



Material Flows of the Home Appliance Industry



Paolo Falcioni
Director-General CECED

We, the home appliance industry in Europe, believe that what goes around should come around and also know that every fruitful discussion should be based on facts.

For this reason, together with the Sustainable Cycles specialised programme of the United Nations University (UNU-VIE SCYCLE), we would like to provide you with an overview of the circularity of the materials flows of one of Europe's most established sectors, making this report a valuable tool for all those interested in the home appliance industry.

The result of investing more than €1.4 billion in research and development and creating nearly 1 million jobs is clear.

The home appliance industry is circular from the outset, tackling the challenges from the production of appliances to material recovery at their end of life. Between 2011 and 2015, the home appliance industry succeeded to reduce water consumption per product by approximately 30%, while waste generation and energy consumption per product decreased by around 15 %.

Once in our homes, thousands of millions of appliances advance our sustainable lifestyles. A dishwasher today uses only 10 litres of water while doing the dishes by hand amounts to ten times more. A fridge conserves 750 kg of food per person every year.

The industry has made considerable investments ensuring the recycling, treatment and recovery of electronic-waste by setting up recycling schemes across Europe. This ensures that discarded products can be collected and recycled according to best available technology and in line with the established standards to meet the recycling and recovery targets set by EU legislation. The steel, copper, aluminium, plastics and the rest of the materials of the appliances that have made it to the recycling facilities come back to production processes in both our sector and other industries, helping to close the material loops.

Because of the high metal content and intrinsic economic value of large appliances, and the historic presence of the recycling industry, already long before EU legislation, market dynamics make sure that a large share of all electronic-waste is handled outside the industry driven recycling schemes.

Some challenges remain, however. We still collect too few small appliances, many of which end up in the waste bin. These are products with low metal content and consumer awareness about the need to bring such appliances to collection points is low. We also need to better ensure that all collected appliances, large and small, inside and outside producer recycling schemes, are treated to the same high standards.

The full circularity of the economy goes beyond what economic actors alone can do: it embraces all our society and is a societal challenge.

A circular society is made by us and by you. Are you with us?

#CircularSociety



About CECED

CECED, the European Committee of Domestic Equipment Manufacturers, **represents the Home Appliance industry in Europe**. CECED has 20 Direct Members, which have at least one manufacturing facility in Europe and a direct presence in at least four European countries. All Direct Members are also a member of the relevant CECED National Associations in more than 50% of the countries in which the company has direct operations. CECED Direct Members subscribe to CECED's statutes, by-laws, all industry-established agreements, and are signatories of the CECED Code of Conduct on Corporate Social Responsibility to promote fair and sustainable standards for working conditions, social compliance and environmental performance.

CECED's mission is to represent and defend industry's interests in terms of competitiveness, profitability, global value and a forward looking vision. CECED provides services including industry standards, market statistics, studies and analysis.

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About UNU-VIE SCYCLE

CECED commissioned this study to the United Nations University, UNU-VIE SCYCLE in 2017.

The mission of the United Nations University is to contribute, through collaborative research and education, dissemination and advisory services, to efforts to resolve the pressing global problems of human survival, development and welfare that are the concern of the United Nations, its Peoples and Member States. In pursuing this mission, UNU conducts research on problems of relevance to the United Nations and its Member States, offers postgraduate programs that prepare people for science-based work in the United Nations or Governments of Member States and functions as a think tank for the United Nations and its Member States. UNU also acts as a bridge between the United Nations and the international academic community, and it serves as a platform for global and local dialogue and creative new ideas.

Sustainable Cycles (SCYCLE) is UNU's specialised programme focused on the development of sustainable production, consumption and disposal patterns for electrical and electronic equipment (EEE), as well as for other ubiquitous goods. SCYCLE advances in a leading role the global e-waste discussion based on life-cycle thinking. It is hosted by the UNU Vice-Rectorate in Europe.

Concretely SCYCLE fosters solutions-oriented dialogues, cooperation and consensus. Within this context SCYCLE:

- Conducts research on eco-structuring towards sustainable societies;
- Develops interdisciplinary and multi-stakeholder public-private partnerships;
- Assists governments in developing e-waste legislation and standards, meeting a growing need for such support;
- Undertakes education, training and capacity development; and
- Facilitates and disseminates practical, science-based recommendations to the United Nations and its agencies, governments, scholars, industry and the public.

Authors: Federico MAGALINI, Ruediger KUEHR, Jaco HUISMAN, Otmar DEUBZER and Deepali SINHA KHETRIWAL

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The data and statistics contained in this publication are based on international recognised statistical guidelines and on official data sources, as well as in information gathered from CECED members.

Data processing has been carried out by UNU-VIE SCYCLE based on the Commission implementing Regulation 2017/699 establishing a common methodology for the calculation of the weight of electrical and electronic equipment (EEE) placed on the national market in each Member State and a common methodology for the calculation of the quantity of waste electrical and electronic equipment (WEEE) generated by weight in each Member State¹.

Datasets used for calculations are derived from Eurostat², Energy using Products (EuP) preparatory studies for Ecodesign Directive³, WEEE Directive article 7 report (implementing measure above), Countering WEEE Illegal Trade (CWIT) project⁴ and Prospecting Secondary raw materials in the Urban mine and Mining wastes (PROSUM) project⁵.

In the report all these calculations are referred as: UNU-VIE SCYCLE calculations.

¹<http://eur-lex.europa.eu/legal-content/EN/TXT/?uri=CELEX:32017R0699>

²<http://ec.europa.eu/eurostat/>

³www.eup-network.de/product-groups/preparatory-studies/completed

⁴www.cwitproject.eu

⁵www.prosumproject.eu

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Executive Summary

Household appliances are universal and an integral part of our daily life. To produce and supply these products, large amounts of raw materials are used every year, and the installed products in homes represent even larger volumes of materials. The objective of this report is to provide statistical data on the flows and stocks of these materials and intends to give necessary background information to the ongoing discussion on the efficient use of materials and resources under the framework of the Circular Economy.

The home appliance industry provides EU citizens with appliances that make our life easier by saving time, energy and water securing a clean and healthy home environment and making food stay fresh for longer. **To produce these appliances, the industry uses 6 million tonnes of raw materials comprising of 3 million tonnes of steel and stainless steel, 1,1 million tonnes of plastics and more than half a million tonne of copper, aluminium and glass and concrete.** While these volumes are significant, they are only a fraction of global material consumption. The **European home appliance market represents a share of global material consumption ranging from 0,2% for**

steel to 1,2% for copper, with the shares of other materials falling in between.

The relatively long lifetime of appliances means that the **number of appliances installed and used in European households,** ranging from electric toothbrushes to kettles and toasters to cookers, fridges and washing machines, **is nearly 8 billion** and many times higher than the annual sales figure. The 8 billion installed products contain **more than 30 million tonnes of steel, 12 million tonnes of plastics, and a few million tonnes of non-ferrous metals and glass.**

When appliances do finally come to the end of their useful life, they are discarded, collected and treated and the materials are recovered for a second life. In 2003 the European Union introduced producer responsibility obligations, requiring producers of appliances to take up the responsibility of environmental sound management of appliances at their end of life. Industry led recycling, mainly via take-back schemes set up by industry, is now well established and today collects and treats about 1,7 million tonnes annually across EU member states. But this volume is nowhere near the estimated total of 5

million tonnes of discarded appliances annually. Other actors, operating outside the official industry channels, fill most of this gap, driven by the possibility to recover valuable metals from the discarded appliances. No complete data exists on this activity at EU level but if assuming that the UK, where this has been mapped, is representative for the European WEEE flows, at least 80% of all scrapped appliances are being collected for recycling either by industry or other actors. About 9% ends up in the waste bin and for the remaining 10%, the fate is not known.

Data about the quality of material recovery from the estimated 4 million tonnes of total collected appliances is only detailed for the volumes handled by industry take-back schemes. If assuming similar recovery quality for the full 4 million tonnes as for the 1,7 million collected by industry we could expect some 3,6 million tonnes of materials recovered, mostly steel, then plastic, then non-ferrous metals. However, data on overall recovery is highly uncertain, especially for plastics and would need further investigation.



* Recovered materials may go to many manufacturing circles and not just back into producing new home appliances.

KEY FIGURES – Material Flows of Home Appliance Industry

The Role of Home Appliances and their Production

Water savings in households thanks to dishwasher use compared to hand cleaning	-83,5%
Energy savings in households thanks to dishwasher use compared to hand cleaning	-63,6%
Employment: Direct + Indirect	921.800 workers
Decrease in number of working hours needed to purchase a product 2004-2014 average	-19,5 hours
Food preservation	750kg/person - year

Production of Home Appliances: Impacts and Benchmarking

Average material composition large home appliances - Metals	63,3%
Average material composition small home appliances - Metals	55%
Average material composition large home appliances - Plastics	21,1%
Average material composition small home appliances - Plastics	27,4%
Copper consumption at global level to produce and annually supply home appliances EU market	1,2%
Aluminium consumption at global level to produce and annually supply home appliances EU market	0,5%
Plastic consumption at global level to produce and annually supply home appliances EU market	0,5%
Steel consumption at global level to produce and annually supply home appliances EU market	0,2%
Reduction in waste generation during production 2011-2015	-15%
Reduction in water consumption during production 2011-2015	-30%
Reduction in energy consumption during production 2011-2015	-13%

Amount of Material in Appliances Installed or Stored in Private Homes

Total stock home appliances 2016	67,3 Million tonnes
Total stock home appliances 2016	7.774 Million units
Total stock home appliances 2016 - Steel	35,7 Million tonnes
Total stock home appliances 2016 - Plastics	12 Million tonnes
Total stock home appliances 2016 - Copper	3,6 Million tonnes
Total stock home appliances 2016 - Aluminium	2,3 Million tonnes
Penetration rate in EU per capita	15 units/inhabitant
Penetration rate in EU households	36 units/household
Total home appliances - Sold in 2016	6,13 Million tonnes

End of Life of Home Appliances

WEEE Generated 2016 - Home appliances	5 Million tonnes
WEEE Generated 2016 - Large home appliances	2,4 Million tonnes
WEEE Generated 2016 - Small home appliances	1,4 Million tonnes
WEEE Generated 2016 - Cooling & freezing	1,2 Million tonnes
Packaging waste 2016	0,8 Million tonnes
Portable batteries placed on the market in home appliances 2015	0,04 Million tonnes
Average % of large home appliances ending in the waste bin in EU	1%
Average % of small home appliances ending in the waste bin in EU	17%
End-of-life management costs 2008-2016	€1348 Million
Waste home appliances collected by Industry in EU 2016	1,7 Million tonnes

01

Introduction

The home appliance sector is a major manufacturing actor, offering highly skilled, highly paid employment directly to almost a quarter of a million people in Europe; and indirectly to a further three-quarters of a million. For each job that can be created in the home appliance industry, between three and four additional jobs are created in the wider economy.

In 2015-16, the sector produced €44 billion in turnover in Europe annually, €1.4 billion in investment and €14 billion collectively to European national treasuries.

The home appliance sector has already a proven record of energy and resource efficiency, circular from the outset. The industry has continuously provided a significant contribution through designing and manufacturing innovative products that cut resource use, especially energy and water, save labour as well as time and money, and reducing waste. Home appliance manufacturers are constantly improving products to maintain this added value that enriches the lives of all of society.





Home appliances are today an integral part of daily life and improve the domestic life in 211 million EU households, fulfilling fundamental needs such as preservation and preparation of food and keeping homes and clothes clean and healthy. The importance of appliances in daily life is shown by the near 100% penetration of products such as fridges and washing machines, a figure that shows how appliances are not only crucial for our way of life but also how available appliances have become.

“Enormous energy efficiency increase over the last 20 years.”

The home appliance sector has been consistently supportive of the product specific regulation under the frameworks of the Energy Label and Ecodesign Directives that have led to an enormous increase of energy efficiency in home appliances over the last 20 years.

The contribution to sustainable modern living will continue to develop over the coming years, not least through the introduction of smart-enabled appliances. Using appliances will continue to develop consumer sustainable lifestyles not only through energy efficiency, as has been traditionally the case, but with the harnessing supply of clean energy when it is available.

To produce appliances, the industry consumes resources such as metals and plastics that are recyclable. Metal, specifically, have been recycled throughout

time thanks to their inherent economic value. In the last years, end-of-life recycling and material recovery has been further promoted by legal requirements introduced by EU waste legislation.

The appliance industry has set up recycling schemes across Europe to ensure that discarded products can be collected and recycled according to best available technology and in line with the established standards to meet the recycling and recovery targets set by the EU WEEE Directive.

“Only one-third of the electronic waste is reported.”

Because of the high metal content and intrinsic economic value of large appliances, and the historic presence of the recycling industry, already long before EU legislation, market dynamics make sure that a large share of all electronic-waste is handled outside the industry driven recycling schemes. With only one-third of e-waste effectively traced in Europe, success has been as much about enforcing legislation as a full societal effort, not just making laws. Society at large needed to tackle actual problems, such as e-waste escaping control.

While the industry driven recycling schemes do collect substantial amounts of WEEE, even larger amounts are handled outside the schemes. Achieving the new collection targets set for 2019 and onwards will therefore only be possible when these quantities handled by other economic operators are accounted for and proper discard by consumers is tackled.

The sector takes a market-based approach to deliver circular economy on the ground. Innovation & competition are key drivers to deliver a circular economy by continuously improving resource efficiency at the production of new products and enabling high quality recycling and recovery of secondary raw materials at end-of-life treatment of products.

Manufacturers, when designing their products, must take into account a large number of criteria: consumer needs and expectations, use of resources, safety and consumer protection, production costs, reparability and end-of-life treatment. The constant drive to reduce costs for both producers and consumers is the most important factor to increase resource efficiency and reduce waste at all stages of the product lifecycle.



There are a variety of ways to limit waste and manufacture sustainable products: targeting at-source material efficiency (i.e. reducing the quantity of material used in the creation of products), increasing the efficiency with which products, once created, are used, using more sustainable materials, designing for extending product use-time by for instance enabling reparability and refurbishment (allowing for re-use), and/or undertaking actions at end-of-life, such as recycling or recovery. Interconnectivity and smart appliances also have the potential to drive circular economy measures in the future.

02

The Role of Home Appliances
and their Production

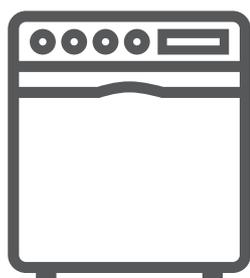
Over the past few decades, home appliances have significantly improved the quality of life for citizens in the EU. From being considered luxuries, they have become essential goods, afforded by all rather than enjoyed by only a selective section of European society. Without these labour saving products, modern life would be unrecognisable.

These products are used in various ways and have a direct connection with the basic needs of society: conserving, processing and cooking food, keeping houses warm in winter and cool during summer, helping with washing, drying and ironing of clothes and washing of dishes; are used to keep houses clean and tidy and helping in personal care.

They are closely connected with the personal well-being and with the surrounding environment of the home.



117 l
2,73 Kwh



10 l
0,96 Kwh



Water consumption: **-83,5%**



Energy consumption: **-63,6%**



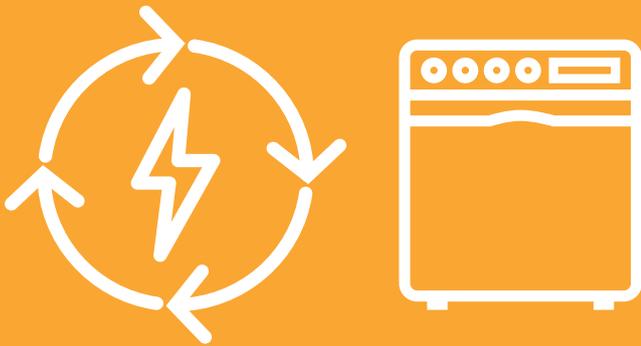
The home appliance sector plays a key role in:

Enabling the saving of resources like energy and water, as well as time considering washing dishes or clothes or food preparation, historically done manually.

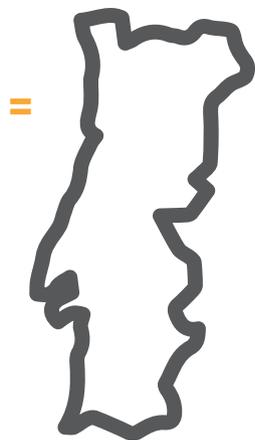
In some cases, the benefits of wider adoption of home appliances can increase the societal benefits at EU level in terms of energy consumption of resources preservation¹:

¹Source: CECED Dishwashers4all campaign.

Considering energy consumption, assuming a penetration rate of 100% in EU28, rather than the current penetration rate of 47%, the potential savings from using a dishwasher compared to washing up by hand would be approximately 92 TWh/year, which is twice the electricity consumption of Portugal, and 3% of the total EU28 electricity consumption in 2015¹.



Energy savings: **92 TWh/year**



=

**x 2 electricity
consumption of
Portugal**

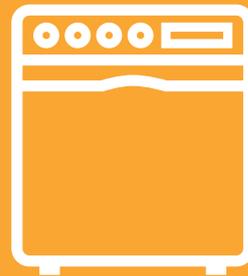


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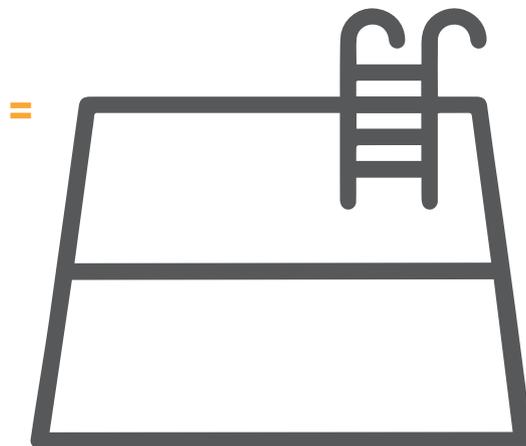
**3% of
total
EU28**

¹Source: CECED Dishwashers4all campaign.

Considering water consumption, assuming a penetration rate of 100% in EU28, rather than the current penetration rate of 47%, the potential savings from using a dishwasher compared to washing up by hand would be approximately 6.142 billion litres/year, equivalent to 2,5 million Olympic size swimming pools¹.



Water savings: **6.142 billion litres/year**



**x 2,5 million
Olympic size
swimming pools**

¹Source: CECED Dishwashers4all campaign.



In 2013, the direct value added of the home appliances sector was € 10,4bn

Value added to EU GDP 2009-2013

	Direct value added	Direct + indirect value added
2009	€11.017 M	€51.967 M
2010	€11.507 M	€54.280 M
2011	€11.300 M	€53.300 M
2012	€11.750 M	€50.707 M
2013	€11.329 M	€48.721 M

Source: Eurostat.

Note: Calculations for the direct + indirect value added are based on the 2015 report on the Economic Impact of the Home Appliances Industry in Europe.

Over 3% of EU manufacturing employment is in the home appliances sector



EU manufacturing employment (% share in 2013)

Direct home appliance employment (manufacturing)

209.500

EU total employment

217,7 million people

Direct and indirect home appliance employment

921.800¹

EU employment in the manufacturing sector

29,7 million people

Source: Eurostat.

¹Based on the Input-Output model from the 2015 report on the Economic Impact of the Domestic Appliances Industry in Europe.



In some countries, the share of the total employment from the home appliance industry is close to 1% (Slovenia), while in many countries it is between 0,1 and 0,2%. In total, it is estimated that

over 3% of EU manufacturing employment
is directly or indirectly related to the home appliance sector.



This resulted in approximately

€6,2 billion paid in salaries.

At the same time the average salary in the HA industry is almost

€500 higher/year
than the average EU salary.



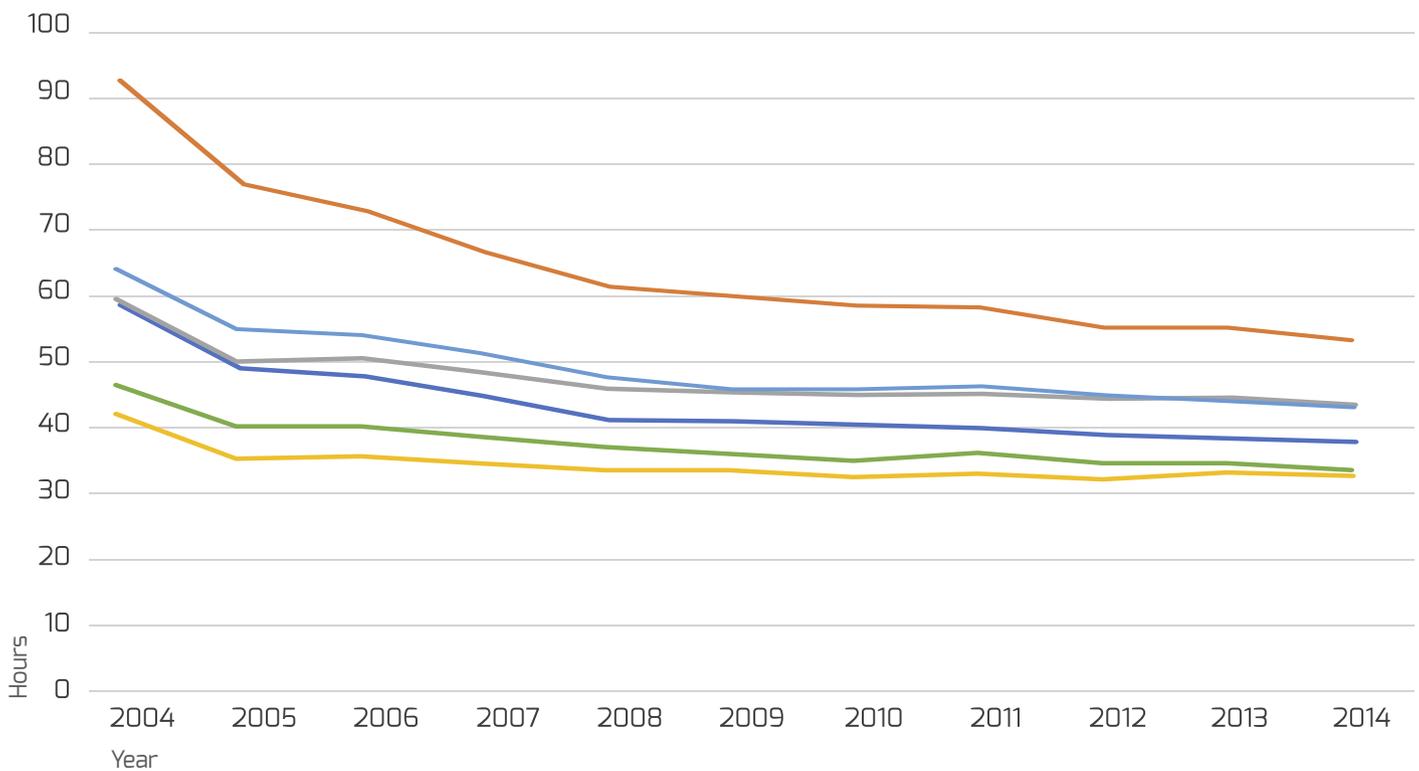
In 2014, the turnover was close to €44 billions, representing at EU level

more than 0,4% of national GDP,

with peaks in countries like Slovenia (3,07%), Hungary (1,17%) and Poland (1,17%). In absolute terms turnover is higher in Germany (€14 billion), Italy (€8,6 billion), Poland (€4,8 billion) and France (€3,8 billion).

Number of working hours needed to purchase a product

Over time product innovation and reduction in production costs has made the purchase of home appliances more affordable for a growing number of citizens. The number of working hours needed to purchase a washing machine went down from 59hrs to 39hrs, on average across EU from 2004 to 2014; from 93hrs to 54hrs for built-in dishwashers, from 59hrs to 44hrs for refrigerators and from 65hrs to 44hrs for cooking appliances.



Washing machines



Cooling



Cooking



Dishwashers



Freezers



Built in hobs

Source: Average price = CECED Member(s), Average income = Eurostat.

All these elements contribute to make home appliances part of our daily life and looking at a few of them, for 2016 we can estimate that EU inhabitants:



Washed more than
148 Mt of clothes,
corresponding to 290 kg/person
per year, almost
1 kg/person per day¹



Washed
**282 billion
place settings,**
corresponding to
533 settings/person per year²



290 kg / person



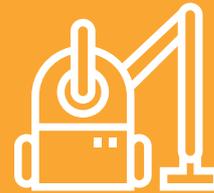
533 settings /person

¹Source: 220 cycles/year (EuP Study) and 3,5 kg/cycle (CECED).

²Source: 280 cycles/year (CECED) and 10 place settings/load (CECED DW campaign).



Conserved more than
360 Mt of food,
corresponding to 750 kg/person
per year, almost
2 kg/person per day³



Used vacuum cleaners for nearly
50 hours a year,
cleaning 87m² in one hour.
It's also equal to cleaning 42% of the
entire European Union surface⁴



750 kg / person



42% EU surface

³Assumption of 20 kg food rotation/week.

⁴Source: According to Ecodesign regulation on vacuum cleaners - Regulation No 666/2013/EU.

03

Production of Home Appliance: Impacts and Benchmarking

To produce and supply appliances, the home appliance industry uses various materials, metal and plastics in particular. **These materials come mainly from virgin sources but also to some extent from recycled sources.**

The average material composition of large home appliances is dominated by steel and stainless steel metals, while plastics are becoming more prominent for small appliances.

While some materials are common to many product types like steel or plastics, others are mainly associated with very specific products and functionalities, e.g. concrete in the counterweight of washing machines; or glass in fridges, washing machines and other kitchen appliances.

Average material composition of home appliances

Freezers

Metals (predominantly steel) are dominating for **large appliances**

Fridges



Large home appliances		Small home appliances	
 Household heating & ventilation	79,4%	 Microwaves	80,7%
 Kitchen appliances	77,5%	 Hot water	60,4%
 Air conditioners	69,0%	 Other small household	59,6%
 Dryers	67,9%	 Food processing	52,1%
 Dishwashers	60,5%	 Personal care	51,8%

Plastics are slightly more prominent for **small appliances**



Large home appliances		Small home appliances	
 Refrigerators	39,2%	 Vacuum cleaners	60,6%
 Freezers	34,8%	 Food processing	32,3%
 Washing machines	29,8%	 Personal care	30,4%
 Dryers	26,8%	 Hot water	18,7%
 Air conditioners	20,3%	 Other small household	16,5%

Source: UNU-VIE SCYCLE calculations based on CECEC members input, EuP studies and other sources.

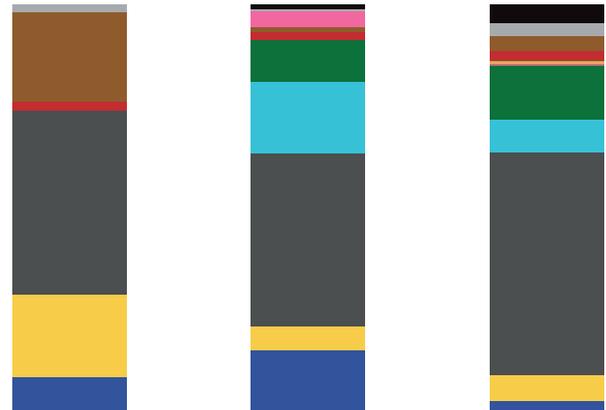
Average material composition of large home appliances:



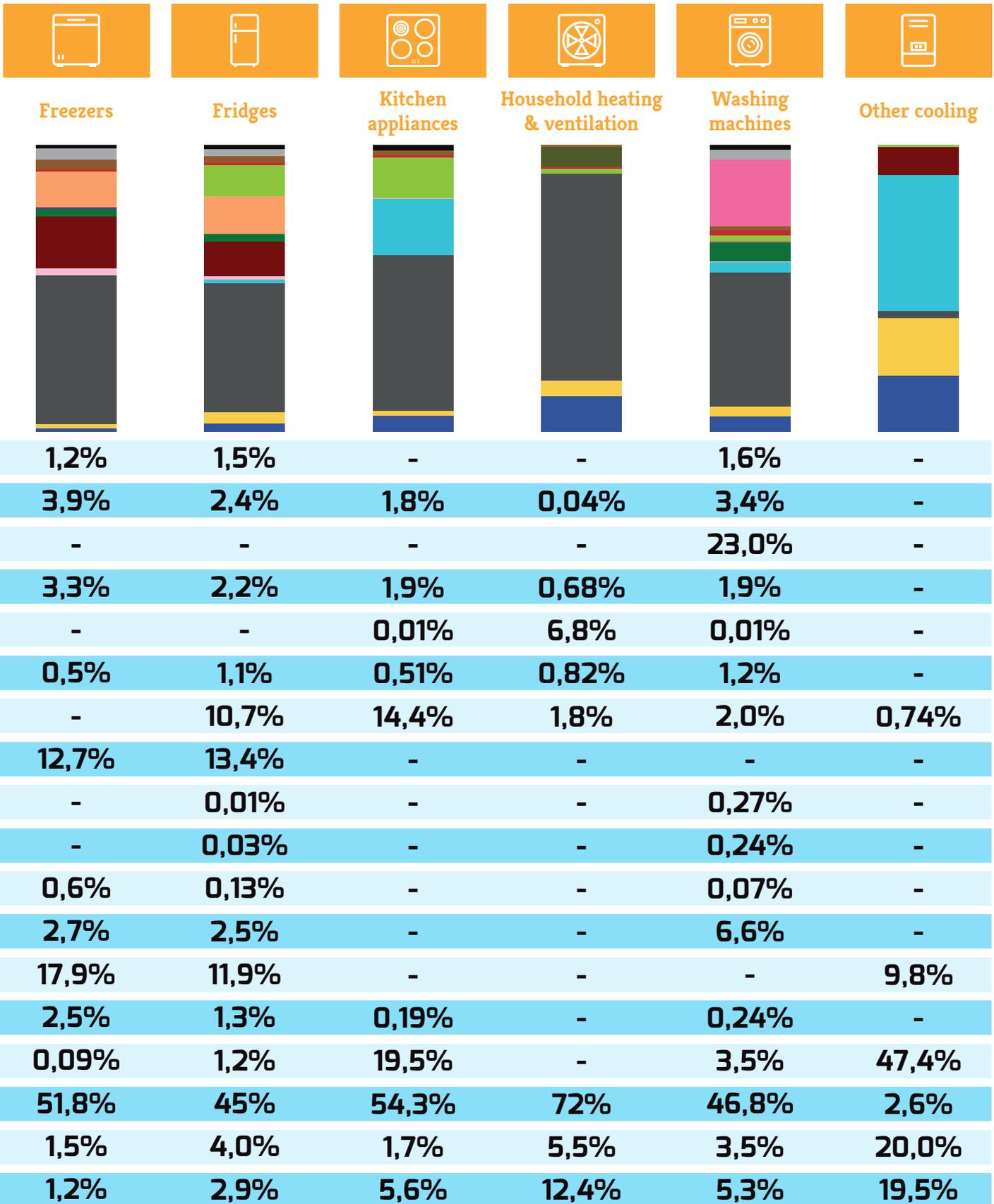
Air conditioners

Dishwashers

Dryers



Acrylonitrile Butadiene Styrene	-	1,2%	4,7%
Aluminium	2,0%	0,25%	3,6%
Concrete	-	4,0%	-
Copper	21,9%	1,3%	3,8%
Copper + Aluminium	-	0,02%	0,01%
Electronics	2,4%	1,7%	2,8%
Glass	-	-	0,10%
Polystyrene	-	0,22%	0,68%
Polyamide	-	0,25%	0,15%
Polycarbonate	-	0,23%	0,13%
Polyethylene	-	0,36%	-
Polypropylene	-	10,2%	14,1%
Polyurethane Foam	-	0,35%	-
Polyvinyl Chloride	-	0,82%	0,17%
Stainless steel	-	17,3%	8,5%
Steel	45,1%	41,6%	52,0%
Other plastics	20,3%	5,8%	7,0%
Other	8,3%	14,4%	2,4%



Average material composition of small home appliances:



Food processing



Hot water



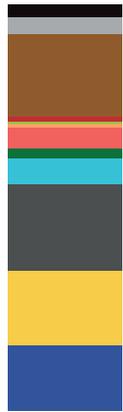
■	Acrylonitrile Butadiene Styrene	0,46%	2,9%
■	Aluminium	11,5%	4,3%
■	Concrete	-	-
■	Copper	6,2%	4,6%
■	Copper + Aluminium	2,1%	0,13%
■	Electronics	1,4%	3,3%
■	Glass	1,3%	7,6%
■	Polystyrene	-	-
■	Polyamide	1,5%	1,1%
■	Polycarbonate	-	0,04%
■	Polyethylene	-	0,02%
■	Polypropylene	6,0%	7,4%
■	Polyurethane Foam	-	-
■	Polyvinyl Chloride	0,18%	0,26%
■	Stainless steel	6,7%	1,8%
■	Steel	25,6%	49,6%
■	Other plastics	24,2%	6,9%
■	Other	12,9%	10,0%



Microwaves



Personal care



Vacuum cleaners



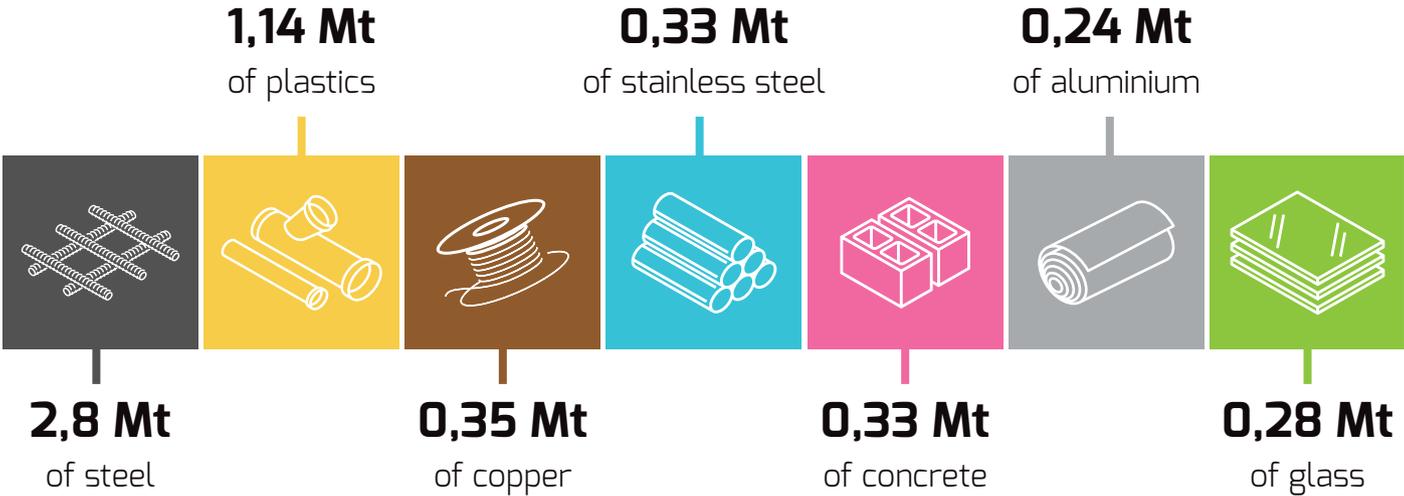
Other small household



1,5%	3,2%	10,8%	5,8%
0,47%	4,0%	5,1%	10,2%
-	0,02%	-	-
12,5%	20,0%	3,5%	3,0%
0,10%	0,38%	0,05%	0,05%
2,4%	1,3%	0,21%	0,26%
6,4%	0,53%	-	-
0,09%	1,0%	-	-
-	4,9%	-	-
0,05%	0,20%	-	-
0,03%	0,28%	-	-
0,59%	2,6%	5,1%	1,4%
-	-	-	-
0,63%	0,12%	2,0%	0,03%
0,92%	6,3%	4,2%	0,87%
66,8%	21,1%	12,6%	45,5%
3,1%	18,0%	42,8%	9,4%
4,6%	16,0%	13,8%	23,6%

Considering the total number of home appliances placed on the EU market in 2016 and the average composition derived from the analysis of more than 320 bills of materials and nearly 40 additional sources providing averages of a number of products, the following quantities of individual materials were used by the home appliance sector:

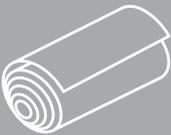
Quantities of individual materials used by the home appliances sector



Sourcing and consumption of raw materials is a global process, as global as the production of home appliances. Considering the main materials, the consumption at global level to produce and annually supply home appliances for EU markets is equal to:



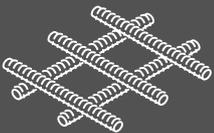
1,2% of global production of Copper



0,5% of global production of Aluminium



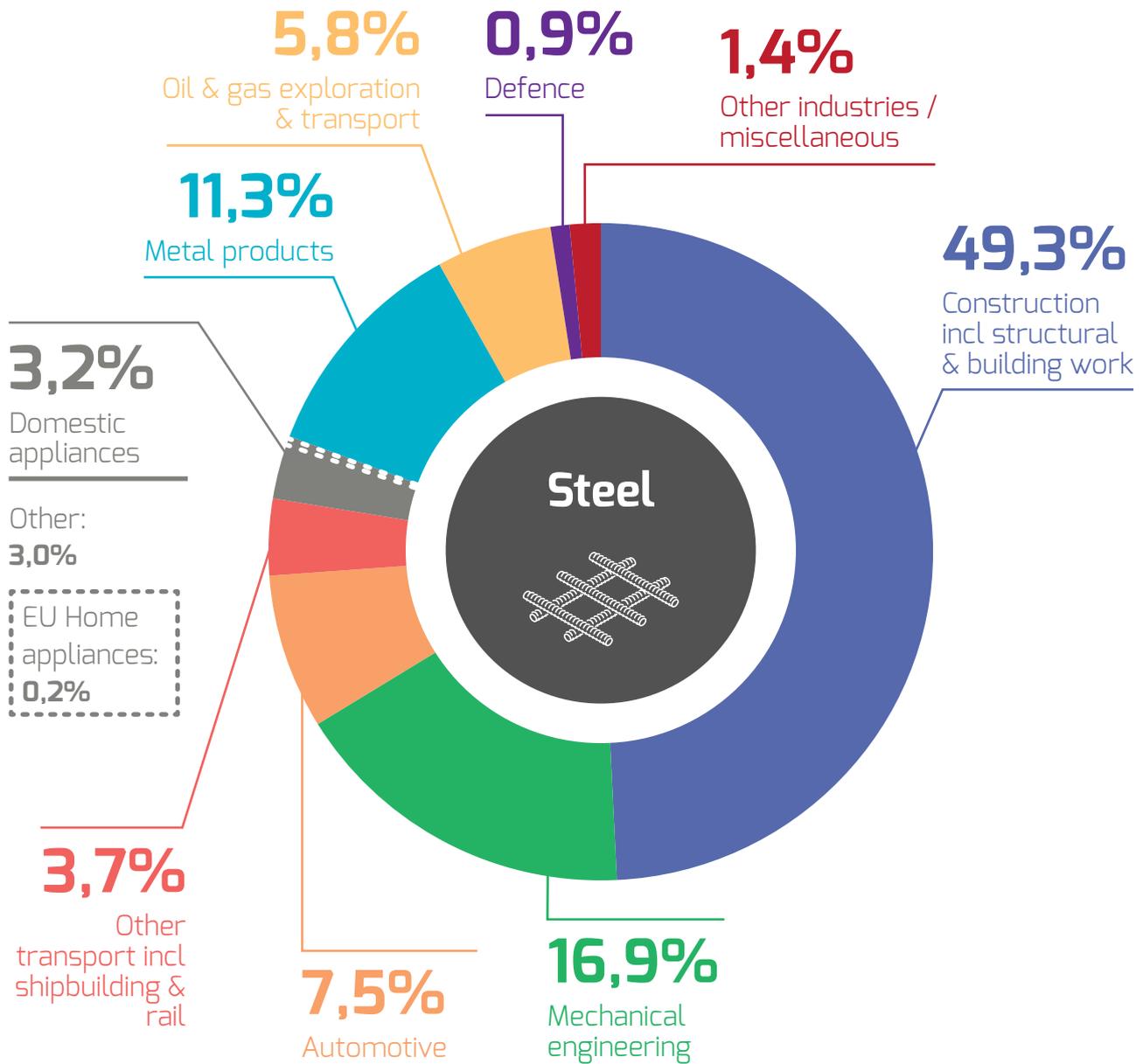
0,5% of global production of Plastics



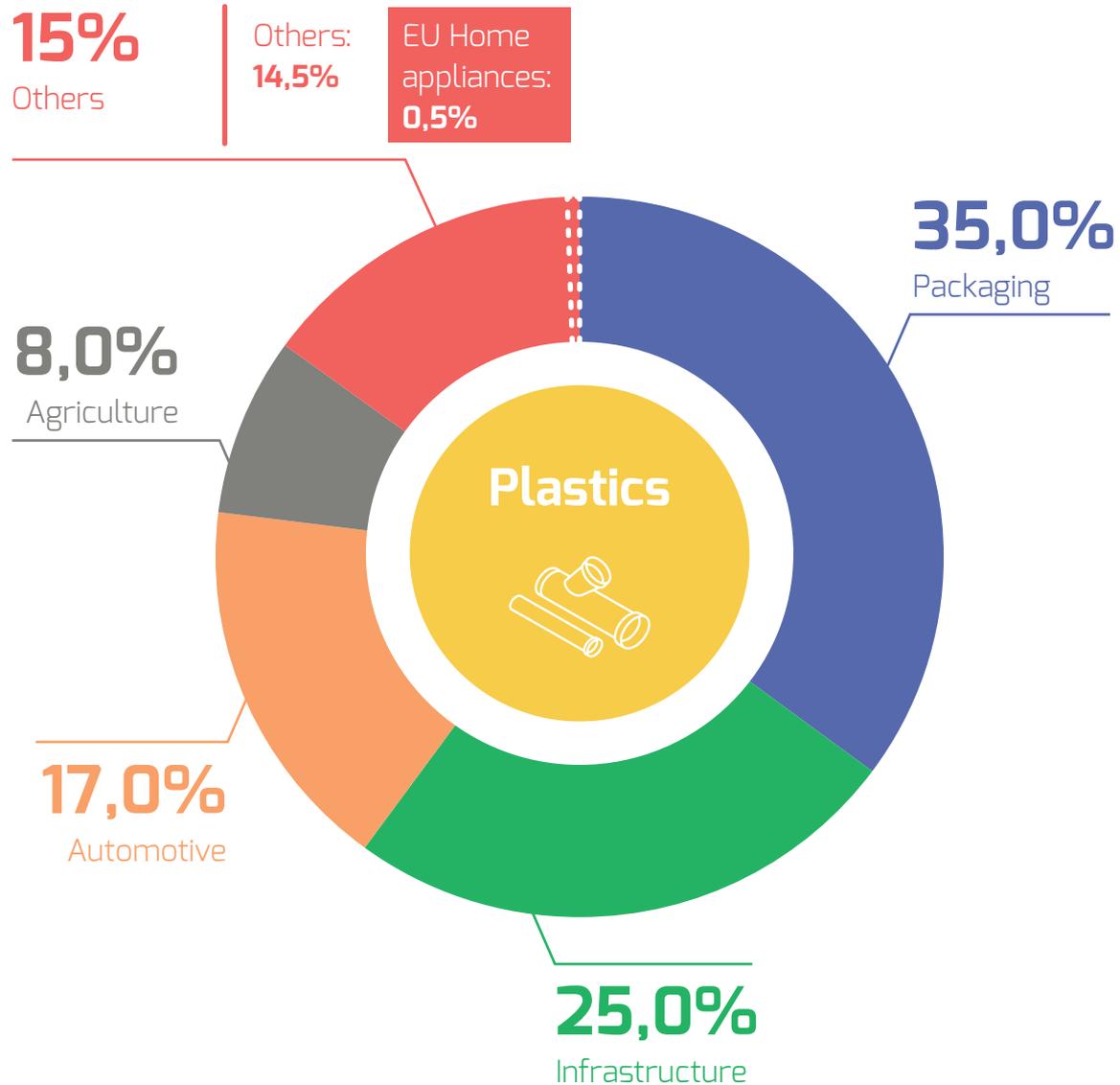
0,2% of global production of Steel¹

¹Steel + Stainless Steel.

Share of end-use

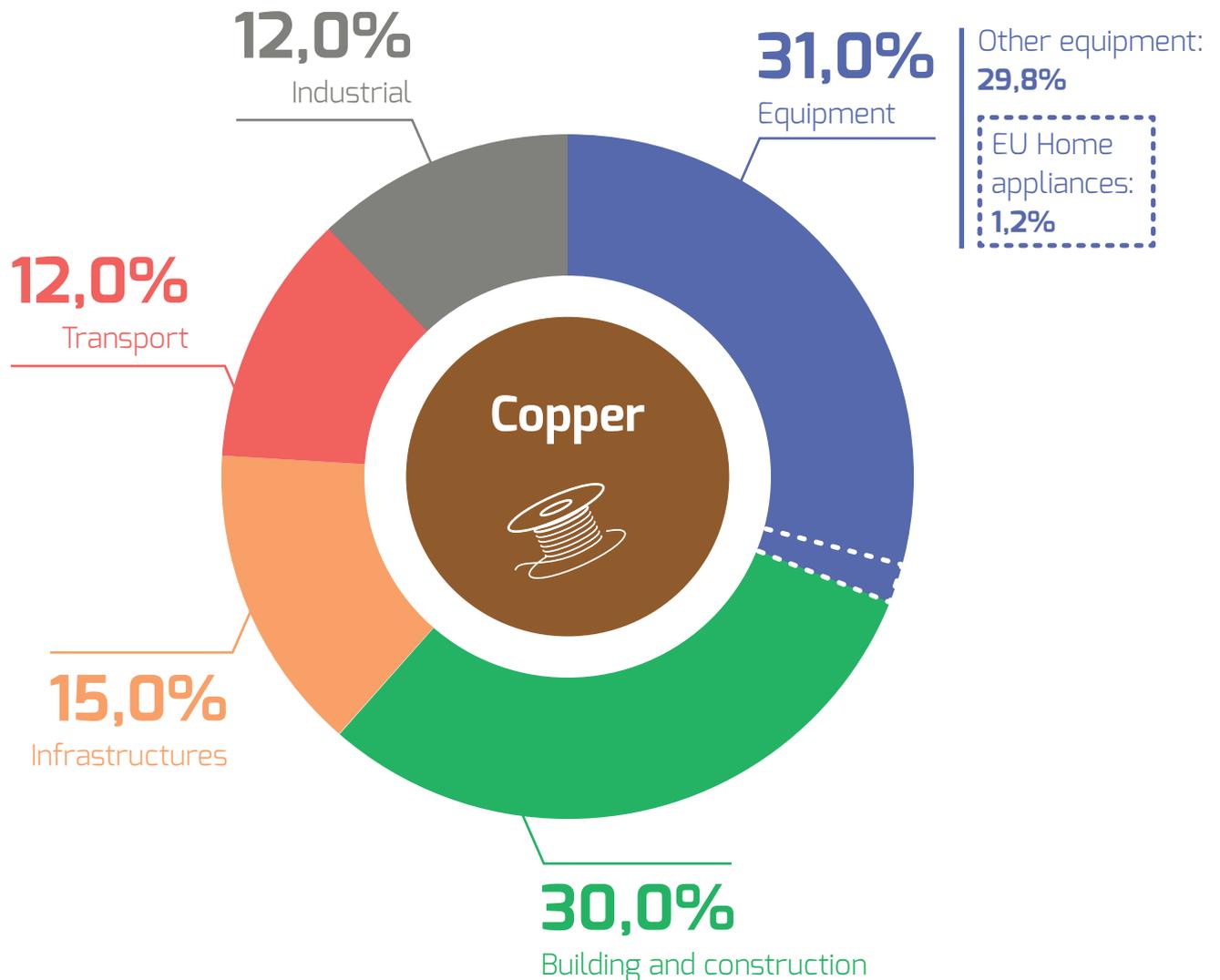


Consumption at global level to produce and annually supply home appliances for EU markets

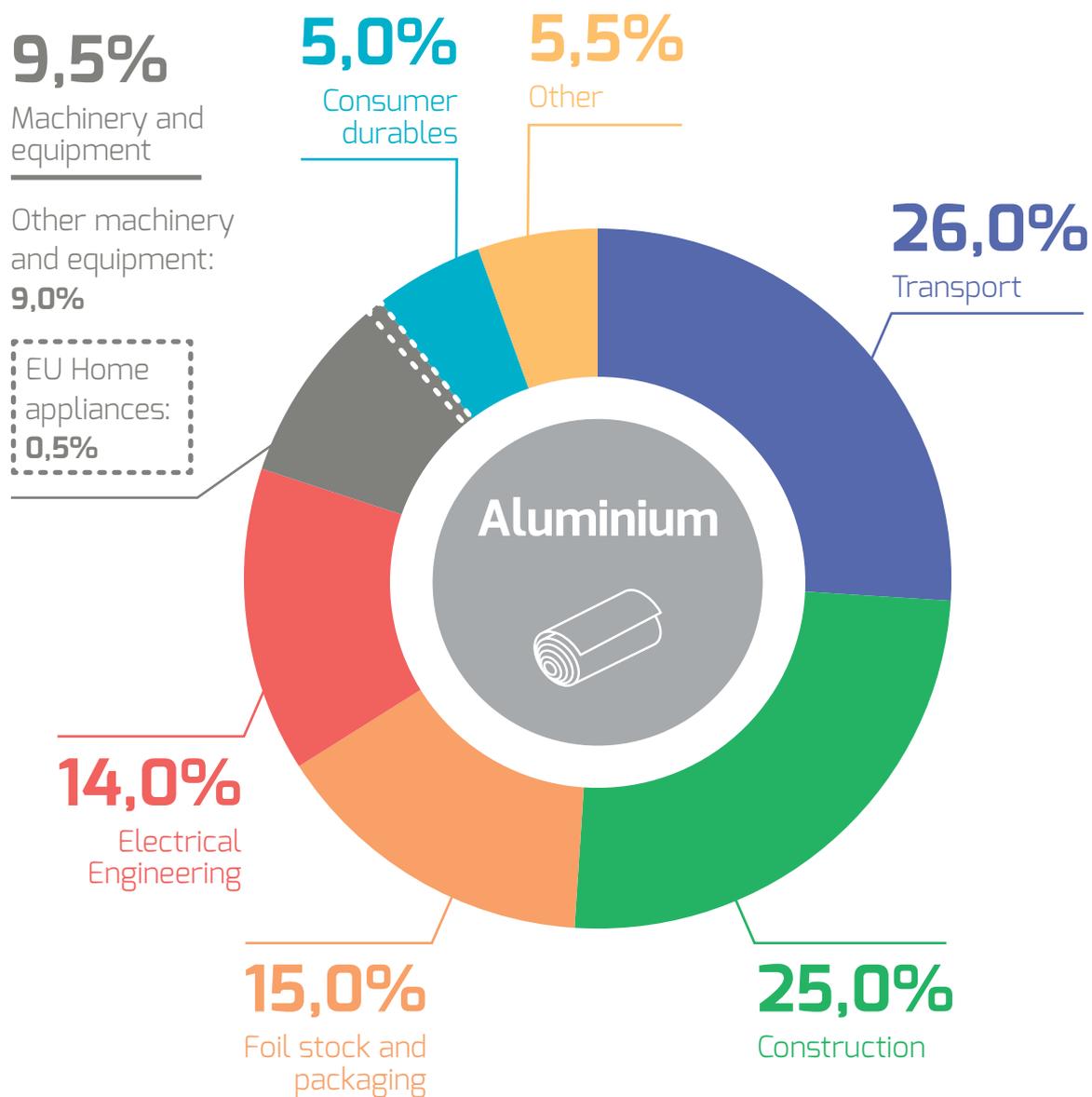


Consumption at global level to produce and annually supply home appliances for EU markets

Share of end-use



Consumption at global level to produce and annually supply home appliances for EU markets



Consumption at global level to produce and annually supply home appliances for EU markets

The choice of materials used for production of home appliances has evolved over time. The two most significant trends are: an increasing amount of plastic, replacing steel, and mechanical controls replacing electronic controls. In addition there are major trends such as products becoming smarter, connected and in some cases multifunctional, which are increasingly setting the tendency for product design, material usage as well as developments in recycling technologies and processes.

With connected and smart appliances and new user interfaces there are more electronics and components such as displays and touch screens in the products.

Products are increasingly fitted with sensors and other technologies, including the use of small electronic components located away from a central printed circuit board, making certain materials more dispersed within a product.

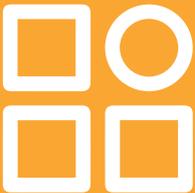
Besides technical developments, other design requirements play a role, with significant implications also at the end-of-life phase.

Major trends impacting the material composition of products



Production cost reduction

This is particularly relevant for the use of plastic polymers which has led to the reduction of production costs while, at the same time, potentially increasing the complexity of final recycling by increasing the number of polymers used.



Appearance

The size, look and feel of the products.



Safety requirements

The necessary use of flame-retardants impacting the possibilities of plastics recycling is a current example.



Endurance

The use of robust fasteners for parts and components.



Thanks to voluntary action and triggered by EU regulations (RoHS and REACH), the electric and electronic equipment (EEE) industry, including the home appliance industry, has avoided the use of approximately 28 kt of lead since 2006

The amounts of cadmium have also been reduced considerably. Compared to 2006, smaller amounts of lead and cadmium have continued to be used by the home appliance industry due to legal exemptions (RoHS) until their substitution becomes technologically feasible and practicable. Carcinogenic Hexavalent chromium will be completely phased out by the home

appliance industry after 2019 when it is foreseeable that more environmentally-friendly alternatives can replace the 0,75 % by weight in the cooling solution of absorption fridges. For substances of very high concern (SVHC) in REACH, the home appliance industry states that it follows a policy of further phase-outs as soon as substitution becomes technically viable¹.

¹European Parliament and Council 2006 2006 "Regulation (EC) No 1907/2006 of the European Parliament and of the Council of 18 December 2006 concerning the Registration, Evaluation, Authorisation and Restriction of Chemicals (REACH): REACH,"





Restricted since 2006 by RoHS (I) Directive 2002/95 CE¹
concentration weight/weight in homogeneous
material pursuant to Directive 2011/65/EU²

82 Pb Lead 0,1%	80 HG Mercury 0,1%	48 Cd Cadmium 0,01%	Cr⁶⁺ Hexavalent Chromium 0,1%
	PBBs Polybrominated biphenyls 0,1% ¹	PBDEs Polybrominated diphenyl ethers 0,1%	

Will be restricted as of 22 July 2019
pursuant to Directive 2015/863/EU

DEHP Bis (2-ethylheyl) phthalate 0,1%	BBP Butyl benzyl phthalate 0,1%	DBP Dibutyl phthalate 0,1%	DiBP Diisobutyl phthalate 0,1%
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¹Directive 2002/95/EC of the European Parliament and of the Council of 27 January 2003 on the restriction of the use of certain hazardous substances in electrical and electronic equipment.

²Directive 2011/65/EU of the European Parliament and of the Council of 8 June 2011 on the restriction of the use of certain hazardous substances in electrical and electronic equipment (recast).

When looking at the evolution of materials consumption in two of the most representative products of the home appliance industry (refrigerators and washing machines), the following trends can be seen:

For refrigerators, the dominant material remains steel, with an increase in stainless steel. This is even more relevant in non-household refrigeration. Compared to the early 2000s, electronic components have increased from 0,5% to 1,5%, and up to 2% for some products.

The share of polyurethane foam (PUR) increased over time (from 10 to 12%), as a consequence of the work to improve the energy efficiency of appliances, as well as glass (from 6% to 14%) mainly because steel-wire shelves (common 10 years ago), have been replaced by glass shelves.

The situation is similar for plastics, which was around 14% in 2000 and increased to nearly 23% today with peaks of 29% in certain cases.

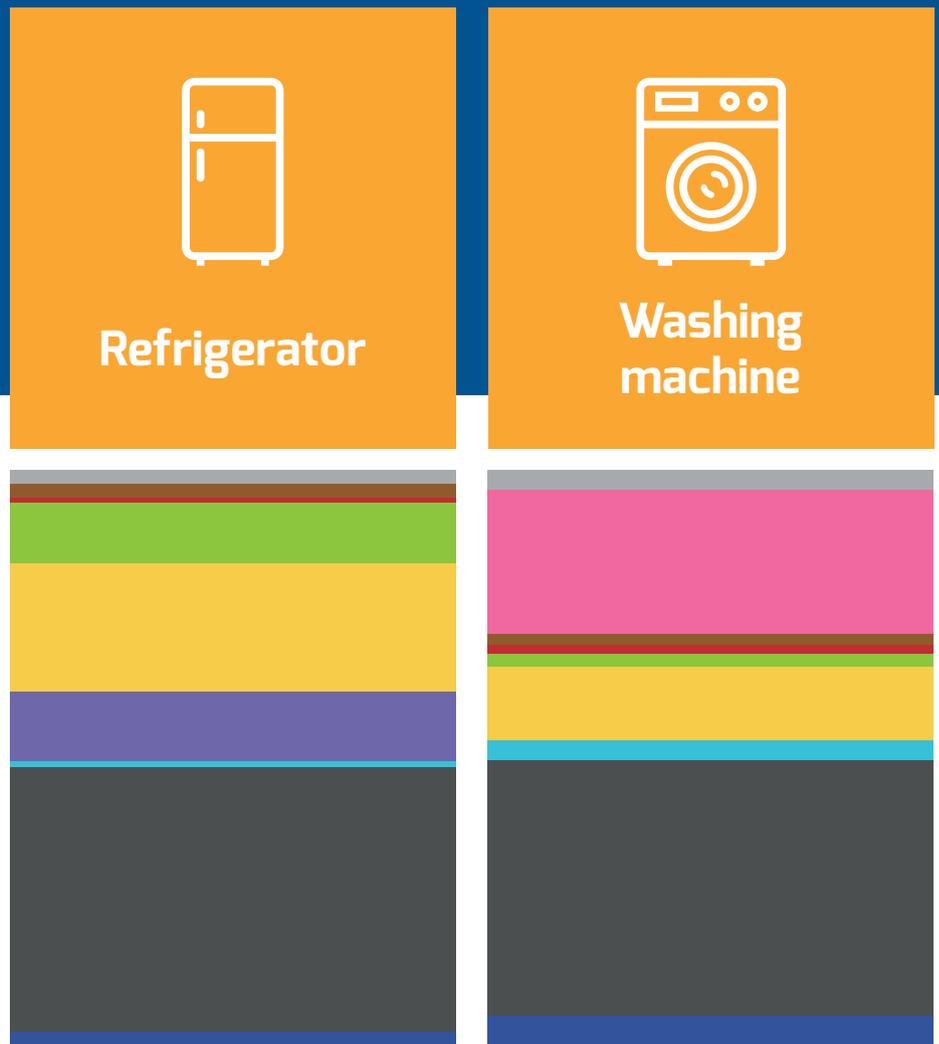
It should also be noted that, over time, products have become larger (about 10%) in net volume and also heavier (up to 15%). Weight increase is linked to the total volume of the appliance, but even more to the larger wall thickness, especially of fridge-freezers and upright freezers (to reduce energy consumption).

Steel chassis and surfaces of the cabinets have increased by around 15%. The polystyrene (PS) inner-liner has increased by around 10%. Increase of product weight is also linked with improvement of refrigeration efficiency: condenser and evaporator surfaces became bigger - thus heavier - and more tube-and-fin evaporators are used.

For washing machines, similar trends can be observed: steel is the dominant material: 67% in older products, with one case having nearly 82% when used also for the counterweight. Today the amount of steel has decreased to 41%, while concrete still represents a relevant share, accounting for more than 25% of the total weight.

As for refrigerators, the use of electronic components increased from 0,2% up to 2,4-2,7% in modern models. The plastic share increased from 6,8% up to 23,4% with some products up to 26,7%. One of the main reasons for replacement of metals (steel in particular) with plastics is connected with the increase of flexibility in production, and reduction of the final product price.

Average material composition:



Aluminium	2,18%	3,4%
Concrete	-	25%
Copper	2,23%	2%
Electronics	1,02%	1,7%
Glass	7,97%	2,1%
Plastics	23,39%	12,9%
Polyurethane Foam	12,39%	-
Stainless steel	1,04%	3,3%
Steel	46,85%	44,2%
Other	2,93%	5,5%

Source: UNU-VIE SCYCLE calculations based on CECEC members input, EuP studies and other sources..

The home appliance industry continuously works to reduce the impact of production processes and particularly the consumption of energy and water as well as the reduction of waste during production processes.

Between 2011 and 2015, the home appliance industry succeeded in reducing water consumption per product unit by approximately 30%, while waste generation and energy consumption per product unit decreased by around 15 % within the same period.



Waste
generated¹:
-15%



Water
consumption¹:
-30%



Energy
consumption¹:
-13%

¹Between 2011 and 2015 in home appliance industry.
Source: CECED members.

WASTE GENERATED
PER UNIT

WATER USAGE
PER UNIT

ENERGY CONSUMPTION
PER UNIT

2011



100



100



100

2012



98



98



98

2013



98



92



96

2014



95



79



91

2015



85



70



87

Note: 2011 considered as baseline year with a value of 100.

Benchmarking with the EU manufacturing industry shows that, in absolute consumption, the home appliance industry reduced water consumption by around 30% from 2011 to 2015.

The reduction of energy consumption also shows a positive trend, well above the improvements of other EU manufacturing industry.

**HOME APPLIANCE
INDUSTRY**

**MANUFACTURING
INDUSTRY**

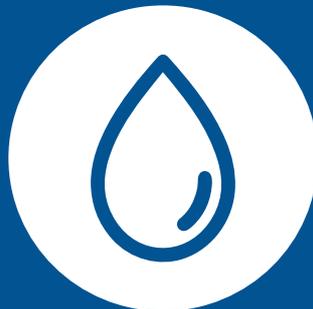
-16%¹



+7%¹

Waste generation
in absolute terms

-30%¹



-9%¹

Water use
in absolute terms

-13%¹



-4%¹

Energy consumption
in absolute terms

¹From 2011 to 2015.
Source: Industry benchmarking: Eurostat, Fraunhofer.

04

Amount of Material in Appliances
Installed or Stored in Private Homes

04

Amount of
Material in
Appliances
Installed or
Stored in
Private Homes

The penetration of home appliances, particularly for those ensuring the basic needs of EU citizens, but also the increase of penetration of small appliances, resulted in a total stock in 2016 of more than 67 Mt.

When looking also at other electric and electronic equipment (EEE), the total is more than 110 Mt.

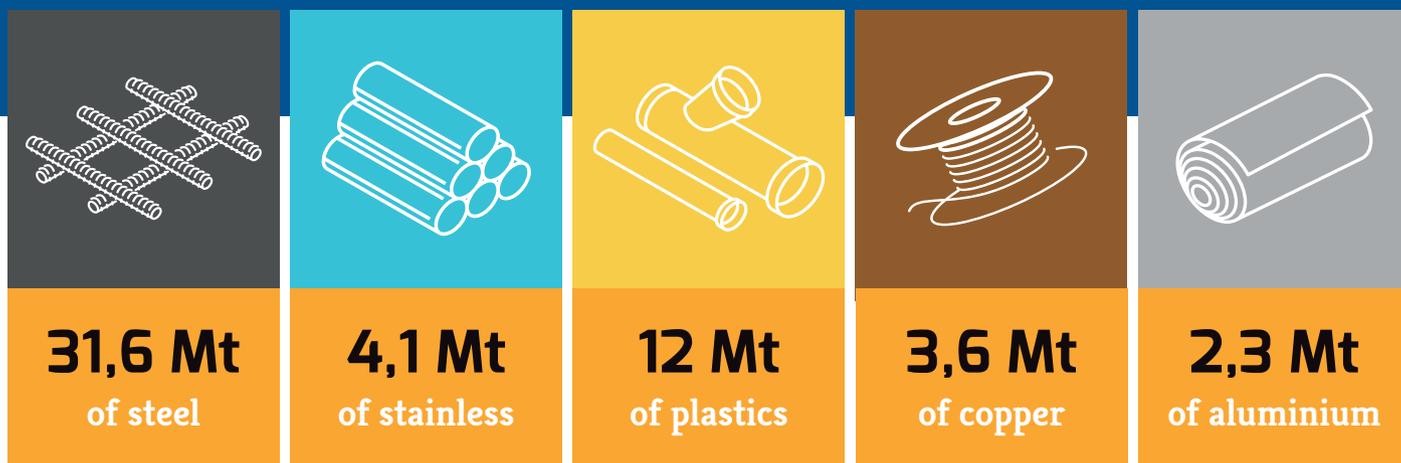
These appliances represent a source of materials for the EU, embedded in our daily life. Materials are used in their production and remain during the use phase in homes.

Total home appliances stock 2016

	Air conditioners	2,5 Mt	91,6 M units
	Dishwashers	5 Mt	100,8 M units
	Dryers	3,5 Mt	89,5 M units
	Freezers	3,5 Mt	80,2 M units
	Fridges	13,5 Mt	346,1 M units
	Kitchen appliances	7,9 Mt	184,5 M units
	Household heating & ventilation	2,8 Mt	477,4 M units
	Washing machines	13,5 Mt	191,9 M units
	Other cooling	0,58 Mt	13,8 M units
	Food processing	4,2 Mt	1.483,2 M units
	Hot water	1,1 Mt	881,2 M units
	Microwaves	4,7 Mt	282,2 M units
	Personal care	0,39 Mt	640,1 M units
	Vacuum cleaners	2,1 Mt	425,1 M units
	Other small household appliances	2,2 Mt	2.487,2 M units
	Total	67,3 Mt	7.774,9 M units

Source: UNU-VIE SCYCLE calculations.

If we look at home appliances, the current stock of materials in the EU is equal to 31,6 Mt of steel and 4,1 Mt of stainless steel, 12 Mt of plastics, 3,6 Mt of copper and 2,3 Mt of aluminium.

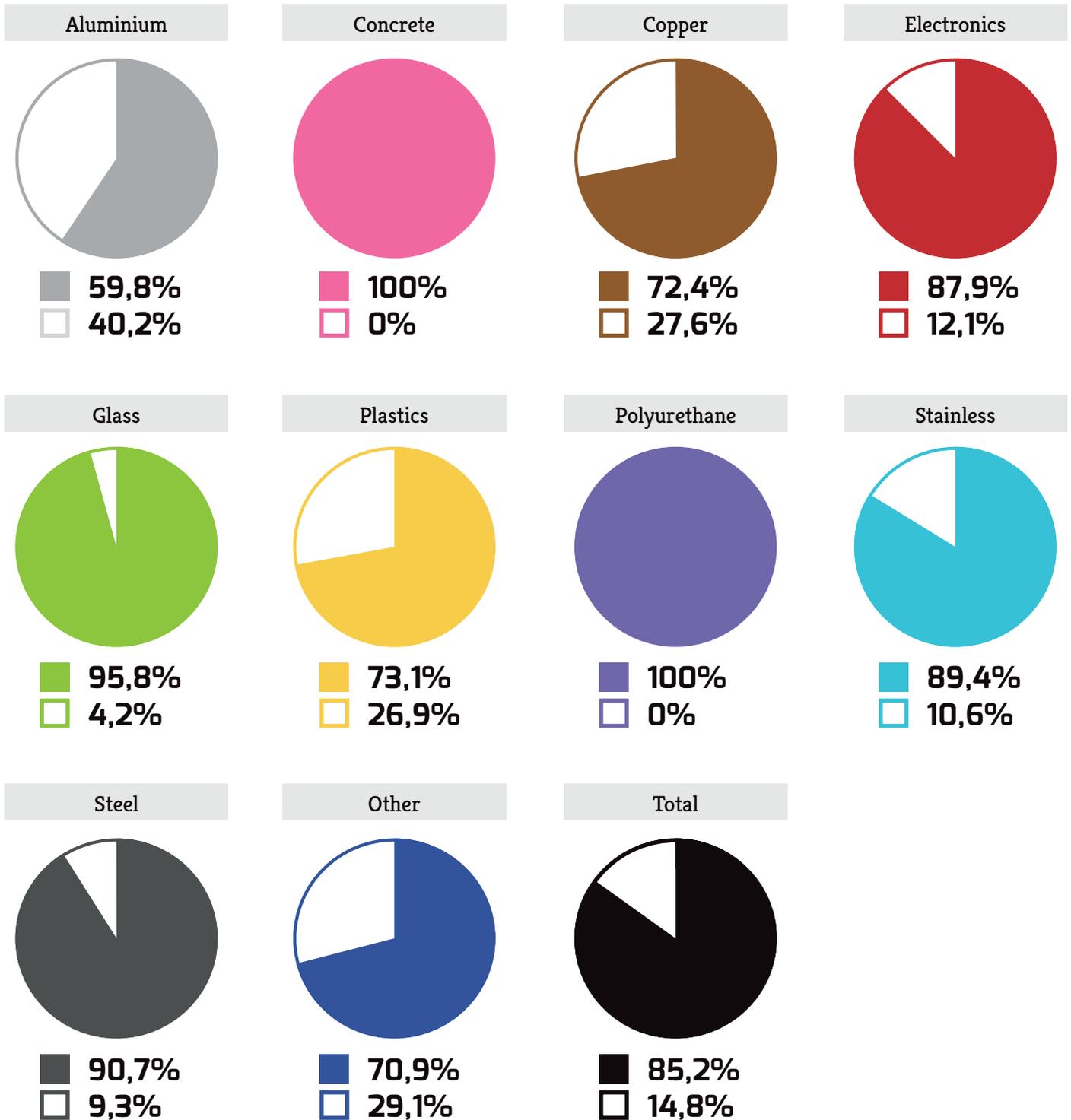


	Large appliances	Small appliances	Total
Aluminium	1,4 Mt	0,92 Mt	2,3 Mt
Concrete	3,3 Mt	-	3,3 Mt
Copper	2,6 Mt	0,99 Mt	3,6 Mt
Electronics	0,79 Mt	0,11 Mt	0,90 Mt
Glass	3,2 Mt	0,14 Mt	3,3 Mt
Plastics	8,8 Mt	3,2 Mt	12 Mt
Polyurethane	2,1 Mt	-	2,1 Mt
Stainless	3,7 Mt	0,43 Mt	4,1 Mt
Steel	28,6 Mt	2,9 Mt	31,6 Mt
Other	2,9 Mt	1,2 Mt	4,1 Mt
Total	57,3 Mt	9,9 Mt	67,2 Mt

Source: UNU-VIE SCYCLE calculations.

Home appliance current stock of materials in the EU

■ Large appliances □ Small appliances

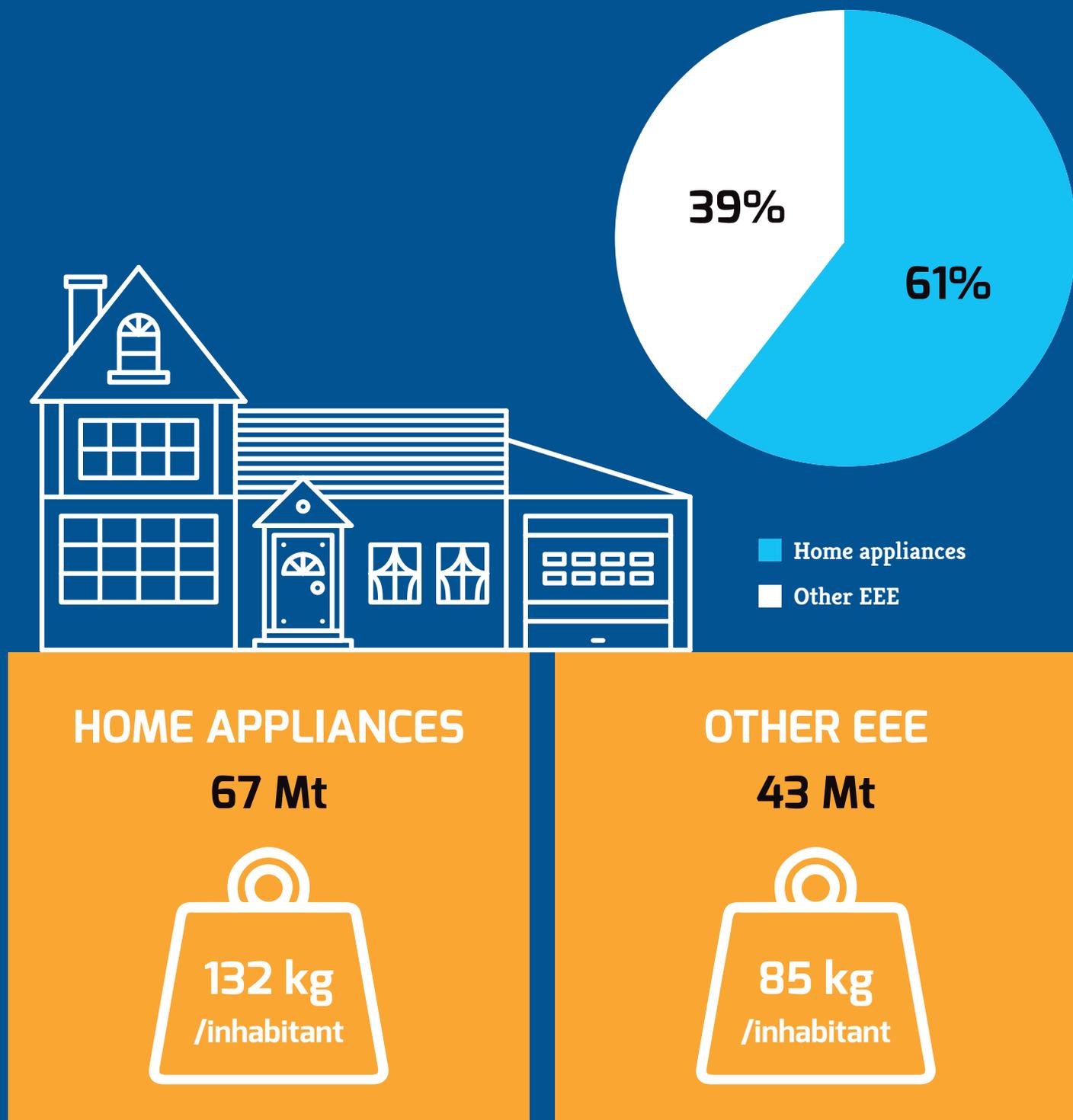


Source: UNU-VIE SCYCLE calculations.

	Home appliances	Other EEE	Total
Acrylonitrile Butadiene Styrene	1,2 Mt	1,6 Mt	2,8 Mt
Aluminium	2,3 Mt	1,3 Mt	3,7 Mt
Concrete	3,3 Mt	-	3,3 Mt
Copper	3,6 Mt	2,8 Mt	6,4 Mt
Electronics	0,90 Mt	2,3 Mt	3,2 Mt
Glass	3,3 Mt	3,6 Mt	7 Mt
Other plastics	5,1 Mt	3,3 Mt	8,4 Mt
Others	4,1 Mt	8,1 Mt	12,2 Mt
Polistyrene	2,3 Mt	1,9 Mt	4,2 Mt
Polycarbonate	0,61 Mt	0,29 Mt	0,36 Mt
Polyethylene	0,70 Mt	0,27 Mt	0,34 Mt
Polypropilene	2,8 Mt	0,05 Mt	2,9 Mt
Polyurethane Foam	2,1Mt	0,55 Mt	2,6 Mt
Polyvinyl Chloride	0,4 Mt	0,26 Mt	0,70 Mt
Stainless steel	4,1 Mt	0,57 Mt	4,7 Mt
Steel	31,5 Mt	15,8 Mt	47,3 Mt
Total	67,2 Mt	42,8 Mt	110 Mt

Source: UNU-VIE SCYCLE calculations.

The total amount of home appliances in stock in 2016 in EU homes totals more than 67 Mt, approximately 132 kg/inhabitant. The stock of home appliances represents approximately 61% of the total stock of Electric and Electronic Equipment (EEE) (216 kg/inhabitant).

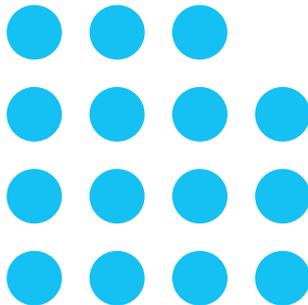




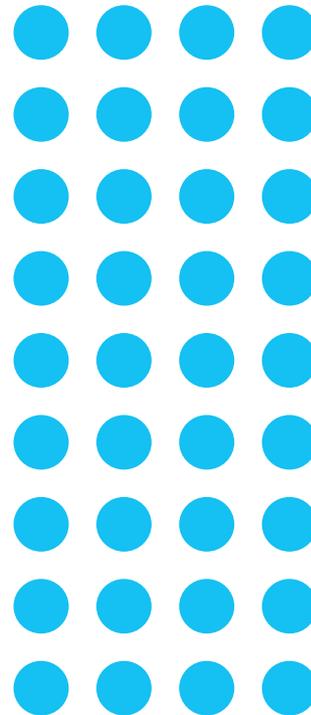
Total number of products in stock in houses
7,7 billion
with a predominance of small home appliances

Number of products in EU household

For home appliances, in 2016, it is more than:



15 products/inhabitant



36 products/household

The penetration rate is close to 1 for essential products like washing machines (0,90) and kitchen appliances (0,86), while it is higher for refrigerators (1,6), and lower for dishwashers at 0,47. For some products, geography and average weather temperatures play a crucial role, as in the case of air conditioners or tumble dryers.

Home appliances penetration rate		 unit/person	 unit/household
	Air conditioners	0,18	0,43
	Dishwashers	0,20	0,47
	Dryers	0,18	0,42
	Freezers	0,16	0,38
	Fridges	0,68	1,62
	Kitchen appliances	0,94	2,24
	Household heating & ventilation	0,36	0,86
	Washing machines	0,38	0,90
	Other cooling	0,03	0,06
	Food processing	2,91	6,94
	Hot water	1,73	4,13
	Microwaves	0,55	1,32
	Personal care	1,25	3,00
	Vacuum cleaners	0,83	1,99
	Other small household	4,87	11,65
Total		15,24	36,40



Small home appliances make a relevant contribution to the total number of products. The average number is almost 29 when considering the total number of small home appliances like toasters, grills, coffee machines or kettles.

Source: UNU-VIE SCYCLE calculations. Number inhabitants and households - Eurostat.

Electrical and electronic products sold in the EU



The amount of
EEE PRODUCTS
placed on the EU market has over the last
ten years been fluctuating between
9,5 and 10,5 Mt per year

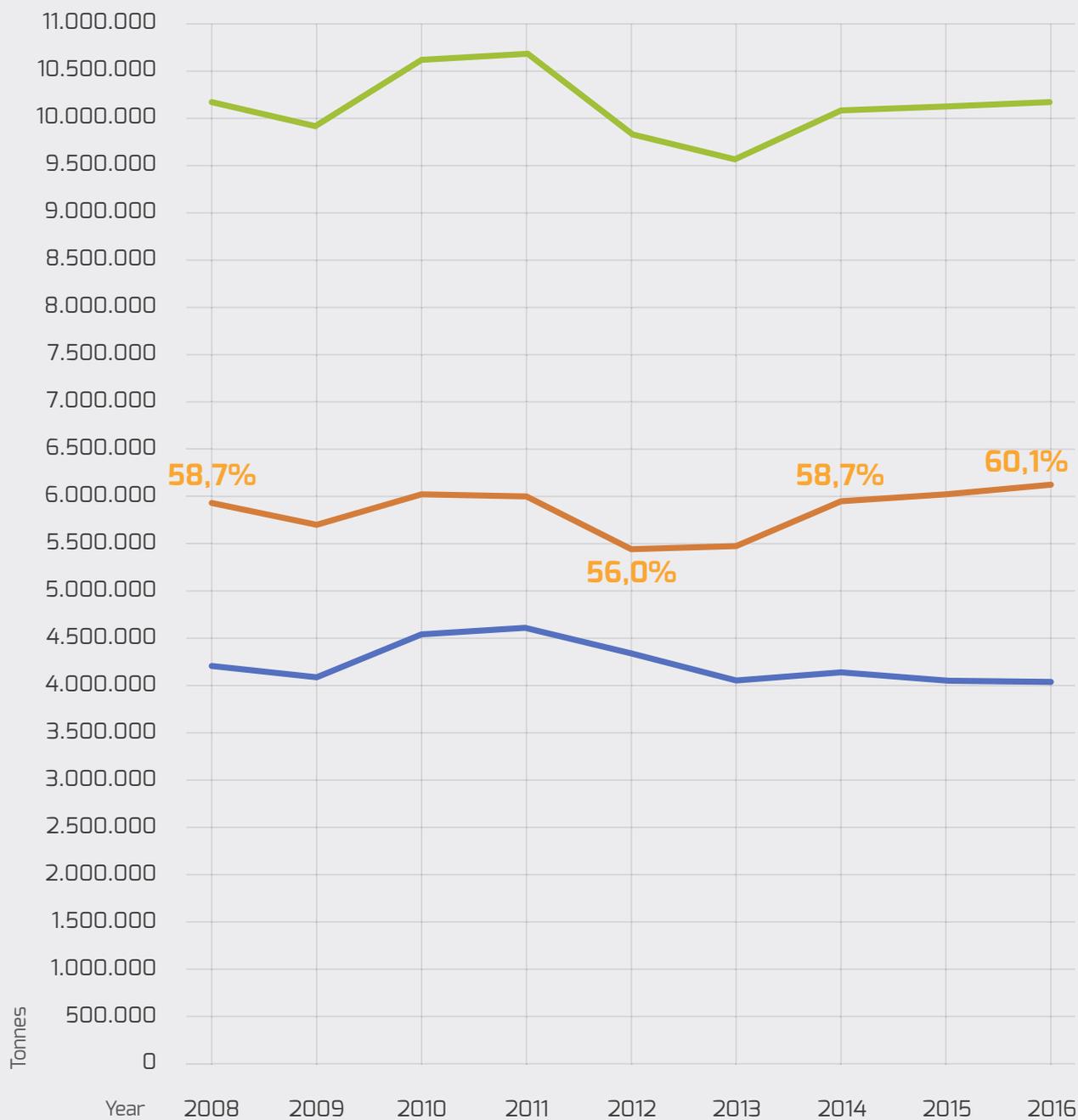
The share of
HOME APPLIANCES
represents
56% and 60%
(in weight)
of the total EEE



■ Home appliances

■ Other EEE

EEE products placed on the EU market



■ Home appliances
 ■ Other EEE
 ■ Total

Source: UNU-VIE SCYCLE calculations.

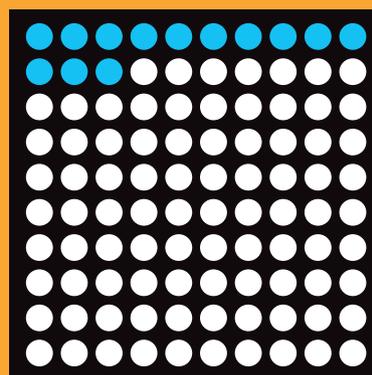
When looking at the home appliance sector, the breakdown per weight or per unit looks quite different:

- Large appliances
- Small appliances

LARGE APPLIANCES
accounts for
71% of the total weight
and
SMALL APPLIANCES
(including microwaves) for
29% of the total



The number of large appliances account only for
13% of the total



Large home appliances sold in 2016



Air conditioners

	Placed on the market	0,22 Mt
	Units	8,2 M
	% Placed on the market of total	3,6%
	% Units of total	0,8%



Dishwashers

	Placed on the market	0,39 Mt
	Units	7,8 M
	% Placed on the market of total	6,3%
	% Units of total	0,8%



Dryers

	Placed on the market	0,23 Mt
	Units	5,8 M
	% Placed on the market of total	3,7%
	% Units of total	0,6%



Freezers

	Placed on the market	0,24 Mt
	Units	5,5 M
	% Placed on the market of total	3,9%
	% Units of total	0,5%



Fridges

	Placed on the market	1,1 Mt
	Units	27,6 M
	% Placed on the market of total	17,5%
	% Units of total	2,7%



Kitchen appliances

	Placed on the market	0,56 Mt
	Units	13,1 M
	% Placed on the market of total	9,1%
	% Units of total	1,3%



Household heating & ventilation

	Placed on the market	0,27 Mt
	Units	45,9 M
	% Placed on the market of total	4,4%
	% Units of total	4,5%



Washing machines

	Placed on the market	1,4 Mt
	Units	19,2 M
	% Placed on the market of total	22%
	% Units of total	1,9%



Other cooling

	Placed on the market	0,04 Mt
	Units	0,88 M
	% Placed on the market of total	0,6%
	% Units of total	0,1%

Total large home appliances placed on the market = 4,36 Mt

Small home appliances sold in 2016

					
Food processing		Hot water		Microwaves	
	Placed on the market	0,53 Mt		Placed on the market	0,22 Mt
	Units	185,8 M		Units	185,5 M
	% Placed on the market of total	8,6%		% Placed on the market of total	3,7%
	% Units of total	18%		% Units of total	18%
	Placed on the market	0,38 Mt		Placed on the market	0,05 Mt
	Units	23,1 M		Units	85,5 M
	% Placed on the market of total	6,2%		% Placed on the market of total	0,9%
	% Units of total	2,2%		% Units of total	8,3%
	Placed on the market	0,27 Mt		Placed on the market	0,32 Mt
	Units	53,9 M		Units	361,6 M
	% Placed on the market of total	4,3%		% Placed on the market of total	5,2%
	% Units of total	5,2%		% Units of total	35,1%

Total small home appliances placed on the market = 1,77 Mt

Total home appliances placed on the market = 6,13 Mt

05

End of Life of Home Appliances

HOME APPLIANCE WASTE GENERATION

Home appliance waste is made up of three main streams:

- Electrical and Electronic Waste (WEEE) - the estimated amount of WEEE generated in EU28 is assumed to be steadily increasing.
- Packaging waste, mainly in the distribution phase.
- Batteries, particularly for small home appliances are also included in the products and thus in the waste generated when home appliances reach their end of life.

Since the WEEE Directive¹ entered into force, the home appliance industry has proactively developed dedicated take back schemes across the EU to ensure waste collected by municipalities and retailers is properly managed. The industry has made considerable investments ensuring the recycling and treatment of electronic-waste by setting up recycling schemes across Europe.

These schemes help ensure that discarded products can be collected and recycled according to the best available technology and in line with the established standards to meet the recycling and recovery targets set by EU legislation. This has been further enhanced in recent years by the development of European treatment standards which help ensure the proper recycling of this stream of waste which is rich in secondary raw materials (WEEELABEX² and CEN-CENELEC³ treatment standards).

Nevertheless, there are three key areas in which industry and society will need to work in the future to ensure even better environmental sound treatment of all home appliance WEEE and ensuring optimal recovery of materials.

- Consumer behaviour
- WEEE Flows
- Recycling and recovery of home appliance WEEE

²http://ec.europa.eu/environment/waste/weee/standards_en.htm

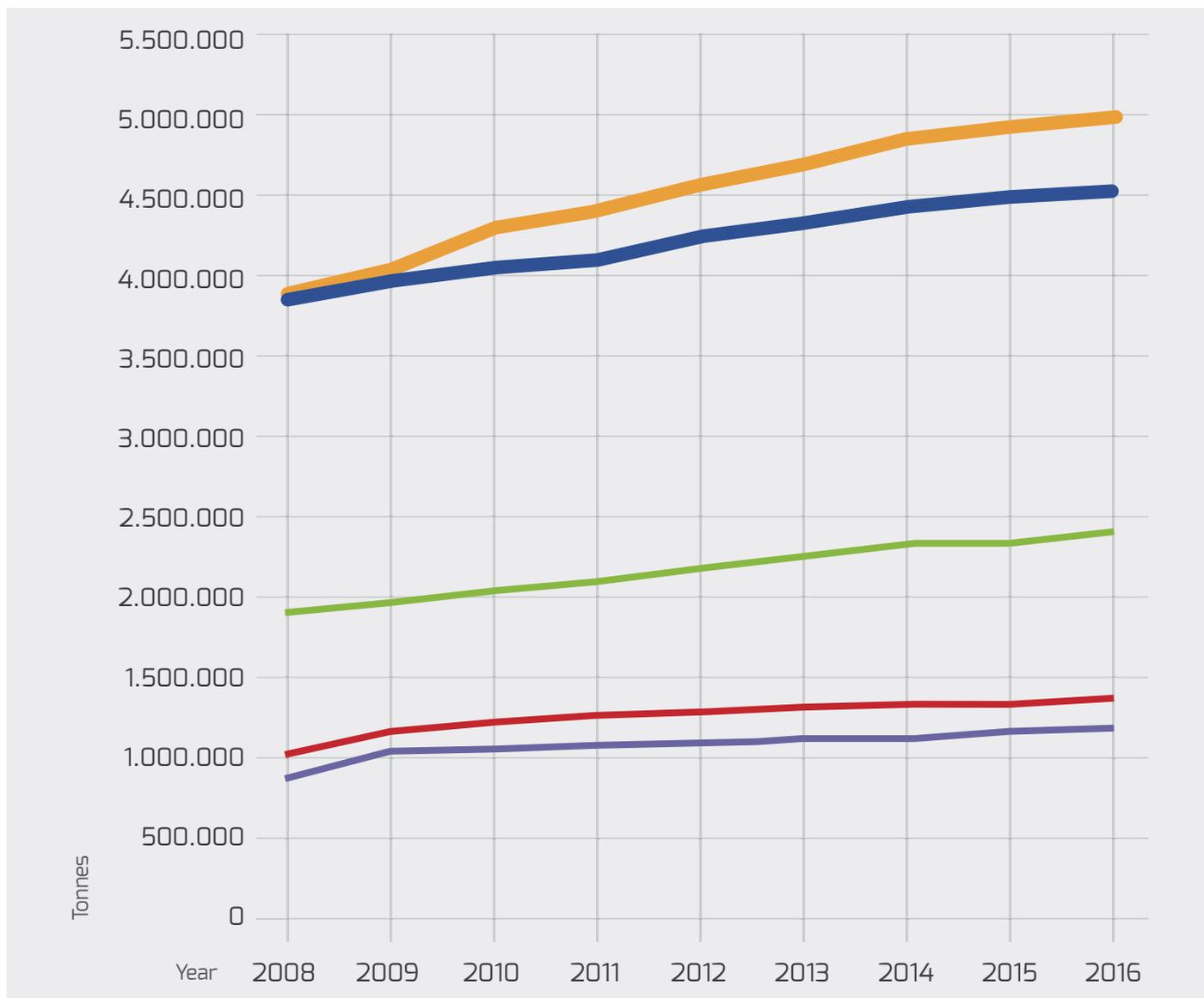
³<http://www.weeelabex.org/standards/>

¹Directive 2012/19/EU of the European Parliament and of the Council of 4 July 2012 on waste electrical and electronic equipment (WEEE)(recast).

EU home appliance WEEE generation

WEEE generation in Europe has been steadily increasing during the last years
Home appliance waste generation in Europe is been estimated as

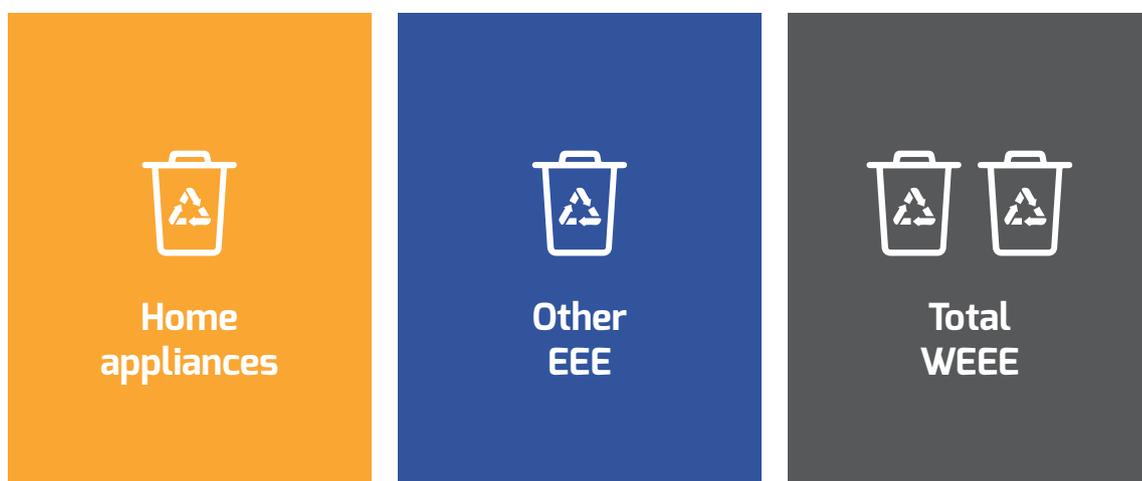
5 million tonnes in year 2016



Home appliances Other EEE Large home appliances Small home appliances Cooling & Freezing

Source: UNU-VIE SCYCLE calculations.

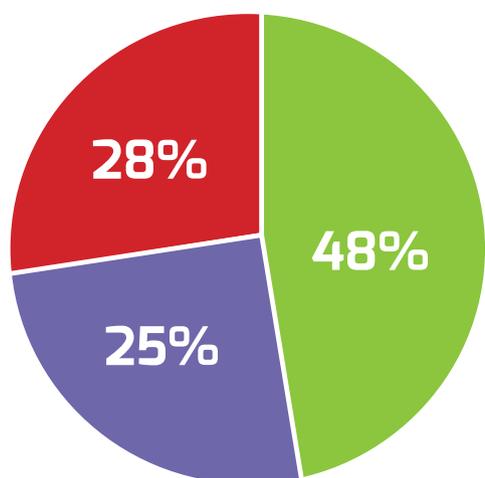
Total EU WEEE generated



Year	Home appliances	Other EEE	Total WEEE
2008	3,9 Mt	3,8 Mt	7,7 Mt
2009	4,1 Mt	4 Mt	8,1 Mt
2010	4,2 Mt	4,1 Mt	8,3 Mt
2011	4,4 Mt	4,2 Mt	8,6 Mt
2012	4,5 Mt	4,3 Mt	8,8 Mt
2013	4,7 Mt	4,3 Mt	9 Mt
2014	4,8 Mt	4,4 Mt	9,2 Mt
2015	4,9 Mt	4,5 Mt	9,4 Mt
2016	5 Mt	4,5 Mt	9,5 Mt

Source: UNU-VIE SCYCLE calculations.

EU home appliances WEEE per category



Year	Large home appliances (Mt)	Small home appliances (Mt)	Cooling & freezing (Mt)
2008	1,8 Mt	1,1 Mt	0,97 Mt
2009	1,9 Mt	1,1 Mt	1,1 Mt
2010	2,0 Mt	1,2 Mt	1 Mt
2011	2,1 Mt	1,2 Mt	1,1 Mt
2012	2,1 Mt	1,3 Mt	1,1 Mt
2013	2,2 Mt	1,3 Mt	1,2 Mt
2014	2,3 Mt	1,3 Mt	1,2 Mt
2015	2,3 Mt	1,4 Mt	1,2 Mt
2016	2,4 Mt	1,4 Mt	1,2 Mt

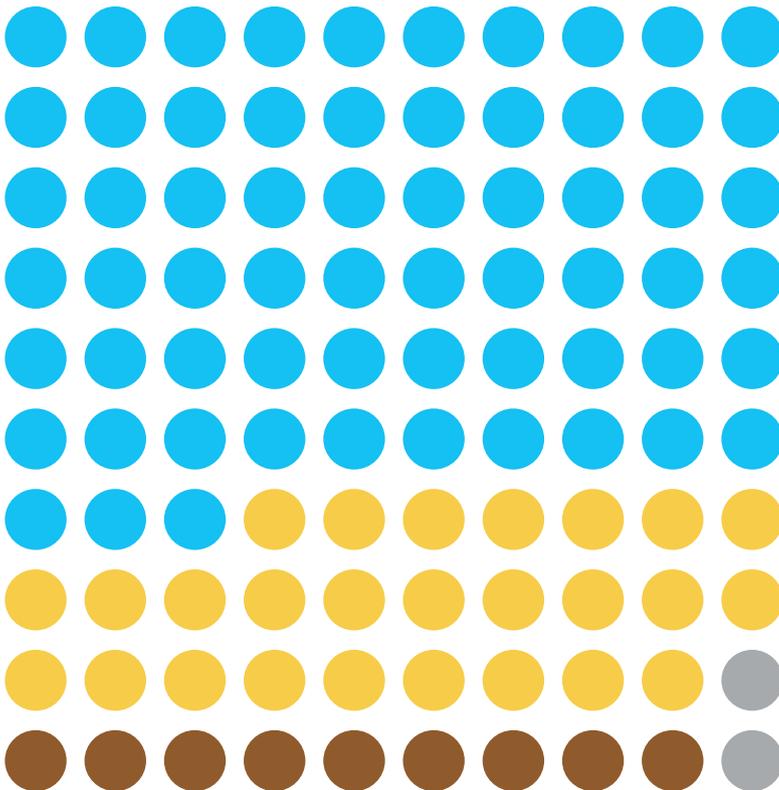
Source: UNU-VIE SCYCLE calculations.

Packaging waste

Production and consumption of home appliances is also generating waste from packaging, mainly in the distribution phase.

The majority of packaging material is paper and cardboard

(including user manuals), accounting for 63%, plastics (26%) and wood (9%) which is mainly used for larger and heavier appliances, are the other main materials used



Paper:
63%



Plastics:
26%



Wood:
9%



Other packaging:
2%



Source: UNU-VIE SCYCLE calculations.

The total weight of packaging placed on the market
with home appliances corresponds to
almost 0,8 Mt per year



The weight of packaging expressed as a percentage of the appliance's weight varies much from small to large appliances.

	Large home appliances	Small home appliances	Cooling & freezing	 Washing machine	 Vacuum cleaner
Total Packaging Waste (Mt)	0,16	0,53	0,1		
Average packaging share relative to equipment					
Packaging waste (t)/Placed on the market (t)	5,0%	38,1%	6,4%	2,3%¹	10,4%²
Packaging waste (kg)/ Placed on the market (unit)	1,39	0,61	2,37	1,61	0,61

¹EuP Preparatory study (table 4-5).

²EuP Preparatory study.

EU home appliances packaging represents
less than 1% of total
packaging waste generated in the EU

0,96% of EU packaging waste is home appliance packaging



1,5%
of paper



1,3%
of plastics



0,56%
of wood



0,08%
of other packaging

Battery waste

In some cases, particularly for small home appliances, portable batteries are also included in the products and thus in the waste generated.



Total amount of portable batteries placed on the EU market in 2015, the share of small appliances was equal to 18%

When considering batteries in other EEE (16%) the electronic sector is responsible for

35% of the total weight of portable batteries placed on the market



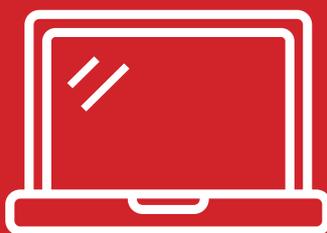
■ EEE batteries
■ Other batteries

Batteries placed on the EU market in 2015



Batteries in
home appliances

0,04 Mt



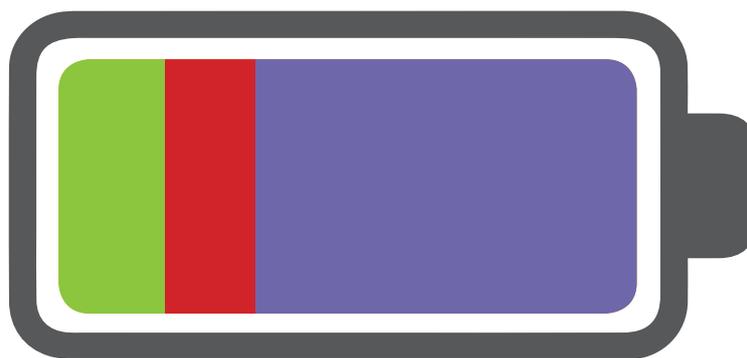
Batteries in
other EEE

0,03 Mt



Other portable
batteries

0,14 Mt



18% 16% 66%

Source: UNU-VIE SCYCLE calculations.

HOME APPLIANCE WEEE MANAGEMENT

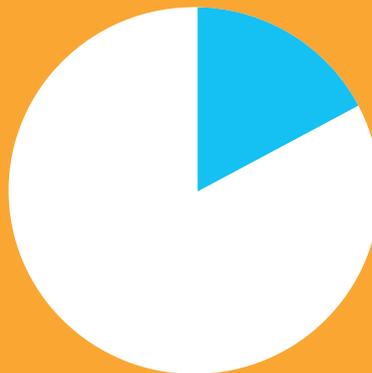
There are three main elements that play a crucial role when analysing the current situation and patterns for home appliance end-of-life management across the EU:

- Consumer behaviour
- WEEE flows
- Recycling and recovery of home appliance WEEE

Consumer behaviour

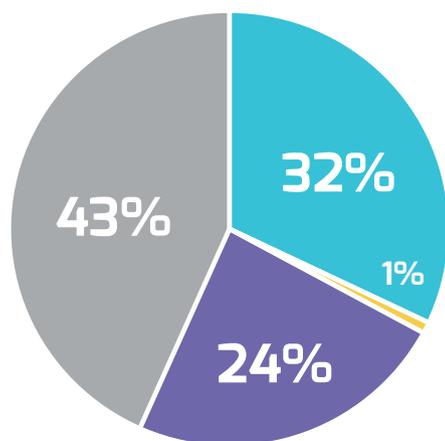
Consumer behaviour in different member states influences the share of products that are ending up in the waste bin and thus in the unsorted municipal waste

This is particularly the case for **small home appliances** where the percentage of products disposed as unsorted municipal waste **averages at 17%**

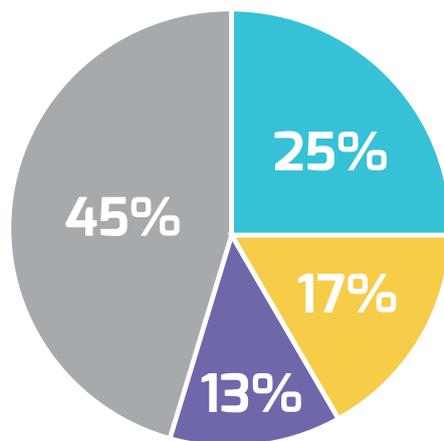


EU home appliance WEEE flows

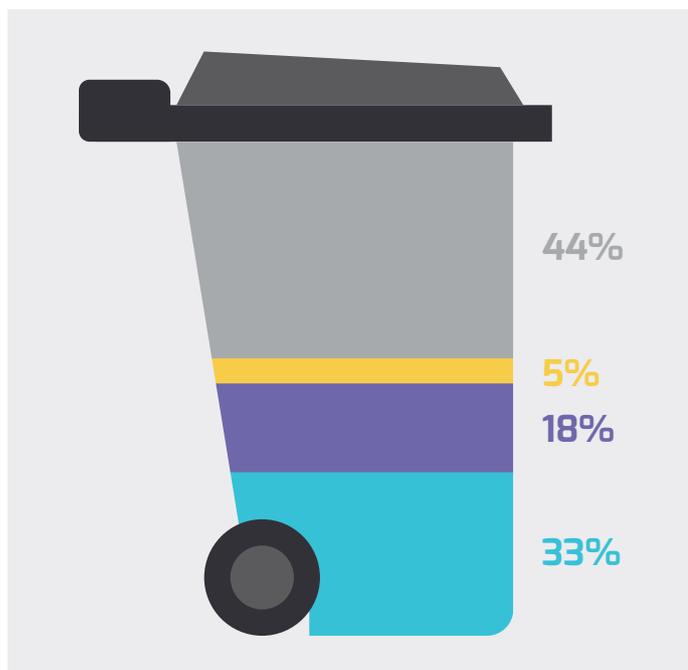
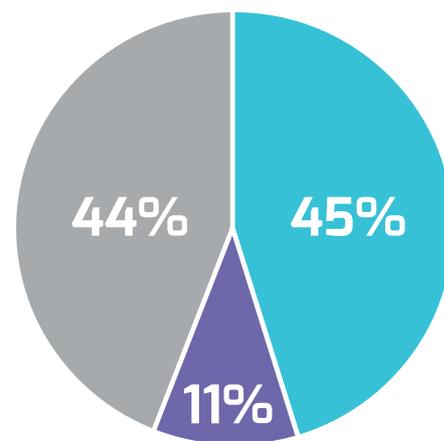
Large home appliances



Small home appliances



Cooling & Freezing



■ Collected
 ■ Complementary
 ■ Waste bin
 ■ Gap

It is estimated that 33% of EU home appliance WEEE generated is collected by industry, a complementary stream of 18% is collected by commercial actors outside industry flows and an estimated 5% end up in the waste bin. This leaves a gap of 44% for which the handling is not documented. There are indications that these gap flows are combined with the treatment of other metal scrap flows.

The reason for this knowledge gap is the lack of data reported to competent authorities, which does not allow the assessment of the real collection and recycling performances of each individual Member State. This data should take into account, not only the amounts collected and treated by industry, but also the amount handled by other commercial operators.

Interestingly, some Member States have started to actively investigate and assess the volumes of all WEEE flows, particularly the complementary streams compared to the quantities handled directly by industry.

In a recent study commissioned by the UK Department of Business, Innovation and Skills (BIS) for the UK EEE flows¹, **273 thousand tonnes** of home appliances were found to be treated as metal scrap and **78 thousand tonnes** diverted from municipal collection points.

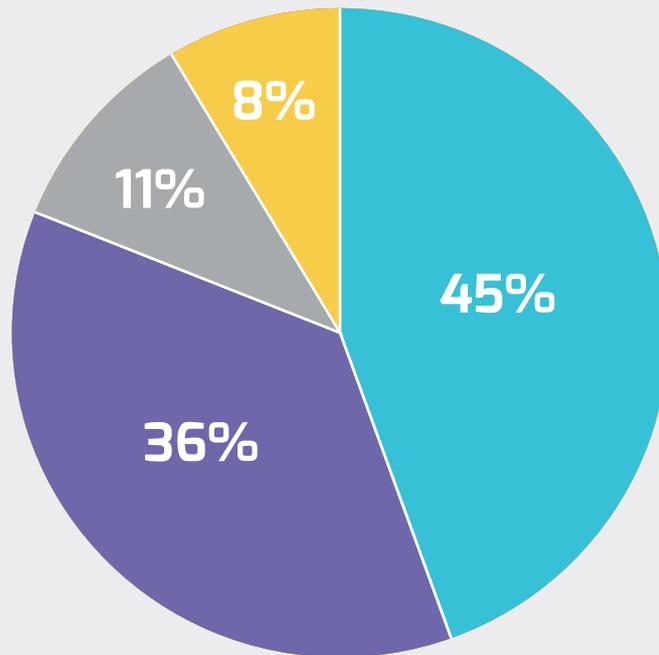
This means that out of the estimated home appliance WEEE generated in the UK: **45% was taken care of by industry, 36% by complementary flows of commercial operators, 10% was diverted from the municipal collection points and 9% was disposed in the waste bin**, mainly small home appliances.

The example of the UK demonstrates that the potential for recovery of materials contained in home appliances is almost fully exploited and accounted for.

¹UK EEE Flows 2016. Quantification of the volume of electrical and electronic equipment placed on the market (POM) and associated waste produced (WEEE) in the UK. Study commissioned by UK Department of Business, Innovation and Skills (BIS) in March 2016 and carried out by WRAP (The Waste and Resources Action Programme) and Valpak Consulting.
<http://www.wrap.org.uk/content/weee-flows-report>

753 Kt

TOTAL HOME APPLIANCE WEEE GENERATED IN UK



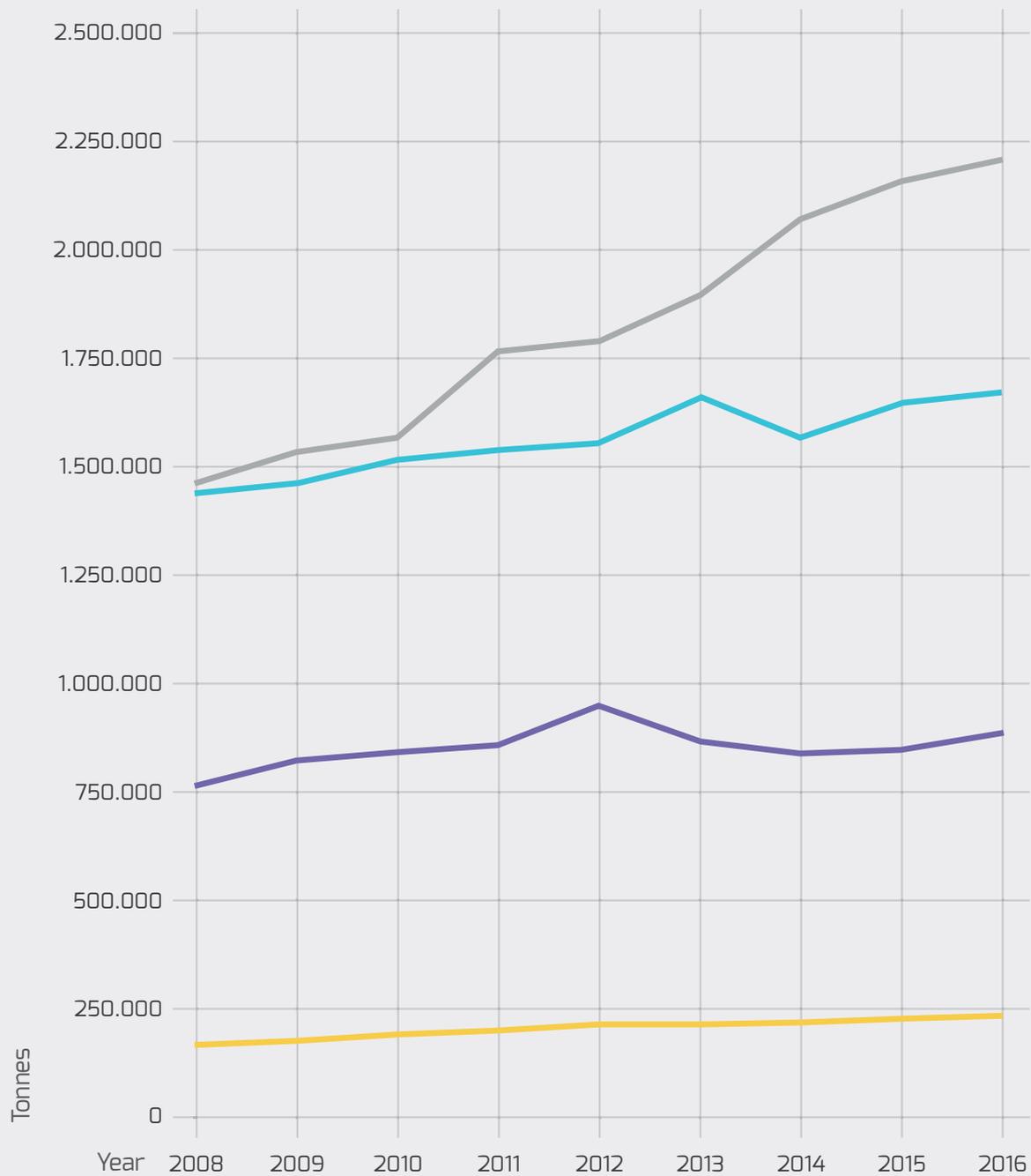
Material	Flows	%
Collected	336 Kt	45%
Complementary	273 Kt	36%
Waste bin	57 Kt	8%
Gap	87 Kt	11%

¹UK EEE Flows 2016. Quantification of the volume of electrical and electronic equipment placed on the market (POM) and associated waste produced (WEEE) in the UK. Study commissioned by UK Department of Business, Innovation and Skills (BIS) in March 2016 and carried out by WRAP (The Waste and Resources Action Programme) and Valpak Consulting.
<http://www.wrap.org.uk/content/weee-flows-report>

EU WEEE flows (Mt)

	COLLECTED	COMPLEMENTARY	WASTE BIN	GAP
2008	1,4 Mt	0,76 Mt	0,21 Mt	1,5 Mt
2009	1,5 Mt	0,80 Mt	0,22 Mt	1,5 Mt
2010	1,5 Mt	0,82 Mt	0,23 Mt	1,6 Mt
2011	1,6 Mt	0,83 Mt	0,23 Mt	1,8 Mt
2012	1,6 Mt	0,90 Mt	0,23 Mt	1,8 Mt
2013	1,7 Mt	0,86 Mt	0,23 Mt	1,9 Mt
2014	1,6 Mt	0,83 Mt	0,23 Mt	2,1 Mt
2015	1,6 Mt	0,86 Mt	0,24 Mt	2,2 Mt
2016	1,7 Mt	0,88 Mt	0,25 Mt	2,2 Mt

EU WEEE flows (t)



Collected Complementary Waste bin Gap

Source: UNU-VIE SCYCLE calculations.

Share of products that are collected and recycled

Home appliance material composition is the main driver for the treatment and recovery of products at the end of life. **The intrinsic economic value of materials has been a trigger for recycling long before the formal WEEE take back schemes were set up by industry as part of their compliance with the WEEE Directive producer responsibility requirements.** Nowadays, the market dynamics of commodity prices play a fundamental role in how home appliances are collected and treated. That is one of the main reasons why a high share of large “metal dominated” home appliances are collected and recycled by commercial operators outside of the formal industry channels.

For large home appliances,

steel is the the predominant material. In terms of weight, 66% of the material is recovered. In terms of economic contribution, 59% is recovered. Concrete is representing 21% of the total mass recovered but represents a net cost.

Small home appliances

are highly influenced by the product mix in the waste stream which is the most heterogeneous one out of those categorised by the WEEE Directive. For small home appliances, the presence and quality of electronics (with printed circuit boards representing the highest value) and the presence of plastics containing brominated flame retardants influences the economic output. Electronics can generate an income, while brominated flame retardants treated in environmentally sound way, generate a cost.

For cooling and freezing appliances,

steel and non-ferrous metals are major contributors to the total amount of materials recovered. Plastics are also relevant, particularly in comparison with other WEEE plastics, due to the absence of flame retardants, which result in higher market values. On the other hand, treatment processes for cooling and freezing appliances are more complex and costly compared to treatment of other large and small home appliances. Proper disposal of ozone depleting substances and oil, as well as polyurethane foam, represent substantial recycling costs.

Materials recovered from home appliance WEEE collected by industry

Large home appliances

Aluminium	0,01 Mt	1,4%
Concrete	0,15 Mt	21%
Copper	0,01 Mt	1,9%
Glass	0,01 Mt	1%
Plastics	0,05 Mt	7%
Steel	0,46 Mt	66,3%
Other	0,01 Mt	1,3%
Material to Energy Recovery	0,002 Mt	0,1%



Small home appliances

Aluminium	0,01 Mt	4,4%
Copper	0,02 Mt	4,8%
Glass	-	-
Plastics	0,11 Mt	33,1%
Steel	0,17 Mt	49,9%
Other	0,01 Mt	3,2%
Material to Energy Recovery	0,02 Mt	4,7%



Cooling & Freezing

Aluminium	0,02 Mt	3,3%
Copper	0,01 Mt	2,2%
Glass	0,01 Mt	1,3%
Plastics	0,08 Mt	15,5%
Polyurethane Foam	0,01 Mt	1,5%
Steel	0,34 Mt	63,4%
Other	0,01 Mt	1,2%
Material to Energy Recovery	0,06 Mt	11,7%



Note: Composition of output flow of WEEE recovery according to industry take back scheme, based on real performance of recyclers. Assumption of 1,7Mt collected by industry across EU.

Compliance with the WEEE Directive also represents a cost for the home appliance industry

While treatment costs evolved over time and for some streams are currently positive, they depend on:

- Commodity prices
- Progressive improvement of processes, and
- Economies of scales

The collection and transport operations for WEEE still represent a major cost. In addition there are costs borne by industry take back schemes to carry out audits and voluntary standards. Considering all the WEEE collected and treated, the total cost of compliance for the home appliance industry from 2008 to 2016 totals:

Producer compliance costs for WEEE



More than

**€1 billion for 4,4 Mt of waste
cooling and freezing appliances**

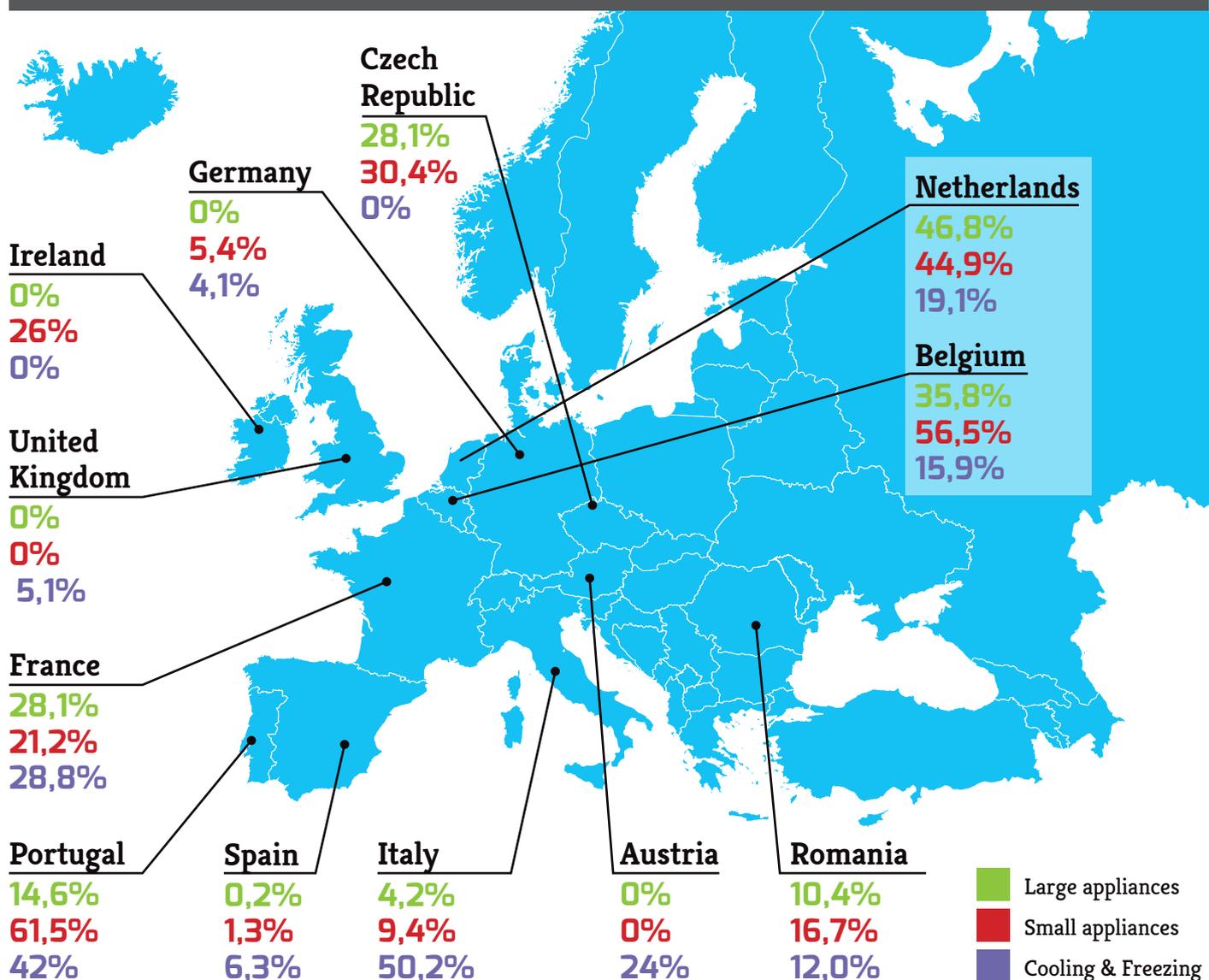
**€185 million for 6,7 Mt
of waste large home appliances,**
principally mitigated by the revenues from treatment in recent years

**€163 million for 3,1 Mt
of waste small home appliances,**
principally mitigated by the revenues from treatment in recent years

Industry also has a proactive role in developing voluntary standards and in advocating for their adoption and implementation across EU Member States, including the recent EU CENELEC EN-50625 standard¹.

In addition to the development of standards, it is critical to ensure a wide adoption and enforcement. WEEELABEX² - which can nowadays provide a good proxy of the future implementation of EN 50625 series, and its roll-out across EU gives an idea of the current situation. Considering the current status of adoption and the average treatment capacity of recycling plants the following "WEEELABEX Certified" treatment capacity across Europe can be estimated. When considering the WEEE Generated, the need of wider adoption of standards is clearly evident.

Coverage of WEEELABEX facilities in December 2016 on total WEEE Generated



¹http://ec.europa.eu/environment/waste/weee/standards_en.htm

²<http://www.weeelabex.org/standards/>

06

The Overall Circularity of Materials

Extrapolating the findings of the recent analysis carried out in UK, a minimum of 80% of home appliances generated as waste could be estimated as collected across EU. In 2016, home appliances waste generation is estimated at 5 Mt, which equals nearly 4 Mt of materials being collected across the EU.

However, the degree of material recovery is only known for part of this total, the 1,7 Mt being officially reported and handled by industry.

These estimations reinforce other studies and survey finding that only one third of home appliance waste generated is officially collected by industry, 34%, and managed in an environmentally sound way.

Assuming that the 46% of home appliance waste collected by complementary commercial actors would be treated according to same standards as waste managed by industry, the total material recovery from the 4 Mt of EU home appliance waste would be 3,1 Mt.



5 Mt

estimated amount of household appliance waste generated in all of EU

Extrapolating UK data:
80%
of waste generated is collected

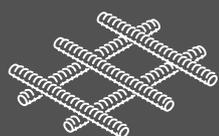


4 Mt of home appliance
waste estimated as collected
across EU

1,7 Mt
of home appliances handled
by industry as reported to
authorities

2,3 Mt
estimated as collected by other
commercial actors (exact degree
of recovery not known)

Considering 2016 as the reference year and the 1,7 Mt of home appliances handled by the industry as waste¹:



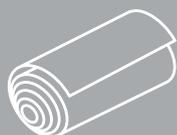
0,97 Mt of Steel has been recovered



0,24 Mt of Plastics has been recovered



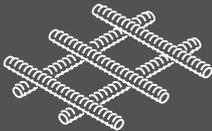
0,04 Mt of Copper has been recovered



0,04 Mt of Aluminium has been recovered

¹See page 85.

For approximately 2,3 Mt, it is not know the degree of recovery or the quality of the treatment. This amount of waste should contain the following amount of recoverable materials, if they were to be treated to the same standard as by the industry¹:



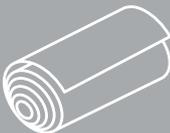
1,3 Mt of Steel



0,37 Mt of Plastics



0,06 Mt of Copper



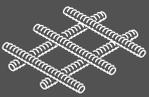
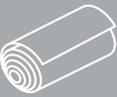
0,06 Mt of Aluminium

Actual recovery performances of streams handled by other economic operators is mainly driven by market dynamics and the price of raw materials, particularly metals, which are historically the main driver behind the collection of home appliances by the metal recovery industry.

While the recovery percentage of main metals might be high, it is unlikely that for other minor metals or materials, the effectiveness of recovery processes is the same.

¹Output flows composition of page 85 applied to complementary flows.

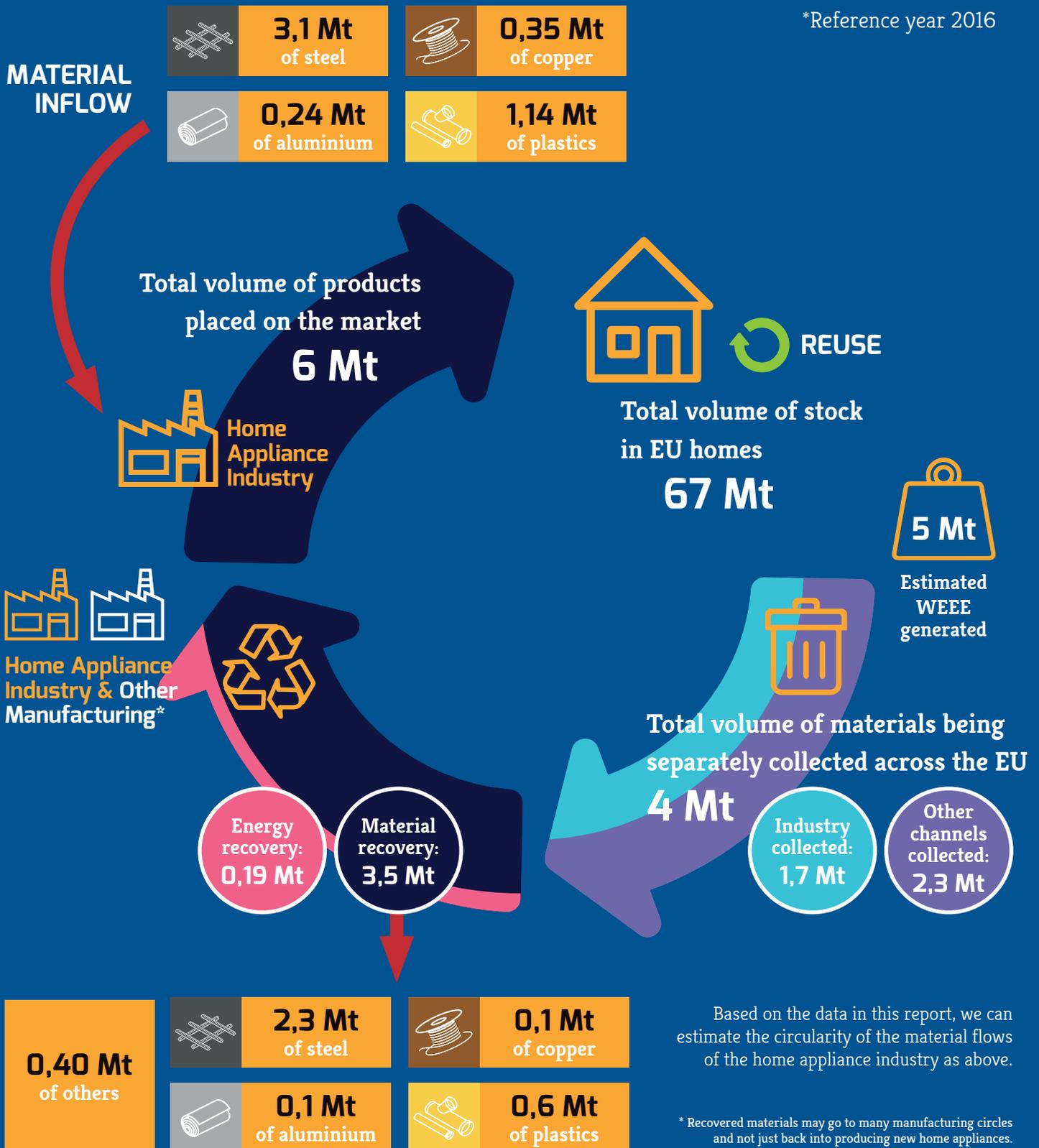
Material recovered

	Recovered from industry flows (Mt)	Recovered from complementary flows (Mt) ¹	Total recovery industry + complementary
Total Recovery	1,6	2,1	3,7
Energy Recovery	0,08	0,11	0,2
Material recovered without energy recovery	1,5	2,0	3,5
 Metal scrap	0,97	1,3	2,3
 Pipes	0,24	0,37	0,61
 Coil	0,04	0,06	0,10
 Roll	0,04	0,06	0,10
Others	0,21	0,21	0,40

¹Recovered from complementary flows (2,3Mt) assuming output flows composition of page 85 for industry flows.

The circularity of the materials flows of the home appliance industry

*Reference year 2016



07

The Future Outlook &
Recommendations

07

The Future
Outlook &
Recommendations

The data and elements presented suggest the following considerations and **call for action:**

Appliances = Saving



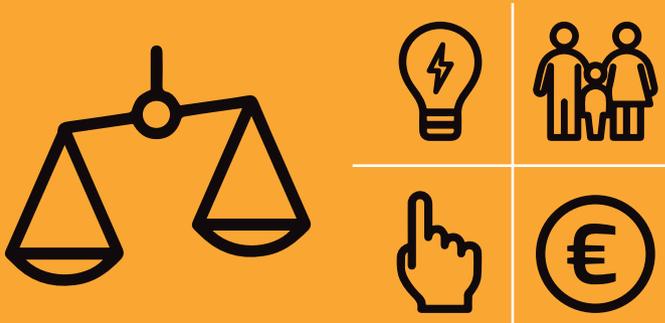
Appliances are a crucial part of societal resource efficiency, saving time, money, energy, water and preventing waste.

Circular Material Flows



The home appliance industry contributes to circularity by providing secondary raw materials back into many manufacturing material flows. Materials recovered from the home appliance industry are used not only in producing some new home appliances, but also in other products, sectors and industries.

Balanced Approach



In striving for a circular economy, there needs to be a balanced approach - taking into account the balance of not only material efficiency but also of improving energy efficiency, citizen welfare, consumer choice and affordability.

While large appliances are recycled to a very high degree, there is still room for improvement in the recycling of smaller appliances. In particular, improvements in collection and sorting of smaller appliances are needed for higher recycling rates.

Improvement in the collection and recycling of smaller appliances



While collection systems can be improved, consumers have an important role in ensuring that small appliances reach the collection points and are not disposed with unsorted municipal solid waste.

Consumers have an important role



While industry-driven recycling schemes do collect substantial amounts of WEEE (14,1 Mt from 2006 to date), even larger amounts are handled outside the schemes, particularly for large home appliances and metal-dominated products. It is recommended to carry out an EU-wide study to identify the fate of flows not handled by Industry.

Identify the fate of flows not handled by Industry



Value chain cooperation



Achieving the new collection targets set for 2019 and onwards will only be possible when all quantities of e-waste handled by other economic operators are identified and accounted for and the proper disposal by the consumer is tackled.

Harmonisation and enforcement of treatment standards for WEEE across EU



The importance of enforcement particularly in regard of treatment operations. This should help ensure market dynamics are not diverting flows from the formal system towards substandard treatments (lower de-pollution) or illegal activities. This can be done when Member States adopt a fair and consistent requirement of mandatory compliance to the EN-50625 Series for all WEEE treatment facilities in the EU.



#CircularSociety
CECED initiative

Made also at home By you, by us

The aim to reduce waste and ensure a full circularity of the economy goes beyond what economic actors alone can do: it embraces all our society and is a societal challenge.

CECED has, in recent times, been examining how best it can contribute to the further development of Europe's circular economy, a stated aim of European Union policy makers. It believes that the success of a circular economy is best secured if all societal actors are brought in to make their contribution. In essence, the aims of reducing waste and ensuring full circularity of the economy goes beyond what economic actors can do alone. It is a societal challenge.

CECED launched on 27 September 2017 its #CircularSociety initiative to support its vision.

It can be viewed at www.circularsociety.eu

CECED Director-General Paolo Falcioni:

“I believe that the transition towards a Circular Society has the potential to become Europe's asset for growth. Are you with us?”

Tell us about your initiative at: contact@circularsociety.eu



European Committee of Domestic Equipment Manufacturers

Boulevard Brand Whitlock 114, 7th floor
1200 Brussels, Belgium

www.ceced.eu
secretariat@ceced.eu

[@CECED_Europe](https://twitter.com/CECED_Europe)

EU transparency register number:
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