Title: Environment Act Targets Impact Analysis: Waste Reduction **IA No:** N/A **RPC Reference No:** N/A **Lead department or agency:** Department for Environment Food and Rural Affairs (Defra) **Other departments or agencies:** N/A	Impact Assessment (IA) **Date:** 19/12/2022 **Stage: Final** **Source of intervention: Domestic** **Type of measure: Secondary legislation** **Contact for enquiries:** ResourcesandWasteTargets@defra.gov.uk

Summary: Intervention and Options

RPC Opinion: Out of Scope

Cost of Preferred (or more likely) Option (in 2020 prices)			
Total Net Present Social Value	**Business Net Present Value**	**Net cost to business per year**	**Business Impact Target Status**
£3,157m	N/A	N/A	Not direct regulatory policy

What is the problem under consideration? Why is government action or intervention necessary?

Waste produces environmental pressures, and treatment infrastructure can impose wider costs on society. The environmental impact of waste treatment is illustrated by the waste hierarchy. The amount of waste produced with the greatest environmental impact exists due to market failures that exist in our economic system. These include negative environmental externalities from pollution, information failures concerning environmental impacts of purchasing decisions, and missing markets for recycled materials. Legally binding targets ensure future government policy remains focused on delivering better environmental outcomes by tackling these market failures, as well as giving a clear signal to industry of the direction of future policy.

What are the policy objectives of the action or intervention and the intended effects?

Waste not reused or recycled, including material that is too degraded or contaminated for these purposes, is termed 'residual' waste. The aim of the target is to encourage reductions in the tonnage of residual waste generated, measured at endpoint treatment (see the 'Target Scope' section). This can be achieved through policies that prevent waste being generated in the first place and where waste is unavoidable, to increase recycling. Such policies keep valuable material resources in the economy for longer rather than being burned or buried. This provides environmental benefits both in the form of reducing reliance of virgin material extraction in consumption and reduced reliance on the most environmentally harmful forms of waste treatment.

What policy options have been considered, including any alternatives to regulation? Please justify preferred option (further details in Evidence Base)

Failure to set a target is not a credible option. This would put the Secretary of State for the Department for Environment, Food and Rural Affairs in breach of the legal requirement in the Environment Act 2021 ("the Environment Act") to set a long-term target relating to resource efficiency and waste reduction.

Option 1 (preferred option): Legally binding Environment Act target to reduce residual waste excluding Major Mineral Waste (MMW) kg per capita by 50% by 2042 from 2019 levels. This option has been modelled to be ambitious but achievable and will help to encourage the environmental improvements associated with reduced residual waste as soon as possible.

Other options for the level of ambition are discussed within 'Options Considered & Preferred Option' section. As all potential ambition levels stem from the same modelled policy pathway (also used to estimate costs and benefits), they are not included as official options in the summary sheets – see further discussion in aforementioned options section.

Wider options considered for area and scope of the target are discussed within the 'Target Scope' section.

Is this measure likely to impact on international trade and investment?	No

Are any of these organisations in scope?	**Micro** Yes	**Small** Yes	**Medium** Yes	**Large** Yes
What is the CO_2 equivalent change in greenhouse gas emissions? (Million tonnes CO_2 equivalent)		**Total:** -35		
Will the policy be reviewed? Yes. **If applicable, set review date:** Environmental Improvement Plan cycle				

I have read the Impact Assessment and I am satisfied that, given the available evidence, it represents a reasonable view of the likely costs, benefits and impact of the leading options.

Signed by the responsible Minister: Minister Trudy Harrison Date: 30th January 2023

Summary: Analysis & Evidence

Policy Option 1

Description: Legally binding Environment Act target to reduce residual waste excluding Major Mineral Waste (MMW) kg per capita by 50% by 2042 from 2019 levels
FULL ECONOMIC ASSESSMENT

Price Base Year 2020	PV Base Year 2022	Time Period Years 2022-2050	Net Benefit (Present Value (PV)) (£m)		
			Low: N/A	**High:** N/A	**Best Estimate:** £3,157m

COSTS (£m)	Total Transition (Constant Price)	Years	Average Annual (excl. Transition) (Constant Price)	Total Cost (Present Value)
Low	N/A		N/A	£3,348m
High	N/A		N/A	£5,022m
Best Estimate	N/A		N/A	£4,185m

Description and scale of key monetised costs by 'main affected groups'

The setting of a legislative target to reduce residual waste places no direct costs onto society. However, it will require the future setting of policy interventions to meet the target, which will impose costs. The costs associated with the target will be highly dependent on the future policies implemented and these policies will be subject to future consultation and corresponding economic assessment of costs.

Illustrative analysis of a potential future policy pathway gives a sense of scale of the potential costs and informs the total cost figures shown here. The best estimate is made up of £3,315m increased waste treatment costs for local authorities/businesses (from illustrative price-based pathway, method explained in the 'Illustrative future pathway to reach the target' section), £841m increased service costs for local authorities/businesses and £29m scheme-running costs to government (both from modelled additional household measures). These figures do not include the costs from the consulted-on Collection and Packaging Reforms (CPR), as this would be double counting with these reforms' published impact assessments.

Due to the illustrative and uncertain nature of this analysis, it is not appropriate to calculate Business Impact Target (BIT) or net cost to business per year values.

Other key non-monetised costs by 'main affected groups'

It is likely that the main group affected by the potential policies will be producers of goods which use excessive material or are not easily recyclable/repairable. Some costs may be passed on to consumers and local authorities/government may face some costs too. Some levers may impose direct costs on businesses and local authorities that manage waste, though this will depend on specific interventions which would be subject to future consultation and associated economic analysis. Beyond CPR, the level of target ambition will influence the policies set. Future policies set to meet a 2042 target date may impose costs sooner than for a later target date and may give businesses and local authorities less time to adapt.

BENEFITS (£m)	Total Transition (Constant Price)	Years	Average Annual (excl. Transition) (Constant Price)	Total Benefit (Present Value)
Low	N/A		N/A	£6,103m
High	N/A		N/A	£8,727m
Best Estimate	N/A		N/A	£7,342m

Description and scale of key monetised benefits by 'main affected groups'

The setting of a legislative target to reduce residual waste places no direct benefits onto society. However, it will require the future setting of policy interventions to meet the target, which will deliver economic and environmental benefits, including substantial carbon savings. The benefits associated with the target will be highly dependent on the future policies implemented and these policies will be subject to future consultation and corresponding economic assessment of benefits.

Illustrative analysis of a potential future policy pathway gives a sense of scale of the potential benefits and informs the total benefits figures shown here. The best estimate is made up of £3,644m of landfill emissions savings, £2,186m of other emissions savings (both based on reductions in waste from illustrative future pathway, method explained in the 'Illustrative future pathway to reach the target' section) and £1,512m in savings in collection costs for local authorities (from modelled additional household measures). These

figures do not include the benefits from the consulted-on CPR, as this would be double counting with these reforms' published impact assessments.

Other key non-monetised benefits by 'main affected groups'

Benefits derive from the reduction in residual waste, such as reduced greenhouse gas (GHG) emissions and reduced disamenity from current and avoided future landfill, incineration, and other residual waste treatment sites. There will also be secondary benefits from the policies implemented to meet the target. These secondary benefits will be dependent on which future policies are chosen to be implemented.

Many of the secondary benefits are environmental. Many policies that reduce the level of residual waste result in reduced carbon emissions over the lifecycle of products (extraction, production, end of life). Increased reuse, repair and reusability improves the circularity of the economy and reduces the depletion of the planet's resources, as well as maintaining existing utilised resources in the economy for longer, enabling greater value per tonne utilised. Businesses that use recycled material in production could see a decrease in producer costs as the secondary material market is stimulated and supply of secondary material is increased. Local authorities may see a benefit from decreased costs of waste disposal as recycling has a lower cost per tonne than residual waste treatments.

Beyond CPR, the level of target ambition will influence the policies set. Future policies set to meet a 2042 target date are likely to bring benefits sooner compared to a later target date, both in terms of the direct benefits from reduced residual waste as well as secondary benefits to the environment, government, businesses, and consumers.

Key assumptions/sensitivities/risks	**Discount rate (%)**	3.5

The appraisal is of pathways that are illustrative of what may be required to reach the target. It does not assume specific policy choices and there is a high degree of uncertainty around what policies will be used to meet the target and what their costs and benefits will be. Any actual policy interventions will be subject to future consultation and presentation of economic analysis. Other pathways to reach the target would have different associated costs and benefits.
The target indicator uses a treatment-based definition of residual waste, meaning the tonnage of residual waste ending up at landfill, incinerators, sent overseas for energy recovery, or used in energy recovery for transport fuel. For policies where the impact is upon waste collection or generation, there is an assumption that this impact will carry through to waste treatment tonnages.
Further discussion can be found in the 'Risks and assumptions' section.

BUSINESS ASSESSMENT (Option 1)

Direct impact on business (Equivalent Annual) £m: N/A			**Score for Business Impact Target (qualifying provisions only) £m:** N/A
Costs: N/A	**Benefits:** N/A	**Net:** N/A	

Contents

Executive Summary

The Environment Act 2021 requires government to set at least one long-term legally binding target in the area of resource efficiency and waste reduction. The target in this area is:

- Reduce residual waste (excluding major mineral wastes) kg per capita by 50% by 2042 from 2019 levels.

The target indicator uses a treatment-based definition of residual waste, meaning the tonnage of residual waste ending up at landfill, incinerators, sent overseas for energy recovery, or used in energy recovery for transport fuel.

Assessment has also been undertaken to investigate a possible target to increase resource productivity as stated in the Targets 2020 policy paper[1]. However, more evidence is required to develop this further, which is not amenable to the timing of initial target setting. For this reason, it is excluded from this impact assessment.

Our aim is to achieve sustained environmental improvement across the whole resources and waste system. The 2018 Resources and Waste Strategy for England[2] sets our path to do so.

In delivering the strategy, major reforms to the way resources and waste are managed in England are being made, including extended producer responsibility (EPR) schemes, consistent municipal[3] waste recycling collections, and a deposit return scheme (DRS) for drinks containers. Actions that may be taken to deliver improved environmental outcomes include utilising powers under the Environment Act related to eco-design standards, food waste prevention measures and the mandated provision of information.

Long-term targets provide businesses a stable environment in which to make investments. They also hold government to account. Introducing a target in the area of waste reduction will help realise the 25 Year Environment Plan goal of using resources from nature more sustainability and minimising waste, in line with the vision of improving the environment within a generation.

This impact assessment does not seek to predict what specific policies will be delivered in the future. Specific policy proposals will be the subject of future consultations where economic impacts will be assessed individually. All potential policies referred to in this document should be considered as illustrative and simply identified as areas that could deliver progress against the target.

This impact assessment contains cost and benefit estimates based on an illustrative future policy pathway, and qualitative discussion of the potential costs of the different lever types

[1] 19 August 2020: Environment Bill - environmental targets - GOV.UK (www.gov.uk)
[2] https://www.gov.uk/government/publications/resources-and-waste-strategy-for-england
[3] Municipal waste is defined as household waste and waste from other sources (for example, businesses and hospitals) that is similar in nature and composition to household waste.

that could be used to progress against the target. Quantitative analysis of uncertain future policies focuses on price-based levers, as these can be most appropriately modelled. This outlined policy pathway is purely illustrative and is useful when considering the achievability of the target and where costs from future policies may lie**.** The exact make-up of future policies will likely be a combination of interventions.

The Government believes it is important that local authorities continue to support comprehensive and frequent rubbish and recycling collections to households. The Government's consistent collection proposals have included consulting on expanding food waste collections, supporting garden waste collections, and introducing a minimum collective frequency for residual waste. Such reforms would help ensure households continue to have access to a comprehensive and frequent service, whilst improving environmental outcomes.

The *Overarching Impact Assessment for proposed Environment Act (2021) targets* provides a high-level, descriptive, and largely qualitative analysis of all the targets under the Environment Act.

The Environment Act creates a new statutory cycle of monitoring, planning and reporting. Long-term targets will be supported by interim targets, which will set a five-year trajectory towards meeting the long-term targets. The Act requires Government to set interim targets in the Environmental Improvement Plan. This will ensure that there is always a shorter-term goal Government is working towards, as well as the long-term target and will allow for an ongoing assessment of whether the government is on track to meet its long-term target ambitions.

Changes made to this Impact Assessment following consultation

- The target scope has been revised to exclude ferrous metals removed from bottom ash, which have been put through incineration or used in energy recovery and then sent for recycling. This is consistent with Defra's annual reporting of Waste from Households recycling rates.

  The target scope has also been revised to:
  - Exclude waste originating in the Devolved Administrations (DAs), sent to England for end-of-life treatment.
  - Include waste originating in England, sent to the DAs for end-of-life treatment.

  These amendments address possible perverse incentives to send waste out of England for end-of-life treatment. They also remove the risk of waste levels being falsely inflated by wastes originating outside of England and match the metric as closely as possible to waste generation in England.

  These amendments are estimated to increase the 2019 baseline from 560 kg per capita to an estimated 574 kg per capita. They do not affect the target ambition level, with a 50% reduction making the 2042 target 287 kg per capita. Further detail on these changes can be found within the 'Target Scope & Metric' section.

- There have been some minor updates to the modelled reduction of residual waste out to 2042. The impacts of the Collection and Packaging Reforms have been updated to reflect the most recently available modelled impacts of these policies. The assumptions used in modelling the impact of the illustrative future pathway on residual waste arisings has been updated, to take into account the impact of the Collection and Packaging Reforms when determining the tonnes of remaining residual waste deemed "avoidable".

- The amendments to the scope and modelling updates outlined above have changed the inputs to the costs and benefits modelling, in terms of modelled waste tonnages and recycling rates, since consultation. This has resulted in total discounted costs in this impact assessment reducing from £4,563m to £4,185m, total discounted benefits reducing from £8,183m to £7,342m and the total net present social value reducing from £3,620m to £3,157m. The methods used for these calculations have not changed. The methods used to calculate the costs and benefits from the illustrative future pathway are outlined within 'Potential costs and benefits of illustrative future pathway'. The costs and benefits from the additional household measures are unchanged and are outlined in 'Collection and packaging reforms plus additional household measures'.

1. Problem under consideration

Reducing residual waste will reduce the environmental impact of waste treatment, as well as helping to preserve our stock of material resources. Alongside labour, capital and technology, material resources and energy are almost always required to produce the goods and services people consume. When material inputs are primary rather than from secondary sources (for example recycled material is a secondary source), they must be harvested or extracted from the natural environment.

In England, the waste hierarchy (which ranks options for waste management by their environmental impact), is a guide to sustainable waste management and taking measures to apply it, that are reasonable in the circumstances, is a legal requirement on anyone managing waste[4]. Priority goes to preventing waste from being generated in the first place, followed by preparing waste for reuse; to recycling, and then recovery. Disposal, such as in landfill, is the most environmentally harmful option.

In line with the waste hierarchy, substantial progress has been made towards the better use of our resources. Since 2000/01, the amount of local authority collected waste (LACW)[5] that is sent to landfill has decreased from 79% of total to 8% in 2020/21. However, while the amount of LACW that is recycled or reused has risen from 12% in 2000/01 to 41% in 2020/21, peaking at 43% in 2014/15, the amount sent for incineration with energy recovery has also increased, from 9% in 2000/01 to a peak of 48% in 2020/21. These changes coincided with a period of increased growth in the rate of Landfill Tax[6] and government financial support mechanisms via the Waste Infrastructure Development Programme.

Since 2018/19, a greater proportion of LACW has been sent to incineration with energy recovery than to recycling or reuse in England. The 'waste from households' (WfH)[7] recycling rate (including metals reclaimed/recycled from incinerator bottom ash) has remained stagnant between 44.3-45.5% since 2015. Our focus remains on moving waste up the hierarchy and minimising the amount of waste produced.

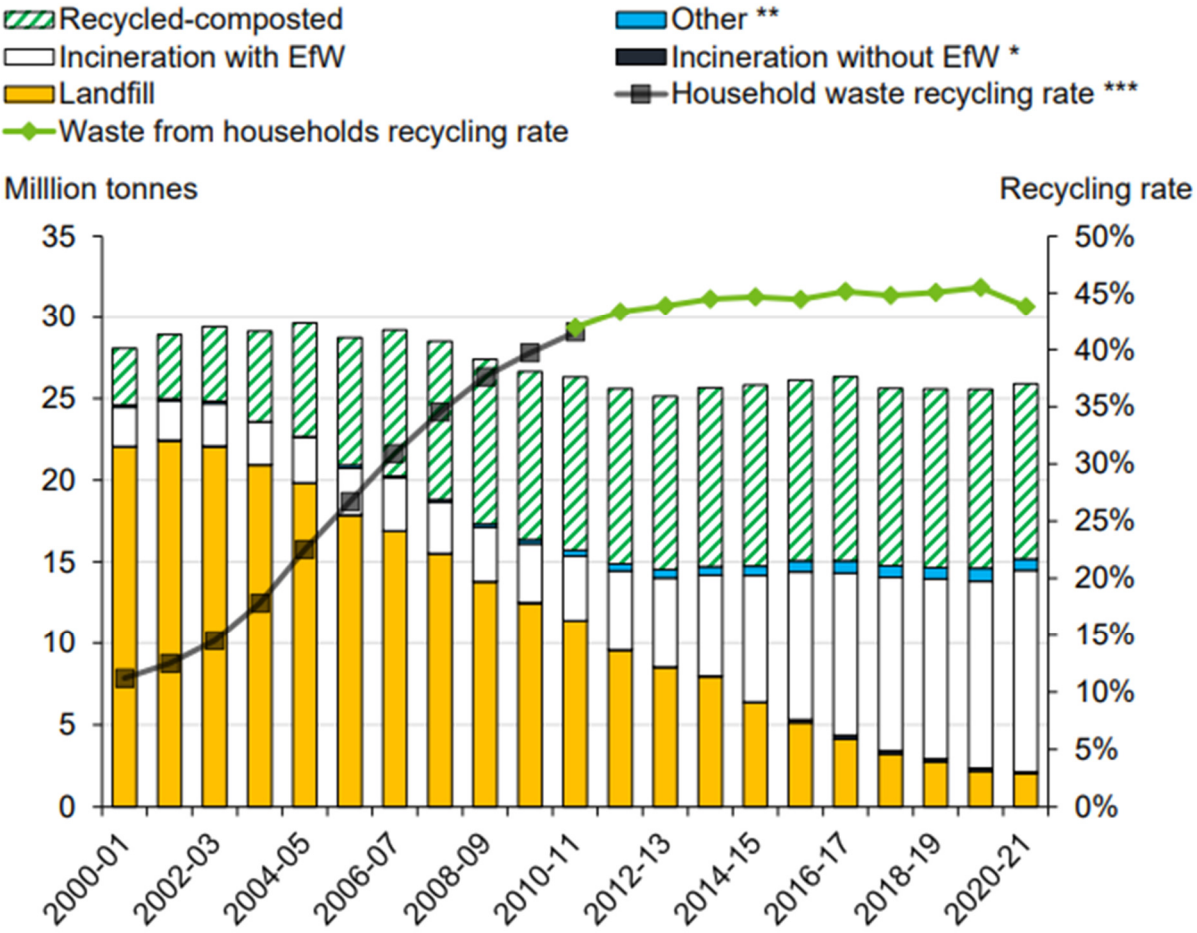
[4] Waste (England and Wales) Regulations 2011

[5] Local authority collected waste (LACW) consists of all 'waste from households', street sweepings, municipal parks and gardens waste, beach cleansing waste, and waste resulting from the clearance of fly-tipped materials plus some commercial and/or industrial waste.

[6] Environmental Taxes historic rates - GOV.UK (www.gov.uk)

[7] Waste from households (WfH) excludes local authority collected waste not considered to have come directly from households, such as street bins, street sweepings, parks and grounds waste, and compost-like output.

Figure 1: Management of all local authority collected waste and recycling rates, England, 2000/01 – 2020/21[8]. EfW = Energy from Waste



Notes

* **Incineration with energy recovery** / **without energy recovery** includes metals reclaimed/recycled from incinerator bottom ash. This is consistent with the existing definition for household waste recycling so is not impacted by the change in 'waste from households' recycling definition.

** **Other** includes waste treated/disposed of through other unspecified methods as well as process and moisture loss.

*** **The household waste recycling rate** is based on a broader measure of waste and is not directly comparable to the 'waste from households' recycling rate. For further information on definitions, please refer to the Local Authority Waste Statistics report[9].

Metals reclaimed/recycled from incinerator bottom ash are included within the 'waste from households' recycling rate shown on this chart from April 2015/16 onwards but are not included in household waste recycling.

Waste prevention avoids unnecessary production and processing in the first place, and therefore the costs and environmental impacts associated with those steps. For this reason, it is at the top of the waste hierarchy. To prevent waste, products need to be designed and manufactured to safely fulfil their intended function for as long as possible, to enable reuse and have their usable lives extended by repair or refurbishment.

[8] Source: Statistics on waste management by local authorities in England in 2019/20

[9] Further details on definitions of 'waste from households' and 'household' recycling rates can be found in Local Authority Collected Waste Management for England for 2020/21.

When products do reach their end of life, society should aim to recover constituent materials and regenerate products where optimal to do so, giving them the opportunity to fulfil useful functions and reducing the damage caused to our natural environment.

Tackling hard to recycle products at the design stage can ensure that when waste does arise, it can be incorporated back into the economy through recycling. Manufacturers can use waste products of other industries as inputs to theirs.

Waste sent for recycling is typically separately collected, for example at kerbside and sent for sorting and reprocessing to make raw materials to re-enter production. Recycling can also include the reprocessing of organic material (for example via anaerobic digestion (AD) or composting) but does not include energy recovery and the reprocessing into materials that are to be used as fuels or for backfilling operations.

Waste that is not reused or recycled, including material that is too degraded or contaminated for these purposes, is termed residual waste. Residual waste is currently dealt with in three main ways: recovery of energy through Energy from Waste (EfW) plants, production of refuse derived fuel (RDF), or disposal to landfill or incineration without energy recovery. Other forms of energy recovery may become more commonplace in the future, for example energy recovery for transport fuel. In 2019, England sent approximately 29m tonnes of residual waste (excluding major mineral wastes) to landfill, energy recovery or incineration[10]. In the same year, approximately 3m tonnes of waste were sent for energy recovery overseas[11].

The target will be measured at endpoint treatment[12] and capture the treatments that are typically associated with residual waste. This includes waste that is sent to landfill, put through incineration (including energy from waste incineration), sent overseas for energy recovery or used in energy recovery for transport fuel. Other forms of energy recovery may become more commonplace in the future and the scope could be amended to capture these. Further discussion in the ‘Target Scope’ section.

Nevertheless, on the basis that some residual waste treatment will be required in the long-term, that is the optimal level is greater than zero, it is important to note the role of the waste hierarchy. It is environmentally less harmful for residual waste to be treated, for example, in efficient incinerators with energy recovery (that is with R1[13] accreditation status), than it is to be incinerated without energy recovery or sent to landfill. Government policy will continue to ensure remaining residual waste tonnages are treated in highly efficient incineration with energy recovery facilities, where possible.

[10] 2019 Waste Data Interrogator - data.gov.uk
[11] International Waste Shipments exported from England - data.gov.uk
[12] Endpoint treatment means the treatment, such as incineration or landfill, is the final point in the waste management chain.
[13] Incineration plants must have R1 status to be classed as energy recovery. Further details on conditions to be met here: https://www.gov.uk/guidance/waste-incinerator-plant-apply-for-ri-status

2. Rationale for intervention

The Environment Act requires government to set at least one long-term legally binding target in the area of resource efficiency and waste reduction. The rationale for intervention in this target area is that there exist multiple market failures (set out within the section below) which prevent a socially optimal outcome, and which contribute to our unsustainable use of resources and generation of waste. Legally binding targets ensure future government policy remains focused on tackling these market failures and delivering long-term environmental improvements. A target would also give clear market signals to provide businesses with certainty, allowing markets to develop and innovate.

All residual waste treatments, whether they result in material resources being burned or buried, lead to the loss of valuable materials to the economy. These waste treatments place greater demand on virgin materials than is necessary. Environmental impacts are embedded into material choices but are not widely incorporated into market prices.

Biodegradable waste sent to landfill breaks down anaerobically to produce methane, a potent greenhouse gas. In 2019, waste management (not including emissions from incineration including with energy recovery) accounted for 5% (16 MtCO2e) of England's territorial emissions and were largely emissions from landfill[14]. Landfills also generate leachate, which unless managed or treated properly can pollute soil and ground and surface water[15]. Landfill sites can also cause disbenefit to local residents, through their odour, visual disamenity and windblown material[16].

Though preferable to landfill, energy from waste treatment still has some environmental impacts. Optimising and reducing the amount of waste sent to incineration will reduce these impacts and support the circular economy principles. The visual disamenity of energy from waste plants is also recognised as an important issue to those that are located near plants[17]. Although plants may also be designed to provide benefits to local residents, such as through using heat offtake to heat homes.

2.1. Market failures

The conditions required for markets to achieve efficiency include:

- **well-defined property rights** – property rights refer to an organisation/individual theoretically/legally owning a resource.

[14] Department for Business, Energy and Industrial Strategy (2021) Greenhouse Gas Inventories for England, Scotland, Wales and Northern Ireland: 1990-2019

[15] https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/290387/scho0904bigd-e-e.pdf

[16] Yun-Ju Ham, David J.Maddison, Robert J.R.Elliott (2013) The valuation of landfill disamenities in Birmingham https://www.sciencedirect.com/science/article/abs/pii/S0921800912003680?via%3Dihub

[17] https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/284612/pb14130-energy-waste-201402.pdf

- **a full set of markets** – this means that where an individual demands a good, the market is able to supply the good.
- **the absence of externalities** – externalities refer to spill over impacts on a third party as a result of an activity.
- **perfect information** – perfect information would result in individuals making perfectly informed decisions. In contrast, imperfect information can result in misinformed decisions – for example, an individual does not know the true extent of the detrimental impact of disposing of waste sub optimally.

Key market failures undermining an improvement in England's resources and waste management system are listed below[18].

[18] http://randd.defra.gov.uk/Default.aspx?Menu=Menu&Module=More&Location=None&Completed=1&ProjectID=20074

Table 1: Market failures undermining an improvement in England's resources and waste management system

Market Failure	Example	How policies linked to a target could resolve this
Negative environmental externalities	Sub-optimal pollution to the natural environment due to environmental costs not being captured in current prices.	Policies implemented to achieve the target would ensure the parties that create the environmental cost are financially responsible for it.
Information failures	Insufficient information available for consumers on environmental impacts of their purchasing decisions.	Voluntary information campaigns or regulatory requirements (for example labelling) can be designed to improve consumer information of the environmental impacts when making a purchase.
Missing markets	Missing markets for recycled materials.	Regulatory interventions could include mechanisms to support supply and/or demand for recyclate and associated secondary materials. Or it could internalise the environmental cost of virgin material use.
Split incentives	Collection and treatment of wastes not fully accounted for in production decisions.	Future government policy such as extended producer responsibility can incentivise production decisions to account for full material lifecycle.

Market failures result in the economy delivering inefficient societal outcomes.

Though functioning relatively well to resolve scarcities on the source side which tends to be reflected in prices[19], in the context of market failure, markets frequently incentivise the over-consumption of resources and over-production of wastes[20]. This is because non-market costs to society (such as pollution and waste disposal costs) aren't factored into the prices of these materials. The market by itself rarely ensures that for the waste generated, the right amount is treated at each level of the waste hierarchy. The existence of market failures provide justification for government intervention to increase social welfare.

2.2. Transition failures

Even well-functioning, efficient markets are often blind to long-term societal goals and the socio-economic transformations required to achieve them[21]. Transitioning to a system of production and consumption which not only maximises market efficiency but is also better aligned to long-term environmental sustainability goals can be undermined by 'transition failures', with insufficient guidance and coordination preventing these from being realised. Overcoming transition failures is an important further justification for government intervention, and a key rationale for introducing long-term targets. Types of transition failures include:

[19] Resource prices rarely follow a path of gradual increase, and pre-empting supply shocks can be a justification for government intervention to avoid the impacts of this.

[20] https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/69500/pb13548-economic-principles-wr110613.pdf

[21] van Ewijk 2018, Resource efficiency and the circular economy: Concepts, economic benefits, barriers, and policies https://www.researchgate.net/publication/327868697_Resource_efficiency_and_the_circular_economy_Concepts_economic_benefits_barriers_and_policies

Table 2: Transition failures undermining an improvement in England's resources and waste management systems

Failure Type	Example	How a target would resolve this
Lack of direction	Lack of shared goal steering long-term transition.	A legally binding long-term target gives a clear signal to industry of the direction of future government policy. This will increase investor confidence and encourage industry to invest in infrastructure and research that will improve the circularity of the economy.
Lack of coordination	Failure to coordinate and include different actors across sectors and levels.	The target will be met by using a range of government policy levers. These levers could include regulation that puts in place rules and standards that producers must follow which will encourage all of industry to improve their products recyclability, repairability and reusability.
Support	A lack of popular backing or market demand.	Behaviour changes are important for long-term target delivery and mechanisms exist to help citizens make well-informed decisions and also encourage more sustainable production.

2.3. The potential role of the market and stakeholder-led change

If no long-term target was set some change in residual waste tonnages may still be expected.

In the absence of additional government regulation, opportunities for increased profits and managing risks may encourage businesses to improve their environmental performance. Cost advantages via eco-efficiencies and differentiation advantages through the sale of products with improved environmental performance in new markets, have the potential to improve businesses' bottom lines provided there exists sufficient consumer demand.

Businesses may try to improve their environmental performance to avoid risks to their returns[22]. Part of this can involve trying to maintain practices in line with what is viewed as acceptable in contexts in which they operate, or competitors.

Actors external to businesses can contribute to improved environmental performance in the absence of government regulation. Poor environmental performance may lead consumers to avoid products or actively boycott businesses, as long as such information is publicly available. Investors may be less likely to provide support to firms viewed as irresponsible. Risks such as these may have grown in recent years in the context of the non-profit sector encouraging shareholder action and sustainability ratings agencies reducing information asymmetries. Government continues to encourage firms to improve their environmental performance, such as through the proposals set out in the Green Finance Strategy[23].

There are examples of firms and sectors improving their resource and waste-related performance in England without the direct pressure of regulation. Supermarkets such as Sainsbury's and Tesco have introduced flexible plastics recycling points in their stores to allow for recycling of packaging that is not possible at kerbside collection. Other examples include major supermarkets' recent commitment to halve the environmental impact of a food shop by 2030[24], the Sustainable Clothing Action Plan[25] and The UK Plastics Pact[26]. These initiatives would likely support some progress in reducing residual waste, without further policies. Nevertheless, there are limits to the level of improvement which might be expected in the absence of government intervention.

While cost savings for businesses through waste prevention (for example improving resource efficiency) have been shown to be potentially high, there exist higher internal hurdles for environmental investments than other forms of investment [27]. Bounded rationality[28] can lock businesses and consumers into certain ways of thinking and doing.

[22] These risks can occur on the supply side, such as those linked to climate change, or on the demand side, such as loss of markets.
[23] BEIS Green Finance Strategy July 2019 (publishing.service.gov.uk)
[24] https://www.bbc.co.uk/news/uk-59184278
[25] https://wrap.org.uk/taking-action/textiles/initiatives/scap-2020
[26] https://wrap.org.uk/taking-action/plastic-packaging/the-uk-plastics-pact
[27] WRAP (Waste and Resources Action Programme) (2019) identified major barriers to small and medium-sized enterprises (SMEs) adoption of resource efficiency – capability (where SMEs do not have the knowledge, understanding and skills to adopt resource efficiency measures), and capacity (where SMEs do not have the time and resources to implement these actions).
[28] Bounded rationality reflects that individual rationality and problem solving is limited by cognitive biases. An example is the availability heuristic, where disproportionate attention is paid to information which is readily available or especially salient. Another is loss aversion, which sees greater weight placed on losses as opposed to gains.

There has been shown to be a limited willingness of consumers to pay a premium for, or switch to, products with superior environmental performance.

A voluntary or non-regulatory approach would not work to deliver policy objectives and the level of change needed, due to the market failures identified above, such as negative environmental externalities and information failures. These initiatives can bring some forward-thinking industry leaders together and help to gather momentum towards reducing waste. But voluntary initiatives, by their nature, will not lead to the economy-wide changes required to reduce residual waste at the rate that regulatory measures can achieve. Coordinated voluntary action can however help to identify the most effective ways in which regulation can be set to deliver policy objectives.

3. Target Baseline

This is a forecast of residual waste levels, assuming no future policies.

Step 1: Forecast waste arisings (in the Future Waste Arisings Project)

The Future Waste Arisings project[29] was designed with input from our Resources and Waste Targets Expert Group[30] and commissioned by Defra to forecast total waste generation figures in a range of different waste streams through to 2050. These waste streams include waste from households, commercial and industrial waste, and construction, demolition and excavation waste. The project models municipal waste as the total of waste from households plus non-household municipal waste. Waste from households (WfH) consists of waste collected kerbside from households and other premises similar to households such as household waste recycling centres (HWRCs) and bring banks. Non-household municipal waste (NHM) consists of household-like waste from other sources, typically commercial.

The drivers used to forecast WfH generation figures in the model were:

- Historic WfH tonnages obtained through WasteDataFlow[31], a web-based system used by local authorities to report their waste arisings and management to government;
- Gross Disposable Household Income (GDHI) based on historic GDHI figures published by the Office for National Statistics (ONS)[32];
- Index of Multiple Deprivation (IMD) based on figures released by the Department for Levelling Up, Housing and Communities[33];
- Population based on local authority population projections published by ONS[34].

The drivers used to forecast NHM generation figures in the model were:

- Historic NHM tonnages were obtained by restricting waste tonnages captured in Defra's Commercial and Industrial (C&I) methodology[35], according to an agreed list of European Waste Catalogue (EWC) codes;

[29] Future Waste Arisings - Defra, UK - Science Search
[30] This is a group of external experts who provide independent technical advice. Resources and Waste Targets Expert Group - GOV.UK (www.gov.uk)
[31] WasteDataFlow Waste Management
[32] Regional gross disposable household income: local authorities by ITL1 region - Office for National Statistics (ons.gov.uk)
[33] https://www.gov.uk/government/statistics/english-indices-of-deprivation-2019
[34] Estimates of the population for the UK, England and Wales, Scotland and Northern Ireland
[35] Commercial and Industrial Waste Arisings Methodology RevisionsFeb2018 contact details update.pdf (publishing.service.gov.uk)

- Sector-specific Gross Value Added (GVA)[36].

The drivers used to forecast C&I generation figures in the model were:

- Defra published figures on C&I waste arisings[37];
- Sector-specific GVA[38].

Step 2: Forecast residual waste (applying recycling and non-residual treatment rates to the waste arisings)

The models above form the basis of our residual waste baseline. In order to convert the generation forecast (which includes both residual waste and that collected for recycling or reuse) into a forecast of residual waste alone, either a predicted recycling rate or a predicted "non-residual treatment" rate was applied to the arisings forecasts. The "non-residual treatment rate" captures all waste sent to end-of-life treatment that is not landfill and incineration in England, sent overseas for energy recovery, or used as energy recovery in transport fuel. This can include, for example, recycling, reuse, other recovery (not including energy from waste incineration), or process loss. Process loss is the difference between the tonnage entering a facility and the tonnage that leaves a facility, which can occur through moisture loss or as a result of industrial processing.

As the generation forecast provides a waste generation estimate for England, there is no need to further account for the amendments to include waste originating in England that is sent to the DAs, or exclude waste originating in the DAs that is sent to England for treatment in the modelling.

Whether waste streams use recycling or non-residual treatment rates:

For WfH, projected recycling rates were used as these were shown to be a good predictor of residual tonnages when applied to the historic data (that is, the vast majority of WfH was either recycled or sent to residual treatment). For the C&I data, estimated recycling rates do not provide a good predictor of tonnages at residual treatment. This is due to larger tonnages of waste being treated at recovery facilities and complexities in the available C&I data, which mean that process losses and data limitations also need to be accounted for when converting from waste arisings. Predicted rates of non-residual treatment based upon the historic data were therefore applied to the C&I projections. The C&I data was split out into NHM waste and non-municipal solid waste (non-MSW) from the C&I sector, to enable us to model policies that only target municipal waste.

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36 https://www.ons.gov.uk/economy/grossvalueaddedgva/datasets/nominalandrealregionalgrossvalueaddedbalancedbyindustry

37 https://www.gov.uk/government/statistics/uk-waste-data

38 https://www.ons.gov.uk/economy/grossvalueaddedgva/datasets/nominalandrealregionalgrossvalueaddedbalancedbyindustry

The recycling or non-residual treatment rates used per stream (with forecasts):

For WfH, the recycling rate is kept flat from the 2019 rate at 45.5% in the absence of any further policy intervention. This is consistent with historic data, where the WfH recycling rate (including metals reclaimed/recycled from incinerator bottom ash) has remained within 1.5 percentage points of this rate since 2015[39]. WfH recycling rates that include metals reclaimed/recycled from incinerator bottom ash have been used to remain consistent with our target scope. For NHM, the non-residual treatment rate is kept flat from the 2019 rate at 53.1% across all years, in the absence of any further policy interventions. This is consistent with historic data, where the NHM non-residual treatment rate estimates have remained steady at around 53.0% to 53.3% since 2016. Finally, for non-MSW C&I, the non-residual treatment rate is kept flat from the 2019 estimated rate at 65.5% across all years. This method was chosen for forecasting the non-residual treatment rate as the rate fluctuates between 55.3% and 73.5% from 2011. As such, a linear projection was not found to provide a sensible prediction for non-MSW C&I. Therefore, the non-residual treatment rate was chosen to be kept flat in the absence of further policy interventions.

Non-WfH, non-C&I, non-major mineral residual waste (with forecasts):

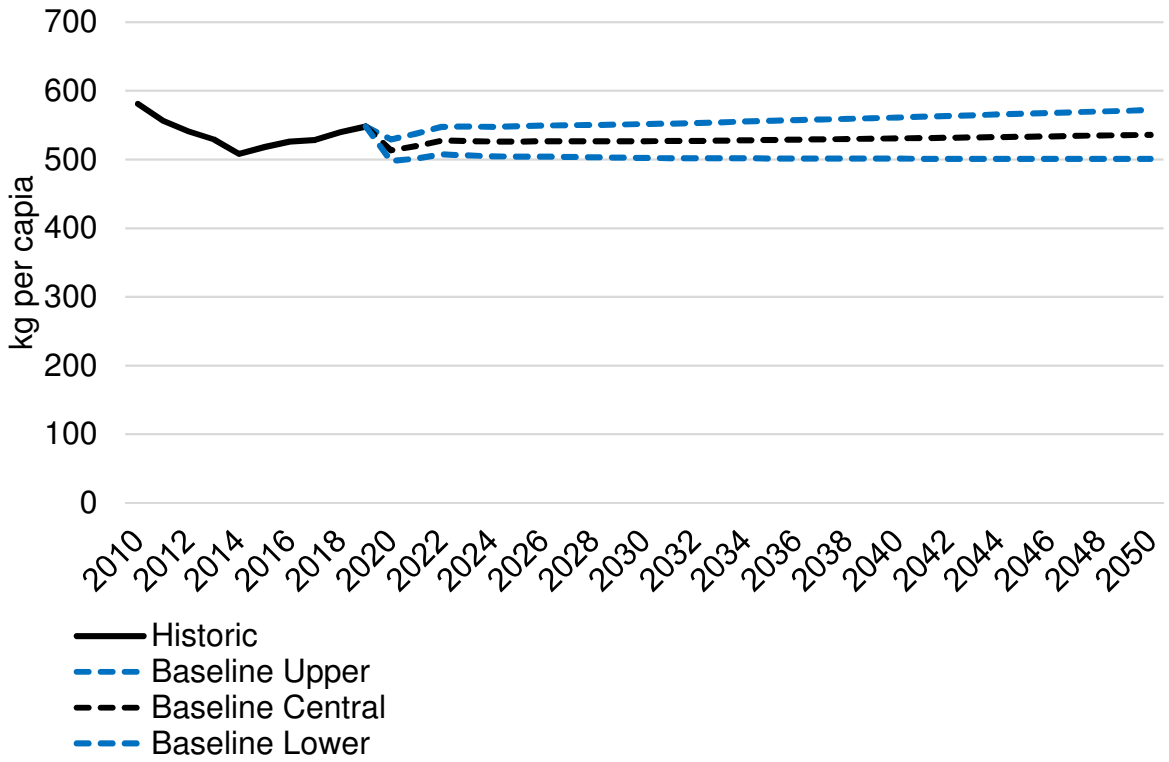
For the scope of all waste excluding major mineral wastes, some non-WfH, non-C&I, non-major mineral waste tonnages also need to be captured, which are defined by a set of EWC codes at residual waste treatment, and includes materials such as sorting residues, wood, metals, slurry and manure, and animal, vegetal and food waste. These EWC codes were broken down into separate waste streams (construction, demolition and excavation, and agriculture, forestry and fishing). Forecasts of residual tonnages for these EWC codes were then produced using projections of individual sector GVAs, along with the historic relationship between residual waste and GVA, which aligns with the approach used for non-household municipal waste arisings in the Future Waste Arisings project.

The resulting baseline is shown in Figure 2.

Figure 2: Baseline residual waste excl. major mineral waste projections up to 2050[40]

[39] ENV23 – UK statistics on waste https://www.gov.uk/government/statistical-data-sets/env23-uk-waste-data-and-management

[40] England WfH recycling rates including metals reclaimed/recycled from incinerator bottom ash are available from 2015 onwards and are included in this baseline. These recycling rates are not available in earlier years, therefore the WfH recycling rates used before 2015 exclude metals reclaimed/recycled from incinerator bottom ash.



In the central baseline scenario, residual waste excluding major mineral waste is projected to decrease slightly in kg per capita over 2019-2042/2050. There is an initial fall in residual waste tonnages around 2020 due to the impact from Covid-19 on the projected economic drivers used to forecast waste arisings in our modelling, such as GDHI and sector-specific GVAs. As a result of this fall, despite a steady slow rise in residual waste in kg per capita after 2020, the 2042/2050 values remain slightly below the 2019 starting figure. The slow rise in residual waste in kg per capita reflects the long-term forecasts of modelling inputs such as GDHI and GVA, which result in a greater increase in residual waste arising tonnes than population to 2042/50. Residual waste excluding major mineral wastes falls from the 2019 figure of 548 kg per capita to 532 kg per capita in 2042, the target end-year, and to 536 kg per capita in 2050. It is projected to rise in the upper baseline scenario, reaching approximately 563 kg per capita in 2042 (572 kg per capita in 2050), and decrease in the lower baseline scenario to 501 kg per capita in 2042 (501 kg per capita in 2050).

4. Accounting for future known policies (Collection and Packaging Reforms)

Future known policies are defined as those which have been consulted on but will not be in force when the target is set into legislation. The relevant policies here are the Collection and Packaging Reforms (CPR).

The reforms are made up of:

Consistent municipal recycling collections (consistent collections) in England:

Local authorities will be mandated to collect a consistent set of dry recyclable waste streams from households across all localities in England, a garden waste collection and a weekly separate food waste collection. Non-household organisations that produce household waste or waste that is similar in nature and composition to household waste, (for example schools, businesses, offices) will also be required to arrange for the separate collection of the same set of recyclable waste streams (except for garden waste) for recycling or composting and to present the waste in accordance with any arrangements. The improved material segregation and consistent approach to waste collection across England will help to make it easier for households, businesses and public organisations to recycle, driving up recycling rates beyond current levels.

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

A DRS will require consumers to pay a deposit on each drink containers at the point of purchase, which they can redeem when they return their container to a designated return point where the material will be collected for recycling. The deposit acts as a financial incentive to encourage consumers to return their drinks containers into the scheme so they can receive the deposit back, whilst enabling us to increase the collection and recycling rates of drinks containers. The DRS will improve the quantity and quality of this recycled material and significantly reduce the number of littered drinks containers in the environment.

Reforming the packaging producer responsibility system in the United Kingdom:

Extended producer responsibility for packaging proposals requires obligated producers to become responsible for the cost of managing the packaging they place on the market, net of any revenues obtained from recycling. It is proposed these payments will be facilitated via a modulated fee system that incentivises obligated producers to use less packaging or where it is necessary for it to be recyclable. Under a modulated fee system, the fees paid will vary according to specific criteria relating to aspects of the packaging's treatment cost,

including environmental impact. Modulated fees should incentivise recyclability of packaging by rewarding good design and penalising poor design.

4.1. Modelling the impact of collection and packaging reforms on residual waste arisings

The potential impacts of the planned collection and packaging reforms as described above have been modelled against our baseline. The details of the reforms are subject to final government decisions – whilst the extended producer responsibility for packaging final impact assessment was published in March 2022[41], consistent collections and deposit return scheme final impact assessments are yet to be published.

The approach taken was to apply the potential impacts of the collection and packaging reforms to both waste from household and non-household municipal (NHM) waste streams (based on central modelling[42]). This was done by applying the potential impact on the waste from household and non-household municipal recycling rates to our model. The scenario that was utilised assumes the waste from households recycling rate increases from 46% in 2019[43] to 52% by 2035, whereas the non-household municipal recycling rate increases from 40% in 2019 to 60% by 2035. For non-household municipal waste, a further 13% recovery rate[44] is added on top of the recycling rate to arrive at an assumed non-residual rate (53% in 2019 and then 73% in 2035).

In the CPR impacts scenario that have been used, an 80% capture rate of recyclate is assumed, determined following engagement with industry experts, which has been applied to the total non-household municipal recycled tonnage[45]. This is as opposed to a 100% capture rate, which would assume that all businesses correctly recycle all material all of the time. An assumption that 15% of all non-household municipal recycling is lost in the sorting stage is also made, determined following engagement with industry experts. These assumptions produce a more conservative estimate of impacts that allows for human error and ongoing behavioural change.

With current modelling, CPR is estimated to reduce residual waste excl. MMW (kg per capita) by 26% by 2042 relative to 2019 figures (from 548 kg per capita in 2019 to 408 kg per capita in 2042). In absolute tonnage terms, this is a reduction from 31m tonnes in 2019 to 25m tonnes in 2042[46]. By 2050, CPR may reduce residual waste excl. MMW (kg per capita) by 26% relative to 2019 figures (again reduced from 548 kg per capita to 408 kg

[41] Impact Assessment (publishing.service.gov.uk)
[42] Utilising an assumed central capture rate of 80%. Low and high scenarios utilised a 70% and 90% capture rate respectively.
[43] ENV23 - UK statistics on waste - GOV.UK (www.gov.uk)
[44] 13.1 percentage points. Any discrepancies in summed figures are due to rounding.
[45] Applied to WRAP projections of NHM material recycled tonnages (the amount of NHM waste that WRAP suggests would be recycled in a given year). An 80% capture rate is applied, reducing the initial material recycled tonnage to 80% of its start value. This then feeds into recycling rate estimates (where recycling rate is calculated as recycled tonnage over total waste arisings).
[46] Absolute tonnage sees a lower percentage reduction than per capita as per capita accounts for population growth.

per capita in 2050). In absolute tonnage terms, this would be a reduction from 31m tonnes to 26m tonnes in 2050.

4.2. Costs and benefits of the collection and packaging reforms

Consultation for CPR has taken place, with the reforms having their own supporting economic assessment. Therefore, the costs and benefits of these reforms are not included within this impact assessment, as these are captured within the reforms' own published impact assessments and to include them here would be double counting. The final stage impact assessment for extended producer responsibility was published in March 2022[47]. The latest published impact assessments for consistent collections[48] and a deposit return scheme[49] are consultation stage and the analysis will be updated for their final stage assessments.

[47] Impact Assessment (publishing.service.gov.uk)
[48] Impact Assessment (defra.gov.uk)
[49] Impact assessment: Introducing a Deposit Return Scheme on beverage containers (defra.gov.uk)

5. Options Considered & Preferred Option

5.1. Options considered

Failure to set a target is not a credible option. Not setting a target would put the Secretary of State in breach of the legal requirement in the Environment Act to set a target within the area of resource efficiency and waste reduction. As outlined in the 'Rationale for Intervention' section, a non-regulatory approach would not work to deliver policy objectives.

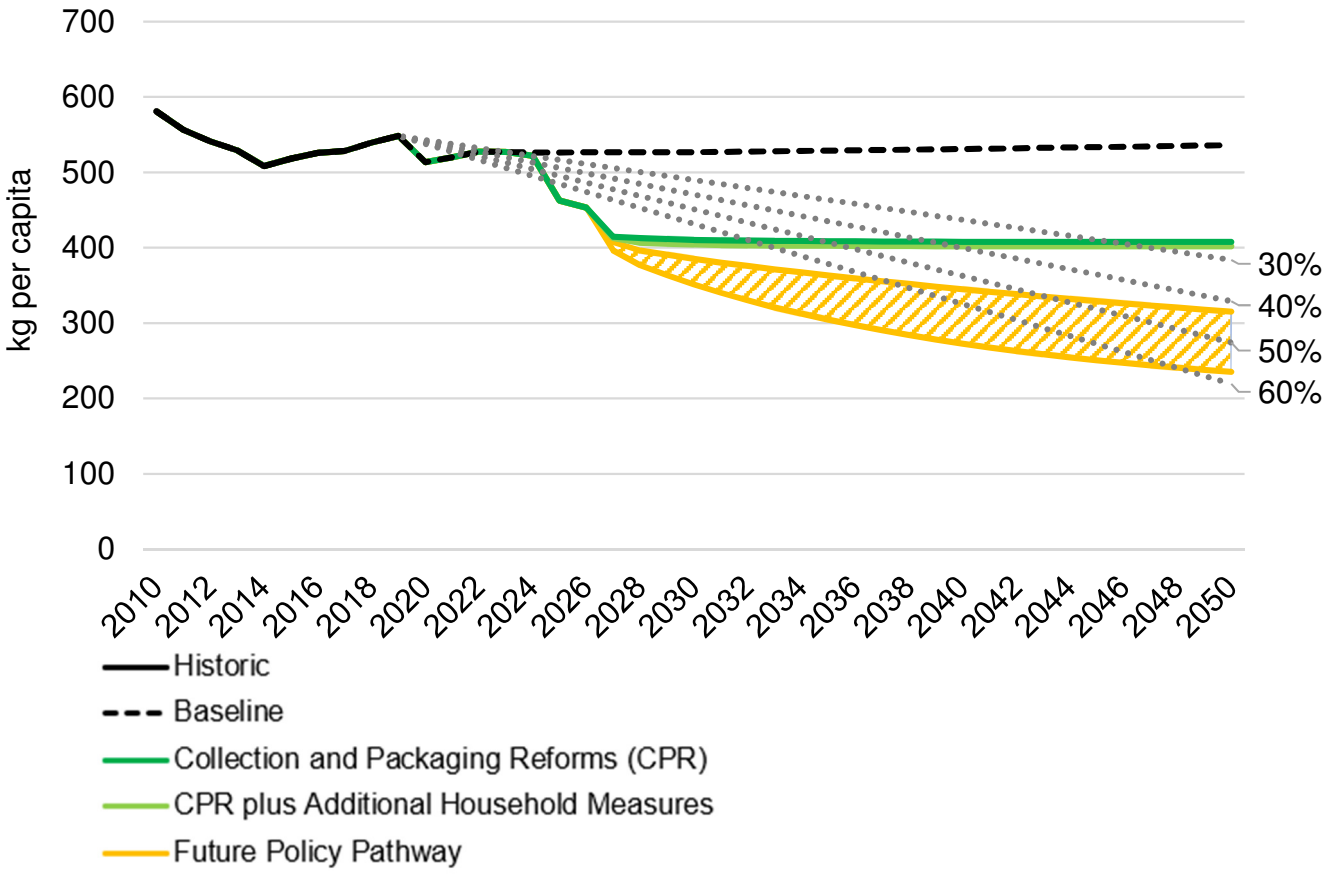
Wider options considered for the area and scope of the target are discussed within the 'Target Scope' section. Included below is a discussion of the options considered for the ambition level of the target, within the given scope.

Target scenarios are where a target is introduced to reduce residual waste. These scenarios assume that the government will intervene in the market through government policy to reach the set target. The target scenarios are compared to the baseline to display the potential impacts of a target in residual waste reduction. Based on the market and transition failures identified, there is a rationale for intervening.

A target to reduce residual waste will reduce greenhouse gas emissions from residual waste treatments, which contribute to climate change, contributing towards the government's net zero goal. The target will also help to preserve our stock of material resources. The future policies implemented to reach the target will also have specific environmental benefits and many policies that reduce the level of residual waste result in reduced carbon emissions over the lifecycle of products (extraction, production, end of life).

Our method for modelling the impact of illustrative future policies on residual waste levels is outlined in later sections. The results of this modelling are shown in Figure 3 below. The future policy pathway gives a range of residual waste levels in a given year, shown by the yellow shaded area. This range stems from different levels of difficulty in removing waste from residual treatment and different levels of effectiveness of the intervention (method outlined in the 'Illustrative future pathway to reach the target' section), to reflect the large amount of uncertainty around the impact of future policies.

Figure 3: Residual waste excl. major mineral waste after potential future policies, up to 2050



This range shows the level of waste reduction that may be possible from future policies, and therefore what may be deemed as a suitable target ambition level. This pathway assumes further policy intervention from 2027 to 2050. Table 3 below outlines numerically the feasible target range for each year between 2042 and 2050, in terms of a % reduction in residual waste compared to 2019 levels. This table in effect shows our long list of policy options.

Table 3: Feasible target range (% reduction in residual waste excluding MMW compared to 2019 levels)

Target deadline	2042	2043	2044	2045	2046	2047	2048	2049	2050
Feasible target range	38% to 52%	39% to 53%	39% to 54%	40% to 54%	41% to 55%	41% to 56%	42% to 56%	42% to 57%	43% to 57%

This policy long list was then narrowed down to two fundamental choices of a 50% reduction by 2042 and a 50% reduction by 2050. This provided a nearer-term and longer-term target deadline, whilst holding the reduction in waste relative to 2019 levels constant to reflect two distinct levels of ambition.

5.2. Preferred option

The preferred option is Option 1: Legally binding Environment Act target to reduce residual waste excluding Major Mineral Waste (MMW) by 50% by 2042 from 2019 levels.

Our modelling suggests that a 50% reduction by 2042 is highly ambitious but achievable. Figure 4 below highlights that the modelled indicative policy pathway reaches beyond a 50% reduction by 2042, under its higher impact scenario assumptions.

A 2050 deadline for the 50% reduction would be a lower risk option but, given that 50% is within the feasible target range for 2042, the target deadline is to be set at the earlier date of 2042 to drive environmental improvements as soon as possible.

Our modelling of existing ambitions and strategies, as outlined later in the impact assessment, provides further evidence that the ambition level is sensible.

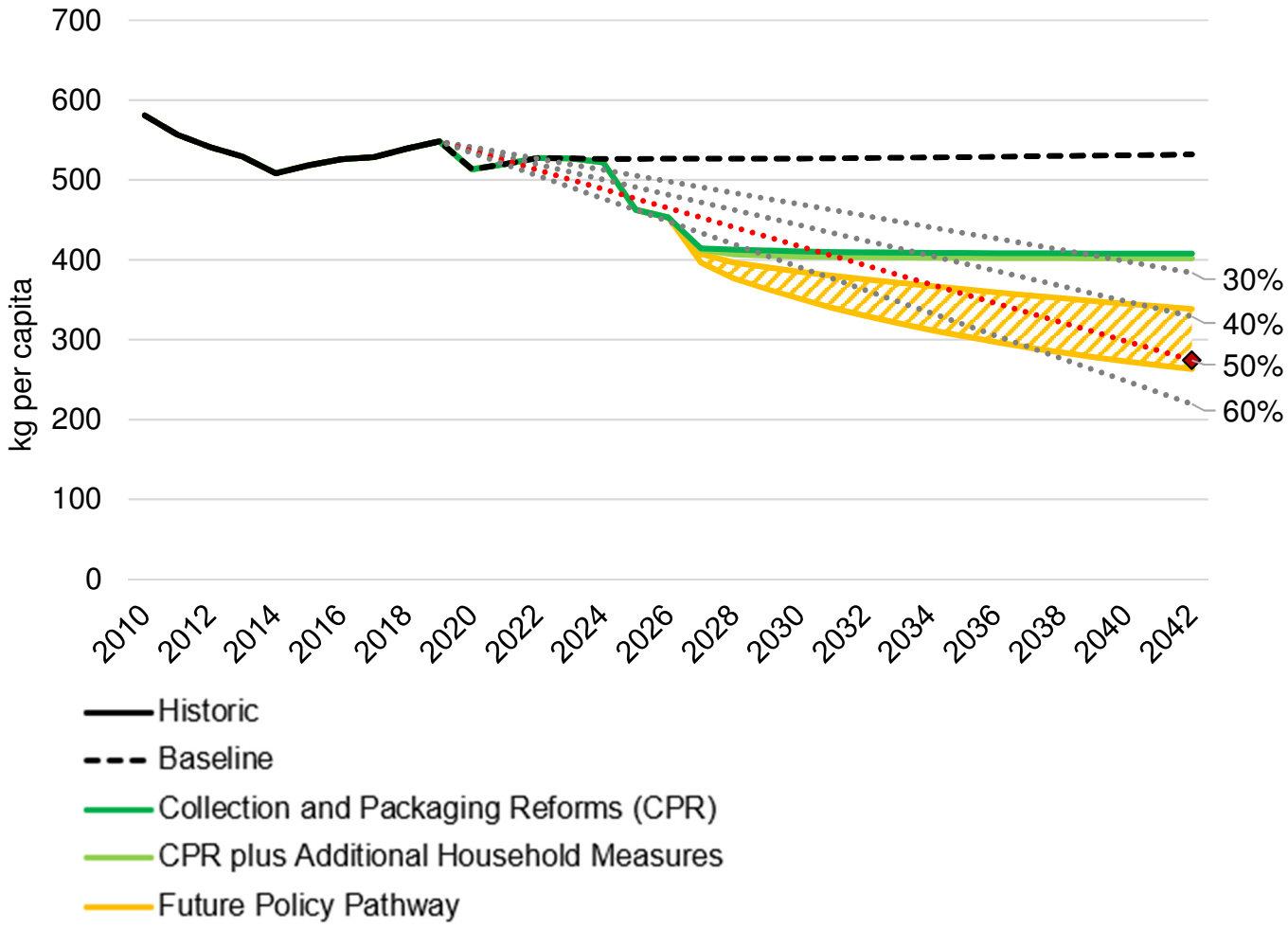
Our modelling approach and target ambition level have been approved by our Resources and Waste Target Expert Group.

2042 and 2050 target deadlines are broadly similar in terms of the types of costs and benefits that may arise from policies implemented to achieve the target. The options derive from the same modelled policy pathway, which allows assessment of their relative risks and achievability. This also means that the modelled costs and benefits for the options, which stem from the policy pathway, are the same[50]. It is for this reason that a 2042 deadline has not been included as an official 'Option 2' within this impact assessment.

In reality, the target ambition level will influence the timing and urgency of the future policies set. A 2042 deadline is likely to bring about both costs and benefits sooner than a 2050 deadline. This includes the direct benefits from reduced residual waste as well as secondary benefits to the environment, government, businesses, and consumers resulting the policies implemented to achieve the target. A 2050 target deadline would allow businesses more time to adapt, potentially lowering some costs. However, the high benefit to cost ratio of the future policy pathway means that it is preferable for future policies to be brought in sooner rather than later, in terms of Net Present Value. The costs and benefits of the target are discussed further within the 'Summary of costs and benefits' section and other subsequent sections of the impact assessment.

[50] For the modelling of the feasibility of a 2050 target deadline, the same policy pathway as for a 2042 target is extended to 2050. This demonstrates that a 50% reduction could be met with more certainty by 2050. Costs and benefits for the 2042 target assume the price-based policy is implemented up to 2042, at which point a 50% reduction is within the feasible target range. At this point, with the target met, the price increases would stop, regardless of the target deadline. Therefore, the 2050 deadline is quantitatively modelled to have the same costs and benefits as the 2042 deadline. A separate policy pathway assuming a 2050 target date with later/lower intervention policies has not been modelled at this stage.

Figure 4: Comparison of the target of 50% reduction in residual waste excl. major mineral waste by 2042 with the impact of potential future policies



6. Outline of analysis of potential future policies

This impact assessment does not seek to predict what specific policies will be delivered in the future which contribute towards meeting the target. Specific policy proposals will be the subject of future consultations where economic impacts will be assessed individually. Beyond CPR, all potential policies referred to in this document should be considered as illustrative and simply identified as areas that could deliver progress against the target.

The cost estimates within this impact assessment have been estimated using indicative future policies that demonstrate how the target could be met. Quantitative analysis of uncertain future policies focuses mainly on price-based levers, as these can be most appropriately modelled. This outlined policy pathway is useful to assess the achievability of the target and where costs from future policies may lie**.** The exact make-up of future policies will likely be a combination of interventions.

An outline of the analysis of potential future policies which follows in the subsequent sections, is shown below.

Collection and packaging reforms plus additional household measures

- Illustrative policy pathway, including additional household measures which are enabled by the investments made within CPR. This includes further expansion of kerbside collections and policies to divert organics from residual waste.
- Quantified impacts on residual waste arisings have been modelled – these reforms are modelled to only have a small impact on waste levels. This is shown by the light green line in Figures 3 and 4, just below the dark green line representing CPR.
- Quantified costs of the potential policies are included where possible, taken from Waste and Resources Action Programme (WRAP)[51] modelling for Defra.

Illustrative future pathway to reach the target

- Illustrative policy pathway, focusing on price-based levers, as these can be most appropriately modelled.
- Quantified impacts on residual waste arisings have been modelled. The uncertainty around these potential impacts is shown by the shaded area between the two yellow lines in Figures 3 and 4.
- This section of the impact assessment includes discussion of how the modelled pathway has informed the ambition level.
- Illustrative analysis on the potential costs and benefits from the pathway has been included.

[51] WRAP unpublished modelling of additional household measures, carried out for Defra in 2021; https://wrap.org.uk/. To note that the modelling does not include any additional policies than those stated in the main text (described in section 8.1).

Possible additional policy levers to reduce residual waste

- Discussion of the broad lever types that could be used to progress towards the target.
- Qualitative discussion of the potential costs and benefits from these lever types has been included.
- These policy levers represent the different options that could be utilised to induce the reduction in waste shown by the yellow shaded area in Figures 3 and 4.

Also analysed within this impact assessment:

Existing ambitions and strategies

- Modelling of how wider government ambitions and strategies might impact residual waste arisings if they are met.
- This provides a sense check to the modelling of potential policy pathways and the ambition level set, adding supporting evidence that the proposal is suitable.

7. Summary of costs and benefits

The level of detail and quantification provided for the potential costs and benefits of policy pathways within this impact assessment is varied, with less detail for more theoretical policies.

For the modelled **additional household measures**, quantified costs from WRAP modelling have been included. The measures are modelled to reduce service costs by around £53m per year, with minimal up-front costs. The policies designed to divert organics from residual waste may also result in some voluntary costs for consumers, such as the purchasing of home composting bins.

The **illustrative future pathway**, using price-based policies as an example, includes illustrative analysis to give an idea of the scale of associated costs and benefits. A future policy pathway would likely be a combination of interventions, and the impact on costs and benefits may vary greatly depending on the policies implemented. The illustrative analysis estimates total carbon savings from the policy pathway to be £608m per year by 2042. The illustrative analysis estimates the future policy pathway to increase total costs to society by £446m per year by 2042. The illustrative future pathway, including the additional household measures, is estimated to result in total present value costs of £4,185m, total present value benefits of £7,342m and a Net Present Value of £3,157m, over the appraisal period of 2022-2050.

For **broad lever types** that may be used to reduce residual waste in the future, a qualitative description of the costs and benefits that may arise is included. Depending on the policies implemented, government, businesses and consumers may see increased costs. However, aside from reducing residual waste and the associated benefits, there are a wide range of secondary benefits that may arise from future policies implemented to reduce residual waste.

The types of costs and benefits that may arise from future policies implemented to reach the target are discussed in more detail in the 'Possible additional policy levers to reduce residual waste' section and are summarised below:

Benefits to businesses:

- Stimulation of secondary material market either by driving secondary material price down or internalising environmental costs into virgin materials
- Increased circularity of resources leading to decreased producer costs
- Greater certainty in future policies, encouraging investment

Costs to businesses:

- Increased costs to resource intensive producers
- Infrastructure – opportunity cost
- Reduced income from energy output to the grid
- Reduced RDF income

- Potential disruption of the economics of landfill/incineration sites
- Reduced gate fee income for residual waste operators and exporters

Benefits to government/local authorities:

- Reduced waste management costs as waste is prevented or recycled instead of going to more expensive residual waste treatments

Costs to government/local authorities:

- Costs to local authorities (and waste collection businesses) of upgrading vehicle fleet and bins and potential information campaigns
- Increased transport costs and emissions because of more segregated waste

Environmental benefits:

- Reduced GHG emissions from landfill/incineration/RDF
- Increase in recycling

Environmental costs:

- Potential for increased ammonia emissions from anaerobic digestion

Benefits to wider society:

- Reduced disamenity costs of landfill and incineration
- Increased jobs in reprocessing and repair sectors

8. Collection and packaging reforms plus additional household measures

8.1. Modelling impact of collection and packaging reforms plus additional household measures on residual waste arisings

On top of the potential impacts of CPR, an illustrative potential policy pathway has been modelled that includes additional household measures which could contribute towards progress to meeting a target to reduce residual waste. These additional household measures are not prescriptive, and only demonstrate one possible future pathway towards achieving the target. As outlined below, these additional measures are modelled to make only small further progress against the target, on top of CPR.

The additional household measures modelled were primarily regulatory levers, including an expanded kerbside waste collection service beyond the consistent recycling requirements. This includes implementation of policies targeted at waste electricals and electronic equipment, batteries, and textiles. General policies to divert organics from residual waste were also modelled.

Based on quantitative modelling carried out by WRAP, it is estimated that these household measures could divert an additional 370k tonnes of waste from the household residual waste stream every year[52]. These tonnages are expected to be additional because they are targeted at waste streams not covered in the consistency requirements. It is expected these additional household measures, when added to the impacts of CPR, to reduce residual waste excluding MMW (kg per capita) by 27% by 2042 relative to 2019 figures (from 548 kg per capita in 2019 to 402 kg per capita in 2042). In absolute tonnage terms, this would be a reduction from 31m tonnes in 2019 to 25m tonnes in 2042. By 2050, CPR plus additional household measures may reduce residual waste excluding MMW (kg per capita) 27% relative to 2019 figures (to 402 kg per capita in 2050). In absolute tonnage terms, this is a reduction to 25m tonnes in 2050.

The Government believes it is important that local authorities continue to support comprehensive and frequent rubbish and recycling collections to households. The Government's consistent collection proposals have included consulting on expanding food waste collections, supporting garden waste collections, and introducing a minimum collective frequency for residual waste. Such reforms would help ensure households continue to have access to a comprehensive and frequent service, whilst improving environmental outcomes.

[52] WRAP unpublished modelling of additional household measures, carried out for Defra in 2021; https://wrap.org.uk/. To note that the modelling does not include any additional policies than those stated in the main text (described in section 8.1).

8.2. Potential costs and savings from additional household measures

The upfront investment costs required for the modelled additional household measures will have already been made through the CPR reforms. With the collection services in place, further smaller interventions to drive down residual waste will be possible with low or minimal upfront cost to government.

Based on quantitative modelling carried out by WRAP, the modelled additional household measures are estimated to save government around £53m per year in service costs[53]. The policies designed to divert organics from residual waste may result in voluntary costs for consumers, for example from purchasing home composting bins.

[53] WRAP unpublished modelling of additional household measures, carried out for Defra in 2021; https://wrap.org.uk/. To note that the modelling does not include any additional policies other than those stated in the main text (described in section 8.1).

9. Illustrative future pathway to reach the target

9.1. Modelling impact of illustrative future pathway on residual waste arisings

It is very challenging to model potential future policy pathways in the long-term as future policies are highly uncertain and will be the decisions of future governments. Following the foundations laid by the CPR reforms, with additional collection services in place, there will be several possible options to try to divert waste from residual waste treatment. The range of potential options are discussed further within the next section of this impact assessment: Possible additional policy levers to reduce residual waste.

The impacts of a potential future policy pathway have been modelled where it is assumed that suitable policies are implemented to drive improved recycling processes and behaviours between 2027 and 2042/2050. The following quantitative analysis of future policies focuses on price-based levers because these can be most appropriately modelled. This outlined policy pathway is purely illustrative[54] and is useful when considering the achievability of the target and where costs from future policies may lie. The exact make-up of future policy pathways will likely be a combination of interventions and may or may not include price-based levers.

The modelling is based on assessing the historic impact of price-based levers on reducing waste to landfill and considering a range of assumptions around what level of reduction that might be expected to be possible when applied more broadly across all residual waste tonnages.

The historic rate of decrease in waste sent to landfill between 2008 and 2014 is calculated, when policies included:

- increased year-on-year rises in Landfill Tax (a rise of approximately £8 per tonne per year for standard rate);
- some requirements for separate collection of recyclates;
- government support for infrastructure investment in the form of the Waste Infrastructure Development Programme.

This relationship is taken as an indication of the rate at which residual waste can be diverted into another treatment stream when under the same level of pressure as exerted by historic waste policies.

[54] The modelling on price-based policies is illustrative and the policy pathway is theoretical. It does not represent government policy. Ongoing work around price-based levers includes the Landfill Tax Review. The call for evidence which closed on February 22nd can be found here: https://www.gov.uk/government/consultations/landfill-tax-review-call-for-evidence

Our modelling makes a series of assumptions:

1. The reduction is only applied to tonnages that are deemed to be “avoidable”. This was determined by applying published definitions of “readily recyclable”, and “potentially recyclable” from the Resources and Waste Strategy Monitoring Progress Report[55] to historic residual waste composition data. The impact of the Collection and Packaging Reforms on residual waste composition was taken into account before determining the “avoidable” tonnages. For further information on these definitions, see the ’Existing ambitions and strategies’ section.
2. It is then assumed that the level of reduction in the tonnages of avoidable residual waste (calculated in step 1) over the modelled time period is between half and the full level of landfill reduction seen between 2008 and 2014. Therefore, it is modelled that the residual waste tonnages experience between half and the full level of pressure to divert from residual waste treatment as seen in this historic time-period. This can account for the fact that there will always be some waste for which residual treatment is the most appropriate option, and that some materials are more difficult to recycle than others, and so reducing residual waste tonnages becomes more challenging as more progress is made. The chosen range of half to full level of pressure was determined using policy judgement and approved by experts.
3. The level of reduction in residual waste is further reduced by another 25-50% to acknowledge that removing recyclates from residual streams requires greater process and/or behavioural changes than simply shifting residual waste from landfill to incineration or energy recovery. This is termed the “effectiveness”.

Our modelling approach and assumptions have been approved by the Resources and Waste Target Expert Group, who felt that the methodology stood up to scrutiny and agreed that a lower rate of change than was seen historically at landfill would be expected.

This gives a range of potential scenarios, with the modelled impact range indicated by the yellow shading in Figures 5 and 6 below.

In the lower impact scenario modelled, it is assumed that only half the rate of the historic landfill reduction is possible, and that introduced policies are only 50% as effective in driving progress (that is a further 50% reduction in the rate of decrease). In this scenario, residual waste excluding major mineral waste is projected to decrease to 338 kg per capita by 2042, a 38% reduction on the 2019 levels. By 2050, this decreases to 315 kg per capita, a 43% reduction on the 2019 levels.

In the higher impact scenario modelled, it is assumed that the same rate of reduction of the historic landfill reduction is possible, and that introduced policies are 75% as effective in achieving this (that is a 25% reduction is applied to the rate of decrease). In this scenario, residual waste excluding major mineral waste is projected to decrease to 263 kg

[55] Resources and waste strategy for England: monitoring and evaluation - GOV.UK (www.gov.uk)

per capita by 2042, a 52% reduction on the 2019 levels. By 2050, this decreases to 235 kg per capita, a 57% reduction on the 2019 levels.

Figure 5: Residual waste excl. major mineral waste after potential future policies, up to 2042

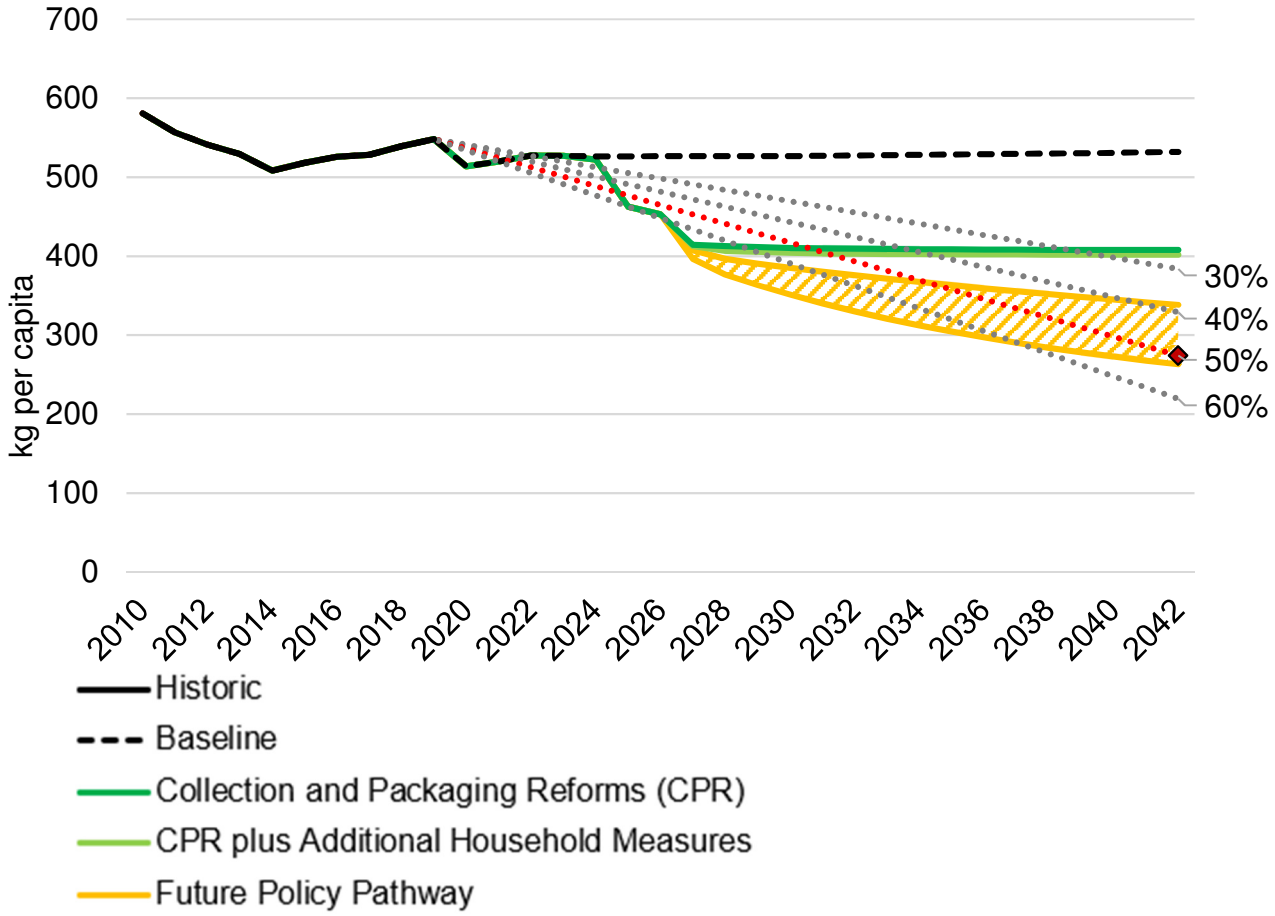
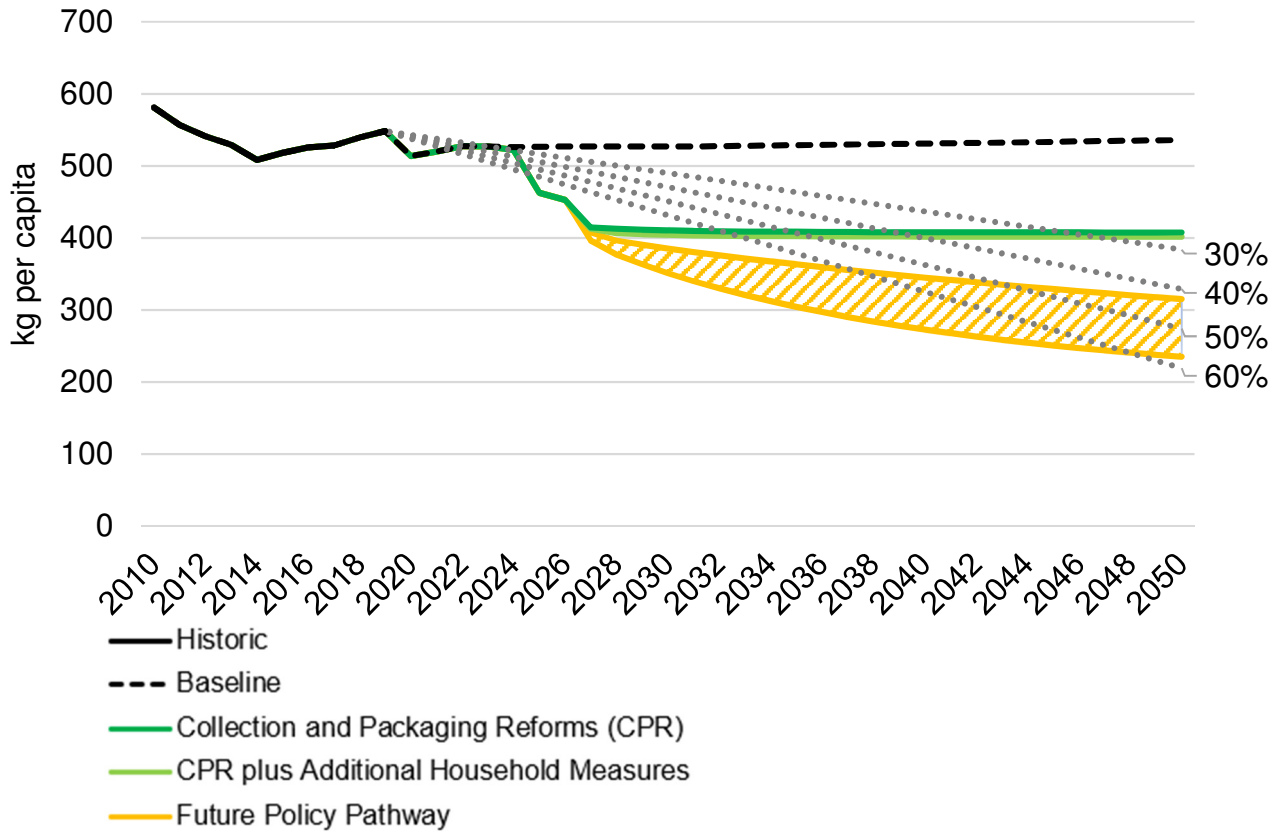


Figure 6: Residual waste excl. major mineral waste after potential future policies, up to 2050



Our modelling indicates that a 2042 target date is achievable if a scenario close to the higher impact scenario is realised (Figure 5). The central estimate for our 2042 modelling is a reduction in residual waste (excluding major mineral waste) per capita of around 45% by 2042. We can be more confident that a target date of 2050 is more easily achievable, with a central estimate for the reduction in residual waste (excluding major mineral waste) per capita being around 50% by 2050 (Figure 6).

A 50% reduction in per capita residual waste (excluding major mineral wastes) represents an ambitious target, irrespective of the target date. The target has been chosen to be set at the earlier date of 2042 to drive continued environmental improvement over time. There

is a level of risk associated with this choice, in that it allows less time for the appropriate policy interventions and long-term behavioural and waste management process changes that will be required to meet the target.

Waste prevention measures[56], including educational campaigns and communications, have not been explicitly modelled as part of the price-based policy pathway but form part of the tools available to government, local authorities and businesses to reduce residual waste. The price-based policy is only illustrative of one way the target could be met. Discussion of the broad lever types that may be used to reduce residual waste can be found in the 'Possible additional policy levers to reduce residual waste' section.

9.2. Potential costs and benefits of illustrative future pathway

The costs and benefits of future policies to reduce residual waste will depend on the exact policies implemented and therefore could vary considerably. The potential future pathway covers an extended future period, with uncertainty around what the policy landscape will look like. The info box below outlines some illustrative analysis to provide a sense of scale of the potential costs and benefits that could arise from the pathway.

For this illustrative cost and benefit analysis, it is assumed price-based levers are used to incentivise taking waste out of residual waste, as these can be most appropriately modelled compared to other possible levers. It is assumed that the level of incentive required to reduce residual waste to the levels associated with the higher impact future scenario is achieved through an £8 per tonne per year increase in the price of residual waste treatment, from 2027-2042[57]. This is purely illustrative; the future pathway could be made up from a variety of policy levers, of which price-based levers are only one potential option. This modelling does not prescribe which policy levers will be used, and should price-based levers be used, this is not necessarily the trajectory that would be seen.

In our policy pathway scenario, the upfront investment costs for additional services have already been made. For local authorities and businesses, the effort to increase recycling therefore becomes more a decision about marginal cost of effort to collect and treat more materials for recycling rather than the alternative which is residual waste treatment. Therefore, our modelling assumes that as the price of residual waste treatment increases, local authorities/businesses send more waste to recycling treatments. The cost calculations outlined below assume that local authorities/businesses send a given tonne of waste to the cheapest treatment option out of residual or recycling. The service provision

[56] More information on waste prevention measures can be found within the Waste Prevention Programme 'Evaluation and description of potential waste prevention measures' WPP Evaluation and description of potential waste prevention measures FINAL.pdf (defra.gov.uk).

[57] Note the difference with the modelling to inform the feasible target range, which assumes continued intervention up to 2050, to assess the achievability of a range of ambition levels. The cost and benefit modelling assumes the price increases end in 2042, at which point the target has been met under the higher impact scenario.

provided by CPR and other interventions should enable more efficient future policies to reduce residual waste levels.

An increase in the price of residual waste treatment will increase the cost of residual waste treatment, per tonne. This higher cost will fall on the operators of residual waste sites, though would be expected to be passed on to the main customers of these sites, namely businesses and local authorities.

Info: Illustrative costs and benefits of the potential future policy pathway: price-based levers used

The costs and benefits given below are based on an illustrative future policy pathway. The long-term policies used to reduce residual waste will be the decision of future governments. This modelling scenario considers only one potential policy pathway to understand the possible scale of impacts, costs and benefits. Future policies may or may not include price-based levers. Should price-based levers such as these be used, we would not necessarily expect the trajectory given here to be observed.

Benefits

A key benefit from a reduction in residual waste is carbon savings. Defra landfill emissions modelling estimates the higher impact future pathway to provide approximately £380m additional carbon savings per year by 2042, compared to a baseline of CPR. The landfill emissions modelling uses modelled recycling rates of CPR and the future policy pathway as inputs. Minor updates to the modelling have slightly altered these inputs, resulting in the small changes to the benefits figures compared to the consultation stage impact assessment.

The modelling outlined above covers only landfill emissions and does not include other areas where carbon savings would be seen, such as plastic moved out of incineration and reduced demand for virgin materials in production. It is approximately estimated that total carbon savings from the reduction in residual waste would be 1.4 - 1.8 times higher than landfill emissions alone. This is based on internal Defra modelling of waste policies, estimating the proportion of emissions savings which typically derive from landfill vs other activities.

The landfill emissions modelling and multiplier provide a central estimate of £608m total carbon savings per year by 2042.

This has decreased from £695m at consultation due to the updated inputs outlined above. The methods used to calculate the benefit figures have not changed.

Costs

This illustrative analysis estimates the price-based policy pathway to increase total costs to society by £446m per year by 2042 (‘Part 1’ cost below). **Costs to local authorities and businesses are estimated to increase by £1.66 billion per year by 2042**, with £1.22 billion of this transferred to government tax revenues (‘Part 2’ cost below). These revenues could be reinvested to bring about further benefits to society.

The costs modelling uses modelled tonnages of residual waste as inputs. These modelled tonnages have been updated since consultation, resulting in a drop in modelled total costs to society of the pathway from £498m to £446m, per year by 2042. The methods used to calculate these costs have not changed.

The 6.7m tonnes of non-municipal, non-major mineral within the target scope is assumed to be out of scope of the price-based policy. Policies to divert municipal residual waste may not necessarily target this waste due to the range of source sectors included. Therefore, we have not included non-municipal non-major mineral wastes in our illustrative future policy pathway modelling. This waste is discussed further within the 'Target Scope' section.

The higher impact price-based pathway is modelled to increase the cost of residual waste treatment by £8 per tonne per year from 2027 to 2042 (inclusive). This is modelled to move waste from residual waste treatment to recycling. There are two parts to the costs from this policy, outlined below:

Part 1: Increased cost of treating waste shifted to recycling

Based on economic rationale, it may be assumed that if the price-based policy shifts a given tonne of waste from residual treatment to recycling, the policy has made recycling the cheaper option for this tonne, where it previously was not. Therefore, the cost of treating this tonne of waste has increased, relative to a baseline of no price-based policy implemented.

For the tonnages shifted from residual to recycling from the first year's (2027) price increase of £8 per tonne, the cost of treatment will have increased between £0 and £8. The first tonne shifted would have previously had a recycling cost £0.01 greater than its residual cost and the last tonne shifted would have had a recycling cost £7.99 greater. This switching point is assumed to increase linearly, for an average of £4 across the tonnage shifted in that year. Therefore, the Part 1 cost for 2027 is £4 multiplied by the modelled shifted tonnage (963,000 tonnes) = £3.85m.

In 2028, the new tonnage shifted to recycling has been shifted by a £16 per tonne increase but was not shifted by an increase of £8. The first tonne shifted in this year would have previously had a recycling cost £8.01 greater than its residual cost and the last tonne shifted would have had a recycling cost £15.99 greater. Again assuming a linear increase, this gives an average switching point of £12. The price-based policy has increased treatment costs for these shifted tonnages by an average of £12. The increased cost of recycling the tonnage that has been shifted is £12 multiplied by the modelled shifted tonnage (787,000 in 2028) = £9.45m. In 2028, the tonnage shifted by the policy in 2027 is still being recycled

(and would not be in a baseline of no price-based policy) so the total Part 1 cost for 2028 is £9.45m + £3.85m = £13.30m.

A generic equation for Part 1 costs is:

(Part 1 cost of previous year) + (new tonnage shifted) * (total price increase - £4)

In 2042, 314,000 new tonnes are shifted. By 2042, the cost of treating residual waste is modelled to have increased by £8 each year, across 16 years, for a total increase of £128 per tonne by 2042.

Therefore, the Part 1 cost for 2042 is:

(Part 1 cost 2041) + 314,000 * £124 = £446m

In 2042, the price-based policy is modelled to shift 8.54m tonnes out of residual waste treatment, compared to a baseline of no price-based policy.

Part 2: Increased cost of treating remaining residual waste

The second part of the cost is the increased cost of treating waste that is still sent to residual waste treatments (has not been shifted to recycling by the policy). The price-based policy increases the cost of treating this remaining waste by £8 per tonne per year.

By 2042, the cost of treating residual waste is modelled to have increased by £8 each year, across 16 years, for a total increase of £128 per tonne by 2042.

It is modelled that in this scenario, 9.49m tonnes of residual waste would remain (excluding non-municipal, non-MMW), to be treated at this higher cost. This results in an increase in costs of approximately £1.22 billion per year by 2042 (9.49m * £128). This is assumed to be a transfer to government revenues.

10. Possible additional policy levers to reduce residual waste

The policy pathways outlined above are only illustrative of how a target could be met. The exact make-up of future policy pathways will likely be a combination of interventions. We know much of waste reduction stems from behaviour change. There are a number of potential levers that could be utilised to achieve this behaviour change and these should be particularly effective following the service provision put in place by CPR. This section includes a discussion of the broad lever types that could be used to progress towards the target and of their potential costs and benefits.

It is important to highlight that policies to reduce residual waste are not limited only to policies aiming to increase recycling. Waste prevention policies, for example eco-design measures or virgin material taxation, and policies aiming to increase re-use and repair will also have an important role to play.

Price-based levers

Price-based levers could include policies that make it more expensive to dispose of waste through waste management options typically associated with residual waste, and/or make it cheaper to dispose of waste through recycling or reuse. These could include policies targeting these waste streams at end-of-life treatment, for example making it more expensive to dispose of waste by sending it to landfill or putting it through incineration. Price-based levers are a realistic lever within the waste sector and there is potential for them to be utilised further to reduce waste, highlighted by the call for evidence on an Emissions Trading Scheme (ETS) for incineration[58] and ongoing Landfill Tax Review[59]. Taxes are proven to cause behaviour change when implemented correctly and are generally efficient, with organisations given flexibility in choosing how to reduce waste or choosing to pay the tax.

Waste impacts will depend on the future policies implemented, though it is expected price-based levers will make the largest contribution to the target, out of future lever types.

Regulatory levers

[58] https://www.gov.uk/government/consultations/developing-the-uk-emissions-trading-scheme-uk-ets
[59] https://www.gov.uk/government/consultations/landfill-tax-review-call-for-evidence

Regulatory policies are a realistic future lever for reducing residual waste, given the powers under the Environment Act and the policies Defra is already enacting such as EPR, DRS, and bans or charges on single-use items. The Environment Act also gives government further additional powers including but not limited to: introduce resource efficiency labelling requirements, introduce eco-design requirements and new powers to tackle waste crime. With the Environment Act only recently coming into force, there is significant potential to further utilise these powers in the future, to build on CPR and further reduce residual waste. Waste impacts will depend on the future policies implemented, though it is expected regulatory levers will make the second largest contribution to the target, out of future lever types.

Waste impacts will depend on the future policies implemented, though it is expected regulatory levers will make the second largest contribution to the target, out of future lever types.

Information-based levers

Information-based levers aim to provide guidance and raise awareness, for example of how to correctly recycle different types of materials.

In a 2020 survey undertaken by WRAP[60], it was found that 56% of UK households dispose of items in the general rubbish that could be collected for recycling from their home, and 80% of UK households put items in their recycling that are not collected locally. Uncertainty about what can and can't be recycled has been identified as a key barrier to UK households recycling more - 44% of UK households are not satisfied with the clarity of currently available information. Information-based levers would aim to address this barrier.

Waste impacts will depend on the future policies implemented, though it is expected information-based levers will make the third largest contribution to the target, out of future lever types.

Spend levers

Spend levers could include, for example, further government funding to make sure that there is sufficient infrastructure in place to allow for the diversion of waste from landfill and incineration, and into the recycling and reuse waste stream. Any future policies here would be dependent on government funding, though could be a major pull factor in reducing residual waste, if funded.

[60] Recycling Tracker Report 2020: Behaviours, attitudes and awareness around recycling | WRAP

11. Costs and benefits of policy levers used to meet the target

11.1. Impacts on Businesses

Benefits:

Stimulation of secondary material market either by driving secondary material price down or internalising environmental costs into virgin materials

Policies that lead to an increase in recycling will increase supply of secondary materials that businesses use as inputs in production. This increase in the supply of secondary materials will drive the price down in a competitive market which will lower producer costs. This cost reduction benefit could be passed on to consumers in the form of lower prices to increase sales or businesses could reinvest profits. The secondary material market may also see an increase in demand as virgin material consumption is reduced.

Levers that can contribute to this: price-based, regulatory, information-based and spend.

Increased circularity of resources leading to decreased producer costs

Many interventions that deter resources from going to residual waste treatments will aim to reuse, recycle, or repair materials to move closer to a circular economy. Increased circularity of resources will allow businesses to improve the efficiency of how they use material inputs which could translate in to reduce producer costs. It may also create new business opportunities where in resource efficient practices.

Levers that can contribute to this: price-based, regulatory, information-based, and spend.

Greater certainty in future policies, encouraging investment

A legally binding long-term target gives a clear signal to industry of the direction of future government policy. This may increase investor confidence and encourage industry to invest in infrastructure and research that will drive innovation and improve the circularity of the economy. This should decrease costs for producers and may ultimately reduce prices for consumers.

Costs:

Increased costs to resource intensive producers

Government regulation will aim to reduce the amount of resources that end up as residual waste. This could lead to an increase in costs to resource intensive producers as they will be incentivised to change their current methods. For example, if eco-design regulations were introduced then producers who do not already meet the product longevity requirements will need to spend time improving the design of their product.

Levers that may impose this cost: regulatory and price-based.

Infrastructure – opportunity cost

Government intervention to divert material away from residual waste streams will incentivise industry to invest in secondary material infrastructure. A legally binding target may also increase investor confidence. Investment in infrastructure typically involves large up-front capital costs. This comes with an opportunity cost.

Opportunity cost is the cost of using assets and resources, which is defined by the value that reflects the best alternative use to which a good or service could be put[61]. The capital that businesses use to invest in secondary material infrastructure could be invested in alternative projects that could potentially be profitable, therefore there is a cost to investing capital in secondary material infrastructure beyond the direct financial cost.

Levers that may impose this cost: price-based, regulatory, information-based and spend.

Reduced income from energy output to the grid

Landfill sites produce landfill gas which can be captured and used to generate electricity. EfW sites also generate electricity from the waste incinerated. Any reduction in tonnages of waste going to these sites will also reduce electricity output to the national grid and impact site owners' revenues. It is estimated that the total power exported by EfW sites in the UK in 2020 was 7,762 Gigawatt hours (GWh) - approximately 2.5% of total net UK generation of 307,556GWh[62]. A reduction in this energy export from EfW sites and landfills will require electricity to be sourced elsewhere to meet the national grids electricity demand. It is possible this replacement electricity could come from more carbon-intensive sources.

Levers that may impose this cost: price-based, regulatory, information-based, spend.

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61 https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/938046/The_Green_Book_2020.pdf

62 https://www.tolvik.com/wp-content/uploads/2021/05/Tolvik-UK-EfW-Statistics-2020-Report_Published-May-2021.pdf

Reduced Refuse Derived Fuel (RDF) income

RDF is municipal waste that has been shredded and baled that can be burned to generate electricity. In 2019, England exported around 2.4m tonnes of RDF[63]. As waste is diverted away from RDF, exports will fall and therefore exporters will receive reduced income.

Levers that may impose this cost: price-based, regulatory, information-based and spend.

Potential disruption of the economics of landfill/incineration sites

Despite the government's ambition to divert waste away from residual waste treatment and push waste further up the waste hierarchy, there is still value in these treatments as methods of dealing with non-recyclable waste, waste streams such as chemical and hazardous waste, and in emergency situations. There are many impacts described above which shift revenue and cost levels for these site owners and there is a risk that the economics of landfill/incineration is disrupted such that it becomes unprofitable to run these sites. This risk, for EfW sites specifically, is discussed further in the 'Risks and Assumptions' section.

Levers that may impose this cost: price-based, regulatory, information-based and spend.

Reduced gate fee income for residual waste operators and exporters

Government intervention will aim to divert waste away from landfill and incineration. The site owners will receive reduced gate fee income as it is derived on a weight basis.

Levers that may impose this cost: price-based, regulatory, information-based and spend.

11.2. Impacts on government/local authorities

Benefits:

Reduced waste management costs as waste is prevented or recycled instead of going to more expensive residual waste treatments

The average cost per tonne of waste recycled in a Material Recovery Facility is estimated to be £60, cheaper than for incineration (£95) and non-hazardous landfill (£125, including Landfill Tax)[64]. As government interventions are brought in to increase recycling, municipal waste will be disposed of in a more cost-effective manner. This includes savings to local authorities and businesses from no longer having to pay Landfill Tax.

Levers that can contribute to this: price-based, regulatory, information-based and spend.

[63] International Waste Shipments exported from England - data.gov.uk
[64] WRAP Gate Fees 2021-22 Report. Median figures, excluding transport costs. https://wrap.org.uk/resources/report/gate-fees-202122-report

Costs:

Costs to local authorities (and waste collection businesses) of upgrading vehicle fleet and bins and potential information campaigns

Improved recycling may require changes in collection methods and require investment in vehicle fleets with the necessary compartmentalised segregation of waste. Furthermore, separate collections of waste could require local authorities to provide each household with additional recycling bins. Government has already committed to funding the net new burdens costs of Separate Food Waste collections in England. EPR for packaging will also fund the net costs of managing households' packaging waste. As the ways in which waste is collected changes, information campaigns will be needed to inform the public of the changes which could require public sector funding.

Levers that may impose this cost: price-based, regulatory, information-based and spend.

Increased transport costs and emissions because of more segregated waste

Higher levels of waste segregation mean that different types of waste will need to be sent to different treatment facilities instead of all going to landfill or incineration. For example, where one household may have previously disposed of all waste in residual waste with some recycling, they may now sort their dry recyclables and food waste separately which need to go to both a recycling centre and an anaerobic digestion facility. This additional transport will cause an increase in transport emissions and fuel costs for local authorities[65].

Levers that may impose this cost: price-based, regulatory, information-based and spend.

(transfer) Reduced landfill tax revenue for government

As tonnages through the gate and landfill sites reduce, the amount of landfill tax revenue generated will decrease[66] as it is calculated on a per tonne basis.

Levers that may impose this cost: price-based, regulatory, information-based and spend.

11.3. Impacts on the environment

Benefits:

Reduced GHG emissions from landfill/incineration/RDF

Disposal methods at the bottom of the waste hierarchy such as landfill, incineration and RDF are associated with higher greenhouse gas emissions. Reducing the levels of waste being disposed of via these residual waste methods will lead to an increase in the reuse, repair and remanufacture of materials and move England's waste system to a more

[65] Assuming waste disposal companies pass on additional costs to local authorities
[66] Lower tonnages of landfill will reduce landfill tax income if landfill tax rates remain constant. Any increases in the rates may mean that landfill tax revenue increases overall.

circular economy. As resources are kept in the circular economy for longer the emissions associated with residual waste treatments decrease. Government intervention such as consistent collections of kerbside waste will aim to increase recycling and reduce biodegradable waste going to landfill. Biodegradable waste produces methane when broken down, a potent greenhouse gas.

Levers that can contribute to this: price-based, regulatory, information-based and spend.

Increase in recycling

Government intervention to divert materials from residual waste treatment will improve the circularity of the economy and therefore increase recycling. Recycling allows materials to serve a new purpose instead of being destined for landfill, incineration, RDF or transport fuel. Increasing recycling means that there will be more secondary material on the market which reduces the need to extract primary material. Lower levels of extraction of primary material reduces emissions associated with extraction and stems the depletion of finite natural resources. Increased recycling will also strengthen the secondary material market. As supply increases the price of secondary material will decrease as suppliers try to undercut each other. This will cause secondary materials to become more attractive to manufacturers and will increase its usage. The growth in the size of the secondary material market will allow businesses which treat this material to expand their infrastructure and benefit from economies of scale, which will further reduce the price level of secondary material to allow it to compete with primary materials more.

Levers that can contribute to this: price-based, regulatory, information-based and spend.

Costs:

Potential for increased ammonia emissions from anaerobic digestion (AD)

Biodegradable waste is an important issue to tackle as it releases methane when sent to landfill, a potent greenhouse gas. Policies brought in to remove this waste from landfill will not necessarily be the same policies brought in to progress against the target, though there may be some overlap. Many interventions to reduce the amount of biodegradable waste going to landfill aim to increase food and garden waste collections so this waste can be sent to AD plants. AD plants process biomass into gas for heating and power, as well as producing fertiliser. This process utilises the biomass' energy and nutrition as well as emitting fewer GHG emissions than if it were sent to residual waste treatment. However, the digestion of these materials increases ammonia (NH_3) emissions.

Ammonia emissions have negative impacts on both the environment and human health. Ammonia is a highly reactive and soluble alkaline gas. Ammonia emissions can harm soil, rivers, and lakes as emissions lead to increased acid depositions and excessive levels of nutrients[67]. The emissions also have potential negative impacts on human health too.

[67] https://www.eea.europa.eu/highlights/ammonia-emissions-from-agriculture-continue

Ammonia can bind with other gases to form ammonium which can harm the cardiovascular and respiratory systems[68].

Levers that can contribute to this: price-based, regulatory, information-based and spend.

11.4. Impacts on wider society

Benefits:

Reduced disamenity costs of landfill and incineration

Landfill and incineration sites are associated with disamenity costs to local residents as it is undesirable to live in close proximity to these sites. Hedonic price modelling has demonstrated that proximity to a landfill site has a negative impact on house value[69]. There is this tangible monetary negative impact on house prices but there is also the impact of the decreased utility for local residents due to the sight and smell which is difficult to quantify.

Levers that can contribute to this: price-based, regulatory, information-based and spend.

Increased jobs in reprocessing and repair sectors

The expansion of the secondary material market would lead to job creation. Green Alliance estimate that on the current path, the circular economy has the potential to create 200,000 jobs and reduce unemployment by 54,000 by 2030[70]. It is expected that job creation caused by the increase in reprocessing and repair will outweigh the job loss in residual waste treatment. It is expected these new jobs will be created throughout England, including in more deprived areas, contributing towards the government's ambition to level up the UK economy.

Levers that can contribute to this: price-based, regulatory, information-based and spend.

[68] https://www.rand.org/randeurope/research/projects/impact-of-ammonia-emissions-on-biodiversity.html
[69] Ham, Y.J., Maddison, D.J. and Elliott, R.J., 2013. The valuation of landfill disamenities in Birmingham. *Ecological economics*, *85*, pp.116-129.
[70] Employment and the circular economy: job creation in a more resource efficient Britain » Green Alliance (green-alliance.org.uk)

12. Small and micro business assessment

The setting of a legislative target to reduce residual waste places no direct costs onto small and micro businesses. However, it will require the future setting of policy interventions to meet the target, which may impose some costs. It is not expected for small and micro businesses to be disproportionately affected by future policies contributing towards the target. All future policies will be subject to future consultation and corresponding economic assessment of costs, including small and micro business assessments.

13. Wider impacts

The wider impacts from the target will depend on the future policies which are implemented to reach it. As outlined within the ‘Possible additional policy levers to reduce residual waste’ section, future policies and the target itself should encourage investment that will drive innovation to improve the circularity of the economy. It is not expected for future policies contributing towards the target to have substantial impacts on competition or on trade. It is not expected for these policies to have substantial distributional or regional impacts. All future policies will be subject to future consultation and corresponding economic assessment of impacts, including on wider impacts.

14. Target Scope & Metric

14.1. Target Scope

An alternative target considered but not progressed at this stage was 'Resource Productivity', measured in terms of Gross Domestic Product/Raw Material Consumption. Due to the large sectoral coverage, cross-government remit and complexity in calculating the target itself, it was decided not to set a target at this time. We will continue to develop the evidence base on resource productivity and how best to develop it as a potential future target. Work in this area so far has included commissioning WRAP and the University of Leeds to undertake a quantitative assessment of the effects of possible regulatory policy intervention on reducing resource consumption and GHG emissions associated with their production[71]. It also includes commissioning Cambridge Econometrics to model the macroeconomic impacts of potential resource productivity policies[72].

The target chosen to be set at this time relates to a reduction in residual waste. Residual waste can originate from a range of sectors, including households (as "black bag waste"), commercial and industrial, and construction, demolition and excavation sources. Some waste is also designated for example hazardous or clinical and must be treated in specific ways.

The target will be measured at endpoint treatment and capture the treatments that are typically associated with residual waste – that is waste that is sent to landfill, put through incineration (including energy from waste incineration), sent overseas for energy recovery or used in energy recovery for transport fuel. Other forms of energy recovery may become more commonplace in the future and may also be captured within the scope. This treatment-based scope is instead of defining residual waste at point of collection, such as kerbside or at HWRCs, for which there is currently less robust data for some sources of waste. We will continue to review which treatments it is appropriate to capture in the metric as new technologies and treatment options emerge.

The target scope includes all residual waste, excluding major mineral wastes, the predominant, and largely inert, waste categories from construction and demolition, such as concrete, bricks and sand, as well as soils and other mineral wastes from excavation and mining activities.

This scope has been chosen to focus attention on where the environmental impact per tonne of waste is greatest, such as landfilling biodegradable materials or incinerating plastic. Furthermore, while we want to reduce overall residual waste, the data for some areas of waste is currently less robust than others, with uncertainties in construction, demolition and excavation data of particular concern for setting a meaningful long-term target.

[71] UK policy pathways for Increasing Resource Productivity to 2050 | WRAP
[72] Cambridge Econometrics report published here: Defra, UK - Science Search

Additionally, our evidence base on alternatives to residual treatment for mineral wastes is less strong, and the large tonnages associated with these wastes would risk perverse outcomes. For example, including mineral wastes is likely to mask the importance of reducing the residual treatment of other materials, for which lower tonnages are generated, but have greater environmental impacts per tonne. For example, landfilling biodegradable wastes or incinerating plastic wastes. Therefore, it is believed that excluding MMW is the best option for the target scope.

Initially two approaches to narrow the scope of the target to exclude MMW were identified:

Option A) The material-based scope of all residual waste, excluding MMW.

Option B) A source-based scope of municipal residual waste, defined as household and household-like waste, that is waste from households, plus waste from other sources, such as commercial waste, which is similar in composition to household waste.

Owing to the varying environmental impacts of different materials at the different residual waste treatments (that is landfill and incineration), it is important for us to give regard to the individual materials that make up residual waste, in order to deliver the best possible environmental improvements. For example, plastic waste has relatively little environmental impact at landfill but a high impact at incineration.

Option A has therefore been selected as the most appropriate scope. It provides a more holistic approach, which will incorporate all tonnages of a given material type where the environmental impacts of waste treatment are comparable, rather than arbitrarily limiting some materials by source. For example, a municipal waste scope would largely exclude industrial waste as well as some biodegradable materials from construction and demolition sources, such as wood waste.

In comparison to option B, the broader scope of option A captures approximately 6.7m additional tonnes of non-municipal non-major mineral waste (based on 2019 data). These additional tonnes include industrial waste, non-MMW from construction and demolition sources, and agriculture, forestry, and fishing waste. The preferred scope includes these tonnes to maximise transparency around the tonnages of residual waste that are treated. It also acknowledges that within these waste streams are materials that are captured in municipal waste definitions and have the same environmental impact. Policies to divert municipal residual waste may not necessarily target this waste due to the range of source sectors included. Therefore, we have not included non-municipal non-major mineral wastes in our illustrative future policy pathway modelling.

Soenecs were commissioned to undertake a rapid evidence assessment investigating alternate non-residual treatment options and policy interventions for non-municipal, non-major mineral waste in England[73]. This work has found that if implemented, suitable policy interventions would be able to reduce this residual waste through both waste prevention and driving waste up the hierarchy. Policy suggestions from this research include

[73] Report to be published shortly.

expanding Extended Producer Responsibility to more products, extending End of Waste Criteria, fiscal instruments, aligning planning systems with circular economy aims and extending and tightening regulations. Further work would be required to investigate and model the quantitative impacts of particular policies on this waste.

An overarching residual waste target has been chosen instead of individual, material-specific targets, such as a plastics waste reduction target, as these would risk shifting the environmental impact to other environmental harmful material types and could even lead to increases in residual waste due to switching to heavier materials. Including a wide range of materials ensure a holistic view to waste is taken and reduces waste overall.

Following consultation, the target scope has been revised to exclude ferrous metals removed from bottom ash, which have been put through incineration or used in energy recovery and then sent for recycling. This is consistent with Defra's annual reporting of Waste from Households recycling rates.

The target scope has also been revised to:

- Exclude waste originating in the Devolved Administrations (DAs), sent to England for end-of-life treatment.
- Include waste originating in England, sent to the DAs for end-of-life treatment.

These address possible perverse incentives to send waste out of England for end-of-life treatment. It also removes the risk of waste levels being falsely inflated by wastes originating outside of England and matches the metric as closely as possible to waste generation in England.

The data around these metric amendments is currently less robust than it is for other aspects of the metric. The best approach has been agreed with Defra's Head of Profession for Statistics. Improved data is expected with the introduction of electronic waste tracking.

14.2. Target Metric

The target to reduce residual waste excluding MMW will be measured on a kg[74] per capita basis as described in the metric below. Controlling for population in this way will ensure that the target remains comparable over time and isn't affected by impacts beyond our control. It is noted that sustained population growth would dampen the benefits to the environment of reduced per capita waste levels.

$$\text{Residual waste (excl. major mineral waste) per capita (kg)} = \frac{\text{(Tonnes of waste (excl. major mineral waste) originating in England, which is identified as: (sent to landfill + put through incineration + sent overseas for energy recovery + used in energy recovery for transport fuel) – IBA metals removed from incineration sites in England)} * 1000}{\text{Population of England}}$$

[74] Kg used over tonnes to avoid unnecessary use of decimals.

In the metric the tonnage of waste sent to landfill is derived from the Environment Agency's Waste Data Interrogator, the tonnage of waste put through incineration is derived from Environment Agency incineration monitoring reports, and the tonnage of waste exported for energy recovery is derived from International Waste Shipments data. When production begins, it is expected waste used in energy recovery for transport fuels to be reported by the Environment Agency. Waste Data Interrogator will also provide data on the tonnage of ferrous metals removed from bottom ash, which have been put through incineration or used in energy recovery and then sent for recycling, tonnages that originate in England that are sent on to landfill or incineration in the DAs, and tonnages that are sent to landfill or incineration in England that originate from outside of England. Population estimates will be taken from the Office for National Statistics (ONS) published data. These datasets are published on an annual basis and are expected to continue to be available for the foreseeable future. For more information, see the 'Monitoring and Evaluation' section.

15. Existing ambitions and strategies

To provide a sense check to the modelling of potential policy pathways, we have also modelled how wider government ambitions and strategies might impact upon our baseline. The additional ambitions that have been considered in our modelling include:

- Meeting a 65% municipal recycling rate by 2035 and,
- Achieving zero avoidable waste by 2050.

In modelling the trajectory for a 65% municipal recycling rate by 2035, the year-on-year growth in the recycling rate required to reach this commitment is calculated and then a continued growth scenario is assumed, where this increase continues at a linear rate to 2042. This results in a municipal recycling rate in 2042 of approximately 75%. Based on current modelling, it is expected this would result in a 54% reduction of residual waste excl. MMW (kg per capita) by 2042 relative to 2019 (from 548 kg per capita in 2019 to 253 kg per capita in 2042). In absolute tonnage terms, this would be associated with a reduction to 16m tonnes in 2042 from 31m tonnes in 2019.

If it were assumed that this linear growth in the municipal recycling rate continued at the same pace to 2050, it is expected this would result in a municipal recycling rate of approximately 86%. In the current modelling, this would be associated with a 72% reduction of residual waste excl. MMW (kg per capita) by 2050 relative to 2019 (from 548 kg per capita in 2019 to 151 kg per capita in 2050). In absolute tonnage terms, this would be associated with a reduction to 10m tonnes in 2050.

Regarding the ambition to reach zero avoidable waste by 2050, we have defined avoidable waste for modelling purposes as all waste within the residual waste stream that is either readily or potentially recyclable, with some scenarios where waste that is potentially substitutable to a material that could be recycled is also included. This categorisation is based on WRAP's 2017 composition study of municipal waste[75], and avoidability classifications detailed in the Resources and Waste Strategy Monitoring Progress report, where:

1. **Readily recyclable** (with current technologies) refers to items that shouldn't be in the residual waste stream whatsoever because they are recyclable or compostable at the kerbside or household waste recycling centres;

2. **Potentially recyclable** (with technologies in development) refers to items where recycling of this material either: a) happens already but not at scale due to collection or technical challenges; or b) could be possible with technological/methodological changes that are already on the market and can be readily envisaged;

[75] Quantifying the composition of municipal waste | WRAP

3. **Potentially substitutable** (to a material which could be recycled) refers to items where it is hard to envisage a recycling route for these materials, but they could be substituted for something else which could be recycled;

4. **Difficult to recycle or substitute** refers to items where the material is difficult to avoid becoming residual and no feasible alternative can be envisaged without entailing substantial cost.

The zero avoidable waste trajectories that have been modelled are relatively ambitious, including both household and non-household municipal waste within their scope.

From the above avoidability classifications and WRAP 2017 composition study, the modelling estimates that, after CPR impacts are applied, 45.7% of municipal waste in the residual waste stream will be readily recyclable, 69.5% will be either readily or potentially recyclable, and 89.0% will be either readily or potentially recyclable or potentially substitutable to a material that can be recycled. The modelling then derives the amount of municipal waste that would be left in the residual waste stream if this commitment were to be achieved by 2042 (baseline municipal residual waste minus the proportion assumed to be avoidable) and maps a linear trajectory towards achieving that goal.

Systems loss caps have been applied on top of this, where it is assumed that a certain proportion of potentially avoidable waste is never removed from the residual waste stream:

- **Minimal systems loss** assumes that 10% of readily recyclable material, 20% of potentially recyclable material, and 20% of potentially substitutable material is never removed from the residual waste stream;
- **Low systems loss** assumes that 10% of readily recyclable material, 20% of potentially recyclable material, and 100% of potentially substitutable material is never removed;
- **Medium systems loss** assumes that 20% of readily recyclable material, 40% of potentially recyclable material, and 100% of potentially substitutable material is never removed.

Effectively, both low and medium systems loss assume scenarios in which potentially substitutable material is not included within the working definition of avoidable waste. Minimal systems loss assumes a more ambitious scenario in which this is included. These assumptions are illustrative only and should not be taken to be indicative of a planned or expected trajectory to reach zero avoidable waste. However, they enable us to model a range of scenarios that may be possible.

Based on current modelling, it is expected reaching zero avoidable waste by 2042 would reduce residual waste excluding MMW (kg per capita) by between 43% and 62% relative to 2019 levels (from 548 kg per capita in 2019 to between 207 and 314 kg per capita in 2042). In absolute tonnage terms, this would be associated with a reduction in residual waste to between 13m and 19m tonnes in 2042, from 31m tonnes in 2019.

Due to the method used, which maps a linear trajectory to a specified proportion of waste removed from the municipal residual waste stream, the modelling produces very similar results if we were to achieve zero avoidable waste by 2050. Accordingly, we would expect reaching zero avoidable waste by 2050 to reduce residual waste excl. MMW (kg per capita) by between 43% and 63% relative to 2019 levels (from 548 kg per capita in 2019 to between 204 and 314 kg per capita in 2050). In absolute tonnage terms, this would be associated with a reduction in residual waste to between 13m and 20m tonnes.

The modelled trajectories detailed above and shown in the figures below provide further evidence that the target ambition level is ambitious but achievable and that our illustrative policy pathway is a sensible illustration of the level of waste reduction that may be achieved.

Figure 7: Residual waste excl. major mineral waste after existing strategies and ambitions, up to 2042. RR = Recycling Rate

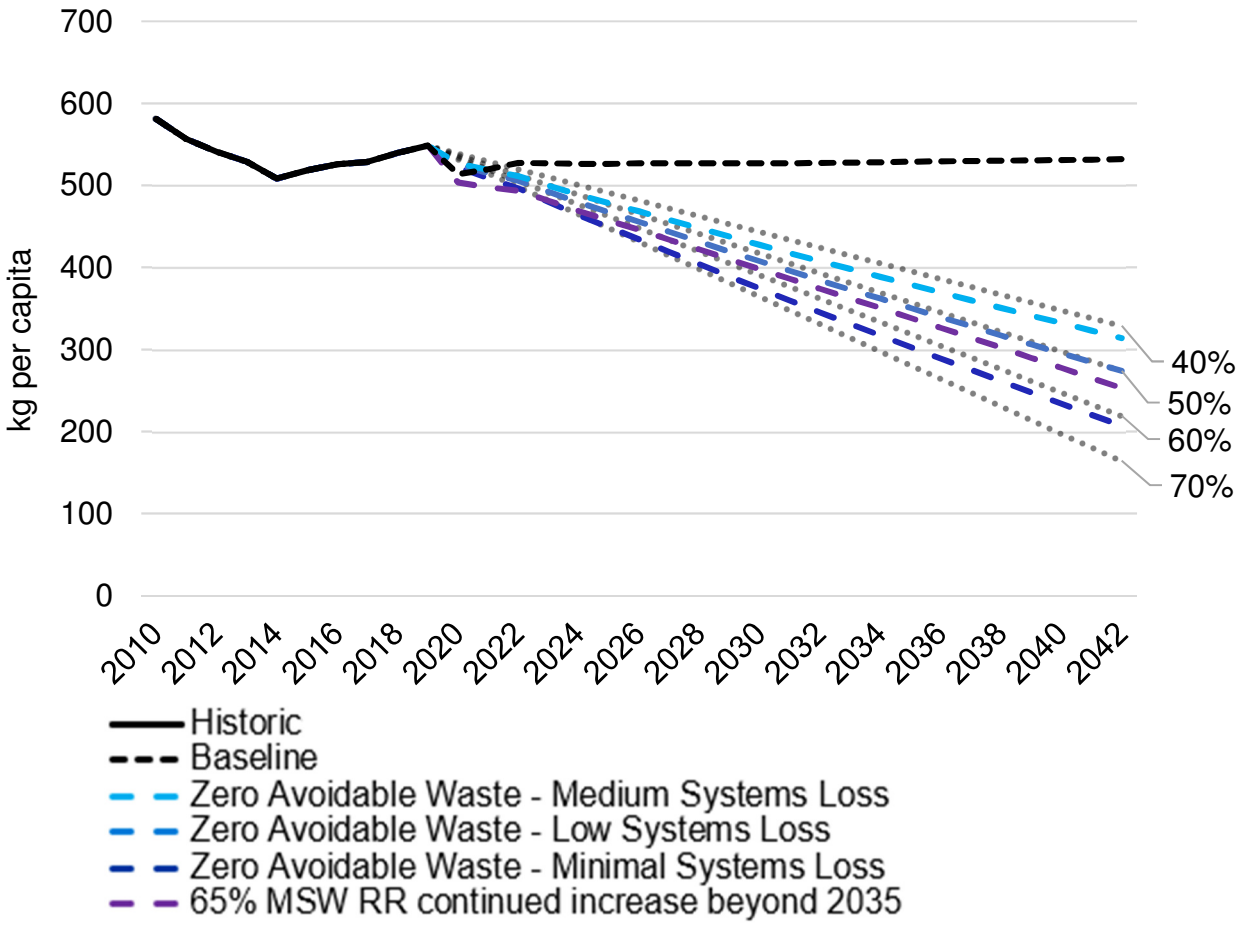
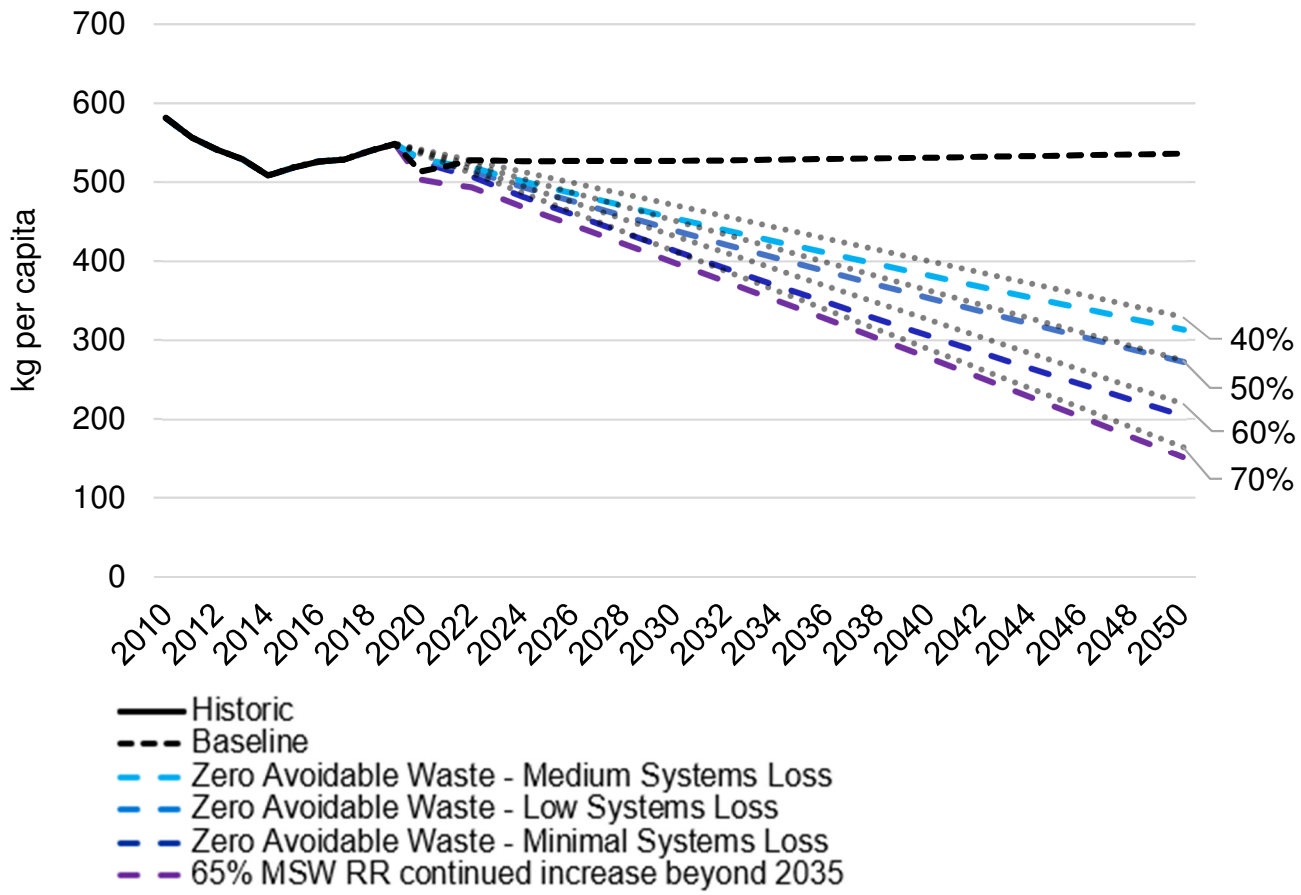


Figure 8: Residual waste excl. major mineral waste after existing strategies and ambitions, up to 2050. RR = Recycling Rate


700
600
500
400
300
200
100
0
kg per capita
2010
2012
2014
2016
2018
2020
2022
2024
2026
2028
2030
2032
2034
2036
2038
2040
2042
2044
2046
2048
2050
40%
50%
60%
70%
Historic
Baseline
Zero Avoidable Waste - Medium Systems Loss
Zero Avoidable Waste - Low Systems Loss
Zero Avoidable Waste - Minimal Systems Loss
65% MSW RR continued increase beyond 2035

16. Risks and assumptions

The target scope uses a treatment-based definition of residual waste, covering residual waste that is sent to landfill, put through incineration (with or without energy recovery), sent overseas for energy recovery, or used in energy recovery for transport fuel. It is assumed that only residual waste is sent to these end-of-life treatment options, and that residual waste is sent nowhere else. For policies where the impact is upon waste collection or generation, there is an assumption that this impact will carry through to waste treatment tonnages, and that a treatment-based definition of residual waste is a fair proxy for residual waste at point of collection. This does not account for waste collected as residual waste that is then diverted for recycling or reuse at a reprocessor site but does capture waste collected as recyclate that is then rejected and diverted to a residual waste end of life treatment option. The risk of this substantially affecting policy impacts is considered to be slight as rejects and waste diverted from one waste stream to the other make up a very small proportion of total waste.

The WfH residual waste projection is calculated by multiplying the forecasted waste arisings by a flat 45.5% recycling rate (including metals reclaimed/recycled from incinerator bottom ash). The waste arisings figures have uncertainty from the projections of the external variables that feed into the forecast. The NHM and non-MSW C&I residual waste forecasts are both calculated by multiplying the C&I waste arisings (split into MSW and non-MSW by EWC code) by their respective non-residual rates. The waste arisings figures are sensitive to any external factors which can impact the GVA of the commercial or industrial sectors. These non-residual rates are held flat to minimise the effects of fluctuations in the underlying data, which is subject to the same methodological uncertainties and data limitations as the C&I methodology[76]. The impact of Covid-19 on the considered waste arisings has not been directly incorporated in the forecasting model as it is still unclear what impact Covid-19 will have on future waste arisings and how long these effects will last. However, Covid-19 impacted the GDHI and sector-specific GVAs around 2020, which affected the waste arisings forecasts (that is causing a reduction in arisings).

The non-WfH, non-C&I, non-major mineral residual waste is defined by a set of EWC codes at residual waste treatment. This waste includes materials such as sorting residues, wood, metals, slurry and manure, and animal, vegetal and food waste. These are projected forward using the GVAs of individual sectors and therefore are sensitive to any external factors which can impact these GVAs. Additionally, by projecting these tonnages directly from data at end-of-life treatment, unlike the other waste streams, it is assumed that this is comparable to the tonnages of this waste at point of collection after non-residual rates are applied.

76 Commercial and Industrial Waste Arisings Methodology RevisionsFeb2018 contact details update.pdf (publishing.service.gov.uk)

Furthermore, the appraisal is of pathways that are illustrative of what may be required to reach the target, it does not assume specific policy choices and there is a high degree of uncertainty around what policies will be used to meet the target and what their costs and benefits will be. Other pathways to reach the targets would have different associated costs and benefits. The modelling of only price-based pathways adds risk to the cost and benefit estimates, and these should only be seen as illustrative.

The modelled impacts of CPR policies on residual waste levels are based on the latest available information. There is a risk that the implemented policies may differ slightly from those modelled and their residual waste impacts may be different.

A risk considered during analysis of options is that of stranded assets, principally EfW plants. A rapid fall in residual waste could have the potential to make some EfW plants redundant, with long-term contracts still in place. However, for both 2042 and 2050 target end date options, this is not considered to be a major risk. The current EfW capacity has been built primarily by the local authorities sector on the basis of 25-year contracts that will expire before 2042. EfW plants currently under construction are being built primarily by the private sector on the basis of 15-year contracts, also expiring before 2042. Whilst the technical life of an EfW plant may be up to 40 years, the risk of loss is tied to the long-term contracts. Outside of these contract terms, if residual waste is not at level viable for these plants, the plants will be decommissioned – this will come at a cost to the owners.

17. Monitoring and Evaluation

To monitor progress against the target, we will track **changes in the amount of residual waste**. A treatment-based approach to the indicator has been chosen, defining residual waste as all waste sent to landfill, put through incineration (including energy from waste incineration), sent overseas for energy recovery, or used in energy recovery for transport fuel. Other forms of energy recovery may become more commonplace in the future and may also be captured within the scope. The indicator will require data from the Environment Agency's Waste Data Interrogator, which is published on an annual basis, as well as the Environment Agency's Incineration Monitoring reports, made available to Defra annually, and International Waste Shipment data, also published on an annual basis. Population estimates will be taken from ONS published data, also updated annually. These datasets are expected to continue to be available for the foreseeable future.

Waste Data Interrogator provides data on all waste received and removed from permitted waste facilities in England, including hazardous waste, but excluding exempt facilities. It holds the data for around 6,000 regulated sites and, though it is officially used to monitor compliance, has historically been used by Defra and local authorities to assist in planning for new waste facilities, monitoring against statutory targets, and reporting waste treatment figures such as in the UK Waste Statistics notice. It provides tonnages of waste sent to landfill and incineration in England by EWC code, self-reported by the permitted sites.

The Environment Agency's Incineration Monitoring reports provide data on tonnages of waste put through (as opposed to simply sent to) permitted waste incinerators in England. By request, the Environment Agency provides Defra with this report further mapped by EWC code.

International Waste Shipment data includes records of international shipments permitted under Transfrontier Shipment of Waste Regulations (2007). The dataset covers RDF sent overseas for energy recovery as well as other waste types such as solid recovered fuel (SRF). RDF and SRF largely consist of combustible components of both municipal and commercial industrial waste such as plastics and biodegradable waste.

Major mineral wastes will be excluded from the target scope based on an agreed list of European Waste Classification for Statistics (EWC-Stat) codes. Excluding major mineral wastes from the target scope excludes the predominant, and largely inert, waste categories from the construction and demolition waste stream, such as concrete, bricks and sand, as well as soils and other mineral wastes from excavation and mining activities.

Progress will be reported against the target on an annual basis beginning 2023.

Future policies that contribute towards the target will be subject to their own monitoring and evaluation plans under the Resources & Waste Strategy evaluation. Annex A sets out further information on this evaluation.

The Environment Act creates a new statutory cycle of monitoring, planning and reporting. Long-term targets will be supported by interim targets, which will set a five-year trajectory towards meeting the long-term targets. The Act requires Government to set interim targets in the Environmental Improvement Plan. This will ensure that there is always a shorter-term goal Government is working towards, as well as the long-term target and will allow for an ongoing assessment of whether the government is on track to meet its long-term target ambitions.

Annex A – Monitoring & Evaluation of future policies that may contribute towards the target

We are currently procuring a large-scale, multi-year evaluation of progress against the key commitments of the Resources and Waste Strategy. This programme of work will fill any gaps in theory of change (ToC) development both at a Strategy level and for the following policies:

1. Extended producer responsibility for packaging
2. A deposit return scheme for drinks packaging
3. Consistent recycling collections for households and businesses
4. Reform of the carriers, brokers and dealers regulations
5. Reform of exemptions to licensing/permitting
6. Waste tracking
7. Bans on certain single use plastic items – phase 2
8. Reforms to WEEE extended producer responsibility
9. Reforms to batteries extended producer responsibility
10. Framework of policy options for textiles

A theory of change and indicator framework will be developed for each policy by the end of 2022.

Evaluation of future policies

We have commissioned an evaluation of the Resources and Waste Strategy starting in 2022 and reporting in 2027. This focuses on the policies listed above and looks at their contribution to five key outcomes;

- The demand for new products is reduced as more products are repaired, reused or remanufactured.
- Recycling rates for households, businesses, municipal waste increase.
- Household, municipal and business waste streams improve in quality.

- Plastic waste, including litter, is reduced. Plastic recycling rates are increased. All plastic packaging placed on the market is recyclable or reusable.

- Waste crime is reduced.

The evaluation programme will deploy three types of evaluation – process, impact and value-for-money. Each is outlined below.

Process evaluation

Each of the policies listed above will be subject to process evaluation. This will check progress as the policy rolls out, enabling us to adjust, where we can, to increase effectiveness, efficiency and equity of impact. The process evaluations will be based on primarily qualitative interview data with Defra and Environment Agency colleagues and programme documentation and reporting information and will assess the extent to which progress is being made as intended, why and for whom; summarise the early benefits and disbenefits; and make recommendations for adjustments. Each process evaluation will start 6 months prior to policy go-live date and be complete 12 months after the go-live data. Each process evaluation has a nominal budget of approximately £15-20k.

Impact evaluation

The impact evaluation will take the monitoring data on amounts of residual waste arising and answer the question, “to what extent, how, for whom and in what circumstances, have the policies in the Resources and Waste Strategy (focusing on those listed above) contributed to the observed outcome?”. Recognising the complexity of the context and the interacting nature of the policies, we will take a theory-based approach. Data sources will include available monitoring and datasets, qualitative interviews with Defra colleagues and four online surveys among local authorities, businesses, waste sector businesses and citizens.

Value for money (economic) evaluation

A cost-benefit analysis will be carried out for the Strategy, using the quantified attribution of impact and data to be collected by the contractor on costs of taking action. Impacts will be monetised in accordance with best practice and will draw on official Government guidance, published impact assessments and the knowledge of Defra’s team of resources and waste economists. It will involve making estimates of cost and monetising direct and consequential benefits. The analysis will produce estimates of uncertainty, using sensitivity analysis and qualitative ratings where quantitative measures are unavailable. Results will be reported as cost benefit ratios which demonstrate the scale of return (or otherwise) on public investment.

The evaluation started in February 2022 with implementation, planning and baseline data collection taking place until the end of the financial year. All final elements of the evaluation will be reported on by 2027 and published on Defra’s Science portal. We would need to commission evaluations in future to evaluate the impacts of policies implemented post-2027 up to 2050. Future evaluations will learn lessons from this initial 2022-27 evaluation.

The evaluation budget for the Resources & Waste Strategy evaluation is £2.5 million for 2022 - 2027, with £390,000 committed for FY22/23.

As part of the evaluation, a list of indicators of change based on the Theories of Change for the Strategy, outcomes and policies will be developed. This will include measurable, meaningful and manageable indicators of outcomes (or proxy indicators) and impacts. A Monitoring Data Collection Plan will be produced in 2022 outlining available data sources and new approaches to gathering necessary data (what, how and how frequently). This will feed into the existing Monitoring Progress report for the Resource & Waste Strategy and baseline data will be collected in 2023. Monitoring data will be reported (approximately) annually in the Monitoring Progress publication.

Dissemination and use

A dissemination plan for the evaluation is under production. The results from the evaluation will be shared with policy teams ongoing throughout the evaluation to inform policy development and implementation as quickly as possible. Policy teams will be engaged and participate through workshops and reviewing outputs. Final reports will be published on Defra Science portal.