

# **Accounts and Indicators for Danish Plastic Flows**

**Physical supply-use tables for plastics 2016  
Circular material use rates for plastics 2011-2019**

**by**

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## Summary

This report uses the physical supply-use table methodology to quantify and map the flows of plastics of the Danish economy. All types of plastic products and waste, inclusive of plastics in composite products and mixed waste, are included in the mapping.

The first part of the report provides a definition and classification of plastics, plastic products and plastic waste. It presents the supply-use methodology and explains how this can be applied to plastic flows. Subsequently three sets of supply-use tables are presented: one for pure plastic products and waste, one for plastics in composite products and mixed waste, and one for all plastic flows in the Danish economy. For pure plastic and waste a few Sankey diagrams are used to give an overview of some of the main flows.

The second part of the report presents calculations of the recycling rate of plastics of the Danish economy. For this purpose, so-called circular material use rates (CMUR) has been estimated based on different datasets and scopes. One version uses Danish waste statistics and international trade statistics. The second version builds on data derived from the supply-use tables for pure plastic products and waste. The third version includes plastics in composite products and recycled plastics in mixed waste in the estimation of circular material use rates.

A few of the facts that can be found in this report are

- The total Danish supply and use of plastics in pure and composite products was 3,2 million tonnes in 2016. Most plastics were found in pure plastic products, less than one third of the total amount of plastics was embedded in composite products.
- Nearly two thirds of plastics in products came from imports and little more than one third from Danish production.
- Imports of plastics in pure and composite products weigh twice as much as the corresponding exports.
- The private and government consumption of plastics is dominated by processed plastic products, although there is also a considerable amount of plastics embedded in the consumption of composite products.
- The total amount of plastics in waste flows were 1.1 million tonnes. Approximately 80 per cent were embedded in mixed waste and approximately 20 per cent in waste sorted specifically for recycling.
- Almost 480 000 tonnes of plastic in waste were incinerated in Denmark and ended as air emissions to the atmosphere or other residues.
- The Danish circular material use rates for pure plastic has followed an overall increasing trend in the period 2011-2019. It was approaching 12 per cent in 2019.
- When composite products are taken into account the circular material use rate increases to 12.7 per cent compared to 11.5 per cent for pure plastic products for 2016.

# 1. Introduction

Plastics and circular economy are two issues, which have high priorities on the agenda at EU level and in most European countries. At EU level it is demonstrated by the *EU Strategy for Plastics in a Circular Economy*<sup>1</sup> and the *Circular Economy Package*<sup>2</sup>.

Pursuing the strategies for plastics and circular economy requires information systems and monitoring frameworks, which enables policy makers and others to analyse and follow the development towards circular economies.

In that context this report describes the results of project carried out at Statistics Denmark to develop detailed Danish material flow accounts for plastics measured in tonnes and a so-called circular material use rate indicator (CMUR) for plastics. Part of the work has also been to gain experience with the use of Sankey-diagrams for the presentation of the often quite complicated material flow patterns.

The project has aimed to collect relevant statistical data for flows of plastics and to bring them together into a supply-use framework consistent with the guidelines of environmental-economic accounts, SEEA CF (UN et al, 2012). This provides a new and coherent information tool for plastics, which up to now has been missing in Denmark and other countries.

The work has only been made possible thanks to a grant from the European Commission – Eurostat.<sup>3</sup>

It must be underlined that results presented in this report should be used with some caution. Many of the data are the result of first estimations and involve the use of assumptions and shortcuts. It has not been possible within the scope and resources available for the project to make a complete quality check of all data. Also for that reason some of the data may therefore conflict with data from other sources.

The many uncertainties and preliminary status of the accounts for plastic flows is also one reason for not presenting the results at the most detailed level. The accounts have been established at a very detailed level including 117 industries and almost 2000 products and types of waste. In this report data are presented at a much more aggregated level including 10 industry groups and approximately 60 product and waste groups. Another reason for this, of course, is that it is not possible in a meaningful way to present such detailed data within a report.

Chapter 2 in this report describe the main material groups, and the data and estimation procedures used to establish the physical material flow accounts/supply-use tables for plastics.

Chapter 3 presents the supply-use tables for plastic products and plastic waste (pure plastics). Sankey-diagrams are used to highlight some of the main flows of plastics. To further highlight some of the main flows and to illustrate the multitude of information that can be derived from physical supply-use tables a separate section describes some of the characteristics of Danish flows of pure plastic products and plastic waste.

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<sup>1</sup> <https://eur-lex.europa.eu/legal-content/EN/TXT/?qid=1516265440535&uri=COM:2018:28:FIN>

<sup>2</sup> [https://ec.europa.eu/environment/circular-economy/first\\_circular\\_economy\\_action\\_plan.html](https://ec.europa.eu/environment/circular-economy/first_circular_economy_action_plan.html)

<sup>3</sup> However, the content of this report represents the views of the authors only and is his/her sole responsibility. The European Commission does not accept any responsibility for use that may be made of the information it contains.

Chapter 4 includes supply-use tables for plastics embedded in composite products and mixed waste, i.e. products and waste consisting of different material types, including some plastics. Examples are household machines and mixed municipal waste, respectively. The chapter includes also a description of the characteristics of the main flows of plastics embedded in such products and waste fractions.

Chapter 5 reconciles the data from chapters 3 and 4, i.e. it accounts for all plastics, whether it is in the form of pure products and waste or it is embedded in composite products and mixed waste. Reconciling the data from chapter 3 and 4 makes it clear that it is necessary to introduce so-called balancing items, which capture flows that has otherwise not been included, but also uncertainties and statistical differences.

Chapter 6 deals with indicators for the circular use of plastics. A Danish *circular material use rate* (CMUR) for plastics is calculated, using two different data sets. A set of CMUR for 2011-2019 is presented using data from trade and waste statistics. IN addition, a CMUR for 2016 based the supply-use tables in chapter 3 for pure plastic products is calculated. Finally, a CMUR for 2016 including plastics in composite products and mixed waste is estimated based on the data in chapter 3 and 4. It is compared to the other CMU rates and followed by some concluding remarks on the interpretations of the indicator.

## 2. Supply-use tables for plastics - methodology and data

### 2.1. Definitions and classifications

#### ***Plastics***

In order to map and quantify the plastic flows of the Danish economy, it is useful to apply a basic definition of plastics. Hence, the following definition has served as a guideline to the project.

*Plastics are materials made of synthetic polymers.*

The most common synthetic polymers are made from crude oil and natural gas. Some well-known types of synthetic polymers are *polyethylene*, *polystyrene* and *polypropylene*, which are the main ingredients in multiple different plastic products. There are, however, numerous other synthetic polymers, and the list of different plastic types is long.

Some synthetic polymers are made from chemical substances such as *melamin*, *formaldehyde* and *phenol*. In this report, these polymers are also considered ingredients of plastics.

So-called natural polymers such as diamonds and graphite are not included in the list of relevant polymers. Furthermore, cellulose, which is made from various types of biomass, is also not considered a plastic material in this report.

#### ***Plastic products***

Two types of plastic products are distinguished in this his report: *raw plastic products* and *processed plastic products*.

Raw plastic products consist of unprocessed synthetic polymers (granules), which can be moulded into a very wide range of different plastic products.

Processed plastic products are processed products that only consist of plastics. Examples of products in this category are plastic chairs, pipes and boxes made of synthetic polymers.

Together, the two categories, raw and processed plastic products, are called pure plastic products in this report.

In practice, the raw and processed plastic products have been identified in the basic statistics (statistics on international trade and production) as chapter 39 in the *Combined Nomenclature*. The raw plastic products are found within the four digit groups 3901-3914, and the processed products within groups 3916-3926. In addition, a few other product groups, plastic toys and some electrical appliances, have been included in the supply-use tables as pure plastic products.

Plastic packaging is a specific type of processed plastic products, which are of particular interest, and in this project we have included two types of plastic packaging: *empty plastic packaging products*, (plastic films, boxes, sacks etc.) and *filled plastic packaging*.

While, in principle, empty and filled packaging are fundamentally the same plastic products<sup>4</sup>, it is important to explicitly include filled plastic packaging in order to obtain a complete picture of the plastic packaging flows from the production or imports through use in industries, delivery to other industries and households to the disposal phase and generation of waste.

### ***Plastic waste***

Part of the discarded plastic from industries and households is sorted from other types of waste. The Danish *waste statistics* from the Danish Environmental Protection Agency and *the waste accounts* from Statistics Denmark record the following types of plastic waste: *Plastic packaging waste*, *PVC*, and (*sorted*) *plastic waste*. Further, a distinction is made between hazardous and non-hazardous plastic waste. However, since the amounts of hazardous plastic waste are tiny, no distinction is made between hazardous and non-hazardous waste at the presentation level in this report.

In addition to the waste recorded in the waste statistics and the waste accounts, data from the international trade statistics and production statistics give information on additional flows of plastic waste. This may to some extent be flows that are not captured by the waste statistics and waste accounts, but it can also be assumed to be secondary waste flows, i.e. flows of plastics that has been treated and made ready for re-cycling. This type of waste is called *waste products and scrap of plastics, n.e.c.* in the following.

### ***Plastics in composite products***

Plastics are also found in a large number of *composite products* i.e. *products* composed of different materials such as metal, wood, non-metallic minerals and plastics. Examples of such composite products are cars, refrigerators and computers.

There are no primary statistical data or classification that can be used to identify these composite products. Therefore, we have gone through all items in the classification of

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<sup>4</sup> For the supply-use tables the Danish production of filled packaging is estimated based on industries' use of empty packaging, but taking into consideration that some empty packaging is used as inputs for further processing. Data for flows of filled packaging associated with international trade are obtained from a report (in Danish) on packaging from the Danish Environmental Protection Agency, <https://www2.mst.dk/Udgiv/publikationer/2019/11/978-87-7038-120-8.pdf>.

products used for the monetary supply-use tables of the national accounts and the general physical supply-use tables for Denmark (see section 2.3). This classification include approximately 1900 goods at a level comparable with the four digit level of the *Combined Nomenclature*. This number was then narrowed down to 660 composite product groups with a partial content of plastics. For each of these product groups the plastic content was estimated (see section 2.4). For the presentation in this report the 660 composite product groups have been aggregated to the two-digit level of the *Classification of Products by Activity in the European Union (CPA)*.

### ***Mixed waste with plastics***

In addition to the “pure” plastic waste fractions, which are collected from industries and households as well as imported and exported, plastics is also included in mixed fractions of waste, for instance, mixed municipal waste. Plastics in mixed waste include recyclable plastics (sorted incorrectly) as well as contaminated or mixed materials not suitable for recycling. Similar to the plastic content in composite products no primary statistics include information on the plastic content in these fractions. The general physical supply and use tables for Denmark (see section 2.3) include 66 different waste fraction. We identified half of them as mixed waste fractions that include some plastics and estimated the amount of plastics in each of them. For this report the approximately 30 groups of mixed waste have been aggregated to 8 groups of mixed waste with plastics embedded.

## **2.2. Short introduction to physical supply-use tables**

The supply-use table methodology is well developed and has shown its relevance and suitability for many years in relation to the national accounts (monetary flows) and in also in relation to physical accounts, especially for energy.

The general purpose of the physical supply-use tables is to shed light on the type and quantity of materials (natural resources, goods, waste and other residuals) linked to the activities of industries and the consumption of households and government, etc. As the name indicates, there are two separate tables, one describing the supply of products/materials, etc., and one describing the use of the same products/materials.

The headings (columns) of the tables (see for instance table 1 below) include the activities/units in the economy by listing all industries as well as categories for private and government consumption, accumulation (inventories and capital formation) and the rest of the world (imports and exports). In the physical supply table, these categories represent the origin (production and imports, etc.) of the material flows, and in the use table, they represent the destination (intermediation consumption, exports, consumption, etc.).

The category ‘The environment’ is also often found in the headings of physical supply/use table in order to make an explicit recording of the flows of natural resources that comes from nature, and the flows of air emission, etc. that flows back to the environment. To simplify the tables in this report we do not introduce the environment separately as a category, but see it as part of the accumulation category in the tables<sup>5</sup>.

The leading column (rows) include the product or materials that are of interest. Three main groups of materials are found in generic physical supply-use tables: Natural resources, products (goods) and residuals. However, when it comes to specific physical supply-use tables focusing on a subset of materials (such as plastics) it is not always relevant to include natural resources as a category in the tables. Therefore, the tables

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<sup>5</sup> In practice the only consequence of this is that air emissions from incineration of plastics are recorded as flowing to the accumulation category in the use tables (see table 4).

presented below does only include products and residuals. Residuals is the generic term used in physical supply-use tables for waste and air emissions, etc.

It is an essential feature of supply and use tables that they include bookkeeping identities. For the physical supply-use tables this means that if all relevant materials and flows have been recorded the supply and use should balance.

For each of the activities along the heading, i.e. each of the industries and the consumption categories, the total inputs (intermediate consumption, private consumption, etc.) of materials should match exactly with the total outputs (outputs of goods and residuals).

For each group of natural resources, products or residuals specified in the tables the balancing principle means that the total supply (extraction, production, imports, etc.) of the material group should match the total use (intermediate consumption, private and government consumption, exports, accumulation).

The advantage of organising data within supply-use tables and applying the bookkeeping identities is that it is often possible to identify and estimate otherwise missing data from the data that are recorded in the tables. Often these estimates for missing data (as well as uncertainties involved) are introduced in the tables as so-called balancing items, i.e. items that ensures that there is a balance between supply and use of materials.

### **2.3. Physical supply and use tables for all products**

Statistics Denmark has published a first set of complete physical-supply use tables for Denmark for 2016 as part of the development of a comprehensive set of environmental-economic accounts according to SEEA CF. These physical supply and use tables in tonnes include all supply and use of natural resources extracted from the Danish nature and all types of goods and residuals.

At the most detailed level they include approximately 1900 goods, 26 types of natural resources and 130 types of residuals, 117 industries and various groups of final consumption. Due to the uncertainty on data at this level the Danish physical supply-use tables are however only published by 182 material types and 76 supply/use categories<sup>6</sup>.

The complete physical supply-use tables are the starting point for the supply-use tables for plastics presented in this report.

### **2.4. Method for the construction of supply-use tables for plastics.**

The physical supply and use tables for plastics are based partly by extracting the relevant data for pure plastic products as a subset of the complete physical supply and use tables mentioned in section 2.3. This subset is identified by using the codes for plastic products in the combined nomenclature and the relevant plastic fractions from the Danish waste accounts (see section 2.1).

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<sup>6</sup> The physical supply-use tables are available at [www.statbank.dk](http://www.statbank.dk) -> Geography, environment and energy -> Environmental-Economic Accounts -> Material flows and waste -> Detailed material flow accounts (physical supply-use tables). The tables can also be accessed directly as [www.statbank.dk/DMR3T](http://www.statbank.dk/DMR3T) and [www.statbank.dk/DMR3A](http://www.statbank.dk/DMR3A). A short documentation of the tables, the basic data behind them and the methodology for the construction can be found in the [Documentation of PSUT](#).



In addition, the plastic content of composite products and mixed waste are estimated by using the rest (i.e. the non-plastic part) of the complete physical supply use tables. Each of the (non-plastic) products and waste types are multiplied by a percentage for the plastic content in the products or waste. In principle, each product and each type of waste is assigned a specific percentage for the waste content. However, in practise, similar product types are often assigned the same percentage depending on the available information. For instance, the same average percentage has been assigned to a range of different types of machinery although there is of course variations in the actual plastic content of different types of machineries.

Altogether, approximately 40 different sources (reports, research articles, environmental reports websites) have been used to identify or estimate percentages for the plastic content in different products and waste fractions.

The procedure has led to the identification of 660 composite product groups and 30 waste fractions with a partial content of plastics. The rest of the goods and waste types were products assumed to be without any plastics embedded.

It should be noted that the estimation procedure we have used assumes that the same percentage apply across all types of supply and use of the specific composite product or waste type. Especially for the mixed waste this may not apply, and during the final reconciliation procedure, some upward adjustments were made of the plastic content in mixed waste from households. This was necessary since the numbers for household consumption of pure and composite products indicated that the plastic content was higher than we first assumed based on the sources.

### **3. Plastic products and waste**

#### **3.1. Supply-use tables**

Table 1 and 2 present the supply and use tables for plastic products and plastic waste.

As mentioned in Section 2.1, two types of plastic products are distinguished: raw plastics and processed plastic products. The data on raw plastic products are presented in the top of the tables in the light green areas. Data on processed plastic products are presented in the darker green area. Plastic waste is represented in the bottom part of the tables marked with the darkest green colour. Each of the categories are divided into more specific product or waste types.

The supply table and the use table include the same categories in the headings/columns. The first column (with numbers) is total supply and total use, respectively. Total use equals total supply for each plastic product and each waste type.

The second column in the supply table shows imports in the supply table and exports in the use table.

The third column represents households and individual government consumption. No production of plastic products takes place in relation to household and government consumption and only waste flows are represented in this column in the supply table. In contrast, the column in the use table shows the weight of primarily processed plastic products used for private and government consumption.

The fourth column is related to the flows of plastic products and plastic waste, which are either drawn from accumulations in the economy or added to the accumulations.

Accumulations are first of all inventories, capital equipment and waste deposits. When plastic products are withdrawn from inventories, it is shown in the supply table. Products added to inventories and products used for capital formation is recorded in the use table. Plastic waste, which is deposited is also shown as accumulation in the use table<sup>7</sup>.

The remaining columns represent flows from and to the industries. The fifth column in the supply tables include the production of plastic products and generation of waste from all industries in total, while the following columns shows the corresponding output from individual industries. Similarly, the fifth column in the use table shows intermediate consumption of plastic products and plastic waste, and the following columns the intermediate consumption of individual industries.

A graphical illustration of the overall data contained in the supply-use tables is given in figure 1, which maps the the inflow and outflow of plastic products and plastic waste for eight aggregated “sectors” (industries private and government consumption, accumulation and the rest of the world). For practical purposes, the figure employs a slightly different industrial breakdown, than the one, which can be found in the supply-use tables. Each inflow and outflow is divided into five different categories of plastic products including raw, processed, empty and filled packaging, and waste.

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<sup>7</sup> The convention for supply-use tables is to record net changes in accumulations (net changes in inventories and acquisitions less disposals of capital goods) in the use tables as negative or positive numbers. However, we deviate from this convention since it is not possible to represent negative numbers in e.g. Sankey diagrams. In addition, difficult numbers are more difficult to understand in relation to physical flows.

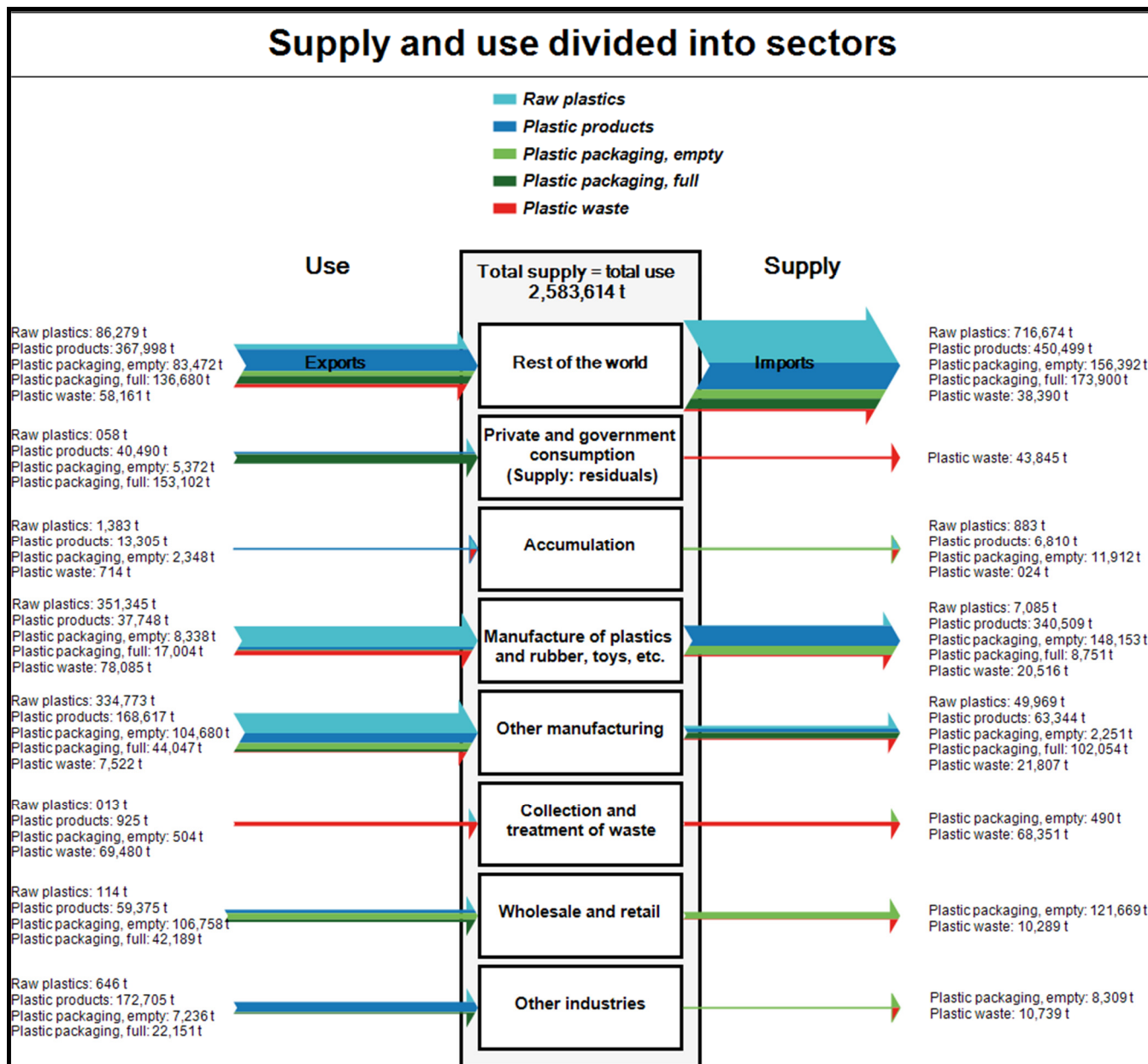
Table 1

Supply table for plastic products and waste 2016, tonnes			Total supply	Imports	Residuals from private and government consumption	From accumulation	Output from industries										
							Total	Manufacture of food products and beverages	Manufacture of textiles	Manufacture of basic chemicals	Manufacture of paints and soap, etc.	Manufacture of plastics and rubber, etc.	Manufacture of toys, etc.	Other manufacturing	Collection and treatment of waste	Wholesale and retail	Other industries
							CA12	CB13	CE10	CE20	CG22	CM32	C099	E380	G467	X000	
<b>Total supply</b>			<b>2 583 614</b>	<b>1 535 855</b>	<b>43 845</b>	<b>19 629</b>	<b>984 286</b>	<b>57 705</b>	<b>45 489</b>	<b>48 574</b>	<b>24 129</b>	<b>470 294</b>	<b>54 720</b>	<b>63 528</b>	<b>68 841</b>	<b>131 958</b>	<b>19 048</b>
<b>Total raw plastic products</b>			<b>774 611</b>	<b>716 674</b>		<b>883</b>	<b>57 054</b>			<b>43 105</b>	<b>5 859</b>	<b>7 085</b>		<b>1 005</b>			
Raw plastic products	A3901	Ethylene in primary forms	197 808	191 734		680	5 394			2 496		2 797		101			
	A3902	Propylene in primary forms	196 657	189 505			7 152			2 234	4 918						
	A3903	Polystyrene in primary forms	68 557	67 543			1 014			1 014							
	A3904	Polyvinyl chloride in primary forms	40 813	40 659		150	4			4							
	A3905	Other vinyl polymers in primary forms	16 986	16 803			183			183							
	A3906	Acrylic polymers in primary forms	50 186	50 075			111			2	107			2			
	A3907	Polyether, polyethylen, polyester, etc. in primary forms	113 164	111 845		13	1 306			111	292	2		901			
	A3908	Polyamides, in primary forms	15 892	15 835			57			53	4						
	A3909	Amino and phenolic resins, polyurethanes, etc. in primary forms	71 662	30 143		40	41 479			37 190	2	4 286		1			
	A3910	Silicones, in primary forms	2 144	1 790			354			1	353						
A3914	Ion-exchangers based on polymers	742	742														
<b>Total processed plastic products</b>			<b>1 595 042</b>	<b>780 791</b>		<b>18 722</b>	<b>795 530</b>	<b>53 883</b>	<b>45 080</b>	<b>4 507</b>	<b>17 542</b>	<b>443 621</b>	<b>53 792</b>	<b>46 637</b>	<b>490</b>	<b>121 669</b>	<b>8 309</b>
Processed plastic products	B3916	Rods, sticks and profile shapes of plastics	12 054	7 117			4 937					1 229		3 708			
	B3917	Tubes, pipes and fittings, etc. of plastics	132 764	51 549		151	81 064					75 407	380	5 277			
	B3918	Floor, wall or ceiling coverings of plastics	19 787	19 774		5	8							8			
	B3919	Self-adhesive plates, strips, etc. of plastics	47 201	22 812		497	23 892	790				22 413		689			
	B3920	Plates, sheets, film, foil and strips of plastics	304 658	183 661		5 980	115 017	55	26		2	111 876		3 058			
	B3922	Baths, shower-baths, sinks, lavatory pans, seats, etc. of plastics	8 803	5 493			3 310					3 310					
	B3923e	Packaging (empty) of plastics	318 708	156 392		11 912	150 404	144	10	28	146	148 065	88	1 923			
	B3923f	Packaging of plastics, filled	415 173	173 900			241 273	53 733	473	4 453	16 478	4 043	4 708	26 917	490	121 669	8 309
	B3924	Tableware, kitchenware and household articles of plastics	39 166	36 189		2	2 975	6	196		93	1 926	718	36			
	B3925	Reservoirs, tanks, doors, windows, etc. of plastics	29 942	9 696		139	20 108					18 615	2	1 491			
B3926	Apparel, clothing accessories and other goods of plastics	131 019	71 551		34	59 434		9			56 583	75	2 767				
B5603	Nonwoven of filaments	64 513	19 840			44 673		43 547			823		303				
B899	Toys and other goods of plastics, n.e.c.	71 254	22 817		2	48 435					154	47 518	763				
<b>Total plastic waste</b>			<b>213 961</b>	<b>38 390</b>	<b>43 845</b>	<b>24</b>	<b>131 702</b>	<b>3 822</b>	<b>409</b>	<b>962</b>	<b>728</b>	<b>19 588</b>	<b>928</b>	<b>15 886</b>	<b>68 351</b>	<b>10 289</b>	<b>10 739</b>
Plastic waste (sorted)	WP0039	Waste products and scrap of plastics, n.e.c.	98 109	25 267		24	72 818			17		4 086		2 222	66 493		
	WP1450	Sorted plastic waste	60 002	9 282	15 822		34 898	1 304	345	873	113	12 713	861	9 747	1 779	3 462	3 701
	WP1454	PVC waste	5 834		2 059		3 775	1				31	1	174	1	83	3 484
	WP1457	Plastic packaging waste	50 016	3 841	25 964		20 211	2 517	64	72	615	2 758	66	3 743	78	6 744	3 554

**Table 2**

Use Table for plastic products and waste, 2016, tonnes			Total use	Exports	Private and government consumption	To accumulation	Intermediate consumption										
							Total	Manufacture of food products and beverages	Manufacture of textiles	Manufacture of basic chemicals	Manufacture of paints and soap, etc.	Manufacture of plastics and rubber, etc.	Manufacture of toys, etc.	Other manufacturing	Collection and treatment of waste	Wholesale and retail	Other industries
							CA12	CB13	CE10	CE20	CG22	CM32	C099	E380	G467	X000	
		<b>Total use</b>	<b>2 583 616</b>	<b>732 590</b>	<b>199 022</b>	<b>17 750</b>	<b>1 634 255</b>	<b>107 465</b>	<b>65 063</b>	<b>29 123</b>	<b>104 257</b>	<b>432 394</b>	<b>60 126</b>	<b>353 732</b>	<b>70 922</b>	<b>208 436</b>	<b>202 738</b>
		<b>Total raw plastic products</b>	<b>774 611</b>	<b>86 279</b>	<b>58</b>	<b>1 383</b>	<b>686 891</b>	<b>381</b>	<b>58 872</b>	<b>15 731</b>	<b>80 940</b>	<b>296 854</b>	<b>54 491</b>	<b>178 849</b>	<b>13</b>	<b>114</b>	<b>646</b>
Raw plastic products	A3901	Ethylene in primary forms	197 808	19 984		45	177 779	138	629	4 931	34 339	98 343	1 182	38 202			15
	A3902	Propylene in primary forms	196 657	25 131		532	170 994		56 043	3 421	17 427	76 363	2 367	15 330			43
	A3903	Polystyrene in primary forms	68 557	2 803		213	65 541		282	345	374	32 756	29 107	2 661			16
	A3904	Polyvinyl chloride in primary forms	40 813	3 085		27	37 701		153	238	3 086	25 078	23	9 123			
	A3905	Other vinyl polymers in primary forms	16 986	3 824		72	13 090	80	17	558	1 987	877	127	8 980	10	98	356
	A3906	Acrylic polymers in primary forms	50 186	2 559		350	47 277	72	315	2 153	3 144	5 932	409	35 251			1
	A3907	Polyether, polyethylen, polyester, etc. in primary forms	113 164	15 070		9	98 085	78	1 334	2 082	9 306	26 312	13 298	45 621			54
	A3908	Polyamides, in primary forms	15 892	4 038		43	11 811			33	424	2 387	7 794	1 173			
	A3909	Amino and phenolic resins, polyurethanes, etc. in primary forms	71 662	9 063		64	62 535		95	1 785	10 335	28 310	183	21 748			79
	A3910	Silicones, in primary forms	2 144	444	58	28	1 614	1	4	93	466	418		621			11
A3914	Ion-exchangers based on polymers	742	278			464	12		92	52	78	1	139	3	16	71	
		<b>Total processed plastic products</b>	<b>1 595 043</b>	<b>588 150</b>	<b>198 964</b>	<b>15 653</b>	<b>792 277</b>	<b>107 084</b>	<b>6 042</b>	<b>8 295</b>	<b>23 317</b>	<b>57 455</b>	<b>5 635</b>	<b>172 607</b>	<b>1 429</b>	<b>208 322</b>	<b>202 092</b>
Processed plastic products	B3916	Rods, sticks and profile shapes of plastics	12 054	10 714	15	49	1 276	9	64	2	2	354	19	635	2	9	180
	B3917	Tubes, pipes and fittings, etc. of plastics	132 764	35 215	4 510	2 565	90 474	829	633	217	64	6 347	219	22 574	254	1 782	57 555
	B3918	Floor,wall or ceiling coverings of plastics	19 787	1 629	2 726	11	15 421	15	33	4	1	3	1	2 597	4	1 647	11 116
	B3919	Self-adhesive plates, strips, etc. of plastics	47 201	19 101	810	83	27 207	4 590	197	1 201	168	3 666	20	9 819	25	3 617	3 904
	B3920	Plates, sheets, film, foil and strips of plastics	304 658	122 052	5 301	2 929	174 376	29 168	2 857	1 461	2 454	23 453	210	48 909	113	49 511	16 240
	B3922	Baths, shower-baths, sinks,lavatory pans, seats, etc. of plastics	8 803	5 719	552	736	1 796					177		51			1 568
	B3923e	Packaging (empty) of plastics	318 708	83 472	5 372	2 348	227 516	54 296	478	4 503	16 648	4 088	4 250	28 755	504	106 758	7 236
	B3923f	Packaging of plastics, filled	415 173	136 680	153 102		125 391	15 793	402	433	3 839	16 584	420	23 580		42 189	22 151
	B3924	Tableware, kitchenware and household articles of plastics	39 166	19 979	9 353	787	9 047	648		12	8	20	114	492	23	227	7 503
	B3925	Reservoirs, tanks, doors, windows, etc.of plastics	29 942	4 393	1 508	992	23 050	37	1	11	2	610	12	2 611	10	35	19 722
	B3926	Apparel, clothing accessories and other goods of plastics	131 019	45 578	5 027	750	79 664	1 699	165	448	128	1 609	369	24 511	494	2 547	47 694
	B5603	Nonwoven of filaments	64 514	53 261	302	747	10 204		1 212	3	3	543		7 721			722
	B899	Toys and other goods of plastics, n.e.c.	71 254	50 357	10 386	3 656	6 855					1	1	352			6 501
			<b>Total plastic waste</b>	<b>213 962</b>	<b>58 161</b>		<b>714</b>	<b>155 087</b>		<b>149</b>	<b>5 097</b>		<b>78 085</b>	<b>2 276</b>	<b>69 480</b>		
Plastic waste (sorted)	WP0039	Waste products and scrap of plastics, n.e.c.	98 109	10 513		114	87 482		149	5 097		78 085		2 276		1 875	
	WP1450	Sorted plastic waste	60 002	21 675		171	38 156									38 156	
	WP1454	PVC waste	5 834	1 671		174	3 989									3 989	
	WP1457	Plastic packaging waste	50 017	24 302		255	25 460									25 460	

Figure 1. Supply and use of plastic products and waste by main sectors



Note : The legend *plastic products* refers to processed plastics products.

## 3.2. Analysis of main flows

### ***Raw plastics***

There is no production of raw plastics (plastics in primary form) based on oil in Denmark. Instead, 716 674 tonnes of raw plastics is imported from abroad, see table 1 and figure 1 and 2. The imports consist of different types of raw plastics. Ethylene, propylene and polyether are the main types of raw plastics imported.

Some production of raw plastics do, however, take place in Denmark, primarily by the manufacture of basic chemicals industry. The Danish production, 57 054 tonnes, is dominated by 37 190 tonnes amino and phenolic resins, etc. Inputs for this production (including inputs of formaldehyde and phenols) fall outside the scope of the tables as the raw materials are characterised as chemical products and not as plastics.

The total supply (sum of imports and the Danish production) of raw plastics is 774 611 tonnes. One third, 296 854 tonnes, is used by the manufacturing of plastics and rubber industry, while one fourth, 178 849 tonnes is used by the other manufacturing industry. Manufacturing of textiles and manufacturing of toys, etc, are also quite significant users of raw plastics. In addition 86 279 tonnes of raw plastics is exported.

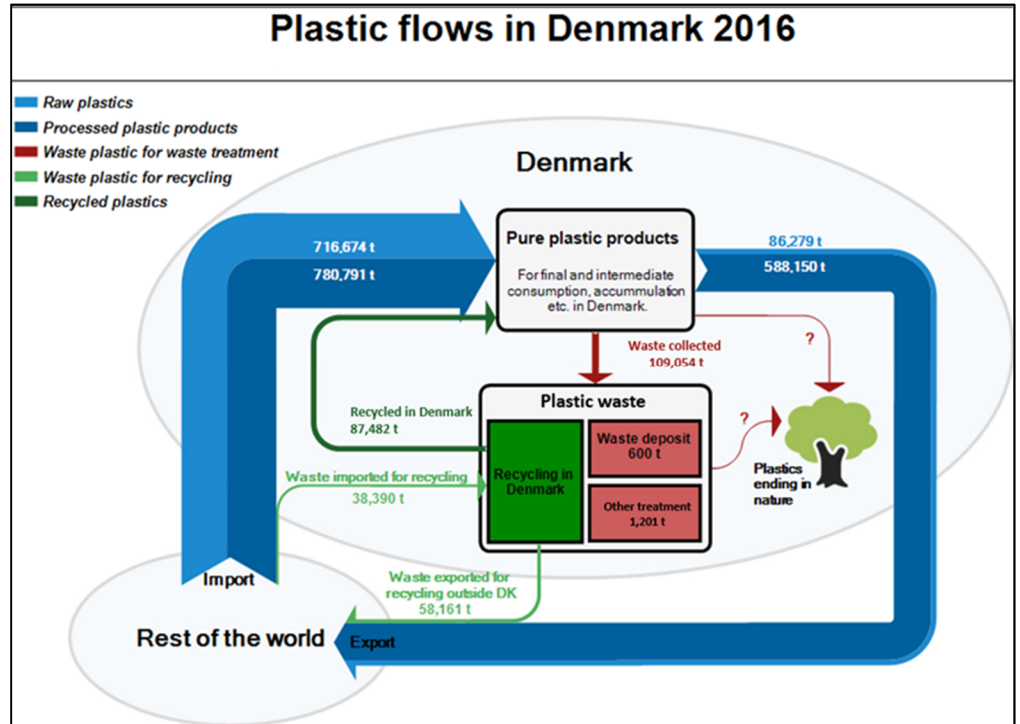
### ***Processed plastic products***

The imports of processed plastic products weighs a little more than the imports of raw plastics. 780 791 tonnes are of processed plastic products are imported. The biggest single item, 183 661 tonnes, is imports of plates, sheets, film and strips of plastics. The corresponding Danish production of this item is 115 017 tonnes. Plastic plates, films and strips are used extensively by the industry group for other manufacturing and the wholesale and retail industry.

Together flows of empty and filled plastic packaging materials outweigh all other flows of processed plastic products (plates, sheets, films and strips have not been characterised as packaging material, although some of it may very well be used as such). The supply of 318 798 tonnes empty plastic packaging materials is approximately split in half from imports and half from Danish production. 83 472 tonnes of empty plastic packaging is exported, while 227 516 tonnes is used by industries.

241 273 tonnes of filled packaging leaves the Danish industries. This is somewhat more than the input of empty packaging materials because some of the filled packaging materials received by the industries is assumed to be forwarded to customers. In addition we find an import of filled plastic packaging, resulting in a total supply of filled packaging at 415 173 tonnes. 136 680 tonnes leaves Denmark as part of the exports. 153 102 tonnes ends up in households, and the rest, 125 391 tonnes is allocated to various industries.

Figure 2



**Plastic waste**

43 845 tonnes of sorted plastic waste, PVC waste, and plastic packaging waste are collected from households, and 58 884 tonnes comes from Danish industries. From industries most of this plastic waste is generated by the manufacture of plastic and rubber products industry followed by other manufacturing industries. The wholesale and retail trade industry generates quite much plastic packaging waste, but also manufacture food and beverages and other industries contributes to the amounts of plastic packaging waste.

6 325 tonnes of waste products and scrap of plastics, n.e.c. ready for recycling comes from manufacturing industries. Adding this to the two numbers mentioned above gives a total of 109 054 tonnes of waste collected for recycling in Denmark<sup>8</sup>, see figure 2.

However, all is in fact not recycled, 600 tons goes to waste deposits and 1 201 tonnes for other treatment (incineration, net changes in inventories, etc.). In addition 38 390 tonnes of waste is imported and 58 161 tonnes is exported. This leaves 87 482 tonnes of plastic waste for recycling in Denmark, see figure 2. The manufacturing of plastic and rubber industry uses the main part, 78 085 tonnes, but there is also some use in the basic chemical industry, other manufacturing, and the textile industry.

It is worth noting that while the total use of filled plastic packaging by households and industries is 153 102 and 125 391 tonnes (see above), the amount of plastic packaging waste collected from households and industries is 25 964 tonnes and 20 211 tonnes, respectively, i.e. 17 per cent and 16 per cent of the plastic packaging. This seems to indicate a substantial theoretical potential for increasing the recycling of plastic packaging materials.

<sup>8</sup> Here we do not include the output of 66 493 tonnes of waste products and scrap of plastics from the waste treatment industry, since these amounts are the results of the treatment of primary sorted plastic waste, PVC waste and plastic packaging waste, and thus already included.

## 4. Composite products and mixed waste

As illustrated clearly by figure 1 there is a lack of material balance when supply and use of plastic products and waste are compared for each of the categories whether they are industries, consumption, accumulation or the rest of the world.

The imbalances are explained by the fact, that many products contains not only plastics, but also metals, non-metallic minerals, wood, and glass, etc. Since they are not made 100 per cent from plastics, they are not characterised as plastic products, and therefore not recorded as outflows from the producing industries. However, the intermediate consumption of pure plastic products for the production of these composite products is recorded as inflows in table 1 and figure 1.

Similarly, most industries and also households generates waste, which include plastics, but since the plastic is not sorted and collected specifically as plastic waste it has not been recorded as outflows in table 1 and figure 1.

As explained in Section 3.3 we have estimated the quantities of plastics in such composite products and mixed waste by multiplying the actual weight of the products and waste fractions by a percentage for the plastic content. The results are presented as supply-use tables for composite products and mixed waste, tables 3 and 4.

It should be noted, that the tables represent first and rough estimates and that only some initial efforts have been made to ensure the quality and to reconcile all data. Thus, the numbers are associated with much uncertainty and they should be used with caution.

### 4.1. Supply-use tables

The upper light blue part of tables 3 and 4 includes information on the plastics in composite products. The lower, darker blue, part presents data for the plastic content in mixed waste. In the latter part, data on other residuals in the form of air emissions released to the atmosphere as well as other residues from incineration of plastics in mixed waste are also recorded.

The headings of the tables are the same as the headings of tables 1 and 2, but the leading columns do now present the composite products and the mixed waste types.



**Table 3**

<b>Supply table for plastics in composite products and waste 2016, tonnes</b>			<b>Total supply</b>	<b>Imports</b>	<b>Residuals from private and government consumption</b>	<b>From accumulation</b>	<b>Output from industries</b>																				
							<b>Total</b>	<b>Manufacture of food products and beverages</b>	<b>Manufacture of textiles</b>	<b>Manufacture of basic chemicals</b>	<b>Manufacture of paints and soap, etc.</b>	<b>Manufacture of plastics and rubber, etc.</b>	<b>Manufacture of toys, etc.</b>	<b>Other manufacturing</b>	<b>Collection and treatment of waste</b>	<b>Wholesale and retail</b>	<b>Other industries</b>										
																		CA12	CB13	CE10	CE20	CG22	CM32	C099	E380	G467	X000
<b>A0</b>	<b>Total supply</b>	<b>2 234 255</b>	<b>565 679</b>	<b>305 745</b>	<b>18 475</b>	<b>1 344 357</b>	<b>17 698</b>	<b>31 741</b>	<b>395</b>	<b>95 581</b>	<b>7 901</b>	<b>5 345</b>	<b>210 599</b>	<b>478 718</b>	<b>22 637</b>	<b>473 741</b>											
	<b>Total plastics in composite products</b>	<b>862 311</b>	<b>509 444</b>	<b>13 488</b>	<b>17 804</b>	<b>321 574</b>	<b>26</b>	<b>31 282</b>	<b>1</b>	<b>90 127</b>	<b>6 232</b>	<b>5 199</b>	<b>188 661</b>			<b>46</b>											
	C01 Products of agriculture and hunting	200	200																								
	C10 Food products	13	13																								
	C12 Tobacco products	557	295		6	257										257											
	C13 Textiles	96 963	65 384		1 076	30 503	25	28 934		43	226	661	614														
	C14 Wearing apparel	80 841	62 993	13 488	245	4 115		31				9	4 074														
	C15 Leather and related products	18 062	17 438		305	320		3		0	9	6	302														
	C16 Wood and of products of wood and cork, except furniture, articles of straw	11 950	3 492			8 458					25		8 433														
	C17 Paper and paper products	69 035	17 588		472	50 975	0	78	0	4		0	50 891														
	C20 Chemicals and chemical products	143 997	46 570		702	96 725		1 981		90 065	2 413		2 266														
	C21 Basic pharmaceutical products and pharmaceutical preparations	634	485			149		0		5			145														
	C22 Rubber and plastic products	1 989	1 014			975				7	795		174														
	C23 Other non-metallic mineral products	21 694	8 039		3	13 652		29		0	2 419		11 203														
	C25 Fabricated metal products, except machinery and equipment	8 272	4 069		45	4 158	0	0	0		154	26	3 977														
	C26 Computer, electronic and optical products	30 994	23 459		89	7 446		0			8	1	7 437														
	C27 Electrical equipment	100 186	71 527		170	28 488		1		2	8	599	27 877														
	C28 Machinery and equipment n.e.c.	49 262	23 273		113	25 876		2		0	35	1	25 838														
	C29 Motor vehicles, trailers and semi-trailers	111 762	88 432		13 920	9 410		10			52		9 347														
	C30 Other transport equipment	4 385	2 802		91	1 493		2				1	1 490														
	C31 Furniture	46 095	27 669		63	18 363		207			4	0	18 151														
	C32 Other manufactured goods	56 216	39 399		489	16 329		2		1	83	3 895	12 347														
	C58 Books and journals, etc.	8 709	5 050		14	3 644						0	3 644														
	C71 Construction and machine plans and drawings	1	0		0	0							0														
	C74 Photographic plates and film	304	110			194							194														
	C90 Paintings, drawings and sculptures	53	7			46																					
	C91 Other art products and antiques	138	138																								
	<b>Total plastics in mixed waste</b>	<b>895 608</b>	<b>56 234</b>	<b>292 257</b>	<b>671</b>	<b>546 446</b>	<b>17 673</b>	<b>459</b>	<b>395</b>	<b>5 454</b>	<b>1 669</b>	<b>146</b>	<b>21 938</b>	<b>2 381</b>	<b>22 637</b>	<b>473 695</b>											
	WA110 Waste, primary, mixed municipal waste and similar	227 179		214 818		12 361	2 321	3		60	53	6	568	114	1 186	8 050											
	WA115 Waste, primary, organic waste, including garden waste	7 238		1 389		5 849	2 196	0	8	27	0	7	1 120	13	1 257	1 221											
	WA120 Waste, primary, waste suited for incineration	212 232	47 543	49 721		114 967	12 929	385	305	5 345	1 530	96	17 066	1 655	17 131	58 526											
	WA125 Waste, primary, waste from paper and cardboard	139	1	57		81	7	0	0	0	1	1	39	1	15	18											
	WA140 Waste, primary, metal waste, incl. packaging	5 377	303	717		4 357	18	2	2	8	11	3	1 424	98	603	2 188											
	WA150 Waste, primary, electronic waste, batteries, etc.	26 304	1 421	18 537	658	5 687	70	1	55	10	6	9	389	401	2 192	2 555											
	WA155 Waste, primary, mixed construction waste, etc.	386 338	2 708			383 630										383 630											
	WA999 Other waste, n.e.c.	30 801	4 257	7 018	13	19 513	133	67	25	4	68	24	1 331	99	254	17 508											
<b>Others</b>	<b>RE001 Residuals, air emissions from incineration, etc.</b>	<b>476 337</b>				<b>478 798</b>								<b>478 798</b>													

**Table 4**

Use Table for plastics in composite products and waste 2016, tonnes		Total use	Exports	Private and government consumption	To accumulation	Intermediate consumption										
						Total	Manufacture of food products and beverages	Manufacture of textiles	Manufacture of basic chemicals	Manufacture of paints and soap, etc.	Manufacture of plastics and rubber, etc.	Manufacture of toys, etc.	Other manufacturing	Collection and treatment of waste	Wholesale and retail	Other industries
						CA12	CB13	CE10	CE20	CG22	CM32	C099	E380	G467	X000	
<b>A0</b>	<b>Total use</b>	<b>2 234 254</b>	<b>413 785</b>	<b>150 569</b>	<b>611 233</b>	<b>1 058 667</b>	<b>3 134</b>	<b>15 235</b>	<b>677</b>	<b>2 005</b>	<b>3 789</b>	<b>2 001</b>	<b>80 422</b>	<b>479 098</b>	<b>11 820</b>	<b>460 485</b>
	<b>Total plastics in composite products</b>	<b>862 308</b>	<b>394 194</b>	<b>150 569</b>	<b>96 204</b>	<b>221 341</b>	<b>3 134</b>	<b>15 152</b>	<b>677</b>	<b>2 005</b>	<b>3 789</b>	<b>2 001</b>	<b>80 228</b>	<b>1 509</b>	<b>11 820</b>	<b>101 026</b>
	C01 Products of agriculture and hunting	200	2		34	164							164			
	C10 Food products	13	6			7						7				
	C12 Tobacco products	557	250	263	39	5							5		0	0
	C13 Textiles	96 962	32 097	15 051	8 000	41 814	531	10 588	392	46	913	451	11 139	31	6 665	11 058
	C14 Wearing apparel	80 841	49 187	22 494	2 579	6 581	69	33	19	11	4		780	195	500	4 969
	C15 Leather and related products	18 062	7 035	8 388	961	1 677	12	9	4	3	0	2	279	7	84	1 278
	C16 Wood and of products of wood and cork, except furniture, articles of straw	11 950	2 775		556	8 619						1	383			8 236
	C17 Paper and paper products	69 035	39 545	16 855	304	12 331	1 571	117	38	193	313	41	5 071	3	2 389	2 596
	C20 Chemicals and chemical products	143 997	99 923	6 291	474	37 310	262	4 045	68	1 069	1 688	758	21 428	69	205	7 718
	C21 Basic pharmaceutical products and pharmaceutical preparations	634	439	13	2	180		0		0	33		6			141
	C22 Rubber and plastic products	1 988	1 535	217	5	232					1	6	15			210
	C23 Other non-metallic mineral products	21 694	7 970	1 607	182	11 935		97	0		624	1	3 361			7 852
	C25 Fabricated metal products, except machinery and equipment	8 271	2 269	331	240	5 432	98	23	4	12	96	6	2 073	4	70	3 046
	C26 Computer, electronic and optical products	30 994	14 676	5 152	4 731	6 435	73	1	20	6	12	5	2 824	42	178	3 276
	C27 Electrical equipment	100 186	39 125	18 536	4 147	38 378	313	10	82	23	64	69	14 305	515	480	22 517
	C28 Machinery and equipment n.e.c.	49 261	23 609	1 123	10 376	14 153	155	3	39	9	28	11	10 959	49	136	2 762
	C29 Motor vehicles, trailers and semi-trailers	111 762	27 436	29 174	48 524	6 628					8		1 308		398	4 915
	C30 Other transport equipment	4 385	1 427	2 059	694	206							194			12
	C31 Furniture	46 095	21 653	11 538	10 327	2 576		10					1 121			1 445
	C32 Other manufactured goods	56 215	20 725	6 880	3 873	24 737	42	214	12	632	3	642	4 630	583	427	17 554
	C58 Books and journals, etc.	8 709	2 486	4 565	7	1 651	7	0	1	1	0	2	40	10	285	1 304
	C71 Construction and machine plans and drawings	1	0			1							0			0
	C74 Photographic plates and film	305	4		12	289	1				2		144		5	138
	C90 Paintings, drawings and sculptures	53	4		50											
	C91 Other art products and antiques	138	16	32	91											
	<b>Total plastics in mixed waste</b>	<b>895 609</b>	<b>19 592</b>		<b>38 692</b>	<b>837 325</b>		<b>83</b>					<b>194</b>	<b>477 589</b>		<b>359 459</b>
	WA110 Waste, primary, mixed municipal waste and similar	227 180			229	226 951										226 951
	WA115 Waste, primary, organic waste, including garden waste	7 238			1 824	5 413								5 408		6
	WA120 Waste, primary, waste suited for incineration	212 232	234		43	211 955								211 955		
	WA125 Waste, primary, waste from paper and cardboard	139	60		0	79							78	0		
	WA140 Waste, primary, metal waste, incl. packaging	5 377	4 424		2	951								951		
	WA150 Waste, primary, electronic waste, batteries, etc.	26 304	12 729		16	13 559								13 559		
	WA155 Waste, primary, mixed construction waste, etc.	386 338	766		15 932	369 640								10 187		359 453
	WA999 Other waste, n.e.c.	30 801	1 378		20 646	8 777		83					116	8 578		
<b>Others</b>	<b>RE001 Residuals, air emissions from incineration, etc.</b>	<b>476 337</b>				<b>478 798</b>										

## 4.2. Analysis of main flows

The upper part of table 3 indicates that 862 311 tonnes of plastics is embedded in composite products. 59 per cent, 509 944 tonnes, enters the Danish economy together with the imports of composite products. Most plastics are embedded in the imports of motor vehicles, electrical equipment, textiles, wearing apparel, and chemical products. However, the table also shows clearly that plastics are embedded in almost all types of products.

The output of composite products from Danish industries contains 321 574 tonnes of plastics. In addition to plastics in the current production products withdrawn from inventories, etc. contains 17 804 tonnes of plastic.

For the Danish production the largest plastic containing group is chemicals and chemical products with a plastic content of 96 725 tonnes. This include Danish production of synthetic fibres. Products classified as paper and paper products include plastics (50 975 tonnes) as well. Although, for instance, laminated paper products include plastics it reflects mainly that the classification (see section 2.1) include diapers and sanitary napkins in the paper and paper products group. Textiles (30 502 tonnes) and other non-metallic mineral products, mainly building materials (13 652 tonnes) are also added considerable amounts of plastics during the production processes. 13 488 tonnes of plastics is embedded in wearing apparel, which are recycled by Danish households.

Out of the total 862 311 tons of plastics in composite products 394 194 tonnes is exported and 96 204 tonnes is accumulated in inventories and as part of industries' capital equipment. It includes, for instance, 48 524 tonnes of plastics in vehicles owned by companies, 10 376 tonnes in machinery and equipment and 10 327 tonnes in furniture, see table 4,

150 569 tonnes of plastics is embedded in private and government consumption of composite products. The plastics is spread in all types of products consumed by households, but the plastic content is especially high in textile and wearing apparel, vehicles, electric equipment, paper and paper products (i.e. diapers and sanitary napkins, see above) and furniture.

The intermediate consumption of composite products by industries contains 221 341 tonnes of plastics. The main part of the intermediate consumption lies outside the manufacturing industries. Thus, almost half of the plastics, 101 026 tonnes, is input into "Other industries" (which include construction activities). Just as for households, plastics is spread across all product groups, but electrical equipment, textile and other manufactured goods (e.g. medical equipment and sports goods) brings quite much plastics into the "Other industries".

"Other manufacturing" receives 80 228 tonnes of plastics with composite products. Machinery, electrical equipment, chemicals and chemical products, and textiles are the main carriers.

The main composite product group that carries plastics into the textile industry is textile, among which textile yarn with plastics is a larger contributor.

### ***Plastics in mixed waste***

While a lot of plastic is embedded in composite products a quite similar amount, 895 608 tonnes is embedded in mixed waste fractions. Mixed construction waste, mixed

municipal waste and waste categorised as suited for incineration<sup>9</sup> contains 386 338, 227 179 and 212 232 tonnes of plastic, respectively.

Plastics in construction waste, which originate from the construction industry (part of the “other industries” in the tables) are almost entirely recycled back to the construction industry together with mixed construction waste.

Plastics in mixed municipal waste originate mainly from private and government consumption and it is collected by the “Collection and treatment of waste” industry.

The main sources of plastics embedded in waste suited for incineration is industrial activities, of which “Other industries” counts for 58 526 tonnes of plastics. The detailed data behind table 4 shows that the waste is spread quite evenly over various service industries, and that construction activities contribute with approximately 10 000 tonnes.

Waste suited for incineration is also imported to Denmark. According to our estimations it brings 47 543 tonnes of plastics into Denmark.

Except for a tiny amount of exports, waste suited for incineration is input into the collection and treatment of waste industry, where it is being incinerated together with other types of mixed waste. Through the incineration process the plastics contained in the mixed waste is transformed into carbon and other substances, which are emitted to the atmosphere, or is contained in ashes or other residues from the incineration. Plastics ending up in air emissions and other residues have been estimated at 476 337 tonnes.

## 5. Reconciliation of all plastic flows

### 5.1. Supply-use tables

Tables 5 and 6 collects and organise the main totals from tables 1-4 in order to give a complete picture of flows of plastics into, through the Danish economy, and out from the economy.

Totals for raw plastics, processed plastic products and plastics embedded in composite products are presented in the first block from the top.

Totals for sorted plastic waste, plastics in mixed waste and other residuals in the form of air emissions and other residues from incineration are shown in the middle block.

The third block includes balancing items, which reconciles the data and ensure a balance between inputs and outputs of materials for each industry and for households.

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<sup>9</sup> *Waste suited for incineration* is a specific waste category, but it does not include all waste that is incinerated. Thus, for instance, municipal waste is also used for incineration.

**Table 5**

Supply table for plastics 2016, tonnes		Total supply	Imports	Residuals from private and government consumption	From accumulation	Output from industries										
						Total	Manufacture of food products and beverages	Manufacture of textiles	Manufacture of basic chemicals	Manufacture of paints and soap, etc.	Manufacture of plastics and rubber, etc.	Manufacture of toys, etc.	Other manufacturing	Collection and treatment of waste	Wholesale and retail	Other industries
						CA12	CB13	CE10	CE20	CG22	CM32	C099	E380	G467	X000	
	<b>Total supply</b>	<b>5 331 409</b>	<b>2 101 533</b>	<b>349 590</b>	<b>112 735</b>	<b>2 767 551</b>	<b>110 599</b>	<b>80 297</b>	<b>48 969</b>	<b>119 710</b>	<b>478 195</b>	<b>62 127</b>	<b>434 154</b>	<b>550 020</b>	<b>220 255</b>	<b>663 223</b>
<b>Products</b>	<b>Total plastic products</b>	<b>3 231 964</b>	<b>2 006 909</b>	<b>13 488</b>	<b>37 409</b>	<b>1 174 158</b>	<b>53 909</b>	<b>76 362</b>	<b>47 613</b>	<b>113 528</b>	<b>456 938</b>	<b>58 991</b>	<b>236 303</b>	<b>490</b>	<b>121 669</b>	<b>8 355</b>
	Raw plastics	774 611	716 674		883	57 054			43 105	5 859	7 085	1 005				
	Processed plastics	1 595 042	780 791		18 722	795 530	53 883	45 080	4 507	17 542	443 621	53 792	46 637	490	121 669	8 309
	Plastics in composite products	862 311	509 444	13 488	17 804	321 574	26	31 282	1	90 127	6 232	5 199	188 661			
<b>Waste</b>	<b>Total plastics in waste</b>	<b>1 109 569</b>	<b>94 624</b>	<b>336 102</b>	<b>695</b>	<b>678 148</b>	<b>21 495</b>	<b>868</b>	<b>1 357</b>	<b>6 182</b>	<b>21 257</b>	<b>1 074</b>	<b>37 824</b>	<b>70 732</b>	<b>32 926</b>	<b>484 434</b>
	Plastic waste (sorted)	213 961	38 390	43 845	24	131 702	3 822	409	962	728	19 588	928	15 886	68 351	10 289	10 739
	Plastics in mixed waste	895 608	56 234	292 257	671	546 446	17 673	459	395	5 454	1 669	146	21 938	2 381	22 637	473 695
<b>Others</b>	<b>Residuals, air emissions from incineration, etc.</b>	<b>476 337</b>				<b>476 337</b>								<b>476 337</b>		
<b>Balance</b>	<b>Total balance</b>	<b>513 539</b>			<b>74 631</b>	<b>438 909</b>	<b>35 196</b>	<b>3 067</b>				<b>2 063</b>	<b>160 027</b>	<b>2 461</b>	<b>65 660</b>	<b>170 434</b>
	Balance, primarily plastics, n.e.c. in building materials, etc.	368 119				368 119	35 196						160 027	2 461		170 434
	Balance, chemicals, etc. for production of plastics	74 631			74 631											
	Balance, statistical differences	70 790				70 790		3 067				2 063			65 660	

**Table 6**

Use Table for Plastics 2016, tonnes		Total use	Exports	Private and government consumption	To accumulation	Total intermediate consumption										
						Total	Manufacture of food products and beverages	Manufacture of textiles	Manufacture of basic chemicals	Manufacture of paints and soap, etc.	Manufacture of plastics and rubber, etc.	Manufacture of toys, etc.	Other manufacturing	Collection and treatment of waste	Wholesale and retail	Other industries
						CA12	CB13	CE10	CE20	CG22	CM32	C099	E380	G467	X000	
	<b>Total use</b>	<b>5 331 409</b>	<b>1 146 375</b>	<b>349 590</b>	<b>1 067 892</b>	<b>2 767 552</b>	<b>110 599</b>	<b>80 297</b>	<b>48 969</b>	<b>119 710</b>	<b>478 195</b>	<b>62 127</b>	<b>434 154</b>	<b>550 020</b>	<b>220 256</b>	<b>663 223</b>
<b>Products</b>	<b>Total plastic products</b>	<b>3 231 964</b>	<b>1 068 623</b>	<b>349 590</b>	<b>113 240</b>	<b>1 700 509</b>	<b>110 599</b>	<b>80 065</b>	<b>24 702</b>	<b>106 262</b>	<b>358 098</b>	<b>62 127</b>	<b>431 684</b>	<b>2 951</b>	<b>220 256</b>	<b>303 764</b>
	Raw plastics	774 611	86 279	58	1 383	686 891	381	58 872	15 731	80 940	296 854	54 491	178 849	13	114	646
	Processed plastics	1 595 042	588 150	198 964	15 653	792 277	107 084	6 042	8 295	23 317	57 455	5 635	172 607	1 429	208 322	202 092
	Plastics in composite products	862 311	394 194	150 569	96 204	221 341	3 134	15 152	677	2 005	3 789	2 001	80 228	1 509	11 820	101 026
<b>Waste</b>	<b>Total residuals</b>	<b>1 109 569</b>	<b>77 753</b>		<b>39 406</b>	<b>992 412</b>		<b>232</b>	<b>5 097</b>		<b>78 085</b>		<b>2 470</b>	<b>547 069</b>	<b>359 459</b>	
	Plastic waste (sorted)	213 961	58 161		714	155 087		149	5 097		78 085		2 276	69 480		
	Plastics in mixed waste	895 608	19 592		38 692	837 325		83					194	477 589	359 459	
<b>Others</b>	<b>Residuals, air emissions from incineration, etc.</b>	<b>476 337</b>			<b>476 337</b>											
<b>Balance</b>	<b>Total balance</b>	<b>513 539</b>			<b>438 909</b>	<b>74 631</b>		<b>19 170</b>	<b>13 449</b>	<b>42 012</b>						
	Balance, primarily plastics, n.e.c. in building materials, etc.	368 119			368 119											
	Balance, chemicals, etc. for production of plastics	74 631				74 631		19 170	13 449	42 012						
	Balance, statistical differences	70 790			70 790											

## 5.2. Analysis of main flows

### ***Plastic products***

The total of plastics in pure plastic products and in composite products is 3 231 964 tonnes. Nearly two thirds, 2 006 909 tonnes come from imports and a little more than one third, 1 174 158 tonnes, comes from Danish production.

Most of the plastics are found in pure plastic products, less than one third of the total amount of plastics was embedded in composite products. The share is almost the same for imports and Danish production.

The Danish production of pure plastic products takes mainly place within the manufacturing of basic chemicals and the manufacturing of plastics and rubber industries, while the output of plastics in composite products is found within the industries for manufacture of paints and soap, etc., and other manufacturing industry.

The exports of pure and composite plastic products weighs 1 146 375 tonnes. It means that the total imports of plastics is more than double the exports. The imports of plastics is spread quite evenly on raw, processed and composite products. For exports, the share of processed plastic products is bigger at the expense of raw plastic products.

The largest part of plastics used by industries comes from processed plastic products, 792 277 tonnes, but the use of raw plastics comes close with 686 891 tonnes. Only 13 per cent of plastics in intermediate consumption are embedded in composite products.

The private and government consumption of plastics is also dominated by processed plastic products, 198 964 tonnes, although there is also a considerable amount of plastics in composite product acquired by the households, 150 569 tonnes.

### ***Plastics in waste and other residuals***

The total supply and use of plastics in waste have been estimated at 1 109 569 tonnes. It should be noted however, that some double counting is involved since both the primary flows of waste (sorted plastic waste, PVC and plastic packaging waste) and the waste products and scrap of plastics resulting from the treatment of the primary waste is included. Thus, this number should be reduced by 67 605 tonnes if double counting should be avoided.

Approximately 80 per cent is embedded in mixed waste and approximately 20 per cent in waste sorted specifically for recycling. For households the fraction of waste that is sorted and collected is 13 per cent.

The main carrier of plastics in imported waste is mixed waste aimed for incineration. 56 234 tonnes of plastics is embedded in the mixed waste for incineration, while 38 390 tonnes of plastic waste is imported for recycling.

For exports the picture is different, 58 161 tonnes of sorted plastic waste is exported, while plastics in mixed waste weighs 19 592 tonnes.

Approximately one half of all plastics in waste, 547 069 tonnes, ends as up inputs in the collection and waste treatment industry. After treatment 70 732 tonnes leave the industry again, primarily for recycling, while 476 337 tonnes leaves as air emissions to the atmosphere or as other residuals from incineration.

One third of the plastics in all waste, 359 459 tonnes, is re-used by the construction industry (part of the "other industries") and 8 per cent, 85 885 tonnes, are re-used,

first of all for manufacturing of new plastics, but to some degree also for intermediate consumption in the basic chemicals, textiles and other other manufacturing.

### ***Balancing items***

The integrated recording of pure and composite plastic products, waste, and air emissions, etc. gives a comprehensive picture of the plastic flows. If all flows had been included and estimated precisely the picture would be complete. This is however not the case partly because some source data have been missing or are being flawed. Especially the estimation of the plastic content in composite products and mixed waste by multiplying material weight by a percentage for plastic content is a rough approximation to the real plastic content.

One type of missing information is the content of plastic in the output of construction activities, and in some equipment. Especially the construction industry use plastic products, e.g. plastic tubes, pipes, fittings, doors, windows, and electrical equipment, which are accumulated in constructions and buildings. Based on the other data in the supply-use tables we can estimate this amount of plastics to 368 119 tonnes. By allocating this quantity to the output of relevant industries in table 6 we ensure a balance between the inputs and outputs of these industries. The quantity appears to be quite reasonable if it is compared to inputs of the type of plastics and composite products that are usually used for construction and building activities and as part of various equipment in companies. 46 per cent is attributed to "Other industries", which includes the construction industry, while 43 per cent is attributed to "Other manufacturing". Part of this balancing item can also be due to incorrect percentages for the plastic content in composite products. In the use table it is recorded as part of the accumulation of plastics.

A second type of missing information relates to the inputs of chemicals (e.g. formaldehyde and phenols) for the production of amino and phenolic resins, etc. The production of these types of plastics weighs 41 479 tonnes. It is also not impossible that some of the products, which we have characterised as pure plastic products may in fact include some other materials.

In order to balance the manufacturing industries for basic chemicals, paints and soap etc. and plastics and rubber, etc. we add 74 631 tonnes as balancing items in the use table. Part of this balancing item can also be due to incorrect percentages for the plastic content in composite products. In order to introduce a supply of these non-plastic products it is by convention recorded in the supply table as coming from accumulation. By doing this we do not disturb the balances for plastics of the other categories in the tables.

Finally, we have some minor imbalances for the manufacture of textiles, manufacture of toys, and a rather large imbalance for wholesale and retail trade industry. The minor imbalances can probably be attributed to incorrect percentages for plastic content in mixed products.

The rather large balancing item for wholesale and retail trade (65 660 tonnes, 30 per cent of the total supply/use of this industry) is to a large extent related to inputs of plastic plates, sheets and films. These products have not been characterised as packaging materials, and have not resulted in similar outputs of filled packaging materials. This may be incorrect. Another explanation could be that parts of these products are used for displays etc., but one would then expect that a similar amount of waste would be generated. In that case the amount of plastics in mixed waste from this industry may have been estimated too low.

## 6. Indicators for the circular use rate of plastics (CMUR)

In order to quantify the degree of circularity in an economy, Eurostat has proposed the application of the Circular Material use Rate (CMUR). Expressed in simple terms, CMUR measures the share of material recovered and fed back into the economy – thus saving extraction of primary raw materials – in overall material use (Eurostat 2018). Even though CMUR generally concerns all materials used in a given economy, Eurostat also proposes CMUR for the measurement of the use rate of specific materials. Hence, for the purposes of this report, the CMUR indicator has been applied to measure the contribution of recovered plastics (secondary raw plastic materials) in overall plastics use in the Danish economy.

The Danish CMUR for plastics has been estimated as the ratio of recycled plastic (U) to the overall consumption of plastics (M).

$$\text{CMUR} = \frac{U}{M} = \frac{U}{(\text{DMC} + U)}$$

U is the amount of sorted plastic waste collected for recycling inside the Danish borders or exported for recycling abroad. U does not include imported plastic waste. This is consistent with the Eurostat's (2018) definition of CMU rate in *Circular material use rate – calculation method*. U does not contain sorted plastics collected for other waste treatment, e.g. incineration or deposition.

M is the sum of the domestic material consumption (DMC) and U. Normally the input for domestic material consumption will represent extraction of materials as well as import. But as extraction of raw material for and manufacturing of plastics does not happen inside Denmark, DMC\* is used as an expression of net import of plastics, i.e. the import subtracted the export of plastics. In addition, DMC\* contains pure plastic products, whereas waste is not part of DMC\*.

When calculating CMUR, DMC\* is used as a proxy for raw material consumption (RMC), and therefore excludes waste. However, waste for recycling is introduced in the CMUR calculations in M, as described above. Thus

$$\text{DMC}^* = \text{Import of pure plastic products} - \text{Export of pure plastic products}$$

Then, by calculating the ratio between U and M, the CMUR expresses the contribution of recycled plastic in overall plastic use.

The CMUR for plastics in 2016 has been calculated using two different datasets:

1. The waste statistics from the Danish Environmental Protection Agency and international trade statistics from Statistics Denmark
2. Data from a plastics supply-use table from Statistics Denmark

Data set 1 has been used to calculate a time series for CMUR for 2011-2019.

The two data sets have been used for calculating a CMUR for pure plastic products. In addition, using dataset 2, a Danish CMUR for plastic including plastics in composite products and mixed waste has been calculated.



## 6.1. CMUR based on Danish waste and trade statistics

From the Danish international trade in goods statistics, we include the total import of plastics (1) and the total export of plastics (2). Data from the waste statistics include the three plastic waste categories plastic (3), plastic packaging (4) and PVC (5). The waste statistics do not include imported waste, but do include waste which is collected domestically and then exported to other countries. The amounts of waste listed in the table as (3), (4) and (5) are sent to recycling, and the summed amount represents U.

**Table 7**

### **Danish CMUR for plastics. 2016 based on Waste Statistics**

*Unit: ton*

Import of plastics (1)	1,355,750
Export of plastics (2)	550,915
Plastic waste, for recycling (3)	49,785
Plastic packaging waste, for recycling (4)	45,818
PVC waste, for recycling (5)	5,657
<b>DMC* (1) - (2)</b>	<b>804,835</b>
<b>U (3)+(4)+(5)</b>	<b>101,260</b>
<b>M (U + DMC*)</b>	<b>906,095</b>
<b>CMUR (U/M)</b>	<b>0.1118</b>

The calculation of CMUR using trade and waste statistics for 2016 yields a CMUR of 0.1118, meaning that recycled plastics account for 11.18% of the overall plastic use.

The CMUR for plastics is presented for 2011-2019. The time series is calculated using the dataset based on trade and waste statistics (data set 1). CMURs with two decimals are shown in table 8, with the purpose of visualising developments in the time series. However, there are uncertainties in the calculations and source data. Therefore, interpreting the specific CMURs should be done with caution and with these uncertainties in mind.

**Table 8**

### **Danish CMUR for plastics**

*Unit: per cent*

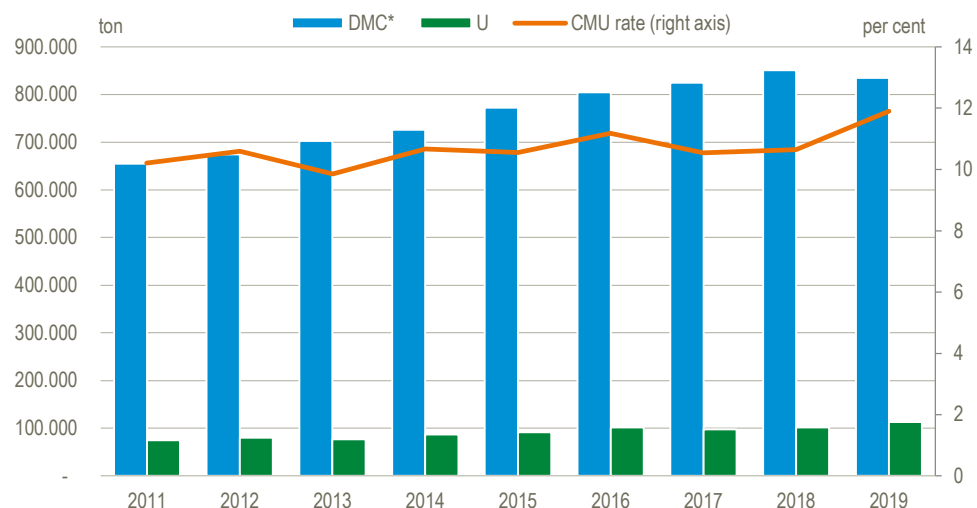
	2011	2012	2013	2014	2015	2016	2017	2018	2019
CMUR	10.21	10.61	9.85	10.67	10.55	11.18	10.54	10.65	11.91

Note: The Danish CMUR for plastics 2011-2019 is based on Danish trade and waste statistics (data set 1).

The development in Danish CMUR for plastics has fluctuated but followed an overall increasing trend in the period 2011-2019. CMUR was in a range around 10 and 11 per cent in 2011-2018, and approaching 12 per cent in 2019.

The increase in CMUR in 2019 is due to increased collection of plastic waste for recycling. In addition, DMC\* decreased as a result of less imported plastics in 2019. The decrease in CMUR in 2013 and 2017 were caused by less plastic waste collected for recycling, as well as an increase in DMC due to more import and less export.

**Figure 3**  
**Danish DMC\*, U and CMUR for plastics 2011-2019**



Note: The Danish CMUR for plastics 2011-2019 is based on waste statistics (data set 1).

Both DMC\* for plastic and plastics recovery (U), have increased in the years 2011-2019. DMC\* has increased by 27 per cent, due to increasing imports. The amount of recovered plastic waste (U) has increased by 51 per cent due to more sorting and collection of recyclable plastic waste from households and companies. As an example, the sorting and collection of plastic packaging has doubled from 30.000 tons in 2011 to 60.000 tons in 2019.

## 6.2. CMUR based on the plastic supply-use tables

The Danish CMUR for plastics is calculated based on supply-use tables (PSUT, data set 2, see first part of this report).

The import of pure plastic products, as indicated in table 1 as the sum of raw and processed products, is 1 497 465 tonnes, and the export, in table 2, is 674 429 tonnes. Import and export of pure plastic products are both bigger than in the basic data from the trade statistics. This can be explained by the inclusion of additional plastic products in the PSUT, compared in the trade statistics. Small differences may also occur due to the data being collected from a more updated version of the trade statistics.

As is indicated in the Sankey diagram (Figure 2) and elaborated in section 3.2 above, the plastic waste collected is 109 054 tonnes in 2016. However, this includes some plastic waste collected for deposition (600 tonnes) and other treatment, including incineration (1 201 tonnes). Thus, the real amount of plastic waste collected for recycling in Denmark (U) is 107 235 tonnes. In addition, this amount excludes a small flow (90 tonnes) of plastic waste which goes to accumulation.

**Table 9**  
**Danish CMUR for plastics. 2016 (PSUT)**

*Unit: ton*

Import of pure plastic products (1)	1,497,465
Export of pure plastic products (2)	674,429
Plastic waste, for recycling (3)	107,253
<b>DMC* (1) - (2)</b>	<b>823.036</b>
<b>U (3)-(4)</b>	<b>107.253</b>
<b>M (U + DMC*)</b>	<b>930.289</b>
<b>CMUR (U/M)</b>	<b>0.1153</b>

*Note: 'Plastic waste, for recycling (3)' includes plastic, plastic packaging and PVC waste sorted for recycling as well as plastic waste flows, which have been identified from the supply-use tables and which are not included in the basic waste statistics from the Danish EPA*

The CMUR based on the supply-use tables is 11.53 per cent, and is slightly higher than the CMUR based solely on the trade and waste statistics. The explanation for this is that the PSUT include additional plastic flows, which have been identified from the supply-use tables and which is not included in the trade and waste statistics.

### **6.3. CMUR including plastic in composite products and mixed waste**

The CMU rates have so far described the pure plastic flows in trade and waste statistics, as well as pure plastic flows in the PSUT framework.

However, in the PSUT for plastics, the plastic content of composite goods is estimated (in chapter 4). This means that it is possible to estimate a CMUR for all plastics in the economy, both flows of pure plastics and plastics in composite products and mixed waste. For 2016, the CMUR including these products is calculated in table 10.

In table 10, the flows of pure plastic products and waste from table 9 are summed with the plastic in composite products from tables 3 and 4.

Import of plastic in composite products of 509 444 tonnes is indicated in table 3, whereas exports of 349 194 tonnes, is indicated in table 4. Plastics in mixed waste (4) in table 10 is found in the detailed plastics supply-use tables, as a smaller part of the aggregate amount of plastics input in the waste collection and treatment industry in table 4. Specifically, it is the sum of the input to waste treatment and recycling industries, and adds up to 29 071 tonnes of waste for recycling in mixed waste fraction.

When including all plastics in the CMUR, the rate is 12.69 per cent, which is about one percentage-point higher than CMUR with only pure plastic goods. This can be explained by exports containing a larger proportion of plastic in composite goods, than imports. This leads to a lower DMC, when including composite products, which in turn increases CMU rate for plastics.

**Table 10**  
**Danish CMUR for plastics in pure and composite products. 2016 (PSUT)**

*Unit: ton*

Import of plastics total (1)	2,006,909
<i>Pure plastic products</i>	1,497,465
<i>Plastic in composite products</i>	509,444
Export of plastics total (2)	1,068,623
<i>Pure plastic products</i>	674,429
<i>Plastic in composite products</i>	394,194
Plastic waste, for recycling (3)	107,253
<i>Plastic in mixed waste, for recycling (4)</i>	29,071
<b>DMC* (1) - (2)</b>	<b>938.286</b>
<b>U (3)+(4)</b>	<b>136.324</b>
<b>M (U + DMC*)</b>	<b>1.074.610</b>
<b>CMUR (U/M)</b>	<b>0.1269</b>

*Note: 'Plastic waste, for recycling (3)' includes plastic, plastic packaging and PVC waste sorted for recycling as well as plastic waste flows, which have been identified from the supply-use tables and which are not included in the basic waste statistics from the Danish EPA*

#### **6.4. Interpretations of Danish CMUR for plastics**

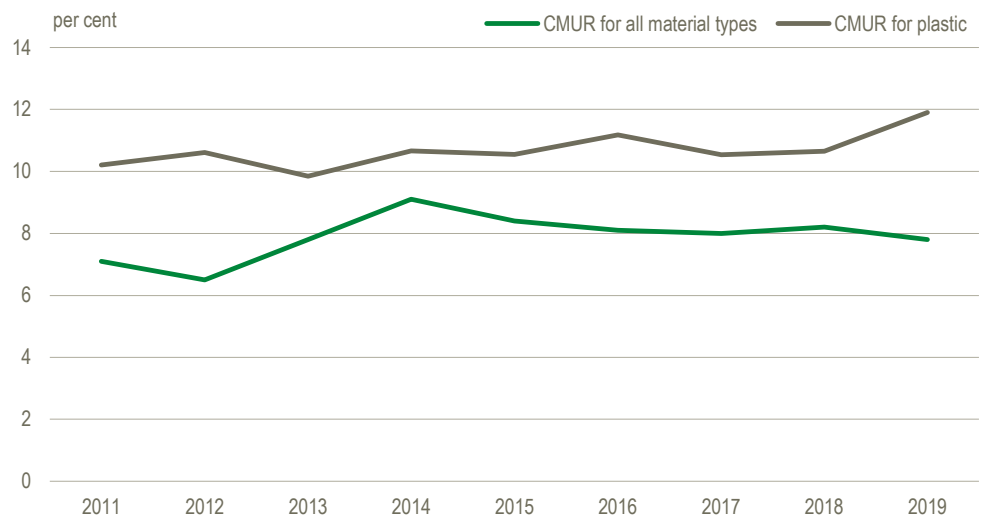
The Danish CMUR for plastics in 2016 ranges between 11,2 og 12,7 per cent, depending on the source data and defined scope of plastic products. The highest CMUR is estimated when including plastic in composite goods.

CMUR has increased over time, as a result of increased efforts to sort and collect plastic waste. However, the net import of pure plastic products has also increased in the period, suggesting that recycled plastics cannot cover the demand for new raw materials. As the developments in the CMUR components in Figure 3 indicate, in order to achieve a substantial increase in CMUR, it is necessary to both lower the import of pure plastic products, as well as increase efforts to recycle materials.

Figure 4 compares the Danish CMUR for plastics to the Danish CMUR for all material types. CMUR for plastic is higher than the overall CMUR for all material types in Denmark.

For comparison, Figure 5 shows the EU-28 countries CMUR for metal ores, fossil energy materials, biomass and non-metallic minerals. The total CMUR for all material types is shown as the dotted line in Figure 5. Comparing to the total Danish CMUR for all material types in Figure 4, it is seen that the EU average is slightly higher than the Danish CMUR for all material types.

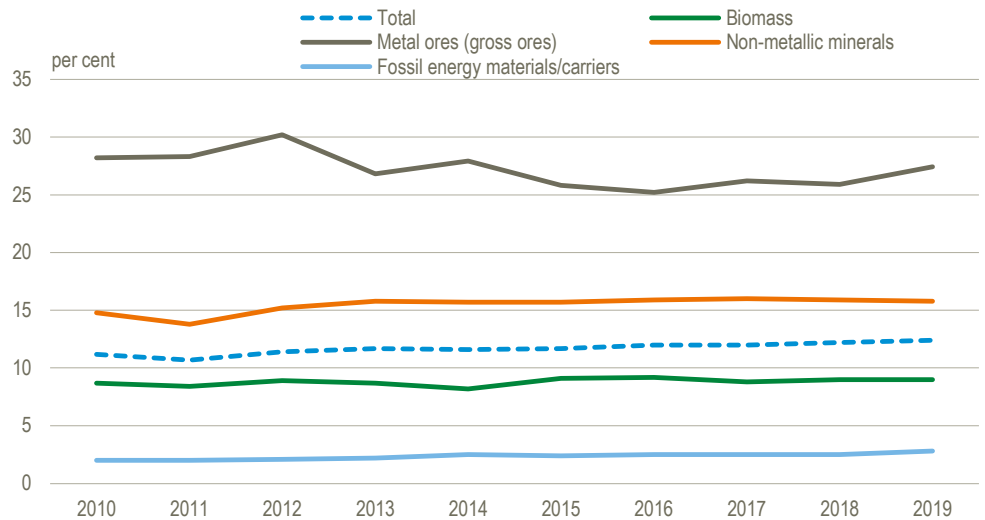
**Figure 4**  
**Danish CMUR for plastics and all material types**



Source: Eurostat<sup>10</sup> and Statistics Denmark

The EU average for all material types (total) in Figure 5 is similar to the calculated Danish CMUR for plastics at about 12 per cent in 2016. For other material types, the CMUR varies between 2 and 30 per cent depending on the material type.

**Figure 5**  
**CMUR for EU-28 by material type**



Source: Eurostat<sup>11</sup>

There is not data available to compare CMURs across counties specifically for plastics.

CMUR results and interpretations are sensitive to the definitions and scope of the DMC\* and U. How to address the trade with recyclable plastic waste and the different plastic products included in the PSUT framework, also has an impact on the results and implications.

<sup>10</sup> Circular material use rate, table reference ENV\_AC\_CUR, available at [https://appsso.eurostat.ec.europa.eu/nui/show.do?dataset=env\\_ac\\_cur&lang=en](https://appsso.eurostat.ec.europa.eu/nui/show.do?dataset=env_ac_cur&lang=en)

<sup>11</sup> Circular material use rate by material type, table reference ENV\_AC\_CURM, available at [http://appsso.eurostat.ec.europa.eu/nui/show.do?dataset=env\\_ac\\_curm&lang=en](http://appsso.eurostat.ec.europa.eu/nui/show.do?dataset=env_ac_curm&lang=en)

As an example, In CMUR for plastic, calculations of (U) exclude waste imported for recycling, but include Danish waste exported for recycling. This approach is consistent with the Eurostat's (2018) definition of CMUR in *Circular material use rate – calculation method*, and gives a view of Danish efforts to collect waste for recycling. It does not show the capacity for recycling plastic waste in domestic recovery plants (which would require deducting the amount of exported waste, and adding imported waste for recycling).

The inclusion of exported waste in CMUR, means that the indicator focuses on the waste sorting and collection side, rather than the waste treatment side of the circular economy. The more plastic waste we sort and collect, the higher the CMUR, regardless of where the waste ends up. On the other hand, the CMUR remains unchanged if Denmark for example was to invest in large scale recycling plants within its own borders.

The degree of quality in recycled plastic is of importance to the substitution by secondary raw materials, and is not covered by the CMUR. Particularly for plastics, there are known issues with loss rates in recycling processes.<sup>12</sup>

## References

Danish Environmental Protection Agency (2020), *Affaldsstatistik 2019*. Available in Danish: <https://mst.dk/service/publikationer/publikationsarkiv/2020/dec/affaldsstatistik-2019/>

Eurostat (2018), *Circular material use rate. Calculation method*. 2018 edition. <https://ec.europa.eu/eurostat/documents/3859598/9407565/KS-FT-18-009-EN-N.pdf/b8efd42b-b1b8-41ea-aaa0-45e127ad2e3f>

Eurostat

Table reference ENV\_AC\_CUR, available at [https://appsso.eurostat.ec.europa.eu/nui/show.do?dataset=env\\_ac\\_cur&lang=en](https://appsso.eurostat.ec.europa.eu/nui/show.do?dataset=env_ac_cur&lang=en)

Table reference ENV\_AC\_CURM, available at [http://appsso.eurostat.ec.europa.eu/nui/show.do?dataset=env\\_ac\\_curm&lang=en](http://appsso.eurostat.ec.europa.eu/nui/show.do?dataset=env_ac_curm&lang=en)

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<sup>12</sup> The Danish EPA estimates that about 54 per cent of plastics collected for recycling is lost in the recycling process. Plastic has a high loss rate compared to other waste types. (*Danish Environmental Protection Agency, 2020*).