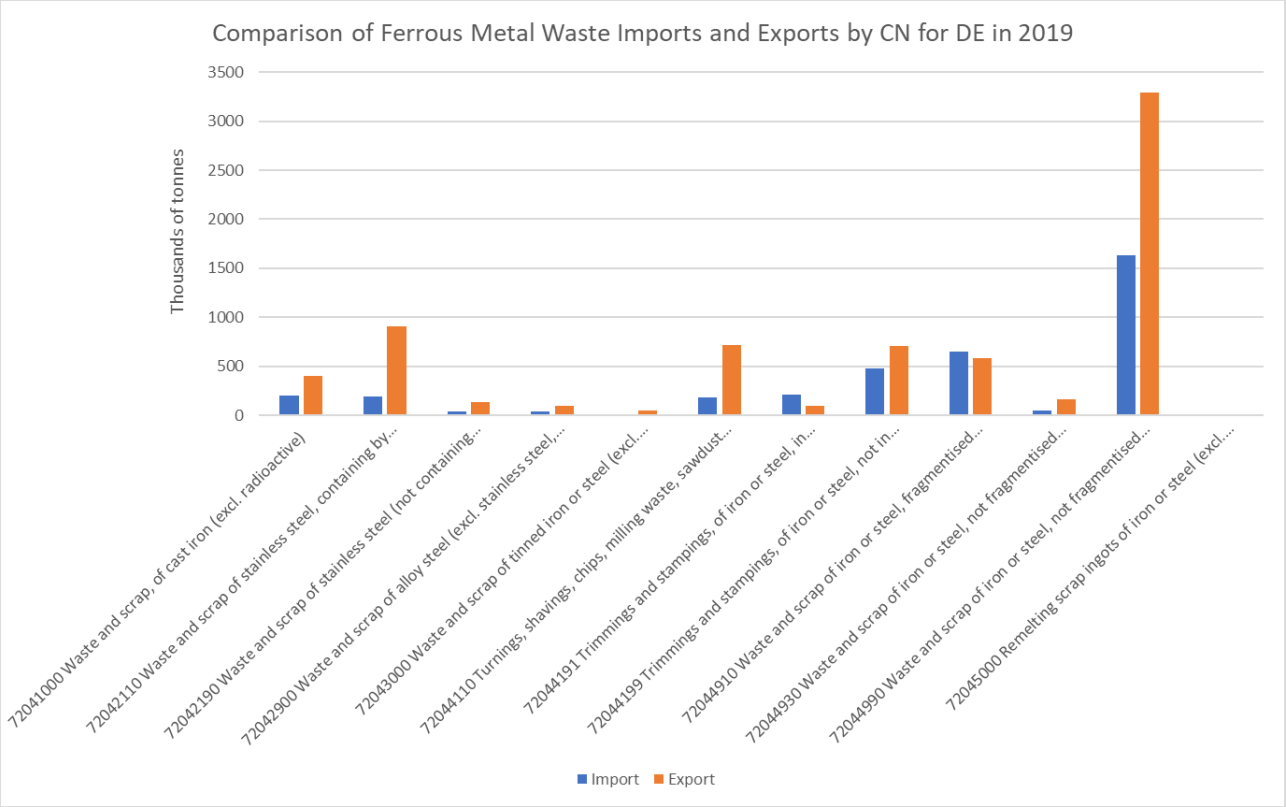
Figure 3-15 net shipments of ferrous metals waste by Member State



IT, BE, ES and LU appear to be the overall countries of destination for ferrous metal wastes from other EU Member States. DE, FR and FR appear to rely more heavily on exports to other Member States of their ferrous metal wastes.

Given DE appears to have the largest number of waste ferrous metal shipments by waste moving into and out of the country an extraction of data for 2019 has been made for ferrous metal wastes to see if any patterns exist in relation to the types of ferrous metal wastes imported and exported. The results of this are presented below.

Figure 3-16 Comparison of Ferrous Metal Waste Imports and Exports by CN code for Germany in 2019



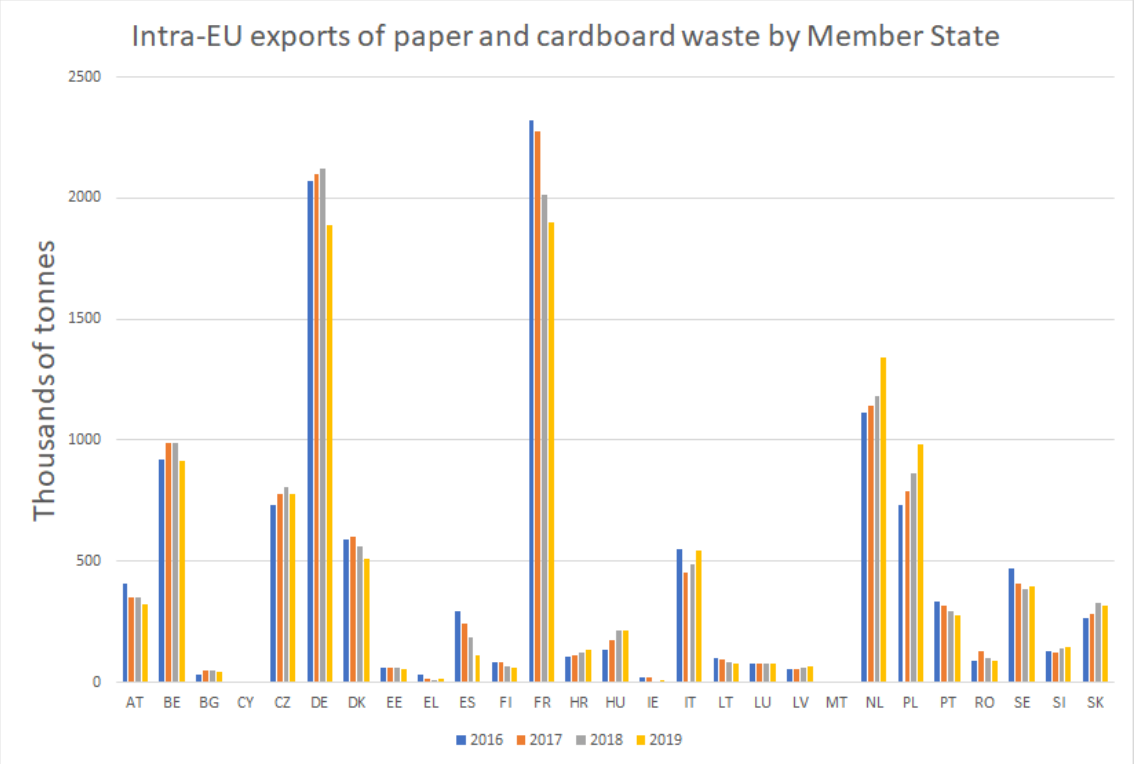
Germany accounted for over 25% of crude steel production in the EU[7] in 2019. With over 157M tonnes of crude steel produced in the EU overall in 2019 this means that Germany produced almost 40M tonnes of crude steel in 2019. With net exports of ferrous metal wastes of just under 3.5M tonnes, exports of ferrous metal waste represent just under 10% of total production. When compared with FR, that accounts for 14.5M tonnes of crude steel production in 2019, net exports of ferrous metal wastes as a percentage of crude metal production in FR are 30% of total production. A similar proportion to FR is found in CZ.

3.2.6 Paper and cardboard waste

The figures below present export (i.e. an export of wastes from the Member State concerned) and import (i.e. an import of wastes into the Member State concerned) data for paper and cardboard wastes for Member States for the years 2016-2019.

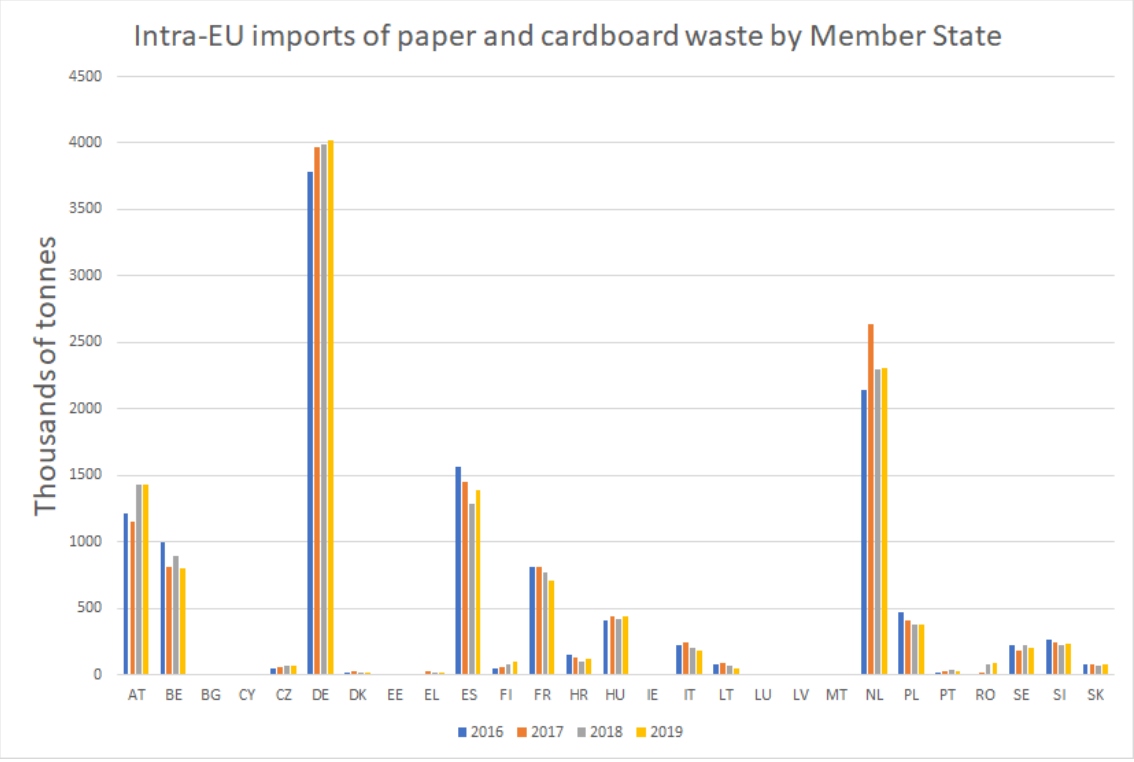
[7] EUROFER (2020) European Steel Figures

Figure 3-17 Intra-EU exports of paper and cardboard waste by Member State



The largest exporters of paper and cardboard waste to other EU Member States are DE, FR, NL, PL and BE. FR, as the largest exporter overall, shows a decreasing level of exports over the period 2016-2019. AT, DK, ES and PT appear to show trends of reducing exports of paper and cardboard wastes over this period whereas CZ, HR, HU, NL, PL and SK show increases in exports.

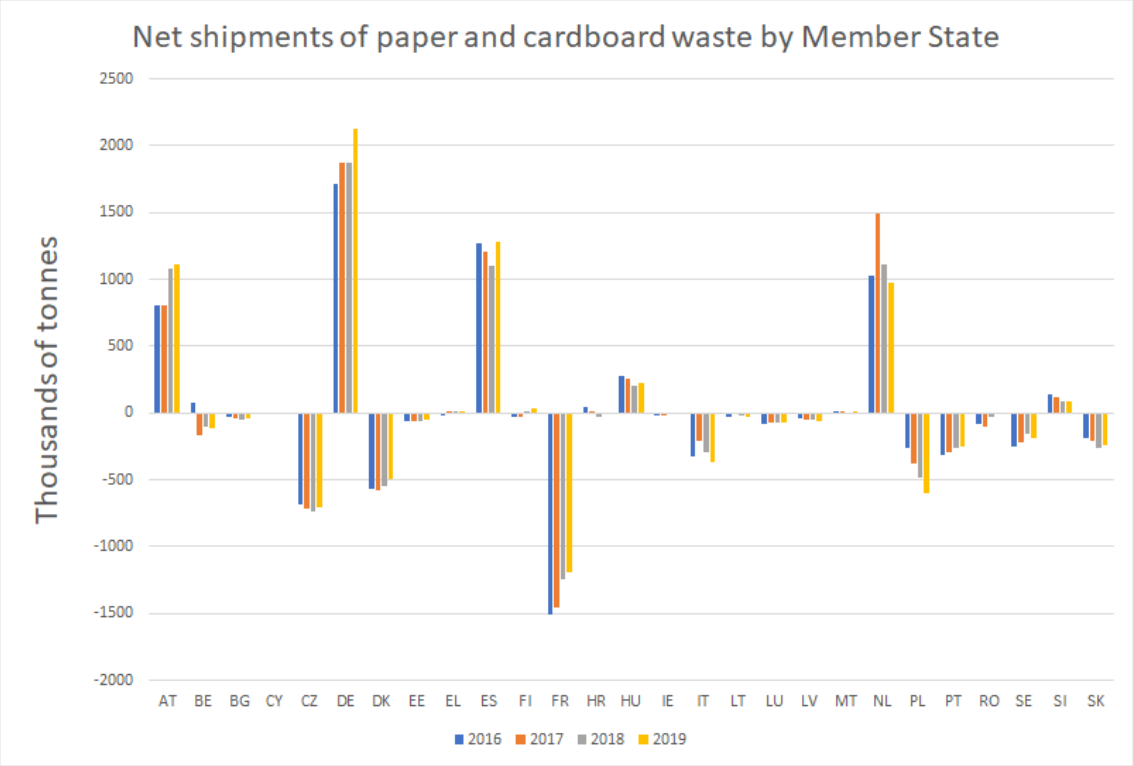
Figure 3-18 Intra-EU imports of paper and cardboard waste by Member State



The trend for the EU overall appears to be one of stable imports of paper and cardboard wastes from other EU Member States.

An examination of net values (considering imports versus exports) is presented below.

Figure 3-19 net shipments of paper and cardboard waste by Member State

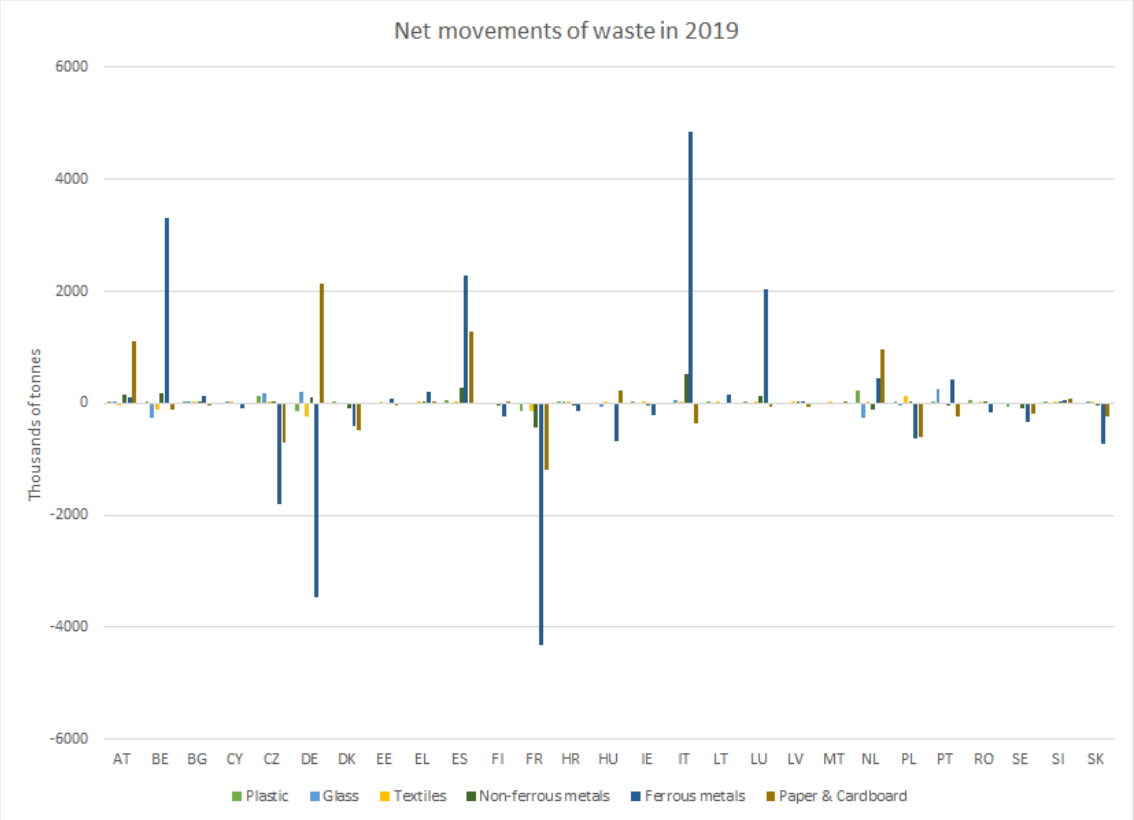


AT, DE, ES, HU and NL appear to be the overall countries of destination for paper and cardboard wastes from other EU Member States. CZ, DK, FR and PL appear to rely more heavily on exports to other Member States of their paper and cardboard wastes.

3.2.7 EU totals

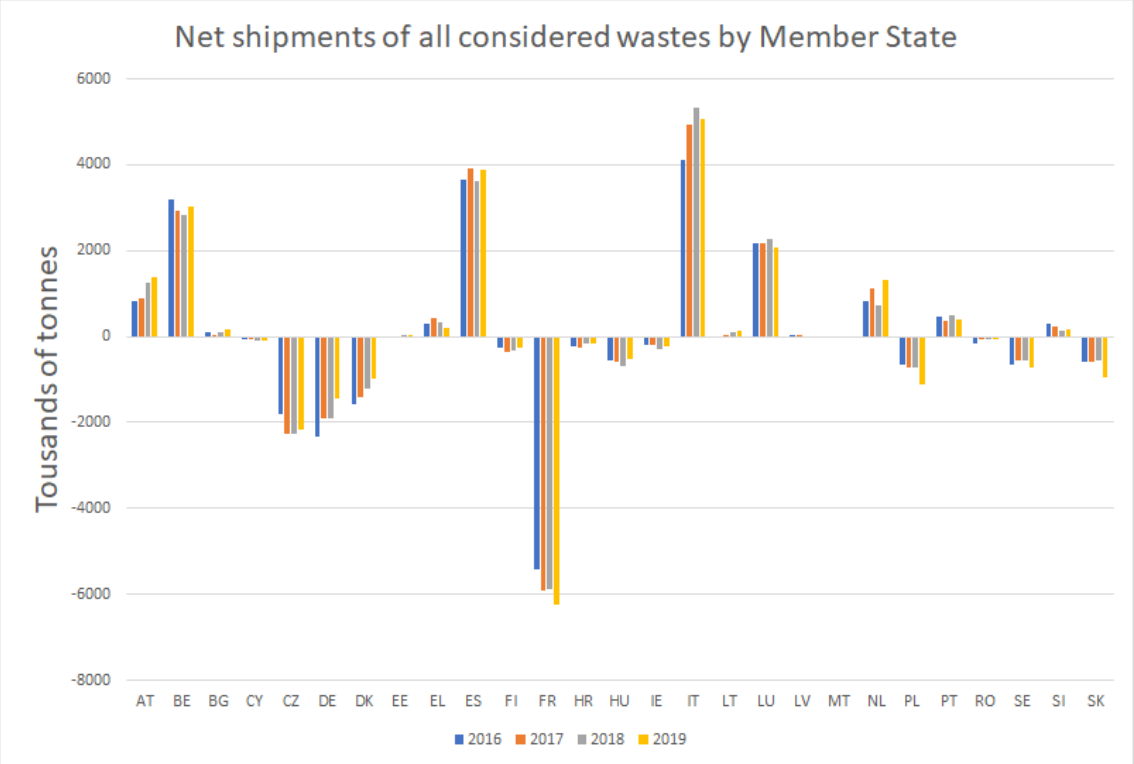
Having looked at the volumes and trends in movements by waste type, the figures below look at figures for movements of the selected wastes within the EU overall.

Figure 3-20 Net movements of waste by waste type and Member State in 2019



Examining wastes by volume, ferrous metal wastes dominate by weight shipments of the wastes concerned within the EU, with paper and cardboard waste the second largest by volume. However, it is apparent that for some Member States the trend is for exports to be larger than imports (i.e. the countries are net exporters of the wastes concerned) — see FR, DE, CZ and PL in the figure above as the more obvious countries that fall into this category. Others, such and IT, ES and NL generally import more waste materials than they export.

Figure 3-21 Net shipments of all wastes considered combined



The figure above looks at volumes shipped by weight. This more clearly shows the net exporters and net importers of the wastes concerned within the EU. The nature of the countries plays an important role in these figures. Countries such as BE, NL and LU are generally transport hub countries, LU as a result of its location amongst a number of large Member States and BE and NL as a result of the rail and port infrastructure in those countries that undertake a considerable share of transboundary shipments of waste both within the EU and between the EU and third countries. This is likely to account for their proportionally higher levels of exports of wastes than countries of a similar size in terms of population and economy.

3.2.8 Movements of RDF, other wastes and MSW for energy recovery and incineration

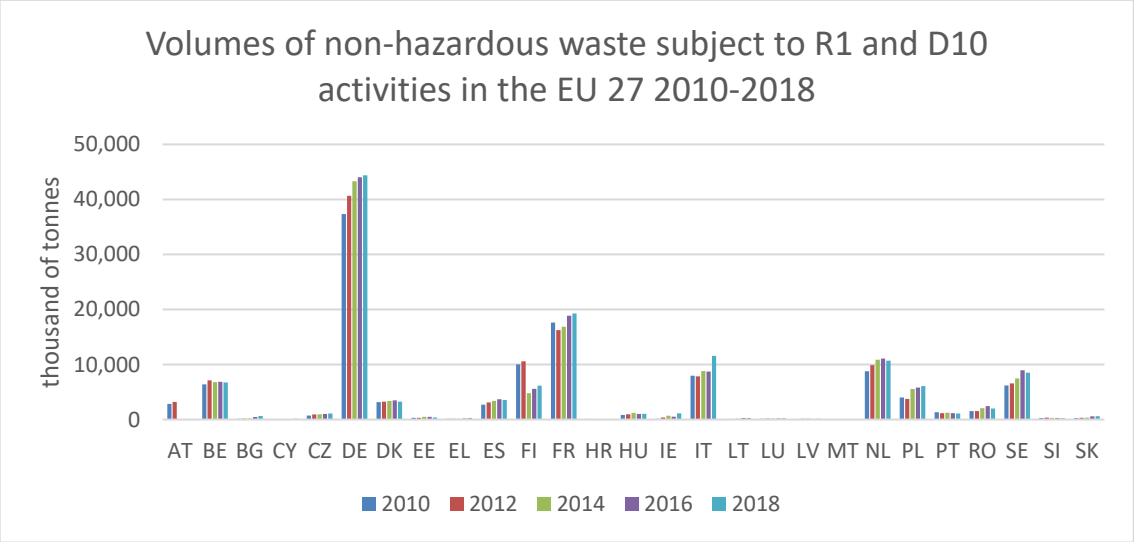
Our examination of shipments of waste within the EU of notified wastes has focussed on the following waste codes:

- 19 12 10 combustible waste (refuse derived fuel);
- 19 12 12 other wastes (including mixtures of materials) from mechanical treatment of wastes;
- 20 03 01 mixed municipal waste.

The idea behind the examination is to identify the main importers and exporters of these wastes for the purpose of energy recovery R1 or disposal D10. A consideration of the total amount of waste subject to R1 and D10 in each Member State has also been included in order to identify the importance of imports and exports of these wastes for incinerator operations in the EU.

The figure below looks at R1 and D10 treatments employed in the EU by weight of non-hazardous wastes generated.

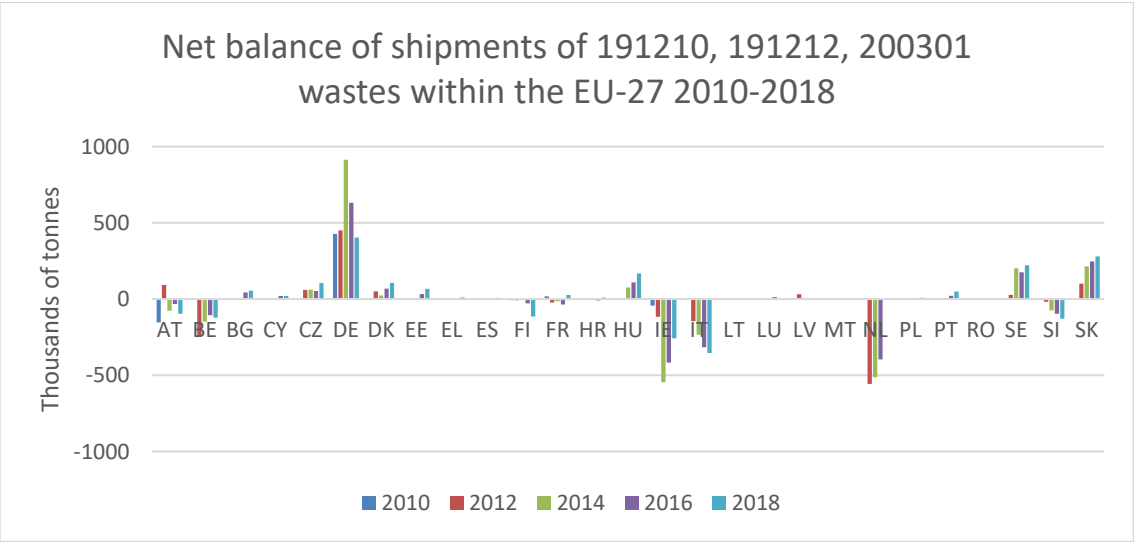
Figure 3-22 Volumes of non-hazardous waste subject to R1 and D10 activities in the EU 27 2010-2018



The general trend across all Member States that operate R1 and D10 activities is a general increase in wastes subject to those treatments between 2010 and 2018. However, the figure does not separate out waste generated within the Member State themselves and those wastes imported or exported from other Member States.

In order to consider the importance of transboundary movements of wastes for Member States in relation to R1 and D10 activities an examination of imports and exports of wastes 19 12 10, 19 12 12 and 20 03 01 has been undertaken for all Member States. This allows the identification of those Member States that are net exporters and net importers of wastes for the purpose of R1 and D1 activities. This is shown in the figure below where positive values show net imports are higher than exports and negative values showing the opposite.

Figure 3-23 Net balance of shipments of 191210, 191212, 200301 wastes within the EU-27 2010-2018

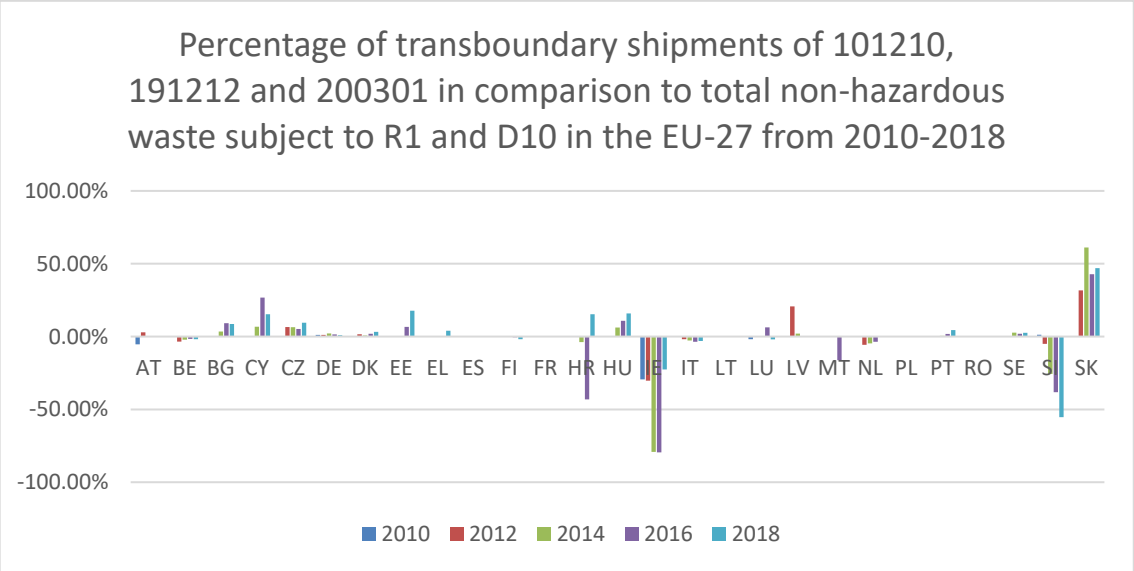


Some countries are generally net importers of the wastes concerned such as DE, SE and SK. Others, such as IE, IT and NL export more of these materials for incineration than they import. However, it is clear that the totals concerned by transboundary shipment represent a small proportion of the total amounts

of wastes subject to R1 and D10 activities in the EU, meaning that the majority of wastes subject to R1 and D10 activities are generated within the country where they are finally recovered or disposed.

In order to determine the relative importance of transboundary shipments of 19 12 10, 19 12 12 and 20 03 01 wastes for individual Member States a comparison of the percentage of shipments in comparison to total non-hazardous waste subject to R1 and D10 has been made as presented in the Figure below where positive values indicate a net import into the Member States concerned and negative values indicate a net export.

Figure 3-24 Percentage of transboundary shipments of 191210, 191212 and 200301 in comparison to total non-hazardous waste subject to R1 and D10 in the EU-27 from 2010-2018



This shows that, DE and SE are net importers of these wastes for R1 and D10 activities but that the proportions imported are a small fraction of the total wastes subject to these activities. However, for SK, imports are an important fraction of the total feedstocks for R1 and D10 capacity. Conversely, IE and to a lesser extent SI are heavily reliant on exports for the incineration of their wastes. The results from this figure are different in comparison to assessments that have been made in the past such as the EEA report from 2012 on movements of waste across the EU's internal and external borders. The main difference in volumes results from the UK having left the EU, with the UK having previously been an important exporter of RDF to EU Member States.

3.3 Prices attributed to the waste movements

3.3.1 Method

The attribution of prices to waste movements varies considerably by waste type. In some cases, market data on the value of wastes and of secondary materials that obtained an end-of-waste status is relatively easy to obtain. For example, this is the case for steel scrap (see the market reporting under the metal bulletin metalbulletin.com). For others, the value is more difficult to obtain.

The treatment of many waste streams by third parties abroad is often associated with a cost to be paid for by the exporter. Such negative pricing is common not only for hazardous wastes that are exported to be treated and/or disposed in (an)other MS, but also for waste or waste derived materials, such as

RDF or construction aggregates, from which the importer will recover the calorific or material value to an economic benefit.

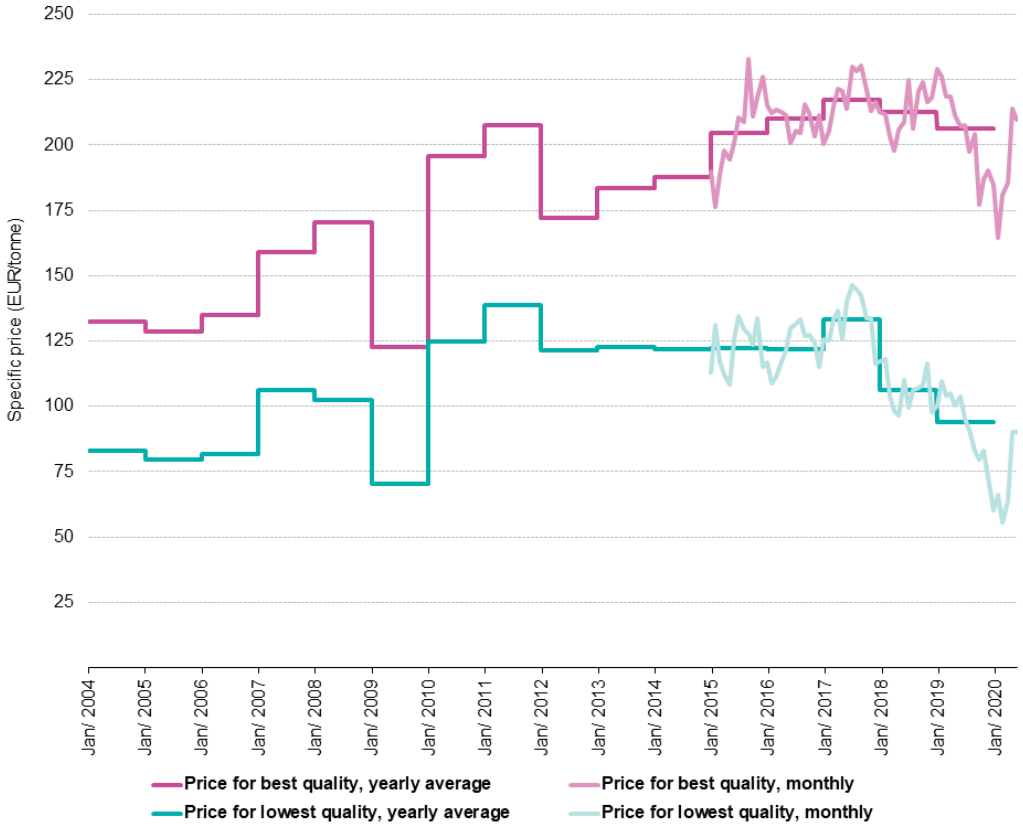
COMEXT includes value data against movements of certain types of waste that can be extracted on a CN code basis, therefore allowing a greater degree of granularity in terms of values. At the same time, the Eurostat data on trade in recyclable raw materials by waste[8] contains import and export values both in tonnes and € covering 2010 to 2019 for the categories of 'total waste' 'plastics' 'paper and cardboard' 'iron and steel' 'precious metals' 'copper, aluminium and nickel' with the CN codes used to determine such categories defined by Eurostat to aid ease of understanding[9]. Eurostat also provides updates to its secondary material price indicators that are likely to prove useful in this study[10].

Prices of waste categorised under a single CN code or European List of Waste (LoW) category differ greatly according to the specific quality of the (end-of-)-waste material (see the figure below on paper). This observation can be used to derive conclusions on the quality differences between the exported and imported waste of the same CN code. E.g. export values per tonne of Belgian ferrous scrap (per tonne of scrap) clearly differ per receiving country (Turkey or Germany), which reveals something about the recycling activities that take place in the respective destinations.

Figure 3-25 Prices of waste categorised under a single CN code or European LoW, 2015 to 2019 (USD)

[8] Eurostat (2021) Trade in recyclable raw material by waste
[9] Eurostat (n.d.) Annex - List of CN-codes used for indicator calculation (Trade in recyclable raw materials)
[10] Eurostat (2021) Recycling - secondary material price indicator

Price development for low and high quality waste paper, EU-27, 2004 to June 2020



Note: As examples, the trade positions of paper waste with the highest (code 47072000) and lowest (code 47079010) price were chosen:
47072000: Recovered 'waste and scrap' paper or paperboard made mainly of bleached chemical pulp, not coloured in the mass
47079010: Unsorted, recovered 'waste and scrap' paper or paperboard
Source: Eurostat COMEXT

eurostat

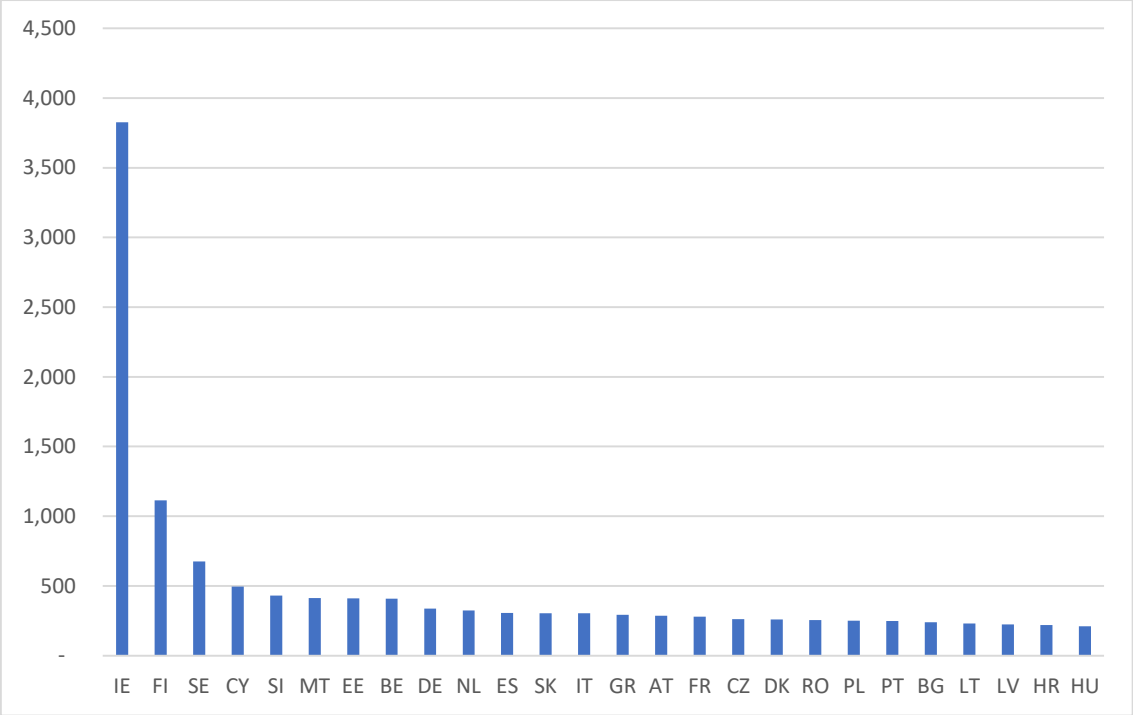
The materials selected include those most typically within green waste that can be recycled, e.g. plastic, paper, glass, metal. Though we also consider some other waste streams of interest (as they could potentially be recycled more, and/or may increase into the future, e.g. textiles. Refuse derived fuel (RDF) are also of interest as they are of the waste streams most commonly shipped within Europe.

3.3.2 *Values of EU shipments to MS*

The COMEXT database reports waste shipments both by value and quantity. Therefore, by combining the two it is possible to deduce the value per weight of the waste shipments by individual waste code or broader waste category. A useful metric to map the value of waste moved within the EU is to look at how this varies across different MSs for the same waste category, that is analysing the value of EU waste exports to different MSs. This allows an identification of which countries receive high-value waste and which low-value waste. The charts below present this analysis for each waste category for 2019 shipments using data for all months as an average. The original COMEXT data for value and quantity was reported by each waste code, and these have been added up to obtain total values and quantities for each waste category. Finally, the total value has been divided by the total quantity, obtaining values of waste shipped expressed in euro per tonne. It is important to note that there are several possible reasons behind some MSs presenting very high values for certain waste categories and we have not been able to fully investigate these in this study. For example, one reason for these

outliers may be that a MS only imports waste belonging to a specific high-value waste code, whereas other MSs are more focussed on low-value waste or a combination of the two.

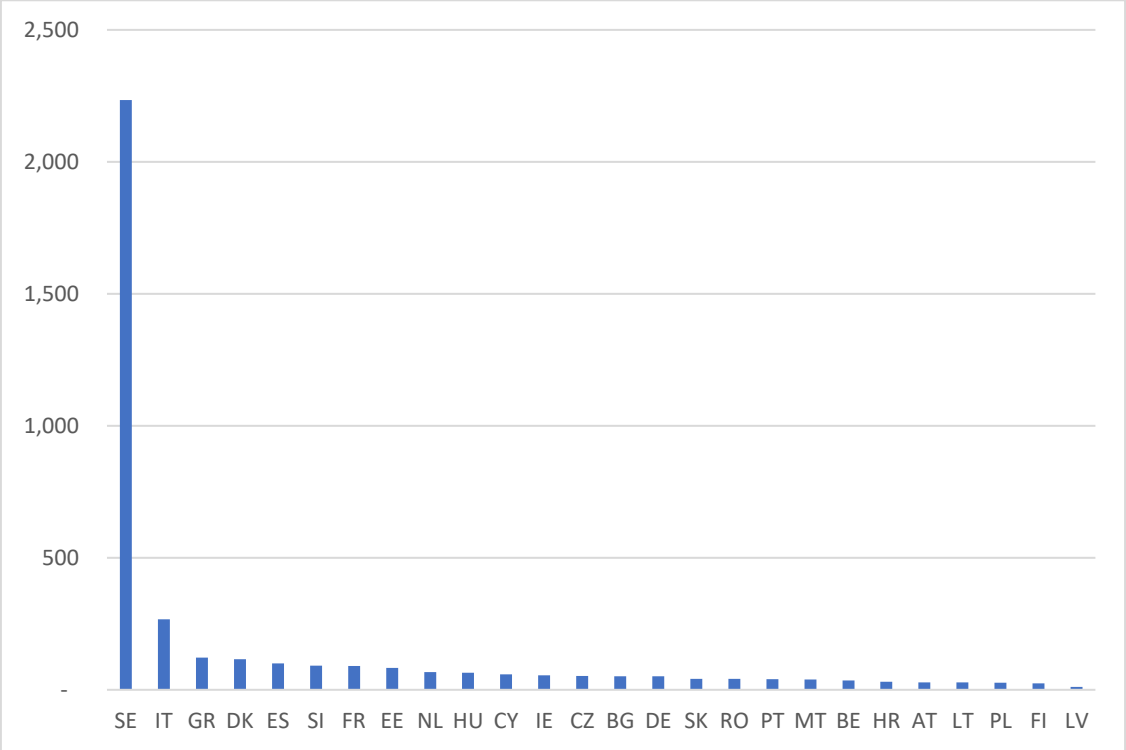
Figure 3-26 Value of EU ferrous metals waste shipments exported to other EU MSs (€/t, 2019)



Source: Own elaborations based on COMEXT data
Note: Luxembourg is included in data for Belgium

Within the ferrous metal category, IE is a clear outlier. IE exports to other EU Member States are dominated by shredded iron and steel (61% of total exports) and ferrous metal alloys (25% of total exports). However, it is the value of stainless-steel scrap from IE that appears to reflect the biggest difference in value compared to other Member States. The precise reason for this difference is unclear.

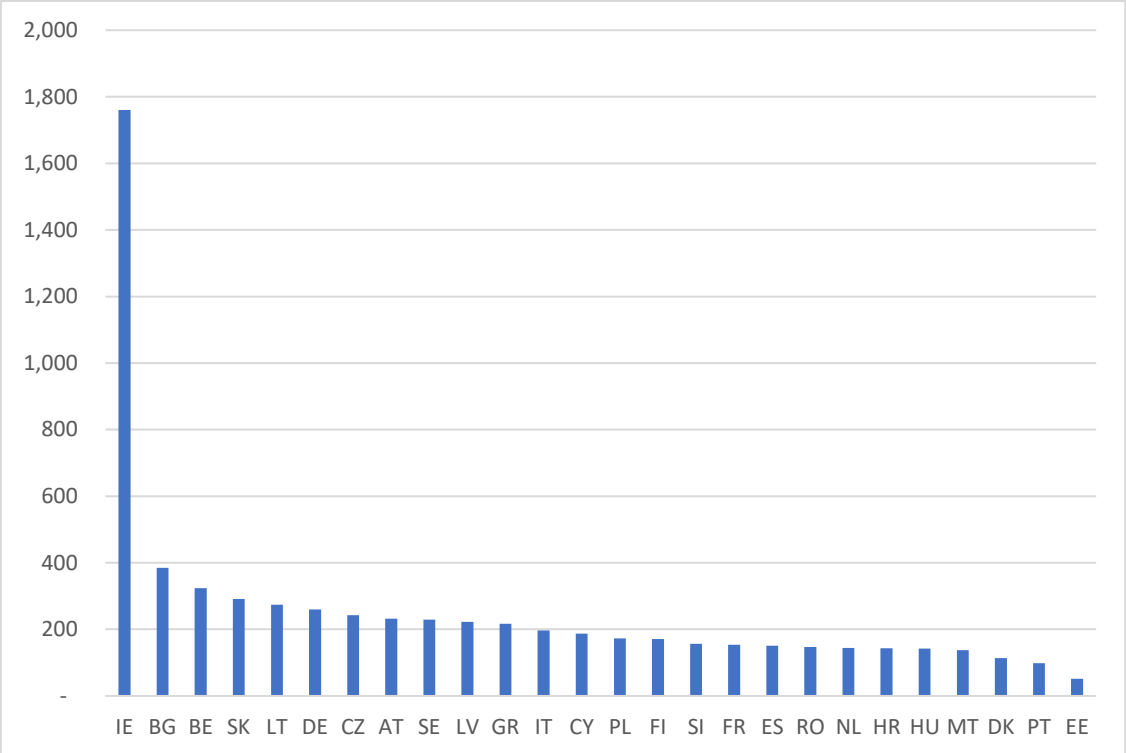
Figure 3-27 Value of EU glass waste shipments exported to other EU MSs (€/t, 2019)



Source: Own elaborations based on COMEXT data
Note: Luxembourg is included in data for Belgium

Within the glass category, SE exports to other EU Member States are dominated by glass cullet. The precise reason for the difference in price with other Member States is unclear.

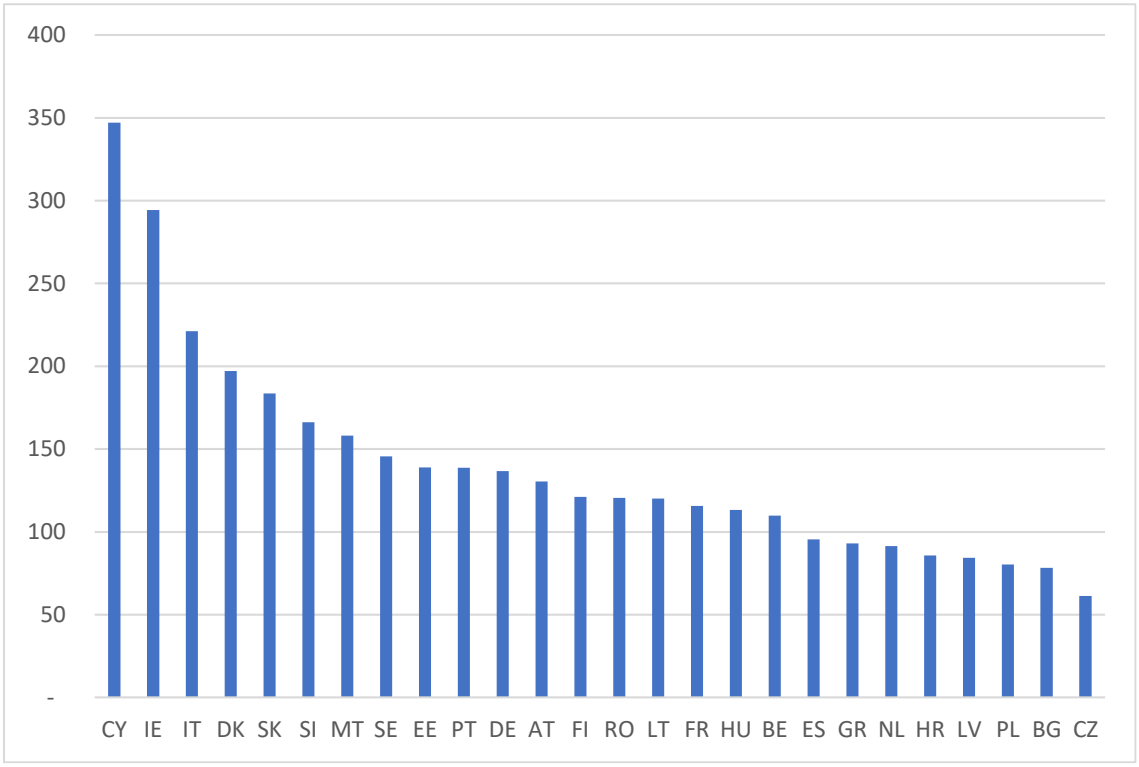
Figure 3-28 Value of EU non-ferrous metals waste shipments exported to other EU MSs (€/t, 2019)



Source: Own elaborations based on COMEXT data
Note: Luxembourg is included in data for Belgium

Almost 85% of non-ferrous metal exports from IE are comprised of lead scrap. The average market value of lead scrap is likely to play a significant role in the higher value of non-ferrous scrap prices in IE in comparison to other EU Member States.

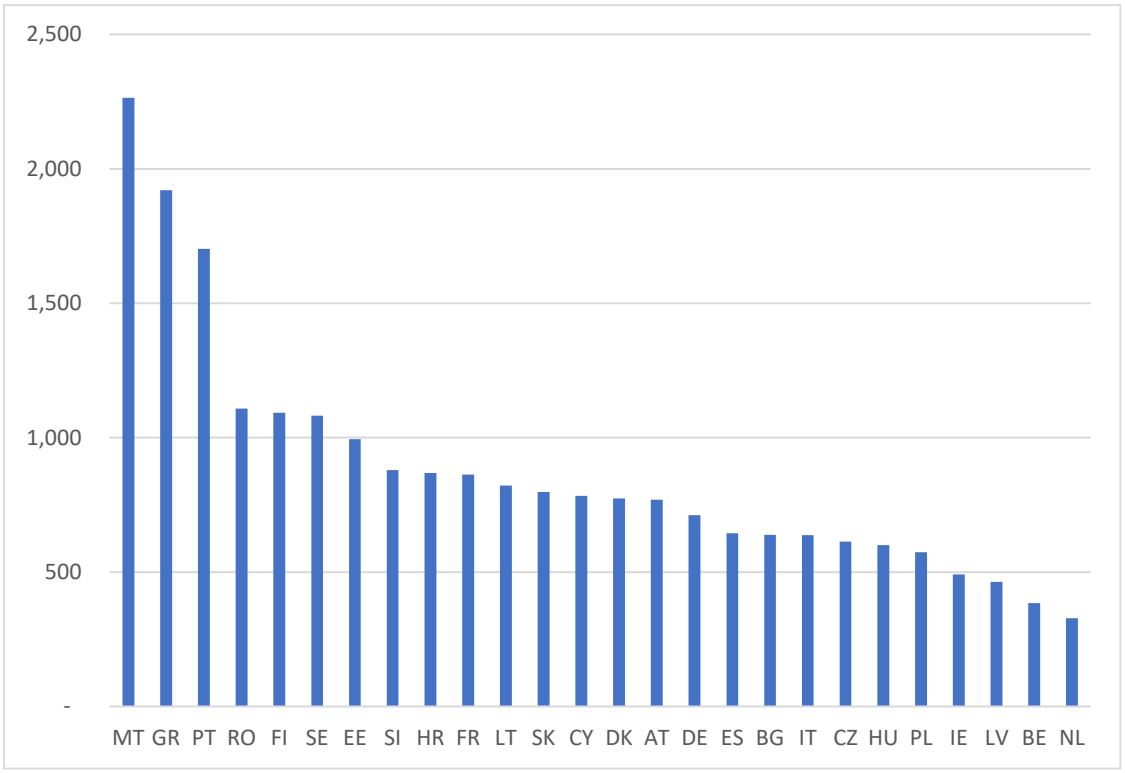
Figure 3-29 Value of EU paper and cardboard waste shipments exported to other EU MSs (€/t, 2019)



Source: Own elaborations based on COMEXT data
Note: Luxembourg is included in data for Belgium

More than two-thirds of exports of paper and cardboard waste from CY are sorted streams, i.e. sorting has already taken place, making the value of the materials exported generally higher than the unsorted streams that are exported by other Member States.

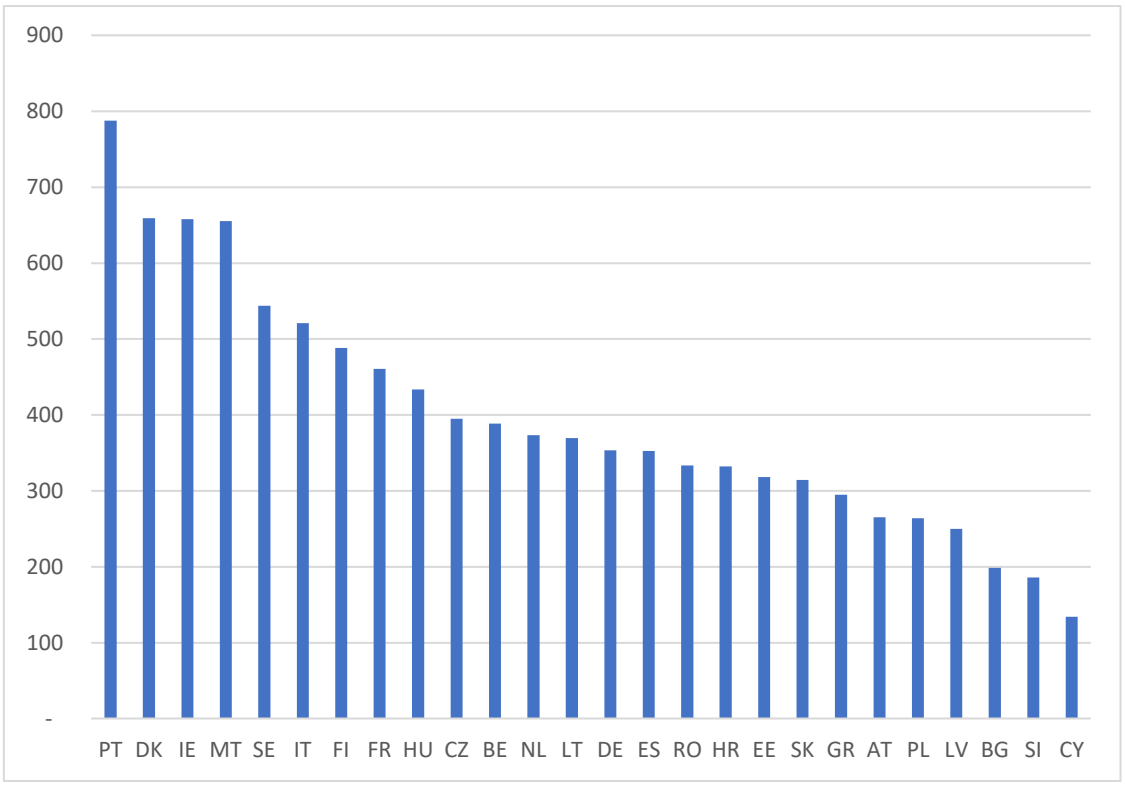
Figure 3-30 Value of EU textile waste shipments exported to other EU MSs (€/t, 2019)



Source: Own elaborations based on COMEXT data
Note: Luxembourg is included in data for Belgium

Whilst there is a difference in price by Member State, the reasons for the price difference in the case of MT, EL (GR (Greece) in the graph) and PT is unclear.

Figure 3-31 Value of EU plastic waste shipments exported to other EU MS (€/t, 2019)



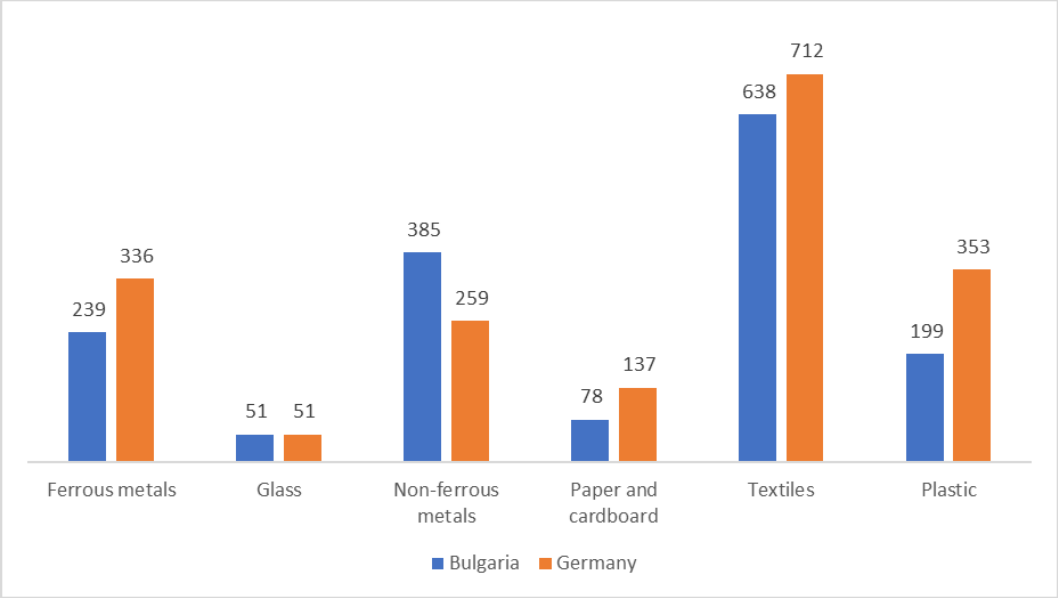
Source: Own elaborations based on COMEXT data. Note: Luxembourg is included in data for Belgium

The composition of plastic waste exported from PT is generally PET and PET mixed with other plastics. As PET generally has the highest value of plastic waste it is considered that this accounts for the higher value per tonne than other Member States. At the opposite end of the spectrum, CY generally only exports mixed plastic wastes, accounting for the lower value of plastic wastes exported. This pattern appears to repeat for other Member States – the greater the sorting of plastic wastes that takes place prior to export the greater the value of the plastic wastes shipped.

3.3.3 *Example country comparison: Bulgaria vs Germany*

A detailed investigation was carried out to compare two specific MSs. Bulgaria and Germany were chosen as they have contrasting GDP and resource consumptions, to analyse how the EU shipments of each waste category to the two MS vary in value. Figure 3-32 shows the results of the comparison.

Figure 3-32 – Value of EU waste shipments to Bulgaria and Germany (€/t, 2019)

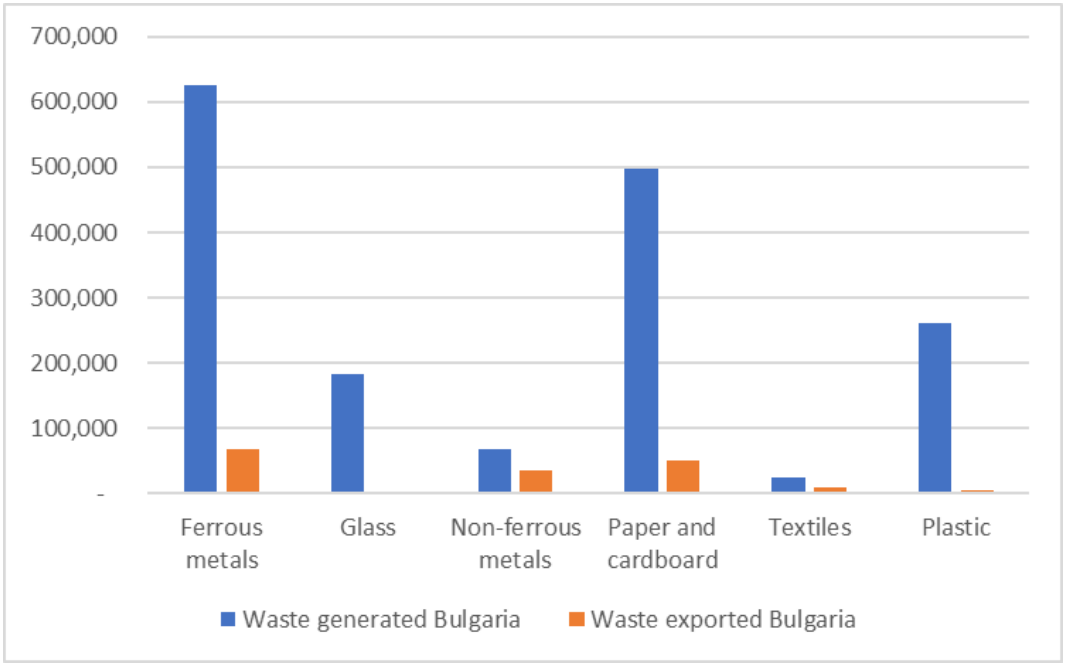


Source: Own elaborations based on COMEXT data

The chart indicates that Germany imports higher-value waste compared to Bulgaria in ferrous metals, paper and cardboard, textiles and plastic, whereas Bulgaria imports higher value material in non-ferrous metals. Glass waste imports appear to have a similar value in the two countries.

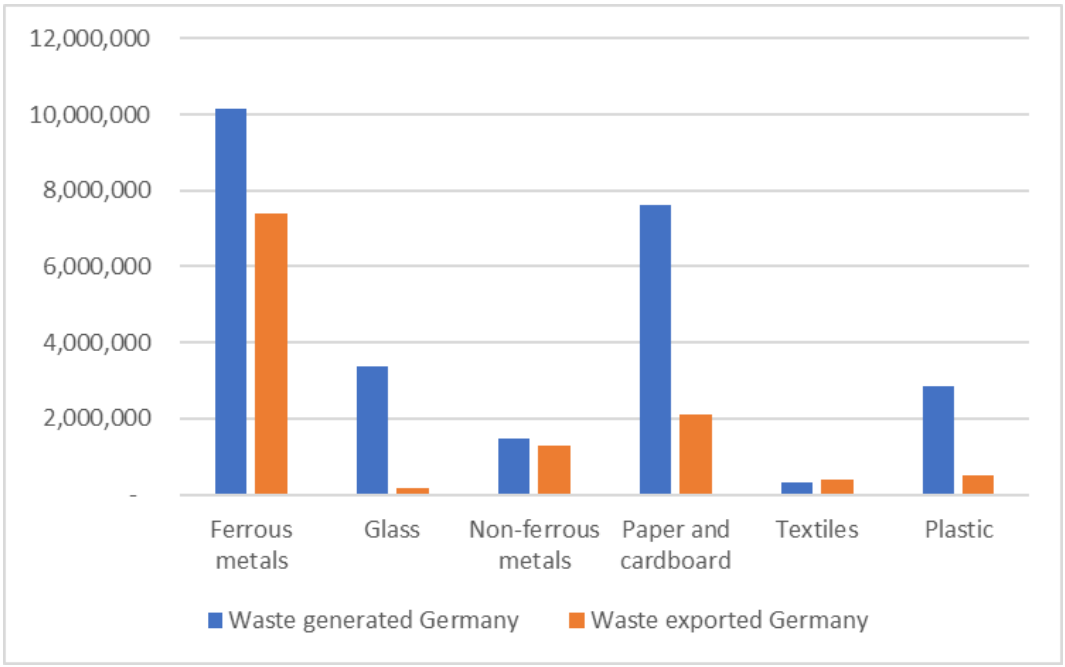
Another useful metric to look at is how much waste these MS export to other EU countries against the waste they generate in order to give an idea of the scale of export needs in comparison to capacity to manage wastes domestically – the smaller the proportion exported the more domestic capacity to treat the waste concerned is likely to exist. The results of this analysis are shown in the figures and tables below. Note that waste generation data was obtained from Eurostat, whereas waste export data from our model, which is based on the COMEXT database. 2019 data was not available for waste generated, therefore 2018 data was used for both waste generation and exports.

Figure 3-33 Waste generation vs waste exports in Bulgaria (t, 2018)



Source: Waste generation, Eurostat (https://ec.europa.eu/eurostat/databrowser/view/env_wasgen/default/table?lang=en); waste exports, model (COMEXT data).

Figure 3-34 Waste generation vs waste exports in Germany (t, 2018)



Source: Waste generation, Eurostat (https://ec.europa.eu/eurostat/databrowser/view/env_wasgen/default/table?lang=en); waste exports, model (COMEXT data)

Table 3-2 Waste exports / waste generation ratio in Bulgaria and Germany (2018)

	Ferrous metals	Glass	Non-ferrous metals	Paper and cardboard	Textiles	Plastic
Bulgaria	10.9%	0.02%	51.3%	10.3%	37.2%	2.2%
Germany	72.7%	5.2%	87.9%	27.8%	114.1%*	17.5%

Source: Waste generation, Eurostat (https://ec.europa.eu/eurostat/databrowser/view/env_wasgen/default/table?lang=en); waste exports, model (COMEXT data)
**: A value above 100% may have different explanations. for example discrepancies in the different databases used for this analysis.*

From the charts and table above it is clear that the ratio between waste exported and generated tends to be much higher in Germany compared to Bulgaria. This hints at a more independent waste management system in Bulgaria, which is able to cope with a larger share of its waste without resorting to shipping it to third countries.

3.4 Summary of key messages

3.4.1 Movements by weight

It is apparent that transboundary shipments remain a small percentage of total waste generated, indicating that, in general, 98% of wastes generated are treated within the Member States themselves, with transboundary movements representing a small percentage by total volume.

The nature of the countries plays an important role in their exports of imports of waste. Countries such as BE, NL and LU are generally transport hub countries, LU as a result of its location amongst a number of large Member States and BE and NL as a result of the rail and port infrastructure in those countries that undertake a considerable share of transboundary shipments of waste both within the EU and between the EU and third countries. This is likely to account for their proportionally higher levels of exports of wastes than countries of a similar size in terms of population and economy.

Analysis of the patterns in the waste streams considered key to the circular economy, as they are the most resource rich (i.e. recyclable) revealed the following:

- ***Plastic waste:*** Some Member States (FR, DE and SE) consistently relying on exports whilst others appear to be expanding their imports (most notably CZ, and RO);
- ***Glass waste:*** Some Member States (BE, HU, EL, HU, NL, RO, SE and SI) consistently relying on exports, whilst others appear either to be expanding their imports of glass waste overall (most notably CZ) or are large destinations for glass waste overall (DE and PT);
- ***Textile waste:*** Some Member States (AT, BE, DE, FI, FR, PT and SE) consistently relying on exports, whilst others are generally net importers of textiles waste (most notably BG, ES, HU, IT, LT, NL, PL and RO);
- ***Non-ferrous metals:*** When considering the significant volume of shipments originating from or entering DE, the balance of imports versus exports is relatively small. DK, FR and NL are the largest Member States by volume that export more non-ferrous metal waste than they import, whereas the likes of AT, ES and IT show increasing trends of net volumes imported increasing over time;
- ***Ferrous metals:*** IT, BE, ES and LU appear to be the overall countries of destination for ferrous metal wastes from other EU Member States. DE, FR and FR appear to rely more heavily on exports to other Member States of their ferrous metal wastes. Imports into Italy are reported

(industry interview) as being relatively high due to the high use of electric arc furnaces in iron and steel production in Italy, and these are capable of using a much higher proportion of waste material than blast furnaces (which are more common in German steel making plants). Germany appears to have the largest number of shipments by waste moving into and out of the country. Germany accounted for over 40M tonnes of crude steel in 2019 (25% of crude steel production in the EU). With net exports of just under 3.5M tonnes, exports of ferrous metal waste represent just under 10% of total production. When compared with FR, that accounts for 14.5M tonnes of crude steel production in 2019, net exports as a percentage of production in FR are 30% of total production. A similar proportion to FR in found in CZ;

- ***Paper and cardboard***: AT, DE, ES, HU and NL appear to be the overall countries of destination for paper and cardboard wastes from other EU Member States. CZ, DK, FR and PL appear to rely more heavily on exports to other Member States of their paper and cardboard wastes;
- ***Refuse derived fuel, other wastes from mechanical treatment and mixed municipal waste for energy recovery and incineration***: DE and SE are net importers of these wastes for R1 and D10 activities but that the proportions imported are a small fraction of the total wastes subject to these activities. However, for SK, imports are an important fraction of the total feedstocks for R1 and D10 capacity. Conversely, IE and to a lesser extent SI are heavily reliant on exports for the incineration of their wastes.

3.4.2 Values of EU shipments between MSs

The COMEXT database reports waste shipments both by value and quantity. Therefore, by combining the two it is possible to deduce the value per weight of the waste shipments by individual waste code or broader waste category. It is important to note that there are several possible reasons behind some MSs presenting very high values for certain waste categories and we have not been able to fully investigate these in this study. For example, one reason for these outliers may be that a MS only imports waste belonging to a specific high-value waste code, whereas other MSs are more focussed on low-value waste or a combination of the two.

This data can also be analysed to compare the relative performance of Member States in the types and value of waste they export and import. To illustrate this the data for Germany and Bulgaria were compared. This comparison indicates that Germany imports higher-value waste compared to Bulgaria in ferrous metals, paper and cardboard, textiles and plastic, whereas Bulgaria imports higher value material in non-ferrous metals. Glass waste imports appear to have a similar value in the two countries. The analysis also shows that the ratio between waste exported and generated tends to be much higher in Germany compared to Bulgaria. This suggests a more independent waste management system in Bulgaria, which is able to cope with a larger share of its waste without resorting to shipping it to third countries.

3.5 Final treatment

Data on the actual treatments at the point of destination are not always easily identifiable, if they exist at all. There are two main sets of data that can be interrogated for this, each with their benefits and shortcomings, including in relation to understanding final treatments applied:

- Comext data provides a lot of detailed and reliable data on flows of materials and their reported values. However, it does not include data on final treatment. Certain assumptions are made in relation to some CN code material identified as recyclable raw materials by waste (i.e. that it is assumed that it always crosses borders for recovery given its inherent value). Whilst this may, in general, be correct, it is almost certain that at least a fraction of the materials transferred across borders are not recycled or reused but may be recovered in energy from waste facilities or disposed of (i.e. sorting residues);
- Eurostat waste shipment data generally contains a significant amount of information on the waste treatments applied to the wastes shipped. However, the dataset is far less encompassing of recyclable raw materials by waste because not all such wastes are subject to notification and reporting under the relevant waste statistics Regulation.

The following three step approach was followed in order to assess the nature of the treatment provided to waste that is shipped between Member States:

- Identification and selection of important (high volume) waste streams transported between EU MSs;
- Analysis of the flows of identified high volume waste types between EU MS;
- Analysis of the treatments provided by EU MS to the intra EU transferred waste volumes.

In the first step, the Comext data delivered in section 3.2, on waste that is traded as goods under particular CN codes, is complemented by waste trade data reported in accordance with the Basel Convention and the Waste Shipment Regulation (EC) No 1013/2006 of the European Parliament and of the Council (as reported by Eurostat). A particular asset of the latter dataset is that it provides insight on the first treatment step that is given to the waste at destination. The most relevant hazardous and non-hazardous waste flows that are reported are identified here. This information on reported waste flows is then aggregated to the traded waste and end-of-waste streams that are reported in the COMEXT database.

The Eurostat data that is analysed is:

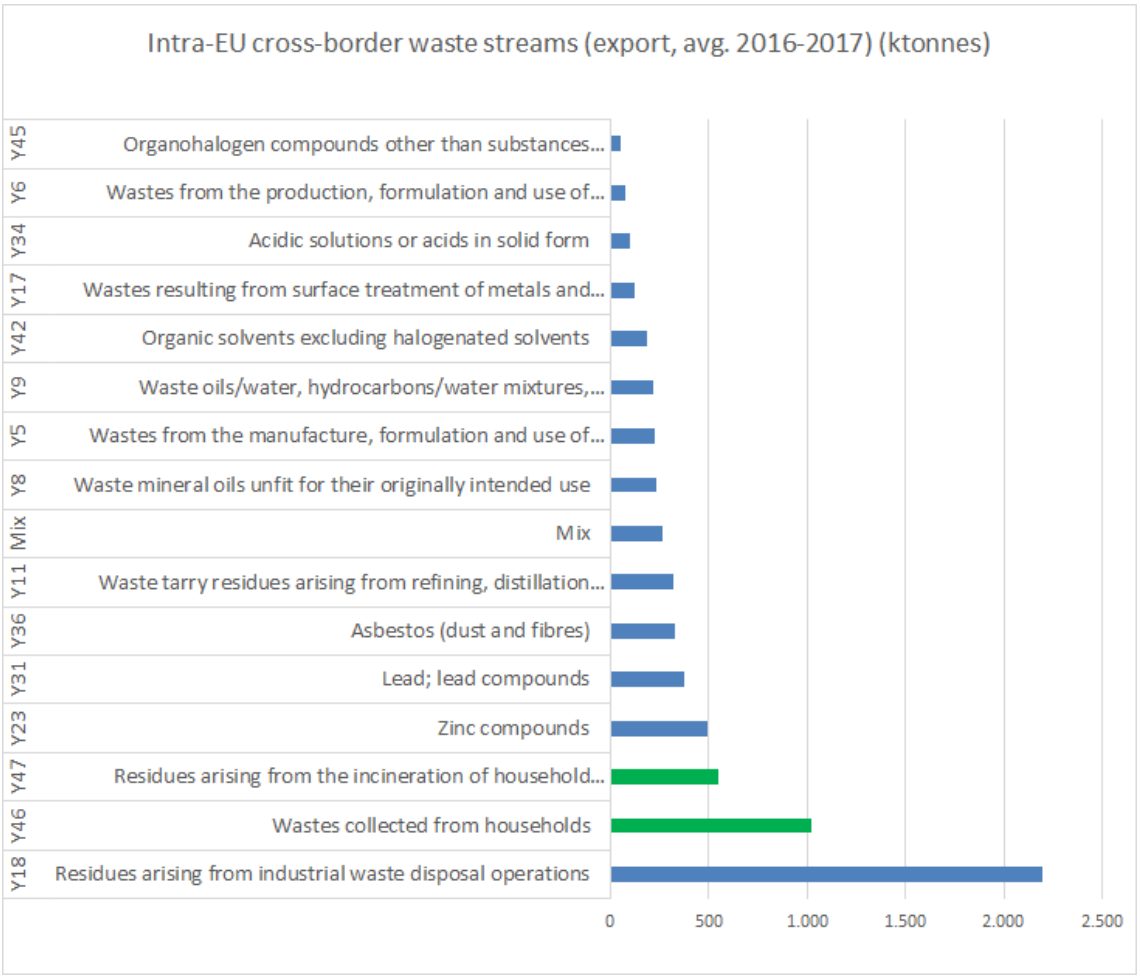
- “Export”: waste streams exported from one (reporting) EU member state to another MS;
- “Import”: waste streams imported from one (reporting) EU member state to another MS;
- Figures for 2016 and 2017.

Table C-1 in Annexe C presents 16 different waste flows, characterised according to their Basel codes, that are considered most relevant when investigating the volumes are transferred between EU member states. It is important to point out that this analysis contains some hazardous wastes. These waste streams are beyond the target scope of this report but they have been included in the analysis because the data is available, and because there are significant environmental benefits to be derived from recovering material from some of these hazardous streams (e.g. those containing metals).

The next table (C-2) in Annexe C then shows the volumes of these waste codes that were transferred between MSs in 2016 and 2017. The analyses focus on these 16 waste types, each with annual intra EU

shipment volumes of over 100 kilotons. Averages are taken for the two years, in order to account for possible disruptive events that might have affected particular waste streams in a certain year. As the decision to proceed to ship waste is taken by the exporting operators, the data referring to intra-EU exports (as opposed to imports) is used for the analysis.

Figure 3-35 Illustration of intra-EU cross border waste streams (avg. 2016-2017) as reported under the Basel Convention (as export) (Blue = Hazardous; Green = Non-hazardous)



The figure above shows the order of magnitude of the main intra-EU waste streams which are reported under the Basel Convention. The most important categories, in terms of volume, are residues from industrial waste disposal operations, wastes collected from households, and residues from the incineration of household waste, followed by zinc- and lead-containing compounds and asbestos.

It should be noted that by far the most voluminous waste stream that is transferred between EU member states corresponds to the category 'Not specified', representing between 55 to 61% of the total reported waste flow. The category of 'not specified' waste also has a total weight that is about 4.5 times higher than the second most relevant waste stream, the already very generic category of 'residues from industrial waste disposal'. This implies that for most of the waste that is reported to the Basel Convention, the waste properties and characteristics are very generic or completely unknown.

Although this information gap represents a clear and important limitation for the study of the environmental benefits from intra-EU waste movements, the nature of the reported, expected and intended treatments still allows for some meaningful analysis.

3.5.1 *Analysis of the flows of identified high volume waste types between EU MS*

The flows of CN coded waste-related goods have been analysed earlier in this report. In order to complement this information with an assessment of the waste treatment that this waste receives, the most important (high volume) waste exports from specific EU member state to other member states, and that are reported in accordance with the Basel Convention, are identified in the table below.

Table 3-3 Geographical distribution of cross-border waste transfers within the EU

Export (from)	Volume (t) (2016)	Export (from)	Volume (t) (2017)
Germany		**Belgium**	
Total (16+1 categories)	**2.495.993**	**Total (16+1 categories)**	**3.859.992**
to Netherlands	1.116.898	to Netherlands	3.202.527
to France	401.479	to Germany	334.728
to Austria	281.347	to France	291.203
Netherlands		**Germany**	
Total (16+1 categories)	**2.486.969**	**Total (16+1 categories)**	**3.214.876**
to Germany	1.805.020	to Netherlands	1.359.396
to Belgium	488.431	to France	535.822
to Sweden	76.206	to Austria	434.733
Belgium		**Netherlands**	
Total (16+1 categories)	**2.438.440**	**Total (16+1 categories)**	**2.791.341**
to Netherlands	1.776.045	to Germany	2.132.186
to Germany	374.684	to Belgium	469.134
to France	265.677	to France	64.954
Luxembourg		**France**	
Total (16+1 categories)	**1.994.585**	**Total (16+1 categories)**	**1.651.329**
to France	1.558.502	to Belgium	429.966
to Germany	401.945	to Germany	379.298
to Belgium	26.382	to Netherlands	278.019
Italy		**Luxembourg**	
Total (16+1 categories)	**1.167.376**	**Total (16+1 categories)**	**1.474.125**
to Germany	579.313	to France	957.792
to Austria	209.659	to Germany	472.134
to Hungary	104.286	to Belgium	39.742
France		**Italy**	
Total (16+1 categories)	**1.110.005**	**Total (16+1 categories)**	**1.207.694**
to Germany	365.158	to Germany	592.964
to Belgium	331.470	to Austria	189.500
to Netherlands	208.136	to France	99.678
Austria		**Austria**	
Total (16+1 categories)	**823.553**	**Total (16+1 categories)**	**800.711**
to Germany	410.763	to Germany	362.716

Export (from)	Volume (t) (2016)	Export (from)	Volume (t) (2017)
to Slovakia	181.805	to Slovakia	187.620
to Czechia	135.064	to Czechia	150.831
Ireland		**Ireland**	
Total (16+1 categories)	**574.397**	**Total (16+1 categories)**	**503.745**
to Germany	209.626	to Netherlands	231.713
to Netherlands	183.689	to Germany	111.874
to Belgium	65.535	to Sweden	51.082
Denmark		**Sweden**	
Total (16+1 categories)	**326.322**	**Total (16+1 categories)**	**372.015**
to Germany	215.824	to Germany	271.195
to Sweden	71.121	to Sweden	80.898
to Netherlands	28.605	to Poland	10.328
Finland		**Greece**	
Total (16+1 categories)	**246.759**	**Total (16+1 categories)**	**119.972**
to Sweden	98.104	to Italy	32.360
to Estonia	96.397	to Germany	30.692
to Germany	34.614	to France	18.713

Analysis for 16+1 Basel waste categories for the top 10 member states with the highest volumes of wastes exported to other countries in the EU, (2016 and 2017). Volumes are ranked from high to low. Top-3 destinations are shown for each country.*
**16 Basel waste categories selected in section 3.3.1, representing large volumes of cross-border transport: Y18, Y46, Y47, Y23, Y31, Y36, Y11, Y8, Y5,Y9, Y42, Y17, Y34, Y6, Y45, 'Mix' + 'Not specified'-category.*

The table above gives an overview of the largest flows (for the 16 Basel codes above the 100 kilotons per year cut-off, plus the reported but not specified waste) between countries in the EU, it is clear that:

- Belgium, Germany, the Netherlands, France, Luxembourg, Italy, Austria and Ireland are the main waste exporting countries for the selected Basel-coded waste categories;
- Most of the top 10 exporting member states are also listed in the individual member state's top 3 of receiving countries. Exceptions are Slovakia and Czechia that receive waste from their neighbours Austria, and Poland and Estonia that import wastes from their respective neighbours Sweden and Finland. This shows that the member states cannot be categorised into receiving and exporting countries, but rather can be grouped into member states that transfer high volumes of waste among each other, and others that are less involved in intra EU waste movements;
- Luxembourg, despite its small population and size, appears both in 2016 as in 2017 in the top five exporting member states;
- Main exporters and their corresponding top three destinations, are roughly the same in 2016 and 2017, but volumes appear to vary considerably from one year to another. In 2017, the top three exporting member states exported 1/3 more compared to the previous year;
- Cross-border shipments of these flows, which mostly consist of hazardous waste, mainly go to the neighbouring countries.

3.5.2 *Analysis of the treatments provided by EU MS to the intra EU transferred waste volumes*

For waste streams which are notified under the Basel Convention, the treatment foreseen in the country of destination is reported. The reporting distinguishes disposal (Dx) and recovery (Rx) codes. The following treatment codes are attributed to the waste streams in the dataset:

Table 3-4 Disposal (D) and recovery (R) codes assigned to treatments of notified waste transfers

Code	Description
D1	Deposit into or onto land (e.g. landfill,...)
D3	Deep injection (e.g. injection of pumpable discards into wells, salt domes or naturally occurring repositories, etc.)
D4	Surface impoundment (e.g. placement of liquid or sludge discards into pits, ponds or lagoons, etc.)
D5	Specially engineered landfill (e.g. placement into lined discrete cells which are capped and isolated from one another and the environment)
D6	Release into a water body except seas/oceans
D7	Release into seas/oceans including sea-bed insertion
D8	Biological treatment not specified elsewhere in this list which results in final compounds or mixtures which are discarded by means of any of the operations in this list
D9	Physico-chemical treatment not specified elsewhere in this list which results in final compounds or mixtures which are discarded by means of any of the operations in this list (e.g. evaporation, drying, calcination, etc.)
D10	Incineration on land
D11	Incineration at sea
D12	Permanent storage (e.g. emplacement of containers in a mine (etc.)
D13	Blending or mixing prior to submission to any of the operations in this list
D14	Repackaging prior to submission to any of the operations in this list
D15	Storage pending any of the operations in this list
Code	**Description**
R1	Use as a fuel (other than in direct incineration) or other means to generate energy (Basel/OECD) - Use principally as a fuel or other means to generate energy (EU)
R2	Solvent reclamation/regeneration
R3	Recycling/reclamation of organic substances which are not used as solvents
R4	Recycling/reclamation of metals and metal compounds
R5	Recycling/reclamation of other inorganic materials
R6	Regeneration of acids or bases
R7	Recovery of components used for pollution abatement
R8	Recovery of components from catalysts
R9	Used oil refining or other reuses of previously used oil
R10	Land treatment resulting in benefit to agriculture or ecological improvement
R11	Uses of residual materials obtained from any of the operations numbered R1 to R10
R12	Exchange of wastes for submission to any of the operations numbered R1 to R11
R13	Accumulation of materials intended for any operation in this list

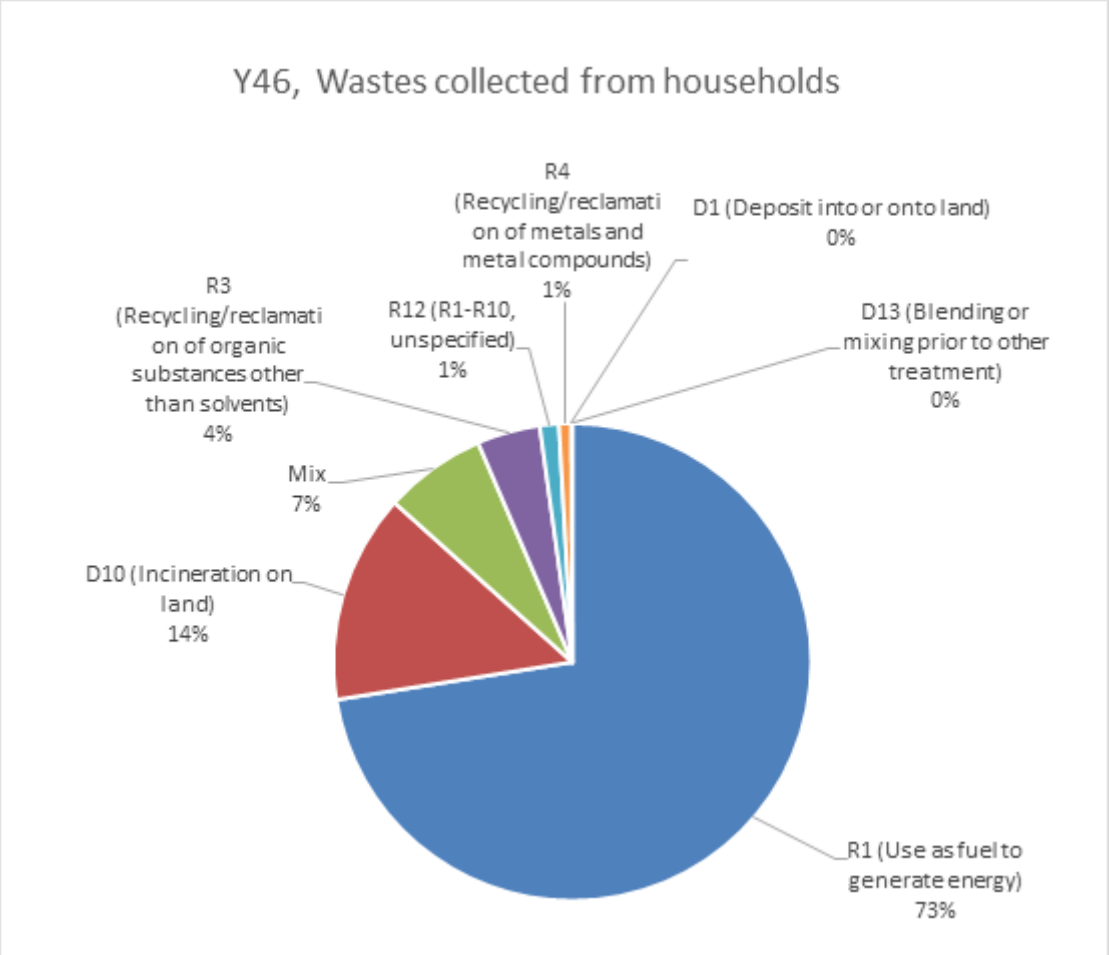
As in sections 3.2 and 3.3 we are able to pull out certain waste streams for additional analysis. We have focussed on the streams for which there is data that are closest to those in sections 3.2 (and 3.3), i.e. those that are known to contain valuable resources and are relatively high volume. However, this is constrained by the fact that we are using a different data source - data reported under the Basel convention to Eurostat as opposed to Comext trade data. The waste streams we have analysed are:

- Waste collected from households and residues from the incineration of household wastes (Y46)
- Residues from the incineration of household wastes (Y47);
- Not specified waste – covers a wide variety of waste, including mixed household waste;
- Residues from industrial waste disposal operations (Y18);
- Other types of hazardous waste – covering the (mainly hazardous) waste streams not captured above.

Figure 3-37 shows what treatments are given to waste collected from households (Y46) when it is transferred to another member state (2016 figures):

- • 73% of this waste is eventually incinerated for energy production;
- • 14% is incinerated without energy recuperation;
- • 13% is treated for other recovery purposes.

Figure 3-36 Treatment of wastes collected from households (Y46)



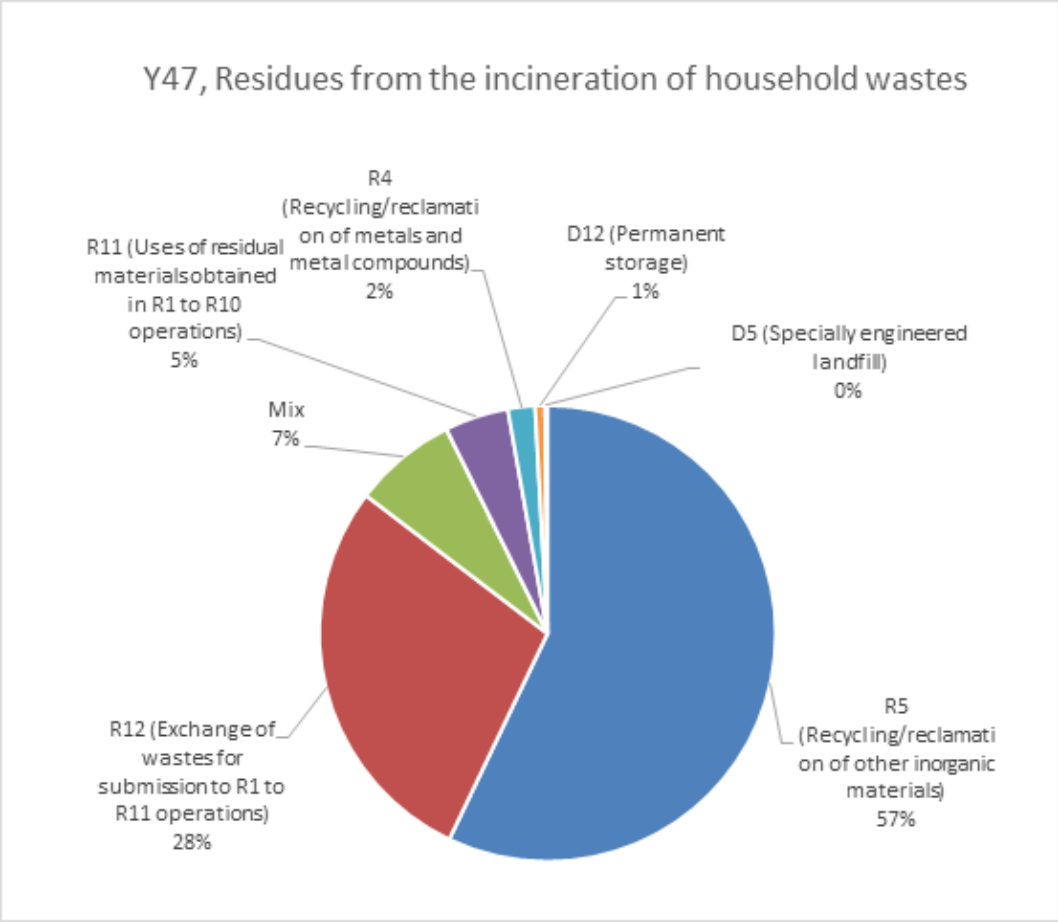
(Based on Eurostat data, as reported directly to The Basel Convention on the Control of Transboundary Movements of Hazardous Wastes and their Disposal)

Figure 3-38 shows the treatments given to residues from the incineration of household wastes (Y47) when it is transferred to another member state (2016 figures):

Several recovery operations are applied (according to the figures for 2016):

- For 57% of the volume, the purpose is to recycle or recover inorganic materials, other than metals;
- For 40% of the volume several recovery techniques (R1 to 11) are applied – there is no further detailed information on the exact treatment and/or the share of the different treatments;
- Reclamation of metals and metal compounds is applied to 2% of the volume;
- Only 1% of the volume goes to a landfill or is permanently stored.

Figure 3-37 Treatment of residues from the incineration of household wastes (Y47)

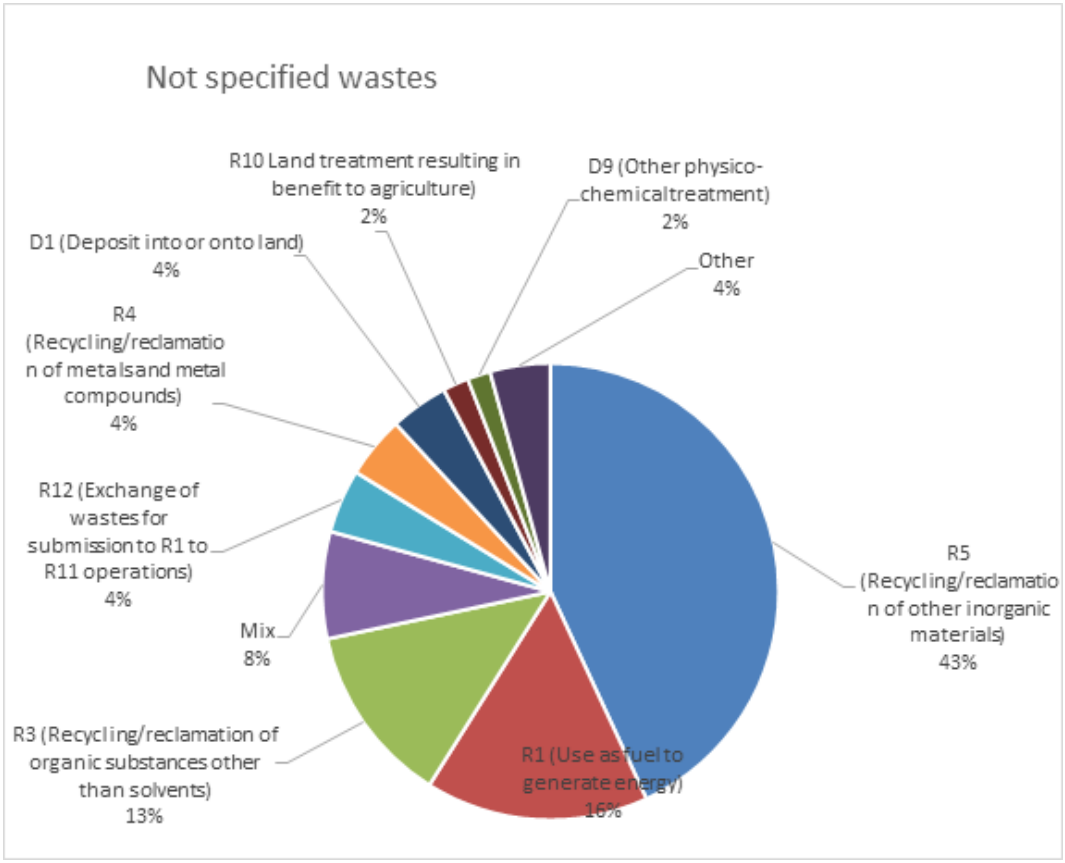


(Based on Eurostat data, as reported directly to The Basel Convention on the Control of Transboundary Movements of Hazardous Wastes and their Disposal)

Figure 3-39 shows what treatments are given to waste that is categorised as 'not specified' when it is transferred to another member state (2017 figures):

- For 43% of the volume, the purpose is to recycle or recover inorganic materials, other than metals;
- 16% of the volume is used as a fuel to generate energy;
- The recycling or reclamation of organic substances other than solvents is applied as a waste treatment on 13% of the intra-EU exported volume;
- The rest of the waste that is categorised as not specified receives very diverse disposal and recovery treatments at destination.

Figure 3-38 Treatment of waste that is categorised as 'not specified'

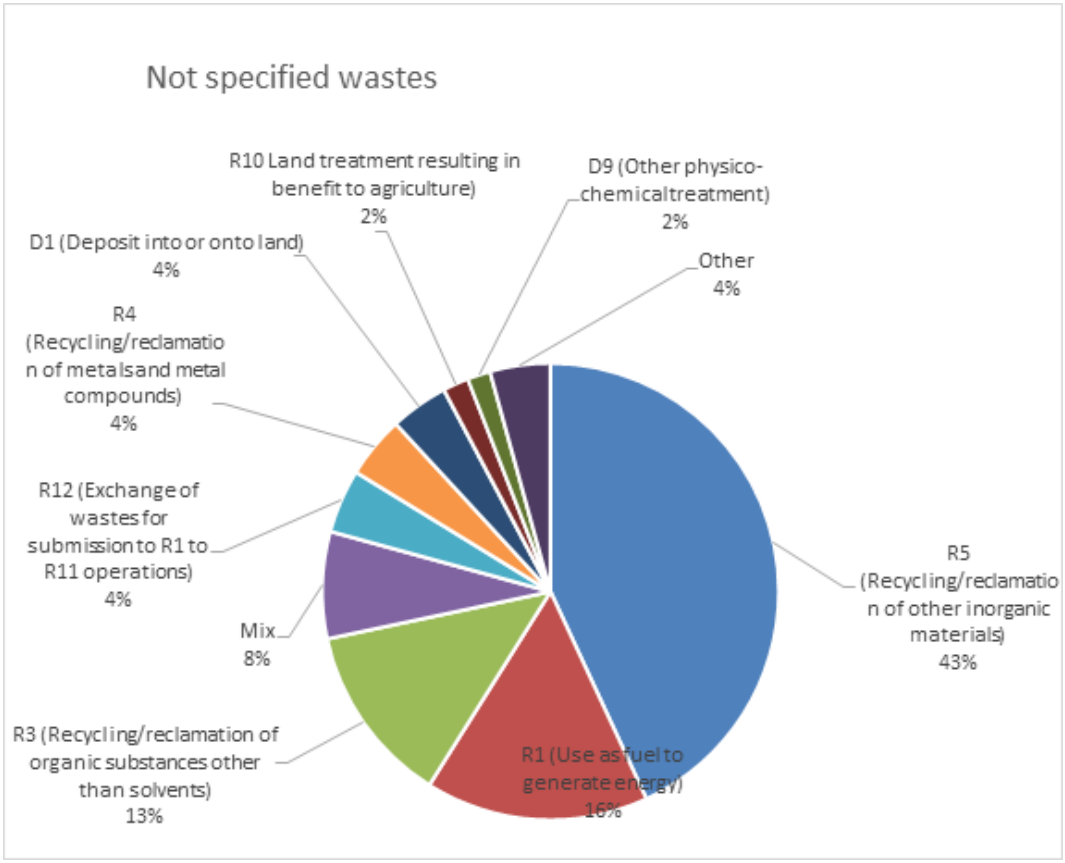


Based on Eurostat data, as reported directly to The Basel Convention on the Control of Transboundary Movements of Hazardous Wastes and their Disposal

For Residues from industrial waste disposal operations (Y18), depending on the exact nature of the residue, several treatment options are available. The most important destinations, representing 75% of the exported volume, are shown in Figure 3-40:

- Almost half of the residues from industrial waste disposal operations are incinerated, mostly with energy recovery (R1: use as fuel to generate energy), but also without energy recovery;
- About one third of the total volume of residues in this category is treated in order to recycle inorganic materials other than metals, organic substances other than solvents, or metals and metal compounds.

Figure 3-39 Treatment of residues arising from industrial waste disposal operations (Y18)



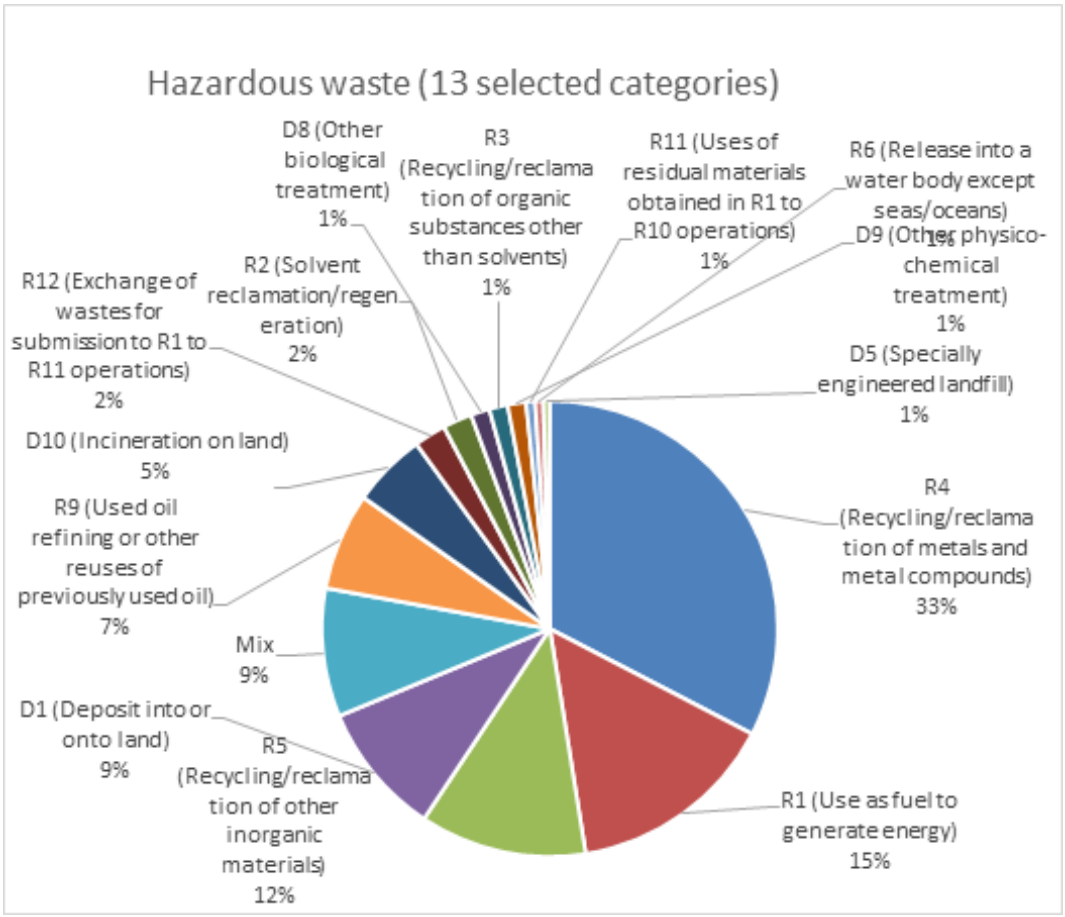
Based on Eurostat data, as reported directly to The Basel Convention on the Control of Transboundary Movements of Hazardous Wastes and their Disposal

Figure 3-41 shows that the main treatments for the remaining 13 waste categories not analysed so far are:

- R4: Recycling/reclamation of metals and metal compounds
- R1: use as fuel to generate energy;
- R5: Recycling/reclamation of other inorganic materials;
- D1: Deposit into or onto land (e.g. landfill, etc.)
- R3: Recycling/reclamation of organic substances other than solvents.
- Mix: unspecified combination of treatments

Together, the above listed treatments account for 78% of the total volume of these waste categories. For some waste streams, specific treatments are available. These will often dominate for the relevant waste stream. For instance, for waste oils/water, hydrocarbons/water mixtures and emulsions (Y9), the preferred treatment is the refining or reuse of previously used oil (R9), and a similar situation is observed regarding the regeneration of solvents (R2) as a treatment for organic solvents (Y42).

Figure 3-40 Reported treatment type distribution for notified waste flows, other than non-hazardous wastes (Y46 and Y47), residues from industrial disposal operations (Y18), and not specified wastes



Based on Eurostat data, as reported directly to The Basel Convention on the Control of Transboundary Movements of Hazardous Wastes and their Disposal)
Data for 27 EU member states - export to other EU MS, in 2016. Notified waste categories: Y11, Y17, Y23, Y31, Y34, Y36, Y42, Y45, Y5, Y6, Y8, Y9 and Mix. Total volume analysed: 2.851.872 t. (A number of treatment options with a yearly volume less than 10.000 t -in total these accounted for 16.757 t- were left out of the analysis).

3.5.3 EU importers' waste treatment specialisation

In section 3.5.1, a group of eight member states (Belgium, Germany, the Netherlands, France, Luxembourg, Italy, Austria and Ireland) were identified as those that transfer high volumes of waste between each other, while others are less involved in intra EU waste movements. Several member states from the group with an intensive exchange of notified waste types, have specialised in the treatment of specific waste streams, and account for the treatment of more than half of particular types of notified waste.

An overview for all specialised waste treatment providers is given in table C-3 in Annexe C. It can be observed that only three EU countries, namely Belgium, the Netherlands and Germany, account for more than half of the treatment capacity required for a series of different, notified waste streams. Additionally, five other MSs each offer sufficient capacity for treating a major share of the total volume of a specific waste category transferred from other EU MS.

4 Member State measures under WSR Article 11 and 12

In the following section we present examples of measures that Member States have taken under Article 11 and 12 of the WSR, including other measures, to object or restrict waste imports. These measures are of interest to this study because they could be acting as a barrier to the free movement of recoverable resources. An explanation of the legal basis is provided in Annex D.

In the WSR, the EU lays down the principle that waste subject to recovery activities should be able to move freely within the EU without any unjustified restrictions imposed by national, regional or local policy and legislation. The Regulation also addresses waste movements for the purpose of disposal. The idea is that waste movements for recovery should be given priority and must be allowed to move to the facility where it is best treated to reduce the overall amount of waste disposed. According to the WFD recovery is '*any operation the principal result of which is waste serving a useful purpose by replacing other materials which would otherwise have been used to fulfil a particular function, or waste being prepared to fulfil that function, in the plant or in the wider economy*'[11]. Examples of recovery are preparation for reuse, recycling or the use of waste as a fuel (incineration with energy recovery). Recycling is defined as '*any recovery operation by which waste materials are reprocessed into products, materials or substances whether for the original or other purposes. It includes the reprocessing of organic material but does not include energy recovery and the reprocessing into materials that are to be used as fuels or for backfilling operations*'[12]. Disposal, on the contrary, is defined as '*any operation which is not recovery even where the operation has as a secondary consequence the reclamation of substances or energy*'[13]. It includes practices like landfilling or permanent storage[14]. According to the waste hierarchy, the practices falling under waste disposal are less desirable than recovery and should be reduced in the long-run.

If the EU's waste markets function efficiently, without unjustified restrictions, waste would be routed to better sorting techniques, optimised processes and more effective treatment and recovery including recycling. This would improve the protection of the environment and public health, create more jobs and increase growth in the EU's waste management and recycling sectors. However, based on Article 11 and 12 of the WSR and Article 16 of the WFD, Member States can object to imports of waste for recovery and/or disposal purposes of waste that require a prior informed notification and consent procedure. This only applies to those waste types mentioned in Annexes II and VIII of the Basel Convention (hazardous waste, mixed municipal waste, residues from incineration of household waste and unlisted waste).

4.1 MS Measures to object or restrict the shipments of waste

The compilation of measures (table 4-5) and their subsequent analysis are based on outcomes extracted from the Study of Efficient Functioning of Waste Markets in the EU (2016), information reported by the

[11] European Parliament and the Council of the European Union (2008) Directive 2008/98/EC on waste and repealing certain Directives
[12] Ibid
[13] Ibid
[14] Ibid

Member States to the European Commission[15] and Basel Convention[16], and publicly available information such as political announcements. The Basel Convention parties are required to transmit their national reports to the Secretariat which includes providing information on transboundary movement of waste as well as restriction measures of waste shipments of hazardous and other wastes[17]. Information reported to the European Commission is collected through comprehensive implementation questionnaires of the WSR. These include, inter-alia, objections to planned shipments for disposal and recovery or measures taken to generally or partially prohibit the shipments of waste between Member States[18].

Almost all Member States (23/27) have reported measures that restrict the disposal or recovery of imported waste from other EU Member States. Countries that have not communicated within the last 20 years any objections towards the import of waste and its treatment are Ireland, Italy, and Luxembourg. Greece last reported restrictions in 2011, but has eased them in the meantime. Comparing the number of restriction measures for disposal and recovery, the data suggests that most restrictions are imposed on the disposal of imported waste from other EU MS than on the recovery of waste. Currently, 22 Member States have developed or planned measures to restrict the disposal of imported waste while 12 Member States restrict the recovery of imported waste. 11 Member States restrict both activities (see the table below for details of the Member States).

Table 4-1 Member States structured by restricting the disposal, recovery or both of imported waste

Activity	Countries
Restricting the disposal of imported waste only	Cyprus, Croatia, Germany, Estonia, Finland, France, Denmark, Portugal, Romania, Slovakia, Malta and Spain
Restricting the recovery of imported waste only	n/a
Restricting both activities	Austria, Belgium, Bulgaria, Netherlands, Hungary, Czech Republic, Lithuania, Latvia, Poland, Sweden and Slovenia

Source: Own table

For restricting the disposal of waste, the most common measure amongst Member States is to ban the import of all waste for disposal purposes or for specific types of waste through implementing it into national legislation or issuing a notification to the European Commission or Basel Convention (BC). The specific types of waste that Member States restrict or prevent the import of for disposal are asbestos waste (such as asbestos cement), hazardous waste, mixed municipal waste, sewage sludge and incineration residues from MSW (RDF). The table below (Table 4-4) shows which waste types are addressed through measures to object to waste imports and those Member States that put the respective measure in place. It also includes partial restrictions on certain waste types when self-sufficiency is threatened, no permit is issued or no capacity is left.

[15] European Commission (2018) Generation, treatment and transboundary shipment of hazardous and other waste in the MS of the EU, 2013-2015 and recent email conversation between the Member States and the European Commission, provided by Gael de Rotalier.
[16] UNEP-CHW-NREP-COMPI-2011-question3e.English.pdf (2011) and Basel Convention National Reports (2018)
[17] Basel Convention (2018) National Reports – Year 2018
[18] European Commission (2018) Generation, treatment and transboundary shipment of hazardous and other waste in the MS of the EU, 2013-2015

Table 4-2 Restriction measures according to Art. 11 & 12 structured by waste type

Ban of waste imports for disposal (Art. 11)	Waste type	Countries
Ban of waste for imports for disposal (Art. 11)	Asbestos	Austria
	All waste	Belgium (Wallonia), Estonia, Netherlands, Slovenia, Bulgaria, Hungary, Czech Republic, Malta, Portugal, Romania, Poland, Latvia, Slovakia, Cyprus
	All waste with exceptions for hazardous waste	Denmark
	Hazardous waste, MSW and RDF	Croatia, Lithuania
	Sewage sludge	France
	Partial restriction for cases when self-sufficiency is threatened	Finland, Spain, Sweden
	Partial restriction depending on final disposal operation and/or capacity	Belgium
Ban of waste for imports for recovery (Art. 12)	**Measure**	**Countries**
	MSW	Austria, Slovenia
	All waste (conditionally)	Bulgaria
	Sewage Sludge and RDF	France (only sewage sludge), Hungary (planned)
	All waste, except green listed	Poland, Czech Republic
	National waste management plan limits import of waste for recovery (flexible import level)	Netherlands
	MSW, RDF and hazardous waste	Lithuania
	Partial restriction on hazardous waste if no permit/capacity	Latvia
	Partial restriction on hazardous/amber listed when no permit/capacity	Sweden
	Partial restriction on certain types and proportion of waste (not further specified) and if self-sufficiency is threatened	Belgium

Source: Own table

The next table (Table 4-3) lists all legal measures applied by Member States to restrict waste imports destined for disposal or recovery, presented by country, source and year. The majority of the listed measures have been taken from the study of the Efficient Functioning of Waste Markets in the European Union (based on reporting to the Basel Convention), which, however, dates back to the years 2013-2015. Additional literature review (e.g. Basel convention database) has been conducted to verify if these measures are still current. Information has also been provided by the European Commissions (DG ENV). The compiled list was then sent out to the WSR correspondent contacts for all Member States. Of 27 Member States, eleven replied (Germany, Denmark, Lithuania, France, Czech Republic, the Netherlands, Finland, Poland, Belgium, Greece and Latvia. 3 MSs (Latvia, Greece and Finland) confirmed the measures we sent for validation, while the others suggested slight adjustments to reflect their recent updates. The other 16 Member States did not provide any feedback.

Table 4-3 Legal measures of Member States to restrict the import of waste for disposal or recovery within the EU

Activity	Country (year of report)	Legal measures	Source
Restricting the disposal of imported waste	Austria (2014; 2018)	• Prohibit the import of asbestos waste (asbestos cement) for disposal.	Implementation review Art. 11 & 12, Annex 2; Basel Convention (2018);
	Belgium (2013-2015; 2018)	• Region of Wallonia banned all imports of waste destined for landfill (2013-2015); • Partial restriction of all waste covered by the BC depending on the final disposal operation and/or capacity (2019). • Region of Flanders follows principle of self-sufficiency (WFD) for landfilling (D1 / D5) and incineration (R1 / D10).	Implementation review Art. 11 & 12, Annex 2; Basel Convention (2018); Confirmed via email conversation with Member States (2021).
	Estonia (2019)	Ban on imports of all waste for disposal.	Announcement by Environmental Board (2019);
	Netherlands (2015)	Ban of all waste imports destined for deposit, such as landfill since 2015 (self-sufficiency WFD).	Implementation review Art. 11 & 12, Annex 2; Adjusted via email conversation with Member State (2021)
	• Slovenia (2013-2015; 2018) automatically rejected (2013-2015); Restrictions for	• All shipments of waste, especially shipments of municipal waste, to Slovenia intended to be landfilled are • municipal and other waste (all waste) (2018).	Implementation review Art. 11 & 12, Annex 2; Basel Convention (2018);
	Bulgaria (2013-2015; 2018)	Prohibition of waste with objective to store, dispose of whatever other form of disposal, except of take-back obligation, residues of waste treated for Bulgaria, recovery facility treats more that local waste.	Implementation review Art. 11 & 12, Annex 2; Study of efficient functioning of waste markets in the EU/Basel Convention (2016); Basel Convention (2018);
	Croatia (2013-2015; 2018)	Ban of import of hazardous waste, mixed municipal and incineration residues for disposal.	Implementation review Art. 11 & 12, Annex 2; Basel Convention (2018);
	Hungary (2013; 2014-2015; 2018)	• Prohibition of import of hazardous waste for disposal in 2013; • Expansion to MSW and residues arising from incinerated MSW are banned; • Prohibition of all wastes for disposal (2018).	Implementation review Art. 11 & 12, Annex 2; Basel Convention (2018);
	Czech Republic (2016; 2019)	Prohibition of all waste imports for disposal.	Study of efficient functioning of waste markets in the EU (2016); Basel Convention (2019); Adjusted via email conversation with Member State (2021)

Activity	Country (year of report)	Legal measures	Source
	Denmark (2015; 2020)	General prohibition on the import and export of waste for disposal (exceptions made for: hazardous waste for incineration D10 and for cases where the country of dispatch do not have treatment possibilities and where establishment of new facilities in relation to the generated amounts would be uneconomic).	Study of efficient functioning of waste markets in the EU (2016); Email conversation provided by the EEA (2020); Adjusted via email conversation with Member State (2021)
	Malta (2015; 2018)	All shipments of waste destined for disposal is prohibited.	Implementation review Art. 11 & 12, Annex 2; Basel Convention (2018);
	Portugal (2020)	Systematic ban of waste for disposal.	Email conversation provided by the EEA (2020);
	Romania (2014-2015)	Prohibition of all waste destined for disposal.	Study of efficient functioning of waste markets in the EU (2016); Implementation review Art. 11 & 12, Annex 2;
	Slovakia (2013-2015)	Imports of waste for disposal are prohibited.	Implementation review Art. 11 & 12, Annex 2;
	Cyprus (2016; 2018)	• Ban of hazardous waste imports for final disposal, as there are no facilities for this purpose; • Ban of all wastes destined for disposal (2018).	Study of efficient functioning of waste markets in the EU (2016); Basel Convention (2018);
	Finland (2016; 2018)	• Ban of imports of all wastes to disposal operations D1, D2, D3, D4, D5, D6, D7, D11 and D12, exceptions for D8, D9 and D10 (2016); • Partial restriction of imports of all waste if self-sufficiency is threatened (2018).	Study of efficient functioning of waste markets in the EU (2016); Basel Convention (2018); Approved via email conversation with Member State on the 12/01/21
	France (2020)	• Ban on imports of sewage sludge or any other material obtained from sewage sludges whether mixed or not. Exemptions include countries having a border with France.	Law No. 2020-105, Article 86; Adjusted via email conversation with Member State (2021)
	Latvia (2001; 2018)	• Prohibition of import of any waste for disposal or long-term storage (2001); • Prohibition of imports of all wastes for disposal (2018)	Study of efficient functioning of waste markets in the EU (2016): Basel Convention (2018); Approved via email conversation with Member State on the 12/01/21
	Lithuania (2014-2015; 2020)	• Prohibition of waste and solid fuel recovered from waste intended for disposal (2014-2015); • Ban on MSW and solid recovered fuel for disposal (2018);	Implementation review Art. 11 & 12, Annex 2; Basel Convention (2018); Email conversation provided by the EEA (2020); Adjusted via email conversation with Member State (2021)

Activity	Country (year of report)	Legal measures	Source
		• Ban of MSW and hazardous waste, residues of municipal waste incineration intended for disposal (2020).	
	Poland (2013-2015; 2018; 2020)	• Prohibition of import of certain waste types for disposal (2013-2015). • Prohibition of waste imports for disposal in processes defined as D1-15 (2018; 2020).	Implementation review Art. 11 & 12, Annex 2; Basel Convention (2018); Email conversation provided by the EEA (2020);
	Spain (2018)	Partial restriction of all waste when no capacity.	Basel Convention (2018);
	Sweden (2018)	Partial restriction of Amber listed waste when no permit and capacity.	Basel Convention (2018);
Restricting the recovery of imported waste	Austria (2018)	Prohibition of MSW imports for incineration purposes (R1 and D10).	Basel Convention (2018);
	Belgium (2013-2015)	Ban of certain proportion of residual waste in the context of imports destined for recovery (some types of waste such as hazardous or inert C&D waste is accepted). Region of Flanders follows self sufficiency principle (WFD) for energy recovery (R1).	Implementation review Art. 11 & 12, Annex 2; Screening template for C&D waste management, European Commission (2015);
	Bulgaria (2013-2015; 2018)	Prohibition of waste imports for recovery if during the previous calendar year the operator has utilised smaller quantity waste from Bulgarian origin in comparison with the quantity of imported waste for utilisation in the same installation.	Implementation review Art. 11 & 12, Annex 2; Basel Convention (2018);
	Czech Republic (2020)	General prohibition of waste imports for recovery purposes (exception applies to green-listed waste imported for interim recovery; here, the final facility must be known prior to shipment and information on final non-interim operation is obligatory to accompany the shipment).	According to email conversation with Member State (2020); Adjusted via email conversation with Member State (2021)
	Croatia (2013-2015; 2018)	• Ban of import of mixed municipal waste for energy purposes (2013-2015); • Report that there is no longer any restriction on import of waste for recovery (2019).	Implementation review Art. 11 & 12, Annex 2; Basel Convention (2018);

Activity	Country (year of report)	Legal measures	Source
	France (2020)	• Ban on imports of sewage sludge or any other material obtained from sewage sludges whether mixed or not. Exemptions include countries having a border with France.	Law No. 2020-105, Article 86.; Adjusted via email conversation with Member State (2021)
	Hungary (2020)	• Planned restriction on the import of sewage sludge and RDF waste for recovery purposes (affected MS: Italy, Slovenia, Germany and Austria (RDF) and Croatia, Slovenia, Italy and Austria (SS))	Email conversation provided by the EEA (2020);
	Lithuania (2014-2015; 2018; 2020)	• Prohibition of imports of waste and solid recovered waste intended for energy recovery (2014-2015; 2018); • Prohibition of import of MSW, solid recovered waste and hazardous waste intended for energy recovery (2020).	Implementation review Art. 11 & 12, Annex 2; Basel Convention (2018); Email conversation provided by the EEA (2020); Confirmed via email conversation with Member States (2021).
	Latvia (2018)	• Partial restriction to imports of hazardous wastes for recovery purposes, prohibited if no capacity and no permit (2019).	Basel Convention (2018); Approved via email conversation with Member State on the 12/01/21
	Netherlands (2020)	• Regulation in the national waste management plan to limit the import of waste for recovery (flexible import limit since 2015).	Email conversation provided by the EEA (2020); Adjusted via email conversation with Member State (2021)
	Poland (2018)	• Ban on imports of all waste except green waste.	Basel Convention (2018); Adjusted via email conversation with Member State (2021)
	Sweden (2011; 2018)	• Restriction of import of hazardous waste for recovery (2011); • Partial restriction to imports of amber listed waste, only allowed if capacity and permit (2018).	Basel Convention/UNEP (2011); Basel Convention (2018);
	Slovenia (2018)	• Restriction of imports of MSW for recovery purposes.	Basel Convention (2018);

Source: Own table

Another type of measure applied to restrict waste movements that does not strictly relate to Article 11 and 12, are fiscal measures, e.g. imposing a tax on waste to energy recovery purposes. Currently, two countries have such a tax in place: the Netherlands and Sweden (Table 4-6). These taxes apply irrespective of whether the waste is domestically generated or imported[19,20]. The Netherlands imposed this tax on the incineration of domestically produced waste in 2015. In 2020, it was extended to waste imports, specifically targeting RDF waste which represents a quarter of all waste incinerated in the Netherlands[21]. The government aims to eliminate RDF imports in just three years as the tax (32€/tonne) raises the total cost of waste incineration in the country above other countries. This could suggest the aim of creating a level playing field for imported vs. domestic wastes. Denmark has also pursued similar means of discouraging imports of RDF for energy recovery[22].

Table 4-4 Fiscal measures of Member States to restrict the import of waste for recovery

Activity	Country	Fiscal measures	Source
Restricting the recovery of imported waste	Netherlands	Imposition of waste incineration tax of 32€ per tonne on imports	EUWID (2020) Danish ministers call for cuts to waste imports
	Sweden	Imposition of waste incineration tax of 7€ per tonne irrespective of whether the waste is domestic or imported	EUWID (2020) Danish ministers call for cuts to waste imports Avfallsverige (2020) Skatt på förbränning redan 2020

Source: Own table

4.2 Analysis of the measures to restrict the import of waste for disposal or recovery

In order to analyse the significance of the measures imposed to restrict the import of waste for disposal and recovery with the absolute intra-EU waste flows we have initially focussed on those countries that import 70% of the total waste volume imported (to pick up the most significant volumes). However, since the largest importers rarely have restriction measures in place, we also analysed those countries that are known (from the previous section) to have import restrictions. For this analysis, we have assessed the data to look for trends that suggest an influence from the import restrictions. For example, if the restrictions are influential, one would expect a lower volume of imports to countries that have restrictions in comparison to a country which does not have these restrictions. As the waste streams which are more frequently restricted are not captured in the intra-EU waste flow model (based on COMEXT), this analysis was conducted with Eurostat waste shipment data[23]. Owing to the high level (i.e. multiple waste stream coverage) of many restrictions, the total import data for all recovery operations and disposal operations (respectively) was analysed. However, for certain cases, specific waste operation codes were analysed (i.e. for energy recovery imports: R1). Furthermore, certain specific waste flows (RDF, Sewage Sludge, and MSW) were disaggregated to better analyse measures focused on specific wastes.

[19] Avfallsverige (2019) Skatt på förbränning redan 2020
[20] Belastingdienst (2021) Tables of environmental tax rates
[21] Taylor, I. (2019) Dutch tax on imported waste will impact the UK
[22] EUWID (2020) Danish ministers call for cuts to waste imports
[23] Eurostat: WShipR. Available here.

4.2.1 Analysis of the largest importers of waste — disposal

The countries responsible for importing 70% of the notified waste shipped **for disposal** across the EU between 2013-2018 are Germany, France and the Netherlands.

Table 4-5: MSs responsible for the largest volume of waste for disposal (2013-2018)

Member State	Total imports [tonnes]	Percentage of total EU imports
Germany	**7 173 753**	**53%**
Netherlands	**1 726 562**	**13%**
France	**1 682 517**	**12%**

Source: Calculations are based on Eurostat (WShipR)

The Netherlands has restricted the import of all waste for deposit and disposal since 2015 — the other countries did not have restrictions within the timeframe of 2013-2017 (as no data exists for the Netherlands in 2018). According to Eurostat (WShipR) data, the total imports for waste for disposal to the Netherlands did not see significant reductions in imports between 2014 (507 ktonnes) and 2015 (420 ktonnes). The figures for 2016 even increased to 446 ktonnes, only to finally decrease to 153 ktonnes in 2017. It is unclear if these trends are related to restrictions. However, a possible reason could be that the ban in the Netherlands is based on the self-sufficiency principle (WFD). This would allow waste imports for disposal if capacity was not fully utilised with domestic waste and if the waste was processed in accordance with the minimum standards set in the national waste plan based on the waste hierarchy[24].

The Member States which export the most waste for disposal purposes into the Netherlands are Germany, Belgium and, to a lesser extent, France. Since 2014, the tonnage of waste imports from Belgium and France has fluctuated, with only Germany seeing continuous (and gradual) reductions between 2014 and 2017 (from 214 to 53 ktonnes, respectively).

The Netherlands has one of Europe's largest ports (Port of Rotterdam). This needs to be considered as an influence on the level of waste imports for disposal because the Netherlands could be a transit country for waste to be shipped from other EU countries for shipment outside of the EU (extra-EU shipments). However, the Netherlands shows no data on waste exports for disposal to extra-EU countries between 2014-2018. This fits with the WSR regulation which prohibits the export of wastes for disposal, except for some EFTA exceptions (WSR, Article 34). Furthermore, they import relatively little waste from extra-EU countries (from 116 ktonnes in 2013, to 4 ktonnes in 2018).

The Netherlands was a net-exporter of waste for disposal between 2013 and 2017. In 2013, they exported 585 ktonnes more than they imported, a balance which reduced in subsequent years to a net export of waste for disposal of 206 ktonnes in 2017. This could explain the increased imports of waste, which may be in transit to other European countries. The Netherlands exports mostly to Germany (67% of exports between 2013-2017), Belgium, and, to a lesser extent, Denmark and France.

In regard to imports of RDF waste for disposal purposes, the data is relatively uninformative. Only Germany has data which is randomly scattered in spikes across the years (2010, 2011, 2014 and 2016), and the rest of the time they do not report any imports. This is most likely owing to RDF's use as a fuel in energy recovery processes. Therefore, more data is available for the recovery imports (see below).

[24] According to the email conversation in 2021 with Ytzen Lont, Dutch Ministry of Infrastructure and Water Management.

However, the one important insight is that Germany is the only country from the four that has no restrictions on waste for disposal and is the only country with imports of RDF for disposal. France is the only outlier, which does not ban waste shipments of RDF for disposal, but nonetheless has no imports. It remains unclear why this is the case.

4.2.2 *Analysis of the largest importers of waste — recovery*

The countries importing 70% of the waste shipped **for recovery** across the EU between 2013-2018 are the Germany, Netherlands, France, and Sweden.

Table 4-6: MSs responsible for the largest volume of waste for disposal (2013-2018)

Member State	Total imports [tonnes]	Percentage of total EU imports
Germany	**29 608 992**	**25%**
Netherlands	**22 221 515**	**19%**
France	**20 762 390**	**18%**
Sweden	**13 744 976**	**12%**

Source: Calculations are based on Eurostat

Germany has no measures to restrict imports of waste for recovery. France has some restrictions on the import of sewage sludge (and related) wastes. However, these restrictions were only imposed in 2020 so it is not yet possible to track their impact using the 2013-2018 data. The Netherlands has a flexible import limit on waste for recovery, since 2015. The restriction is only applied if the national capacity for waste recovery is depleted (i.e. waste-to-energy), and as a consequence Dutch waste has to be landfilled. The set limit is very high, and therefore this restriction is rarely applied[25]. The only country with a (partial) restriction on importing waste for recovery purposes within the timeframe is Sweden. Since 2011, Sweden has had a restriction on the import of hazardous wastes for recovery. A further partial restriction is placed on amber-listed wastes, if there is no capacity for recovery in Sweden.

The amount of waste imported into the Netherlands has steadily increased between 2013 and 2017, from 2.9 Mt to 5.4 Mt (no data available for 2018). A large majority of this was imported for R1 (2.1 Mt; 51%) and R5 (2.7 Mt; 51%) recovery processes. Imports for both recovery types follow the broader import trends (a steady increase from 2013-2017). For R1 energy recovery, this appears counter intuitive because the only restriction by the Dutch authorities is the flexible limit[26] on R1 waste imports (since 2015). However, the increase of imports is possible as this flexible limit is so high that it is rarely applied. It has only been applied once when the largest Dutch waste-to-energy plants was out of order (during the summer of 2019)[27]. The countries they import most waste for recovery purposes from include Belgium, Germany and, to a lesser extent, France.

Sweden's import rates of wastes for recovery have been relatively stable (with minor fluctuations) between 2013 and 2018, with a low of 2 Mt in 2013 and a peak of 2.4 Mt in 2014 with an average import rate of 2.3 Mt per year. R1 recovery made up more than 90% of all imports for recovery in all years from 2013-2018 (96% between 2016-2018). Sweden's largest imports for wastes destined for recovery come from the Netherlands, Ireland, Finland, and Denmark (intra-EU). Sweden imports most of its wastes from Norway and the United Kingdom (extra-EU). This is understandable owing to Norway's close proximity, and the UK's dependence on exporting wastes that would otherwise be landfilled. Sweden's

[25] According to the email conversation with Ytzen Lont, Dutch Ministry of Infrastructure and Water Management on the 05/01/21.
[26] The flexible target may not have actually tried to limit R1 recovery, but to meet climate targets (owing to popular demand). However, it was made so large to still allow R1 import while meeting climate targets.
[27] According to an email conversation in 2021.

dependence on imports to run its energy-from waste facilities, is a likely justification for this stabilised import across the years.

France and Germany are the only countries considered in this analysis of the top four largest importers of waste with no restrictions on the import of wastes for recovery within the timeframe considered (2013-2018). France has seen a relative increase in the amount of waste imported, from 2.3 M in 2013 to 4.5 Mt in 2018. However, this figure has fluctuated slightly from year to years. Germany has seen a similar relative increase, from 4.3 Mt in 2013 to 5.0 Mt in 2018. As with France, the imports fluctuated during the period, with a high of 5.2 Mt imported in 2015. France's imports mostly arrive from Luxembourg, Germany, and to a lesser extent Belgium and the Netherlands. However, just under 50% of all imports arrive from extra-EU countries. Germany received most of its imports from the Netherlands, with a smaller amount of imports arriving from a broad range of other countries (Austria, Belgium, Denmark, France, Italy and Luxembourg). This is very likely to be linked to the central location of Germany in Europe.

When viewing the levels of imports of RDF waste for recovery purposes, Germany and the Netherlands are two of the largest importers of such waste. For Germany, they imported 533 kt in 2013, which increased to 1 025 kt in 2015 dropping to 661 kt in 2018. The Netherlands consistently grew from 1.0 Mt to 1.7 Mt between 2013-2016 and then decreased to 1.5 Mt in 2017 (no data exists for 2018). Sweden had a large increase in imports of RDF between 2013 (421 kt) and 2015 (721 kt). From 2015-2018, the imports have fluctuated an average of 748 kt per year. This was largely imported from the UK (>70% from 2015-2018). Much of this relates to Sweden's reliance on imports for R1 recovery, as previously noted. It is unclear why exactly France has a low import quantity of RDF, as none of the four countries had import restrictions (or taxes) within the timeframe 2013 to 2020.

Based on the preceding analysis which was impeded by data limitations, **no clear links between the presence and use of Article 12 restrictions on importing of wastes intended for recovery, and import rates could be identified**. For instance, the Netherlands has Article 12 restrictions in place but still imports waste for recovery, and these volumes appear large relative to its size (i.e. compared to France). Germany, imports the largest amounts of waste for recovery. This is likely to be related to its large size, treatment capacity and centrality in Europe rather than its lack of Article 12 restrictions.

4.2.3 Analysis of all Member States with import restrictions (Article 12, WSR) — disposal

Another approach to analysing the importance of the Article 11 and 12 measures is to identify those countries which have limited the most waste flows through these measures, i.e. it can be postulated that the MSs with the most measures under Article 11 and 12 related to restricting the import of all waste, including the import of hazardous, MSW and RDF for disposal and recovery purposes, could see a relatively lower volume of waste imports[28].

According to Table 4-4, countries that restrict the import of waste **for disposal** are Belgium (Wallonia), Bulgaria, Cyprus, Czech Republic, Estonia, Hungary, Latvia, Malta, Netherlands, Poland, Romania, Slovakia, Slovenia. The majority of these countries have little to no imports of waste for disposal during the time period, except Belgium, the Netherlands, and Poland. Belgium's imports relate to the fact that the ban was only in place for one region of the country (Wallonia — and not in Flanders or Brussels). For the Netherlands, a likely reason is the fact that the country is a net-exporter of waste for

[28] More recent strict measures (e.g. banning all waste for disposal purposes) cannot be considered as the waste model data only covers until 2019.

disposal (as mentioned above). This could suggest that the Netherlands is a transit country where waste is imported and later shipped on elsewhere to which restriction according to Article 11 and 12 do not apply. However, no link has been made to the "Rotterdam effect" (i.e. related to large shipment quantities from Rotterdam port to/from extra-EU countries). In the case of Poland, which is a net-importer of waste for disposal (by a large margin), the import ban for all waste destined for disposal has only been imposed in 2018, which is the last year of our period of analysis. Prior to this date the import ban was only related to specific waste streams (which could not be further identified). Therefore, it is not possible to draw any conclusions.

The import of hazardous waste, MSW and RDF is banned by Croatia and Lithuania. When viewing the Eurostat (WShipR) data, it becomes clear that both countries imported little to no hazardous, MSW, or RDF wastes for disposal. Lithuania only imported waste for disposal in 2014 and 2015, however, this was an insignificant quantity (150 tonnes total over both years). In both cases, these were imports of soils and stones (containing hazardous substances)[29] from Latvia for D8 biological treatment. Lithuania is a large net-exporter for waste for disposal by 1 557 tonnes across the two years (2014-2015). Therefore, it is possible that this waste is transiting through Lithuania towards central Europe. When looking beyond countries with restrictions, the only country with imports of RDF for disposal is Germany.

4.2.4 Analysis of all Member States with import restrictions (Article 12, WSR) — recovery

Countries that established measures to restrict imports of all waste and **for recovery** purposes within the timeframe 2013-2018 are Austria, Bulgaria, Slovenia, France, Poland, and Czechia. These are mostly focused on MSW, RDF and hazardous waste (however, different Member States have different measures). Bulgaria, Poland and Czechia are the only countries that ban all wastes for recovery (unless green-listed, for the latter two). The Netherlands, Latvia, Sweden, and Belgium have partial restrictions based on domestic waste recovery capacity.

Bulgaria, Poland, and Czechia have restrictions in place for all wastes for recovery purposes (except green-listed waste for Poland and Czechia). Poland's imports of waste for recovery increased from 65 ktonnes in 2013 to 406 ktonnes in 2018. At the same time, it is notable that Poland increased its recycling capacity between 2012-2018 from 961 to 3,095 recycling facilities[30]. This is a likely reason to justify this increase. Bulgaria has low levels of imports of waste for recovery purposes, which has fluctuated over the years. From 2015–2018, there is a notable increase in imports of 61 ktonnes to 114 ktonnes. This may be linked to the conditional ban on all wastes for recovery. Czechia shows large increases in imports from 243 ktonnes in 2013 to 505 ktonnes in 2018. Most of this waste is non-hazardous, and likely green-listed waste (which is not included in Czechia's ban).

The three countries banning the imports of MSW for recovery purposes are Austria, Slovenia, and Lithuania. Austria only banned the import of MSW in 2018, therefore data is not yet available to reflect any impacts of this ban. For Slovenia, the only import in this period was a quantity of 38 tonnes in 2015, from Croatia. In the same year, Slovenia exported 539 tonnes of MSW. For Lithuania, there are only occasional imports made across the years from a variety of Member States. Within the period of 2013-2018, only Denmark, Latvia and Sweden sent MSW to Lithuania. The largest shipment was 924 tonnes of discarded electronic equipment with hazardous substances from Denmark in 2014. The years 2015 and 2016 showed no imports to Lithuania. Lithuania is not generally a net-exporter of MSW, therefore, it is unclear how certain imports are possible.

[29] European List of Wastes code: 17 05 03.
[30] Eurostat: env_wasfac. Available here.

Only Lithuania has a ban on imports of RDF for recovery purposes, during the timeframe 2013-2018. France introduced a ban in 2020 and Hungary plan to introduce one in the future. Eurostat (WShipR) data shows that Lithuania does not import any RDF waste for recovery purposes. Beyond countries with restrictions: the Eurostat data highlights that almost all countries import RDF for energy recovery to various degrees. The only countries that do not are Italy, Lithuania, Malta and Romania. It is therefore clear that Lithuania's restrictions are effective. Malta's lack of imports will be related to the fact that it has no energy recovery facilities (based on Eurostat env_wasfac data[31]). This, however, does not explain Italy or Romania's lack of imports, as both countries have a significant number of energy recovery facilities – but they appear to meet their demand domestically.

4.3 Summary of key messages

Eurostat (WShipR) data was used instead of the intra-EU waste flow model (based on COMEXT) to compare with restrictive measures by Member State. This was due to the fact that waste types in the model do not match the waste types of the MS measures, whereas Eurostat data reports all waste types.

The dominant countries in the EU importing waste for disposal or recovery purposes are Germany, the Netherlands, France, and Sweden. They have very little to no restrictions on waste imports, which matches with the high trend of imports these countries have within the time period analysed (2013-2018). The first three countries import waste either from each other or from Italy, Luxembourg, Austria. Sweden received more waste from extra-EU countries (Norway and United Kingdom). Other reasons for these countries (except Sweden) receiving higher imports could be their location as central European countries and their close proximity to other Member States, their treatment capacities, or their economic stability (and size). For Sweden, imports were almost all related to energy recovery practices (R1), and therefore suggest that Swedish imports are a necessity to fill the capacity of Swedish energy recovery plants.

It was assumed that countries with large ports, e.g. the Netherlands and Rotterdam, may have received larger import shares as a transit waste to be shipped to extra-EU countries. According to our analysis, for disposal this is not the case, with little to no exports of waste for disposal to extra-EU countries. This is in-line with the WSR regulation.

The level of effectiveness of waste import restrictions in accordance with Article 11 and 12, WSR, is difficult to confirm. The largest waste flows for disposal or recovery purposes occur between large and centrally located countries which have no, or only partial restricting measures in place. The import rates of smaller countries changed only slightly or showed no correlation, following the reported implementation of new restriction measures. This lack of apparent impact could relate to data limitations (the broad scope of Eurostat data and time period limitations), or smaller treatment and import levels. Therefore, no clear conclusion on the effectiveness of waste import restriction measures can be drawn.

With regard to RDF, it is possible that restrictions have led to reduced imports in Member States. Germany is the only MS reported by Eurostat (WShipR) to be importing RDF for disposal, and is one of the few that has no restrictions. For RDF for energy recovery, only Lithuania has a measure in place to

[31] Eurostat env_wasfac. Available here.

ban its import and Lithuania was one of few countries with no RDF imports for energy recovery purposes.

5 Drivers motivating waste movements within the EU

This section provides an overview and analysis of the drivers of shipping waste across the EU.

5.1 Categorisation and evaluation of drivers

Compiling the list of drivers behind intra-EU waste movements has drawn from a literature review including:

- European Commission evaluations, assessments and reports on waste, waste markets, shipments and the WSR;
- Reports and documents by relevant umbrella organisations, industry associations, and NGOs (active at EU level, but also national organisations);
- Government reports;
- Existing case studies in literature highlighting drivers of waste movements in EU countries.

We have also drawn upon the work in other sections of this report and interviews with the following waste industry stakeholders:

- Suez (Global waste company in waste and water management);
- EuRIC (European Recycling Industries' Confederation, umbrella organisation of European recycling industries);
- CEWEP (Confederation of European Waste-to-Energy Plants, umbrella association of the operators of waste-to-energy plants);
- Campine (European recycling company of raw materials);
- MWE (Municipal Waste Europe, European umbrella association representing public responsibility for waste).

The interviews helped improve our understanding of the drivers and provided examples.

The literature suggests that drivers can be categorised into the following five groups. It is important to stress that they should not be thought of as independent from each other as, in some cases, they interrelate and have a causal relationship:

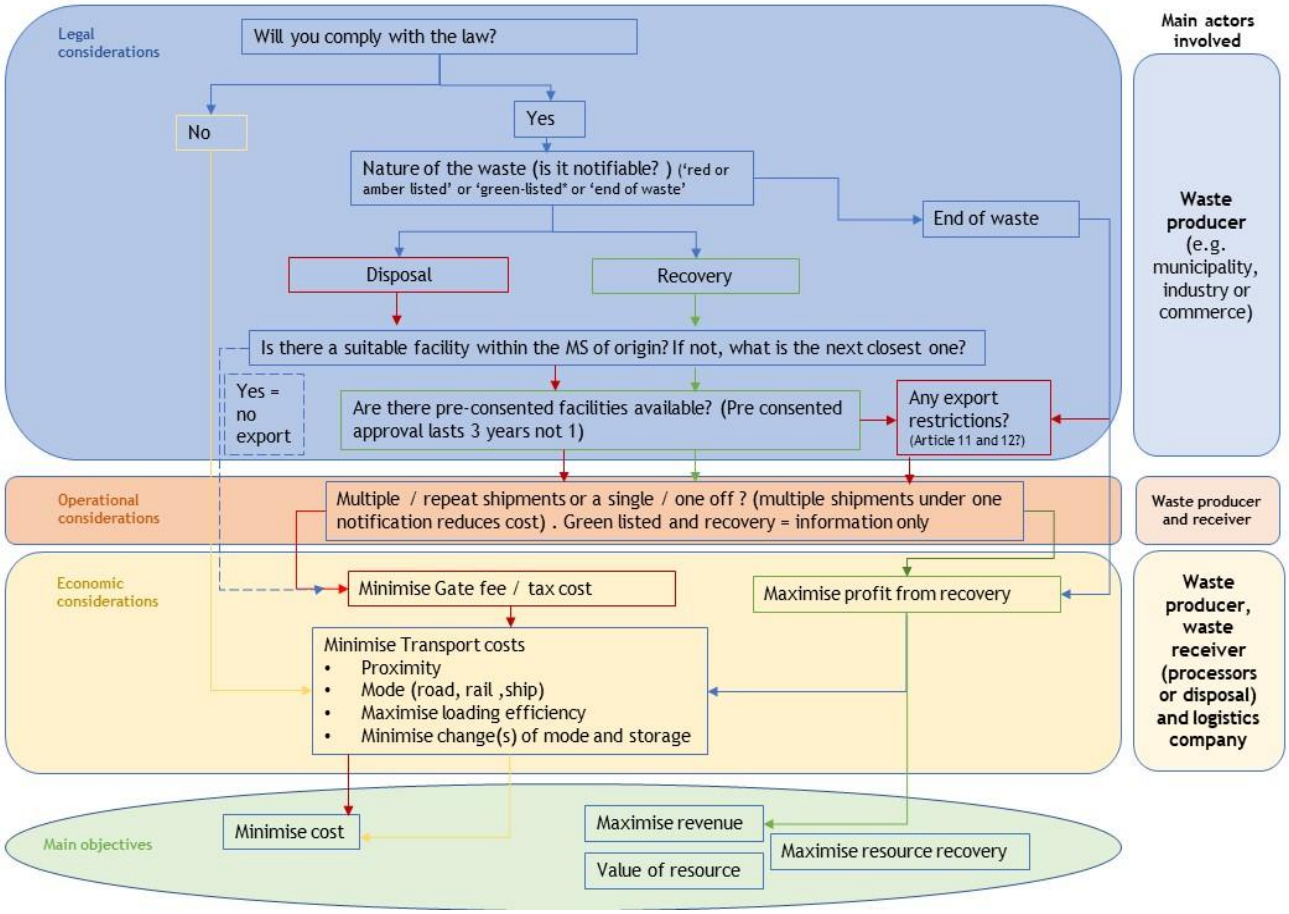
1. Economic;
2. Regulatory;
3. Technical;
4. Geographic;
5. Environmental.

The analysis of the drivers behind intra-EU waste movements is different for hazardous and non-hazardous waste. Non-hazardous waste is the primary focus of this work (as this typically contains more recyclable resources), but some of the issues apply to both hazardous and non-hazardous waste streams.

Non-hazardous waste, such as metals, plastic, paper or glass, can be traded between EU MS without any prior notification procedure or any restrictions imposed by the MS for recovery purposes. However, where waste is shipped with the intention of disposal, the waste shipment needs notification.

Before presenting the different drivers, it is important to point out that they cannot simply be ranked, although economic drivers always appear to be the most important, and there is clear interplay between the drivers. We have attempted to summarise and capture the influential factors and different considerations that waste holders face in the decision-tree in the figure below.

Figure 5-1 Decision-tree for intra-Eu waste shipments



Source: own table

Box 5-1 Explanation decision matrix

The decision matrix for any specific waste is specific to it and influenced by legal, operational and economic considerations. Therefore, it should be stressed that this decisions tree is only intended to illustrate the drivers, and how they interact with each other, and it cannot capture every option for every waste stream.

The very first thought facing a waste holder is if they wish to comply with the law or not. If not, the decision will be to pursue the cheapest option, with environmental considerations playing no role.

Assuming the waste holder wishes to comply with the law (which will apply to all the waste captured in the statistics), the first question is if the waste is green-, or amber-listed, or if it can actually be defined as a resource according to 'end of waste' definitions. In the case of green-listed waste, a suitable recovery facility has

to be found, either within the country of origin or outside. If the facility is located in another MS, it also has to be checked if the respective MS imposes any restrictions on the import of the waste in question. Once options are clear, factors, such as transports costs and value of the resource, will determine where the waste will finally go for recovery.

In order to reduce administrative costs for shipments which require notification an important consideration is whether the facility is pre-consented. This would make future shipments significantly faster as consents last for 3 years not one. Consenting multiple shipments as opposed to each individual shipment is another cost saving approach waste holders pursue.

The next consideration cluster relates to practical and operational factors (orange) which decide on the transport mode and method for the shipment. Thereafter, the economic considerations (yellow) relate to treatment costs (gate fees and taxes). Depending on the waste type, the decision arrives at options representing either the minimisation of costs (for disposal) or maximising revenue through recovery.

5.1.1 Economic drivers

*Economic drivers include issues related to minimising the costs of treatment and transport. These include **gate fees** or **taxes** for sending waste to incineration plants or landfills, the cost and efficiency of **transport** as well as the **market price for secondary materials**.*

Landfill tax is a well known example of how the cost / price of waste disposal influences the disposal and recovery options that waste prodcuers / holders select, including wether or not to ship waste between MSs. To show a link between landfil taxes and the volumes of waste imported for disposal, we have attempted to correlate data on waste shipments and landfill taxes using Eurostat data on shipments of waste (hazardous and non-hazardous) intended for disposal[32]. Importantly, Eurostat data shows the total shipment for all disposal types and not specifically landfilling. However, the figures shold be indicative of landfilling trends in MSs. Even if minimal or no correlation can be seen with landfill taxation data, it could show that such taxes are not a significant driver on EU waste shipments. The waste shipment data indicates that **such taxes have a limited impact on total imports for waste being disposed** of in relevant MSs. For example, in Portugal there was a tax levied in 2007, but there is no indication of an impact on waste shipments in 2010-2012, however from 2013-2018 waste shipments for disposals increased greatly. The full list of landfill taxes can be found in Annex E.

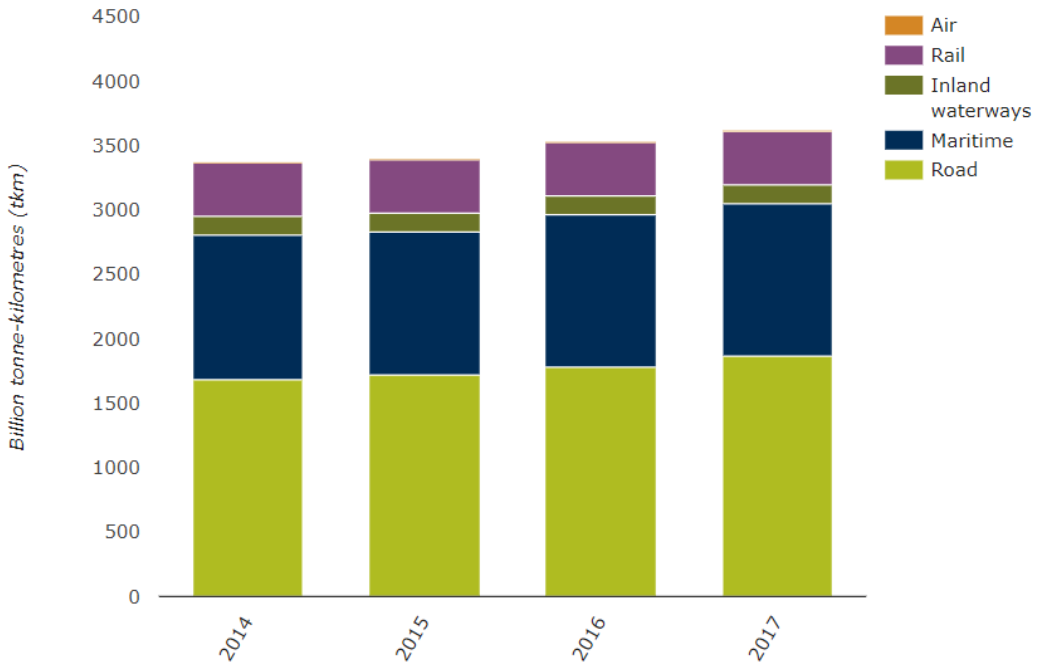
The data for the Netherlands demonstrates a correlation between landfill taxes and increased/ decreased waste imports intended for disposal. During the years when the tax was suspended (2012-2015) there was a marked increase in imports for disposal of 100 000 to nearly 200 000 tonnes per year (not including 2013, which can be viewed as an outlier year). In 2016, the first year of reintroducing a landfill tax, there were similar high levels of imports. However, 2017 showed a reduction of nearly 50% in waste imports for disposal. Eurostat data on imports for disposal in Sweden also show some correlations with landfill taxes. In 2015, following the increase of the tax to 500 SEK (50€) per tonne, there was a decrease in imports of waste for disposal. Figures from 2015-2018 fluctuated but their average remained 50% lower per year compared with the 2014 figure.

[32] Eurostat env_wasship. See here.

A related aspect that was raised by waste industry stakehodlers during our interviews is that the cost or value of final treatment also influences the decision of intermediates, i.e. waste brokers or traders. Even though the waste was originally notified (if applicable) and shipped as waste to be recycled, waste brokers might still decide against recycling if market prices decrease far enough to make the value of the resource lower than the transport cost. However, there is no method to hold intermeditate 'brokers' responsible for where the waste they broker is going.

Another relevant economic driver is the **cost of transport** which is highly dependent on the **mode of transport and the distance**. According to the EEA, road transport accounts for more than 50% of all freight transport within the EU, followed by maritime and inland waterways, and railway Figure 5-2). This distribution of modes appears broadly applicable to waste. According to our interviews with waste stakeholders, most of them already consider truck and ship (if infrastructure allows) as their preffered shipment mode. This is due to the flexibility that transport by truck offers and the low price for water shipments[33]. As would be expected the closest disposal or treatment facility is preferred as it implies the lowest transport costs. The distance that waste can be economically shipped depends on its value per tonne/shipment. For example for organic waste that will be converted to compost, it is not economically viable to transport it more than 40 km[34]. However, for waste lead acid batteries the value per tonne is much higher, so the economic radius for transport to a recyling facility is more that 10 times higher at 5-600 km. The same logic applies in regard to where the production of the 'new' product will happen – this should ideally be as close as possible to the recycling facility[35].

Figure 5-2 Freight transport volume and modal split within the EU



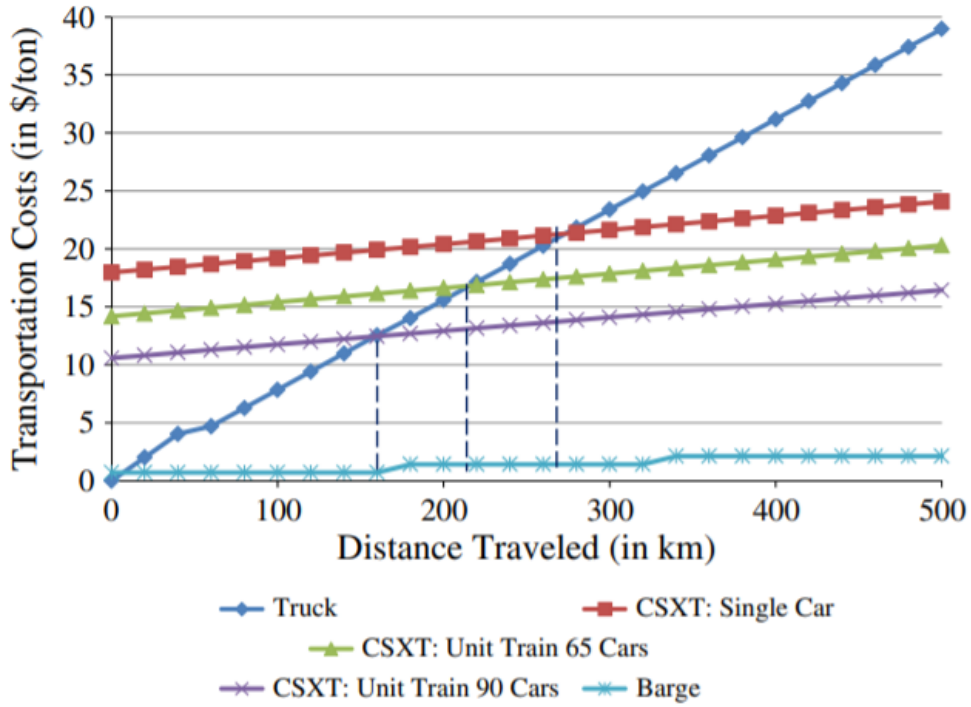
Source: EEA (2019) Freight transport volume and mdel split within the EU

To give an indication of the cost per distance and mode Figure 5-3 shows the average transportation costs for densified feedstock (grains) shipped by different transport means within the USA. The data is

[33] For example, according to the interview with EuRIC on the 27/01/21.
[34] According to the interview with MWE on the 10/02/21.
[35] According to the interview with EuRIC on the 27/01/21.

based on the following load size assumptions truck (26 tonnes load), train single car (cargo capacity of 112 tonnes), train unit (90 cars) and barge (container ship, carrying more than 1 500 tonnes). The analysis shows that if shipping is not an option, trucks are the lowest cost option up to a certain distance (here, up to 161 km). For longer distances, trains are most cost-efficient. However, when the volume shipped is too small to justify the use of a unit train, then a truck is the best alternative for transportation distances up to 282 km. For longer distances, single rail car shipments are the most economical choice. However, if maritime and inland water transport are viable alternatives and the quantity shipped is larger than 1 400 tonnes, this is always the most economical option.[36]

Figure 5-3 Transportation costs for densified feedstock by transport means and distance



Source: Gonzales, D. et al. (2012) Cost analysis for high-volume and long-haul transportation of densified feedstock

For recycable waste the **commodidy price** plays a key role. This is directly influenced by the **balance between market offer (supply) and its demand**. For most recylable commodities, there is a European market, such as for Wood or alternative fuels, but also a global one, e.g. for paper and metals[37]. As an example, for lead (coming from end of life vehicle batteris), there is a clear added value on the market through a consistent demand for the recycled material (making new vehicel batteries). However, for other streams that can be recycled, there is less of a clear and obvioud market, or it is highly variable, with occasions of no value. This requires recyclers to vary the price they offer in line with market price development (e.g. for metals, the London Metal Exchange is accessed)[38]. For some materials, e.g. plastics, the prices for sorted or recycled material can go very low. This can result in the lowest cost disposla route for it being to put it into solid recovered fuel (SRF) or RDF waste to boost the calorific value and make it more attractive to incinerators or industrial users. This does not represent a good outcome and wastes the years of effort spent in changing conumers' behavious to encourage them to separate out their plastic waste, as well as investment ins the plant to sort and reprocess it[39].

[36] Gonzales, D. et al. (2012) Cost analysis for high-volume and long-haul transportation of densified feedstock
[37] According to the interviews with EuRIC on the 27/01/21 and with Suez on the 26/01/21.
[38] According to the interview with Campine on the 03/02/21.
[39] According to the interview with Suez on the 26/01/21.

Summary of key messages

Of the three economic drivers examined (gate fees/taxes, transport costs and market prices for secondary materials) the strongest drivers appear the transport costs and secondary material market prices. In theory, high gate fees or landfill taxes should provide an incentive for waste holders to find alternative solutions, such as separating and preparing the waste for recycling. However, cross-checking this hypothesis with Eurostat data, this seems not to be the case in practice. For the transport costs, which do play a strong role, the most common means to ship waste from its country of origin to the receiving country are truck or ship. If infrastructure allows (presence of connecting river, canal or sea), ships are the preferred option as they are cheaper per tonne of waste transported than trucks. Regarding the **market price for secondary materials**, which clearly relates to the Circular Economy, it can be concluded that increasing prices for recycled materials are a key factor in mobilising recycling industries to expand their capacities.

5.1.2 Regulatory drivers

*Regulatory drivers primarily derive from the **administrative requirements** of compliance with legislation (WSR) and related to the cross-border transport of waste as well as the **lack of harmonisation** in the application of the legislative framework.*

The WSR demands a notification for waste destinated for all disposal operations, and certain recovery activities, which causes administrative barriers and costs for waste operators. These are reinforced through frequent delays on parts of the responsible authority[40]. However, waste operators still have to deal with their waste and recovery facility operators require inputs of waste to operate, so these burdens are overcome, with the typical response being to start consent application procedures earlier if a delay is expected. All of the waste stakeholders interviewed confirmed that they try to find and use pre-consented facilities (consents that last for 3 years instead of 1 year) and prefer general notification agreements (covering multiple shipments as opposed to single shipments) while they also start the notification process as early as possible[41].

Beyond the WSR, several directives[42] require MSs to recycle and/or reuse a minimum percentage of certain waste types. Also of relevance is the European target under the WFD of 50% preparation for reuse and recycling for MSW to be reached by 2020. Despite being reached for the EU as a whole in 2018, the Commission announced that 14 MSs are at risk of missing the 2020 target[43]. Barriers to reach these targets include a lack of collection and recycling infrastructures, and relevant industrial production facilities.

The lack of harmonisation is especially strong in the application of the restriction measures on waste imports for disposal or recovery, in accordance with Article 11 and 12 under the WSR (further discussed in Annex D) and the different standards in each MS as well as definition of e.g. end-of-waste (EoW) criteria (an extensive analysis can be found in the WSR evaluation report[44] and the study on efficient

[40] European Commission (2016) The efficient functioning of waste markets in the EU
[41] For instance, according to the interview with Campine on the 03/02/2021.
[42] For instance, the Packaging and Packaging Waste Directive (EU, 1994), the Directive on End-of-life Figure 4.1 Exports of waste plastics and selected waste metals from EU Member States, 1999–2011 Vehicles (EU, 2000) and the Directive on Waste Electrical and Electronic Equipment (EU, 2002 and 2012), as well as the recycling targets for household waste and construction and demolition waste in the revised Waste Framework Directive (EU, 2008).
[43] European Commission (2018) Early warning for Member States at risk of missing the 2020 target of 50% preparation for re-use/recycling for municipal waste
[44] European Commission (2020) SWD Evaluation of Regulation (EC) No 1013/2006 of the European Parliament and of the Council of 14 June 2006 on shipments of waste

functioning of the EU waste markets[45]). For example, in Germany EoW criteria for recovered paper are reported as only existing in the state of North-Rhine-Westphalia and Bavaria. Therefore, it would be easier to ship the paper waste from the Netherlands to Indonesia, than to Bavaria where it would change its status four times from waste to non-waste[46]. The interpretations of what is green-, orange- and green-listed waste also vary by MS. The differences in green listing of waste typically relate to different contamination and impurity levels deciding if a shipment is green listed or not. This causes practical difficulties as green-listed waste shipments do not have to be notified and can be shipped immediately while orange-listed waste has to be notified and has to await consent. Examples of this causing problems have been reported at the Danish-German border regarding mixed plastic waste, which is green-listed in Denmark, but orange-listed in Germany. Such misalignment causes delays or even stops the shipment of recyclable materials, which hinders the Circular Economy. During the current health crisis, these effects are reinforced through more border controls with higher standards in terms of safety and hygiene for waste that has been in contact with people, such as packaging waste. This causes additional costs which is putting major financial pressure on many waste- and EPR companies.[47]

Two other regulatory factors of interest are illegal shipments and price signals through taxes. Illegal shipments remain a key issue of waste shipments, as exemplified by the frequency of commodities seized by Operation DEMETER IV[48] and by increased illegal plastic shipments outlined by Interpol.[49] However when analysing regulatory drivers only legal operations are focused on. The price signals delivered via taxes could also be considered regulatory drivers but are covered under economic drivers.

Summary of key messages

The most common administrative burden associated with regulation is the notification for all shipments for disposal purposes and some shipments for recovery activities. The lack of harmonisation in the application of the WSR relate to Article 11 and 12 and unaligned standards and definitions present in MSs. However, these **do not typically block shipments**. Its typical impact is to increase waiting times and costs of shipments that ultimately **decreases profit margins and / or slows resource movement**.

5.1.3 Technical drivers

*The main technical driver influencing intra-EU waste movements relates to the presence or not of **sufficient infrastructure** to deal with all waste treatment and **recycling** needs within a country's boundary.*

A recent report of relevance is "Study on investment needs in the waste sector and on the financing of municipal waste management in MS[50]". This includes a review of the plastic and textile recyclate processing capacity in Europe. It also includes information on costs for some other waste streams (ELV plastic, WEE plastic, CMD plastic, etc.) but assumes that there would be no extra processing costs for paper and card, metal, and glass. The report estimates that Europe requires an extra 2.7 million tonnes of plastic reprocessing capacity to deal with municipal plastic waste currently exported from Europe. They estimate a cost of €750/tonne/yr — for this capacity based on the costs reported for three

[45] European Commission (2016) The efficient functioning of waste markets in the European Union
[46] According to the interview with EuRIC on the 27/01/21.
[47] According to the interview with MWE on the 10/02/2021.
[48] IMPEL (2018) "IMPEL supports WCO operation on illegal waste trafficking". Available here.
[49] Interpol (2018) "Emerging criminal trends in the global plastic waste market since January 2018". Available here.
[50] https://op.europa.eu/en/publication-detail/-/publication/4d5f8355-bcad-11e9-9d01-01aa75ed71a1

recycling plants. On other exported wastes that could be recycled (glass metal, paper, card) the report states that there is no more processing capacity needed as existing capacity is sufficient.

The data gathered on additional capacity and capital investment requirements across the different MSs for the 2021-2027 period highlights that the MSs most in need of further recycling re-processor infrastructure (particularly for MSW, non-MSW plastics, and textiles wastes) include France, Italy, Germany, Poland and Spain (Table D-1 and Annex D, Figure D-2).

Table 5-1 Additional capacity requirements and investment requirements (2020-2027)

Member State	Additional capacity requirements (thousand tonnes)	Capital investment requirements (€ million)
France	2 220	1 678
Italy	1 146	805
Germany	976	683
Poland	930	677
Spain	845	591

Source: Eunomia and COWI (2019)[51]
Note: This factors in MSW, non-MSW plastic packaging, and textile wastes.

The model data (as shown in Task 2) provides a comparison of how the infrastructure needs may effect waste flows. All the countries from the Eunomia/COWI study were generally net exporters of many of the non-hazardous wastes[52]. In 2019, France (13.9 Mt), Germany (4.1 Mt) and Poland (3.2 Mt) were all net exporters of these wastes. Italy and Spain were both net importers of all waste types in the same year owing to their large imports of ferrous metals (Spain, 5.8 Mt, Italy, 9.7 Mt), and paper for Spain (2.0 Mt).

France, Italy and Germany all show net-export trends for both plastics and textiles in the years 2016 to 2019. Nevertheless, the waste quantities are far less than that for other secondary materials, such as paper and pulp or different metals. In 2019, the net exports for plastics were: 0.37 Mt for France, 0.065 Mt for Italy, and 0.7 Mt for Germany. For textiles, net exports in the same period the figures were: 0.39 Mt for France, 0.073 for Italy, and 0.6 for Germany. None of these countries show exclusively exports of these wastes. For France, imports made up a smaller share of total imports/exports for textiles (17–20%) and plastics (23–31%). For Germany, the import share was slightly greater for textiles (23–28%) and plastics (35–36%). While for Italy, the import share made up a greater percentage for textiles (40-48%) and plastics (44–47%). In other words, total imports in 2019 for textiles (0.1 Mt for France, 0.16 for Italy, 0.28 for Germany) and plastics (0.29 Mt for France, 0.25 Mt for Italy, 0.84 Mt for Germany) is not an insignificant amount. This does not completely reflect the hypothesis that these countries require additional recycling capacity, but would **ensure that they become larger exporters of non-hazardous wastes** (in regard to plastic and textiles).

Furthermore, in Spain and Poland there is no clear trends of net exports, with the data on plastics and textiles fluctuating between the respective country being a net exporter and net importer between 2016 and 2019. Imports represent a significant share of total imports and exports for both countries and both waste streams (45–66%).

[51] Eunomia and COWI (2019) "Study on investment needs in the waste sector and on the financing of municipal waste management in Member States". DOI: 10.2779/769124
[52] Ferrous and non-ferrous metals, Plastics, Textiles, Paper and pulp, and Glass.

The data does not provide a clear view on how the technical driver of recycling capacity effects waste flows of non-hazardous wastes (plastics and textiles). **Germany, Italy, and France are net exporters of wastes that they have been identified as being the EU countries requiring most additional recycling capacities**. However, they also import significant amounts of these wastes, which seems improbable in countries with a lack of recycling capacity. It seems logical that a lack of technical recycling capacity would be a key driver, however, further data is required to confirm this assumption and it may be that the data is not sufficient defined (within streams) to pick up supply and capacity mismatches. If there was more detailed data on recycling capacity per MS, by waste type, this data could be reassessed more accurately.

Incineration capacity also represents a relevant driver for moving waste across the EU. The previous analysis implies that overall, the EU faces recycling capacity constraints which is also confirmed through the interviews held with several waste stakeholders[53]. In terms of incineration capacity, the case is different: while the capacities by country within the EU range from no capacity to overcapacity, overall it appears that the EU has enough incineration capacity to deal with its waste generated[54] — with a tendency to further increase.

The article 'Europe's waste incineration capacities in a circular economy', assesses the incineration capacity of waste-to-energy plants (R1 treatment) treating municipal solid waste (Y18 and 46). It, thereby, excludes RDF. The total number of incineration plants covered under the scope of the study is 372 with a capacity of 62 733 128 tonnes in 2011. The full table listing the incineration capacity for each MS, can be found in Annex D, Table D-4.

In some countries, large waste-to-energy plants are common, while in other countries smaller plants are more common. Germany and France have the largest capacities for MSW incineration. Although Germany has a higher capacity than France, France has a higher number of plants (125).

Denmark has the highest per capita incineration capacity with over 550 kg per capita. This is followed by the Netherlands, Norway and Sweden with per capita capacities of 300–550 kg. The remaining countries are in the middle range or have small capacities of less than 100 kg per capita — some countries had no MSW incineration capacity at all in 2011.

Overall, most of the countries have an incineration capacity of less than a quarter of their generated MSW, which could indicate either high recycling rates or large parts of the waste being landfilled[55]. Some of these countries use mechanical-biological treatment plants as an alternative route to treating mixed MSW. However, these countries could also be exporting waste to countries with larger capacities. In cases of high capacities compared with generated MSW, the risk of competing with recycling needs to be considered.

When assessing over- and under capacities a deeper analysis of the waste import and export figures is useful as it gives an idea of how much of the capacity is used with imports and how much waste is exported in relation to the country's capacity. In general, imports and exports of municipal waste for incineration can give an indication of regional over- and under capacities.

[53] For instance with CEWEP on the 29.01.21.
[54] Wilts, H. and von Gries, H. (2015) Europe's waste incineration capacity in a circular economy
[55] Ibid

Only considering the Y46 waste flows, MSW imports from the Netherlands, Italy, Ireland, France and Finland constitute between less than 1% and up to 6% of their respective incineration capacities. Except for Italy, no MSW from extra-EU countries has been imported. Italy imported between 7 841 and 9 590 tonnes for R1 purposes over the period of 2016-2018. Belgium, Luxembourg and Sweden require significant amounts of imports in order to keep their incineration capacities at sufficient utilisation rates. Of these countries, only Sweden imports from an extra-EU country, i.e. 17 796 in average per year between 2013-2018 from Norway (25% of its total waste imports). For Germany, imports of MSW for incineration are higher than the export. After 2011 until 2018, this trend remains, however, Germany's MSW imports multiplied by 15 (from 31 048 to 476 277 tonnes). Of these imports, only 2% have originated from extra-EU countries (between 2013-2018).

The imports or exports of MSW for R1 purposes only refer to a limited number of countries — almost no Eastern European EEA members or southern European countries are included. It becomes clear that in Sweden (with regard to imports), waste incineration capacities have, despite its waste incineration tax being in place since 2006, a high level of importance for the waste incineration market. Another related observation is that the Netherlands, Belgium and Germany both import and export MSW.

This analysis shows the enormous differences between the different member states. In 2011, it ranged from 0-<550 kg per capita of incineration capacity. In four of the 27 MS, the incineration capacities exceed 50% of the annual waste generation (Austria, the Netherlands, Denmark, Sweden), while in two of them the total amount of annually generated municipal waste is not enough to fill all the incineration plants (Croatia and Estonia). These capacities might be used to incinerate waste from non-municipal sources or imports. Though there remain uncertainties regarding the calculation of capacities, it is clear that they exceed the amount of MSW generated.

The overall incineration overcapacity, together with the lacking recycling capacity, implies a potential **trade-off between filling incineration capacities and achieving the 2020 50% recycling target** of the WFD, as well as the objectives of the EU's Environmental Action Programme to move towards a circular economy, to limit energy recovery to non-recyclable material and to reduce the generation of waste. Nevertheless, additional investments in waste incineration capacity might be useful to divert additional waste streams from landfilling. Regardless of this, interviewed waste stakeholders stress that especially for the waste streams plastic, paper and steel, Europe needs to create a new domestic market for recycled materials which would divert extra-EU shipments and create more balanced supply and demand dynamics as well as reduce the vulnerability to global market price volatilities.

The following five suggestions / issues were raised as useful for supporting and developing the EU recycling market:

- A mapping of recycling facilities as well as pre-consented facilities would significantly facilitate current and future increased intra-EU recycling efforts[56];
- There should be an inspection and verification system in place ensuring that waste really goes to recycling — waste shipments must be transparent and notifiable. This could go hand in hand with an online verification system (Electronic data interchange);[57]
- The aim should not be to have recycling plants for every waste stream in every country. The EU is one economic area which should manage the issue in a broader picture. This could be an

opportunity to unlock the potential of economically-weaker countries by making them centres of excellence in recovering certain waste streams for the EU;[58]

- Considering the fact that there is some spare Energy from waste capacity in Western and Northern Europe while capacity is missing in Southern and Eastern countries, it is crucial to establish a flow that brings waste from the East to the North in order to avoid landfilling in the South and East of Europe.[59]

Under the pressure of the European target to only landfill a maximum of 10% by 2035 of each MS's waste combined with the lack of knowledge, many public waste authorities take the decision to build an incineration plant. This decision is taken because it is seen as a relatively fast and easy solution (in comparison to the efforts required to develop a system to separately collect and treat the recyclable streams. This approach is potentially hampering the European recycling target. Hence, decisions of waste authorities could be better supported through more effective incentives as well as capacity building and technical advice.[60]

Box 5-2 Diverse opinions related to RDF waste in the EU

During our interviews with European waste companies and operators, we received a diverse range of opinions on RDF waste. These are summarised below:

1. RDF is produced from commercial, industrial and household waste and is then used as a fuel for incineration in e.g. power generation facilities or cement kilns. However, in practice this seems a misnomer as a significant part of RDF is burnt in energy from waste (EfW) plants. This is mainly due to two factors. First, the restricted number and capacity of cement kilns (And other industrial facilities that can use RDF) cause market demand limitations. Second, the potentially corrosive content in some RDF (e.g. chlorine in plastic) might cause damage to the combustion equipment in some industries making it less attractive for use as a fuel.
2. The production of RDF was originally pursued as a means to reduce the volume and moisture content of mixed waste to makes its transport cheaper and to reduce the landfilling volumes (and costs). Its continued existence is driven by this objective (meeting landfill diversion targets) and not by meeting any fuel need. This continued existence could be seen as a barrier to recycling, as it provides too 'easy' of route for waste disposal.
3. Cement kilns require a high calorific value which pure RDF supplies. However, as it becomes more common to burn RDF in EfW plants, the level of carbon-neutral content —driven by biogenic content — and calorific value are emerging topics (typically offered in low, medium and high levels). The demand is increasing for more carbon-neutral content as it enables higher capacities for WtE plants and implies a lower carbon tax on the electricity produced from burning the waste. This is achieved by mixing RDF with waste wood[61].
4. Considering the points raised above there appears a case for better defining standards for RDF. Applying EoW classification to RDF or even classifying it as green-listed, raises the risk of bypassing current waste legislation as these classifications do not need notification. It is, therefore, arguably better to regulate it in a harmonised way on the European level. Germany, the Netherlands and France already have standards for calorific value and the absence of contaminants in RDF. However, even with standards for RDF there can be market distortions, e.g. Portugal tried to produce RDF from their mechanical biological treatment plants, but could not compete on price with RDF being imported from the UK.[62]

[61] According to the interview with EuRIC on the 27/01/2021.
[62] According to the interviews with MWE on the 10/02/2021 and CEWEP 29/01/2021.

Summary of key messages

It is clear that a MS, when lacking capacity to treat or recycle a particular waste, will export to a country which has an overcapacity. Several waste flows can be linked to imbalances between waste treatment capacity and waste generation. For example, Sweden imports high volumes of waste for ***incineration*** *as it has an overcapacity. Overcapacity also has a clear impact on waste treatment prices In the case of incineration, it results in lower national treatment costs and reduced gate fees.*

5.1.4 Geographic drivers

Geographic drivers relate to two main factors. First, the ***size*** *of the country from which the waste derives (with bigger countries more likely to have more treatment and disposal capacity). Second, the* ***geographic location*** *which determines access to infrastructure and* ***proximity to neighbouring countries*** *and their facilities.*

As explained in section 3.5, the majority of the waste shipped for disposal and recovery happens between 8 countries which are adjacently located. This confirms that proximity as well as trust-worthy trade partnerships also have a moderate influence on the decision where to treat the waste.

The remaining aspects falling under this driver closely relate to transport costs and technical drivers (capacity). These factors are also of relevance to peripheral and island countries, as these (by definition) face larger distances and costs to access the capacity in continental Europe.

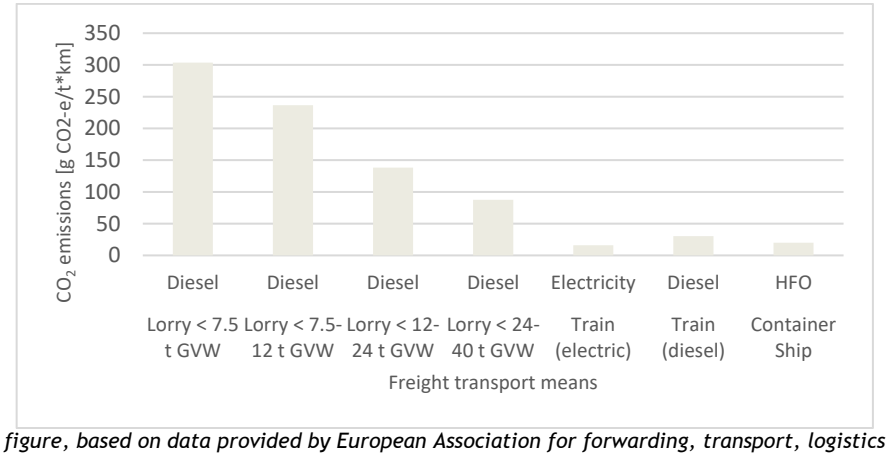
5.1.5 Environmental drivers

Environmental drivers relate to the ***choice of transport means*** *and* ***the final disposal or treatment operation*** *which is influenced by legislation or individual conviction.*

The primary environmental driver is arguably compliance with environmental legislation that aims to support the superior long-term goal GHG emission reduction target of 60% by 2050 —in 2017, the transport sectors was responsible for 27% of total greenhouse gas (GHG) emissions in the EU[63]. Comparing the emissions released by the most commonly utilised transport means (truck, train and ship), it becomes clear that the trend correlates with the transport costs for long distances (Figure 5-4). Lorries between 7.5-24 tonnes of cargo capacity emit the most emissions, with lower emissions for higher loads. Diesel trains rank next while the electric version emit the least emissions. However, it should be noted that electric railways are less interesting for heavy cargo shipments. The container ship performs as second best in terms of contributing to CO_2-equivalent emissions.

[63] EEA (2019) Greenhouse gas emissions from transport in Europe

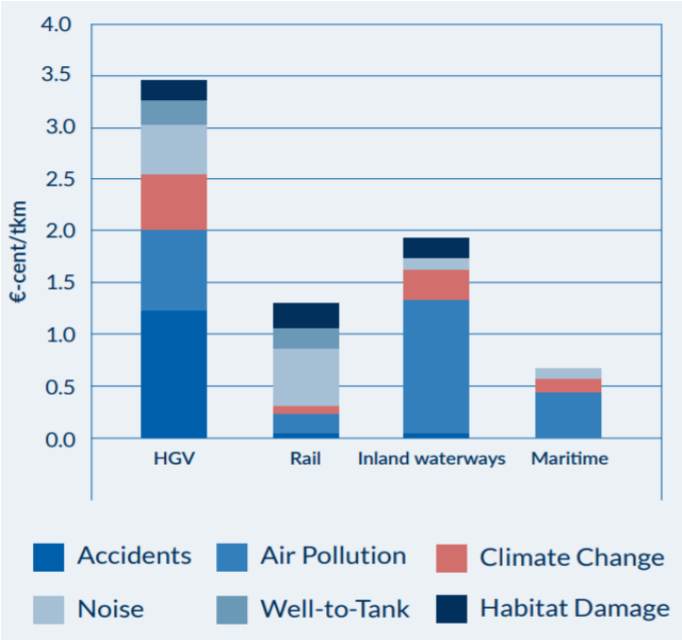
Figure 5-4 Average CO2 emissions by freight transport means



Source: own figure, based on data provided by European Association for forwarding, transport, logistics and customs services (2015) Calculating GHG emissions for freight forwarding and logistics services in accordance with EN 16258
*Note *: average emissions are calculated as a mean of values from average, volume and bulk goods.*

Beyond CO_2 emissions, freight transport activities also cause other externalities which are not represented in their respective transport costs, such as noise pollution or habitat damage. The European Commission study 'Sustainable Transport Infrastructure Charging and Internalisation of Transport Externalities' concludes that railways should be given a stronger role in European transport, inter-alia because of its lowest contribution to climate change and air pollution.[64]

Figure 5-5 Externalities by transport means



Source: CER (2019) Commission study results suggest greater role for European railways

There are also drivers related to the minimising of emissions from waste disposal and treatment techniques. Landfilling, both open and controlled, has the highest environmental impact due to leachate and gas production, such as methane and CO_2[65]. Although the environmental impact of waste incinerators depends on the technology and waste composition, generally, this treatment ranks next.

[64] CER (2019) Commission study results suggest greater role for European railways
[65] Danthurebandara, M. et al. (2013) Environmental and socio-economic impacts of landfills

In the contrary, recovery activities, such as sorting and recycling of metals, paper, etc. improve the environmental impact[66].

However, all the waste stakeholders interviewed agreed that purely environmental consideration have the weakest influence on their decision-making related to how they treat their waste (recycling or disposal) or where they ship it. Most of them would like and/or already plan to give it a larger role, however, the environmental considerations only come out top when they match the economics (e.g. minimising transport costs typically minimises emissions, and getting paid for a recoverable resource is better than paying a gate fee and tax for disposal).

Summary of key messages

The main reasons to take environmental considerations into account are the compliance with environmental legislation, that aims to reduce GHG emissions, and the transport and treatment costs, as these correlate with the environmental impact (transport means with high CO_2 emissions, come at a higher cost). This confirms how important economics, regulation and market incentives are for driving the single market in the EU towards more environmentally-friendly decisions[67].

As mentioned in the beginning of this section, the main drivers presented influencing the decision-making about how and where to treat the waste, cannot be ranked throughout different waste flows. However, within our literature review and interviews with various waste stakeholders, it became clear that the ***total price*** *(composed of disposal/treatment costs, transport costs and/or value of resource, in case of recovery)* ***plays a primary role*** *in the decision of where to ship the waste and what to do with it. For the other drivers no general conclusion can be made.*

[66] Cremiato, R. et al. (2017) Environmental impact of municipal solid waste management using LCA: The effect of anaerobic digestion, materials recovery and secondary fuels production
[67] According to the interview with Suez on the 26/01/21.

6 Assessment of environmental benefits and risks from intra-EU waste movements

Having reviewed the data on the volumes and nature of waste being shipped between MSs, and considered the reasons why these shipments occur we know consider if these movements can be considered environmentally beneficial and in line with the objectives of the Circular Economy.

6.1 Methodology

As discussed in section 3.5 (and elsewhere in this report) there are two main sources of data that we can analyse; the Comext trade data and the Eurostat data on WSR and Basel waste shipments. Although the focus of this report is on non-hazardous (recyclable) waste, in order to maximise the use of the available data, and to gain maximum insight we have considered some hazardous waste streams (reported under the Eurostat/ Basel / WSR data) in this analysis. It should be pointed out that recovery of resource from these hazardous streams is possible and offers large steps up the waste hierarchy (and hence environmental benefits). Moreover, for the assessment of environmental benefits in a Circular Economy, the administrative status of waste (hazardous/non-hazardous/) or waste-related materials is of very little relevance.

With regard to the Comext data, this analysis builds on the assumption that CN-coded waste streams, which are traded as goods, will typically be recycled in view of their material content. Unfortunately, it is not possible to ascertain destinations (recovery technologies) for all CN-coded waste flows, as already explained earlier in this report. There is also a lack of public information available on the yields and efficiencies of the particular recycling processes that are used, and on the corresponding volumes of secondary waste (residues) that is generated that in turn has to be treated or disposed of.

Therefore, the different types of primary treatments are categorised according to their position on the waste hierarchy. The waste hierarchy has been accepted as a guiding principle in the Waste Framework Directive, for reducing the environmental impact of waste and to promote resource efficiency through reuse, recycling and recovery. The positioning on the waste hierarchy, of a waste treatment that is given to a particular waste type, allows us to qualitatively derive environmental benefits, since material recycling is commonly assumed to present higher net benefits than energy recovery, and energy recovery is environmentally preferred over disposal.

The data and information on exported and imported waste flows obtained for each member state, including both COMEXT and WSR (Eurostat) data, is categorised according to the first treatment on arrival (assuming recycling for CN-coded waste). This allows conclusions to be drawn on the environmental benefits that are generated by moving waste from one member state to another.

However, the magnitude of the environmental benefits as a consequence of waste treatment does not only depend on the type of treatment that is provided, but also varies according to:

- The potential environmental burdens that could be inflicted by a particular category of waste;
- The environmental impacts that are avoided by recycling activities that produce secondary raw materials that can substitute for resource-intensive, primary equivalents.

In order to take account of this an *"environmental performance level"* between 0 and 4 has been assigned to different waste treatment types as distinguished by the Basel Convention, according to the potential environmental benefit which could be realised by the treatment (0 = no benefit; 4 = highest benefit). For the waste streams which are notified under the Basel Convention, the provided or intended treatments are documented, and a treatment code is attributed to each notified waste transfer.

The following environmental performance levels (EPL) have been distinguished for Basel-coded, notified wastes:

- **EPL 0:** Deposit, injection, impoundment, incineration without energy recovery, release, blending or mixing, storage, and accumulation, are treatments that provide the lowest possible environmental benefits;
- **EPL 1:** Repackaging, biological or physico-chemical treatment, and disposal in specially engineered landfills, are more or less complex treatments that aim to decrease the hazardousness of the waste, providing a limited environmental benefit;
- **EPL 2**: The use of notified waste as a fuel or means to generate energy, is here categorized as providing a medium environmental performance level;
- **EPL 3**: The recycling, recovery or reclamation of materials from notified waste is expected to provide a high level of environmental performance, since the secondary raw materials that result from such treatments, will substitute for primary resources, and thus avoid the associated environmental impacts;
- **EPL 4**: Oil production, ore extraction and the production of basic metals are all associated with considerable environmental impacts. Therefore, the regeneration of waste oil and recycling of metals and metal compounds is categorised among the highest performing waste treatments. The use of residual materials from waste treatment avoids these secondary wastes to be disposed of, and returning organic components to the benefit of agriculture, are also considered as complex but highly beneficial treatment option for notified waste.

A similar approach was applied to the Comext data (for the years 2016 and 2017). For these CN-coded waste transfers however, the actual treatment to which the waste will be submitted on arrival is not exactly known. Therefore, it was necessary to assume the most plausible treatment for a selection of 23 of the most relevant waste-related trade flows. The assignment of treatment codes was supported by private consultant guidance that provided waste disposal and recovery code-based flowcharts[68]. The overview of assumed treatments is provided in Table 6-1.

[68] Chart can be found here: https://www.360environmental.co.uk/documents/DRCodeFlowchart.doc

Table 6-1 Assumed treatment options for CN-coded waste transfers

CN	NAME	
2303	RESIDUES OF STARCH MANUFACTURE, BEET-PULP, ETC	R3
2308	VEGETABLE WASTE	R3
2620	SLAG, ASH AND RESIDUES CONTAINING METALS	R4
2621	SLAG AND ASH, INCL. SEAWEED ASH "KELP"	R10
271099	WASTE OILS CONTAINING MAINLY PETROLEUM OR BITUMINOUS MINERALS	R9
3915	WASTE, PARINGS AND SCRAP, OF PLASTICS	R3
4004	WASTE, PARINGS AND SCRAP OF SOFT RUBBER	R1
440139	SAWDUST AND WOOD WASTE AND SCRAP (EXCL. PELLETS)	R1
4706	PULPS OF FIBRES DERIVED FROM RECOVERED PAPER WASTE	R3
4707	RECOVERED "WASTE AND SCRAP" PAPER OR PAPERBOARD	R3
5202	COTTON WASTE	R3
53013	FLAX TOW AND WASTE, INCL. YARN WASTE AND GARNETTED STOCK	R3
5505	WASTE OF MAN-MADE STAPLE FIBRES	R3
7001	CULLET AND OTHER WASTE AND SCRAP OF GLASS	R5
7112	PRECIOUS METAL WASTE AND SCRAP	R4
7204	FERROUS WASTE AND SCRAP	R4
7404	COPPER WASTE AND SCRAP	R4
7602	ALUMINIUM WASTE AND SCRAP	R4
7902	ZINC WASTE AND SCRAP	R4
810197	TUNGSTEN WASTE AND SCRAP	R4
81053	COBALT WASTE AND SCRAP	R4
81083	TITANIUM WASTE AND SCRAP	R4
8548	WASTE AND SCRAP BATTERIES AND ACCUMULATORS	R4

The assignment of treatment codes to the CN-coded intra-EU waste transfers allows both Basel and Comext registered waste movements to be categorised according to their environmental performance level.

However, since the waste that is transferred as goods lacks the hazardous characteristics that characterise notified wastes, the environmental performance level for the treatment of CN-coded waste transfers was assumed to be one performance level lower as compared to the analogue treatment option given to the notified waste.

For non-hazardous Basel coded waste transfers (Y46, Y47 and non-hazardous ‘not specified’ wastes), the same EPL were applied as for the CN-coded waste-related goods, i.e. one performance level lower than the same treatment applied on hazardous waste. The resulting EPL are summarised in the table below.

Table 6-2 Environmental performance level (EPL) per treatment and per type of waste

Code	Description	Haz Basel codes	Non-Haz Basel codes + COMEXT
D1	Deposit into or onto land (e.g. landfill, etc.)	0	0
D3	Deep injection (e.g. injection of pumpable discards into wells, salt domes or naturally occurring repositories, etc.)	0	0
D4	Surface impoundment (e.g. placement of liquid or sludge discards into pits, ponds or lagoons, etc.)	0	0
D5	Specially engineered landfill (e.g. placement into lined discrete cells which are capped and isolated from one another and the environment)	1	0
D6	Release into a water body except seas/oceans	0	0
D7	Release into seas/oceans including sea-bed insertion	0	0
D8	Biological treatment not specified elsewhere in this list which results in final compounds or mixtures which are discarded by means of any of the operations in this list	1	0
D9	Physico-chemical treatment not specified elsewhere in this list which results in final compounds or mixtures which are discarded by means of any of the operations in this list (e.g. evaporation, drying, calcination, etc.)	1	0
D10	Incineration on land	0	0
D11	Incineration at sea	0	0
D12	Permanent storage (e.g. emplacement of containers in a mine (etc.)	0	0
D13	Blending or mixing prior to submission to any of the operations in this list	0	0
D14	Repackaging prior to submission to any of the operations in this list	1	0
D15	Storage pending any of the operations in this list	0	0
R1	Use as a fuel (other than in direct incineration) or other means to generate energy (Basel/OECD) - Use principally as a fuel or other means to generate energy (EU)	2	1
R2	Solvent reclamation/regeneration	3	2
R3	Recycling/reclamation of organic substances which are not used as solvents	3	2
R4	Recycling/reclamation of metals and metal compounds	4	3
R5	Recycling/reclamation of other inorganic materials	3	2
R6	Regeneration of acids or bases	3	2
R7	Recovery of components used for pollution abatement	3	2
R8	Recovery of components from catalysts	3	2
R9	Used oil refining or other reuses of previously used oil	4	3
R10	Land treatment resulting in benefit to agriculture or ecological improvement	4	3
R11	Uses of residual materials obtained from any of the operations numbered R1 to R10	4	3
R12	Exchange of wastes for submission to any of the operations numbered R1 to R11	3	2
R13	Accumulation of materials intended for any operation in this list	0	0

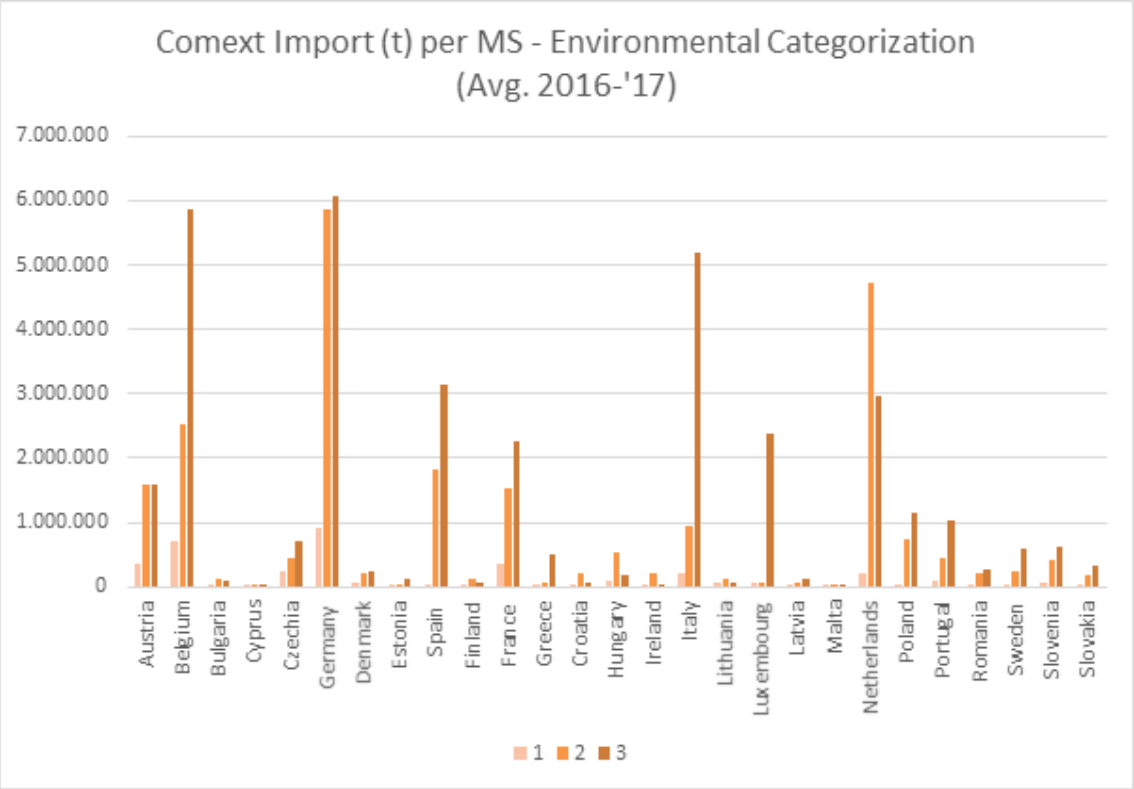
6.2 Environmental performance levels of CN-coded waste movements

Figure 6-1 shows that Germany, Belgium and Italy are the main contributors to the realisation of environmental benefits, by being able to apply beneficial treatment options to high volumes of waste-related goods. Other countries that import relevant volumes of wastes to be submitted to the environmentally most preferable treatment are Spain, Netherlands, Luxembourg, France. Germany, the

Netherlands and Belgium are the top three countries for treating wastes at the second highest performance level.

It is noted that the performance levels achieved are always the result of the combination of the supply of a particular waste feedstock and the treatment options that are applicable and (technically and economically) available for that waste; and are thus rarely determined by a deliberate and free choice of the waste trader. In other words, it is impossible to decide to export cotton waste for used oil refining.

Figure 6-1 Environmental performance levels (EPL), associated with CN-coded intra-EU waste movements, realised in receiving MS



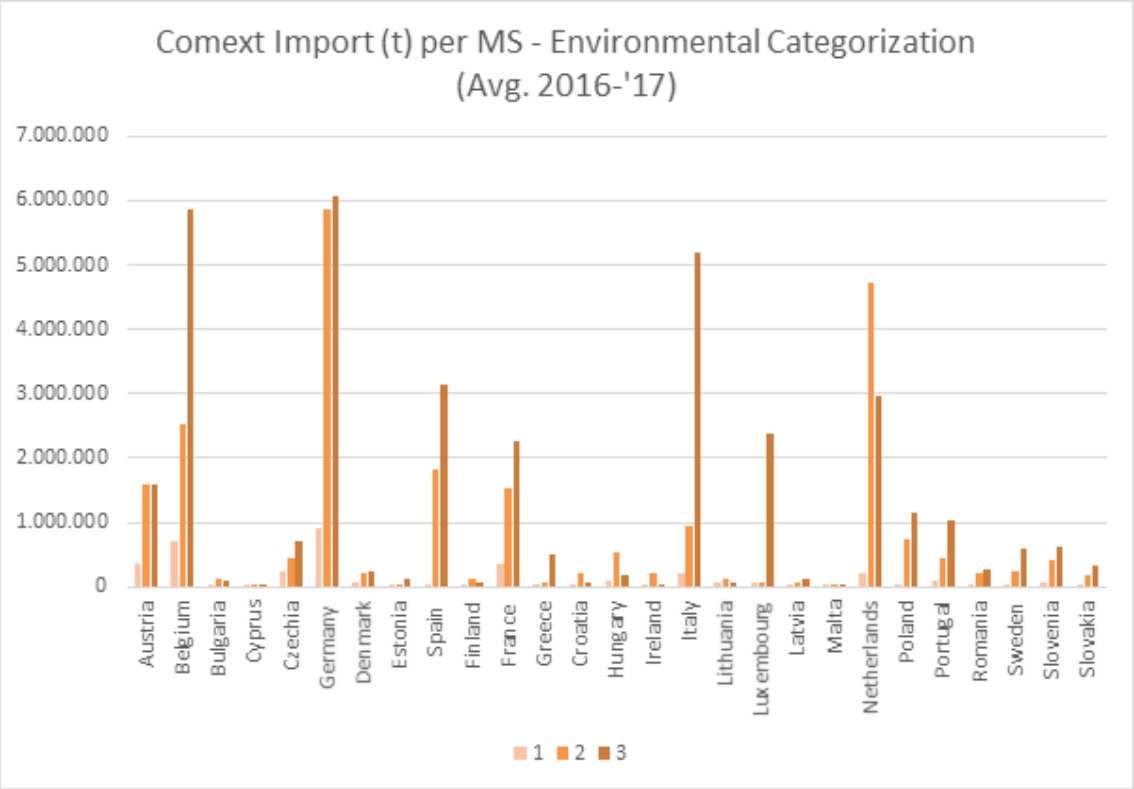
As an illustration to provide further insights, for the Netherlands, the large volume at EPL 2 (4.7 Mt/y) is explained by:

- A large volume of imported 'Recovered 'waste and scrap' paper or paperboard (excl. paper wool)': 2.4 Mt/y
- Also in this category: 'Residues of starch manufacture and similar residues, beet-pulp, bagasse and other waste of sugar manufacture, brewing or distilling dregs and waste, whether or not in the form of pellets': 838 kt/y; 'Acorns, horse-chestnuts, marc and other vegetable materials and vegetable waste, vegetable residues and by-products of a kind used in animal feeding, whether or not in the form of pellets, n.e.s.': 496 kt/y; 'Waste, parings and scrap, of plastics': 481 kt/y and 'Cullet and other waste and scrap of glass; glass in the mass (excl. glass in the form of powder, granules or flakes)': 450 kt/y.

Figure 6-2 shows that those MS that export relevant volumes of CN-coded waste-related goods to other MS, expect that more of the exported waste will be treated in those options that allow for the highest environmental benefits. This is particularly the case for Germany, France and the Netherlands. These

same countries also export most of the wastes for which the treatments foreseen will probably provide somewhat lower environmental benefits. Of all MSs, only Belgium exports more waste to be submitted to a lower performing treatment as compared to the volume sent to the higher performing treatment.

Figure 6-2 Environmental performance levels (EPL), associated with CN-coded intra-EU waste movements, projected by exporting MS



As an illustration, it can be noted that for Belgium, the volume at EPL 2 (2,8 Mt/y) is larger than at EPL 3 (1,7 Mt/y):

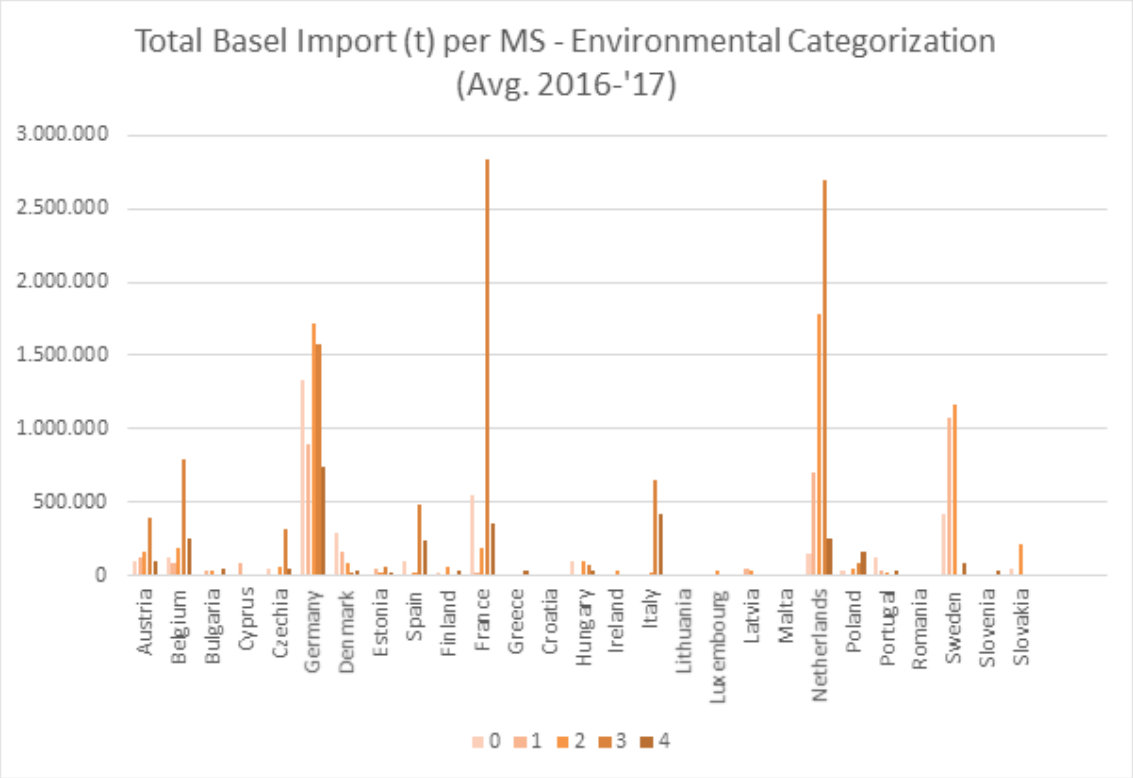
- Mainly due to 'Recovered 'waste and scrap' paper or paperboard (excl. paper wool)': 953 kt/y and 'Residues of starch manufacture and similar residues, beet-pulp, bagasse and other waste of sugar manufacture, brewing or distilling dregs and waste, whether or not in the form of pellets': 895 kt;
- Also: 'Cullet and other waste and scrap of glass; glass in the mass (excl. glass in the form of powder, granules or flakes)': 592 kt.

6.3 Environmental performance levels of Basel-coded waste movements

Figure 6-3 shows that imports of Basel-coded wastes are dominated by only three countries: Germany, the Netherlands and France. In the Netherlands and in France, the environmentally well-performing treatment options related to the recycling, recovery or reclamation of materials dominate the environmental profile. Germany presents a more balanced profile, with volumes of the same order of magnitude being recycled (EPL 3), incinerated with energy recovery (EPL 2), or disposed of through deposit, injection, impoundment, incineration without energy recovery, release, blending or mixing, storage, or accumulation (EPL 0). In Germany, the Netherlands and Sweden, relevant volumes (between 0,7 and 1,1 million tons) of the imported notified wastes are disposed of through repackaging, biological or physico-chemical treatment, or disposal in specially engineered landfills (EPL 1). Both in

Germany and in the Netherlands, more than 1.7 million tons of notified waste are incinerated with energy recovery (EPL 2), followed by Sweden with about 1.1 million tons. In Denmark and Portugal, the lowest performing disposal options dominate the treatment environmental profiles, but in both cases, the absolute volumes for each of these countries are below 300 kilotons per year. Also in France, such disposal options are relevant in the environmental profile, also in absolute numbers.

Figure 6-3 Environmental performance levels (EPL), associated with Basel-coded coded intra-EU waste movements, realised in receiving MS



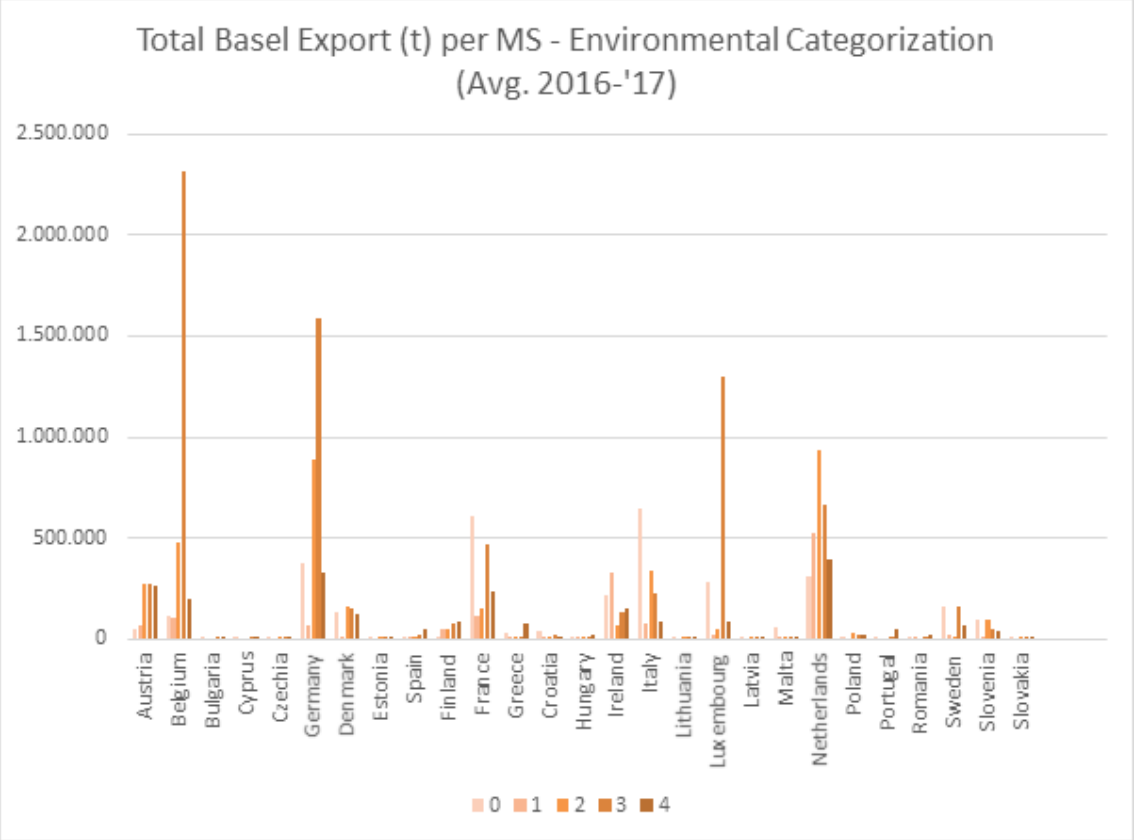
As an illustration, the following specificities regarding to the effect of particular waste categories (other than 'not specified' wastes), can be highlighted for some of the receiving MS:

- Germany: large volumes in categories 0 and 1:
  - Due to Y36 (Asbestos (dust and fibres)) at EPL 0: 186 kt in 2017, and 198 kt in 2016;
  - Due to Y46 (Wastes collected from households) at EPL 1: 759 kt in 2017 and 960 kt in 2016.
- Netherlands: large volumes in categories 2 and 3:
  - Due to Y18 (Residues arising from industrial waste disposal operations) at EPL 2: 1,3 Mt in 2017 and 1,7 Mt in 2016;
  - Due to Y18 (Residues arising from industrial waste disposal operations) at EPL 3: 470 kt in 2017 and 591 kt in 2016, and also Y11 (Waste tarry residues arising from refining, distillation and any pyrolytic treatment): 265 kt in 2017 and 324 kt in 2016.
- Sweden: large volumes at EPLs 0 and 1:
  - Due to Y46: 190 kt in 2017, and 115 kt in 2016 at EPL 0, and 973 kt (2017) and 1,2 Mt (2016) at EPL 1 (2017).

Figure 6-4 shows that Basel-coded exports to other EU countries are led by the same group of eight countries identified earlier (see section 3.5.1), (Belgium, Germany, the Netherlands, France, Luxembourg, Italy, Austria and Ireland). The resulting environmental profiles of the exporting countries

are however diverse: for Austria, Germany and the Netherlands, exports for treatment at the highest performance level are relevant in absolute terms (>250 kilotons each); Belgium, Germany and Luxemburg dominate by far regarding the notified exports intended for material recycling, recovery and reclamation (EPL 3). The environmental profiles of waste exports from Italy, France, Sweden, Slovenia and Malta are dominated by the lowest performing option of disposal through deposit, injection, impoundment, incineration without energy recovery, release, blending or mixing, storage, or accumulation (EPL 0). Belgium, the Netherlands and Germany export more relevant volumes of Basel-coded wastes for incineration with energy recovery (EPL 2); Irish environmental profile regarding to notified waste export volumes is dominated by disposal treatments that consider repackaging, biological or physico-chemical treatment, and disposal in specially engineered landfills (EPL 1).

Figure 6-4 Environmental performance levels (EPL), associated with Basel-coded intra-EU waste movements, projected by exporting MS



As an illustration, the following specificities regarding to the effect of exports of particular waste categories (other than 'not specified' wastes), can be highlighted for some MSs:

- Germany: high volumes at EPL 0: due to Y46 (Wastes collected from households): 156 kt (2017) and 159 kt (2016);
- France: high volumes at EPL 0: due to Y18 (Residues arising from industrial waste disposal operations): 100 kt in 2016 and 136 kt in 2017; and Y5 (Wastes from the manufacture, formulation and use of wood preserving chemicals): 46 kt in 2016 and 38 kt in 2017;
- Ireland: high volumes at EPls 0 and 1: due to
  - High volumes of Y46 (Wastes collected from households) in category 0 (63 kt (2017); 62 kt (2016)) and 1 (275 kt in 2017; 274 kt in 2016);
  - High volumes of Y 47 (Residues arising from the incineration of household wastes) in category 0 (38 kt (2017).

- Italy: high volumes at EPL 0: due to Y18 (Residues arising from industrial waste disposal operations) (146 kt in 2016; 196 kt in 2017) and Y36 (Asbestos (dust and fibres)) (250 kt in 2016; 219 kt in 2017);
- Netherlands: high volumes at EPls 0, 1 and 2:
  - EPLs 0 and 2, this is due to Y18 (Residues arising from industrial waste disposal operations): 168 kt and 680 kt respectively in 2017, and 211 kt and 617 kt in 2016.
  - For category 1, this is due to Y46: 475 kt in 2017 and 454 kt in 2016.
- Sweden: high volumes at EPL 0:
  - Mainly due to Y9 (Waste oils/water, hydrocarbons/water mixtures, emulsions): (73 kt in 2016, and 65 kt in 2017).

6.4 Waste treatment environmental profiles for main waste transferring MS

In the following pie-charts, total volumes of (Basel+Comext) waste streams (averages for 2016 and 2017) were analysed in terms of environmental performance level (EPL) for the six most important countries (collectively accounting for approximately 70% of the total import or export of these streams): Germany, The Netherlands, France, Italy, Belgium and Austria. Pie chart sizes are proportional to the total transferred waste or waste-related material volumes (aggregated COMEXT + Basel).

Both for the non-hazardous, CN-coded waste streams traded as goods, and for the notified waste streams subject to the Basel Convention, it is clear that the more environmentally beneficial treatment options (2-3-4) are favoured over the less beneficial ones (0-1).

Figure 6-5 Environmental Performance Levels for main waste importing MS. Figures include (i) CN coded non-hazardous waste volumes, (ii) Basel notified non-hazardous waste volumes, and (iii) Basel notified hazardous waste volumes

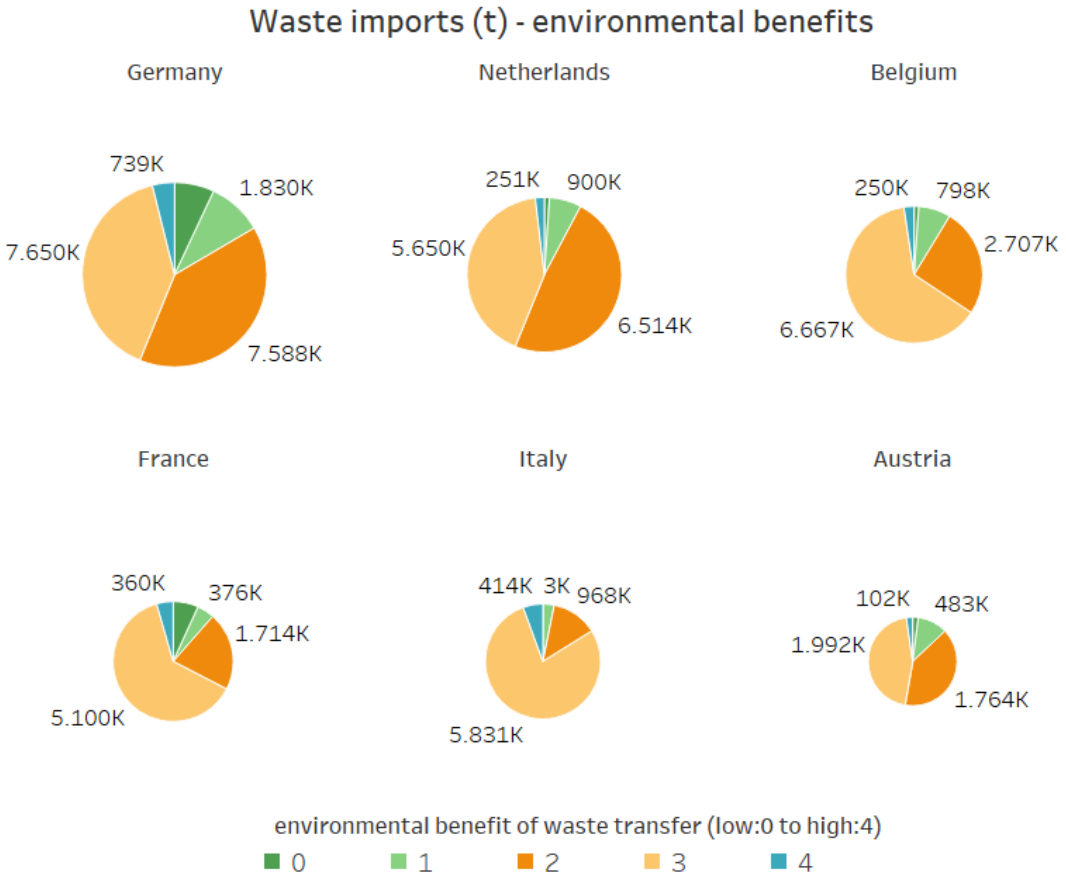
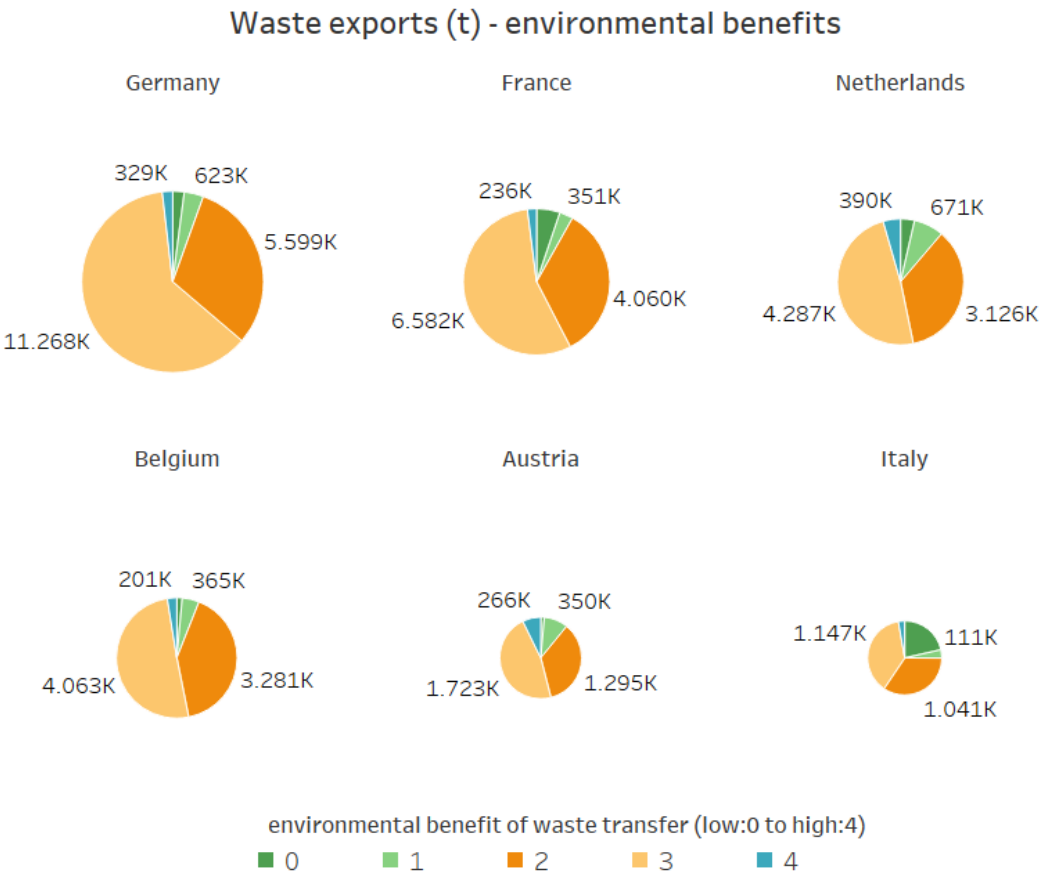


Figure 6-6 Environmental Performance Levels for main waste exporting MS. Figures include (i) CN coded non-hazardous waste volumes, (ii) Basel notified non-hazardous waste volumes, and (iii) Basel notified hazardous waste volumes



6.5 Summary of key messages

Intra EU (and any other) waste movements can be considered to provide environmental and circular economy benefits though:

- Enabling the increased recycling of waste into secondary raw materials that effectively **substitutes waste for primary materials**, avoiding the resource consumption and associated environmental impacts from primary production,;
- Providing **safe sinks** for materials contained in wastes, that could damage human health and/or the environment, and should be removed from new production loops.

Attempting to analyse the environmental benefits of intra EU waste movements is constrained by the availability of data that classifies waste by its trade / product category (Comext) or by its level of potential hazard (Eurostat (Basel/WSR data)). Both classifications contain material that could potentially be recovered and provide environmental benefits. In order to reflect this we have analysed all significant waste flows - so using data from Comext and Eurostat.

The physical and chemical characteristics of the waste are of course key for estimating the environmental benefits generated by treating them; e.g. hazardous waste that is treated in order to contain or diminish its hazardousness (safe sink benefit) and from which energy and/or materials can be recovered (substitution benefit) will be higher ranked in terms of environmental performance than waste that is only treated to diminish its hazardousness.

The Environmental Performance scale used in this report therefore includes four performance levels, in order to try and cover all types of intra EU waste shipments for which there is data (both Comext and Eurostat). This scale allows us to assess (i) CN coded non-hazardous waste volumes (Comext), (ii) Basel notified non-hazardous waste volumes (Eurostat), and (iii) Basel notified hazardous waste volumes (Eurostat), together, in order to provide the most complete possible assessment of the environmental benefits resulting from intra EU waste movements. This resulted in waste treatment environmental profiles for the main waste transferring MS.

Both Basel (Eurostat) and CN codes (Comext) data provide valuable details on the type of waste as well as on the treatment given at destination. The Basel (Eurostat data) is more precise on the treatment provided (but less on the waste characteristics, e.g. 'not-specified' is the highest volume waste type), whereas COMEXT reveals more detail on the characteristics of the waste and its secondary raw material potential, but less on the exact treatment at destination.

From the analysis, it is clear that:

- Volumes of waste traded and documented in the Comext database are much higher than the volumes of (hazardous) waste transported with Basel notification;
- Countries active in transporting hazardous waste are equally active in the trade of non-hazardous waste and residues;
- Both for the non-hazardous, CN-coded waste streams traded as goods, and for the notified waste streams subject to the Basel Convention, it is clear that the more environmentally beneficial treatment options are favoured over the less beneficial ones;
- The largest volumes usually go to the more beneficial waste treatments.

The waste volumes that are treated within the MS are much bigger than the ones that are exported to other MS. Export will always be more complex and more burdensome as compared to local processing, so it is a reasonable assumption that waste will not be (legally) exported without having a motive and a good reason that makes it a better choice than local treatment.

7 Conclusions

This section has been structured to answer the three questions presented in the introduction.

1. What can the available data tell us about the intra EU shipments of Waste?
2. What drives and constrains these waste movements?
3. What are the environmental benefits of these waste movements?

7.1 What can the available data tell us about the intra EU shipments of Waste?

The table below presents total waste generated, excluding major mineral waste generation, compared to total waste imports and exports both within the EU and with third countries in millions of tonnes. It is apparent that transboundary shipments remain a small percentage of total waste generated, indicating that, in general, over 90% of wastes generated are treated within the Member States themselves, with transboundary movements representing a small percentage by total volume. When major mineral wastes are included in waste generation the percentage rises to 98% of wastes generated being treated within Member States themselves.

Table 7-1: Total EU waste generation, intra EU and Extra EU waste exports

	2004	2006	2008	2010	2012	2014	2016	2018
Total EU waste generated (excl. major mineral wastes)	781	790	760	759	758	770	785	809
Total waste exported (extra-EU)	18.6	19.5	24	30	32	28	29	31
Total waste imported (intra-EU)	42	44.5	46.4	46.4	46.4	46.4	45.3	49.2

The economy and location of the countries plays an important role in their exports of imports of waste. Countries such as BE, NL and LU are generally transport hub countries, LU as a result of its location amongst a number of large Member States and BE and NL as a result of the rail and port infrastructure in those countries that undertake a considerable share of transboundary shipments of waste both within the EU and between the EU and third countries. This is likely to account for their proportionally higher levels of exports of wastes than countries of a similar size in terms of population and economy.

Analysis of the patterns in the waste streams considered key to the circular economy, as they are the most resource rich (i.e. recyclable) revealed the following:

- ***Plastic waste:*** Some Member States (FR, DE and SE) consistently relying on exports whilst others appear to be expanding their imports (most notably CZ, and RO).
- ***Glass waste:*** Some Member States (BE, HU, EL, HU, NL, RO, SE and SI) consistently relying on exports, whilst others appear either to be expanding their imports of glass waste overall (most notably CZ) or are large destinations for glass waste overall (DE and PT).
- ***Textile waste:*** Some Member States (AT, BE, DE, FI, FR, PT and SE) consistently relying on exports, whilst others are generally net importers of textiles waste (most notably BG, ES, HU, IT, LT, NL, PL and RO).
- ***Non-ferrous metals:*** There are a significant volume of shipments originating from or entering DE, and the difference between imports versus exports is relatively small. DK, FR and NL are the Member States that export the largest volumes and export more non-ferrous metal waste

than they import, whereas AT, ES and IT show increasing trends of net volumes imported increasing over time.

- ***Ferrous metals:*** IT, BE, ES and LU appear to be the overall countries of destination for ferrous metal wastes from other EU Member States. DE, FR and NL appear to rely more heavily on exports to other Member States of their ferrous metal wastes. Imports into Italy are reported (industry interview) as being relatively high due to the high use of electric arc furnaces in iron and steel production in Italy, and these are capable of using a much higher proportion of waste material than blast furnaces (which are more common in German steel making plants). Germany appears to be the MS with largest volume of ferrous waste moving into and out of the country. This reflects Germany's position as the largest steel maker in the EU, they accounted for over 40M tonnes of crude steel production in 2019 (25% of crude steel production in the EU). With net exports of just under 3.5M tonnes, exports of ferrous metal waste represent just under 10% of total production. When compared with FR (with 14.5M tonnes of crude steel production in 2019), net exports as a percentage of production in FR are 30% of total production.
- ***Paper and cardboard***: AT, DE, ES, HU and NL appear to be the overall countries of destination for paper and cardboard wastes from other EU Member States. CZ, DK, FR and PL appear to rely more heavily on exports to other Member States of their paper and cardboard wastes
- ***Refuse derived fuel, other wastes from mechanical treatment and mixed municipal waste for energy recovery and incineration***: DE and SE are net importers of these wastes for R1 and D10 activities but that the proportions imported are a small fraction of the total wastes subject to these activities. However, for SK, imports are an important fraction of the total feedstocks for R1 and D10 capacity. Conversely, IE and to a lesser extent SI are heavily reliant on exports for the incineration of their wastes.

With regard to the **value of Intra EU waste shipments**, the COMEXT database reports waste shipments both by value and quantity. Therefore, by combining the two it is possible to deduce the value per weight of the waste shipments by individual waste code or broader waste category. It is important to note that there are several possible reasons behind some MSs presenting very high values for certain waste categories and we have not been able to fully investigate these in this study. For example, one reason for these outliers may be that a MS only imports waste belonging to a specific high-value waste code, whereas other MSs are more focussed on low-value waste or a combination of the two.

This data can also be analysed to compare the relative performance of Member States in the types and value of waste they export and import. To illustrate this, and to compare two contrasting MSs in terms of GDP and resource use, the data for Germany and Bulgaria were compared. This comparison indicates that Germany imports higher-value waste compared to Bulgaria in ferrous metals, paper and cardboard, textiles and plastic, whereas Bulgaria imports higher value material in non-ferrous metals. Glass waste imports appear to have a similar value in the two countries. The analysis also shows that the ratio between waste exported and generated tends to be much higher in Germany compared to Bulgaria. This suggests a more independent waste management system in Bulgaria, which is able to cope with a larger share of its waste without resorting to shipping it to third countries.

With regard to the **treatments that intra-EU waste shipments receives** the analysis is constrained by the data. The Comext (trade) data does not specify the treatments that the waste receive. The Eurostat (WSR/Basel) data does give some information on waste treatment but does not cover non

notifiable waste shipments and some of the waste classifications it provides lack detail. For example, the category 'Not specified', is 55 to 61% of the total reported waste flow.

Looking at the Eurostat (WSR/Basel) data

- Eight member states (Belgium, Germany, the Netherlands, France, Luxembourg, Italy, Austria and Ireland) are the main waste exporting countries for the highest volume Basel-coded waste categories;
- Most of the top 10 exporting member states are also listed in the individual member state's top 3 of receiving countries. This shows that the MSs cannot be categorised into receiving and exporting countries, but rather can be grouped into MSs that transfer high volumes of waste among each other, and others that are less involved in intra EU waste movements;
- Cross-border shipments of these flows, which mostly consist of hazardous waste, mainly go to the neighbouring countries.
- Looking at the eight MSs who export most waste, some have also specialised in the treatment of specific waste streams, and account for the treatment of more than half of particular types of notified waste. It can be observed that three MSs (Belgium, the Netherlands and Germany), account for more than half of the treatment capacity required for a series of different, notified waste streams. Five other MSs (Denmark, France, Portugal, Slovakia and Spain) each offer sufficient capacity for treating a major share of the total volume of a specific waste category transferred from other EU MS

7.2 What drives and constrains these waste movements?

Articles 11 and 12 of the WSR allow MSs to impose restrictions on the import of certain waste streams for disposal or recovery. These measures are of interest to this study because they could be acting as a barrier to the free movement of recoverable resources between MSs.

The MSs which import the most waste for disposal or recovery purposes are Germany, the Netherlands, France, and Sweden. They have very little to no restrictions on waste imports, which matches with the high trend of imports these countries have within the time period analysed (2013-2018). The first three countries import waste either from each other or from Italy, Luxembourg or Austria. Sweden received more waste from extra-EU countries (Norway and United Kingdom). Other reasons for these countries (except Sweden) receiving higher imports could be their location as central European countries and their close proximity to other Member States, their treatment capacities, or their economic stability (and size). For Sweden, imports were almost all related to energy recovery practices (R1), and therefore suggest that Swedish imports are a necessity to fill the capacity of Swedish energy recovery plants.

The level of effectiveness of waste import restrictions in accordance with Article 11 and 12, WSR, is difficult to confirm. The largest waste flows for disposal or recovery purposes occur between large and centrally located countries which have no, or only partial restricting measures in place. The import rates of smaller countries changed only slightly or showed no correlation, following the reported implementation of new restriction measures. This lack of apparent impact could relate to data limitations (the broad scope of Eurostat data and time period limitations), or smaller treatment and import levels. Therefore, no clear conclusion on the effectiveness of waste import restriction measures can be drawn.

With regard to RDF, it is possible that restrictions have led to reduced imports in Member States. Germany is the only MS reported by Eurostat (WShipR) to be importing RDF for disposal, and is one of the few that has no restrictions. For RDF for energy recovery, only Lithuania has a measure in place to ban its import and Lithuania was one of few countries with no RDF imports for energy recovery purposes.

The literature suggests that **drivers for shipping waste** can be categorised into the following, five groups.:

- ***Economic:*** Include issues related to minimising the costs of treatment or disposal and transport. These include gate fees or taxes for sending waste to incineration plants. The cost and efficiency of transport also plays a key role -as it does for the transport of any material.
- ***Regulatory***; It is important to clarify that the administrative burden associated with regulation does not typically block shipments. Its typical impact is to increase waiting times and costs of shipments that ultimately decreases profit margins and / or slows resource movement.
- ***Technical***; Mainly relating to the presence or not of sufficient infrastructure to deal with all waste treatment and recycling needs within a country's boundary.
- ***Geographic***: Related to transport costs and infrastructure.
- ***Environmental***: Regarded as relatively minor by waste companies and closely related to economic and regulatory drivers.

These drivers cannot simply be ranked, although economic drivers always appear to be the most important, and there is clear interplay between the drivers. We have attempted to summarise and capture the influential factors and different considerations that waste holders face in a decision-tree. The decision tree for any specific waste is specific to it and influenced by legal, operational and economic considerations. Therefore, it should be stressed that this decisions tree is only intended to illustrate the drivers, and how they interact with each other, and it cannot capture every option for every waste stream.

The first option facing a waste holder is if they wish to comply with the law or not. If not, the decision will be to pursue the cheapest option, with environmental considerations playing no role.

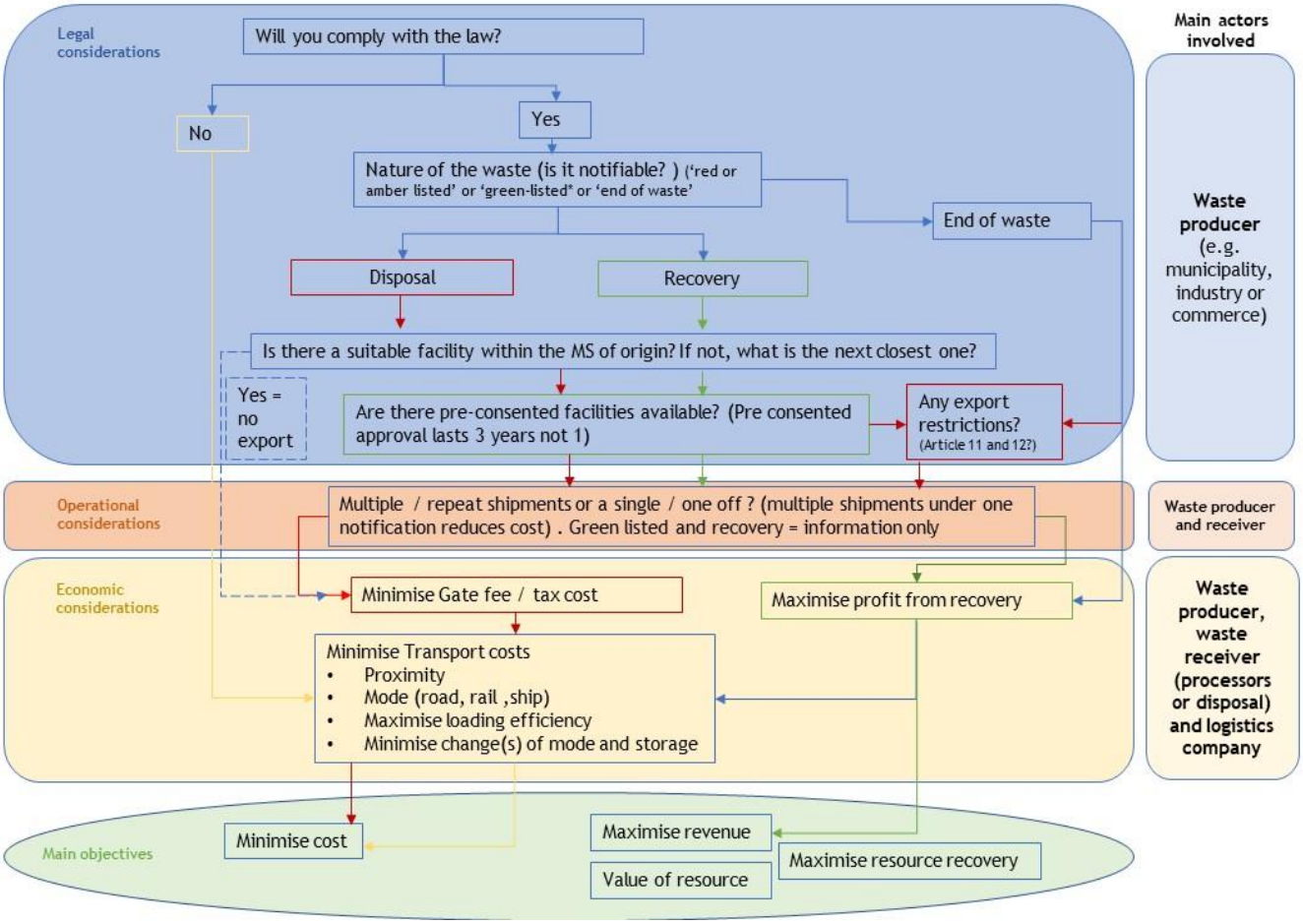
Assuming the waste holder wishes to comply with the law (which will apply to all the waste captured in the statistics), the first question is if the waste is green-, orange- or red-listed, or if it can actually be defined as a resource according to 'end of waste' definitions. In the case of green-listed waste, a suitable recovery facility has to be found, either within the country of origin or outside. If the facility is located in another MS, it also has to be checked if the respective MS imposes any restrictions on the import of the waste in question. Once options are clear, factors, such as transports costs and value of the resource, will determine where the waste will finally go for recovery.

In order to reduce administrative costs for shipments which require notification an important consideration is whether the facility is pre-consented. This would make future shipments significantly faster as consents last for 3 years not one. Consenting multiple shipments as opposed to each individual shipment is another cost saving approach waste holders pursue.

The next consideration cluster relates to practical and operational factors (orange) which decide on the transport mode and method for the shipment. Thereafter, the economic considerations (yellow) relate

to treatment costs (gate fees and taxes). Depending on the waste type, the decision arrives at options representing either the minimisation of costs (for disposal) or maximising revenue through recovery.

Figure 7-1 Decision-tree for intra-Eu waste shipments



Source: own table

7.3 What are the environmental benefits of these waste movements?

Intra EU (and any other) waste movements can be considered to provide environmental and circular economy benefits though:

- Enabling the increased recycling of waste into secondary raw materials that effectively **substitutes waste for primary materials**, avoiding the resource consumption and associated environmental impacts from primary production,;
- Providing **safe sinks** for materials contained in wastes, that could damage human health and/or the environment, and should be removed from new production loops.

Attempting to analyse the environmental benefits of intra EU waste movements is constrained by the availability of data that classifies waste by its trade / product category (Comext) or by its level of potential hazard (Eurostat (Basel/WSR data)). The Basel (Eurostat data) is more precise on the treatment provided, but has less information on the waste characteristics, e.g. 'not-specified' is the highest volume waste type. COMEXT data has more detail on the characteristics of the waste and its secondary raw material potential, but less on the exact treatment at destination. Both classifications

contain material that could potentially be recovered and provide environmental benefits. In order to reflect this we have analysed all significant waste flows – so using data from Comext and Eurostat.

The physical and chemical characteristics of the waste are key for estimating the environmental benefits generated by treating them; e.g. hazardous waste that is treated in order to contain or diminish its hazardousness (safe sink benefit) and from which energy and/or materials can be recovered (substitution benefit) should be higher ranked in terms of environmental performance than waste that is only treated to diminish its hazardousness. Our Environmental Performance scale therefore includes four performance levels, in order to try and cover all types of intra EU waste shipments for which there is data (both Comext and Eurostat).

Total volumes of (Basel+Comext) waste streams (averages for 2016 and 2017) were analysed in terms of environmental performance level (EPL) for the six MSs which transfer the most waste (collectively accounting for approximately 70% of the total import or export of these streams): Germany, The Netherlands, France, Italy, Belgium and Austria. Both for the non-hazardous, CN-coded waste streams traded as goods (Comext data), and for the notified waste streams subject to the Basel Convention (Eurostat data), it is clear that the more environmentally beneficial treatment options are favoured over the less beneficial ones.

From the analysis, it is clear that:

- Both for the non-hazardous, CN-coded waste streams traded as goods, and for the notified waste streams subject to the Basel Convention, the more environmentally beneficial treatment options are favoured over the less beneficial ones;
- The largest volumes of wastes that are moved between MSs usually go to the more beneficial waste treatments;
- Much larger volumes of waste are treated within MSs than are exported to other MSs.
- Volumes of waste traded and documented in the Comext database are much higher than the volumes of (hazardous) waste transported with Basel notification;
- The Countries most active in moving notified wastes are equally active in the trade of non-hazardous waste and waste-related goods.

Export will always be more complex and more burdensome as compared to local processing, so it a reasonable assumption that waste will not be (legally) exported without having a motive that makes it a more valuable choice than local treatment.

Annex A - COMEXT code list - WSR IA model

Table A-1 COMEXT code list

Eurostat present CN-code	Description of CN-code (label)	Type of waste
26201100	Hard zinc spelter	Non-ferrous metal wastes
39151000	Waste, parings and scrap, of polymers of ethylene	Plastic wastes
39152000	Waste, parings and scrap, of polymers of styrene	Plastic wastes
39153000	Waste, parings and scrap, of polymers of vinyl chloride	Plastic wastes
39159011	Waste, parings and scrap, of polymers of propylene	Plastic wastes
39159013	Parings and scrap, of acrylic polymers	Plastic wastes
39159018	Waste, parings and scrap, of addition polymerization products (excl. that of polymers of ethylene, styrene and vinyl chloride and propylene)	Plastic wastes
39159019	parings and scrap, of addition polymerization products (excl. that of acrylic polymers, polymers of ethylene, styrene and vinyl chloride and propylene)	Plastic wastes
39159080	Waste, parings and scrap, of plastics (excl. that of polymers of ethylene, styrene, vinyl chloride and propylene)	Plastic wastes
39159090	Waste, parings and scrap, of plastics (excl. that of addition polymerization products)	Plastic wastes
39159091	Parings and scrap, of epoxide resins	Plastic wastes
39159093	Parings and scrap, of cellulose and its chemical derivatives	Plastic wastes
39159099	Parings and scrap, of plastics (excl. that of addition polymerization products, epoxide resins, cellulose and its chemical derivatives)	Plastic wastes
41152000	Parings and other waste of leather or of composition leather, not suitable for the manufacture of leather articles; leather dust, powder and flour	Textile wastes
47071000	Recovered "waste and scrap" paper or paperboard of unbleached kraft paper, corrugated paper or corrugated paperboard	Paper and cardboard wastes
47072000	Recovered "waste and scrap" paper or paperboard made mainly of bleached chemical pulp, not coloured in the mass	Paper and cardboard wastes
47073010	Old and unsold newspapers and magazines, telephone directories, brochures and printed advertising material	Paper and cardboard wastes
47073090	Waste and scrap of paper or paperboard made mainly of mechanical pulp (excl. old and unsold newspapers and magazines, telephone directories, brochures and printed advertising material)	Paper and cardboard wastes

Eurostat present CN-code	Description of CN-code (label)	Type of waste
47079010	Unsorted, recovered "waste and scrap" paper or paperboard (excl. paper wool)	Paper and cardboard wastes
47079090	Sorted, recovered "waste and scrap" paper or paperboard (excl. waste and scrap of unbleached kraft paper or kraft paperboard, or of corrugated paper or corrugated paperboard, that of paper or paperboard made mainly of bleached chemical pulp not coloured in the mass, that of paper or paperboard made mainly of mechanical pulp, and paper wool)	Paper and cardboard wastes
50030000	Silk waste, incl. cocoons unsuitable for reeling, yarn waste and garnetted stock	Textile wastes
50031000	Silk waste, incl. cocoons unsuitable for reeling, yarn waste and garnetted stock, neither carded nor combed	Textile wastes
50039000	Silk waste, incl. cocoons unsuitable for reeling, yarn waste and garnetted stock, carded or combed	Textile wastes
51031010	Noils of wool or of fine animal hair - not carbonised	Textile wastes
51031010	Noils of wool or of fine animal hair - carbonised	Textile wastes
51032000	Waste of wool or of fine animal hair, incl. yarn waste (excl. noils and garnetted stock)	Textile wastes
51032010	Yarn waste of wool of fine animal hair	Textile wastes
51032091	Waste of wool or of fine animal hair, non-carbonised (excl. yarn waste, noils and garnetted stock)	Textile wastes
51032099	Waste of wool of fine animal hair, carbonised (excl. yarn waste, noils and garnetted stock)	Textile wastes
51033000	Waste of coarse animal hair, incl. yarn waste (excl. garnetted stock, waste of hair or bristles used in the manufacture of brooms and brushes, and of horsehair from the mane or tail)	Textile wastes
52021000	Cotton yarn waste, incl. thread waste	Textile wastes
52029100	Garnetted stock of cotton	Textile wastes
52029900	Cotton waste (excl. yarn waste, thread waste and garnetted stock)	Textile wastes
53013000	Flax tow and waste, incl. yarn waste and garnetted stock	Textile wastes
53013010	Flax tow	Textile wastes
53013090	Flax waste, incl. yarn waste and garnetted stock	Textile wastes
55051010	Waste of staple fibres of nylon or other polyamides, incl. noils, yarn waste and garnetted stock	Textile wastes
55051030	Waste of staple fibres of polyesters, incl. noils, yarn waste and garnetted stock	Textile wastes
55051050	Waste of acrylic or modacrylic staple fibres, incl. noils, yarn waste and garnetted stock	Textile wastes
55051070	Waste of polypropylene staple fibres, incl. noils, yarn waste and garnetted stock	Textile wastes
55051090	Waste of synthetic staple fibres, incl. noils, yarn waste and garnetted stock (excl. that of polypropylene, acrylic, modacrlyic, polyester, nylon and other polyamide staple fibres)	Textile wastes
55052000	Waste of artificial staple fibres, incl. noils, yarn waste and garnetted stock	Textile wastes

Eurostat present CN-code	Description of CN-code (label)	Type of waste
63090000	Worn clothing and clothing accessories, blankets and travelling rugs, household linen and articles for interior furnishing, of all types of textile materials, incl. all types of footwear and headgear, showing signs of appreciable wear and presented in bulk or in bales, sacks or similar packings (excl. carpets, other floor coverings and tapestries)	Textile wastes
63101000	Used or new rags, scrap twine, cordage, rope and cables and worn-out articles thereof, of textile materials, sorted	Textile wastes
63101010	Used or new rags, scrap twine, cordage, rope and cables and worn-out articles thereof, of wool or fine or coarse animal hair, sorted	Textile wastes
63101030	Used or new rags, scrap twine, cordage, rope and cables and worn-out articles thereof, of flax or cotton, sorted	Textile wastes
63101090	Used or new rags, scrap twine, cordage, rope and cables and worn-out articles thereof, of textile materials, sorted (excl. flax, cotton, wool or fine or coarse animal hair)	Textile wastes
63109000	Used or new rags, scrap twine, cordage, rope and cables and worn-out articles thereof, of textile materials (excl. sorted)	Textile wastes
70010010	Cullet and other waste and scrap of glass (excl. glass in the form of powder, granules or flakes)	Glass wastes
70010091	Cullet and other waste and scrap of glass; glass in the mass - optical glass	Glass wastes
70010099	Cullet and other waste and scrap of glass; glass in the mass - other	Glass wastes
71123000	Ash containing Precious metal or Precious-metal compounds	Non-ferrous metal wastes
71129100	Waste and scrap of gold, incl. metal clad with gold, and other waste and scrap containing gold or gold compounds, of a kind used principally for the recovery of Precious metal (excl. ash containing gold or gold compounds, waste and scrap of gold melted down into unworked blocks, ingots, or similar forms, and sweepings and ash containing Precious metals)	Non-ferrous metal wastes
71129200	Waste and scrap of platinum, incl. metal clad with platinum, and other waste and scrap containing platinum or platinum compounds, of a kind used principally for the recovery of Precious metal (excl. ash containing platinum or platinum compounds, waste and scrap of platinum melted down into unworked blocks, ingots, or similar forms, and sweepings and ash containing Precious metals)	Non-ferrous metal wastes
71129900	Waste and scrap of silver, incl. metal clad with silver, and other waste and scrap containing silver or silver compounds, of a kind used principally for the recovery of Precious metal (excl. ash, and waste and scrap of Precious metals melted down into unworked blocks, ingots or similar forms)	Non-ferrous metal wastes
72041000	Waste and scrap, of cast iron (excl. radioactive)	Ferrous metal wastes

Eurostat present CN-code	Description of CN-code (label)	Type of waste
72042110	Waste and scrap of stainless steel, containing by weight >= 8% nickel (excl. radioactive, and waste and scrap from batteries and electric accumulators)	Ferrous metal wastes
72042190	Waste and scrap of stainless steel (not containing >= 8% nickel, radioactive, or waste and scrap from batteries and electric accumulators)	Ferrous metal wastes
72042900	Waste and scrap of alloy steel (excl. stainless steel, and waste and scrap, radioactive, or waste and scrap from batteries and electric accumulators)	Ferrous metal wastes
72043000	Waste and scrap of tinned iron or steel (excl. radioactive, and waste and scrap of batteries and electric accumulators)	Ferrous metal wastes
72044110	Turnings, shavings, chips, milling waste, sawdust and filings, of iron or steel, whether or not in bundles (excl. such items of cast iron, alloy steel or tinned iron or steel)	Ferrous metal wastes
72044191	Trimmings and stampings, of iron or steel, in bundles (excl. such items of cast iron, alloy steel or tinned iron or steel)	Ferrous metal wastes
72044199	Trimmings and stampings, of iron or steel, not in bundles (excl. such items of cast iron, alloy steel or tinned iron or steel)	Ferrous metal wastes
72044910	Waste and scrap of iron or steel, fragmentised "shredded" (excl. slag, scale and other waste of the production of iron and steel; radioactive waste and scrap; fragments of pigs, blocks or other primary forms of pig iron or spiegeleisen; waste and scrap of cast iron, alloy steel or tinned iron or steel; turnings, shavings, chips, milling waste, sawdust, filings, trimmings and stampings; waste and scrap of primary cells, primary batteries and electric accumulators)	Ferrous metal wastes
72044930	Waste and scrap of iron or steel, not fragmentised "shredded", in bundles (excl. slag, scale and other waste of the production of iron and steel; radioactive waste and scrap; fragments of pigs, blocks or other primary forms of pig iron or spiegeleisen; waste and scrap of cast iron, alloy steel or tinned iron or steel; turnings, shavings, chips, milling waste, sawdust, filings, trimmings and stampings; waste and scrap of primary cells, primary batteries and electric accumulators)	Ferrous metal wastes
72044990	Waste and scrap of iron or steel, not fragmentised "shredded", not in bundles (excl. slag, scale and other waste of the production of iron and steel; radioactive waste and scrap; fragments of pigs, blocks or other primary forms of pig iron or spiegeleisen; waste and scrap of cast iron, alloy steel or tinned iron or steel; turnings, shavings, chips, milling waste, sawdust, filings, trimmings and stampings; waste and scrap of primary cells, primary batteries and electric accumulators)	Ferrous metal wastes
72045000	Remelting scrap ingots of iron or steel (excl. Products whose chemical composition conform//or ferro-alloys)	Ferrous metal wastes

Eurostat present CN-code	Description of CN-code (label)	Type of waste
74040010	'Waste and scrap, of refined copper (excl. ingots or other similar unwrought shapes, of remelted refined copper waste and scrap, ashes and residues containing refined copper, and waste and scrap of primary cells, primary batteries and electric accumulators)	Non-ferrous metal wastes
74040091	Waste and scrap, of copper-zinc base alloys "brass" (excl. ingots or other similar unwrought shapes, of remelted waste and scrap of copper-zinc alloys, ashes and residues containing copper-zinc alloys and waste and scrap of primary cells, primary batteries and electric accumulators)	Non-ferrous metal wastes
74040099	Waste and scrap, of copper alloys (excl. of copper-zinc alloys, ingots or other similar unwrought shapes, of remelted waste and scrap of copper alloys, ashes and residues containing copper alloys, and waste and scrap of primary cells, primary batteries and electric accumulators)	Non-ferrous metal wastes
75030010	Waste and scrap, of non-alloy nickel (excl. ingots or other similar unwrought shapes, of remelted non-alloy nickel waste and scrap, ashes and residues containing non-alloy nickel, waste and scrap of primary cells, primary batteries and electric accumulators)	Non-ferrous metal wastes
75030090	Waste and scrap, of nickel alloys (excl. ingots or other similar unwrought shapes, of remelted nickel alloys waste and scrap, ashes and residues containing nickel alloys)	Non-ferrous metal wastes
76020011	Turnings, shavings, chips, milling waste, sawdust and filings, of aluminium; waste of coloured, coated or bonded sheets and foil, of a thickness "excl. any backing" of <= 0,2 mm, of aluminium	Non-ferrous metal wastes
76020019	Waste of aluminium, incl. faulty workpieces and workpieces which have become unusable in the course of production or processing (excl. slag, scale and other waste from the production of iron or steel, containing recyclable aluminium in the form of silicates, ingots and other primary forms, of smelted waste or scrap, of aluminium, ash or the residues of the production of aluminium, and waste in heading 7602.00.11)	Non-ferrous metal wastes
76020090	Scrap of aluminium (excl. slags, scale and the like from iron and steel production, containing recoverable aluminium in the form of silicates, ingots or other similar unwrought shapes, of remelted waste and scrap, of aluminium, and ashes and residues from aluminium production)	Non-ferrous metal wastes
78020000	Lead waste and scrap (excl. ashes and residues from lead production "heading No 2620", and ingots or other similar unwrought shapes, of remelted waste and scrap, of lead "heading No 7801" and waste and scrap of primary cells, primary batteries et electric accumulators)	Non-ferrous metal wastes
79020000	Zinc waste and scrap (excl. ash and residues from zinc production "heading 2620", ingots and other similar unwrought shapes, of remelted waste and scrap, of zinc "heading 7901" and waste and scrap of primary cells, primary batteries and electric accumulators)	Non-ferrous metal wastes
79031000	Zinc dust	Non-ferrous metal wastes

Eurostat present CN-code	Description of CN-code (label)	Type of waste
79039000	Zinc powders and flakes (excl. grains of zinc, and spangles of heading 8308, and zinc dust)	Non-ferrous metal wastes
80020000	Tin waste and scrap (excl. ash and residues from the manufacture of tin of heading 2620, and ingots and similar unwrought tin produced from melted tin waste and scrap of heading 8001)	Non-ferrous metal wastes
81019700	Tungsten waste and scrap (excl. ash and residues containing tungsten)	Non-ferrous metal wastes
81029700	Molybdenum waste and scrap (excl. ash and residues containing molybdenum)	Non-ferrous metal wastes
81033000	Tantalum waste and scrap (excl. ash and residues containing tantalum)	Non-ferrous metal wastes
81042000	Magnesium waste and scrap (excl. ash and residues containing magnesium, and raspings, turnings and granules graded according to size)	Non-ferrous metal wastes
81053000	Cobalt waste and scrap (excl. ash and residues containing cobalt)	Non-ferrous metal wastes
81060010	Unwrought bismuth; bismuth powders; bismuth waste and scrap (excl. ash and residues containing bismuth)	Non-ferrous metal wastes
81073000	Cadmium waste and scrap (excl. ashes and residues containing cadmium)	Non-ferrous metal wastes
81083000	Titanium waste and scrap (excl. ash and residues containing titanium)	Non-ferrous metal wastes
81093000	Zirconium waste and scrap (excl. ash and residues containing zirconium)	Non-ferrous metal wastes
81102000	Antimony waste and scrap (excl. ash and residues containing antimony)	Non-ferrous metal wastes
81110019	Manganese waste and scrap (excl. ash and residues containing manganese)	Non-ferrous metal wastes
81121300	Beryllium waste and scrap (excl. ashes and residues containing beryllium)	Non-ferrous metal wastes
81122200	Chromium waste and scrap (excl. ash and residues containing chromium and chromium alloys containing > 10% by weight of nickel)	Non-ferrous metal wastes
81123040	Germanium waste and scrap (excl. ashes and residues containing germanium)	Non-ferrous metal wastes
81124010	Unwrought vanadium; vanadium powders; vanadium waste and scrap (excl. ash and residues containing vanadium)	Non-ferrous metal wastes
81125200	Thallium waste and scrap (excl. ashes and residues containing thallium)	Non-ferrous metal wastes
81129210	Unwrought hafnium "celtium"; hafnium powders; hafnium waste and scrap (excl. ash and residues containing hafnium)	Non-ferrous metal wastes
81129221	Niobium "columbium", rhenium, gallium, indium, vanadium and germanium waste and scrap (excl. ashes and residues containing these metals)	Non-ferrous metal wastes
81129239	Niobium "columbium" and rhenium waste and scrap (excl. ash and residues containing these metals)	Non-ferrous metal wastes
81129250	Gallium and indium waste and scrap (excl. ashes and residues containing these metals)	Non-ferrous metal wastes
81129291	Unwrought vanadium; vanadium powders (excl. ash and residues containing vanadium)	Non-ferrous metal wastes
81130040	Waste and scrap of cermets (excl. ashes and residues containing cermets)	Non-ferrous metal wastes

Annex B - COMEXT - Combined Nomenclature (CN) waste codes

Table B-1: COMEXT code list including industrial slags, ashes and metal wastes (plus others)

CN	Heading	Description
1802	Cocoa shells	Cocoa shells, husks, skins and other cocoa waste
2303	Residues of starch manufacture, beet-pulp, etc	Residues of starch manufacture and similar residues, beet-pulp, bagasse and other waste of sugar manufacture, brewing or distilling dregs and waste, whether or not in the form of pellets
2308	Vegetable waste	Acorns, horse-chestnuts, marc and other vegetable materials and vegetable waste, vegetable residues and by-products of a kind used in animal feeding, whether or not in the form of pellets, n.e.s.
2619	Slag, waste from the manufacture of iron or steel	Slag, dross, scalings and other waste from the manufacture of iron or steel (excl. Granulated slag)
2620	Slag, ash and residues containing metals	Slag, ash and residues containing metals, arsenic or their compounds (excl. Those from the manufacture of iron or steel)
2621	Slag and ash, incl. seaweed ash "kelp"	Slag and ash, incl. Seaweed ash "kelp"
2621 10 00		Ash and residues from the incineration of municipal waste
2621 90 00		Other
2710	Petroleum oils and oils from bituminous minerals	Petroleum oils and oils obtained from bituminous minerals (excl. Crude)
3825	Residual products of various waste	Residual products of the chemical or allied industries, n.e.s.; municipal waste; sewage sludge; clinical waste, waste organic solvents, wastes of metal pickling liquors, of hydraulic fluids, brake fluids and anti-freeze fluids and other wastes from chemical or allied industries (excl. Wastes containing mainly petroleum oils or oils obtained from bituminous minerals)
3915	Waste, parings and scrap, of plastics	Waste, parings and scrap, of plastics
4004	Waste, parings and scrap of soft rubber	Waste, parings and scrap of soft rubber and powders and granules obtained therefrom
4017	Hard rubber	Hard rubber, e.g. ebonite, in all forms, incl. Waste and scrap; articles of hard rubber, n.e.s.
4110	Parings and other waste of leather	Parings and other waste of leather, parchment-dressed leather or composition leather, not suitable for the manufacture of leather articles; leather dust, powder and flour
4115	Composition leather with a basis of leather	Composition leather with a basis of leather or leather fibre, in slabs, sheets or strip, whether or not in rolls; leather dust, powder and flour
4115 20 00		Parings and other waste of leather or of composition leather, not suitable for the manufacture of leather articles; leather dust, powder and flour
4401	Fuel wood	Fuel wood, in logs, billets, twigs, faggots or similar forms; wood in chips or particles

CN	Heading	Description
4401 11 00	Fuel wood, in logs, in billets, in twigs, in faggots or in similar forms	Coniferous
4401 12 00	Fuel wood, in logs, in billets, in twigs, in faggots or in similar forms	Non-coniferous
4401 21 00	Wood in chips or particles	Coniferous
4401 22 00	Wood in chips or particles	Non-coniferous
4401 31 00	Sawdust and wood waste and scrap, agglomerated in logs, briquettes, pellets or similar forms	Wood pellets
4401 39 00	Sawdust and wood waste and scrap, agglomerated in logs, briquettes, pellets or similar forms	Other
4401 40		Sawdust and wood waste and scrap, not agglomerated
4706	Pulps of fibres derived from recovered paper waste	Pulps of fibres derived from recovered "waste and scrap" paper or paperboard or of other fibrous cellulosic material (excl. Wood)
4707	Recovered "waste and scrap" paper or paperboard	Recovered "waste and scrap" paper or paperboard (excl. Paper wool)
5202	Cotton waste	Cotton waste, incl. Yarn waste and garnetted stock
5301	Flax	Flax, raw or processed, but not spun; flax tow and waste, incl. Yarn waste and garnetted stock
5301 30 00		Flax tow and waste
5303	Jute and other textile bast fibres	Jute and other textile bast fibres, raw or processed, but not spun; tow and waste of such fibres, incl. Yarn waste and garnetted stock (excl. Flax, true hemp and ramie)
5305	Coconut, ...other vegetable textile fibre	Coconut, abaca "manila hemp or musa textilis nee", ramie and other vegetable textile fibres, n.e.s., raw or processed, but not spun; tow, noils and waste of such fibres, incl. Yarn waste and garnetted stock
5505	Waste of man-made staple fibres	Waste of man-made staple fibres, incl. Noils, yarn waste and garnetted stock
6808	Panels, boards, tiles, blocks	Panels, boards, tiles, blocks and similar articles of vegetable fibre, of straw or of shavings, chips, particles, sawdust or other waste of wood, agglomerated with cement, plaster or other mineral binders (excl. Articles of asbestos-cement, cellulose fibre-cement or the like)
7001	Cullet and other waste and scrap of glass	Cullet and other waste and scrap of glass; glass in the mass (excl. Glass in the form of powder, granules or flakes)
7112	Precious metal waste and scrap	Waste and scrap of precious metal or of metal clad with precious metal; other waste and scrap containing precious metal or precious-metal compounds, of a kind used principally for the recovery of precious metal (excl. Waste and scrap melted down into unworked blocks, ingots, or similar forms)

CN	Heading	Description
7204	Ferrous waste and scrap	Ferrous waste and scrap; remelting scrap ingots of iron or steel (excl. Slag, scale and other waste from the production of iron or steel; radioactive waste and scrap; fragments of pigs, blocks or other primary forms of pig iron or spiegeleisen)
7404	Copper waste and scrap	Waste and scrap, of copper (excl. Ingots or other similar unwrought shapes, of remelted copper waste and scrap, ashes and residues containing copper, and waste and scrap of primary cells, primary batteries and electric accumulators)
7503	Nickel waste and scrap	Waste and scrap, of nickel (excl. Ingots or other similar unwrought shapes, of remelted nickel waste and scrap, ashes and residues containing nickel and waste and scrap of primary cells, primary batteries and electric accumulators)
7602	Aluminium waste and scrap	Waste and scrap, of aluminium (excl. Slags, scale and the like from iron and steel production, containing recoverable aluminium in the form of silicates, ingots or other similar unwrought shapes, of remelted waste and scrap, of aluminium, ashes and residues from aluminium production)
7802	Lead waste and scrap	Lead waste and scrap (excl. Ashes and residues from lead production 'heading no 2620', and ingots or other similar unwrought shapes, of remelted waste and scrap, of lead 'heading no 7801' and waste and scrap of primary cells, primary batteries et electric accumulators)
7902	Zinc waste and scrap	Zinc waste and scrap (excl. Ash and residues from zinc production 'heading 2620', ingots and other similar unwrought shapes, of remelted waste and scrap, of zinc 'heading 7901' and waste and scrap of primary cells, primary batteries and electric accumulators)
8002	Tin waste and scrap	Tin waste and scrap (excl. Ash and residues from the manufacture of tin of heading 2620, and ingots and similar unwrought tin produced from melted tin waste and scrap of heading 8001)
8101	Tungsten "wolfram"	Tungsten "wolfram" and articles thereof, n.e.s.; tungsten waste and scrap (excl. Ash and residues containing tungsten)
8101 97 00		Waste and scrap
8102	Molybdenum	Molybdenum and articles thereof, n.e.s.; molybdenum waste and scrap (excl. Ash and residues containing molybdenum)
8102 97 00		Waste and scrap
8103	Tantalum	Tantalum and articles thereof, n.e.s.; tantalum waste and scrap (excl. Ash and residues containing tantalum)
8103 30 00		Waste and scrap
8104	Magnesium	Magnesium and articles thereof, n.e.s.; magnesium waste and scrap (excl. Ash and residues containing magnesium)
8104 20 00		Waste and scrap

CN	Heading	Description
8105	Cobalt mattes and other co intermediates	Cobalt mattes and other intermediate products of cobalt metallurgy; cobalt and articles thereof, n.e.s.; cobalt waste and scrap (excl. Ash and residues containing cobalt)
8105 30 00		Waste and scrap
8107	Cadmium	Cadmium and articles thereof, n.e.s.; cadmium waste and scrap (excl. Ash and residues containing cadmium)
8107 30 00		Waste and scrap
8108	Titanium	Titanium and articles thereof, n.e.s.; titanium waste and scrap (excl. Ash and residues containing titanium)
8108 30 00		Waste and scrap
8109	Zirconium	Zirconium and articles thereof, n.e.s.; zirconium waste and scrap (excl. Ash and residues containing zirconium)
8109 30 00		Waste and scrap
8110	Antimony	Antimony and articles thereof, n.e.s.; antimony waste and scrap (excl. Ash and residues containing antimony)(2002-2500); antimony and articles thereof n.e.s.; antimony waste and scrap (excl. Ash and residues containing antimony)(1988-2001)
8110 20 00		Waste and scrap
8111	Manganese	Manganese and articles thereof, n.e.s.; manganese waste and scrap (excl. Ash and residues containing manganese)
8111 00 19		Waste and scrap
8112	Beryllium, chromium, germanium, etc…	Beryllium, chromium, germanium, vanadium, gallium, hafnium "celtium", indium, niobium "columbium", rhenium and thallium, and articles of these metals, n.e.s.; waste and scrap of these metals (excl. Ash and residues containing these metals)
8112 13 00		Beryllium waste and scrap
8112 22 00		Chromium waste and scrap
8112 52 00		Thallium waste and scrap
8112 92		Unwrought; waste and scrap; powders of hafnium (celtium), niobium (columbium); rhenium; gallium; indium; vanadium; germanium
8113	Cermets and articles thereof, including waste and scrap	Cermets and articles thereof, n.e.s.; waste and scrap of cermets (excl. Ash and residues containing cermets)
8113 00 40		Waste and scrap
8548	Waste and scrap of primary cells, etc…	Waste and scrap of primary cells, primary batteries and electric accumulators; spent primary cells, spent primary batteries and spent electric accumulators; electrical parts of machinery or apparatus, not specified or included elsewhere in chapter 85

Annex C - Selection of waste codes and final treatment volumes

Table C-1 Waste categories with the highest volumes transferred between EU member states (2016 and 2017)

Category	Description
Y18	Residues arising from industrial waste disposal operations
Y46	Wastes collected from households
Y47	Residues arising from the incineration of household wastes
Y23	Zinc compounds
Y31	Lead; lead compounds
Y36	Asbestos (dust and fibres)
Y11	Waste tarry residues arising from refining, distillation and any pyrolytic treatment
Y8	Waste mineral oils unfit for their originally intended use
Y5	Wastes from the manufacture, formulation and use of wood preserving chemicals
Y9	Waste oils/water, hydrocarbons/water mixtures, emulsions
Y42	Organic solvents excluding halogenated solvents
Y17	Wastes resulting from surface treatment of metals and plastics
Y34	Acidic solutions or acids in solid form
Y6	Wastes from the production, formulation and use of organic solvents
Y45	Organohalogen compounds other than in this Annex (e.g. Y39, Y41, Y42, Y43, Y44)
Mix	

Table C-2 Total volumes transferred (exported and imported) between countries in the EU, in 2016 and 2017, per waste category as defined by the Basel Convention. Main categories, representing more than 100.000 t/year of intra-EU export or import in at least one of these years, are in bold and underlined

Ranking	Category	Export (t) (2016)	Category	Export (t) (2017)	Category	Import (t) (2016)	Category	Import (t) (2017)
1	Not specif.	8.300.631	Not specif.	10.212.530	Not specif.	10.119.263	Not specif.	9.591.381
2	**Y18**	**2.135.830**	**Y18**	**2.258.169**	**Y18**	**2.243.098**	**Y18**	**1.922.123**
3	**Y46**	**968.743**	**Y46**	**1.069.243**	**Y46**	**1.211.226**	**Y46**	**899.322**
4	**Y47**	**561.356**	**Y47**	**529.099**	**Y23**	**428.591**	**Y23**	**547.103**
5	**Y23**	**486.395**	**Y23**	**499.807**	**Y47**	**343.704**	**Y47**	**381.650**
6	**Y31**	**340.253**	**Y11**	**415.840**	**Y31**	**342.034**	**Y31**	**337.175**
7	**Y36**	**288.564**	**Y31**	**363.855**	**Y11**	**340.079**	**Y11**	**304.398**
8	**Y11**	**279.114**	**Mix**	**360.922**	**Y9**	**248.291**	**Y8**	**223.125**
9	**Mix**	**259.078**	**Y36**	**272.892**	**Y8**	**214.366**	**Y9**	**221.632**
10	**Y8**	**221.871**	**Y5**	**238.813**	**Y36**	**214.309**	**Y36**	**218.083**
11	**Y5**	**220.318**	**Y45**	**237.335**	**Y42**	**136.010**	**Mix**	**179.082**
12	**Y9**	**209.707**	**Y8**	**229.225**	**Y17**	**118.229**	**Y17**	**125.459**
13	**Y42**	**155.613**	**Y9**	**208.913**	**Mix**	**109.829**	**Y42**	**118.263**
14	**Y17**	93.944	**Y42**	**155.992**	**Y34**	**101.139**	**Y6**	**110.621**
15	**Y34**	93.329	**Y34**	**98.224**	**Y6**	91.199	**Y34**	**97.801**
16	Y41	71.297	**Y17**	**91.924**	Y12	70.790	Y12	66.342
17	Y12	69.302	Y41	72.907	Y4	53.014	Y22	51.268
18	**Y6**	61.876	Y12	67.237	Y41	45.225	**Y5**	**48.870**
19	Y2	43.213	**Y6**	**64.525**	Y2	43.090	Y41	47.729
20	**Y45**	39.543	Y35	41.770	Y22	39.672	Y2	40.661
21	Y35	37.908	Y22	39.876	**Y5**	33.214	Y20	24.992
22	Y22	37.671	Y2	36.638	Y20	29.330	Y35	23.404
23	Y4	28.452	Y1	29.611	Y38	17.610	Y4	22.773
24	Y38	18.149	Y24	23.532	Y35	17.188	**Y45**	**21.509**
25	Y24	15.282	Y4	18.729	Y29	16.174	Y38	21.446
26	Y10	15.049	Y29	19.021	**Y45**	15.800	Y10	21.000

C-3 EU imports' waste treatment specialisations

		Belgium	Denmark	France	Germany	Netherlands	Portugal	Slovakia	Spain
Waste substances and articles containing or contaminated with PCBs and/or PCTs and/or PBBs;	Y10	14,5	2,0	1,5	4,8	74,7			1,0
Wastes tarry residues arising from refining, distillation and any pyrolytic treatment;	Y11	1,0		0,2	16,5	80,6	1,2		
Waste chemical substances arising from research and development or teaching activities;	Y14	83,5	5,5	5,5		4,1			
Wastes resulting from surface treatment of metals and plastics;	Y17	13,3		11,8	66,9	0,9	0,1		0,3
Wastes from the production and preparation of pharmaceutical products;	Y2	55,0	0,9	6,6	18,7	11,5			3,3
Beryllium; beryllium compounds;	Y20					100,0			
Hexavalent chromium compounds;	Y21	0,2		93,0					
Zinc compounds	Y23	4,1		16,9	39,4	1,4	0,0		9,9
Arsenic, arsenic compounds;	Y24				85,3	0,5		1,8	
Selenium; selenium compounds;	Y25	4,1		6,7	10,6	3,2	64,2		
Cadmium; cadmium compounds;	Y26	52,7		13,3	9,7	0,0	0,0		15,7
Antimony; antimony compounds;	Y27	13,6		0,1	63,1	2,2	2,0		
Inorganic fluorine compounds excluding calcium fluoride;	Y32	0,0		1,1	1,6	0,0		71,2	25,6
Acidic solutions or acids in solid form;	Y34	8,8		23,7	52,6	2,2			3,0
Basic solutions or bases in solid form;	Y35	31,5	0,1	2,9	6,9	53,5			4,7
Asbestos (dust and fibres);	Y36	1,1		0,2	89,4	9,1	0,1		0,1
Organic phosphorous compounds;	Y37		93,4	0,0	0,0	6,6			
Phenols; phenolcompounds including chlorophenols;	Y39				46,6	53,4			
Any congener of polychlorinated dibenzo-furan;	Y43				0,0	100,0			
Any congener of polychlorinated dibenzo-p-dioxin;	Y44				0,0	0,0			99,4
Residues arising from the incineration of household wastes;	Y47	2,0		7,8	29,8	53,0			
Wastes from the manufacture, formulation and use of organic solvents;	Y5	81,9			0,0	6,6			
Wastes from heat treatment and tempering operations containing cyanides;	Y7				100,0				
Waste mineral oils unfit for their originally intended use;	Y8	1,2	5,4	3,0	68,2	5,7			

Annex D - Background information Article 11 & 12, WSR

Explanation of the legal basis (Article 11 and 12 & WFD Art 16)

Article 11 and 12 of the WSR allows Member States of dispatch, transit or destination to raise reasoned objections, based on a limited set of grounds. Article 11 covers shipments for disposal, Article 12 for recovery or recycling. The use in practice of these grounds for objection constitutes part of the playing field on which a Member State can develop policy strategies on import and export of waste. In cases of objection, the competent authorities of destination must notify the country of dispatch within the statutory time period of 30 days following the date of transmission of the acknowledgement in accordance with Article 8 of the WSR. This is done by indicating the objection in the notification form (block 25) and sending it back to the country of dispatch.

Examples of specific reasons for objection are that the shipment would not be in accordance with EU or national legislation or that the person shipping the waste has previously been convicted of illegal shipments, see Article 12 (1)(a-k). All other possible grounds to object are listed in the table below.

Table D-1 Grounds for objecting to waste shipments for disposal and recovery, according to Article 11 and 12 of the WSR

Article of objection to ship waste for disposal or recovery		
	Article 11 - Objections to shipments of waste destined for **disposal**	**Article 12** - Objections to shipments of waste destined for **recovery**
Grounds for objections	**(a)** that the planned shipment or disposal would not be in accordance with measures taken to implement the principles of proximity, priority for recovery and self-sufficiency at Community and national levels in accordance with Directive 2008/98/EC, to prohibit generally or partially or to object systematically to shipments of waste; or **(b)** that the planned shipment or disposal would not be in accordance with national legislation relating to environmental protection, public order, public safety or health protection concerning actions taking place in the objecting country; or **(c)** that the notifier or the consignee has previously been convicted of illegal shipment or some other illegal act in relation to environmental protection. In this case, the competent authorities of dispatch and destination may refuse all shipments involving the person in question in accordance with national legislation; or **(d)** that the notifier or the facility has repeatedly failed to comply with Articles 15 and 16 in connection with past shipments; or **(e)** that the Member State wishes to exercise its right pursuant to Article 4(1) of the Basel Convention to prohibit the import of hazardous waste or of waste listed in Annex II to that Convention; or **(f)** that the planned shipment or disposal conflicts with obligations resulting from international conventions concluded by the Member State(s) concerned or the Community; or **(g)** that the planned shipment or disposal is not in accordance with Directive 2006/12/EC, in particular Articles 5 and 7 thereof, while considering geographical circumstances or the need for specialised installations for certain types of waste: (i) in order to implement the principle of self-sufficiency at Community and national levels, or	**(a)** that the planned shipment or recovery would not be in accordance with the WFD (Directive 2008/98/EC), in particular Articles 3, 4, 7 and 10 thereof; or **(b)** that the planned shipment or recovery would not be in accordance with national legislation relating to environmental protection, public order, public safety or health protection concerning actions taking place in the objecting country; or **(c)** that the planned shipment or recovery would not be in accordance with national legislation in the country of dispatch relating to the recovery of waste, including where the planned shipment would concern waste destined for recovery in a facility which has lower treatment standards for the particular waste than those of the country of dispatch, respecting the need to ensure the proper functioning of the internal market; This shall not apply if: (i) there is corresponding Community legislation, in particular related to waste, and if requirements that are at least as stringent as those laid down in the Community legislation have been introduced in national legislation transposing such Community legislation, (ii) the recovery operation in the country of destination takes place under conditions that are broadly equivalent to those prescribed in the national legislation of the country of dispatch, (iii) the national legislation in the country of dispatch, other than that covered by (i), has not been notified in accordance with Directive 98/34/EC of the European Parliament and of the Council of 22 June 1998 laying down a procedure for the provision of information in the field of technical standards and regulations and of rules on Information Society services (8), where required by that Directive, or **(d)** that the notifier or the consignee has previously been convicted of illegal shipment or some other illegal act in relation to environmental protection. In this case, the competent authorities of dispatch and destination may refuse all shipments involving the person in question in accordance with national legislation; or **(e)** that the notifier or the facility has repeatedly failed to comply with Articles 15 and 16 in connection with past shipments; or **(f)** that the planned shipment or recovery conflicts with obligations resulting from international conventions concluded by the Member State(s) concerned or the Community; or

Article of objection to ship waste for disposal or recovery		
	Article 11 - Objections to shipments of waste destined for **disposal**	**Article 12** - Objections to shipments of waste destined for **recovery**
	(ii) in cases where the specialised installation has to dispose of waste from a nearer source and the competent authority has given priority to this waste, or (iii) in order to ensure that shipments are in accordance with waste management plans, or **(h)** that the waste will be treated in a facility which is covered by Directive 96/61/EC, but which does not apply best available techniques as defined in Article 9(4) of that Directive in compliance with the permit of the facility; or **(i)** that the waste is mixed municipal waste collected from private households (waste entry 20 03 01); or **(j)** that the waste concerned will not be treated in accordance with legally binding environmental protection standards in relation to disposal operations established in Community legislation (also in cases where temporary derogations are granted).	**(g)** that the ratio of the recoverable and non-recoverable waste, the estimated value of the materials to be finally recovered or the cost of the recovery and the cost of the disposal of the non-recoverable fraction do not justify the recovery, having regard to economic and/or environmental considerations; o **(h)** that the waste shipped is destined for disposal and not for recovery; or **(i)** that the waste will be treated in a facility which is covered by Directive 96/61/EC, but which does not apply best available techniques as defined in Article 9(4) of that Directive in compliance with the permit of the facility; or **(j)** that the waste concerned will not be treated in accordance with legally binding environmental protection standards in relation to recovery operations, or legally binding recovery or recycling obligations established in Community legislation (also in cases where temporary derogations are granted); or **(k)** that the waste concerned will not be treated in accordance with waste management plans drawn up pursuant to Article 7 of Directive 2006/12/EC with the purpose of ensuring the implementation of legally binding recovery or recycling obligations established in Community legislation.

Source: Own table (based on Waste Shipment Regulation (EC) No 1013/2006)

Another justification for Member States to object to waste shipments are the proximity and self-sufficiency principles in Article 16(1), para. 2 of the WFD. Both are closely related and often treated as one. Article 16 of the WFD states how Member States should establish an integrated and adequate network of waste disposal installations, in order to enable the Community as a whole to become self-sufficient in waste disposal, and in the recovery of mixed municipal waste collected from private households (see further Article 3(5) of the WSR). Member States should move towards that aim individually, taking into account geographical circumstances or the need for specialised installations for certain types of waste.

In accordance with Article 11 of the WSR, Member States may, in order to protect their own network of waste disposal installations and or installations for the recovery of mixed municipal waste collected from private households (including where such collection also covers waste from other producers), limit incoming shipments of waste destined to incinerators that are classified as recovery. The condition for doing so is establishing that such shipments would result in national waste having to be disposed of or waste having to be treated in a way that is not consistent with their waste management plans at Community or national level. The situation is different for waste shipments for recovery or recycling. For such shipments (other than in the specific case mentioned above of mixed municipal waste), Member States may not make any objections by referring to the principles of proximity and self-sufficiency — only in well justified exceptional cases this is still an option.

Non-harmonised applications of the proximity *and self-sufficiency principles*

The WSR and the WFD aim to strengthen intra-EU waste management and promote operations at the higher levels of the waste treatment hierarchy, while allowing flexibility for individual national circumstances and conditions through Article 11 and 12 of the WSR as well as through Article 16 of the WFD. However, the interpretation and application of these articles are not harmonised between Member States, and there is a perception that this may be causing distortions, delays or even the use of treatments lower down the waste hierarchy[69]. For example, the proximity principle can be abused to prohibit shipments of waste to other Member States or regions where the waste can be recycled. Common reasons are to meet domestic incineration capacity or favouring domestic recyclers. A more consistent implementation of the waste hierarchy and of the proximity principle should help achieve a more circular economy.

The Waste Market Study[70], identified eleven groups of diverging or non-harmonised interpretations of Article 11 and 12 of the WSR. These are summarised in the table, below. The findings help to differentiate between individual/country-specific and general/legal approaches. They also serve as a partial explanation of why different measures have been applied and illustrate certain drivers for objecting or restricting waste imports.

Table D-2 Grounds for non-harmonised or diverging interpretations of Article 11 and 12 of the WSR

Article of WSR	Grounds for non-harmonised interpretation
Article 11(a)	**Inconsistent application of proximity and self-sufficiency principles** The shipment or disposal is not in accordance with measures taken to implement the proximity principle, priority for recovery and self-sufficiency. Member States apply different forms of general applications of the proximity principle and thus a systematic objection in case of trans-frontier shipment for disposal.
Article 11(b) and 12(b)	**Non-accordance with national legislation** The shipment or disposal is not in accordance with national legislation relating to environmental protection, public order, public safety or health protection. This can only be applied to actions such as treatment, shipment taking place in the objecting country itself.
Article 11(e)	**Exercise right pursuant to Article (4)1 of the Basel Convention** The inclusion of provisions, like a general ban of waste import for disposal of hazardous wastes, waste collected from households, or residues arising from the incineration of household waste in their national legislation, in accordance with Article 4(1) of the Basel Convention.
Article 11(h) and 12(i)	**Waste treatment in facilities not applying best available techniques.**
Article 12(c)	**Non-accordance with national legislation** The shipment or recovery is not in accordance with national legislation on recovery in the country of dispatch. An objection can be made where the recovery would take place in a facility which has lower treatment standards for the particular waste than those of the country of

[69] Eunomia (2009) International Review of Waste Management Policy: Annex 65 to Main Report -Exports and Imports of Waste
[70] European Commission (2016) The efficient functioning of waste markets in the European Union

Article of WSR	Grounds for non-harmonised interpretation
	dispatch. However, provision of Article 12(1)(c) does not seem to have had any effect on environmental protection and the functioning of the internal market.
Article 12(g)	**Unjustified activities in regard to economic and environmental considerations** The ratio of the recoverable and non-recoverable waste, the estimated value of the materials to be finally recovered or the cost of the recovery and the cost of the disposal of the non-recoverable fraction do not justify the recovery, having regard to economic and/or environmental considerations.
Article 12(k)	**Non-accordance with waste management plans drawn up pursuant to the WFD** The waste is not treated in accordance with waste management plans drawn up pursuant to the WFD with the purpose of ensuring the implementation of legally binding recovery or recycling obligations established in Community legislation. **Unequal use of administrative procedure of prior notification** On the prior notification procedure under the WSR, Member States use the administrative procedures in an unequal way, some asking for more proof than others, and requiring different conditions for the waste shipments, e.g. inconsistent usage of the 'pre-authorised facilities' approach, relating to the administrative periods. Consequently, the pre-consented recovery facility status in the current WSR is not providing any real facilitation of shipment due to the lack of compliance with the tacit consent and due to different criteria being used in different Member States. In addition, some MSs do not consider/recognise the status and go through the usual check list for notification.
Article 12(k)	**Non-harmonisation of municipal waste definition** The submission of non-harmonised definitions of municipal waste to the proximity principle in case of incineration with sufficient energy recovery.
Article 12(k)	**Different application of strategies on open or closed borders** Due to the non-obligatory principles of proximity and self-sufficiency for competent authorities, Member States have different strategies on open or closed borders.
Article 12(k)	**Submission to self-sufficiency principle for internal waste shipments for recycling** Certain Member States apply the practices of the self-sufficiency principle, within their own boarders, for shipments of waste for recycling (as not all recovery capacity is filled). This can result in certain regions being prohibited from shipping waste for higher recovery purposes. This principle is not applicable, according to the WSR, to such waste for recycling purposes.
Article 12(k)	**Different classification of specific waste treatment operations** The divergent interpretation and classification of specific waste treatment operations, i.e. mine backfilling as recovery, makes the principles of proximity and self-sufficiency not applicable.

Source: European Commission (2016) Study on efficient functioning of waste markets in the European Union

Annexe E - Supporting data on Section 3.2.2

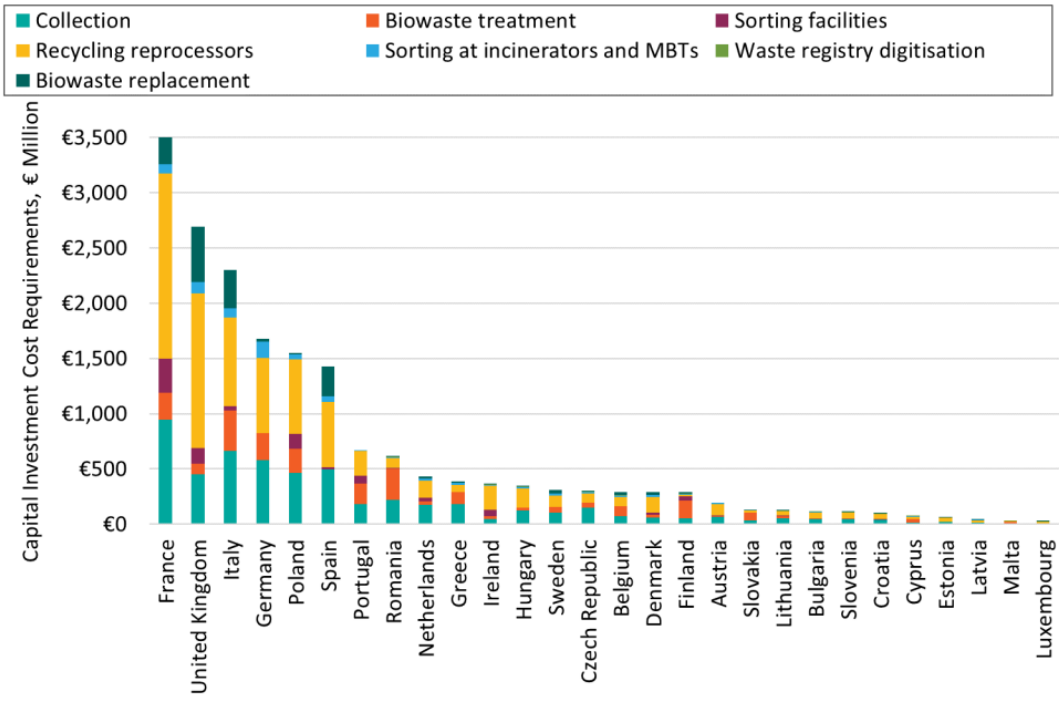
Table E-1 Landfill taxes by Member State

Member State	Date of introduction	Costs (where data is available)
Austria	Unclear Untreated waste landfilling banned	**2006**: 87 € / tonne
Belgium (Flanders)	Unclear	(no date): 87.62 € / tonne *It is further banned.*
Belgium (Wallonia)	Unclear	(no date): 75.71 € / tonne
Belgium (Brussels)	No tax *There are no landfills*	
Bulgaria	Unclear	**2017**: 40 BGN (20 €) / tonne **2018**: 45 BGN (23 €) / tonne **2019**: 57 BGN (30 €) / tonne **2020**: 95 BGN (50 €) / tonne
Cyprus	No tax	
Czechia	Unclear	(no date): 500 Kc (20€) / tonne for municipal waste
Denmark	(x).(x).1987	**2010**: 79 € / tonne (including VAT)
Germany	No tax Untreated waste landfilling banned	
Estonia	(x).(x).2003	**2017**: 29.84 € / tonne
Spain	Unclear	Depends on region. Only 4 of 17 regions have taxes representing 25% of the population. Costs range from 7 €-47.1 € / tonne.
Finland	Unclear *Effective ban in place*	**2017**: 70 € / tonne
France	Unclear	**2017**: "Unauthorised" 150 € / tonne A: "Authorised" landfilling (ISO 14001) 32 € / tonne B: "Authorised" landfilling with biogas recovery 23 € / tonne C: "Authorised" bioreactor landfill cells and biogas recovery 32 € / tonne B + C: 15 € / tonne
Greece	01.01.2014 Suspended from 01.01.2017 - 31.12.2017	**2014**: 35 € / tonne Increased by 5 € / tonne each year *National experts note it was never practically implemented*
Hungary	01.01.2013	**2013**: 6 000 HUF (19.35 €) / tonne
Croatia	No tax	
Ireland	Unclear	**2013**: 75 € / tonne
Italy	Unclear	Regionally based from 5.2 € / tonne to 25.82 € / tonee
Latvia	(x).(x).2001	**2017**: 25 € / tonne **2018**: 35 € / tonne **2019**: 43 € / tonne **2020**: 50 € / tonne
Lithuania	Unclear	**2017**: 3 € / tonne **2018**: 5 € / tonne **2019**: 21.72 € / tonne **2020**: 27.51 € / tonne

Member State	Date of introduction	Costs (where data is available)
Luxembourg	No national tax, however local municipal tax (in only municipality with landfilling)	(no date): 8 € / tonne
Malta	No tax	
The Netherlands	(x).(x).1995 Repealed between 2012 and 2015 Reintroduced in (x).(x).2015	**2017**: 13.11 € / tonne
Poland	Unclear	**2018**: 140 PLN (33€) / tonne **2019**: 170 PLN (40€) / tonne **2020**: 270 PLN (64€) / tonne
Portugal	(x).(x).2007	**2017**: 7.7 € / tonne **2018**: 8.8 € / tonne **2019**: 9.9 € / tonne **2020**: 11 € / tonne
Romania	01.01.2017	**2017**: 80 RON (17€) / tonne **2018**: 120 RON (26€) / tonne
Sweden	(x).(x).2000	**2015**: 500 SEK (50€)
Slovenia	(x).(x).2001	(no date) 11 € / tonne
Slovakia	01.01.2014	**2016**: 9.96 € / tonne of MW in less than 4 fractions 5.98 € / tonne of MW in 4 fractions 4.98 € / tonne of MW in 5 fractions

Source: Eunomia and COWI 2019[71]

Figure E-1 Capital investment including biowaste facility replacement costs 2021-2027, € million



Source: Eunomia and COWI (2019)
Note: These categories can be viewed by capacity requirement and investment cost requirements.

[71] Eunomia and COWI (2019) "Study on investment needs in the waste sector and on the financing of municipal waste management in Member States". DOI: 10.2779/769124

Figure E-2 Additional capacity requirements (2020-2017), thousand tonnes

	Additional MSW dry + biowaste recycling collection	Biowaste			Sorting	Recycling Reprocessors		Residual	
		Open Air Composting	In-Vessel Composting	Anaerobic Digestion		MSW & non MSW Plastic Packaging	Textiles	Front End Sorting on Incineration	Sorting Upgrading on MBT
Austria	98	18	18	11	12	147	1.1	129	47
Belgium	105			250		125	0.5	146	14
Bulgaria	59	5.5	5.5	5.6	21	69	0.6	5.5	61
Croatia	214	39		1.9	31	54	5.9	0.0	46
Cyprus	161		28	72.1	15	20	8.8		22
Czech Republic	589	64	117	52		108	18	110	41
Denmark	434	52	78	27	100	206	0.0	181	
Estonia	62	1.8	7.1		7.7	51	0.7	17	3.6
Finland	37			200	219.2	15	0.1	69	30
France	6,142		1,411	29	1,740	2,220	207	839	99
Germany				686		976		1,387	276
Greece	968	0.8	636			94			183
Hungary	720	111	75			239	15	21	147
Ireland	854	67	76	12	341	277	44	67	17
Italy	1,198		679	534	214	1,146	5.5	597	329
Latvia						30			31
Lithuania	279	55	26	22	47	39	15		41
Luxembourg	27	0.7		0.7	8.0	21	0.1	10	2.1
Malta	69	0.6	0.6	39	23	7.0	1.8	0.0	8.2
Netherlands	694	20	77	62	149	196	30	210	23
Poland	2,628	430		503.8	754	930	44	51	465
Portugal	1,640	251	251	323	432	290	32	62	20
Romania	581	27		812	52	129	4.4		74
Slovakia	110			201	19	19	2.1	29	10
Slovenia	42	0.7	3.0	5.4	10	1.7	1.2	15	17
Spain	518				98	845		321	264
Sweden	691	49	50	106		137	13	232	
United Kingdom	2,125	190	104	148	806	1,979	27	669	491
Total EU28	**21,044**	**1,383**	**3,643**	**4,103**	**5,099**	**10,368**	**476**	**5,167**	**2,763**

Source: Eunomia and COWI (2019)

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