XR ZERO WASTE

WASTE MANAGEMENT POLICY BRIEF
EXPANSION OF INCINERATION IN ENGLAND AT ODDS WITH UK RECYCLING AND NET-ZERO CARBON TARGETS

July 2021

KEY FINDINGS

- **Doubling of incineration capacity.** By 2030, energy-from-waste (EfW) incineration capacity in England is set to expand from 14 to 27 million tonnes, as 50 new plants with planning permission become operational. At least 17 of these incinerators are to begin operations by 2025, with 5 million tonnes of capacity.
- **Recycling targets undermined.** Any expansion of EfW incineration capacity in England is incompatible with the government's 2035 recycling target. If the 50 approved EfW incinerators were to be built and operate at capacity, only 34% of total waste arisings would be available for recycling in 2035, not the 65% to be mandated by UK law.
- **Very high risk of overcapacity.** Absent government intervention, EfW incineration capacity will exceed England's incineration need by 15 million tonnes by 2035 (27 million tonnes of capacity v. a need of 12 million tonnes).
- **Net zero in jeopardy.** If EfW capacity expands as planned, the waste sector would emit 28 million tonnes of CO_2 in 2035, endangering the UK's net-zero carbon target. The Climate Change Committee's net-zero pathway requires sector emissions to drop below 16 million tonnes by 2035.
- **Tripling of EfW CO_2 emissions.** Government inaction would allow EfW CO_2 emissions to triple by 2030, from 5.5 to 15 million tonnes, leading waste sector emissions to be higher in 2035 than in 2019. In contrast, government intervention could *halve* incineration emissions by 2035.
- **Green job growth hindered.** Reuse and repair generate 15 times more jobs than the waste disposal sector, whose expansion is preventing a green job boom.
- **Recycling revenue at risk.** A shift away from landfilling and EfW incineration is required to secure £1.6 billion per year in recycling revenue for the UK economy by 2035.

POLICY RECOMMENDATIONS

- In the Finance Bill 2022, **introduce an EfW incineration tax**, including on exported waste, to boost investment in recycling infrastructure. Announce the tax in advance.
- **Restrict EfW incinerators to burning only low-carbon feedstock** so as to reduce greenhouse gas emissions, preferably by amending the Waste Regulations 2011 or, alternatively, in the Energy Bill.
- Amend the National Planning Policy to **require reassessments of existing planning permission** to ensure compatibility with the UK's recycling and net-zero targets.
- **Institute a carbon charge** in the Finance Bill to correct market distortions and enable the UK to meet its 2050 net-zero carbon target. Announce the charge in advance.

Contents

The expansion of energy-from-waste (EfW) incineration capacity in England[1] is on a collision course with the UK's 65% recycling target for 2035 and the 2050 net-zero carbon target. This brief unpacks the adverse climate and socio-economic impacts of staying the course and recommends immediate regulatory reform to address the current policy clash.

1. IMPLICATIONS OF BUSINESS AS USUAL

The 2020s are poised to witness the doubling of England's EfW incineration capacity: 49 plants with a capacity of 14.2 million tonnes (as of June 2021) are to be joined by 50 new facilities, while only 2 plants are to be decommissioned, resulting in a net added capacity of 12.9 million tonnes (see Section 4). Seventeen of the new EfW projects are already being commissioned or built, and all have secured local or national government planning approval. Thus, **by 2030, England is to have 97 EfW incinerators that require 27 million tonnes of waste** per year to run at capacity, even though the UK's 65% recycling target for 2035 means that the country needs less than half that treatment capacity.

The ongoing expansion of EfW incineration capacity is problematic on two main counts. First, it is **at odds with the UK's recycling target of 65% by 2035**. By signing contracts with EfW plant operators, local authorities and businesses lock themselves into long-term agreements to burn waste that they collect from households as well as commercial and industrial sources. If EfW incineration capacity were permitted to swell to 27 million tonnes during the second half of this decade, local authorities and businesses would have to send 59% of the waste to incineration to be able to fulfil their contractual obligations, assuming that 7% of their combined waste would still go to landfill. That would leave only 34% of the collected waste for recycling, far less than required to meet the UK government's target of 65% recycling by 2035. Indeed, **England already has more incineration capacity than required** to treat the residual waste that would be left over if that recycling target were met (see Section 5).

Second, the expansion of EfW capacity **threatens the UK's 2050 net-zero carbon imperative**. EfW incinerators currently emit nearly half a tonne of fossil CO_2 per tonne of incinerated waste, primarily due to the burning of plastics.[2] If operating at capacity, the 50 new EfW plants would raise annual fossil CO_2 emissions by up to 9.4 million tonnes, from an estimated 5.5 million tonnes in 2019 to 14.9 million tonnes by 2030. In other words, **fossil CO_2 emissions from EfW incineration would nearly triple** if the new facilities were to become operational.

This trajectory is incompatible with the sixth carbon budget of the Climate Change Committee (CCC), which requires UK electricity production to reach zero carbon by 2035.[3] The only approach that can put the waste sector on track to meet this target is an immediate halt to the expansion of EfW incineration, combined with the use of pre-sorting technology to remove as much plastic as possible from residual waste prior to incineration. Taking these steps would **halve current EfW incineration emissions in England** and enable the UK to reach its net-zero carbon target by 2050 (see Section 6).

While the above-mentioned 50 plants already have planning permission, consent is also being sought for another 30 EfW facilities with 9.3 million tonnes of capacity in England. This analysis assumes that none of these additional incinerators will be realised, as extrapolations of current residual waste arisings in England indicate that the country would not produce enough residual waste for them to be viable.

In the absence of government intervention, the expansion of EfW incineration capacity is set to continue apace. The UK's forthcoming legislative instruments under the Resources and Waste Strategy for England and the Environment Bill will not be able to curb this growth. **The only way the UK can meet its recycling and net-zero targets – and avert EfW incineration overcapacity and stranded incineration assets of the kind encountered in Denmark, the Netherlands, and Sweden[4] – is to introduce new policies**, as discussed below.

2. POLICY RECOMMENDATIONS

This analysis points to an urgent need for measures that can stop the expansion of EfW incineration capacity and redirect investments towards reuse and recycling infrastructure, to ensure that the recycling and the net-zero carbon targets remain in reach. The UK government can achieve these goals by:

- introducing an **EfW incineration tax** per tonne of incinerated input, similar to the landfill tax. In conjunction with incineration gate fees, this tax would shift economic incentives away from EfW incineration and towards recycling, with the aim of rendering investment in recycling capacity more economically attractive to the waste industry and investors. The tax should also be applied to waste that is exported for incineration elsewhere, so as to avoid 'leakage' and dumping of waste abroad. As specified by the UK's environment minister, Rebecca Pow: 'Should wider policies not deliver the Government's waste ambitions in the long term, the introduction of a tax on incineration of waste will be considered, taking into account how a tax would work alongside landfill tax and the possible impacts on local authorities.'[5]
- passing a **regulation to restrict EfW incinerators to burning processed refuse-derived and solid recovered fuel with a low fossil carbon content**.[6] This measure would help to curb greenhouse gas emissions by ensuring that operators use pre-sorting to recover as much plastic as possible from the residual waste stream before burning the remaining waste, thereby ending the practice of direct incineration of municipal solid waste. The recovered plastics could then be redirected to UK recycling facilities.
- **reevaluating existing planning permissions** to prevent EfW incineration overcapacity and ensure compatibility with the UK's 65% recycling and 2050 net-zero targets, in line with the Environment Bill and the Paris Agreement.
- instituting a **carbon charge** at the point of emission to cost carbon emissions and thereby level the playing field, correcting distortions that currently favour EfW incineration over other forms of energy generation with waste treatment. Research shows that the UK's 2050 net-zero target requires a carbon price trajectory that reaches at least £75 per tonne of CO_2 equivalent (CO_2e) by 2030.[7]. The charge would be linked to the above-mentioned incineration tax to help propel the shift away from incineration and towards recycling.

Taken jointly, these four measures would not only enable the UK to meet its recycling and net-zero targets, but also help to unleash innovation potential in the waste and resource industry. The UK is currently lagging behind countries such as Germany, the Netherlands, and Sweden in terms of installing state-of-the-art recycling facilities for plastics and other materials (see Section 8).

By taking the above-mentioned steps, the UK government would make recycling economically attractive to investors, which would unlock research, development, and innovation (R&D&I) potential and stimulate a multiplier effect across the entire UK economy.[8]

3. WASTE AND RECYCLING: 2019 AND 2035

This section provides a breakdown of current waste flows in England, projections for 2035 in relation to incineration capacity, and analysis of the factors that are leading to reductions in waste arisings. It considers the impacts of the UK's recycling targets and other policies, as well as that of COVID-19.

A breakdown of waste in England

England currently landfills and incinerates nearly two-thirds of its municipal solid waste, either domestically or abroad. In 2019/20 England's 23 million households produced about 25.4 million tonnes of waste. An estimated 41% of that waste was recycled, 43% was incinerated, 10% was landfilled, and 5% was exported.

The same year, English businesses produced an estimated 18.6 million tonnes of commercial and industrial (C&I) waste that was suitable for incineration. About 33% of that C&I waste was recycled, 7% was incinerated, 47% was landfilled, and 14% was exported (see Box 1 and Table 1).

About 90% of the exported household and C&I waste went to incinerators in various countries, including the Netherlands, Sweden, and Turkey. All in all, England sent 27.4 million tonnes of household and C&I waste generated in 2019/20, or 62% of all generated waste, to landfill or incineration in the UK or abroad.

Box 1

HOUSEHOLD AND C&I WASTE

Household waste is collected by local authorities or by companies they contract out for this purpose, such as Veolia and Biffa. Either way, the collection of household waste falls under local authority-collected waste (LACW), which can also include a portion of local trade or commercial waste.

Commercial and industrial (C&I) waste is a broad category that covers hazardous and non-hazardous waste, including packaging waste, trade waste, waste from all industries, bottom and fly ash from thermal processes, and medical waste. Waste management companies collect most C&I waste.

C&I waste includes inert materials such as fly ash and soil, which are not combustible in energy-from-waste (EfW) incineration and should thus be excluded from estimates of residual waste arisings suitable for EfW incineration, landfilling, or recycling. Hazardous waste, which is not directly recyclable due to its toxicity, needs to be treated in dedicated hazardous waste incinerators, which burn contents at higher temperatures. This brief does not cover C& categories such as hazardous waste, sewage sludges, or inert construction and demolition waste.

Table 1 Household and C&I* waste flows in England, 2019/20

	Waste (millions of tonnes)		
	Household	C&I	Total
Total waste arisings	**25.36**	**18.55**	**43.91**
Recycled	10.46	6.03	16.49
Incinerated in England	11.01	1.23	12.24
Incinerated abroad	1.25	2.65	3.90
Landfilled	2.64	8.64	11.28

Notes: * See Box 1. Figures may not add up to totals due to rounding.
Sources: household waste: DEFRA WasteDataFlow (https://www.wastedata-flow.org/); C&I: Environment Agency Waste Data Interrogator (https://data.gov.uk/dataset/d409b2ba-796c-4436-82c7-eb1831a9ef25/2019-waste-data-interrogator)

The impact of recycling targets

The UK recycling target for 2035 is 65% of municipal solid waste, including household waste and household-like waste generated by the commercial sector. The government is also aiming for 70% of packaging waste to be recycled and for less than 10% of all municipal solid waste to go to landfill by 2035.

Assuming a ban on waste exports and a stable level of waste arisings in England (as described below), these targets imply a need for a **maximum of 11.3–12.2 million tonnes of domestic EfW incineration capacity by 2035**, depending on the level of landfilling of C&I waste (see Table 2). Note that England's EfW incineration capacity had already reached 14.2 million tonnes in June 2021, exceeding the maximum need projected for 2035.

Table 2 Forecast: household and C&I* waste flows in England, assuming 65% recycling and 5%–15% landfill by 2035

	Waste per year (millions of tonnes)		
	Household with 5% landfill	C&I with 10%–15% landfill	Total
Total waste arisings	**25.4**	**18.5**	**43.9**
Recycled	16.5	12.0	28.5
Incinerated in England	7.6	3.7–4.6	11.3–12.2
Incinerated abroad	0	0	0
Landfilled	1.3	1.9–2.8	3.2–4.1

Notes: * See Box 1. Figures may not add up to totals due to rounding.
Sources: household waste: DEFRA WasteDataFlow (https://www.wastedata-flow.org/); C&I: Environment Agency Waste Data Interrogator (https://data.gov.uk/dataset/d409b2ba-796c-4436-82c7-eb1831a9ef25/2019-waste-data-interrogator)

Trends in waste arisings

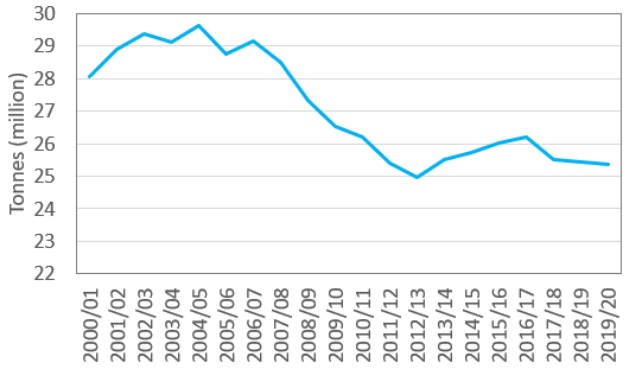
The need for residual waste treatment fluctuates in relation to two factors. First, it decreases as recycling rates increase, since the amount of residual waste declines. Second, it responds to the rise and fall in waste arisings, which themselves reflect changes in variables such as GDP, population, product design, dematerialisation efforts, and packaging regulations.

XR Zero Waste's conservative analysis of DEFRA data indicates that waste arisings in England are likely to remain stable into the foreseeable future. If, however, the analysis is broadened to consider additional factors – such as the expected impact of policies under the Resources and Waste Strategy for England, the 2021 Waste Prevention Programme for England, and the UK Environment Bill, along with pandemic-related reductions in commercial waste and significant industry efforts to reduce food and plastic waste – then total **waste arisings are expected to decline by the end of this decade**.

DEFRA data indicate that over the past 20 years, household waste, which accounts for the vast majority of local authority-collected waste (LACW) in England, declined slightly (see Figure 1). English C&I waste data, which are available from 2010, show that commercial waste grew while industrial waste remained relatively stable through 2018 (see Figure 2). Since most of DEFRA's C&I data are not currently disaggregated, it is not possible to assess the underlying economic and technical factors that drive these trends (see Box 1).

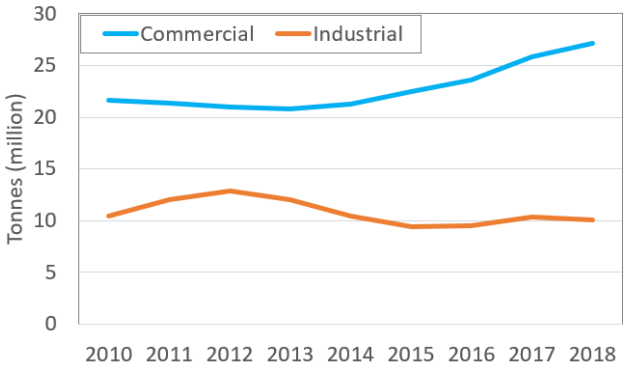
Both DEFRA and VALPAK, the main producer responsibility organisation for packaging in the UK, provide data on packaging waste, which is found in both household and C&I waste streams. Over the past 15 years, the annual amount of packaging waste has been fairly stable at around 11.5 million tonnes (see Figure 3). This trend indicates that packaging waste is likely to remain stable for the foreseeable future.

Figure 1 Household waste in England, 2000/01–2019/20



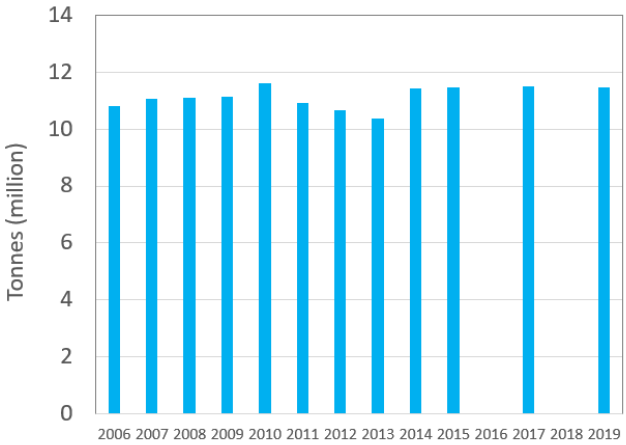
Source: DEFRA (https://www.gov.uk/government/statistics/uk-waste-data)

Figure 2 C&I waste in England, 2010–18



Source: DEFRA (https://www.gov.uk/government/statistics/uk-waste-data)

Figure 3 Packaging waste, including paper and card, glass, aluminium, steel, plastic, and wood, 2006–19

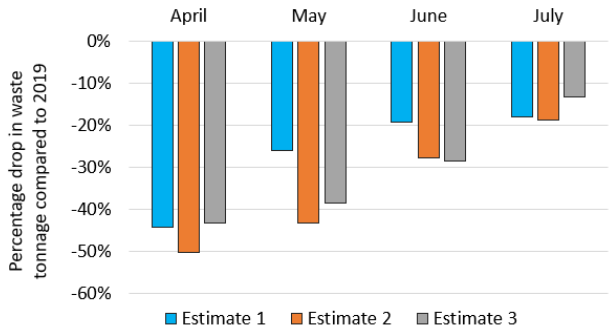


Sources: DEFRA (https://www.gov.uk/government/statistics/uk-waste-data); VALPAK (https://www.valpak.co.uk/more/material-flow-reports)

The above-mentioned upward trend in commercial waste arisings came to an abrupt end in 2020, as the economic impact of COVID-19 deepened. Indeed, C&I waste arisings in April–July 2020 in England were 38% lower than they were during that period in 2019 (see Figure 4). Tolvik Consulting

reports that 2020 witnessed a decrease of 2% (0.4 million tonnes) in household waste in England compared to previous years, due to sharp reductions in garden waste collections and limited access to recycling centres, which diverted waste to commercial skips. Tolvik estimates that total waste arisings declined by 14%–16% between 2019 and 2020, and that they will remain 6%–13% lower than pre-COVID levels in 2021.[9]

Figure 4 Impact of COVID-19 on C&I waste tonnage in England, April–July 2020 relative to the same period in 2019



Note: The three industry estimates are largely in agreement, indicating a high level of confidence in Tolvik's forecasts of waste arisings.
Source: Tolvik (https://www.tolvik.com/published-reports/view/briefing-covid-19-and-uk-waste-sector-autumn-2020/)

As the economy recovers from the pandemic, waste arisings are likely to grow, although they may take several years to reach 2018/19 levels. Tolvik expects commercial waste arisings to remain below pre-COVID amounts through 2025.[10]

The following **government policies are also likely to reduce waste arisings**:

- **the plastic packaging tax of £200 per tonne**, which will come into force on 1 April 2022.
- **a target for residual waste reduction**, to be set in 2022 under the Environment Bill.
- **extended producer responsibility for packaging waste** as of 2023/24, which will make packaging producers responsible for the full costs of managing packaging once it becomes waste, raising the packaging costs for major food companies and other producers, and thereby incentivising companies to minimise their use of it.
- **the extension of waste prevention efforts**, which will cover furniture, electronics, vehicles, textiles, the construction of plastic packaging, and food under the 2021 Waste Prevention Programme for England.

In view of the trends outlined in this section, the impact of COVID-19 on C&I waste, and the expected impacts of imminent government policies, this brief conservatively assumes that waste arisings will remain stable in the foreseeable future.

4. EXPANSION OF INCINERATION CAPACITY

This XR Zero Waste review of industry and other available data reveals that, as of June 2021:

- 49 EfW incinerators with a capacity of 14.2 million tonnes were operational in England, and that two of these facilities (with a combined capacity of 885,000 tonnes) were to be decommissioned by 2025.
- 17 plants with 4.7 million tonnes of capacity were likely to become operational by 2025, as 2 were already being commissioned and 15 were under construction.
- 33 facilities with 9.0 million tonnes of capacity had received local or national planning consent, including one intended to replace an existing 675,000-tonne plant that is to be decommissioned.
- 30 incinerators with 9.3 million tonnes of capacity were in the planning stages (see Table 3 and Figures 5–6).[11]

Figure 7 presents all of these incinerators on a map, using coloured circles of different sizes to indicate their capacity and whether they are operational, 'advanced' (being commissioned, under construction, or approved), or planned.

Table 3 EfW incineration capacity in England, June 2021

Status		Number of facilities	Total capacity
Operational		49	14,183,300
Advanced*	Commissioning	2	593,000
	Under construction	15	4,160,500
	Approved	33	8,990,970
To be decommissioned**		-2	-885,000
Subtotal (by 2030)		**97**	**27,042,770**
Planned		30	9,270,450
Dormant, to be revived		1	190,000
Grand total		**129**	**36,503,220**

Note: * This brief uses the term 'advanced' to refer to the 50 plants that were being commissioned, were under construction, or had been approved as of June 2021. ** Excludes the decade-old Lakeside EfW facility that is to be replaced if the third Heathrow runway is built, given the project's uncertainty.

Figure 5 EfW incineration capacity in England, June 2021

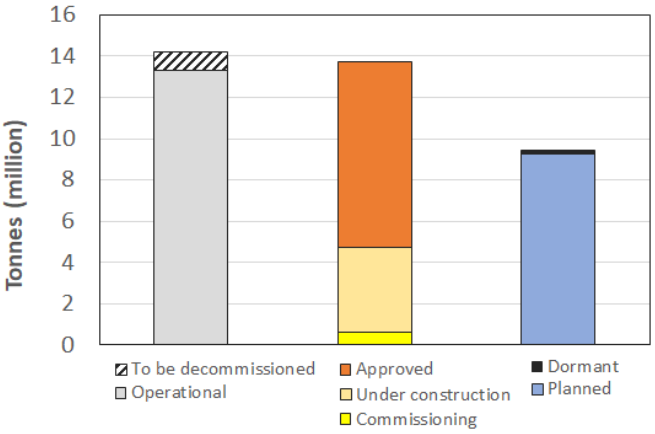


Figure 6 Number of EfW incinerators in England, June 2021

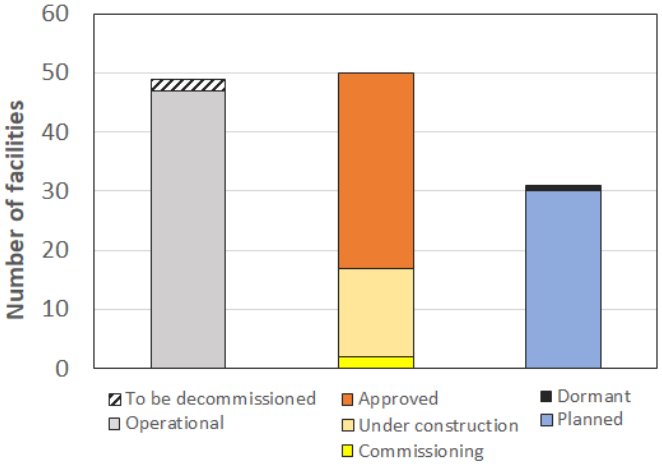
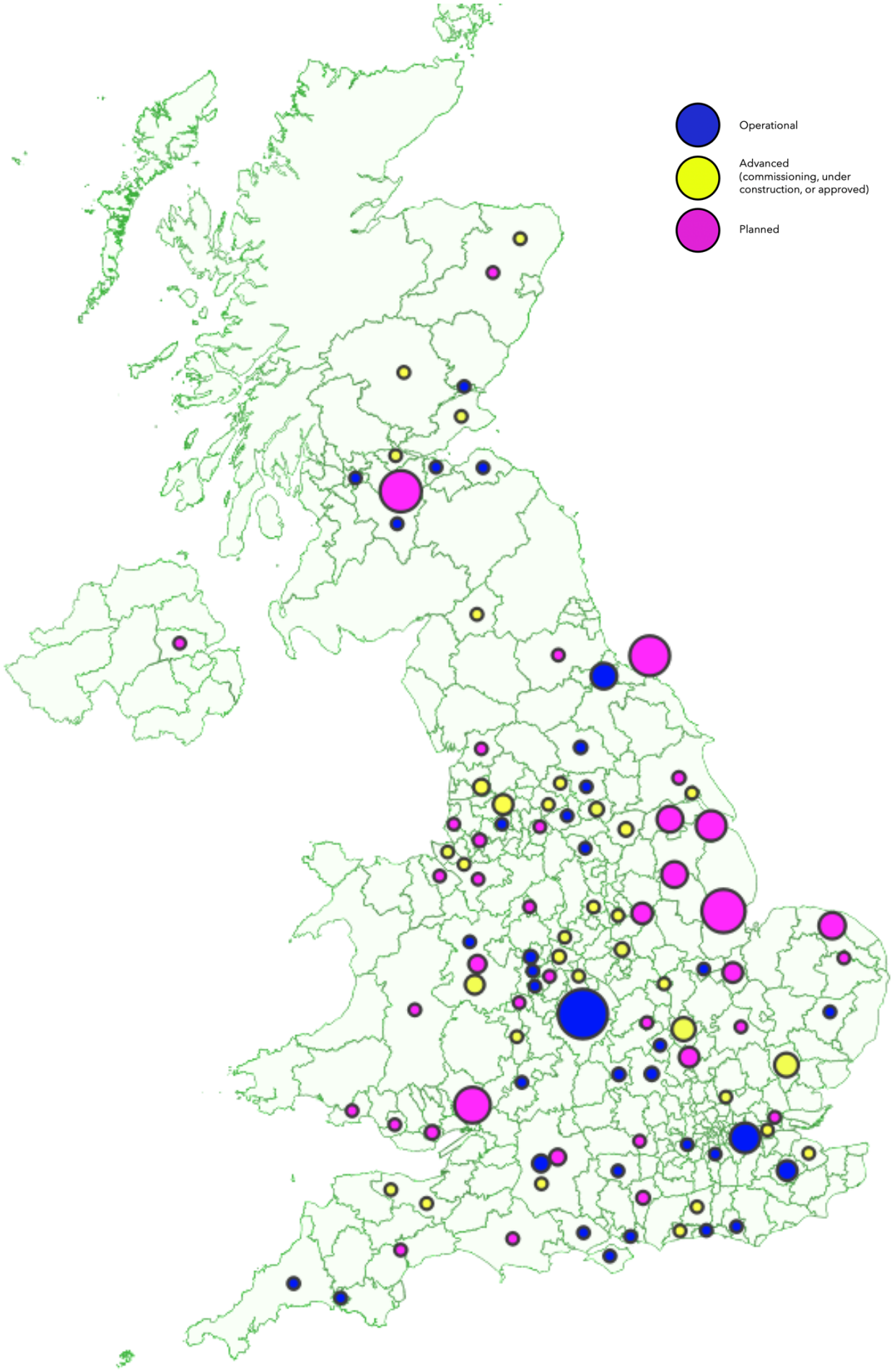


Figure 7 Operational, advanced (commissioning, under construction, or approved), and planned incinerators in the UK



Notes: Circles are scaled to the size of incinerator capacity. A single circle can represent multiple incinerators that are affiliated with the same local authority.

As noted above, 17 of the 50 'advanced' plants are currently being commissioned or built; they are due to increase EfW incineration capacity to 18.9 million tonnes by 2025. The other 33 advanced projects are highly likely to be realised by 2030, for three reasons:

- **Consent has been granted.** The 9 million tonnes of capacity already received either local planning or national planning consent (for facilities with less than or at least 50 MW of energy-generation capacity, respectively). A large number of these facilities have also received environmental permission from the Environment Agency.
- **Incineration benefits from market distortions.** Today's economic conditions favour EfW over alternatives, offering industry and private investors a high return on investment over a short period of time. Legislative reform is needed to level the playing field and to make investment in recycling more financially attractive (see Section 8).
- **Investment in circular infrastructure is sluggish.** Unlike countries such as Germany, the Netherlands, and Wales, England has been slow to invest in and deliver infrastructure designed to turbocharge reuse, repair, and recycling.[12] In Wales, for example, the government has invested more than £1 billion since 2000 to support its 22 local authorities in setting up world-class recycling collection services and recycling centres.[13] As part of its circular economy grant scheme, it invested £13 million in reuse and repair.[14]

The likelihood that the 50 advanced EfW plants will become operational by 2030 is thus high. If all were realised while only two plants were decommissioned, EfW capacity in England would grow to 27 million tonnes, 15 million tonnes more than the projected incineration need for 2035 (see Section 5).

In contrast to the 50 advanced EfW plants, the fate of the 30 planned facilities is uncertain, not only because they have yet to secure approval, but also because they would not be able to operate at capacity without a dramatic reversal in current trends (see Section 3). Either recycling rates would have to plunge, or total waste arisings would have to shoot up while recycling stagnates – unlikely scenarios given the government's recycling and net-zero targets. Nevertheless, many companies in the EfW sector are pushing for this unnecessary expansion in an attempt to outcompete one another in securing lucrative EfW contracts with local authorities, regardless of the high risks associated with overcapacity (see Figure 8).

EfW plants are built for 30–50 years of operation, and nearly half (48%) of all incineration contracts between local authorities and waste operators cover at least 25 years, while 75% are for 10 years or more.[15] The majority of the 50 EfW facilities that are expected to be realised by 2030 would therefore be in operation in the foreseeable future, not just in 2035, but also in 2050 and beyond, raising serious concerns about their impact on the UK's ability to meet its recycling and net-zero targets (see Sections 5 and 6).

5. NATIONAL AND REGIONAL OVERCAPACITY

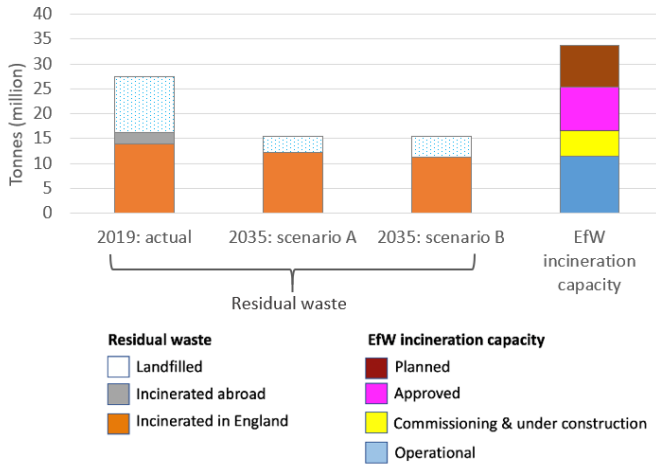
This section shows that, barring government intervention, England is poised to face significant EfW overcapacity if the UK's 65% recycling rate is to be achieved by 2035. It describes how the expansion of EfW incineration capacity threatens the recycling target, both at the national and regional levels, and provides a breakdown of overcapacity by region and by waste partnership.

Overcapacity in England

In the process of reaching its 65% recycling target by 2035 and sharply reducing landfilling, the UK will essentially reduce its domestic EfW incineration need to a maximum of 11.3–12.2 million tonnes, as discussed in Section 3. If the UK were to follow the example set by Wales, it would subsequently introduce higher targets to facilitate the transition to a circular economy.

In this context, the imminent expansion of incineration capacity to **27 million tonnes would translate into nearly 15 million tonnes of overcapacity by 2035**, assuming that the 65% recycling target will be met by then (see Figure 8).[16] This forecast also assumes that England will produce at most 12.2 million tonnes of residual waste (see Table 2). As noted above, England's current incineration capacity of 14.2 million tonnes already exceeds that residual waste treatment need, such that any additional facilities would contribute to overcapacity.

Figure 8 Operational, advanced, and planned EfW capacity v. residual waste suitable for incineration, 2019 and 2035



Notes: Scenarios A and B both assume that the UK will reach the 65% recycling target and send at most 10% of local authority-collected residual waste to landfill by 2035. The proportion of C&I residual waste that goes to landfill in 2035 is 10% in scenario A and 15% in scenario B. See Box 1 and Table 3.

In practice, overcapacity restricts or drives down the recycling rate, thereby undermining the 65% target for 2035. This risk is currently baked into incineration contracts, which obligate local authorities to ensure their incinerators operate at capacity – or to pay financial penalties.[17] As a result, **local authorities are contractually incentivised to supply recyclable materials to their incinerators** to make up for any shortfalls, such as are expected as residual waste levels drop in relation to recycling. Given that incineration contracts tend to run for decades, local authorities are locked into the commitment to supply incinerators for the long term, regardless of – and in direct opposition to – the government's recycling ambitions. For example, Oxfordshire County Council's 25-year contract with Viridor, under which 150,000 tonnes of residual waste are to be sent for incineration at the Ardley EfW facility every year until 2036, contractually incentivises the council to supply recyclable materials to the incinerator.[18]

If all 50 advanced EfW projects listed in Table 3 were to be realised, leading capacity in England to grow to 27 million tonnes, the recycling rate for household and C&I waste would drop to 34% by 2035 – at a time when the rate should be increasing to the UK's 65% target. As part of this decrease, the household recycling rate would plummet to 26% from the current 41% (see Table 4).

Table 4 English household and C&I* recycling rates based on EfW incineration expansion scenarios

Year	% of advanced capacity built	Recycling rates (%) Household	C&I	Total
2019/20	0	41.3	32.5	37.6
2035	0	65.0	65.0	65.0
	50	35.5	63.5	47.4
	100	26.4	44.8	34.2

Notes: * See Box 1. This brief uses the term 'advanced' to refer to the 50 plants that were being commissioned, were under construction, or had been approved as of June 2021 (see Table 3). The table shows that **if all advanced EfW plants were to be built, only 34% of collected waste would be available for recycling in 2035, far less than the UK's 65% target.** Of the remaining waste, 59% would be sent to incineration to fulfil contractual obligations, while 7% would still go to landfill. The scenarios assume that England will produce at most 12.2 million tonnes of residual waste in 2035 (see Table 2).

The significant drop in recycling would be the direct result of the above-mentioned contractual obligations, which would impel local authorities and businesses to send specified amounts of waste to incineration – 59% of the total waste in 2035, if 7% were still going to landfill. Recycling streams would consist of the remaining waste – only 34% of the total.

Even if only half (7 million tonnes) of the advanced plants were to become operational, the total recycling rate would remain below 50%, as shown in Table 4. Indeed, **any expansion of EfW incineration capacity would be incompatible with the government's 65% recycling target for 2035**. Simply put, the UK's policy of allowing incineration capacity to expand is entirely at odds with its recycling policy.

Overcapacity in England's nine regions

This section reveals which regions of England are likely to face EfW overcapacity within the next 15 years, both at current and expanded levels of EfW incineration capacity.

Table 5 presents data on residual household and C&I waste arisings per region for 2019/20 and shows that **the 65% recycling rate can be expected to halve total waste arisings by 2035**. Table 6 compares the halved waste arisings to regional EfW incineration capacity,[19] highlighting areas where overcapacity may be expected in the absence of government intervention. This evaluation is conservative in that it assumes that permission will not be granted to any of the 30 EfW incineration projects that are in the planning stages. It yields the following insights:

- **Current situation:** Available data for 2019/20 show that:
  - residual waste arisings exceeded EfW incineration capacity in seven of England's nine regions; and
  - capacity was proportional to arisings in the North East and the West Midlands (see Figure 9).

- **65% recycling without EfW expansion:** If all regions were to meet the 65% recycling target by 2035 and EfW incineration capacity did not expand beyond current levels, then:
  - incineration capacity would significantly exceed residual waste arisings in five regions (London, the North East, the South East, the South West, and the West Midlands);
  - incineration capacity would be close to sufficient in two regions (the North West as well as Yorkshire and the Humber); and
  - only the East of England and the East Midlands would require significant additional EfW capacity and would thus need to rely on overcapacity in neighbouring regions (see Figure 9).

- **65% recycling with EfW expansion:** If all regions were to meet the 65% recycling target by 2035 and all 50 advanced EfW incineration projects were to be realised, causing EfW capacity to expand from 14 to 27 million tonnes, then:
  - **EfW capacity would exceed the incineration need in eight regions** (the East of England, London, the North East, the North West, the South East, the South West, the West Midlands, and Yorkshire and the Humber);
  - six of the eight regions with EfW overcapacity would have more than twice the required capacity (the North East, the North West, the South East, the South West, the West Midlands, and Yorkshire and the Humber); and
  - the East Midlands would be the only region in which EfW capacity would be proportional to residual waste arisings (see Figure 9).

It follows that England already has enough EfW incineration capacity to treat residual waste in 2035, so long as the 65% recycling target is met. Moreover, as noted above, **the country would face up to 15 million tonnes of overcapacity by 2035** if the government failed to curtail EfW expansion.

Table 5 Residual waste arisings per region, 2019/20 and with 65% recycling by 2035 (tonnes)

Region	Tonnes of residual waste arisings* Household 2019/20	Household with 65% recycling by 2035	C&I 2019/20	C&I with 65% recycling by 2035	Total 2019/20	Total with 65% recycling by 2035
East Midlands	1,218,422	691,385	1,002,173	436,729	2,220,594	1,128,114
East of England	1,512,843	858,452	1,224,214	533,491	2,737,057	1,391,943
London	1,899,425	1,077,815	1,404,795	612,185	3,304,220	1,690,000
North East	677,764	384,593	448,814	195,585	1,126,578	580,178
North West	1,852,268	1,051,056	1,286,331	560,560	3,138,600	1,611,617
South East	2,134,068	1,210,962	1,522,447	663,455	3,656,515	1,874,417
South West	1,370,665	777,774	540,729	235,640	1,911,394	1,013,414
West Midlands	1,446,520	820,817	1,616,542	704,460	3,063,062	1,525,278
Yorkshire & the Humber	1,295,542	735,146	1,595,739	695,395	2,891,281	1,430,541
Total	**13,407,518**	**7,608,000**	**10,641,784**	**4,637,500**	**24,049,301**	**12,245,500**

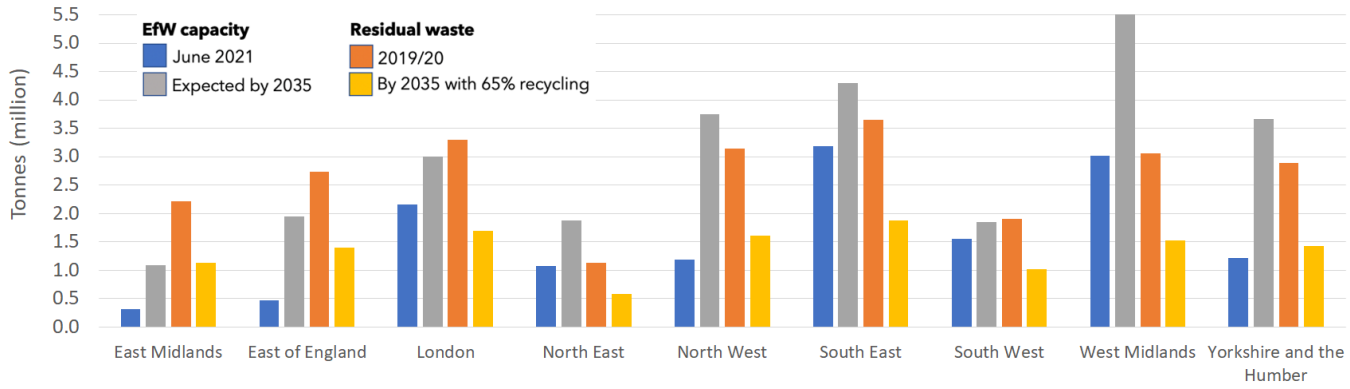
Notes: * See Box 1. This table shows that if England achieves its 65% recycling target, its regions will cut their residual waste arisings in half by 2035.
Sources: household waste: DEFRA WasteDataFlow (https://www.wastedataflow.org); C&I: Environment Agency Waste Data Interrogator (https://data.gov.uk/dataset/d409b2ba-796c-4436-82c7-eb1831a9ef25/2019-waste-data-interrogator)

Table 6 EfW incineration capacity and overcapacity v. estimated residual waste arisings with 65% recycling by 2035, by region

	EfW capacity and overcapacity vis-à-vis waste arisings with 65% recycling (tonnes)						Waste arisings with 65% recycling by 2035 (tonnes)
Region	**Operational capacity (June 2021)**	Commissioning & under construction	Approved	Planned	To be decommis-sioned	**Operational capacity by 2035**	
East Midlands	310,000	350,000	425,000	1,764,950	0	1,085,000	1,128,114
East of England	470,000	1,180,000	300,000	2,145,000	0	**1,950,000**	1,391,943
London	**2,165,000**	0	1,505,920	0	675,000	**2,995,920**	1,690,000
North East	**1,080,000**	0	800,000	1,209,000	0	**1,880,000**	580,178
North West	1,185,000	1,240,000	1,320,000	1,063,000	0	**3,745,000**	1,611,617
South East	**3,183,300**	480,000	632,000	480,000	0	**4,295,300**	1,874,417
South West	**1,555,000**	120,500	170,050	630,000	0	**1,845,550**	1,013,414
West Midlands	**3,020,000**	1,033,000	1,733,000	255,000	210,000	**5,576,000**	1,525,278
Yorkshire & the Humber	1,215,000	350,000	2,105,000	1,723,500	0	**3,670,000**	1,430,541
Total	**14,183,300**	4,753,500	8,990,970	9,270,450	885,000	**27,042,770**	12,245,500
Overcapacity by 2035	**1,937,800**					**14,797,270**	

Notes: EfW incineration overcapacity vis-à-vis waste arisings in 2035 (with 65% recycling) is highlighted in orange for current capacity levels as well as capacity that is expected to be operational by 2035 (operational capacity in June 2021 – decommissioned capacity + capacity that was being commissioned, was under construction, or had been approved by June 2021). This assessment assumes that none of the 30 'planned' projects will be granted planning permission (see Section 4). The table shows that if England reaches its 65% recycling target by 2035, a) **the capacity that is already in place today would be sufficient to treat waste arisings**, as long as the five regions with overcapacity treat some of the waste of the other regions, and b) **the capacity that is expected to be operational by 2035 would exceed the treatment need by nearly 15 million tonnes** (27.0 – 12.2 = 14.8 million tonnes), with 8 of 9 regions exhibiting significant overcapacity.

Figure 9 Current and expected EfW incineration capacity (2021 and 2035), relative to current and expected residual waste arisings (2019/20 and 2035 with 65% recycling), per region in England



Notes: The blue bars in this figure reflect operational EfW capacity in June 2021; the grey bars show EfW capacity in 2035, by which time the 50 'advanced' plants are expected to be operational (the ones that were being commissioned, were under construction, or had received approval by June 2021, as detailed in Section 4). Actual total residual waste arisings for 2019/20 appear in orange; if the 65% recycling target is achieved by 2035, arisings will drop by about 50%, as shown in yellow (see Table 5). **In eight of England's nine regions, EfW capacity is expected to exceed waste arisings by a significant margin** if the 65% recycling target is met by 2035; only in the East Midlands would capacity and waste be proportional. The figure excludes the 30 incineration facilities for which planning consent is still being sought. See Table 3.

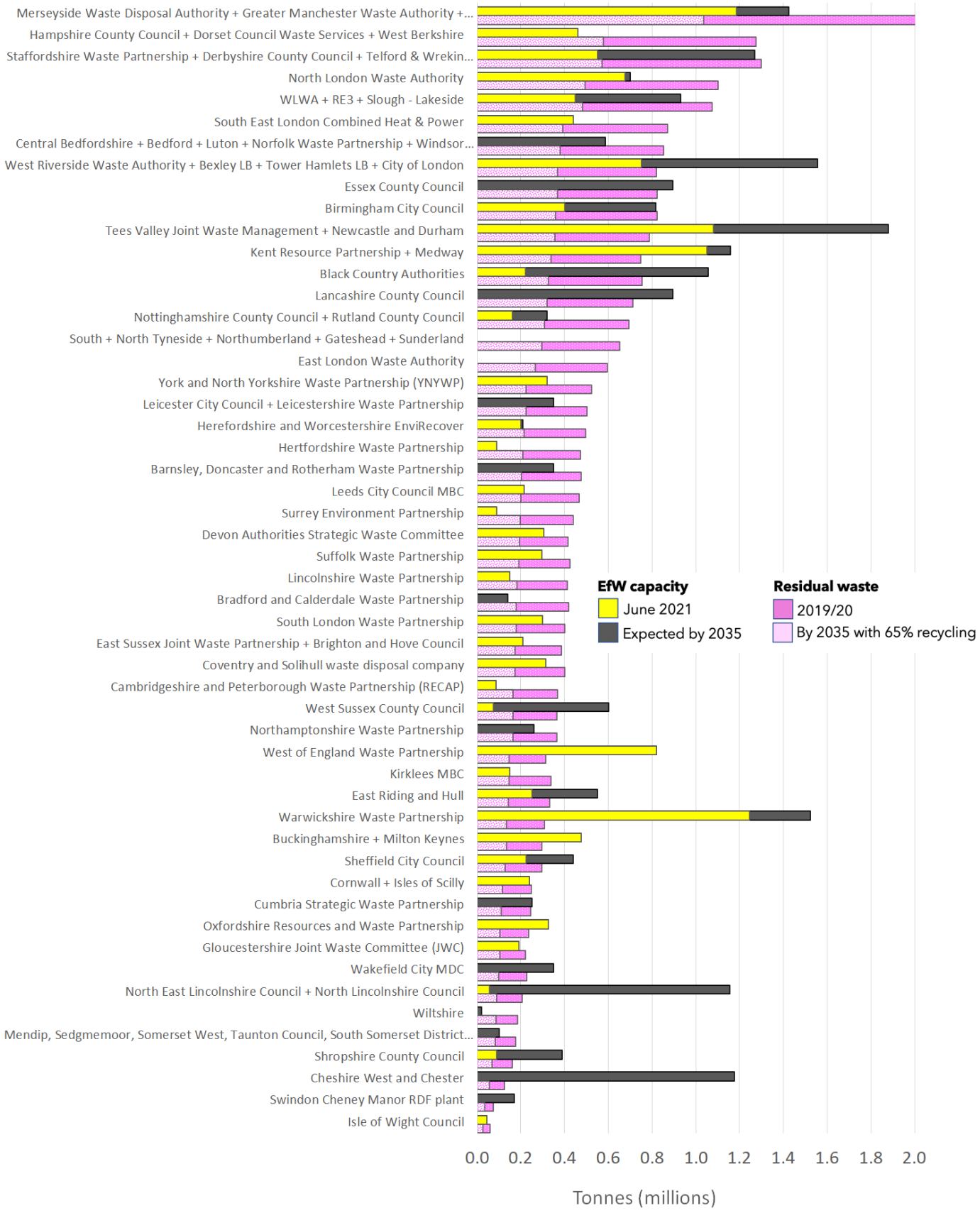
Overcapacity in England's waste partnerships

This section reveals which waste treatment partnerships in England would have EfW incineration overcapacity if the 65% recycling rate were reached by 2035. As shown in Figure 10 and Table 8 (in the annex), the assessment reviews 52 partnerships between local authorities and incinerator operators, most of which involve more than one local authority.[20] The analysis indicates how the realisation of the 50 advanced EfW incinerators would affect capacity across the partnerships; it assumes that none of the 30 EfW plants in the pipeline will secure planning permission (see Table 3). It offers the following conclusions:

- **Current situation:** EfW incineration capacity exceeds residual waste arisings in six out of England's 52 residual waste treatment partnerships (see Figure 10).
- **65% recycling without EfW expansion:** If all councils involved in the 52 residual waste treatment partnerships were to meet the 65% recycling target by 2035 and EfW incineration capacity did not expand beyond current (2021) levels, then incineration capacity would exceed residual waste arisings in 25 of the 52 waste partnerships (see Figure 10). Crucially, **current incineration capacity would be sufficient to treat the residual waste of all 52 partnerships in 2035**, so long as incinerators with surplus capacity were shared as required.
- **65% recycling with EfW expansion:** If all regions were to meet the 65% recycling target by 2035 and all 50 advanced EfW incineration projects were to be realised, causing EfW capacity to expand from 14 to 27 million tonnes, then:
  - EfW capacity would exceed the residual waste treatment need for 42 (81%) of 52 waste partnerships;
  - 34 (65%) of all waste partnerships would have at least 50% more EfW capacity than they require; and
  - 22 (42%) of all waste partnerships would have more than twice the required EfW capacity (see Figure 10).

These results indicate that **a large majority of waste partnerships in England would face significant EfW overcapacity by 2035** if the government failed to curb ongoing expansion, with significant financial implications.

Figure 10 Current and expected EfW incineration capacity (June 2021 and 2035), relative to current and expected residual waste arisings (2019/20 and 2035 with 65% recycling), per waste treatment partnership in England (n=52)



Notes: The dark pink bars correspond to actual residual waste arisings of each waste partnership for 2019/20; assuming the 65% recycling target is met, arisings are expected to drop by about 50% by 2035, as indicated by the light pink bars. The yellow bars represent operational EfW capacity in June 2021; by 2035, new EfW capacity is due to become operational in 30 of the 52 partnerships, as shown by the dark grey bars. **In 26 (87%) of the 30 partnerships where new EfW capacity is expected, the expanded EfW capacity would exceed projected waste arisings by 2035.** The figure shows that that only 6 partnerships had surplus EfW capacity vis-à-vis their residual waste arisings in 2019/20. Overall, **EfW overcapacity is expected in 42 (81%) of the 52 partnerships by 2035**.
Data sources: Table 3; Table 8 (in the annex to this brief)

6. FORECASTING CO_2 EMISSIONS FOR 2035

This section takes as a point of departure the decarbonisation pathway for the waste sector, as developed by the Climate Change Committee (CCC). The **CCC pathway requires the waste sector to cut its CO_2 emissions to below 16 million tonnes by 2035** to enable the UK to meet its net zero goal by 2050.[21]

Using 2019 as a baseline year and applying the standardised carbon accounting guidelines outlined in Box 2, this section presents potential scenarios for 2035 to assess what steps the waste sector must take to adhere to the pathway.

In 2019, plastics accounted for an estimated 20% of the residual waste that was sent to EfW incineration in England.[22] Thus, plastics made up about 2.5 of the 12.2 million tonnes of residual waste incinerated in England (see Table 1).[23] The burning of these plastics accounted for 45% of all carbon emissions from waste incineration, or 5.5 million tonnes of fossil CO_2 (see Box 2 and Table 7). This estimate is in line with emission values reported by the Environment Agency and within the range estimated by other organisations.[24]

Relative to 2019, this analysis considers four different scenarios, as defined by two variables: the proportion of plastic in waste sent for incineration and the amount of incinerated waste (see Table 7 and Figure 11). In scenarios I and II, the proportion of plastics in residual waste falls from 20% in 2019 to 10% by 2035. Such a drop would be likely if presorting were to be used to remove as much plastic as possible prior to EfW incineration (see Section 8).

In contrast, scenarios III and IV expect the proportion of plastics to increase to 25%, which could happen if the overall use of plastics were to grow, for example if virgin polymer production capacity expands as anticipated.[25]

With respect to the second variable, scenarios I and III assume that England will continue to send about 12.2 million tonnes of waste to incineration, in line with the 65% recycling target and in anticipation of immediate government intervention to prevent EfW overcapacity.

Meanwhile, scenarios II and IV represent futures with 50 additional EfW plants and contractual lock-ins that require the incineration of 27 million tonnes of waste per year.

To enhance comprehensiveness, this analysis also factors in greenhouse gas (GHG) emissions from other waste sector activities, namely anaerobic digestion, composting, landfilling, mechanical and biological treatment (MBT), and waste-water handling (see Figure 11). For 2019, the baseline year, GHG emissions comprised 14.2 million tonnes of CO_2e from landfill, 5.2 million tonnes from waste-water treatment, and 2.6 million tonnes from other sources.[26] Projections for 2035 are based on estimates in the CCC's sixth carbon budget, which includes 4.2 million tonnes of GHGs from waste-water treatment and 2.6 million tonnes from other sources.[27] This analysis estimates that landfill will emit about 6.8 millon tonnes of GHGs in 2035.[28]

As shown in Table 7 and Figure 11, only one of the four scenarios (scenario I) would allow the waste sector to adhere to the CCC's decarbonisation pathway. Indeed, **the only means by which the sector can reduce its GHGs to below 16 million tonnes by 2035 is by taking two immediate steps**:

- **implementing policies to halt the expansion of EfW incineration capacity** in England; and
- **removing most plastics from residual waste streams** (by reducing the proportion of plastic in the waste that is sent for incineration to 10% or less, via advanced mixed-waste presorting facilities, as discussed in Section 8).

As Table 7 and Figure 11 reveal, the **waste sector could halve the fossil CO_2 emissions from EfW incineration by 2035** by pursuing scenario I. If, however, the UK government were to continue to stand by as any number of the 50 approved EfW incinerators become operational, and as the proportion of plastic in the residual waste stream increases, EfW incineration emissions would nearly triple relative to 2019 levels. These characteristics define scenario IV, which warns that **government inaction could lead total waste sector emissions to be higher in 2035 than in 2019**, despite declines in GHGs from landfilling. In this scenario, all waste reduction benefits would effectively be cancelled out.

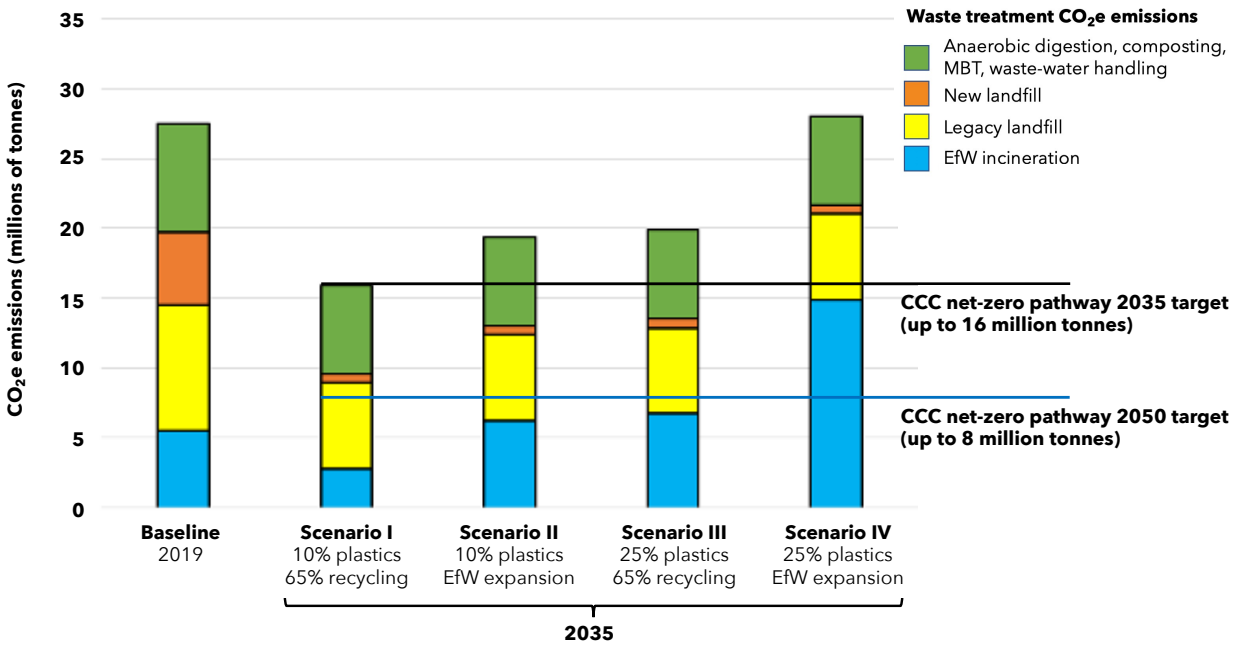
Moreover, **new plants would impair carbon emission savings from reuse and recycling**, which could save at least 1.5 tonnes of CO_2 per tonne of waste that is not incinerated,[29] mainly by obviating the need for virgin materials that are extracted abroad. If the government were to prevent EfW expansion, it could secure total **annual savings of up to 22 million tonnes of CO_2**, based on averting the incineration of up to 14.8 million tonnes of additional residual waste.[30]

Table 7 CO_2e emissions associated with different waste scenarios, 2019 (actual) and 2035 (estimated)

Year	Scenario	Description	Waste composition ratio (%)		Waste incinerated (millions of tonnes)	CO_2e emissions (millions of tonnes) relative to 2019 (% change)	
			Plastic	Organic		EfW incineration	Waste sector
2019	Baseline	Actual	20	80	12.2	5.5	27.5
2035	I	Less plastic burnt, 65% recycling	10	90	12.2	2.8 **(-49%)**	16.0* **(-42%)**
	II	Less plastic burnt, EfW expansion	10	90	27.0	6.2 (+13%)	19.4 (-30%)
	III	More plastic burnt, 65% recycling	25	75	12.2	6.7 (+22%)	19.9 (-28%)
	IV	More plastic burnt, EfW expansion	25	75	27.0	14.3 (+260%)	28.0 (+2%)

Notes: * In its sixth carbon budget, the CCC sets out a decarbonisation pathway that requires the waste sector to reduce emissions to below 16 million tonnes of CO_2e by 2035 if net zero is to be met by 2050. **Achieving that target requires a reduction in the plastic proportion of waste that is sent for incineration to a maximum of 10%, a prevention of EfW incineration capacity expansion beyond current levels, and attainment of the 65% recycling target by 2035**, as reflected in scenario I. Scenario IV foresees business as usual. See also Figure 11 and Box 2.
Sources: see Section 6

Figure 11 **CO_2e emissions associated with different waste scenarios, 2019 (actual) and 2035 (estimated), relative to the CCC net-zero pathway targets for the waste sector (2035 and 2050)**



Note: The 2035 and 2050 net-zero pathway targets for the waste sector are drawn from the CCC's sixth carbon budget. For 2035, scenario I is the only approach to achieving the CCC's emissions target for the waste sector, meaning that **plastics may not comprise more than 10% of residual waste and the UK recycling target of 65% must be met to enable the UK to achieve its 2050 net zero target**. Scenario IV foresees business as usual. See also Table 7 and Box 2.

Box 2

CO_2 EMISSIONS FROM WASTE: A PRIMER

What are CO_2 emissions from EfW incineration?

When materials are burnt in a waste incinerator, they release carbon, which combines with oxygen to produce CO_2. In England, **fossil fuel CO_2 currently comprises 45% of EfW incineration emissions**, while biogenic CO_2 makes up the remaining 55%. The fossil fuel portion comes from the burning of plastics, more than 99% of which are made from fossil fuels. They are contained in materials such as packaging, textiles, nappies, and mattrasses. Biogenic CO_2 results from the burning of organic materials, including paper, food waste, wood, and textiles, such as clothing made of wool or cotton.

Which CO_2 emissions 'count' towards net zero?

Standardised **carbon accounting guidelines require only fossil fuel CO_2 to be recorded** in inventories, since only that portion is officially recognised as increasing the total amount of carbon in the atmosphere. In contrast, biogenic CO_2 is treated as part of the natural carbon cycle.[31] Simply put, the combustion of organic materials is thought to return to the atmosphere the carbon that plants absorb as they grow.

How much CO_2 is released through EfW incineration?

How much fossil fuel CO_2 is emitted depends on the proportion of plastic in the waste that is being incinerated. Based on the current average composition of residual (black bag) waste in England, an estimated **0.45 tonnes of fossil fuel CO_2 are released per tonne of waste burnt**. At the same time, an estimated 0.55 tonnes of biogenic CO_2 are released for every tonne burnt, yet this amount is not included in standardised carbon accounting, as noted above.

How much carbon is released from landfill?

Landfilling also comes with a significant carbon cost. Unlike the incineration of plastics, which contributes fossil fuel CO_2 to the atmosphere, the decomposition of organic waste in landfill releases methane (CH_4). This greenhouse gas stays in the atmosphere for a relatively brief period before breaking down, yet its global warming potential (GWP) is far greater than that of CO_2. Although methane is a biogenic emission, it is not absorbed via the natural carbon cycle and is thus reported in standardised carbon accounting, expressed as CO_2 equivalent (CO_2e), or the amount of methane multiplied by its GWP. Based on the current average composition of waste, **landfill releases an estimated 0.46 tonnes of CO_2e per tonne of residual waste in the form of methane**.[32] Since landfill emissions are highly dependent on composition, they may be expected to decline over time, as organic wastes – such as food waste and paper & card – are increasingly reduced, reused, and recycled.

What was the carbon impact of waste disposal in 2019?

About 12.2 million tonnes of residual (black bag) waste were incinerated in England in 2019, indicating that EfW incineration released 5.5 million tonnes of CO_2 into the atmosphere that year. In addition, an estimated 11.3 million tonnes of residual waste were landfilled in 2019: about 5.2 million tonnes of CO_2 equivalent (CO_2e) were released from new landfilling, while legacy landfilled waste emitted about 9 million tonnes. Taken together, **EfW incineration and landfilling emitted 27.5 million tonnes of CO_2e in 2019**.

Comparing incineration and landfill in terms of CO_2

In the absence of more sustainable options, the following rules of thumb can help to minimise carbon emissions:

- **organic materials**: incineration is better than landfilling
- **plastics**: landfilling is better than incineration.

Over significant periods of time, however, landfilled plastics may break down into microplastics, some of which can leach into groundwater and slowly seep into river systems via soil transport mechanisms. Meanwhile, exporting plastic waste simply transfers the problem abroad, potentially exacerbating social and environmental injustice.

7. POTENTIAL JOBS AND VALUE ADDED

Waste incineration results in the loss of significant social and economic opportunities, in terms of both jobs and revenue.

The circular economy as a job engine

The UK economy already generates about **15 times more jobs in the reuse and repair sector than in waste disposal** (191,400 jobs in the circular economy v. 13,500 jobs in landfill and EfW incineration combined). In addition, work associated with the recovery of dry and organic materials, such as sorting and recycling, accounts for roughly 27,500 jobs.[33]

Redirecting materials and products to reuse, repair, and recycling thus has a far greater employment impact than sending the same materials to an EfW incinerator. For local authorities that are seeking **to spur job creation, the key is to turbocharge reuse, repair, and recycling instead of initiating or renewing a commitment to EfW incineration**.

Boosting revenue through circularity

In 2019, EfW incineration contributed about £407 million to the UK economy by recovering metals from bottom ash, generating electricity, and, in a limited number of cases, supplying heat.[34] During the same year, the recovery and recycling of 16.5 million tonnes of used materials contributed more than twice that amount to the UK economy: £885 million (see Figure 12). This comparison highlights that **the economic value of sorting waste is already double that of incinerating it**.[35]

As recycling increases, so too will the value it delivers to the economy, not only in absolute terms, but also in relation to the value added by incineration. If sufficient progress is made to reach the 65% recycling target by 2035, the amount of waste sent to incineration is likely to drop slightly, to 11–12 million tonnes per year, while landfilling will nearly be phased out. At the same time, nearly 30 million tonnes of materials are expected to be recovered for recycling. As Figure 12 shows, the UK economy would benefit accordingly, securing a value added of nearly **£3 billion per year, 85% of which (£2.55 billion) would derive from the recovery and recycling of materials**, while only 15% would result from incineration (£360 or £390 million, depending on the scenario).

Compared to a business-as-usual scenario, **shifting away from waste disposal (landfilling and EfW incineration) and towards recycling would thus add about £1.6 billion per year to the UK economy** by 2035, relative to revenue streams in 2019.[36] By the same token, the UK would forego £1.6 billion per year in value added if it failed to boost recycling over the next 15 years.

While this brief is focused on enabling the UK to meet its 65% recycling target, it should be borne in mind that the **waste hierarchy prioritises reuse and repair over recycling**. As noted in Section 4, England has been slow to invest in all circular infrastructure, especially compared to Germany, the Netherlands, and Wales. For details on enhancing product lifespan, reuse, repair, and remanufacture, see XR Zero Waste's blueprint for waste sector reform.[37]

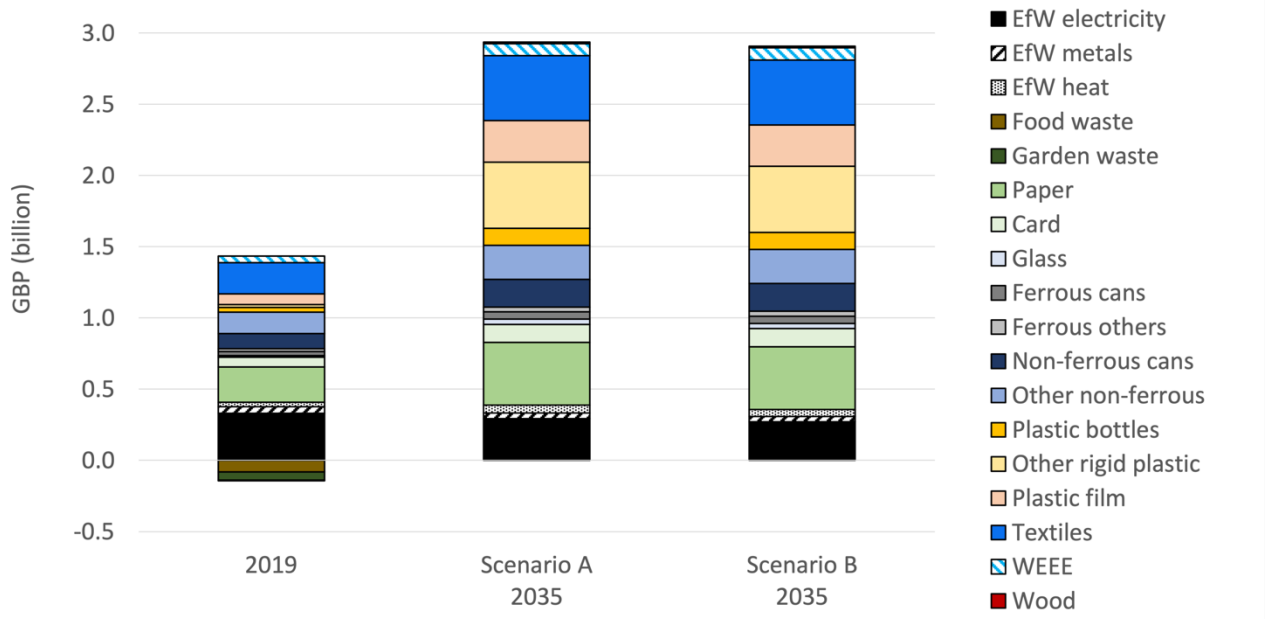
8. THE RECYCLING INVESTMENT GAP

As demonstrated in this brief, achieving the 2050 net-zero carbon target and the 65% recycling target by 2035 requires a marked shift away from business as usual and, in particular, far greater investment in effective recycling equipment.

In the words of Philip Dunne MP, who chairs the Environmental Audit Committee: 'The Government needs urgently to outline its overall strategy for attracting both public and private sector investment in green technology. Without this, businesses and innovators will struggle to understand the ground rules for future investment decisions, which will seriously impede our ability to develop the technologies required to reach net-zero by 2050.'[38]

The fact that investment in the expansion of EfW incineration capacity continues to dwarf investment in recycling infrastructure points to a lack of financial incentives for the latter. This discrepancy has become increasingly stark as key recycling technologies and facilities have become readily available (see Box 3). Despite their proven ability to boost both recycling rates and income streams, these solutions are hardly pursued in the UK. Targeted financial incentives could easily address this investment gap and, together with the other measures outlined in Section 2, enable the UK to meet its 65% recycling target by 2035 and its net-zero target by 2050.

Figure 12 Value added to the UK economy by EfW incineration and recycling, 2019 and 2035



Notes: Scenarios A and B both assume that the UK will reach the 65% recycling target by 2035. In 2019, the market prices of food waste, garden waste, and wood were negative, meaning that local authorities had to pay to send these recovered streams to recyclers.
Source: see note 34 for prices of materials

Box 3

STATE-OF-THE-ART RECYCLING TECHNOLOGY

1. Mixed-waste material recovery facilities (MRFs)

Mixed-waste MRFs take residual (black bag) waste and sort out plastics and metals for recycling, as well as organic waste for anaerobic digestion. These facilities complement MRFs that handle and sort commingled and source-separated kerbside recycling collections, also referred to as single- or dual-stream MRFs.[39]

Mixed-waste MRFs have reduced the residual waste stream by 40% in Dutch cities where they are deployed, as they recover at least 50% of plastics and 70% of metals, and more than 50% of organic materials. Mixed-waste MRFs are operating in the following cities, among others:

- Glasgow: This mixed-waste MRF, the first in the UK, was established in 2019 as part of the Glasgow Recycling and Renewable Energy Centre (GRREC) for the recovery of plastics and metals. It has a capacity of 350,000 tonnes.
- Rotterdam: Since its deployment in 2019 by AVR, this 450,000-tonne mixed-waste MRF has been recovering 51% of plastics and metals from residual waste, providing hard plastics, soft plastics, drink cartons, and metal bales for recycling. It has driven up the local rate of materials sent for recycling from 46% to 69%.[40]
- Wijster, the Netherlands: This 800,000-tonne mixed-waste MRF is the largest facility of its kind. Since 2011, it has undertaken mixed-waste sorting together with an anaerobic digester, a plastics sorting facility, and a facility that transforms residual waste into plastic regrind pellets (rLDPE) for closed-loop plastic film and plastic bag production.[41]

2. Secondary sorting recovery facilities

Secondary sorting facilities handle commingled recyclables that are difficult to sort, transferring them from single-stream MRFs to mixed-waste MRFs. In the United States, their use has **improved recovery from commingled recycling streams to 95%**.

3. Advanced plastic sorting and recycling facilities

About 10% of MRF-produced plastic bales have contamination. Advanced plastic sorting and recycling facilities sort these bales into **homogenous streams with less than 1% contamination** to obtain nearly pure HDPE, LDPE, PE, PET, PP, PVC, and other plastics, including through colour sorting, to ensure optimal value.[42] Examples of such facilities include:

- AEB Plastic Sorting: Operational since 2018, this facility in Amsterdam takes plastics from several cities, including from the mixed-waste sorting facility in Rotterdam, and separates them into streams of HDPE, LDPE, PE, PET, PP, and PVC, each of which is shredded into flakes, hot washed, and then sent for recycling.
- Aganfoils (As Good As New Foils): This £35-million facility began operating in 2019 in Wijster, the Netherlands. It removes LDPE soft plastics with high contamination from the local residual (black bag) waste separation facility, then sorts, cleans, and hot washes them, and finally upcycles them into high-quality LDPE regranulate.
- Integra Plastics: Realised in 2019, this £40-million facility in Bulgaria recycles LDPE soft plastics and HDPE and PP hard plastics with less than 10% contamination. After shredding, cleaning, hot washing, and colour-sorting the plastics into transparent, red/blue/green/yellow, and grey/black streams, it transforms them into post-consumer regrind.

4. Robotics for MRFs

When it comes to kerbside collections of commingled household recycling, robotics have consistently been shown to **enable separation yields of 90% or more**. The first UK MRF to deploy this technology is under construction in Coventry.

5. Advanced cleaning and colour sorting for glass

This type of sorting **enhances the quality of glass sent for recycling** by substantially reducing the amount of low-value mixed-glass fractions and providing single-stream coloured-glass fractions.

6. Advanced separation and cleaning of plastics

The following mechanical technologies are among those now available for separating and cleaning plastics:

- Bright Green's BrightFusion additive technology enables the combined use of PE and PP in recycled plastics.[43]
- Impact Solution's Baffled Oscillation Separation System (BOSS) separates PE and PP into 99%-pure streams.[44]
- TUSTI removes frying oil from HDPE.[45]
- Umincorp's magnetic density separation (MDS) technology separates plastics into streams that are 99% pure, including for ABS, HDPE, PE, PET, PP, PS, and PVC.[46]

7. Solvent- and oxidant-based recycling of plastics

The following technologies use solvents and oxidants:

- In California in 2020, Novoloop developed a process that employs an undisclosed oxidant to facilitate the rapid breakdown of PE into dicarboxylic acid at temperatures below 200°C.[47] Dicarboxylic acid is a key building block for both polyesters and polyurethanes.
- In Florida in 2019, PureCycle Technologies opened the world's first PP-restoration facility, which can create 100% virgin-quality PP post-consumer regrind that is odour-free and transparent.

8. Advanced packaging recognition technology

The HolyGrail 1.0 and HolyGrail 2.0 consortiums developed **machine-readable digital watermarks for any packaging**. Imperceptible to the human eye, the watermarks provide information on the composition of packaging, which allows for enhanced sorting of all types of packaging, even if it contains multiple materials.

ANNEX

Table 8 Current and expected residual waste arisings (2019/20 and 2035 with 65% recycling), relative to current and expected EfW incineration capacity (June 2021 and 2035), in tonnes per waste treatment partnership in England (n=52)

	Residual waste		EfW (over)capacity	
Waste treatment partnership*	**2019/20 (actual)**	**By 2035** (expected)**	**June 2021 (actual)**	**By 2035*** (expected)**
Barnsley, Doncaster, and Rotherham WP	474,537	203,419	0	**350,000**
Birmingham City Council	823,890	356,020	**400,000**	**817,000**
Black Country Authorities	752,586	325,209	220,000	**1,056,000**
Bradford and Calderdale WP	418,343	179,330	0	140,000
Buckinghamshire + Milton Keynes	295,123	132,264	**477,000**	**477,000**
Cambridgeshire and Peterborough WP (RECAP)	368,477	163,491	85,000	85,000
Cen. Bedfordshire, Bedford, Luton, Norfolk WP, Windsor & Maidenhead	852,599	378,593	0	**585,000**
Cheshire West and Chester	125,546	56,384	0	**1,175,000**
Cornwall + Isles of Scilly	249,234	116,558	**240,000**	**240,000**
Coventry and Solihull waste disposal company	399,959	172,831	**315,000**	**315,000**
Cumbria Strategic WP	246,305	110,618	0	**250,000**
Devon Authorities Strategic Waste Committee	415,489	194,308	**305,000**	**305,000**
East London WA	596,169	266,423	0	0
East Riding and Hull	331,443	142,079	**250,000**	**550,000**
East Sussex Joint WP + Brighton and Hove Council	386,726	173,317	**210,000**	**210,000**
Essex CC	823,028	365,172	0	**895,000**
Gloucestershire Joint Waste Committee	220,629	103,180	**190,000**	**190,000**
Hampshire CC + Dorset Council Waste Services + West Berkshire	1,274,241	576,331	462,000	462,000
Herefordshire and Worcestershire EnviRecover	496,595	214,589	200,000	**208,000**
Hertfordshire WP	472,318	209,564	90,000	90,000
Isle of Wight Council	59,605	26,713	**44,000**	**44,000**
Kent Resource Partnership + Medway	748,460	335,434	**1,050,000**	**1,157,000**
Kirklees MBC	338,344	145,037	**150,000**	**150,000**
Lancashire CC	712,813	320,132	0	**895,000**
Leeds City Council MBC	465,758	199,656	**214,000**	**214,000**
Leicester City Council + Leicestershire WP	503,966	223,313	0	**350,000**
Lincolnshire Waste Partnership	412,006	182,564	150,000	150,000
Mendip, Sedgmemoor, Somerset W., Taunton, S. Somerset DC, Somerset CC	176,968	82,761	0	**100,050**
Merseyside WDA, Greater Manchester WDA, Wigan, Warrington, Cheshire East	2,299,882	1,032,903	**1,185,000**	**1,425,000**
North East Lincolnshire Council + North Lincolnshire Council	206,626	88,574	56,000	**1,156,000**
North London WA	1,101,741	492,360	**675,000**	**700,000**
Northamptonshire WP	365,589	161,996	0	**260,000**
Nottinghamshire CC + Rutland CC	694,901	307,918	160,000	**320,000**
Oxfordshire Resources and Waste Partnership	234,907	105,277	**326,300**	**326,300**
Sheffield City Council	295,768	480,720	**225,000**	**440,000**
Shropshire CC	160,194	126,786	**90,000**	**390,000**
South & North Tyneside, Northumberland, Gateshead, Sunderland	653,039	69,223	0	0
South East London Combined Heat & Power	871,161	389,315	**440,000**	**440,000**
South London WP	401,396	179,381	**300,000**	**300,000**
Staffordshire WP + Derbyshire CC + Telford & Wrekin Council	1,299,946	567,572	550,000	**1,270,000**
Suffolk WP	426,132	189,072	**295,000**	**295,000**
Surrey Environment Partnership	438,754	196,634	89,000	89,000
Swindon Cheney Manor refuse-derived fuel plant	75,282	35,206	0	**170,500**
Tees Valley Joint Waste Management + Newcastle and Durham	788,201	355,301	**1,080,000**	**1,880,000**
Wakefield City MDC	227,958	294,373	0	**350,000**
Warwickshire WP	308,582	97,719	**1,245,000**	**1,525,000**
West London WA + RE3 + Slough (Lakeside EfW plant)	1,074,882	133,345	450,000	**930,000**
West of England WP	312,657	146,218	**820,000**	**820,000**
West Riverside WA, LB Bexley, LB Tower Hamlets, City of London	819,575	366,262	**750,000**	**1,555,920**
West Sussex CC	363,757	163,024	75,000	**600,000**
Wiltshire	185,575	86,786	0	20,000
York and North Yorkshire WP	523,116	224,243	**320,000**	**320,000**
Total	**27,570,778**	**12,245,500**	**14,183,300**	**27,042,770**
Overcapacity by 2035, assuming 65% recycling			**1,937,800** without EfW expansion	**14,797,270** with EfW expansion

Notes: * CC = county council; DC = district council; LB = London borough; MBC = metropolitan borough council; RE3 = waste management partnership of Bracknell Forest, Reading, and Wokingham borough councils; WA = waste authority; WP = waste partnership.
** Residual waste estimates assume that England will meet its 65% recycling target and that 3.2 million tonnes of residual waste will still be landfilled in 2035 (see Table 2).
*** Capacity estimates assume that all 50 advanced EfW plants will be operational and that 2 plants will be decommissioned by 2035, with the result that England will have nearly 15 million tonnes of surplus capacity (see Tables 3 and 6 and Figures 9–10).
Sources: household waste: DEFRA WasteDataFlow (https://www.wastedataflow.org); C&I: Environment Agency Waste Data Interrogator (https://data.gov.uk/dataset/d409b2ba-796c-4436-82c7-eb1831a9ef25/2019-waste-data-interrogator

ABOUT THIS BRIEF

This XR Zero Waste brief is designed to provide an up-to-date picture of the current and expected residual waste treatment need in England, as it relates to current and expected energy-from-waste (EfW) incineration capacity. The most recent such overview was Tolvik Consulting's *UK Residual Waste: 2030 Market Review*, produced in 2017 on behalf of the Environmental Services Association. Since then, the context in which waste management decisions take place has changed significantly, not least because the UK released the 2018 Resources and Waste Strategy for England, enshrined the 2050 net-zero target in law, and introduced the Environment Bill (see Section 3). The past few years have also witnessed a rapid growth in the number of realised, pending (approved), and announced EfW facilities. By providing up-to-date data and analysis of the current context and emerging trends, this brief aims to support informed decision-making and democratic debate about EfW incineration.

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NOTES

[1] In March 2021, Wales introduced an immediate moratorium on new large-scale EfW incinerators (10MW or greater). The Scottish National Party's manifesto includes a commitment to review incineration in Scotland, which could also lead to a moratorium. In view of these developments, and given that only one EfW incinerator is planned in Northern Ireland, this brief is focused on the threat of EfW incineration overcapacity in England, where most of the UK's EfW expansion is planned (see Figure 7).

[2] Carbon emissions from EfW incineration are reported under energy sector emissions, not waste sector emissions.

[3] See https://www.theccc.org.uk/publication/sixth-carbon-budget/2035.

[4] See https://www.xrzerowaste.uk/view-the-letter.

[5] See https://hansard.parliament.uk/Commons/2021-01-12/debates/FDCB3E79-CA6C-4804-A81A-6B98F04DC320/WasteIncinerationAndRecyclingRates?highlight=incineration%20tax#contribution-20EBB5FE-AC44-4756-84BF-969A27CA1134.

[6] For details on 'low-CO_2' refuse-derived fuel (RDF) and 'plastic-reduced' RDF (which is also known as 'low-carbon waste'), see https://www.letsrecycle.com/news/latest-news/geminor-to-provide-low-co2-rdf-to-danish-plant; for information about RDF, see https://www.betalabservices.com/renewable-carbon/refuse-derived-fuels.html.

[7] See https://www.zeroc.org.uk/s/White-Paper-How-carbon-pricing-can-help-Britain-reach-net-zero-by-2050.pdf.

[8] See https://www.xrzerowaste.uk/view-the-letter.

[9] See https://www.tolvik.com/wp-content/uploads/2020/11/Covid-19-and-UK-Waste-Sector-Autumn-20_published-10-November-2020.pdf.

[10] See https://www.tolvik.com/wp-content/uploads/2020/11/Covid-19-and-UK-Waste-Sector-Autumn-20_published-10-November-2020.pdf.

[11] This assessment is based on industry data from ENDS Waste & Bioenergy (see https://www.endswasteandbioenergy.com/article/1492635/ewb-plant-tracker), the UKWIN database of incinerators (see https://ukwin.org.uk/incinerators), and a review of press coverage.

[12] As indicated by the waste hierarchy, reuse and repair are to be prioritised over recycling (see https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/765914/resources-waste-strategy-dec-2018.pdf). For details on reuse and repair infrastructure, see XR Zero Waste's blueprint for waste sector reform at https://www.xrzerowaste.uk/view-the-letter.

[13] See https://www.circularonline.co.uk/research-reports/blog-what-steps-are-most-important-to-become-the-highest-recycling-nation-in-the-world.

[14] See https://wrapcymru.org.uk/taking-action/grants and https://gov.wales/ps35m-circular-economy-fund-public-bodies-support-green-recovery-opens.

[15] See https://wrap.org.uk/sites/default/files/2021-01/Gate-Fees-Report-2019-20.pdf.

[16] This assessment also assumes that total waste arisings will remain stable, that the majority of the waste that is currently landfilled will either be sent to EfW incineration or be recycled, that EfW plants that are decommissioned will be replaced, and that none of the 30 EfW facilities that are in the planning phase will be realised.

[17] In 2009/10, for instance, Stoke-on-Trent City Council had to pay EfW operator Hanford Waste Services £650,000 for delivering less residual waste than agreed in their long-term waste incineration contract. See https://www.letsrecycle.com/news/latest-news/stoke-faces-bill-for-sending-less-waste-to-efw.

[18] See https://www.pennon-group.co.uk/oxfordshire-residual-waste-treatment-ppp-contract-signed.

[19] This assessment takes into account all EfW plants that will be decommissioned and replaced.

[20] The Oxfordshire Resources and Waste Partnership, for instance, is a collaboration between Oxfordshire County Council and the county's five district councils. The councils' residual waste is treated at the 325,000-tonne Ardley EfW facility in Cherwell, Oxfordshire.

[21] See https://www.theccc.org.uk/wp-content/uploads/2020/12/The-Sixth-Carbon-Budget-Charts-and-data-in-the-report.xlsb.

[22] In 2017, England's residual waste contained plastic film (5.8%); textiles and shoes (6.0%); sanitary waste (6.9%); dense plastics (7.3%); and carpet, underlay, furniture, and matrasses (8.1%). Following conversion to dry weight, plastics accounted for an estimated 20% of the residual waste. For details, see the study by Eunomia and WRAP at https://www.eunomia.co.uk/quantifying-municipal-waste-composition-uk.

[23] The total volume of plastic waste produced in the UK has been estimated at 3.5 million tonnes for 2015 and 3.8 million tonnes for 2019. See https://commonslibrary.parliament.uk/research-briefings/cbp-8515 and https://wrap.org.uk/resources/market-situation-reports/plastics-2019.

[24] Estimated fossil CO_2 emissions from EfW incineration for 2019 range from 5.3 to 6.7 million tonnes, depending on the source and calculation method. The Climate Change Committee (CCC) estimates a total of 5.32 million tonnes of fossil CO_2 for the UK (see https://www.theccc.org.uk/publication/sixth-carbon-budget). The Environment Agency reported 11.95 million tonnes of CO_2 emissions from EfW incineration for England alone, including emissions from organic sources (see https://data.gov.uk/dataset/cfd94301-a2f2-48a2-9915-e477ca6d8b7e/pollution-inventory). If the fossil portion is assumed to account for 45% of all of CO_2 emissions (see https://www.ice.org.uk/ICEDevelopmentWebPortal/media/Events/Conferences/Cory-Carbon-Report.pdf), this figure implies 5.4 million tonnes of fossil fuel CO_2 for England, slightly more than the CCC estimates for all of the UK. Meanwhile, the waste sector consultancy Tolvik estimates that the carbon intensity of EfW

incineration is higher (53% rather than 45%) and that plastic accounts for a larger proportion of residual waste. It reports that 12.7 million tonnes of waste were incinerated in 2019 in the UK, which would correspond to about 6.7 million tonnes of fossil CO_2 (see https://www.tolvik.com/wp-content/uploads/2020/05/Tolvik-UK-EfW-Statistics-2019-Report-June-2020.pdf).

[25] Plastic production is expected to expand by more than 30% between 2021 and 2026, which would lead to an increase in plastic waste. See https://www.minderoo.org/plastic-waste-makers-index/findings/executive-summary. For details on the impact of COVID-19 on biomedical plastic waste, see https://www.sciencedirect.com/science/article/pii/S2405844021004485.

[26] See https://www.gov.uk/government/statistics/final-uk-greenhouse-gas-emissions-national-statistics-1990-to-2019. Note that the BEIS estimate for GHGs from landfill in 2019 (14.2 million tonnes) is significantly lower than the CCC's (19.2 million tonnes). See https://www.theccc.org.uk/wp-content/uploads/2020/12/The-Sixth-Carbon-Budget-Charts-and-data-in-the-report.xlsb.

[27] See https://www.theccc.org.uk/wp-content/uploads/2020/12/The-Sixth-Carbon-Budget-Charts-and-data-in-the-report.xlsb.

[28] This calculation is based on a linear decline in landfilling (from 11.3 million tonnes in 2019 to 3.2 million tonnes in 2035) and a linear decrease in the landfill emissions factor (from 0.46 tonnes of CO_2e per tonne landfilled in 2021 to 0.20 tonnes in 2035), assuming a sharp decrease in the landfilling of biodegradable materials.

[29] See https://www.xrzerowaste.uk/annex-1.

[30] This figure is the difference between 27 million tonnes and 12.2 million tonnes.

[31] In this context, it is important to note that anthropogenic activities can transform carbon sinks into carbon emitters. A case in point is the Amazon rainforest, which now releases more greenhouse gases than it stores, largely due to climate change and deforestation. See https://www.smithsonianmag.com/smart-news/amazon-rainforest-now-emits-more-greenhouse-gases-it-absorbs-180977347.

[32] See https://www.gov.uk/government/publications/greenhouse-gas-reporting-conversion-factors-2020. Note that emission factors for landfill have a high relative uncertainty (±42%). See https://www.theccc.org.uk/wp-content/uploads/2017/04/Quantifying-Greenhouse-Gas-Emissions-Committee-on-Climate-Change-April-2017.pdf.

[33] See https://www.xrzerowaste.uk/annex-1.

[34] This calculation is based on a wholesale electricity price of £45 per MWh, a heating price of £20 per MWh, and a mixed recovered metals price of £170 per tonne. Price sources: electricity: https://www.ofgem.gov.uk/data-portal/electricity-prices-day-ahead-baseload-contracts-monthly-average-gb; heating: https://www.ovoenergy.com/guides/energy-guides/wholesale-energy-prices.html; metals: see endnote 34.

[35] The added value estimate is based on the tonnage and recent average prices of household and C&I materials recovered in material recovery facilities, which produce bales of sorted waste for onward shipment to recycling centres. Table 9 lists prices for organics and other materials.

Table 9 Prices of materials used in estimating the added value from recycling in 2019 and 2035 (GBP)

	Price per tonne (£)	
	2019	**2035**
Aluminium scrap	1,800	1,800
Aluminium cans	850	850
HDPE	290	400
Textiles	255	330
Steel scrap	171	171
Paper	140	140
Plastic film	124	300
Plastic bottles	120	230
Steel/mixed cans	102	102
Card	70	70
Mixed rigids	25	200
Glass	11	19
Wood	-7	10
Organics	-24	0

Sources: non-organic materials: MRW (https://www.mrw.co.uk); organics: Letsrecycle.com (https://www.letsrecycle.com/prices/composting)

[36] This value for 2035 is calculated using the highest average price range from the past three years for recovered materials that are sent to recyclers. The estimate reflects the expectation that ongoing improvements in sorting and cleaning technologies will allow recovered materials to command higher prices over the coming 15 years. Sources for price values: see note 34, above.

[37] For the waste hierarchy, see https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/765914/resources-waste-strategy-dec-2018.pdf). XR Zero Waste's blueprint for waste sector reform is available at https://www.xrzerowaste.uk/view-the-letter.

[38] See https://www.mrw.co.uk/news/government-funding-for-carbon-capture-tech-in-waste-sector-24-05-2021.

[39] A mixed-waste MRF treats residual waste streams, whereas a single-stream MRF handles commingled streams, which contain mixed, kerbside-sorted recyclable materials. See https://en.wikipedia.org/wiki/Materials_recovery_facility.

[40] Data drawn from the Statistics Netherlands (see https://www.cbs.nl/en-gb).

[41] rLDPE = recycled low-density polyethylene.

[42] HDPE=high-density polyethylene; LDPE=low-density polyethylene; PE=polyethylene; PET=polyethylene terephthalate; PP=polypropylene; PVC=polyvinyl chloride.

[43] See https://brightgreenplastics.com.

[44] See https://impact-recycling.com.

[45] See https://www.tusti.nl.

[46] See http://www.umincorp.com. ABS = acrylonitrile butadiene styrene; PS = polystyrene.

[47] See https://www.novoloop.com/technology and https://recyclinginternational.com/business/interview/novoloop-ceo-miranda-wang-we-want-to-help-double-the-size-of-the-circular-economy/32810.