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Book

Plastic account for Norway : preliminary methodological approach and use of data sources

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Plastic account for Norway

Preliminary methodological approach and use of data sources

TALL

SOM FORTELLER

NOTATER / DOCUMENTS

2023/35

Gisle Berge, Terje L. Landsem and Camilla Skjerpen

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Preface

Plastic has become an integral part of our daily lives due to its versatility, durability and affordability. Over the years, the use of plastic has increased significantly, as it has become a popular choice in various industries and products. However, the widespread increase in plastic usage has also led to a range of environmental and health concerns, including accumulation of plastic waste and release of toxic chemicals and microplastic to the environment.

Negotiations are currently underway in the United Nations to establish a legally binding international agreement against plastic pollution, aimed to be implemented before the end of 2024. One of the main questions in the negotiations is whether the plastic situation can be solved by improving the way we handle plastic waste or if there is a need to use less plastic in a more rational manner.

To address these challenges, there is a growing need to better understand the flow of plastic in our society, from production to disposal. Obtaining accurate statistics for amounts of plastic that surrounds us is considered crucial for informed decision-making about the future.

This report aims to quantify the amount of plastic, both in terms of waste generated and products put on the Norwegian market. It should be stressed that all the results and methods explained in this report may be subject for change in the coming time and must be considered preliminary. The final outcome of this project is expected in 2024.

The project is made possible with funding from Norwegian Environment Agency.

Statistics Norway, 30 June 2023

Per Morten Holt

Abstract

Plastic has become a major environmental issue in recent years and is a topic of increasing attention. This report aims to create a more complete picture of plastic fluxes in Norway based on available data sources.

The report is divided into two main topics. The first topic focuses on plastic waste, utilising the long-existing waste account, supplemented with new data. The second topic delves deeper into the product side, outlining the initial steps in creating a model and presenting preliminary results.

Part A: Plastic waste

The massive consumption of plastic products has generated a huge amount of plastic waste, which has led to environmental pollution and health hazards. It is therefore important to understand the various elements of the plastic production and waste management chain.

The first part of this report aims to provide a first overview of plastic waste and the amounts and treatments that are used. Data from the waste accounts, which is the overall umbrella statistics on waste in Norway, sorting analysis and several external articles and sources has been utilised to provide results by sector and product groups. A preliminary estimate suggested that in 2021, approximately 620 000 tonnes of plastic waste was generated, where less than 30 per cent was material recovered.

Part B: Plastic products

The second part of the report describes a methodology for estimating the total amount of plastic put on the Norwegian market. The work is still at an early phase, and under development.

Two main data sources have been used, (1) external trade statistic, covering the import and export of products and (2) manufacturing production statistics, covering the domestic production. These are well established statistics within Statistics Norway, containing time series that extend back in time.

Plastic products have been divided into the three distinct groups, (1) primary plastic, (2) semi-finished and finished plastic products and (3) plastic containing products. Preliminary estimates have been generated for these three groups encompassing import, export and domestic production, in addition to "net plastic", defined as production + import – export.

In 2021, the net primary plastic put on the Norwegian market was estimated to approximately 410 000 tonnes. For semi-finished and finished plastic products, and plastic containing products the amounts was estimated to be 570 000 and 330 000 tonnes respectively.

In terms of export of plastic, primary plastic clearly constitutes the largest group, with around 435 000 tonnes leaving the country. The import side is more evenly distributed among the three – 330 000 tonnes primary plastic, 420 000 tonnes semi-finished and finished and 390 000 tonnes plastic containing products.

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1. Definitions and concepts

Amber listed waste – Waste subject to the procedure of prior written notification and consent, covered by one or more of the following fractions:

- Hazardous waste
- Waste for final disposal, for example disposal or incineration without energy recovery
- Mixed waste, for example household waste
- Ships and other vessels that does not fall under regulation on “forskrift om gjenvinning av skip og flyttbare innretninger” (eng: recycling of ships and movable devices)
- Waste that does not comply with requirements on green listed waste

Combined Nomenclature (CN) – Classification of goods, designed to meet the needs of the Common customs tariff and the international trade statistics of the EU.

Energy recovery - Utilising the energy released by incineration, such as for heating up buildings. Calculated as the share of utilised energy to the share of produced energy.

Green listed waste – Waste that qualifies as clean, meaning it does not contain health- or environmentally harmful substances, and sorted waste specifically intended for recycling.

Harmonized system (HS) – International classification and nomenclature of goods crossing country borders, administered by the World Customs Organisation.

Household waste – In terms of external trade statistics data defined specifically by the combined nomenclature (CN) code 38.25.10. In waste statistics, it is broadly defined as waste coming from activities in households (food residuals, packaging material, paper, furniture etc.).

Material recovery - Material recovery is the utilisation of the waste in such way that the material is retained, either wholly or in partially.

Norwegian waste standard (NS 9431) - The Norwegian standard for classification of waste (NS 9431), administered by Standards Norway. Classification by material and treatment/disposal. Available from Standard Norway (2011).

Plastic – Materials made of synthetic polymers.

Plastic containing products – Products with plastic as one of their constituent materials but not entirely composed of plastic, resulting in a mixture of plastic and other materials.

Primary plastic – Plastics on the product side in their raw form that have not undergone any significant processing or transformation. In the combined nomenclature (CN) represented by codes in the interval from 39.01.00 to 39.14.99.

Producer Responsibility Schemes (PRS) - Policies that assign producers responsibility for the end-of-life of products, including both financial and operational responsibility. The goal of PRS is to reduce the environmental and economic burdens of waste management by extending producer responsibility to the end-of-life stage.

PRODCOM – List that currently comprises around 4000 headings relating to industrial products and some industrial services in the European Union.

Semi-finished and finished plastic products – Encompasses all 6-digit numbers within the range of 39.16.00 to 39.99.99 in the combined nomenclature (CN). These constitute a range of products which is entirely built from plastic.

2. Plastic waste

Plastic waste is a major environmental issue that has drawn increasing attention in recent years. This report by Statistics Norway is an attempt to investigate different data sources and quantify the amount and treatment of pure plastic waste as well as plastic in other types of waste.

2.1. Data sources

The waste account (Statistics Norway, 2023a) is the official Norwegian statistics on waste, providing essential data on the quantity and characteristics of the waste generated in Norway. The account is updated annually, serving as an important resource for understanding waste patterns and fluxes in Norway.

Data from amber listed (notifiable waste) and green listed waste is used to obtain information on import and export of waste in Norway. Unfortunately, these sources are not always accurately reported to the respective authorities and data collectors. Consequently, it becomes necessary to work towards improving the data quality in the future in order to reach the full potential of these data sources.

All municipalities in Norway report on annual basis their household waste to Statistics Norway. Together with the data on waste amounts and treatments, the municipalities that have conducted a sorting analysis of their mixed waste are encouraged to also report this data. Data from the reported sorting analysis for the years 2018-2021 have been used in the calculation of plastic and other waste types in the mixed waste fraction.

Waste account

The main objective of the Waste Account is to provide a comprehensive and complete overview of the waste situation in Norway. Waste streams are quantified based on three distinct dimensions:

- material type
- source of origin
- type of treatment

Although plastic is one of several materials specified in the waste account, there are still certain plastic waste streams that carry some level of uncertainty and require further attention. These waste streams will be addressed in chapter 2.4.

Import and export of waste

There are two main data sources for information regarding import and export of waste:

- Statistics on External trade in goods (Statistics Norway 2023b), which is based on the TVINN database operated by Norwegian Customs (2023a)
- Amber-listed waste, administered by the Norwegian Environment Agency (Norwegian Environment Agency 2023)

External trade in goods statistics (hereafter external trade) is supposed to cover all waste crossing the Norwegian boarder, including both amber and green listed waste.

On the other hand, the notification procedure administered by the Norwegian Environmental Agency covers only amber-listed waste, resulting in a narrower scope compared to the external trade statistics. Nonetheless, it does provide additional information regarding the treatment of the waste, which might prove useful to track the fate of exported plastic waste abroad.

Utilising external trade statistics in this project poses a challenge, as the distinction between green listed and amber listed waste in the dataset is not entirely straightforward. At the border, the registration process offers an option to differentiate between green listed and amber listed waste. However, it is not obligatory to provide this information. Consequently, a portion of the waste in the external trade data is classified as “not specified” because it has not been assigned as either green or amber listed (see Figure 2.1 and Figure 2.2 for details). Ideally, to enhance overview and facilitate accurate statistical analyses, it would be advantageous to enforce mandatory registration of this specific information.

Cross-checking data between the two sources to determine whether plastic waste in one dataset is included in the other, and vice versa, has proven to be difficult. Thus, this inconsistency in the data needs further examination to address any discrepancies.

2.2. Import and export of plastic waste

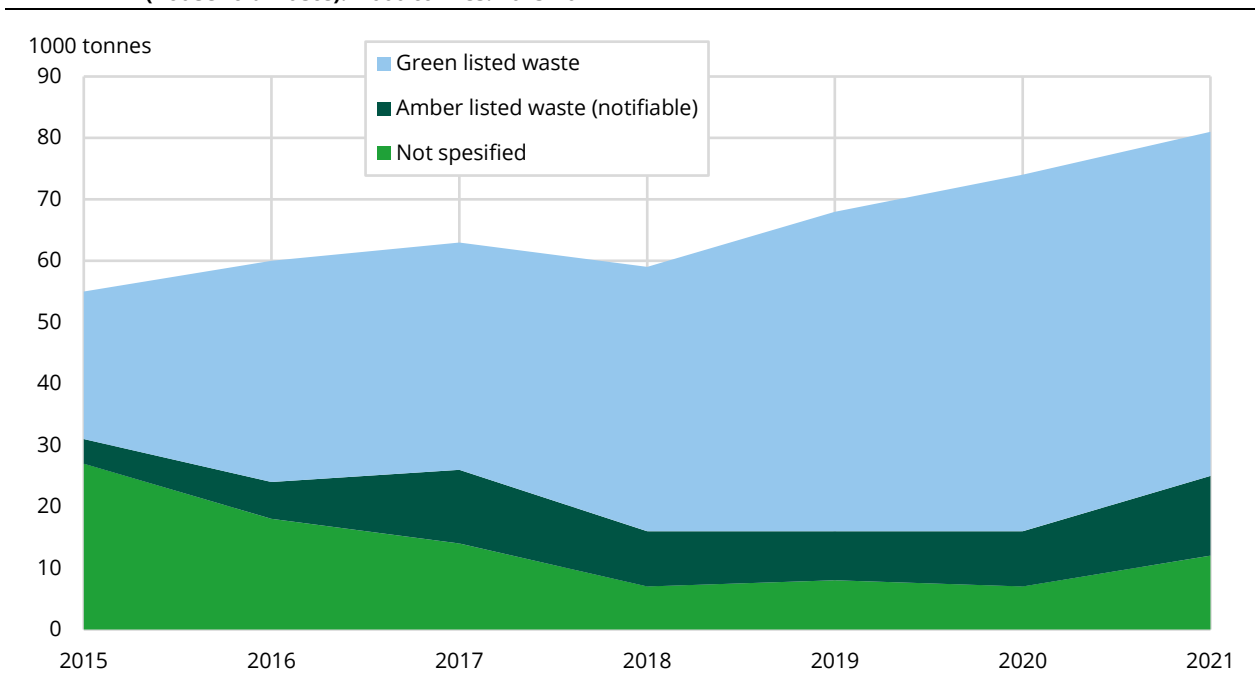
In order to get a complete overview of import and export of plastic waste, it is important to cover both the green listed and the amber listed waste. As mentioned in chapter 2.1, external trade statistics contain both, while the notification procedure, administered by Norwegian Environment Agency only consider the amber listed waste.

The amount of plastic that can be extracted from the two data sources is presented in the following.

External trade in goods statistics – green listed and amber listed waste

The amount of plastic waste for export found in external trade statistics is illustrated in Figure 2.1 for the years 2015-2021.

Figure 2.1 Export of plastic waste, by type of waste (green and amber listed). CN 39.15.xx + plastic from 38.25.10 (household waste). 1 000 tonnes. 2015-2021



Source: Statistics Norway, External trade in goods statistics

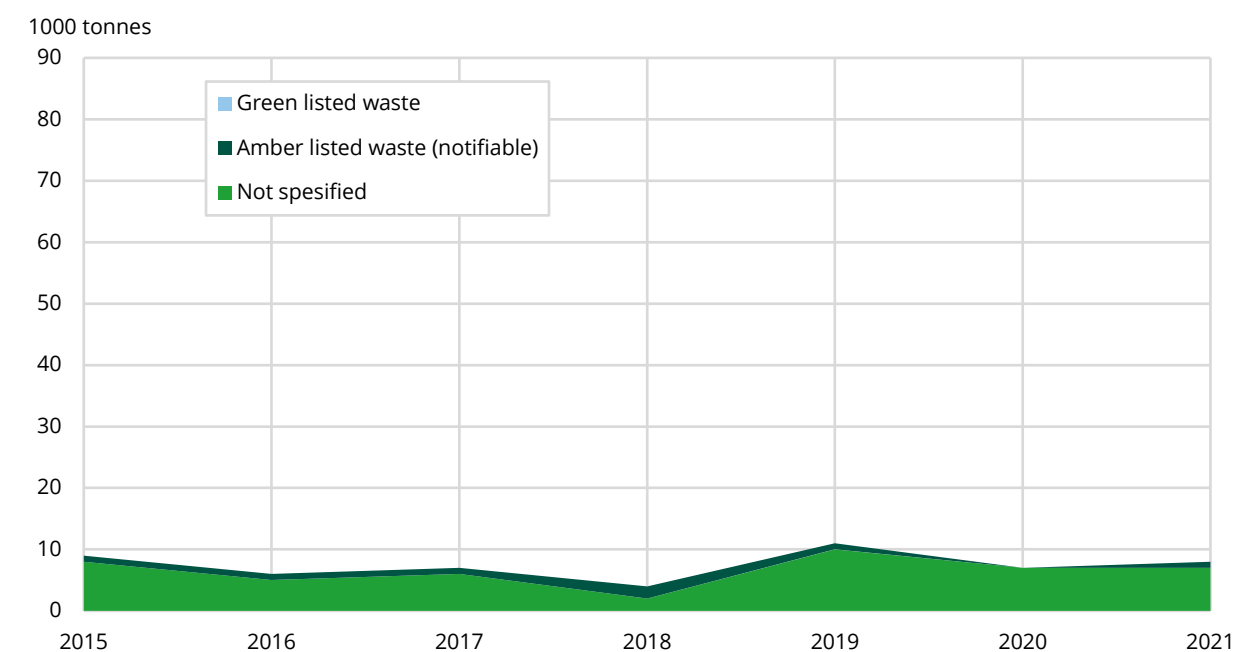
In addition to green listed and amber listed plastic waste, there is an additional category called “Not specified”, referring to plastic waste with no information attached regarding green or amber listing. For analytical purposes this makes it harder to achieve a comprehensive overview, as some amounts are missing from the listing. It has also proven somewhat hard to cross check the data in

the external trade statistics with similar plastic waste reported as amber listed to the Norwegian Environment Agency.

In 2021, based on external trade statistics, there were around 56 000 tonnes plastic waste exported registered as green listed waste, 13 000 tonnes as amber listed and 12 000 tonnes categorised as “not specified”. Thus, green listed plastic waste constitutes the dominant fraction in terms of export, with the same trend throughout the time series from 2015 to 2021. The amount of exported green listed plastic waste appears to be increasing over time.

On the other side, the import of plastic waste in external trade statistics does not provide much information regarding green listed or amber listed plastic waste, as illustrated in Figure 2.2.

Figure 2.2 Import of plastic waste, by type of waste (green and amber listed). CN 39.15.xx + plastic from 38.25.10 (household waste). 1000 tonnes. 2015-2021

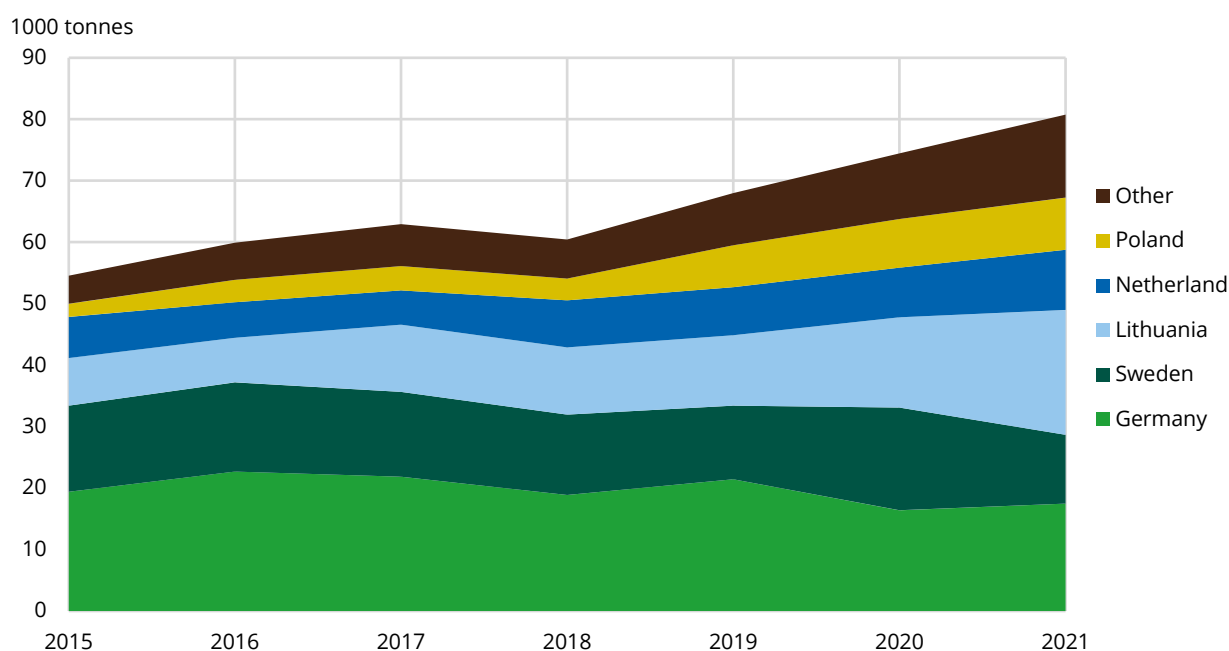


Source: Statistics Norway, External trade in goods statistics

In 2021, only 1 000 tonnes of plastic originating from household waste, which is amber listed, can be singled out here. The remaining 7 000 tonnes of total plastic waste imported is not specified.

The previous result can also be illustrated based on what country the plastic is exported (Figure 2.3). Germany, Sweden, Lithuania, the Netherlands, and Poland are the five largest destinations for Norwegian plastic waste export.

Figure 2.3 Export of plastic waste, by country. CN 39.15.xx + plastic from 38.25.10 (household waste). 1000 tonnes. 2015-2021



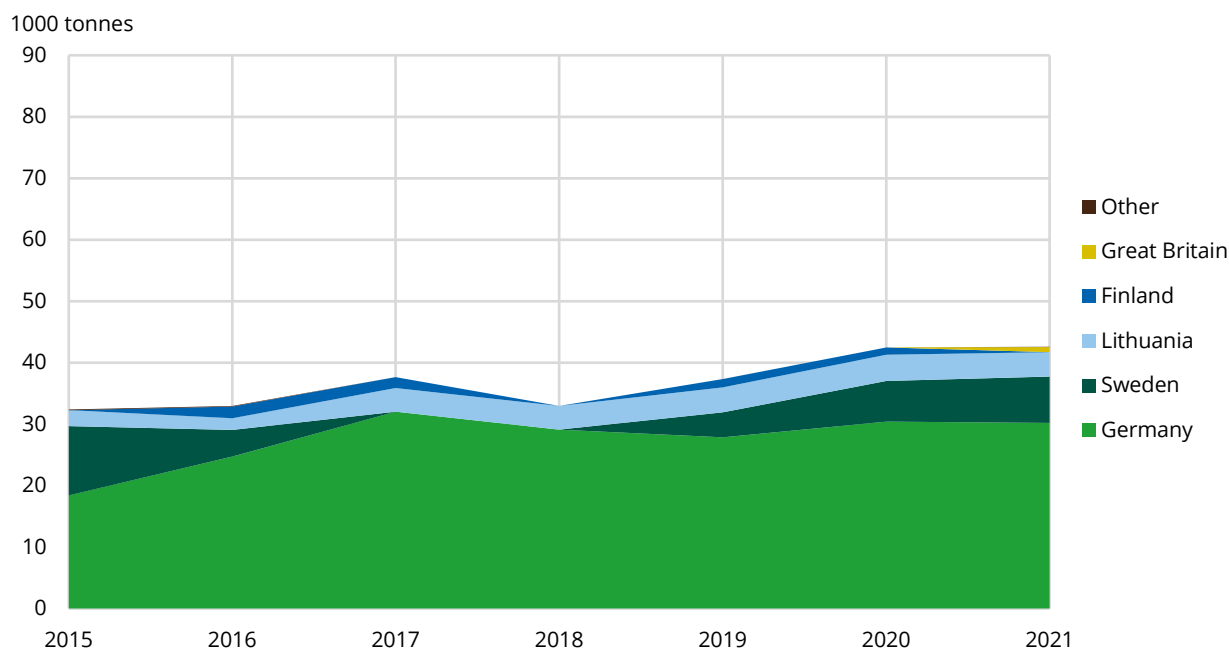
Source: Statistics Norway, External trade in goods statistics

The import side of Figure 2.3 cannot be presented here due to confidentiality (too few companies involved in import of plastic waste to the relevant countries for detailed data to be revealed).

Norwegian Environment Agency – amber listed waste (notifiable to the authorities)

All amber listed waste exported or imported must be notified to Norwegian Environment Agency, and parallel to external trade statistics, they have their own dataset. An attempt to derive the amount of plastic registered there is shown in Figure 2.4 and Figure 2.5.

Figure 2.4 Export of plastic waste. Amber listed only. 1000 tonnes. 2015-2021



Source: Norwegian Environment Agency

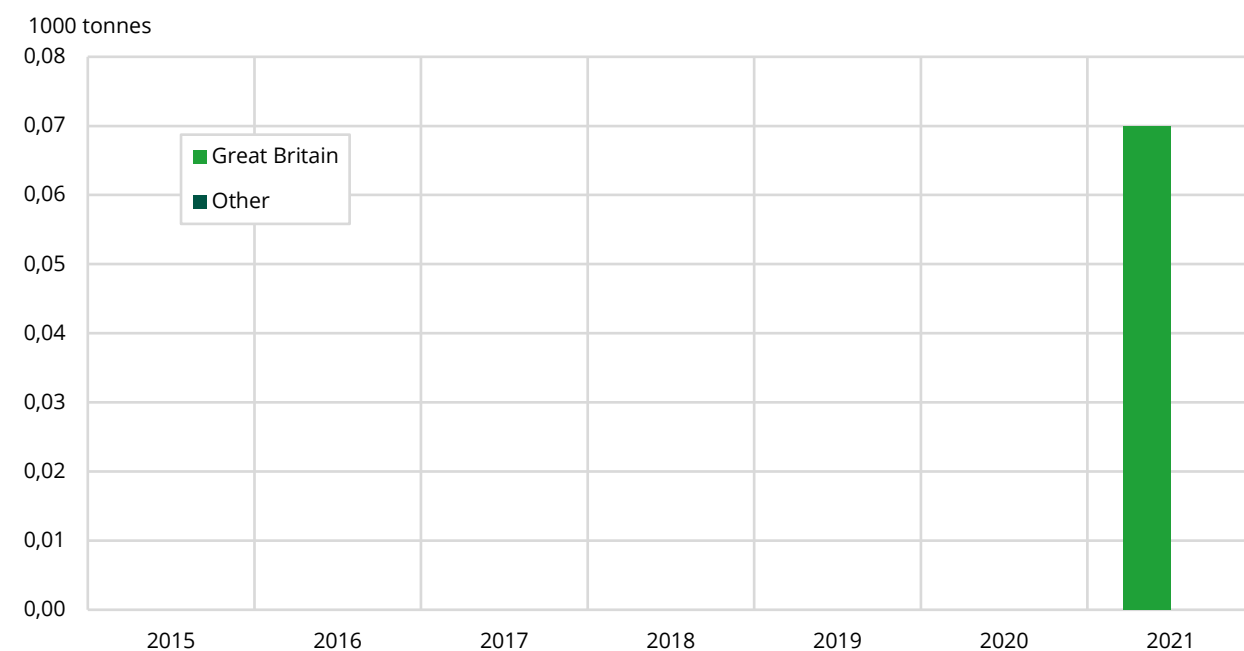
The amount of amber listed waste exported in 2021 was approximately 43 000 tonnes. Most of the waste was exported to Germany, with smaller amounts to Sweden and Lithuania.

The 43 000 tonnes notified to the Norwegian Environment Agency is significantly larger compared to the 13 000 tonnes that was found in external trade statistics on amber listed waste (Figure 2.1). Even if all the “Not specified” plastic waste from external trade proved to be amber listed it would still only reach 25 000 tonnes. Thus, there is a deviation between the two data sources which readily cannot be explained when seeing them together.

The 13 000 tonnes of amber listed waste in external trade are based on what is registered as amber listed waste under CN code 39.15, added an estimated amount of plastic derived from household waste (CN 38.25.10).

The amber listed waste for import is insignificant compared to the export side. For the last 7 years the only import has been from Great Britain, with 70 tonnes in 2021 (Figure 2.5).

Figure 2.5 Import of plastic waste. Amber listed. 1000 tonnes. 2015-2021



Source: Norwegian Environment Agency

2.3. Plastic waste amounts

According to Statistic Norway's waste account and sorting analysis data, the estimated amount of plastic waste for 2021 was approximately 620 000 tonnes. Out of this total, 250 000 tonnes were categorised as sorted plastic waste, while the remaining 370 000 tonnes comprised plastic found in mixed waste (Table 2.1). However, it is important to note that this estimate does not encompass plastic integrated into other products or falls under other categories, such as vehicles and electronic waste.

Table 2.1 Plastic waste per sector. 2021

Source of origin	Sorted out [tonnes]	From mixed waste [tonnes]	Total [tonnes]
All sectors	248 800	371 400	620 200
Agriculture, forestry and fishing	25 000	6 000	31 000
Mining and quarrying	600	200	800
Manufacturing industries	58 000	23 000	81 000
Electricity, gas, steam and air conditioning supply	200	200	400
Water supply, sewerage, waste management and remediation activities	15 000	23 000	38 000
Construction	11 000	14 000	25 000
Service industries	78 000	127 000	205 000
Other or unspecified	0	33 000	33 000
Households	61 000	145 000	206 000

Source: Statistics Norway, Waste accounts

Sorting analysis of mixed waste has been reported to Statistics Norway since 2018, as part of the household waste survey and statistics. This information has been applied in the waste statistics for all sectors of society, except from the construction and demolition sector. For this sector, sorting analysis reported by Hjeltnes (2015) have been used.

Treatment

In 2021, 61 per cent of all the plastic waste that was sorted out and delivered as plastic, was sent to material recovery (Table 2.2). However, as there is a loss before the final treatment, due to further fine sorting of the plastic waste, considerably less is finally material recovered.

Table 2.2 Treatment of plastic waste. 2021

Treatment	Plastic - sorted out [tonnes]	Plastic in the mixed waste [tonnes]	Total [tonnes]	Per cent of total	Per cent of sorted out
Treatment, total	248 000	371 000	619 000	100 %	100 %
Sent to material recovery	151 000	29 000	180 000	29 %	61 %
Biogas production	0	0	0	0 %	0 %
Composting	0	0	0	0 %	0 %
Filling compound and cover material	0	0	0	0 %	0 %
Incineration	80 000	270 000	350 000	57 %	32 %
Landfill	13 000	40 000	53 000	9 %	5 %
Other disposal	0	0	0	0 %	0 %
Unknown	4 000	32 000	36 000	6 %	2 %

Source: Statistics Norway, Waste accounts

If plastic in the mixed waste is also included in the calculation, a significantly smaller percentage is being sent for material recovery. Treatment of the plastic in the mixed waste is complicated to estimate and surrounded with uncertainty.

Most of the plastic in the mixed waste is still expected to be treated alongside other waste fractions of the mixed waste. However, it is also possible that some portions of it may undergo an additional sorting process for material recovery, but the exact figures regarding this are highly uncertain.

However, assuming no further sorting processes take place, the material recovery percentage could be as low as 29 percent, and energy recovery/incineration accounting for 57 percent.

The figures in tables 2.1 and 2.2 do not exactly match due to rounding.

2.4. Product groups

The amounts of plastic in the different product groups in Table 2.3 includes both pure plastic and plastic embedded in the waste component.

Table 2.3 Plastic waste per product group

	Total waste amount [tonn]	Plastic fraction	Total amount of plastic [tonnes]	Source for plastic fraction
End of life vehicles	242 000	0.1	24 000	Mashek et al., 2016
End of life boats	4000	0.68	3000	Kongelig Norsk Båtforbund 2018
WEEE	140 000	0.2	28 000	Buekens et al., 2014 Butturi et al., 2020
Fishing and aquaculture			28 000	Mepex, 2022
Packaging	250 000	1.0	250 000	Packaging waste by waste management operations
Textiles	100 000	0.5	50 000	Klepp et al., 2022 and other
Car tyres	62 500	0.24	15 000	Tik Root, 2019
Agriculture	22 000	0.525	12 000	Grønt Punkt Norge, 2021
Construction and Demolition	11 000 plastic + 260 000 mixed waste	0.055	25 000	Hjellnes, 2015
Other			..	

In terms of plastic embedded in products, assumptions on the amount of plastic in the total product has been made, hereby called “plastic fraction” (see Table 2.3 for references). However, it is important to stress that some plastic factors and waste amounts are more uncertain than others. Textiles, as well as construction and demolition, are among the product groups that pose higher levels of uncertainty.

End of life vehicles

Statistics Norway estimated the amount of discarded vehicles in 2021 to be approximately 251 000 tonnes, and 242 000 tonnes without tyres. This includes both smaller vehicles like cars and motorcycles and larger ones such as buses and tractors.

As the plastic amount and the weight of the tyres for these vehicles differ, an average weight of 18 kg per tyre has been used, and a plastic fraction of 10% for the vehicles (Mashek et al., 2016). The plastic fraction of 10% does not include tyres, so this amount is subtracted first, to make a total estimate of 24 000 tonnes of plastic in scrapped vehicles.

End of life boats

Old leisure boats that are left in nature or sunk illegally is contributing to littering and local pollution. Over time, plastic also breaks down into microplastics and end up in the aquatic environment, as well as terrestrial.

From 2017, there is a system for returning old leisure boats of up to 15 meters. All boat owners who hand in their discarded leisure boats will be paid NOK 1 000. Because there is no compulsory registration of leisure boats in Norway, a significant number of older boats remain unattended as they age or are no longer needed.

The amount of leisure boats that were scrapped in 2021 roughly adds up to around 4 000 tonnes. These leisure boats are made of different materials, and according to Kongelig Norsk Båtforbund, (2018, p. 31), 81 percent of the boats in use are made of plastic or fiberglass.

The material boats are made of also changes over time. When boat owners were asked about the composition of the boats they intended to dispose, it was found that only 68 percent of the boats were made of plastic or fiberglass (Kongelig Norsk Båtforbund, 2018, p. 64). This is also the percentage that has been used in the calculation of plastic in end-of-life leisure boats in this report.

Waste from Electrical and Electronic Equipment (WEEE)

The plastic fraction in electronic waste is estimated using the plastic fraction calculated by Buekens et al. (2014) and Butturi et al. (2020). It is important to note that not all plastics found in WEEE will be readily available for recycling due to the presence of environmental toxins.

The plastic fraction of WEEE generally represents about 20 per cent of the weight of e-waste, depending on the device category.

The recycling of this plastic fraction is a complex landscape, and again heavily conditioned by the content of harmful additives, such as brominated flame retardants. Thus, the management and reprocessing of WEEE plastics pose several environmental and human health concerns (Butturi et al., 2020).

Fishing and aquaculture

The Norwegian Environment Agency has now recommended the introduction of producer responsibility schemes for equipment containing plastic from fisheries, aquaculture, and recreational fishing. The first reporting is due by the end of June 2024, and it covers the amount of equipment put on the market and the amount of waste or discarded equipment collected.

The current estimated amount of 28 000 tonnes of plastic waste from fishing, aquaculture, and recreational fishing is a rough estimate based on the amount put on the market (Mepex, 2022).

As the first reporting is not yet in place, more accurate numbers are expected once the reporting has started.

Packaging

The official dataset reported to Eurostat according to Decision 2005/270/EC for plastic packaging has been used for the product group of packaging (Eurostat, 2023a).

However, these official figures have a few weaknesses and limitations. One of the limitations is the calculation of "free riders". That means correcting and adding to account for those businesses who are not members of a return company. Another limitation is the exclusion of packaging items larger than 100 litres, which among other things includes large IBC containers. The figures reported by Grønt Punkt Norge will not include such packaging, which means that the estimated amount is most likely too low.

Textiles

The revised EU framework directive for waste from 2018 requires separate collection of textiles in the member states by 1 January 2025. This is expected to provide a better estimate of the amount of textile waste and plastic in textile waste in the future. As part of the European Economic Area (EEA), Norway is obliged to adopt the same set of rules.

As of now, textiles donated to organizations like UFF and Fretex, which resell or donate the textiles for humanitarian and social goals, are not considered waste.

In March 2022, the European Commission launched a separate textile strategy with the aim of reducing the environmental impact from textiles throughout the value chain. In this strategy, the European Commission announced that proposals on producer responsibility for textiles will be included in the revision of the framework directive for waste in 2023.

Considering both the amount that is sorted out and the amount in the mixed waste in the Waste Accounts there is about 100 000 tonnes of textile waste. The same sorting analysis as mentioned in chapter 2.1 has then been used for all sectors, except the construction and demolition. For construction and demolition, the numbers from Hjellnes (2015) are used. Synthetic fibres represent over two-thirds (69%) of all materials used in textiles, a number which is expected to increase in the coming years (Changing Markets Foundation, 2021).

The consumption of clothing in Norway is expected to be largely similar to international trends, although a higher proportion of wool is anticipated compared to the global average. The discarded textiles do not accurately reflect the composition of consumption today, because many of the textiles were produced several years ago when the proportion of synthetic materials was smaller. Therefore, it is likely that the synthetic content of textiles that are out of use will increase rapidly in the coming years. Several studies on the composition of discarded textiles are in production. In one study, it was found that 65 per cent of discarded textiles were either entirely or partially made of plastic (Klepp et al., 2022). An average factor of 50 per cent for the plastic fraction in textiles has therefore been used for this estimate and an estimate of 50 000 tonnes of plastic from textiles produced.

Car tyres

In 2021, 62 500 tonnes of car tires were collected, of which about three per cent of the weight is estimated to be water and ice. Car tires consist of various components, and one of them is synthetic rubber. On average, car tires consist of about 19 per cent natural rubber and 24 per cent synthetic rubber, which is a plastic polymer (Tik Root, 2019). The rest of the tyre is made up of metal and other compounds.

Using a plastic fraction of 24 per cent, the total amount of plastic/synthetic rubber from car tires collected in 2021 was estimated to be 15 000 tonnes. It is worth noting that discarded car tires are a significant source of microplastics in the environment (Kole et al., 2017).

Agriculture

The total estimate of 12 000 tonnes of waste from agriculture is based only on numbers from Grønt Punkt Norge (2021) as the second company, Norsirk, that also collects plastic and plastic packaging in Norway do not collect plastics from agriculture. It is estimated that more was collected than what was put on the market, possibly due to private import and collection from non-members of Grønt Punkt Norge, who's numbers are not included in the amount put on the market.

Construction and Demolition

According to the preliminary calculations using the figures from The Waste Accounts for 2021, the total amount of sorted plastic waste from construction and demolition is around 11 000 tonnes, and there are around 260 000 tonnes of mixed waste.

Based on an assumed plastic fraction of 5.5 per cent for plastic, this equates to approximately 14 000 tonnes of plastic within the mixed waste. This indicates a total of approximately 25 000 tonnes of plastic waste from the construction industry. However, plastic waste from the construction of

roads, bridges, and similar structures is not included in this estimate. Other fractions in the mixed waste from the construction site that contain a proportion of plastic (e.g., EE-waste, textiles) are calculated separately.

Other

Although there are other areas where it is reasonable to estimate the amount of waste containing plastic, this report does not make any attempt to estimate this quantity. Therefore, no totals have been calculated based on the product layout either.

2.5. Recommendation for further work

The issue of plastic waste is complex and challenging to quantify correctly. The estimates of plastic waste from different sectors and product groups have large uncertainties associated with them, with the largest coming from the plastic fraction in mixed waste. More sorting analyses from several sectors in society are needed to improve the statistical numbers.

While several studies have been conducted on different areas like textiles and fishing, the uncertainties are still significant, and the plastic fraction is often uncertain. The upcoming compulsory reporting of data to the EU may help to get better data in some areas, while more time is needed to dig deeper into already existing national and international literature in other areas.

The plastic fractions are also a concern as it is not possible to update all of them every year and data may not be available to update them every year. This means that changes in the composition of waste will not be readily visible in the numbers, only changes that directly concern the amounts of waste will be visible.

Relevant figures from this project will be used to supplement the waste account, so that the work done in this paper also can be beneficial for Statistics Norway's other statistics.

3. Plastic in products

Official statistics specifically targeting quantification of plastic in products are currently unavailable in Norway. Therefore, the work presented in this chapter is preliminary and expected to undergo revisions, as ongoing research and progress unfolds in the future.

The methodology and use of data sources presented in this chapter is partly inspired by previous work done by Statistics Norway, as described by Skullerud and Stave (2000). However, this work was conducted more than 20 years ago and has been discontinued as an active part of the official waste statistics. Consequently, efforts have been dedicated to updating and incorporating these ideas into a new and improved model.

This chapter aims to establish a framework and methodology for estimating the total amount of plastic introduced into the Norwegian market. This is achieved by analysing the supply of goods through examination of domestic production, import, and export of products. The process involves identifying and isolating the plastic component within a range of different products.

3.1. Data sources

The two key data sources included in this project are *External trade in goods* (Statistics Norway, 2023b), which is derived from customs data provided by the customs authority, and *Production of commodities in manufacturing, mining and quarrying* (Statistics Norway, 2023c).

Both data sources constitute annual data collection and cover most of the goods coming from import, export and domestic production. By combining these datasets and adding information about plastic fraction in the different types of goods, we achieved a simple overview of the overall plastic situation.

No additional data collection was required as these data sources already exist internally within Statistics Norway. However, information on plastic fraction in the different product categories was a new addition to the data, primarily obtained from various available literature studies (see chapter 3.4). In addition, data reported to Eurostat was included for estimates on plastic packaging.

External trade in goods

The statistics on External trade in goods consists of data describing the flow of import and export of goods across the Norwegian border (Statistics Norway, 2023b). It is a well-established official statistic, and the data originates from the TVINN database operated by the Norwegian Customs (see Norwegian Customs, (2023a) for more information about data collection etc.).

The data is product-wise structured following the Harmonized system (HS). For each HS code in the dataset, corresponding information is provided on the quantity, price and unit of products that have been imported and exported. Majority of products in the dataset are listed with the unit of kilogram or item. Additionally, the dataset includes some products that are listed in gross tonnage, representing the internal volume capacity of a ship. To simplify the estimation of plastic quantities, these products have not been further considered, despite the possibility of containing plastic components to some extent (see Appendix B: for details on these products).

It is important to note that the weights provided in the dataset are intended to solely reflect the weight of the product itself, without any packaging material that may be present. Therefore, data on packaging remain scarce in the dataset.

Production of commodities in manufacturing, mining and quarrying (domestic production)

The statistics on the production of commodities in manufacturing, mining and quarrying includes most of the domestic production in Norway's manufacturing sector (Statistics Norway 2023c). The production statistics are organised based on the PRODCOM system and provide detailed information regarding the production and sale of goods and services within the manufacturing, mining and quarrying sectors. Sold production is divided into 8-9-digit production codes and aggregated up to industries to make them comparable with other types of manufacturing statistics.

The statistic does not provide a complete count but covers 90 per cent or more of the total production. As a result, it can be inferred that most of the domestic production is accounted for by the dataset, but smaller production businesses might be left out.

Packaging

A third data source should also be mentioned, covering plastic used for packaging. Obtaining accurate data on the quantities of plastic packaging based on the two previous mentioned data sources presents several challenges.

Firstly, the external trade statistics, which provides information regarding import and export, does not provide specific information about the packaging of goods. This makes it difficult to determine the quantities of plastic packaging being imported or exported, as we only have data on the products themselves. Moreover, it is important to differentiate between filled packaging and empty packaging, as data on empty packaging is already available (CN code 39.23.xx). This further complicates the quantification of overall plastic packaging.

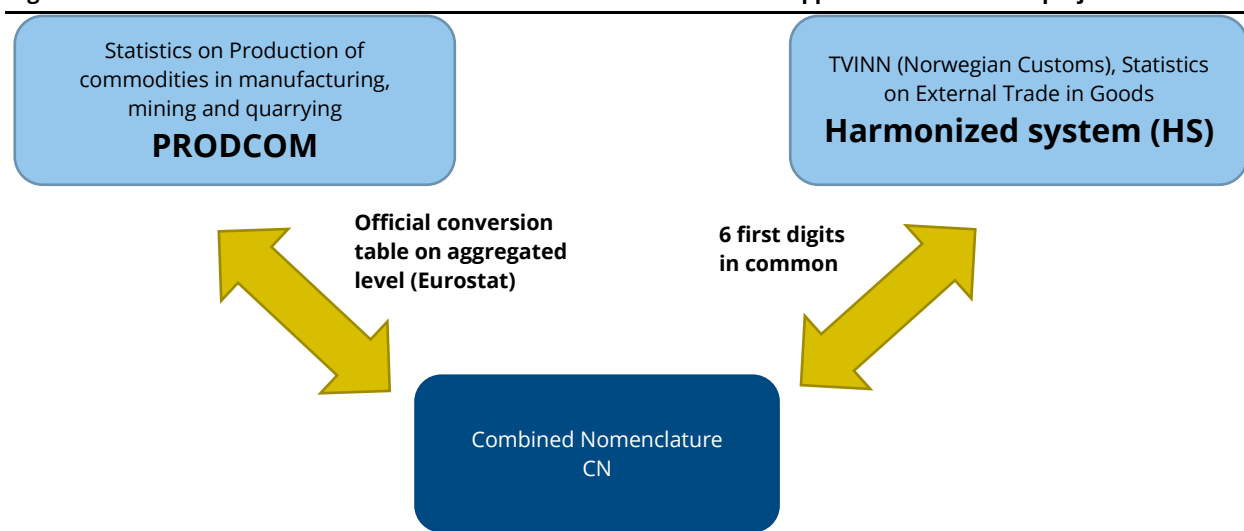
To address this data gap, we had to rely on additional information reported to Eurostat. Norway reports annual data on packaging waste to the EU, and plastic packaging is one of the materials that needs to be accounted for. It is the Norwegian Environment Agency that report on Norway's behalf.

As the lifespan of plastic packaging is short, waste is assumed to reflect the packaging put on the Norwegian market. Data is collected based on the European Parliament and Council Directive 94/62/EC of 20 December 1994 on packaging and packaging waste, as last amended. Country specific data is readily available from Eurostat (2023a), and official data for Norway has been applied in this project.

It is important to note that the data reported to EU already may include some instances of empty packaging, already accounted for in the external trade and domestic production data (CN code 39.23.xx). When interpreting the data, it is essential to consider these limitations and the potential for double counting of the same plastic. Consequently, combining the two sources of plastic packaging data could result in an overestimation of the actual quantities of plastic packaging.

3.2. Nomenclatures and international standards

Since goods from production data and goods from external trade statistics are built up around two different nomenclatures, namely PRODCOM and Harmonized System (HS), it is necessary to establish a connection between these data sources using a unified standard. In our case, the data is linked to the common coding system known as the Combined Nomenclature (CN), consisting of a six-digit numerical representation, as illustrated in Figure 3.1.

Figure 3.1 Nomenclature and International standards: Conversion and application used in this project

Consequently, since CN and HS share the same hierarchy the first six digits, a minor aggregation procedure on the six-digit level of the external trade data is necessary to convert from HS and into CN.

On the other side, the translation and conversion from PRODCOM into CN is done by using a conversion table provided by Eurostat (2023b). The relationship between PRODCOM and CN can either be a 1:1 or a 1:many relationship, and in those cases where there it is a 1:many relationship the quantity for a specific PRODCOM code is equally distributed across the relevant CN codes.

Harmonized Commodity Description and Coding System (HS)

The classification by HS (the international customs and statistics nomenclature, the Harmonized System) is a six-digit grouping of goods organised primarily according to the material characteristics of goods at the time of crossing the border. The World Customs Organization (WCO) is responsible for this nomenclature.

There are approximately 7 100 different HS codes at the eight-digit level in the Norwegian Customs tariff. The two last digits constitute a country specific extension of the original six-digit grouping from WCO. In some cases, the eighth digit is used to distinguish between goods subject to duties and/or fees. The Norwegian version is published annually on Statistics Norway (2023d) along with a text version of the nomenclature developed by Statistics Norway. The detailed commodity list, which includes all commodity numbers, also provides information about the validity of each commodity number.

For general look-up of a specific code, Custom Authorities own list can also be used (see Norwegian Customs (2023b)).

Combined (tariff and statistical) Nomenclature (CN)

The Combined nomenclature (CN) is a classification of goods, designed to meet the needs of: (1) the Common customs tariff, setting import duties for products imported into the European Union (EU), as well as the Integrated tariff of the European Communities (Taric), incorporating all EU and trade measures applied to goods imported into and exported out of the EU and (2) the international trade statistics of the EU.

The CN facilitates the collection, exchange, and publication of data on EU international trade statistics. It is also used for the collection and publication of international trade statistics in intra-EU trade.

The CN nomenclature is available from Eurostat's Ramon website (see Eurostat 2023c).

List of Products of the European Community (PRODCOM)

PRODCOM can be applied to both a survey and a nomenclature, but in this project, it has primarily been used with reference to the nomenclature.

The PRODCOM nomenclature currently comprises around 4000 headings relating to industrial products and some industrial services. These products are specified at an eight-digit level, where the initial four digits correspond to the equivalent class in the Statistical classification of economic activities in the European Community (NACE). The subsequent two digits represents subcategories within the Statistical classification of products by activity (CPA). It is worth noting that the majority of PRODCOM headings correspond to one or more Combined nomenclature (CN) codes.

The PRODCOM nomenclature is available from Eurostat (2023c).

3.3. Product groups

Aggregating statistics into product groups may prove useful for several purposes. However, the development of formalised product groups relevant for plastic, is still pending and will be addressed in the future. These future product groups will need to be derived from the CN nomenclature system, which is the endpoint in terms of results at current time.

For now, the result would only be available in the form of product aggregations directly derived from the CN nomenclature, such as the CN sections as illustrated in Table 3.1.

Table 3.1 Sections in the CN-nomenclature.

CN_section_from	CN_section_to	Section	Description
1	5	I	LIVE ANIMALS; ANIMAL PRODUCTS
6	14	II	VEGETABLE PRODUCTS
15	15	III	ANIMAL OR VEGETABLE FATS AND OILS AND THEIR CLEAVAGE PRODUCTS; PREPARED EDIBLE FATS; ANIMAL OR VEGETABLE WAXES
16	24	IV	PREPARED FOODSTUFFS; BEVERAGES, SPIRITS AND VINEGAR; TOBACCO AND MANUFACTURED TOBACCO SUBSTITUTES
25	27	V	MINERAL PRODUCTS
28	38	VI	PRODUCTS OF THE CHEMICAL OR ALLIED INDUSTRIES
39	40	VII	PLASTICS AND ARTICLES THEREOF; RUBBER AND ARTICLES THEREOF
41	43	VIII	RAW HIDES AND SKINS, LEATHER, FURSKINS AND ARTICLES THEREOF; SADDLERY AND HARNESS; TRAVEL GOODS, HANDBAGS AND SIMILAR CONTAINERS; ARTICLES OF ANIMAL GUT (OTHER THAN SILKWORM GUT)
44	46	IX	WOOD AND ARTICLES OF WOOD; WOOD CHARCOAL; CORK AND ARTICLES OF CORK; MANUFACTURES OF STRAW, OF ESPARTO OR OF OTHER PLAINTING MATERIALS; BASKETWARE AND WICKERWORK
47	49	X	PULP OF WOOD OR OF OTHER FIBROUS CELLULOSIC MATERIAL; RECOVERED (WASTE AND SCRAP) PAPER OR PAPERBOARD; PAPER AND PAPERBOARD AND ARTICLES THEREOF
50	63	XI	TEXTILES AND TEXTILE ARTICLES
64	67	XII	FOOTWEAR, HEADGEAR, UMBRELLAS, SUN UMBRELLAS, WALKING STICKS, SEAT-STICKS, WHIPS, RIDING-CROPS AND PARTS THEREOF; PREPARED FEATHERS AND ARTICLES MADE THEREWITH; ARTIFICIAL FLOWERS; ARTICLES OF HUMAN HAIR
68	70	XIII	ARTICLES OF STONE, PLASTER, CEMENT, ASBESTOS, MICA OR SIMILAR MATERIALS; CERAMIC PRODUCTS; GLASS AND GLASSWARE
71	71	XIV	NATURAL OR CULTURED PEARLS, PRECIOUS OR SEMI-PRECIOUS STONES, PRECIOUS METALS, METALS CLAD WITH PRECIOUS METAL, AND ARTICLES THEREOF; IMITATION JEWELLERY; COIN
72	83	XV	BASE METALS AND ARTICLES OF BASE METAL
84	85	XVI	MACHINERY AND MECHANICAL APPLIANCES; ELECTRICAL EQUIPMENT; PARTS THEREOF; SOUND RECORDERS AND REPRODUCERS, TELEVISION IMAGE AND SOUND RECORDERS AND REPRODUCERS, AND PARTS AND ACCESSORIES OF SUCH ARTICLES
86	89	XVII	VEHICLES, AIRCRAFT, VESSELS AND ASSOCIATED TRANSPORT EQUIPMENT
90	92	XVIII	OPTICAL, PHOTOGRAPHIC, CINEMATOGRAPHIC, MEASURING, CHECKING, PRECISION, MEDICAL OR SURGICAL INSTRUMENTS AND APPARATUS; CLOCKS AND WATCHES; MUSICAL INSTRUMENTS; PARTS AND ACCESSORIES THEREOF
93	93	XIX	ARMS AND AMMUNITION; PARTS AND ACCESSORIES THEREOF
94	96	XX	MISCELLANEOUS MANUFACTURED ARTICLES
97	99	XXI	WORKS OF ART, COLLECTORS' PIECES AND ANTIQUES

Source: Eurostat 2023c

These sections of the CN hierarchy are not always relevant to plastic, and future efforts will be made to develop a more adaptable version of product groups. A tentative and draft version of the product groups might look something like this (adjustments may be carried out in the future):

- Packaging
- Household products
- Leisure boat
- Construction
- Automotive
- EE-products
- Agriculture
- Fishing
- Clothing and textiles
- Other products

The process of connecting the CN nomenclature with the future product groups will require some manual updates to maintain the link between the two. The main reason for this is that it is common for the CN nomenclature to undergo some annual updates to its coding framework, and this again will necessarily involve a need for re-connection between new or adjusted codes in CN with the product categories. It is currently around 5 400 CN codes on a six-digit level that needs to be connected to the product groups. The exact workload of this will vary depending on the scale of changes to the CN nomenclature.

3.4. Plastic fraction in products

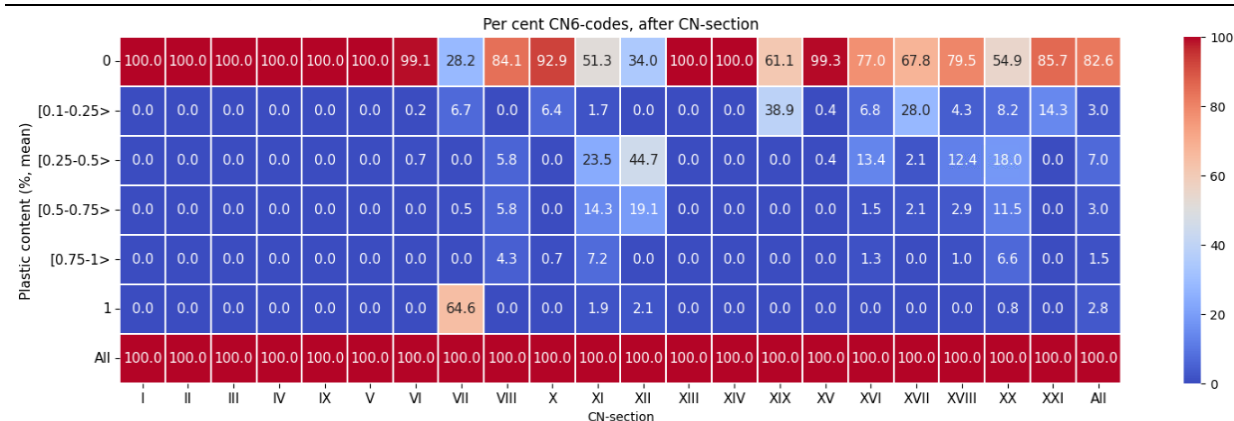
The input data of the model presented here includes a vast range of products and not all products are composed, either fully or partly, of plastic. Thus, it is important to identify and isolate products that contain plastic from the overall supply of products. Furthermore, the model requires the plastic fraction of the different products. This allows for an estimation of the total amount of pure plastic introduced to the Norwegian market. It is important to note that the plastic fraction of products can vary significantly. Consequently, estimating the plastic fraction of mixed products (such as toys, electrical and electronic equipment, textiles etc.) may introduce substantial uncertainty to the estimate.

To address plastic fraction in mixed products, this project relies on existing literature studies that reports plastic fractions in various products (see Amadei et al., 2022; Drewniok et al., 2023; Gravgård et al., 2021). When different references assigned different plastic fraction to the same product code, the average plastic fraction was used. Using the average value ensures a more representative estimation of the plastic fraction for the product. Additionally, it enables the calculation of the uncertainty associated with the plastic fraction to some extent. This information is valuable for conducting further simulations and assessing the potential variation and range of plastic fraction in the analysed products.

It should be noted that while some of the references mentioned above were originally stated in the PRODCOM nomenclature, this project utilises the CN nomenclature at a six-digit level as the baseline. Thus, some conversion was needed to arrive at an input that could readily be used in this project (as already illustrated in Figure 3.1).

The final and complete version of plastic fractions on a CN six-digit level contain around 5 400 codes. Many of them, 82.6 per cent, receive 0 per cent plastic, while 2.8 per cent of them receive 100 per cent plastic (Figure 3.2). The rest is somewhere in the range above 0 or less than 100 per cent.

Figure 3.2 Distribution of plastic fraction of CN codes on 6-digit level within all the in different CN-sections. 2021



Source: Statistics Norway

CN-section VII, Plastic and articles thereof (chapter 39), Rubber and articles thereof (chapter 40), in Figure 3.2 contains not surprisingly the largest share of the pure plastic products, made up from 100 per cent plastic. These plastic products are further differentiated in chapter 3.5.

Details regarding plastic fractions can be found in Appendix A.

3.5. Primary plastic, semi-finished plastic and finished plastic products

Different plastic products can be involved at various stages in the plastic value chain. Chapter 39 of the customs tariff (all CN 39 codes) includes products that are made up from 100 per cent plastic. Some products in this category are considered primary plastics, which is generally not the end-product, but normally enter as input factor in production of finished products. Other products are considered semi-finished or finished products. For the purpose of this report, we have adopted the following categorization, which is also used by Statistics Denmark (Gravgård et al., 2021):

- **39.01.00-39.14.99:** Primary plastics
- **39.15.xx:** Waste plastic (not relevant for products)
- **39.16.00-39.99.99:** Semi-finished and finished plastic products.

As this report focuses on estimating plastic quantities, the codes 39.12.xx and 39.13.xx have been excluded. These codes comprise natural polymers or cellulose, and are not considered as plastic (i.e., synthetic polymers) in this report.

All the remaining products that contain plastic, with CN code outside chapter 39, is categorised as plastic containing products.

3.6. Calculations

Combining data sources

As previously mentioned, the initial data is based on PRODCOM and HS classifications. To facilitate calculations using both data sources, both classifications are converted into a common CN nomenclature.

Main ideas and concepts

The quantity of plastic introduced into the Norwegian market is estimated by first calculating the net supply of goods for each product code (CN) using production, import and export data:

Equation 3-1

$$\text{Net supply of goods} = \text{Domestic production} + \text{import} - \text{export}$$

This is straight forward for products containing 100 percent plastic (e.g., CN 39 codes). However, products containing only parts of plastic must be multiplied by the plastic fraction of the product to isolate the actual plastic from the product:

Equation 3-2

$$\text{Supply of plastic} = \text{Supply of goods} * \frac{\text{plastic fraction (\%)}}{100}$$

Where the plastic fraction is a theoretical value for plastic in the different products.

Monetary values into kilogrammes

An additional challenge lies in the fact that the primary data sources in this context, namely production data and data from the external trade statistics, have undergone thorough quality checks primarily for monetary values, with relatively less emphasis on kilogram units.

With the production data there is also a weakness that kilogram is not always provided in the data and only monetary values have been reported. The presence of this is illustrated in Table 3.2.

Table 3.2 Share of the enterprises reporting values for weight (kg) and monetary values (NOK) in the production data. Percent annually. 2015-2021

UNIT: kg UNIT: NOK	Missing (NaN)			Null (0)			Positive (+)			Total
	Missing	Null (0)	Positive (+)	Missing	Null (0)	Positive (+)	Missing	Null (0)	Positive (+)	
2015			37,5			0,0	1,7		60,8	100,0
2016			37,3			0,0	1,8	0,0	60,8	100,0
2017			37,6			0,1	1,6	0,0	60,7	100,0
2018			38,8			0,2	1,5	0,0	59,5	100,0
2019			36,3			0,0	0,6	0,1	63,0	100,0
2020			36,5			0,1	0,5		62,9	100,0
2021	0,0		37,2			0,1	1,1	0,0	61,6	100,0

Source: Statistics Norway, Production of commodities in manufacturing, mining and quarrying

In 2021, around 62 per cent of the data records contained both values in monetary unit and kilogram, while around 37 per cent lacked kilogram, while they had monetary values. This situation is relatively stable throughout the times series (Table 3.2).

The incompleteness of kilogram values mainly affects the domestic production data. To address this problem, factors in terms of average price (NOK) per kilogrammes are calculated from corresponding products in the external trade data (or production data, if that has been available). These factors are then applied on the domestic production data where necessary to derive kilogram values from monetary data based on the following equation:

Equation 3-3

$$\text{Domestic production (kg)} = \frac{\text{Domestic production (NOK)}}{\text{Factor (NOK/kg)}_{\text{foreign trade}}}$$

In certain circumstances, the conversion factors derived from the external trade statistics can exhibit significant variation in values, which again implies some degree of uncertainty when estimating a value for domestic production in kilogram. For instance, the price per kilo may differ greatly for the same CN-code. This is expected due to potential differences in the price per kilo within the same CN-code, which can occur due to multiple distinct products falling under the same code. To address this variability, the median factor over the past five years is used for each CN-code to estimate the corresponding domestic production quantity of the same products.

3.7. Uncertainty

The uncertainty in this project does not primarily originate from the complexity of the calculations, but rather from the theoretical assumptions made regarding the various reported product categories. This uncertainty arises from factors such as determining the plastic fraction of specific products and converting monetary units into estimated weighted amounts. In addition, there is potential occurrence of double counting instances where the same plastic might be accounted for more than once.

Plastic containing products

A portion of the CN codes are considered plastic containing products, meaning that the product can be a mix of plastic and other components. The process of mapping and deciding which CN codes to include in this category is an ongoing task and may be subject for change in the future. There is a need for more thorough research on these codes, including what their plastic fraction should be on average, and for that reason, the codes ending up in plastic containing product in appendix A and the information in there is most likely not final.

Potential double counting

As mentioned in chapter 3.5, the categorization of plastic at the product level is established based on three overarching categories. These categories are primarily derived from the hierarchical structure of the CN nomenclature.

- Primary plastic
- Semi-finished and finished plastic products
- Plastic containing products

However, it is not as simple as concluding that the total plastic production in Norway is the sum of these categories. The boundaries between the three categories are not always clear-cut. For instance, primary plastic may later be used in production of other products, both plastic containing products and semi-finished and finished plastic products.

The complete lifecycle of plastic is more complex than it initially appears within these three broad groups and potential double counting must be considered when assessing the overall amount of plastic put on the market.

Inflation of the dataset

There is a slight limitation in terms of coverage of the domestic production of commodities. This data covers 90 per cent or more of total production, thus it is not fully complete.

The intention is to further develop the model and correct for the missing 10 per cent. This data gap will be addressed by introducing an estimation procedure that will be implemented into the model in the future. It will possibly involve the use of the business register, to inflate the dataset based on information available there (number of employees or annual turnover).

3.8. Confidentiality

The data used in this project follow some confidentiality considerations, such that detailed information regarding the subjects reporting can be disclosed. The general rule is specified in Statistics Act §7 (Statistics Act, 2019), covering disclosure of information.

Both external trade statistics and production of commodities data need suppression when there is three or fewer registrations, or if one company constitutes 90 or more of the total sum which is to be presented as a separate number in the statistics (same applies if two companies constitutes more than 95 per cent).

Any future publications of plastic statistics based on the above-mentioned data sources must follow the same constraints, and a very detailed aggregation may be problematic as it may conflict with the confidentiality requirements of the underlying statistics.

Most likely, when the plastic statistics mature more in the future, a confidentiality module may need to be included as an integrated part of the data model creating the plastic account. Therefore, only

coarse aggregations have been shared in this report. A possible future product grouping, mentioned in chapter 3.3, will also need to take into consideration confidentiality.

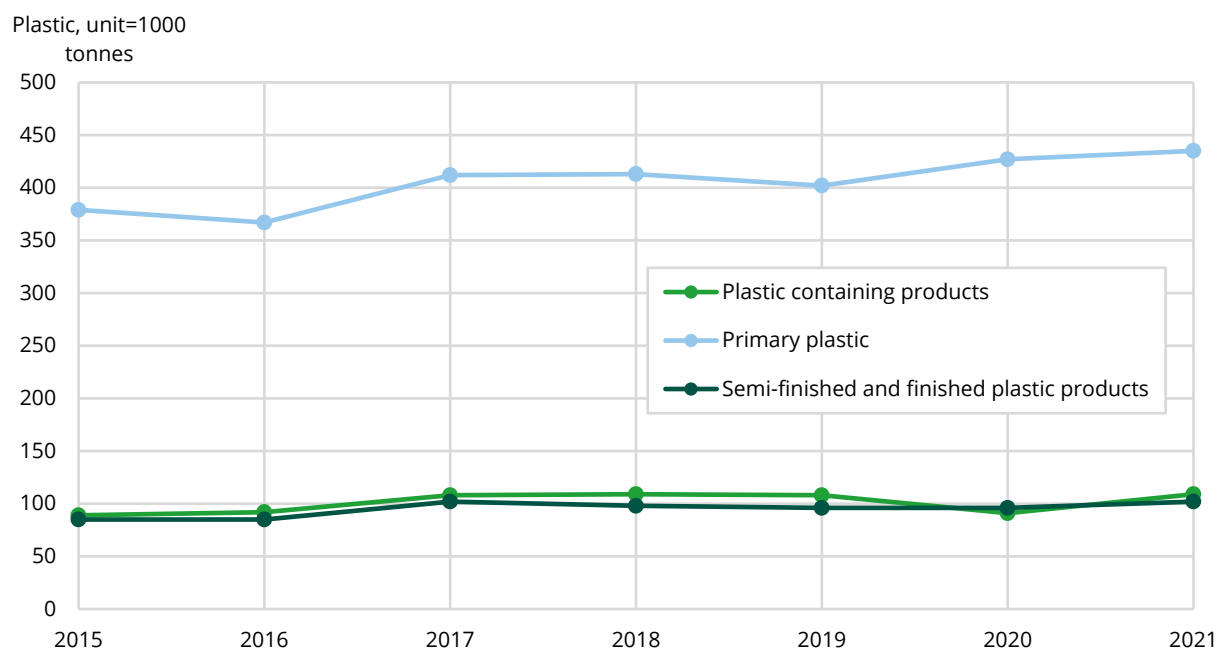
For further information about confidentiality and methods applied in official statistics, see Statistics Norway (2023e).

3.9. Preliminary results

Some preliminary results regarding the product side of plastic are presented here in order to illustrate possible outcomes of the modelling framework as described in the previous chapters. These preliminary results may change in the coming time as the methodology applied may be adjusted and further developed.

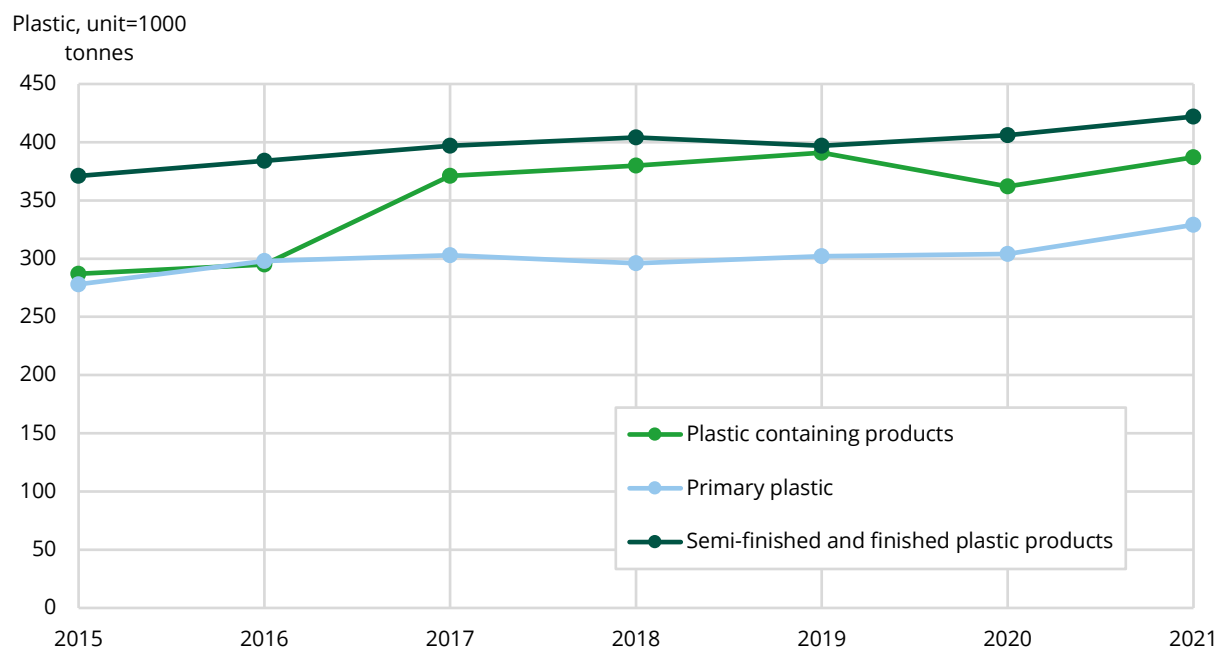
Primary plastic constitutes the largest portion of the plastic exported (Figure 3.3), estimated to be around 435 000 tonnes in 2021. The export of plastic containing products and semi-finished and finished plastic products are lower, with around 110 000 tonnes and 100 000 tonnes respectively.

Figure 3.3 Plastic in exported goods. 1000 tonnes. 2015-2021



Source: Statistics Norway, External trade in goods statistics

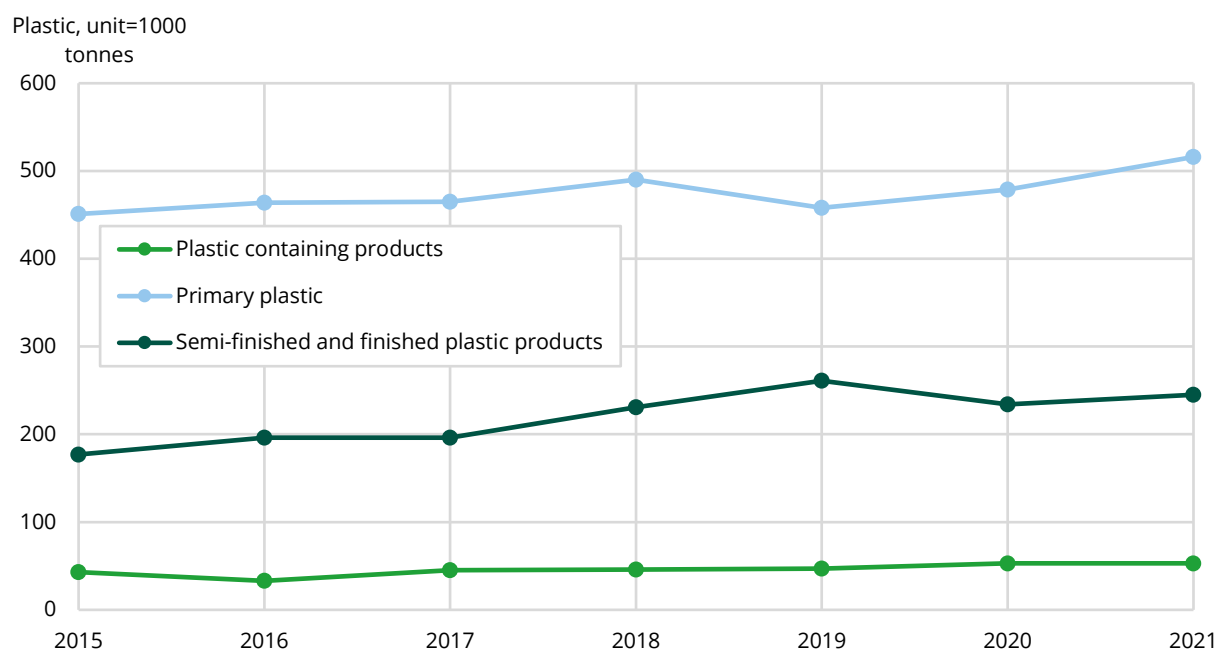
Import of plastic in goods, on the other hand, is more influenced by plastic products entering the country, either in terms of semi-finished and finished plastic products or plastic containing products (Figure 3.4).

Figure 3.4 Plastic in imported goods. 1000 tonnes. 2015-2021

Source: Statistics Norway, External trade in goods statistics

In 2021, import of semi-finished and finished plastic product was estimated to be around 420 000 tonnes, while plastic containing products beeing 390 000 tonnes. Nevertheless, primary plastic still makes up for a large share although there is a large share exported also, alone standing for around 330 000 tonnes.

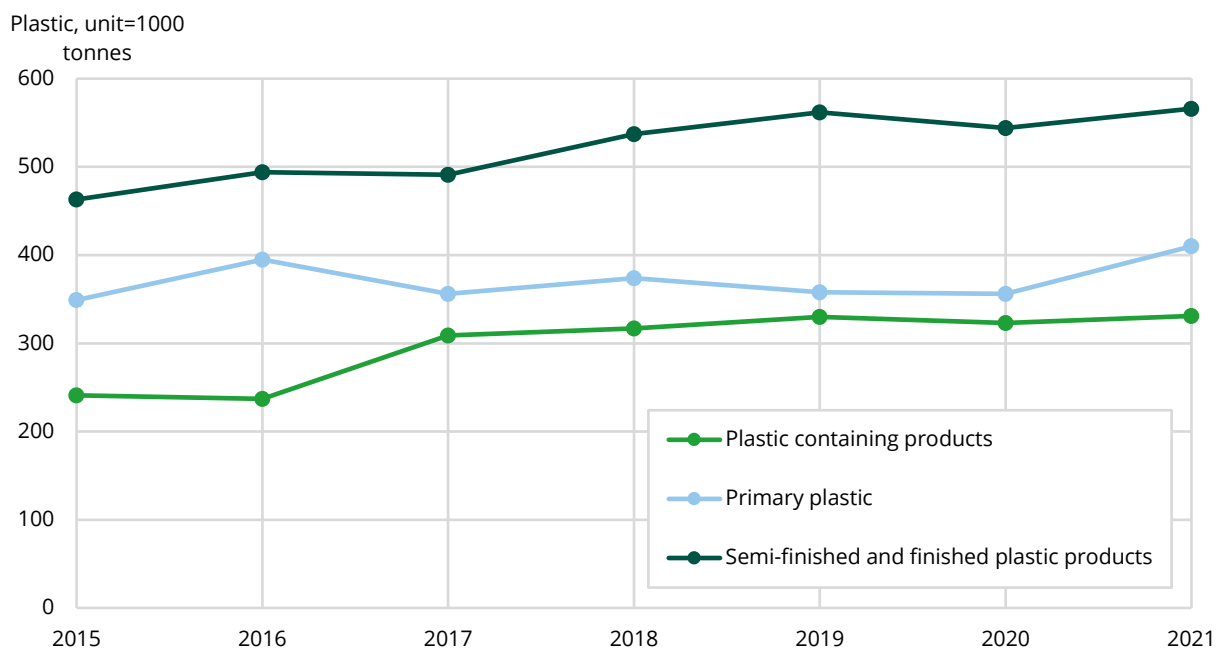
There is a relatively large plastic production situated in Norway, especially in terms of primary plastic (see Figure 3.5). It is estimated here to be around 520 000 tonnes in 2021. Much of this is exported, as illustrated in Figure 3.3.

Figure 3.5 Production of plastic. 1000 tonnes. 2015-2021

Source: Statistics Norway, Production of commodities in manufacturing, mining and quarrying (domestic production)

The total production, import and export are used in order to obtain a net quantity of plastic put on the Norwegian market. This is called “net plastic” (Figure 3.6) and is calculated based on Equation 3-1 (production + import – export).

Figure 3.6 Net plastic. 1000 tonnes. 2015-2021



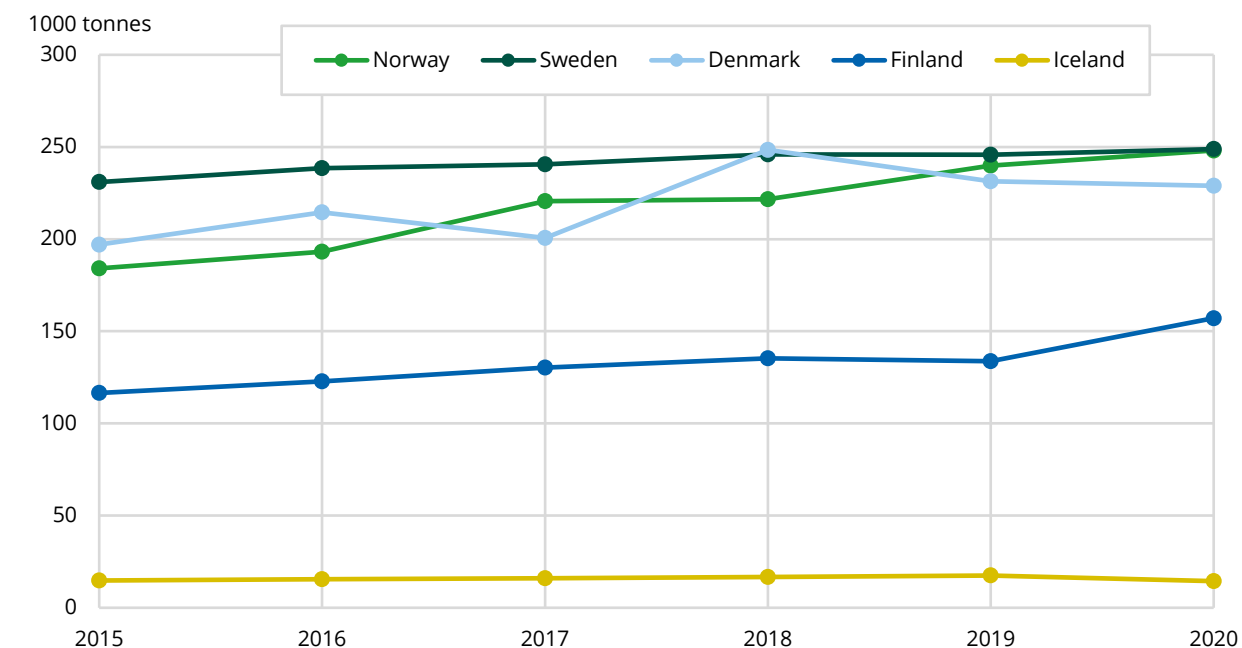
Source: Statistics Norway, (1) External trade in goods statistics and (2) Production of commodities in manufacturing, mining and quarrying (domestic production)

As illustrated in Figure 3.6, semi-finished and finished plastic has the highest amounts in terms of net plastic, with around 570 000 tonnes, well above the 410 000 tonnes that has been estimated on primary plastic and around 330 000 tonnes of plastic from plastic containing products.

The most uncertain category of the three is plastic containing product as the plastic fraction is hard to estimate precisely for all the different products, as mentioned in chapter 3.7.

The amount of plastic from packaging is in this project not directly derived from the model, simply because such data is not readily available based on the input sources. This is a topic that will receive more attention in the future. For now the only relevant datasource available is what can be found in Eurostat (2023a).

Officially reported data on packaging waste from Norway is illustrated in Figure 3.7, along with the result from the rest of the Nordic countries. In 2020, the estimated plastic packaging waste for Norway was 248 000 tonnes, around the same amount as Sweden.

Figure 3.7 Plastic packaging waste. 1000 tonnes. 2015-2020

Source: Eurostat (2023a)

3.10. Recommendations for further work

As stated in the preface, the work presented here is still in the early stages of development. Further verification and testing are required before reaching final conclusions. At this stage, several issues have emerged that underscore the constraints related to the availability of data and operation of the model.

Nomenclatures

The first and most obvious challenge with the data is that it is built around nomenclatures that do not originate around the purpose of measuring the quantity of plastic.

In terms of the nomenclatures, CN, HS and PRODCOM, it would be advantageous if there was a clearer differentiation between finished and end-product. That would make it easier to differentiate what can be added together without the risk of double counting something in the plastic account.

In this project primary plastic has been singled out, which is relatively straight forward. However, there are some CN codes for which it is not clear whether they constitute input factors for other plastic products or if they are final products ready to be sold to the end-consumer. It is important to note that this aspect of the project is still unfinished, and further investigation is required to delve into more details.

Plastic fraction in products

The project relies on information on plastic fraction in various products. It would be beneficial to have more readily available information on the plastic fraction in these products, preferably specified in terms of either PRODCOM or CN codes. The latter is preferred since it is the nomenclature that the results in this project is built on.

However, there is an evident weakness in this approach as the composition of plastic in different products may change over time. Therefore, it would require a considerable effort to consistently keep track of possible changes and update the factors for plastic fraction accordingly.

To capture potential changes in products, it could prove quite elaborate to consistently update the model in terms of plastic fraction in the products. The implementation of international standards or guidelines pertaining to this topic would provide significant assistance. Standardisation of codes and plastic fraction would be of great advantage for international comparisons across countries.

Missing data on packaging

Plastic packaging holds special significance in the context of plastic waste management. However, accurately estimating the quantity of plastic packaging presents a significant challenge. This challenge will further introduce a significant uncertainty in the estimation of total plastic put on the Norwegian market. The problem is particularly caused by "filled packaging," as the weights of the products provided in the data do not account for the packaging that comes along with it.

At present, the best estimate for filled packaging is derived from Eurostat (2023a), an annual reporting to the EU on the amount of packaging waste, including data from Norway (Figure 3.7). However, it is essential to conduct further analysis and evaluate whether adjustments are necessary when using this data with the data used in this project as the same packaging is likely to be accounted for twice.

4. Concluding remarks

Norway has a long experience with official statistics on waste account, including waste streams on plastic waste. The waste account consists of many data sources put together to present the desired level of details or precision in the statistical result. However, it is not complete and requires continuous building and rebuilding to align with the ever-changing waste streams and policy changes.

In this report some supplemental data sources have been investigated to see if they can provide additional information to the existing waste account, with primarily reference to plastic. In addition, an attempt has been made to provide data at product group level. To be able to provide more reliable and accurate data it is important to get access to sorting analysis of mixed waste from more industries. Producer responsibility schemes and other upcoming reporting obligations will also help to provide better data in the coming years.

On the product side, Statistics Norway has attempted to create a draft of a plastic account, and the extension of this is also to dig into the possibility of a new official statistics. It should be stressed that there are parts of the model as presented in this report that will need further development, thus it is not complete.

It is especially plastic fraction in products that proves to be the biggest challenge and need to be addressed properly. There are thousands of product groups from both the PRODCOM and CN/HS-nomenclature that need to be explored in more details and verified that no double counting of the same plastic is taking place. In addition, a more detailed understanding of plastic packaging is needed to obtain accurate estimates of the total plastic amounts.

The overall principle here is to make use of well-established and already existing datasets as input, which is external trade statistics and production data in manufacturing, to investigate the fluxes of plastic in society. It is possible that more data sources will be added to the model later, but for now it has been kept to a minimum to not complicate unnecessarily at an early phase of the project.

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Appendix A: CN-codes on a 6-digit level and corresponding plastic fraction

The CN codes listed below constitute input to the the model for generating plastic as described in chapter 3.

CN6	Plastic fraction	Type of plastic (category)	CN-section
320810	0,26	Plastic containing products	VI - PRODUCTS OF THE CHEMICAL OR ALLIED INDUSTRIES
320820	0,26	Plastic containing products	VI - PRODUCTS OF THE CHEMICAL OR ALLIED INDUSTRIES
320890	0,26	Plastic containing products	VI - PRODUCTS OF THE CHEMICAL OR ALLIED INDUSTRIES
320910	0,26	Plastic containing products	VI - PRODUCTS OF THE CHEMICAL OR ALLIED INDUSTRIES
360300	0,03	Plastic containing products	VI - PRODUCTS OF THE CHEMICAL OR ALLIED INDUSTRIES
370400	0,50	Plastic containing products	VI - PRODUCTS OF THE CHEMICAL OR ALLIED INDUSTRIES
370500	0,50	Plastic containing products	VI - PRODUCTS OF THE CHEMICAL OR ALLIED INDUSTRIES
382510	0,16	Household waste	VI - PRODUCTS OF THE CHEMICAL OR ALLIED INDUSTRIES
390110	1,00	Primary plastic	VII - PLASTICS AND ARTICLES THEREOF; RUBBER AND ARTICLES
390120	1,00	Primary plastic	VII - PLASTICS AND ARTICLES THEREOF; RUBBER AND ARTICLES
390130	1,00	Primary plastic	VII - PLASTICS AND ARTICLES THEREOF; RUBBER AND ARTICLES
390140	1,00	Primary plastic	VII - PLASTICS AND ARTICLES THEREOF; RUBBER AND ARTICLES
390190	1,00	Primary plastic	VII - PLASTICS AND ARTICLES THEREOF; RUBBER AND ARTICLES
390210	1,00	Primary plastic	VII - PLASTICS AND ARTICLES THEREOF; RUBBER AND ARTICLES
390220	1,00	Primary plastic	VII - PLASTICS AND ARTICLES THEREOF; RUBBER AND ARTICLES
390230	1,00	Primary plastic	VII - PLASTICS AND ARTICLES THEREOF; RUBBER AND ARTICLES
390290	1,00	Primary plastic	VII - PLASTICS AND ARTICLES THEREOF; RUBBER AND ARTICLES
390311	1,00	Primary plastic	VII - PLASTICS AND ARTICLES THEREOF; RUBBER AND ARTICLES
390319	1,00	Primary plastic	VII - PLASTICS AND ARTICLES THEREOF; RUBBER AND ARTICLES
390320	1,00	Primary plastic	VII - PLASTICS AND ARTICLES THEREOF; RUBBER AND ARTICLES
390330	1,00	Primary plastic	VII - PLASTICS AND ARTICLES THEREOF; RUBBER AND ARTICLES
390390	1,00	Primary plastic	VII - PLASTICS AND ARTICLES THEREOF; RUBBER AND ARTICLES
390410	1,00	Primary plastic	VII - PLASTICS AND ARTICLES THEREOF; RUBBER AND ARTICLES
390421	1,00	Primary plastic	VII - PLASTICS AND ARTICLES THEREOF; RUBBER AND ARTICLES
390422	1,00	Primary plastic	VII - PLASTICS AND ARTICLES THEREOF; RUBBER AND ARTICLES
390430	1,00	Primary plastic	VII - PLASTICS AND ARTICLES THEREOF; RUBBER AND ARTICLES
390440	1,00	Primary plastic	VII - PLASTICS AND ARTICLES THEREOF; RUBBER AND ARTICLES
390450	1,00	Primary plastic	VII - PLASTICS AND ARTICLES THEREOF; RUBBER AND ARTICLES
390461	1,00	Primary plastic	VII - PLASTICS AND ARTICLES THEREOF; RUBBER AND ARTICLES
390469	1,00	Primary plastic	VII - PLASTICS AND ARTICLES THEREOF; RUBBER AND ARTICLES
390490	1,00	Primary plastic	VII - PLASTICS AND ARTICLES THEREOF; RUBBER AND ARTICLES
390512	1,00	Primary plastic	VII - PLASTICS AND ARTICLES THEREOF; RUBBER AND ARTICLES
390519	1,00	Primary plastic	VII - PLASTICS AND ARTICLES THEREOF; RUBBER AND ARTICLES
390521	1,00	Primary plastic	VII - PLASTICS AND ARTICLES THEREOF; RUBBER AND ARTICLES
390529	1,00	Primary plastic	VII - PLASTICS AND ARTICLES THEREOF; RUBBER AND ARTICLES
390530	1,00	Primary plastic	VII - PLASTICS AND ARTICLES THEREOF; RUBBER AND ARTICLES
390591	1,00	Primary plastic	VII - PLASTICS AND ARTICLES THEREOF; RUBBER AND ARTICLES
390599	1,00	Primary plastic	VII - PLASTICS AND ARTICLES THEREOF; RUBBER AND ARTICLES
390610	1,00	Primary plastic	VII - PLASTICS AND ARTICLES THEREOF; RUBBER AND ARTICLES
390690	1,00	Primary plastic	VII - PLASTICS AND ARTICLES THEREOF; RUBBER AND ARTICLES
390710	1,00	Primary plastic	VII - PLASTICS AND ARTICLES THEREOF; RUBBER AND ARTICLES
390720	1,00	Primary plastic	VII - PLASTICS AND ARTICLES THEREOF; RUBBER AND ARTICLES
390730	1,00	Primary plastic	VII - PLASTICS AND ARTICLES THEREOF; RUBBER AND ARTICLES
390740	1,00	Primary plastic	VII - PLASTICS AND ARTICLES THEREOF; RUBBER AND ARTICLES
390750	1,00	Primary plastic	VII - PLASTICS AND ARTICLES THEREOF; RUBBER AND ARTICLES
390761	1,00	Primary plastic	VII - PLASTICS AND ARTICLES THEREOF; RUBBER AND ARTICLES
390769	1,00	Primary plastic	VII - PLASTICS AND ARTICLES THEREOF; RUBBER AND ARTICLES
390770	1,00	Primary plastic	VII - PLASTICS AND ARTICLES THEREOF; RUBBER AND ARTICLES
390791	1,00	Primary plastic	VII - PLASTICS AND ARTICLES THEREOF; RUBBER AND ARTICLES
390799	1,00	Primary plastic	VII - PLASTICS AND ARTICLES THEREOF; RUBBER AND ARTICLES
390810	1,00	Primary plastic	VII - PLASTICS AND ARTICLES THEREOF; RUBBER AND ARTICLES
390890	1,00	Primary plastic	VII - PLASTICS AND ARTICLES THEREOF; RUBBER AND ARTICLES
390910	1,00	Primary plastic	VII - PLASTICS AND ARTICLES THEREOF; RUBBER AND ARTICLES

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CN6	Plastic fraction	Type of plastic (category)	CN-section
900640	0,48	Plastic containing products	XVIII - OPTICAL, PHOTOGRAPHIC, CINEMATOGRAPHIC, MEASURING,
900651	0,48	Plastic containing products	XVIII - OPTICAL, PHOTOGRAPHIC, CINEMATOGRAPHIC, MEASURING,
900652	0,48	Plastic containing products	XVIII - OPTICAL, PHOTOGRAPHIC, CINEMATOGRAPHIC, MEASURING,
900653	0,48	Plastic containing products	XVIII - OPTICAL, PHOTOGRAPHIC, CINEMATOGRAPHIC, MEASURING,
900659	0,48	Plastic containing products	XVIII - OPTICAL, PHOTOGRAPHIC, CINEMATOGRAPHIC, MEASURING,
901480	0,30	Plastic containing products	XVIII - OPTICAL, PHOTOGRAPHIC, CINEMATOGRAPHIC, MEASURING,
901520	0,30	Plastic containing products	XVIII - OPTICAL, PHOTOGRAPHIC, CINEMATOGRAPHIC, MEASURING,
901540	0,30	Plastic containing products	XVIII - OPTICAL, PHOTOGRAPHIC, CINEMATOGRAPHIC, MEASURING,
901580	0,30	Plastic containing products	XVIII - OPTICAL, PHOTOGRAPHIC, CINEMATOGRAPHIC, MEASURING,
901600	0,21	Plastic containing products	XVIII - OPTICAL, PHOTOGRAPHIC, CINEMATOGRAPHIC, MEASURING,
901831	0,36	Plastic containing products	XVIII - OPTICAL, PHOTOGRAPHIC, CINEMATOGRAPHIC, MEASURING,
901839	0,36	Plastic containing products	XVIII - OPTICAL, PHOTOGRAPHIC, CINEMATOGRAPHIC, MEASURING,
901890	0,17	Plastic containing products	XVIII - OPTICAL, PHOTOGRAPHIC, CINEMATOGRAPHIC, MEASURING,
901910	0,17	Plastic containing products	XVIII - OPTICAL, PHOTOGRAPHIC, CINEMATOGRAPHIC, MEASURING,
902000	0,21	Plastic containing products	XVIII - OPTICAL, PHOTOGRAPHIC, CINEMATOGRAPHIC, MEASURING,
902121	0,66	Plastic containing products	XVIII - OPTICAL, PHOTOGRAPHIC, CINEMATOGRAPHIC, MEASURING,
902300	0,21	Plastic containing products	XVIII - OPTICAL, PHOTOGRAPHIC, CINEMATOGRAPHIC, MEASURING,
902519	0,30	Plastic containing products	XVIII - OPTICAL, PHOTOGRAPHIC, CINEMATOGRAPHIC, MEASURING,
902580	0,60	Plastic containing products	XVIII - OPTICAL, PHOTOGRAPHIC, CINEMATOGRAPHIC, MEASURING,
902610	0,60	Plastic containing products	XVIII - OPTICAL, PHOTOGRAPHIC, CINEMATOGRAPHIC, MEASURING,
902620	0,60	Plastic containing products	XVIII - OPTICAL, PHOTOGRAPHIC, CINEMATOGRAPHIC, MEASURING,
902680	0,60	Plastic containing products	XVIII - OPTICAL, PHOTOGRAPHIC, CINEMATOGRAPHIC, MEASURING,
902710	0,30	Plastic containing products	XVIII - OPTICAL, PHOTOGRAPHIC, CINEMATOGRAPHIC, MEASURING,
902780	0,30	Plastic containing products	XVIII - OPTICAL, PHOTOGRAPHIC, CINEMATOGRAPHIC, MEASURING,
902830	0,30	Plastic containing products	XVIII - OPTICAL, PHOTOGRAPHIC, CINEMATOGRAPHIC, MEASURING,
903020	0,30	Plastic containing products	XVIII - OPTICAL, PHOTOGRAPHIC, CINEMATOGRAPHIC, MEASURING,
903032	0,30	Plastic containing products	XVIII - OPTICAL, PHOTOGRAPHIC, CINEMATOGRAPHIC, MEASURING,
903039	0,30	Plastic containing products	XVIII - OPTICAL, PHOTOGRAPHIC, CINEMATOGRAPHIC, MEASURING,
903040	0,30	Plastic containing products	XVIII - OPTICAL, PHOTOGRAPHIC, CINEMATOGRAPHIC, MEASURING,
903082	0,30	Plastic containing products	XVIII - OPTICAL, PHOTOGRAPHIC, CINEMATOGRAPHIC, MEASURING,
903084	0,30	Plastic containing products	XVIII - OPTICAL, PHOTOGRAPHIC, CINEMATOGRAPHIC, MEASURING,
903089	0,30	Plastic containing products	XVIII - OPTICAL, PHOTOGRAPHIC, CINEMATOGRAPHIC, MEASURING,
903210	0,42	Plastic containing products	XVIII - OPTICAL, PHOTOGRAPHIC, CINEMATOGRAPHIC, MEASURING,

CN6	Plastic fraction	Type of plastic (category)	CN-section
903220	0,30	Plastic containing products	XVIII - OPTICAL, PHOTOGRAPHIC, CINEMATOGRAPHIC, MEASURING,
903289	0,30	Plastic containing products	XVIII - OPTICAL, PHOTOGRAPHIC, CINEMATOGRAPHIC, MEASURING,
903300	0,21	Plastic containing products	XVIII - OPTICAL, PHOTOGRAPHIC, CINEMATOGRAPHIC, MEASURING,
910400	0,21	Plastic containing products	XVIII - OPTICAL, PHOTOGRAPHIC, CINEMATOGRAPHIC, MEASURING,
910700	0,21	Plastic containing products	XVIII - OPTICAL, PHOTOGRAPHIC, CINEMATOGRAPHIC, MEASURING,
920600	0,21	Plastic containing products	XVIII - OPTICAL, PHOTOGRAPHIC, CINEMATOGRAPHIC, MEASURING,
930200	0,03	Plastic containing products	XIX - ARMS AND AMMUNITION; PARTS AND ACCESSORIES THEREOF
930400	0,03	Plastic containing products	XIX - ARMS AND AMMUNITION; PARTS AND ACCESSORIES THEREOF
930621	0,03	Plastic containing products	XIX - ARMS AND AMMUNITION; PARTS AND ACCESSORIES THEREOF
930629	0,03	Plastic containing products	XIX - ARMS AND AMMUNITION; PARTS AND ACCESSORIES THEREOF
930630	0,03	Plastic containing products	XIX - ARMS AND AMMUNITION; PARTS AND ACCESSORIES THEREOF
930690	0,03	Plastic containing products	XIX - ARMS AND AMMUNITION; PARTS AND ACCESSORIES THEREOF
930700	0,03	Plastic containing products	XIX - ARMS AND AMMUNITION; PARTS AND ACCESSORIES THEREOF
940120	0,17	Plastic containing products	XX - MISCELLANEOUS MANUFACTURED ARTICLES
940130	0,17	Plastic containing products	XX - MISCELLANEOUS MANUFACTURED ARTICLES
940140	0,27	Plastic containing products	XX - MISCELLANEOUS MANUFACTURED ARTICLES
940161	0,17	Plastic containing products	XX - MISCELLANEOUS MANUFACTURED ARTICLES
940171	0,17	Plastic containing products	XX - MISCELLANEOUS MANUFACTURED ARTICLES
940310	0,02	Plastic containing products	XX - MISCELLANEOUS MANUFACTURED ARTICLES
940370	0,86	Plastic containing products	XX - MISCELLANEOUS MANUFACTURED ARTICLES
940390	0,50	Plastic containing products	XX - MISCELLANEOUS MANUFACTURED ARTICLES
940421	0,62	Plastic containing products	XX - MISCELLANEOUS MANUFACTURED ARTICLES
940430	0,56	Plastic containing products	XX - MISCELLANEOUS MANUFACTURED ARTICLES
940490	0,31	Plastic containing products	XX - MISCELLANEOUS MANUFACTURED ARTICLES
940592	0,20	Plastic containing products	XX - MISCELLANEOUS MANUFACTURED ARTICLES
940690	0,70	Plastic containing products	XX - MISCELLANEOUS MANUFACTURED ARTICLES
950300	0,84	Plastic containing products	XX - MISCELLANEOUS MANUFACTURED ARTICLES
950420	0,30	Plastic containing products	XX - MISCELLANEOUS MANUFACTURED ARTICLES
950430	0,30	Plastic containing products	XX - MISCELLANEOUS MANUFACTURED ARTICLES
950440	0,30	Plastic containing products	XX - MISCELLANEOUS MANUFACTURED ARTICLES
950450	0,30	Plastic containing products	XX - MISCELLANEOUS MANUFACTURED ARTICLES
950490	0,30	Plastic containing products	XX - MISCELLANEOUS MANUFACTURED ARTICLES
950611	0,39	Plastic containing products	XX - MISCELLANEOUS MANUFACTURED ARTICLES
950631	0,30	Plastic containing products	XX - MISCELLANEOUS MANUFACTURED ARTICLES
950632	0,30	Plastic containing products	XX - MISCELLANEOUS MANUFACTURED ARTICLES
950639	0,30	Plastic containing products	XX - MISCELLANEOUS MANUFACTURED ARTICLES
950640	0,60	Plastic containing products	XX - MISCELLANEOUS MANUFACTURED ARTICLES
950651	0,56	Plastic containing products	XX - MISCELLANEOUS MANUFACTURED ARTICLES
950659	0,56	Plastic containing products	XX - MISCELLANEOUS MANUFACTURED ARTICLES
950661	0,56	Plastic containing products	XX - MISCELLANEOUS MANUFACTURED ARTICLES
950662	0,56	Plastic containing products	XX - MISCELLANEOUS MANUFACTURED ARTICLES
950669	0,56	Plastic containing products	XX - MISCELLANEOUS MANUFACTURED ARTICLES
950699	0,50	Plastic containing products	XX - MISCELLANEOUS MANUFACTURED ARTICLES
950710	0,80	Plastic containing products	XX - MISCELLANEOUS MANUFACTURED ARTICLES
950720	0,80	Plastic containing products	XX - MISCELLANEOUS MANUFACTURED ARTICLES
950730	0,80	Plastic containing products	XX - MISCELLANEOUS MANUFACTURED ARTICLES
950790	0,80	Plastic containing products	XX - MISCELLANEOUS MANUFACTURED ARTICLES
960310	0,10	Plastic containing products	XX - MISCELLANEOUS MANUFACTURED ARTICLES
960321	0,69	Plastic containing products	XX - MISCELLANEOUS MANUFACTURED ARTICLES
960329	0,54	Plastic containing products	XX - MISCELLANEOUS MANUFACTURED ARTICLES
960330	0,47	Plastic containing products	XX - MISCELLANEOUS MANUFACTURED ARTICLES
960340	0,44	Plastic containing products	XX - MISCELLANEOUS MANUFACTURED ARTICLES
960350	0,18	Plastic containing products	XX - MISCELLANEOUS MANUFACTURED ARTICLES
960390	0,49	Plastic containing products	XX - MISCELLANEOUS MANUFACTURED ARTICLES
960500	0,90	Plastic containing products	XX - MISCELLANEOUS MANUFACTURED ARTICLES
960810	0,63	Plastic containing products	XX - MISCELLANEOUS MANUFACTURED ARTICLES

CN6	Plastic fraction	Type of plastic (category)	CN-section
960820	0,59	Plastic containing products	XX - MISCELLANEOUS MANUFACTURED ARTICLES
960840	0,11	Plastic containing products	XX - MISCELLANEOUS MANUFACTURED ARTICLES
960860	0,48	Plastic containing products	XX - MISCELLANEOUS MANUFACTURED ARTICLES
961210	0,65	Plastic containing products	XX - MISCELLANEOUS MANUFACTURED ARTICLES
961310	0,45	Plastic containing products	XX - MISCELLANEOUS MANUFACTURED ARTICLES
961320	0,45	Plastic containing products	XX - MISCELLANEOUS MANUFACTURED ARTICLES
961380	0,45	Plastic containing products	XX - MISCELLANEOUS MANUFACTURED ARTICLES
961511	0,83	Plastic containing products	XX - MISCELLANEOUS MANUFACTURED ARTICLES
961590	1,00	Plastic containing products	XX - MISCELLANEOUS MANUFACTURED ARTICLES
961700	0,18	Plastic containing products	XX - MISCELLANEOUS MANUFACTURED ARTICLES
961800	0,50	Plastic containing products	XX - MISCELLANEOUS MANUFACTURED ARTICLES
961900	0,40	Plastic containing products	XX - MISCELLANEOUS MANUFACTURED ARTICLES
970300	0,11	Plastic containing products	XXI - WORKS OF ART, COLLECTORS PIECES AND ANTIQUES
970500	0,11	Plastic containing products	XXI - WORKS OF ART, COLLECTORS PIECES AND ANTIQUES

Appendix B: CN-codes on a 6-digit level which has not been added to the model

The CN codes listed below has not been considered in the model as described in chapter 3. The reason is primarily due to the somewhat cumbersome unit conversion into kilogrammes.

CN6	CN6 explanatory text	Unit
890110	Cruise ships, excursion boats and similar vessels principally designed for the transport of persons; ferry-boats of all kinds	brutto tonn
890120	Tankers	brutto tonn
890130	Refrigerated vessels (excl. tankers)	brutto tonn
890190	Vessels for the transport of goods and vessels for the transport of both persons and goods (excl. refrigerated vessels, tankers, ferry-boats and vessels principally designed for the transport of persons)	brutto tonn
890200	Fishing vessels; factory ships and other vessels for processing or preserving fishery products (excl. fishing boats for sport)	brutto tonn