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Research and analysis

Residual waste infrastructure capacity note

Published 30 December 2024

Applies to England

Contents

This publication is available at https://www.gov.uk/government/publications/residual-waste-infrastructure-capacity-note/residual-waste-infrastructure-capacity-note

Executive summary

Our current use of resources is economically, environmentally and socially unsustainable and we are determined to transition to a circular economy in the UK. To achieve this, all efforts must be made to prevent waste from arising in the first instance. Where waste does occur, we need to manage it in the most resource-efficient way possible, preparing items for reuse, or recycling those items that cannot be reused. To this end, The Environmental Targets (Residual Waste) (England) Regulations 2023 set a statutory target to ensure that the total mass of all residual waste (excluding major mineral wastes) arising in England for 2042 does not exceed 287kg per person. This is the equivalent of a 50% reduction from 2019 levels.

This note presents the evidence and analysis relating to municipal residual waste arisings and infrastructure capacity in England from 2020 to 2035, accounting for the effect of Defra's packaging reforms. Consideration is also given to total residual waste (excluding major mineral wastes) arisings in 2042. This note is intended to support decision makers in planning for residual waste treatment to support the transition to a circular economy.

The evidence presented in this note demonstrates that England is on track to send less than 10% of municipal waste to landfill by 2035, at least in terms of residual waste infrastructure provision. This is based on modelling the implementation of:

- Extended Producer Responsibility for packaging in 2025
- Simpler Recycling for non-micro businesses in 2025, households in 2026, and micro businesses in 2027 – which will require collections for dry recyclable materials and food and garden waste, unless a transitional arrangement applies
- a Deposit Return Scheme for drinks containers in 2027

In 2035, total energy recovery capacity is estimated to include 18.8 megatonnes (Mt) in comparison to 19.4Mt of municipal residual waste. Total residual waste treatment capacity is forecast to be approximately 24.9Mt, including an allowance for capacity in landfills to manage 10% of all municipal solid wastes.

The modelling undertaken demonstrates that, following implementation of these policies, there will therefore be sufficient residual waste infrastructure capacity to treat forecast municipal residual waste arisings at a national level.

The evidence presented in this note does however identify that there are certain areas in England, in particular the East Midlands and East of

England, where alternative treatment options to landfill for municipal residual wastes are required.

The assessment undertaken does not consider treatment needs for non-municipal residual wastes. While some non-municipal residual wastes currently disposed of in landfill could be managed through existing energy recovery facilities as volumes of municipal residual waste reduce, creating ‘headroom’, it may be that alternative or additional facilities are required to divert these wastes, where they cannot be prevented or recycled, away from landfill. Alternatively, declining municipal residual waste volumes may facilitate the decommissioning of older, less efficient residual waste management infrastructure in some areas to avoid over-capacity.

Based on current population growth estimates, the total volume of residual waste (excluding major mineral wastes) in England in 2042 will need to be at most approximately 17.6Mt to meet the legally binding residual waste target. This is for both municipal and non-municipal residual wastes, and acts as a long-term signal for our residual waste treatment capacity needs that should be taken into account when planning or considering residual waste treatment infrastructure.

While there are a number of waste incineration facilities that are consented, but not yet under construction, it is highly unlikely that these will be brought forward if sufficient waste volumes cannot be secured via contracts to make a proposed development financially viable.

The government is committed to transitioning to a circular economy, in which we maximise resource use and minimise residual waste arisings. Where residual wastes do occur, they should be managed in the most efficient manner. This means that we will only support the development of further residual waste treatment infrastructure where they meet a clearly defined need to facilitate the diversion of non-recyclable waste away from landfill, or enable the replacement of older, less-efficient facilities.

The data in this note suggests that while we are approaching a point where national residual waste treatment capacity is sufficient to manage municipal residual wastes, there are regional variations. Evidence also suggests that alternatives are required to support the diversion of non-municipal wastes from landfill.

We do not, however, support the development of overcapacity of energy recovery infrastructure in England and will work to strengthen planning considerations to ensure that this does not happen. For those energy recovery developments we do need, we will only support projects that offer the best efficiency and are future proofed towards supporting our net zero objectives. This means that further developments must be able to demonstrate that making use of the heat they produce is viable and that

they can be built carbon capture ready, in accordance with the government's 'decarbonisation readiness' requirements once they come into force. The government will also explore how to incentivise the decommissioning of facilities that are less efficient, cannot support our net zero objectives or are no longer required.

1. Introduction

Resources are finite and precious, and their extraction and manufacture can cause environmental harm. All efforts must be made to prevent waste from arising in the first instance. Where waste does occur, we need to manage it in the most resource-efficient way possible, preparing items for reuse, or recycling those items that cannot be reused.

To this end, The Environmental Targets (Residual Waste) (England) Regulations 2023 sets a statutory target to ensure that the total mass of residual waste (excluding major mineral wastes) arising in England for 2042 does not exceed 287kg per person. This is the equivalent of a 50% reduction from 2019 levels.

Recovering energy from residual waste, including through the supply of electricity and heat, or through processing waste into fuel for use elsewhere in the economy, while making a valuable contribution to our energy generation and decarbonisation needs, should be seen as the last resort to prevent waste being disposed of in landfill or incinerated without recovering energy.

We are introducing 3 major waste reforms to improve the way resources and waste are managed:

- an Extended Producer Responsibility (EPR) scheme for packaging
- Simpler Recycling in England
- a Deposit Return Scheme (DRS) for drinks containers

This set of packaging reforms are expected to reduce residual waste through incentivising and improving recycling. The packaging reforms are estimated to reduce annual municipal residual waste arisings by 18% by 2035 relative to 2020 figures.

This note presents the evidence and analysis relating to municipal residual waste arisings and infrastructure capacity in England from 2020 to 2035, an assessment period that aligns with targets set under the Waste (England and Wales) Regulations 2011 (https://www.legislation.gov.uk/uksi/2011/988/contents).

This analysis has accounted for the effect of the packaging reforms on municipal recycling rates and, therefore, the amount of municipal residual waste generated. Consideration is given to the residual waste reduction target. However, detailed policies to achieve reductions beyond the packaging reforms and create the circular economy have not yet been developed. Detailed analysis and forecasts of residual waste arisings post-2035 are, therefore, not currently possible. There will likely be additional factors that affect the future composition and tonnage of municipal residual waste that have not been considered within this note.

This note has been prepared to consider residual waste arisings in England at both a regional and national level. Local authorities consider their waste treatment capacity needs at local level and this note will support decision making regarding the need for additional or alternative residual waste management infrastructure. A proposed plant must not compete with greater waste prevention, reuse, or recycling, or result in overcapacity of residual waste treatment. This position is set out in the Energy National Policy Statement for renewable energy infrastructure, which establishes planning considerations for nationally significant generation projects that fall outside of local planning authority competence, including energy from waste (EfW) facilities generating more than 50 megawatts in England.

This note does not set out to prioritise one form of energy recovery treatment over another. The UK has a thriving competitive market for waste management services. There are a range of recovery options, both established and emerging, available to waste handling operators, which will be selected according to market conditions and local needs, taking account of the waste hierarchy and the need to ensure the best available environmental outcome for the waste.

This note is intended to support decision makers in planning for residual waste treatment to support our national resources and deliver a circular economy. Based on forecasts of waste arisings and infrastructure capacity, headline results indicate that there will be sufficient residual waste infrastructure capacity (including an allowance of no more than 10% municipal waste to landfill) to treat forecast municipal residual waste arisings from around 2026 until the end of the assessment period, at the national level. There are however certain areas in England where alternative treatment options to landfill for municipal residual wastes is required to further support our environmental objectives and obligations. There is also likely a need for alternative treatment options to landfill for non-municipal residual wastes.

We will continue to monitor waste infrastructure capacity due to its important role supporting the transition to a circular economy and informing future policy directions.

2. Background

Residual waste is typically mixed waste that may be suitable for energy recovery or disposal to landfill, such as that collected from households and businesses in black bags or wheelie bins, as distinct from waste collected or otherwise segregated for recycling or reuse.

The government is committed to transitioning to a circular economy, which will support economic growth, deliver green jobs, promote efficient and productive use of resources, minimise negative environmental impacts and help us accelerate to net zero. Reducing residual waste is supported by a number of targets in the Waste (England and Wales) Regulations 2011 (https://www.legislation.gov.uk/uksi/2011/988), including at least 65% of municipal solid waste (by weight) being recycled and less than 10% of municipal solid waste (by weight) being sent to landfill by 2035. The Environmental Targets (Residual Waste) (England) Regulations 2023 (https://www.legislation.gov.uk/uksi/2023/92/contents/made) sets a statutory target to ensure that the total mass of residual waste (excluding major mineral wastes) for 2042 does not exceed 287kg per person. This is the equivalent of a 50% reduction from 2019 levels.

2.1 Packaging reforms

Defra's packaging reforms are expected to provide a significant contribution towards the reduction in residual waste and are composed of 3 interconnected reforms.

Simpler Recycling in England

Simpler Recycling will mean that across England it will be possible to recycle the same materials. These reforms will make it easier for people to do the right thing, maximise use, minimise waste and increase recycling rates. The improved recycling system will support investment in domestic reprocessing facilities, creating UK jobs and increasing resource security. Additionally, these reforms will mean that people can recycle the same items at home, work or school throughout England. These policies will make it much easier to know what can and cannot be recycled and will increase recycling rates. By increasing recycling of the materials covered by Simpler Recycling, the policy will reduce the tonnage of these materials sent to residual waste treatments.

A Deposit Return Scheme (DRS) for drinks containers in England, Scotland and Northern Ireland:

A DRS for drinks containers will require consumers to pay a deposit at the point of purchase and then return their drinks container to a specific return point for recycling to redeem the deposit. The financial incentive offered to consumers to return their drinks containers to designated return points provides the incentive to increase drinks container recycling. It will improve the quantity and quality of the recycled material and reduce the number of littered drinks containers in the environment. By increasing the recycling of drinks containers, the policy will reduce the tonnage of these items sent to residual waste treatments.

Reforming the packaging producer responsibility system in the United Kingdom

The EPR scheme for packaging invokes the ‘polluter pays’ principle and requires obligated producers to become responsible for the cost of managing the packaging they place on the market, net of any revenues obtained from recycling. These payments will be facilitated via a modulated fee system that incentivises obligated producers to use less packaging, or where it is necessary, for it to be recyclable. Under a modulated fee system, the fees paid will vary according to specific criteria relating to aspects of the packaging’s treatment cost, including the effect on the environment. Modulated fees should incentivise recyclability of packaging by rewarding good design and penalising poor design. By increasing the recycling of packaging, the policy will reduce the tonnages of packaging sent to residual waste treatments.

3. Methodology

3.1 Municipal waste arisings

Our municipal waste arisings forecasts have been modelled using 2 scenarios. A business-as-usual scenario and a scenario that accounts for the packaging reforms being implemented. No policies outside of the packaging reforms have been included within this analysis.

The packaging reforms will have the largest effect on the waste management system, this, along with a lack of comparable data for other policies, means that only the effect of the packaging reforms have been quantified within the modelling. There are other relevant policies, for example, the Plastic Packaging Tax, expansion of the UK Emissions Trading Scheme to include waste incineration and EfW, and the near

elimination of biodegradable waste from landfill. These policies are expected to affect waste arisings but are not within the scope of the analysis.

The waste arisings forecasts were produced as part of the analysis supporting the development of the Environmental Targets (Residual Waste) (England) Regulations 2023 (https://www.legislation.gov.uk/uksi/2023/92/contents/made), with updated input data and reflect the latest policy positions.

The Future Waste Arisings project (http://sciencesearch.defra.gov.uk/Default.aspx?Menu=Menu&Module=More&Location=None&ProjectID=20915&FromSearch=Y&Publisher=1&SearchText=future%20waste%20arisings&SortString=ProjectCode&SortOrder=Asc&Paging=10#Description), commissioned by Defra to forecast total waste generation figures in a range of different streams, forms the basis of the business-as-usual scenario. The project modelled municipal waste as the total of waste from households, plus non-household municipal waste (NHM). It used a number of socio-economic drivers to forecast the separate waste streams. The drivers used to forecast waste from households figures in the model were:

- historic waste from households tonnages (https://assets.publishing.service.gov.uk/media/65b8f10f4ec51d0014c9f160/WFH_England_Data_202223.ods)
- gross disposable household income (GDHI) (https://www.ons.gov.uk/economy/regionalaccounts/grossdisposablehouseholdincome/datasets/regionalgrossdisposablehouseholdincomelocalauthoritiesbyitl1region)
- Index of Multiple Deprivation (IMD) (https://www.gov.uk/government/statistics/english-indices-of-deprivation-2019) and Office for National Statistics (ONS) population mid-year estimates (https://www.ons.gov.uk/peoplepopulationandcommunity/populationandmigration/populationestimates/datasets/populationestimatesforukenglandandwalesscotlandandnorthernireland) and projections (https://www.ons.gov.uk/peoplepopulationandcommunity/populationandmigration/populationprojections/datasets/2020basedinterimnationalpopulationprojectionsyearendingjune2022estimatedinternationalmigrationvariant)

The drivers used to forecast non-household municipal tonnages were historic NHM tonnages, derived by Defra from Waste Data Interrogator and gross value added (based on Office for Budget Responsibility (OBR) gross domestic product (GDP) forecasts (https://obr.uk/data/#historical)) for the food and manufacturing and services sector (https://www.ons.gov.uk/economy/grossvalueaddedgva/datasets/nominalandrealregionalgrossvalueaddedbalancedbyindustry) (excluding activities from households). The combined effect of Simpler Recycling,

the DRS for drinks containers and EPR for packaging on residual municipal waste arisings in England is not included in the Future Waste Arisings business-as-usual scenario.

To separate the generation of waste forecast into residual and recycling tonnages, predicted rates of 'non-residual treatment' were applied to the arisings, based upon the historic data. The non-residual treatment rate captures all waste sent to end treatment that is not landfill, incineration, or energy recovery (including transport fuels or waste sent overseas for energy recovery).

To obtain a forecast that includes the effects of the packaging reforms, the cumulative recycling rates under the packaging reforms, from their final impact assessment modelling, have been applied to the model. Waste arisings and methodology for estimating residual waste levels are separate and part of residual waste reduction target modelling.

For waste from households, the estimated packaging reform recycling rates were used to forecast residual waste arisings as waste from households recycling rates were shown to be a good predictor of residual tonnages when applied to the historic data (meaning the vast majority of waste from households was either recycled or sent to residual treatment).

For non-household waste, recycling rates alone were not a suitable predictor of tonnages at residual treatment due to larger tonnages of residual waste treated at recovery facilities and complexities in the available data used to calculate the recycling rates. For example, this includes the use of materials recovery facilities to recover waste from the residual stream.

Therefore, for NHM, an approximate 13 percentage point recovery rate was added on top of the estimated packaging reforms recycling rates to arrive at an assumed non-residual rate. The recovery rate accounts for process losses, waste that is treated in the devolved governments, and data limitations.

While the effects of the Simpler Recycling recycling rate feed into the model, some of the assumptions and methodology used within the waste arisings methodology in this note differ from those used in the final impact assessment for Simpler Recycling. The assumptions used here are in line with those used in the analysis supporting the residual waste reduction target, where the analytical context takes account of all three reforms that make-up the packaging reforms rather than Simpler Recycling alone.

A main difference relates to the waste arisings business-as-usual scenario. As outlined above, the residual waste reduction target modelling utilised a number of socio-economic drivers to forecast separate waste streams, for both waste from households and NHM.

Other differences include the use of a recovery rate for NHM and the inclusion of food manufacturing waste in NHM in the targets proposal analysis and the proportion of mixed waste codes, that are assumed to be municipal in each assessment.

The recovery rate was calculated by measuring the difference between historic non-household municipal residual tonnages (that is calculated using the estimated proportion of waste generated that was not recycled based on estimated NHM recycling rates) and Environment Agency (EA) regulatory historic data (for example, data on waste received at landfill and incineration facilities).

In the analysis for the resource efficiency and waste reduction target proposal, 20% of the code 19 12 12 (sorting residues from mechanical sorting of waste) was assumed to originate from construction and demolition activity (and 80% was counted as municipal waste). For the Simpler Recycling final impact assessment, all of code 19 12 12 is deemed municipal.

The effects of packaging reform in the residual waste reduction target modelling includes an 80% ‘capture’ rate of recyclate that is applied to the tonnages of recycled NHM. The NHM capture rate reflects an estimate of the proportion of businesses that correctly recycle all material all the time. The 80% rate is in line with the central Simpler Recycling scenario. There is some uncertainty associated with this assumption, so a sensitivity using a more conservative (higher residual waste levels) 70% rate has also been modelled within this note, in line with the lower Simpler Recycling sensitivity scenario.

Residual waste forecasts in this note are derived from the ambition level modelling used in the residual waste reduction target analysis. This differs from the method used to calculate the metric for the residual waste reduction target, which is used to report progress against the target in the published statistics notice (https://www.gov.uk/government/statistics/estimates-of-residual-waste-excluding-major-mineral-wastes-and-municipal-residual-waste-in-england). Therefore, residual waste estimates in this note will differ from those in the published statistics notice. Further detail on the methodologies used for the ambition level modelling and the metric can be found in the target’s evidence report (https://consult.defra.gov.uk/natural-environment-policy/consultation-on-environmental-targets/supporting_documents/Resource%20efficiency%20and%20waste%20reduction%20targets%20%20Detailed%20evidence%20report.pdf).

3.2 Infrastructure capacity

Within this note, residual waste treatment infrastructure capacity refers to the treatment of residual waste through:

- domestic energy recovery (either as received or pre-treated by mechanical or biological processes)
- exporting as refuse-derived fuel (RDF) for energy recovery overseas
- disposal in landfill

Energy recovery operational capacity forecasts are produced by the Waste Infrastructure Delivery Programme (WIDP). These forecasts for energy recovery facilities using municipal solid waste feedstocks in England include EfW, advanced thermal treatment (ATT) and advanced combustion technology (ACT) facilities. The forecast contains 3 categories of infrastructure:

1. operational
2. under construction
3. consented

These forecasts account for operational capacity rather than total permitted capacity. Forecasts assume that facilities will remain operational throughout the assessment period unless there is evidence otherwise.

To calculate the forecast operational capacity of operational facilities, WIDP uses average throughput (the last 3 years where available) as a proxy for operational capacity.

For consented facilities or those under construction, the WIDP forecasts assume that the facilities will operate at 90% of their permitted capacity, however, this capacity estimate is further risk adjusted on a facility-by-facility basis. The risk adjusted capacity of under construction and consented infrastructure is only added to the total available capacity in the year that the facilities are expected to become operational. It is also assumed that once plants come on stream, they will remain operational and will not be decommissioned within the assessment period unless there is evidence to the contrary.

WIDP also incorporates the waste arisings forecast outlined in the section above into their infrastructure forecasts. This is to assess whether there will be sufficient residual waste to warrant currently consented, at the time of forecasting, energy recovery infrastructure being developed (in the forecast). When existing energy recovery capacity (including in-construction) plus the consented capacity due to come on-stream exceeds the annual forecasted tonnages of available residual waste, it is assumed that any new capacity will not be developed to come on-stream in that year (that is on the risk adjusted date).

Currently consented capacity is, therefore, capped in reference to forecast residual waste arisings. This is because consented capacity is highly unlikely to be financed for construction unless sufficient waste feedstocks under long term contracts are secured. When existing EfW capacity plus the new capacity due to come online does not exceed annual forecasted tonnages of available residual waste, it is assumed that any new capacity will come online on the risk adjusted date.

For the energy recovery forecasts included in this note, WIDP used the spring 2024 update of the residual waste arisings forecasts produced to support the Residual Waste Reduction Target (as outlined within the 'Municipal waste arisings' section above).

3.3 Sensitivity analysis

Due to the limited scope of the analysis and data uncertainty, the results presented in this note should be recognised as a forecast, not a precise prediction. To mitigate the uncertainty associated with the 80% NHM capture rate assumption, a sensitivity analysis using a more conservative (higher residual waste levels) 70% rate has been modelled in Appendix A.

4. Results

4.1 Municipal waste arisings

Municipal waste refers to household waste and waste from other sources which is similar in nature and composition to household waste, including 'household-like' waste generated by businesses and collected by private contractors.

Table 1: Forecasted annual municipal waste arisings, residual waste arisings, and tonnage collected for recycling.

	2020 (Mt)	2035 baseline (without packaging reforms) (Mt)	2035 (Mt)

	2020 (Mt)	2035 baseline (without packaging reforms) (Mt)	2035 (Mt)
Municipal waste arisings	45.2	52.7	51.1
Residual municipal waste arisings	23.6	27.8	19.4
Municipal tonnage collected for recycling	18.3	21.1	29.2

Table 1 shows the effect that the packaging reforms are expected to have on the tonnage of municipal waste collected for recycling and, therefore, residual waste arisings. In the business-as-usual scenario (without the effect of the packaging reforms), municipal residual waste arisings are forecast to increase from 23.6Mt in 2020 to 27.8Mt by 2035. When accounting for the effects of packaging reforms, municipal residual waste arisings are forecast to decrease from 23.6Mt in 2020 to 19.4Mt by 2035, alongside a 10.9Mt increase in material collected for recycling.

4.2 Forecasted residual waste infrastructure capacity

As detailed in Table 2, there is 20.6Mt of residual waste infrastructure capacity in England. Of this total, 14.3Mt is energy recovery infrastructure capacity. In the absence of existing facilities ceasing operation, it is forecast that residual waste capacity will reach 24.9Mt in 2035, of which 18.8Mt will be (operational) energy recovery infrastructure. This forecast includes landfill allowance capacity of 10% of municipal waste, as per the target set out in the Waste (England and Wales) Regulations 2011.

Cement kilns are not included within the analysis due to insufficient available data. It is, however, unlikely that excluding cement kilns will have a material effect on total energy recovery capacity as tonnes per annum of residual waste processed in these facilities is likely very small.

Table 2: Forecasted annual residual waste treatment infrastructure capacity, RDF exports and landfill allowance.

Infrastructure	2020 (Mt)	2024 (Mt)	2035 (Mt)

Infrastructure	2020 (Mt)	2024 (Mt)	2035 (Mt)
Energy recovery	12.8	14.3	18.8
Mechanical biological treatment	2.0	1.7	0.4
RDF exports	2.4	1.6	0.5
Landfill allowance (10% municipal solid waste)	4.5	4.8	5.2
Total	19.7	20.6	24.9

Notes for Table 2:

- Mechanical biological treatment (MBT)-type processes do result in mass loss due to moisture loss and some carbon loss, however, this has not been taken into consideration here as it is deemed minimal.
- Future RDF exports are forecast using the assumption that RDF exports fall by 20% of new EfW capacity that comes online in the previous year.
- Forecast MBT capacity is not included in the total as this would be double counting capacity. Totals may not sum due to rounding.
- 2020 capacity being lower than 2020 arisings is due to greater than 10% of municipal arisings being sent to landfill.

In addition to operational capacity shown in Table 2, Table 3 shows that to date approximately 3.9Mt (permitted capacity) of energy recovery facilities are under construction. Additionally, as of October 2024 a further approximately 9.5Mt of energy recovery (permitted) capacity has received planning consent, but has not yet entered construction. This consented capacity consists almost entirely of proposed merchant EfW facilities that have no underlying local authority contract.

While this consented capacity is significant, we do not assume that all consented capacity will be built in addition to existing capacity. Typically, a proposed merchant facility development will first secure planning consent, then gain an environmental permit to operate, and secure a (typically 15-year) contract for the disposal of residual waste feedstock and financing before construction begins.

If a consented development cannot secure a long-term contract for feedstock supply, it is highly unlikely that it will receive financing and proceed to construction. Some of this consented capacity may also constitute replacement capacity for existing facilities nearing end of life.

Consented capacity, therefore, should be viewed as a pool of potential projects that may or may not be constructed in line with local residual waste management needs.

Table 3: Operational, under construction and planned energy recovery facilities (including ATTs and ACTs) in England as of October 2024.

	Number	Approximate total capacity (Mt p/a)
Operational	50	14.3
Under construction	12	3.9
Consented	35	9.5

4.3 Regional energy recovery infrastructure

The data presented in Table 3 can be broken down by planning region, as presented in Figure 1. Figure 1 shows that some areas currently have greater operational and under construction energy recovery capacity than local authority collected residual waste arisings, while other regions currently have operational and under construction energy recovery treatment capacity below their volume of local authority collected residual waste arisings.

This could be for a variety of reasons, including certain areas treating a greater volume of non-local authority collected residual waste via energy recovery or making use of rail networks to source residual waste from a range of locations. Other regions may be in the process of contracting and procuring energy recovery facilities, as alternative treatment options to landfill. Almost all regions currently have total operational and under construction energy recovery capacity lower than overall residual municipal solid waste arisings for that region, reflecting the mix of residual waste treatment options set out in Table 2.

Figure 1 does show however that there are a number of regions where consented capacity far exceeds municipal residual waste arisings. As detailed above, consented facilities should be considered a pool of potential projects, not a guarantee of development of those facilities. Without securing a contract for managing residual wastes consented facilities are highly unlikely to ever be built. The results presented in Figure 1 should, however, be taken into account by developers and

decision makers when determining the need for proposed waste treatment capacity.

While regard must be given to the proximity principle, which encourages residual waste to be recovered in one of the nearest appropriate facilities, this must not be over-interpreted. It does not require using the absolute closest facility to the exclusion of all other considerations. Accepting waste from, or sending waste to, another council, city, or region in many cases may be the best economic and environmental solution and be the only outcome achievable at a given time that is the most consistent with the proximity principle. The ability to source waste from a range of locations and organisations helps ensure existing capacity is used effectively and efficiently.

Figure 1: Operational, under construction and consented energy recovery capacity in England broken down by planning region.

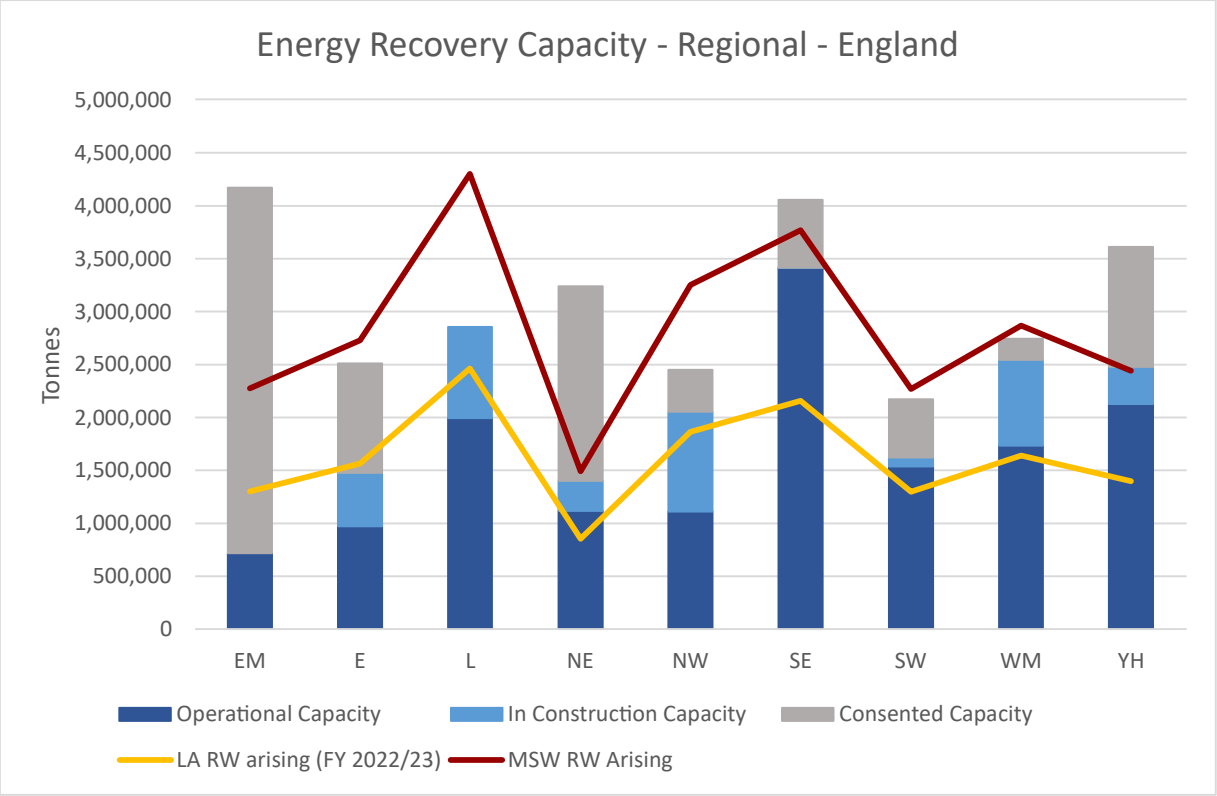

Figure 1 information:

Figure 1 shows operational energy recovery capacity (dark blue), in construction capacity (light blue) and consented capacity (grey), broken down by planning region. These are represented in a stacked bar chart, with English regions on the x-axis and tonnes of waste on the y-axis. Local authority collected residual waste arisings (municipal and non-municipal) for 2022 to 2023 are shown with a yellow line. Estimated residual municipal solid waste arisings for each planning region are shown with a red line. These are approximate estimates, apportioning national residual municipal solid waste tonnages by region. These figures

are to show which regions may be likely to have greater or less capacity than municipal solid waste residual waste arisings and should not be seen as an exact estimate of waste arisings in a given region.

The data presented in Figure 1 is presented Table 4.

Table 4: Operational, under construction and consented energy recovery capacity (Mt) in England broken down by region.

	East Midlands (EM)	East of England (E)	London (L)	North East (NE)	North West (NW)	Sout Eas (SE
Operational capacity (Mt)	0.72	0.97	2	1.12	1.11	3.4
In construction capacity (Mt)	0	0.51	0.86	0.28	0.94	0.0
Consented, but not yet under construction capacity (Mt)	3.46	1.03	0	1.84	0.39	0.6
Local authority residual waste arising (Mt) (2022 to 2023)	1.3	1.56	2.46	0.85	1.86	2.1
Residual municipal solid waste arising (Mt)	2.27	2.73	4.3	1.49	3.25	3.7

Analysis of the local authority collected waste statistics (https://www.gov.uk/government/statistics/local-authority-collected-waste-management-annual-results) shows that 7 local authorities reported sending more than 40% of their residual waste to landfill in 2022 to 2023, shown in Table 5. These

results broadly align with the English regions shown in Figure 1 where the areas with the lowest operational energy recovery facilities (East of England and East Midlands) include 4 of the 7 local authorities who sent more than 40% of their residual waste to landfill.

Table 5: Residual waste treatment of local authority collected waste 2022 to 2023.

Authority	Landfilled	Incineration with EfW	Incineration without EfW	Other
Essex County Council	95%	2%	0%	3%
Cambridgeshire County Council	87%	9%	1%	3%
Southend-on-Sea Borough Council	74%	25%	0%	1%
Darlington Borough Council	61%	16%	0%	23%
Lancashire County Council	59%	32%	0%	9%
Leicester City Council	57%	39%	0%	4%
Newcastle-upon-Tyne City Council	56%	41%	0%	3%

4.4 Types of residual waste treatment

Energy recovery

Energy recovery is the current and forecast predominant residual waste treatment option, namely EfW facilities. It refers to the process of recovering energy, usually in the form of electricity and heat, but also via conversion of waste into fuels for use in other areas of the economy, via the thermal treatment of waste feedstocks.

Between 2024 and 2035, the operational capacity of energy recovery

facilities in England is forecast to increase by 4.5Mt. Technologies that are included within the term energy recovery, here, are:

- conventional EfW – electricity only
- conventional EfW – combined heat and power
- ATTs and ACTs – such as gasification and pyrolysis

ATT and ACT facilities using residual waste as a feedstock, while not currently in widespread use within England, may continue to emerge over the forecast period. This is likely to be driven, for example, by the desire to develop facilities to produce low carbon or recycled carbon fuels, including sustainable aviation fuel or hydrogen, to deliver carbon savings within the transport sector or across other sectors of the economy. Where they have been consented, they have been considered within the consented capacity figure in Table 3. As for all energy recovery facilities, residual waste treatment capacity needs at a national and local level must be considered when designing and planning for these facilities.

Mechanical treatment or MBT can be used as a pre-treatment process to prepare residual waste inputs for use in energy recovery, either domestically or overseas, by converting it into RDF (a material that is produced from waste, that has undergone some sort of treatment process, and is intended for use as a fuel). Due to the variation in the nature of MBT facilities there is also a large variation in the outputs of different facilities (for example, different volumes of RDF, dry recyclates, compost-like output or digestate). Approximately 2Mt of residual waste were processed through MBT type processes in 2020 and this is forecast to fall to around 0.4Mt by 2035.

Landfill

Landfill continues to be used as a residual waste disposal option in England. However, in accordance with the waste hierarchy, Defra is seeking to minimise waste to landfill. This is underpinned by the target set out in the Waste (England and Wales) Regulations 2011 to send no more than 10% of municipal waste arising to landfill by 2035, and the decarbonisation pathways that require the near elimination of biodegradable waste sent to landfill from 2028.

EA data (https://data.gov.uk/dataset/237825cb-dc10-4c53-8446-1bcd35614c12/remaining-landfill-capacity) shows that at the end of 2023 (the most recent data available at the time of writing), the total remaining permitted landfill capacity in England was 325,898,697 cubic metres (m3). This includes all landfill types (that is non-hazardous landfill, non-hazardous landfill with a stabilised non-reactive hazardous waste cell, inert landfill, hazardous merchant landfill and hazardous restricted landfill).

The remaining non-hazardous landfill capacity in England was 193,275,182m3 which, using a conversion factor, equates to approximately 224Mt of remaining capacity (conversion factor 1.159 (https://randd.defra.gov.uk/ProjectDetails?ProjectId=20309)). This figure captures the reported remaining capacity of around 250 permitted landfill sites in England.

Table 2 demonstrates that in order to send less than 10% of municipal waste to landfill by 2035, this would equate to no more than 5.2Mt being disposed of in this way.

RDF exports

Total RDF exports from England are forecast (based on Defra assumptions) to fall from 2.4Mt in 2020 to 0.5Mt in 2035. This forecast is based on the internal assumption that RDF exports will fall by 20% of the new energy recovery capacity that comes on stream in the previous year.

There is, however, uncertainty surrounding the future of RDF exports from England due to external factors, for example the exchange rate and foreign RDF import tax rates, acting as determinants of demand for RDF exports from England. The internal market for RDF may also change in future, with emerging residual waste treatment technologies, such as the conversion of residual waste to transport fuel, seeking to access a greater portion of RDF feedstocks.

5. Additional considerations

While the focus of the analysis within this note relates to the municipal waste forecasts detailed in preceding sections, there are factors outside the scope of this analysis that should be taken into account when considering the management of residual wastes as a whole.

5.1 Non-municipal, non-major mineral residual wastes

In addition to the municipal forecasts outlined above, Defra has published statistics (https://www.gov.uk/government/statistics/estimates-of-residual-waste-excluding-major-mineral-wastes-and-municipal-residual-waste-in-england) estimating the total amount of residual waste (excluding major mineral wastes) and municipal residual waste generated in England.

In 2022, the estimated amount of residual waste excluding major mineral wastes per person in England was 558.8kg, the equivalent of 31.9Mt. Using these statistics, we can estimate that in 2022 there were approximately 5.4Mt of non-municipal, non-major mineral residual wastes. This figure has been calculated by subtracting the total tonnage of residual municipal waste (published in Defra's Estimates of Residual Waste (Excluding Major Mineral Wastes) and Municipal Residual Waste in England (https://www.gov.uk/government/statistics/estimates-of-residual-waste-excluding-major-mineral-wastes-and-municipal-residual-waste-in-england) from the total tonnage of residual waste excluding major mineral wastes.

Residual municipal waste includes several waste codes that are not present in the excluding major mineral wastes measure: 20 02 02 (soils and stones) and 20 02 03 (other non-biodegradable waste). This figure is therefore likely to be an underestimation of the total tonnage of non-municipal, non-major mineral waste generated in England that is sent to landfill, put through incineration, or sent overseas for energy recovery.

Non-municipal residual wastes not being treated at energy recovery facilities or exported as RDF are likely being managed through disposal at landfill. While Table 2 presents an allowance of 10% municipal residual waste being disposed of in landfill (equating to 5.2Mt in 2035), it is estimated that there is 224Mt non-hazardous landfill capacity in England. As municipal residual wastes decrease, through overall waste reduction and improved recycling, it is likely that headroom for non-municipal residual wastes will become available at existing and under construction energy recovery facilities.

While total available capacity will be in part determined by changes in waste composition and calorific value, as well as other controls on throughput, every effort should be made to utilise this existing capacity and maximise efficiency of these assets rather than developing additional stand-alone facilities, leading to potential risk of over-capacity of energy recovery facilities in England and the creation of stranded assets.

It is recognised, however, that additional energy recovery facilities may be required. In particular to support the near elimination of biodegradable waste being disposed in landfill, although every effort should be made to minimise or recycle those wastes. This could result in development of residual waste treatment capacity over the coming years in excess of our infrastructure requirements in line with the long-term residual waste reduction target in 2042. However, as further wastes are prevented and recycling improves to meet this target, and deliver a circular economy, it is likely that the oldest, least efficient facilities or those facilities that are no longer viable will be decommissioned.

Important to this success will be preventing recyclable material, now or in the future, being locked into long-term contracts for residual waste

treatment. To this end, the Simpler Recycling policy update on 29 November 2024 (https://www.gov.uk/government/publications/simpler-recycling-in-england-policy-update) set out the new default requirements and local authorities flexibility to suit local need.

5.2 Persistent organic pollutants (POPs)

Waste incineration, including EfW facilities, play an important role in destroying POPs that are present in municipal and other wastes. While POPs can be present in mixed municipal waste, some waste incinerators also accept segregated POPs waste streams, such as waste upholstered domestic seating and plastic from waste electrical and electronic equipment.

These waste streams are currently a relatively small percentage of residual wastes, amounting to approximately 200 to 300 kilotonnes (kt) per year in England. However, arisings of waste containing POPs are likely to increase, potentially significantly, as waste producers and regulators identify more wastes containing POPs, and as legislation is updated, including as a result of new POPs listings agreed by parties to the UN Stockholm Convention. Our preliminary analysis suggests that by 2025 up to a further 106 to 158kt per year of plastic and construction waste could require incineration and, beyond this, there is also up to 2.5Mt per year of waste that contains chlorinated paraffins that may require incineration.

This preliminary analysis is highly uncertain due to several factors including the estimate of presence of POPs being based on limited literature across countries, the size of the waste streams, where the waste is currently destined for (EfW or landfill), the international position on what levels of POPs in waste are considered to be ‘low’ and thus may not require destruction, and the timing and nature of subsequent updates to domestic legislation.

This analysis will need further verification through sampling and testing and engagement with industry to assess the amounts of POPs present in waste. This analysis is also likely to be an overestimate as the quantity of waste requiring incineration will be reduced through treatment (for example targeting of affected POPs-rich components rather than whole items) and by regulators taking targeted action. The timing of these effects is also uncertain.

While not specifically identified within the municipal residual waste forecasts detailed within this note, the management of POPs and the need to incinerate these wastes will play an important role in determining

the required level of residual waste infrastructure.

5.3 Composition of residual waste and calorific value

As well as changes in the total tonnage, the packaging reforms and the forthcoming expansion of the UK Emissions Trading Scheme (https://www.gov.uk/government/consultations/uk-emissions-trading-scheme-scope-expansion-waste) to include fossil carbon emissions from waste incineration and EfW, may lead to changes in the composition of municipal residual waste. In particular, through removing or incentivising the removal of greater quantities of plastics from the residual waste stream, such as through the separate collection of plastic films.

This may affect the calorific value of residual waste, which is a measure of how much energy is available per tonne of waste. The higher the calorific value, the more energy can potentially be captured from the waste. Different waste components have different individual calorific values for example, food waste tends to have a relatively low value due to its high moisture content, while plastic has a much higher one. Differing proportions of these will therefore change the overall calorific value.

The volume of waste that may be processed through an EfW facility is partly determined by the calorific value of the waste combusted. In simple terms, should calorific value increase, the facility may have to process less waste to moderate combustion temperatures, should calorific value decrease, the facility may be able to process more waste within operational thermal parameters. If residual municipal waste composition changes significantly in future, this may affect the calorific value of the residual waste requiring treatment and, consequently, on the effective operational capacity of existing facilities. It is important to note, however, that any effect may also be governed by additional technical and regulatory considerations, such as bunker capacity and grate loading limits, or planning and permitting conditions the facility may be subject to.

These considerations are not part of the analysis undertaken in this note. Some technologies can cope with a broad range of calorific values and water content, while others require much more specific levels to operate efficiently, meaning the likely effect of any calorific value changes will be highly facility specific and dependent on a complex set of considerations.

Regardless, this is an important consideration and energy recovery processes, including those planning for new or replacement facilities, need to ensure that their requirements do not act as a brake, or hindrance to improved recycling, or risk being unviable due to changes in

calorific value. Approaches need to be flexible enough to cope with such change or to seek out routes, with due consideration to the waste hierarchy, to rebalance the calorific value whilst minimising the fossil content of waste going to energy recovery.

5.4 Long-term residual waste reduction target

Based on current population growth estimates and the legally binding target for the total mass of residual waste (excluding major mineral wastes) to not exceed 287kg per person, the total volume of all residual waste (excluding major mineral wastes) in England in 2042 will need to be at most approximately 17.6Mt.

6. Conclusion

This note is intended to support decision makers in planning for residual waste treatment needs and to support our national resources and deliver a circular economy. The analysis presented here will support the planning process and should be given due consideration when proposing, designing, or considering residual waste infrastructure treatment needs. The results presented should be used to ensure that we do not deliver overcapacity, especially where this risks compromising waste prevention or recycling now or in the future.

Results of the analysis undertaken in this note are presented in Figure 2, which demonstrates that the government is on track to send less than 10% of municipal waste to landfill by 2035, at least in terms of residual waste infrastructure provision. This is based on modelling the implementation of EPR for packaging in 2025, Simpler Recycling for non-micro businesses in 2025, households in 2026, and micro businesses in 2027, which will require collections for dry recyclable materials and food and garden waste, unless a transitional arrangement applies, and a DRS for drinks containers in 2027. The modelling undertaken demonstrates that, following implementation of these policies, there will be sufficient residual waste energy recovery (including waste incineration) infrastructure capacity to treat forecast municipal residual waste arisings at a national level.

Figure 2: Forecast residual waste infrastructure capacity and municipal waste arisings (2020 to 2035) – packaging reforms with 80% NHM capture rate, from internal Defra analysis.

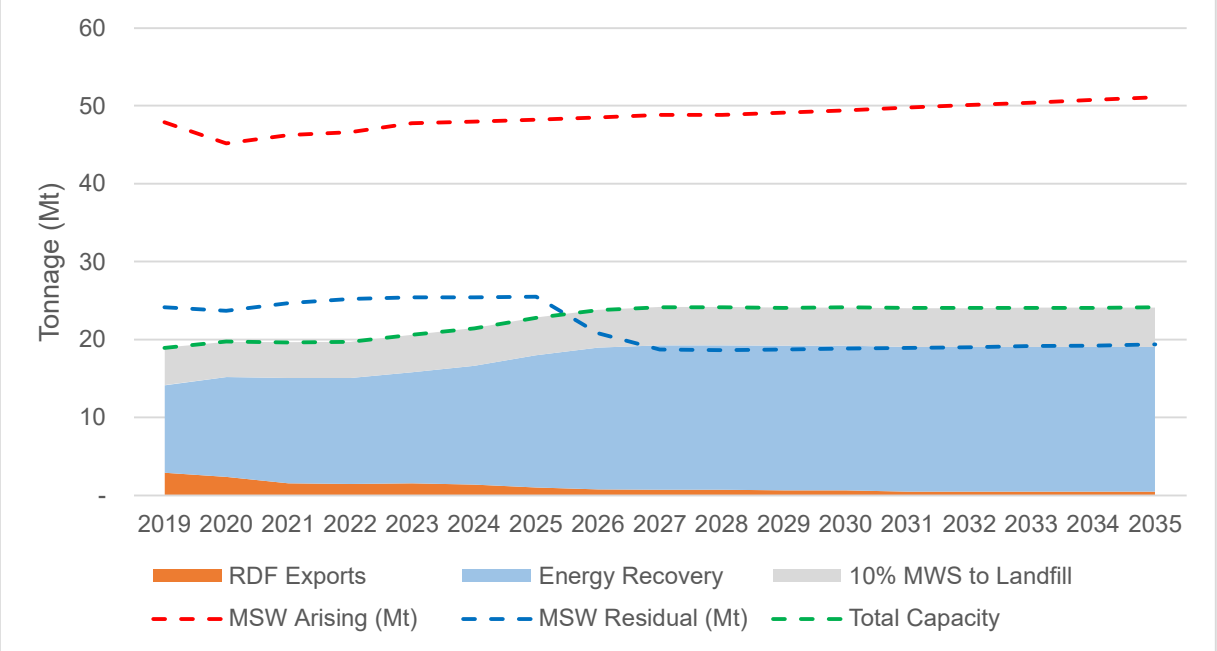

Figure 2 information: Figure 2 includes blue and red dashed lines that show forecast municipal waste arisings. Total municipal solid waste arisings (red line) are forecast to increase across 2020 to 2035, from 45.2Mt to 51.1Mt. The tonnage of municipal solid waste sent to residual waste treatments (blue line) is forecast to decrease from 23.6Mt in 2020 to 19.4Mt in 2035. The blue line shows a clear reduction in residual waste as a result of the implementation of the packaging reforms, as more waste is moved out of residual waste treatments and into recycling. The shaded areas represent residual waste treatment capacity, with the green dashed line showing the total infrastructure capacity including RDF exports and an allowance of sending 10% municipal residual waste to landfill.

The evidence presented in this note identifies that there are certain areas in England, in particular East Midlands and East of England, where alternative treatment options to landfill for municipal residual wastes is currently required.

The assessment undertaken does not consider treatment needs for non-municipal residual wastes. While some non-municipal residual wastes disposed of in landfill could be managed through existing energy recovery facilities as volumes of municipal residual waste reduce, creating ‘headroom’, it may be that alternative or additional facilities are required to divert these wastes, where they cannot be prevented or recycled, away from landfill. Alternatively, declining municipal residual waste volumes

may facilitate the decommissioning of older, less efficient residual waste management infrastructure in some areas to avoid over-capacity.

Based on current population growth estimates, the total volume of residual waste (excluding major mineral wastes) in England in 2042 will need to be at most approximately 17.6Mt to meet the government's legally binding residual waste environmental target. This is for both municipal and non-municipal residual wastes, and acts as a long-term signal for our residual waste treatment capacity needs that should be taken into account when planning or considering residual waste treatment infrastructure.

While there are a number of waste incineration facilities that are consented, but not yet under construction, these will not be brought forward to construction if sufficient waste volumes cannot be secured via contracts to make a proposed development financially viable.

The government is committed to transitioning to a circular economy, in which we maximise resource use and minimise residual waste arisings. Where residual wastes do occur, they should be managed in the most efficient manner. This means that we will only support the development of further residual waste treatment infrastructure where they meet a clearly defined need to facilitate the diversion of non-recyclable waste away from landfill, or enable the replacement of older, less-efficient facilities.

The data in this note suggests that while we are approaching a point where national residual waste treatment capacity is sufficient to manage municipal residual wastes, there are regional variations. Evidence also suggests that alternatives are required to support the diversion of non-municipal wastes from landfill.

We do not, however, support the development of overcapacity of energy recovery infrastructure in England and will work to strengthen planning considerations to ensure that this does not happen. For those energy recovery developments we do need, we will only support projects that offer the best efficiency and are future proofed towards supporting our net zero objectives. This means that further developments must be able to demonstrate that making use of the heat they produce is viable and that they can be built carbon capture ready, in accordance with the government's 'decarbonisation readiness' requirements once they come into force. The government will also explore how to incentivise the decommissioning of facilities that are less efficient, cannot support our net zero objectives or are no longer required.

Appendix A – sensitivity analysis

Packaging reforms impact sensitivity: 70% NHM capture rate

The effect of the packaging reforms in the residual waste reduction target modelling used in the main analysis above includes an 80% ‘capture’ rate of recyclate that is applied to the tonnages of recycled NHM. The non-household municipal capture rate reflects an estimate of the proportion of businesses that correctly recycle all material all the time. The 80% rate is in line with the central Simpler Recycling scenario. To mitigate the uncertainty associated with this assumption, a sensitivity analysis using a more conservative (higher residual waste levels) 70% rate has been modelled, as presented in Figure 3. In the sensitivity scenario municipal residual waste in 2035 is forecast to be 21.5Mt, compared to 19.4Mt in the main scenario.

The results in the sensitivity scenario indicate that there will be sufficient residual waste infrastructure capacity to send less than 10% municipal waste to landfill by 2035. In 2035, total residual waste infrastructure capacity is forecast to be 24.9Mt (including an allowance of no more than 10% municipal waste to landfill) in comparison to 21.5Mt of municipal residual waste.

Figure 3: Sensitivity analysis: residual waste infrastructure capacity and municipal waste arisings (2020 to 2035) – packaging reforms with 70% NHM capture rate from internal Defra analysis.

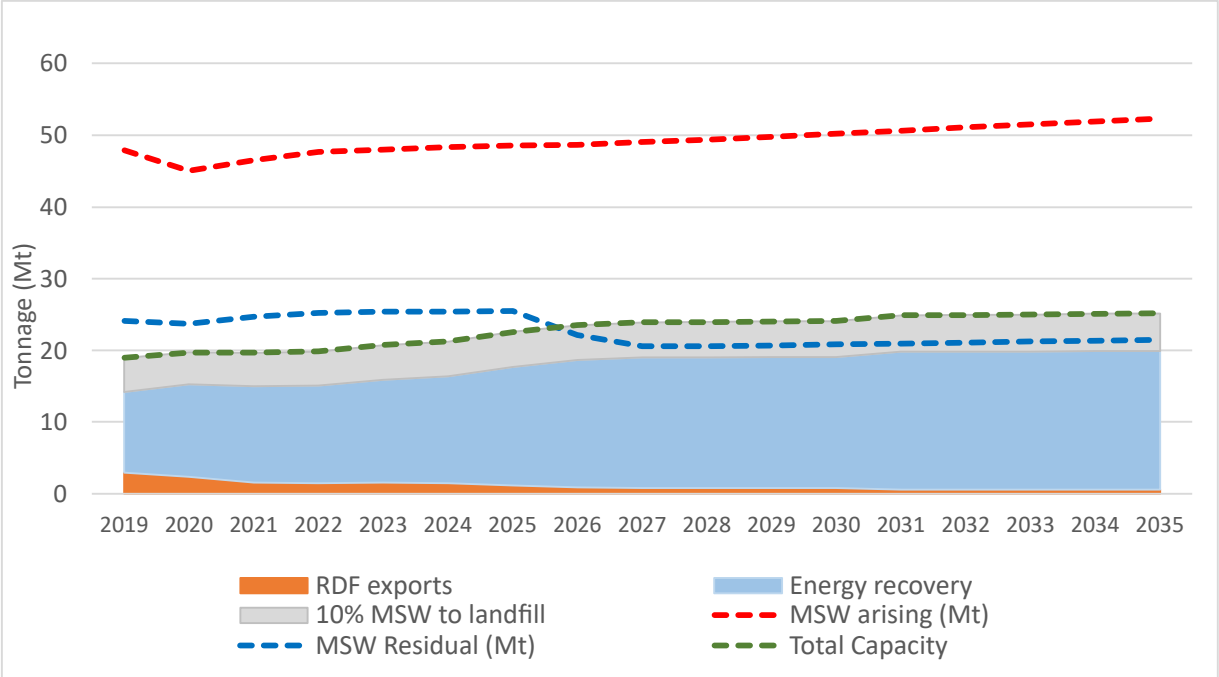

Figure 3 information: Figure 3 represents the sensitivity scenario which models a NHM capture rate of 70%. It includes blue and red dashed lines that show forecast municipal waste arisings. Total municipal solid waste arisings (red line) are forecast to increase across 2020-2035, from 45.2Mt to 51.1Mt. The tonnage of municipal solid waste sent to residual waste treatments (blue line) is forecast to decrease from 23.6Mt in 2020 to 21.5Mt in 2035. The blue line shows a clear reduction in residual waste as a result of the implementation of the packaging reforms, as more waste is moved out of residual waste treatments and into recycling. This reduction is smaller than the main scenario (Figure 2), which assumes an 80% non-household municipal capture rate. The shaded areas represent residual waste treatment capacity, with the green dashed line showing the total infrastructure capacity including RDF exports and an allowance of sending 10% municipal residual waste to landfill.

Under the sensitivity scenario, while there are greater forecast volumes of municipal residual waste, it is not until 2039 that this is forecast to result in additional energy recovery capacity coming online, beyond that which comes online in the main scenario (assuming no further policy interventions or other factors minimise residual waste). This is due to the assumption that energy recovery capacity will not come online if existing operational capacity plus new capacity exceeds available residual waste. Therefore, under the 70% non-household municipal scenario it is assumed that more municipal residual waste is sent to landfill.

Appendix B – assumptions and

limitations

Limitations

There are a number of limitations that have been identified and should be taken into account when viewing these results. These include the following.

The future policies within scope of the analysis are the packaging reforms

There are other proposed policies and external forces that may affect the volume, composition, and treatment of residual waste over time that have not been accounted for within this analysis. For example, the Plastic Packaging Tax (https://www.gov.uk/government/collections/plastic-packaging-tax), intended expansion of the UK Emissions Trading Scheme to include waste incineration and EfW (https://www.gov.uk/government/consultations/uk-emissions-trading-scheme-scope-expansion-waste), the near elimination of biodegradable waste to landfill (https://www.gov.uk/government/consultations/near-elimination-of-biodegradable-waste-to-landfill), the introduction of mandatory waste tracking (https://consult.defra.gov.uk/environmental-quality/waste-tracking/), or the transition to a circular economy.

Data uncertainty surrounding non-household municipal arisings

Comparisons between NHM arisings forecasts and data on all wastes received at permitted waste sites suggests forecasts may overestimate the tonnage of NHM that reaches residual waste treatment infrastructure. To account for this, a recovery rate has been applied to NHM arisings reflecting process losses, waste treated in the devolved governments and data limitations.

This analysis assumes that residual municipal waste composition will not change

If residual municipal waste composition changes significantly in future as a result of government policy interventions in the waste sector, this may affect the calorific value of the residual waste requiring treatment and, consequently, on the effective operational capacity of existing facilities.

This analysis does not consider EfW capacity in context of combustible non-municipal residual waste arisings

Defra's estimates of residual waste (excluding major mineral wastes) and

municipal residual waste in England estimate that in 2020 total residual waste (excluding major mineral wastes) arising were 31.9Mt, of which 26.5Mt were municipal residual wastes. The assumed 5.4Mt of non-municipal residual wastes are not included in this analysis.

However, it is likely that a significant proportion of these non-municipal wastes are combustible and will require alternative treatment to landfill, in accordance with the waste hierarchy. While some of this waste could be managed as capacity becomes available in existing facilities, it is possible that energy recovery capacity may need to grow beyond our projections for facilities to be developed to process combustible non-municipal residual waste and divert this waste from landfill.

Uncertainty surrounding the realisation of energy recover capacity forecasts

This has, in part, been mitigated by adjusting energy recovery operational capacity forecasts in reference to forecasted tonnages of available residual waste.

Uncertainty surrounding RDF export forecasts

Future levels of RDF exports will likely be influenced by factors such as the exchange rate and spare residual waste infrastructure capacity in Europe.

This analysis is not an environmental assessment of where is best to send residual waste

Instead it is a capacity assessment of England’s residual waste infrastructure capacity whilst sending less than 10% of municipal solid waste to landfill by 2035.

Assumptions

Table 6: summary of assumptions and associated uncertainties

Assumption	Associated uncertainty
The residual waste forecast assumes that the effects of the packaging reforms are in line with	Given the scale of reforms there is uncertainty surrounding the cumulative effect of the packaging reforms on estimated recycling rates and residual waste arisings.

Assumption	Associated uncertainty
packaging reforms impact assessment modelling at the time of analysis.	Packaging reforms modelling assumes materials collected for recycling are reprocessed (domestically or abroad). If there are cases where there is not initially domestic reprocessing capacity available and the material cannot be exported, we may see a more gradual reduction in residual waste.
An approximate 13 percentage point recovery rate is added to the NHM recycling rate to arrive at the non-residual rate.	If the use of a NHM recovery rate on top of the estimated NHM recycling rate is not a suitable predictor of future non-household municipal residual waste arisings, there is a risk we may underestimate future capacity needs.
The modelling of the effects of the packaging reforms on residual waste levels uses an 80% ‘capture’ rate of recyclate that is applied to the tonnages of recycled NHM.	If the capture rate is lower, there is a risk we underestimate residual waste levels. To mitigate this risk, a sensitivity scenario using a 70% capture rate has been modelled (Appendix A).
Refuse derived fuel exports fall by 20% of new energy recovery capacity that comes online in the previous year.	If RDF exports do not respond to the increase in energy recovery capacity as assumed or other external factors affect the level of exports, we risk incorrectly estimating total capacity.
Currently consented (as of October 2024) energy recovery capacity will not come online if existing operational capacity plus new capacity exceeds available residual waste.	If, in practice, there are not considerable barriers to consented capacity plants being built where these exceed available tonnages of residual waste, there is a risk that we may misestimate future energy recovery capacity.
Energy recovery forecasts assume that facilities will remain operational throughout the assessment period unless there is evidence	If energy recovery facilities are decommissioned earlier than anticipated there is a risk that our forecasts may misestimate total capacity.

Assumption	Associated uncertainty
otherwise.	
2% of residual municipal solid waste is assumed to be unprocessable at energy recovery plants and is sent to landfill.	If this percentage were to be significantly different in practise, there is a risk we may misestimate the tonnage of residual waste available for energy recovery treatment.
Non-municipal wastes are not contained within these forecasts.	The forecasts and overriding narrative in this document pertains to municipal residual wastes. There are approximately 5.4Mt of non-municipal residual wastes (excluding major mineral wastes) that arise in England each year and must also be considered in relation to residual waste treatment infrastructure capacity and needs. See section below for further detail on non-municipal, non-major mineral waste tonnages.
Residual waste forecasts are derived from the ambition level modelling used in the Residual Waste Reduction Target analysis, rather than the method used to calculate the metric for the target.	The method used to calculate the metric results in higher residual waste level estimates, therefore there may be a risk we are underestimating residual waste levels. We estimate this assumption to not have a significant effect on the main conclusions of this note.

Appendix C – energy recovery and local authorities

Evolution of energy recovery in England

Energy recovery from residual waste has grown significantly over the last 20 years. In 2000 approximately 2.4Mt (10%) of local authority residual waste in England was treated through 9 EfW facilities. There were 50 operational energy recovery facilities in England as of October 2024. The

development of energy recovery capacity since 2000 can be described as follows.

Initial phase of development

The initial phase of development (2006 to 2019) was led by the local authority sector through the Private Finance Initiative (PFI) or Public Private Partnership (PPP) contractual arrangements. These contractual arrangements were based on 25-year operational lives and provided the operator with a guaranteed minimum tonnage of waste or exclusivity rights over the waste arising in the local authority catchment. Essentially, the guaranteed minimum tonnage of waste was ‘locked up’ for a 25-year period. The local authority that was the lead in the development was said to have provided the ‘anchor’ contract that was the basis for raising the finance for the project.

At the end of the 25-year period the EfW plant would revert to the local authority who, at this point can decide to continue to operate the facility or decommission it. This decision would be taken in context of the local authority’s continuing waste management needs, in addition to the technical and commercial viability of continuing to operate the EfW plant.

Some local authorities decided not to go down the PPP route, preferring instead to rely on capacity being developed by others (including overseas operators). In this case the local authorities were able to procure capacity based on simple service-based contracts of typically 5 to 10 years duration.

Second phase of development

The second phase of development covers the period from 2020. New developments are primarily led by the private or ‘merchant’ sector (‘M’ in Figure 4). Here there is no underlying local authority contract. Instead, the contractual guarantees for supply of waste are provided by waste management companies who act as aggregators of waste. These companies are generally able to provide guaranteed minimum tonnages of approximately 15 years to developers who then raise the finance for the plant.

The development of EfW capacity since 2006 is illustrated in Figure 4, which counts local authority third party usage under the PPP banner and highlights recent merchant capacity development. The data in Figure 4 is taken from WIDP forecasts.

Figure 4: Energy recovery capacity and contract type from WIPD analysis.

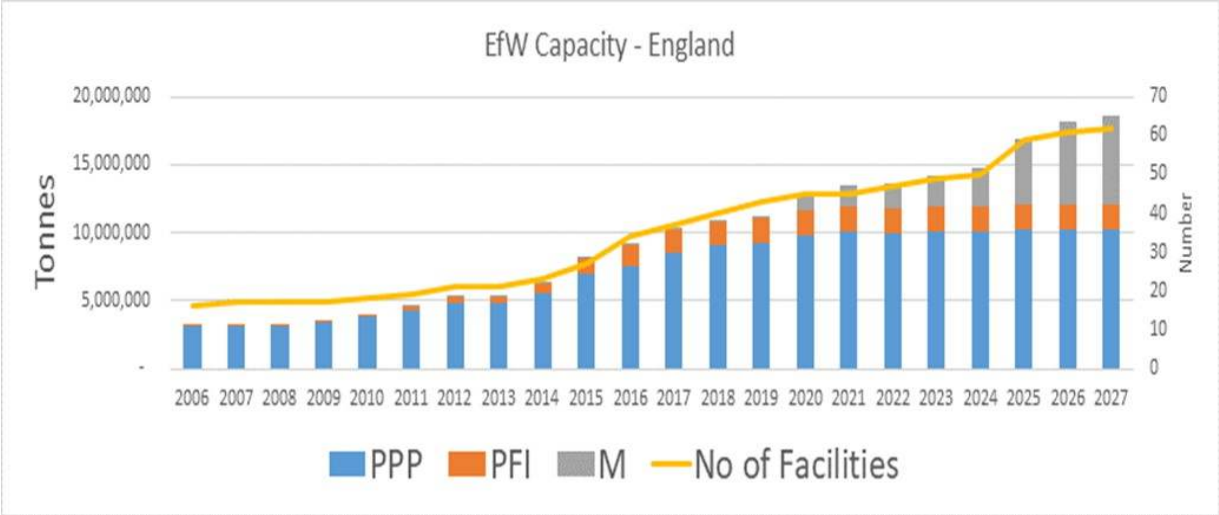

Figure 4 information: Figure 4 is a stacked bar chart showing how energy recovery capacity and contract types for energy recovery facilities have changed since 2006, and how it is projected to change to 2027. It shows that overall the number of facilities (yellow line) has increased from 16 in 2006, to 50 in 2024 and a forecast 63 in 2027. Between 2006 and 2027, PPP contracts (in blue) are the most common. Numbers of PFI contracts (in orange) increase between 2011 and 2019, but still represent a minority of contracts. Between 2019 and 2027, the number of merchant contracts (that have no underlying local authority contract) (in grey) have grown and are forecast to grow significantly, increasing from approximately 2% of total contracted tonnage in 2019 to approximately 33% of contracted tonnage in 2027.

Local authority contracts

As shown in Figure 5, local authority contracted capacity for energy recovery will decline over time through contracts coming to an end, unless they are renewed, with most existing local authority developments reaching end of contract life by the mid-2040s. Contracts will only be renewed if there is residual waste requiring treatment and the existing facility continues to represent a commercially viable treatment solution. This will allow energy recovery infrastructure capacity levels to adapt to reducing volumes of residual waste in the longer term.

Where local authority contracts are renewed, these will typically be on a 5-to-10-year basis, through an operating and maintenance contract if it is a local authority's primary residual waste management facility or a service contract for a third party local authority. Further 25-year contracts would only be seen in the case of new local authority facilities.

Figure 5: Local authority contracted tonnage.

Future of energy recovery

The Department for Energy Security and Net Zero (DESNZ) are updating the decarbonisation readiness requirements (https://www.gov.uk/government/consultations/decarbonisation-readiness-updates-to-the-2009-carbon-capture-readiness-requirements) to include EfW facilities. The proposals would require new build and substantially refurbished EfW facilities to be built in such a way that they can easily decarbonise by retrofitting carbon capture within the plant's lifetime. While this is not expected to significantly affect currently operational facilities, or developments that have already secured an environmental permit, in the longer term this may result in a shift towards locating new EfW developments to facilitate access to carbon capture and storage networks, either directly or via transportation. Only those facilities that can satisfy this requirement will be supported once this comes into force. This broadly aligns with a recommendation from the National Infrastructure Commission.

Carbon capture and storage for EfW can also result in negative emissions from permanent storage of carbon captured from combustion of the biomass within residual waste. This would be subject to meeting the greenhouse gas removals standard or relevant criteria. Negative emissions will play an important role in reaching net zero by offsetting emissions generated elsewhere in the economy. Two EfW carbon capture

and storage projects, Viridor's facility at Runcorn and Encyclis' Protos Energy Recovery Facility development at Ellesmere Port, both in Cheshire, have been taken forward to negotiations for support under the waste industrial carbon capture business model.

The government is also exploring how new plants can export heat from day one and are incentivised to export heat as soon as possible after commencing operation, and at most within 3 years. Developers are encouraged to discuss the potential for co-location or connection to a heat offtake customer with local planning authorities when developing their proposals for waste and non-waste development.

Residual waste infrastructure outputs, specifically those produced via advance thermal treatments and advanced conversion technologies, have the potential to deliver carbon savings in other areas of the economy beyond the waste sector. In this context, competition to access residual waste feedstocks may increase significantly in future. For example, the Department for Transport has confirmed support for use of the fossil component of residual waste, in addition to the biomass portion, through the Renewable Transport Fuel Obligation (RTFO) (https://www.gov.uk/government/consultations/supporting-recycled-carbon-fuels-through-the-renewable-transport-fuel-obligation/outcome/supporting-recycled-carbon-fuels-through-the-renewable-transport-fuel-obligation-government-response) as a feedstock to produce recycled carbon fuels for the transport sector.

DESNZ is also exploring support for eligible projects using residual waste feedstocks to produce low carbon hydrogen under the Net Zero Hydrogen Fund, Hydrogen Production Business Model, and the Hydrogen BECCS Innovation Programme. Non-mechanical recycling, using pyrolysis of waste plastics to produce polymers for production of new plastics, is another emerging technology that may lead to a reduction in residual waste volumes in the future as currently non-recyclable materials become recyclable. This has the potential to create circularity for certain plastics and would be preferable to using this material for energy recovery, although priority must continue to be given to minimising waste and increasing the reuse of products. Recycling should only be preferable for wastes that cannot be avoided.

Conventional incineration with energy recovery currently predominates the mix of energy recovery infrastructure within England with a small number of gasification facilities, generally using the syngas produced to generate electricity via a gas turbine. This mix may change in future as wider decarbonisation ambitions increasingly inform investment decisions for new infrastructure. The Advanced Fuels Fund has already awarded a total of £69,494,000 to support several residual waste gasification projects seeking to produce sustainable aviation fuel (SAF) in the UK. These include Alfanar's Lighthouse Green Fuels project in Teesside, Fulcrum BioEnergy's NorthPoint facility in Ellesmere Port, Esso's Solent

SAF project, and Velocys' Altalto project in Immingham. The Department for Transport's ambition is to see 5 commercial-scale sustainable aviation fuel production facilities under construction in the UK by 2025.

Development of advance thermal treatment and advance conversion technology facilities that can safely, efficiently, and sanitarily manage residual waste could come to supersede conventional EfW in the coming years if the technology is able to prove itself as the optimum means of managing residual waste.

Regardless of the specific technology or advances in sustainability of energy recovery facilities, in order to meet our residual waste reduction target, all residual wastes (excluding major mineral wastes) must not exceed approximately 17.6Mt in 2042. Residual waste infrastructure must not lock-in materials that compromises the achievement of this target, minimising waste and maximising recycling and resource efficiency. To that end, government does not support overcapacity of energy recovery treatment regardless of the technology used and all new developments must demonstrate the genuine need for additional or replacement energy recovery treatment capacity.

Glossary

Advanced thermal treatments (ATTs)

Waste management processes involving medium and high temperatures to recover energy from the waste. Primarily pyrolysis and gasification based processes, excludes incineration.

Energy from waste (EfW)

The incineration of residual waste with energy recovery in the form of electricity generation via steam turbine or heat offtake.

Energy recovery

The process of recovering energy from residual waste, usually in the form of electricity or heat, but also via conversion of waste into fuels for use in other areas of the economy, via the thermal treatment of waste feedstocks.

Landfill

A form of disposal operation, in which waste is buried under ground. Sits at the bottom of the waste hierarchy.

Local authority collected waste

This is waste that is collected by a local authority. This includes household waste and household-like waste collected from the commercial and industrial sector. Non-municipal waste includes construction and demolition waste, agricultural waste and tyres. Defra (2011) Local authority collected waste – definition of terms (https://www.gov.uk/guidance/local-authority-collected-waste-definition-of-terms).

Mechanical biological treatment (MBT)

A generic term for mechanical sorting or separation technologies used in conjunction with biological treatment processes, such as composting.

Municipal waste

Municipal waste refers to household waste and that from other sources which is similar in nature and composition to household waste, including ‘household-like’ waste generated by businesses and collected by private contractors.

Non-hazardous landfill

In this note, this refers to non-hazardous landfills and non-hazardous landfill with stabilised non-reactive hazardous waste cells.

Operational capacity

This is typically lower than permitted capacity as the former will depend on factors such as the calorific value of input waste and the maintenance regime of the treatment plant.

Permitted capacity

This refers to the maximum annual tonnage of waste that the facility is permitted by the EA to process or manage on-site.

Refuse-derived fuel (RDF)

Material that is produced from waste, has undergone some sort of treatment process, and is intended for use as a fuel.

Residual waste

Residual waste is mixed waste, typically intended for energy recovery or disposal to landfill, such as that collected from households in black bags or wheelie bins, as distinct from waste bound for recycling or prepared for reuse.