European Environment Agency

Analysing material footprint of the EU: Trends and changes from 2010 to 2021

Technical note on the methodology and additional results from the EEA briefing 60/2024

EUROPEAN ENVIRONMENT AGENCY

Analysing material footprint of the EU: Trends and changes from 2010 to 2021.

Technical note on the methodology and additional results underpinning the EEA briefing: *From data to decisions: material footprints in European policy making*

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Contents

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1 Introduction

This technical note presents the datasets and methods used to analyse the material footprint datasets published by Eurostat. The results of these analyses are summarised and discussed in the EEA briefing "From data to decisions: material footprints in European policy making". This briefing and the technical note constitute deliverable D4.1b of the Service Level Agreement between the EEA and Eurostat.

2 Content of the analyses

In the analyses the two datasets characterising the material footprint of the EU were complemented with the data on total final expenditure. Both terms are defined in section 2.2.

2.1 Datasets

The analyses summarised in this technical note were based on the following datasets:

a) Material Footprints - main indicators (https://doi.org/10.2908/ENV_AC_RME; last updated 07/02/2024);
b) Material Footprints - Details by final use of products (https://doi.org/10.2908/ENV_AC_RMEFD; Material footprints split by final use of 63 products according to the Statistical Classification of Products by Activity in the European Economic Community (CPA, 2008), last updated 29/04/2024);
c) Symmetric input-output table at basic prices (product by product) calculated based on the FIGARO tables published in Eurostat's database. Datasets for 2010-2021 were provided by Eurostat, Unit E2.

All datasets offer readily available aggregated values for the European Union (EU).

Data from the years 2020 and 2021 were used to analyse the change in consumption patterns. To comment on trends data for the years from 2010 up to 2021 were analysed.

2.2 Definitions and assumptions

2.2.1 Total final consumption expenditure

In the National Accounts, final use refers to goods and services consumed in their final state, by individual consumers and governments. It includes the final consumption expenditure (P3) and gross capital formation (P5). Final consumption expenditure is broken down into final consumption expenditure of households (P3_S14), non-profit institutions serving households (NPISH; P3_S15) and expenditure of general government (P3_S13). Gross capital formation includes gross fixed capital formation (RMC_P51G) and changes in inventories and acquisitions less disposals of valuables (RMC_P52_53).

In this study, it is assumed that the expenditure of non-profit institutions serving households and of general government (on education, health, justice and defence systems or on infrastructure, as well as investments (gross capital formation), all ultimately serve the EU citizens (households). Therefore, in this report, the sum of the final consumption expenditure (P3) and gross capital formation (P5), is

used to analyse the EU citizens' spending on goods and services. This sum is referred to as the **total final consumption expenditure**[1].

2.2.2 Raw material consumption (material footprint)

Raw Material Consumption (RMC) is the amount of material, expressed in raw material equivalents, required to produce the products consumed in the geographical reference area (i.e. the amount of domestic and foreign extraction required, directly and indirectly to serve the final demand of goods and services). Raw material consumption is also called material footprint.

Analogous to the logic behind the calculation of total final consumption expenditure, the material footprint resulting from final consumption expenditure of non-profit institutions serving households, from general governments, as well as from investments (gross capital formation), can ultimately be attributed as serving EU citizens. These categories, on the top of the material footprint resulting from consumption of households, were used to derive the total material footprint. Therefore, the total material footprint, or simply the **material footprint** in this analysis, is the sum of (RMC_P3) *raw material consumption as a result of final consumption expenditure* and (RMC_P5) *raw material consumption as a result of gross capital formation.*

2.2.3 The final use

The raw material consumption is closely related to the national account's concept of final use (FU), expressed in monetary units. Hence, the two can be combined as follows:

$$\mathrm{RMC_{i,k}\,[tonnes]} = \mathrm{FU_{i,k}\,[€]} * \frac{\mathrm{RMC_{i,k}\,[tonnes]}}{\mathrm{FUi,k\,[€]}}$$

where:

RMC: raw material consumption; in this study it is the material footprint by the final use of products;

FU: final use in monetary units; in this study the input-output table at basic prices (product by product) [naio_10_cp1700] was used (unpublished datasets for 2010-2021, provided by Eurostat, Unit E2);

i: index for products; in this study 63 CPA product groups were analysed;

k: index for types of final use; in this study the index is the sum of P3 and P5.

In the equation above the change in consumption patterns is represented by the term = $FU_{i,k}$ [€].

The material intensity (MI) along the production chain of a product is represented by the term:

$$\mathrm{MI} = \frac{\mathrm{RMC_{i,k}\,[tonnes]}}{\mathrm{FUi,k\,[€]}}$$

2.2.4 Deflation of monetary data

To make the expenditures in different years comparable, their values have been deflated using the price index (implicit deflator) dataset (GDP and main components (output, expenditure and income)).

2.2.5 The material intensity of a consumption domain

While the equation used to compute the material intensity per product is provided in section 2.2.3, the material intensity of a consumption domain (MI_CD) was calculated as a weighted average of the

[1] In the briefing based on the analyses summarized in this note, the term "total final consumption expenditure" has been simplified for the non-expert readers into "total consumption expenditure".

material intensity of the contributing CPA product groups, weighted by the relative contribution the RMC of the CPA product to the total material footprint of the consumption domain.

$$MI\_CD = \sum_j MI_j * \frac{RMC_j}{\sum_j RMC_j}$$

where:

MI_CD: material intensity of a consumption domain;

RMC_j: raw material consumption of a product belonging to a consumption domain;

j: index of products belonging to a consumption domain.

2.3 Consumption domains

As previously mentioned, the material footprint and the total final expenditure (datasets b and c in section 2.2.1) are broken down by the final use of 63 CPA products. In order to facilitate the interpretation of the results and to make them comprehensive for the broader audience and non-expert readers, the 63 product groups have been allocated into the following six household consumption domains:

- **food** – food and beverages purchased directly by households or provided in restaurants, etc;
- **housing** – dwellings and utilities such as heating, hot water and electricity or gas;
- **personal mobility** – own vehicles (purchase, maintenance and repair, including servicing and parts), public transport, taxis and the transport of goods, including postal and courier services;
- **household goods** – household equipment and appliances;
- **services** – health, education, finance, security, safety, recreation;
- **clothing and footwear**.

The consumption domains are based on the aggregated COICOP classification following the logic used in (ETC-CE, forthcoming).

The task of allocating the 63 CPA product groups to the 6 consumption domains was not trivial and was carried out in consultation with Eurostat Unit E.2 'Environmental statistics and accounts, sustainable development'. In the study (ETC-CE, forthcoming) an analogous allocation was made for the NACE activities used in Exiobase v.3.8.2, mostly based on literature review and expert knowledge of the authors. This study adopted most of the entries of the allocation table (assuming correspondence between the NACE activities and CPA products), except for the following products: CPA_B, CPA_C16, CPA_C20, CPA_C23, CPA_H49, CPA_H50, CPA_H51, CPA_H52, CPA_I, for which the allocation is based on Eurostat's expert's knowledge and the dataset documented in (Cai and Vandyck, 2020).

The resulting allocation table of the 63 CPA product groups to the 6 consumption domains is presented in Annex 1 of this document.

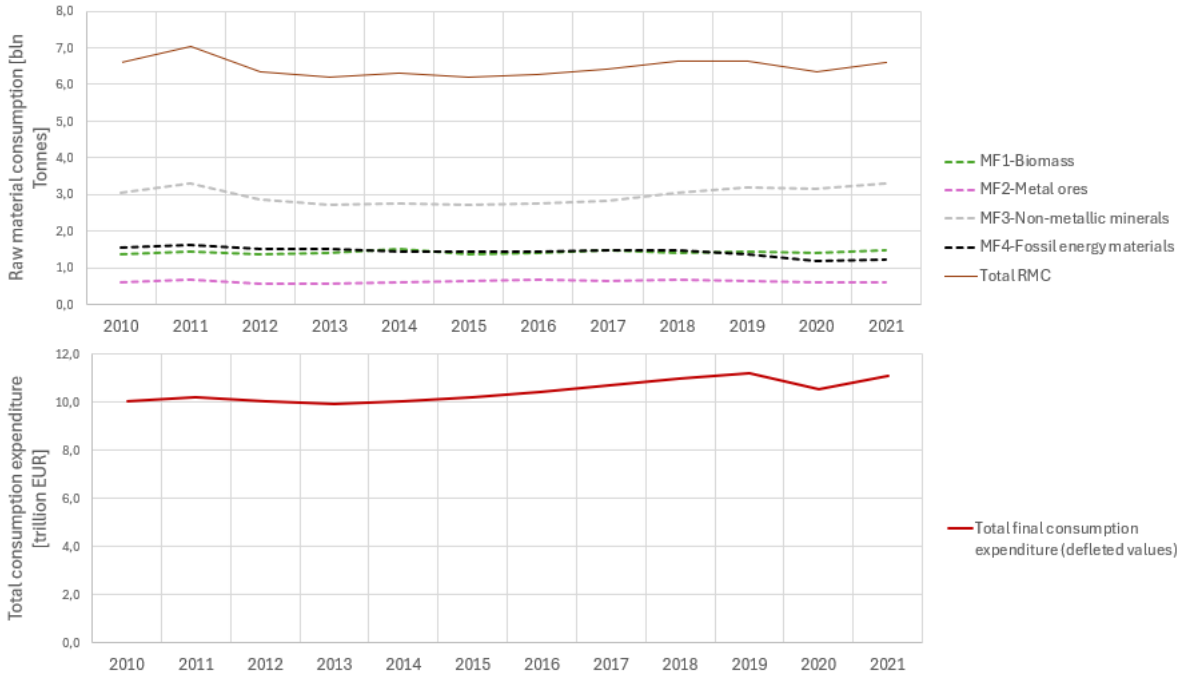
3 Decomposition of material footprint and total final consumption expenditures

3.1 Trends in material footprint and total final consumption expenditure

Total raw material consumption (material footprint) in the EU in 2021 was at the level of 6,6 billion tonnes (Figure 1). It remained relatively stable between 2010 and 2021, with an increase of +6,9% in

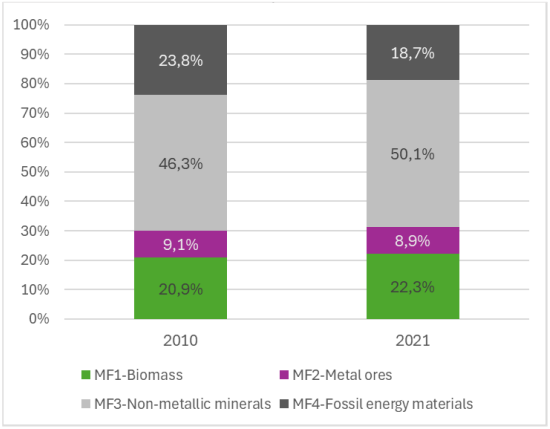
2011, a decrease of -9.8% in the following year, small changes (-2,1% to 3,2%) until 2020, when a decrease of -4,4% was observed, followed by an increase of +3,7% in 2021, resulting in the total value of material footprint in 2021 reaching again the value of 2010 (+0,2%).

Figure 1. Raw material consumption (material footprint) of the four main material categories, total material footprint and total final consumption expenditure in the EU (2010-2021).



- Among the four main material categories, the consumption of **non-metallic minerals** was the highest. In 2021, it was at the level of 3,3 billion tonnes of material equivalent, which is 8% more than in 2010. From 2016 onwards, the use of non-metallic minerals has been increasing, except in 2020 when a decrease of 1,2% was observed, probably as a side effect of the COVID-19 pandemic. In 2021, non-metallic minerals accounted for 50,1% of the total material footprint, compared to 46,3% in 2010 (Figure 2).
- The second large material category in 2021 was **biomass,** which accounted for 1,5 billion tonnes of material equivalent, 7% more than in 2010. The relative contribution of the biomass to the total material footprint increased from 20,9% in 2010 to 22,3% in 2021.
- Despite the 4,8% increase in the use of **fossil energy materials** in 2021 compared to 2020, in 2021 it was at the level of 1,2 million tonnes of material equivalent, which is 79,0% of the use in 2010. The use of fossil energy materials decreased between 2010 and 2021, except for the years 2011, 2017 and 2021. The share of fossil fuels in the total material footprint decreased from 23,8% in 2010 to 18,7% in 2021.
- The use of **metal ores** increased by 21,9% between 2012 and 2018 and then decreased to 0,6 billion tonnes of material equivalent in 2021. This is 98% of the metal ore use value in 2010. Metal ores have the smallest relative contribution to the total material footprint, 9,1% in 2010 and 8,9% in 2021.
- Changes in the consumption of non-metallic minerals were shaping the overall trend in material footprint (the Pearson correlation between the material footprint and the consumption of non-metallic minerals is R = 0,83).

Figure 2. Shares of the main material categories in material footprint in the EU in 2010 and 2021.



- The total final consumption expenditure of the EU was at the level of 11,1 trillion EUR in 2021 (Figure 1). It increased by 10,3% between 2010 and 2021 (deflated values). The overall trend was increasing, except for the years 2012 (-2,0%), 2013 (-0,7%), and 2020 (-6,0%).

Figure 3. Total final consumption expenditure, total raw material consumption (material footprint) and consumption of the four main material categories in the EU between 2010 and 2021 (indexed to 2010).

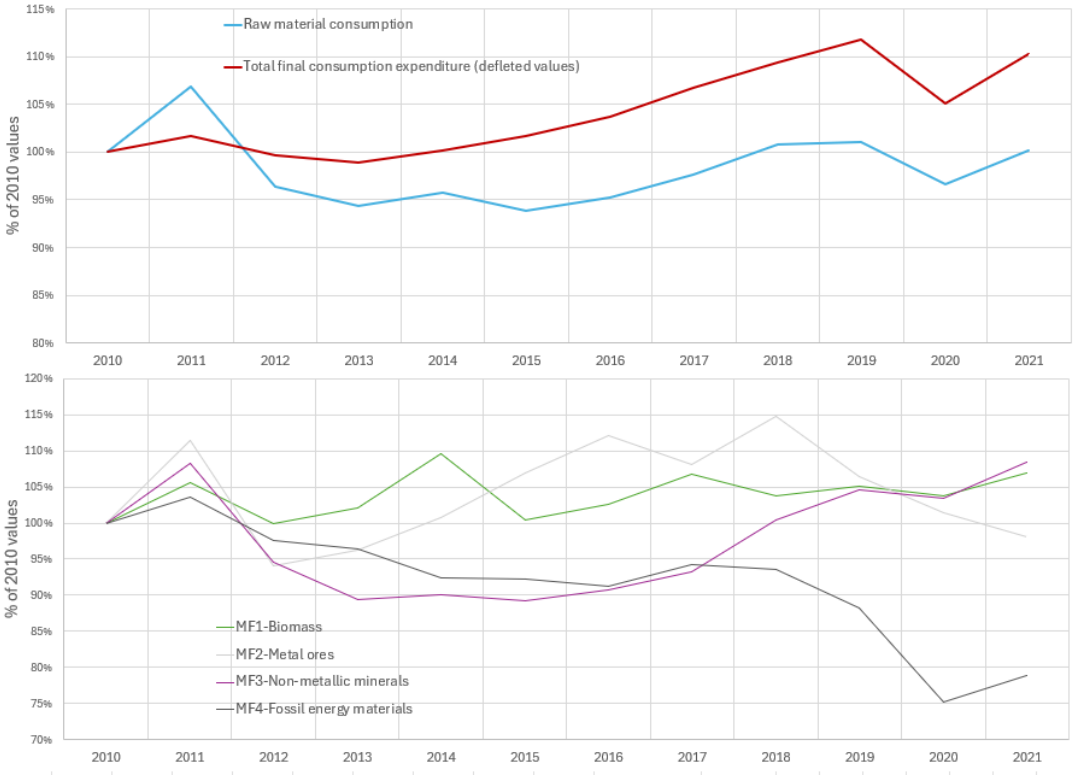


Table 1. The contribution of the main material categories to the material footprint in the EU in 2020 and 2021.

	Year	MF1-Biomass	MF2-Metal ores	MF3-Non-metallic minerals	MF4-Fossil energy materials	Total material footprint
Material footprint [kTonnes]	2010	1 373 540	600 270	3 046 994	1 565 187	6 585 991
	2021	1 468 224	588 665	3 305 960	1 234 763	6 597 612
% of total material footprint	2010	20,9%	9,1%	46,3%	23,8%	-
	2021	22,3%	8,9%	50,1%	18,7%	-
% change 2010-2021		6,9%	-1,9%	8,5%	-21,1%	0,2%

3.1.1 Products and services shaping the material use in the EU in 2010 and 2021

Figure 4 shows 20 CPA product groups with the largest material footprint in 2021.

The three product groups with the highest material footprint in 2021 (marked in red in Figure 4) that all together accounted for 53,0% of the total EU material footprint in 2021 are:

- (CPA_F) Constructions and construction works (36,5%),
- (CPA_C10-12) Food, beverages and tobacco products (10,8%) and
- (CPA_A01) Products of agriculture, hunting and related services (5,7%).

Eleven product groups (marked in purple in Figure 4) with the largest material footprint in 2021 all together account for 75,3% of the total material footprint.

Figure 4. The 20 CPA product groups with the largest material footprint in 2021 in the EU and their share of the cumulative sum [%].

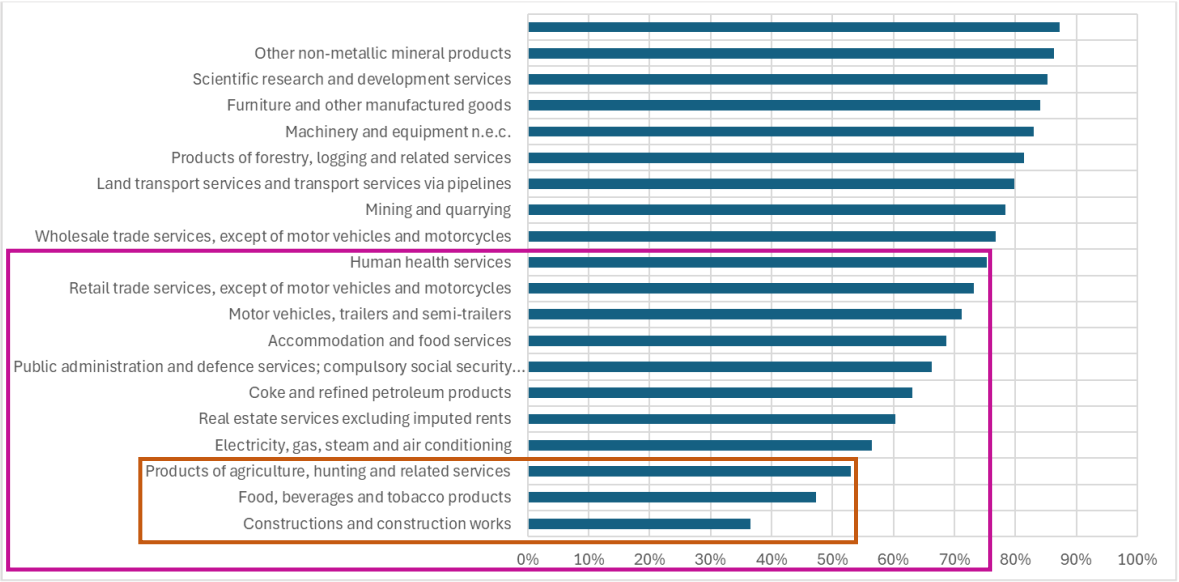
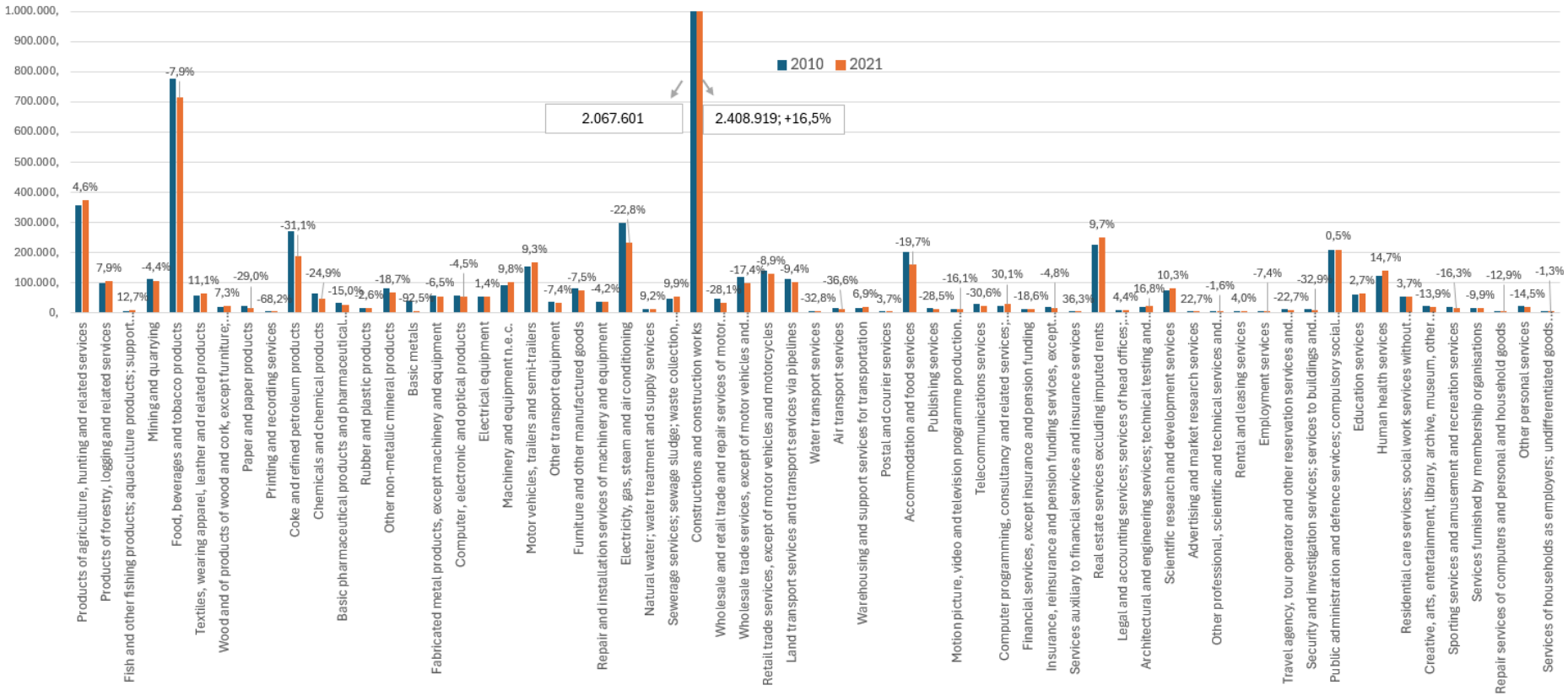


Figure 5 presents the EU's material footprint in 2010 and 2021 broken down by 63 CPA products. Numbers above the bars indicate the change in raw material consumption between 2010 and 2021.

Figure 5. Material footprint [kTonnes] in the EU in 2010 and 2021, by CPA products.

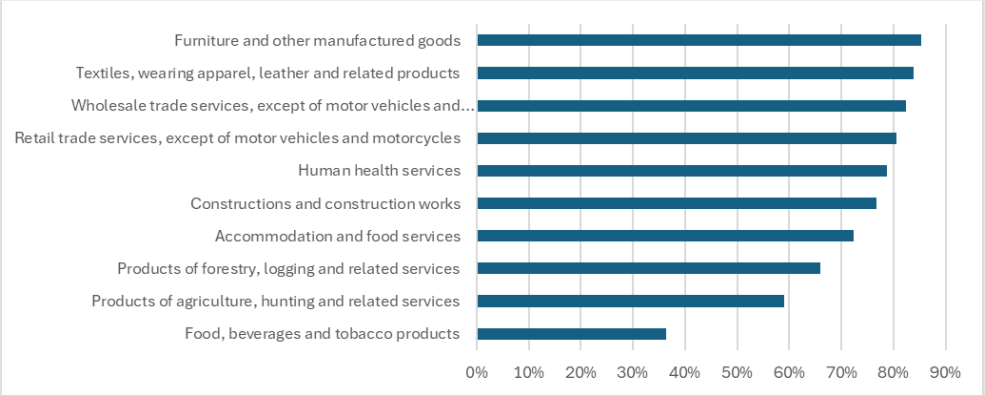


3.1.2 Biomass

The five CPA product groups with the largest **biomass** consumption that all together accounted for more than 75% of the total biomass consumption in 2021 are:

- (CPA_C10-12) Food, beverages and tobacco products,
- (CPA_A01) Products of agriculture, hunting and related services,
- (CPA_A02) Products of forestry, logging and related services,
- (CPA_I) Accommodation and food services and
- (CPA_F) Constructions and construction works.

Figure 6. The 10 CPA products with the largest biomass material consumption in the EU in 2021 and their share of the cumulative sum [%].



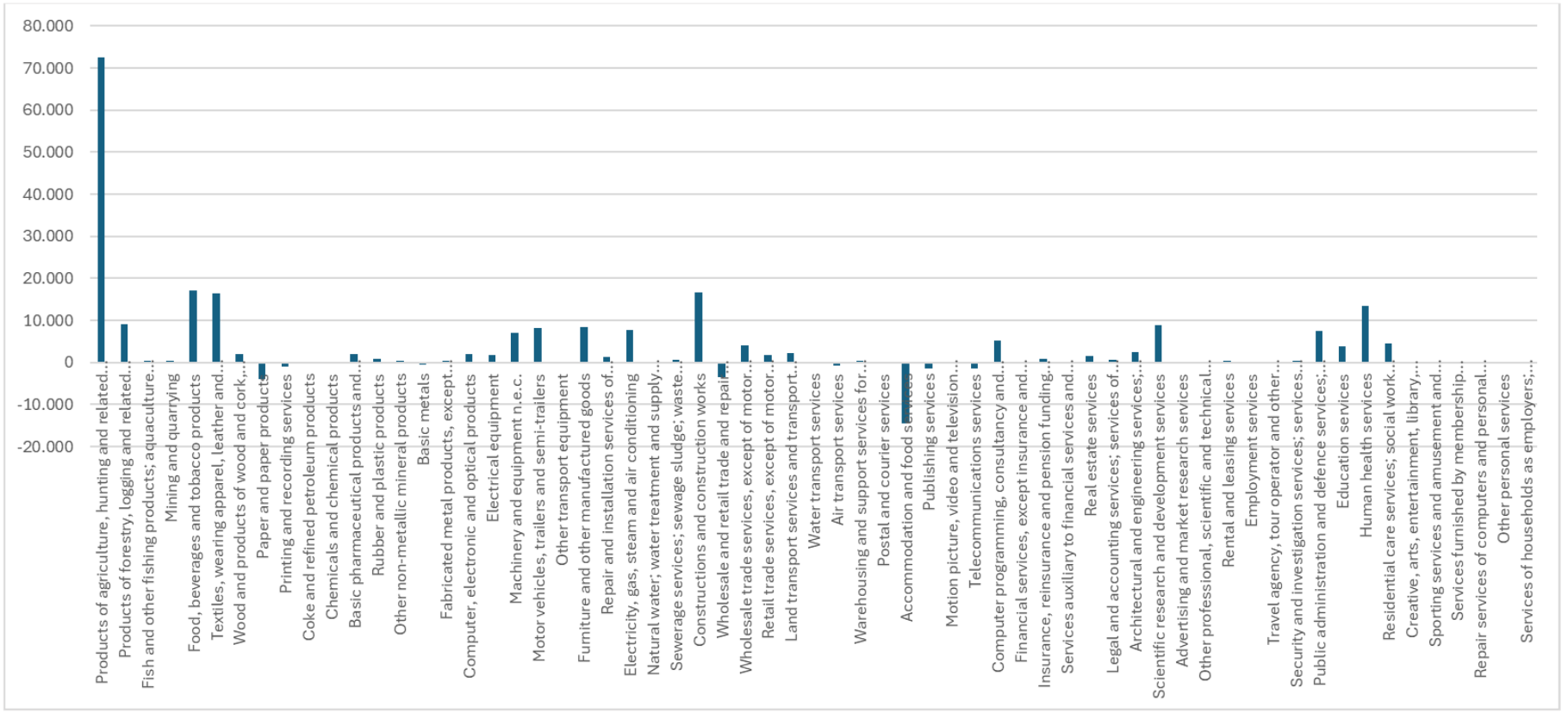
The biggest increases in the use of biomass between 2010 and 2021 were observed in the following CPA product groups (Figure 7):

- (CPA_A01) Products of agriculture, hunting and related services,
- (CPA_C10-12) Food, beverages and tobacco products,
- (CPA_C13-15) Textiles, wearing apparel, leather and related products,
- (CPA_F) Constructions and construction works and
- (CPA_Q86) Human health services.

Between 2010 and 2021 biomass use decreased in:

- (CPA_I) Accommodation and food services,
- (CPA_G45) Wholesale and retail trade and repair services of motor vehicles and motorcycles and
- (CPA_C17) Paper and paper product.

Figure 7. The absolute difference in material footprint of biomass in the EU in 2010 and 2021, by CPA product groups [kTonnes]. Positive values indicate an increase between 2010 and 2021.



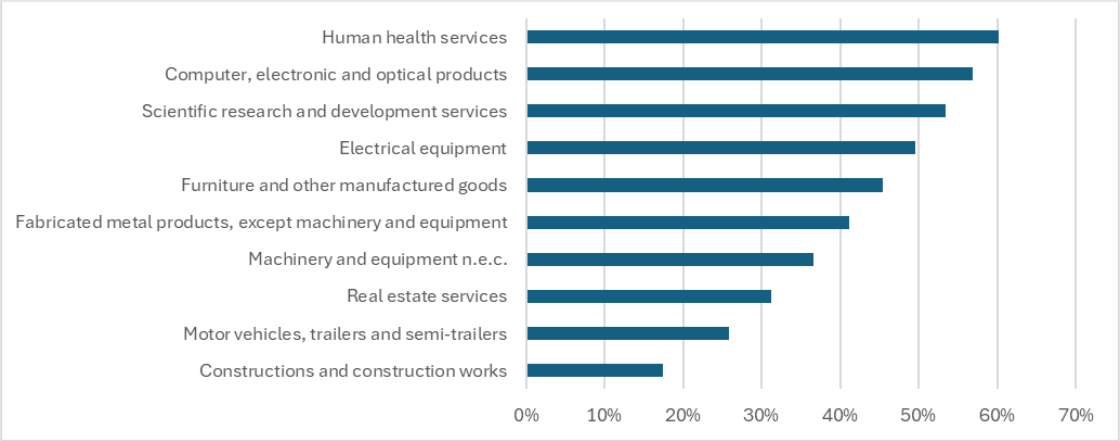
3.1.3 Metal ores

The product groups with the highest use of **metal ores** in 2021 were:

- (CPA_F) Constructions and construction works,
- (CPA_C29) Motor vehicles, trailers and semi-trailers, (CPA_L) Real estate services,
- (CPA_C28) Machinery and equipment n.e.c.,
- (CPA_C25) Fabricated metal products, except machinery and equipment,
- (CPA_C31_32) Furniture and other manufactured goods and
- (CPA_C27) Electrical equipment.

Together they accounted for nearly 50% of the total metal ores consumption in the EU in 2021 (Figure 8).

Figure 8. The 10 CPA products with the largest metal ore material consumption in the EU in 2021 and their share of the cumulative sum [%].



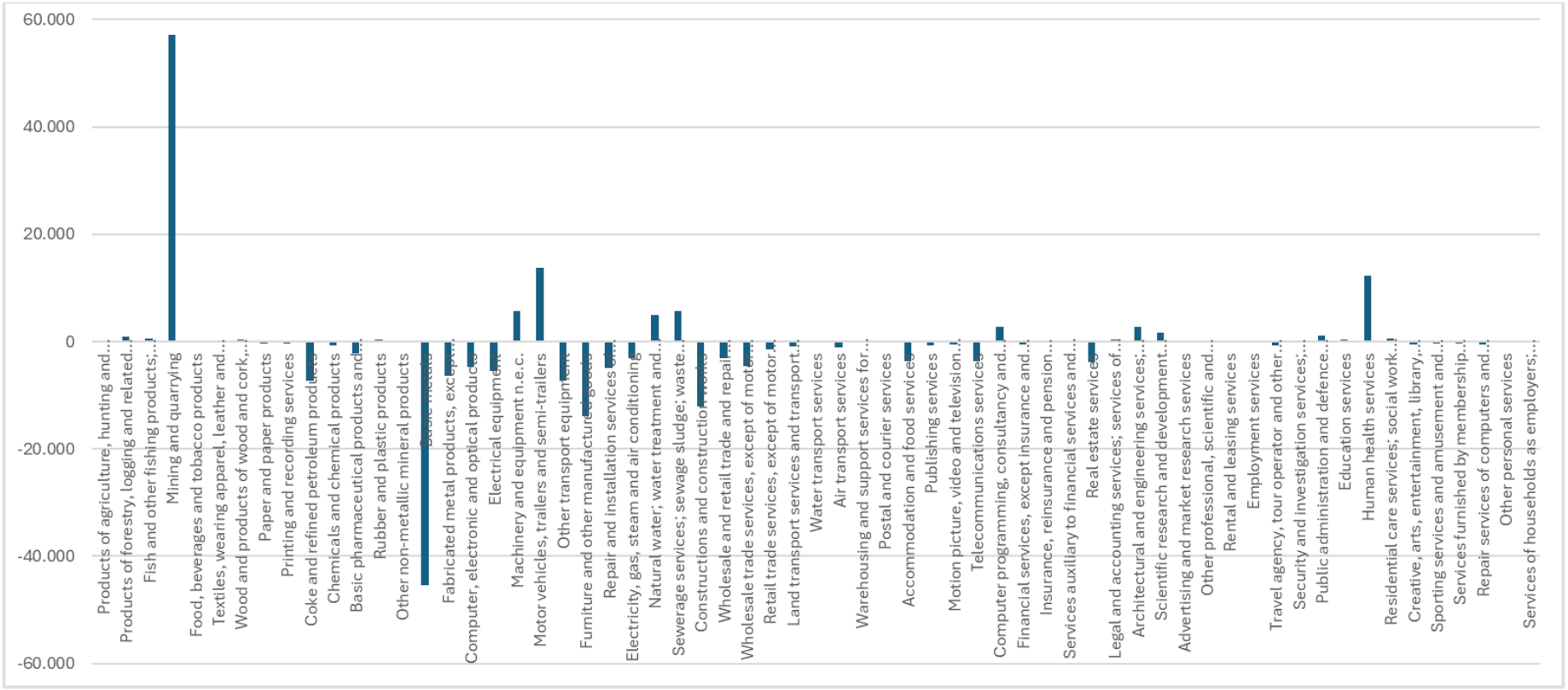
Between 2010 and 2021 the biggest increases in the use of metal ores were observed in the following CPA product groups (Figure 9):

- (CPA_B) Mining and quarrying,
- (CPA_Q86) Human health services and in
- (CPA_C29) Motor vehicles, trailers and semi-trailers.

The use of metal ores dropped in:

- (CPA_C24) Basic metals,
- (CPA_C31_32) Furniture and other manufactured goods and in
- (CPA_F) Constructions and construction works.

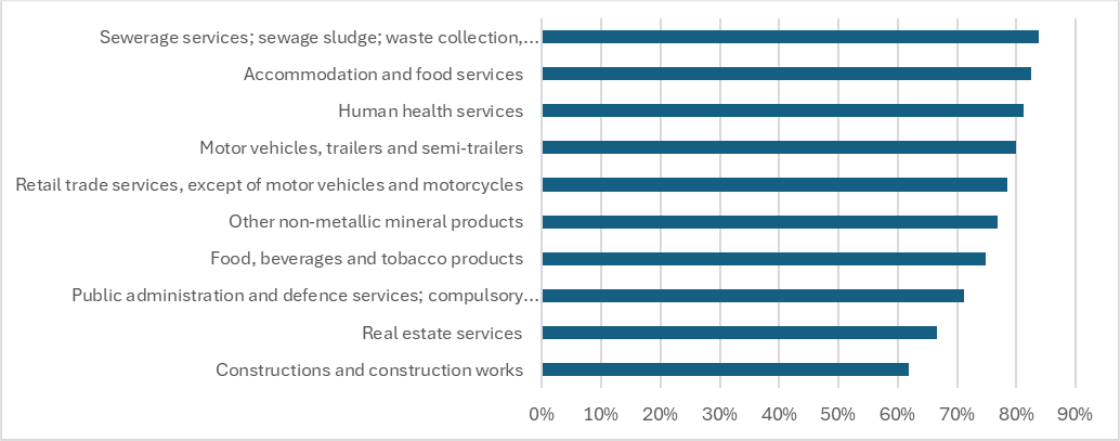
Figure 9. The absolute difference in material footprint of metal ores [kTonnes] in the EU in 2010 and 2021, by CPA product groups. Positive values indicate an increase between 2010 and 2021.



3.1.4 Non-metallic minerals

Constructions and construction works (CPA_F) accounted for more than 60% of the total **non-metallic materials** use in EU in 2021 (Figure 10).

Figure 10. The 10 CPA products with the largest non-metallic minerals material consumption in EU in 2021 and their share of the cumulative sum [%].



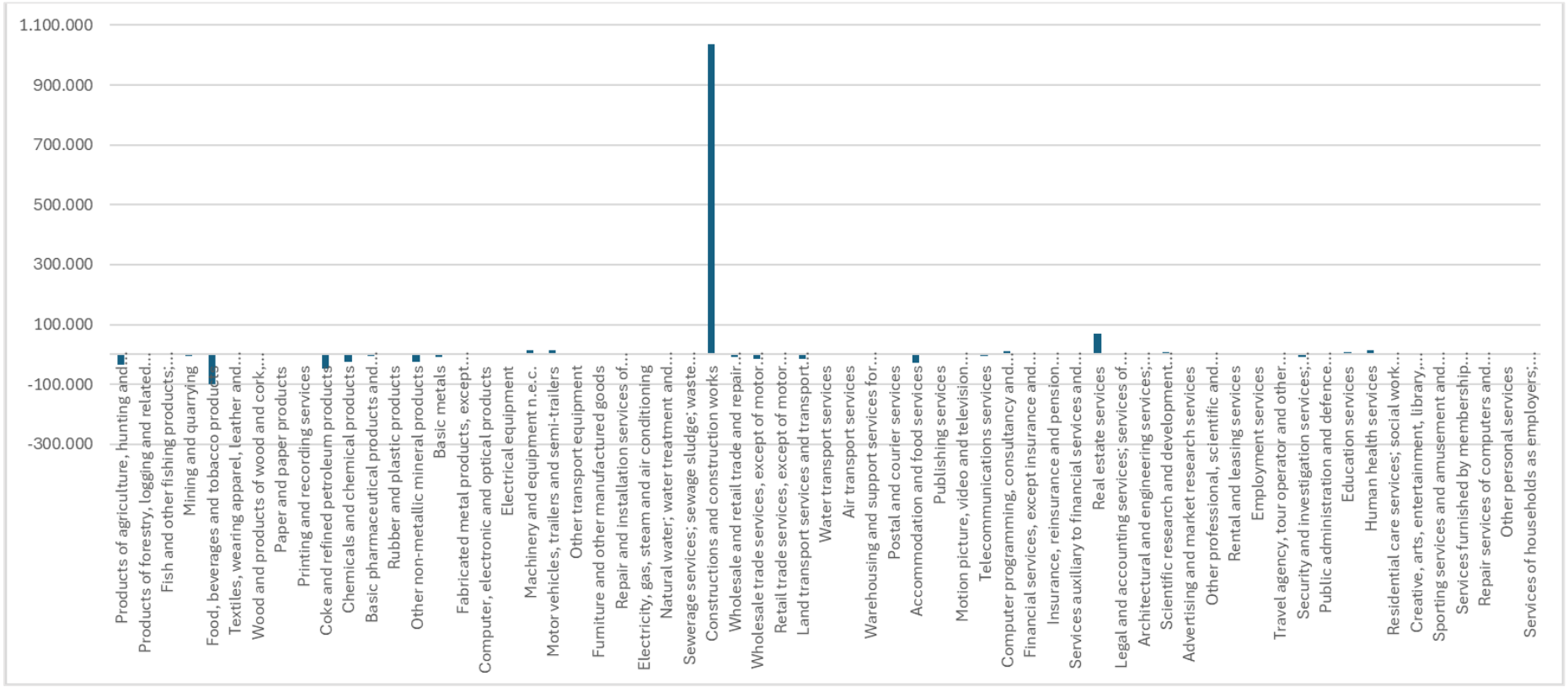
Between 2010 and 2021 the biggest increases in the use of non-metallic minerals were observed in the following CPA product groups (see also Figure 11):

- (CPA_F) Constructions and construction works and
- (CPA_L) Real estate services.

The use of non-metallic minerals dropped in:

- (CPA_C10-12) Food, beverages and tobacco products,
- (CPA_C19) Coke and refined petroleum products,
- (CPA_A01) Products of agriculture, hunting and related services.

Figure 11. The absolute difference in material footprint of non-metallic minerals [kTonnes] in the EU in 2010 and 2021, by CPA product groups. Positive values indicate an increase between 2010 and 2021.

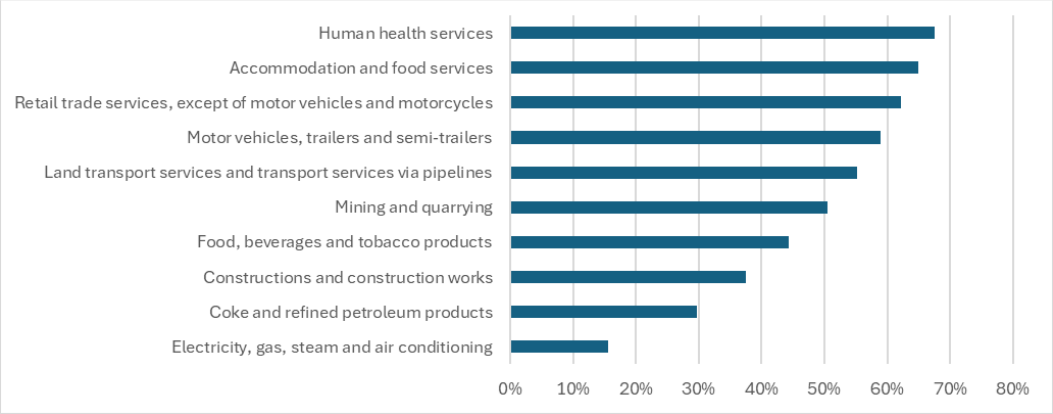


3.1.5 Fossil energy materials

The following five CPA product groups accounted for around 50% of the total **fossil energy materials** use:

- (CPS_D) Electricity, gas, steam and air conditioning,
- (CPA_C19) Coke and refined petroleum products,
- (CPA_F) Constructions and construction works,
- (CPA_C10-12) Food, beverages and tobacco products,
- (CPA_B) Mining and quarrying.

Figure 12. The 10 CPA products with the largest fossil energy material consumption in the EU in 2021 and their share of the cumulative sum [%].



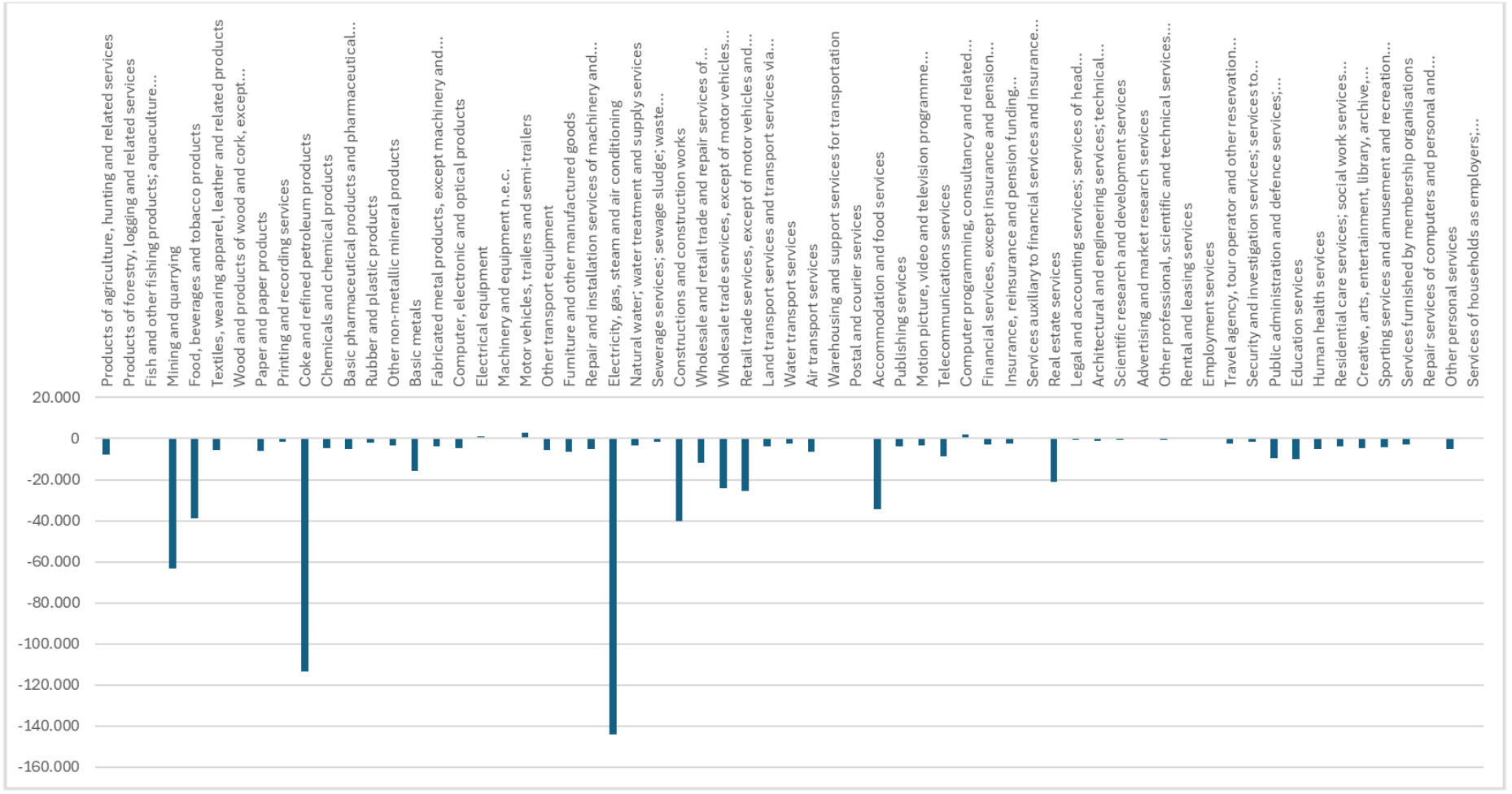
Between 2010 and 2021 small increases in the use of fossil energy materials were observed in the following CPA product groups (Figure 13):

- (CPA_C29) Motor vehicles, trailers and semi-trailers and in
- (CPA_K64) Financial services, except insurance and pension funding.

The use of fossil energy materials dropped in almost all the CPA product groups, with the most distinctive drops in:

- (CPS_D) Electricity, gas, steam and air conditioning,
- (CPA_C19) Coke and refined petroleum products and in
- (CPA_B) Mining and quarrying.

Figure 13. The absolute difference in material footprint of fossil energy fuels [kTonnes] in the EU in 2010 and 2021, by CPA product categories. Positive values indicate an increase between 2010 and 2021.



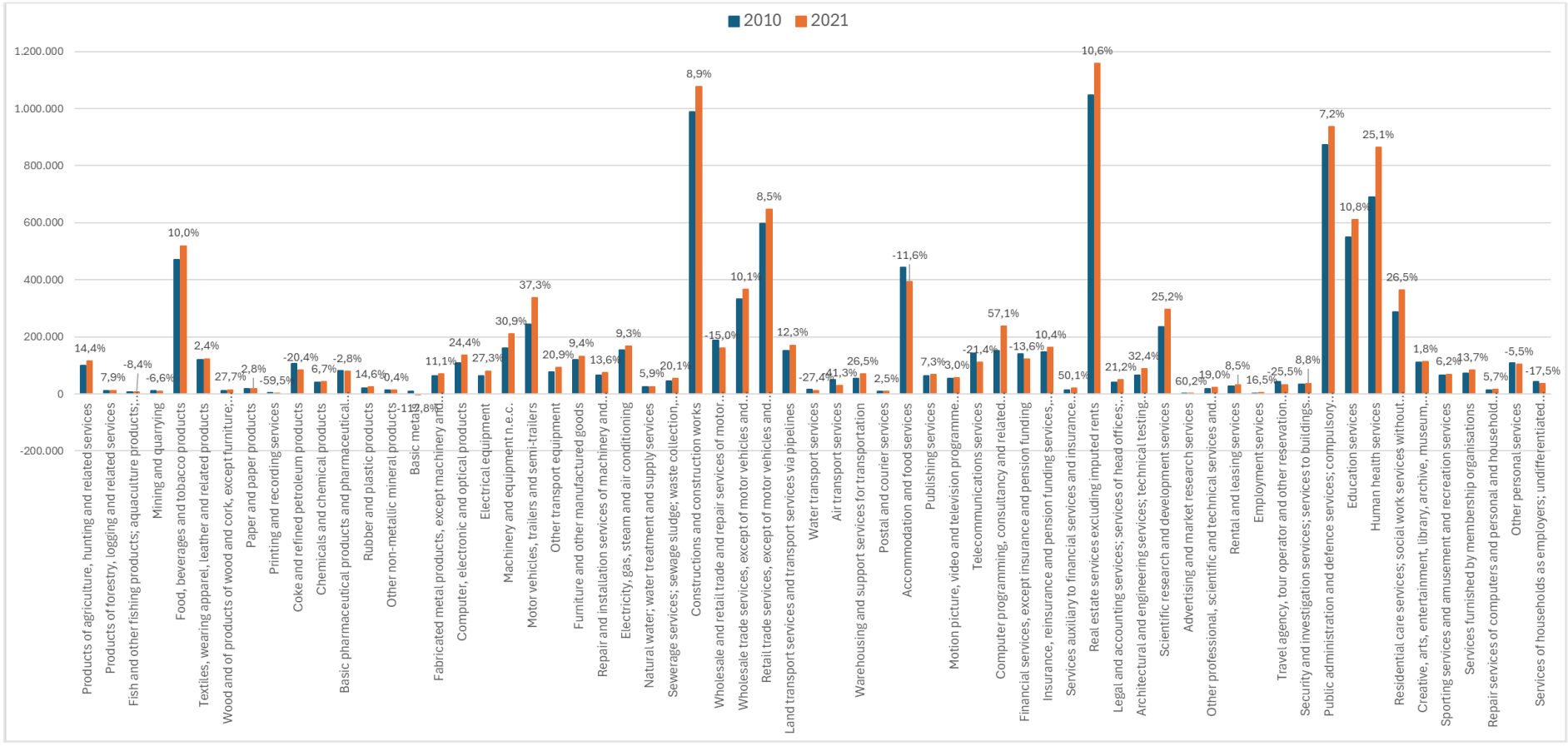
3.1.6 Products and services shaping the total final consumption expenditure in the EU in 2010 and 2021

Figure 14 presents 20 CPA product groups with the largest total final expenditure in the EU in 2021. Seven product groups with the largest total final expenditure all together account for 52% of the total final expenditure of the EU in 2021. Sixteen product groups (marked in purple) with the largest total final expenditure in 2021 all together account for 75% of the total final expenditure of the EU in 2021.

Figure 14. The 20 CPA products with the largest total final consumption expenditure in the EU in 2021 and their share of the cumulative sum [%].

Figure 15 presents the total final consumption expenditure of the EU in 2010 and 2021 broken down by 63 CPA products. Numbers above the bars indicate the change in total final consumption expenditure between 2010 and 2021.

Figure 15. Total final consumption expenditure [mln EUR] in the EU in 2010 and 2021, by CPA products.

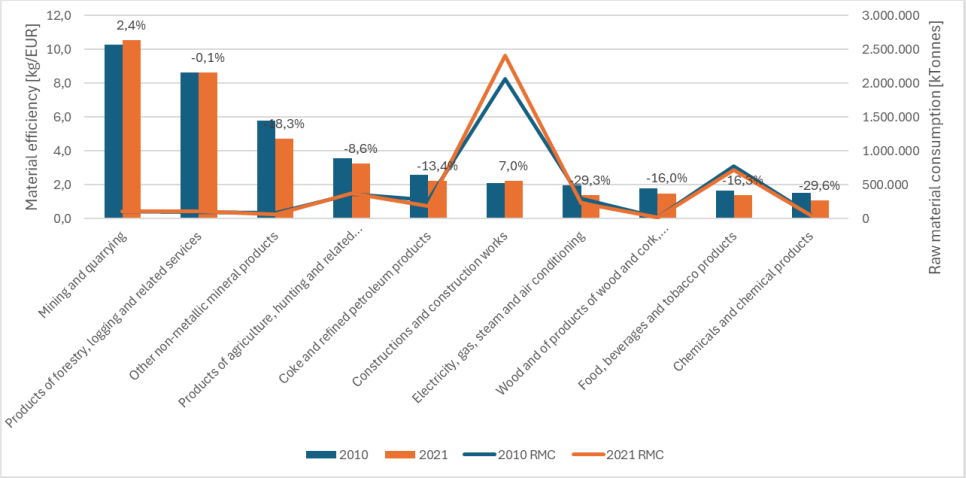


3.1.7 *Products and services shaping the material intensity in the EU in 2010 and 2021*

The CPA product groups with the highest and lowest material intensity are presented in Figure 16 and Figure 17 respectively.

The three product groups with the highest material intensity are (CPA_B) Mining and quarrying, (CPA_A02) Products of forestry, logging and related services and (CPA_C23) Other non-metallic mineral products. The material intensity of the first two products has not improved between 2010 and 2021, while an 18% improvement was noted for the (CPA_C23) other non-metallic mineral products.

Figure 16. The 10 CPA products with the highest material intensity (bar chart [kg/EUR]) and the relevant material footprint (line chart [kTonnes]) in the EU in 2010 and 2020.



The lowest material intensity was observed for products of services (Figure 17).

Figure 17. The 10 CPA products with the lowest material intensity (bar chart [kg/EUR]) and the relevant material footprint (line chart [kTonnes]) in the EU in 2010 and 2020.

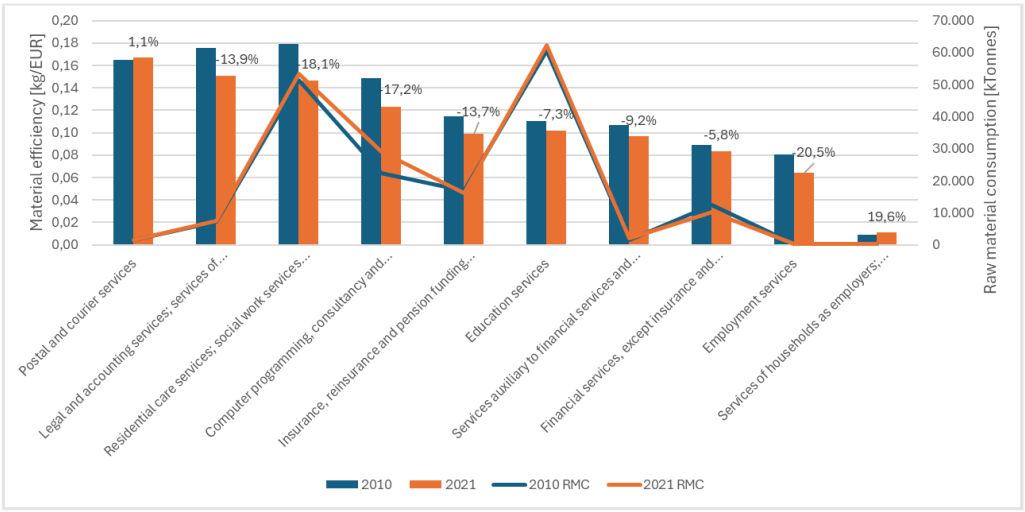
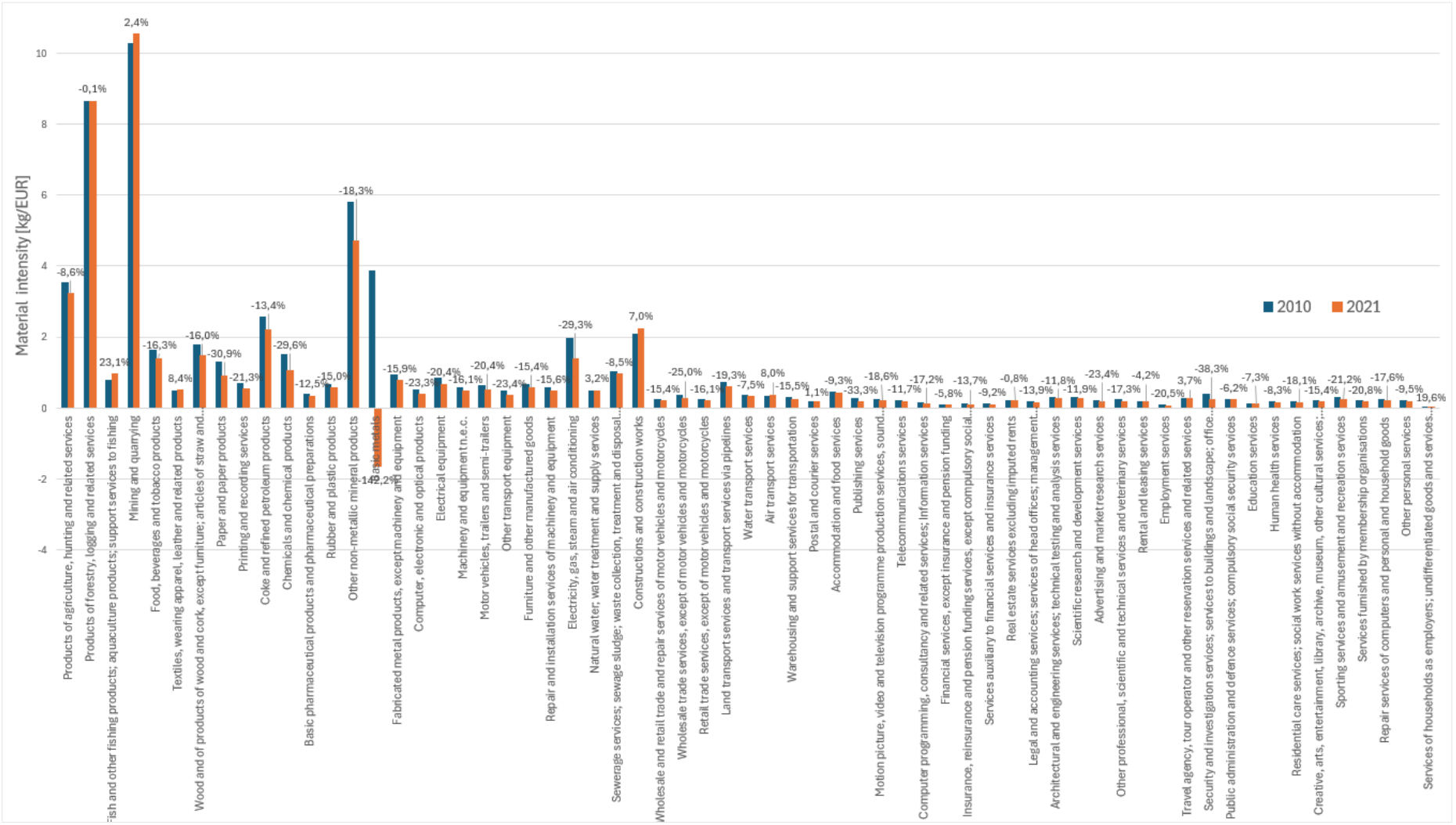


Figure 18. Material intensity of the 63 CPA product groups in the EU in 2010 and 2021.



3.2 Analysis of material footprint, total final expenditure and material intensity in consumption domains

As previously mentioned (see section 2.3) the material footprint dataset and the data on total expenditure are broken down by the 63 CPA product groups. To facilitate the interpretation of the analysis results for the policymakers, the product relevant data were aggregated into 6 broad consumption domains, namely housing, food, personal mobility, household goods, services, clothing and footwear, according to the allocation table included in Annex 1. This section presents the results of the analysis of material footprint, total final expenditure and material intensity of all the consumption domains.

The shares of consumption domains in the total EU material footprint in 2010 and 2021 are presented in Figure 19.

Figure 19. Relative contribution of the consumption domains to the material footprint in the EU in 2010 and 2021.

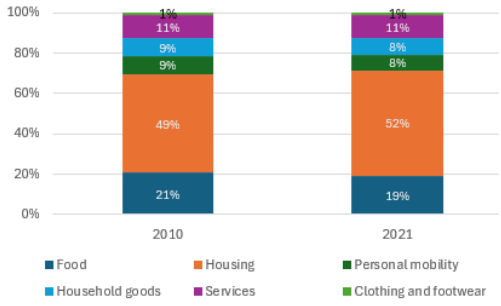


Figure 20. The EU's material footprint by consumption domain in 2010 and 2021.

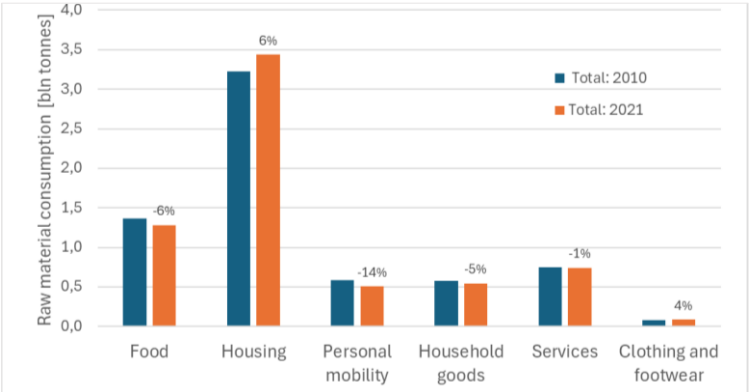


Figure 20 and Figure 21 show the material footprint and total final expenditure in the EU in 2010 and 2021. Housing drives the use of material resources in the EU, accounting for 52% of the EU's material footprint in 2021. Food followed with 19%, while services, household goods and personal mobility accounted for 11%, 8% and 8% of the total material footprint respectively (Figure 19). Clothing and footwear consumed the least resources of the six consumption domains, accounting for only 1% of the material footprint. In terms of the change between 2010 and 2021, the material footprints of food, personal mobility, household goods and services decreased, while those of housing, clothing and footwear increased (Figure 20).

Figure 21 presents the total final EU consumption expenditure for the years 2010 and 2021. The three consumption domains with the highest total final expenditure, accounting for 79% of total final EU consumption expenditure in 2021 were:

- services accounting for 38%,
- housing accounting for 29% and
- household goods accounting for 12% of expenditure.

Household goods and services showed the highest increases in total final consumption expenditure, rising 21% and 11% respectively, while expenditure on food, and clothing and footwear showed little change.

Figure 21. Total final expenditure by consumption domain in the EU in 2010 and 2021.

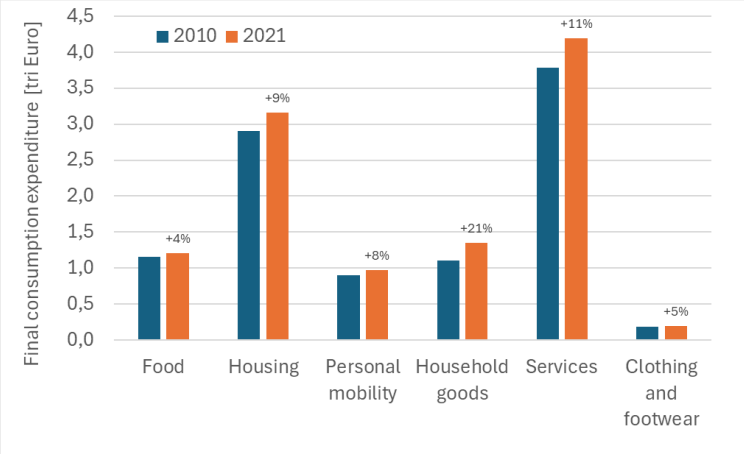
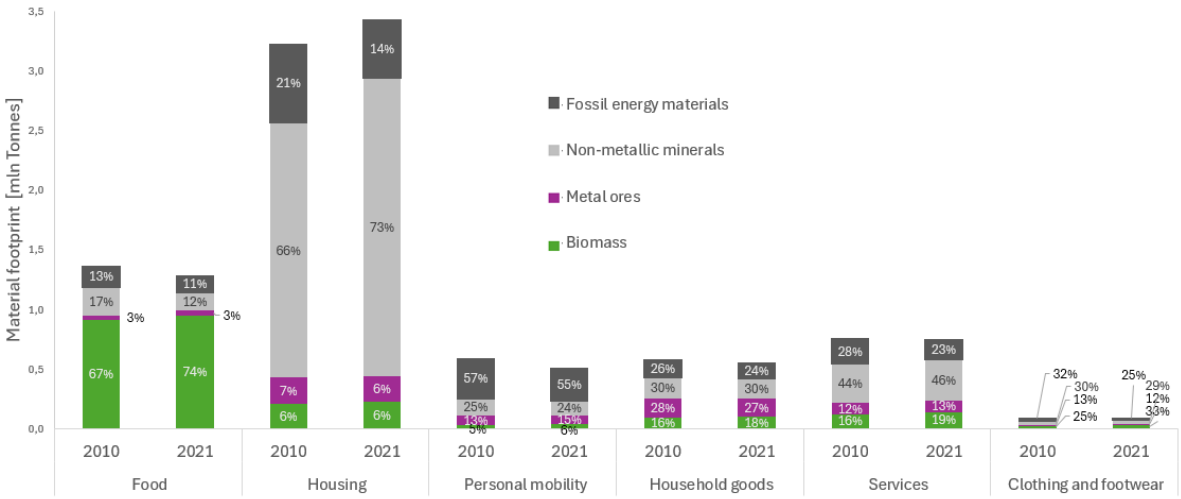


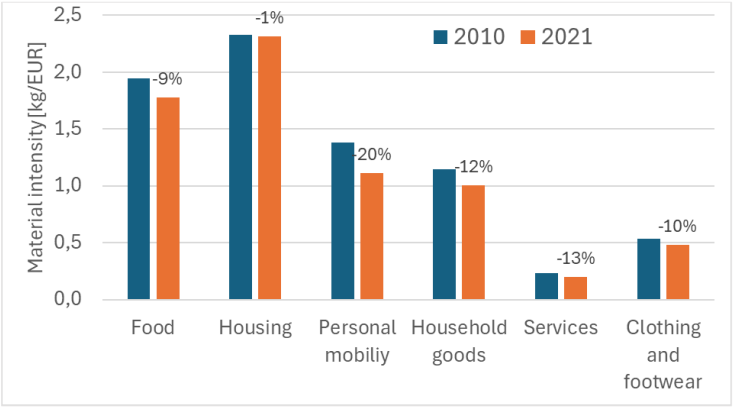
Figure 22 indicates the contribution of the main material categories to the total material consumption of the EU consumption domains in 2020 and in 2021.

Figure 22. Contribution of the main material categories into the material footprint of the six consumption domains in the EU in 2020 and 2021.



Material intensity (Figure 23) improved in all the consumption domains when comparing data from 2010 and 2021, with the largest enhancements in personal mobility (-20%), services (-13%) and household goods (-12%) followed by clothing and footwear (-10%) and food (-9%), and housing (-1%).

Figure 23. Material intensity in the consumption domains in the EU in 2020 and 2021.



The two consumption domains with the highest contribution to the total material footprint, housing and food, have also the highest material intensity, at the level of 2,31kg/EUR and 1,78kg/EUR respectively. The material intensity of housing is roughly twice worse than that of the household goods and 10 times worse than that of services.

Table 2 contains a summary of the material footprint, total final consumption expenditure and material intensity of the six broad consumption domains in the EU in 2020 and 2021.

Table 2. Material footprint, total final consumption expenditure and the material intensity of the six broad consumption domains in the EU in 2020 and 2021.

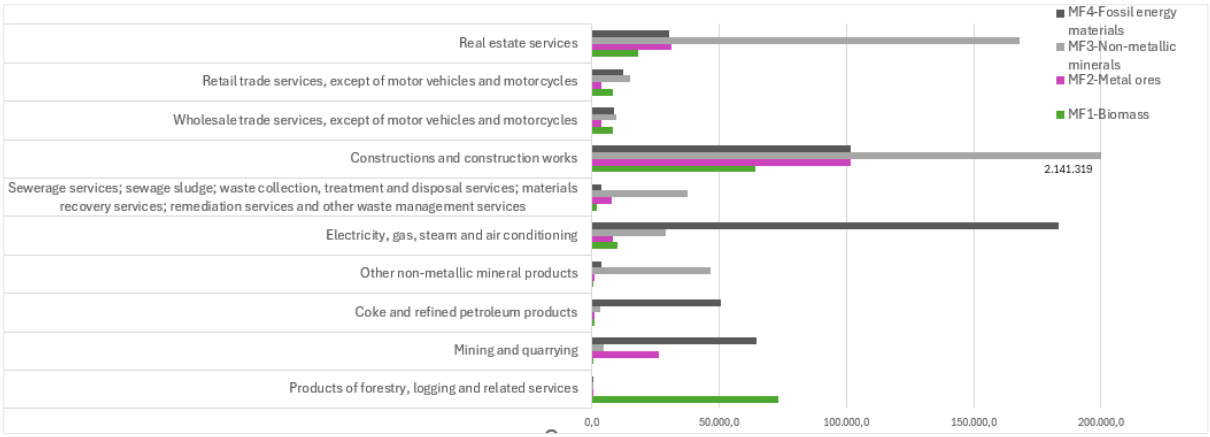
Measure	Year/ %change	Food	Housing	Personal mobility	Household goods	Services	Clothing and footwear
Material footprint [mlnTonnes]	2010	1 364,8	3 228,2	587,2	575,6	750,8	82,1
	2021	1 282,5	3 435,2	506,3	546,1	744,1	85,4
	%change	-6%	6%	-14%	-5%	-1%	4%
Material footprint per capita [tonnes/hab]	2010	3,10	7,33	1,33	1,31	1,70	0,19
	2021	2,87	7,68	1,13	1,22	1,66	0,19
	%change	-7%	5%	-15%	-6%	-2%	2%
% of material footprint	2010	20,7%	49,0%	8,9%	8,7%	11,4%	1,2%
	2021	19,4%	52,1%	7,7%	8,3%	11,3%	1,3%
Total final consumption expenditure [bln EUR]	2010	1157,7	2908,3	899,3	1107,6	3779,8	185,6
	2021	1202,6	3162,5	966,9	1344,8	4195,8	195,2
	%change	4%	9%	8%	21%	11%	5%
Total final consumption expenditure per capita [EUR/hab]	2010	2627	6600	2041	2513	8578	421
	2021	2690	7074	2163	3008	9385	437
	%change	2%	7%	6%	20%	9%	4%
% of total final consumption expenditure	2010	11,5%	29,0%	9,0%	11,0%	37,7%	1,8%
	2021	10,9%	28,6%	8,7%	12,2%	37,9%	1,8%
Material intensity	2010	1,95	2,33	1,38	1,15	0,23	0,54
	2021	1,78	2,31	1,11	1,01	0,20	0,48
	%change	-9%	-1%	-20%	-12%	-13%	-10%

Technical note: Analysing material footprint of the EU. Trends and changes from 2010 to 2021.

3.2.1 Housing

- Among the six consumption domains **housing** covers around half of the total material footprint. The material footprint of housing was at a level 3435,2 bln tonnes in 2021, which is 6% more than in 2010.
- The relative share of housing in the material footprint increased from 49% in 2010 to 52% in 2021.
- In 2021 non-metallic minerals accounted for 73% of the material footprint of housing, followed by fossil energy materials (14%), biomass (7%) and metal ores (6%).
- In that period the share of non-metallic minerals increased by 6,4%, of fossil energy materials dropped by -6,0%, while no large changes were observed for biomass and metal ores (+0,1% and -0,4% respectively).

Figure 24. Contribution of the material categories [kTonnes] in the 10 CPA products with the largest contribution to housing in the EU in 2021.

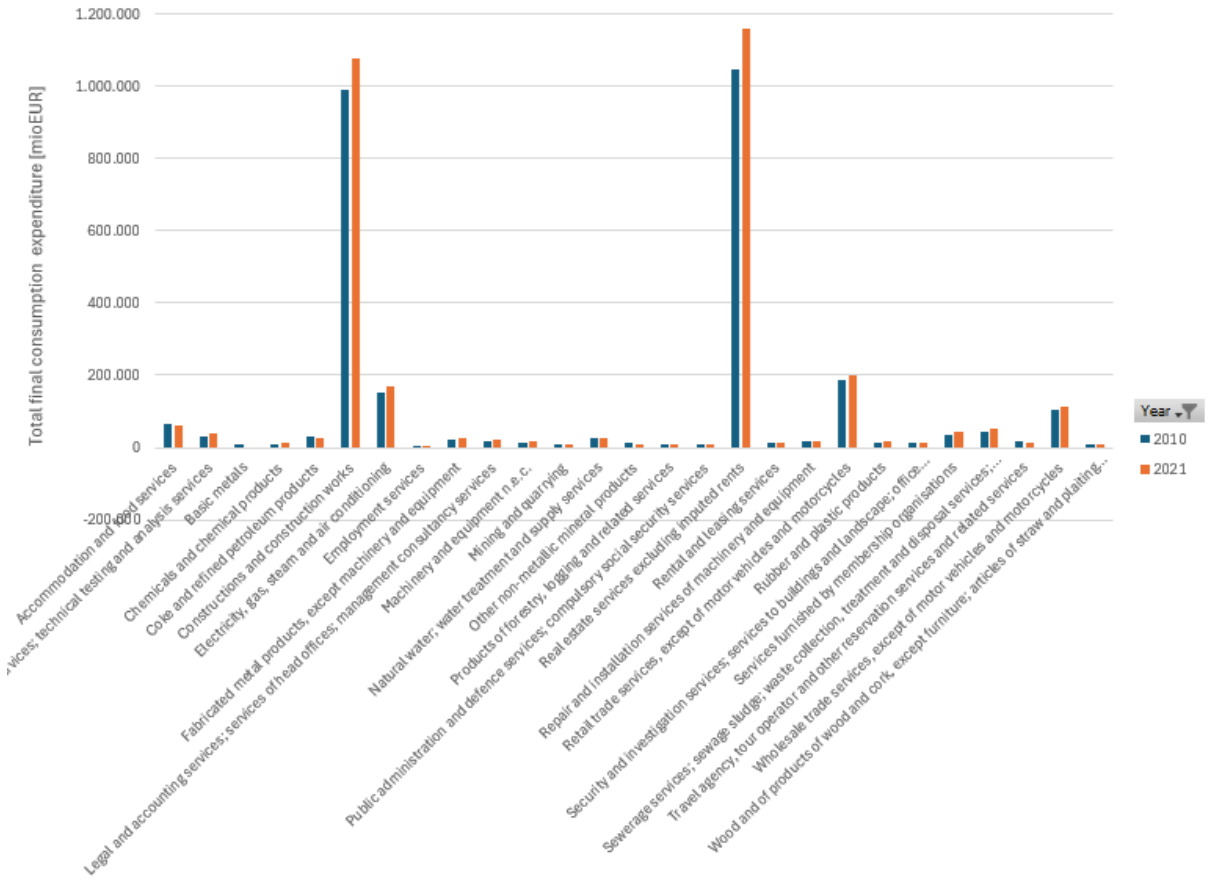


- The use of non-metallic minerals in housing results mostly from the consumption of (CPA_F) Constructions and construction works and (CPA_L68B) Real estate services excluding imputed rents.
- The use of fossil energy materials is dominated by the consumption of (CPA_D) Electricity, gas, steam and air conditioning, (CPA_F) Constructions and construction works (CPA_B) Mining and quarrying and (CPA_C19) Coke and refined petroleum products.
- The use of metal ores results from the consumption of (CPA_F) Constructions and construction works, (CPA_L68B) Real estate services excluding imputed rents and (CPA_B) Mining and quarrying.
- The use of biomass in housing results from the consumption of the following product groups: (CPA_A02) Products of forestry, logging and related services, (CPA_F) Constructions and construction works and (CPA_L68B) Real estate services excluding imputed rents.

- Housing is the consumption domain with the second highest total final consumption expenditure, accounting for 29% of the total final expenditure in the EU in 2021. In 2021 3.1 trillion euro was spent in the EU on housing, which is 9% more than in 2010.
- The total final consumption expenditure in housing results mostly from the consumption of (CPA_F) Constructions and construction works, (CPA_L68B) Real estate services excluding imputed rents, (CPA_G47) Retail trade services, except of motor vehicles and motorcycles and (CPA_D) Electricity, gas, steam and air conditioning.
- Opposite to the general trend of higher total final expenditure in 2021 comparing to 2010, the expenditure on the following products dropped in 2021: (CPA_C24) Basic metals (-117,8%), (CPA_N79) Travel agency, tour operator and other reservation services and related services (-

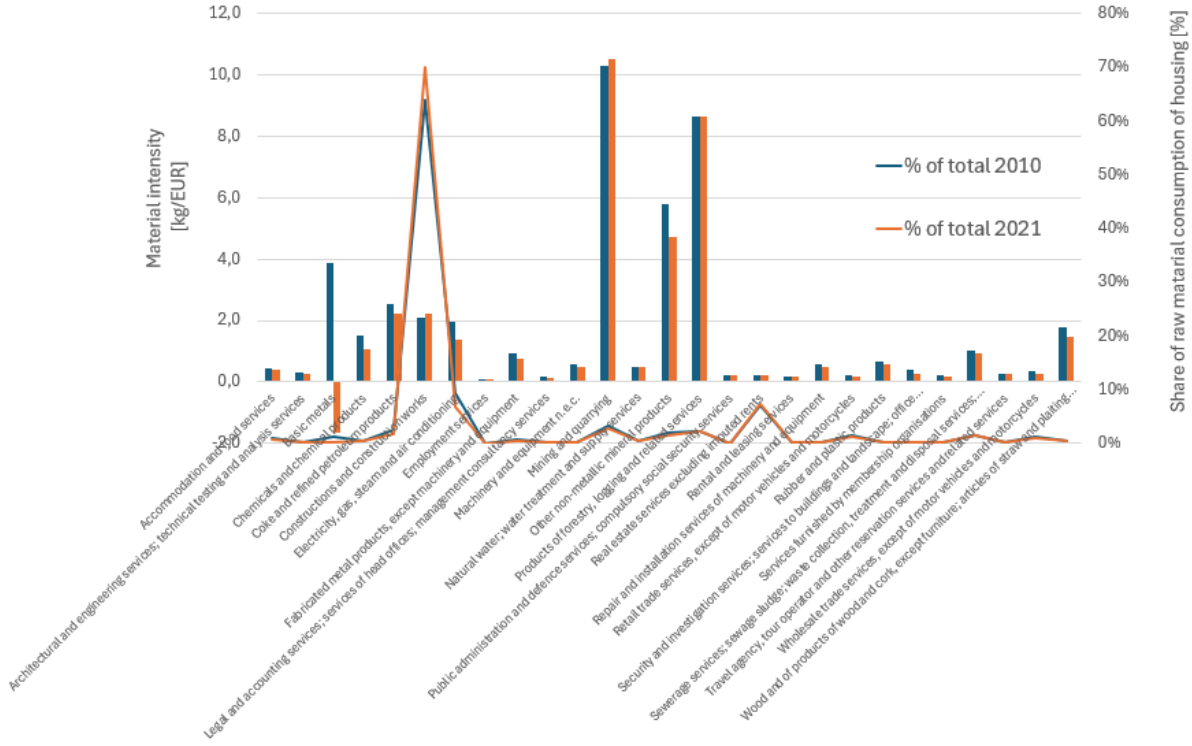
25,5%), (CPA_C19) Coke and refined petroleum products (-20,4%), (CPA_I) Accommodation and food services (-11,6%) and (CPA_B) Mining and quarrying (-6,6%).

Figure 25. Total final consumption expenditure in the CPA product groups contributing to the consumption area of housing in the EU in 2010 and 2021.



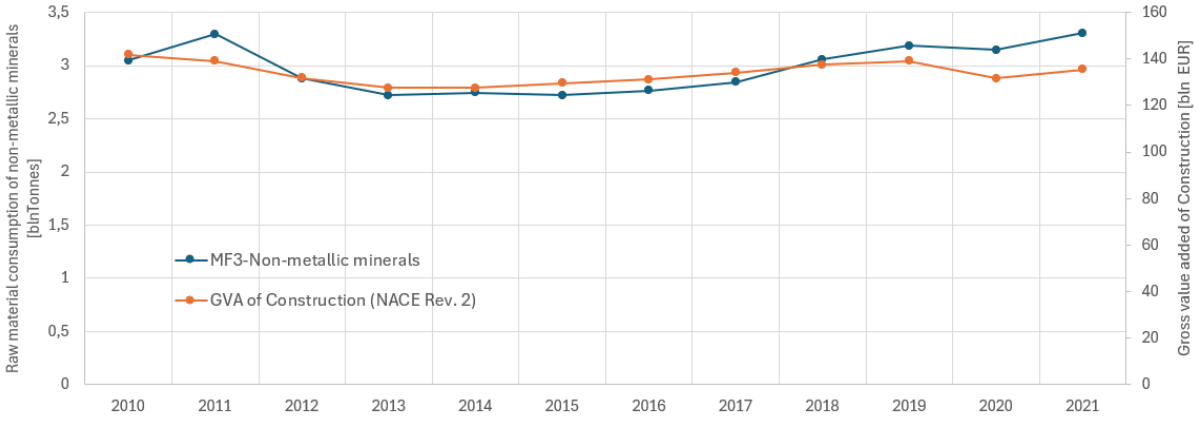
- The material intensity of housing is the highest of all the domains, improved only by -1%, from 2,33kg/EUR in 2010 to 2,31kg/EUR in 2021.

Figure 26. Material intensity of the CPA product groups contributing to the consumption area of housing in the EU in 2010 and 2021. The line chart presents the share of the CPA products in the material footprint of this consumption domain.



- The Pearson correlation coefficient R=0,74 suggests a strong correlation between the use of non-metallic minerals and the gross value added (GVA) of the construction industry (Figure 27). Both trends are plotted in Figure 27.

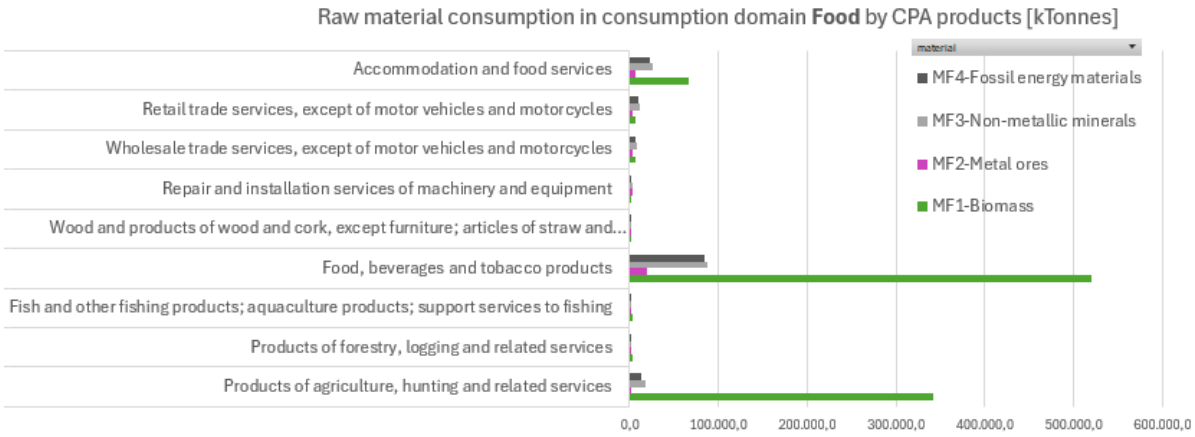
Figure 27. Material footprint of non-metallic minerals and the gross value added of the construction industry (chain linked volumes (2010), million euro) in the EU, 2010 – 2021.



3.2.2 Food

- **Food** was the second largest material consumption domain and accounted for 19% of the material footprint in 2021 (21% in 2010). The material footprint of food was at a level 1282,5 bln tonnes in 2021, which is 6% less than 2010.
- In 2021 the biomass accounts for 74% of the material footprint of food, followed by non-metallic minerals (12%), fossil energy materials (11%) and metal ores (3%).

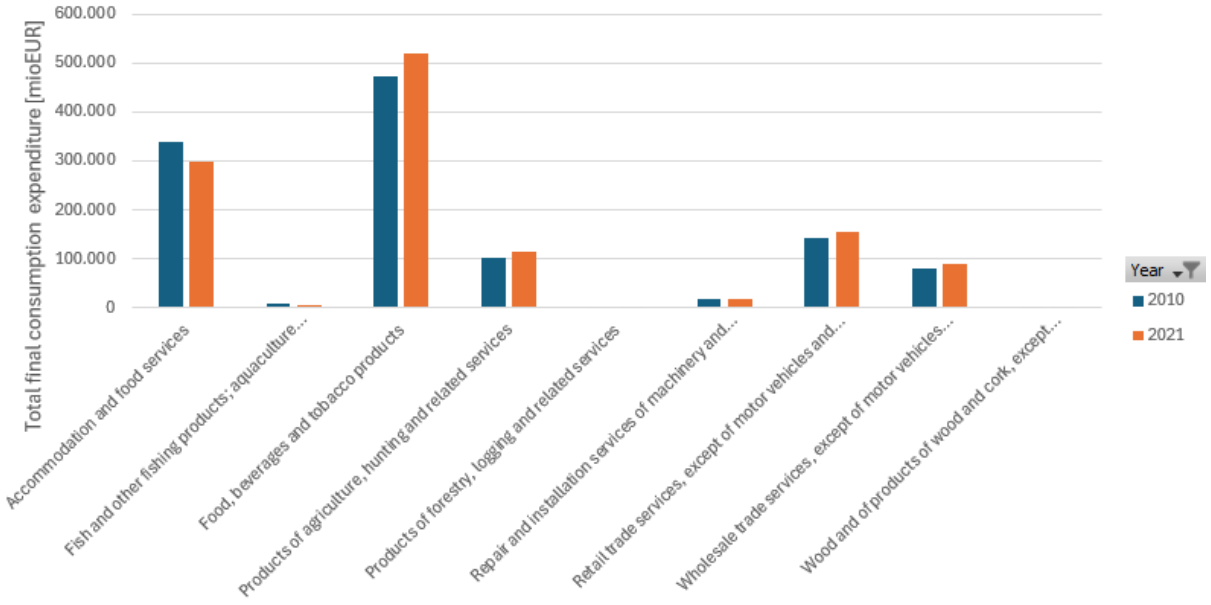
Figure 28. Contribution of the material categories to the CPA products allocated in the consumption area of food in the EU in 2021 [kTonnes].



- The use of biomass, non-metallic minerals and fossil energy materials mostly results from consumption of (CPA_C10-12) food, beverages and tobacco products, (CPA_A01) products of agriculture, hunting and related services and (CPA_I) accommodation and food services.
- The use of metal ores is very small (3%) and results from consumption of (CPA_C10-12) Food, beverages and tobacco products and (CPA_I) Accommodation and food services.

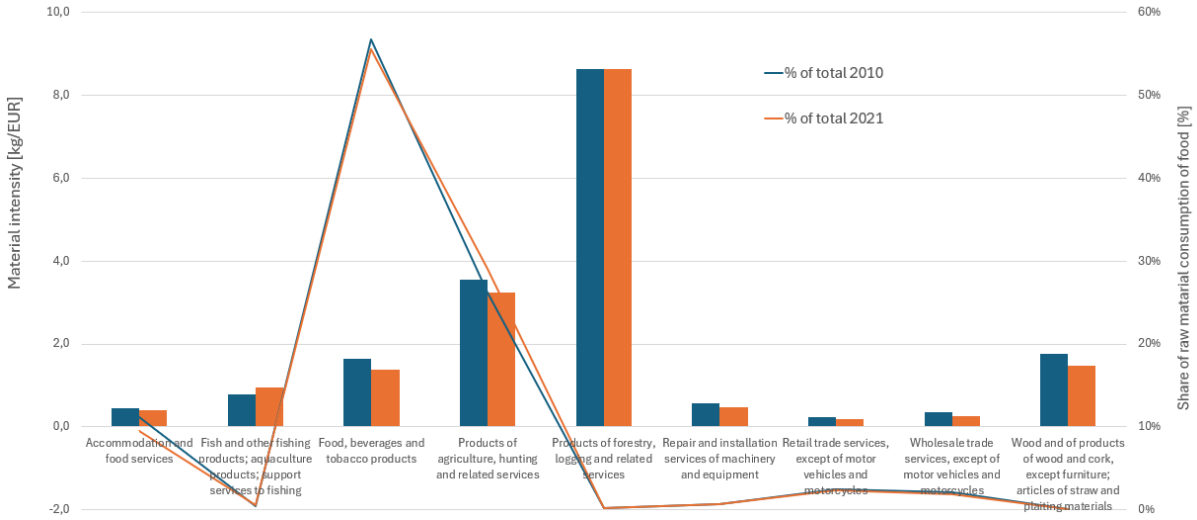
- Food is the consumption domain with the third lowest total final consumption expenditure, accounting for 11% of the total final expenditure in the EU in 2021. In 2021 1,2 trillion euro was spent in the EU on food, which is 4% more than in 2010.
- The products contributing the most to the total final consumption expenditure of food in 2021 are: (CPA_C10-12) Food, beverages and tobacco products, (CPA_I) Accommodation and food services. (CPA_G47) Retail trade services, except of motor vehicles and motorcycles, (CPA_G46) Wholesale trade services, except of motor vehicles and motorcycles and (CPA_A01) Products of agriculture, hunting and related services).
- Opposite to the general trend of higher total final expenditure in 2021 compared to 2010, the expenditure on (CPA_I) Accommodation and food services and (CPA_A03) Fish and other fishing products; aquaculture products; support services to fishing, dropped in 2021 by -13% and -10% respectively.

Figure 29. Total final consumption expenditure in the CPA product groups contributing to the consumption area of food in the EU in 2010 and 2021.



- The material intensity of food is the second highest of all the domains, 1,78kg/EUR in 2021, but improved by -9%, when compared to 2010.

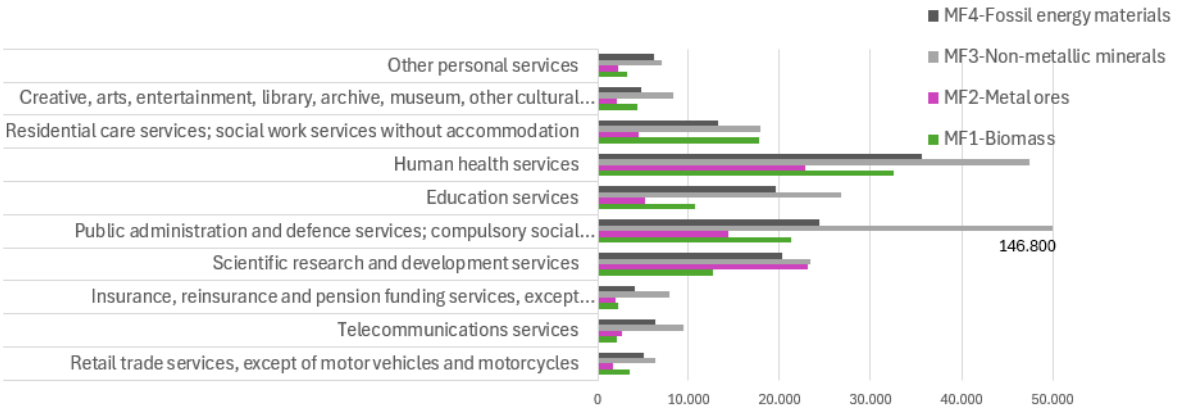
Figure 30. Material intensity of the CPA product groups contributing to the consumption area of food in the EU in 2010 and 2021. The line chart presents the share of the CPA products in the material footprint of this consumption domain.



3.2.3 Services

- **Services** account for around 11% of the total material footprint in 2021, similar to the year 2010. The material footprint of services was at a level 750,8 bln tonnes in 2021, which is -1% less than 2010.
- In 2021 non-metallic minerals accounted for 46% of the material footprint of services, followed by fossil energy materials (23%), biomass (18%) and metal ores (13%).

Figure 31. Contribution of the material categories [kTonnes] in the 10 CPA products with the largest contribution to the consumption area of services in the EU in 2021.

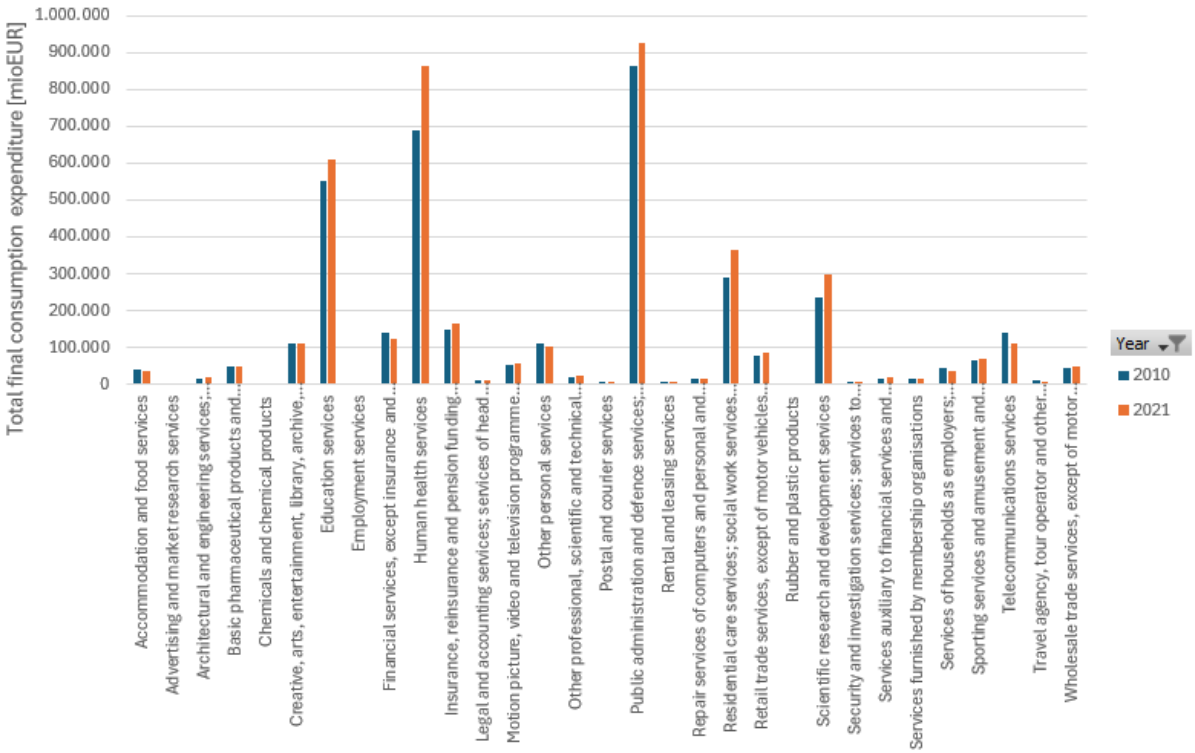


- The use of non-metallic minerals in services is mostly resulting from the consumption of (CPA_O) Public administration and defence services; compulsory social security services, (CPA_Q86) Human health services, (CPA_P) Education services, (CPA_M72) Scientific research and development services, (CPA_Q87_88) Residential care services; social work services without accommodation and (CPA_J61) Telecommunications services.
- The use of fossil energy materials in services is due to the consumption of (CPA_Q86) Human health services, (CPA_O) Public administration and defence services; compulsory social security services, (CPA_P) Education services, (CPA_M72) Scientific research and development services, (CPA_Q87_88) Residential care services; social work services without accommodation and (CPA_J61) Telecommunications services.
- The biomass used in services results from the consumption of following product groups: (CPA_Q86) Human health services, (CPA_O) Public administration and defence services; compulsory social security services, (CPA_Q87_88) Residential care services; social work services without accommodation, (CPA_M72) Scientific research and development services and (CPA_P) Education services.
- The use of metal ores results from the consumption of (CPA_M72) Scientific research and development services, (CPA_Q86) Human health services, (CPA_O) Public administration and defence services; compulsory social security services, (CPA_P) Education services and (CPA_J61) Telecommunications services.

- Services is the consumption domain with the highest total final consumption expenditure, accounting for 38% of the total final expenditure in the EU in 2021. In 2021 4,2 trillion euro was spent in the EU on services, which is 11% more than in 2010.
- Total final consumption expenditure in services is dominated by expenditures on (CPA_O) Public administration and defense services; compulsory social security services, (CPA_Q86) Human health services, (CPA_P) Education services, (CPA_Q87_88) Residential care services; social work services without accommodation and (CPA_M72) Scientific research and development services.

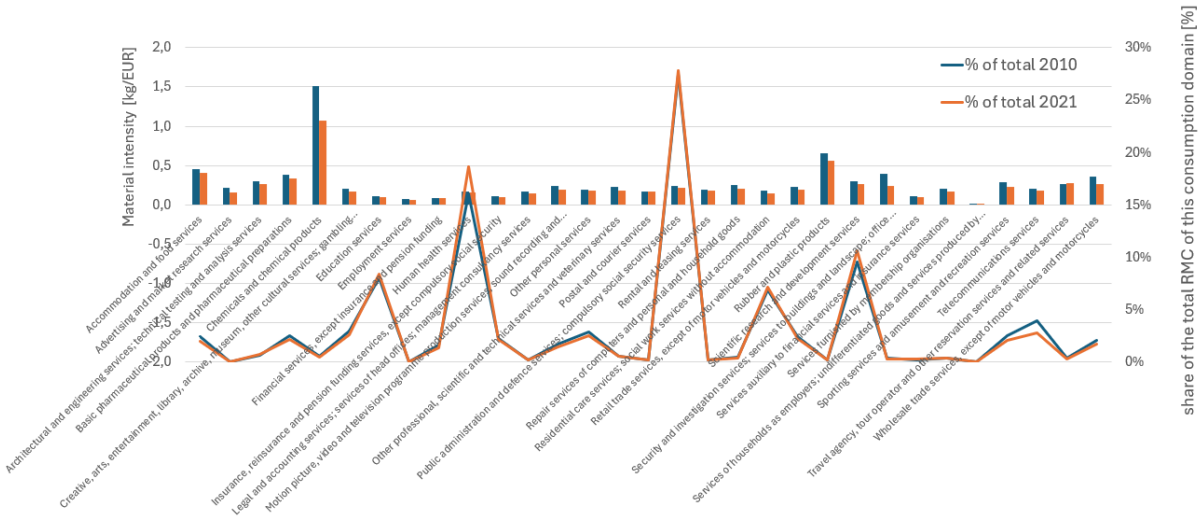
- Opposite to the general trend of higher total final expenditure in 2021 compared to 2010, the EU spending on the following products dropped in 2021: (CPA_N79) Travel agency, tour operator and other reservation services and related services (-25%), (CPA_J61) Telecommunications services (-21%), (CPA_T) Services of households as employers; undifferentiated goods and services produced by households for own use (-17%), (CPA_K64) Financial services, except insurance and pension funding (-14%), (CPA_I) Accommodation and food services (12%), (CPA_S96) Other personal services (-5%) and (CPA_C21) Basic pharmaceutical products and pharmaceutical preparations (-3%).

Figure 32. Total final consumption expenditure in the CPA product groups contributing to the consumption area of services in the EU in 2010 and 2021.



- The material intensity of services is the lowest among all the consumption domains and improved by -13%, from 0,23kg/EUR in 2010 to 0,20kg/EUR in 2021.

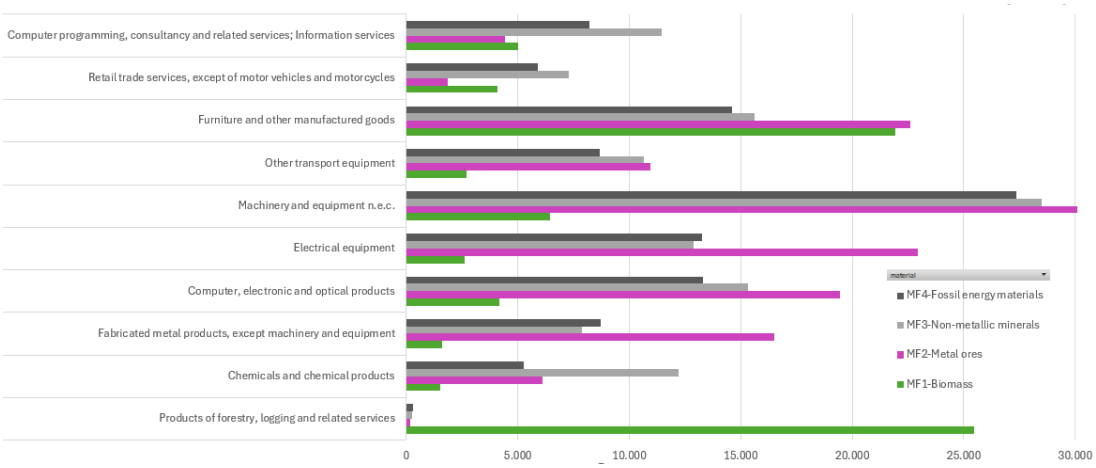
Figure 33. Material intensity of the CPA product groups contributing to the consumption area of services in the EU in 2010 and 2021. The line chart presents the share of the CPA products in the material footprint of this consumption domain.



3.2.4 Household goods

- **Household goods** accounted for 8% of the material footprint in 2021 dropping from 9% in 2010. The material footprint of household goods was at a level 545,1 bln tonnes in 2021, which is -5% less than 2010.
- In 2021 the non-metallic minerals account for 30% of the material footprint of household goods, followed by metal ores (28%), fossil energy materials (24%), and biomass (18%).

Figure 34. Contribution of the material categories [kTonnes/hab] in the 10 CPA products with the largest contribution to the consumption area of household goods in the EU in 2021.

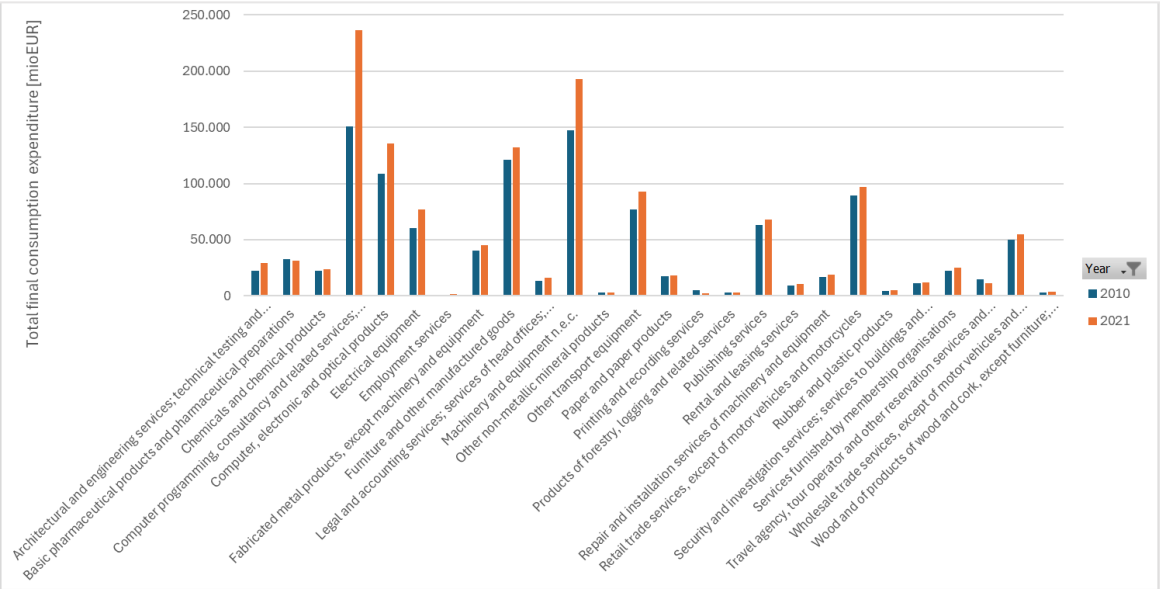


- The use of non-metallic minerals in household goods is mostly due to the consumption of (CPA_C28) Machinery and equipment n.e.c., (CPA_C31_32) Furniture and other manufactured goods, (CPA_C26) Computer, electronic and optical products, (CPA_C27) Electrical equipment, (CPA_C20) Chemicals and chemical products, (CPA_J62_63) Computer programming, consultancy and related services; Information services, (CPA_C30) Other transport equipment.

- The use of metal ores results from consumption of (CPA_C28) Machinery and equipment n.e.c., (CPA_C27) Electrical equipment, (CPA_C31_32) Furniture and other manufactured goods, (CPA_C26) Computer, electronic and optical products, (CPA_C25) Fabricated metal products, except machinery and equipment and (CPA_C30) Other transport equipment.
- The use of fossil energy materials is mostly due to the consumption of (CPA_C28) Machinery and equipment n.e.c., (CPA_C31_32) Furniture and other manufactured goods, (CPA_C27) Electrical equipment, (CPA_C26) Computer, electronic and optical products, (CPA_C25) Fabricated metal products, except machinery and equipment, (CPA_C30) Other transport equipment and (CPA_J62_63) Computer programming, consultancy and related services; Information services.
- The biomass used in household goods comes is due to the consumption of (CPA_A02) Products of forestry, logging and related services, (CPA_C31_32) Furniture and other manufactured goods, (CPA_C28) Machinery and equipment n.e.c., (CPA_C17) Paper and paper products and (CPA_J62_63) Computer programming, consultancy and related services; Information services.

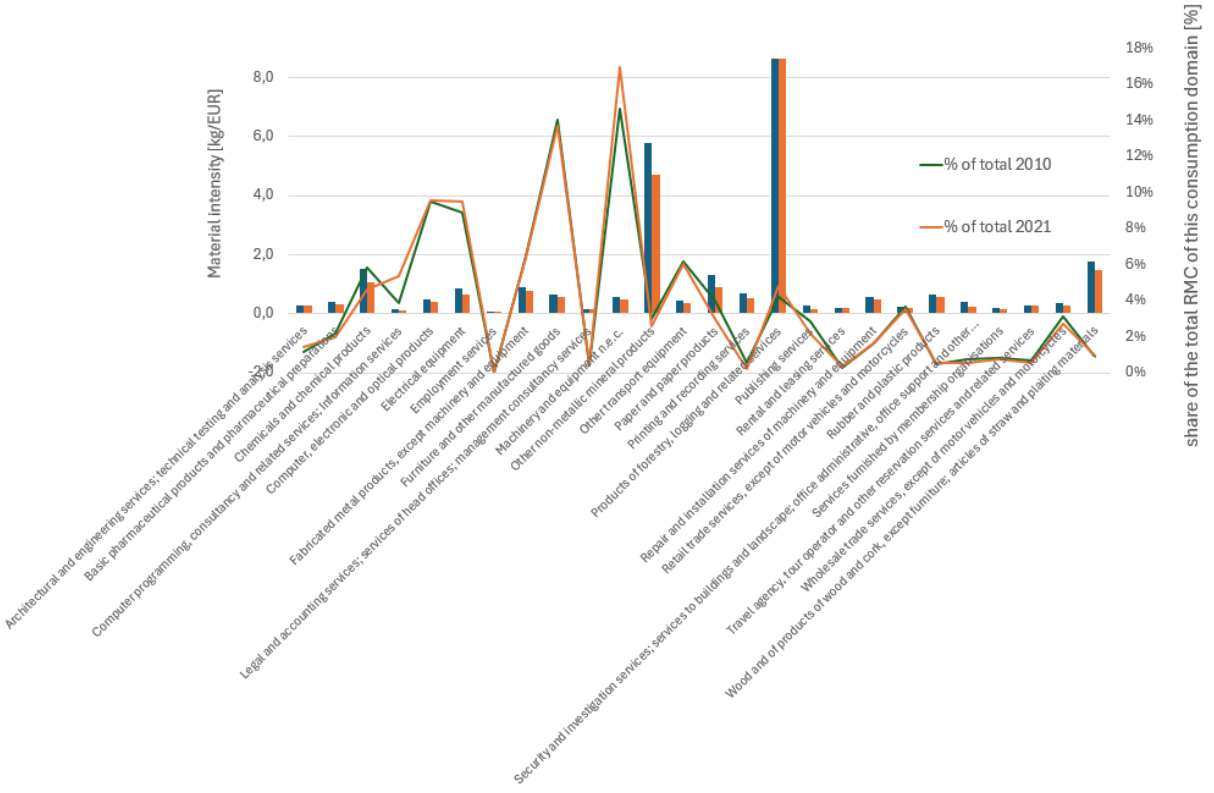
- Household goods is the consumption domain with the third highest total final consumption expenditure, accounting for 12% of the total final expenditure in the EU in 2021. In 2021 1.3 trillion euro was spent in the EU on household goods, which is 21% more than in 2010. Household goods is the consumption domain with the largest increase of expenditures in the analysed period.
- The total final consumption expenditure of household goods results from the consumption of (CPA_J62_63) Computer programming, consultancy and related services; Information services, (CPA_C28) Machinery and equipment n.e.c., (CPA_C31_32) Furniture and other manufactured goods, (CPA_C26) Computer, electronic and optical products, (CPA_G47) Retail trade services, except of motor vehicles and motorcycles, (CPA_C30) Other transport equipment and (CPA_C27) Electrical equipment.
- Opposite to the general trend of higher total final expenditure in 2021 compared to 2010, the EU expenditure on the following products dropped in 2021: (CPA_C18) Printing and recording services (-60%), (CPA_N79) Travel agency, tour operator and other reservation services and related services (-25%) and (CPA_C21) Basic pharmaceutical products and pharmaceutical preparations (-3%).

Figure 35. Total final consumption expenditure in the CPA product groups contributing to the consumption area of household goods in the EU in 2010 and 2021.



- The material intensity of household goods domain improved by -12%, from 1,15kg/EUR in 2010 to 1,01kg/EUR in 2021.

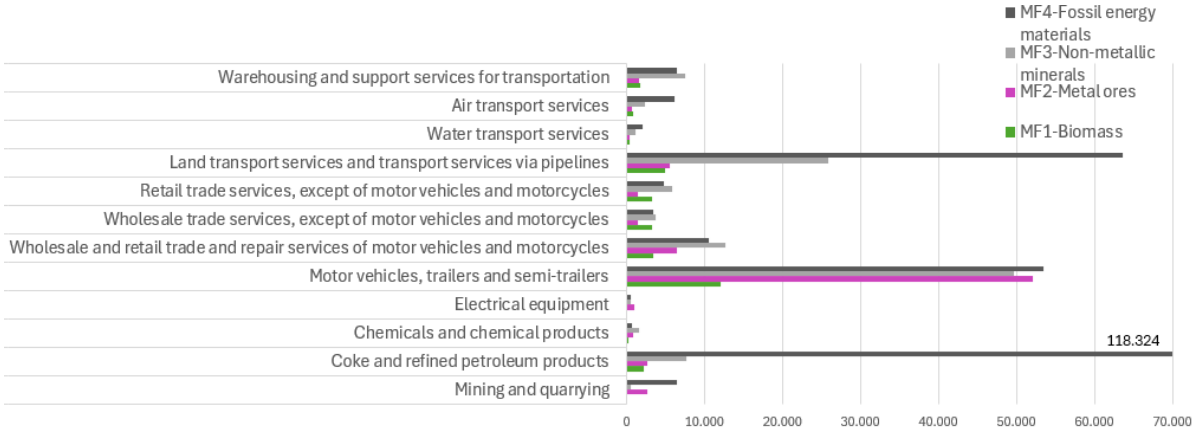
Figure 36. The material intensity of the CPA product groups contributing to the consumption area of household goods in the EU in 2010 and 2021. The line chart presents the share of the CPA products in the material footprint of this consumption domain.



3.2.5 *Personal mobility*

- **Personal mobility** accounts for around 8% of the material footprint in 2021, dropping from 9% in 2010. The material footprint of personal mobility was at a level 506,3 bln tonnes in 2021, which is -14% less than 2010. That is the highest drop among the consumption domains, resulting from decreased use of fossil energy fuels (-19,1%) and non-metallic minerals (-15,1%) in this domain.
- In 2021 fossil energy materials accounted for 55% of the material footprint of personal mobility, followed by non-metallic minerals (24%), metal ores (15%) and biomass (6%).

Figure 37. Contribution of the material categories [kTonnes] in the CPA products allocated to the consumption area of personal mobility in the EU in 2021.

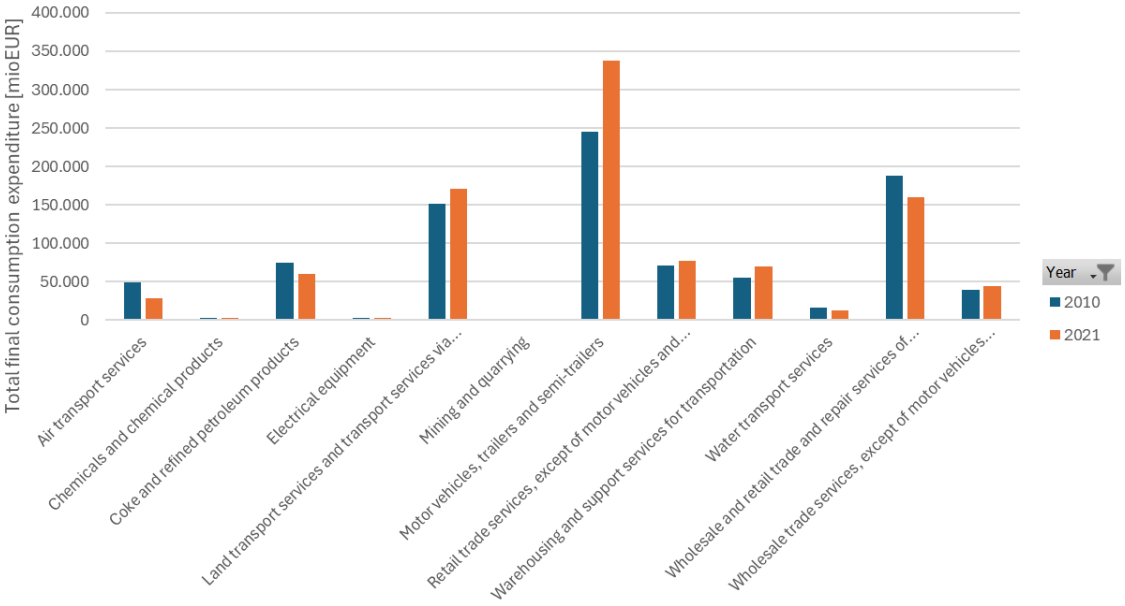


- The use of fossil energy materials in personal mobility mostly results from the consumption of (CPA_C19) Coke and refined petroleum products, (CPA_H49) Land transport services and transport services via pipelines and (CPA_C29) Motor vehicles, trailers and semi-trailers.
- The use of non-metallic minerals in personal mobility is mostly due to consumption of (CPA_C29) Motor vehicles, trailers and semi-trailers, (CPA_H49) Land transport services and transport services via pipelines, (CPA_G46) Wholesale trade services, except of motor vehicles and motorcycles, and (CPA_C19) Coke and refined petroleum products.
- The use of metal ores results from the consumption of (CPA_C29) Motor vehicles, trailers and semi-trailers, (CPA_G45) Wholesale and retail trade and repair services of motor vehicles and motorcycles and (CPA_H49) Land transport services and transport services via pipelines.
- The biomass consumed in personal mobility is due to the demand of the following product groups: (CPA_C29) Motor vehicles, trailers and semi-trailers, (CPA_H49) Land transport services and transport services via pipelines, (CPA_G46) Wholesale trade services, except of motor vehicles and motorcycles and (CPA_G47) Retail trade services, except for motor vehicles and motorcycles.

- Personal mobility is the consumption domain with the second lowest total final consumption expenditure, accounting for 9% of the total final expenditure in the EU in 2021. In 2021 1.0 trillion euro was spent in the EU on personal mobility, which is 8% more than in 2010.
- Total final consumption expenditure in personal mobility is dominated by consumption of (CPA_G47) Retail trade services, except of motor vehicles and motorcycles, (CPA_G46) Wholesale trade services and (CPA_C29) Motor vehicles, trailers and semi-trailers.
- Opposite to the general trend of higher total final expenditure in 2021 compared to 2010, the EU spending on the following products dropped in 2021: (CPA_H51) Air transport services (-41%), (CPA_H50) Water transport services (-27%), (CPA_C19) Coke and refined petroleum

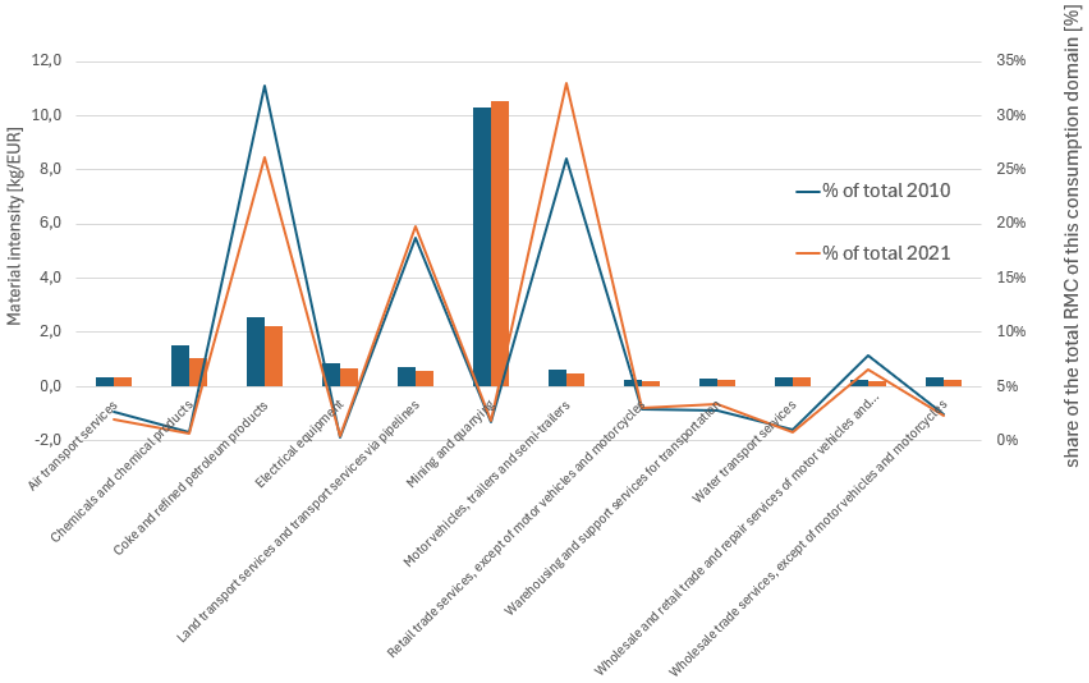
products (-20%), (CPA_G45) Wholesale and retail trade and repair services of motor vehicles and motorcycles (-15%) and (CPA_B) Mining and quarrying (-7%).

Figure 38. Total final consumption expenditure in the CPA product groups contributing to the consumption area of personal mobility in the EU in 2010 and 2021.



- The material intensity of personal mobility improved the most, by -20%, from 1,38kg/EUR in 2010 to 1,11kg/EUR in 2021.

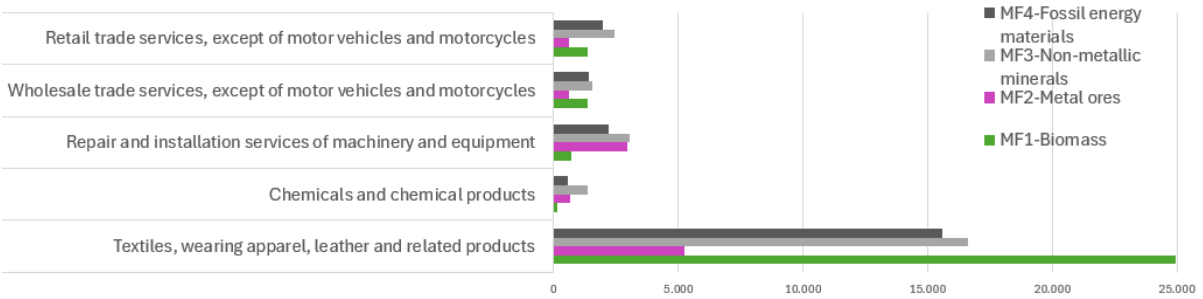
Figure 39. The material intensity of the CPA product groups contributing to the consumption area of personal mobility in the EU in 2010 and 2021. The line chart presents the share of the CPA products in the material footprint of this consumption domain.



3.2.6 *Clothing and footwear*

- **Clothing and footwear** accounted for only 1% of the material footprint in 2010 and in 2021. The material footprint of clothing and footwear was at a level 85,4 bln tonnes in 2021, which is 4% more than 2010.
- In 2021 biomass accounted for 33% of the material footprint of clothing and footwear, followed by non-metallic minerals (29%), fossil energy materials (26%), and metal ores (12%).

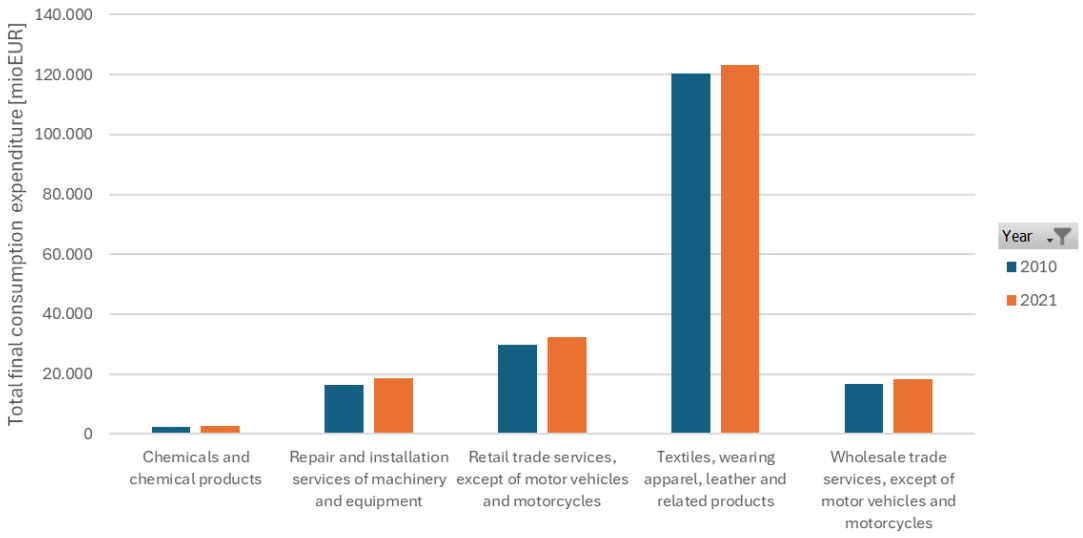
Figure 40. The contribution of the material categories [kTonnes/hab] in the CPA products allocated the consumption area of personal mobility in the EU in 2021.



- The biomass use in clothing and footwear is dominated by the consumption of (CPA_C13-15) Textiles, wearing apparel, leather and related products.
- The use of non-metallic minerals clothing and footwear is due to the consumption of (CPA_C13-15) Textiles, wearing apparel, leather and related products, (CPA_C33) Repair and installation services of machinery and equipment and (CPA_G47) Retail trade services, except of motor vehicles and motorcycles.
- The use of fossil energy materials results from the consumption of (CPA_C13-15) Textiles, wearing apparel, leather and related products, (CPA_C33) Repair and installation services of machinery and equipment and (CPA_G47) Retail trade services, except of motor vehicles and motorcycles.
- The use of metal ores is mostly resulting from consumption of (CPA_C13-15) Textiles, wearing apparel, leather and related products and (CPA_C33) Repair and installation services of machinery and equipment.

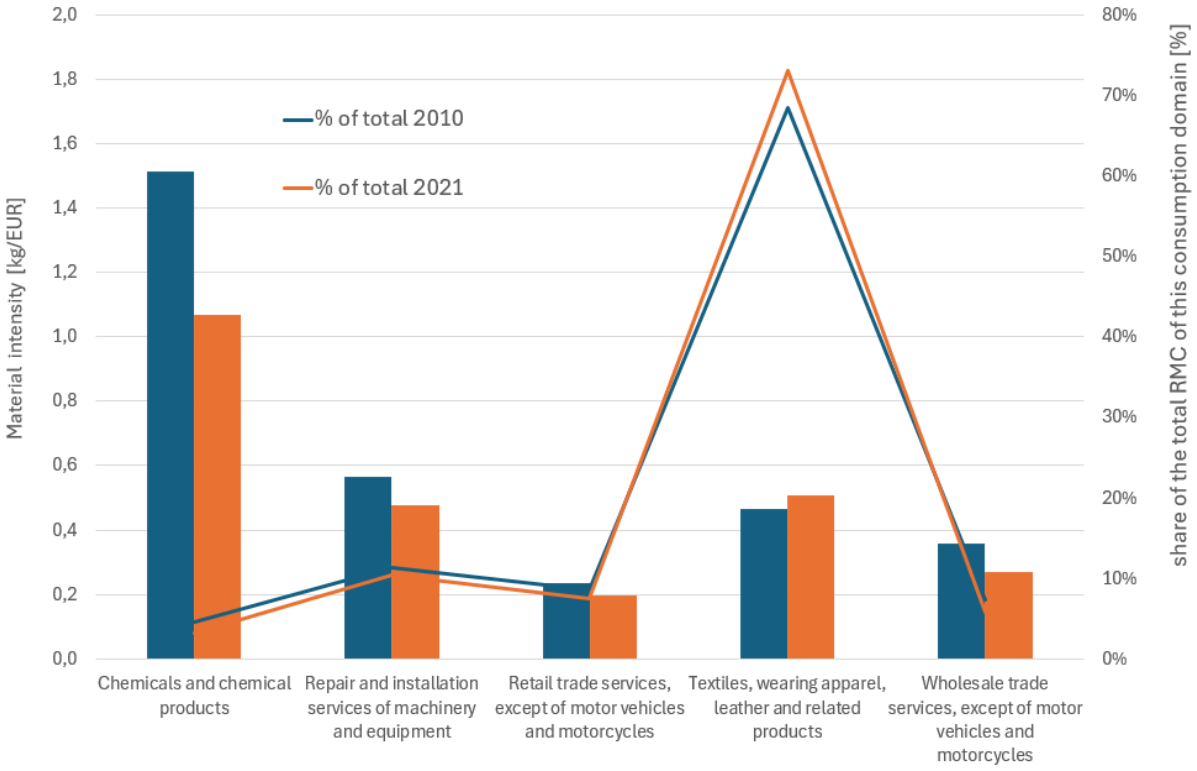
- Clothing and footwear was the consumption domain with the lowest total final consumption expenditure, accounting for 2% of the total final expenditure in EU in 2021. In 2021 0,2 trillion euro was spent in the EU on clothing and footwear, which is 5% more than in 2010.
- Total final consumption expenditures in clothing and footwear is mostly due to the expenditure on (CPA_C13-15) Textiles, wearing apparel, leather and related products, (CPA_G47) Retail trade services, except of motor vehicles and motorcycles and (CPA_C33) Repair and installation services of machinery and equipment.

Figure 41. Total final consumption expenditure in the CPA product groups contributing to the consumption area of clothing and footwear in the EU in 2010 and 2021.



- The material intensity of clothing and footwear is the second lowest among all the domains and at the level of 0,48kg/EUR in 2021. It improved by -10%, when compared to 2010.

Figure 42. The material intensity of the CPA product groups contributing to the consumption area of household goods in the EU in 2010 and 2021. The line chart presents the share of the CPA products in the material footprint of this consumption domain.



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Annex 1. Allocation of the 63 CPA product groups to the 6 consumption domains

CPA code	Total CPA products	Food	Housing	Personal mobility	Household goods	Services	Clothing and footwear
CPA_A01	Products of agriculture, hunting and related services	1,00	-	-	-	-	-
CPA_A02	Products of forestry, logging and related services	0,03	0,72	-	0,25	-	-
CPA_A03	Fish and other fishing products; aquaculture products; support services to fishing	1,00	-	-	-	-	-
CPA_B	Mining and quarrying		0,91	0,09			
CPA_C10-12	Food, beverages and tobacco products	1,00	-	-	-	-	-
CPA_C13-15	Textiles, wearing apparel, leather and related products	-	-	-	-	-	1,00
CPA_C16	Wood and products of wood and cork, except furniture; articles of straw and plaiting materials	0,03	0,72	-	0,25	-	-
CPA_C17	Paper and paper products	-	-	-	1,00	-	-
CPA_C18	Printing and recording services	-	-	-	1,00	-	-
CPA_C19	Coke and refined petroleum products	-	0,30	0,70	-	-	-
CPA_C20	Chemicals and chemical products	-	0,26	0,07	0,54	0,07	0,06
CPA_C21	Basic pharmaceutical products and pharmaceutical preparations	-	-	-	0,40	0,60	-
CPA_C22	Rubber and plastic products	-	0,67	-	0,21	0,12	-
CPA_C23	Other non-metallic mineral products		0,79	-	0,21	-	-
CPA_C24	Basic metals	-	1,00	-	-	-	-
CPA_C25	Fabricated metal products, except machinery and equipment	-	0,36	-	0,64	-	-
CPA_C26	Computer, electronic and optical products	-	-	-	1,00	-	-
CPA_C27	Electrical equipment	-	-	0,04	0,96	-	-
CPA_C28	Machinery and equipment n.e.c.	-	0,08	-	0,92	-	-
CPA_C29	Motor vehicles, trailers and semi-trailers	-	-	1,00	-	-	-
CPA_C30	Other transport equipment	-	-	-	1,00	-	-
CPA_C31_32	Furniture and other manufactured goods	-	-	-	1,00	-	-
CPA_C33	Repair and installation services of machinery and equipment	0,25	0,25	-	0,25	-	0,25
CPA_D	Electricity, gas, steam and air conditioning	-	1,00	-	-	-	-
CPA_E36	Natural water; water treatment and supply services	-	1,00	-	-	-	-
CPA_E37-39	Sewerage services; sewage sludge; waste collection, treatment and disposal services; materials recovery services; remediation services and other waste management services	-	1,00	-	-	-	-
CPA_F	Constructions and construction works	-	1,00	-	-	-	-
CPA_G45	Wholesale and retail trade and repair services of motor vehicles and motorcycles	-	-	1,00	-	-	-
CPA_G46	Wholesale trade services, except of motor vehicles and motorcycles	0,24	0,31	0,12	0,15	0,13	0,05
CPA_G47	Retail trade services, except of motor vehicles and motorcycles	0,24	0,31	0,12	0,15	0,13	0,05
CPA_H49	Land transport services and transport services via pipelines	-	-	1,00	-	-	-
CPA_H50	Water transport services	-	-	1,00	-	-	-
CPA_H51	Air transport services	-	-	1,00	-	-	-
CPA_H52	Warehousing and support services for transportation	-	-	1,00	-	-	-
CPA_H53	Postal and courier services	-	-	-	-	1,00	-
CPA_I	Accommodation and food services	0,76	0,15	-	-	0,09	-

CPA_J58	Publishing services	-	-	-	1,00	-	-
CPA_J59_60	Motion picture, video and television programme production services, sound recording and music publishing; programming and broadcasting services	-	-	-	-	1,00	-
CPA_J61	Telecommunications services	-	-	-	-	1,00	-
CPA_J62_63	Computer programming, consultancy and related services; Information services	-	-	-	1,00		-
CPA_K64	Financial services, except insurance and pension funding	-	-	-	-	1,00	-
CPA_K65	Insurance, reinsurance and pension funding services, except compulsory social security	-	-	-	-	1,00	-
CPA_K66	Services auxiliary to financial services and insurance services	-	-	-	-	1,00	-
CPA_L	Real estate services	-	1,00	-	-	-	-
CPA_M69_70	Legal and accounting services; services of head offices; management consultancy services	-	0,43	-	0,33	0,24	-
CPA_M71	Architectural and engineering services; technical testing and analysis services	-	0,43	-	0,33	0,24	-
CPA_M72	Scientific research and development services	-	-	-	-	1,00	-
CPA_M73	Advertising and market research services	-	-	-	-	1,00	-
CPA_M74_75	Other professional, scientific and technical services and veterinary services	-	-	-	-	1,00	-
CPA_N77	Rental and leasing services	-	0,43	-	0,33	0,24	-
CPA_N78	Employment services	-	0,43	-	0,33	0,24	-
CPA_N79	Travel agency, tour operator and other reservation services and related services	-	0,43	-	0,33	0,24	-
CPA_N80-82	Security and investigation services; services to buildings and landscape; office administrative, office support and other business support services	-	0,43	-	0,33	0,24	-
CPA_O	Public administration and defence services; compulsory social security services	-	0,01	-	-	0,99	-
CPA_P	Education services	-	-	-	-	1,00	-
CPA_Q86	Human health services	-	-	-	-	1,00	-
CPA_Q87_88	Residential care services; social work services without accommodation	-	-	-	-	1,00	-
CPA_R90-92	Creative, arts, entertainment, library, archive, museum, other cultural services; gambling and betting services	-	-	-	-	1,00	-
CPA_R93	Sporting services and amusement and recreation services	-	-	-	-	1,00	-
CPA_S94	Services furnished by membership organisations	-	0,50	-	0,30	0,20	-
CPA_S95	Repair services of computers and personal and household goods	-	-	-	-	1,00	-
CPA_S96	Other personal services	-	-	-	-	1,00	-
CPA_T	Services of households as employers; undifferentiated goods and services produced by households for own use	-	-	-	-	1,00	-

allocated following the study by the European Topic Cente Circular Economy (ETC-EC) study

adopted from the ETC-CE after clarifications

Allocation based on Eurostat's expert's knowledge and (Cai and Vandyck, 2020)