MARGINALISING WASTE: A TRADING SCHEME TO REDUCE RESIDUALS

REPORT FOR RELOOP AND ZERO WASTE EUROPE

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Executive Summary

Despite extensive EU waste legislation, large quantities of waste continue to be landfilled or incinerated. Existing policy instruments – including landfill bans, landfill and incineration taxes, and recycling targets - have delivered uneven outcomes across Member States. In many cases, they have encouraged a shift between disposal routes, typically from landfill to incineration, rather than a significant reduction in *residual waste,* though they may have contributed to that when used in conjunction with other policies.

This report examines the case for a new policy instrument: an EU-level **cap-and-trade scheme for residual waste**. The central objective of the proposed scheme is to reduce the total quantity of waste that remains after prevention, reuse and recycling, thereby supporting the transition to a circular economy more effectively than instruments that target landfill or incineration alone.

E.1.0 Key Findings

The analysis shows that, once major mineral wastes (MMW) and combustion wastes are excluded, residual waste sent to landfill and incineration is dominated by a small number of waste streams. These include household and similar waste, sorting residues, mixed and undifferentiated materials, and certain wood wastes. Together, a limited number of categories account for the large majority of residual waste (excluding MMW and combustion wastes) managed in the EU.

The report finds that including MMW and combustion wastes within the scope of a residual waste cap would significantly change the effect of the policy. These waste streams are managed largely through inert landfills and backfilling, are cheap to divert, and are unevenly distributed across Member States due to differences in construction activity, mining, and energy systems. Their inclusion would likely lead to large apparent reductions in residual waste with limited climate or resource benefits, while leaving municipal-type residual waste largely unaffected.

On balance, the analysis concludes that **residual municipal waste** provides a reasonably robust and equitable basis for an EU-wide scheme. Municipal waste is more evenly distributed across Member States, has a longer history of statistical reporting, and is more directly linked to consumption patterns and waste system design. It therefore offers a fairer and more policy-relevant foundation for setting an EU-level cap. It was also proposed by the Joint Research Centre as a key indicator of performance for waste management in the EU.[1] The MMW and combustion wastes, which dwarf other sources, and are virtually all landfilled (with substantial amounts backfilled), warrant separate attention given the specific circumstances applicable to how they are managed.

[1] See Dri M., Canfora P., Antonopoulos I. S., Gaudillat P., (2018) *Best Environmental Management Practice for the Waste Management Sector*, JRC Science for Policy Report, EUR 29136 EN, Publications Office of the European Union, Luxembourg, 2018.

E.2.0 Outline of the Proposed Scheme

In a previous report, we proposed two approaches based on what we described as 'passive trading'.[2] These approaches retain merit, but this study also proposes a possible alternative. The proposed policy instrument would establish an **EU-wide cap on residual municipal waste**, expressed on a per-capita basis. Each Member State would receive a notional allocation reflecting its population, with potential adjustments to account for specific factors such as tourism.

A proportion of allowances would be allocated free of charge, allowing Member States to decide how these allowances are distributed nationally in line with the principle of subsidiarity. The remaining allowances would be auctioned at EU level. This structure ensures that the economic incentive operates primarily *at the margin*, rather than imposing a uniform cost on all residual waste, as is the case with taxes.

Operators of landfill and incineration facilities would be required to surrender allowances for every tonne of in-scope residual municipal waste that they manage. Trading of allowances would be permitted, enabling residual waste reductions to take place where they can be achieved at lowest cost, while still ensuring that the overall EU cap is met.

E.2.1 Compliance: Monitoring, Reporting and Verification

The proposed scheme would build on existing EU waste reporting systems, particularly municipal waste reporting under the Waste Framework Directive. The use of six-digit List of Waste (LoW) codes, including relevant outputs from sorting and treatment facilities, would allow residual waste to be traced back to municipal sources: faster implementation of electronic tracking for waste would support this.

Compliance would be assessed at the point of landfill or incineration, where weighing systems and permitting requirements already exist. A central EU registry, with national administrators, would track allowance allocation, trading and surrender. Robust penalties for non-compliance would be required to ensure the credibility of the scheme. Over time, the scheme would also act as a driver for improved data quality and more consistent reporting across Member States.

E.3.0 Strategic Benefits of the Scheme

The strategic benefits of the proposed residual waste trading scheme are multiple and significant.

First, the scheme directly aligns policy incentives with the objectives of the circular economy. By placing a binding limit on residual waste, it rewards waste prevention, reuse, refill and high-quality recycling, rather than encouraging a simple shift from landfill to incineration.

Second, the scheme delivers greater climate and resource efficiency benefits than disposal-focused instruments. Evidence suggests that moving waste from landfill to incineration often delivers limited, and sometimes negative, net environmental benefits. Reducing residual waste altogether provides

[2] Dominic Hogg (2025) *Cap-and-trade on residuals: Proposals for a Circular Economy Act* Report for Zero Waste Europe. October 2025.

higher climate and resource gains per tonne. That is especially true if, as we propose here, no waste is landfilled without first being stabilised to an agreed level.

Third, the scheme improves policy coherence across the EU. It helps address the current imbalance between Member States with excess incineration capacity and those still heavily reliant on landfill, and reduces the risk of lock-in to capital-intensive disposal infrastructure that delivers limited long-term benefits.

Fourth, the scheme enhances cost-effectiveness and fairness. Allowance trading enables residual waste reductions to occur where they are cheapest, while ensuring that all Member States contribute to a common EU objective. This reduces the overall cost of achieving waste reduction targets while maintaining environmental integrity.

Finally, the scheme shifts attention towards the waste streams and measures that matter most. It discourages low-impact actions that inflate recycling rates without reducing residual waste, and instead prioritises measures such as food waste prevention and effective separate collection, where the environmental benefits are greatest.

E.4.0 Conclusion

A cap-and-trade scheme for residual municipal waste represents a significant and innovative evolution of EU waste policy. It complements existing legislation, strengthens incentives for waste prevention and system redesign, and provides a flexible yet robust mechanism to drive reductions in residual waste, through recycling and upstream actions, across all Member States. If carefully designed and phased in, it could become a cornerstone instrument for delivering the EU's long-term zero waste and climate objectives. Configured as an EU-wide scheme, it also has the potential to improve implementation of waste policy across Member States.

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1.0 Introduction

Equanimator Ltd is pleased to present this Report to Reloop and Zero Waste Europe on a scheme to reduce the quantity of residual waste in the EU.

In a previous study[3], conducted in the context of the Circular Economy Act (CEA), we considered the potential role that different policy instruments might play in reducing residual waste in a manner that supports the development of a more circular economy. In highlighting the limitations of some of the instruments proposed in the public consultation on a CEA, we advanced proposals for a scheme that focussed not on banning or limiting landfill alone, or on taxing incineration, but on limiting all residual waste as a whole.

We began to explore the potential for a scheme that would place limits on residual waste, and within which, some form of trading of allotted quotas across Member States could take place. The focus on residual waste was designed to encourage both recycling *and* waste prevention, including reuse and refill, as well as remanufacturing and other ways of retaining value in products, parts and materials. It was also designed to ensure that the scheme did not simply move waste from one form of residual waste management to another, an outcome that experience with landfill bans, and tradable landfill allowances suggests may be their principal effect, though they can support other policies where they make it more expensive to manage waste as 'residual waste'.

This report takes that thinking further. It seeks to answer several key questions :

- Which wastes should be included in the scope of the scheme and how should this scope be defined?
- What would be the nature of the trading scheme, including to whom any targets would be assigned and how allowances would be issued, surrendered and accounted for?
- What advantages might it offer relative to alternative policy approaches?

2.0 Scope of Wastes for Inclusion

As discussed in the previous study, significantly more waste is landfilled than incinerated in the EU, but the difference between the two is largely accounted for by the major mineral wastes (Figure 1). [4] The amount of residual waste sent to landfill -and the combined total of waste landfilled and incinerated - is dominated by 'major mineral wastes' (MMW), which covers the following categories:

- Mineral waste from construction and demolition (EWC-Stat 12.1)
- Other mineral wastes (EWC-Stat 12.2,12.3, 12.5)

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[3] Dominic Hogg (2025) *Cap-and-trade on residuals: Proposals for a Circular Economy Act* Report for Zero Waste Europe. October 2025.

[4] Note that these statistics are derived from the Eurostat dataset on treatment of waste: these wastes cover the treatment of generated waste, net of exports and imports. In principle, the data should not include 'double counting' of flows, other than for 'combustion residues from waste incineration and energy recovery' (and presumably, co-incineration also) where the mass of the output is clearly derived from the mass input (see Eurostat (2022) Manual for the Implementation of Regulation (EC) No 2150/2002 on Waste Statistics, Draft March 2022).

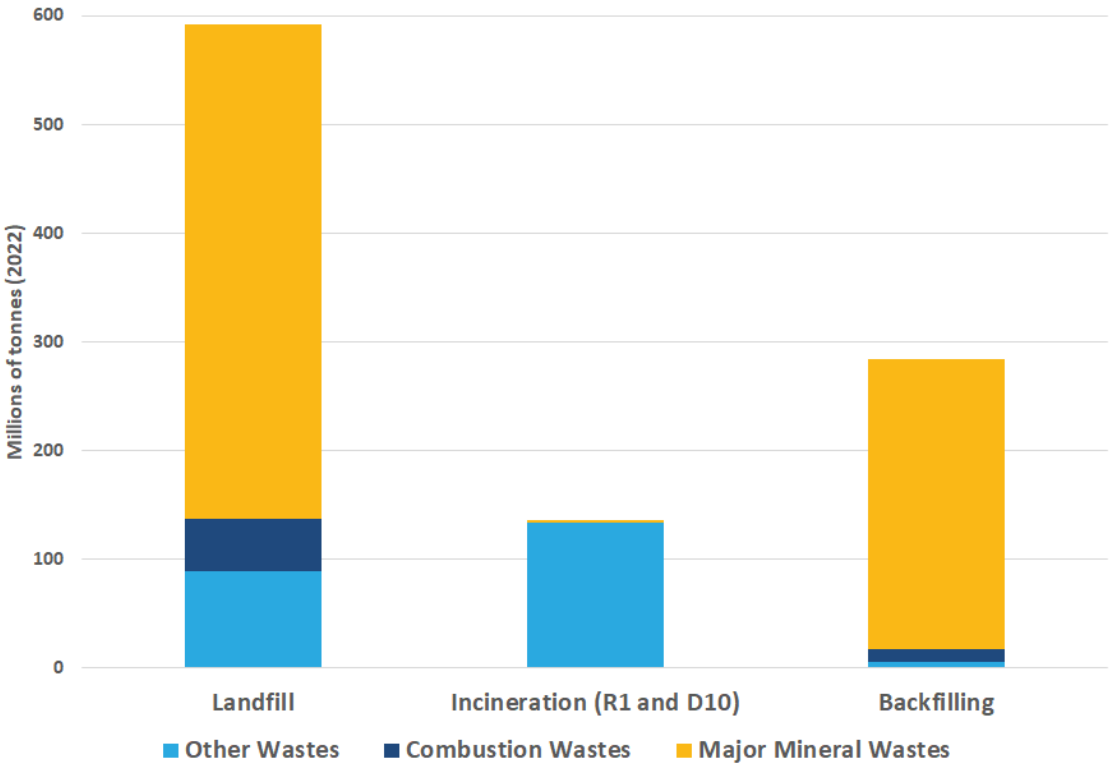
- Soils (EWC-Stat 12.6)
- Dredging spoils (EWC-Stat 12.7).

By contrast, of all wastes sent to R1 and D10 incineration, less than 2% is MMW, which are generally not combustible. In addition, a considerable quantity of MMW is backfilled.

When major mineral wastes are excluded, the quantities of waste landfilled and incinerated become more comparable. Furthermore, in 2022, approximately 36% of the wastes landfilled (excluding MMW) were, 'combustion wastes', which are not amenable to incineration, although a small portion is reported as being incinerated). Like MMW, combustion wastes are distributed unevenly across Member States.

It should be noted that 'combustion waste' (EWC-Stat 12.4) may include ash residues from co-incineration. However, ash residues from incineration are coded differently under both the European Waste Statistics regulation (EWC-Stat), where they fall under 'Mineral wastes from waste treatment and stabilised wastes' (EWC-Stat 12.8), and the List of Waste (LoW), where they fall under the 19 01 LoW.

Figure 1: Wastes Sent to Landfill, Incineration and Backfilling, MMW, Combustion Wastes and Other, EU-27, 2022 (million tonnes)



Source: Eurostat

Of the remaining wastes, the breakdown by key contributing categories is shown in Figure 2 (in which the line – plotted on the right hand axis – indicates the cumulative contribution made by the different categories, reding from left to right). For both landfill and incineration, key contributing categories are:

- Household and similar wastes
- Sorting residues
- Mixed and undifferentiated materials

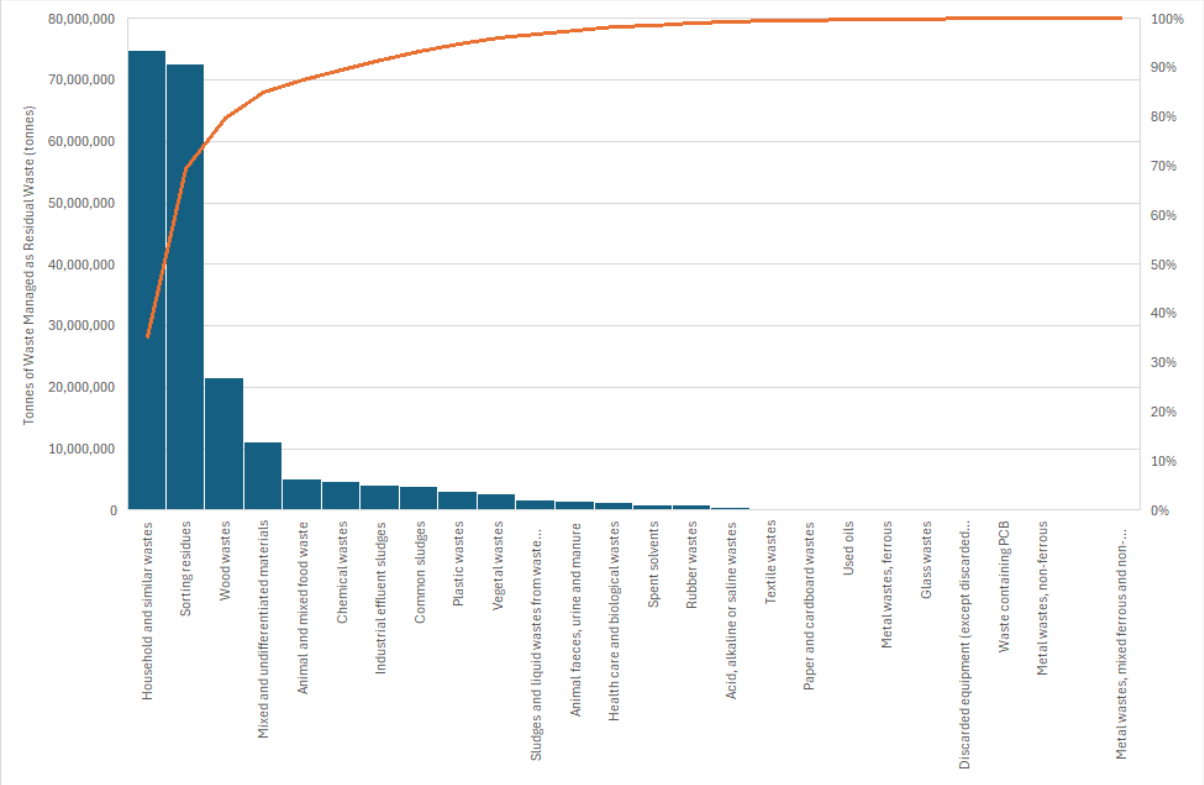
For landfills, the category ‘Mineral wastes from waste treatment and stabilised wastes’, which includes residues from incineration, makes a significant contribution (see Figure 3). Beyond this there are relatively few other major categories contributing to landfilled waste. The remaining landfilled waste - -just over 15% of the total - is composed of sludges, chemical wastes, and animal and mixed food wastes.

For incineration, a major contribution comes from ‘Wood wastes’ (see Figure 4). Other significant contributors (each exceeding 1 million tonnes) include animal and mixed food wastes, chemical wastes, sludges, plastic waste, vegetal waste, animal faeces, urine and manure and healthcare and biological wastes.

It is worth noting that categories such as ‘plastics’, as reported for the purposes of EU waste statistics, do not include the plastic component of mixed wastes. Instead, they generally reflect material what has been separated from other wastes and is identifiable as ‘plastics’. The same applies to other ‘single material’ categories, such as ‘textiles’, and ‘wood waste’.

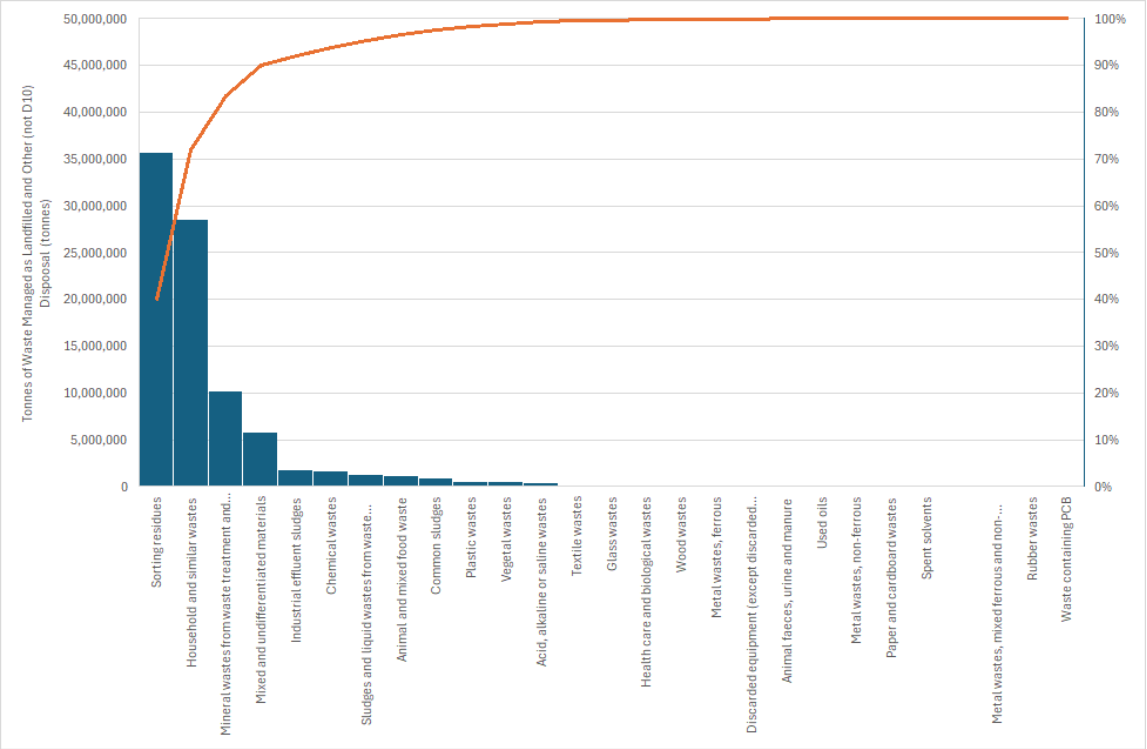
With regards to chemical wastes, the majority of the wastes managed as residual waste (approximately 85%) are classified as hazardous. The same is the case for solvents (100%) and healthcare and biological wastes.

Figure 2: Waste, Excluding MMW and Combustion Waste, sent to Landfill and Incineration, EU27, 2022, by EWC-Stat Category and Cumulative (tonnes)



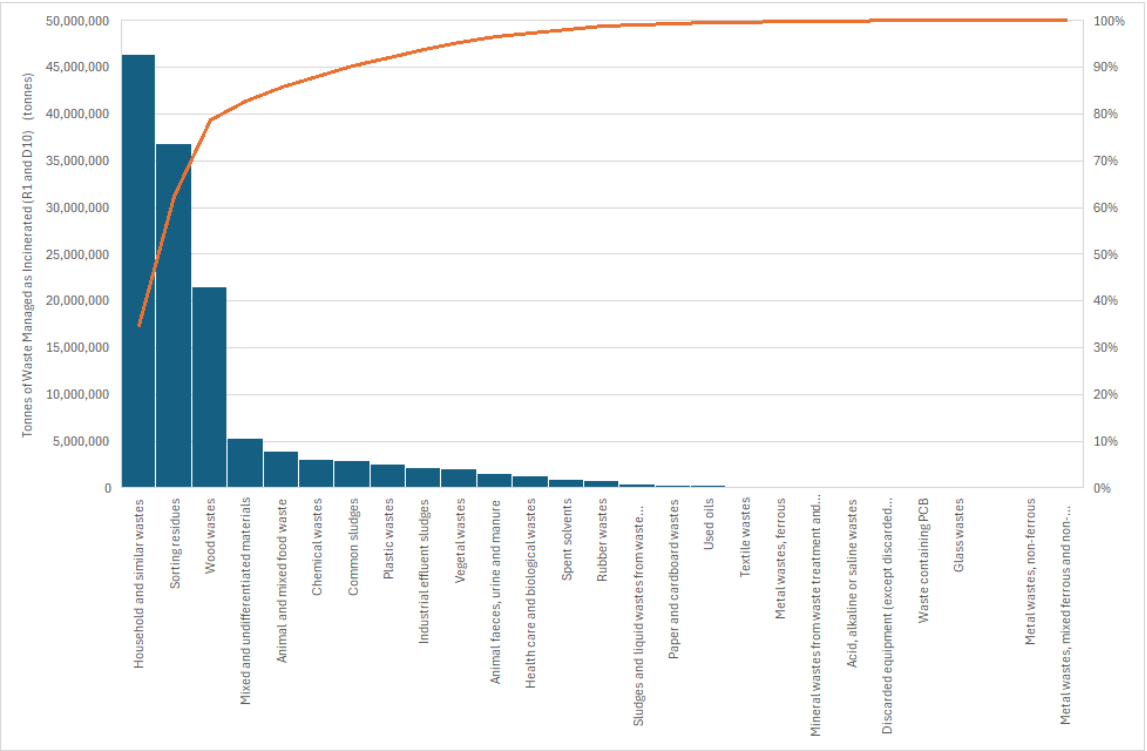
Source: Eurostat

Figure 3: Waste, Excluding MMW and Combustion Waste, sent to Landfill, EU27, 2022, by EWC-Stat Category and Cumulative (tonnes)



Source: Eurostat

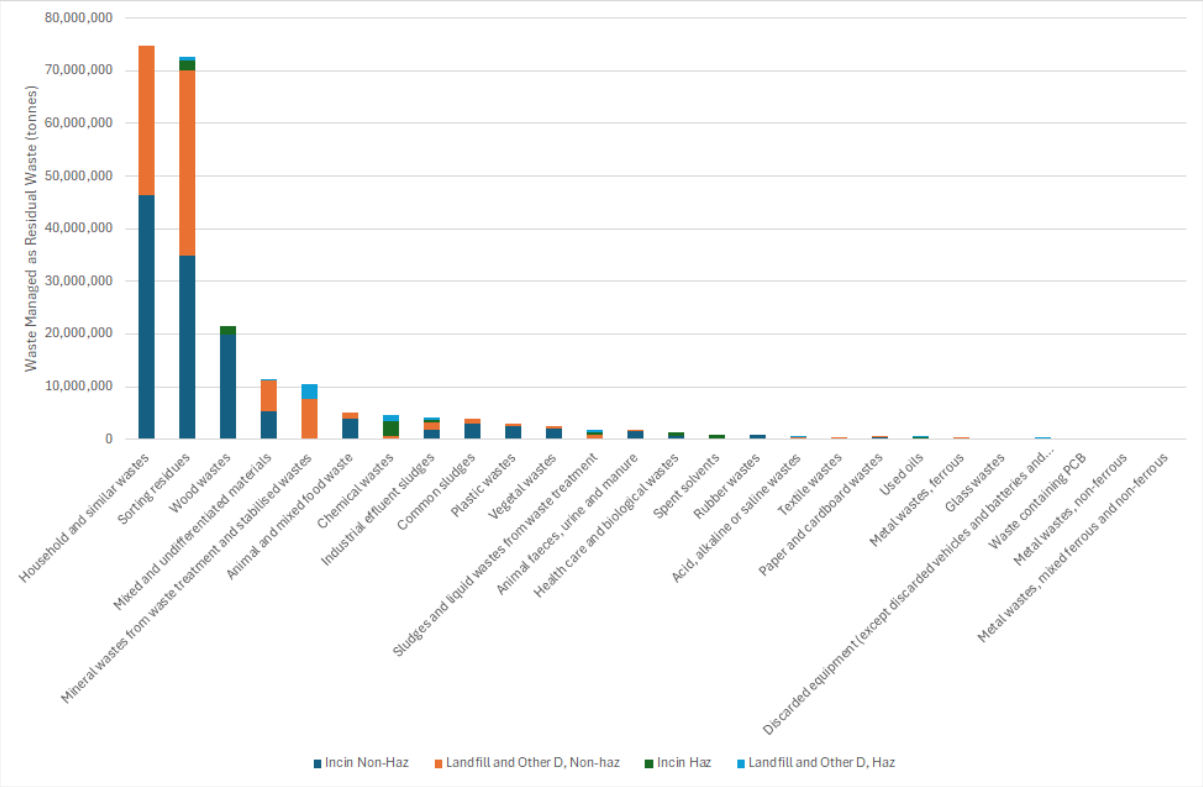
Figure 4: Waste, Excluding MMW and Combustion Waste, sent to Incineration, EU27, 2022, by EWC-Stat Category and Cumulative (tonnes)



Source: Eurostat

With regards to chemical wastes, the majority of the wastes managed as residual waste (85%) are classified as hazardous. The same is the case for solvents (100%) and healthcare and biological wastes. This hazardous / non-hazardous split is shown in Figure 5 below.

Figure 5: Waste, Excluding MMW and Combustion Waste, sent to Landfill and Incineration, EU27, 2022, by EWC-Stat Category and Hazardousness (tonnes)



Source: Eurostat

This analysis helps set the context:

- The landfilling of waste in the EU is dominated by **major mineral waste** and **combustion waste**, which are uninteresting categories from the perspective of incineration. The origin of major mineral wastes is mainly construction and demolition, and in the case of 'Other mineral wastes', the mining and quarrying industries, though with a significant contribution from manufacturing. Large quantities of these wastes are also backfilled.
  Combustion wastes are largely generated by manufacturing, mainly basic metals and fabricated metals products, and electricity supply, with some contribution from the waste sector.
- Wastes sent to incineration, on the other hand, are dominated by **household and similar wastes**, **sorting residues**, **mixed and undifferentiated materials** and **wood wastes.** With the partial exception of wood wastes, these are wastes largely derived not from the aforementioned sectors, but from households, manufacturing and services, as well as the waste management sector itself.
- Excluding major mineral wastes and combustion wastes, the wastes contributing most to landfilling are broadly similar to those sent to incineration, with the notable exception of segregated wood wastes. Overall, most waste managed as residual waste is derived from a small number of categories: five categories account for more than 85% of residual waste, though one of these, wood waste, is largely incinerated, and another, Mineral wastes from waste treatment and stabilised wastes, is largely landfilled, and arises mainly as residues from incineration.

These considerations are relevant when assessing policies and approaches aimed at reducing waste sent for landfill and incineration.

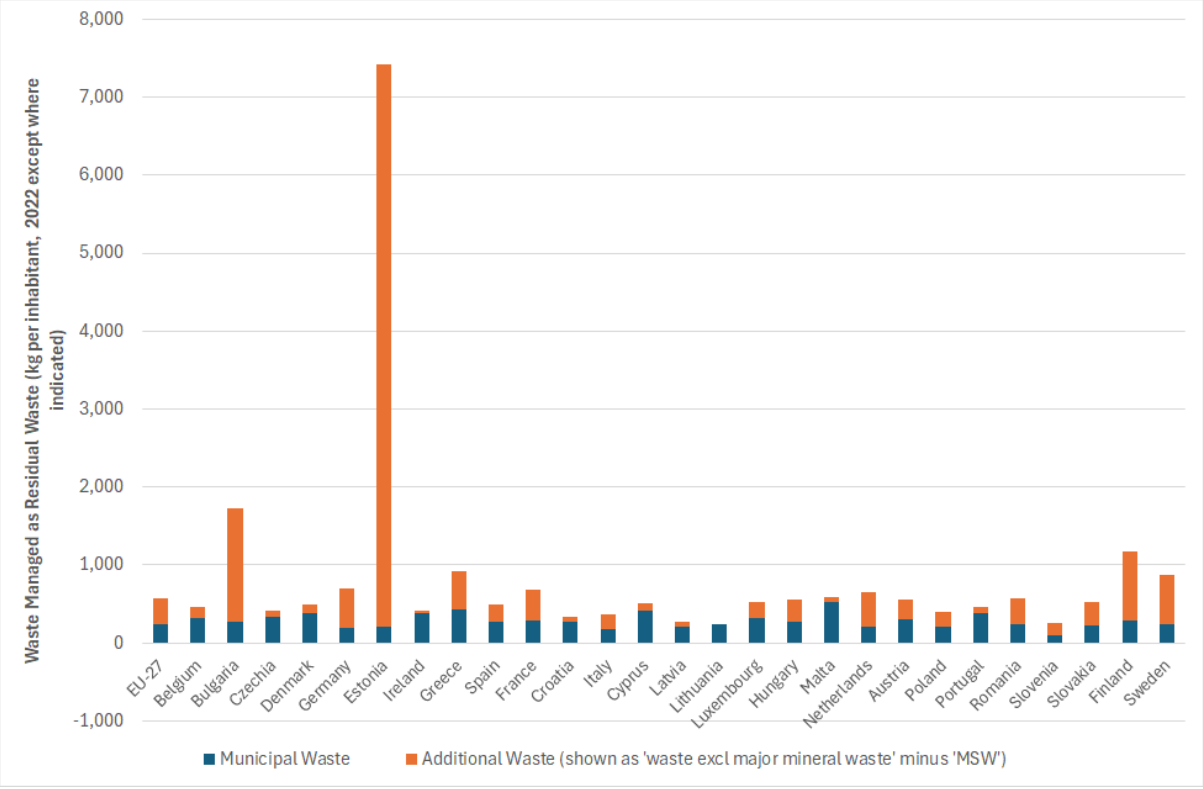
Eurostat already recognises the distinctive nature of major mineral wastes generation. It therefore provides a dataset reporting on 'all waste excluding major mineral wastes', designed to give a more comparable picture across Member States. This approach reflects the fact that activities such as mining and quarrying are unevenly distributed across the EU Member States, with some having greater or more readily accessible reserves than others.

In Figure 6, we present data, based on Eurostat data for 2022, on:

- Waste, other than major mineral waste, sent to D10 and R1 incineration, and to landfill and other disposal (D1-D7 and D12); and
- 'Municipal waste' sent to D10 and R1 incineration, and landfill and other disposal (D1-D7 and D12).

Inspection of these data shows that the remaining 'gap' is still influenced by activities and wastes that are unevenly distributed across Member States. We have already alluded to one of these which is 'combustion wastes'. Combustion wastes are generated primarily by 'Manufacturing', 'Electricity, gas, steam and air conditioning supply' with these two sectors contributing 80-90% of the total. Any contribution from the waste sector in this category should be understood as relating to co-incineration, rather than incineration. This also explains the exceptional figures for Estonia and Bulgaria, both of which indicate large quantities of combustion waste generation (2.084kg/inh. and 4,737 kg/inh., respectively, in 2022) in their reporting.

Figure 6: Waste Managed Through Landfill and Incineration, MSW, and Additional Waste (Waste Excluding MMW minus MSW), EU Member States, 2022, kg/inhabitant



Source: Eurostat

Given the above, and acknowledging that data available and statistics are not without limitations, it is nevertheless reasonable to consider that the waste sent to landfill and incineration as comprising the following components:

a) Household waste;
b) Municipal waste originating from sources other than households, the amount varying according to the way in which Member States report on 'municipal waste';
c) An additional amount that makes up the balance of 'residual waste, excluding MMW and combustion waste', which includes:
    - Additional residues from sorting;
    - Additional amounts of mixed and undifferentiated materials
    - Wood wastes;
    - Mineral wastes from waste treatment, around a quarter of which are hazardous;
    - Additional Animal and mixed food wastes;
    - Chemical wastes, much of which are hazardous;
    - Industrial effluent sludges, around 20% of which are hazardous;
    - Additional common sludges;
    - Additional plastic wastes;
    - Sludges and liquid wastes from waste treatment, just under half of which are hazardous;
    - Animal faeces, urine and manure;
    - Healthcare and biological wastes, much of which are hazardous;
d) MMW and combustion wastes

In addition to the above, a considerable quantity of waste is backfilled. This is mainly MMW and combustion waste, but also includes considerable amounts of 'Mineral wastes from waste treatment and stabilised wastes' and 'sorting residues', as well as some sludges and liquid waste from waste treatment, certain 'glass wastes' and some 'chemical wastes'. It remains an open question whether all materials currently sent for backfilling pass the relevant tests, and might not instead be put to higher-value uses.

2.1 Implications for Measures to Limit Landfilling and Incineration

An economic instrument designed to reduce landfilling and incineration would, if it covered all of the waste described above, be likely to have an effect dominated by its impact on MMW and combustion wastes. The costs of landfilling and backfilling these wastes are likely to differ substantially from the costs of landfilling or incinerating the other types of residual waste. In practice, the wastes may also be managed at different types of landfill sites. According to Eurostat, there were more than 3,500 inert landfills in operation in the EU-27 in 2022, as well as 7,070 backfilling operations. In addition, EU Member States may regulate these wastes somewhat differently, for example, with respect to the extent to which sites designated as 'recovery sites' may be exempted from permitting requirements under Article 24 of the Waste Framework Directive.

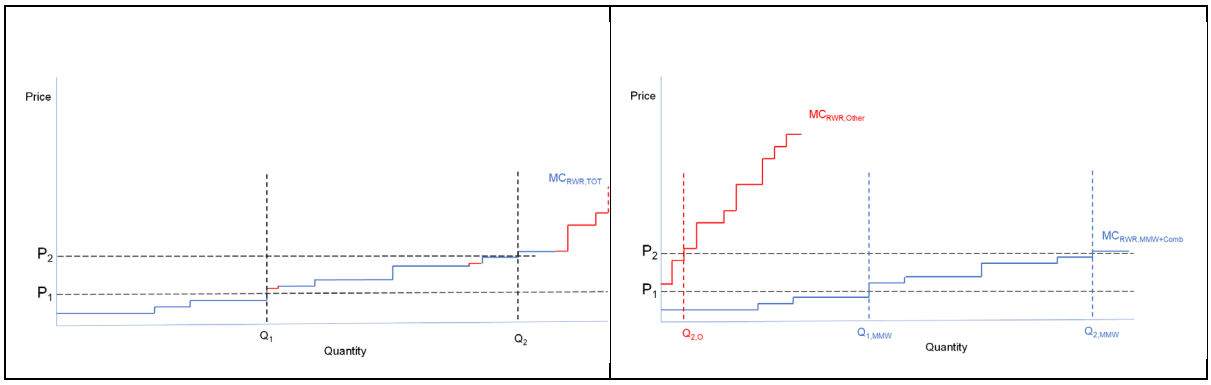
Without full details being available, the marginal costs of avoiding landfill or incineration for major mineral and combustion wastes would be expected to be relatively low. This would be especially true if no restrictions were placed on backfilling, as a considerable amount of waste could be diverted from landfill to backfilling instead. Consequently, some of the other wastes could remain relatively unaffected until relatively severe constraints on the quantities permitted for landfilled or incineration were introduced.

This effect is illustrated conceptually in Figure 7. The left hand-side panel shows the marginal cost curve for 'residual waste reduction' (RWR) for all wastes, and the effect of imposing a restriction on

landfilling and incineration sufficient to reduce residual waste by Q_1, and then, Q_2. In a well-functioning market, this would generate an allowance price approximately P_1, rising to P_2 as the restriction becomes more stringent, assuming allowances are auctioned.

The right-hand panel disaggregates the overall marginal cost curve for RWR into two separate curves: one for 'MMW and combustion wastes', and one for all other wastes. The aggregate marginal cost curve shown in the left-hand graphic is the sum of these two curves. The reduction Q1 comes entirely from the MMW and combustion wastes (left hand side Q_1 = right hand side $Q_{1,\,MMW}$). The larger reduction Q2 is achieved mostly through reductions in these wastes, with only a relatively small contribution from 'other' wastes (left hand side Q_2 = right-hand side $Q_{2,\,MMW} + Q_{2,\,O}$).

Figure 7: Potential Impact of Restrictions Covering All Wastes



Source: Equanimator

If all wastes were included within scope of the scheme, then even apparently significant reductions in residual waste achieved though residual waste reduction (RWR) measures might arise mainly, or entirely, from actions relating to MMW and combustion wastes. This would not least be due to the very large quantities of these wastes. Other wastes could therefore remain largely unaffected by the scheme.

Such an outcome might be considered acceptable if, for example, the principal objectives were to reduce the disamenity associated with the existence of landfills (though this might be offset by any disamenity associated with alternatives), or to increase the likelihood that a greater share of MMW and combustion wastes were recycled. If, on the other hand, the principal objectives were instead to reduce methane emissions, or to increase the recycling of materials other than MMW and combustion wastes, where the benefits on a tonne-for-tonne basis are greater[5], then it seems appropriate to consider these wastes separately.

On balance, we believe this argument to be persuasive, not only for the economic reasons outlined above, but also because:

- the MMW and combustion wastes are managed almost exclusively through landfills, not incinerators;

[5] See, for example, J.H. Sund, P.F. Albizzati, C. Scheutz, D. Tonini (2025) Comprehensive assessment of environmental and economic impacts of the entire EU waste management system, *Waste Management*, Volume 204, 2025,

- the landfills used for such wastes might not be the same landfills as are used for other wastes. The Landfill Directive distinguishes between three classes of landfill, one being for inert waste;[6]
- MMW and combustion wastes are also the wastes most likely to be backfilled.[7] The extent to which backfilling is, or should remain, an option available for the 283 million tonnes managed via this option deserves closer examination. However, as long as backfilling remains available as an option, there is a risk that any scheme seeking to limit landfilling and incineration could be undermined by the excessive reliance on this option.

It would, nonetheless, be useful to consider measures to address the MMW and combustion wastes, not least to increase the value derived from them. Such measures could include the use of taxes on primary aggregates, and potentially, on other minerals. Such measures have the effect of enhancing the value of recovered materials. Unfortunately, restricting residual waste can, where these wastes are concerned, have perverse consequences (in terms of illegal dumping). Electronic tracking of waste movements may help in this regard, alongside enhanced enforcement and associated penalties.

Assuming that MMW and combustion wastes are not to be included in the scope of the instrument we are considering, this still leaves open the question of whether all 'other' wastes should be included within such a scheme, and whether some MMW (and combustion wastes) might be considered within scope.

2.2 Focussing In

In our previous study, we initially identified at least five options for defining the scope of a residual waste scheme:

- Household waste;
- A specified 'range' of wastes;
- All wastes sent to incineration and to all hazardous and non-hazardous landfills;
- Municipal waste; and
- All wastes other than major mineral wastes (and other exclusions, such as combustion wastes).

We looked at the final two options in greater detail and, on balance, favoured setting a target in terms of residual MSW per capita. This was considered to provide a 'fair' and transparent basis on which to distribute an EU-level restriction across Member States:[8]

> *The differential between the two metrics (municipal waste and all waste other than major mineral waste) exhibits enormous variation across the Member States. Given this wide variation (likely, reflecting the specific industrial structures and power mix in different Member States), the longer history of data collection for MSW, and the need to harmonise data on MSW for other*

[6] The scope of the Landfill Directive also excludes '*the use of inert waste which is suitable, in redevelopment / restoration and filling-in work, or for construction purposes, in landfills*' (Article 3.2).

[7] Backfilling accounted for 15% of Combustion wastes: this is the highest proportion of waste backfilled for any waste category other than soils (44%). '*Mineral wastes from waste treatment and stabilised wastes*' accounted for more than 50% of the 'other' wastes being backfilled.

[8] Dominic Hogg (2025) *Cap-and-trade on residuals: Proposals for a Circular Economy Act* Report for Zero Waste Europe. October 2025.

purposes, then it appears more appropriate to use residual MSW per capita as the basis for cap setting.

Note that the 'amount of mixed MSW collected', measured per inhabitant per year, is considered by the JRC as a key indicator of performance of municipal waste systems (and notwithstanding the wording, the indicator includes post-collection rejects and excludes recyclables sorted from mixed waste).[9]

As a reminder, municipal waste is defined, in the Waste Framework Directive, as:

2b. '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;

We considered each of the EWC-Stat categories with a view to understand the correspondence between the EWC Stat codes and LoW codes likely to fall under a definition of MSW. A publicly available document setting out the correspondence between the EWC Stat codes and the LoW codes has informed the selection of LoW codes set out at Appendix 1.[10] The European Commission also provides some pointers on the interpretation of the definition of MSW in its Guidance on MSW statistics.[11] Although this Guidance does not completely clarify matters, it also includes a mapping of 'municipal waste' to selected LoW codes as shown in the box below.

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[9] See Dri M., Canfora P., Antonopoulos I. S., Gaudillat P., (2018) *Best Environmental Management Practice for the Waste Management Sector*, JRC Science for Policy Report, EUR 29136 EN, Publications Office of the European Union, Luxembourg, 2018.

[10] Guidance on classification of waste according to EWC-Stat categories: Supplement to the Manual for the Implementation of the Regulation (EC) No 2150/2002 on Waste Statistics, Version 2, December 2010. The document states:

'The European List of Wastes (LoW) is the waste classification in the EU for administrative purposes, i.e. for permitting and supervision in the field of waste generation and management […]
Whereas the Waste Statistics Regulation stipulates that the EWC-Stat has to be used for the reporting of data to Eurostat it does not prescribe a specific classification to be used for data collection. Countries are free to use any waste classification as long as they can produce the defined formats in the required quality.
In practice, most of the countries collect their data according to the List of Waste and convert it subsequently into the required EWC-Stat-categories on the basis of the transposition table in Annex III of the Regulation. The direct use of the EWC-Stat for data collection is applied only by a few countries. Where countries use the EWC-Stat for data collection, the present guidance document is of particular help to clarify which wastes are covered by the defined reporting categories.'

[11] European Commission (2023) Guidance for the compilation and reporting of data on municipal waste according to Commission Implementing Decisions 2019/1004/EC and 2019/1885/EC, and the Joint Questionnaire of Eurostat and OECD Guidance for the compilation and reporting of data on municipal waste, Version of 6th October 2023.

The LoW codes in the box match almost exactly those we selected (see Appendix 1). This suggests that, at least as regards waste generation, there is a sound basis for linking to scope of our policy to LoW codes, and that this can support the use of 'residual MSW per inhabitant' as the key target for the scheme. A problem, however, lies in ensuring that LoW codes that are not explicitly linked to a specific source of waste can be reliably identified as originating from 'household and other similar sources'. There is further work to be done to ensure reporting is more consistent in this regard.

Chapter 20: Municipal wastes (Household waste and similar commercial, industrial and institutional wastes) including separately collected fractions
20 01 separately collected fractions (except 15 01)
- 20 01 01 paper and cardboard
- 20 01 02 glass
- 20 01 08 biodegradable kitchen and canteen waste
- 20 01 10 clothes
- 20 01 11 textiles
- 20 01 13* solvents
- 20 01 14* acids
- 20 01 15* alkalines
- 20 01 17* photochemicals
- 20 01 19* pesticides
- 20 01 21* fluorescent tubes and other mercury-containing waste
- 20 01 23* discarded equipment containing chlorofluorocarbons
- 20 01 25 edible oil and fat
- 20 01 26* oil and fat other than those mentioned in 20 01 25
- 20 01 27* paint, inks, adhesives and resins containing dangerous substances
- 20 01 28 paint, inks, adhesives and resins other than those mentioned in 20 01 27
- 20 01 29* detergents containing dangerous substances
- 20 01 30 detergents other than those mentioned in 20 01 29
- 20 01 31* cytotoxic and cytostatic medicines
- 20 01 32 medicines other than those mentioned in 20 01 31
- 20 01 33* batteries and accumulators included in 16 06 01, 16 06 02 or 16 06 03 and unsorted batteries and accumulators containing these batteries
- 20 01 34 batteries and accumulators other than those mentioned in 20 01 33
- 20 01 35* discarded electrical and electronic equipment other than those mentioned in 20 01 21 and 20 01 23 containing hazardous components
- 20 01 36 discarded electrical and electronic equipment other than those mentioned in 20 01 21, 20 01 23 and 20 01 35
- 20 01 37* wood containing dangerous substances
- 20 01 38 wood other than that mentioned in 20 01 37
- 20 01 39 plastics
- 20 01 40 metals
- 20 01 41 wastes from chimney sweeping
- 20 01 99 other fractions not otherwise specified

20 02 garden and park wastes (including cemetery waste)
- 20 02 01 biodegradable waste
- 20 02 03 other non-biodegradable wastes

20 03 other municipal wastes
- 20 03 01 mixed municipal waste
- 20 03 02 waste from markets
- 20 03 03 street-cleaning residues
- 20 03 07 bulky waste
- 20 03 99 municipal wastes not otherwise specified

Chapter 15 Waste packaging; absorbents, wiping cloths, filter materials and protective clothing not otherwise specified
15 01 packaging (including separately collected municipal packaging waste i.e. also waste similar to household waste)
- 15 01 01 paper and cardboard packaging
- 15 01 02 plastic packaging
- 15 01 03 wooden packaging
- 15 01 04 metallic packaging
- 15 01 05 composite packaging
- 15 01 06 mixed packaging
- 15 01 07 glass packaging
- 15 01 09 textile packaging
- 15 01 10* packaging containing residues of or contaminated by dangerous substances
- 15 01 11* metallic packaging containing a dangerous solid porous matrix (for example asbestos), including empty pressure containers

Source: European Commission (2023) Guidance for the compilation and reporting of data on municipal waste according to Commission Implementing Decisions 2019/1004/EC and 2019/1885/EC, and the Joint Questionnaire of Eurostat and OECD Guidance for the compilation and reporting of data on municipal waste, Version of 6th October 2023.

The data reported by Eurostat on MSW generation data might be expected to approximate closely to EWC-Stat data on:

- the amount of 'household and similar waste' generated by households, plus
- the amount of 'household and similar waste' generated in other NACE sectors, plus
- the amount of waste generated by households which is reported under categories other than 'household and similar waste', for example, because wastes are collected separately and reported as specific materials.

For 2022, data for the EU27 indicate that:

- 233 kg/inh. are 'household and similar waste' from households;
- 206 kg/inh. are waste from households but not reported as 'household and similar waste', for example, because they are separately collected); and
- 56 kg/inh. are 'household and similar waste', but reported as being generated by NACE sectors other than 'households'.

That gives a total of 495 kg/inh., or 477 kg/inh. if mineral waste from construction and discarded vehicles are excluded, as these wastes fall outside the WFD definition of MSW.[12]

In the same year, MSW generation was reported as 514kg/inh.[13] This leaves a 'gap' of 37kg/inh.[14] It is possible that part of this difference is accounted for by the inclusion, in EWC-Stat coding, of two categories of municipal waste - 20 02 02 soils and stones, and 20 02 03 other non-biodegradable wastes, under Soils and other mineral wastes, respectively. It might be expected that the service sector excluding wholesale of waste and scrap, could be the source of this additional contribution.

Operators of facilities tend to use LoW codes, or closely linked national variants, in their record keeping and reporting, and many Member States rely on these codes as the basis for reporting under EWC-Stat categories. It is therefore worth considering whether the types of 'other' waste (i.e. wastes excluding MMW and combustion waste) being managed as residual waste, as shown in Figure 2, would fall within a definition of municipal waste, and what operational challenges this might create.

A key issue is whether the relevant wastes can be readily identified along the chain of supply, and how easy it might be to misclassify, deliberately, certain wastes as falling outside the scheme's scope when they should properly be included. Receiving installations must be capable of making this distinction, or be in possession of documentation that allows the distinction to be made, so that the distinction must be preserved along the supply chain.

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[12] Note that the way in which wastes related to small refurbishment jobs on homes, which may lead to construction-type wastes being generated by households, and sent to household waste facilities, may not be being reported consistently by different Member States. Even the decision-tree in the European Commission's Guidance seems to suggest that anything other than septic tank sludge, waste from sewage cleaning, and separately collected 'soil and stones' that is generated by households is municipal waste (see European Commission (2023) Guidance for the compilation and reporting of data on municipal waste according to Commission Implementing Decisions 2019/1004/EC and 2019/1885/EC, and the Joint Questionnaire of Eurostat and OECD Guidance for the compilation and reporting of data on municipal waste, Version of 6th October 2023).

[13] Note that in the same year, the figure for 'waste excluding MMW' was 1,771kg/inh., dropping to 1,574 kg/inh. when combustion wastes are excluded, of which 1,245 kg/inh. are 'primary' wastes (i.e. excluding the secondary wastes arising from waste treatment).

[14] The same 'correspondence' was conducted for specific selected Member States and the 'gap' is never straightforward to explain (sometimes, the 'gap' is a negative number).

Finally, since our proposed scheme is focusing on residual waste and that robust monitoring and verification of reported data would be required, the ability to trace waste flows through the system is important. This reinforces the importance of understanding waste flows through all treatment operations so that the residuals from such processes can be traced back to their source waste streams. In this context, particular attention will need to be paid to LoW codes relating to outputs from waste management activities (the 19 XX XX codes). The inputs of greatest relevance are those wastes falling under the scope of municipal waste, while the outputs of interest are those derived from these inputs.

We also considered whether the scheme – which is intended mainly to report on the quantity of waste landfilled or incinerated – should also include residues from these processes(such as landfill leachate, or ash residues from incineration. There are arguments on either side: on balance, however, so as to avoid the potential risk of double counting 'residual waste management', we believe the scheme should 'stop' at the point at which waste is consigned to the body of a landfill, or enters the thermal treatment step at an incineration facility. There may, nevertheless, be reasons to revisit this position at a later date.

Given that a residual waste target would be 'weight based', it would be important to avoid perverse incentives arising from the accounting mechanism. In the case of waste destined for landfill, it may be important to guard against the mechanism promoting biodrying, or other forms of drying waste purely as a means to further progress towards compliance, since reducing moisture content, the recorded weight of waste would be lower. In other studies, we have argued instead for a requirement to treat waste to reduce its biodegradability.[15] Such treatment also reduces the mass of waste, but does so through the consumption of organic material by micro-organisms as well as through moisture loss. In such a biostabilisation process, biodegradation ceases if there is insufficient moisture present (so that moisture content must be maintained), whereas in biodrying processes, the emphasis is purely on reducing moisture content via the heating of the waste caused by aerobic biodegradation.

Similar issues arise in relation to waste sent for incineration, although there may be countervailing factors at play. For example, other things being equal, drying waste increases its net calorific value, which may reduce the weight of waste that can be treated by a given facility. Subject to contractual constraints, this could lead to higher gate fees A range of interacting factors is therefore at play, and it would be preferable to minimise incentives for 'drying without purpose'. Where biodrying is deployed as a means to produce a refuse derived fuel, this is typically (not always) done to meet the requirements of specific types of (co-)incineration installations.

Non-marginal changes of this nature would, however, require new investments in such treatment facilities, which seems unlikely if such changes were motivated solely by the residual waste target. It might be more likely in the context of an investment in an integrated facility incorporating mixed waste sorting. In this case, the nature of outputs destined for landfill or incineration would depend on the relative costs of incineration, and landfilling of stabilised waste with Member State-specific policies likely to play a decisive role.

[15] See Equanimator (2021) *Rethinking the EU Landfill Target*, Report for Zero Waste Europe, October 2021, https://zerowasteeurope.eu/library/rethinking-the-eu-landfill-target/; Dominic Hogg (2022) *The Case for Sorting Recyclables Prior to Landfill and Incineration*, Special Report prepared for Reloop, June 2022; Dominic Hogg and Dinkar Suri (2023) *Nothing left behind: Modelling MRBT to maximise recovery of resources and minimise contributions to climate change*, Report for Zero Waste Europe, April 2023.

3.0 Effects of Existing Policies in Member States

Another relevant issue concerns the role played by the wide variety of policies affecting landfill and incineration in the different Member States. These range from situations in which little or no policy is in place, to cases where levies are applied to incineration, and where landfilling of specific types of waste, or wastes with particular characteristics, is subject to both levies and outright bans.

Though the most profound effect is often on the shares of landfill and incineration in the management of residual waste, a further effect of these policies may be to provide a slightly stronger economic rationale for undertaking actions that reduce residual waste than would otherwise be the case. This is shown diagrammatically in Figure 8, which shows, for 'municipal type waste', how the level of economically driven residual waste reduction may change as policy conditions move between:

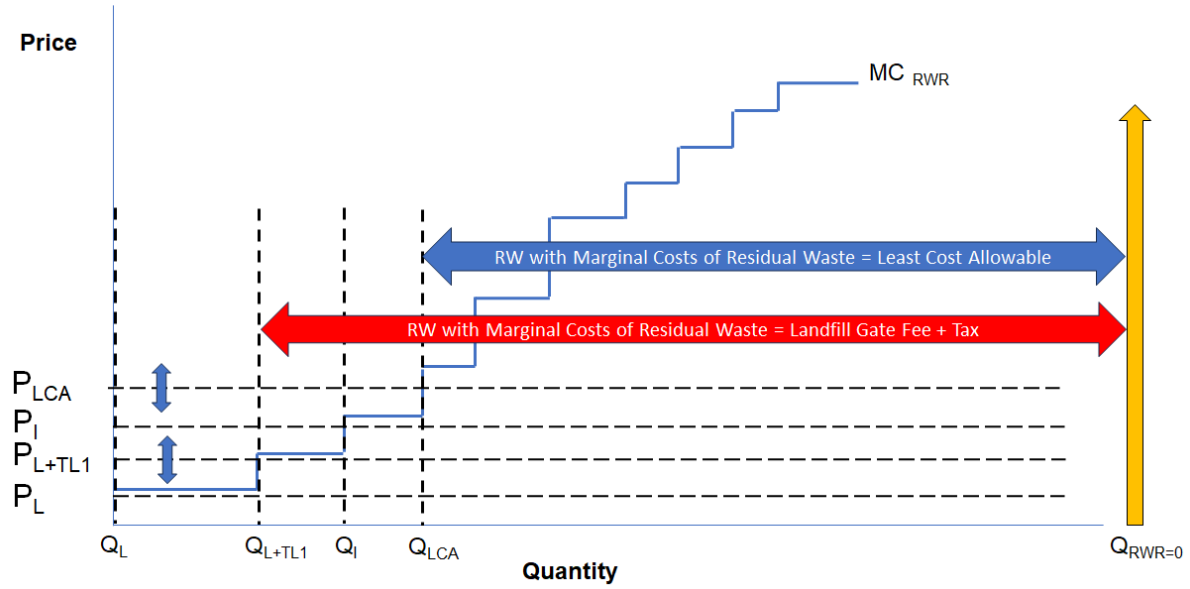
- a situation in which the lowest cost option for managing residual waste is landfilling, with no tax applied (P_L);
- to a situation in which a landfill tax at a rate T_1 is introduced, increasing the lowest cost of managing residual waste increases to P_{L+T1};
- to a situation in which landfill is either banned, subject to mandatory treatment, or taxed at a level that makes incineration the lowest cost option for managing residual waste P_I, and
- to a situation in which, with various policy instruments in place, the lowest cost available (LCA) for managing residual waste is represented by P_{LCA}.

Note that it is assumed that moving through these scenarios implies a progressive increase in the costs of managing residual waste. Note also that P_{LCA} may reflect the costs of managing waste either through landfill or incineration, depending on the particular mix of policies being applied. In the illustration, rising costs of managing residual waste render an increasing number of RWR measures economically viable. As these measures are taken up, the amount of residual waste falls.

If the quantity of waste generated in the absence of any RWR activity is represented on the x-axis by the position of the orange arrow ($Q_{RWR=0}$), then, at a given price of managing residual waste, the amount of residual waste (RW) remaining to be managed is represented by the gap between $Q_{RWR=0}$ and the level of RWR undertaken.

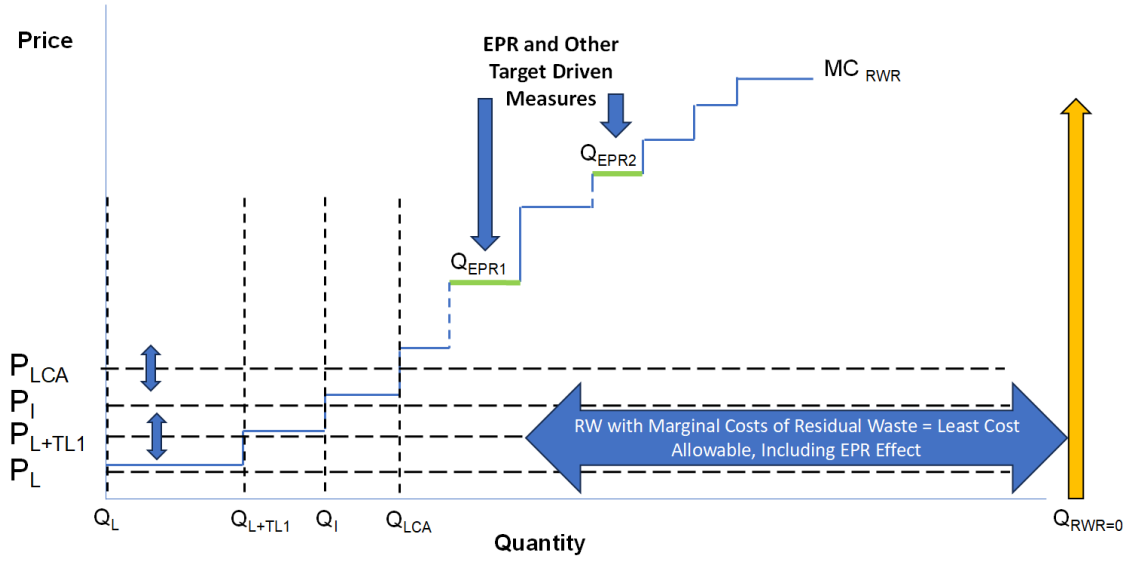
Note that not all RWR measures are driven by the price of landfilling / incinerating residual waste. Other mechanisms, such as extended producer responsibility, or requirements for separate collection of various wastes, may lead to RWR measures being taken up that are not economically justified solely by the price of landfilling / incinerating residual waste. That can lead to additional RWR taking place (see Figure 9).

Figure 8: Effects of Policies on Economic Drivers for Residual Waste Reduction



Source: Equanimator

Figure 9: Effects of Policies on Economic Drivers for Residual Waste Reduction



Source: Equanimator

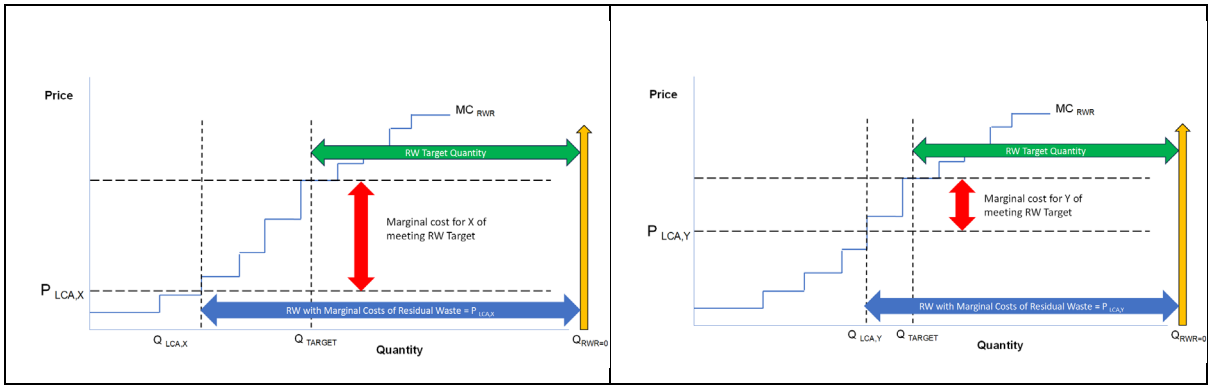
All of this has implications for the marginal costs- over and above those rising from existing policies- of undertaking activities that reduce residual waste further. In principle, the costs of deploying a given residual waste reduction measure may be the same, or similar, in different Member States. What varies, however, is the extent to which existing policies reduce the costs of undertaking such measures relative to a 'business as usual' scenario.

This point is illustrated by the two otherwise identical cases shown on the left and right sides of Figure 10. In both cases, a residual waste target has been set, and in both cases, the amount of

waste generated in the absence of RWR is represented by $Q_{RWR=0}$. Both entities, X and Y (left-, and right-hand side, respectively) face the same marginal cost curve for RWR. However, the entity X faces lower costs of managing residual waste($P_{LCA,X}$) while entity Y faces higher costs ($P_{LCA,Y}$).

As a result, the marginal cost of the additional RWR required to achieve the target, measured relative to existing waste management practices, is higher for X than it is for Y. Under these circumstances, Y would not be willing to pay as much as X for an allowance to landfill or incinerate an additional tonne of waste.

Figure 10: Implications of Higher and Lower Landfill / Incineration Costs on Marginal Costs of Meeting a Specified Residual Waste Target

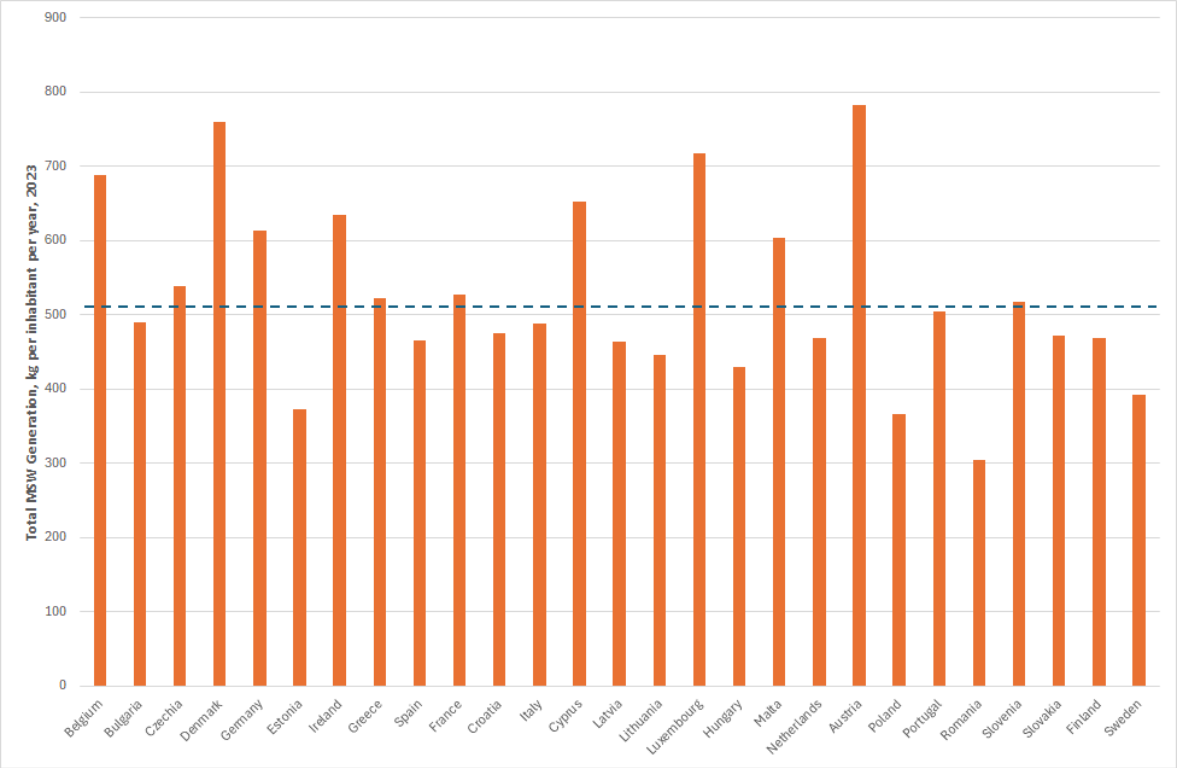


Source: Equanimator

This might matter in the context of systems designed to trade either allowances to landfill or incinerate waste, or 'quota' for residual waste to be landfilled or incinerated, since differences in Member State policies will affect the value that participants are willing to bid for allowances or quota. While this issue may be less significant in a trading system that was restricted to a single Member State, it does raise questions as to whether this needs to be addressed in the context of a scheme that is designed to work across Member States, and if so how.

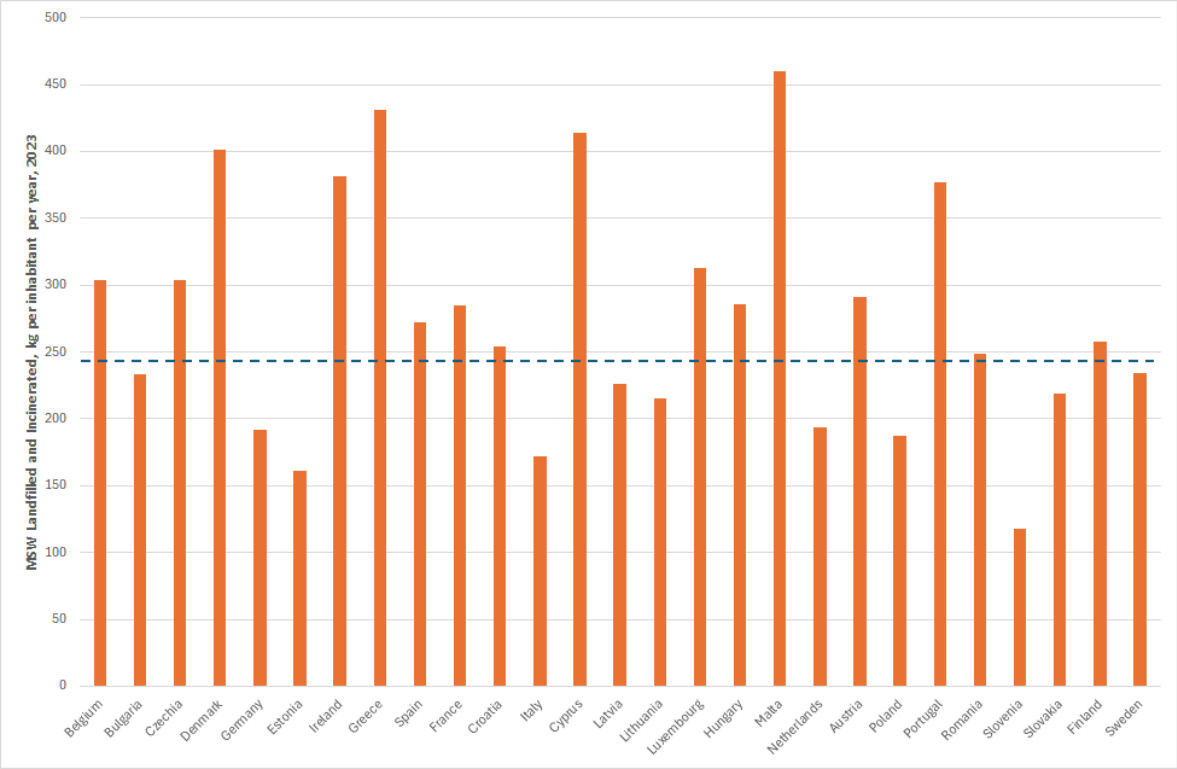
In practice, the above situation, whilst helpful in demonstrating the principle, is somewhat unrealistic: where policy drives quite different prices for residual waste management, all other things are rarely equal. $Q_{RWR=0}$ varies significantly (see Figure 11), and the cost curves for RWR will not be identical. Furthermore, the variation across the quantities of MSW sent for landfill and incineration shows no obvious pattern (see Figure 12). These parameters, and the variables underlying them, may also be significant. Note that similar questions already arise in the context of the EU Emissions Trading Scheme, where Member State policies on greenhouse gas emissions interact with the trading of EU allowances.

Figure 11: MSW Generation by Member State (kg/inh, 2023)



Note: the horizontal dotted line represents the EU average = 511kg/inh

Figure 12: MSW Landfilled / Incinerated by Member State (kg/inh, 2023)



Note: the horizontal dotted line represents the EU average = 243kg/inh

One possible approach, were it to be considered fundamental to address this, would be to adjust bids and offers for allowances / quota originating from different Member States to reflect the average costs of residual waste management in the Member State concerned. A bid / offer from a given Member State would be increased in line with the difference in its average costs of residual waste management relative to the cost of residual waste management in the least cost Member State. The relevant market clearing mechanism would operate with such adjusted values, and the agreed clearing price would have the reverse adjustment applied to the successful buyers and sellers. This would be possible, but agreeing average prices for residual waste management would not be without its problems: the price actually paid for landfill or incineration of waste can be set out contractually, but equally, the price can be the result of spot market transactions, with these prone to fluctuations in (sometimes local) supply and demand of residual waste. The age of a facility – the year in which it commenced operation – may also have an effect on prices. Though not without problems, this could, though, be a means of dealing with this matter should that be considered essential.

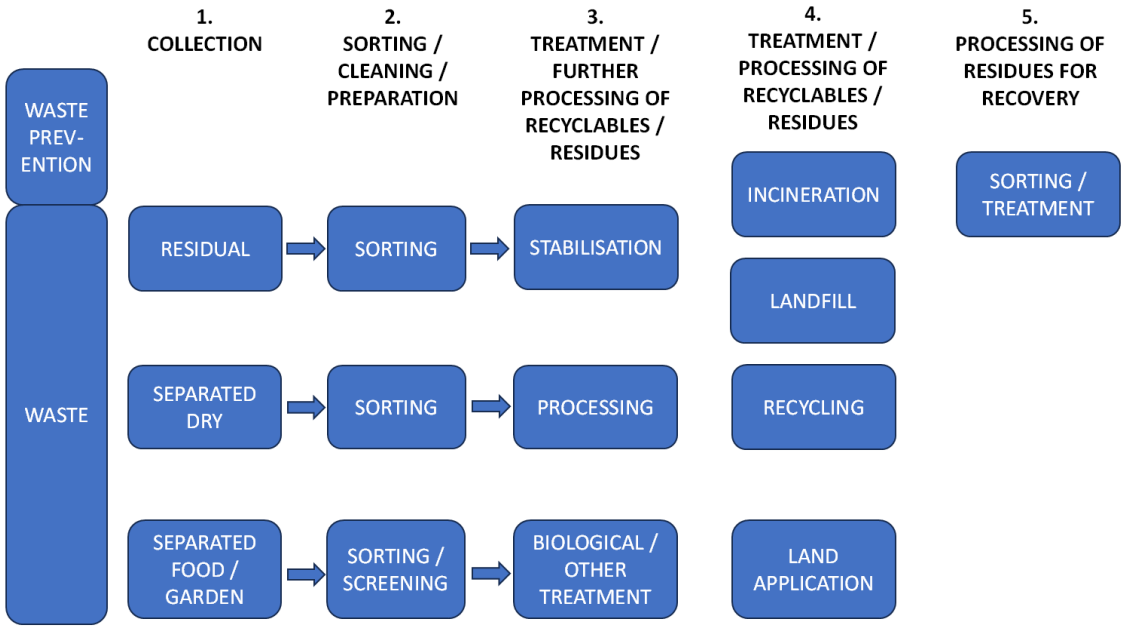
4.0 Possible Addressees for a Residual Waste Trading Scheme

In our previous study, we briefly considered the issue of which entities might be the most appropriate addressees. The supply of the types of wastes under consideration generally follows the flow in the schematic shown in Figure 13. (there may be, for example, more than one sorting step, but the flow is broadly as shown). One reason for seeking a more precise definition of 'municipal waste' is that, in the past, Member States have included wastes of varying scopes in the past. Indeed, some limited the reporting to what was collected 'by, or on behalf of' local authorities in the different Member States.

The revised definition aims to achieve greater harmonisation, with the result that not all 'municipal waste' is necessarily under the control of local authorities or those collecting waste on their behalf. This is more pronounced in some Member States than in others. The extent to which municipalities, or those acting on their behalf, are involved in collecting municipal waste originating from sources other than households varies considerably, and in at least one Member State – Ireland – there is no requirement for local authority involvement in municipal waste management at all, other than regarding street sweepings).

When England implemented a scheme for trading allowances for municipal waste, local authorities were designated as the entities required to hold and trade allowances. Even within a single Member State, however this approach proved problematic, as local authorities retained discretion over the extent to which they engaged in the collection of non-household waste. Variations in local authority responsibilities across Member States would, therefore, make it difficult to prevent strategic behaviour under such a system. A uniform allocation of responsibilities to local authorities across the EU could mitigate this issue, but such harmonisation appears unlikely in the near future.

Figure 13: Basic Schematic of Activities



Source: Equanimator

It might make more sense to designate local authorities as the trading entities if the scope of wastes within the scheme were limited to household waste alone. Our understanding is that, in virtually all Member States, local authorities have responsibility for collecting, or arranging the collection of, household waste, with the exception of Ireland. Local authorities may also be well-placed to engage with, and inform, households as regards waste prevention measures, including reuse and refill opportunities. Nonetheless, as indicated above, reporting on 'waste from households' is of limited quality. In some Member States collection arrangements make it difficult to distinguish accurately between the wastes originating from households and waste generated by, for example, commercial businesses, who might be able to use road containers, or whose waste might be collected on the same round as that from households. Solutions to both these issues exist and could be implemented without major changes to collection systems. Nonetheless, such changes would not be without cost, and restricting the scope to household waste would, of course, limit the overall impact of the mechanism.

It is generally considered a sound approach to target an economic instrument at the entity with the greatest capacity to respond to the relevant incentive. Local authorities fit that description to the extent that they have responsibility for the waste management services. However, the provision of services alone does not necessarily ensure that they are used as intended. In principle, directly targeting waste generators themselves – households, businesses and other organisations – and seeking to incentivise their behaviour is a sound approach. In practice, however, requiring individual, household, or organisation to participate directly in an allowance trading scheme could create perverse incentives, such as encouraging illegal burning, or dumping, particularly where adequate waste infrastructure is lacking.

A more promising approach of addressing the behaviour of households and other waste generators lies in the pricing of waste management services. Instruments such as pay as you throw schemes, or other forms of differential and variable charging offer a more practical means of conveying economic signals to waste generators (including the effect of the scheme on the costs of managing residual waste). Wider introduction of PAYT for households, alongside adjustments to charging

structures for businesses, would be expected to contribute to reductions in residual waste. Such schemes would need to be implemented carefully and supported by high quality services in order to mitigate risks such as illegal burning and dumping, and increased contamination of separately collected fractions.

Those entities - businesses and local authorities - engaged in waste collection could be considered as potential addressees of a residual waste trading scheme, given their central role in designing and implementing waste collection systems that influence the amount of the waste ultimately managed as residual waste. However, collection systems are not the only determinant of residual waste generation. Downstream sorting systems, including for waste which is not separated at source, will also play an important role, and collectors have limited influence over their performance. Similar considerations apply, though from a different perspective, to entities engaged in sorting and other treatment activities that affect residual waste quantities prior to landfill or incineration.

At the end of the chain are the operators of incinerators and landfills that receive residual waste. In principle, this is an option that could be introduced. In addition ,it is important to consider whether this approach would transmit effective economic signals upstream. For example, it is unclear how potentially fluctuating prices for 'marginal changes in residual waste' would affect local authority collection systems that are often delivered through contracts, lasting five- to seven years or longer. Experience in the UK with tradable Packaging Recovery Notes (PRNs) suggests that fluctuations in economic incentives can have limited effects on operational practice, in part due to contractual rigidities within the waste management system.[16] Nonetheless, any trading scheme which seeks to cap residual waste of a given scope would require, as part of its architecture, robust monitoring and verification of the quantities of residual waste landfilled or incinerated. To that end, even if landfill and incineration facilities are not necessarily central to the trading of allowances, it is difficult to see how a system could operate (other than in the ways suggested in our previous report) without there being some means of cross-checking the quantity of waste managed at the facility with the allowances held by those sending waste to it, or by the operators themselves. That might not mean that the operators have to be the purchasers of the allowances: rather, that when waste is transferred to the operator, the waste is accompanied by evidence that the allowance is held, or the allowance is transferred at the same time.

It was on the basis of these considerations that, in the earlier work, we suggested two options involving a form of passive trading on Member State performance, as reported and verified. Under this approach, accurate monitoring, reporting and verification would determine whether, and to what extent, Member States would either pay into, or receive revenue from, a fund. This mechanism has the advantage of avoiding the need for a dedicated trading platform, and for trading of allowances. However, like all mechanisms discussed here, it would be critically dependent upon reliable monitoring, reporting and verification (MRV) of performance (see below).

One issue raised by this approach, as originally formulated was the perception that the Commission might act as a conduit for financial transfers between Member States. A further concern was the need for EU level coordination. In principle, this could be avoided by establishing separate schemes in each Member State. Whilst such an approach might sidestep issues arising from differences in national policies (see Section above), it would introduce other challenges . For example, it would raise questions about how Member State's 'target' should be set, particularly in the absence of

[16] Dominic Hogg, Chris Sherrington, Tanzir Chowdhury and Ayesha Bapasola (2015) Evidence on the U.K. PRN/PERN System: Briefing Note 3: Constraints on the UK's Ability to Increase Packaging Recycling, and their Relationship to Prices in the PRN Market, Report to Defra, 30th June 2015.

opportunities to purchase allowances from other Member States. A purely national approach might also replicate some of the implementation challenges that have affected EU waste policy in the past.

It would seem preferable to have a scheme in which all Member States participate, not least so that all have a strong interest in the quality of implementation.

Partly for these reasons, and because Member States retain responsibility for addressing both past and future implementation challenges, we continue to believe that the options originally proposed have considerable merit. Nonetheless, in the interest of identifying an alternative approach that may be more acceptable, this report develops an alternative proposal to the approach originally suggested .

5.0 Possible System Architecture

In the scheme, as with the design previously considered, the Commission would establish an overall cap on the amount of residual municipal waste, expressed in terms of a per inhabitant amount.

We believe that a key feature of our previous proposal was that the incentive operated 'at the margin'. Unlike a tax on landfill or incineration, which is paid on all tonnes managed in that way, the intention here is to incentivise action 'at the margin'. Recognising this, and recognising also that there are variations across Member States in the way that waste management is organised (as discussed above), the intention would be to allocate a proportion of each Member State's notional quota such that the Member State could decide for itself, in line with the principle of subsidiarity, how the freely allocated quota would be distributed. The notional quota of residual municipal waste for each Member State would effectively represent the target per capita amount of residual waste, with potential adjustments to account for the effects of tourism (see Box below).

Box: Accounting for the Effects of Tourism

From Figure 11, it can be observed that two tourism-heavy island states – Cyprus and Malta – have relatively high rates of MSW generation. Though this could be linked to a range of reasons, it might be due to the relative significance of tourism in these Member States: the waste from hotels and other establishments would be included in the scope of municipal waste. It follows that some form of adjustment might be necessary to take account of the net influx of people producing waste. Some adjustment could be made on this basis, for example, by converting the number of tourists into a population equivalent (eqpop). A JRC report suggested this could be based on data on overnight stays, using the following formula:[1]

$$eqpop = residents + (tourist\ guest\ nights\ /\ 365)$$

It might be relevant to make these adjustments relative to 'an average', given that such guest nights might include business as well as hotel accommodation. It should be recognised, after all, that as regards tourism, where intra-EU tourism is concerned, a night spent in one location implies one fewer night spent in another. Nonetheless, some adjustment of this nature would seem appropriate: exactly how it should be conducted is worth of further consideration.

The balance of the overall residual waste quota would be reserved for periodic auctions held at specified times throughout the year. Participants in the auctions could, in principle, be any actors involved in the chain of waste management, with the type of registrant varying across Member States depending on how Member States chose to allocate their freely allocated allowances. The need to purchase allowances would reflect the extent to which freely allocated allowances were sufficient to meet a participant's needs. This need would be driven by the requirement that, for all

'in scope' waste that is landfilled or incinerated, the operators of landfill and incineration facilities must hold allowances (quota) covering all waste managed at the facility.

This requirement would, in turn, be the focus of monitoring and verification. Ultimately, the operators of landfills and incinerators would be required to hold sufficient allowances to cover the amount of in-scope wastes they receive. Note that this is why we emphasised the need to include the LoW 19 codes – Wastes from Waste management Facilities - especially the 19 12 category, as codes of relevance to the scheme.[17] It will be important to verify which residual wastes originate from the 'in scope' wastes, and which do not. Such an approach should be entirely consistent with an accurate approach to reporting loss rates from the recycling system, as required for the calculation of MSW recycling rates.

In addition, an appropriate compliance mechanism would be required. As with the EU ETS, a central registry for allowances could be established, with Member State regulators maintaining distinct, national sections (so that, for example, those required to register in a given Member States would do so with their national administrator). The registry is crucial for tracking ownership and trading of allowances, including via auctioning. It would record the entities benefitting from Member States' free allocation, as well as those required to surrender allowances at the end of each compliance period - namely, operators of landfill and incineration facilities permitted to accept in scope wastes, including the LoW 19 codes insofar as they originate from MSW. The registry would also record the verified amounts of MSW landfilled or incinerated, which would form the basis for determining the number of allowances to be surrendered by each registered operator. In addition to auctioning, peer-to-peer trading on secondary markets could emerge, and such trades would also need to be recorded in the registry.

It might be sensible to restrict participation in allowance auctions and trading, as happens under the EU ETS. In this case, participation could be restricted to entities awarded free allowances, and to operators of relevant landfills and incineration facilities. We would expect recipients of free allowances to be either a) municipalities, b) waste collectors (for example, in Ireland) or c) the operators themselves. In the case of municipalities, for example, they would be able to exchange their allowances with landfill or incineration operators up to the level of their residual waste. They could also trade any unused free allocation on secondary markets, which could be configured, for example, to preferentially satisfy demand within a given Member State, particularly if, as indicated in Figure 8 and Figure 10 above, a Member State has especially high costs for residual waste management, and there is no 'adjustment' as considered in Section 3.0).

5.1 Monitoring, Reporting and Verification

In principle, existing reporting on MSW should cover all matters relevant to the reporting envisaged here, (including the relevant flows of LoW code 19 wastes derived from MSW, though in practice, it

[17] The Guidance on reporting on municipal waste also makes this point, though it stresses this principally in relation to reporting on the amount of waste landfilled. Given the requirement to report on recycling in line with Decision 2019/1004, the significance of residues (losses) might have been given greater prominence, including as regards reporting on quantities incinerated (see Eurostat (2022) Manual for the Implementation of Regulation (EC) No 2150/2002 on Waste Statistics, Draft March 2022; 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 (notified under document C(2019) 4114).

might not always do so. In terms of timing, ideally the compliance cycle would align as closely as possible with existing reporting on MSW. This is set out as follows:

- *The 'Joint Questionnaire' table reporting is to be made using the 'JQ' Excel Questionnaire and submitted by month 11 after the reference year; and*
- *The Waste Framework Directive and Landfill Directive reporting is to be made using the two separate Excel Questionnaires (the municipal waste reporting obligation [MWRO] questionnaire, and the landfill questionnaire) and submitted by month 18 after the reference year. It will be validated by Eurostat and then submitted to the Commission, or updates requested through clarification exchanges, for submission thereafter.*

The second bullet indicates that the quantity reported as landfilled is submitted some 18 months after the end of a calendar year, which would, in this case, constitute a 'compliance year'. The 18-month reporting period is much longer than that allowed for reporting of GHG emissions under the EU-ETS.[18] Such a lengthy elapsed period of time might make monitoring, and verification, and subsequent data revisions, more difficult. It is important to recognise, however, that the type of scheme here can, and should, act as driver of better-quality data(and more timely reporting. This might, therefore, act as driver to bring forward the reporting cycle for data on MSW.

In this context, the following would be required:

- All entities engaged in waste collection and waste transfer would record waste movements, including, for each unique load, 6-digit LoW codes, quantities of waste transported, and, for waste coded outside LoW 20 codes, whether -- and if so, what proportion of - the waste originates from 'in-scope' sources.
- Operators of landfills and incinerators facilities have an appropriate Annual Monitoring Plan in place. This should require, at a minimum:
    - Weighing of all inputs to, and outputs from, the facility, using suitably calibrated weighbridges, with checks undertaken as part of the Annual Monitoring Plan.
    - Accurate recording of each unique load, using LoW 6-digit codes, including quantities of waste received at, and transferred from, the landfill / incineration facility. For codes other than LoW 20(municipal waste) codes, reporting would include whether- and if so, what proportion of - the waste is of 'in-scope' origin. This would require cross-checks regarding the quantity and type of waste reported by the delivering waste, with particular attention paid to any XX XX 99 codings, and to LoW 19 codes.

Ideally, all the above would take place within a system of digital waste tracking from source through to landfill or incineration, with data uploaded to a suitable database in (close to) real time. This would allow for data validation algorithms to identify anomalies.[19] Operators would then prepare

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[18] Under the EU-ETS, verified annual emissions reports have to be submitted to the relevant authority by the end of March following the compliance year, after which there may be a need for an improvement report in the event that a verification report reveals anomalies. This has to be submitted by end of June in the year following the compliance year, with the deadline for surrendering allowances being end of September in the same year.

[19] Article 11a.3 of the WFD (regarding calculations of preparation for reuse and recycling rates for MSW) notes:

> *3. Member States shall establish an effective system of quality control and traceability of municipal waste to ensure that the conditions laid down in point (c) of paragraph 1 of this Article and in paragraph 2 of this Article are met. To ensure the reliability and accuracy of the data gathered on recycled waste, the system may consist of electronic registries set up pursuant to Article 35(4), technical specifications for the quality requirements of sorted waste, or average loss rates for sorted waste for various waste types and waste management practices respectively. Average*

their verified annual report on the waste they manage. Regulators would inspect and check the report for any anomalies. Following any required amendments, operators would be required to surrender the requisite number of allowances by a set date. Failure to surrender the requisite number of allowances would trigger a penalty. Such penalties should be sufficiently punitive: in some trading schemes, they are set at fixed values per tonne of allowances shortfall, and in others, at multiples of (e.g. four times) the traded value of allowances.

The intention would be to reduce the cap, and with it each Member State's free allocation, on an annual basis. Setting out a schedule of reductions several years in advance would enable Member States to plan accordingly. In previous work, we suggested a reduction in residual waste per inhabitant – from existing levels of 243kg/inh. to 150kg/inh. by 2035. This assumes that reported quantities remain broadly unchanged. It seems likely, however, that MSW reporting would change if reporting became more uniform across Member States under implementation of the envisaged scheme. Whether this would result in the average quantity of residual waste per inhabitant rising, or falling, remains unclear (we suspect that for some Member States, their figure might increase, and for others, it may decline).

5.2 Variants on Allocation of the Cap

Rather than allocating the overall cap on a relatively even per-capita basis, adjusted only for factors such as tourism, an alternative approach would be to set each Member State's cap so that it progressively declines from its current level of residual municipal waste per inhabitant toward an agreed common target. In this way, each country would follow a defined pathway from its existing performance to the same end goal.

For example, if the target were set at 150 kg per inhabitant by 2035 (as noted above), and the first "active scheme year" were 2028, each Member State would have eight years to reduce residual waste to that level.

However, this type of approach may not readily support allowance trading across Member States. If surpluses and deficits in allowances arise from significantly different starting levels of residual waste per inhabitant, Member States that already generate lower amounts could effectively be disadvantaged relative to those starting from much higher levels. In particular, countries with lower caps could—depending on how free allocation is structured—receive allowances that have tradable value, creating an uneven distribution of benefits.

As a result, this approach may be better suited to Member State–specific schemes that operate independently, rather than to a system linked through cross-border trading.

5.3 Variants on Scope

In principle, the scope of wastes covered could be broadened. As noted above, however, extending the scope to include all major mineral wastes (MMW) and combustion wastes may not be advisable

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loss rates shall only be used in cases where reliable data cannot be obtained otherwise and shall be calculated on the basis of the calculation rules established in the delegated act adopted pursuant to paragraph 10 of this Article.

This seeks accuracy in respect of reporting of recycling, but does not necessarily guarantee accuracy regarding the fate of the 'losses' in the recycling process.

for several reasons. Many of the same issues discussed previously would arise, and these would, to some extent—if not largely—reflect differences in the scale and role of mining and quarrying activities across Member States. This variation is, in fact, one of the key reasons why Eurostat reports a dataset that excludes MMW, in order to provide a more meaningful and comparable basis for analysis.

Seeking to cover all wastes other than major mineral wastes (MMW) and combustion wastes may present a stronger rationale. However, there may still be a need for Member State–specific targets, as current waste profiles often reflect the relative importance of particular sectors. This, again, raises questions about the extent to which schemes could operate consistently or remain interoperable across the EU.

This broader scope would include wastes from agriculture, fisheries, and forestry, as well as from the chemical industry. It could be argued that such wastes are generally less likely to be managed as "residual waste" and, because all sectors contribute to some extent, differences in industrial structure across Member States might have a smaller influence on outcomes.

Nonetheless, determining what would constitute a fair allocation of a cap across Member States may still prove difficult. Any system of free allocation could also be contentious. Conversely, without free allocation, the cap would begin to resemble a tax and would affect all wastes managed as residual waste. That would have broader cost implications (though it would also help to raise revenue).

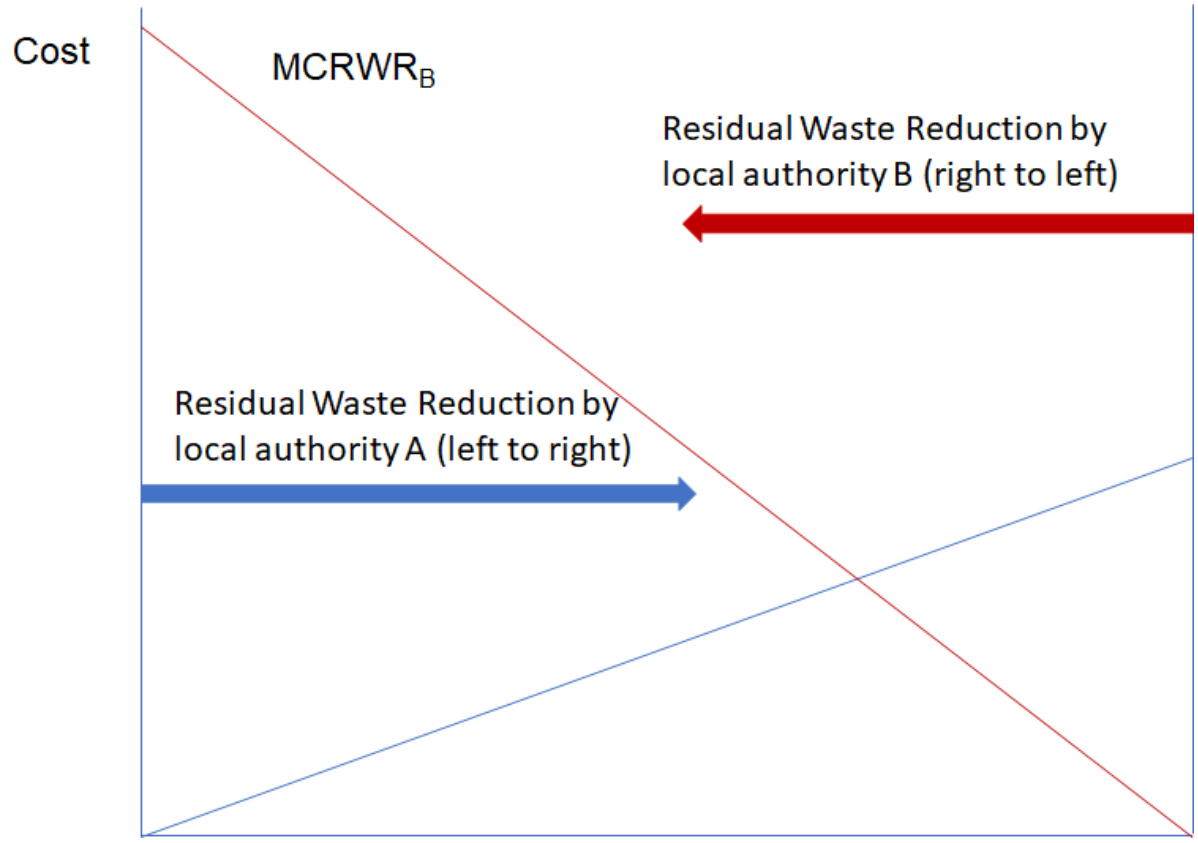
5.4 Costs / Efficiency

The benefits of trading within a cap arise because different organisations face different costs when trying to reduce residual waste. In other words, some can cut residual waste relatively cheaply, while for others it is more expensive. This is both the purpose of, and the rationale for, allowance trading. Authorities with higher residual waste reduction costs can buy "residual waste quota" from those with lower costs of residual waste reduction. Reductions, therefore, take place where they are cheapest to achieve, which lowers the overall cost of the system. Conversely, the benefits from allowance trading are minimal if all parties within the scheme face similar costs.

In practice, the savings are not usually captured in full. Instead, part of the savings is transferred from the higher-cost authority to the lower-cost one as compensation for the extra reductions undertaken. Even so, trading still makes the system more cost-effective than requiring everyone to reduce waste by the same amount.

Imagine two local authorities, A and B. Authority A can reduce waste at relatively low cost, while authority B faces higher costs to achieve the same level of reduction. We represent them below with different marginal cost curves for RWR, with the costs for A being lower (at equivalent levels of reduction) than for B. Note that the curve for A is drawn from left to right, the curve for B is drawn from right to left, and the x-axis is effectively the total quantity of RWR required under a given target (see Figure 14).

Figure 14: Representation of Residual Waste Reduction Costs for two Local Authorities



If both are required to make the same amount of reduction, A will spend much less money than B, even though they are contributing equally. The situation is shown in Figure 15 below: the overall costs to each local authority are represented by the area under the cost curve, shaded blue for A and red for B. The cost to local authority B is much higher than the cost to local authority A. This means the total cost of meeting the target is higher than it needs to be, because B is being forced to carry out expensive reductions that A could achieve more cheaply.

A more efficient approach (see Figure 16) would be for A to do more of the waste reduction and for B to do less. B could then compensate A financially for taking on the additional effort. Both parties would benefit: A receives payment, and B avoids higher reduction costs. The overall target is still met, but at a lower total cost. Allowance trading enables such a situation, and allows for benefits to arise from trading schemes by allowing those for whom marginal costs of RWR are higher to benefit from buying 'residual waste quota' from those for whom the marginal costs of RWR are lower. The relevant cost curves are likely to vary both within a Member State and across Member States (not least for reasons explored in Section 3.0).

Figure 15: Scenario Where two Local Authorities are Required to Make Equal Contributions to Residual Waste Reduction

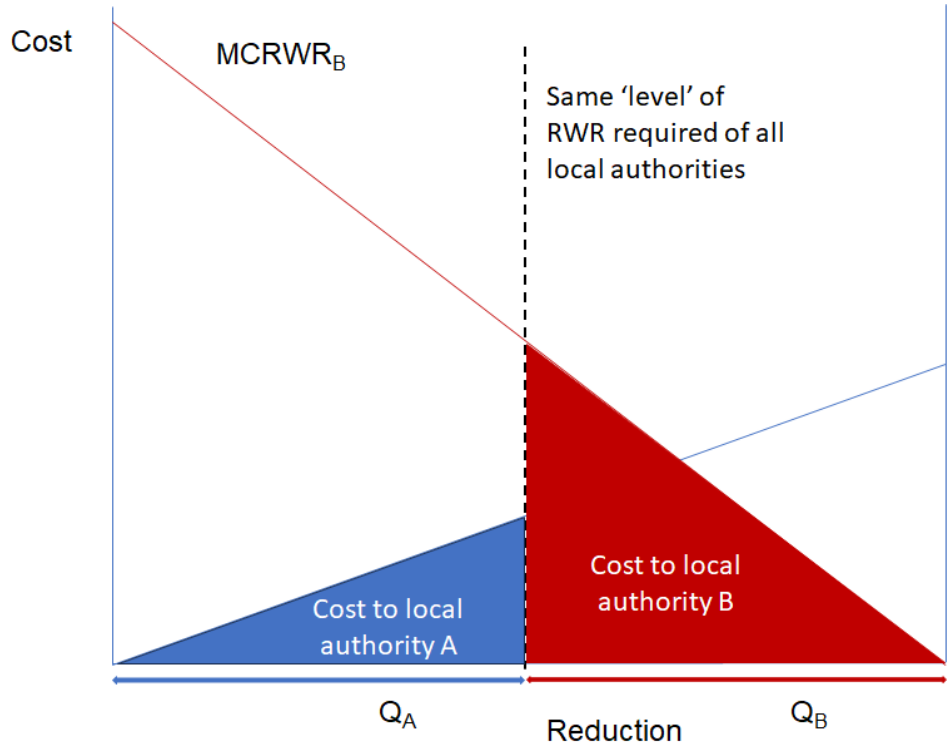
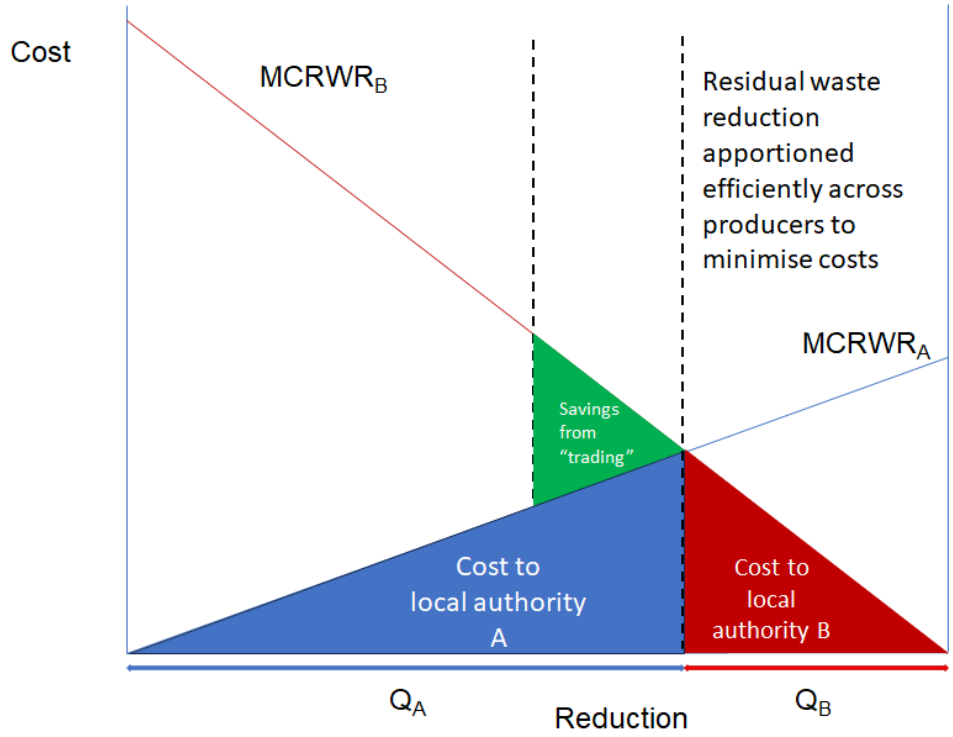


Figure 16: Scenario Where Two Local Authorities Make Contributions to Residual Waste Reduction Based on Least Cost Achievement of the Target



Note: the 'savings' indicated are not usually 'fully realised' – the savings provide the logic for a transfer of revenue from B to A so that A is compensated by B for its 'additional efforts', and the green triangle may be somewhat reduced, depending on the basis for the transfers (the nature of the market clearing mechanism).

6.0 Benefits of the Approach

It is beyond the scope of this paper to fully assess the comparative costs and benefits of the different measures considered in the CEA consultation relative to the proposal outlined here. There are also several methodological issues that would need to be addressed in order to conduct such an assessment.

For example, if it is assumed that all Member States fully comply with existing EU legislation, residual waste originating from municipal sources would likely decline in any case. The scale of that decline would depend on a range of factors, including policy choices, changes in statistical reporting practices, and the extent of any growth in waste generation in the years before targets must be met.

A simple scenario with "no growth" and "no reduction" in waste generation suggests that, for the EU-27, a further 40 million tonnes would need to be diverted into recycling and away from residual waste management in order to achieve a 65% recycling target. This would correspond to an approximate 37% reduction, relative to 2023 levels, in the amount of municipal waste managed through landfill or incineration.

At the same time, Member States face the requirement to limit the landfilling of municipal waste to 10% of total municipal waste generation. There is currently a clear imbalance in incineration capacity across the EU, and the need to develop additional capacity in Member States with little or none should be considered alongside the significant capacity likely to become available in those Member States that currently rely more heavily on incineration to manage residual waste. This imbalance is particularly pronounced between southeast and northwest Europe, as noted previously.[20]

Introducing a residual waste constraint, combined with a requirement to stabilise waste prior to landfilling, could support a more rational and coordinated development of recycling systems. This is especially relevant for Member States that appear to face a dual challenge: reducing landfill to the required levels while simultaneously expanding recycling in order to meet targets.

Where landfill reduction is achieved primarily by diverting waste to incineration—unless spare capacity elsewhere can be used, or co-incineration options are available and adopted—significant capital investment may be required for changes that deliver limited environmental benefit.[21] By contrast, shifting waste away from residual treatment and into recycling typically depends more on operational expenditure and a larger number of smaller-scale capital investments. These measures are likely to deliver greater environmental benefits, particularly for dry recyclable fractions.

[20] Equanimator (2023) *Enough Is Enough: The Case for a Moratorium on Incineration*, Report for Zero waste Europe, September 2023.

[21] Equanimator (2021) *Rethinking the EU Landfill Target*, Report for Zero Waste Europe, October 2021, https://zerowasteeurope.eu/library/rethinking-the-eu-landfill-target/

In this context, producer responsibility could play an important role in financing the necessary improvements, especially in Member States that remain furthest from compliance. Recent evidence from PRO Europe on compliance contributions would support the view that further progress is needed to ensure that the costs identified under Article 8a of the Waste Framework Directive—intended to be covered by extended producer responsibility (EPR) for packaging waste—are fully borne by producers in some Member States.[22]

In this context, assuming full compliance with existing legislation may be optimistic. One of the merits of the proposed mechanism, particularly in its pan-EU form, is that it could help underpin and strengthen compliance with existing EU targets across Member States. If implementation is a problem, and all the evidence suggests that it is, then seeking to implement this type of scheme on a Member State-specific basis risks simply adding to the list of implementation issues.

With regard to costs and benefits, we have previously highlighted the limited environmental gains associated with switching from landfill to incineration, as reported in the literature.[23] Indeed, not all studies identify positive effects; several suggest that the benefits may in fact be negative. When assessed in terms of resource costs (that is, excluding transfers such as taxes, as well as implicit or explicit subsidies), such a switch can be difficult to justify on economic grounds, although other considerations not captured in these analyses may still motivate the change. Where waste is stabilised prior to landfilling, the environmental advantages of incineration are further reduced, even though the resource costs of landfilling increase once stabilisation is included.

The principal benefit of placing a direct limit on residual waste, rather than relying solely on landfill or incineration taxes or bans, is that it steers outcomes toward the options that deliver the greatest overall benefits, regardless of a Member State's specific policy framework for residual waste treatment options. This is not to suggest that taxes on landfill or incineration have no role; rather, their primary function is to internalise the externalities associated with those processes. In principle, under the proposed scheme, a Member State could still face an economic incentive to reduce residual waste even in the absence of high disposal costs. While higher disposal prices can support measures such as pay-as-you-throw systems and waste prevention, the diversity of policies and price levels across Member States means that a trading scheme for residual waste allows reductions to occur wherever they are most cost-effective, irrespective of local disposal costs or the presence of landfill bans.

A further effect of the residual waste reduction (RWR) approach would be to prioritise, within existing policy frameworks, measures that directly reduce residual waste over those that do not. A typical example is the separate collection of garden waste from households and institutions. In suburban and rural areas, where the marginal cost to waste generators is low or zero, such collections can make substantial contributions to recycling targets, including the capture of materials that were previously unmanaged or not collected at all.[24]

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[22] PRO Europe (2025) *Participation Costs Overview 2025*, February 2025.

[23] Equanimator (2021) *Rethinking the EU Landfill Target*, Report for Zero Waste Europe, October 2021, https://zerowasteeurope.eu/library/rethinking-the-eu-landfill-target/

[24] In the UK, separate collection of garden waste, whilst increasing recycling rates, often led to a significant increase in waste being collected: *'The increase in collection of garden waste at the kerbside is not offset on anything like a one-to-one basis by a reduction in the collection at HWRCs, or by a reduction in quantities of refuse collected. Hence, a 'genuine'*

Many Member States capture garden waste extremely effectively—sometimes at levels well above 100% of what was present in the collected waste stream prior to the introduction of separate collection. By contrast, the capture of food waste for recycling is often much less effective. A stronger focus on residual waste reduction (RWR) would shift attention toward the food fraction, which tends to be more consistent and less variable when separate collection systems are introduced. Evidence suggests that the separate collection of food waste can also act as an important trigger for waste prevention, as it makes the quantity of food being discarded more visible and therefore more apparent to households and other waste generators.[25] This 'food waste prevention' effect is aligned with the CEA, and delivers much more significant environmental benefits than ensuring the treatment of separately collected wastes. Importantly, the same effect may be observable in HORECA establishments, which would be in scope under this approach.

Finally, in the context of ongoing discussions regarding inclusion of incineration within the EU-ETS, this mechanism plays a somewhat different role, though there may be overlapping effects. The EU-ETS is intended to incentivise a reduction in CO_2 emissions from a range of sources, of which incineration of municipal waste would become an additional one. Whilst operators could acquire allowances without there being major changes (depending upon their specific situation), the EU-ETS could motivate change through either encouraging capturing of CO_2, reducing the fossil carbon content of what is incinerated, or by reducing incineration. The second and third options are aligned with this mechanism as they would reduce residual waste, but the first addresses emissions at an installation largely independent of the nature of what is incinerated. Furthermore, although the likelihood of major switches to landfill from incineration seems low (not least because the Member States that are most reliant on incineration are in that position because of bans or restrictions on landfilling, sometimes supplemented by taxes), our proposed mechanism would make it even less likely.

increase in collected waste can be expected (as opposed to an increase in collected garden waste simply reducing quantities collected through other routes). In some systems, the ratio of 'new material' to 'material previously collected' might be as high as 2:1 for garden waste' (see Dominic Hogg, Adrian Gibbs, Enzo Favoino and Marco Ricci (2007) *Managing Biowastes from Households in the UK: Applying Life-cycle Thinking in the Framework of Cost-benefit Analysis*, Final Report to WRAP, May 2007). The aforementioned study used the term 'latent uncollected fraction' to represent the garden waste that was 'mobilised' by free collections of garden waste arising from (for example) households tidying gardens more frequently and more zealously.

[25] See Exodus Market Research (2008) *The Food We Waste, Report for WRAP*, April 2008; Resource Futures (2009) *Evaluation of the WRAP Separate Food Waste Collection Trials*, Final Report, Updated June 2009; WRAP (2019) Impact of household food waste collections on household food waste arisings, February 2019.

A.1.0 Appendix: Identifying LoW Codes of Greatest Relevance

We considered each of the EWC-Stat categories with a view to understanding the correspondence between the EWC Stat codes and LoW codes likely to fall under a definition of MSW. A document indicating the correspondence between the EWC Stat codes and the codes used to classify waste under the List of Waste (LoW), is publicly available and has been considered in arriving at the views below:[26]

a) **Household and similar wastes** (28.5 million tonnes landfilled / other disposal, 46.4 million tonnes to incineration)
Given the definition of municipal waste, the full scope of this category should already be included within the scope of reporting on municipal waste. The main question is whether some wastes reported under d) below, which might not be reported as MSW, should be reported under this category, and hence also, as MSW (see d) below). All the component LoW codes are 'municipal waste' codes. Note that separately collected waste fractions should not be included in this category. It is somewhat surprising, therefore, to see 12.2 million tonnes (14% of what is reported) being reported as 'recycled', given that there are separate EWC Stat categories for reporting 'sorting residues', categories including separately collected fractions, and other suitable categories for reporting what is recycled, unless the wastes collected under this category are directly recycled without any subsequent waste treatment;[27]
20 03 01 mixed municipal waste
20 03 02 waste from markets

[26] Guidance on classification of waste according to EWC-Stat categories: Supplement to the Manual for the Implementation of the Regulation (EC) No 2150/2002 on Waste Statistics, Version 2, December 2010. The document states:
'The European List of Wastes (LoW) is the waste classification in the EU for administrative purposes, i.e. for permitting and supervision in the field of waste generation and management […]
Whereas the Waste Statistics Regulation stipulates that the EWC-Stat has to be used for the reporting of data to Eurostat it does not prescribe a specific classification to be used for data collection. Countries are free to use any waste classification as long as they can produce the defined formats in the required quality.
In practice, most of the countries collect their data according to the List of Waste and convert it subsequently into the required EWC-Stat-categories on the basis of the transposition table in Annex III of the Regulation. The direct use of the EWC-Stat for data collection is applied only by a few countries. Where countries use the EWC-Stat for data collection, the present guidance document is of particular help to clarify which wastes are covered by the defined reporting categories.'

[27] The figures for Italy, in particular, appear to indicate more than 70% of this category of waste was being recycled in 2022. Other Member State reporting shows no obvious consistent pattern: for example, France reports 0 tonnes recycled of the almost 19 million tonnes generated. Guidance from the European Commission appears to confirm that this is not to be expected (see Eurostat (2022) Manual for the Implementation of Regulation (EC) No 2150/2002 on Waste Statistics, Draft March 2022):
'The recycling of the components of 'household and similar wastes' is therefore not reported under W101 but under the material-specific waste categories.
Recycling of 'household and similar wastes' should only be reported under recycling in those cases where the waste is recycled directly. Examples for such cases are:
• the preparing for reuse of bulky waste;
• the biological treatment of market wastes'.

20 03 07 bulky waste
20 03 99 municipal wastes not otherwise specified
20 03 03 street-cleaning residues

b) **Sorting residues** (35.8 million tonnes landfilled / other disposal, 36.9 million tonnes to incineration)

Sorting residues may originate from various wastes and processes. Generally, they refer to the fractions not sent for recycling or not used for composting, and include fluff fractions from shredding metal containing wastes, refuse derived fuel (RDF), and other residues that would typically be expected to be sent onward for residual waste treatment. The EWC-Stat code description states that the category should exclude 'sorting residues from demolition', yet it includes some categories likely to result from sorting construction and demolition wastes (such as RDF) which are not obviously highlighted elsewhere.

The Manual on waste statistics states that reporting on treatment does not include some forms of treatment, such as MBT. It is not entirely clear what the significance of the omission is, and whether or not this affects the amount of sorting residues being reported (or whether this is expected to be reported anyway through inclusion of the appropriate LoW codes).

As with household and similar wastes, it is somewhat strange to see 11.5 million tonnes (or 14% of the total) reported as having been recycled.[28]

Tracing sorting residues to the source may prove somewhat challenging. Residues from sorting construction and demolition wastes should not be included in reporting of MSW, and nor should sorting residues from facilities dealing with end-of-life vehicles, or sorting of production wastes.

The types of sorting equipment typically used to manage construction and demolition waste are usually rather different to those used for municipal waste. The same is true for end-of-life vehicles, and whilst there might be some cross over as the outputs of one sorting system move to another, the extent to which this contributes to additional residual waste might not be so great (the intention would be to further sort and grade for recycling, undoubtedly with some rejects). Sorting of residues from production is also likely to be somewhat more specialised.

The most important codes for tracking residual waste back to source are likely to be:

19 05 01 non-composted fraction of municipal and similar wastes (where from household waste and other similar sources)
19 05 02 non-composted fraction of animal and vegetable waste (where from household waste and other similar sources)
19 05 03 off-specification compost (where from household waste and other similar sources)
19 12 10 combustible waste (refuse derived fuel) (where from household waste and other

[28] In this case, three Member States – Germany, Spain and Italy – account for the majority of the amount reported as recycled. Recycling rates for sorting residues range from 0% (5 Member States, including Denmark, France, Cyprus, Luxembourg and Malta) to 33% (Poland). The Commission's Manual on Waste Statistics notes :
'Sorting residues (EWC-Stat 10.3) are outputs from waste treatment processes (e.g. from chemical-physical treatment, composting or mechanical treatment) that are usually not suitable for recycling without further preparatory treatment. The further treatment generally leads to a change in EWC-Stat classification so that the finally recycled materials will not be reported under EWC-Stat 10.3 but under other categories.'
(see Eurostat (2022) Manual for the Implementation of Regulation (EC) No 2150/2002 on Waste Statistics, Draft March 2022).
It is possible that, because some treatment operations are excluded from reporting (including mechanical biological treatment) that some Member States seek to 'adjust' data accordingly (not least to account for 'missing mass' in the statistics).

similar sources)
19 12 11* other wastes (including mixtures of materials) from mechanical treatment of waste containing dangerous substances
19 12 12 other wastes (including mixtures of materials) from mechanical treatment of wastes other than those mentioned in 19 12 11
The following are likely to be less important:
19 02 03 premixed wastes composed only of non-hazardous wastes
19 02 10 combustible wastes other than those mentioned in 19 02 08 and 19 02 09
19 02 04* premixed wastes composed of at least one hazardous waste
19 02 09* solid combustible wastes containing dangerous substances
19 04 03* non-vitrified solid phase
19 10 03* fluff-light fraction and dust containing dangerous substances
19 10 04 fluff-light fraction and dust other than those mentioned in 19 10 03
19 10 05* other fractions containing dangerous substances
19 10 06 other fractions other than those mentioned in 19 10 05

c) **Wood wastes** (70kt landfilled / other disposal, 21.5 million tonnes to incineration)
The EWC category includes waste bark and wood, as well as sawdust, shavings and cuttings etc. from wood processing and production of panels / furniture, as well as waste bark and wood from the paper and cardboard industry and wood wastes from construction. It also includes wooden packaging and separately collected wood from wastes that originate from municipal sources. Note, though, that formally, that part of wood segregated from MSW that relates to construction and demolition should fall outside the definition of MSW, though how Member States interpret / deal with this in their reporting is unclear.
15 01 03 wooden packaging (where from household waste and other similar sources)
19 12 07 wood other than that mentioned in 19 12 06 (where from household waste and other similar sources)
20 01 38 wood other than that mentioned in 20 01 37 (where separately collected from household waste and other similar sources)
19 12 06* wood containing dangerous substances (where from household waste and other similar sources)
20 01 37* wood containing dangerous substances (where separately collected from household waste and other similar sources)

d) **Mixed and undifferentiated materials** (5.9 million tonnes landfilled / other disposal, 5.4 million tonnes to incineration)
This EWC-Stat category is described as 'Unspecific wastes and mixed waste' originating from 'nearly all industries and from waste treatment'. As the fourth largest contributing category to the residual 'other' wastes, it is important. The large range of LoW codes contributing include composite packaging, and 'wastes not otherwise specified' from all industries, and from waste management / wastewater treatment / water preparation. It includes separately collected municipal waste of 'other fractions not specified', but not 'municipal wastes not otherwise specified', since this falls under the 'household and similar wastes' category.
20 01 99 other fractions not otherwise specified (where separately collected from household waste and other similar sources)
19 01 99 wastes not otherwise specified
19 02 99 wastes not otherwise specified
19 05 99 wastes not otherwise specified
19 06 99 wastes not otherwise specified
19 08 01 screenings
19 08 99 wastes not otherwise specified
19 09 99 wastes not otherwise specified
19 11 99 wastes not otherwise specified

e) **Mineral wastes from waste treatment and stabilised wastes** (10.3 million tonnes landfilled / other disposal, 120kt to incineration)
These wastes include wastes that may have originated from municipal wastes (such as incinerator ash residues) as well as minerals (such as sand and stones) that result from mechanical sorting of wastes.
19 01 12 bottom ash and slag other than those mentioned in 19 01 11
19 01 14 fly ash other than those mentioned in 19 01 13
19 01 16 boiler dust other than those mentioned in 19 01 15
19 01 18 pyrolysis wastes other than those mentioned in 19 01 17
19 01 19 sands from fluidised beds
19 01 05* filter cake from gas treatment
19 01 06* aqueous liquid wastes from gas treatment and other aqueous liquid wastes
19 01 07* solid wastes from gas treatment
19 01 11* bottom ash and slag containing dangerous substances
19 01 13* fly ash containing dangerous substances
19 01 15* boiler dust containing dangerous substances
19 01 17* pyrolysis wastes containing dangerous substances
19 03 05 stabilised wastes other than those mentioned in 19 03 04
19 03 07 solidified wastes other than those mentioned in 19 03 06
19 03 04* wastes marked as hazardous, partly stabilised
19 03 06* wastes marked as hazardous, solidified
19 04 02* fly ash and other flue-gas treatment wastes
19 11 07* wastes from flue-gas cleaning
19 12 09 minerals (for example sand, stones)

f) **Animal and mixed food wastes** (1.1 million tonnes landfilled / other disposal, 4.0 million tonnes incinerated)
This EWC Stat category includes a) 'animal waste from food preparation and products', which derive from agriculture, food processing and preparation, and the dairy products industry, and b) 'mixed waste of food preparation and products', some of which are preserving agents from food processing, but some of which come from separately collected kitchen waste, canteen waste, and edible oil and fat derived that originate from municipal sources. In addition, the category includes 'grease and oil mixture from oil/water separation containing only edible oil and fats' insofar as these are derived from unspecified wastewater treatment plants.[29]
20 01 08 biodegradable kitchen and canteen waste
20 01 25 edible oil and fat

g) **Chemical wastes** (2.1 million tonnes landfilled / other disposal, 3.1 million tonnes incinerated)
The contributing LoW categories include a range of industrial sources. Included in this EWC-Stat category are, however, a range of chemicals also used by households and businesses, such as pesticides, inks, adhesives, paints, varnishes, wood preservatives, as well as 'wastes from chimney sweeping'. Hence, the EWC-Stat expects separately collected fractions of this nature that are reported as MSW under the LoW to be included. The size of this contribution

[29] Some food wastes from households may be flushed into the sewer system where accumulated fat (and other materials) may cause blockages (and not least, to avoid this being encouraged as a means of 'waste prevention'). In theory, such wastes ought to be included in the scope of MSW, even though residues from sewers are excluded from the definition of MSW (see 'Common Sludges' below).

to the total seems likely to be limited.
20 01 17* photochemicals
20 01 19* pesticides
20 01 32 medicines other than those mentioned in 20 01 31
20 01 31* cytotoxic and cytostatic medicines
20 01 28 paint, inks, adhesives and resins other than those mentioned in 20 01
20 01 27* paint, inks, adhesives and resins containing dangerous substances
20 01 30 detergents other than those mentioned in 20 01 29
20 01 29* detergents containing dangerous substances
15 01 10* packaging containing residues of or contaminated by dangerous substances (where originating from household and similar waste)
19 01 10* spent activated carbon from flue-gas treatment (from incineration)

h) **Industrial effluent sludges** (1.84 million tonnes landfilled / other disposal, 2.23 million tonnes to incineration)
This category includes sludges from industry resulting from their wastewater treatment facilities, and excludes sludges from municipal wastewater treatment. It does include 'de-inking sludges from paper recycling', and 'fibre rejects, fibre-, filler- and coating sludges from mechanical separation'. These could be relevant as 'rejects' from separately collected fractions of municipal waste.
03 03 05 de-inking sludges from paper recycling
03 03 10 fibre rejects, fibre-, filler- and coating sludges from mechanical separation

i) **Common sludges** (900kt landfilled / other disposal, 3.0 million tonnes to incineration)
This category includes wastewater treatment sludges from municipal sewerage systems as well as sludges from food preparation and processing, and others of a biogenic (rather than chemical) origin. Two 'municipal waste' (as per LoW codes) types are considered: septic tank sludge and waste from sewage cleaning. Though falling under the LoW list of 20 xx xx municipal waste codes, perhaps confusingly, these are excluded from the definition of municipal waste under the WFD. For consistency with the WFD definition, we suggest they are not considered within scope, although if it were demonstrated that 'waste from sewage cleaning' largely derived from municipal waste (food waste, wet-wipes), then there might be good reason to include this code.
(possibly) 20 03 06 waste from sewage cleaning

j) **Plastic wastes** (580kt landfilled / other disposal, 2.51 million tonnes to incineration)
This category includes wastes from agriculture etc., wastes from the MFSU of plastics, synthetic rubber and man-made fibres, shavings and turnings from wastes from shaping and physical and mechanical surface treatment of metals and plastics, plastics from ELVs and their dismantling, and plastic from construction and demolition wastes. It also includes plastic packaging, and separately collected plastics from municipal waste, as well as plastics from mechanical sorting of wastes. The last three categories would be expected to contribute the bulk of the contribution from MSW;
15 01 02 plastic packaging (where from household waste and other similar sources)
19 12 04 plastic and rubber (where from household waste and other similar sources) (note that these are not separately identified)
20 01 39 plastics

k) **Vegetal wastes** (550kt landfilled / other disposal, 2.1 million tonnes to incineration)
This EWC Stat category is akin to a 'vegetable equivalent' of the 'animal and mixed food wastes' category. It includes various wastes from agriculture and food processing, and garden and park wastes of municipal origin.
20 02 01 biodegradable waste

l) **Sludges and liquid wastes from waste treatment** (1.29 million tonnes landfilled / other disposal, 410kt to incineration)

This EWC-Stat category includes landfill leachate, as well as digestate and liquor from anaerobic digestion of municipal waste. Separately, the category includes digestate and liquor from anaerobic digestion of 'animal and vegetable waste': in practice, there may be facilities where municipal waste is co-digested with animal and vegetable waste from other sources.
19 06 03 liquor from anaerobic treatment of municipal waste
19 06 04 digestate from anaerobic treatment of municipal waste
19 07 03 landfill leachate other than those mentioned in 19 07 02
19 07 02* landfill leachate containing dangerous substances

m) **Animal faeces, urine and manure** (20kt landfilled / other disposal, 1.5 million tonnes to incineration)
These wastes are from agriculture only. There is no overlap with reporting on municipal waste.
None

n) **Health care and biological wastes** (70kt landfilled / other disposal, 1.27 million tonnes to incineration)
This EWC-Stat category refers specifically to the healthcare sector. There is no overlap with reporting on municipal waste.
None.

o) **Spent solvents** (no RW landfilled, 890kt to incineration)
The majority of these wastes are likely from manufacture, formulation, supply and use (MFSU) in a range of industrial sectors, though there may be some from '*recycling of refrigerators and separate collection of solvents from households*'. Hence, one of the contributing LoW categories is separately collected solvents from MSW. We would anticipate these making a very small contribution to the total
20 01 13* solvents (separately collected from waste that is from households or similar in nature);

p) **Rubber wastes** (0kt landfilled / other disposal, 810kt to incineration)
None

q) **Acid, alkaline or saline wastes** (390kt landfilled / other disposal, 110kt to incineration)
The majority of these wastes are likely from manufacture, formulation, supply and use (MFSU) in a range of industrial sectors, though there may be some from '*recycling of refrigerators and separate collection of solvents from households*'. Hence, two of the contributing LoW categories are separately collected acids and alkalines from MSW. We would anticipate these making a very small contribution to the total;
20 01 14* acids (separately collected from waste that is from households or similar in nature)
20 01 15* alkalines (separately collected from waste that is from households or similar in nature)

r) **Textile wastes** (160kt landfilled / other disposal, 210kt to incineration)
This EWC-Stat category includes textile packaging, as well as textiles mechanically sorted from waste, and separately collected textile and clothing wastes of municipal origin. It also includes wastes from the leather and fur industry, and from the textile industry.
15 01 09 textile packaging (where from household waste and other similar sources)
19 12 08 Textiles (where sorted from waste that is from households or similar in nature)
20 01 11 Textiles
20 01 10 Clothes

s) **Paper and cardboard wastes** (10kt landfilled / other disposal, 340kt to incineration)
This category consists of paper and cardboard packaging, separately collected paper and cardboard from municipal waste, as well as paper and cardboard from mechanical sorting of wastes. No other categories are included, suggesting that the main issue would be to ensure

that paper and cardboard are allocated on a consistent basis to municipal waste.
15 01 01 paper and cardboard packaging (where from household waste and other similar sources)
19 12 01 paper and cardboard (where sorted from household waste and other similar sources)
20 01 01 paper and cardboard

t) **Used oils** (10kt other disposal, 300kt to incineration)
This EWC category concerns mineral oils and the wastes are all considered hazardous. Separately collected oil and fat is the only code contributing that is of a municipal nature.
20 01 26* oil and fat other than those mentioned in 20 01 25

u) **Metal waste, ferrous** (50kt landfilled / other disposal, 130kt to incineration)
This EWC-Stat category makes no particular link to MSW, not even separately collected ferrous metals from municipal waste, or metallic packaging. It does include iron and steel waste from shredding metal-containing wastes, ferrous materials recovered from bottom ash, and ferrous metals from the mechanical treatment of waste (for example sorting, crushing, compacting, pelletising).
19 01 02 ferrous materials removed from bottom ash (incineration of residual waste from households and other similar waste)
19 10 01 iron and steel waste
19 12 02 ferrous metal (from mechanical processing of waste from households and other similar waste)
should also include 15 01 04 metallic packaging
20 01 40 metals

v) **Glass wastes** (140kt landfilled / other disposal, 10kt to incineration)
This EWC-Stat code includes packaging glass and separately collected glass from municipal waste, as well as glass from mechanical sorting of waste. In addition, it includes glass from construction, end-of-life vehicles and the glass industry. In principle, data on MSW ought to exclude all sources other than the separately collected glass from municipal waste, packaging from municipal waste, and glass residues from sorting of waste of municipal origin. In practice, this should be possible to a tolerable degree of accuracy, not least given the small quantities that are managed as residual waste. Note that there may be a grey area regarding the extent to which 'backfilling' of glass is recorded as such, or is reported as glass recycling.
15 01 07 glass packaging (where from household waste and other similar sources)
19 12 05 glass (where sorted from household waste and other similar sources)
20 01 02 glass

w) **Discarded equipment** (except discarded vehicles and batteries and accumulators waste) (50kt landfilled / other disposal, 60kt to incineration)
This EWC-Stat category includes Discarded electrical and electronic equipment, e.g. small and large household equipment, IT equipment, electric tools, as well as Fluorescent tubes. It originates mainly from households and businesses, principally from separate collection
20 01 23* discarded equipment containing chlorofluorocarbons
20 01 34 batteries and accumulators other than those mentioned in 20 01 33
20 01 35* discarded electrical and electronic equipment other than those mentioned in 20 01 21 and 20 01 23 containing hazardous components
20 01 36 discarded electrical and electronic equipment other than those mentioned in 20 01 21, 20 01 23 and 20 01 35
20 01 21* fluorescent tubes and other mercury-containing waste
20 01 33* batteries and accumulators included in 16 06 01, 16 06 02 or 16 06 03 and unsorted batteries and accumulators containing these batteries
20 01 34 batteries and accumulators other than those mentioned in 20 01 33

x) **Waste containing PCBs** (0kt landfilled / other disposal, 30kt to incineration)
This EWC-Stat category includes oil wastes, wastes from ELVs and from WEEE, as well as wastes from construction and demolition (e.g. PCB-containing sealants, PCB-containing resin-based floorings, PCB-containing sealed glazing units, PCB-containing capacitors). There is no category related to municipal waste - though legacy products may still contain PCBs, an LoW code for such materials is included under 'discarded equipment' (see above);
None

y) **Metal waste, non-ferrous** (10kt landfilled / other disposal, 0kt to incineration)
This EWC-Stat category makes no particular link to MSW, not even separately collected non-ferrous metals from municipal waste, or metallic packaging. It does include non-ferrous waste from shredding metal-containing wastes, non-ferrous metals from the mechanical treatment of waste (for example sorting, crushing, compacting, pelletising). Comparing with the ferrous metals category, there is no category for non-ferrous metals recovered from bottom ash (there appears to be no LoW equivalent to the ferrous metal category).
19 10 02 non-ferrous waste
19 12 03 non-ferrous metal
Should also include non-ferrous from incinerator bottom ash (as per 19 01 02 for ferrous)
See also metal packaging 'Metal waste, ferrous'.

Note that the above categories exclude MMW and combustion wastes. Two municipal waste LoW codes appear therein: 20 02 03 other non-biodegradable wastes (under 'Other mineral wastes') and 20 02 02 soil and stones (under 'Soils'). The former is included as MSW under the Commission's Guidance whilst the latter is excluded. That seems to be anomalous given that their origin is the same (gardens and parks) and neither soil nor stone need necessarily to have been derived from construction and demolition. Our view is that both should be included unless they originate from construction and demolition activities.

A.2.0 Acknowledgements

Reloop is an international non-profit platform dedicated to accelerating the global transition to a circular economy, working with governments, industry, civil society and other stakeholders to build a world free of waste and pollution through data-driven research, policy guidance and collaborative action.

www.reloopplatform.org

Zero Waste Europe (ZWE) is the European network of communities, local leaders, experts, and change agents working towards a better use of resources and the elimination of waste in our society. We advocate for sustainable systems; for the redesign of our relationship with resources; and for a global shift towards environmental justice, accelerating a just transition towards zero waste for the benefit of people and the planet.

www.zerowasteeurope.eu

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