

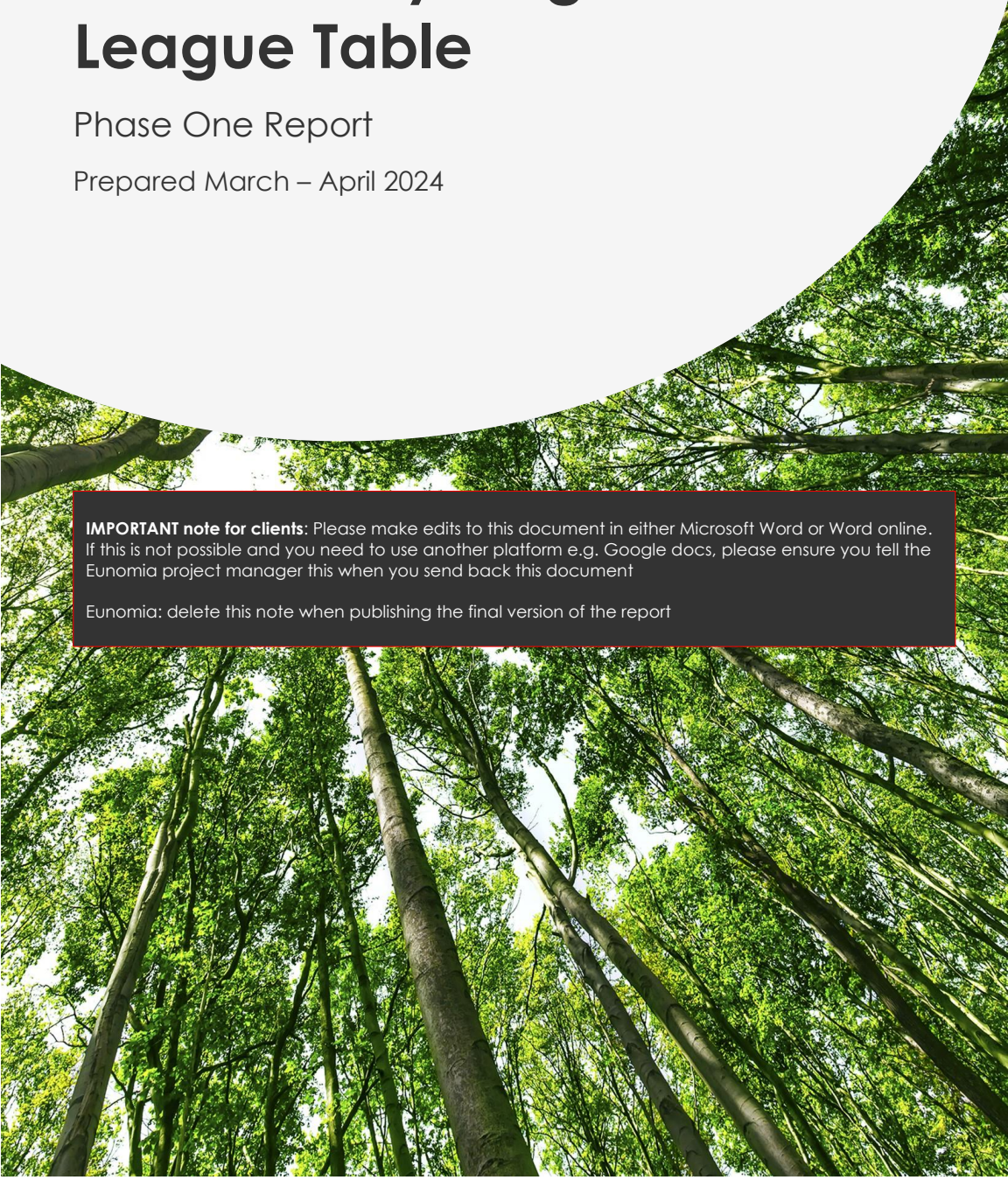
Global Recycling League Table

Phase One Report

Prepared March – April 2024

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Version control table

Version	Date	Author	Description
V1.0	23/04/24	Eunomia	First draft for funders to review (sent to client)
V1.1	DD/MM/YY	Full Name	Second draft (internal)
V1.2	DD/MM/YY	Full Name	Client comments (internal)
V2.0	DD/MM/YY	Full Name	Draft final (sent to client)
V3.0	DD/MM/YY	Full Name	Final version

1.0 Introduction

Which countries are the world's best recyclers? This deceptively simple question conceals a great deal of complexity, which this report tries to unpick.

A logical starting point is to examine published recycling statistics. Several databases exist which do this, including those published by Eurostat¹ and the OECD,² and by presenting different countries' statistics alongside one another, they invite comparisons. However, while these statistics may be indicative, comparisons must be undertaken with caution as countries have generally developed individual approaches to calculating recycling performance. Individual countries' approaches to measurement are often based on the data that it was convenient for them to collect, with the goal of tracking changes in performance at a national level. It is rare that recycling statistics have been developed with the goal of facilitating international comparisons of recycling performance on a like-for-like basis.

The European Union (EU) has made the most substantial efforts to enable international comparisons, which has become important because its Member States are required to meet common recycling targets for municipal waste and packaging waste, among several other waste streams. The European Commission has therefore sought to standardise the way in which recycling rates are calculated for the EU Member States.³ While this approach has begun to change the way the EU Member States report their waste statistics, it has not yet had its full effect, and some differences in calculation methods appear to remain even in the most recently published data.

This project seeks to compare countries' recycling rates on a like-for-like basis. The main focus is on 'municipal waste' recycling rates in line with the definition used by the EU. Municipal waste is household waste and waste from other sources that are similar in nature and composition to household waste.

Countries' reported recycling rates differ in a wide range of ways, but the most common are:

- the scope of material included in recycling calculations (e.g. the extent to which waste from businesses is included);
- the types of material included within the scope of the recycling calculation (e.g. whether waste building materials or septic tank waste from households are counted towards the recycling rate calculation);
- whether material recovered from residual waste treatment, such as incinerators or composting of residual waste, can be counted towards recycling rate calculations;
- the extent to which losses after collection for recycling are accounted for;
- Whether material that is composted at source (e.g. home composting), without needing to be collected and transferred to a composting facility, can be counted towards the recycling rate calculation; and

¹ Eurostat (no date) Waste Database. Available at: <https://ec.europa.eu/eurostat/web/waste/data/database>

² OECD (no date) Waste - Municipal waste: generation and treatment. Available at: https://www.oecd-ilibrary.org/environment/data/oecd-environment-statistics/municipal-waste_data-00601-en

³ European Commission (2019) Commission Implementing Decision (EU) 2019/1004 of 7 June 2019 laying down rules for the calculation, verification and reporting of data on waste in accordance with Directive 2008/98/EC of the European Parliament and of the Council and repealing Commission Implementing Decision C(2012) 2384. Available at: <https://eur-lex.europa.eu/legal-content/EN/TXT/PDF/?uri=CELEX:32019D1004&from=EN>

- The extent to which any informal recycling is accounted for.

This report examines the recycling performance of 48 countries around the world. It begins from their officially reported recycling rate (if they have one – wherever possible using a figure that approximates a “municipal” recycling rate) and endeavours to use underlying waste data and other published sources to adjust the results to present them on a consistent basis.

1.1 Objectives

This project aims to:

- Create a clearer understanding of the scale of the waste issue on a global and regional scale, and contribute to national and supranational policy (e.g., Plastics Treaty in the short term, national and supranational policy in the long term);
- Identify low and high performers, as well as any countries where their method of reporting may overstate performance; and
- Drive debate about wastefulness and the importance of consistent, high quality data to enable better policy and practice to be implemented.

1.2 Scope and Approach

This Phase 1 report examines an initial tranche of 48 countries, including the countries that report the highest recycling rates in the world and many of the world's largest economies. The study also includes lower income countries in Latin America, Asia and Africa, to highlight global disparities. It is being published in line with the fourth UN Plastic Treaty Intergovernmental Negotiating Committee (INC-4) to inform the debate.

It is intended that a Phase 2 publication covering a larger number of countries will be published prior to INC-5 in the autumn. A database will be produced and published on the Reloop Global Data Observatory. Countries wishing to provide additional information to improve our estimates of their adjusted performance are welcome to submit this to Eunomia for review.

The work was carried out in the following stages:

- Agreeing definitions of what should be included in municipal solid waste (MSW) recycling rates (1.2.1)
- Selecting 48 countries that appeared likely to have sufficient data to be usable and would provide some representation from every populated continent.
- Collecting official, academic and other data on waste and recycling for the selected countries.
- Analysing and standardising, as far as possible, the MSW recycling performance for the selected countries to produce figures that approximate their recycling rate under the agreed definitions.
- Analysing other data collected, including recycling rates by material.

Further details on the method are included as an appendix in A.1.0.

1.2.1 Definitions and Approach to Applying Definition

A key underpinning of this work is formed by the clear definitions of:

- What is, or is not, municipal waste; and
- What is, or is not, recycling.

The definitions used are intended to correspond as closely as possible with the definitions of municipal waste and recycling based on the 2018 amended EU Waste Framework Directive definition:

“‘municipal waste’ means:

(a) mixed waste and separately collected waste from households, including paper and cardboard, glass, metals, plastics, bio-waste, wood, textiles, packaging, waste electrical and electronic equipment, waste batteries and accumulators, and bulky waste, including mattresses and furniture;

(b) mixed waste and separately collected waste from other sources, where such waste is similar in nature and composition to waste from households;

Municipal waste does not include waste from production, agriculture, forestry, fishing, septic tanks and sewage network and treatment, including sewage sludge, end-of-life vehicles or construction and demolition waste.

This definition is without prejudice to the allocation of responsibilities for waste management between public and private actors.”⁴

This definition is helpful, but leaves open some room for interpretation and inconsistency (e.g. regarding how materials such as wood, rubble, soil, scrap metal or non-packaging glass or plastics should be treated when they arise from households, or arise in large quantities from non-household sources).

However, for many countries the data available is limited and it can be challenging to establish exactly what has been measured and how. The goal is a standardised recycling rate calculation which:

- Applies a recycling calculation point based on the principles behind the EU's new measurement method using assumptions regarding post-collection loss rates.
- Includes only metals separated from incinerator bottom ash (IBA) as recycling, but not other IBA.
- Excludes construction and demolition waste, agricultural waste and industrial wastes that are not municipal in character, as far as possible.
- Limits the contribution that can be made to municipal waste and recycling from non-packaging metal, wood and plastic.

⁴ European Commission (2018) *Directive (EU) 2018/851 of the European Parliament and of the Council of 30 May 2018 amending Directive 2008/98/EC on waste*. Available at: <https://eur-lex.europa.eu/legal-content/EN/TXT/?uri=celex%3A32018L0851>

Where anomalies in composition are identified, various efforts have been made to establish whether they reflect the character of municipal waste in the country or indicate an issue with the way the country records its data. The process of applying this definition inevitably required the application of some judgement. The general adjustments made are summarised in A.1.3 and individual country by country details will follow in a more detailed appendix.

2.0 Results and Commentary

2.1 Municipal Waste Recycling Rates

The reported and adjusted recycling rates, applying the methodology described in A.1.0, for the 48 selected countries are presented graphically in Figure 2-1 and on a world map in Figure 2-2. Table 2-1 summarises how each country ranks before and after adjustment and provides insight regarding data quality for each country.

The adjustments most commonly applied across the countries that led to a reduction of the reported recycling rate were:

- Removal of construction and demolition waste from both the total reported MSW and from dry recycling reported tonnages;
- Exclusion of estimates of waste recycled informally counted towards the reported recycling rate – this is mainly applicable to lower-income countries; and
- Application of sorting losses to the tonnages reported for dry recycling and for organics recycling where it appears that these have not been fully accounted for in the published recycling rate.

The countries with the biggest drops from their reported recycling rate to their adjusted recycling rate were:

- **Singapore** (-30%): The country's reported headline national recycling rate was 57% in 2021; however, this includes all waste rather than municipal waste only. In addition, in the same year, Singapore reported a household waste recycling rate of 13% and a non-household waste recycling rate of 72% – the latter including significant amounts of non-municipal materials. We used the reported recycling rate of 13% for household waste and estimated a non-household municipal recycling rate of 33%, using the generated and recycled waste composition and removing industrial-type waste such as construction and demolition and scrap metals. The adjusted municipal recycling rate for Singapore is therefore 27%.
- **South Korea** (-19%): The country's reported municipal recycling rate was 64% in 2019; however, the municipal recycled waste includes significant quantities of bulky waste, recycling residue and waste marked as "unknown". Those categories were excluded from the dry recycling figures, which led to an adjusted recycling rate of 45%.
- **Spain** (-18%): The country reported a municipal recycling rate of 42% in 2021, but MBT is widely used in the country and all of the waste entering MBT plants is counted towards the recycling rate. Based on our understanding of the output composition of MBT and the fates of the output streams, we excluded all but 6% of the waste going to MBT from the recycled tonnages and calculated an adjusted recycling rate of 24%.

- **Germany** (-17%): The country reported a municipal recycling rate of 69% in 2021, but this is based on waste *collected for recycling* rather than actually recycled. In addition, the figures treat most of the waste entering MBT as recycled. We applied contamination and sorting losses (to reflect material lost between collection and the EU calculation point) as well as removing all but 6% of the waste going to MBT from the recycled tonnages, leading to a corrected recycling rate of 52%.

Conversely, a few countries saw their reported recycling rates increase following the adjustments:

- **China** (+15%): Whilst China does not officially report any of their municipal waste generated as recycled, several sources indicate that recycling is happening in the country for certain material types, including plastics, glass, paper and metals. There are also reports of anaerobic digestion which suggest that a part of the generated organic waste is recycled. We applied the recycling rates reported for individual material types, which led to an overall adjusted municipal recycling rate of 15%.
- **South Africa** (+12%): The country reported a municipal recycling rate of 11% in 2018; however, their reported municipal waste generation includes significant quantities of industrial waste which is not recycled, and impairs the overall recycling performance. Removing this non-municipal waste from the generated tonnages increased the recycling rate to 24%.

Following the amendments, the top 10 performing countries from 1 to 10 are

1. Austria
2. Wales
3. Taiwan
4. Germany
5. Belgium
6. Netherlands
7. Denmark
8. Slovenia
9. Northern Ireland
10. South Korea.

This list features a preponderance of Western and Central European countries, reflecting the longstanding use of separate recycling collection systems in this is a part of the world and the impact of European waste policy, which has stimulated the development of infrastructure for logistics, sorting and treatment.

Austria, the leading recycler, has had widespread separate collections of organic waste across the country since 1995, and this long-established practice is likely to have contributed to their high level of recycling. Austria also introduced EPR as long ago as 2002, which applies to WEEE, batteries and packaging. Wales' recycling rate has increased dramatically since

the introduction of a new waste strategy, *Towards Zero Waste*⁵, in 2010. The strategy set long term, escalating recycling targets for local authorities in Wales, backed by financial penalties if the targets were missed. Both Taiwan and South Korea introduced a deposit return scheme for beverage containers in 1997 and adopted waste management policies such as the zero waste policy for Taiwan and the zero organic waste to landfill policy for South Korea which, backed by strong social expectations of complying with waste sorting rules,⁶ have contributed to their recycling rate increasing significantly in the past twenty years.

Some of the lower-income countries do not report an official recycling rate. Many of these countries do not have wide coverage of formal waste collections, much of the recycling that takes place is conducted in the informal sector, often in circumstances that are hazardous to those undertaking the work and whose impact is hard to quantify reliably. Under our adjustment approach, informal recycling is not included in the adjusted recycling rate, due to quantification issues and a desire not to valorise practices that would ideally be deterred. One partial exception to this is Colombia, where waste pickers are paid and a decree in 2016 made 'informal' recycling an official part of the solid waste management system, leading us to take the view that it had been placed on a footing that allowed it to be included within the national recycling rate.

Even in countries where there is no formally reported recycling rate, our research found that there can be significant recycling activity in train – including China, India, and Thailand. A focus only on reported recycling rates leads to their progress not being recognised. Many of the countries showing low recycling performance have little reliable data available, often outdated or based on limited surveys, which made it difficult to estimate their performance with any certainty.

2.2 Data Quality

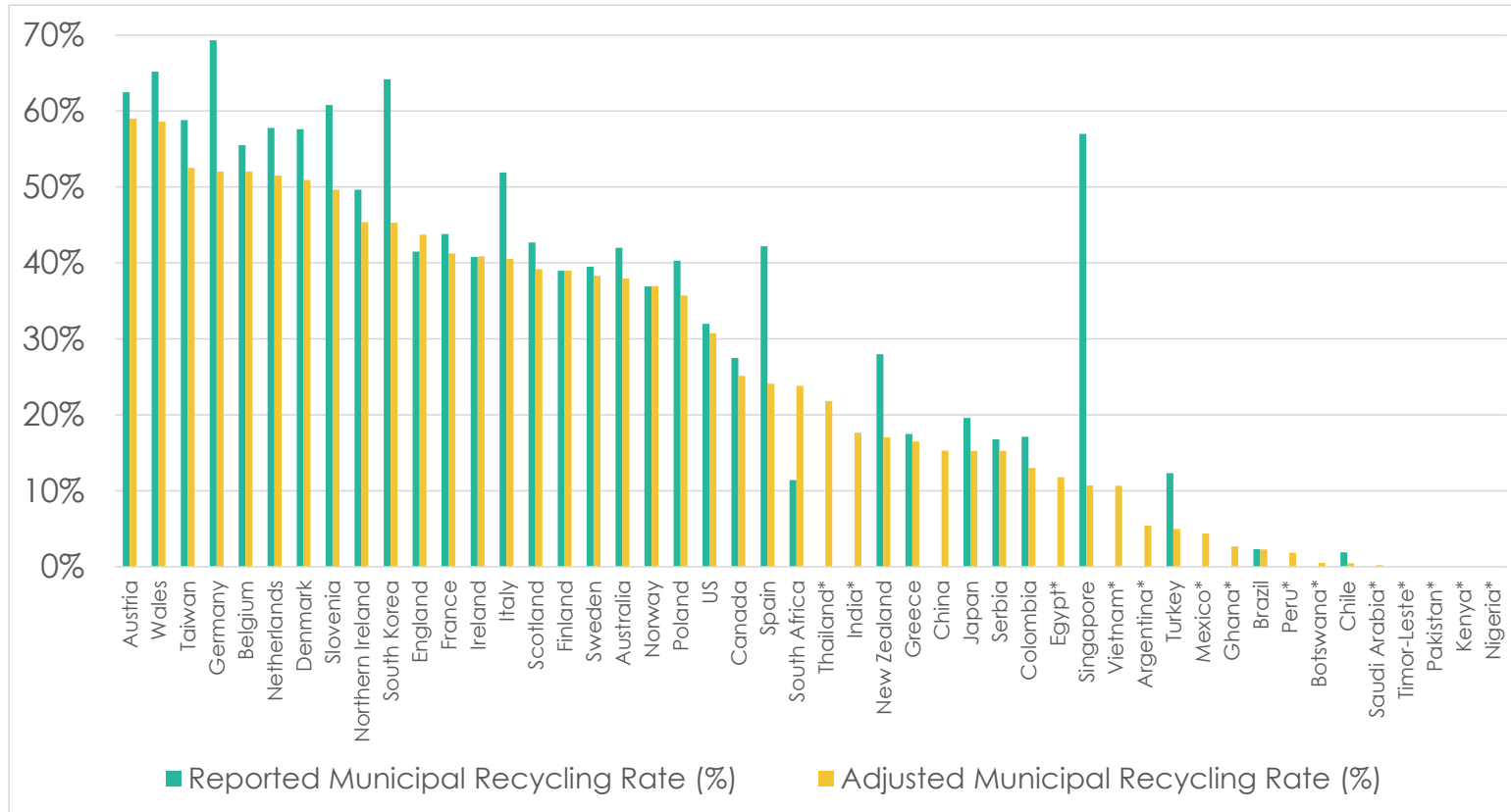
For the purposes of this study, Singapore, Ghana, Egypt, Nigeria, Pakistan, Timor-Leste and Colombia were the countries with the poorest data quality, while Denmark, Finland, Sweden, South Korea and Norway were the countries with the best data quality. Singapore's poor data quality may be surprising, but is due to the country only publishing total waste statistics rather than municipal waste statistics – an issue that could be rectified relatively easily.

The UK nations stood out as having excellent data for local authority collected waste, reported quarterly and validated by the Government. However, those nations lack data on their municipal commercial waste collected by the private sector, especially England and Northern Ireland whose latest non-household data is a survey from 2009; as a consequence, both fell slightly below the standard necessary to receive a "good" score for waste data. By contrast, Wales had a relatively recent commercial data from 2018, and while the survey methodology relied on estimates of the weight of material based on bin volumes and the surveyed businesses being aware of the end destination of their waste, it was a notably better source than those available for England or Northern Ireland.

⁵ Welsh Government (2010), *Towards Zero Waste*. One Wales: One Planet, available [here](#).

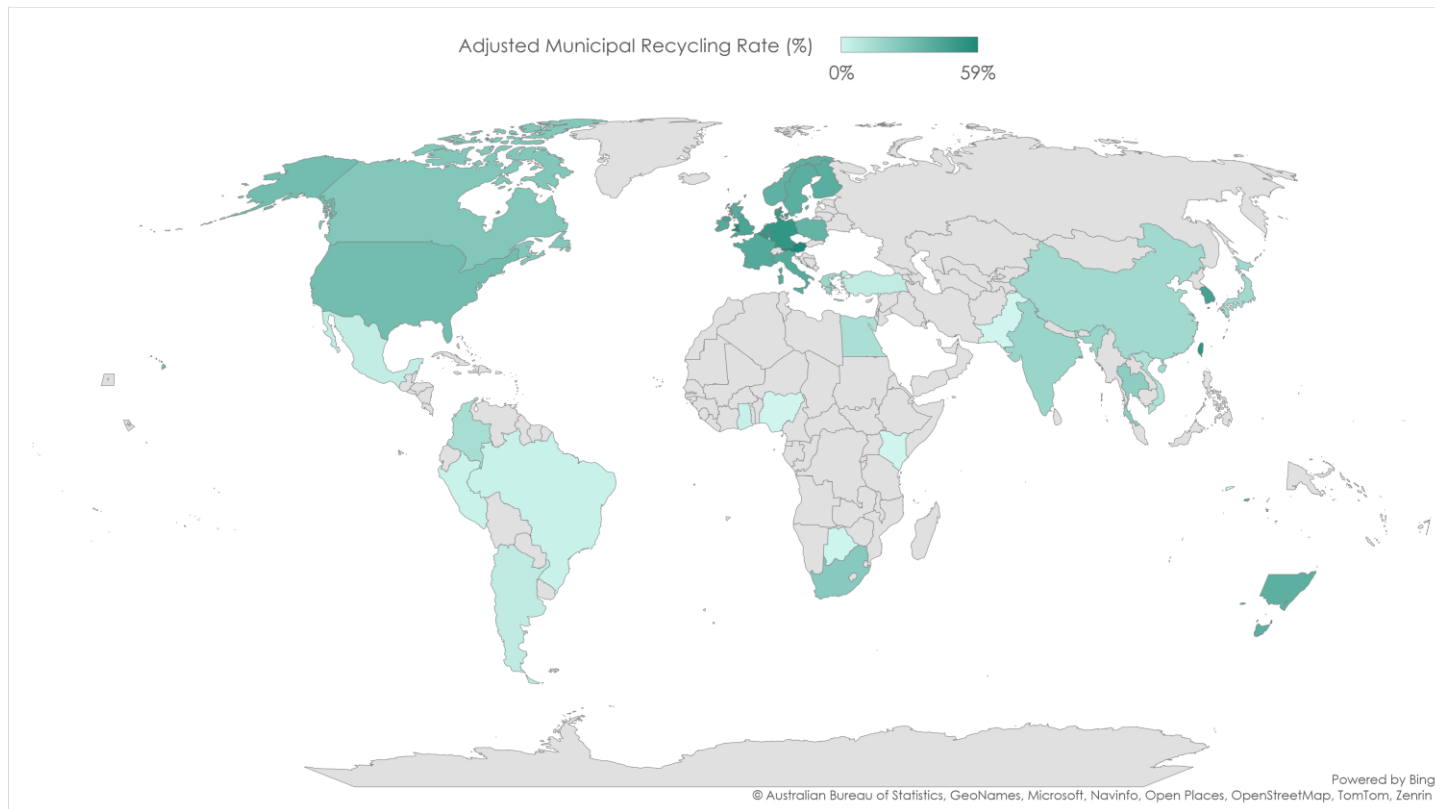
⁶ Lee, E (2020) South Korea: The Future of Trash. Atmos. Available at: <https://atmos.earth/south-korea-recycling-technology/>

Figure 2-1: Reported and Adjusted Municipal Recycling Rate by Country



*No reported municipal recycling rate

Figure 2-2: Map of adjusted municipal recycling rate by country



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Table 2-1: Reported and Calculated Municipal Recycling Rates (RR) by Country

Country	Reported RR		Adjusted RR		Change Between Reported and Adjusted		Data Quality
	Rank	Recycling Rate	Rank	Recycling Rate	Rank	Recycling Rate	
Austria	4	63%	1	59%	3	-3%	Good
Wales	2	65%	2	59%	0	-7%	Good
Taiwan	6	59%	3	53%	3	-6%	Poor
Germany	1	69%	4	52%	-3	-17%	Good
Belgium	10	56%	5	52%	5	-3%	Good
Netherlands	7	58%	6	51%	1	-6%	Good
Denmark	8	58%	7	51%	1	-7%	Good
Slovenia	5	61%	8	50%	-3	-11%	Good
Northern Ireland	12	50%	9	45.4%	3	-4%	Poor
South Korea	3	64%	10	45.3%	-7	-19%	Good
England	17	42%	11	44%	6	2%	Poor
France	13	44%	12	41%	1	-3%	Good
Ireland	18	41%	13	41%	5	0%	Good
Italy	11	52%	14	41%	-3	-11%	Poor
Scotland	14	43%	15	39%	-1	-4%	Good
Finland	21	39%	16	39%	5	0%	Good
Sweden	20	40%	17	38%	3	-1%	Good
Australia	16	42%	18	38%	-2	-4%	Poor
Norway	22	37%	19	37%	3	0%	Good
Poland	19	40%	20	36%	-1	-5%	Good
US	23	32%	21	31%	2	-1%	Poor
Singapore	9	57%	22	27%	-13	-30%	Very Poor
Canada	25	28%	23	25%	3	-2%	Good
Spain	15	42%	24	24%	-8	-18%	Good
South Africa	31	11%	25	24%	7	12%	Poor
Thailand	N/A	None	26	22%	N/A	N/A	Poor
India	N/A	None	27	18%	N/A	N/A	Very Poor
New Zealand	24	28%	28	17%	-3	-11%	Very Poor
Greece	27	18%	29	17%	-1	-1%	Poor
China	34	0%	30	15%	5	15%	Very Poor
Japan	26	20%	31	15%	-4	-4%	Good

Country	Reported RR		Adjusted RR		Change Between Reported and Adjusted		Data Quality
	Value	Percentage	Value	Percentage	Value	Percentage	
Serbia	29	17%	32	15%	-2	-2%	Poor
Colombia	28	17%	33	13%	-4	-4%	Very Poor
Egypt	N/A	None	34	12%	N/A	N/A	Very Poor
Vietnam	N/A	None	35	11%	N/A	N/A	Poor
Argentina	N/A	None	36	5%	N/A	N/A	Very Poor
Turkey	30	12%	37	5%	-7	-7%	Poor
Mexico	N/A	None	38	4%	N/A	N/A	Poor
Ghana	N/A	None	39	3%	N/A	N/A	Very Poor
Brazil	32	2%	40	2%	-8	0%	Poor
Peru	N/A	None	41	2%	N/A	N/A	Very Poor
Botswana	N/A	None	42	1%	N/A	N/A	Very Poor
Chile	33	2%	43	0.5%	-10	-1%	Very Poor
Saudi Arabia	N/A	None	44	0.2%	N/A	N/A	Very Poor
Timor-Leste	N/A	None	45	0%	N/A	N/A	Very Poor
Pakistan	N/A	None	45	0%	N/A	N/A	Very Poor
Kenya	N/A	None	45	0%	N/A	N/A	Very Poor
Nigeria	N/A	None	45	0%	N/A	N/A	Very Poor

2.3 Waste Generation Per Capita

The adjusted MSW generation per capita per country is shown graphically in Figure 2-3 and on the world map in Figure 2-4.

The most impactful adjustment made on the reported MSW generation was the inclusion of municipal non-household waste, as this component is under-reported by many countries. The few countries that appear to record all of their municipal commercial waste include Austria, Belgium, Ireland, Kenya, Mexico, Norway and Slovenia. In these countries, the proportion of municipal waste that is non-household waste varies between 35% and 45% of total MSW. The countries with the lowest reported proportion of non-household municipal waste were Vietnam (6%), Germany and the Netherlands (10%), Greece (16%) and France (17%). The under-reporting countries were all scaled up according to the adjustment methodology detailed in Appendix A.1.3.

Conversely, a few countries report a very high quantity of non-household municipal waste which makes their MSW generated per capita remarkably high, such as Canada reporting 56% of MSW as commercial waste and 942 kg/capita of MSW per year. This generally appears to indicate that the country is including some industrial and/or construction and demolition waste within their municipal waste. After the removal of non-municipal waste from Canada reported figures, their MSW generation per capita decreased to 669 kg/capita which is much more in line with the MSW generation in other developed countries.

Most African, South Asian and Pacific countries do not report the breakdown of household and non-household waste within their municipal waste generation, so we were unable to make any adjustments to reflect missing non-household waste.

As highlighted in Figure 2-3, after adjustments, Saudi Arabia stands out as the country having the highest MSW generation per capita. Indeed, Saudi Arabia is often reported as having one of the highest waste generation per capita in the world, with a particularly high food waste generation rate.⁷ This appears to be consistent with reports regarding the country's consumer culture. The US is also recognised as a "high consumption" country, which is reflected in MSW generation per capita which ranks in the top 5 of the countries included in this study.

India reports very low MSW generation, with a total reported figure of approximately 60 million tonnes per year, which translates to 42 kg/capita. This compares with Pakistan's 140kg/capita, suggesting that India's figure may not be representative of the reality. However, it is corroborated by several sources corroborated and we did not find any reliable source suggesting that a higher volume of waste is being generated. The underlying issue may be a lack of reporting in rural areas, where 64% of the population live. However, since this explanation is speculative rather than being supported by any source, no adjustment has been made.

Italy's MSW generation per capita also appears low in comparison with similar countries. Its 485 kg/capita is almost a third less than the average of 666 kg/capita for the European countries included in the present study. The Italian Institute for Environmental Protection and Research ('ISPRA') recognises this pattern and finds it credible that Italy's current low waste generation figures are linked to a successful National Waste Prevention Program. The strong waste policy measures now active across large parts of the country (mandatory source segregation, fines for non-compliance, and PAYT for residual and organic waste) are likely to contribute to the low waste production rates. A regional assessment also reveals an apparent link between regional MSW generation and regional GDP, which lends credibility to a link between Italy's relatively low GDP per capita and its low national average MSW generation figure. Overall, while there may be some undercounting of non-household waste, the evidence suggests that Italy's MSW generation rate is relatively low, and that may be more related to effective policy measures than to unreported waste.

⁷ UNDP, Food For Thought: Why Is Food Waste a Challenge In Saudi Arabia?, 2022, available [here](#).

Figure 2-3: Adjusted Municipal Solid Waste Generation per Capita and Recycling Rate per Country

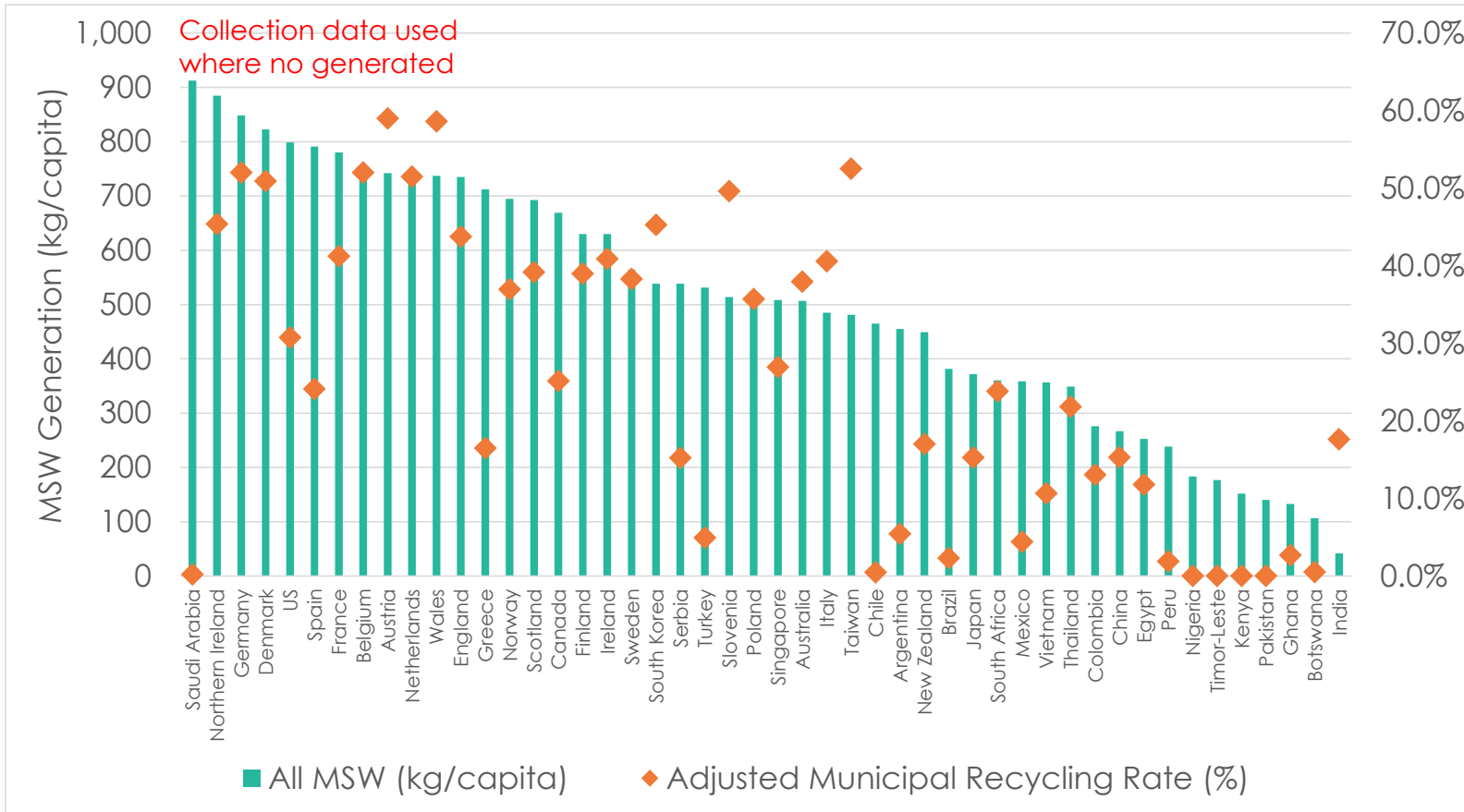
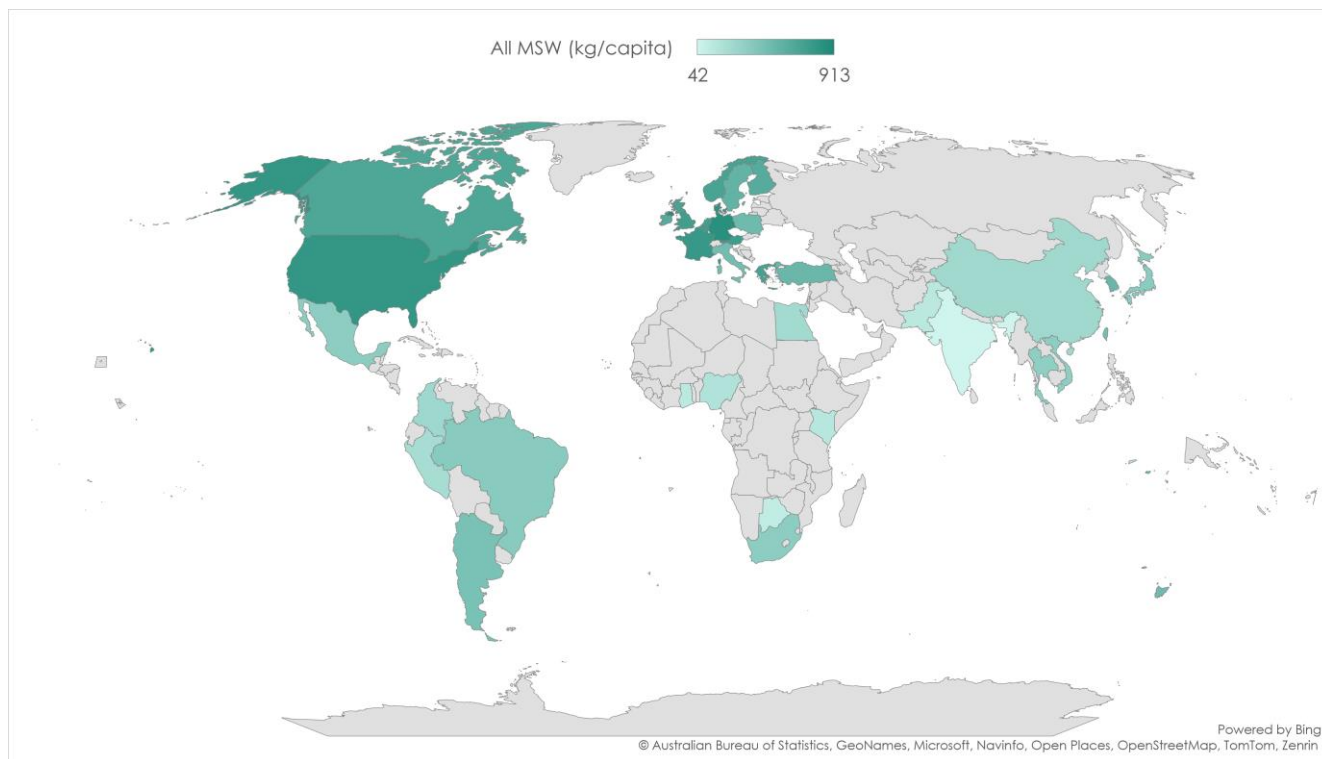


Figure 2-4: Map of Adjusted Municipal Solid Waste per Capita by Country



2.4 Plastic Packaging Waste

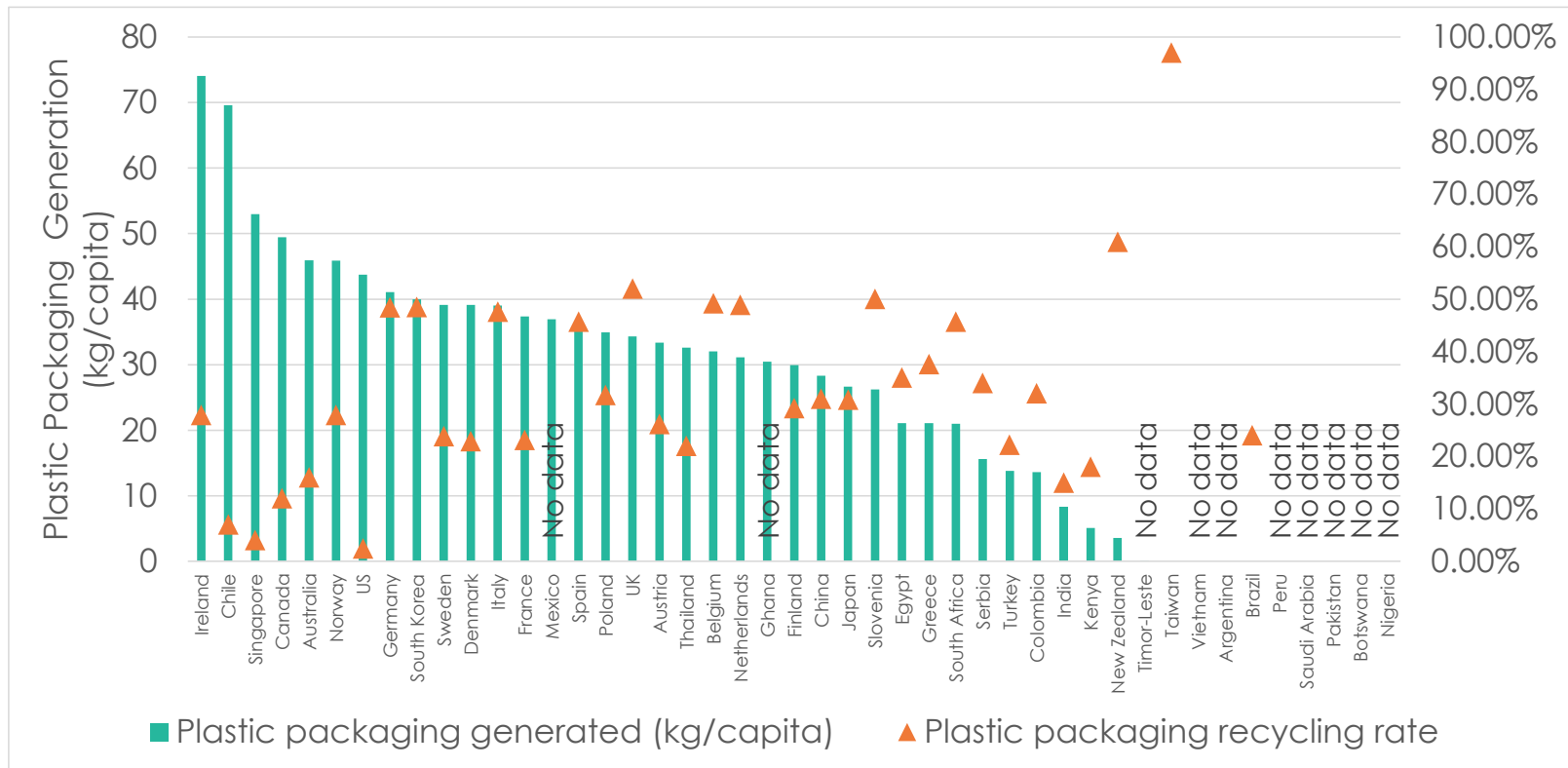
Figure 2-5 shows the reported weight of plastic packaging generated per capita and the reported plastic packaging recycling rate for each country. England, Northern Ireland, Scotland and Wales are replaced by the UK in this graph as the packaging data is currently only reported at the UK level rather than for each nation separately.

Ireland is the biggest producer of plastic packaging waste per capita at 74 kg/capita/year whilst the average generation is 33 kg/capita/year across the countries included in this study that reported plastic packaging data. Ireland also has a relatively low reported recycling rate for plastic packaging waste at 28%. This disparity was highlighted in an Irish EPA research report on packaging waste statistics in 2022,⁸ in response to Ireland reporting the largest amount of plastic packaging waste in the EU in 2019. The EPA report examines several potential explanations for the high figure, including differences between Ireland's way of measuring how much plastic waste is generated and those of other countries, and differences in usage patterns – for example, Ireland's use of HDPE milk bottles is high, because Ireland is among the world's biggest consumers of milk. However, the report does not conclude that there is a statistical anomaly behind Ireland's reported plastic consumption, and we have therefore not sought to normalise down the figure.

Taiwan is the leading country in terms of reported plastic packaging recycling with a 97% recycling rate,⁹ while Timor-Leste and the US have the lowest reported recycling rates at 0.06% and 2.41% respectively. The average plastic packaging recycling rate for the countries included in the study is 33%; this is not negligible, but for comparison it is well under the EU-wide target of 55% by 2025. None of the EU countries included in this study seem to have reached this target level yet.

⁸ EPA, *Packaging Waste Statistics, Producer Motivations and Consumer Behaviour*, 2022, available [here](#).
⁹ Ying-Ying Lai and Yuh-Ming Lee, *Management strategy of plastic wastes in Taiwan*, 2022, available [here](#).

Figure 2-5: Plastic Packaging Generation per Capita and Recycling Rate per Country



2.5 Beverage Containers

As part of this research, we intended to collect data on beverage containers generation and recycling including metal, glass, plastic and cartons beverage containers. Unfortunately, there was not enough data available on metal, glass and cartons containers to be able to report meaningful trends. Reported figures for glass often include non-beverage glass as well as flat glass which makes it challenging to find figures for glass beverage only.

With the help of Reloop and the Aluminium Institute, we were able to report on trends for plastic beverage containers and aluminium beverage cans.

2.5.1 Plastic Beverage Containers

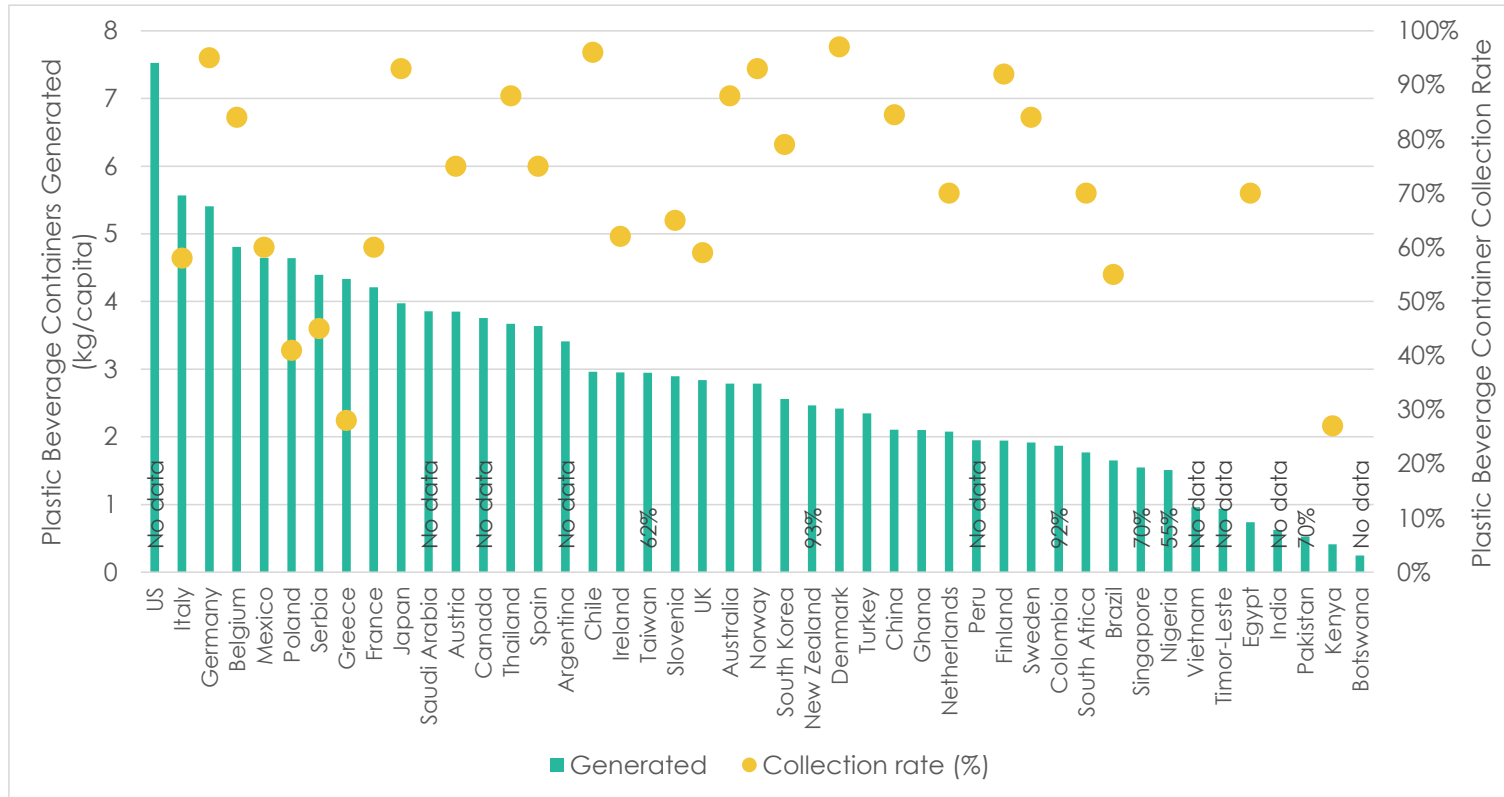
The amount of plastic beverage containers generated along with collection rates per country are presented in Figure 2-6. There were issues with the data available on plastic beverage containers recycling rates, such as recycling rates greater than collection rates and recycling rates only applicable to PET bottles rather than all plastic beverages, so we chose not to include this data in the figure.

Values of generated plastic beverage containers per capita range between 0.2 to 7.5 kg/capita/year, with Botswana generating the lowest quantity per capita and the US the highest. The US does not report a collection rate but reports a recycling rate of 29%.

There are seven countries achieving a collection rate of 90% or over: Finland, Japan, Norway, Germany, Chile and Denmark. 90% is the 2029 target for the separate collection for recycling of waste single-use plastic beverage bottles in the EU, up from the 2025 target of 77%. Many Member States of the EU are still below the 77% target, such as Greece (28%), Poland (41%), Italy (58%), France (60%), Ireland (62%), Slovenia (65%), Netherlands (70%), Austria (75%) and Spain (75%).

Outside Europe, not many countries have a reported collection rate. There are a few South American countries reporting data, including Brazil and Mexico at 55% and 60% respectively. Egypt, Kenya and South Africa are the only African countries included in the study that have a reported rate: Kenya at 27% and Egypt and South Africa at 70%. It is likely that Kenya's rate would be higher if the informal sector collections were accounted for. The collection rates for the Asian and Pacific countries that report this data are rather high, ranging from 88% for Thailand to 93% for Japan.

Figure 2-6: Plastic beverage Containers Generated and Collection Rate per Country



2.5.2 Aluminium Beverage Cans

Figure 2-7 illustrates how many of the countries included in this study publish aluminium beverage cans recovery rates and Figure 2-8 shows how many countries have set up aluminium beverage can recovery targets. England, Northern Ireland, Scotland and Wales have been replaced by the UK in these graphs, as packaging data is only reported at the UK scale rather than for each nation separately. Just over 50% of countries publish an aluminium beverage cans recovery rate and less than 30% have set up recovery targets specific to aluminium cans. For countries that do report aluminium cans recovery rates, those rates are presented in Figure 2-9.

Brazil ranks first with a surprising 100% recovery rate reported by the Brazilian Association of Aluminium Can Manufacturers, Abralatas. Whilst this figure may be somewhat exaggerated due to differences in calculating methods for the number of cans sold and amount of cans recycled, Brazil is recognized as one of the leading countries in the world in cans recycling and was the first country outside of Europe to join the Every Can Counts initiative.¹⁰ As an example of the steps Brazil has taken to reach a high level of performance, significant efforts were made to ensure that cans were recycled at the 2023 Rio de Janeiro carnival, with recycling ambassadors deployed throughout the carnival and nearly 10 tonnes of aluminium cans collected.

New Zealand and the US rank last at 45%, while the average for the countries that have a reported aluminium beverage can recovery figure is 75%. The aluminium recycling rate in the US varies significantly between the different states as reported in Eunomia's 50 States of Recycling 2.0 report,¹¹ with the lowest ranked state recycling only 2% of cans, while the highest ranked achieves 65% due to the set-up of a Recycling Refund (RR) system. The report details how implementing Extended Producer Responsibility (EPR) and RR could significantly increase the packaging rates of each US state in order to increase the overall recycling rates for the country.

¹⁰ European Aluminium, *Every Can Counts*, available [here](#).

¹¹ Eunomia, *The 50 States of Recycling, 2023*, available [here](#).

Figure 2-7: Number of Countries Publishing Aluminium Beverage Cans Recovery Rates

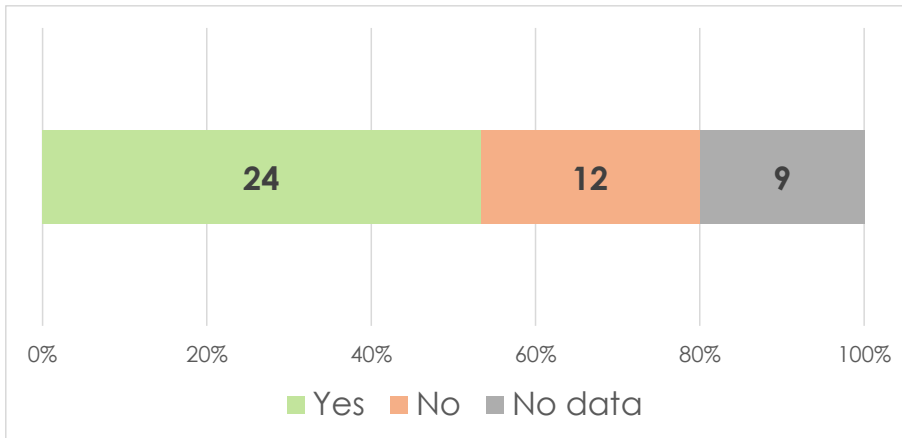


Figure 2-8: Number of countries setting up aluminium beverage can recovery rate targets

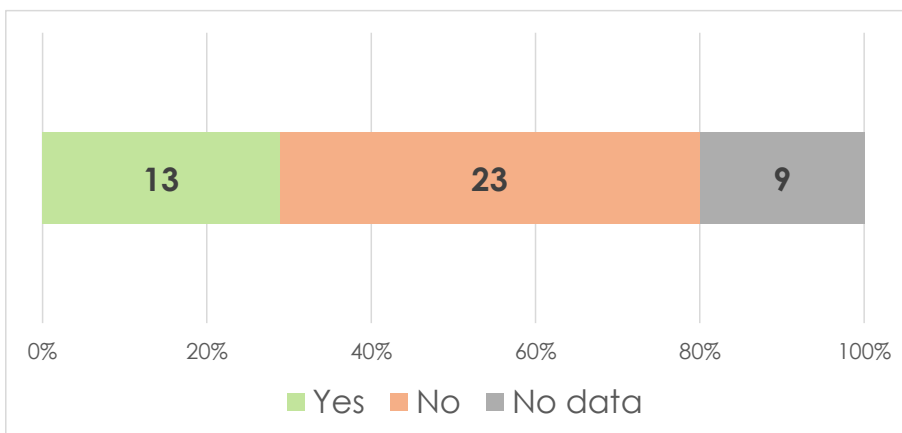
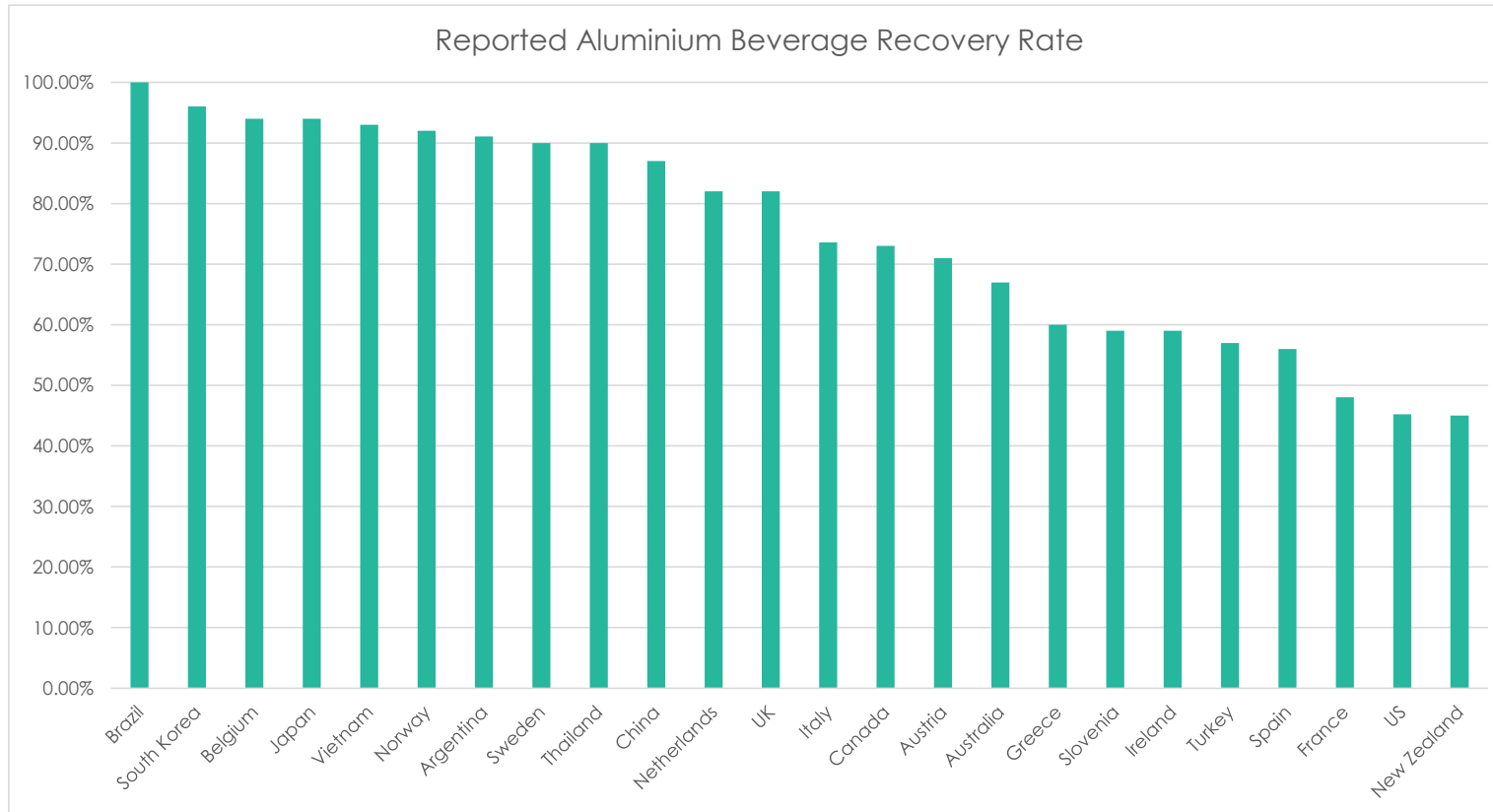


Figure 2-9: Where Reported, Aluminium Beverage Recovery Rate per Country



3.0 Conclusions

Across the countries selected there are vast differences both in real performance and in how data is collected. In order to correct for differences in accounting, the most impactful adjustments made were:

- Removal of construction and demolition waste from both the total reported MSW and from dry recycling reported tonnages;
- Exclusion of waste recycled informally counted towards the reported recycling rate – this is mainly applicable to lower-income countries; and
- Application of sorting losses to the tonnages reported for dry recycling and for organics recycling.

The countries with the biggest drops in reported recycling rates were: Singapore, South Korea, Spain and Germany. Conversely, a few countries saw adjustments increase their performance, or compensate for the fact that they were not reporting recycling rates - China and South Africa being the biggest beneficiaries.

Following adjustments to recycling rates the top performing 10 countries are:

1. Austria
2. Wales
3. Taiwan
4. Germany
5. Belgium
6. Netherlands
7. Denmark
8. Slovenia
9. Northern Ireland
10. South Korea.

However, even the world's top recyclers are not exceeding a 60% recycling rate for municipal waste, once differences in reporting practice are accounted for. Eight of the top 10 are to be found within Europe, with seven being in Western Europe, reflecting the longstanding strategies and policies that have driven investments in collection, logistics, sorting and reprocessing across the continent. The exceptions are two East Asian nations, Taiwan and South Korea, which also have long-established collection and treatment systems. These results highlight the importance of long term investment in making recycling convenient and efficient, as well as the role that establishing behavioural norms over many years plays in creating a recycling culture.

Many lower-income countries do not report official recycling rates, and where a rate is reported it is often low. In such countries, the informal sector is the primary supplier of recycling services, but this work is both too difficult to quantify and too dangerous to condone and is therefore not included in our adjustment approach.

The lack of a formally reported recycling rate does not necessarily mean that there is no formal recycling being carried out in a country. This study found sufficiently reliable evidence to demonstrate that China, India, and Thailand are achieving a quantifiable level of recycling, which would be missed if reported recycling rates were taken as the only data source. The data quality available was variable, with the poorest quality data for Singapore, Ghana, Egypt, Nigeria, Pakistan, Timor-Leste and Colombia – though there are very few countries where the quality and transparency of data could not be improved.

Looking at waste generation per capita, the most impactful adjustment made was to account for additional municipal non-household waste, as this component of MSW is widely under-reported – indeed, it is often measured less well than household waste recycling, or not measured at all. In some countries where non-household MSW figures are quoted, the quantity is very high, which can make their MSW generated per capita figure appear as an outlier.

In order to correct for such anomalies, adjustments were made where the data allowed. However, most African, South Asian and Pacific countries within the study did not report any breakdown of household and non-household waste within their municipal waste generation, and there was limited information available to drive a reasonable inference regarding non-household waste, so we were unable to make any adjustments in these cases.

After adjustments, Saudi Arabia stands out as the country having the highest MSW generation per capita (913kg), which appears to reflect the country's high per capita GDP and known patterns of consumption. At the other end of the scale, India reports a very low MSW generation per capita (42kg), which is a finding replicated in several studies, but appears so low as to suggest that under-reporting of waste (especially in rural areas) may be a contributing factor. Italy's MSW generation per capita is also lower than many comparable European nations; while there may be some MSW that Italy does not account for, it appears that this may be connected with relatively low GDP per capita and a successful National Waste Prevention Program.

Based upon the trends observed in this work the general recommendations for countries looking to improve their municipal waste and recycling reporting and performance would be:

- To report municipal waste and recycling rates annually with a consistent clear definition and to separate out household and non-household municipal waste so far as possible. Non-household municipal reported is generally much poorer quality and frequency than household, which can lead to countries neglecting the potential role that the non-household sector can play in boosting MSW recycling;
- To report breakdowns of recycling rates for key materials, including different types of beverage containers. This level of breakdown is important to allow officials to identify material streams whose performance is poor and to focus action on particular materials and formats that may be poorly recycled in a particular country;
- To distinguish as far as possible between estimates of waste generated, collected and ultimately recycled. This granularity of data is important in enabling governments to understand important issues such as:
 - How much waste is being lost through uncontrolled burning and burial; and
 - The extent of any losses that occur between collection and final recycling

This will enable efforts to be targeted on the stage of the waste management process that has the most room for improvement – and for researchers, it makes it easier to understand how far countries have taken account of recycling losses in their figures.

- To take care in accounting for intermediate treatments (especially MBT plants, but also incineration if there is recovery of metals or other materials from their ash) and to be clear about the extent to which material entering these facilities is ultimately being recycled;
- To carefully consider the definition of municipal waste and ensure that wood and metal that are not household-like in nature are not included in waste data;
- Where the informal recycling sector operates, examine how this could be formalised to protect human health and the environment, raise living standards – and improve recycling (and recycling data) beyond the level that the sector can achieve unaided;
- Where home composting is happening, to make a formal estimate of this so this can be reflected in recycling rates and given appropriate credit;

The features of countries whose systems yield high recycling rates can usefully be examined by those looking to improve. Typical elements of good systems include:

- A formal waste and recycling strategy, including clear goals regarding targets to be achieved and steps to be taken to improve.
- Widespread separate collection of common recyclables, including organics, to provide households and businesses with a convenient way to recycle.
- Methods to ensure that recycling is funded on a “polluter pays” basis, such as EPR, to incentivise producers to avoid selling unnecessary packaging and to prevent performance from being restricted by the funds available to public bodies;
- The use of financial and other behavioural incentives to encourage households and businesses to use the recycling system (e.g. to avoid costs).

While this study has noted some of the policies and schemes in use in the countries examined, it has not attempted a comprehensive survey or an analysis of which are associated with the highest levels of performance. It is hoped that further work on policy impacts could be included within Phase 2 of the project.

We recognise that the resources available for countries to dedicate to producing and publishing waste data are variable and limited; equally, while we have taken all steps available to us to uncover the relevant data to answer our research questions, we acknowledge that we may not have found every data set or document that could cast light on real recycling performance. We would be happy to discuss with representatives of any of the countries featured in this report regarding how we have adjusted their data through this desk-based exercise, and to receive any additional data that could enable us to refine our approach. Additional information that is made available to us will be used to improve our estimates in Phase 2 of this research, which we also expect to see the study extended to cover a larger pool of countries.

Appendix

A.1.0 Method

A.1.1 Selection of Countries

For this first phase of the project we investigated a longer list of countries on the basis of:

- Countries which we know have reasonable data available;
- Countries which provide interest (i.e. not just selecting all European countries on basis of data availability); and
- Countries which give some representation from every continent, whilst acknowledging the data availability and timescale of the project necessitated that European and developed countries dominate given data availability.

Further scoping of the long-list of countries was then undertaken to ensure the minimum amount of data was available. The final countries selected are shown in Table 3-1

Table 3-1: Countries Selected

No.	Country	Region	No.	Country	Region	No.	Country	Region
1	Austria	Europe	17	Scotland	Europe	33	South Africa	Africa
2	Belgium	Europe	18	Northern Ireland	Europe	34	Ghana	Africa
3	Denmark	Europe	19	Norway	Europe	35	Keyna	Africa
4	Finland	Europe	20	Turkey	Europe	36	Egypt	Africa
5	France	Europe	21	Serbia	Europe	37	Nigeria	Africa
6	Germany	Europe	22	Brazil	Latin America	38	Botswana	Africa
7	Greece	Europe	23	Mexico	Latin America	39	Australia	East Asia & Pacific
8	Ireland	Europe	24	Chile	Latin America	40	Japan	East Asia & Pacific
9	Italy	Europe	25	Peru	Latin America	41	South Korea	East Asia & Pacific
10	Netherlands	Europe	26	Argentina	Latin America	42	New Zealand	East Asia & Pacific
11	Poland	Europe	27	Colombia	Latin America	43	Singapore	East Asia & Pacific

No.	Country	Region	No.	Country	Region	No.	Country	Region
12	Slovenia	Europe	28	Saudi Arabia	Middle East	44	Vietnam	East Asia & Pacific
13	Spain	Europe	29	Canada	North America	45	China	East Asia & Pacific
14	Sweden	Europe	30	US	North America	46	Thailand	East Asia & Pacific
15	Wales	Europe	31	India	South Asia	47	Timor-Leste	East Asia & Pacific
16	England	Europe	32	Pakistan	South Asia	48	Taiwan	East Asia & Pacific

A.1.2 Collection of Data

We first defined the year of focus, the year 2021 was chosen. This year was chosen as for EU countries it would be under the new calculation rules, which became mandatory from 2020 and also is the last full year of validated data. However, for some of the countries where data collection is not annual, particularly developing countries, the latest year of data was older than 2021 and some adjustments have been made. As noted in **Error! Reference source not found.** selecting the year 2021 this does mean for EU countries the standardised calculation method was not fully in effect in this publication year of data. There is a disadvantage in using the year 2021 as for many countries part of the year was still impacted by lockdowns arising as a result of COVID-19, whilst there was some recovery from the reduction in commercial activity seen in 2020 the shift to home working was still seen and this might have affected:

- The volumes of household and commercial waste;
- The ability of providers of waste services to maintain normal operation; and
- The ability of national waste data managers to identify inconsistencies or issues with the statistics.

On balance, the advantage of selected the latest year of data we felt most countries would have consistently available outweighed the disadvantage of any COVID-19 effects.

A standard data collection template was developed and data collected for each country by researchers. The data collection template included detailed breakdowns by material that we were aware would not be available for many countries, to include a geographic spread of countries the focus was on getting the minimum data for each country of overall municipal recycling rate with other data optional.

A.1.3 Adjustment of Data

The key adjustments made to recycling rate to meet the definition outlined in 1.2.1 were:

- Applying a calculation point for dry recycling losses based on the principles behind the EU's new measurement method using assumptions regarding post-collection loss rates. Information regarding loss rates for material after it has been

sorted is very limited, and it is difficult to determine the extent to which different countries have accounted for this in their reporting, especially where material is being exported for reprocessing. We have sought, as far as possible, to make allowance for contamination in material that is destined to be input into the final recycling process, but have not sought to correct for additional losses that may occur. It is therefore likely that, if some countries are not fully accounting for subsequent losses, the performance figures reported in this study will somewhat overstate their recycling rate compared with strict adherence to the latest EU reporting rules, and such countries may be advantaged against those that are fully accounting for losses. The possible extent of such losses are summarised in the "sorting loss" rows of Figure 3-1. Where no compositional breakdown is available we have used a standard composition to arrive at a loss rate of 5% which is applied (6% for household waste and 3% for non-household municipal waste). Whilst these losses are European specific similar losses have been used in other countries, including those with manual sorting, as these provided the best available estimated. It could be argued that manual sorting captures more material but also that where infrastructure is less well developed that contamination could be higher. Wherever possible we seek to verify whether losses have already been accounted for to avoid double counting.

Figure 3-1: Losses Incurred in Sorting and Recycling Processes within the European Union¹²

	Plastics	Glass	Paper/board	Metals	Wood
Sorting loss					
- Household	25%	8%	4%	5%	5%
- Commercial/Industrial	5%	1%	2%	2%	10%
Recycling loss					
- Household	29%	5%	10%	14%	-
- Commercial/Industrial	5%	5%	10%	14%	11%

- Excluding any waste which is not municipal in character, such as construction and demolition waste and industrial waste.
 - This includes looking at the composition of waste and making a judgement as to whether it is likely to include non-municipal waste and adjusting as appropriate, for example where there is a high amount of wood or bulky waste.
- Excluding any outputs from residual waste processes from being counted as recycled, including incineration and MBT, except for metals from IBA (but not other IBA). Where all inputs going to MBT are accounted for recycled, we adjusted this quantity to 6% of inputs actually being recycled.
- Including non-household municipal waste where the data shows that this waste stream is missing from the reported municipal waste quantities. For developed countries and urban areas of developing countries, we have used a 60%/40% ratio for household/non-household municipal waste. For rural areas of developing countries, we have used a 95%/5% ratio for household/non-household municipal waste.
- Exclusion of any waste which is collected and managed through the informal sector. For some countries this can be significant. This can also result in a reduction in recycling rates where some of the informally managed waste is recycled, for example for Thailand this reduces reported recycled rate. This informally managed waste is excluded on the basis that it cannot be verified that this waste is being managed appropriately and on the assumption the aim is for all waste and recycling to be managed formally.

¹² EXPRA [Extended Producer Responsibility Alliance] (2014), *The effects of the proposed EU packaging waste policy on waste management practice - A feasibility study*, available [here](#).

Whilst the aim has been to, as far as possible, align the results for each country with the latest EU reporting requirements, there are two respects where it has not been possible to be fully consistent:

- Whilst it is assumed some home composting occurs in all countries, not all report it. Since it is consistent with EU reporting rules to count home composting towards recycling performance, we have not removed this material when amending recycling rates. However, we cannot know the extent of home composting in the countries that do not currently report it, and so have not sought to add in an estimate of home composting for countries where this is absent. This therefore remains a point of inconsistency between countries in the study.
- As discussed in the first bullet above, it is challenging to be completely consistent on how we apply post-collection loss rates.
- Some recycling rates will be inclusive of any preparation for reuse that is taking place within the country.

A.2.0 Adjustments and Data Recommendations by Country

This appendix summarises the adjustments made by individual country and any specific data recommendations recognised during the adjustment process.

Commented [CD2]: Not for summary report

Country	Data adjustments
Austria	•
Belgium	
Denmark	
Finland	
France	
Germany	
Greece	
Ireland	
Italy	
Netherlands	
Poland	
Slovenia	
Spain	
Sweden	

Country	Data adjustments
Wales	
England	
Scotland	
Northern Ireland	
Norway	
Turkey	
Serbia	
Brazil	
Mexico	
Chile	
Peru	
Argentina	
Colombia	
Saudi Arabia	
Canada	

Country	Data adjustments
US	
India	
Pakistan	
South Africa	
Ghana	
Keyna	
Egypt	
Nigeria	
Botswana	<ul style="list-style-type: none">•
Australia	
Japan	
South Korea	
New Zealand	
Singapore	

Country	Data adjustments
Vietnam	
China	
Thailand	
Timor-Leste	
Taiwan	

