RSVP
ReuSe Vanguard Project

# Deciphering the EU's packaging landscape for warm takeaway drinks

Quantification of environmental aspects for the packaging of warm takeaway drinks for the Netherlands, Belgium, Germany, France, Spain and EU28 through iterative collaborative research

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**About the report**

This report is part of a broader study commissioned by Zero Waste Europe to Recycling Netwerk Benelux (RNB), as part of a European project – called the ReuSe Vanguard Project (RSVP) – which includes stakeholders from 5 European countries, namely Belgium, The Netherlands, Germany, Spain and France.

With the broader study, we aim to highlight the findings related to the concrete packaging sectors that present the biggest potential in terms of their environmental impacts as well as the feasibility of replacing single-use with reusable packaging in the coming years. This dedicated report provides more detailed results of the first part, which relates to warm takeaway drinks and related packaging.

*Part of a study produced by José Potting (ed.), Bram Honig (Recycling Netwerk Benelux) & Jason Wilcox (Reloop) (Utrecht, February 2022) for Zero Waste Europe.*

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## Project partners

## Funding

# Summary

In the spring of 2021, Zero Waste Europe (ZWE) started the ReuSe Vanguard Project (RSVP). The goal of RSVP is for “Reusable solutions for packaging for beverages, takeaway drinks, and food as well as online delivery to get to scale in Europe and become the new normal in the sectors selected”. An essential part of RSVP is to “Map the packaging landscape in Europe and detect the Ecosystemic Leverage Points (ELPs)” through an iterative collaborative research. ZWE tasked Recycling Netwerk Benelux (RNB) to take the lead in this iterative collaborative research. The other collaborators, besides ZWE (Belgium) and RNB (the Netherlands), were RSVP’s core stakeholders ECOS (Europe), ENVIU (the Netherlands), Deutsche Umwelthilfe (Germany), Reloop (global), Retorna (Spain), Rezero (Spain), and Zero Waste France (France).

The iterative collaborative research was performed in two parts. The first part quantified 20 products in terms of the type and weight of their packaging, the amount of resources (raw materials) needed to produce this packaging, and the quantities and types of waste and environmental pressures associated with this. The second part qualitatively assessed the possibilities for shifting from disposable to reusable packaging (or none) for seven products identified from the 20 products covered in the first part.

This report provides the results of the first part for disposable paper and polystyrene cups and disposable polystyrene lids for warm takeaway drinks. The number of used disposable cups for warm takeaway drinks has been identified for the Netherlands, Belgium, Germany, France, Spain and the present European Union & United Kingdom as now former member state (i.e. EU28). Subsequently, the numbers of used disposable cups used for warm takeaway drinks in these countries have been combined with data for the weights and material composition by cup types and lids used in Germany. Next the contributions to the related energy uses and environmental impacts has been calculated..

EU28's use of disposable polystyrene cups and disposable polystyrene lids for warm takeaway drinks account for 1,8% of EU28's total demand of polystyrene. The low density polyethylene lining of the disposable paper cups for warm takeaway drinks used by EU28 accounts for less than 0,1% of EU28's total demand of low density polyethylene (PlasticsEurope (2020). The paper in EU28's disposable paper cup use makes up around 0,15% of total paper and board use in Europe minus the Russian federation CEPI (2020).

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# 1. Introduction

In spring 2021, Zero Waste Europe (ZWE) started the ReuSe Vanguard Project (RSVP). The goal of RSVP is "Reusable solutions for packaging for beverages, takeaway drinks and food, as well as online delivery to get to scale in Europe and become the new normal in the sectors selected". RSVP consists of two phases. Phase 1 will identify necessary logistic, legislative, media and economic conditions resulting in plans to successfully shift three to five product and market segments, referred to as 'Ecosystemic Leverage Points' (ELPs), from disposable to reusable packaging (or none). The actual transitions are to take place in Phase 2.

An essential part of Phase 1 is to "Map the packaging landscape in Europe and detect the potential ELPs" through an iterative collaborative research. ZWE tasked Recycling Netwerk Benelux (RNB) to take the lead in this iterative collaborative research. The other collaborators, besides ZWE (Belgium) and RNB (the Netherlands), were RSVP's core stakeholders. These core stakeholders were ECOS (Europe), ENVIU (the Netherlands), Deutsche Umwelthilfe (Germany), Reloop (global), Retorna (Spain), Rezero (Spain), & Zero Waste France (France).

There is a large number and wide range of products on the market, and many of these products are sold in different types of packaging. One example is warm takeaway drinks in disposable polystyrene or paper cups, often covered with disposable polystyrene lids. It would have been impossible to decipher in depth the whole packaging landscape for each product on the market. The iterative collaborative research therefore took a funnel approach to arrive at the five products qualifying as ELPs for which plans to shift their packaging from disposable to reusable (or avoided) ones are to be developed. The focus in the iterative collaborative research was on disposable packaging.

The funnel approach started from all products and narrowed them down in eight steps to the final five products qualifying as ELPs. The first five steps

made up the first part, and the next three steps constituted the second part of the iterative collaborative research. The funnelling steps were at the beginning of each part, and concluded the second part. The approach for the first part took the following steps:

1. Selecting 20 products in order to quantify their disposable packagings
2. Quantifying the consumption of the selected products
3. Quantifying their disposable packaging and the materials from which these are made
4. Quantifying the environmental pressures for producing the packaging materials
5. Identifying the rates of waste recycling and littering of the empty packaging

The second part of the iterative collaborative research has qualitatively assessed the prospects for shifting from disposable to reusable packaging (or none) for seven products identified as potential ELPs from the 20 products covered in the first part. One of these products was warm takeaway drinks. This report provides the results for the first part for disposable cups used for warm takeaway drinks.

The body of the report starts with a description of the product to be packed, here warm takeaway drinks falling under food and catering services, then explores the number of warm drinks in disposable cups in the selected countries and EU28, before going into quantifying the disposable cups. The report closes with some main conclusions.

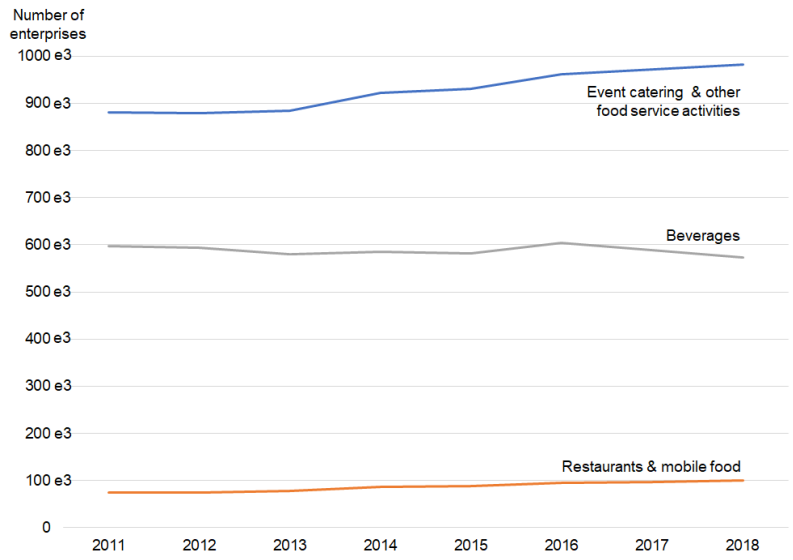
The quantification uses the newest available data which is from before the disruptive Covid-19 pandemic emerged.

# 2. Results and discussion

## 2.1 Food and beverage service activities

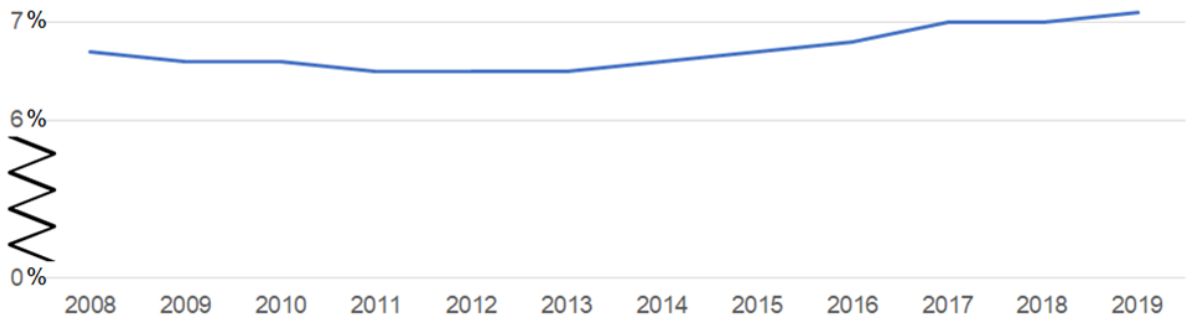
Food and beverage service activities is a container term for service activities providing meals, snacks, drinks and refreshments for onsite or off the premises consumption (i.e. for takeaway). Eurostat's enterprise-statistics splits food and beverage service activities into beverage service activities, restaurants and mobile food services activities, and catering and other food service activities (together spanning up food and beverage service activities). Over the last decade, EU28 shows an increase in the number of enterprises for restaurant and mobile food and event catering and other food service activities, and a slight decline in the number of enterprises for beverage service activities (see figure 1) (Eurostat, 2022a).

Figure 1: Number of enterprises in beverages, restaurants and mobile food, and event catering and other food service activities in EU28 (Eurostat, 2022a)



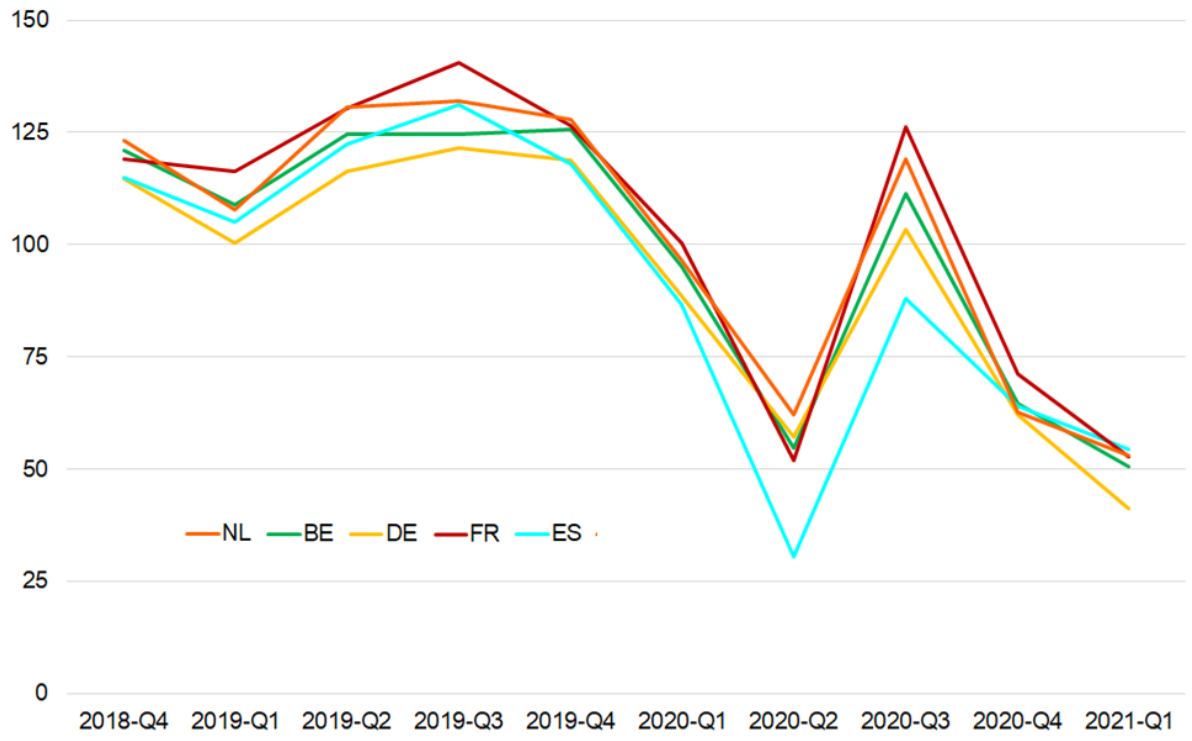
In line with the overall increase of enterprises for food and beverage service activities, household expenditures on catering services in the EU28 also increased between 2008 and 2019 (see figure 2). Household expenditures on catering services in 2019 were 7.1% of total household expenditures on average, with a minimum of 3.0% for Poland and a maximum of 13.3% for Spain. It should be noted that a household according to the Eurostat-statistics consists of two or more persons sharing a common accommodation or address (i.e. they exclude one-persons households) (Eurostat, 2020; Eurostat, 2022b).

Figure 2: Expenditures on catering services of EU28-countries from 2010 to 2019 as percentage of total expenditures (Eurostat, 2022b)




Eurostat (2022b) does not yet provide data about household expenditures on catering services for 2020 onwards, and neither does Eurostat (2022a) for the number of enterprises with food and beverage service activities. However, food and beverage service activities worldwide and also in Europe largely went down when the Covid19-pandemic fiercely hit the world around March 2020. In Europe this initially caused a sharp decline in the total turnover of food and beverage service activities due to the lock-downs in most European countries (see figure 3). There was a fairly good recovery during late spring and early summer when infection rates were low as a result of which lockdowns were relieved. This situation unfortunately turned around again when lock-downs needed to be reinstalled after the Covid 19-infections surged again in late summer (Eurostat, 2022c).

Figure 3: Total turnover for food and beverage service activities in the Netherlands (NL), Belgium (BE), Germany (DE), France (FR) and Spain (ES) from the last quarter in 2018 up to, and including the first quarter in 2021 (2015 = 100; no seasonal adjustment) (Eurostat, 2022c)

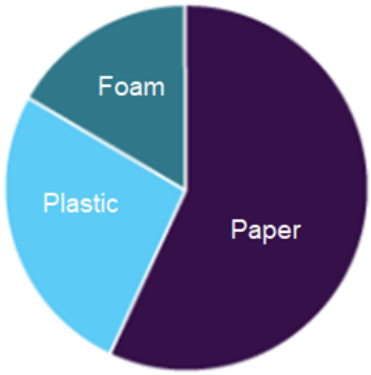



## 2.2 Disposable cups for warm takeaway drinks

Providing warm takeaway drinks is obviously part of beverage service activities, but these service activities are not separately covered by Eurostat's enterprise statistics (Eurostat, 2022a), and neither is the use of disposable cups as typically used in providing warm takeaway drinks. There is little market-information available about disposable cups, and information available for the European use of disposable cups is to some extent contradictory.

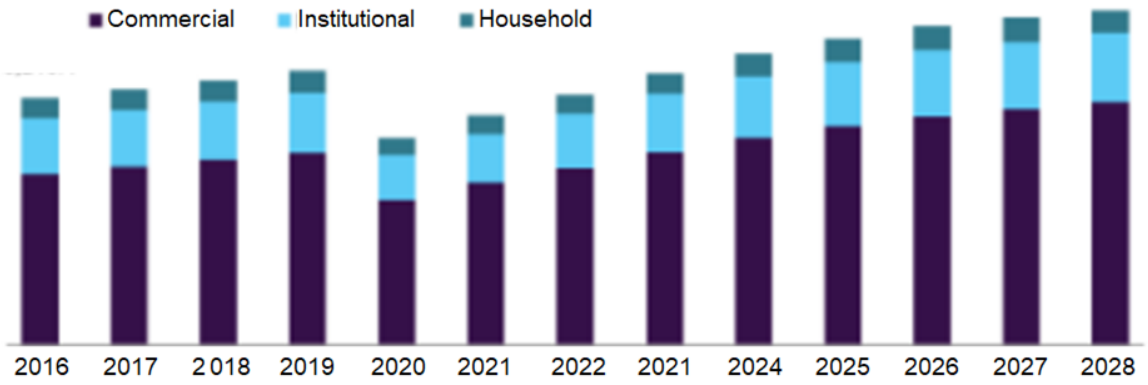
For market-information outside Europe only one source was identified and used, i.e. Grand View Research (2021). According to Grand View Research (2021), the global market size value for disposable cups for cold and hot drinks would be 11.9 mjd $ in 2020, and the larger part of this market would be taken by paper cups (see figure 4 ). Statista (2022) mentions a market value of 15.03 mjd $ in 2020, but this seems to be a forecast as the publication itself stems from 2020.

Figure 4: Distribution of the global market size value for disposable cups according to cup-material in 2020 (Grand View Research, 2021)



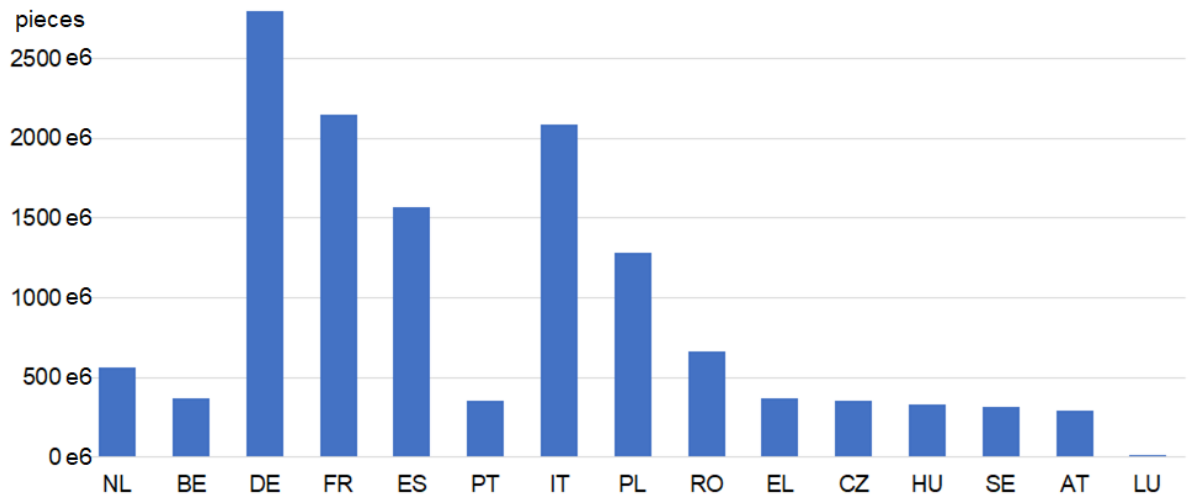

Grand View Research (2021) also provides a time series with the distribution of the disposable cup market value according to end-use for the United States (figure 5). The United States culture differs in many respects from the European. It seems not common in Europe  to use disposable cups at home. Although the household-part in figure 5 thus seems not to reflect European conditions, the distribution between commercial and institutional use of disposable cups might give some indication about the European market.

Figure 5: Distribution of the market size value for disposable cups in the United State according to their commercial institution or household end-use (Grand View Research, 2021)




Statista (2019) provides data about the number of disposable cups for warm takeaway drinks used in a couple of European countries in 2015 (see figure 6; no additional information was found for the other European countries). The data from Statista (2019) show a considerable difference between the included countries, but so does the number of inhabitants for each country in 2015 (Eurostat, 2022d). The number of used disposable cups per capita lies between 32 and 34 cups for all countries except Luxembourg. Luxembourg stands out with only 20 disposable cups per capita.
The similarity of the per capita number of disposable cups for warm takeaway drinks across European countries gives confidence in the data from Statista (2019). Kauertz et al. (2019) also reports 2,800 mln disposable cups for warm take-ways drinks used in Germany. The data from Statista (2019) for the Netherlands, however, are fiercely contradicted by the Dutch data from Schep (2020a) and Schep (2020b).

Figure 6: Use of disposable cups for warm drinks in the Netherlands (NL), Belgium (BE), Germany (DE), France (FR), SPain (SP), Portugal (PT), Italy (IT), Poland (PL), Romania (RO), Greece (EL), Switzerland (CH), Hungary (HU), Sweden (SE), Austria (AT) and Luxembourg in 2015 (Statista, 2019)




The Dutch use of disposable cups, according to Statista (2019), would be 561 mln cups. Schep (2020a) and Schep (2020b) come with a more than 5 times larger number, i.e. 3,000 mln disposable cups (i.e. 178 disposable cups per capita), for which Schep (2020a) cites the Dutch political Party for the Animals (PvdD, 2018). The Party for the Animals does not substantiate this number. Schep (2020a) additionally cites from the Dutch Railways (NS, 2019) that annually 30 mln disposable cups for warm drinks are used at Dutch train stations. Schep (2020a) furthermore estimates, based on partly not (anymore?) available primary sources, that another 39 mln warm drinks would be bought at gasoline stations. These cups for warm drinks at train and gasoline stations are primarily made up of paper lined with polyethylene (PE) at the inside to prevent permeation of the warm drinks to the outside of the cup (Schep, 2020a; expert knowledge of the author). Disposable cups for warm drinks bought at train and gasoline stations together make up 2,3% of the 3,000 mln mentioned by Schep (2020a) and Schep (2020b). Schep (2020a) assumes, similar as the cited SSG Search, 2019) (not publically available), that

the remainder would be used in vending machines[1] in schools, companies and hospitals. The later research of Schep (2020b) adds some information to Schep (2020a):

1. The first additional information concerns 110 mln paper cups for warm drinks, 85 mln lined with biodegradable poly lactic acid (PLA) and 25 mln lined with polyethylene (PE), used in central governmental offices (based on Pointer (2020)). This together with the 69 mln cups used at train and gasoline stations, makes up 179 mln or almost 6% of the 3,000 mln disposable cups mentioned by Schep (2020a) and Schep (2020b). Schep (2020b) follows Schep (2020a) who follows SSG Search, 2019) (not publically available) that the remaining 94% would be used in vending machines in schools, companies and hospitals etc. This fiercely contradicts the situation in the United States (figure 5), where the majority of disposable cups is used for commercial purposes (thus not institutional uses like in schools, offices and hospitals). There is no reason to assume that the Dutch situation is that radically different from the one in the United States.

2. The second additional information provided by Schep (2020b), based on a primary source cited in a journal-article of Smeets (2019) that refused to confirm the data to Schep (2020b), is that some 500 mln disposable plastic cups would be used annually in the Netherlands. According to Schep (2020b), it is unclear whether those 500 mln disposable plastic cups are used for warm drinks, or for both cold and warm drinks. However, the number is nearing the 561 mln disposable cups for warm drinks as provided by Statista (2021). As already mentioned, Statista (2019) does not specify whether their date is covering both plastic and paper cups, or only one of them.

[1] 'Used in vending machines' is a verbatim translation of Schep (2020a). This 'in' suggests vending machines with automatic cup supply. In practice, however, vending machines are predominantly used in situations with peak consumption and/or where one has to pay for the coffee (like often in schools and hospitals), but not where warm drinks are for free to take (like in companies and offices).

3. A last additional information provided by Schep (2020b), taken from Sira Consulting (2020), is that the Netherlands would count roughly 29.000 fast food-restaurants, cafetaria's, ice cream shops and food stalls. This number roughly complies with the number of enterprises in the category of food and mobile food service activities in the Eurostat-statistics, but triples the more obvious category of beverage serving activities under the main category food and beverage service activities of Eurostat (2022a). It is not fully clear why Schep (2020b) comes up with this third additional information.

Altogether, the above informations cast doubt on the data in Schep (2020a) and Schep (2020b).The number of 3,000 mln disposable cups is also provided by Mission Reuse (MR, 2020), but they do neither substantiate this number and it looks rather like they just took over the number from Schep (2020a) or Schep (2020b) or from the message of the Dutch political Party for the Animals (PvdD, 2018).
There are also alternative numbers published for Germany by different sources, i.e. Kauertz et al. (2019), GMV (2018) and NABU (2017). GMV (2018) basically summarizes the results of NABU (2017) in a slide show. All three sources contain a quantification of the use of disposable cups for warm takeaway drinks in numbers and in tons of material used.
Based on a review of different sources (it goes too far to repeat or review details here), Kauertz et al. (2019) concluded a total use of 2,800 mln disposable cups for warm drinks. This total is exactly the same as provided by Statista (2019). Statista (2019) and Kauertz et al. (2019) possibly took this number from the same source, but Statista (2019) does not provide its primary data sources (not with its freely available data). However, the thorough review by Kauertz et al. (2019) supports the credibility of the data from Statista (2019). Kauertz et al. (2019) also specify the number of used disposable cups for warm drinks in Germany according to their end-uses (see table 1). Table 1 shows a roughly fifty-fifty share between institutional and commercial end-uses for warm drinks, meaning a larger share for warm drinks in an institutional

setting than figure 5 does for the United States, but a far smaller institutional share than as suggested by Schep (2020a) and Schep (2020b).
According to Kauertz et al. (2019), the disposable paper cups for warm drinks mainly have a commercial end-use, whereas the disposable polystyrene ones are mainly used with vending machines. Disposable polystyrene cups are indeed preferred in vending machines with automatic cup supply as paper cups tend to disturb the automatic cups supply. Ambient humidity causes expansion of the paper cups which hinders their automatic falling down (Potting & Van der Harst, 2015).

Table 1: The annual use of disposable cups for warm drinks according to end-use in Germany in recent years (Kauertz et al., 2019)

| Type of end-use | Cups (mln pieces |
|---|---|
| Commercial - large fast food and beverage chains - to go | 1200 |
| Commercial - bakeries, bars, gasoline-stations, supermarkets -to go | |
| Institutional (schools, hospitals, offices etc.) - vending machines | <1,300 |
| Other [1] | < 400 |
| Total [1]<br>- 200 ml single wall paper cup, 7,8 g, of which 6.5% PE-lining<br>- 200 ml single wall paper cup, 7,8 g, of which 6,5% PE-lining, & 3.2 g PS-lid<br>- 200 ml double wall paper cup, 12 g, of which 4,5% PE-lining<br>- 200 ml double wall paper cup, 12 g, of which 4,5% PE-lining, & 3.2 g PS-lid<br>- 300 ml single wall paper cup, 10,7 g, of which 6% PE-lining<br>- 300 ml single wall paper cup, 10,7 g, of which 6% PE-lining, & 3.2 g PS-lid<br>- 300 ml double wall paper cup, 18,2 g, of which 6% PE-lining<br>- 300 ml double wall paper cup, 18.2 g, of which 4% PE-lining, & 3.2 g PS-lid<br>- 180 ml polystyrene , 4,1 g<br>- 180 ml polystyrene, 4.1 g, & 3.2 g PS-lid | 2,800<br>132 -<br>309 -<br>67 -<br>157 -<br>216 -<br>504 -<br>82 -<br>192 -<br>969 -<br>171 - |

[1] This number is deduced from the numbers provided by Kauertz et al., (2019).for the total number of cups for warm drinks minus the number of cups for to go and for vending machines

[1] According to Kauertz et al., (2019), the total use of cups for warm drinks consists of 1660 mln paper (70% with lids) and 1140 plastic cups (15% with lids). The number used for each cup type is calculated by dividing the total weight per cup type divided by the weight for that cup type as both provided by Kauertz et al., (2019). PE stands for polyethylene.

According to NABU (2017) and GMV (2018), 2,86 mln disposable cups for warm takeaway drinks would be used in 2017, which is slightly higher than the number from Kauertz et al. (2019). NABU (2017) and GMV (2018) also reports the weights of used disposable cups and lids by material type, namely 18,421 ton paper and 10,244 ton unspecified plastic (probably polystyrene). This is for paper 20% lower than, and for plastics doubling the weight as reported by Kauertz et al. (2019). NABU (2017) and GMV (2018) do, unlike Kauertz et al. (2019), not provide details about the number and weight of disposable cups by volume and material type.
The next section uses the data from Statista (2019) and Kauertz et al. (2019) as their data for the number of disposable cups for warm takeaway drinks is consistent. This may mean an underestimate for Germany, given that NABU (2017) and GMV (2018) thus provide slightly higher numbers for the disposable cups used.

## 2.3 Disposable cup use and its energy uses and environmental impacts

The country-data for the number of disposable cups used for warm drinks from Statista (2019) have been adopted for the Netherlands, Belgium, Germany, France and Spain. These countries and the other ones in figure 6 account for 401 mln or 79% of the 509 mln inhabitants of the EU28 (Eurostat, 2022d). The EU28 use of disposable cups for warm drinks has been calculated by simple extrapolation on the basis of population (see table 2 and 3).

Table 2: Overview of the number of disposable paper cups for warm takeaway drinks, weight of paper and of high-density polyethylene (HD-PE) in the cups and polystyrene (PS) in the lids (for 70% of the cups), recycling and incineration percentages, and contributions to grey (non-renewable) and green (renewable) energy, global warming (GW), eutrophication (EU), land use (LU) and water use (WU) for the Netherlands (NL), Belgium (BE), France (FR), Spain (ES) and European Union (EU) in 2019 (see text above for used sources)

| Countries | NL | BE | DE | FR | ES | EU28 |
|---|---|---|---|---|---|---|
| Paper cups (mln pieces) | 333 | 219 | 1,660 | 1,275 | 928 | 10,149 |
| - Paper in cup (ton)<br>- HD-PE in cup (ton)<br>- PS in lid (ton) | 3,575<br>202<br>746 | 2,351<br>133<br>491 | 17,820<br>1,007<br>3,718 | 13,687<br>774,<br>2,856 | 9,962<br>563<br>2,079 | 108,947<br>6,158<br>22,734 |
| Grey energy (TJ) | 141.0 | 92.7 | 702.9 | 539.9 | 393.0 | 4297.7 |
| - Fossil energy | 132.6 | 87.2 | 661.0 | 507.7 | 369.5 | 4041.3 |
| - Nuclear energy | 8.3 | 5.5 | 41.5 | 31.9 | 23.2 | 253.7 |
| - Biomass | 0.1 | 0.1 | 0.5 | 0.3 | 0.3 | 2.8 |
| Green energy (TJ) | 49.2 | 32.3 | 245.2 | 188.3 | 137.1 | 1499.1 |
| - Biomass | 46.4 | 30.5 | 231.2 | 177.6 | 129.2 | 1413.3 |
| - Wind, solar, geoth. | 0.6 | 0.4 | 3.2 | 2.5 | 1.8 | 19.6 |
| - Hydro | 2.2 | 1.4 | 10.8 | 8.3 | 6.1 | 66.2 |
| GW (kton $CO_2$-eq.) | 8.9 | 5.8 | 44.2 | 33.9 | 24.7 | 270.1 |
| EU (kton $PO_4$-eq.) | 0.0 | 0.0 | 0.1 | 0.1 | 0.0 | 0.5 |
| LU (mln $m^2$a crop-eq.) | 2.0 | 1.3 | 10.2 | 7.8 | 5.7 | 62.2 |
| WU (mln $m^3$) | 0.2 | 0.1 | 1.0 | 0.7 | 0.5 | 5.9 |
| Recycling (%) | > 0 | > 0 | > 0 | > 0 | > 0 | > 0 |
| Incineration (%) | < 100 | < 100 | < 100 | < 100 | < 100 | < 100 |

| | | | | | | |
|---|---|---|---|---|---|---|
| Littering (%) | 6 | 6 | 6 | 6 | 6 | 6 |

Statista (2019) does not specify whether their data cover both disposable paper and plastic cups, or only one of them, but data from Kauertz et al. (2019) suggest they cover both (see above). The German data from Kauertz et al. (2019) about the ratio of disposable paper and plastic (i.e. polystyrene), including for additional caps used, and weight and material composition of cups and caps have been applied to all other countries and EU28 (see table 2 and 3).

The number of disposable cups for warm takeaway drinks from Statista (2019) are considered reliable, because its German disposable cups use has been evaluated as reliable above, based on the thorough review of Kauertz et al. (2019). However, German data about used disposable cups for warm takeaway drinks from Kauertz et al. (2019) shows similarities but also differences with NABU (2017) and GMV (2018). Some unknown uncertainty has thus been introduced by applying Kauertz et al. (2019)'s data for the types, weight and material composition of used disposable cups and lids to other countries and EU28. The number and weight of disposable cups and lids in table 2 and 3 are nevertheless expected to be a good approximation in the absence of better data for the other countries than Germany.

Table 3: Overview of the number of disposable polystyrene cups for warm takeaway drinks, weight polystyrene (PS) in the cups and lids (for 15% of the cups), recycling and incineration percentages, and contributions to grey (non-renewable) and green (renewable) energy, global warming (GW), eutrophication (EU), land use (LU) and water use (WU) for the Netherlands (NL), Belgium (BE), France (FR), Spain (ES) and European Union (EU) in 2019 (see text above for used sources)

| Countries | NL | BE | DE | FR | ES | EU28 |
|---|---|---|---|---|---|---|
| Paper cups (mln pieces) | 228 | 151 | 1,140 | 875 | 638 | 6,970 |
| - PS in cup (ton)<br>- PS in lid (ton) | 935<br>109 | 619<br>72 | 4,674<br>547 | 3,588<br>420 | 2,616<br>306 | 28.577<br>3,346 |

| | | | | | | |
|---|---|---|---|---|---|---|
| Grey energy (TJ) | 9.7 | 61.4 | 463.5 | 355.8 | 259.4 | 2834.1 |
| - Fossil energy | .8.2 | 59.1 | 446.2 | 342.4 | 249.7 | 2727.8 |
| - Nuclear energy | 3.5 | 2.3 | 17.4 | 13.3 | 9.7 | 106.3 |
| - Biomass | 0.0 | 0.0 | 0.0 | 0.0 | 00 | 0.0 |
| Green energy (TJ) | 0.4 | 0.2 | 1.8 | 1.4 | 1.0 | 11.2 |
| - Biomass | 0.2 | 0.1 | 0.8 | 0.6 | 0.5 | 5.1 |
| - Wind, solar, geoth. | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.1 |
| - Hydro | 0.2 | 0.1 | 1.0 | 0.8 | 0.6 | 6.0 |
| GW (kton $CO_2$-eq.) | 4.1 | 2.7 | 20.5 | 15.8 | 11.5 | 125.6 |
| EU (kton $PO_4$-eq.) | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| LU (mln $m^2$a crop-eq.) | 0.0 | 0.0 | 0.0 | 00 | 0.0 | 0.1 |
| WU (mln $m^3$) | 0.1 | 0.0 | 0.3 | 0.2 | 0.2 | 1.7 |
| Recycling (%) | 52.0 | 42.4 | 47.1 | 26.9 | 50.7 | 41.8 |
| Incineration (%) | 42.3 | 56.3 | 52.8 | 43.0 | 15.4 | 33.6 |
| Share in litter (%) | 6 | 6 | 6 | 6 | 6 | 6 |

The calculated weights of cup materials have been multiplied using conversion factors to calculate environmental pressures from the production of the materials (from resource extraction up to and including material production; i.e. excluding manufacturing packaging from those materials). The environmental pressures covered are the use of renewable and non-renewable energy carriers, global warming, eutrophication, land use, and water consumption. The conversion factors used are widely used in life cycle assessment (LCA) studies and can be extracted from all mainstream LCA software.

The used conversion factors are the same across countries. Kauertz et al. (2019) also calculated the contribution to global warming, but from cradle up to and including waste processing, with data specific for Germany and

expressed by cup type per thousand disposable cups. The results in tables 2 and 3 and from Kauertz et al. (2019) are thus not comparable one to one.

An unknown small part of the disposable (polystyrene) cups is contracted by institutional users with a recycle-guarantee, but the large majority of the used disposable paper and polystyrene cups end up as commingled waste. The disposable paper cups are incinerated after collection. Collected disposable polystyrene cups are in principle separated from commingled waste in the Netherlands. The same is assumed for the other countries and EU28.

It should be noted that the recycling percentages from Eurostat (2022e) in Table 3 differ across countries in the way they are established, and in some cases are calculated from the weight of collected plastic packaging (that is, without excluding losses from sorting and cleaning). The European Commission has recently published Directive 2018/852 (EC, 2018) and Implementing Decision 2019/655 (EC, 2019b) to harmonise the way of establishing the percentage of recycled packaging materials, i.e. the recycling results for countries.

Directive 2018/852 (EC, 2018) and Implementing Decision 2019/655 (EC, 2019b) entered into force on 5 July 2020, and may first be implemented in 2021 by the selected countries. However, Brouwer et al. (2019) explored the influence of the new way of establishing the percentage by recalculating the Dutch recycling results for 2017 (see Table 3). The Dutch recycling rates for plastics and glass have fallen considerably following this new way of establishing the percentage. The recycling percentages in Table 3 for the other countries covered are probably also an overestimate compared to whether they would have been established according to Directive 2018/852 (EC, 2018) and Implementing Decision 2019/655 (EC, 2019b).

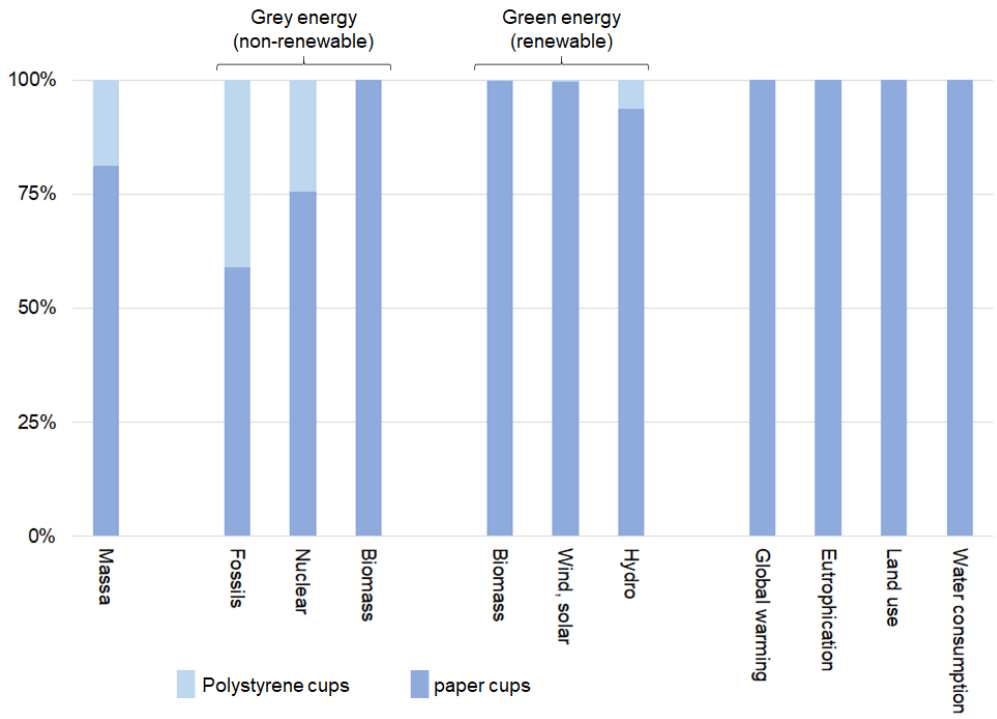
According to the national Dutch monitoring of litter, disposable cups make up 6% of total littering in the Netherlands (Lieverse & Ter Beek, 2020). This

percentage is assumed to apply as well to the other countries and EU28 (see table 2 and 3).

Figure 7 shows how much disposable paper and polystyrene cups contribute each in the total cup weight, and energy use and environmental impacts. More clearly than tables 2 and 3 do, figure 7 shows a larger total weight for the disposable paper than polystyrene cups. That is the combined results of more disposable paper cups than disposable polystyrene cups (10,149 mln versus 6,970 mln for EU28), a larger weight per disposable paper cup than disposable polystyrene cup ((7,8 - 18,2 g versus 4,1 g), and a disposable polystyrene lid more often used with disposable paper than polystyrene cups (70% versus 15%). Note a disposable polystyrene lid is 3.2 g, whereas the disposable polystyrene cup weighs 4.1 g.

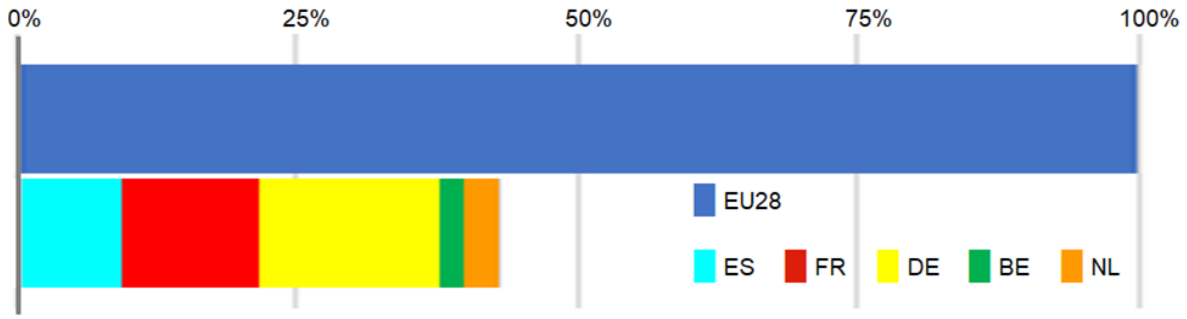
Also visible from figure 7 is that the disposable polystyrene cups contribute more and the disposable paper cups contribute less to total grey (non-renewable) energy use than to total cup-weight. This is the opposite way around for green (renewable) energy use and the environmental impacts. That can be explained by the fact that polystyrene is produced from a fossil-based resource, whereas paper originates from the biobased resource wood. Growing wood needs land, water and fertilizer. The latter contributes to eutrophication. Paper as a material basically embodies green energy.

Figure 7: Contribution of the disposable paper and polystyrene cups for warm takeaway drinks in the total cup weight, and energy use and environmental impacts of the cradle-to-production of the materials for the disposable cups




As said above, weight and cradle to production energy use and environmental impact of the disposable cups are calculated for the selected countries and the EU28 by multiplying their number with the same (German) conversion factors. As a result, expressed in percentages, each of selected countries make exactly the same contribution to the EU28-total (see figure 8).

Figure 8: Contribution of the Netherlands, Belgium, Germany, France, Spain to the number and weight of EU28's use of disposable cups for warm takeaway drinks, and the energy use and environmental impacts of the cradle-to-production of the materials for the disposable cups




All together, the selected countries make up 44% of the EU28-total (see figure 8). In 2019, the selected countries counted for 226 or almost 43% of the 513 mln inhabitants of the EU28 (Eurostat, 2022d). So per capita, the selected countries use the same number of disposable cups for warm takeaway drinks as the rest of the EU28, namely 34 disposable cups for warm takeaway drinks per year.

According to PlasticsEurope (2020), in 2019, EU28 used approximately 3 mln ton polystyrene (including expanded polystyrene). Polystyrene is in a range of applications, like food packaging, building insulation, electrical equipment, inner liner of fridges, and frames for glasses. The 28,577 ton disposable polystyrene cups and 26,079 ton disposable polystyrene lids make up 54,656 ton, which accounts for around 1,8% of EU28's total polystyrene demand. Also according to PlasticsEurope (2020), in 2019, EU28 used approximately 8,4 mln ton low-density polyethylene (including linear low density polyethylene). Low-density polyethylene is used in bags, trays, agricultural film, food packaging film etc. The 6158 ton low-density polyethylene used as lining in the paper cups is less than 0.1% of EU's total use of low-density polyethylene. According to CEPI (2020), in 2019, Europe minus the Russian federation used 75 mln ton paper and cardboard. The 108,947 ton paper in the disposable

paper cups accounts for 0.15% of total paper and board use in Europe minus the Russian federation.

# 3. Conclusions

This report deciphers the packaging landscape for warm takeaway drinks for the Netherlands, Belgium, Germany, France, Spain and the EU28. The number of used disposable cups for warm takeaway drinks has been identified for the Netherlands, Belgium, Germany, France, Spain and the present European Union & United Kingdom as now former member state (i.e. EU28). Subsequently, the numbers of used disposable cups used for warm takeaway drinks in these countries have been combined with data for the weights and material composition by cup types and lids used in Germany. Next the contributions to the related energy uses and environmental impacts has been calculated.(see table 2 and 3).

EU28's use of disposable polystyrene cups and disposable polystyrene lids for warm takeaway drinks account for 1,8% of EU28's total demand of polystyrene. The low density polyethylene lining of the disposable paper cups for warm takeaway drinks used by EU28 accounts for less than 0,1% of EU28's total demand of low density polyethylene (PlasticsEurope (2020). The paper in EU28's disposable paper cup use makes up around 0,15% of total paper and board use in Europe minus the Russian federation CEPI (2020).

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*All internet-links were still working at the time of publication of this document*


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