Report

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Energy from Waste: A New Perspective

VOLUME 2:
THE FUTURE OF RESIDUAL WASTE

Roland Berger

PREFACE

The introduction of landfill diversion targets in the 1990s and the adoption of the Waste Framework Directive in 2008 resulted in a strong impetus to pursue holistic waste management in the European Union (EU). The UK, however, has lagged its prominent EU peers in achieving certain targets set by the EU. Historically, energy from waste (EfW) capacity development in the UK was slow, resulting in a huge gap between residual waste and EfW capacities. This status quo, however, started to evolve since 2011. The country saw the development of several new incineration facilities. Many domestic and international investors have since shown strong interest in acquiring some of the largest and most profitable EfW facilities.

As investors evaluate the commercial viability of their investments, it is crucial to assess the long-term EfW demand-supply dynamics and infrastructure capacity gap. While there is substantial literature on EfW capacity gap at the national level, a similar abundance of information and analyses is unavailable for the local levels. This is a critical information gap as EfW facilities often have localised catchment areas. Therefore, any meaningful assessment needs to extend this analysis to the level of the region or the catchment area of the EfW facility in consideration.

In this three-volume series we provide a new perspective on EfW demand-supply dynamics and its evolution in England at the county level:

- **Volume 1: The regional capacity gap**
- **Volume 2: The future of residual waste**
- **Volume 3: The 2035 capacity gap**

Providing such a detailed view has many challenges as there is no official data on addressable commercial and industrial (C&I) waste arisings, waste arisings by material are not tracked at the local authority level, there are different reporting standards across nations and there are no suitable government-published forecasts. Our analysis and insights are built on a multidimensional dataset derived from reliable sources and a combination of regional macroeconomic, population, and sociological statistics, alongside temporal efficiency factors.

In this volume (Volume 2), we examine the impact of key drivers of EfW addressable residual waste, including COVID-19, and develop forecasts for the volume of residual waste to 2035.

FAST FACTS & CONTENTS

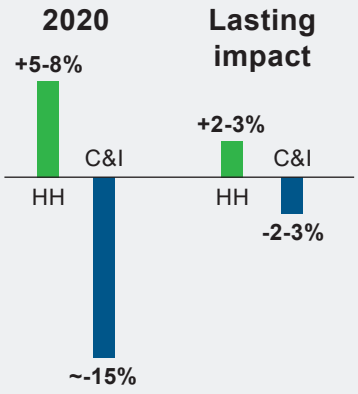
8% decline in addressable residual waste expected by 2035 in the Median scenario

53% household recycling rate expected by 2035 in the Median scenario

1 / Waste arisings

Total household and C&I waste arisings in England are expected to grow at 0.4% p.a. increasing from 56.7 MT[1] in 2019 to 60.8 MT in 2035. The lowest regional growth is expected in the North East (0.0% p.a.) and the highest in Greater London (0.8% p.a.). Household and C&I waste arisings are expected to grow at comparable rates, as pre-COVID-19 expectations of moderately faster growth in C&I arisings have changed due to the shift towards home working. In 2020, total household and C&I waste arisings are expected to have declined by 7%, with the drop in C&I waste arisings outweighing the growth in household waste arisings. → A

A / COVID-19 impact on waste arisings



Source: Roland Berger

HOUSEHOLD WASTE

Historically, household waste arisings were primarily driven by population growth. However, more complex drivers, including sociological factors, consumer habits and preferences, and material efficiency are increasingly influencing this growth. Since 2010, household waste arisings within England have remained flat compared with an annual population growth of ~1%. This complexity has been modelled in our report through a regression analysis to examine the relationship between these factors at a local authority level and through qualitative overlays to extrapolate these trends over the forecast period.

In 2020, the UK is estimated to have witnessed 5-8% growth in household waste arisings driven by the shift to remote working, pushing certain C&I waste streams to the household, and the rise in e-commerce resulting in more packaging waste. This shift is expected to continue, albeit to a lesser extent, as we see a structural change towards increased home working. We anticipate this will drive an uplift in household waste volumes in 2021 by 2-3% compared with 2019 levels. From 2021 onwards, we expect household waste arisings to remain broadly stable, with a 0.3% p.a. increase to 2035.

C&I WASTE

C&I waste has historically shown strong correlation with economic output and grew at ~1% p.a. over the past decade. At a regional level this picture becomes more dynamic, with differences in the industry mix impacting the composition and future evolution. Therefore, we have considered the second order impact of manufacturing efficiency, material development, and sustainability on C&I waste arisings.

In 2020, we have seen a significant shortfall in C&I waste arisings driven by the COVID-19 pandemic, with arisings expected to have fallen short of 2019 levels by ~15%. In 2021 we anticipate a lasting impact from the shift towards home working, reducing expected arisings by 2-3% compared with 2019 levels. Thereafter, C&I waste arisings are expected to grow at 1.0% p.a. until 2035.

1 Values may differ slightly to those presented in Volume 1 due to the inclusion of updated government data and a minor refinement to the C&I forecasting methodology

2/ Recycling rates

HOUSEHOLD WASTE RECYCLING

The evolution of household waste recycling rates is likely to be the greatest influencing factor on future residual waste. As part of the Resources and Waste Strategy for England, published in December 2018, the UK government set out an ambitious municipal recycling target of 65% by 2035. Such a target, if met, could see the volumes of residual household waste reduced by almost 40%.

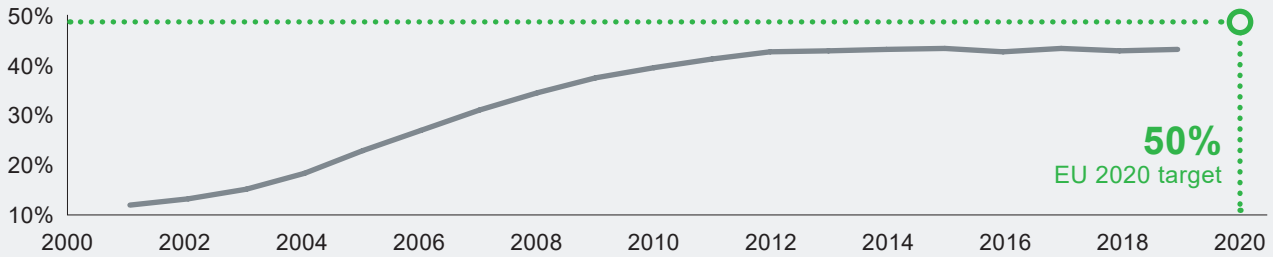
However, the achievability of such a target should be met with a healthy degree of scepticism. Whilst the UK achieved a significant increase in its recycling rate between 2000 and 2012 (following the implementation of landfill taxes in 1996 and subsequent tax increases throughout the early 2000s), recycling rates have since stagnated, leading to the UK's inevitable failure to meet its 2020 target of 50%. This demonstrates the significant challenge the UK has faced in suitably developing its waste management regulation, processes, and infrastructure. The stark difference in regional performance (and between the devolved administrations) also highlights some of the structural issues present within the current system. → B, C

Whilst the UK's exit from the EU may give rise to profound changes to the way the country approaches waste management (e.g. a redefinition of waste targets, such as CO_2 equivalent or "avoided energy" metrics), there appears to be support for continued alignment with the EU.

Across Europe, household waste recycling rates differ widely, from less than 10% to more than 65% with the difference driven by many factors, such as government subsidies, environmental policy, treatment infrastructure, cultural, and socio-demographic factors (e.g. population density, urban concentrations, types of housing, etc.).

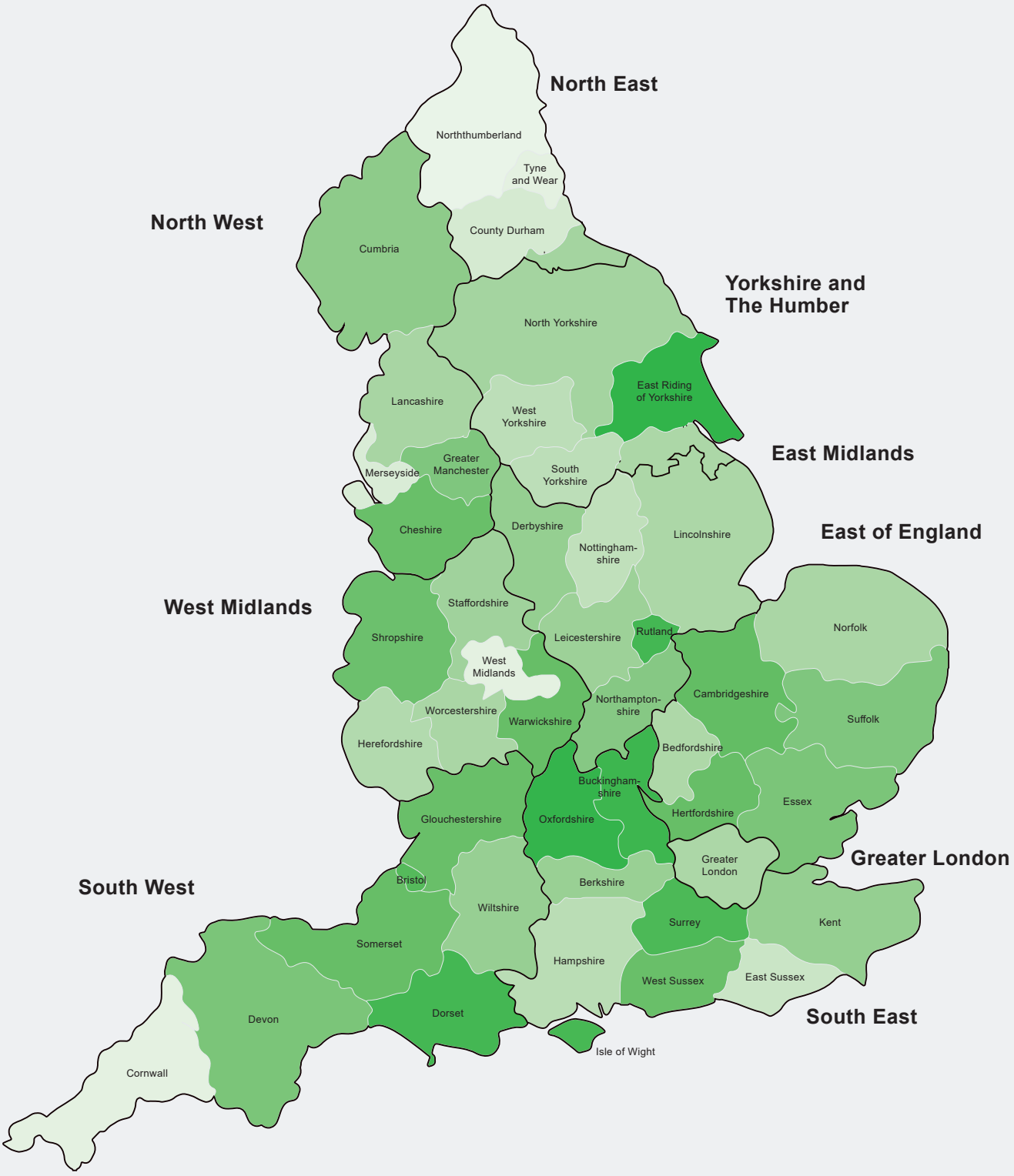
At 67%, Germany has the highest household waste recycling rate. The country successfully increased its household waste recycling rate from 44% in 1997 (where England is today) to 65% in 2012. However, this transition required significant investment and a radical change to Germany's waste management system, which would be challenging to replicate in England. For example, an

B / Household waste recycling rate in England, 2001-2019 [%]



Source: DEFRA

C / England recycling rates by county



45% 64%

Source: EA, SEPA, Welsh government, Oxford Economics, Roland Berger

Extended Producer Responsibility (EPR) scheme was introduced in 1991, a comprehensive deposit return scheme in 2003, and many other subsequent measures, including strict landfill bans, high recycling spend per capita, and thorough separation at source (up to six separate streams). Moreover, Germany has built a strong culture of recycling and sustainability which enable it to reach high levels of recycling.

Comparisons of the historical evolution of recycling rates of several well-performing European countries highlights several common patterns:

1) A 5-8 year period of rapid improvement, typically following the rollout of landfill restrictions alongside other tax-based policies and infrastructure investment.
2) A plateau after reaching a ceiling from core policies with incremental improvements driven by changes in consumer behaviour, ongoing infrastructure/technological improvements, and commonly a Deposit Return Scheme rollout in more mature markets.
3) Peaks and troughs driven by the trailing or rollout of new initiatives/ policies (e.g. incineration tax in the Netherlands and Sweden).

We can see that the UK lags behind key EU countries by 6-10 years and reached its plateau at around 43%. Therefore, reaching a target of 65% by 2035 appears ambitious, likely requiring significant policy intervention and investment. → D

C&I WASTE RECYCLING

Historically, C&I waste recycling rate in England has been significantly higher than that of household waste, driven by composition differences, and cost incentives which drive significantly better sorting and management. Whilst less reliably reported, C&I recycling rates are expected to have improved from 52.5% in 2012 to an estimated 55-56% in 2019.

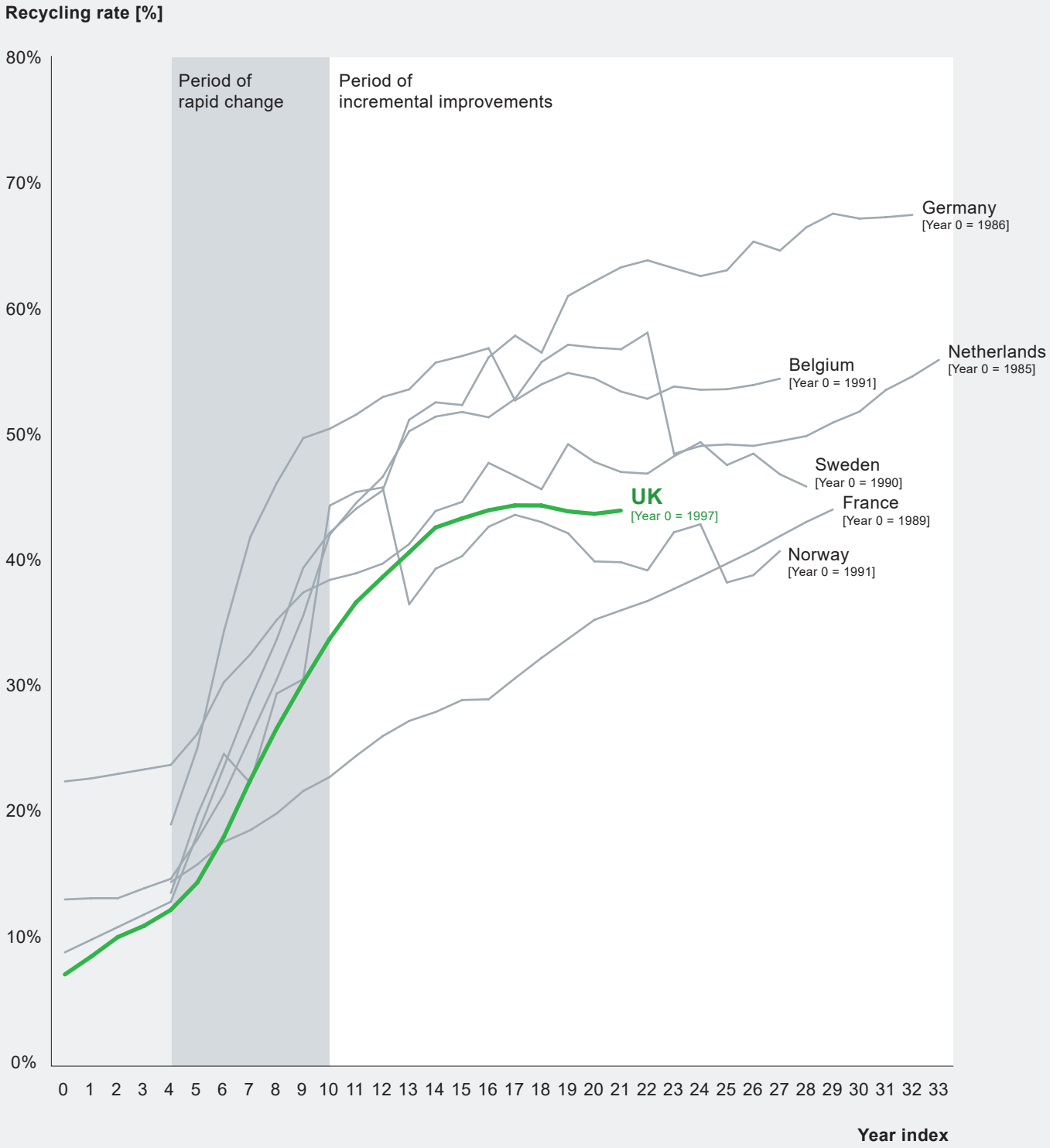
Over the coming years, active policy intervention is expected to primarily target household waste, given the low levels of recycling to date. However, C&I waste recycling is expected to achieve gradual improvements, driven by increasing disposal costs, a shift towards sustainability, greater levels of sorting, and the impact of policies, such as EPR.

RECYCLING SCENARIOS

We have defined three potential scenarios for the recycling rate based on the extent of government policy intervention. → E

England's target of 65% household recycling by 2035 appears ambitious. Such a target would require a radical overhaul of the current waste management system, significant investment, and disruption. On the other hand, England's stagnation of recycling rate at current levels necessitates some degree of active policy intervention. Our median scenario assumes a moderate degree of government intervention, with the rollout of initiatives, such as a light deposit return scheme, EPR, and waste food separation most likely. Under this scenario, we believe that the UK could realistically improve its household and C&I recycling rates to 53% and 62% respectively by 2035. Policy implementation is likely to translate into recycling improvements mostly beyond 2025.

D / European household waste recycling rate development[1]

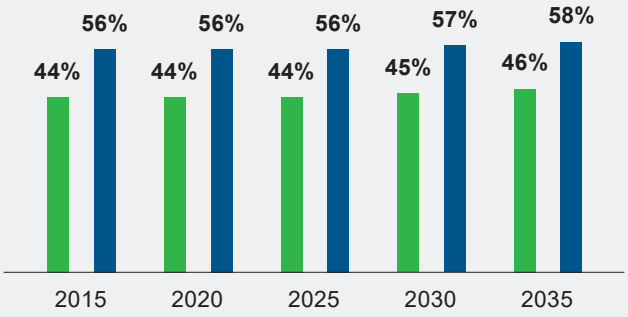


1 Recycling rate shown for the UK rather than England due to data availability pre-2005

Source: Eurostat, Local government publications, Roland Berger

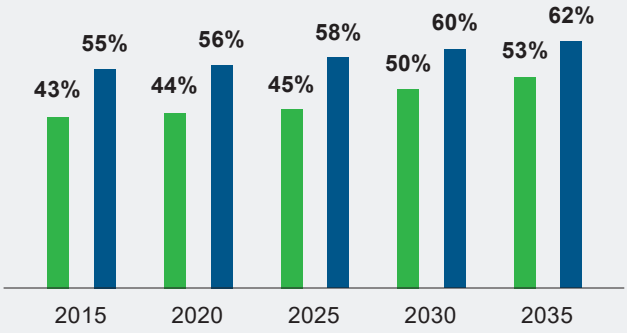
E / Recycling scenarios for England, 2015-2035 [%]

Incremental change – No government intervention



- Discretionary changes to business, municipal and household practices
- Continuation of current initiatives (e.g., producer responsibility scheme target growth, landfill tax increases)
- Free market driven technology developments and investment in recycling infrastructure

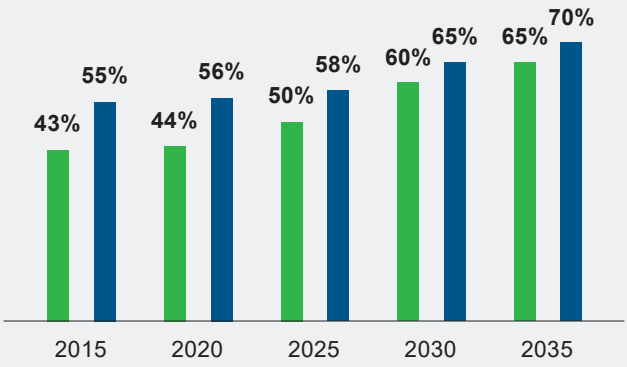
Median – Moderate government intervention



Scenario 1 drivers in addition to some/all of the following initiatives:

- Light Deposit Return scheme (DRS)
- Extended Producer Responsibility (EPR) scheme
- Separation and mandatory collection of LA food waste

Radical change – Significant government intervention



Scenario 1 & 2 drivers in addition to some/all of the following initiatives:

- Comprehensive DRS scheme
- Multi-stream waste separation
- Pay-per-use HH collection model
- Incineration tax
- Carbon/green tax

Household Commercial & Industrial (C&I)

Source: Roland Berger

3/ Residual waste addressability

So far we have assessed the key drivers of residual waste. In order to bridge the gap between total residual waste and that available for incineration, we must consider residual waste composition, RDF exports, and incineration technology.

RESIDUAL WASTE COMPOSITION

Residual waste comprises of a variety of materials, including unextracted recyclate, organic waste, hazardous substances, and inert materials. The respective properties of these materials, including calorific value, moisture content, and ash production, impact their effectiveness for incineration. In addition, the incineration of hazardous materials is largely prohibited. Around 80% of the total residual waste is considered addressable by EfW incineration.

Calorific Value (CV) is the measure of the energy content for a given mass of material and is key when it comes to analysing residual waste composition. Counterintuitively lower CV values are, in general, preferable for incineration operators, at least while a capacity-supply gap exists. This is because an EfW plant is limited by the calorific input required to maintain an optimum boiler temperature, and not the gross tonnage. Therefore, a lower CV enables greater volumes of waste to be processed per year resulting in higher gate fees without impacting the total annual energy production. However, by the same logic, a CV decline will also act to increase the total effective capacity thereby further closing the capacity gap and increasing competition for waste.

The evolution of CV is impacted by many competing factors. For example, increased recycling of high CV materials such as plastics would seek to reduce the CV, whilst better separation and processing of organic waste, and other less combustible waste types, would increase the average CV. In addition, the increasing proportion of C&I waste incinerated acts to increase CV. However, on-balance we believe that the overall impact will be a modest net decrease in CV, reducing the overall average (and hence increasing the effective EfW installed capacity) by 2-4% by 2035.

WASTE EXPORTS

In 2010, the UK permitted the export of refuse derived fuel (RDF) and solid recovered fuel (SRF) for overseas incineration. Bolstered by the lack of domestic capacity alongside a waste supply shortage in Europe, UK's RDF exports increased rapidly from 2010 to 2016. At its peak, 3.2 MT of RDF was exported from the UK, equivalent to ~13% of the total volume of incinerable residual waste.

Since 2016, export volumes have declined, driven by increasing UK capacity, a weakened pound, increased European gate fees (due to rising utilisation rates and aging EfW infrastructure) and growing concerns about potential European waste import taxes.

In the short-term there is uncertainty around export volumes given the likely introduction of a waste import tax in the Netherlands, which accounted for 44% of the UK exports over 2017-2019. In addition, Brexit may accelerate the

imposition of waste tariffs alongside potential port congestion delays. However, whilst the UK operates with an EfW capacity shortage and exports remain a more cost-effective solution for local authorities with nearby shipping access, exports are likely to retain their importance, but at levels below that experienced between 2016 and 2019.

In the long-term, as the UK capacity gap closes, we expect to see a vast reduction or even elimination of RDF exports as UK alternatives become more price competitive or even legislatively required.

INCINERATION TECHNOLOGY

Today, most large incinerators utilise a "moving grate" technology, which has proven effective at dealing with large throughputs of waste whilst achieving sufficient energy efficiency to be categorised as a recovery treatment method (i.e. "R1" certified) in many modern facilities. Owing to the significant investment and risk associated with commissioning new EfW infrastructure, investors are highly cautious when it comes to the adoption of novel incineration technologies.

In recent years, there have been significant investments in gasification plants, of which the majority have had notable performance issues with some failing to pass the final commissioning or even having the projects abandoned. This has solidified the market view towards traditional moving grate technology which is expected to remain the front runner for the EfW infrastructure pipeline in England.

A more effective development has been the move towards combined heat and power (CHP) plants, whereby some of the steam is used as a direct heat source, enabling greater energy efficiencies. This shift, however, is not expected to impact the demand for, or nature of, residual waste incinerated.

FURTHER READING: EVOLUTION OF C&I WASTE INCINERATION

Historically, the prevalence of PFI/PPP contracts backed by comprehensive long-term municipal waste contracts lead to incinerator designs focused heavily on household waste, and a significant imbalance in the EfW capacity available to C&I waste.

In the last decade, the emergence of privately funded EfW infrastructure reliant on the spot market and short-term private contracts for residual waste led to a significant increase in C&I incineration. However, the lasting impact is still evident. In 2019, ~35% of addressable residual C&I waste underwent EfW incineration, compared with almost 80% for Household waste.

Going forward, we expect to see the demand for C&I waste to continue to increase as spot market reliant infrastructure continues to be developed and the capacity gap reduces. Therefore, as the proportion of C&I waste processed increases, this will drive an increase in the average CV of waste processed across England.

4/ Residual waste forecast

From understanding the outlook for waste arisings, recycling (via our three scenarios), and residual waste addressability, we can forecast the evolution of residual waste. The key findings and residual waste forecast are summarised in the following charts. → G

KEY FINDINGS

Residual waste is set to decline

In the median scenario, we anticipate a decline across all regions and an 8% drop overall from 2019 to 2035.

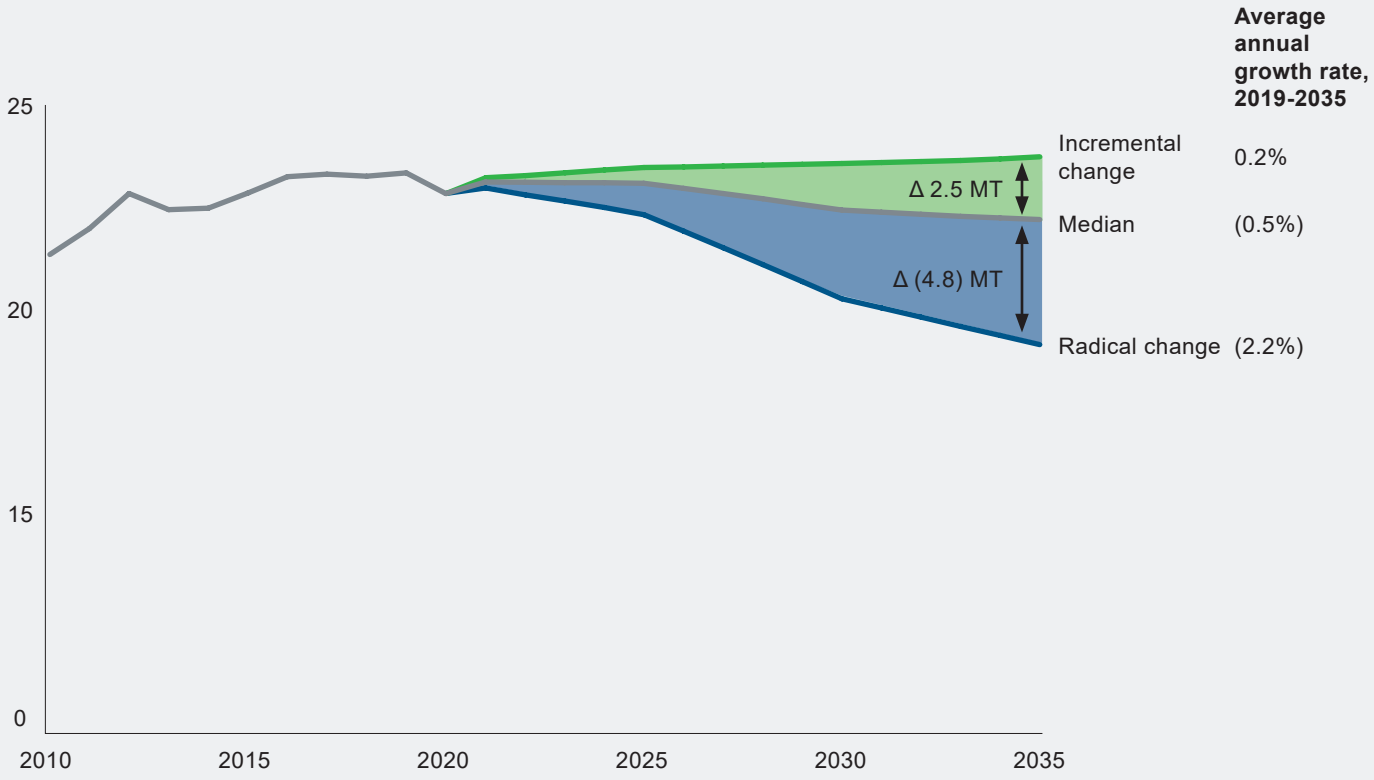
Significant regional divergence exists

Whilst most regions will follow the national trend given the national nature of future government policy, the variances between regions may have significant consequences when it comes to understanding the catchment capacity gap. London is expected to be the most resilient market with a 4% decline by 2035, supported by its growth in waste arisings, whilst the North East is expected to see a more significant decline of 15% by 2035, primarily owing to its current recycling underperformance.

The outlook is highly sensitive to the degree of government intervention

Whilst a decline in volumes appears most likely, its magnitude is highly dependent on future recycling rates and therefore the degree of government intervention. Between the incremental change and radical change scenarios, we see a gap of 7.4 MT by 2035, or in other words, the difference between a 3% increase and a 30% decline in residual waste volumes. However, our median scenario reflects a more probable outcome of an 8% decline.

G / EfW addressable residual waste forecast, 2010-2035 [MT][1]



	2019 Residual Waste [MT]	2019-2035 growth [CAGR %]			2035 residual waste [MT]		
		Incremental change	Median	Radical change	Incremental change	Median	Radical change
London	4.4	0.5%	-0.2%	-1.9%	4.7	4.2	3.2
South East	3.6	0.2%	-0.5%	-2.1%	3.7	3.3	2.5
North West	2.8	0.0%	-0.7%	-2.4%	2.8	2.5	1.9
East of England	2.4	0.2%	-0.5%	-2.1%	2.5	2.2	1.7
West Midlands	2.3	0.0%	-0.7%	-2.5%	2.3	2.1	1.6
South West	2.1	0.1%	-0.6%	-2.2%	2.2	1.9	1.5
Yorkshire & Humber	2.0	-0.1%	-0.8%	-2.5%	2.0	1.7	1.3
East Midlands	1.8	0.2%	-0.6%	-2.3%	1.9	1.7	1.3
North East	1.0	-0.2%	-1.0%	-2.7%	1.0	0.9	0.7
England	**22.4**	**0.2%**	**-0.5%**	**-2.2%**	**23.0**	**20.5**	**15.6**

1 Export volumes have not been excluded from the residual waste volumes given that these volumes are expected to become addressable in the long-term as domestic capacity increases

Source: Roland Berger

VOLUME 3 FOREWORD: THE 2035 CAPACITY GAP

As the availability of residual waste declines and incineration capacity continues to grow, the national capacity gap is squeezed from both sides. However, as was the motivation for this publication series, it is the local picture and local dynamics that are most critical to understand. With a current regional imbalance in the capacity gap, a significant pipeline of infrastructure, and regionally distinct residual waste developments, stark regional differences are expected to emerge. Understanding these differences, and hence the relative investment attractiveness of different regions will be key for the EfW industry both in terms of the long-term operational planning of current facilities and the commercial feasibility of facilities in the pipeline.

In the third and final volume of this series "The 2035 capacity gap" we explore the future infrastructure pipeline and present a regional view on the evolution, magnitude, and indeed existence, of the EfW capacity gap.

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